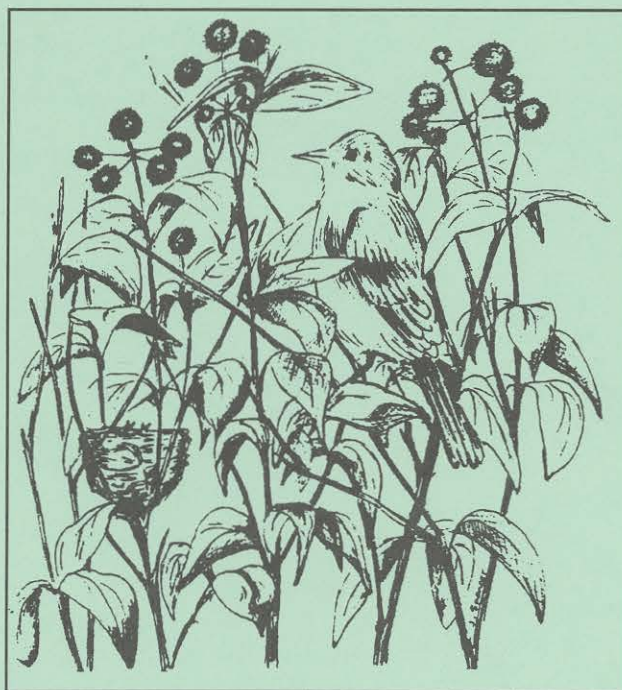


ARIZONA PARTNERS IN FLIGHT 1995 SOUTHWESTERN WILLOW FLYCATCHER SURVEY

Janine A. Spencer, Nongame Birds Biologist
Susan J. Sferra, Nongame Birds Program Manager
Troy E. Corman, Neotropical Migratory Birds Coordinator
Jay W. Rourke, Nongame Birds Biologist
Michael W. Sumner, Nongame Birds Biologist

Nongame Branch, Wildlife Management Division
Arizona Game and Fish Department



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Program Chief: Terry B. Johnson
Arizona Game and Fish Department
2221 West Greenway Road
Phoenix, Arizona 85023-4399

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Current address: ¹132 Park Ave., Prescott, AZ 86303; ²4249 N. Long Valley Rd., Hernando, FL 34442; ³9259 E. Raintree Dr. #2042, Scottsdale, AZ 85260

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EXECUTIVE SUMMARY

Purpose. The southwestern willow flycatcher (*Empidonax traillii extimus*) is federally listed as endangered. Factors contributing to population declines are loss, alteration, and fragmentation of native riparian habitat, brown-headed cowbird (*Molothrus ater*) brood parasitism, loss of wintering habitat, and depredation. Concern about the declining populations prompted *Arizona Partners in Flight* to initiate statewide, standardized surveys in 1993 to provide a basis for management recommendations to benefit the willow flycatcher and other riparian birds.

Current Distribution. Since surveys were begun in 1993, willow flycatcher nesting has been documented at 18 sites in Arizona. Sites below 3400 ft (1036 m) include: the Colorado, Bill Williams, Big Sandy, Verde, Gila, and San Pedro rivers, and the Tonto Creek and Salt River inflows to Roosevelt Lake. Sites above 7900 ft (2408 m) include: the upper Little Colorado and San Francisco river drainages.

Surveys and Detections. Seventeen of the 122 sites surveyed in 1995 supported a total of 85 (± 2) territorial willow flycatchers, of which 62 (possibly 63) were paired males. Singing willow flycatchers were detected as early as 14 May.

Nesting Attempts. The 56 nesting attempts documented in 1995 fledged an estimated 63+ young. Nest building was observed as early as 24 May. Eggs were observed as late as 31 July.

Nest Parasitism. Brown-headed cowbirds were observed at all 12 sites where willow flycatcher nests or fledglings were found. Brood parasitism was documented in four of 56 nesting attempts. Whether it caused or contributed to abandonment at other nests is unknown.

Nests Monitored by the Arizona Game and Fish Department. Forty-eight willow flycatcher nests were monitored in 1995 to determine nesting success (probability of eggs or nestlings surviving to fledging). Clutches averaged 2.6 eggs, excluding nests abandoned prior to egg laying. Fledging averaged 1.2 young overall ($n = 48$), 2.1 per successful nest ($n = 27$), and 1.6 per nest with three or more eggs. Nesting success averaged 42 percent, ranging from 69 percent in high elevation willow to 34 percent in tamarisk and 11 percent in mixed riparian. However, sample sizes were poor for high elevation willow ($n = 10$) and mixed riparian ($n = 7$).

Nesting Habitat Characterization. In 1995, willow flycatchers nested in three general habitat types: tamarisk and mixed riparian at low elevations, and willow at high elevations. Tamarisk was present in varying density at all low elevation sites, except Cook's Lake Cienega. Percent canopy density was high in all three vegetation types in which nests were found. Median canopy density was 88.0 percent in tamarisk, 93.7 percent in mixed riparian, and 89.7 percent in high elevation willow. Percent vertical foliage density, a measure of vertical cover surrounding the nest, increased consistently with height above ground for all three vegetation types. Percent vertical foliage density was highest nearer the nest, and decreased with increased distance from the nest in tamarisk and high elevation scrub willows, although this trend was not observed at the mixed riparian site. Nest height correlated positively with nest shrub height.

TABLE OF CONTENTS

Executive Summary	i
Introduction	1
Methods	4
Surveys	4
Nest Monitoring	7
Nesting Habitat Characterization	8
Descriptive Analysis and Comparisons	9
Results	10
Surveys, Detections, and Distribution	10
Nesting Success	11
Nesting Habitat Types	13
Descriptive Analysis and Comparisons	14
Nest/Nest Shrub Characteristics	15
Nest Site Characteristics	17
Stand Level Characteristics	22
Discussion	23
Survey Methods	23
Detections and Distribution	23
Nesting Success	24
Nesting Habitat and Nest Site Characterization	25
Population Site Fidelity	26
Willow Flycatcher Behavior	27
Disturbances to Nesting Willow Flycatchers	27
Unconfirmed and Possible Detections	29
Management	30
Recommendations	30
Survey Effort	30
Survey Methods	31
Nest Monitoring	31
Habitat	32
Management	32
Literature Cited	33
Personal Communications	41

FIGURES

Figure 1. Subspecies distribution of the willow flycatcher	2
Figure 2. Areas in Arizona surveyed for willow flycatchers in 1995	6
Figure 3. Vertical foliage density in four height intervals for three habitat types, at willow flycatcher nest sites monitored by the Arizona Game and Fish Department in 1995	18
Figure 4. Percent vertical foliage density in four height intervals at distances of 1.5 m, 4.5 m, 7.5 m, and 11.3 m from the nest at high elevation willow flycatcher nest sites (n = 10) in Arizona, 1995	19
Figure 5. Percent vertical foliage density in four height intervals at distances of 1.5 m, 4.5 m, 7.5 m, and 11.3 m from the nest at tamarisk willow flycatcher nest sites (n = 31) in Arizona, 1995	20
Figure 6. Percent vertical foliage density in four height intervals at distances of 1.5 m, 4.5 m, 7.5 m, and 11.3 m from the nest at mixed riparian willow flycatcher nest sites (n = 7) in Arizona, 1995	21

TABLES

Table 1. Arizona sites surveyed for willow flycatchers in 1995	5
Table 2. Willow flycatcher nesting success at sites monitored by the Arizona Game and Fish Department in 1995	12
Table 3. Comparisons of vegetation variables between habitat types at willow flycatcher nest sites monitored by the Arizona Game and Fish Department in 1995	16
Table 4. Riparian dimensions of willow flycatcher nest sites monitored by the Arizona Game and Fish Department in 1995	22

APPENDIXES

Appendix A. Survey form for Arizona willow flycatcher surveys, 1995	42
Appendix B. Detection form for Arizona willow flycatcher surveys, 1995	43
Appendix C. Nest site data form for Arizona willow flycatcher surveys, 1995	44
Appendix D. Willow flycatcher nest monitoring field data form for Arizona, 1995	45
Appendix E. Willow flycatcher nest record form for sites monitored by the Arizona Game and Fish Department in 1995	47
Appendix F. Vegetation data form used by the Arizona Game and Fish Department at willow flycatcher nest sites in 1995	48
Appendix G. Description of willow flycatcher nesting habitat variables for sites monitored by the Arizona Game and Fish Department in 1995	49
Appendix H.	50
Appendix I. Willow flycatcher nest summary data for sites monitored by the Arizona Game and Fish Department in 1995	64
Appendix J. Summary of habitat characteristics for willow flycatcher nest sites monitored by the Arizona Game and Fish Department in 1995	69
Appendix K. Distance from nest to habitat features at willow flycatcher nest sites monitored by the Arizona Game and Fish Department in 1995	70
Appendix L. Summary of nest site characteristics for willow flycatcher nest sites monitored by the Arizona Game and Fish Department in 1995	71
Appendix M. Percent vertical foliage density for willow flycatcher nest sites monitored by the Arizona Game and Fish Department in 1995	72
Table A. Riparian distribution of willow flycatcher nest sites monitored by the Arizona Game and Fish Department in 1995	24
Nesting Habitat and Nest Site Characterization	25
Population Site Fidelity	26
Willow Flycatcher Behavior	27
Disturbances to Nesting Willow Flycatchers	27
Unconfirmed and Possible Detections	29
Management	30
Recommendations	30
Survey Effort	30
Survey Methods	31
New Monitoring	31
Habitat	32
Management	32
Literature Cited	33
Personal Communications	41

ARIZONA PARTNERS IN FLIGHT 1995 SOUTHWESTERN WILLOW FLYCATCHER SURVEY

Janine A. Spencer, Susan J. Sferra, Troy E. Corman, Jay W. Rourke, Mike W. Sumner

INTRODUCTION

This report summarizes statewide southwestern willow flycatcher (*Empidonax traillii extimus*) survey and monitoring work conducted in 1995. Efforts from the 1993 and 1994 field seasons are summarized in earlier reports (Muiznieks et al. 1994, Sferra et al. 1995).

The willow flycatcher (*Empidonax traillii*) is a widely distributed summer resident of much of the United States and southern Canada (Brown 1988). Before 1958, willow flycatchers and alder flycatchers (*E. alnorum*) were considered a single species, Traill's flycatcher (*E. traillii*). Now they are known to differ in morphology, song, habitat, nest structure and placement (Aldrich 1951, Aldrich 1953, Barlow and McGillivray 1983), and genetics (Seutin and Simon 1988). The willow flycatcher is most easily distinguished from other species of *Empidonax* flycatchers by its characteristic "fitz-bew" song.

The four (or five) subspecies of willow flycatcher recognized in North America (Fig. 1) are distinguished from each other by subtle differences in color and morphology, which can only be observed by careful study of birds in the hand (Phillips 1948, Aldrich 1951, Hubbard 1987, Unitt 1987, Browning 1993). *E.t. extimus* tends to be paler than the other subspecies (Hubbard 1987, Unitt 1987, Browning 1993). Dark individuals have been collected at higher elevations in eastern Arizona (Phillips et al. 1964), and may represent an intergrade or another subspecies. Migrating subspecies with which *E.t. extimus* can be confused are *E.t. brewsteri* and *E.t. adastus*. The breeding range of *E.t. extimus* includes Arizona, southern California, New Mexico, southern Nevada, southern Utah, southwestern Colorado, western Texas, and extreme northwestern Mexico. Its migration patterns are largely unknown, but *E.t. extimus* probably winters in Mexico, Central America, and northern South America (Phillips 1948, Ridgely 1981, American Ornithologist's Union 1983, Stiles and Skutch 1989, Ridgely and Tudor 1994, Howell and Webb 1995).

The southwestern willow flycatcher is a riparian obligate bird restricted to dense streamside vegetation. The breeding habitat of willow flycatchers has been studied by Aldrich (1953), Barlow and McGillivray (1983), Flett and Sanders (1987), Brown (1988), Whitfield (1990), Sedgwick and Knopf (1992), Sferra et al. (1995), Sogge et al. (1995), Whitfield and Strong (1995), and others. Measurements at willow flycatcher nest sites have indicated that high canopy cover, high foliage density, and in some cases proximity to water, may be important factors in placement of nests. However, more information on nesting habitat use by the southwestern subspecies is needed.

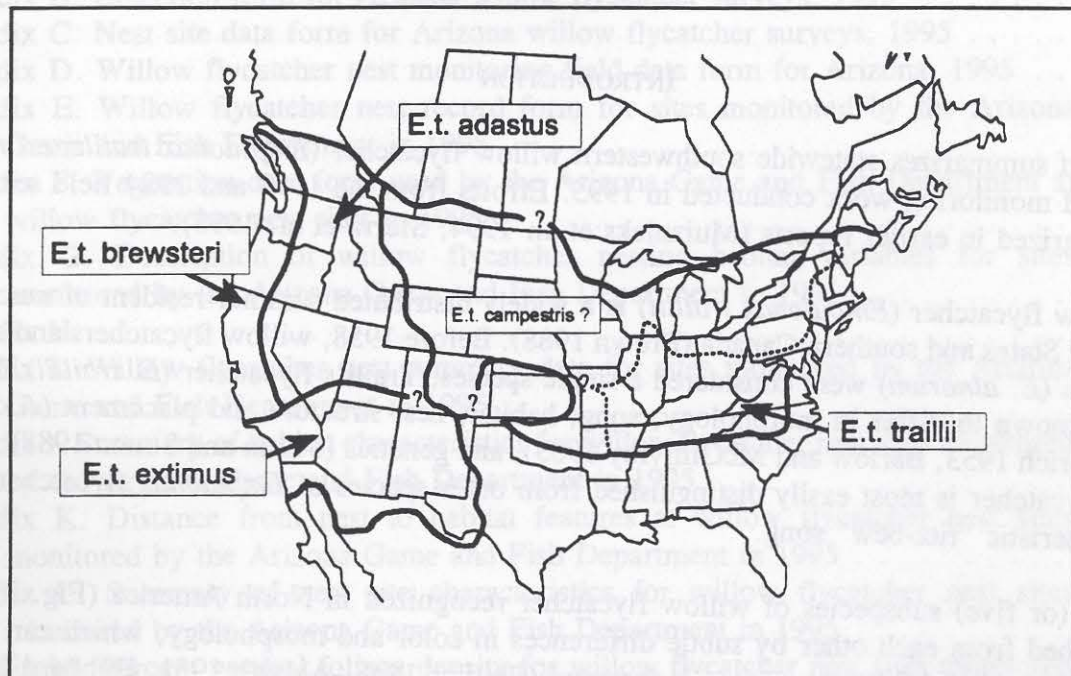


Figure 1. Subspecies distribution of the willow flycatcher. Adapted from Unitt (1987) and Browning (1993).

For the purpose of status and distribution surveys, areas with a dense understory and/or midstory of shrubs or small trees are considered suitable habitat for southwestern willow flycatchers. At high elevations, nests and territorial birds occupy dense, monotypic stands of Geyer willow (*Salix geyeriana*). At low elevations, they inhabit dense, diverse mixed riparian associations of Fremont cottonwood (*Populus fremontii*), willow (*Salix* spp.), boxelder (*Acer negundo*), tamarisk (*Tamarix pentandra*), seepwillow (*Baccharis glutinosa*), arrowweed (*Tessaria sericea*), buttonbush (*Cephalanthus occidentalis*), and/or ash (*Fraxinus* spp.). Currently, pure stands of dense and mature tamarisk are considered suitable habitat because willow flycatchers nest there. However, nest success data over several years is needed to determine if willow flycatcher populations can be sustained in tamarisk habitat. Surface water or saturated soil is usually present in or adjacent to nesting sites during at least the initial portion of the nesting period (Muiznieks et al. 1994, Tibbitts et al. 1994).

Much of the former willow flycatcher habitat in Arizona has been adversely altered or no longer exists (Phillips 1948, Phillips et al. 1964). Preliminary riparian mapping estimates indicate that approximately 930 miles of historically perennial water in Arizona is no longer perennial (Brown 1981). Some of these waters supported historical willow flycatcher habitat. Riparian habitats along Arizona's major river drainages, which include the Colorado, Little Colorado, Gila, Salt,

San Pedro, Santa Cruz, Verde, and Agua Fria, have been altered, degraded, or destroyed since the turn of the century (Phillips 1948, Phillips et al. 1964). These changes have been documented by Hastings and Turner (1965), Dobyns (1978), Rea (1983), Fradkin (1984), Todd (1985), Bahre (1991), Carothers and Brown (1991), Rosenberg et al. (1991), Valencia et al. (1993), McNamee (1994), and others.

Phillips (1948) was perhaps the first ornithologist to express concern over diminishing numbers of willow flycatchers in Arizona. Although many historical records for breeding willow flycatchers exist along the lower Colorado River (Huels in litt.), few birds have been documented there in recent years (Phillips et al. 1964, Unitt 1987, Rosenberg et al. 1991, Muiznieks et al. 1994, Sferri et al. 1995). Willow flycatchers appear to have been absent in historical locations on the lower Salt (downstream from Stewart Mountain Dam), Santa Cruz, and upper San Pedro (south of Cascabel) rivers since at least the late 1940s (Phillips 1948, Phillips et al. 1964, Hunter et al. 1987, Unitt 1987).

Factors contributing to the decline of willow flycatcher populations are loss and fragmentation of native riparian habitat due to flood control, urban development, agriculture, overgrazing, and invasion of exotic plants. Brown-headed cowbird (*Molothrus ater*) brood parasitism, potential loss of wintering habitat, and depredation are also deleterious (Phillips 1948, Phillips et al. 1964, Unitt 1987, Whitfield 1990, Harris 1991, Rosenberg et al. 1991, USFWS 1993).

The willow flycatcher is included on the list of *Wildlife of Special Concern in Arizona* (in prep.), which will replace the Arizona Game and Fish Department's *Threatened Native Wildlife in Arizona* (AGFD 1988). This is an advisory document to land management agencies of the Department's concerns and management priorities for Arizona wildlife that may be in jeopardy. Inclusion on the list does not provide additional legal or regulatory protection (i.e. the list is vested in policy, not specifically in law). However, as with all native wildlife in Arizona, wildlife of special concern are protected by the general provisions of Arizona Revised Statutes, Title 17. Unlike Arizona, New Mexico and California provide specific legal protection for the willow flycatcher as a state-listed endangered species (NMDGF 1988, CDFG 1992).

The southwestern willow flycatcher was first federally listed as a category 2 candidate species in 1989, and was elevated to category 1 candidate status in November 1991. In January 1992, the U.S. Fish and Wildlife Service (USFWS) was petitioned to list it as an endangered species. In July 1993, it was proposed as an endangered species with critical habitat [Federal Register 58 (140): 39495]. The southwestern willow flycatcher was listed as an endangered species by the USFWS in March 1995 [Federal Register 60 (38): 10694]. At the same time, the comment period on critical habitat was opened for 60 days. To date, a final rule on critical habitat has not been published, due to a congressionally imposed moratorium on such actions.

Concern over declining willow flycatcher populations and native riparian habitat prompted *Arizona Partners in Flight*, an interagency program dedicated to conserving neotropical

migratory birds, to initiate a statewide willow flycatcher survey in 1993 (Muiznieks et al. 1994). The primary objective was to determine the status of the flycatcher in riparian and wetland habitat, using standardized methods. The 1993 effort focused on conducting surveys throughout Arizona, and identified the need to collect habitat and nest information. During the 1994 and 1995 field season, efforts to determine habitat characteristics and locate nests increased. Federal and state land and resource management agencies, nongovernment organizations, and consulting firms pooled biologists and resources to accomplish the surveys. Management recommendations resulting from this study will also benefit other riparian species.

Specifically, the 1995 objectives were as follows:

1. Continue statewide survey efforts in areas where the birds were found in previous years, as well as in new areas that appeared suitable.
2. Monitor nests to determine nesting success in three known breeding areas: the lower San Pedro River, the Salt River and Tonto Creek inflows to Roosevelt Lake, and two high elevation populations at Alpine and Greer.
3. Document the presence or absence of brown-headed cowbird occurrence and assess the impacts of brown-headed cowbird parasitism on nesting success.
4. Characterize vegetation and physiographic traits at nest sites.
5. Document presence or absence of livestock occurrence in all survey areas.
6. Develop management recommendations for the willow flycatcher.

METHODS

SURVEYS

Surveys were conducted in suitable or potentially suitable habitat, including previously surveyed and new sites (Table 1, Fig. 2). An attempt was made to survey sites where birds were found in previous years. Surveys were conducted according to a standard protocol (Tibbitts et al. 1994). Two survey training workshops were held in May at the Central Arizona College, Aravaipa campus, near the lower San Pedro River. Forty-seven people from the Bureau of Land Management, U.S. Forest Service, USFWS, U.S. Bureau of Reclamation, National Biological Service, Arizona Game and Fish Department (AGFD), USDA Natural Resources Conservation Service, Navajo Natural Heritage Program, and consulting firms were trained to conduct standardized surveys and identify southwestern willow flycatchers in the field. Proposed survey sites included locations occupied in previous years and additional areas with potentially suitable habitat. Survey areas were assigned to participants from all agencies at the training sessions. All surveyors were required to obtain federal endangered species permits.

Table 1. Arizona sites surveyed for willow flycatchers in 1995. (See map, Fig. 2)

Colorado River	East of Marsh	O'Brien
1. Yuma	Big Sandy River	Seal Mountain
Hunter's Hole	10. Lower Big Sandy River	Agua Fria River
Gadsden Pond	Santa Maria River	27. Gillette Ruins
Gadsden Bend	11. Date Creek	Verde River
County 12.5 St.	Billingsley Spring	28. Clarkdale
State Route 24	Date Creek Beaver Ponds	Tavasci Marsh
2. Fort Yuma Indian Reservation	Tres Alamos Falls	Tuzigoot Bridge
Area 1	12. Lower Santa Maria River	Mescal Gulch
Area 2	Yerba Mansa Creek	Tapco
Area 3	Above Date Creek	29. White Bridge
Area 4	E of Date Creek - North	30. Red Rock Crossing
3. Martinez Lake	E of Date Creek - South	31. Dry Beaver Creek
4. Imperial NWR	Lower Santa Maria River	32. Sycamore Canyon
Dredge Channel	Big Stick Mine	33. Sheepshead Canyon
IS	Gila River	34. Granite Creek
IB	13. 91st Ave.	35. West Clear Creek
Killdeer	14. Picacho Lake	Campground
Farm Field	15. Safford	Bull Pen
Flycatcher	Sanchez Road @ Gila River	Roosevelt Lake
Cottonwood Nursery	North Buena Vista	36. Tonto Creek Inflow
Firebreak	Southwest Sanchez	37. Salt River Inflow
Cattail	16. Ray Jct. to Ashurst-Hayden Dam	Inflow Roosevelt Lake
5. Cibola NWR	San Pedro River	Meddler Point
Anderson Revegetation Unit	17. Dudleyville	Salt River - Arm
Cibola Lake	Dudleyville Crossing	Tonto Creek
Arnet Ditch/Tieback Level	PZ Ranch	38. Tonto Creek
6. Havasu NWR	Cook's Lake Cienega	39. Bear Hide Spring
West South Dike	Cook's Lake Seep	40. Gibson Creek (Round Valley)
East South Dike	Indian Hills	Chevelon Creek
New South Dike	18. San Manuel Crossing	41. Upper Chevelon Creek
Pintail Slough	Above Crossing	Gauge Station
Glory Hole	19. Cascabel	Chevelon Crossing - North
Levee Road	Soza Wash	East Clear Creek
Interior Road	Lower San Pedro River	42. Enchinique
7. Little Spring (Kanab Wilderness)	20. Bass Canyon	Little Colorado River
8. Grand Canyon Area (river mile; L/R = left/right bank)	21. San Pedro Riparian NCA	43. Saw Mill Creek
-3.4 to -2.9 R	Contention	44. Wenima Ranch
-6.1 R	Palominas	45. Nelson Reservoir
-8.5 to -8.3 R	Summers	46. Greer
46.1 to 46.9 R	Boquillas	Hall Creek
50.4 to 51.5 L	Carr to Hunter	Tunnel Reservoir
52.0 L	22. Paige Creek	Benny Creek
65.3 L Lava Chuar	Paige Creek	Greer - Upper West Fork
71.0 L Cardenas	Ash Creek I	Greer - Town
136.0 R	Ash Creek II	Greer - North
143.0 R	Santa Cruz River	San Francisco River
196.0 R	23. Anza Trail	47. Alpine
197.5 to 198.0 R	24. Cottonwood Spring	Horse Pasture
204.7 to 204.8 L	25. Cienega Creek	Pheasant Farm
Bill Williams River	Hassayampa River	Black River
9. Bill Williams River NWR	26. Lower Hassayampa River	48. Thompson Ranch
Marsh Edge	Box Canyon Area	
	King Solomon Gulch	

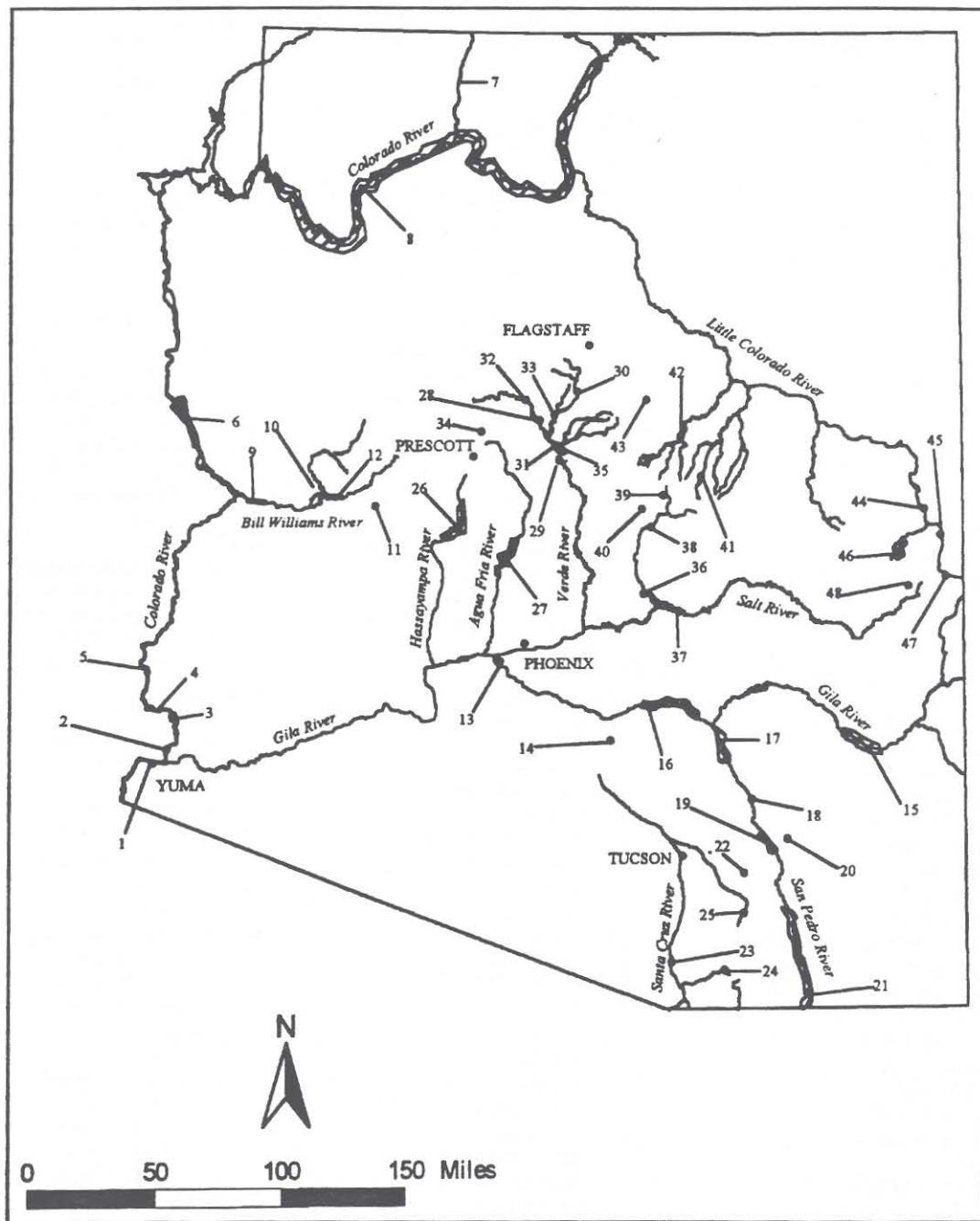


Figure 2. Areas in Arizona surveyed for willow flycatchers in 1995. (See Table 1 for site names).

The *Arizona Partners in Flight* willow flycatcher survey is designed to count occupied breeding territories statewide. To ensure consistency in data interpretation, a territory is defined as a singing bird detected during the established survey period of 15 June to 25 July, regardless of whether a possible or known mate is observed. A site is defined as a patch or length of contiguous habitat where singing birds are detected.

Initial surveys were conducted in late May/early June. Willow flycatchers detected before 15 June or after 25 July were considered possible migrants. If a bird was detected before the 15 June date, a follow-up visit was made to confirm its status. Surveys were conducted by walking or boating through or adjacent to potential habitat using playback recordings and listening for vocalizing willow flycatchers from dawn to late morning. A few supplemental surveys were conducted from late afternoon to dusk, when willow flycatchers may again sing and/or respond to tape playback calls (Sogge and Tibbitts 1992, Sogge et al. 1993). Afternoon surveys were always accompanied by morning surveys.

Each survey site was approached quietly, and the surveyor listened for one to three minutes. The willow flycatcher song tape was broadcast for 15-30 seconds to elicit responses from potential territorial flycatchers. An intensive, systematic nest search was conducted when pairs were detected. Evidence of nesting was confirmed if birds were observed carrying nest material, nest building at an actual nest site, or attending an active nest or fledged young.

Willow flycatcher surveys, detections, and nest information were recorded on standardized forms (Appendixes A, B, and C). Surveyors completed survey forms regardless of whether willow flycatchers were detected, to document habitat suitability and provide a record of habitat surveyed. Additional information recorded on survey forms included presence/absence of livestock, presence/absence of cowbirds, and associated bird species. Data forms were returned to AGFD and USFWS. Information was compiled and entered into AGFD's Heritage Data Management System. Permission was obtained from landowners before conducting surveys on private land.

NEST MONITORING

AGFD observed the behavior of birds detected on surveys to determine nesting status. Nests were monitored at sites surveyed by the AGFD crew using a mirror pole or a miniature portable video camera on a pole. The monitoring crew attempted to visit each nest every three days. However, the interval ranged from 3 to 14 days between visits, due to limited resources. The information was recorded in the field on standardized nest monitoring data forms (Appendix D). Brown-headed cowbird parasitism of nests was recorded. Predation was inferred when one or more eggs or all nestlings disappeared prematurely. Notes were taken on whether the nest was intact or damaged. Damaged nests may indicate predation, severe weather, or nest material being reused at a new nest site.

Nesting success was calculated using Mayfield's (1961) method, which estimates the probability of eggs or nestlings surviving to fledging. This method accounts for variation in the number of nests lost, with the total number of nests and the time span covered by observations. The combination of nests and time observed is referred to as exposure. A nest seen on two consecutive days represents an exposure of one nest-day. A nest in existence five days after it was found represents an exposure of five nest-days, whether it was visited many times or only at the end of the interval. A nest lost during an interval of several days is arbitrarily assumed to have been lost on the day at the middle of the interval. Fledging was assumed if the young were not in the nest on the next monitoring day after the estimated fledge date, and if nest failure was unlikely since the previous visit. Nests were assumed successful if feathered young were observed in the nest on the last visit, a maximum of three days prior to the estimated fledging date.

Survival was calculated for the periods of incubation and nestling phases, using the formula $(1 - r)^d$, where r is the number of nests lost divided by the total number of observation days for that nest phase, and d is the period of days covered by a nest phase (Mayfield 1961). Since $1 - r$ is the survival rate, the probability of survival is S^d . For example, $d = 12$ for the incubation phase because, on average, eggs hatch within 12 days of clutch completion. The product of individual probabilities for surviving the incubation and nestling phases provides the overall survival rate from incubation to fledging. Fledging dates were estimated on nest record forms (Appendix E) for each nest located using the following standards: clutches of three to four eggs are usually completed within four days, eggs hatch an average of twelve days after the clutch is completed, and nestlings fledge 12 to 14 days after hatching (Ettinger and King 1980).

NESTING HABITAT CHARACTERIZATION

Habitat measurements collected in 1995 were modified from the 1994 methods (Sferra et al. 1995). Methods from both years were based on Brown and Trosset (1989), Whitfield (1990), and Sedgwick and Knopf (1992). The data form used for habitat measurements is in Appendix F. Review of the 1994 willow flycatcher nesting vegetation data (Sferra et al. 1995) indicated that structural rather than floristic variables should be emphasized. Therefore, in 1995, nesting habitat was characterized at three levels: nest/nest shrub, comprising characteristics within the immediate vicinity of the nest; nest site, including characteristics of the habitat patch surrounding the nest (Martin and Roper 1990); and stand level, which includes the spatial arrangement of patches and characteristics of the surrounding riparian area occupied by willow flycatchers. The procedures used to measure habitat variables are described in Appendix G.

The 1994 methodology was also modified to facilitate more efficient data collection. Global Positioning System (GPS) technology was used to locate and measure distances between nests, plot vegetation patches and open water sources, and determine the elevation at nests. The circumference at breast height [4.5 ft (1.4 m) above ground] was measured on Geyer willows in lieu of stem diameter since the bushes were multi-stemmed at the base of nest shrubs.

Circumference measurements were recorded separately and were not averaged with stem diameters of lower elevation nest shrubs, since the two are not comparable. Distance from nest to nearest saturated soil and water was estimated while the nest was active and then GPS-located to that point at the end of the breeding season.

Vertical foliage density was estimated within a 0.10 ac (0.04 ha) circle centered at the nest, along four 37.0 ft (11.3 m) transects (radii) located in each of the four cardinal directions. A fiberglass survey rod was placed vertically at intervals of 4.9 ft (1.5 m), 14.8 ft (4.5 m), 24.6 ft (7.5 m), and 37.0 ft (11.3 m) along each of the four transects at each nest site. The percent of foliage obscuring the rod was estimated between increments of 3.0-6.0 ft (0.9-1.8 m), 6.1-9.0 ft (1.9-2.7 m), 9.1-12.0 ft (2.8-3.7 m), and > 12.0 ft (> 3.7 m) above ground. The survey rod was read from a random direction and distance from one to five meters from the rod, using a random numbers table (Nudds 1977). The percent of each vertical section of rod covered by vegetation was recorded and averaged for each 0.10 ac (0.04 ha) circle.

Percent canopy density was averaged at each nest site from readings in the four cardinal directions 4.9 ft (1.5 m) from a vertical projection below the nest, using a densiometer and tripod. Tree stem/bole intercepts were not included. The densiometer was read 3.3 ft (1 m) above ground, using procedures described by Strickler (1959), as modified by Griffin (1985).

To avoid excessive disturbance, vegetation data were collected at nest sites after nests were no longer occupied. Plant heights were measured using a survey rod. If vegetation exceeded the height of the survey rod, plant heights were measured using a clinometer. Distances were measured using a meter tape in the field, or (for longer distances) from aerial photos or GPS information. Patch size in linear tamarisk areas at the Salt River and Tonto inflows to Roosevelt Lake, and Indian Hills and PZ Ranch on the San Pedro River, was measured to the farthest point at which willow flycatchers were detected. The dominant midstory and overstory plants were determined visually. The overstory layer was defined as the upper tree canopy layer, while the midstory layer included vegetation from a height of 20 in (50 cm) to the bottom of the overstory layer (Cooperrider et al. 1986).

DESCRIPTIVE ANALYSIS AND COMPARISONS

Statistical analyses were performed on vegetation data, including descriptive measures such as mean, standard deviation, and range for all continuous variable data, using Statgraphics (Bitstream 1992) and Quattro Pro (Borland International, Inc. 1992). For discrete data, percentage per class and mode were determined. Due to small sample size (Zar 1984), nonparametric statistics were used to analyze 1995 vegetation variables to account for variations from the assumption of normality of data. Alpha level was set at 0.05 for all tests. Habitat variables were analyzed for lack of significant difference across vegetation types, which was indicated by a significance level of $P > 0.05$. Comparisons using Kruskal-Wallis tests (Zar 1984) were performed to test the null hypothesis that there was no significant difference between

habitat variables for tamarisk, mixed riparian, and high elevation willow patches. Mann-Whitney U tests were used to compare characteristics between two vegetation types, tamarisk and mixed riparian (H_0 = no significant difference between measured variables at the two vegetation types), for variables that were not applicable at high elevation willow sites. A Spearman Rank Correlation (Zar 1984) was performed to determine whether a correlation existed between nest height and nest substrate height. Rayleigh's R Statistic (Zar 1984) was computed to test for uniformity in the distribution of nest azimuths (H_0 = the azimuths are uniformly distributed, i.e. there is no mean direction).

RESULTS

SURVEYS, DETECTIONS, AND DISTRIBUTION

Fifty-eight surveyors spent approximately 738 hours surveying approximately 132 miles (212 km) of riparian and wetland habitat throughout Arizona in 1995 (Appendix H). Of these totals, a six person AGFD crew completed 403 hours of surveys (exclusive of many hours spent nest searching, monitoring, and collecting vegetation data).

Excluding the Grand Canyon, 99 sites were surveyed for willow flycatchers in 1993, and an additional 99 new sites in 1994. Grand Canyon sites were excluded because all suitable habitat along the Colorado River corridor from Glen Canyon Dam to Lake Mead was surveyed from 1992 through 1994. In 1995, 53 new survey sites were added. Therefore, excluding the Grand Canyon, 251 different sites have been surveyed in Arizona during the past three years. The maximum number of sites surveyed in the Grand Canyon in a single year was 182 in 1994. A total of 122 sites were surveyed statewide in 1995, including 14 sites in the Grand Canyon.

In 1995, 83-87 territorial willow flycatchers were found during the 15 June to 25 July survey period. Sixty-two to 63 of these territorial birds were paired. Territorial willow flycatchers were found at 17 of the 122 sites surveyed (14%). Nests or fledglings were confirmed at 12 sites (Appendix H). Permission to survey Camp Verde and Tuzigoot Bridge was not granted from private landowners in 1995, therefore we were unable to confirm nesting at these previously confirmed breeding sites.

The greatest concentrations of willow flycatchers were again at the inflows to Roosevelt Lake (17 pairs), on the lower San Pedro River at Cook's Lake Cienega (7 pairs), Cook's Lake Seep (6-7 pairs), PZ Ranch (12 pairs), and at two high elevation sites at Alpine (3 pairs) and Greer (7 pairs). The lowest elevation at which breeding willow flycatchers were observed was approximately 456 ft (139 m) at Havasu National Wildlife Refuge. Willow flycatchers were detected as high as approximately 8240 ft (2512 m). Territorial willow flycatchers were not located in the mid-elevation range between 3359 ft (1024 m) and 7957 ft (2426 m) in Arizona, which is consistent with findings in past years. Singing willow flycatchers were detected as early

as 14 May at Havasu National Wildlife Refuge. Singing males and nests were detected on initial surveys in Grand Canyon on 22 May and at Cook's Lake Cienega on 24 May.

Although some observers neglected to report associated species of birds, those who did reported the following common species in high elevation sites: American robin (*Turdus migratorius*), red-winged blackbird (*Agelaius phoeniceus*), brown-headed cowbird, violet-green swallow (*Tachycineta thalassina*), belted kingfisher (*Ceryle alcyon*), song sparrow (*Melospiza melodia*), mourning dove (*Zenaida macroura*), blue grosbeak (*Guiraca caerulea*), broad-tailed hummingbird (*Selasphorus platycercus*), red-tailed hawk (*Buteo jamaicensis*), and Cooper's hawk (*Accipiter cooperii*). In low elevation tamarisk, the most common species reported were: mourning dove, vermilion flycatcher (*Pyrocephalus rubinus*), brown-headed cowbird, yellow warbler (*Dendroica petechia*), common yellowthroat (*Geothlypis trichas*), yellow-breasted chat (*Icteria virens*), summer tanager (*Piranga rubra*), Abert's towhee (*Pipilo aberti*), and western kingbird (*Tyrannus verticalis*). In low elevation mixed riparian areas, most frequently reported were red-winged blackbird, mourning dove, white-winged dove (*Zenaida asiatica*), brown-headed cowbird, black phoebe (*Sayornis nigricans*), ash-throated flycatcher (*Myiarchus cinerascens*), Bell's vireo (*Vireo bellii*), verdin (*Auriparus flaviceps*), Abert's towhee, bronzed cowbird (*Molothrus aeneus*), and great blue heron (*Ardea herodias*). Statewide, surveyors reported 20 sites with bronzed cowbirds and six sites with yellow-billed cuckoos, but it is unknown how many sites were not checked for these species.

Surveyors reported brown-headed cowbird presence at 87 sites and absence at 19 sites (Appendix H). Observers neglected to report cowbird presence/absence at 15 sites. The most cowbirds reported during a single visit was approximately 100, along the Gila River near Ashurst-Hayden Diversion Dam.

Livestock were present at 30 (36%) of the 83 sites at which evidence of livestock presence or absence was recorded. Evidence less than one year old was reported at an additional 14 sites (17%), and evidence more than one year old was reported at five sites (6%).

NESTING SUCCESS

Fifty-six willow flycatcher nesting attempts were located throughout the state (data from cooperators and AGFD crew), fledging an estimated 63 or more young. Of the 53 nesting attempts with known outcome, a total of 31 fledged willow flycatcher young (Table 2, Appendixes H,I).

Nests were found in three new areas in 1995: one on the Gila River, two on the lower Big Sandy River, and an inferred nest (two fledgling willow flycatchers observed) on the Havasu National Wildlife Refuge.

Brown-headed cowbirds were observed at all 12 general sites statewide where nests were located (Appendix H). Four nests were known to be parasitized by brown-headed cowbirds (Appendixes H,I). An unknown number of nests may have been abandoned prior to egg laying as a result of cowbird parasitism. At two parasitized nests at Tonto Creek inflow to Roosevelt Lake and the Grand Canyon, the brown-headed cowbird eggs disappeared and the nests successfully fledged willow flycatchers. Two nests parasitized by brown-headed cowbirds at Salt River inflow to Roosevelt Lake and Cook's Lake Cienega fledged only cowbirds and no willow flycatchers. Additionally, one nest appeared to have been parasitized by a bronzed cowbird at PZ Ranch, possibly after the willow flycatcher nest had already failed.

Table 2. Willow flycatcher nesting success at sites monitored by the Arizona Game and Fish Department in 1995.

No. nests with known outcome	No. nests fledging young ¹	Total no. young fledged ²	Number of young fledged/nest	No. nests fledging young /no. nests with known outcome	Mayfield (1961) method nest success
48	27	≥57	≥1.2	0.56	0.42

¹Success assumed if feathered young in nest a maximum of three days prior to estimated fledging date (except six days prior to fledging for one nest).

²Exact number fledged could not be determined.

Dates and locations of the earliest nests found are a result of limited survey effort in mid to late May. If survey crews had begun field work earlier, earlier nests might have been found. The first two nests that hatched young were first found on 25 May at Cook's Lake Seep in tamarisk habitat. Hatching dates were estimated to be 10 June and 12 June, respectively. Both nests hatched two young. The earlier hatching nest failed, but the later nest fledged two young. The latest active nest with eggs was discovered at PZ Ranch on 31 July. This nest later failed.

Forty-eight of the 56 nesting attempts were monitored by the AGFD crew, making it possible to use the Mayfield (1961) method of determining nesting success. Three additional nesting attempts documented by the AGFD crew were not included in the Mayfield (1961) nest success calculations because one nest was too high to monitor and only fledglings were found at two sites. At these 48 nests, success averaged 42 percent for all three vegetation types (tamarisk, mixed riparian, and high elevation willows). Nest success was 57 percent during the incubation period and 74 percent during the nestling period ($0.57 \times 0.74 = 0.42$). When broken into three vegetation types, nest success averaged 69 percent in native high elevation willow patches at Alpine and Greer ($n = 10$); 34 percent in tamarisk patches at Cook's Lake Seep, Tonto Creek and Salt River inflows to Roosevelt Lake, Indian Hills, and PZ Ranch ($n = 31$); and 11 percent

in native mixed riparian habitat at Cook's Lake Cienega ($n = 7$). Low success in native mixed riparian habitat at Cook's Lake Cienega is attributable to: nest abandonment (33%), fledging only brown-headed cowbirds (8%), and disappearance of eggs or young (17%). Mean number of fledglings per successful nest monitored varied with habitat type. The average number of fledglings per successful nest was 2.1 for all habitats ($n = 27$), 2.3 in high elevation Geyer willow ($n = 7$), 1.5 in mixed riparian ($n = 2$), and ≥ 1.9 in tamarisk ($n = 18$).

A total of 116 willow flycatcher eggs were counted at the AGFD monitored sites ($n = 48$). The maximum number of willow flycatcher eggs found in one nest was four and the minimum was one (which produced one nestling, presumed fledged). Additional nest success calculations are as follows, where n = number of nests:

1. Average number of eggs per nest, including clutches of any size, excluding nests abandoned prior to egg laying ($n = 44$): 2.6
2. Average number of young fledged per nest, including unsuccessful nests, excluding those abandoned before eggs were laid ($n = 44$): 1.3
3. Average number of young fledged per successful nest ($n = 27$): 2.1
4. Average number of young fledged per nest with ≥ 3 eggs ($n = 25$): 1.6

Renesting may have occurred at as many as five territories (Appendix I), but without banded birds confirmation was not possible to determine if there were polygynous pairs. None of the possible renesting attempts were successful. Only one pair was documented at each of these five locations. One territory at the Salt River inflow successfully fledged three young on the first nesting attempt, and a second nest was located two weeks after the fledge date of the first nest. The second nest failed, as the eggs gradually disappeared until the nest was abandoned by the adults. Two nests found within what was thought to be a single territory at PZ Ranch were either from a single pair or two females. The second clutch was completed five days after the first nest was estimated to fledge. The last visit to the first nest was six days prior to the estimated fledging date. Assuming the nest was successful, a second clutch was not possible within this time frame unless there was a polygynous male and a second female. However, if the nest failed, a second clutch would have been possible. Both first and second nests in the remaining three territories failed.

NESTING HABITAT TYPES

As in previous years, willow flycatchers nested in three general habitat types in Arizona.

1. Willow - arctic boreal wetland (Brown 1982) at high elevations > 7000 ft (2134 m).

Habitat: patches of densely growing shrubs averaging 15-20 ft (4.6-6.1 m) tall. Composed primarily of Geyer willow, with dense herbaceous ground cover. Alders (*Alnus* spp.) are interspersed in some areas. Pools and

marshes created by beaver dams, wet meadows, or saturated soil are usually present in the immediate vicinity.

Sites: Greer and Alpine.

2. Tamarisk - primarily dense mid- and/or overstory at low elevations <4000 ft (1219 m).

Habitat: primarily contiguous stands of dense, mature tamarisk averaging 35-40 ft (10.7-12.2 m) tall along larger river drainages. This habitat may be interspersed with willow and cottonwood trees or patches, with tamarisk dominant in the midstory.

Sites: Tonto Creek and Salt River inflows to Roosevelt Lake, Indian Hills, Colorado River miles 50.5, 51.4 and 65.3 in the Grand Canyon, the north end of PZ Ranch, Cook's Lake Seep, and Havasu National Wildlife Refuge.

3. Mixed Riparian - Sonoran riparian deciduous forest and Sonoran marshland (Brown 1982) in lower elevations <4000 ft (1219 m).

Habitat: primarily cottonwood and willow, with some ash and boxelder overstory averaging 50-55 ft (15.2-16.8 m) tall and often with some tamarisk in the understory. Open water, cienegas, marshy seeps or saturated soil are often present in the immediate vicinity and may include dense stands of buttonbush, cattail (*Typhus* spp.), bulrush (*Scirpus* spp.), and other wetland plants.

Sites: Cook's Lake Cienega, Tuzigoot Bridge, Bill Williams River National Wildlife Refuge, and the lower Big Sandy River.

DESCRIPTIVE ANALYSIS AND COMPARISONS

Vegetation data were collected at 48 nests monitored by the AGFD crew. Data were not collected at two other locations where adult willow flycatchers were observed feeding fledglings, because their nests were not found. A third nest site was not measured because the nest was too high in the tree.

Habitat variables were analyzed for lack of significant difference across all vegetation types at the 48 nests monitored at Greer, Alpine, Tonto Creek and Salt River inflows to Roosevelt Lake, Indian Hills, Cook's Lake Cienega, and Cook's Lake Seep (H_0 = no significant difference between means of values of variables within the three vegetation types) with the Kruskal-Wallis test (Zar 1984). For most variables $n = 31$ for tamarisk, $n = 7$ for mixed riparian, and $n =$

10 for high elevation willows because these nests were located and monitored for nesting success by the AGFD crew. Habitat variables at a subset of nest sites were analyzed for uniformity across two vegetation types, using the Mann-Whitney U test (Zar 1984). For a few variables, "n" was less than stated above, because data were not collected at all nests or were not applicable (for example, distance between nests was not measured at Indian Hills because only one nest was found there). Lack of significant difference was indicated by $P > 0.05$ for five variables (Table 3) for the Kruskal-Wallis and Mann-Whitney U tests.

All 48 nest sites were used in the Spearman Rank Correlation test (Zar 1984) and Rayleigh's test (Zar 1984). Nest height correlated significantly with nest substrate height (Table 3). However, the nest azimuth between nest sites was randomly distributed (Table 3).

NEST/NEST SHRUB CHARACTERISTICS

Stem diameter of the nest shrub was not significantly different between tamarisk and mixed riparian vegetation (Table 3, Appendix J), although variation was high within each vegetation type. A comparison of stem diameter was made for only two vegetation types because Geyer willow in high elevation was measured differently. Geyer willow was measured in circumference at breast height because it was multi-stemmed at the base. Nest height correlated positively with nest substrate height, across sites in all three vegetation types.

The distance from nest to center of nest shrub (Table 3, Appendix K) was not significantly different between vegetation types. Mean distance from nest to shrub center ranged from a low of 1.6 ft (0.5 m) in mixed riparian sites to 1.9 ft (0.6 m) in tamarisk, and a high of 4.0 ft (1.2 m) in high elevation willows.

Distance between nearest known nests also showed no significant difference, averaging 133 ft (40 m) in tamarisk, 198 ft (60 m) in mixed riparian, and 233 ft (71 m) in high elevation willow sites. There was no indication of a mean direction for nest placement in relation to the substrate stem (i.e. the direction was random).

Of the 48 nesting attempts, 17 nests were in native vegetation [buttonbush, Geyer willow, or black twinberry (*Lonicera involucrata*)]. The other 31 were in non-native tamarisk. All but one nest found at the two higher elevation sites were in Geyer willow; the other was in black twinberry. Nests consisted of compact cups of fiber, bark, and grass, as described by Harrison (1979). In tamarisk, nests were built solely of dry tamarisk leaves and twigs. All nests were built in forks of 2-7 vertical stems or branches.

Table 3. Comparisons of vegetation variables between habitat types at willow flycatcher nest sites monitored by the Arizona Game and Fish Department in 1995. (See Appendixes J, K, and L for parameters).

Test/Variable	Test Value	Significance*
Kruskal-Wallis Test $(0.05, (2))$ ¹		
Percent canopy density $(n = 31, 7, 10)$	H = 3.274	>0.05
Distance from nest to shrub center $(n = 31, 6, 10)$	H = 2.333	>0.05
Distance from nest to shrub edge $(n = 31, 6, 10)$	H = 12.104	<0.05
Distance from nest to edge of vegetation type $(n = 30, 7, 10)$	H = 12.036	<0.05
Distance from nest to edge of patch $(n = 31, 7, 10)$	H = 11.873	<0.05
Distance from nest to saturated soil $(n = 31, 7, 10)$	H = 33.521	<0.05
Distance from nest to open water $(n = 30, 7, 10)$	H = 23.456	<0.05
Distance to nearest known nest $(n = 28, 7, 10)$	H = 5.904	>0.05
Overstory height $(n = 31, 7, 10)$	H = 23.778	<0.05
Nest height $(n = 31, 7, 10)$	H = 21.856	<0.05
Substrate height $(n = 31, 7, 10)$	H = 17.532	<0.05
Mann-Whitney U Test $(0.05(2))$ ²		
Midstory height $(n = 15, 7)$	U = 28.5, U' = 76.5	>0.05
Nest shrub stem diameter $(n = 29, 5)$	U = 57.5, U' = 113	>0.05
Spearman Rank Correlation Test $(0.05(2), 48)$ ³		
Nest height: nest substrate height	r = 0.8371	<0.05
Rayleigh's Test $(0.05, 48)$ ³		
Nest azimuth	z = 2.5977	>0.05

¹ n = # nests tamarisk, # nests mixed riparian, # nests high elevation willow

² n = # nests tamarisk, # nests mixed riparian

³ n = total # nests for all three vegetation types

* significant if <0.05

NEST SITE CHARACTERISTICS

Percent canopy density was consistently high between vegetation types, ranging from an average of 89 percent in tamarisk to a high of 93 percent in mixed riparian (Appendix L). The variation within each type was small. Percent canopy density over nests was 89 percent in high elevation willow patches, although there were no overstory trees above the willows.

Canopy overstory height differed significantly ($p < 0.05$) between the three habitat classes; high elevation willow were shortest and mixed riparian were tallest (Appendix L). Mean overstory canopy height within tamarisk was 33.8 ft (10.3 m). Mixed riparian canopy height averaged 39.0 ft (11.9 m), and overstory canopy height averaged 14.1 ft (4.3 m) at high elevation willow sites.

Average midstory height was similar between tamarisk and mixed riparian sites (Appendix L). Mean midstory height was 12.8 ft (3.9 m) for tamarisk and 13.8 ft (4.2 m) for mixed riparian sites. Only the two vegetation types were compared, since high elevation Geyer willows consisted of just one layer. Vegetation height at high elevation willow was considered overstory because it was tall enough to provide thermal protection and cover above nests, and not simply vertical protection, as occurred with the midstory in the other two vegetation types.

Vertical foliage density increased consistently with height above ground for tamarisk, mixed riparian, and high elevation willows (Appendix M, Fig. 3). In high elevation willows, vertical foliage density decreased in the 12.0-25.0 ft (3.7-7.6 m) range because the mean height of the willow patches was only 14.4 ft (4.4 m). At high elevation willow nest sites, vertical foliage density was greatest near the nest, and decreased with increased distance away from the nest (Fig. 4). The same trend was evident but less dramatic in tamarisk stands (Fig. 5), and was not evident at mixed riparian sites (Fig. 6).

Tamarisk was the most common midstory (49%) and overstory (44%) species. Willows were second most common (27%). Other mid- and overstory plants included buttonbush (10%) and cottonwood (9%), with a few *Ipomoea* sp., mesquite (*Prosopis* spp.), *Convolvulus* sp., and *Nicotiana* sp.

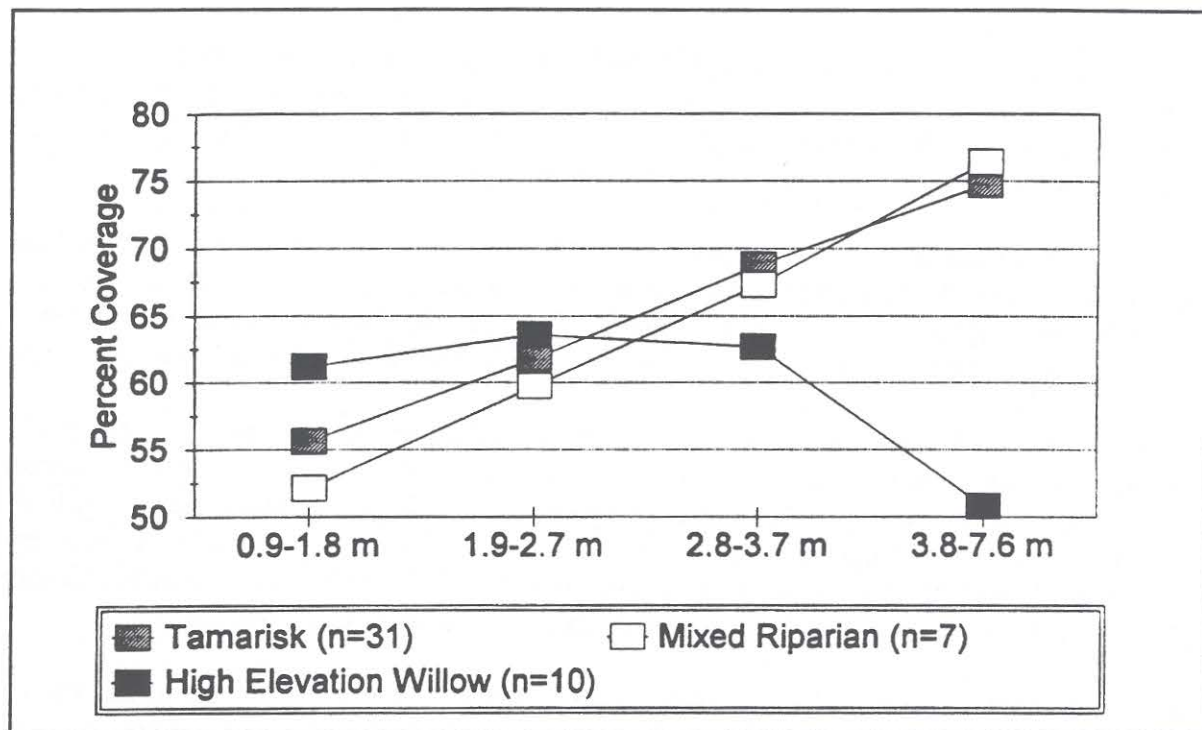


Figure 3. Vertical foliage density in four height intervals for three habitat types, at willow flycatcher nest sites monitored by the Arizona Game and Fish Department in 1995. (See Appendix M for parameters).

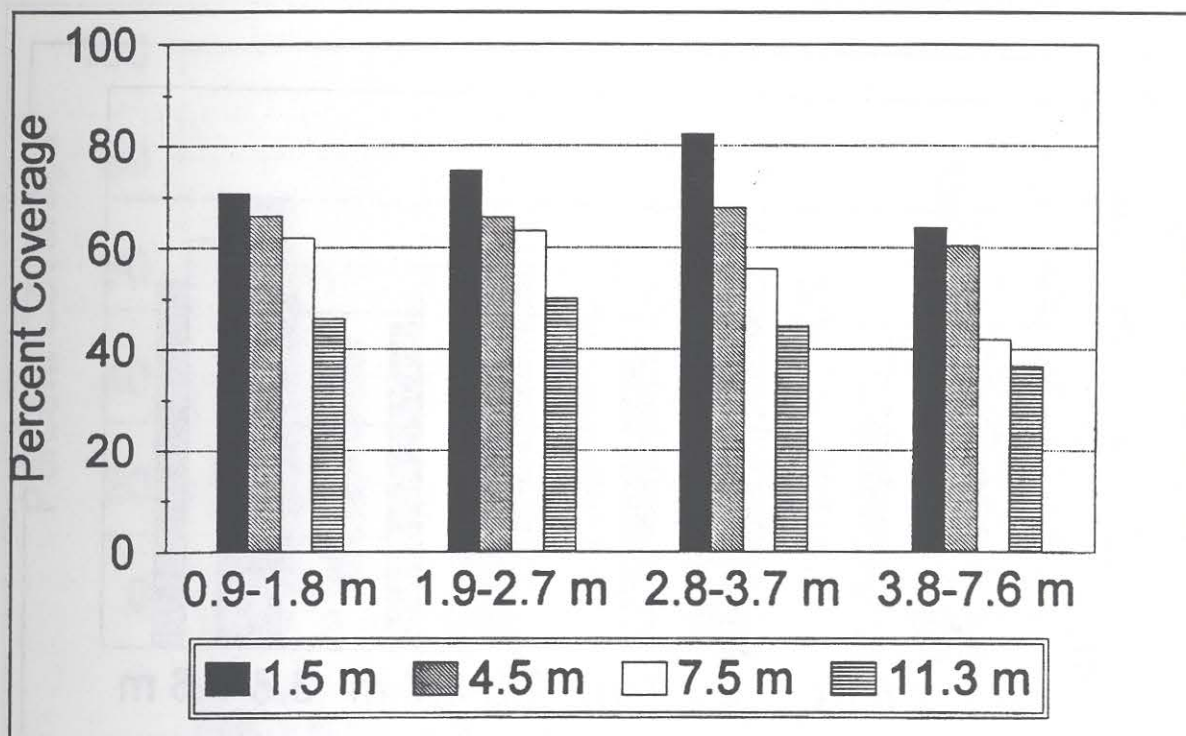


Figure 4. Percent vertical foliage density in four height intervals at distances of 1.5 m, 4.5 m, 7.5 m, and 11.3 m from the nest at high elevation willow flycatcher nest sites ($n = 10$) in Arizona, 1995. (See Appendix M for parameters).

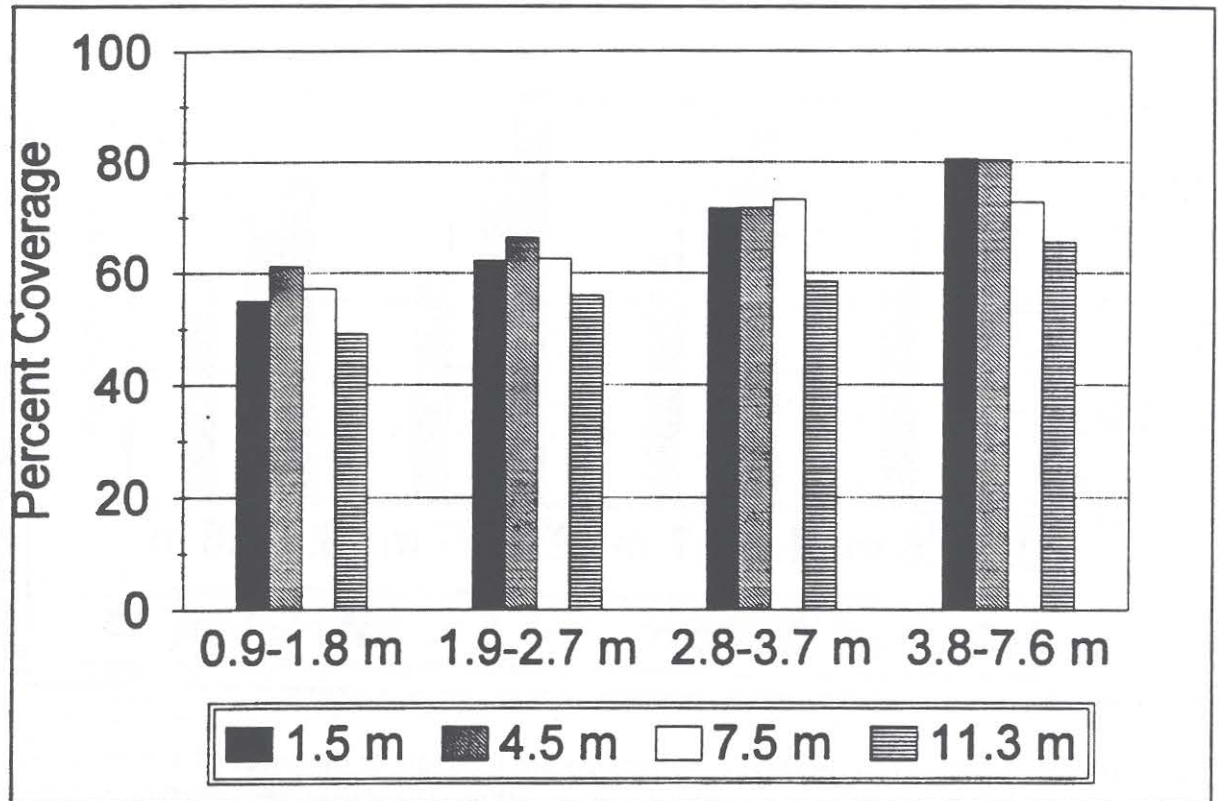


Figure 5. Percent vertical foliage density in four height intervals at distances of 1.5 m, 4.5 m, 7.5 m, and 11.3 m from the nest at tamarisk willow flycatcher nest sites ($n = 31$) in Arizona, 1995. (See Appendix M for parameters).

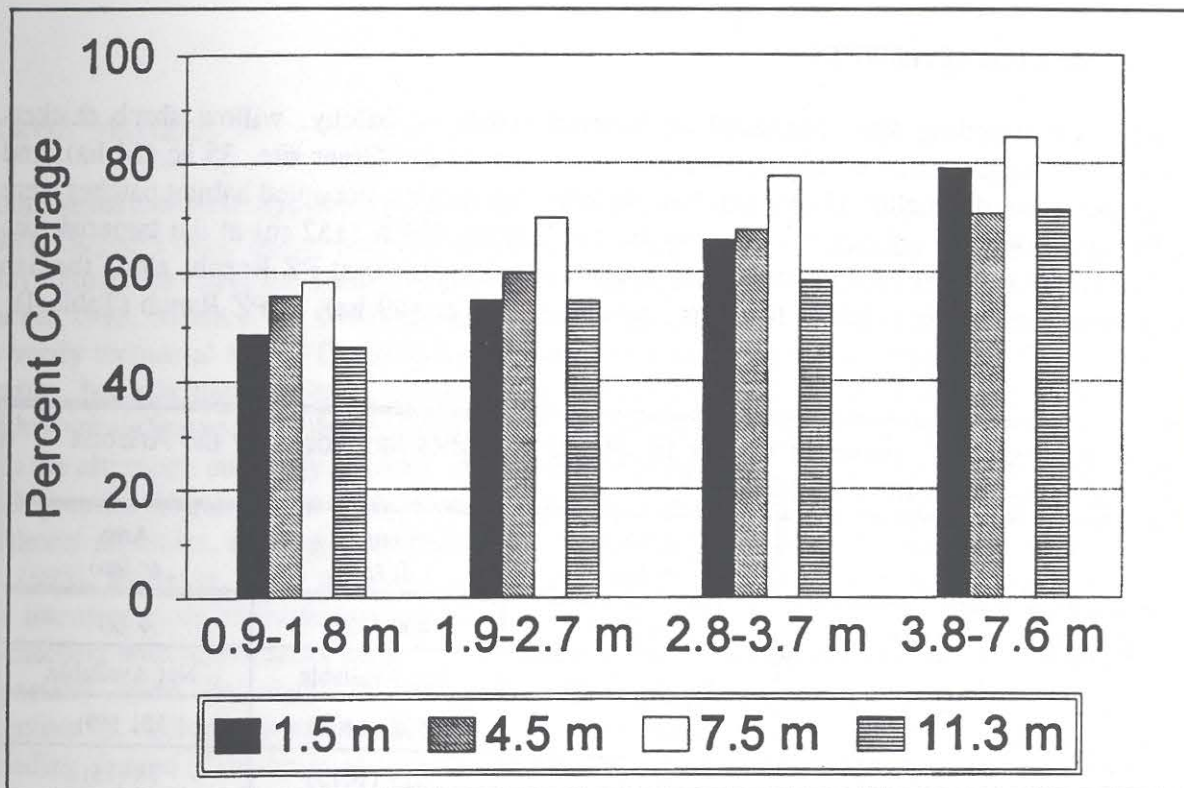


Figure 6. Percent vertical foliage density in four height intervals at distances of 1.5 m, 4.5 m, 7.5 m, and 11.3 m from the nest at mixed riparian willow flycatcher nest sites ($n = 7$) in Arizona, 1995. (See Appendix M for parameters).

STAND LEVEL CHARACTERISTICS

High elevation breeding sites consisted of isolated stands of patchy, willow shrub thickets (Table 4). The largest stand in high elevation willow was at the Greer site, 35 ac (14 ha), and was interspersed with smaller willow patches. At lower elevations, occupied habitat patches were generally more linearly contiguous, varying in width from 499 ft (152 m) at the tamarisk site at the Salt River inflow to Roosevelt Lake, to ca. 1148 ft (350 m) at PZ Ranch, along the San Pedro River. The largest patch in linear tamarisk was 121 ac (49 ha), at PZ Ranch (Table 4).

Table 4. Riparian dimensions of willow flycatcher nest sites monitored by the Arizona Game and Fish Department in 1995.			
Site Name	Width ft (m)	Length ft (m)	Area ac (ha)
Cook's Lake Seep (tamarisk)	550 (168)	400 (122)	5 (2)
Indian Hills (tamarisk)	Not Available	Not Available	Not Available
PZ Ranch (tamarisk)	1148 (350)	4592 (1400)	121 (49)
Salt River Inflow Roosevelt Lake (tamarisk)	499 (152)	3329 (1015)	38 (15)
Tonto Creek Inflow Roosevelt Lake (tamarisk)	167 (51) 222 (68) 167 (51)	555 (169) 555 (169) 444 (135)	7.1 (2.8) Total
Median (tamarisk)	562 (171)	1865 (568)	22.7 (9.1)
Min. (tamarisk)	499 (152)	213 (65)	5 (2)
Max. (tamarisk)	1148 (350)	4592 (1400)	38 (15)
Cook's Lake Cienega (mixed riparian)	750 (229)	597 (182)	10.3 (4.2)
Alpine (high elevation willow)	62 (19)	495 (151)	0.7 (0.3)
Greer (high elevation willow)	659 (201)	2323 (708)	35 (14)
Median (high elevation willow)	361 (110)	1409 (430)	18 (7)
Min. (high elevation willow)	62 (19)	495 (151)	0.7 (0.3)
Max. (high elevation willow)	659 (201)	2323 (708)	35 (14)

DISCUSSION

SURVEY METHODS

Southwestern willow flycatchers arrive on territories in late April and early May (Hunter et al. 1987, Sogge 1995). Initial surveys should begin in May, since nesting begins in mid to late May. However, because some willow flycatchers are still relocating in mid June (Hull and Parker 1995, Sferra et al. 1995), follow up visits should be conducted in late June to early July to verify territorial birds. Territorial males are more likely to be detected early in the breeding season, because they are more likely to be unpaired or without an active nest, and thus are highly vocal (Sogge and Tibbitts 1994). Early in the breeding season, territorial males often sing into the afternoon and early evening. As the season progresses, males tend to sing primarily, and with greatest frequency, in early morning. Surveys conducted late in the season are less likely to detect all males, as song rates diminish (Sogge and Tibbitts 1994, Maynard 1994, Sferra et al. 1995). However, some unpaired males can be found singing later in the breeding season with the intensity more characteristic of birds found earlier in the season. Paired male and female flycatchers with active nests elicit "whitt" notes and engage in bill snapping throughout the day, especially when disturbed. Therefore, surveyors should be particularly familiar with, and attentive to, willow flycatcher "whitt" and interaction calls, and bill snapping throughout the breeding season (Tibbitts et al. 1994). The birds were most vocal and easiest to detect in the early morning, from first light until mid-morning.

The current survey protocol (Tibbitts et al. 1994) is being revised to include new guidelines for the number and timing of visits. This modification is intended to ensure detection of birds during the peak vocalization period, as well as presence/absence throughout the breeding season.

DETECTIONS AND DISTRIBUTION

Annual fluctuations in willow flycatcher abundance must be regarded cautiously because comparisons between years are difficult. Timing of surveys, number of visits, survey effort, area surveyed, and observer experience vary among years and can influence the number of detections. Different numbers may be attributed to sampling error or actual changes in populations.

In 1995, willow flycatchers were again mainly found breeding in groups. Territories of paired birds were often adjacent to at least one other pair. Exceptions include single males at Bill Williams National Wildlife Refuge and at River Miles 50.5 and 65.3 in the Grand Canyon, and a pair at Indian Hills on the San Pedro River.

Low numbers of willow flycatchers in the Grand Canyon are of concern, considering they were reported as common nesters in Glen Canyon before inundation by Lake Powell (Behle and Higgins 1959, Behle 1985). Only one nest was found this year, which successfully fledged one willow flycatcher. In 1994, there were four unsuccessful first nests and five unsuccessful renests

(Sogge and Tibbitts 1994). Periodic surveys for breeding willow flycatchers conducted in the Grand Canyon since 1986 (Brown 1988) report fluctuating numbers. Sogge et al. (1995) report low numbers and poor productivity since intensive monitoring began in 1992. Willow flycatchers in the Grand Canyon are vulnerable to extirpation by stochastic events (e.g. floods, severe weather, or fire), brown-headed cowbird nest parasitism, or natural attrition, since the resident population is small. The canyon population is probably partially composed of willow flycatchers produced elsewhere that disperse into the canyon as breeders (Sogge and Tibbitts 1994).

Singing and territorial willow flycatchers were detected along the lower Colorado River near Yuma again in 1995. However, since they were detected only before 15 June, they might have been migrants. More surveys are needed in areas where recent willow regeneration has produced what appears to be suitable breeding habitat. Surveys have been conducted in the Yuma area each year since 1993, but the effort has never been sufficient to cover the entire area adequately. This area may have been an important source population, based on historical records (Huels in litt.). Replacement of native cottonwood/willow forest by tamarisk may have created unfavorable conditions for nesting at this low elevation (Anderson et al. 1977, Hunter et al. 1988), or perhaps native vegetation occurred in larger contiguous patches than the tamarisk patches. Breeding has not been reported on the lower Colorado River in the Yuma area since 1902 (Hunter et al. 1987, Sferra et al. 1995), despite intensive surveys from 1992-1995.

Locations of willow flycatchers recorded early in the breeding season through a separate study (NBS unpublished data) provided the first observations of the season. Birds persisted at all sites throughout the breeding season, except the lower Colorado River in Yuma. However, at all sites, fewer birds were detected during later surveys than during the early season (late May to early June). Disparity in numbers can be attributed to presence of migrants early in the season or inaccurate counts when vocalization rates decline. These observations reinforce the need to conduct both early and follow-up surveys during the breeding season and the need to band birds at long-term monitoring sites.

In a separate study, the National Biological Service (Hodgetts in litt.) began color banding to determine site fidelity of willow flycatchers in 1995. As more birds are banded it may be possible to distinguish movements, renesting attempts, double clutches, and incidence of polygamy. In July, ten adult birds and one nestling willow flycatcher were color banded. One adult bird was banded at the Tonto Creek inflow to Roosevelt Lake, seven adults and one nestling were banded at Greer, and two adults were banded at Alpine.

NESTING SUCCESS

Fledglings were not observed for all nests believed to be successful. We emphasize that fledging was assumed if the young were not located in the nest on the next morning after the estimated fledging date and if it was unlikely that the nest failed since the previous visit. Therefore, nesting success is an estimate.

The overall willow flycatcher nesting success rate (per Mayfield 1961) of 42 percent in this study is similar to the 40 percent and 43 percent reported by Whitfield and Strong (1995) for the Kern River in California in 1994 and 1995 respectively. However, prior to cowbird removal at the Kern River sites, nest success ranged from 23 percent to 32 percent between 1989 and 1992 (Whitfield and Strong 1995). Comparing nesting success using the ratio of number of successful nests to the number of nests with known outcome, the 56 percent estimated at AGFD monitored nests was higher than the 47.9 percent averaged between 1993 and 1995 on the Kern River in California in the cowbird trap area and 35.7 percent in the non-trap area (Whitfield and Strong 1995). Sedgwick and Knopf (1988) calculated 40.7 percent nesting success in Colorado.

Overall nesting success is misleading in that it gives no indication of fledglings per nest. Number of fledglings per nest was estimated at 1.2 at AGFD monitored nests in 1995, compared with 1.39 on the Kern River in the trap area and 0.72 in the non-trap area between 1993 and 1995 (Whitfield and Strong 1995). Sedgwick (pers. comm.) and Whitfield and Strong (1995) found that completed willow flycatcher clutches are typically composed of three or four eggs. The average clutch size in Arizona is not known with certainty, since additional eggs could have been laid in between nest visits. Controlling for complete clutches of at least three eggs, the number of fledglings per nest at AGFD monitored nests was slightly higher, at 1.6.

Nesting success needs to be monitored over the next few years to minimize sampling error and small sample size. Nesting success was highest in the native, high elevation willow patches (69%) and was lowest in the native, mixed riparian habitat (11%). However, only seven nests were found in mixed riparian habitat. Nesting success in mature tamarisk stands was calculated primarily from large expanses of contiguous, but patchy, habitat. Although only a portion of this habitat is considered suitable, this large matrix of vegetation may contribute to better success than small, isolated patches. However, the 34 percent nesting success in tamarisk can be considered only marginal in 1995.

Only a portion of the total clutch of eggs or young survived in some nests (see Appendix I). In some nests, individual eggs disappeared on consecutive visits. Snakes or avian predators could have taken the eggs without destroying nests. At two high elevation nests, some but not all the nestlings from each nest disappeared. We hypothesize that the nestlings died and were ejected from the nest by the adults, or were depredated.

Renesting after a successful first nest has been documented by Whitfield (1990) on the Kern River and Haas (pers. comm.) on the upper San Luis Rey River in California. Without banded individuals, we were unable to confirm renesting in the five nest sites where it was suspected.

NESTING HABITAT AND NEST SITE CHARACTERIZATION

Nests continue to be found in Arizona below approximately 3400 ft (1036 m) and above approximately 7900 ft (2408 m), but not between those elevations. The valleys and steep-walled

canyons present within that mid-elevation band tend to be narrow, with high gradients, and scour frequently, possibly preventing suitable habitat from developing or persisting. In contrast, a broad floodplain exists between 4460-4540 ft (1359-1384 m) on the Gila River in New Mexico, where in 1995, 107 pairs were recorded (Hull and Parker 1995).

Willow flycatchers historically nested in willows and other native vegetation near marshes, streams, and rivers, and in buttonbush swamps in Arizona (Phillips et al. 1964, Unitt 1987, Rosenberg et al. 1991). Woodbury and Russell (1945) also reported a nest in "a tamarisk among willows" at Lee's Ferry in 1938. In 1995, we found willow flycatchers breeding in these habitats, as well as monotypic tamarisk stands and patches with a mixture of tamarisk and native riparian species.

Tamarisk is now a dominant species in portions of many riparian areas in Arizona, including some historical willow flycatcher breeding sites. It also is an understory or edge plant species in mixed riparian communities. Southwestern willow flycatchers were found using large, mature stands of tamarisk, but they were not found in monotypic stands of young tamarisk or isolated, small restricted stands, such as along the Bill Williams, San Pedro, and Salt rivers. This is the first year that willow flycatchers have been documented breeding in tamarisk at an elevation as low as 456 ft (139 m), at Havasu National Wildlife Refuge. In contrast, willow flycatchers have not been found in monotypic stands of tamarisk in New Mexico (Maynard 1994).

Density appeared to be the most important vegetation property and remained consistent across vegetation types (tamarisk, high elevation willow, and mixed riparian) for canopy. High canopy density may account, in part, for the use of mature tamarisk as nesting sites and for the success of nests within mature tamarisk during this first year of nest monitoring. Tall, mature tamarisk appears to be similar in ecological and/or structural characteristics to native vegetation (Brown and Trosset 1989). In addition, the consistency of midstory height between tamarisk and mixed riparian was corroborated by high vertical foliage density at midstory vertical heights.

Although willow flycatchers breed in habitat where surface water is present (Phillips 1964, Stafford and Valentine 1985, Harris et al. 1987), distance from nests to saturated soil or open water varied between and within sites, being greatest at 807 ft (246 m) from a nest at PZ Ranch. A flood-irrigated field adjacent to the nesting patch at PZ Ranch may have contributed to insect prey population for the birds nesting there. Distance from nest to water/saturated soil was lowest at Cook's Lake Cienega and Greer, where nests were often above standing water.

POPULATION SITE FIDELITY

Population site fidelity is inferred from consistency of 1994 territories with those of 1995. Willow flycatchers returned to Cook's Lake Cienega, Tuzigoot Bridge, Alpine, Greer, Salt River and Tonto Creek inflows to Roosevelt Lake; and Colorado River Miles 50.5, 51.4, and 65.3. At Tuzigoot Bridge, a male willow flycatcher banded in 1994 was in the same territory in 1995.

Site turnover also can be inferred from our surveys. No willow flycatchers were located in 1995 as the following areas in which they had been detected within the previous two years: San Manuel Crossing, Dudleyville, Nelson Reservoir, Greer town site, and Soza Wash.

Although nests or nesting attempts were detected at three new locations in 1995, it is unknown whether birds have recently moved into these areas, since limited or no surveys were conducted at these sites in previous years.

WILLOW FLYCATCHER BEHAVIOR

Observer familiarity with all vocalizations of willow flycatchers is essential to determining the number of pairs and breeding status of the birds. Observers must be aware of female singing so as not to record females as territorial males. A singing female was observed at Greer as the pair was beginning its nesting activities and calling to each other with a "ritt," then both birds were heard and observed "fitz-bewing." One bird called frequently and the other called infrequently. At Roosevelt Lake two birds that might have been a pair were heard singing, one more softly than the other. Early season female singing was also reported from Colorado River Mile 50.5 (Sogge 1995). Seutin (1987) and Maynard (1994) have also discussed females singing.

Occasionally, willow flycatcher songs were interspersed with "grrrrrrp" or "brrrit!" calls (Unitt 1987). Males, both paired and unpaired, also emitted a soft "brrrrrrrr" sound often accompanied by fluttering of the wings. Both sexes used at least two different calls: the well known "whitt" and a "whurp" note. The latter may be the same as the "churr" described by Sanders and Flett (1989). Fledged young emitted a "tewhitt" call resembling the adult "whitt" note but with a sharper, higher pitched, beginning note.

Calls between paired birds and between territorial birds were similar, although the latter were often louder and harsher (Sferra et al. 1995). These were only encountered when one bird approached another. Behavior during and after the interaction call was the best clue in determining if two birds were mates or rival birds. A mated pair would briefly tussle, give the interaction call, and then would often perch near one another. Two territorial birds never perched for any length of time near one another. Bill snapping was also heard near the nest site, often following an interaction between adults. Listening for these interaction calls, especially "whitts," between the male and female was frequently the easiest way to locate nests.

DISTURBANCES TO NESTING WILLOW FLYCATCHERS

During the breeding season, fencing excluded livestock from all high elevation willow sites where nesting willow flycatchers were detected in 1995. However, active livestock grazing was observed at the Tonto Creek and Salt River inflows to Roosevelt Lake, as well as at Cook's Lake Seep. Herds of cattle were observed directly within the dense tamarisk at nest sites.

Studies in high elevation willow communities have shown that willow flycatcher habitat is altered by the presence of cattle (Duff 1979, Taylor and Littlefield 1986, Valentine et al. 1988). Use of adjacent land by cattle also increases brood parasitism by providing feeding sources for cowbirds (Rothstein et al. 1980, Verner and Ritter 1983).

Riparian habitat in the Southwest is linear, with a naturally high amount of edge. Association of increased cowbird parasitism rates with greater edge to patch size ratio has been observed elsewhere on other species (Rothstein et al. 1980, Brittingham and Temple 1983, Airola 1986, Harris 1991). However, a recent study by Hahn and Hatfield (1995) in New York concluded that parasitism was higher in forest interior than in edge habitat and that it may not be homogeneous across a landscape. They found a significantly higher parasitism rate on ground- and low-nesting species, even those that are well concealed. Cowbirds may now be so widespread in the Southwest that they are likely to find nests regardless of the patch size or amount of edge.

The brown-headed cowbird parasitism rate of 6.3 percent in this study was low compared to rates reported by Whitfield and Strong (1995) on the Kern River, California, which averaged 63.5 percent prior to cowbird removal. However, the parasitism rate declined to 15.6 percent in Kern River in areas where ongoing trapping has occurred. Griffith and Griffith (1993) reported an increase in least Bell's vireos and willow flycatchers following cowbird trapping on Camp Pendleton, California. Williams (pers. comm.) reported a preliminary estimate of 4 of 23 (17.4%) nests parasitized in the Gila Valley of New Mexico in 1995. Haas (pers. comm.) reported no parasitism in 1995 at 19 nests on the upper San Luis Rey River, San Diego County, California, where a cowbird trapping program has been underway since 1993. Parasitism of willow flycatcher nests in other studies has ranged from 4.5 percent in southeast Washington (King 1955), to 40.7 percent in Colorado (Sedgwick and Knopf 1988), and 50 percent along the Colorado River in the Grand Canyon (Brown 1988). Further study of Arizona nest parasitism is needed to compensate for effects specific to one year's study. Avian researchers reported fewer cowbird numbers in the southwestern United States in 1995 than in previous years (Laymon pers. comm.). We do not know how many willow flycatcher nests were abandoned as a result of cowbird parasitism.

Interactions between willow flycatchers and brown-headed cowbirds were observed at several locations. At Bill Williams River National Wildlife Refuge, a willow flycatcher flew out of a tamarisk in which it was perched when a female brown-headed cowbird flew into the same tree. At Havasu National Wildlife Refuge, willow flycatchers were also reported as "avoiding" brown-headed cowbirds. Willow flycatchers were documented chasing cowbirds, sometimes responding aggressively by chasing, whitting loudly, and bill clacking (Sogge et al. 1995). Conversely, a cowbird was observed usurping a frequent song perch from a flycatcher in the Grand Canyon. Other studies have documented willow flycatcher interactions with cowbirds (Whitfield 1990, Parker and Hull 1994, Hull and Parker 1995). However, aggressive behavior toward cowbirds does not necessarily deter parasitism (Bent 1958, Robertson and Norman 1976, Whitfield 1990). Uyebara and Narins (1995) hypothesize that the risk of drawing attention to the nest by chasing

cowbirds away may be counterproductive when the intruder is greater than 6.6 ft (2 m) from the nest. They found that willow flycatchers in the Kern River California population chased female cowbirds only if they were within 6.6 ft (2 m) of the nest.

Whitfield (1990) and others (Friedman 1963, Nolan 1978, Rothstein 1975, Rothstein 1986) conclude that the presence of a cowbird egg in the nest before the host lays its own eggs appears to be the main cause of abandonment or egg burial. Since AGFD monitored nests at a minimum of every third day, it is possible that a nest with a cowbird egg could have been depredated between nest visits.

Cowbirds are also responsible for poor survival of young in second nesting attempts after first nests fail due to parasitism. Late nesting attempts are less likely to fledge young, and if young are produced they are less likely to survive until the next breeding season than young willow flycatchers fledged earlier in the season (Whitfield and Strong 1995).

Observer disturbance at nest sites may have affected breeding success. The Geyer willow patch in Alpine was so dense that it was difficult to avoid making a trail on subsequent visits to nests. Although care was taken to avoid leaving dead-end trails, one nest with three eggs failed when the female abandoned it. It is possible, however, that the eggs in this nest were infertile. Abandonment was high at Cook's Lake Cienega for nests visited early in the breeding season, during nest building ($n = 4$) or when only one egg had been laid. In the future, hatching and fledging dates should be estimated for nests in extremely thick vegetation to avoid frequent disturbance. This will help minimize human impact on shrub density and vertical cover surrounding nests, and possibly decrease abandonment early in the season.

Whitfield (pers. comm.) documented minimal nest abandonment prior to completion of egg laying on the Kern River, and found no correlation between observer distance and nest abandonment. In contrast, Sedgwick (pers. comm.) documented increased probability of nest abandonment prior to clutch completion and cautions observers to remain distant from nests prior to completion of nest building. Götmark (1992) found that the earlier in the summer a study was initiated, the greater the occurrence of investigator-induced nest failure. His summary of various avian studies indicated disturbance resulted in increased predation by avian predators and nest desertion.

UNCONFIRMED AND POSSIBLE DETECTIONS

Many detections on the Gila River were reported from a float trip survey during the 1995 survey period between Kearney and Florence (Hughes pers. comm.). However, most detections were not recorded as 100 percent certainty of detection, because either visual or vocal confirmation was lacking. Unfortunately, follow-up visits were not conducted because of limited resources. This area should be thoroughly surveyed in 1996.

A singing willow flycatcher was reported on 23 June from Pasture Canyon on the Hopi Reservation (Cooper pers. comm.). Interestingly, two specimens have been collected from this location: one was an adult male (with enlarged gonads), collected on 7 July 1936; the other was an adult female, collected on 22 July 1938 (Woodbury and Russell 1945). This area should be surveyed in 1996 using standardized protocol.

MANAGEMENT

Cowbird removal is costly and must be repeated annually, but it has been successful in increasing willow flycatcher nesting success on the Kern River (Whitfield and Strong 1995) and Camp Pendleton (Griffith and Griffith 1993) in California. In some Arizona areas, such as Tuzigoot Bridge, cowbird removal may be the best management method available, if the willow flycatcher population is heavily parasitized and/or composed of only a few pairs.

Promoting riparian restoration and growth of large trees and dense vegetation can provide additional habitat, as well as create cover to help conceal nests from predators. Minimizing water diversions and groundwater pumping, and fencing riparian areas and providing off-site water for cattle will help maintain streamside vegetation. These basic actions will help improve conditions for the southwestern willow flycatcher and other riparian obligate species.

RECOMMENDATIONS

SURVEY EFFORT

1. Focus survey efforts at breeding sites and sites where lone males were detected in 1995.
2. Conduct more surveys in areas with broad open valleys or broad floodplains with wide patches of riparian vegetation. Indian Hills and Soza Wash should be surveyed earlier and more thoroughly next year since they were surveyed later than other areas in 1995. A thorough survey should be conducted on the Gila River between Kearney and Florence in 1996. The area of the Hopi Reservation in which a singing willow flycatcher was reported in 1995 should be surveyed in 1996, using standard survey protocol.
3. Survey potential habitat away from main channel flow in backwaters, seeps, or wide floodplains.
4. Examine aerial photographs or video footage before surveys are conducted to estimate area and plan survey routes.

SURVEY METHODS

1. Begin surveys at known or probable/suspected breeding sites by mid May. Surveys of other areas at lower elevations should be initiated in early to mid May, and re-checked between 15 June and 25 July to confirm breeding status. This will provide additional information on areas used by migrants, as well as providing a longer period to survey early, while birds are most vocal. Prior to nest building, surveyors should be especially careful not to disturb birds.
2. Initiate nest searches in the third week of May. Avoid disturbing birds during nest building and early egg-laying, to minimize abandonment.
3. Surveyors should be familiar with willow flycatcher calls, behavior, and methods for finding pairs and nests.
4. Nest monitors must have federal endangered species permits, since the southwestern willow flycatcher is federally listed as an endangered species.
5. Once a response has been elicited from a territorial willow flycatcher, discontinue broadcasting the tape recording. Prolonged tape playing can alter bird behavior. Allowing birds to resume normal activities will often allow easier determination of breeding status and increase likelihood of finding nests.
6. Capture and band birds at long-term monitoring sites to help establish residence status, determine territory size, and increase accuracy of population estimates.
7. Record presence of other bird species in the survey area to assess associated species and alternate brown-headed cowbird hosts.
8. Record presence of potential nest predators observed.

NEST MONITORING

1. Continue follow-up visits at territories after a nest has failed, to determine if the birds renest somewhere nearby.
2. Spend more time watching active nests (perhaps a selected subsample of the population) to gain further insight into territory size, interactions between willow flycatchers and between willow flycatchers and brown-headed cowbirds, and to identify renesting and second nesting attempts.
3. Minimize trampling and trailing while conducting nest searching and monitoring.

HABITAT

1. Implement a more intensive nesting habitat vegetation study, comparing occupied nest sites to random, unoccupied areas.
2. Use aerial photographs of willow flycatcher breeding locations on a macro scale to measure patch size (see Sedgwick and Knopf 1992, Sogge et al. 1995).
3. Continue to evaluate reproductive success in exotic habitat (tamarisk) compared to native habitats (mixed riparian and high elevation willow).
 - a. Determine the influence of breeding population size on productivity.
 - b. Monitor cowbird parasitism.
 - c. Evaluate impacts of disturbance at nest sites (e.g. grazing, predation, observers, human use).

MANAGEMENT

1. Restrict grazing in willow flycatcher breeding areas at Cook's Lake Seep, the Salt River and Tonto Creek inflows to Roosevelt Lake, PZ Ranch, and Greer during the breeding season.
2. Promote regeneration of native species in riparian habitats. Restore reaches of riparian habitat by reconnecting unnaturally fragmented patches.
3. Predict future suitable willow flycatcher habitat using riparian mapping information (AGFD in prep.). Monitor areas where extensive regeneration of native riparian vegetation is occurring and consider them for future surveys.
4. Remove cowbirds from high risk areas, such as Tuzigoot Bridge to reduce parasitism.
5. Fence riparian habitat and provide off-site water for cattle in potential and occupied, but degraded, willow flycatcher habitat.
6. Minimize water diversions and groundwater pumping to maintain streamside vegetation.

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PERSONAL COMMUNICATIONS

Cooper, C.A. 159K Calle Ojo Feliz, Santa Fe, NM 87505.

Haas, W. Varanus Biological Services, Inc. 10601-A Tierrasanta Blvd., Suite 127, San Diego, CA 92124

Hughes, T. Bureau of Land Management, 2015 West Deer Valley Road, Phoenix, AZ 85027.

Laymon, S.A. Kern River Research Center, P.O. Box 990, 7872 Fay Ranch Rd., Weldon, CA 93283.

Peterson, B. National Biological Service, Nat. Ecol. Res. Center, 4412 McMurry, Fort Collins, CO 80525-3400.

Sogge, M.K. National Biological Service, Colorado Plateau Research Station / Northern Arizona University, Box 5614, Flagstaff, AZ 86001.

Whitfield, M.J. Kern River Research Center, P.O. Box 990, 7872 Fay Ranch Road, Weldon, CA 93283.

Williams III, S.O. New Mexico Department of Fish and Game, Villagra Building, P.O. Box 25112, Santa Fe, NM 87504.

Appendix A. Survey form for Arizona willow flycatcher surveys, 1995.

Willow Flycatcher Survey Form

(Revised May 15, 1995)

SITE INFORMATION

Site Name: _____ USGS Quad Name(s): _____
Survey Date: _____ Survey Time: Start _____ End _____ Total Hrs. _____
Surveyor(s) [name/affiliation/phone #]: _____
Site Ownership: _____ County: _____
(If private, permission is required prior to survey) (Attach xerox of surveyed area.)
Site Location: T _____ R _____ Sec(s) _____ UTM _____ Elev. _____
T _____ R _____ Sec(s) _____
Tape-playback method used? (Circle one) Y N
Date site last surveyed: _____ WIFL present during previous surveys: Y N
Weather: Temp (min/max): _____ Wind (min/max): _____ Cloud cover % _____ Precip: _____
Background noise: (Describe wind, stream, etc.) _____

SPECIES DETECTED

Willow Flycatcher (circle one): Absent Present

If present, fill out flycatcher detection form

Brown-headed Cowbird (circle one): Absent Present

Number observed: Male _____ Female _____ Unknown _____

Describe cowbird activity (e.g. singing, flying over, etc.) _____

HABITAT

If no willow flycatchers detected, does habitat appear: suitable unsuitable potentially suitable

Describe general habitat (include % of each dominant vegetation species, density, etc): _____

Describe patch morphology (include shape, height, terrain; describe understory, midstory, canopy) _____

Water present: Y N Describe: _____

Size of Area (ha): _____ # of survey miles: _____ Estimated or measured? _____

Were livestock present? Y N Type _____ Number _____

Any sign of livestock? Y N Type (e.g. dung, hoof prints, trails, etc.) and age (< 1 yr. or > 1 yr.) of sign: _____

COMMENTS: _____

Please circle additional riparian bird species identified in immediate survey area:

WWDO MODO YBCU BCHU ANHU BEKI GIWO RNSA WISA LBWO NOFL WWPE DUFL BLPH VEFL ATFL BCFL CAKI
WEKI VERD BUSH BEWR SWTH AMRO GRCA PHAI EUST BEVI WAVI OCWA VIWA LUWA YEWA MAWA COYE
YBCH SUTA BHGR BLGR LABU INBU GTTO ABTO SOSP LISP RWBL BRBL GTGR BRCO HOOR NOOR HOFI LEGO

Appendix B. Detection form for Arizona willow flycatcher surveys, 1995.

Willow Flycatcher Detection Form

(Revised May 15, 1995)

Site Name: _____ USGS Quad Name: _____
Surveyor(s) [name/affiliation/phone #]: _____ Detection Date and Time: _____
Site Ownership: _____ County: _____
(If private, permission is required prior to survey) (Attach xerox of surveyed area.)
Site Location: T _____ R _____ Sec _____ UTM _____ Elev. _____
Bird detected before Playback? Y N Type of initial detection: Visual Aural Both
If bird responded to Playback, describe response: _____
Number of birds detected in this patch: _____ Number of Males _____ Females _____
How sex determined? _____
Pair(s) confirmed? Y N # of pairs: _____ How determined? _____
Any young of year? _____ How determined? _____
Degree of certainty of species ID (circle one): 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Describe quality of detection (how far/long seen, lighting, vocalizations, etc.):

Describe flycatcher's behavior (how using habitat):

Describe any signs of breeding behavior (e.g. territorial defense, paired birds, carrying nest material, etc.):

Nest found? Y N (State and Federal permits required to gather nest site data)
Cowbirds present? Y N How many: Male _____ Female _____ Unknown _____
Describe willow flycatcher response to cowbirds:

Comments: _____

Make a sketch of the area (on the back of this form and/or xerox map or aerial photo) to show location of patch, key landmarks, general vegetation characteristics, willow flycatcher location and movements within the patch, nest site, etc. A photograph of the habitat patch or willow flycatcher observation area is also useful and should be attached if available.

Please return all completed data forms by August 15 to: Arizona Game and Fish Dept., Nongame Branch, Willow Flycatcher Survey, 2221 W. Greenway Road, Phoenix, Arizona 85023.

Appendix C. Nest site data form for Arizona willow flycatcher surveys, 1995.

Willow Flycatcher Nest Site Data (Revised May 15, 1995)
(STATE AND FEDERAL PERMITS REQUIRED - DO NOT TOUCH ACTIVE NEST OR NEST TREE)

Date nest located: _____ How was nest located?: _____

Nest fully constructed? Y N

If not, describe state of construction and why you think it is a willow flycatcher nest: _____

Number of eggs: WIFL _____ BHCO _____ UNKNOWN _____

Number of young: WIFL _____ BHCO _____ UNKNOWN _____

Age of young (describe): _____

Description of nest location (mark the location on the sketch below, xerox of topo, or on aerial photo):

General description of nest habitat: _____

Nest substrate (plant species in which nest is placed): _____

If the nest is still active, estimate the following from a distance, being careful to avoid disturbance to the nest. If the nest is no longer active, measure accurately using a meter tape or meter stick.

Date measurement taken: _____ Are measurements estimated _____ or measured _____?

Height of nest: _____ Nest substrate height: _____ Nest substrate dbh: _____ Patch height: _____

Nest azimuth (degree) _____

Distance from nest to: Substrate center _____ Canopy top _____ Substrate edge _____

Nearest edge of vegetation type: _____ Nearest edge of patch: _____

Water or saturated soil _____

Type of water (seep, cienega, stream, river, etc.): _____

Were photos taken of the nest or nesting habitat? Y N Are photos attached? Y N

Use this area to draw a sketch of the willow flycatcher site and/or nest site. Indicate vegetation patch borders, major landmarks, watercourses, etc. Please give some indication of scale and the direction "North". If possible, indicate flycatcher movements within the patch (e.g. where bird was located; song perches; nest site, etc.).

1995 WILLOW FLYCATCHER NEST MONITORING DATA FORM

[illegible]

*If nest failed, mark in comments section and elaborate in additional comments

Appendix D (Continued). Willow flycatcher nest monitoring field data form for Arizona, 1995.

Obs.- observers initials

Nest #- same as the pair number

Date- the date you checked nest

Time- the time you checked nest

Adult

Built- check box if the nest is still being constructed

On- check box if the adult is on the nest

Nest Contents- fill in the appropriate number of eggs and/or young for each species. (i.e. willow flycatcher or brown-headed cowbird)

Comments- write anything you think is important, interesting (e.g. flushed female off nest, nest failed because... etc.). Also try and estimate the fledging date of the nest while you are in the field.

Aging:

downy < 1 week old

pin feathers ~ = 1 week old

fully feathered ~ = 2 weeks old

Chronology:

Nest building = ~ 1 week

Egg laying = 4 days

Incubation = 12 days

Time to fledging = 12 days

Female broods young 7-8 days (post fledging?)

Appendix E. Willow flycatcher nest record form for sites monitored by the Arizona Game and Fish Department in 1995.

1995 WILLOW FLYCATCHER NEST RECORD FORM

Location: _____
Nest No.: _____

Date	Adult		Contents				Comments	Date	Adult		Contents				Comments
			WIFL		BH CB						WIFL		BHCO		
			Built	On	Egg	Young					Egg	Young	Built	On	

Date	Number
Found	eggs
1st egg	nestlings
Clutch completion	fledged
Hatched	
Fledged or failed	
Last date active	

Outcome (Record code & describe): _____

Period	Number of days observed	Success
Egg Laying		
Incubation		
Nestling		

Outcome codes: UN = unknown because not revisited; FY = fledged, with at least one young seen leaving or in vicinity of nest; FP = fledged young, as determined by parents behaving as if dependent fledgling(s) near by; FU = Suspected fledging of at least one young, but uncertain; FC = fledging at least one host young w/cowbird parasitism; PO = predation observed; PE = probable predation, nest empty and intact; PD = predation, damage to nest structure; AB = nest abandoned prior to eggs; DE = deserted with egg(s) or young; CO = failure due to cowbirds; WE = failure due to weather; HA = failure due to human activities; OT = other.
Success codes: S = successful, D = depredated, N = status unknown/nest not occupied, U = status unknown/nest occupied- fate unknown, M = mortality other than predation, A = abandoned, Z = abandoned, no (zero) eggs laid.

Appendix F. Vegetation data form used by the Arizona Game and Fish Department at willow flycatcher nest sites in 1995.

VEGETATION DATA FORM 1995

Site Name _____ Nest No. _____
Recorders _____ Date _____

Elevation _____ No. Stems Supporting Nest _____

Orientation of Nest (degrees) _____

Nest Plant Species _____

Nest Plant Ht. (m) _____

Ht. Nest Above Ground _____

Relative Ht. Nest/Plant _____

Stem Diam @ 0.25 m above Ground (cm) _____

Dist. Nest - Edge of Plant (m) _____
" " - Center of Plant (m) _____
" " - Canopy Top (m) _____
" " - Edge Patch (m) _____
" " - Edge Veg. Type (m) _____
" " Nearest Adjacent willow flycatcher Nest (m) _____
" " Nearest Saturated Soil (m) _____
" " Nearest Open Water (m) _____ Type _____

Dominant 2-3 Species in Overstory (> 2 m) _____

Dominant 2-3 Species in Midstory (1-2 m) _____

Ave. Ht. (3 rdgs.) Overstory (m) _____ Ave = _____
Ave. Ht. (3 rdgs) Midstory (m) _____ Ave = _____

% O.S. Canopy Cvr. N: _____ S: _____
1.5 m from nest tree E: _____ W: _____ Ave. = _____

Vertical Foliage Density (1.5m 4.5m 7.5m 11.3m along transect)
N _____ S _____
E _____ W _____

Dispersion of Veg Within Patch _____
Visual Est. High=uniform or randomly interspersed, Moderate=
patchy but interspersed, Low=clumped, few patches

Dispersion of Patches Within Riparian Area _____

Nest Patch Size (ha) _____ Edge Circumference of Patch (m) _____

Riparian Width (m) _____ Riparian Length (m) _____

Appendix G. Description of willow flycatcher nesting habitat variables for sites monitored by the Arizona Game and Fish Department in 1995.

AT NEST/NEST SHRUB:

1. Distance from nest to:
 - a. Center of nest plant (measured to nearest 0.1 m, by measuring rod).
 - b. Edge of nest plant (measured to nearest 0.1 m).
 - c. Edge of contiguous patch (measured to nearest 0.1 m, from mapped GPS locations).
 - d. Edge of vegetation type (measured in the field to nearest 0.1 m).
 - e. Nearest open water (measured from aerial photos, to nearest 0.1 m).
 - f. Nearest saturated soil (measured from aerial photos to nearest 0.1 m).
 - g. Nearest known adjacent willow flycatcher nest, active during breeding season (measured from GPS data).
2. Height of nest above ground (measured to nearest 0.1 m).
3. Nest plant species and height above ground (measured to nearest 0.1 m).
4. Number of stems supporting the nest.
5. Orientation of the nest from main stem (measured by compass to the nearest degree).
6. Site location, in UTM's from GPS data.
7. Stem diameter of main stem of nest plant (measured at 0.25 m above ground, to nearest 0.1 cm). On Geyer willow, which are multi-stemmed at the base, circumference at breast height (1.4 m above ground) of the bush was measured.
8. Type of nearest water (i.e. seep, river, stream, marsh).

AT NEST SITE:

9. Average height of midstory layer (averages of three measurements by clinometer or surveyor's rod).
10. Average height of overstory layer (averages of three measurements by clinometer or surveyor's rod).
11. Dominant species in midstory layer(s).
12. Dominant species in overstory layer(s).
13. Elevation (recorded using GPS to nearest 1 m).
14. Percent overstory canopy density (measured in the four cardinal directions using a convex densiometer and tripod set 1.5 m from a vertical projection below the nest. The densiometer was read 1.0 m above ground, in the four cardinal directions. The Strickler modification (1959) was used).
15. Percent vertical foliage density, categorized by estimates of percent of a 7.6 m survey rod obscured by vegetation, in increments of: 0.9-1.8 m, 1.9-2.7 m, 2.8-3.7 m, 3.8-7.6 m above ground. (Survey rod read from a random direction determined by spinning a compass, at random distances from 1-5 m from the rod. Readings taken along four 11.3 m transects at intervals of: 1.5 m, 4.5 m, 7.5 m, and 11.3 m. Transects located in each of the four cardinal directions).

AT STAND LEVEL:

16. Overall stand size per site defined visually as area contiguous willow flycatcher nesting habitat, with similar vegetation density, canopy cover, canopy height, and vegetation type (measured on aerial photos or by GPS, to nearest 0.1 ha).
17. Riparian length (measured on aerial photos or by GPS, to nearest meter).
18. Riparian width (measured on aerial photos or by GPS, to nearest meter).

Appendix H. Willow flycatcher detections in Arizona, 1995.

Site Name - County Site description/ 1995 survey hrs/ Yr. first surveyed	Elev. (m)	Date	Adult WIFLs ¹ Observed	Total Terr.	# of Pairs	BHCOs ² Present	Para- sitism
Colorado River							
Hunter's Hole - Yuma Co. Narrow strip of willow (<i>Salix</i> sp.), tamarisk (<i>Tamarix pentandra</i>), and Fremont cottonwood (<i>Populus fremontii</i>) at edge of pond; water present in spring but dried up in early-mid June/ 17.85/ 1993	27	6/05/95 6/13/95 6/19/95 6/22/95 7/11/95	8 1 0 0 0	0 0 0 0 0	0 0 0 0 0	20+	-
Gadsden Pond - Yuma Co. Patch of tamarisk, dense willows, and a few cottonwoods along slough/ 1.75/ 1993	27	6/06/95 6/15/95 6/19/95	2 1 0	0 1 0	0 0 0	Yes	-
Gadsden Bend - Yuma Co. Patch of willows, tamarisk, and cottonwoods along still water ponds/ 3.75/ 1993	27	6/06/95 6/14/95 6/19/95	2 0 0	0 0 0	0 0 0	Yes	-
County 12.5 Street - Yuma Co. 75% Goodding willow (<i>Salix gooddingii</i>), 5% cottonwood, 10% tamarisk, 10% common reed (<i>Phragmites australis</i>)/ 1.00/ 1993	49	6/14/95	0	0	0	4	-
State Route 24 - Imperial Co. CA 90% willow, 10% arrowweed (<i>Tessaria sericea</i>), tamarisk, seepwillow (<i>Baccharis glutinosa</i>)/ 1.00/ 1995	49	6/16/95	0	0	0	Yes	-
Fort Yuma Indian Reservation "Areas 1 - 2" - Yuma Co. Patches of mature tamarisk 30 x 20 m, with some mesquite (<i>Prosopis</i> sp.) and arrowweed/ NA ³ / 1995	38	6/02/95 6/03/95 6/05/95 6/06/95 6/27/95 6/29/95	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	9	-
Fort Yuma Indian Reservation "Area 2" - Yuma Co. Monotypic Tamarisk 3.5- 5m high/ NA / 1995	38	6/04/95 6/28/95	0 0	0 0	0 0	1	-
Fort Yuma Indian Reservation "Area 3" - Yuma Co. Mixed riparian zone. Most plants immature. 40% tamarisk, 15% willow, <5% cottonwood/ NA / 1995	38	6/03/95 6/30/95	0 0	0 0	0 0	2 0	-
Fort Yuma Indian Reservation "Area 3 - 4" - Yuma Co. Band of riparian vegetation 40 - 50 m wide. 60% tamarisk, 20% willow, 20% arrowweed/ NA / 1995	38	6/06/95 6/30/95	0 0	0 0	0 0	0 1	-
Martinez Lake - Yuma Co. Willow overstory; tamarisk, common reed, and arrowweed understory/ 3.00/ 1993	58	6/02/95 6/16/95 6/20/95	2 0 0	0 0 0	0 0 0	Yes	-
Imperial NWR "Dredge Channel" - Yuma Co. Dense tamarisk, mesquite, one willow tree, arrowweed, common reed/ 0.30/ 1994	63	5/26/95 6/28/95	0 0	0 0	0 0	Yes	-
Imperial NWR "IS" - Yuma Co. Patchy willow, dense tamarisk, mesquite, common reed, seepwillow/ 0.30/ 1994	63	5/26/95 6/28/95	0 0	0 0	0 0	Yes Yes	-

Appendix H (continued). Willow flycatcher detections in Arizona, 1995.

Site Name - County Site description/ 1995 survey hrs/ Yr. first surveyed	Elev. (m)	Date	Adult WIFLs ¹ Observed	Total Terr.	# of Pairs	BHCOs ² Present	Para- sitism
Colorado River (Continued)							
Imperial NWR "IB" - Yuma Co. Willow, dense tamarisk, arrowweed, common reed, seepwillow, and some cottonwood/ 1.30/ 1994	64	5/26/95 6/28/95	1 0	0 0	0 0	Yes No	-
Imperial NWR "Killdeer" - Yuma Co. A few willows, dense tamarisk, arrowweed, common reed, and seepwillow/ 0.15/ 1994	63	5/26/95	0	0	0	Yes	-
Imperial NWR "Farm Field" - Yuma Co. Dense tamarisk, arrowweed, seepwillow/ 0.15/ 1994	63	5/26/95	0	0	0	Yes	-
Imperial NWR "Flycatcher" - Yuma Co. Patchy willow, tamarisk, arrowweed, common reed, seepwillow/ 0.60/ 1994	63	5/26/95 6/28/95	1 0	0 0	0 0	2 No	-
Imperial NWR "Cottonwood Nursery" - Yuma Co. Dense cottonwood nursery/ 0.15/ 1994	63	6/28/95	0	0	0	Yes	-
Imperial NWR "Firebreak" - Yuma Co. Willow, dense tamarisk, arrowweed/ 1.15/ 1994	61	5/26/95 6/28/95	0 0	0 0	0 0	Yes	-
Imperial NWR "Cattail" - Yuma Co. Willow, a few cottonwood, tamarisk, dense arrowweed, dense cattails (<i>Typha</i> sp.)/ 3.50/ 1994	61	6/02/95 6/20/95	1 0	0 0	0 0	Yes	-
Cibola NWR "Anderson Revegetation Unit" - La Paz Co. Mature cottonwoods planted in rows at mid-high density. Mesquite, palo verde (<i>Cercidium</i> sp.), and willow; some eucalyptus (<i>Eucalyptus</i> sp.) at north end/ 4.75/ 1993	69	5/30/95 6/01/95 6/21/95	0 0 0	0 0 0	0 0 0	12	-
Cibola NWR "Cibola Lake" - La Paz Co. 85% tamarisk, 10% willow, 5% cottonwood/ 4.25/ 1995	65	5/31/95 7/11/95	0 0	0 0	0 0	7	-
Cibola NWR "Arnet Ditch/ Tie-Back Levee" - La Paz Co. Willow and cottonwood approx. 20 m tall with a dense midstory of tamarisk and arrowweed/ 2.75/ 1994	66	5/29/95 6/21/95	0 0	0 0	0 0	8	-
Havasu NWR "West South Dike" - Mohave Co Goodding willows, arrowweed, tamarisk/ 0.60/ 1994	138	5/14/95	0	0	0	No	-
Havasu NWR "East South Dike" - Mohave Co. Goodding willow, tamarisk, and arrowweed/ 0.45/ 1994	139	5/21/95	0	0	0	2	-
Havasu NWR "New South Dike" - Mohave Co. Arrowweed, tamarisk, cottonwood, mule-fat (<i>Baccharis viminea</i>)/ 0.50/ 1994	139	5/21/95	0	0	0	1	-
Havasu NWR "Pintail Slough" - Mohave Co. Farm fields with canal and tamarisk interspersed with screwbean mesquite (<i>Prosopis odorata</i>), cottonwood, and mule-fat/ 1.10/ 1995	139	5/22/95	0	0	0	No	-

Appendix H (continued). Willow flycatcher detections in Arizona, 1995.							
Site Name - County Site description/ 1995 survey hrs/ Yr. first surveyed	Elev. (m)	Date	Adult WIFLs ¹ Observed	Total Terr.	# of Pairs	BHCOs ² Present	Para- sitism
Colorado River (Continued)							
Havasu NWR "Glory Hole" - Mohave Co. Overstory Goodding willow, midstory coyote willow (<i>Salix exigua</i>), mule-fat, arrowweed, and bulrush (<i>Scirpus</i> sp.) near water/ 0.75/ 1993	138	5/14/95	0	0	0	8	-
Havasu NWR "Levee Road" - Mohave Co. Arrowweed, tamarisk, Goodding willow/ 0.90/ 1994	139	5/23/95	0	0	0	Yes	-
Havasu NWR "Interior Road" - Mohave Co. ⁴ One Goodding willow (9.1 m), surrounded by dense tamarisk; 4.6 m high on the south side and a bulldozer cut to the north/ 0.40/ 1994	139	monitor 5/21/95 thru 7/21/95	3	2	1	10	Unk
Little Spring (Kanab Wilderness) - Coconino Co. Willow (70%) intermixed w/ tamarisk/ 1.90/ 1994	1342	7/07/95	0	0	0	Unk.	-

Appendix H (continued). Willow flycatcher detections in Arizona, 1995.

Site Name - County Site description/ 1995 survey hrs/ Yr. first surveyed	Elev. (m)	Date	Adult WIFLs ¹ Observed	Total Terr.	# of Pairs	BHCOs ² Present	Para- sitism
Grand Canyon Area							
River Mile (-8.5) - (-8.3)R - Coconino Co. 0.20/ 1993	NA	6/28/95	0	0	0	Unk.	-
River Mile -6.1 R - Coconino Co. 0.10/ 1993	NA	6/28/95	0	0	0	Unk.	-
River Mile (-3.4) - (-2.9)R - Coconino Co. 0.20/ 1993	NA	6/28/95	0	0	0	Unk.	-
River Mile 46.1 - 46.9 R "Saddle/Triple Alcoves" Coconino Co./ 5.20/ 1993	NA	5/22/95 6/04/95 6/17/95 7/02/95	0 0 0 0	0 0 0 0	0 0 0 0	Unk.	-
River Mile 50.5 L - Coconino Co. ⁵ Relatively large patch of dense, tall tamarisk adjacent to a small backwater and sandbar/ NA/ 1993	884	5/22/95 5/23/95 6/04/95 6/19/95 7/02/95 7/03/95 7/04/95	3 3 3 3 3 3 3	2 2 2 2 2 2 2	1 1 1 1 1 1 1	Yes	Yes
River Mile 50.5 - 51.4 L - Coconino Co./ 18.30 /1993	880	5/23/95 6/06/95 6/18/95 7/02/95 7/04/95	1 1 1 1 1	1 1 1 1 1	0 0 0 0 0	Yes	Yes
River Mile 52.0 L - Coconino Co./ 0.35/ 1993	NA	5/24/95	0	0	0	Unk.	-
River Mile 65.3 L "Lava Chuar" - Coconino Co./ 7.70/ 1993	853	5/24/95 6/06/95 6/07/95 7/04/95	1 1 1 1	1 1 1 1	0 0 0 0	Yes	-
River Mile 71.0 L "Cardenas" - Coconino Co./ 6.00/ 1993	NA	5/25/95 6/07/95 6/08/95	0 0 0	0 0 0	0 0 0	Unk.	-
River Mile 136.0 R - Coconino Co./ 0.90/ 1993	NA	5/26/95	0	0	0	Unk.	-
River Mile 143.0 R - Coconino Co./ 1.40/ 1993	NA	6/09/95	0	0	0	Unk.	-
River Mile 196.0 R - Mohave Co./ 2.10/ 1993	NA	5/27/95	0	0	0	Unk.	-
River Mile 197.5 - 198.0 R - Mohave Co./ 2.40/ 1993	NA	5/27/95 6/10/95	0 0	0 0	0 0	Unk. Unk.	-
River Mile 204.7 - 204.8 L - Coconino Co./ 0.10/ 1993	NA	6/10/95	0	0	0	Unk.	-

Appendix H (continued). Willow flycatcher detections in Arizona, 1995.							
Site Name - County Site description/ 1995 survey hrs/ Yr. first surveyed	Elev. (m)	Date	Adult WIFLs ¹ Observed	Total Terr.	# of Pairs	BHCOs ² Present	Para- sitism
Bill Williams River							
Bill Williams River NWR "Marsh edge" - La Paz/Mohave Co. Mixed riparian vegetation; tamarisk, coyote willow, and cattails bisected by stream channel/ N/A / 1993	171	6/01/95 6/07/95 6/26/95 7/18/95	1 1 1 0	1 1 1 0	0 0 0 0	Unk.	-
Bill Williams River NWR "East of marsh" La Paz/Mohave Co. Areas of standing water with dense tamarisk, also stringers of moderate to young cottonwood/willow/ ≥17.15/ 1993	171	5/02/95 5/05/95 5/08/95 5/10/95 6/12/95 6/15/95	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	25+	-
Big Sandy River							
Lower Big Sandy River - Mohave Co. ⁶ Interspersed standing water, cottonwood/willow canopy/ 6.00/ 1994	347	6/15/95 7/06/95	8 6	6 4	2 2	5 Unk.	-
Santa Maria River							
Big Stick Mine - Yavapai Co. 60% willow, 30% mesquite, 10% tamarisk/ 6.00/ 1995	537	6/21/95	0	0	0	1	-
Yerba Mansa Spring - La Paz Co. 80% mesquite, 15% cattail, 5% cottonwood/ 1.00/ 1995	421	6/29/95	0	0	0	Yes	-
Above Date Creek - La Paz Co. 20% cattails, 20% willow, 10% cottonwood, 20% mesquite, 5% seepwillow, arrowweed/ 1.50 /1993	372	6/29/95	0	0	0	Unk.	-
East of Date Creek (N. of river) - Mohave Co. 10% cattails, 30% tamarisk, 30% mesquite, 15% cottonwood, 5% arrowweed, 10% willow/ 1.75/ 1994	366	6/28/95	0	0	0	Yes	-
East of Date Creek (S. of river) - La Paz Co. 80% tamarisk, 10% cottonwood, 10% mesquite/ 0.50/ 1994	378	6/28/95 6/29/95	0 0	0 0	0 0	Yes	-
Billingsley Spring (Date Creek) - Yavapai Co. Mostly dense overstory of willow with some ash (<i>Fraxinus</i> sp.)/ 8.00/ 1995	976	6/02/95 6/30/95	0 0	0 0	0 0	3 1	-
Beaver Pond (Date Creek) - Yavapai Co./ NA / 1995	939	5/31/95	0	0	0	Unk.	-
Lower Santa Maria River -La Paz/Mohave Co. Dense willow/tamarisk stand around beaver dam/ 3.00/ 1994	358	6/16/95	1	1	0	1	-
Tres Alamos Falls (Date Creek) - La Paz Co. Densely vegetated desert wash with desert-willow (<i>Chilopsis linearis</i>), and mesquite/ 0.50/ 1994	762	6/15/95	0	0	0	No	-

Appendix H (continued). Willow flycatcher detections in Arizona, 1995.

Site Name - County Site description/ 1995 survey hrs/ Yr. first surveyed	Elev. (m)	Date	Adult WIFLs ¹ Observed	Total Terr.	# of Pairs	BHCOs ² Present	Para- sitism
Gila River							
91st Ave (Southwest Phoenix) - Maricopa Co. Mature willows interspersed with tamarisk, overstory of cottonwood; marshy/ 16.00/ 1994	335	NA	0	0	0	Many	-
Picacho Reservoir - Pinal Co. 3.0- 9.0 m high willows, patches thin and not continuous/ 1.50/ 1994	358	6/30/95	0	0	0	12	-
Sanchez Road at the Gila River - Graham Co. ⁷ Patch is 50% willow, 30% cottonwood, 20% tamarisk. Patch long and narrow; 0.16 km x 1.3 km/ 19.50/ 1995	900	5/25/95	3	0	0	3	-
		5/26/95	1	0	0	4	
		6/20/95	0	0	0	40	
		6/21/95	4	2	2	Yes	
North Buena Vista - Graham Co. 80% willow, 10% cottonwood, 5% tamarisk, 5% seepwillow, desert broom (<i>Baccharis salicifolia</i>), etc./ 0.75/ 1995	918	7/13/95	0	0	0	4	-
Southwest Sanchez - Graham Co. 75% willow, 15% cottonwood, 10% seepwillow, tamarisk, and desert broom/ 0.60/ 1995	925	7/13/95	0	0	0	No	-
Ray Junction to Ashurst (Hayden Dam) - Maricopa Co. Mix of tamarisk/willow with some areas consisting of a mature cottonwood gallery. Some patches are very dense/ 11.80/ 1995	1650	6/21/95	0	0	0	4	-
		6/22/95	0	0	0	8	
		6/23/95	0	0	0	0	
		6/29/95	0	0	0	0	
		6/30/95	0	0	0	100	

Appendix H (continued). Willow flycatcher detections in Arizona, 1995.

Site Name - County Site description/ 1995 survey hrs/ Yr. first surveyed	Elev. (m)	Date	Adult WIFLs ¹ Observed	Total Terr.	# of Pairs	BHCOs ² Present	Para- sitism
San Pedro River							
Dudleyville Crossing - Pinal Co. Dense stand of mature tamarisk and less mesquite, only very scattered mature cottonwoods adjacent to river bed/ 5.00/ 1993	604	7/01/95 7/18/95	0 0	0 0	0 0	4	-
PZ Ranch - Pinal Co. Mostly tamarisk with cottonwood/willow gallery forest, also small seep near middle of site/ 69.50/ 1994	27	monitor 6/14/95 thru 8/07/95	30	16	14	10	No
Cook's Lake Cienega - Pinal Co. Natural marsh with willow, cottonwood and ash overstory and dense buttonbush (<i>Cephalanthus occidentalis</i>), cattail, seepwillow and sedge (<i>Carex</i> sp.) understory/ 39.00/ 1993	643	monitor 5/24/95 thru 8/01/95	16	8-9	7	15	Yes
Cook's Lake Seep - Pinal Co. Tamarisk interspersed with cottonwood/willow overstory with grassy understory on edge of Cook's Lake Cienega/ 20.00/ 1995	643	monitor 5/25/95 thru 8/01/95	12-14	6-7	6-7	13	No
Indian Hills - Pinal Co. Mostly tamarisk with some cottonwood/ willow bordered on east by dense mesquite/ 16.00/ 1995	604	monitor 7/18/95 thru 8/07/95	3	3	1	4	No
San Manuel Crossing - Pinal Co. Scattered patches of varying size composed of tamarisk or young cottonwood/willow/ 7.50/ 1993	792	7/04/95	0	0	0	8	-
Above San Manuel Crossing - Pinal Co. Linear tracks of tamarisk 10 m high with willow and cottonwood/ 7.00/ 1993	793	7/17/95	0	0	0	No	-
Soza Wash - Cochise Co. 30% Cottonwood gallery, 30% mesquite, 40% tamarisk/willow/ 10.50/ 1993	914	7/02/95	0	0	0	4	-
Lower San Pedro - Cochise Co. 30% willow/cottonwood, 10% tamarisk, 30% mesquite, 20% shrubs, 10% open/ 5.00/ 1993	930	7/03/95	0	0	0	4	-
Bass Canyon - Cochise Co. Riparian mix: Cottonwood, willow, ash, Arizona walnut (<i>Juglans major</i>), Arizona sycamore (<i>Platanus wrightii</i>), with some mesquite and oak (<i>Quercus</i> sp.)/ 5.00/ 1995	1250	7/12/95	0	0	0	No	-
San Pedro Riparian NCA "Contention" - Cochise Co. 50% cottonwood/willow and 50% mesquite/ 5.00/ 1994	1143	7/11/95	0	0	0	4	-
San Pedro Riparian NCA "Palominas" - Cochise Co. 30% cottonwood/willow, 5% ash, 10% mesquite, 55% abandoned ag. fields/ 5.30/ 1994	1280	6/21/95	0	0	0	7	-

Appendix H (continued). Willow flycatcher detections in Arizona, 1995.

Site Name - County Site description/ 1995 survey hrs/ Yr. first surveyed	Elev. (m)	Date	Adult WIFLs ¹ Observed	Total Terr.	# of Pairs	BHCOs ² Present	Para- sitism
San Pedro River (Continued)							
San Pedro Riparian NCA "Summers" - Cochise Co. 40% cottonwood/willow, 40% mesquite, 20% shrubs/grasses/open/ 4.00/ 1994	1128	6/22/95	0	0	0	9	-
San Pedro Riparian NCA "Boquillas" - Cochise Co. 30% cottonwood/willow, 30% mesquite, 30% shrubs, 10% open/ 2.50/ 1995	1189	6/23/95	0	0	0	7	-
San Pedro Riparian NCA "Carr to Hunter" - Cochise Co. 40% cottonwood/willow, 60% mesquite, sacaton grass (<i>Sporobolus wrightii</i>) edge with marshy stretches/ 3.00/ 1995	NA	6/19/95	0	0	0	3	-
Paige Creek - Pima Co. 40% sycamore, 15% cottonwood, 30% Arizona walnut, 15% ash, grape (<i>Vitus arizonica</i>)/ 4.30/ 1994	1268	7/06/95 7/13/95	0 0	0 0	0 0	10 0	-
Ash Creek I - Pima Co. 60% ash, 20% seepwillow, 10% buttonbush, 10% oak/ 1.00/ 1995	1220	7/17/95	0	0	0	No	-
Ash Creek II - Pima Co. 20% ash, 30% oak, 30% sycamore, 20% seepwillow/ 0.45/ 1995	1220	7/17/95	0	0	0	No	-
Santa Cruz River							
Anza Trail "Tubac to Tumacacori" - Santa Cruz Co. 75% willow, 25% cottonwood, mesquite dominant on upper terrace/ 3.75/ 1995	976	6/22/95	0	0	0	1 - 2	-
Cottonwood Spring "Sonoita Creek" - Santa Cruz Co. Cottonwood/willow overstory with cattails in a fairly open understory/ 1.00/ 1995	1372	6/21/95	0	0	0	No	-
Cienega Creek - Pima Co. Vegetation varies but overall 30% cottonwood, 20% willow, 30% mesquite, 20% shrubs and grasses/ 7.00/ 1993	1325	6/30/95	0	0	0	7	-

Appendix H (continued). Willow flycatcher detections in Arizona, 1995.							
Site Name - County Site description/ 1995 survey hrs/ Yr. first surveyed	Elev. (m)	Date	Adult WIFLs ¹ Observed	Total Terr.	# of Pairs	BHCOs ² Present	Para- sitism
Hassayampa River							
Box Canyon - Yavapai Co. 75% willow, 16% mesquite, 5% burro-brush (<i>Hymenoclea</i> sp.) with some tamarisk and cottonwood/ 3.25/ 1995	686	6/22/95	0	0	0	6	-
King Solomon Gulch Area - Yavapai Co. 3% scattered willow, 3% desert-willow, 5% burro- brush?, 8% mesquite, 81% open/ 2.25/ 1995	732	6/23/95	0	0	0	8	-
O'Brien - Yavapai Co. Mostly bare with some willow/cottonwood and mesquite/ 4.00/ 1995	841	6/27/95	0	0	0	14	-
Seal Mountain - Yavapai Co. 8% willow, 2% cottonwood, 5% bermuda grass (<i>Cynodon dactylon</i>), 1% oak, 1% burro-brush, 1% Arizona walnut, 1% ash (/ 2.00/ 1995	1030	6/28/95	0	0	0	5	-
Agua Fria River							
Gillette Ruins - Maricopa/Yavapai Co. Mostly scoured channel with some willow, mesquite, and cottonwood/ 1.50/ 1995	537	7/07/95	0	0	0	3	-

Appendix H (continued). Willow flycatcher detections in Arizona, 1995.

Site Name - County Site description/ 1995 survey hrs/ Yr. first surveyed	Elev. (m)	Date	Adult WIFLs ¹ Observed	Total Terr.	# of Pairs	BHCOs ² Present	Para- sitism
Verde River							
Tavasci Marsh - Yavapai Co. Marsh with scattered, mature cottonwood and willows with patches of mesquite and other shrubs/ 9.00/ 1993	1018	6/27/95	0	0	0	10	-
Tuzigoot Bridge - Yavapai Co. Mixed patch of cottonwood, willow, boxelder (<i>Acer negundo</i>) and tamarisk with small stream and some cattails/ NA / 1993	1024	4/23/95	0	0	0	Yes	Unk
		4/30/95	0	0	0		
		5/08/95	0	0	0		
		5/12/95	0	0	0		
		5/16/95	2	2	0		
		5/23/95	3	2	1		
		5/26/95	1	1	1		
		5/27/95	1	1	1		
		5/30/95	2	2	1		
		6/01/95	1	1	1		
		6/27/95	3	2	1		
		6/30/95	2	2	1		
		7/05/95	3	2	1		
		7/11/95	3	2	1		
		7/18/95	0	0	0		
Mescal Gulch - Yavapai Co. Thin patches dominated by tamarisk; canals bordered by walnut and sycamore (<i>Platanus wrightii</i>)/ 4.00/ 1993	976	7/01/95	0	0	0	No	-
Tapco - Yavapai Co. 90% tamarisk, 10% willow, linear patch 100-150 m wide/ 1.00/ 1993	1067	7/12/95	0	0	0	3	-
White Bridge - Yavapai Co. Many solitary willows, mixed with tamarisk/ 0.75/ 1994	927	6/22/95	0	0	0	25	-
Red Rock Crossing "Oak Creek" - Yavapai Co. Dense, fairly linear, vegetation, 25% cottonwood, 15% ash, 35% willow, 10% alder (<i>Alnus</i> sp.)/ 1.00/ 1995	1207	6/21/95	0	0	0	2	-
Dry Beaver Creek - Yavapai Co. A mix of willow and ash from all age classes/ 2.50/ 1993	1098	6/13/95	0	0	0	1	-
Sycamore Canyon - Coconino Co. Vegetation is listed in order of dominance: ash, cottonwood, sycamore, willow, alder, hackberry (<i>Celtis</i> sp.), and boxelder/ 1.25/ 1993	1104	6/15/95	0	0	0	1	-
Sheepshead Canyon - Yavapai Co. Dominated by dense patches of coyote willow, with cottonwood providing some over story cover/ 1.60/ 1993	1052	6/18/95	0	0	0	No	-
Granite Creek - Yavapai Co. Willow and young cottonwoods on both sides of creek. Once suitable habitat, now marginal/ 1.10/ 1995	1586	7/13/95	0	0	0	3	-

Appendix H (continued). Willow flycatcher detections in Arizona, 1995.

Site Name - County Site description/ 1995 survey hrs/ Yr. first surveyed	Elev. (m)	Date	Adult WIFLs ¹ Observed	Total Terr.	# of Pairs	BHCOs ² Present	Para- sitism
Verde River (Continued)							
West Clear Creek "Campground" - Yavapai Co. Area consists of three patches of willow. Each patch varied in density from sparse to very dense/ 1.25/ 1993	982	6/22/95	0	0	0	3	-
West Clear Creek "Bull Pen" - Yavapai Co. Linear patches dominated by willows and cottonwoods with fewer alders/ 1.50/ 1993	1122	7/25/95	0	0	0	2	-
Roosevelt Lake							
Tonto Creek Inflow - Gila Co. Stand of dense, mixed-age tamarisk with few, scattered mature willows/ 89.25/ 1993	646	monitor 6/17/95 thru 7/31/95	17	9	8	76	Yes (two nests)
Salt River Inflow - Gila Co. Large, stand of tall, dense tamarisk adjacent to river/ 66.00/ 1993	652	monitor 6/20/95 thru 8/02/95	21	12	9	23	Yes
Meddler Point - Gila Co. Area 3.9 km west of Route 288. 50% tamarisk, 5% cottonwood overstory, 25% mesquite, 20% clearing/ 5.00/ 1994	655	7/01/95	0	0	0	3	-
Salt River Arm - Gila Co. Area from Route 288 to a point 8.5 km west of bridge along river. Vegetation dominated by tamarisk. Potentially suitable/ ≥ 12.80 / 1994	652	6/30/95 7/01/95	0 0	0 0	0 0	2 11	-

Appendix H (continued). Willow flycatcher detections in Arizona, 1995.

Site Name - County Site description/ 1995 survey hrs/ Yr. first surveyed	Elev. (m)	Date	Adult WIFLs ¹ Observed	Total Terr.	# of Pairs	BHCOs ² Present	Para- sitism
Tonto Creek							
Tonto Creek (2 km NE of Gisela) - Gila Co. 100 m of vegetation dominated by 1.5 - 3.0 m willows and tamarisk understory/ 1.40/ 1995	915	6/23/95	0	0	0	No	-
Bear Hide Spring - Gila Co. One small patch; 5 x 12 m, and one large patch; 20 x 96 m, of 2-3 m willow/ 0.60/ 1995	1647	6/30/95	0	0	0	No	-
Gibson Creek "Round Valley" - Gila Co. Overstory of large cottonwoods, midstory dense willows 3-5 m tall, 0.4 km linear patch 5-20 m wide/ 5.60/ 1995	1464	6/23/95 6/27/95	0 0	0 0	0 0	Yes No	-
Chevelon Creek							
Gauge Station - Coconino Co. Site within stream bed. 60% false indigo (<i>Amorpha fruticosa</i>), 25% willow, 5% Arizona walnut, 5% cottonwood, 5% boxelder/ 4.50/ 1993	1796	7/10/95	0	0	0	No	-
Chevelon Crossing North - Coconino Co. 30% coyote willow, 20% false indigo, 10% Arizona rose (<i>Rosa arizonica</i>), 5% sedge, 5% bulrush on banks, 50% boxelder, 30% Arizona walnut, 20% narrowleaf cottonwood (<i>Populus angustifolia</i>)/ 3.50/ 1993	1860	6/05/95	0	0	0	No	-
East Clear Creek							
Enchinique - Coconino Co. Stream bed with limestone cliffs. 50% coyote willow, 10% narrowleaf cottonwood, 10% boxelder, 10% Arizona walnut, 10% ash, 2% choke cherry (<i>Prunus virginiana</i>), 3% false-indigo, 2% sedge, 2% bulrush, 2% Arizona rose, and 1% grasses/ 3.50/ 1995	1768	7/06/95	0	0	0	No	-

Appendix H (continued). Willow flycatcher detections in Arizona, 1995.							
Site Name - County Site description/ 1995 survey hrs/ Yr. first surveyed	Elev. (m)	Date	Adult WIFLs ¹ Observed	Total Terr.	# of Pairs	BHCOs ² Present	Para- sitism
Little Colorado River							
Sawmill - Coconino Co. Sparse, small willows due to flood in 1993/ 2.00/ 1993	2196	6/02/95	0	0	0	Yes	-
Wenima Ranch - Apache Co. 50% willow, 15% Arizona walnut, 30% grasses, 5% tamarisk/ 4.00/ 1994	2043	7/02/95	0	0	0	3	-
Nelson Reservoir - Apache Co. Patches of shrubby willows in open dry meadow of grasses and sedges/ 4.60/ 1993	2262	6/04/95 6/30/95	0 0	0 0	0 0	1 0	-
Hall Creek - Apache Co. Scattered clumps of willow in open, grassy meadow/ NA/ 1994	2798	6/06/95	0	0	0	Yes	-
Tunnel Reservoir - Apache Co. Patch of willow 100 m x 40 m/ 1.50/ 1993	2518	7/02/95	0	0	0	No	-
Greer "Benny Creek" - Apache Co. Discrete patches of willow interspersed with grass/ 5.50/ 1993	2500	6/04/95 7/16/95	0 0	0 0	0 0	Unk. 1	-
Greer "Upper West Fork" - Apache Co. Very sparse strip of willow and cottonwood south of Greer. Unsuitable habitat/ 2.20/ 1993	2568	6/06/95	0	0	0	No	-
Greer "Town" - Apache Co. Referred to as Townsite North and South on 1995 data sheets/ 22.00/ 1993	2524	6/04/95 6/05/95	0 0	0 0	0 0	8	-
Greer "North" (Inflow to River Reservoir) - Apache Co. Shrubby willows west of Rd. 373, in area flooded by beaver dams and area east of Rd. 373 to telephone line/ 73.10/ 1994	2512	monitor 6/02/95 thru 7/29/95	16	9	7	37	-

Appendix H (continued). Willow flycatcher detections in Arizona, 1995.

Site Name - County Site description/ 1995 survey hrs/ Yr. first surveyed	Elev. (m)	Date	Adult WIFLs ¹ Observed	Total Terr.	# of Pairs	BHCOs ² Present	Para- sitism
San Francisco River							
Alpine "Horse Pasture" - Apache Co. Patches of shrubby willows in open, dry meadow of grasses and sedges/ 22.00/ 1993	2426	monitor 6/01/95 thru 7/25/95	7	4	3	16	-
Alpine "Pheasant Farm" - Apache Co. Linear strip of shrubby willow/ 1.00/ 1993	2426	6/01/95	0	0	0	7	-
Black River							
Thompson Ranch - Apache Co. Small patches of willow scattered along river/ 1.00 1995	2682	6/06/95	0	0	0	No	-
Totals: 122 sites			164-166	-	-	87 sites	-
Totals During Breeding Season (15 June and 25 July):			148-150	83- 87	62- 63	-	4 sites

¹ WIFL = willow flycatcher

² BHCO = brown-headed cowbird

³ information not available

⁴ Havasu NWR Interior Rd: one nest inferred, adults and 2 WIFL fledglings observed

⁵ Grand Canyon River Mile 50.5: one nest fledged one WIFL young; WIFL clutch parasitized w/ 1 BHCO egg which later disappeared.

⁶ Lower Big Sandy River: two nests located; one with 2 WIFL hatchlings, outcome unknown, one with 3 WIFL eggs, depredated (1 egg broken with a hole in it, other eggs missing).

⁷ Gila River, Sanchez Rd: one nest located, outcome unknown

Appendix I. Willow flycatcher nest summary data for sites monitored by the Arizona Game and Fish Department in 1995.

[illegible]

Appendix I (continued). Willow flycatcher nest summary data for sites monitored by the Arizona Game and Fish Department in 1995.

[illegible]

[illegible]

Appendix I (continued). Willow flycatcher nest summary data for sites monitored by the Arizona Game and Fish Department in 1995.

[illegible]

Appendix I (continued). Willow flycatcher nest summary data for sites monitored by the Arizona Game and Fish Department in 1995.								
Nest	Date Found	Date Clutch Completed	WIFL ¹ Clutch Size	Date Hatched	Number Nestlings	Date Fledged/Failed	Number Fledged	Number Failed
Alpine (High elevation willow)								
1	6-07-95	≈ 6-19-95	3	7-02-95	3	≥ 7-18-95	3	0
2	6-27-95	≈ 6-20-95	4	7-03-95	2	≥ 7-18-95	1	3
3	6-27-95	6-27-95	3	-	0	-	0	3
Nest comments:								
1	Three feathered WIFL young in nest on 7-17-95, WIFL fledglings seen in area on 7-25-95.							
2	Two WIFL eggs probably infertile because two other eggs hatched.							
3	All WIFL eggs probably infertile, female did not incubate, or possible human induced failure.							
Greer (High elevation willow)								
1	6-14-95	≤ 6-28-95	3	-	0	Unknown	0	3
2	6-14-95	≈ 6-24-95	4	≈ 7-05-95	2	7-15-95	2	2
3	6-14-95	≈ 6-28-95	4	≈ 7-06-95	3	≥ 7-20-95	3	1
4	6-15-95	6-30-95	4	7-12-95	4	≥ 7-26-95	2	2
5	6-14-95	≤ 6-14-95	4	-	0	-	0	4
6	6-29-95	≈ 6-25-95	4	≈ 7-07-95	4	≈ 7-20-95	4	0
7	6-29-95	7-03-95	2	7-15-95	1	≤ 7-29-95	1	1
Nest comments:								
1	WIFL eggs disappeared, likely depredated. Nest destroyed later.							
2	Two WIFL eggs disappeared							
3	One WIFL egg probably infertile because three other eggs hatched.							
4	Two WIFL nestlings disappeared.							
5	Nest disappeared.							
7	One egg probably infertile, because other egg hatched.							
Totals:			≥ 116	-	≥ 76	-	≥ 60 ⁴	54

¹WIFL = willow flycatcher

²b = possible reneest

³BHCO = brown-headed cowbird

⁴Exact number fledged could not be determined, success assumed if feathered young in nest a maximum of three days prior to estimated fledging date (except six days prior to fledging for one nest), includes two sites where only fledged birds were found.

Appendix J. Summary of habitat characteristics for willow flycatcher nest sites monitored by the Arizona Game and Fish Department in 1995.

	Nest Height ft (m)	Nest Shrub Height ft (m)	Nest Shrub Stem Diam. in (cm)	Nest Azimuth (in degrees)	Nearest Known WIFL ¹ Nest ft (m)
Tamarisk: (n = 31)					
Mean	14.7 (4.5)	24.2 (7.4)	8.7 (22.2)	150	131.3 (40.0)
S.D.	5.2 (1.6)	6.2 (1.9)	8.1 (20.7)	116	102.7 (31.3)
Median	12.5 (3.8)	24.9 (7.6)	3.3 (8.5)	164	132.8 (40.5)
Min.	7.5 (2.3)	14.1 (4.3)	1.8 (4.5)	0	0.0
Max.	25.6 (7.8)	36.1 (11.0)	30.3 (77.0)	358	393.6 (120.0)
Mixed Riparian: (n = 7)					
Mean	12.2 (3.7)	21.1 (6.4)	13.5 (34.2)	165	198.2 (60.4)
S.D.	5.2 (1.6)	7.5 (2.3)	6.5 (16.4)	129	109.3 (33.3)
Median	13.8 (4.2)	19.7 (6.0)	15.0 (38.0)	156	209.9 (64.0)
Min.	4.9 (1.5)	11.5 (3.5)	4.7 (12.0)	5	62.3 (19.0)
Max.	19.7 (6.0)	32.8 (10.0)	19.7 (50.0)	277	373.9 (114.0)
	Nest Height ft (m)	Nest Shrub Height ft (m)	Nest Shrub Circum. ft (m)	Nest Azimuth degrees	Nearest Known WIFL Nest ft (m)
High elevation Willows: (n = 10)					
Mean	5.9 (1.8)	14.4 (4.4)	4.5 (11.4)	184	232.9 (71.0)
S.D.	1.0 (0.3)	1.3 (0.4)	2.5 (6.4)	131	112.2 (34.2)
Median	6.2 (1.9)	14.1 (4.3)	4.6 (11.7)	218	214.8 (65.5)
Min.	4.1 (1.3)	12.1 (3.7)	1.4 (3.5)	36	131.2 (40.0)
Max.	7.1 (2.2)	16.1 (4.9)	9.7 (24.7)	355	459.2 (140.0)

¹WIFL = willow flycatcher

Appendix K. Distance from nest to habitat features at willow flycatcher nest sites monitored by the Arizona Game and Fish Department in 1995.

	Shrub Center ft (m)	Shrub Edge ft (m)	Edge of Veg. Type ft (m)	Edge of Patch ft (m)	Open Water ft (m)	Saturated Soil ft (m)
Tamarisk: (n = 31)						
Mean	2.0 (0.6)	3.9 (1.2)	47.6 (14.5)	48.2 (14.7)	269.9 (82.3)	271.3 (82.7)
S.D.	2.3 (0.7)	3.0 (0.9)	57.7 (17.6)	58.4 (17.8)	249.7 (76.1)	244.1 (74.4)
Median	2.0 (0.6)	3.6 (1.1)	31.8 (9.7)	31.8 (9.7)	145.0 (44.2)	144.3 (44.0)
Min.	0.0	0.0	0.0	0.0	0.0	29.5 (9.0)
Max.	8.2 (2.5)	10.5 (3.2)	293.9 (89.6)	292.0 (89.0)	806.9 (246.0)	806.9 (246.0)
Mixed Riparian: (n = 7)						
Mean	1.6 (0.5)	1.0 (0.3)	25.6 (7.8)	28.2 (8.6)	0.0	0.0
S.D.	1.3 (0.4)	1.3 (0.4)	16.7 (5.1)	22.6 (6.9)	0.0	0.0
Median	1.0 (0.3)	2.0 (0.6)	23.0 (7.0)	22.0 (6.7)	0.0	0.0
Min.	0.0	0.0	1.0 (0.3)	0.7 (0.2)	0.0	0.0
Max.	3.3 (1.0)	3.3 (1.0)	49.2 (15.0)	65.6 (20.0)	0.0	0.0
High elevation Willow: (n = 10)						
Mean	3.9 (1.2)	8.2 (2.5)	12.8 (3.9)	12.8 (3.9)	100.0 (30.5)	1.3 (0.4)
S.D.	4.3 (1.3)	5.9 (1.8)	4.9 (1.5)	4.6 (1.4)	131.2 (40.0)	3.9 (1.2)
Median	3.9 (1.2)	5.6 (1.7)	13.1 (4.0)	12.5 (3.8)	19.7 (6.0)	6.6 (2.0)
Min.	0.0	0.7 (0.2)	5.2 (1.6)	5.2 (1.6)	3.3 (1.0)	0.0
Max.	13.5 (4.1)	17.4 (5.3)	21.3 (6.5)	21.3 (6.5)	331.3 (101.0)	13.1 (4.0)

Appendix L. Summary of nest site characteristics for willow flycatcher nest sites monitored by the Arizona Game and Fish Department in 1995.

	Average Height Overstory ft (m)	Average Height Midstory ft (m)	Canopy Density (%)
Tamarisk: (n = 31)			
Mean	33.8 (10.3)	12.8 (3.9)	88.7
S.D.	10.8 (3.3)	3.3 (1.0)	6.1
Median	31.2 (9.5)	13.1 (4.0)	88.0
Min.	22.6 (6.9)	0.0	75.0
Max.	69.9 (21.3)	18.4 (5.6)	97.0
Mixed Riparian: (n = 7)			
Mean	39.0 (11.9)	13.8 (4.2)	92.9
S.D.	14.8 (4.5)	3.0 (0.9)	4.1
Median	36.7 (11.2)	14.4 (4.4)	93.7
Min.	18.7 (5.7)	7.9 (2.4)	85.0
Max.	53.5 (16.3)	17.1 (5.2)	98.0
High elevation Willows: (n = 10)			
Mean	14.1 (4.3)	NA	89.3
S.D.	1.0 (0.3)	NA	5.7
Median	14.4 (4.4)	NA	89.7
Min.	13.1 (4.0)	NA	75.0
Max.	16.1 (4.9)	NA	94.4

Appendix M. Percent vertical foliage density for willow flycatcher nest sites monitored by the Arizona Game and Fish Department in 1995.

Tamarisk (n = 31)

	Distance from nest shrub ft (m)			
	4.9 (1.5)	14.8 (4.5)	24.6 (7.5)	37.1 (11.3)
Mean	67.3	69.9	66.4	57.3
S.D.	11.1	8.2	7.9	6.7
Median	66.9	69.0	67.6	57.2
Min.	55.0	61.2	57.1	49.2
Max.	80.5	80.3	73.2	65.5
	Height above ground ft (m)			
	3.0-6.0 (0.9-1.8)	6.1-9.0 (1.9-2.7)	9.1-12.0 (2.8-3.7)	12.1-25.0 (3.8-7.6)
Mean	55.6	61.8	68.7	74.7
S.D.	4.3	3.7	5.9	6.2
Median	56.1	62.4	71.6	76.5
Min.	49.2	55.9	58.5	65.5
Max.	61.2	66.3	73.2	80.5

Appendix M (continued). Percent vertical foliage density for willow flycatcher nest sites monitored by the Arizona Game and Fish Department in 1995.

Mixed Riparian (n = 7)

	Distance from nest shrub ft (m)			
	4.9 (1.5)	14.8 (4.5)	24.6 (7.5)	37.1 (11.3)
Mean	62.0	63.4	72.6	57.6
S.D.	13.4	6.9	11.4	10.4
Median	60.3	63.6	73.6	56.5
Min.	48.5	55.6	58.1	46.3
Max.	78.9	70.6	84.8	71.2
	Height above ground ft (m)			
	3.0-6.0 (0.9-1.8)	6.1-9.0 (1.9-2.7)	9.1-12.0 (2.8-3.7)	12.1-25.0 (3.8-7.6)
Mean	52.1	59.7	67.3	76.4
S.D.	4.9	6.2	6.8	5.8
Median	50.9	55.2	66.7	75.1
Min.	46.3	54.6	58.3	70.6
Max.	58.1	69.8	77.5	84.8

Appendix M (continued). Percent vertical foliage density for willow flycatcher nest sites monitored by the Arizona Game and Fish Department in 1995.

High elevation Willow (n = 10)

	Distance from nest shrub ft (m)			
	4.9 (1.5)	14.8 (4.5)	24.6 (7.5)	37.1 (11.3)
Mean	72.9	65.2	55.8	44.3
S.D.	7.7	3.3	9.7	5.6
Median	72.8	66.1	58.9	45.3
Min.	63.9	60.4	42.0	36.7
Max.	82.3	67.9	63.3	50.0
	Height above ground ft (m)			
	3.0-6.0 (0.9-1.8)	6.1-9.0 (1.9-2.7)	9.1-12.0 (2.8-3.7)	12.1-25.0 (3.8-7.6)
Mean	61.2	63.6	62.7	50.8
S.D.	9.3	9.0	14.0	11.6
Median	64.1	64.7	61.9	51.2
Min.	46.0	50.0	44.6	36.7
Max.	70.6	75.0	82.3	63.9