SOUTHWESTERN WILLOW FLYCATCHER
FINAL SURVEY AND NEST MONITORING REPORT

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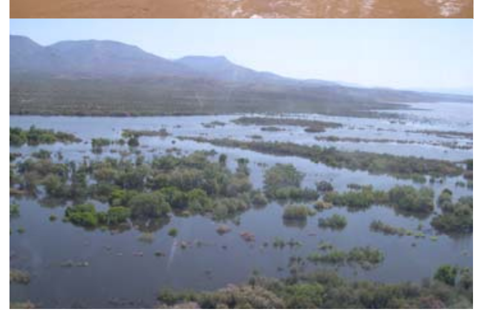

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EXECUTIVE SUMMARY

Purpose: The southwestern willow flycatcher (*Empidonax traillii extimus*, flycatcher) was federally listed as endangered in 1995. The main factors contributing to population declines in Arizona are loss, alteration, and fragmentation of native riparian breeding habitat. In 1996, the Arizona Game and Fish Department (AGFD) entered into a cooperative agreement with the U.S. Bureau of Reclamation (Reclamation) to conduct a long-term project to fulfill mandates of the 1996 Biological Opinion related to the modification of Roosevelt Dam. The main objectives were to track statewide distribution and abundance of flycatchers, monitor populations at 4 study areas, document effects of inundation at Roosevelt Lake on flycatchers, and determine major nest predators.

Surveys: We have compiled more than 10 years of statewide flycatcher population and distribution data in Arizona. Although flycatcher distribution continuously shifts due to the dynamic nature of riparian habitat, we have identified current locations of the largest known flycatcher populations in Arizona. We have also identified areas frequented by migrant willow flycatchers, though subspecies has not been determined because subspecies overlap and are difficult to identify.

Consistent surveys at the Salt River, Tonto Creek, Gila River, and San Pedro River study areas have allowed us to evaluate natural habitat succession, and the effects of fire and water fluctuations on habitat and flycatcher distribution. Information obtained from our surveys highlight the dynamic nature of riparian habitat and emphasize the need to protect habitat at varying stages of succession. Observations at AGFD study areas demonstrate that the presence of flowing water, standing water, and saturated soil along lakes, rivers, and streams in the Southwest are important for flycatcher habitat growth and maintenance. Further, the presence of water can positively influence flycatcher recruitment and occupancy.

Inundation: Inundation of Roosevelt Lake in 2005 changed the habitat on the landscape level and nest level at the Salt River and Tonto Creek study areas. At the landscape level, the location of suitable breeding habitat and habitat structure (e.g., thinner vegetation, more canopy gaps) changed. The flycatcher population at Roosevelt Lake decreased 47% from 2004 to 2006 in response to habitat changes. Flycatchers made fewer nesting attempts and had a significantly lower nest success rate during inundation (2005 and 2006) than pre-inundation (1996–2004). Combined, these factors negatively affected the populations' productivity. The Roosevelt Lake population remains one of the largest in the state and territory numbers are still high enough that the population may not suffer long-term effects if habitat regenerates at the reservoir. Although inundation caused extensive vegetation die-off, we did observe regeneration of vegetation in some areas at Roosevelt Lake in 2006.

General Nesting: Estimates of demographic parameters (e.g., clutch size, fledge date, nest success, nest cycle length) and causes of nest failure in our study populations are similar to those reported in other populations of willow flycatchers and other songbirds. With an overall parasitism rate of 2.8%, our study populations do not appear to be threatened by brown-headed cowbird (*Molothrus ater*) parasitism. Flycatchers nest predominately in mixed native and exotic habitat at all of our study areas. Although tamarisk is an exotic species, flycatchers readily use it as a nest tree. Tamarisk was the most common nest tree species used by flycatchers at our study areas (75.7% of nests). Based on our 10-year study, the demographic parameters of these populations fluctuate in response to changing environmental conditions and vary greatly between years.

River and Reservoir Nesting: Mayfield nest success was greatest at the San Pedro River study area, followed by the Gila River study area, and lowest at Salt River and Tonto Creek study areas. The Salt River and Tonto Creek study areas experienced greater impacts (larger decreases in nesting attempts and nest success) from the 2002 drought than did the San Pedro and Gila River study areas. Increases in rainfall had a greater positive affect on nest success at the San Pedro and Gila River study areas than the Salt River and Tonto Creek study areas. We found no difference in nest success among native-dominated, mixed native and exotic, or exotic-dominated habitat. Differences in nest success at these areas may be attributed to microhabitat differences between the systems. While nest success was lower at the reservoir study areas than the river study areas, rates are still comparable or better to those of other flycatcher populations.

Depredation: Depredation accounted for the largest proportion of flycatcher nest failures. Approximately 35% of camera-monitored nests failed due to depredation, which is typical for open-cup nesting birds, and similar rates have been documented in other flycatcher populations. Depredation rates increased in the latter part of the nestling stage, perhaps due to increased activity at the nest. Cooper's hawks (*Accipiter cooperii*) and California kingsnakes (*Lampropeltis getula californiae*) were the 2 main predators documented.

Management recommendations: Documenting population sizes and distribution is required to determine whether recovery goals in the Southwestern Willow Flycatcher Recovery Plan have been achieved. An important component of evaluating the effectiveness of recovery efforts is continued maintenance of the Arizona Southwestern Willow Flycatcher Database that tracks all surveys conducted in the state. Additionally, continued survey training and outreach activities are necessary. Conservation management agreements need to be developed that provide protection from threats and secure sufficient habitat. Therefore, conservation and recovery of the flycatcher will be dependent on the cooperation and support of federal and state agencies, as well as that of private landowners, Native American nations, and non-governmental organizations.

In this report, we recommend areas where surveys and monitoring should continue or increase and areas that could benefit from increased connectivity. Emphasis should be placed on maintaining existing populations and habitat. This includes increasing the connectivity of populations, monitoring habitat and population recovery following disturbance events (such as the inundation at Roosevelt Lake), and management of riparian systems at the drainage and landscape scale.

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CHAPTER 1

SPECIES AND PROJECT HISTORY

REPORT PURPOSE AND ORGANIZATION

This report synthesizes results of a long-term research project on the federally endangered southwestern willow flycatcher (*Empidonax traillii extimus*, flycatcher) conducted by the Arizona Game and Fish Department (AGFD) from 1996 to 2007. The project was funded primarily by the U.S. Bureau of Reclamation (Reclamation) to meet recommendations of a 1996 Section 7 Biological Opinion related to modifications of Roosevelt Dam in Gila County, Arizona issued by the U.S. Fish and Wildlife Service (USFWS 1996). This introduction will provide background information on the species, its status, and our project. Following Chapter 1, “Species and Project History”, this report is organized into 5 chapters discussing specific topics and a final summary chapter with management recommendations. Chapter 2, “Surveys, Detections, and Distribution”, provides an overview of surveys and detection trends at AGFD study sites as well as a summary of statewide survey data collected by other agencies, non-profits, and private entities. Chapter 3, “Roosevelt Lake Inundation”, describes impacts of 2005 and 2006 habitat inundation on the Roosevelt Lake flycatcher population. Chapter 4, “Nesting Biology”, provides a summary of general demographic traits and comparisons with other populations. Chapter 5, “River and Reservoir Nesting”, provides a comparison of nest success and productivity of flycatchers nesting at Roosevelt Lake and on the San Pedro and Gila rivers. Chapter 6, “Monitoring Nest Predators with Time-lapse Video”, summarizes a study identifying nest predators at flycatcher nests. Finally, in Chapter 7, “Management Recommendations”, we summarize our findings, including management recommendations, in light of the Southwestern Willow Flycatcher Recovery Plan (USFWS 2002) and its goals.

THE SOUTHWESTERN WILLOW FLYCATCHER AND ITS HABITAT

The willow flycatcher (*Empidonax traillii*) is one of the most widely distributed members of the genus *Empidonax*. The species breeds across much of the continental United States and southern Canada (Brown 1988, Sedgwick 2000) and arrives on its breeding grounds in late April or early May. By mid-September, flycatchers depart for their wintering grounds, which range from Mexico to northern South America. Like other members of its genus, the willow flycatcher is best identified by its unique vocalizations.

The southwestern willow flycatcher subspecies (*E. t. extimus*) is 1 of 4 recognized subspecies, though some authors suggest a fifth (Phillips 1948, Aldrich 1951, Hubbard 1987, Unitt 1987, Browning 1993; Figure 1). These subspecies are distinguished by subtle differences in plumage coloration and other morphometric characteristics, genetics, and song dialects (Phillips 1948; Aldrich 1951; Hubbard 1987; Unitt 1987; Browning 1993; Pyle 1997; Paxton 2000; Sedgwick 2000, 2001; Paxton et al. 2005). Overlap between subspecies near sub-specific boundaries has complicated taxonomic partitioning. Recent genetic and song research has indicated potential in delimiting these boundaries with more precision (Paxton 2000, Sedgwick 2001).

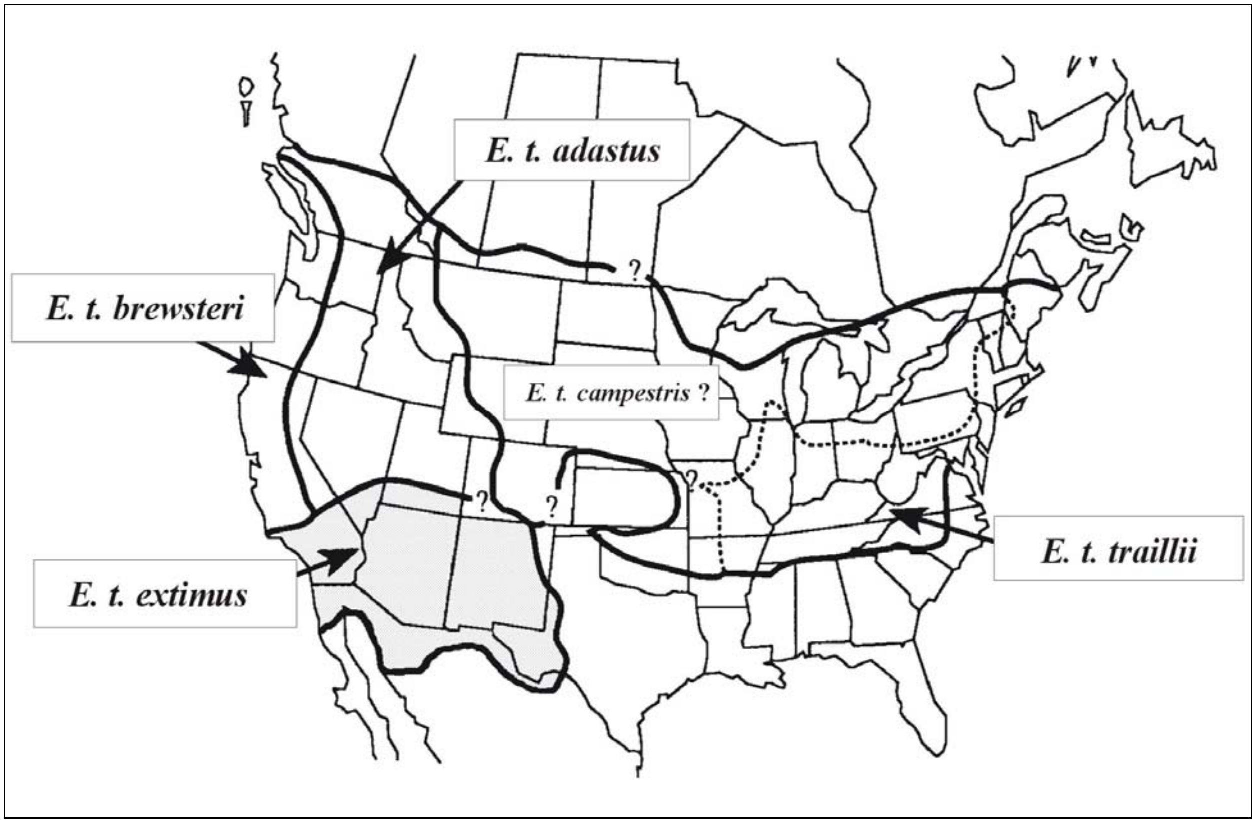

Figure 1. Breeding range distribution of willow flycatcher subspecies. Adapted from Unitt (1987) and Browning (1993).

The southwestern subspecies is generally paler and differs in morphology (e.g., wing formula, bill length, wing to tail ratio; Unitt 1987, Browning 1993) compared to other subspecies; however, distinguishing these characteristics in the field is unreliable (Hubbard 1999, Sogge 2000; Figure 2). As indicated by its name, the southwestern willow flycatcher breeds in the American Southwest, including southern California, southern Nevada, Arizona, southern Utah, southwestern Colorado, and New Mexico. Few historical breeding records have been documented for the flycatcher in extreme northwestern Mexico and southwestern Texas (Unitt 1987, Wilbur 1987, Sedgwick 2000). Current breeding status in Texas and Mexico are unknown as thorough surveys have not been conducted. The flycatcher's current known breeding range is thought to be similar to its historical range, though reduced suitable habitat has resulted in the subspecies' decline rangewide (Sedgwick 2000, USFWS 2002).

The flycatcher is a riparian obligate breeder occurring in a wide range of elevations from sea level in California to over 2500 m in Arizona. While other subspecies of the willow flycatcher may breed away from surface water (Bent 1942, King 1955, McCabe 1991), the southwestern subspecies only breeds near surface water or saturated soil along rivers and streams, reservoirs, cienegas, and other wetlands (Sogge and Marshall 2000; USFWS 2002, 2005; Allison et al. 2003; Paradzick and Woodward 2003). Flycatchers breed in riparian tree and shrub communities that vary in vegetation height and structure, patch size, and species composition, but most breeding flycatchers are found in patches of dense contiguous vegetation or a mosaic of dense vegetation interspersed with multiple small openings (creating a mosaic of forest and openings; Sogge and Marshall 2000; USFWS 2002, 2005; Paradzick and Woodward 2003; Allison et al. 2003).

Several habitat characteristics vary widely among sites including: canopy height and structure, dominant tree species, temporal and spatial fluctuations in water, and size and shape of habitat patch (Sogge and Marshall 2000; USFWS 2002, 2005). Rangewide, flycatchers occupy areas dominated by willow (*Salix* spp.), tamarisk (an exotic tree also known as saltcedar; *Tamarix* spp.), box elder (*Acer negundo*), or live oak (*Quercus agrifolia*; Stoleson and Finch 2003; USFWS 2005; Durst et al. 2006). Flycatchers place their nests in a variety of substrates including: tamarisk, Goodding's willow (*Salix gooddingii*), Geyer willow (*Salix geyeriana*), coyote willow (*Salix exigua*), box elder, Fremont cottonwood (*Populus fremontii*), and Russian olive (*Elaeagnus angustifolia*; USFWS 2005; Graber et al. 2007).

Riparian habitat in which the flycatcher breeds is dynamic and recycles naturally when hydrologic and geomorphic features are intact (reviewed in Poff et al. 1997). As flycatcher habitat matures past suitability, drought, fire, and scouring floods assist in habitat recycling by clearing older unsuitable trees and snags. Habitat is then renewed (in as little as 2–5 years; AGFD unpublished data) by sediment and seed deposition (by floods or partial inundation), periodic inundation, and groundwater recharge (Periman and Kelly 2000; Sogge and Marshall 2000; USFWS 2002, 2005; Allison et al. 2003). Over the past century, this natural cycling and associated habitat continuity has been disrupted by modifications to natural flow regimes due to groundwater pumping, flood control projects, water diversions, and dam operations (Poff et al. 1997; USFWS 1996, 1997*a*, 2002, 2005; Periman and Kelly 2000; Marshall and Stoleson 2000). The trend of habitat loss and degradation has been exacerbated in some areas by increases in fire, heavy grazing, recreation, and other land uses (USFWS 1997*b*). While flycatchers are well adapted to ephemeral conditions, up to 90% of their historical riparian habitat has been lost, altered, or degraded (Governor's Riparian Habitat Task Force 1990, Ohmart 1994). Remaining habitat patches are smaller, more isolated, and more susceptible to stochastic events; thus, flycatchers are more prone to local extirpation.

Figure 2. Southwestern willow flycatcher captured and banded at the San Pedro River study area. Photograph by Brian Cato Cook and Jamie Granger, AGFD.

THREATS AND SPECIES STATUS

Unitt (1987) highlighted the growing recognition of the conservation needs of southwestern willow flycatchers and estimated the subspecies' rangewide population to be between 500 and 1,000 pairs. Population declines have been attributed to loss and degradation of riparian habitats caused by: a reduction of surface water due to diversion and groundwater pumping for agricultural, industrial, and municipal use; changes in hydrological cycles due to damming and channelization of rivers and streams; fragmentation due to development; livestock grazing; increases in wildfire; removal of vegetation; and invasion of exotic species (USFWS 2002). A high rate of brown-headed cowbird (*Molothrus ater*) parasitism has been documented in some populations, but is not a pervasive problem rangewide (USFWS 2002, Graber et al. 2007). Factors negatively affecting the flycatcher's migration stopover or winter habitat are also potential reasons for population decline, although stopover habitat requirements and threats are not well documented (USFWS 2002). Primary threats to the flycatcher's winter habitat include cattle grazing, agriculture (including draining of wetlands for irrigation and agrochemical pollution), and deforestation (for logging, agriculture, or urban development; Lynn et al. 2003).

In 1992, prompted by concern raised by Unitt (1987) and others (Phillips 1948, Serena 1982) over declining populations and degradation of native riparian habitat, a conservation coalition petitioned USFWS to list the flycatcher as an endangered species. Following review of this petition, USFWS proposed to list the flycatcher as endangered and designate 1,038 km of critical habitat (USFWS 1992, 1993).

In 1995, a final rule to list the flycatcher as endangered was published, with designation of critical habitat postponed (events leading to listing and designation of critical habitat are described in U.S. Fish and Wildlife Service Federal Register filings [USFWS 1989, 1991, 1992, 1993, 1995, 1997*a*] and the Southwestern Willow Flycatcher Recovery Plan [USFWS 2002]). In 1997, the USFWS finalized critical habitat designation for 964 km of riparian habitat (USFWS 1997*a*), but in 2001, as a result of a court ruling, this critical habitat was set aside. The final rule re-designating 1,186 km of critical habitat was published on 19 October 2005 and went into effect 18 November 2005 (USFWS 2005).

The Southwestern Willow Flycatcher Recovery Plan describes reasons for endangerment, evaluates the flycatcher's status, addresses important recovery actions, includes issue papers (appendices) on management issues, and outlines recovery goals (USFWS 2002). The recovery plan divides the flycatcher's range into recovery units based on large watersheds or hydrologic units. Recovery units are further divided into management units based on watershed boundaries at a finer scale. Within Arizona, there are 3 recovery units: Gila Recovery Unit (8 management units), Lower Colorado Recovery Unit (6 management units), and Upper Colorado Recovery Unit (3 management units; Appendix A). Criteria to downlist to threatened requires meeting and maintaining target population sizes within the bounds of a defined distribution among recovery and management units that ensure functioning metapopulations (USFWS 2002). Under Criteria A to downlist, 1,950 territories with management units at 80% of target population sizes and recovery units at 100% of target population sizes must be maintained for 5 years. Under Criteria

B to downlist, 1,500 territories with management units at 50% of target population sizes and recovery units at 75% of target population sizes must be maintained for 3 years. Additionally, because Criteria B requires fewer territories than Criteria A, it requires that occupied habitat must be protected into the foreseeable future through the development of conservation management agreements. For delisting, in addition to meeting Criteria A, conservation management agreements must be in place that: minimize stressors to flycatchers and habitat; assure the continued development and maintenance of suitable habitat; and, protect double the amount of habitat required to support the target number of flycatchers within each management unit.

At the state level, the flycatcher is listed in AGFD's *Wildlife of Special Concern in Arizona* (AGFD 1996) and is identified as a Species of Greatest Conservation Need in AGFD's *Comprehensive Wildlife Conservation Strategy* (AGFD 2006). Likewise, the states of Utah, Colorado, and New Mexico identify the flycatcher as a Species of Greatest Conservation Need (Utah Division of Wildlife Resources 2005, Colorado Division of Wildlife [CDOW] 2006, New Mexico Department of Game and Fish [NMDGF] 2006*a*). The flycatcher is considered a Species of Highest Conservation Priority in Nevada and is state-listed as endangered in New Mexico, California, and Colorado (NMDGF 2006*b*, Nevada Department of Wildlife 2006, California Department of Fish and Game 2007, CDOW 2007).

Reservoirs are known to support large concentrations of flycatchers (e.g., Roosevelt Lake in Arizona, Lake Isabella in California, and Elephant Butte Reservoir in New Mexico) and projects in these areas have resulted in formal or informal consultation with the USFWS for actual and anticipated losses (USFWS 1996, 1997*b*, 2002; Durst et al. 2006; Moore and Ahlers 2006; Graber et al. 2007).

ROOSEVELT DAM AND THE 1996 BIOLOGICAL OPINION

Construction of Roosevelt Dam at the confluence of the Salt River and Tonto Creek was completed in 1911, creating Roosevelt Lake 122 km (76 miles) northeast of Phoenix. The dam's primary function is to provide water storage for the Salt River Project's (SRP) customers and flood control for the Salt River Valley. From 1989 to 1996, modifications to Roosevelt Dam raised the height of the dam 77 ft (25 m) and increased the top of the conservation pool from an elevation of 2136 ft (689 m) to 2151 ft (656 m; Figure 3). This increased storage capacity provides water for municipal use by the cities of Chandler, Glendale, Mesa, Phoenix, Scottsdale, and Tempe, and the Salt River Pima-Maricopa Indian Community. In addition to increased water storage and flood control capabilities, the modifications improved the dam's safety and expanded recreational opportunities (USFWS 1996). Roosevelt Lake elevation typically increases with winter precipitation and spring snowmelt and decreases from late spring (May) through September due to peak usage and evaporation, balanced somewhat by inflow and precipitation associated with the monsoon season in late summer (Tim Skarupa, Salt River Project [SRP], personal communication).

Figure 3. Roosevelt Dam in 1996 following modifications that raised the height of the dam 77 ft (23 m), increasing the storage capacity of the lake by roughly 20% (photograph by Reclamation).

Flycatcher surveys were first conducted at Roosevelt Lake in 1993; flycatchers were detected in 1993 and every year since (Muiznieks et al. 1994; Sferra et al. 1995, 1997; Spencer et al. 1996; McCarthey et al. 1998; Paradzick et al. 1999, 2000, 2001; Smith et al. 2002, 2003, 2004; Munzer et al. 2005; English et al. 2006; Graber et al. 2007). The flycatcher population at Roosevelt Lake is one of the largest known in Arizona and rangewide (Durst et al. 2006, Graber et al. 2007). In September 1995, Reclamation submitted a biological assessment of the potential effects of the dam modifications on the flycatcher (USBR 1995). Between 1966 and 1994, Reclamation estimated that the reservoir would have reached the new capacity and inundated nest trees a minimum of 90 days during 6 of the 29 years, a minimum of 120 days during 4 of the 29 years, and a minimum of 150 days during 2 of the 29 years if the conservation pool had already been increased (USBR 1995). Reclamation concluded that the modifications "may affect" the species and requested a formal consultation under Section 7 of the Endangered Species Act (ESA) with the USFWS. USFWS published a Biological Opinion (Opinion) in 1996 regarding dam modifications, stating the proposed action would likely result in:

> "…reduction and eventual displacement of flycatchers from [Roosevelt Lake]… delayed or lost breeding attempts…decreased productivity of adults that [remain] to breed at Roosevelt Lake…higher adult mortality rates…lower survivorship of fledglings…[and] decreased productivity and survivorship of adults that disperse in search of suitable breeding habitat."

USFWS speculated that productivity would be reduced to the point where the population could not maintain itself (USFWS 1996).

Because the Roosevelt Lake population was centrally located in the flycatcher's range and the second largest population in Arizona, USFWS postulated there could be large-scale consequences due to habitat inundation. These included further reductions in rangewide population numbers due to the loss of a potential source population, fragmentation and further isolation of rangewide populations, and loss of genetic exchange (USFWS 1996). USFWS concluded the proposed action would likely jeopardize the continued existence of the flycatcher rangewide (USFWS 1996).

The Opinion outlined a Reasonable and Prudent Alternative (RPA) that would avoid jeopardizing the continued existence of the flycatcher due to modifications to Roosevelt Dam and issued an Incidental Take Permit (ITP) for flycatchers between the old conservation pool (2136 ft) and the new conservation pool (2151 ft). When drafting the RPA, the USFWS assumed that Roosevelt Lake would rise to the new capacity during the 10 years following modifications to the dam, inundating existing habitat and providing an opportunity to assess dam-related impacts to flycatcher habitat, nesting, and dispersal. To satisfy one component of the RPA, Reclamation agreed to implement a comprehensive 10-year research and monitoring program of the Roosevelt Lake and San Pedro River populations. At the time of the Opinion, the San Pedro River population was the largest known population in Arizona. Reclamation agreed to survey and monitor flycatchers at Roosevelt Lake, 3 sites on the San Pedro River (Cook's Lake, Cook's Seep, and PZ Ranch), and any property acquired for mitigation or in the vicinity of the Roosevelt Lake and San Pedro River populations with landowner permission. The Gila River population was unknown when the Opinion was completed, but was included in the research and monitoring program when the population was detected in 1996. Monitoring on the San Pedro River was also expanded as more sites were located and a high degree of movement between sites was documented. The broad objectives of the program were to monitor population size, dispersal patterns, demographic traits, and changes in habitat related to dam operations and habitat inundation. After a prolonged period of drought, habitat inundation finally occurred in the winter of 2005 (the 10th year of the project). Therefore, the Roosevelt Lake survey and nest monitoring component of the research project was extended into an 11th year.

AGFD Project History, Objectives, and Study Areas

USFWS's proposal to list the flycatcher in 1993 encouraged government agencies and private organizations to conduct surveys rangewide (USFWS 1993). In Arizona, this survey effort was spearheaded by Arizona Partners in Flight (APIF), an interagency program dedicated to conserving landbirds, with AGFD as the coordinating agency (Muiznieks et al. 1994). In 1993, APIF and AGFD's primary objective was to survey suitable and historical riparian and wetland habitat using standardized methods to determine status and distribution of the flycatcher in Arizona (Tibbitts et al. 1994). Based on initial surveys, collection of habitat and nest success information was deemed important. In 1994, AGFD began to monitor nests to calculate simple nest success and measure vegetation characteristics at occupied flycatcher sites.

In 1995, following the final rule to list the flycatcher as endangered, survey efforts intensified in Arizona. In 1996, AGFD entered into a cooperative agreement with Reclamation to fulfill some of the mandates associated with the 1996 Opinion. Under this agreement, AGFD would conduct surveys, and locate and monitor nests at Roosevelt Lake and the San Pedro and Gila rivers near their confluence. At the same time, U.S. Geological Survey (USGS) Southwest Biological Science Center also entered into a cooperative agreement with Reclamation to fulfill other research components outlined in the Opinion, including studies on subspecies genetics, survival, and movement (Paxton 2000, Paxton et al. 2007). To organize and track survey results by geographic location, AGFD developed and maintained a statewide database and USGS developed and maintained a rangewide database. Although the agencies had different responsibilities, the overlap in study areas resulted in extensive data sharing on flycatcher territory and nest locations, band resights, and other information.

This study was conducted at 4 breeding areas (Salt River and Tonto Creek study areas, collectively referred to as the Roosevelt Lake complex, and San Pedro River and Gila River study areas, collectively referred to as the San Pedro River/Gila River complex; Figure 4). When comparing this report to our annual reports published prior to 2007, note that we now use the term Roosevelt Lake complex in place of Roosevelt Lake and San Pedro River/Gila River complex in place of Winkelman.

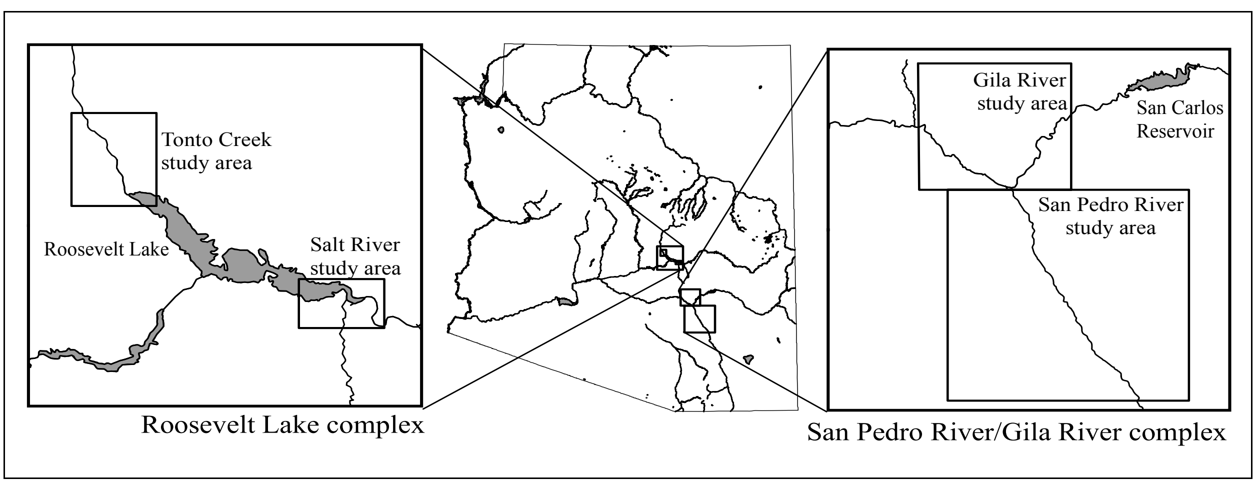

Figure 4. Location of AGFD study areas at the Roosevelt Lake complex (Tonto Creek and Salt River study areas) and the San Pedro River/Gila River complex (Gila River and San Pedro River study areas) in central Arizona.

All 4 breeding areas are in the Arizona Upland subdivision within the Sonoran Desertscrub biome (Turner and Brown 1994). The upland desert vegetation is dominated by an association of saguaro (*Carnegiea gigantea*), palo verde (*Parkinsonia microphylla*), creosote (*Larrea tridentata*), cholla (*Cylindropuntia* spp.), and mesquite (*Prosopis* spp.). Riparian vegetation in the 4 areas is classified as Sonoran Riparian Deciduous Forest (Minckley and Brown 1994) and the composition of vegetation varies from monotypic stands of native broadleaf trees, to stands of mixed native and exotic, to nearly monotypic stands of exotic tamarisk. Dominant riparian tree and shrub species include Goodding's willow, tamarisk, Fremont cottonwood, and seep willow (*Baccharis salicifolia*). Each study area is composed of numerous discrete vegetation patches that vary in vegetation composition and age. We labeled discrete habitat patches or groups of patches in close proximity of each other with a survey site (site) name.

ROOSEVELT LAKE COMPLEX

Salt River and Tonto Creek are located 25 km apart and are the primary inflows to Roosevelt Lake. The Salt River and Tonto Creek study areas are approximately 640 m in elevation and are comprised of U.S. Forest Service (Tonto National Forest) and private land in Gila County. Surveys conducted at the Roosevelt Lake complex included suitable and potentially suitable habitat at Roosevelt Lake and along drainages located within 40 km of the contiguous main study complex. Flycatcher territories at the Roosevelt Lake complex contribute to the Roosevelt Management Unit recovery goals within the Gila Recovery Unit (USFWS 2002).

<u>Salt River study area</u>: The Salt River flows into Roosevelt Lake, approximately 104 km from the confluence of the White and Black rivers (where the Salt River is formed) between the Mogollon Rim and the Natanes Plateau. The study area includes the inflow site at the southeastern end of Roosevelt Lake and extends approximately 15 km upstream. The stretch of Salt River included in the study area is perennial. Vegetation within the study area was primarily exotic, but varied among sites from exotic vegetation (monotypic tamarisk) to mixed native broadleaf and exotic vegetation (primarily Goodding's willow, tamarisk, and Fremont cottonwood) to native broadleaf vegetation (primarily Goodding's willow).

<u>Tonto Creek study area</u>: Tonto Creek flows into Roosevelt Lake, approximately 68 km from its headwaters below the Mogollon Rim. The study area includes the inflow site at the northwestern end of Roosevelt Lake and extends approximately 16 km upstream. Tonto Creek's flow is intermittent and dependent on spring snowmelt and summer monsoon rains, causing it to frequently dry late in the breeding season. Vegetation within the study area was primarily exotic, but varied among sites from exotic vegetation (monotypic tamarisk) to mixed native broadleaf and exotic vegetation (primarily Goodding's willow, tamarisk, and Fremont cottonwood).

SAN PEDRO RIVER/GILA RIVER COMPLEX

The confluence of the San Pedro and Gila rivers is located near Winkelman, Arizona. Sites within the San Pedro River and Gila River study areas range from 491 m to 951 m in elevation and are comprised of municipal, state, federal, and private land in Pinal County. Flycatcher territories at the San Pedro River/Gila River complex contribute to the Middle Gila/San Pedro Management Unit recovery goals within the Gila Recovery Unit (USFWS 2002).

San Pedro River study area: The San Pedro River flows north from Sonora, Mexico. It is one of the largest unregulated rivers in the Southwest and is one of North America's most diverse and well-known avian hotspots (Glennon 2002, Postel and Richter 2003). The San Pedro River study area is located between its confluence with the Gila River and approximately 45 km upstream (south of the confluence). Flows are perennial in some areas and intermittent in others, largely influenced by precipitation and groundwater pumping. Vegetation along the San Pedro River is primarily native, but vegetation within our study area varied among sites from exotic vegetation (monotypic tamarisk) to mixed native broadleaf and exotic vegetation (primarily Goodding's willow, tamarisk, and Fremont cottonwood) to native broadleaf vegetation (primarily Goodding's willow).

Gila River study area: The Gila River study area is located from approximately 20 km below the San Carlos Reservoir, downstream approximately 40 km to the Florence-Kelvin Highway Bridge. Additional surveys were intermittently conducted downstream of the Florence-Kelvin Bridge to the Ashurst-Hayden Diversion Dam. Flows along the Gila River are variable, largely influenced by regulated releases from the San Carlos Reservoir's Coolidge Dam with some natural flow from the San Pedro River. Vegetation within the study area was primarily exotic, but varied among sites from exotic vegetation (monotypic tamarisk) to mixed native broadleaf and exotic vegetation (primarily Goodding's willow, tamarisk, and Fremont cottonwood).

From 1997 to 2005, intensive surveys and nest monitoring took place at these 4 study areas in order to collect detailed local population estimates and nest productivity data. This effort continued in 2006 at Roosevelt Lake complex. We continued surveys at the Gila River study area in 2006 and 2007, with limited nest monitoring.

Since 1993, AGFD produced annual reports synthesizing results from all statewide surveys and nest monitoring efforts (Muiznieks et al. 1994; Sferra et al. 1995, 1997; Spencer et al. 1996; McCarthey et al. 1998; Paradzick et al. 1999, 2000, 2001; Smith et al. 2002, 2003, 2004; Munzer et al. 2005; English et al. 2006; Graber et al. 2007; Weddle et al. 2007). Each year, we distributed reports regionally to government agencies, non-governmental organizations, and private landowners. The ultimate goal of these reports has been to facilitate management decisions regarding the flycatcher. Our annual reports have also been essential in rangewide compilations, which are important for recovery planning and monitoring efforts. These reports also served as a foundation for much of the critical habitat designation effort (USFWS 2005). Additionally, AGFD has produced other documents and publications related to flycatchers including topics such as the influence of various mating strategies on reproductive success (Davidson and Allison 2003), modeling and mapping flycatcher breeding habitat (Hatten and Paradzick 2003, Dockens and Paradzick 2004), and flycatcher habitat selection (Allison et al. 2003, Paradzick 2004). We developed a flycatcher nest monitoring protocol (Rourke et al. 1999) and reported on an earlier synthesis of the distribution, abundance, and habitat characteristics of the flycatcher in Arizona based on statewide surveys from 1993 to 2000 (Paradzick and Woodward 2003).

This final report includes a synthesis of data related to 5 topics:

- Chapter 2: "Surveys, Detections and Distribution" provides a brief description of survey protocol and AGFD methods of data interpretation, including limitations of the data. We summarize statewide survey data on detections and distribution of flycatchers in Arizona, discuss the relationship between survey effort and detections, and discuss potential migratory corridors in Arizona. We examine detection trends at the Roosevelt Lake and San Pedro River/Gila River complexes and summarize the effects of fire and water fluctuations on habitat and occupancy.

- Chapter 3: "Roosevelt Lake Inundation" provides information on the effects of the 2005 and 2006 habitat inundation at Roosevelt Lake on the Roosevelt Lake flycatcher population. We describe changes in habitat at the nest and landscape levels and describe flycatcher movements in response to these changes. We evaluate the effects of habitat inundation on nest chronology, nest success, and productivity.

- Chapter 4: "Nesting Biology" provides a summary of general demographic traits, such as nesting chronology and clutch size, of our study populations and comparisons with other populations.

- Chapter 5: "River and Reservoir Nesting" provides a comparison between flycatchers nesting at the reservoir and river study areas. We compare Mayfield nest success (Mayfield 1961, 1975) of flycatchers and explanatory variables of nest success among the populations along the Salt River, Tonto Creek, San Pedro River and Gila River. We compare the populations' responses to rainfall and drought.

- Chapter 6: "Monitoring Nest Predators with Time-lapse Video" summarizes a time-lapse camera study to identify predators at flycatcher nests. It summarizes the predators identified, their habits, and timing of depredation events.

We conclude with Chapter 7, "Management Recommendations", a brief summary of our findings, and discuss them in the context of the Southwestern Willow Flycatcher Recovery Plan (USFWS 2002), their application, and future management and research needs.

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CHAPTER 2

SURVEYS, DETECTIONS, AND DISTRIBUTION

INTRODUCTION

Concern over declining populations of southwestern willow flycatchers (*Empidonax traillii extimus,* flycatcher) and degradation of native southwestern riparian habitat prompted Arizona Partners in Flight and the Arizona Game and Fish Department (AGFD) to initiate statewide flycatcher surveys in 1993 (Muiznieks et al. 1994). At that time, the primary objective was to survey suitable and historical riparian and wetland habitat using standardized methods to determine the status of flycatchers in Arizona (Tibbitts et al. 1994).

As the coordinating agency, AGFD became the repository for all statewide flycatcher survey data. Federal, state, tribal, municipal, and private entities (collectively referred to as cooperators) performed surveys throughout the state each breeding season for general and project-related purposes, mitigation property evaluation or monitoring, Biological Opinion compliance, land management, and species conservation. AGFD compiled statewide survey data annually to determine the status of flycatchers statewide and to aid in rangewide recovery planning (Durst et al. 2006, Graber et al. 2007).

From 1996 to 2005, AGFD conducted presence and absence surveys and collected distribution and abundance data at 4 study areas: the Salt River and Tonto Creek study areas (Roosevelt Lake complex) and the San Pedro River and Gila River study areas (San Pedro River/Gila River complex; Figure 4 in Chapter 1). Surveys were funded by the U.S. Bureau of Reclamation (Reclamation) as stipulated by the 1996 Biological Opinion related to the modification of Roosevelt Dam. The populations at these study areas are important to the species' rangewide recovery because the Roosevelt Lake and San Pedro/Gila River complexes support 2 of the largest known concentrations of flycatchers in Arizona and comprise approximately 30% of the known rangewide flycatcher population (Durst et al. 2006). In 2006, AGFD did not conduct surveys at the San Pedro River study area as Reclamation had met obligations of the Biological Opinion and in 2007 AGFD only surveyed the Gila River study area. Reclamation continues surveys at the Gila River study area in the event that the San Carlos Apache Tribe executes a water exchange with the Gila River Indian Community or the San Carlos Irrigation Project.

This chapter summarizes statewide survey data collected from 1996 to 2006 (including 2007 Gila River study area data) with an emphasis on AGFD survey data. We identify important flycatcher areas throughout the state and discuss how different factors (e.g., fire, presence of water) have affected the quality and distribution of riparian habitat and corresponding flycatcher abundance and distribution at AGFD study areas. Included in this chapter are:

1) a brief description of flycatcher survey protocol, suitable habitat, AGFD methods of data interpretation, and limitations of the data;

2) a statewide summary of survey data on flycatcher detections and distribution in Arizona, a discussion of the relationship between survey effort and detections, and the identification and importance of migratory corridors in Arizona; and,
3) a summary of results from AGFD study areas including flycatcher detection trends and the effects of fire and water fluctuations on flycatcher habitat.

SURVEY PROTOCOL AND METHODS

The first survey protocol for southwestern willow flycatchers was published in 1994 with the purpose of providing a standard survey technique to detect breeding southwestern willow flycatchers (Tibbits et al. 1994). The protocol was based on the use of repeated tape-playback surveys and the primary objectives were to: 1) determine presence or absence of male willow flycatchers; 2) determine breeding status of resident willow flycatchers; 3) collect productivity and breeding biology information; and 4) describe habitat characteristics and habitat use patterns (Tibbitts et al. 1994). The protocol required that surveyors visit sites at least twice, with the first visit in late May or early June and a second visit in mid-late June or early July.

In 1997, a revision to the survey protocol changed the timing and number of surveys, and included recommendations of how to interpret the results of multiple surveys during the breeding season (Sogge et al. 1997). The main objective of the revised protocol was to improve the standardization of the survey technique to detect presence or absence of southwestern willow flycatchers and to assist in determining if flycatchers are breeders or migrants. The protocol defined survey periods and included a survey period early in the breeding season when flycatchers tend to be very vocal. At a minimum, 3 tape-playback surveys are required, 1 in each of the following 3 survey periods: 15 May–31 May, 1 June–21 June, and 22 June–10 July. Surveys must be performed at least 5 days apart and during the time of day when birds are most active (from 1 hour prior to sunrise to 1000 hrs).

Following another protocol revision in 2000, a minimum of 5 surveys (3 in the third survey period) were required by the U.S. Fish and Wildlife Service (USFWS; USFWS 2000) for proposed projects that require USFWS Section 7 consultation (project-related). Five surveys are required in areas where a proposed project may impact flycatcher habitat (e.g., construction of a bridge through riparian habitat). Three surveys are required in the third survey period to increase the probability of detecting territorial flycatchers, which exhibit less territory defense behavior late in the breeding season. All other protocol requirements remained the same, with the exception that the third survey period was extended until 17 July.

Suitable flycatcher breeding habitat is defined as contiguous riparian forest with dense interior vegetation or an aggregate of dense vegetation patches interspersed with multiple small openings (creating a mosaic of forest and openings) located near surface water or saturated soil (Sogge and Marshall 2000; USFWS 2002, 2005; Paradzick and Woodward 2003; Allison et al. 2003). The riparian habitat is generally classified as Sonoran Riparian Deciduous Forest (Minckley and Brown 1994) and the composition of vegetation varies from monotypic stands of native broadleaf trees, to stands of mixed native and exotic, to nearly monotypic stands of exotic tamarisk. Several habitat characteristics vary widely among sites including: canopy height and structure, dominant tree species, temporal and spatial fluctuations in water, and size and shape of habitat patch (Sogge and Marshall 2000; USFWS 2002, 2005). In Arizona, flycatchers occupy areas dominated by tamarisk (*Tamarix* spp.), Goodding's willow (*Salix gooddingii*), Fremont cottonwood (*Populus fremontii*), coyote willow (*Salix exigua*), and seep willow (*Baccharis salicifolia*).

We assigned a unique survey site (site) name to each area surveyed to track flycatcher presence and absence trends over time. A site refers to any area where flycatcher surveys were conducted, regardless of flycatcher presence, number of territories, or amount of area surveyed. Most sites consisted of discrete habitat patches or groups of patches in close proximity of each other, but the amount of habitat within a site varied greatly among sites. All sites were geographically defined using start and stop Universal Transverse Mercator (UTM) coordinates to maintain consistent site delineations and survey data for each site. UTM coordinates provided a linear distance for each site. The linear distance does not equate to area of the site because the width of sites varied due to habitat or floodplain width (area measurements of sites were not taken).

According to protocol, we considered flycatchers territorial if they were present between 15 June and 25 July, regardless of whether a mate or nesting activity was observed (Sogge et al. 1997). Additionally, we considered flycatchers territorial if nesting activity was observed or nests were found outside of these dates. We considered flycatchers migrants if detected before 15 June but not in subsequent visits, or if first detected after 25 July. We assigned an unknown designation to flycatchers if surveys were not completed according to protocol or if information was insufficient to determine breeding or migrant status. A site was considered occupied if at least 1 flycatcher territory was found. At AGFD study areas, we designated non-territorial adults as floaters (which do not contribute to population numbers) if they were color-banded and detected multiple times at different locations after 15 June.

Surveyors recorded data on a standardized form submitted to AGFD and USFWS (Appendix B). Survey data were interpreted (based on the above definitions for territorial, migrant, and unknown flycatchers) and entered into AGFD's Southwestern Willow Flycatcher Database. Survey data, including flycatcher territory and nest UTM coordinates, were also included in the AGFD's Heritage Database Management System. In addition to flycatcher presence and location information, surveyors recorded elevation and habitat information on the standardized form. Habitat information included classification of vegetation composition at sites as: 1) native broadleaf vegetation (entirely or almost entirely native, >90% native, includes high-elevation willow); 2) mixed native broadleaf and exotic, 50–90% native; 3) mixed native broadleaf and exotic, 50–90% exotic; and 4) exotic vegetation (entirely or almost entirely exotic, >90% exotic). Because of the difficulty surveyors had in distinguishing between categories 2 and 3, these categories were combined for analyses.

Several aspects of data collection varied throughout this project due to the length of the study and the large number of cooperators, limiting some comparisons of the data. Inconsistencies in survey data may result from: 1) surveyor experience or skill (e.g., surveyor familiarity with flycatchers and survey sites); 2) year to year inconsistencies (e.g., not all sites were surveyed every year, some sites were only partially surveyed in some years, many sites were surveyed by different surveyors in some years); and, 3) number of site visits (e.g., some sites were visited repeatedly if nests were monitored, some were surveyed 5 times for project-related purposes, some were not surveyed to protocol).

The goal of the standardized survey protocol is to determine presence or absence and breeding status of flycatchers at a site. AGFD performed additional monitoring with the expanded goal of determining distribution and abundance at our study areas, resulting in data that are more detailed. Therefore, quantitative comparisons of statewide data and AGFD data are limited.

Although we attempted to locate all flycatchers within our study areas, detection of all individuals (i.e., 100% detection probability) is impossible. Therefore, our numbers may not reflect all individuals present in the population. We are not able to accurately estimate population size without a measure of detection probability (i.e., precision), which may vary temporally, spatially, and with level of survey effort (Rosenstock et al. 2002, Thompson 2002).

STATEWIDE SURVEYS

Annual statewide surveys provide important information on flycatcher detection and distribution trends in Arizona. Surveying sites multiple years assists in assessing natural and human-induced habitat changes and the resulting response of flycatchers. Statewide survey data are needed to assist agency resource managers and private organizations in making informed decisions regarding research, management, and conservation efforts. Ultimately, surveys provide critical information for documenting the recovery of the species and evaluating conservation efforts (USFWS 2002).

Here, we summarize flycatcher detections and statewide distribution by year (1996–2006) and site characteristics (e.g., elevation, habitat characteristics, presence of brown-headed cowbird [*Molothrus ater*]). We also discuss possible effects of survey effort on detections, discuss migratory corridors, and identify important migration stopover sites.

DETECTIONS AND DISTRIBUTION

Surveys were conducted along 19 drainages in Arizona over the past 11 years (1996–2006); 15 drainages were occupied by territorial flycatchers during one or more years (Appendices C and D). Annually, an average of 195 sites (range: 153–264) were surveyed covering an average of 322 linear km (range: 269–432) of riparian habitat (Table 1). During our 11-year study, AGFD personnel and cooperators surveyed 520 individual sites throughout the state. Of the 520 sites, 31% were surveyed only once between 1996 and 2006 and 4% were surveyed all 11 years. Sites surveyed ranged in elevation from 19 m along the Colorado River to 2798 m along the Little Colorado River and varied in length from >1 km to 22 km. Most sites (71%) consisted of mixed native and exotic vegetation, 26% of sites were entirely or almost entirely native, and 3% of sites were entirely or almost entirely exotic, although vegetation composition varied between years.

Between 1996 and 2006, AGFD detected the largest known flycatcher populations at the Roosevelt Lake complex and the San Pedro River/Gila River complex (Figure 1). Cooperators detected relatively large proportions of flycatcher territories at Alamo Lake, Topock Marsh, and the Gila-Safford area. In 2006, 76% of occupied sites supported small populations (≤10 territories) and 24% supported large populations (>10 territories; we used 2005 AGFD survey data at sites within the San Pedro River study area not surveyed in 2006).

Occupied sites ranged in elevation from 40 m on the Colorado River (Gila River and Colorado River confluence) to 2539 m on the Little Colorado River (Greer Townsite). A majority of flycatcher territories were detected between 275 m and 920 m in elevation. Most occupied sites (94%) were composed of mixed native and exotic habitats; 3% of occupied sites were entirely or almost entirely native, and 3% of sites were entirely or almost entirely exotic. On average, cowbirds were documented at 80% of all sites surveyed annually.

Table 1. Southwestern willow flycatcher survey effort and detections in Arizona, 1996–2006.

Year	Survey hours	Sites surveyed	Drainages surveyed	Linear km surveyed[a]	Sites with territorial flycatchers	Total territorial flycatchers	Total territories
1996	1611	153	15	269	33	252	145
1997	3432	219	16	432	41	356	190
1998	3510	264	15	399	46	400	220
1999	4802	229	15	371	46	514	291
2000	3798	198	16	312	47	594	329
2001	2774	177	15	226	46	640	347
2002	3150	163	16	252	47	771	430
2003	3259	187	17	319	44	751	413
2004	2690	179	15	282	40	941	522
2005	2646	175	15	294	47	881	483
2006	2590	202	14	387	53	624	351
Average	3115	195	15	322	45	611	338
Individual sites or drainages	na	520	19	na	133	na	na

[a]Linear distance of a site does not equate to the amount of area surveyed because sites varied greatly due to floodplain width.

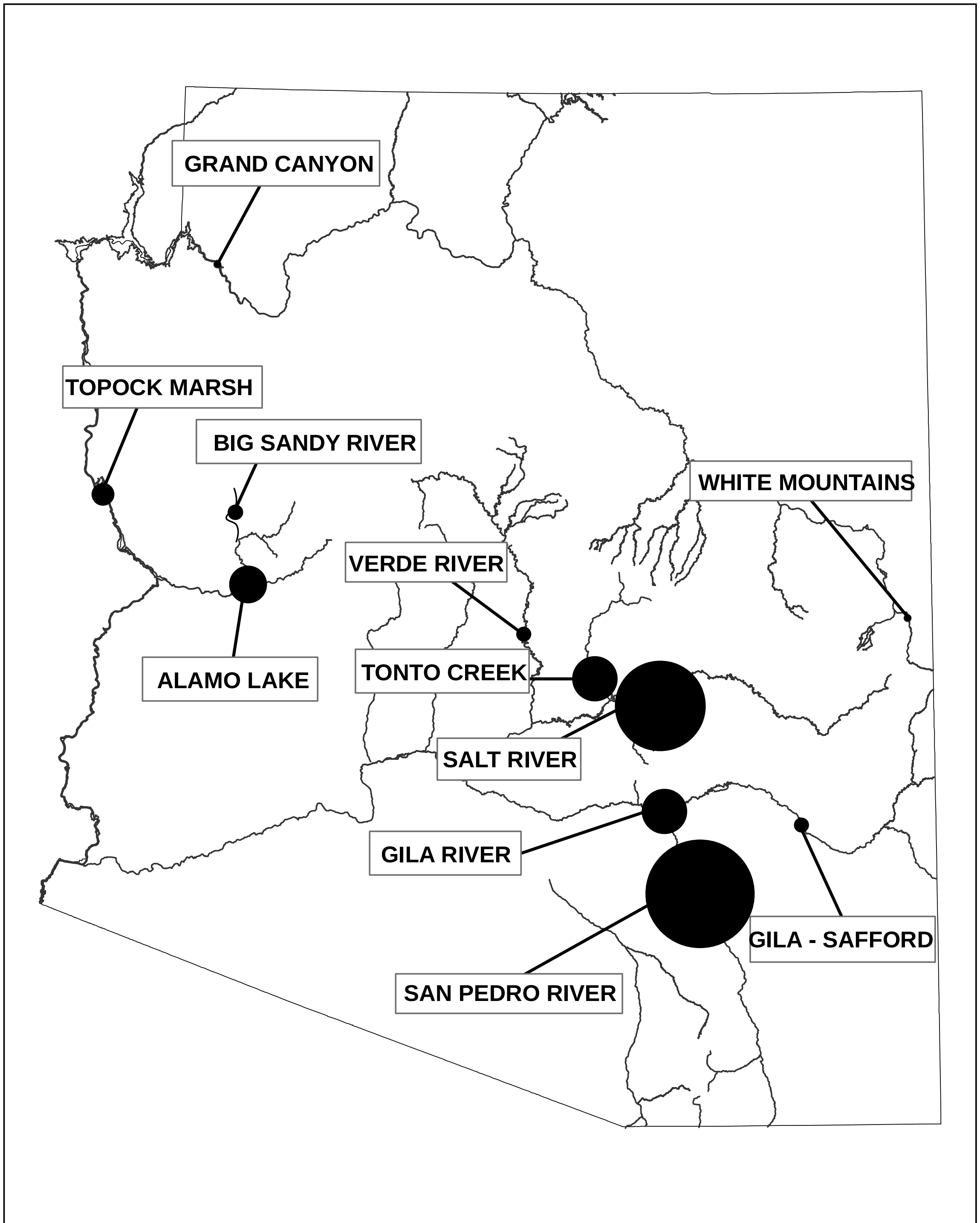

Figure 1. Areas with the largest known flycatcher populations in Arizona (1996–2006). Circles represent the average relative annual proportion of flycatcher territories (i.e., a larger circle indicates that population made up a larger portion of the flycatcher territories detected statewide during years when that area was surveyed).

STATEWIDE SURVEY EFFORT

We did not observe a relationship between statewide survey hours and the numbers of territories detected (Figure 2). From 1996 to 1999, statewide survey effort increased 198% (1611 hours to 4802 hours) and territories doubled from 145 to 291 territories (Table 1), giving the appearance that a correlation exists between survey effort and the number of territories detected. However, from 1999 to 2001 survey effort decreased from a high of 4802 hours to 2774 hours and the number of territories detected continued to increase from 291 to 347 territories. From 2003 to 2006, a second gradual decline in survey hours occurred, yet the greatest number of territories documented during this effort occurred in 2004 (522 territories).

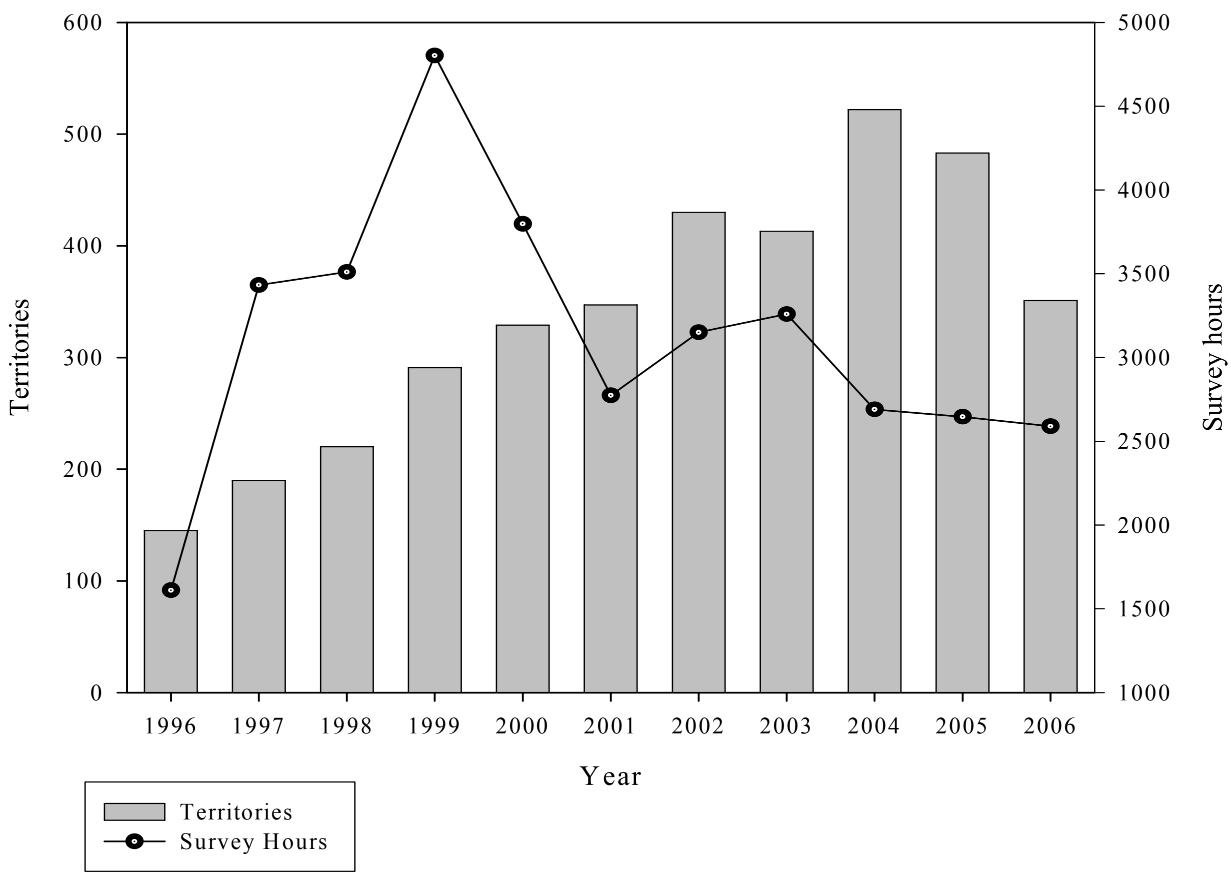

Figure 2. Statewide survey effort and number of southwestern willow flycatcher territories detected from 1996 to 2006 in Arizona.

Intensive surveys were conducted statewide between 1996 and 1999 in order to identify suitable habitat and occupied sites. During these initial years, the greatest number of individual sites (264 sites in 1998) and the greatest linear distance (432 km in 1997) were surveyed. Survey effort declined in subsequent years but we observed a gradual increase in territories. As surveyors located many of the occupied sites, unoccupied sites considered unsuitable for flycatchers were no longer surveyed. Efforts were concentrated on occupied sites, sites with potentially suitable breeding habitat, or sites requiring USFWS project-related surveys. As a result of this concentration, time spent surveying declined; however, territories detected continued to increase, potentially as a result of increased surveyor skill and knowledge and actual population increases at some sites (e.g., Roosevelt Lake).

MIGRATORY CORRIDORS AND STOPOVER SITES

Migratory corridors and stopover sites are important for flycatchers during spring and fall migration and may affect species recovery, yet little has been documented regarding specific routes used (USFWS 2002). Migration requires large amounts of energy, which is replenished at stopover sites between wintering and breeding grounds. Habitat loss and degradation and the resulting loss of food resources are potential threats to flycatcher survivorship during migration (USFWS 2002).

From 1996 to 2006, migrant willow flycatchers were documented at 204 sites and along 15 of the 19 drainages surveyed. While migrants were identified as willow flycatchers based on vocalizations, they may not have all been *E. t. extimus* since subspecies are indistinguishable without genetic testing or colorimeter measurements (Paxton 2000, Paxton et al. 2005). Although *E. t. extimus* is the only subspecies that breeds in Arizona, other subspecies migrate through Arizona *en route* to breeding grounds farther north (Figure 1 in Chapter 1).

Along the Colorado and Bill Williams rivers, cooperators conducted surveys according to a modified 10-survey protocol proposed by Braden and McKernan (1998, McLeod et al. 2007), which allowed them to better distinguish between breeding and migrant flycatchers. Hundreds of flycatcher detections have been recorded each year (over 600 in 2004) along the Colorado River south of the Bill Williams, yet breeding has not been documented since 1938 (Unitt 1987, McLeod et al. 2007). Migrant willow flycatchers were documented at approximately 75% of sites on the Colorado River where territorial *E. t. extimus* were not detected. Migrants were also found at one-third of the sites on the Bill Williams River where territorial *E. t. extimus* were not detected. Studies have shown that Neotropical migrants select stopover sites with specific habitat characteristics and that routes are consistent from year to year, though not necessarily the same in spring and fall (reviewed in Hutto 2000). The Colorado and Bill Williams rivers are likely high quality migration stopovers along an important migration corridor for flycatchers based on the consistency of detections.

Few detections of flycatchers banded at the San Pedro River/Gila River Complex or the Roosevelt Lake Complex have been made along the Colorado or Bill Williams rivers. A single flycatcher from the Roosevelt Lake complex (Salt River study area – Shangri-la site) was detected along the Colorado River at the Topock Marsh site in 2005 (Koronkiewicz et al. 2006), which indicates that these flycatchers are likely using a different migratory corridor in Arizona. Although the upper San Pedro River is an important migratory corridor for songbirds in Arizona (Rojo et al. 1998), we were not able to quantify the importance of the San Pedro River (or other drainages) to migrating flycatchers during this study. The survey protocol for southwestern willow flycatchers is not designed to determine the abundance of migrants (Sogge et al. 1997). Migrants were detected at almost every drainage (15 of 19) surveyed in Arizona, but the extent of their importance is unknown.

Skagen et al. (2004) speculate that food availability is the most important factor in stopover site selection for migrating birds on the Colorado River. Other studies have shown that one of the main roles of migrant stopover sites is to provide fuel replenishment and that the relative value of a stopover site relates to the rate of food acquisition (reviewed in Hutto 2000). Migrating Wilson's warblers (*Wilsonia pusilla*), yellow warblers (*Dendroica petechia*), and Lucy's warblers (*Vermivora luciae*) forage more often in native habitat compared to non-native habitat along the Colorado River (van Riper III et al. 2002). Some evidence suggests that migrating willow flycatchers along the Middle Rio Grande prefer native riparian vegetation, specifically willows (*Salix* spp.) in the spring, which may be linked to the abundance of food sources (reviewed in Finch et al. 2000). Along the lower Colorado River, approximately 170,000 ha of primarily native riparian habitat has decreased to 40,000 ha of mixed native vegetation and tamarisk over the last century (Skagen et al. 2004), likely decreasing the number of optimal migration stopovers. As native riparian habitat has decreased along migration corridors in the Southwest, flycatchers may be using less suitable stopover sites with decreased food sources.

Flycatchers may also be using stopover sites not associated with continuous riparian corridors (e.g., isolated riparian oases), which are typically not surveyed. In southeastern Arizona, Skagen et al. (1998) found that small isolated riparian oases hosted a high diversity of avian species (though *E. t. extimus* were not documented) and served as valuable stopover sites during spring migration. Skagen et al. (1998) conclude that preservation of small isolated riparian patches in addition to large corridors of riparian habitat is essential for migratory birds.

Researchers (e.g., Skagen et al. 1998, Hutto 2000) emphasize the importance of considering migratory stopover sites when designing conservation plans. Successful conservation of migratory birds requires comprehensive consideration of all periods of the life cycle; conserving migratory stopover sites may be as important as conserving breeding and wintering grounds. With the extensive loss of riparian habitat in Arizona (Skagen et al. 1998, 2004), preserving the areas used by migrating flycatchers along the Colorado, Bill Williams, and San Pedro rivers is essential for effective conservation of the species.

Future studies along known and potential migratory corridors in Arizona should determine the extent of use of these corridors and stopover sites by *E. t. extimus* by using genetic or distinguishing morphological (coloration variation) traits (Paxton 2000, Paxton et al. 2005). Further, studies allowing for quantification of migrant use could determine the relative importance of these sites to *E. t. extimus* and other willow flycatcher subspecies. Conservation of stopover sites along migration corridors should be prioritized by their importance to the regional population.

AGFD STUDY AREAS

This study was conducted at 4 breeding areas in central Arizona: Salt River, Tonto Creek, San Pedro River, and Gila River. The Salt River and Tonto Creek are located 25 km apart and are the primary inflows to Roosevelt Lake, a reservoir, within Tonto National Forest in Gila County. The Salt River study area is a perennial 15 km reach that flows into the southeastern end of Roosevelt Lake. The Tonto Creek study area is a 16 km reach that flows into the northwestern end of Roosevelt Lake; flows are intermittent and dependent on spring snowmelt and summer monsoon rains, causing it to frequently dry late in the breeding season. Study areas are comprised of U.S. Forest Service (Tonto National Forest) and private land. The San Pedro River flows into the Gila River near Winkelman, AZ. The San Pedro River study area is a 45 km reach of the San Pedro River upstream of Winkelman; flows are perennial in some areas and intermittent in others, largely influenced by precipitation and groundwater pumping. The Gila River study area is a 40 km reach of the Gila River upstream and downstream of Winkelman; flows along the Gila River are variable, largely influenced by regulated releases from the San Carlos Reservoir's Coolidge Dam with some natural flow from the San Pedro River. Study areas are composed of private, municipal, state, and federal (U.S. Bureau of Land Management and U.S. Bureau of Reclamation) lands (see Chapter 1 for more information).

Data from AGFD's 4 study areas are some of the most detailed long-term flycatcher data in the state. Our goal was to document all flycatchers within our study areas; therefore, we attempted to identify, gain access to, and survey all suitable habitat within these areas each year. Estimates of population sizes within our study areas may also be more accurate than population estimates collected by cooperators because we performed intensive nest monitoring with multiple site visits and banded flycatchers.

We examined AGFD survey data for trends in the number of flycatcher territories detected annually at our 4 study areas. We documented the effects of fire and water fluctuations on habitat and flycatcher distribution and abundance at sites within the San Pedro/Gila River complex. We review the distribution of flycatchers in response to changing water levels at Roosevelt Lake, regulated flows on the Gila River, and fluctuating flows on the San Pedro River. Fire, variation in streamflow, and the presence of water play important roles in habitat health and heterogeneity, which are important components of suitable flycatcher habitat.

DETECTION TRENDS

We examined trends in the number of territories detected at the 4 AGFD study areas over the years (1996–2005) using a linear regression (SPSS 2005). Data were log transformed to normalize residuals. On average, the populations of our 4 study areas increased 12% per year ($t = 3.60$, $P < 0.001$, $R^2 = 0.236$). From visual inspection of the data, a drastic change in slope occurred between 2002 and 2003 indicating a change in the trend of the number of flycatcher territories detected during this time. Therefore, we conducted 2 linear regressions on AGFD survey data; 1 with data from 1996 to 2002 and 1 with 2003 to 2006 data. On average, the number of territories increased by 23% per year (1996–2002; $t = 4.42$, $P < 0.001$, $R^2 = 0.429$).

Year accounted for 43% of the variation in territory numbers. The number of territories did not change significantly between years from 2003 to 2006 (t = -0.08, P = 0.94, R^2 = 0.001). We believe that the increase from 1996 to 2002 was partially related to improvements in identifying and surveying suitable habitat as well as actual population increases at our study areas. The number of sites surveyed increased from 11 in 1996 to 48 in 2002. In years subsequent to 2002, all suitable habitat within our study areas was being consistently covered.

EFFECTS OF FIRE

During the past 11 years, 3 wildfires have occurred at 3 sites within AGFD study areas: 2 on the San Pedro River (PZ Ranch and The Nature Conservancy [TNC] Lower San Pedro River Preserve) and 1 on the Gila River (Kearny). AGFD continued to survey these sites post-fire to document flycatcher abundance, distribution, and the condition and regeneration of habitat.

PZ Ranch was one of the largest known breeding sites for flycatchers in Arizona, with 21 territories in 1994, 14 in 1995, and 15–16 in 1996, and 1 of only 4 known sites to be occupied by >10 territories in 1996 (Paxton et al. 1996). Habitat at the PZ Ranch site consisted of a tamarisk understory with a cottonwood overstory and was farther from the main river channel than most occupied sites on the San Pedro River. The site maintained saturated soil due to regular agricultural irrigation runoff. The fire occurred 1 to 3 June 1996 and burned approximately 75% of the site. Territory numbers declined dramatically in subsequent years, declining to 5 in 1997 and 1 in both 1998 and 1999. From 2000 to 2005, AGFD continued to survey PZ Ranch, but did not detect flycatchers. In years following the fire, the nearby agricultural fields were fallow and not irrigated. Reduced water resulted in little habitat regeneration in burned areas. As of 2005, this site remained dry with remnants of burned vegetation and no new growth.

The fire at the Kearny site occurred from 1 to 3 July 2004 and burned approximately 65% of the habitat, which consisted of tamarisk, with little native willow and cottonwood interspersed. Because the fire occurred just before summer monsoons, habitat regeneration occurred quickly in the burned area. Tamarisk sprouted from the base of burned tamarisk stumps and tree tobacco (*Nicotiana glauca*) and Russian thistle (*Salsola tragus*) colonized open areas. Currently, tamarisk in the burned area is approximately 3 m in height, but is thin and unsuitable for flycatchers. Prior to the fire, habitat quality and territory numbers were in decline due to decreasing water levels at the site so the fire did not directly affect territory numbers.

The number of territories at the TNC Lower San Pedro River Preserve site has fluctuated throughout the years depending on the amount of streamflow and saturated soil present at the site. Territories at the site peaked in 2002 with 17, but declined in 2003 and 2004 to 2 and 1 territories, respectively. Habitat at the site included mature cottonwood, willow, tamarisk, and seep willow. The fire occurred from 17 to 19 July 2005, burning riparian vegetation and adjacent grasslands along the northern portion of the site. The site supported 7 territories in 2005 before the fire occurred. In 2006, TNC Lower San Pedro River Preserve personnel documented 2 flycatcher territories and 5 flycatchers of unknown status south of the burned area. Habitat regeneration has occurred quickly in burned areas with both native (cottonwood and willow) and exotic (tamarisk) growth (Graber et al. 2007). Predicting how flycatcher numbers and distribution will be affected is difficult due to intermittent streamflow at the site.

Habitat regeneration and flycatcher recruitment are unlikely to occur at PZ Ranch without a supplemental water source to compensate for the cessation of agricultural runoff. The burned portions of Kearny and the TNC Lower San Pedro River Preserve are more likely to support flycatchers because they are closer to the active river channel and habitat regeneration is already occurring. The presence of water is a critical factor in riparian habitat regeneration following a fire; without the presence of sufficient ground or surface water, some riparian species are unable to germinate and develop (Poff et al. 1997, Stromberg 1997). Future surveys at the Kearny and TNC Lower San Pedro River Preserve sites will assist in assessing the long-term effects of fire on flycatcher habitat and distribution.

EFFECTS OF CHANGES IN WATER

The presence or absence of water at our study areas has greatly influenced flycatcher abundance and distribution. We examined the effects of fluctuations in water on flycatcher abundance, distribution, habitat, and habitat selection at the Roosevelt Lake and the San Pedro/Gila complexes. At the Roosevelt Lake complex, we examined the effects of drought conditions from 1996 to 2004 followed by increased rainfall during the spring of 2005 on flycatcher abundance and distribution. At the Gila River study area, we examined the effects of declining streamflow during the 1990s and early 2000s followed by the return of more consistent streamflow from 2005 to 2007 on flycatcher abundance and distribution. At the San Pedro River study area, we investigated the effects of streamflow and surface water variation on flycatcher abundance, distribution, and habitat between 1996 and 2005.

Roosevelt Lake: AGFD monitored flycatcher distribution as lake levels fluctuated at Roosevelt Lake over the past 11 years (Appendix E). In 1996, AGFD began intensive surveys of Roosevelt Lake inflow sites along the Salt River and Tonto Creek drainages. As the project continued, we expanded our surveys both upstream and downstream of the original survey sites, though few flycatchers were documented upstream of the initial sites during the first 9 years of our study (1996–2004). During this time, the elevation of Roosevelt Lake remained low; the lake filled to 53% capacity in 1998 and decreased to a low of 10% by 2002 (Tim Skarupa, Salt River Project [SRP], personal communication). As the lake receded, young, suitable habitat developed within the conservation pool. Flycatchers began colonizing this new habitat as it matured, moving downstream from the originally occupied sites surveyed in 1996.

At the Salt River study area, Salt River Inflow and Cottonwood Acres II were the only sites surveyed by AGFD in 1996 (Salt River Inflow was occupied, Cottonwood Acres II was not; Figure 3, Appendix C2). Flycatchers continued to colonize Salt River Inflow in the following years, increasing from 18 territories in 1997 to 66 territories in 2001. During this period, flycatchers moved downstream to the School House Point North and School House Point South sites in 1999 and the Lake Shore site in 2000. These sites were closer to the receding lake and were composed of young, dense tamarisk and willow. From 2001 to 2004 we documented a decline in territories at the Salt River Inflow (66 to 36 territories) and an increase at School House Point North (19 to 84 territories) as flycatchers continued to move into this new, and sometimes partially inundated habitat.

At the Tonto Creek study area we observed movements similar to those at the Salt River study area. Flycatchers colonized new habitat as the lake receded from 1996 to 2004. Flycatchers occupied the Tonto Inflow site in 1996 when the site was adjacent to water and Orange Peel was colonized in 2000 once the lake receded and new habitat developed (Figure 4, Appendix C2). Tonto Creek Inflow increased from 16 territories in 1996 to 28 territories by 1998, and then decreased to 0 by 2004 as flycatchers occupied new habitat at sites farther downstream and closer to the water's edge. A majority of flycatchers detected between 2000 and 2004 were found in younger vegetation close to the receding lake. In 2004, we found flycatchers colonizing a new site, Bermuda Flats, which was immediately adjacent to the lake and composed of young willow and tamarisk.

In winter and spring 2005, increased levels of precipitation (Appendix F) caused the lake to rise to near capacity (96%; Appendix E2) and many of the sites closest to the lake were either partially or completely inundated. Following the rise in lake levels, flycatchers moved to sites upstream that were previously unoccupied or occupied intermittently from 1996 to 2004.

In 2004, most flycatcher territories (71%) within the Salt River study area were detected at the 2 sites closest to the lake (School House Point North and Lake Shore). In 2005, these sites were partially or completely inundated and therefore unsuitable for flycatchers. Flycatchers moved upstream following inundation; we documented flycatchers at Cottonwood Acres II for the first time since 1997 and Cottonwood Acres I for the first time since 2000.

The Tonto Creek study area experienced a similar trend when the most recently occupied sites were inundated in 2005. In 2004, most flycatcher territories (86%) within the Tonto Creek study area were detected at the 2 sites closest to the lake within the conservation pool (Bermuda Flats and Orange Peel). In 2005, these sites were completely or almost completely inundated and flycatchers returned upstream to the Tonto Inflow site. Territories increased from 0 in 2004 to 37 in 2005, the greatest number of territories at the Tonto Inflow site during our study. We also detected flycatchers in areas upstream from Tonto Inflow not previously occupied (A-Cross Road North) or intermittently occupied (A-Cross Road South and Bar-X Road) prior to 2005.

The dynamic nature of riparian habitat and the flycatcher's ability to adjust to habitat change has been evident during the 11 years we surveyed and monitored flycatchers at Roosevelt Lake. As lake levels decreased from 1996 to 2004 and new habitat developed within the conservation pool, flycatchers colonized lower elevation areas. Subsequently, when habitat within the conservation pool was inundated in spring 2005, flycatchers moved upstream to sites not recently occupied. In 2005 and 2006, nearly all detected flycatchers at Roosevelt Lake were at the upstream sites.

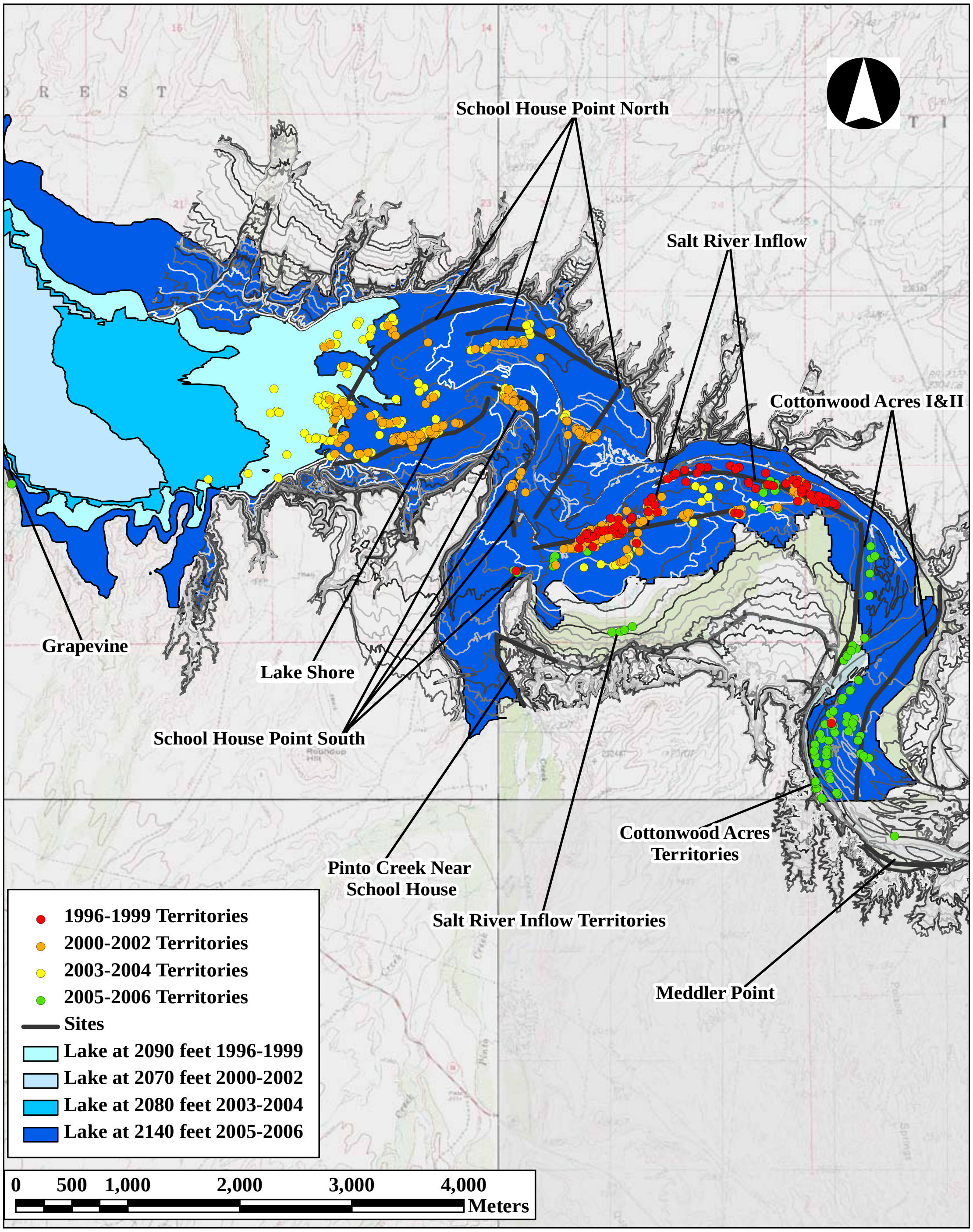

Figure 3. Map of flycatcher distribution at the Salt River study area (1996–2006). Years are grouped based on the general location of territories relative to lake elevation. "Sites" indicate the general location of survey sites. Survey sites farther upstream without territories (Eads Wash, Roosevelt Diversion Dam, Salt River at State Route 288 Bridge, Coon Creek, and Cherry Creek North and South) are not included.

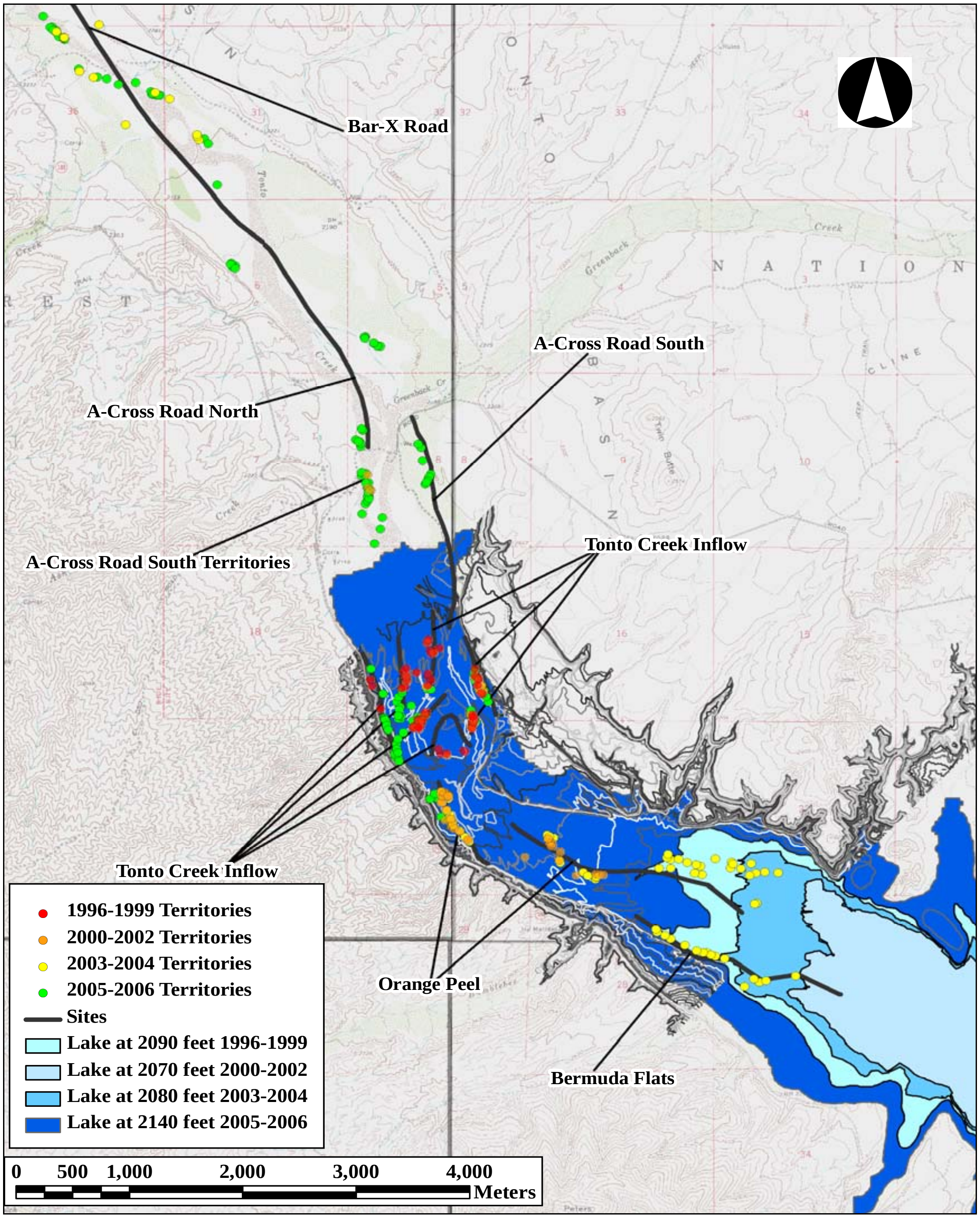

Figure 4. Map of flycatcher distribution at the Tonto Creek study area (1996–2006). Years are grouped based on the general location of territories relative to lake elevation. "Sites" indicate the general location of survey sites. Survey sites farther upstream without territories (Del Shay, Rye Creek, and Gisela) are not included.

San Pedro River: The San Pedro River is one of the largest unregulated rivers in the Southwest and is perennial in many upper (southern) reaches; however, groundwater pumping and drought conditions have caused flows to become intermittent in lower (northern) reaches (Stromberg et al. 2007). The river generally experiences seasonal flooding with late summer (monsoon), winter, and spring rains that have different effects on the landscape and largely influence the structure and composition of riparian habitat (Stromberg et al. 2007). Low flows contribute to the regeneration and maintenance of riparian vegetation, while peak flows maintain habitat complexity along unregulated rivers by scouring older habitat and allowing for the succession of new habitat (Graf et al. 2002). A large portion of riparian habitat along the San Pedro is native, which may be attributed to its mostly unaltered flow regime. Along the San Pedro River, large-scale winter floods combined with high spring and summer flows sustain young, native seedlings during the growing season and reduce competition with tamarisk seedlings (Stromberg 1998).

The San Pedro River study area is located along the lower portion of the river, where sites receive either perennial or intermittent streamflow depending on climatic conditions and water use. Saturated soil or surface water is present at some sites within the study area due to supplemental water sources. From 1996 to 2005, we observed changes in habitat quality corresponding to variations in streamflow and the presence of water. We also documented the dynamic nature of flycatcher distribution and abundance in response to habitat changes. Flycatchers colonized new areas as younger habitat matured and vegetation structure became more suitable due to constant streamflow. Conversely, flycatchers abandoned habitat at other sites as it became unsuitable due to lack of water.

The San Manuel site provides an example of natural habitat succession from sparse, unsuitable habitat to suitable flycatcher habitat due to unregulated and perennial flows on the San Pedro River. A large winter flood occurred along the San Pedro River in 1993, which scoured vegetation and reset habitat succession. When surveys began in 1996, habitat at the site was considered too young to be suitable for flycatchers. Between 1998 and 2001, small patches of suitable habitat developed but streamflow was intermittent due to groundwater pumping by the BHP Copper, Inc. mine adjacent to the site. In the early 2000s, management of this stretch of the river changed which resulted in a substantial decrease in the amount of groundwater used by the mine (Chuck Paradzick, SRP, personal communication). As a result, the site began receiving constant streamflow and habitat improved. In 2002, flycatchers began colonizing the site for the first time since surveys began. As continuous streamflow persisted and habitat continued to improve, flycatcher territories increased from 7 in 2002 to 55 in 2005 (Appendix G).

While we observed riparian vegetation develop and territory numbers increase at some sites, we also observed the opposite trend at other sites. Intermittent streamflow, compounded by drought conditions, have led to the general drying of entire sites at the San Pedro River study area. Habitat quality and flycatcher detections have greatly decreased in these areas. For example, in 1996, over 30% of the San Pedro River study area territories were located at Cook’s Lake Seep. The 1993 flood altered the river channel, decreasing the output of water from a nearby spring. Additionally, long-term drought conditions and intermittent streamflow dramatically reduced the amount of water present at the site between 1996 and 2000 (Troy Corman, AGFD, and Eben

Paxton, USGS, personal communications). Habitat quality and flycatcher territories began declining and territories were not detected after 2002.

Sites that were dependent on supplemental water sources also exhibited changes in habitat and territory numbers as the presence of water fluctuated. For example, water from irrigation runoff supplemented vegetation at Indian Hills in the early years of the study and the habitat supported a large number of territories. When irrigation water was diverted, habitat quality declined and flycatchers no longer occupied the site. Increases in territory numbers were also evident at sites such as Aravaipa Inflow North, TNC Lower San Pedro River Preserve, and the San Pedro/Aravaipa Confluence where beaver ponds were present. Suitable habitat developed due to saturated soils from the ponds, and flycatchers began colonizing new areas within these sites.

The presence of water is a necessary component of suitable flycatcher habitat and during this study we were able to observe the changes in habitat in response to water fluctuations. We believe that the mostly natural flow regime of the San Pedro River is beneficial to flycatcher habitat and the population at the study area. Continuous streamflow contributes to the continued health of young, suitable habitat, while natural flood events have recycled habitat. Although habitat at some sites has declined, flycatchers continue to find new, younger patches along the river to colonize due to the natural recycling of riparian vegetation within the floodplain. Because habitat of various successional stages is staggered at sites along the San Pedro River drainage, flycatchers are able to respond to habitat changes at a local level while maintaining drainage fidelity. Although streamflow provided by the natural hydrologic regime of rivers is beneficial to flycatcher habitat, surface water provided by other sources also positively influence flycatcher habitat and abundance.

Gila River: The Gila River originates in New Mexico and flows westward through Arizona until reaching the Colorado River. Most stretches of the river are regulated for agricultural or urban use. The Gila River basin is divided into an upper and lower basin at the confluence of the Salt River; upper basin flows are not as heavily regulated as lower basin flows. Flows along the lower basin have been variable since construction of Coolidge Dam and the San Carlos Reservoir in 1928 (Benke and Cushing 2005). The Bureau of Indian Affairs operates Coolidge Dam and releases water based on the agricultural demands of downstream users such as the Gila River Indian Community and the San Carlos Irrigation and Drainage District (USBR 2003). Water releases occur year-round with the highest generally occurring during summer months (USFWS 2004).

Riparian habitat along regulated rivers can be dramatically altered due to changes in natural streamflow regimes. The stretch of river downstream from Coolidge Dam does not receive the magnitude and variability of annual peak flows from flood events that occurred prior to construction of the dam. As a result, changes to the natural hydrograph have altered riparian vegetation along the river (USFWS 2002, USBR 2003). The Gila River study area is located downstream of Coolidge Dam and very few patches of native riparian habitat exist; tamarisk is the dominant riparian species.

From 1996 to 2007, we surveyed from Dripping Springs Wash (upstream of Winkelman) to the Kelvin Bridge (or to Florence when flows were high enough to survey from rafts or kayaks). Streamflow varied greatly during our study (USGS 2007; Appendix H) due to variable water releases from the dam (USFWS 2004) and a long-term drought (McPhee et al. 2004). We examined the influence of variation in streamflow on the abundance of flycatcher territories detected at the Gila River study area from 1998 to 2007 using a linear regression (SPSS 2005). We did not include 1996 and 1997 data in the analysis because surveys conducted those years focused more on locating occupied sites and obtaining presence and absence data rather than abundance data.

Condition of habitat at the time flycatchers arrive on breeding grounds (late April–early May) is likely an important determining factor of occupancy. The Sonoran Desert experiences a monsoonal climate defined as a light winter and spring rainfall, a dry early summer, and heavy rainfall from July to September (Brown and Li 1996, Adams 1997, Xu et al. 2004, and Diem and Brown 2006); at least 50% of this region's annual precipitation occurs between July and September (Adams 1997). Surface and ground water availability (influenced by rainfall and dam discharge) positively affect woody and herbaceous species richness and cover on the San Pedro River near its confluence with the Gila River (Lite et al. 2005). We believed increased streamflow could cumulatively improve habitat (as an indicator of the presence of ground and surface water) prior to flycatcher arrival, which could make habitat more appealing and increase occupancy. However, the importance in timing of streamflow was unknown; therefore, we performed linear regressions on streamflow over a variety of time periods:

1. Annual streamflow (May of the previous year through April of the current year);
2. Beginning of previous monsoon season through the beginning of the breeding season (July of the previous year through April of the current year);
3. Breeding season streamflow (April–August); and
4. Winter and spring streamflow (December–April).

We used mean monthly Gila River streamflow data collected at U.S. Geological Survey gauging stations located upstream (#09469500, Gila River Below Coolidge Dam) and downstream (#09474000, Gila River at Kelvin; USGS 2007) of breeding flycatchers. Monthly streamflow data collected at the 2 gauging stations were averaged and used to calculate the sums used in the linear regressions based on the above delineations of time (Appendix H). We conducted our analyses in SPSS ver. 14.0 (2005).

All linear regressions showed a positive relationship between Gila River streamflow and the number of flycatcher territories. Streamflow from the beginning of the previous monsoon season through the beginning of the breeding season (July of the previous year through April of the current year) had the strongest relationship with the number of territories ($R^2 = 0.58$, $t = 3.31$, $P = 0.011$; Figure 5). July through April streamflow explains 58% of the variation in flycatcher territories from 1998 to 2007. On average, an increase of 1.3 territories occurred for every additional 100 cubic feet per second (cfs).

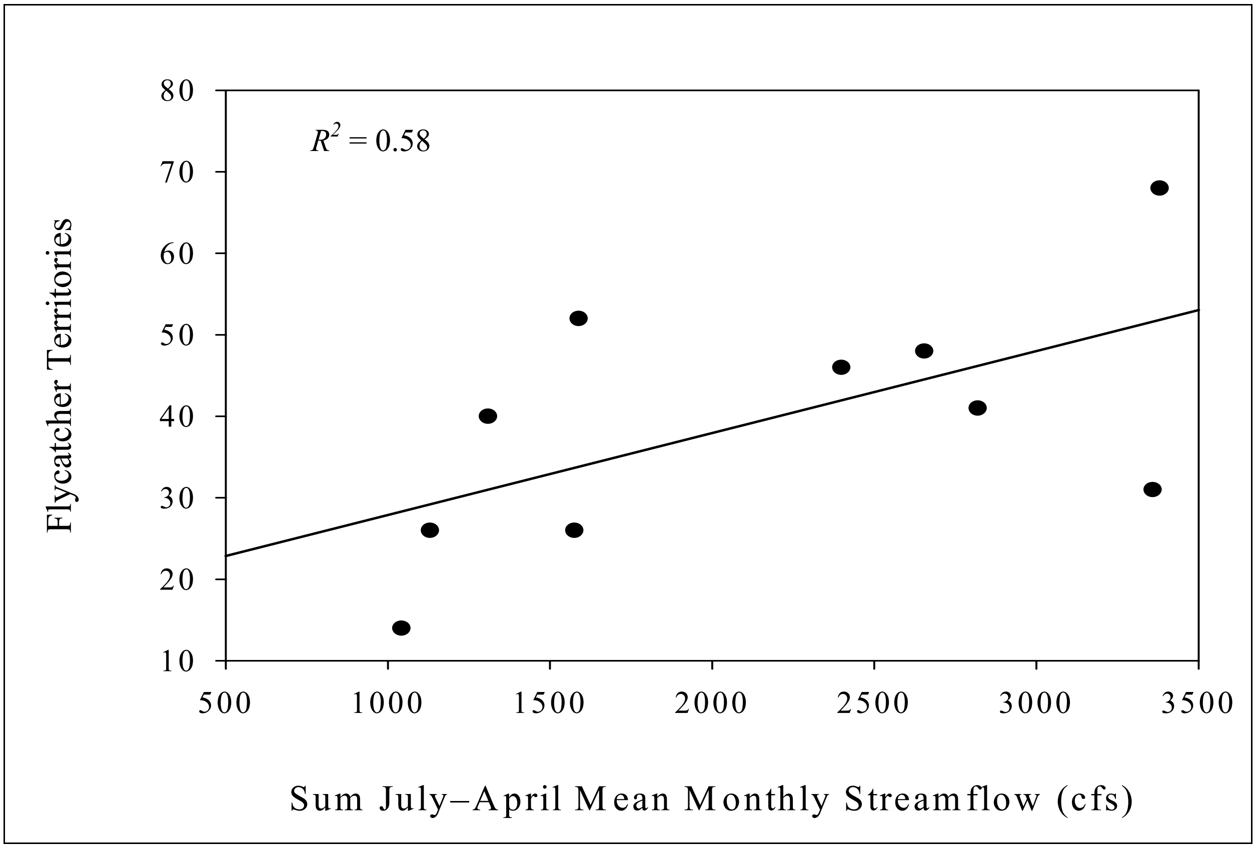

Figure 5. Regression of number of flycatcher territories from the beginning of the previous monsoon season through the beginning of the breeding season (July of the previous year through April of current year) mean cumulative streamflow (cfs) recorded at the Coolidge Dam and Kelvin gauges on the Gila River 1998–2007.

Annual streamflow (May of the previous year through April of the current year) also had a strong relationship with the number of territories (R^2 = 0.55, t = 3.14, P = 0.014). On average, an increase of 0.08 territories for every additional 100 cfs occurred. Winter and spring streamflow (December–April) had a comparatively weak relationship with the number of territories (R^2 = 0.23, t = 1.52, P = 0.17). On average, an increase of 0.04 territories for every additional 100 cfs occurred. Breeding season streamflow (April–August) had the weakest relationship with the number of territories (R^2 = 0.01, t = 0.23, P = 0.826). On average, an increase of 0.001 territories for every additional 100 cfs occurred.

From 1998 to 1999, mean monthly streamflow from July to April was 327 cfs and territory numbers increased by 30% along the Gila River (Appendix I). We detected a high of 69 flycatcher territories in 1999. From 2000 to 2004, July to April streamflow at the Gila River study area decreased to 160 cfs and became inconsistent due to limited releases from Coolidge Dam. In 2004, we observed a 12-year low in flycatcher territories (14) and the number of sites (4) occupied. Due to increased releases associated with downstream demands and increased storage at the San Carlos Reservoir, greater and more consistent flows returned to the Gila River between 2005 and 2007. Mean monthly streamflow from July to April increased to 300 cfs, 88% greater than the 2000–2004 streamflow. The greatest number of territories detected since 1999 was 67 in 2007 and the greatest number of occupied sites between 1996 and 2007 was 16 in 2006.

Several sites at the Gila River study area were affected by the variation in streamflow throughout the years. Two sites, Dripping Springs Wash and Dripping Springs Campground, exhibited the greatest changes in habitat and flycatcher territories due to increased and continuous flows. No territories were detected at Dripping Springs Wash and Dripping Springs Campground in 2004 and habitat was considered unsuitable. As streamflow increased from 2005 to 2007, habitat health and suitability increased and supported more flycatchers. In 2007, territory numbers at the Wash and the Campground increased to 14 and 15, respectively.

As the recent increase in streamflow has had a positive affect on flycatcher abundance at some sites, decreasing flows combined with decreasing surface water had the opposite affect at the Kearny site. The Kearny site supported the greatest number of territories documented at the Gila River study area between 1998 and 2004. Territory numbers began declining from 25 in 1998 to 5 in 2004 because of a reduction in suitable habitat. Natural drought conditions, reduced water releases from Coolidge Dam, and the relocation of the Town of Kearny's sewage ponds in 1998 resulted in partial desiccation of the site and the subsequent decline in available habitat. The Town of Kearny releases some water onto the site to satisfy recommendations of a biological opinion issued to the Federal Emergency Management Agency (USFWS 1998), and flycatchers continued to occupy the site (3 territories in 2005, 5 in 2006, and 4 in 2007). Although habitat within the burn site at Kearny is improving with increased streamflow, the habitat is still unsuitable for flycatchers.

A streamflow regime that mimics natural hydrologic conditions along the Gila River may be beneficial for the health and maintenance of riparian habitat and encourage the long-term existence of a large flycatcher population at the study area. Increased total annual flows and continuous low flows promote the development of new habitat and maintain existing habitat health, while increased peak flows at the appropriate time will reset the natural habitat succession and provide greater habitat variability (Graf et al. 2002). Natural streamflow regimes that provide continuous streamflow at appropriate times of the year may also encourage immigration and site fidelity. Brown and Li (1996) found evidence that Southwest monsoon rainfall from the previous year could influence the growth of insect populations, which may enhance the quality of the overall habitat and influence female physiological condition. Sedgwick (2004) and Paxton et al. (2007) found that willow flycatchers maintain a higher rate of site and territory fidelity when they have higher breeding success and greater productivity, which may be affected directly (e.g., food abundance) or indirectly (e.g., vegetation and habitat quality) by the timing and amount of streamflow. Flycatcher habitat along the Gila River has benefited from the increased and continuous flows along the Gila River for the past 3 years. However, future surveys are needed at the Gila River study area to monitor flycatcher population trends and habitat in response to changing streamflow patterns as a result of dam releases.

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CHAPTER 3

ROOSEVELT LAKE INUNDATION

INTRODUCTION

Damming rivers can result in habitat loss, habitat development, and changes in habitat quality within the conservation pool of a reservoir and downstream of the dam (Nilsson and Dynesius 1994, Reitan and Thingstad 1999). Changes to habitat can be abiotic (e.g., temperature, hydrological patterns), biotic (e.g., vegetation, food supply), and interrelated. Habitat along the newly developed shoreline, which may be constantly shifting within the conservation pool, generally has less vegetation diversity compared to pre-disturbance habitat (Reitan and Thingstad 1999). Dams also can result in conditions conducive to invasion by exotic species, changing vegetation composition (Reitan and Thingstad 1999).

Reservoir inundation can cause a major loss of habitat close to the river or reservoir (Baxter and Glaude 1980, Reitan and Thingstad 1999). The extent to which inundation affects habitat is dependent upon the timing, degree, and length of the inundation (reviewed by Gill 1970; Warren and Turner 1975, Stevens and Waring 1986, Reitan and Thingstad 1999). Loss or degradation of habitat due to reservoir inundation can cause declines in some bird populations, species richness, and nesting success, although some species (e.g., shorebirds, waterfowl) may benefit from improved feeding conditions (Warner and Hendrix 1984, Reitan and Thingstad 1999). The federally endangered southwestern willow flycatcher (*Empidonax traillii extimus*, flycatcher) is a riparian obligate breeder that is frequently found in association with reservoirs and, therefore, could experience habitat loss due to inundation.

Construction of Roosevelt Dam at the confluence of the Salt River and Tonto Creek was completed in 1911, creating Roosevelt Lake. Historical data on the amount of riparian habitat suitable for the flycatcher near the confluence is limited. The first record of flycatchers and suitable habitat at the lake is from 1993; however, surveys were not done previously (Muiznieks et al. 1994). Since monitoring of the flycatcher at Roosevelt Lake began in 1993, riparian habitat suitable for the flycatcher developed within the conservation pool, primarily near the inflows. The inflow sites function as deltas; river flow velocity decreases as it meets the lake, depositing sediment, which aids the development of riparian habitat suitable for flycatchers. The location of the inflow sites, along with suitable habitat, shift as lake levels fluctuate.

Modifications to Roosevelt Dam, completed in 1996, raised the height of the dam 77 ft (23 m), increasing the top of the conservation pool from 2136 ft (651 m) to 2151 ft (656 m). Using water levels between 1966 and 1994 (29 years), U. S. Bureau of Reclamation (Reclamation) estimated that the reservoir would have reached capacity and inundated nest trees a minimum of 90 days during 6 of the 29 years, a minimum of 120 days during 4 of the 29 years, and a minimum of 150 days during 2 of the 29 years (USBR 1995). The biological opinion on the operation of the modified Roosevelt Dam determined that the high probability of habitat inundation and the resulting loss, degradation, and fragmentation of flycatcher habitat “jeopardized” the flycatcher and outlined a Reasonable and Prudent Alternative (RPA; USFWS 1996). Reclamation agreed to implement the RPA, which included an investigation of the effects of inundation on flycatcher nesting success, productivity, survivorship, and dispersal.

Roosevelt Lake's elevation typically increases with winter precipitation and spring snowmelt and decreases from late spring (May) through September due to peak usage and evaporation, balanced somewhat by inflow and precipitation associated with the monsoon season in late summer (Tim Skarupa, Salt River Project [SRP], personal communication). Achieving the 2151 ft pool level would require sufficient inflow (primarily from Tonto Creek and the Salt River) and heavy winter precipitation (USBR 1995). Although water levels at Roosevelt Lake fluctuated in the 1990s and early 2000s, water levels remained well below capacity due to low rainfall (Figure 1; Appendices E and F). During this time, riparian habitat developed at and around the inflow sites, resulting in a stepwise development of habitat within the conservation pool as the water receded. Based on estimations from a spatial-temporal model, suitable habitat at the lake increased from 294 ha in 1996 to a high of 556 ha in 2004 (Paxton et al. 2007). The Roosevelt Lake population grew to become one of the largest known in Arizona and rangewide (Durst et al. 2006, Graber et al. 2007). As such, this population likely plays an important role in regional population dynamics and genetic diversity, and may serve as a source population to smaller or fragmented populations (USFWS 1996). This population was inherently at risk of losing habitat through inundation due to reservoir operations.

The anticipated inundation of riparian habitat within the new conservation pool of Roosevelt Lake occurred in 2005. The lake's highest elevation level during this study prior to 2005 was 2108 ft (643 m; 53% capacity; Appendix E) in 1998. Lake levels consistently dropped in subsequent years until increased precipitation in the winter and spring of 2005 (WRCC 2007) caused Roosevelt Lake to fill to an elevation of 2148 ft (655 m; 96% capacity) by May 2005. As a result, the lake completely or partially inundated almost all breeding sites occupied in 2004, rendering them largely unsuitable in 2005. Paxton et al. (2007) estimated that only 56 of the 556 ha of suitable habitat remained in 2005. This caused a dramatic change in the quantity, quality, and distribution of available habitat.

Breeding sites with the highest concentrations of flycatchers in 2004 were within the conservation pool and were completely inundated in 2005; other sites farther upstream with lower concentrations of flycatchers in 2004 experienced partial inundation in 2005. Lake levels began to drop during the 2005 breeding season and continued to drop throughout 2006 until monsoon rains increased the level of the lake slightly in August (Appendix E2). In 2006, several areas that had been partially inundated dried out leaving a mixture of live, dead, and dying trees, while some areas remained partially inundated. During the 2005 and 2006 breeding seasons, flycatchers nested in areas with partially-inundated habitat and in non-inundated areas.

Here, we describe the changing distribution of flycatchers in response to habitat changes due to inundation. We compare pre- and post-inundation habitat and vegetation characteristics at specific locations (i.e., 2004 nest sites). We compare nesting success and demographic traits between nests in non-inundated habitat and nests in partially-inundated habitat during the inundation years (2005 and 2006). We also compare nesting success and demographic traits between nests during pre-inundation years (1996–2004) and nests during inundation years (2005–2006).

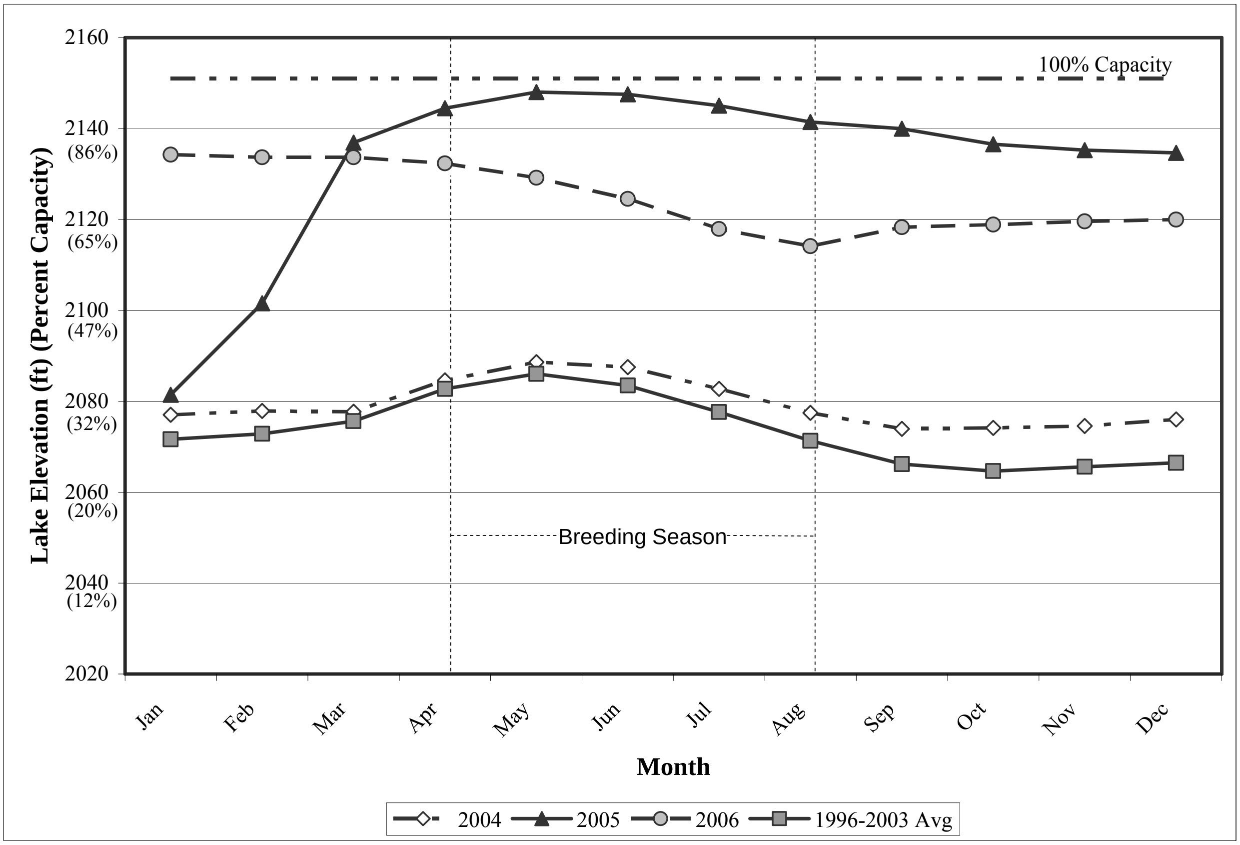

Figure 1. Average monthly lake elevations for Roosevelt Lake, January 2004 to December 2006 and 1996–2003 (Tim Skarupa, SRP, personal communication). Each point represents the elevation of the lake on the first day of each month (Appendix E2).

STUDY AREAS

This study was conducted at 2 breeding areas in central Arizona: Salt River and Tonto Creek. The Salt River and Tonto Creek are located 25 km apart and are the primary inflows to Roosevelt Lake, a reservoir, on the Tonto National Forest in Gila County. The Salt River study area is a perennial 15 km reach that flows into the southeastern end of Roosevelt Lake. The Tonto Creek study area is a 16 km reach that flows into the northwestern end of Roosevelt Lake; flows are intermittent and dependent on spring snowmelt and summer monsoon rains, causing it to frequently dry late in the breeding season. Study areas are comprised of U.S. Forest Service (Tonto National Forest) and private land (see Chapter 1 for more information).

Each study area is composed of numerous discrete vegetation patches that vary in vegetation composition and age. We labeled discrete habitat patches or groups of patches in close proximity of each other with a survey site (site) name. The riparian habitat is classified as Sonoran Riparian Deciduous Forest (Minckley and Brown 1994) and the habitat composition of each site ranges from monotypic stands of native broadleaf trees, to stands of mixed native and exotic, to nearly monotypic stands of exotic tamarisk (see Chapter 1 for more information).

METHODS

SURVEYS AND MOVEMENT

Each year (1996–2006), we surveyed all suitable breeding habitat within each study area for which we obtained landowner permission. Suitable flycatcher breeding habitat is defined as contiguous riparian forest with dense interior vegetation or an aggregate of dense vegetation patches interspersed with multiple small openings (creating a mosaic of forest and openings) located near surface water or saturated soil (Sogge and Marshall 2000; USFWS 2002, 2005; Paradzick and Woodward 2003; Allison et al. 2003). Surveys followed a standardized tape-playback protocol using the flycatcher's song to elicit responses (Tibbitts 1994, Sogge et al. 1997). We performed 1 tape-playback survey at each site in each of the following 3 survey periods: 15 May–31 May, 1 June–21 June, and 22 June–10 July. We performed surveys at least 5 days apart, from 1 hour prior to sunrise to 1000 hrs, the time of day when the birds were most active.

We collected Universal Transverse Mercator (UTM) coordinates of all territories and created maps in ArcGIS 9.2 (ESRI, Inc. 2006) to depict changes in flycatcher territory distribution in 2004, 2005, and 2006 in response to the inundation in 2005 and continuing post-inundation habitat changes in 2006. We describe these movements in the context of the broad-scale habitat changes we observed.

HABITAT AND VEGETATION CHARACTERISTICS

We collected general habitat characteristics and vegetation data at nest sites in 2004. Variables included:

1) height of nest (from the ground to the rim of the nest in meters);
2) height of nest tree (in meters);
3) DBH of nest tree (diameter of the nest tree 1.4 m from the base of the tree in centimeters);
4) distance to water (the horizontal distance from the nest to water or saturated soil in meters);
5) distance to nearest canopy break (the horizontal distance from the nest to the nearest ≥ 1 m^2 gap at the height of the nest in canopy foliage in meters);
6) height of canopy (the estimated average height of the top of the canopy within an 11.3 m radius of the nest);
7) percent of canopy cover (the average of the percent of canopy cover measured with a densiometer 1 m north and 1 m south from the nest); and

8) distance to nearest broadleaf tree (i.e., native deciduous tree such as cottonwood or willow; the horizontal distance from the nest to the edge of the nearest broadleaf tree in meters).

In 2006, we returned to accessible 2004 nest sites that were inundated in 2005 and re-measured the variables to determine the degree to which the inundation changed the nest site. These variables capture major structural and habitat components that would have been affected by inundation (distance to water, distance to nearest canopy break, height of canopy, percent of canopy cover, and distance to nearest broadleaf tree). We also included some variables we believed should not change (height of nest, height of nest tree, and DBH of nest tree) as a way to determine if differences were due to observer error. We were not able to re-measure all variables at all 2004 nest sites because some nests had washed away and some nest trees had fallen.

We compared measurements collected from 2004 nests with measurements taken in 2006 at the same nest sites using paired *t*-tests. These tests were 2-tailed for variables that we did not expect to differ and 1-tailed for variables that we had a directional prediction. We predicted no change in height of nest, height of nest tree, or DBH of nest tree. We predicted decreases in distance to water, distance to nearest canopy break, and percent of canopy cover, and an increase in the distance to nearest broadleaf tree. Distance to nearest canopy break, percent of canopy cover, and distance to nearest broadleaf tree were intended to capture decreases in habitat density, cover, and presence of native species. In 2006, when the nearest broadleaf tree was greater than 30 m, we recorded >30 m. This caused our sample size for distance to broadleaf tree to be small. By changing the >30 m to 30 m (as a minimum) we were able to test our 1-tailed prediction.

NEST MONITORING

We located and monitored nests using the Southwestern Willow Flycatcher Nest Monitoring Protocol (Rourke et al. 1999). Once we detected a flycatcher on a survey, we visited the territory every 4 days in an attempt to locate a nest. Nests were located by watching adults return to a nest or by systematically searching suspected nest areas. Once a nest was located, we visited the territory every 2 to 4 days to confirm incubation, defined as the female sitting on the nest for a minimum of 10 minutes. We monitored nests every 2 to 4 days after incubation was confirmed. During incubation, we observed nest contents directly using a mirror-pole or miniature video camera. After hatching, we confirmed the number of nestlings using these same techniques, with the exception of nests that were too high to safely use a mirror-pole or camera. When nests were too high for the use of a mirror-pole or camera, we visually confirmed the number of nestlings with binoculars (i.e., beaks visible above rim of the nest). Once we confirmed nestlings, we observed nests from a distance to reduce the risk of attracting predators or causing premature fledging. If we observed no activity at a previously active nest, we checked the nest directly to determine nest contents and searched the general area to locate possible fledglings or evidence of depredation.

We considered a nest successful if any of 4 conditions was documented: 1) 1 or more young were visually confirmed fledging from the nest or located near the nest; 2) adults were seen feeding fledglings; 3) parents behaved as if dependant young were nearby (defensive behavior or adults agitated) when the nest was empty; or, 4) nestlings were observed in the nest within 2 days of the estimated fledge date (fledging considered to occur at 12 days; Rourke et al. 1999). Assuming that nestlings successfully fledged if observed in the nest within 2 days of the estimated fledge date is based on observations of southwestern willow flycatchers successfully fledging at 10 days of age during this study. This assumption was not upheld if subsequent visits to the territory provided evidence that fledging did not occur (e.g., building or incubation dates for a renest contradicted the estimated fledge date). The first 2 of these 4 conditions were considered confirmed fledging, while the last 2 were considered presumed fledging; all were designated as successful for these analyses.

We considered a nest to have failed if any of 5 outcomes was documented: 1) the nest was found empty or destroyed more than 2 days prior to the estimated fledge date (depredated); 2) the nest fledged no flycatcher young but contained cowbird eggs or young (parasitized); 3) the nest was deserted with eggs or nestlings remaining (deserted); 4) the entire clutch was incubated unsuccessfully for more than 20 days (infertile); or, 5) the nest failed due to other reasons such as weather or human disturbance (other). We designated an “unknown outcome” if success or failure could not be determined (generally due to infrequent visits to a nest).

Data Analysis

We performed 2 sets of analyses: 1) we compared nests in non-inundated habitat with nests in partially-inundated habitat in 2005 and 2006 (years were pooled to increase sample size), and 2) we compared nests pre-inundation (1996–2004) with nests during inundation (2005–2006). For each set of analyses, we compared simple nest success (excluding nests with unknown outcomes), first-egg day, clutch size, and productivity (number of fledges per nest with known outcome) of nests using χ^2-tests (nest success) and *t*-tests (other variables). We also compared productivity of successful nests using a *t*-test. We were not able to determine some variables (e.g., first-egg day, clutch size) for all nests because of the nest stage when the nest was located (i.e., during the nestling stage). The first set of tests allowed us to examine the effects of inundation on individual nests while minimizing year effects, whereas the second set of tests allowed us to examine the overall effects of the inundation on the population at a landscape scale.

We examined if nesting in inundated habitat increased the rate of brown-headed cowbird (*Molothrus ater*) parasitism or the proportion of failed nests that were depredated by comparing nests in non-inundated habitat and nests in partially-inundated habitat in 2005 and 2006 using χ^2-tests. We repeated the analyses comparing nests pre-inundation (1996–2004) and nests during inundation (2005–2006).

RESULTS

SURVEYS AND MOVEMENT

The number of territories at the lake decreased 27% from 209 territories in 2004 to 153 territories in 2005. This decrease was due to a 51% decline at the Salt River study area that more than offset a 22% increase at the Tonto Creek study area (Tables 1 and 2). The number of territories at the lake decreased again in 2006 by 27% from 153 territories in 2005 to 111 territories in 2006. Both the Salt River and Tonto Creek study areas experienced declines in 2006, 28% and 27%, respectively. Overall, from 2004 to 2006, there was a 47% decrease in flycatcher territories at Roosevelt Lake (Salt River study area: 64%, Tonto Creek study area: 12%).

During inundation in 2005, flycatchers at both the Salt River and Tonto Creek study areas moved to breeding locations upstream of areas occupied prior to inundation (Figures 2 and 3). Sites closest to the lake that supported the majority of flycatcher territories in 2004 (Lake Shore and School House Point North: 71% of 2004 Salt River territories; Bermuda Flats: 58% of 2004 Tonto Creek territories) were completely inundated and supported no territories in 2005 (Figures 4 and 5). Sites slightly upstream experienced partial inundation and territory numbers decreased at these sites in 2005. Sites even farther upstream were occupied for the first time or for the first time since the early 2000s, presumably due to the presence of wet channels and moist soil.

In 2006, flycatcher territories continued to decline at sites closest to the lake. As in 2005, inundated sites did not support flycatchers. Partially inundated sites also generally declined in territory numbers. Flycatchers continued to occupy sites farthest from the lake that were not inundated.

Table 1. Southwestern willow flycatcher territories by year for Salt River study area with average lake elevation during breeding season, 1996–2006. Sites ordered from downstream to upstream. Cells blank if surveys were not performed.

AGFD site name	Year										
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Grapevine†										1	0
Lake Shore†					17	20	19	9	15	**	**
School House Point North†		0	0	2	5	19	45	52	84	0**	0**
School House Point South†				5	7	9	7	7	5	2*	0*
Pinto Creek near School House†										0*	0*
Salt River Inflow†	22	18	20	45	57	66	48	43	36	22*	4*
Cottonwood Acres II†	0	0	0	0	0	0	0	0	0	6*	7
Cottonwood Acres I†			0	1	1	0	0	0	0	38*	38
Meddler Point			0	0	0	0	0	0	0	0	1
Eads Wash			0	0	0	0	0	0	0	0	0
Roosevelt Diversion Dam			0	0	0	0	0	0	0	0	0
Salt River at SR 288 Bridge			0	0	0	0	0	0	0	0	0
Coon Creek										0	0
Cherry Creek North						0				0	0
Cherry Creek South						0				0	0
Territories	**22**	**18**	**20**	**53**	**87**	**114**	**119**	**111**	**140**	**69**	**50**
Number of sites surveyed	**2**	**2**	**8**	**6**	**10**	**12**	**10**	**10**	**10**	**16**	**16**
Average lake elevation during breeding season (ft)[a]	**2083**	**2076**	**2103**	**2084**	**2064**	**2083**	**2048**	**2075**	**2082**	**2145**	**2125**

†Site is within the conservation pool.
**Completely inundated.
* Partially inundated, tops of trees exposed.
[a] Lake level breeding season averages are from April to August.

Table 2. Southwestern willow flycatcher territories by year for Tonto Creek study area with average lake elevation during breeding season, 1996–2006. Sites ordered from downstream to upstream. Cells blank if surveys were not performed.

AGFD site name	Year										
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Bermuda Flats†									40	***	***
Orange Peel†					7	13	19	15	19	5**	2**
Tonto Creek Inflow†	16	21	28	24	20	11	8	6	0	37**	20**
A-Cross Road South			0		1	3	0	0	0	20*	11
A-Cross Road North			0		0	0	0	0	0	10*	8
Bar-X Road		0	0		0	0	0	2	10	12*	20
Del Shay								0	0	0	0
Rye Creek										0	0
Gisela										0	0
Territories	**16**	**21**	**28**	**24**	**28**	**27**	**27**	**23**	**69**	**84**	**61**
Number of sites surveyed	**2**	**2**	**4**	**1**	**5**	**6**	**5**	**6**	**8**	**8**	**8**
Average lake elevation during breeding season (ft)[a]	**2083**	**2076**	**2103**	**2084**	**2064**	**2083**	**2048**	**2075**	**2082**	**2144**	**2125**

†Site is within the conservation pool.
***Completely inundated.
**Partially inundated, tops of trees exposed.
*Saturated soil or more river channels present, but habitat not inundated.
[a] Lake level breeding season averages are from April to August.

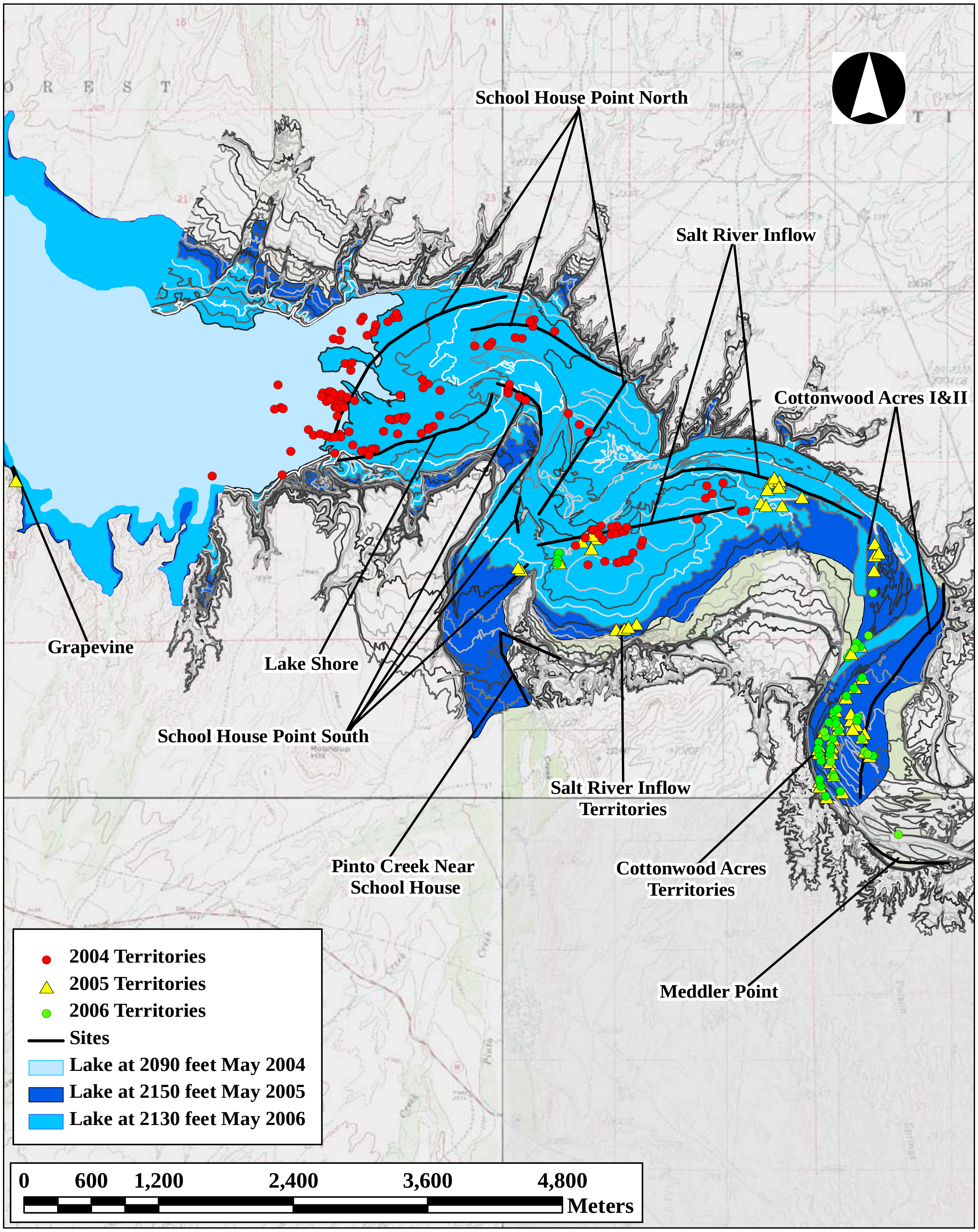

Figure 2. Map of the Salt River study area at Roosevelt Lake complex depicting approximate lake levels and territories locations during 2004, 2005, and 2006. "Sites" indicate the general location of survey sites. Survey sites farther upstream without territories (Eads Wash, Roosevelt Diversion Dam, Salt River at State Route 288 Bridge, Coon Creek, and Cherry Creek North and South) are not included.

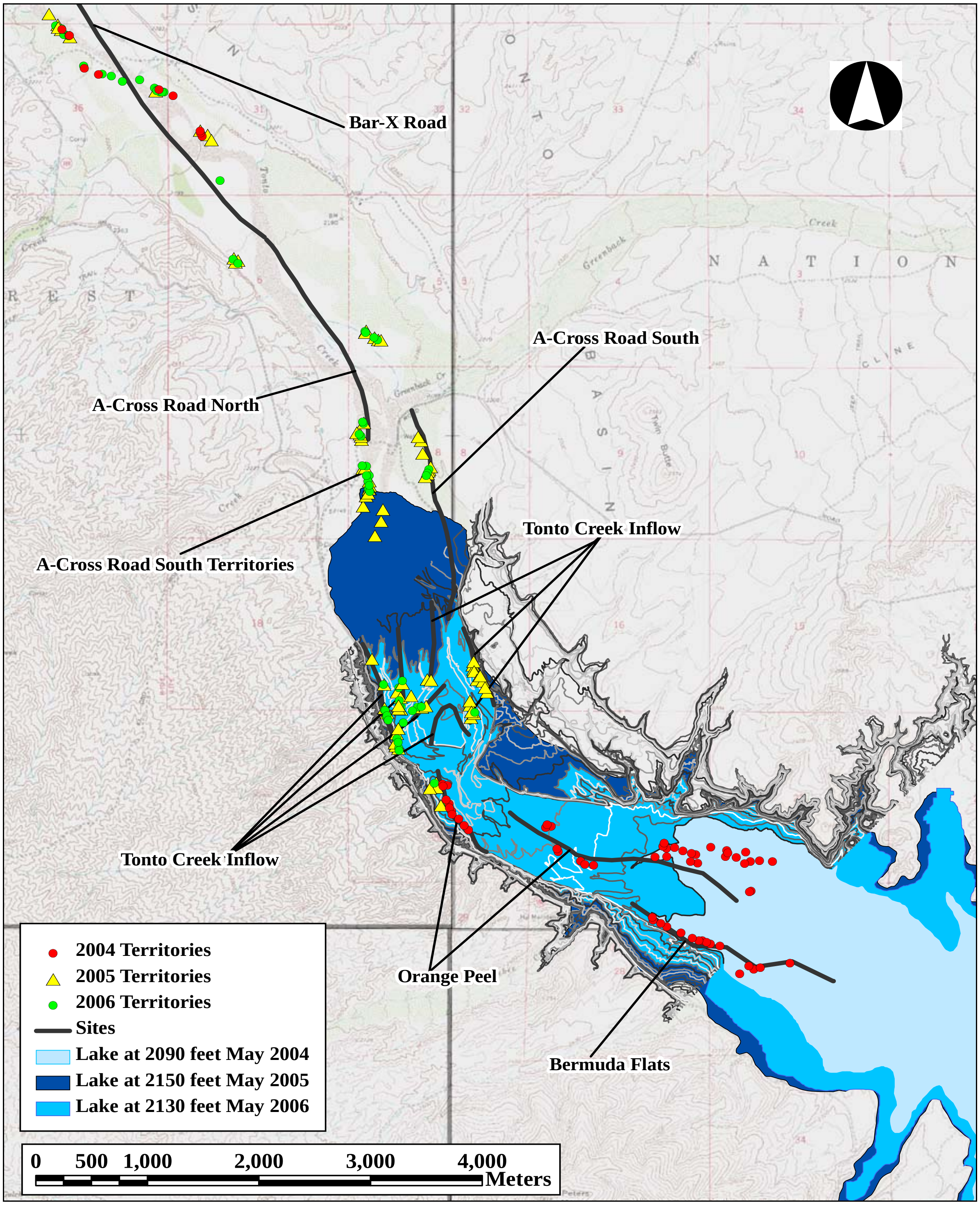

Figure 3. Map of Tonto Creek study area at the Roosevelt Lake complex depicting approximate lake levels and territory locations during the 2004, 2005, and 2006. "Sites" indicate the general location of survey sites. Survey sites farther upstream without territories (Del Shay, Rye Creek, and Gisela) are not included.

Figure 4. School House Point North (Salt River) pre-inundation, 2004.

Figure 5. School House Point North (Salt River) during inundation, 2005.

HABITAT AND VEGETATION CHARACTERISTICS

No differences were found in height of nest, height of nest tree, or DBH of nest tree between 2004 and 2006 measurements at 2004 nest sites (Table 3). Distance to water, distance to nearest canopy break, height of canopy, and percent of canopy cover were significantly less in 2006 than in 2004. Distance to nearest broadleaf tree was significantly greater in 2006 than in 2004.

Table 3. Paired *t*-tests on variables at 2004 nest sites during 2004 (pre-inundation) and during 2006 (during inundation), Roosevelt Lake, Arizona.

Variable	*n*	Year	Mean ± half-width of 95% CI	Mean difference ± half-width of 95% CI	*t*	df	*P*
Nest height	9	2004	4.1 ± 0.9	0.46 ± 0.77	-1.36	8	0.21
		2006	3.7 ± 0.8				
Height of nest tree	14	2004	7.9 ± 1.0	0.70 ± 1.1	-1.73	13	0.11
		2006	7.0 ± 1.7				
DBH of nest tree	13	2004	8.8 ± 2.2	0.12 ± 0.60	-0.45	12	0.66
		2006	8.7 ± 2.5				
Distance to water	20	2004	187.6 ± 4.9	184.1 ± 71.1	-5.41	19	< 0.001
		2006	3.5 ± 3.0				
Distance to canopy gap	30	2004	8.4 ± 1.9	6.2 ± 2.8	-4.58	29	< 0.001
		2006	2.2 ± 1.8				
Height of canopy	29	2004	7.7 ± 0.5	2.04 ± 1.0	-4.04	28	< 0.001
		2006	5.7 ± 1.0				
Percent canopy cover	29	2004	95.1 ± 1.4	59.4 ±12.9	-9.40	28	< 0.001
		2006	35.7 ± 13.2				
Distance to nearest broadleaf	29	2004	6.0 ± 2.2	-14.0 ± 4.4	6.53	28	< 0.001
		2006	20.0 ± 5.0				

NEST MONITORING

In 2004, we monitored 131 nesting attempts at Roosevelt Lake (Salt River: 92, Tonto Creek: 39; Table 4). In 2005, this number increased slightly to 136 (Salt River: 55, Tonto Creek: 81) then declined in 2006 to 82 (Salt River: 34, Tonto Creek: 48). Using ArcGIS 9.2 (ESRI, Inc. 2006), we estimated that 73% of the 2004 Roosevelt Lake territories (75% of Salt River, 70% of Tonto Creek territories) were in locations inundated in 2005 based on the May 2005 lake elevation (Tim Skarupa, SRP, personal communication). In 2005, 63% of monitored nests were located in partially inundated areas at the time they were built (95% of Salt River territories and 40% of Tonto Creek territories). Inundated areas where nests were located included School House Point South, Salt River Inflow, Cottonwood Acres II, and Cottonwood Acres I in the Salt River study area and Orange Peel and Tonto Creek Inflow in the Tonto Creek study area. In 2006, 12% of monitored nests were located in partially inundated areas when built (15% of Salt River territories and 10% of Tonto Creek territories) and included the Salt River Inflow in the Salt River study area and Orange Peel and Tonto Creek Inflow at the Tonto Creek study area.

Table 4. Number of monitored nests at Roosevelt Lake.

Year	Salt River study area nests	Tonto Creek study area nests	Roosevelt Lake total nests
1996	10	7	17
1997	17	23	40
1998	25	25	50
1999	63	23	86
2000	67	31	98
2001	79	33	112
2002	28	7	35
2003	109	26	135
2004	92	39	131
2005	55	81	136
2006	34	48	82
Total	**579**	**343**	**922**

During inundation (2005 and 2006) there was no difference in the proportion of successful nests in non-inundated habitats and nests in partially-inundated habitat (Table 5). However, a higher proportion of nests were successful pre-inundation (1996–2004) than during inundation (2005–2006; Table 6).

Table 5. Chi-squared test comparing rates of simple nest success between nests in non-inundated habitat and partially-inundated habitat during 2005 and 2006.

Nest location	Nest success (*n*)	χ^2	df	*P*
Nests in non-inundated habitat	47.5% (118)	0.51	1	0.476
Nests in partially-inundated habitat	42.5% (94)			

Table 6. Chi-squared test comparing rates of simple nest success between nests pre-inundation (1996–2004) and during inundation (2005–2006).

Nest	Nest success (*n*)	χ^2	df	*P*
Nests pre-inundation	56.6% (680)	8.36	1	0.004
Nests during inundation	45.2% (212)			

We detected no difference between the first-egg day, clutch size, productivity of all nests, or productivity of successful nests during inundation for nests in non-inundated habitats and nests in partially-inundated habitat (Table 7).

Table 7. Univariate *t*-tests on nesting variables comparing nests in non-inundated habitat and nests in partially-inundated habitat during 2005 and 2006, Roosevelt Lake, Arizona.

Variable	Non-inundated mean ± half-width of 95% CI (*n*)	Partially-inundated mean ± half-width of 95% CI (*n*)	*t*	df	*P*
First-egg day	June 16 ± 3.0 (65)	June 17 ± 4.2 (39)	0.22	102	0.83
Clutch size	2.7 ± 0.1 (104)	2.8 ± 0.2 (76)	0.89	178	0.37
Fledges of all nests	1.1 ± 0.2 (118)	1.0 ± 0.2 (94)	-0.75	210	0.46
Fledges of successful nests	2.4 ± 0.2 (56)	2.4 ± 0.2 (40)	-0.23	94	0.82

We detected no difference between the first-egg day or clutch size between pre-inundation (1996–2004) and during inundation nests (2005–2006;Table 8). All nests produced more fledglings pre-inundation than during inundation, but no difference was detected for successful nests between pre-inundation and during inundation (Table 8).

Table 8. Univariate *t*-tests on nesting variables comparing pre-inundation nests (1996–2004) and during inundation nests (2005–2006), Roosevelt Lake, Arizona.

Variable	Pre-inundation mean ± half-width of 95% CI (*n*)	During inundation mean ± half-width of 95% CI (*n*)	*t*	df	*P*
First-egg day	June 17 ± 1.6 (396)	June 16 ± 2.4 (104)	0.20	498	0.84
Clutch size	2.8 ± 0.1 (630)	2.8 ± 0.1 (180)	-0.43	808	0.67
Fledges of all nests	1.4 ± 0.1 (680)	1.1 ± 0.2 (212)	2.93	890	0.003
Fledges of successful nests	2.5 ± 0.1 (385)	2.4 ± 0.2 (96)	0.73	479	0.47

We found no difference between the rate of parasitism of nests in non-inundated habitat and nests in partially-inundated habitat during inundation years (2005 and 2006; Table 9). There was also no difference between the proportion of failed nests that were depredated between nests in non-inundated habitat and nests in partially-inundated habitat (Table 9).

Table 9. Chi-squared test comparing parasitism rates and proportion of failed nests that were depredated between non-inundated habitat and partially-inundated habitat in 2005 and 2006.

Nest location	Parasitism rate (*n*)	χ^2	df	*P*	Failed nests that were depredated (*n*)	χ^2	df	*P*
Nests in non-inundated habitat	4.9% (118)	0.01	1	0.94	71.0% (62)	1.74	1	0.18
Nests in partially-inundated habitat	5.3% (94)				81.5% (54)			

We found no difference between the rate of parasitism of pre-inundation nests (1996–2004) and during inundation nests (2005–2006; Table 10). There was also no difference between the proportion of failed nests that were depredated between pre-inundation nests and during inundation nests (Table 10).

Table 10. Chi-squared test comparing parasitism rates and proportion of failed nests that were depredated between pre-inundation (1996–2004) and during inundation (2005–2006).

Nest	Parasitism rate (*n*)	χ^2	df	*P*	Failed nests that were depredated (*n*)	χ^2	df	*P*
Nests pre-inundation	4.4% (680)	0.1	1	0.64	77.3% (295)	0.09	1	0.76
Nests during inundation	4.6% (212)				75.9% (116)			

DISCUSSION

We observed a large variation in the number of nesting attempts at Roosevelt Lake from 1996 to 2006 (Table 4). In the mid-1990s, sites were still being discovered and the numbers of nests found were low. The number of nests found steadily climbed in the first few years of monitoring as habitat and study area coverage improved. As the lake receded, new habitat developed and provided flycatchers with additional suitable habitat in the conservation pool resulting in increased territories and nesting attempts. The number of nesting attempts declined in 2002, a severe drought year, but quickly rebounded in the following years. Number of nesting attempts during the first year of inundation, 2005, was very similar to 2003 and 2004 numbers, but declined back to late 1990-levels in 2006.

Flycatchers made fewer nesting attempts and nests had a lower probability of being successful during inundation, ultimately had a negative impact on the population's productivity. Although there was not an increase in the proportion of nests failing due to depredation during inundation years, small increases in nest failure occurred due to infertile clutches and other causes (e.g., nestlings found dead in nest), which contributed to lower nest success during inundation. Warner and Hendrix (1984) found that birds at Isabella Reservoir in California were confined to smaller territories with less food following inundation and a decrease in available habitat, causing reduced nesting attempts and nesting success. Further years of study are necessary to determine the long-term impacts of inundation on the demographics of the Roosevelt Lake population, but short-term impacts include reduced nesting attempts and nest success leading to reduced productivity of flycatchers at the reservoir following inundation.

From 1996 to 2006, we documented the ephemeral nature of flycatcher habitat at Roosevelt Lake. As the lake receded, new habitat developed in the conservation pool, followed by inundation causing a reduction in habitat. Along with changes in the amount and distribution of habitat, we have documented the corresponding fluctuation of flycatcher numbers and distribution. The 27% decline in territories at Roosevelt Lake from 2004 to 2005, followed by the additional 27% decline from 2005 to 2006, were the largest declines observed during this 11-year study. The only previous decline was 8% from 2002 to 2003, which was likely due to drought-caused reproductive failure in 2002 (Smith et al. 2003; Chapter 5). In 2005 and 2006, we documented the most drastic redistribution of flycatcher territories at Roosevelt Lake during this study. This redistribution mirrored habitat changes resulting from the inundation.

During 2005, inundation displaced flycatchers from the most recently occupied habitat within the conservation pool to areas that were either partially inundated (with some exposed vegetation) or farther upstream to non-inundated areas. Although flooding is a regular occurrence in riparian areas, and even necessary for dispersal and germination of some plant species (Poff et al. 1997, Stromberg 1997), riparian species are not adapted to survive long-term inundation (Gill 1970, Warren and Turner 1975). Most studies on the ability of trees to survive inundation have been observational and are conflicting in the length and degree of specific species survival, as well as the relative ability of different species to survive (Warren and Turner 1975, Stevens and Waring 1986, Stromberg et al. 1993, reviewed in SRP 2002). In an experimental study, Vandersande et al. (2001) found that native riparian species (cottonwood and willow) outperformed tamarisk when flooded; however, Sprenger et al. (2001) found that cottonwood seedlings did not survive submergence while tamarisk seedlings did survive. Most studies acknowledge that in addition to the length and depth of inundation, other factors such as tree size and location on floodplain, factor into response to inundation (reviewed by Gill 1970; Warren and Turner 1975, Stevens and Waring 1986, Stromberg et al. 1993, Reitan and Thingstad 1999).

In 2006, we began to observe the effects of long-term inundation on habitat. Because winter precipitation within the Salt and Verde watersheds in 2006 was among the lowest on record (WRCC 2007), lake levels dropped at Roosevelt Lake throughout the winter (Appendices E and F). Lake levels continued to drop throughout the breeding season and reached a low of 63% capacity (2118 ft) in August 2006, down from a high of 96% (2148 ft) in May 2005 (Tim Skarupa, SRP, personal communication). As lake levels dropped, stands of dead trees were exposed or partially exposed in previously inundated areas (Figure 6, 7, and 8), indicating that most species where not able to survive inundation over 1 year. We also noticed other changes at the landscape level; for example, a portion of Orange Peel was lost due to erosion during high flows in Tonto Creek in spring 2005.

Figure 6. School House Point North (Salt River) as lake levels decreased, 2006. School House Point North was completely inundated in 2005.

Figure 7. Salt River Inflow as lake levels decreased, 2006. Salt River Inflow was partially inundated in 2005.

Large portions of vegetation died in 2006 at several partially inundated sites that were occupied in 2005 (Salt River Inflow and School House Point South at the Salt River study area and Tonto Creek Inflow and Orange Peel at the Tonto Creek study area). In some areas, the tamarisk understory died while small patches of Goodding's willow overstory survived. At many of our sites, tamarisk seemed more susceptible to post-inundation die-off compared to native vegetation. Other studies (e.g., Stromberg et al. 1993, Stromberg 1997, Gladwin and Roelle 1998) support this observation (but see Warren and Turner 1975, Sprenger et al. 2001). Vandersande et al. (2001) found that during controlled greenhouse experiments, native riparian species (*Populus fremontii, Salix gooddingii,* and *Baccharis salicifolia*) suffered fewer negative effects from inundation than did tamarisk (*Tamarix ramosissima*); all tamarisk plants were unable to remain upright after 58 days and had the lowest root and shoot mass. Stromberg et al. (1993) found native trees were favored following inundation on the Hassayampa River because they were larger and situated on slightly higher floodplains, a possible explanation for our observation at Roosevelt Lake.

In addition to habitat die-off within the conservation pool, habitat farther upstream (e.g., A-Cross Road North and A-Cross Road South) may have been affected by decreasing lake levels. After an initial increase in flycatcher territories in 2005, the number declined in 2006. A temporary increase in habitat quality may have occurred in 2005 when more water and saturated soil were present at these sites, but as the lake receded and precipitation declined, these sites dried out and the quality of that habitat decreased. Sites farther from the lake with standing water and saturated soil (e.g., Bar-X Road) during the entire 2006 breeding season continued to support flycatchers.

In addition to changes in the location of live, suitable habitat available to flycatchers at Roosevelt Lake, the habitat structure also changed. Because of inundation, we found that habitat at 2004 nest sites following inundation was thinner with less canopy cover, more canopy gaps, a lower canopy, and lower tree density than pre-inundation. Similar decreases in tree density, percent canopy cover, tree species diversity, and tree height were observed following inundation at Isabella Reservoir in California (Warner and Hendrix 1984). More data are necessary to fully assess the long-term effects of inundation on changes in habitat structure at Roosevelt Lake.

Although inundation caused extensive vegetation die-off, we did observe regeneration of vegetation in some areas at Roosevelt Lake in 2006. At the Salt River study area, tamarisk began to regenerate at some sites that were partially inundated in 2005 (e.g., Cottonwood Acres I and II) when water levels dropped in the summer and fall of 2005. By the end of the 2006 breeding season, tamarisk had grown to approximately 1.5 m in height at these sites. In parts of Salt River Inflow, native vegetation began to regenerate after water levels dropped in spring 2006. At the Tonto Creek study area, water levels also continued to drop at some sites (e.g., Tonto Creek Inflow) in spring 2006 and Goodding's willow started to regenerate (approximately 0.5 m in height by the end of the breeding season). Spring drawdown at Roosevelt Lake appears to be more conducive to native species regeneration. Stromberg et al. (1993) and Levine and Stromberg (2001) suggest that native vegetation is favored over tamarisk to regenerate if germination sites are moistened only during spring and become dry during summer. However, we noted that some of the new willow growth at Tonto Creek Inflow died as drying occurred in late summer.

During a 2007 site visit, we observed that some young native vegetation persisted in areas where it was associated with large willow trees that had survived inundation. This rapid regeneration of habitat at the lake is encouraging because flycatchers have occupied riparian habitat as young as 2–3 years in Arizona (AGFD unpublished data).

Knopf and Sedgwick (1987) documented a 1-year lag effect in population numbers of brown thrashers (*Toxostoma rufum*) and rufous-sided towhees (*Pipilo erythrophthalmus*) following habitat inundation. There was no change in population size the year of the flood, but both species declined in the following year. Thrasher populations rebounded to almost pre-flood numbers within 2 years, but towhee population numbers remained depressed. They theorized that birds that returned the year during inundation either failed to find suitable habitat to breed or had a failed nesting attempt, and then dispersed that year or the following year to areas outside their study area. This theory could account for the continued decrease in flycatchers in 2006. Birds that were floaters in 2005, had a failed nesting attempt, or failed to find suitable habitat may have dispersed in 2006 causing a decline in nesting attempts. Past reproductive success of willow flycatchers and other species influences site fidelity, with successful individuals being more likely to return to the same breeding area (Harvey et al. 1979, Burger 1982, Blancher and Robertson 1985, Sedgwick 2004, Paxton et al. 2007). Therefore, we would expect flycatchers to disperse from previously occupied sites following the increase in failed nesting attempts during inundation.

Even though we surveyed all suitable habitat within 40 km of Roosevelt Lake that we had permission to access, we did not document breeding dispersal of banded birds to these outer areas. Flycatchers may have moved to areas of suitable habitat on private property even farther upstream from Bar-X Road; however, we were not able to obtain access to these sites to conduct surveys.

Flycatchers also may have dispersed outside of our 40 km radius to areas not surveyed (e.g., San Carlos Reservoir and tributaries, Safford Valley) or may have gone undetected by surveyors. AGFD and cooperating agencies have documented the dispersal of 6 banded birds (4 to Pinal Creek, 1 to the San Pedro River, and 1 to Horseshoe Lake; Causey et al. 2006, Dockens and Ashbeck 2006, Graber et al. 2007) outside of our study areas since inundation. An additional 6 banded birds have been detected outside of the study areas since inundation, but data missing from 1 or more years makes it impossible to tell if the dispersal was pre- or post-inundation (Causey et al. 2006, Dockens and Ashbeck 2006). However, these documented dispersals do not account for the large decreases in birds at Roosevelt Lake in 2005 and 2006. Paxton et al. (2007) found an increase in floaters present at Roosevelt Lake in 2005. Birds that are floaters do not defend a territory and are less likely to respond to tape-playback surveys (Paxton et al. 2007); therefore, floaters are not included in our count of flycatcher territories. Floaters in 2005 may have spent more time assessing the habitat and ultimately decided to forgo establishing a territory and breeding, or there may not have been enough suitable habitat to support all flycatchers in 2005.

Because of the ephemeral nature of riparian habitat and the shifting reservoir levels, the pattern seen over the past decade is likely to be repeated in a cyclic pattern. This pattern, in some ways, mimics a natural river system in which large scale flooding destroys patches of habitat. Flooding along a river is generally followed by a period of habitat regeneration, which creates constant shifting in the location and age of riparian habitat. Flycatchers have evolved within this natural system and display the flexibility to respond quickly to shifts in habitat location and quality; an important factor being the maintenance of refugia habitat in close proximity. This was demonstrated during this study as flycatchers occupied newly developed habitat in the conservation pool prior to inundation and moved to habitat upstream during inundation.

Although natural flooding events along free-flowing rivers may destroy large areas of vegetation, they do not typically result in long-term inundation. Compared to a flood in a river system, habitat loss due to inundation is more expansive and habitat regeneration is postponed until water levels recede. Floods that occur along river systems also scour vegetation and do not typically leave large amounts of dead vegetation in the habitat. At the reservoir, stands of dead trees remained after water levels receded, which may also hinder habitat regeneration.

Following the recent habitat loss caused by inundation, the lake will likely continue to slowly recede, as it has since the fall of 2005, and habitat will develop within the conservation pool at the water's edge. As this new habitat reaches an appropriate age in 2–5 years, the flycatcher population at the lake may increase similarly to what it did in the late 1990s and early 2000s as the lake receded. This cycle may repeat itself as the reservoir fills and empties, providing habitat for flycatchers in varying quantity and quality. Habitat regeneration and flycatcher colonization of new habitat will need to be monitored to determine the ability of habitat to regenerate in areas with stands of dead trees and if flycatchers colonize the habitat.

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CHAPTER 4

NESTING BIOLOGY

INTRODUCTION

The southwestern willow flycatcher (*Empidonax traillii extimus*, flycatcher), a subspecies of the willow flycatcher, was listed as federally endangered in 1995 (USFWS 1995) due to declines in populations over the past 100–150 years (Harris et al. 1987, Unitt 1987). These declines have largely been attributed to loss and degradation of breeding habitat throughout the flycatcher's breeding range (Unitt 1987, Whitfield 1990, Harris 1991, USFWS 1995). Exotic tamarisk (*Tamarix* spp.) is frequently faulted for reducing the quality of riparian habitat. Tamarisk has become a dominant plant species by replacing native species at reservoirs in the Southwest (Warren and Turner 1975, Glenn and Nagler 2005), and may benefit from release patterns downstream of reservoirs, altering the vegetative composition of riparian systems downstream of dams (Stromberg et al. 2005, Beauchamp and Stromberg 2007). A high rate of brown-headed cowbird (*Molothrus ater*) parasitism has negatively impacted nest success and productivity in some populations, but is not a pervasive problem rangewide (USFWS 2002, Graber et al. 2007).

Understanding demographic parameters that may affect population growth can aid conservation and recovery efforts (USFWS 2002). Knowledge of basic nesting biology is important to accurately assess the status of a population and evaluate population trends over time. Demographic parameters can vary between years depending on climatic variations (e.g., temperature, rainfall), which can influence habitat condition and food resources. Long-term studies with large sample sizes capture important variations between years and reduce bias that may be caused by studies that are limited to a field season or a small geographical range. Demographic parameters may also vary among populations and comparisons may yield valuable knowledge on factors limiting species recovery.

Here, we summarize basic demographic parameters of flycatchers at 4 breeding areas in Arizona from 1996 to 2005 and compare these traits with other flycatcher populations. Parasitism rates by brown-headed cowbirds are summarized to determine if nest success and productivity of these populations are likely impacted by parasitism. We also summarize flycatcher use of exotic, native, and mixed habitats and use of nest tree species.

STUDY AREAS

We monitored flycatchers at 4 breeding areas in central Arizona: Salt River, Tonto Creek, San Pedro River, and Gila River. The Salt River and Tonto Creek are located 25 km apart and are the primary inflows to Roosevelt Lake, a reservoir, within Tonto National Forest in Gila County. The Salt River study area is a perennial 15 km reach that flows into the southeastern end of Roosevelt Lake. The Tonto Creek study area is a 16 km reach that flows into the northwestern end of Roosevelt Lake; flows are intermittent and dependent on spring snowmelt and summer monsoon rains, causing it to frequently dry late in the breeding season. Study areas are comprised of U.S. Forest Service (Tonto National Forest) and private land. The San Pedro River flows into the Gila River near Winkelman, AZ. The San Pedro River study area is a 45 km reach of the San Pedro River upstream of Winkelman; flows are perennial in some areas and intermittent in others, largely influenced by precipitation and groundwater pumping. The Gila River study area is a 40 km reach of the Gila River upstream and downstream of Winkelman; flows along the Gila River are variable, largely influenced by regulated releases from the San Carlos Reservoir's Coolidge Dam with some natural flow from the San Pedro River. Study areas are composed of private, municipal, state, and federal (U.S. Bureau of Land Management and U.S. Bureau of Reclamation [Reclamation]) lands (see Chapter 1 for more information).

Each study area is composed of numerous discrete vegetation patches that vary in vegetation composition and age. We labeled discrete habitat patches or groups of patches in close proximity of each other with a survey site (site) name. The riparian habitat is classified as Sonoran Riparian Deciduous Forest (Minckley and Brown 1994) and the habitat composition of each site ranges from monotypic stands of native broadleaf trees, to stands of mixed native and exotic, to nearly monotypic stands of exotic tamarisk (see Chapter 1 for more information).

METHODS

LOCATING AND MONITORING NESTS

Each year (1996–2005), we surveyed all suitable breeding habitat within each study area for which we obtained landowner permission. Suitable breeding habitat is defined as contiguous riparian forest with dense interior vegetation or an aggregate of dense vegetation patches interspersed with multiple small openings (creating a mosaic of forest and openings) located near surface water or saturated soil (Sogge and Marshall 2000; USFWS 2002, 2005; Paradzick and Woodward 2003; Allison et al. 2003). Surveys followed a standardized tape-playback protocol using the flycatcher's song to elicit responses (Tibbitts et al. 1994, Sogge et al. 1997*a*). We performed 1 tape-playback survey at each site in each of the following 3 survey periods: 15 May–31 May, 1 June–21 June, and 22 June–10 July. We performed surveys at least 5 days apart, from 1 hour prior to sunrise to 1000 hrs, the time of day when the birds were most active. We collected Universal Transverse Mercator (UTM) coordinates of all territories.

We located and monitored nests using the Southwestern Willow Flycatcher Nest Monitoring Protocol (Rourke et al. 1999). Once we detected a flycatcher on a survey, we visited the territory every 4 days in an attempt to locate a nest. Nests were located by watching adults return to a nest or by systematically searching suspected nest areas. Once a nest was located, we visited the territory every 2 to 4 days to confirm incubation, defined as the female sitting on the nest for a minimum of 10 minutes. We monitored nests every 2 to 4 days after incubation was confirmed. During incubation, we observed nest contents directly using a mirror-pole or miniature video camera. After hatching, we confirmed the number of nestlings using these same techniques, with the exception of nests that were too high to safely use a mirror-pole or camera. When nests were too high for the use of a mirror-pole or camera, we visually confirmed the number of nestlings with binoculars (i.e., beaks visible above rim of the nest). Once we confirmed nestlings, we observed nests from a distance to reduce the risk of attracting predators or causing premature fledging. If we observed no activity at a previously active nest, we checked the nest directly to determine nest contents and searched the general area to locate possible fledglings or evidence of depredation.

We considered a nest successful if any of 4 conditions was documented: 1) 1 or more young were visually confirmed fledging from the nest or located near the nest; 2) adults were seen feeding fledglings; 3) parents behaved as if dependant young were nearby (defensive behavior or adults agitated) when the nest was empty; or, 4) nestlings were observed in the nest within 2 days of the estimated fledge date (fledging considered to occur at 12 days; Rourke et al. 1999). Assuming that nestlings successfully fledged if observed in the nest within 2 days of the estimated fledge date is based on observations of southwestern willow flycatchers successfully fledging at 10 days of age during this study. This assumption was not upheld if subsequent visits to the territory provided evidence that fledging did not occur (e.g., building or incubation dates for a renest contradicted the estimated fledge date). The first 2 of these 4 conditions were considered confirmed fledging, while the last 2 were considered presumed fledging; all were designated as successful for these analyses.

We considered a nest to have failed if any of 5 outcomes was documented: 1) the nest was found empty or destroyed more than 2 days prior to the estimated fledge date (depredated); 2) the nest fledged no flycatcher young but contained cowbird eggs or young (parasitized); 3) the nest was deserted with eggs or nestlings remaining (deserted); 4) the entire clutch was incubated unsuccessfully for more than 20 days (infertile); or, 5) the nest failed due to other reasons such as weather or human disturbance (other). We designated an "unknown outcome" if success or failure could not be determined (generally due to infrequent visits to a nest).

HABITAT AND VEGETATION CHARACTERISTICS

We collected general habitat characteristics and vegetation data of survey areas and nests. Habitat information included classification of vegetation composition at sites as 1) native broadleaf vegetation (entirely or almost entirely native, >90% native, includes high-elevation willow); 2) mixed native broadleaf and exotic, 50–90% native; 3) mixed native broadleaf and exotic, 50–90% exotic; and 4) exotic vegetation (entirely or almost entirely exotic, >90% exotic). Because of the difficulty surveyors had in distinguishing between categories 2 and 3, these categories were combined for analyses. Species of nest tree was recorded for each nest.

DATA ANALYSIS

First-egg day. We calculated the average first-egg day for all monitored nests. We examined the effects of year, attempt number, and interaction on the average first-egg day of all monitored nests using an ANOVA. Sample size was too small to run the analysis on third nesting attempts, so the analysis was restricted to first and second nesting attempts. Distributions of first, second, and third attempts were calculated.

Clutch size. We examined the effect of nesting attempt number on the average clutch size with an ANOVA. Nests where exact number of eggs could not be determined were not included in average clutch size calculations; inability to determine exact nest contents was due to finding the nest post-hatching, or when nest height or obstructions prevented the use of miniature video cameras or mirror-poles.

Hatching success. We examined the effects of year on variation in hatching success using a logistic regression for binomial counts. Hatching success was analyzed in 2 ways: 1) the number of nestlings hatched compared to all eggs laid and 2) the number of nestlings hatched compared to the number of eggs that survived the incubation period (e.g., eliminating clutches that did not hatch due to depredation or desertion). Rather than use 1 response variable (i.e., the proportion of number of nestlings hatched to eggs laid), we used the events-trial syntax where events were nestlings hatched and trials were eggs laid. This method took into account and weighted differently the same proportion derived from different numbers (e.g., 1 nestling/2 eggs and 2 nestling/4 eggs both equal 50%, but the latter results in twice as many nestlings and has a different biological impact).

Fledge day. We calculated average fledge date and range for the entire breeding season. We examined the effects of year on the average fledge date of all monitored nests using an ANOVA. All attempts were combined so average and range represent the entire breeding season and are not reflective of attempt order. Distribution of fledge day was calculated.

Nesting cycle length. We calculated the length of the overall nesting period and each stage (laying, incubation, and nestling) from a subset of nests with known transition dates (i.e., observed for the entire nesting period with known first-egg day, hatch day, and fledge day). Laying began on the day the first egg was laid and ended with the initiation of incubation. We assumed that females typically began incubation on the penultimate egg. The nestling stage began when the first egg hatched and ended when the first fledgling left the nest.

Nest outcomes and simple nest success. We summarize nests as successful, failed or unknown, and the number of nests parasitized by brown-headed cowbirds. We calculated simple nest success as the number of successful nests divided by the number of monitored nests with known outcomes. We examined if nest success varied among years using a χ^2-test. Due to protocol changes in 2001, we did not have standardized data to calculate comparable Mayfield nest success (Mayfield 1961) pre- and post-2001.

Nest parasitism. We summarize rates of brown-headed cowbird parasitism by year and study area and the outcomes of parasitized nests. Reclamation hired contractors to trap brown-headed cowbirds at some sites within our study areas for 8 breeding seasons between 1996 and 2003.

Nest failure. Causes of nest failure are summarized by year and study area. We calculated the proportion of parasitized nests that failed due to parasitism and the proportion of nest failure caused by depredation for each nest stage.

Habitat type and nest tree species: To explore the use of exotic habitat by flycatchers, we summarize the distribution of nests by habitat type (native, mixed native and exotic, or exotic) by study area. Species of nest tree were summarized by study area. Nest trees were grouped in the lowest taxonomic level reported by researchers (genus or species, if known).

Data analyses were done in SPSS ver. 14.0 (2005) and SAS ver. 9.1 (2004). SigmaPlot ver. 8.0 (2004) was used for all graphs. Mean ± half-widths of the 95% confidence interval are reported. Significance level was set at $P \leq 0.05$.

RESULTS

We monitored 1941 nests from 1996 to 2005 (Table 1). This included 545 attempts on the Salt River, 295 attempts on Tonto Creek, 830 attempts on the San Pedro River, and 271 nesting attempts on the Gila River. There were 1492 first nesting attempts, 464 second nesting attempts, and 48 third nesting attempts.

Table 1. Number of southwestern willow flycatcher nesting attempts by study area, Arizona, 1996–2005.

Year	Study area	First nesting attempt	Second nesting attempt	Third nesting attempt	Total nesting attempts
1996	Salt River	9	1	0	10
	Tonto Creek	6	1	0	7
	San Pedro River	16	8	1	25
	Gila River	1	0	0	1
1997	Salt River	14	3	0	17
	Tonto Creek	17	4	2	23
	San Pedro River	25	2	8	35
	Gila River	8	2	0	10
1998	Salt River	17	6	2	25
	Tonto Creek	18	6	1	25
	San Pedro River	27	17	3	47
	Gila River	32	19	3	54
1999	Salt River	43	18	2	63
	Tonto Creek	21	2	0	23
	San Pedro River	34	15	2	51
	Gila River	26	9	3	38
2000	Salt River	48	18	1	67
	Tonto Creek	20	11	0	31
	San Pedro River	26	16	1	43
	Gila River	18	8	0	26
2001	Salt River	65	14	0	79
	Tonto Creek	21	10	2	33
	San Pedro River	64	42	6	112
	Gila River	34	16	6	56
2002	Salt River	27	1	0	28
	Tonto Creek	7	0	0	7
	San Pedro River	72	11	0	83
	Gila River	22	1	0	23
2003	Salt River	89	20	0	109
	Tonto Creek	21	5	0	26
	San Pedro River	94	24	0	118
	Gila River	17	3	0	20
2004	Salt River	71	20	1	92
	Tonto Creek	30	8	1	39
	San Pedro River	113	45	2	160
	Gila River	10	2	1	13
2005	Salt River	47	8	0	55
	Tonto Creek	66	15	0	81
	San Pedro River	115	41	0	156
	Gila River	18	12	0	30
Total	Salt River	430	109	6	545
	Tonto Creek	227	62	6	295
	San Pedro River	586	221	23	830
	Gila River	186	72	13	271
	Total	**1429**	**464**	**48**	**1941**

First-egg day. The mean first-egg day for first nesting attempts was 10 June ± 1.2 days (11 June in leap years; $n = 1056$). The earliest first-egg for first nesting attempts documented was 14 May on the San Pedro River in 2004 and the latest was 5 August on the Gila River in 2005. The mean first-egg day for second nesting attempts was 3 July ± 1.7 days (4 July in leap years; $n = 345$). There was significant effect of year, attempt number, and an interaction between year and attempt number indicating that the first-egg day varied over time but not in the same way for first and second nest attempts (i.e., the difference between the mean first-egg of first clutches and the mean first-egg of second clutches varied among years; Table 2 and Figure 1).

Table 2. Results of 2-way ANOVA to test for the effects of year, nesting attempt number, and interaction on first-egg day.

Source	F	df	P
Year	10.6	9, 1381	< 0.001
Nesting attempt number	555.3	1, 1381	< 0.001
Year * Nesting attempt number	2.7	9, 1381	0.004

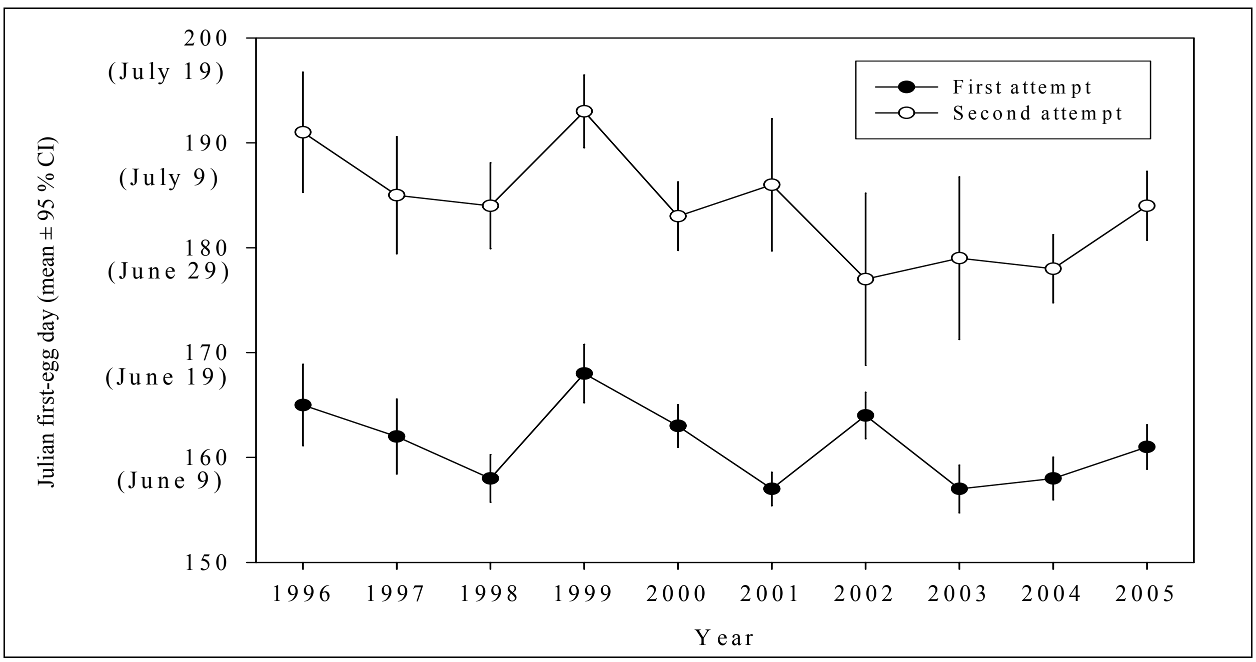

Figure 1. Mean first-egg day by year and attempt number.

The latest documented first-egg day (a third attempt) was 17 August on the Gila River in 1999. The distribution of first-egg day by nesting attempt number shows a peak during the first attempt, followed by a more equal distribution for second and third nesting attempts (Figure 2).

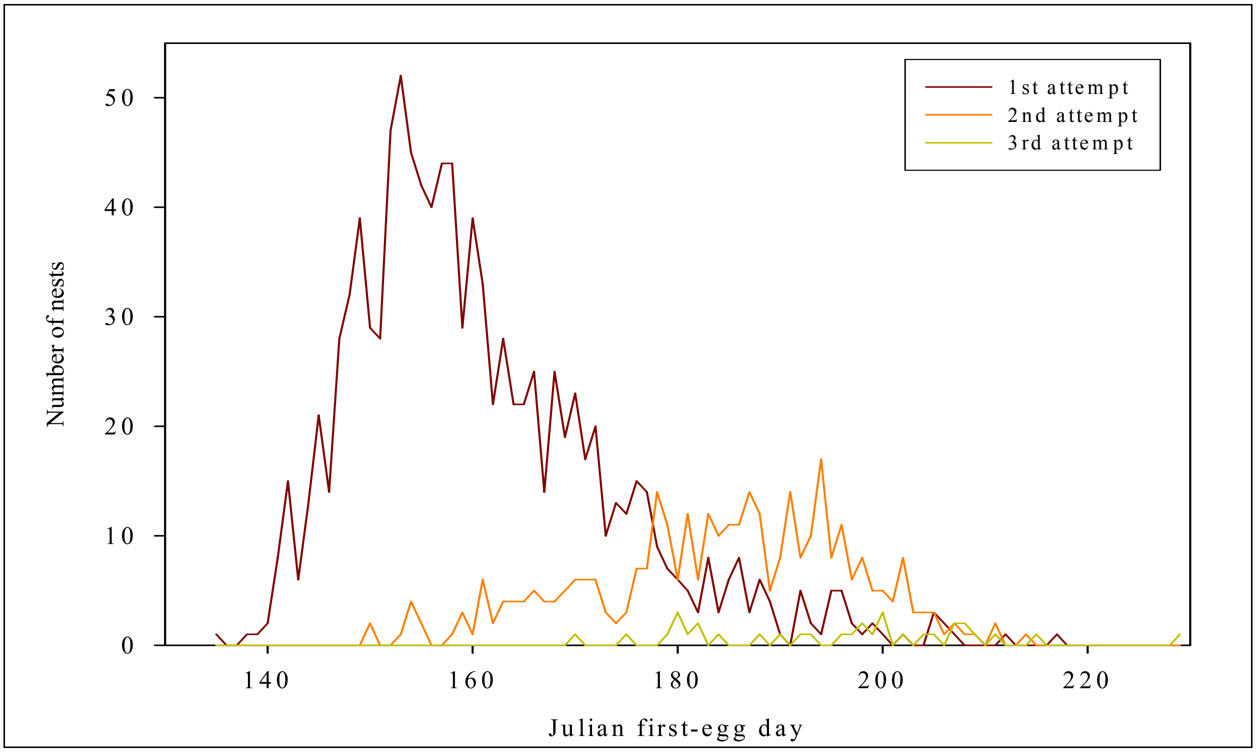

Figure 2. Distribution of first-egg day by attempt number.

Clutch size. The overall mean clutch size was 2.8 ± 0.1 eggs (first clutch: 2.9 ± 0.1, n = 1262; second clutch: 2.5 ± 0.1, n = 410; third clutch: 2.4 ± 0.1, n = 36). There was a significant difference in clutch size for nesting attempt number with clutch size decreasing after the first nesting attempt ($F_{2, 1705} = 46.9$, $P < 0.001$; Figure 3). Clutch size ranged from 1 to 5 eggs with the majority of clutches consisting of 3 eggs (1 egg: 4.0%; 2 eggs: 25.2%; 3 eggs: 60.6%; 4 eggs: 10.0%; 5 eggs: 0.2%).

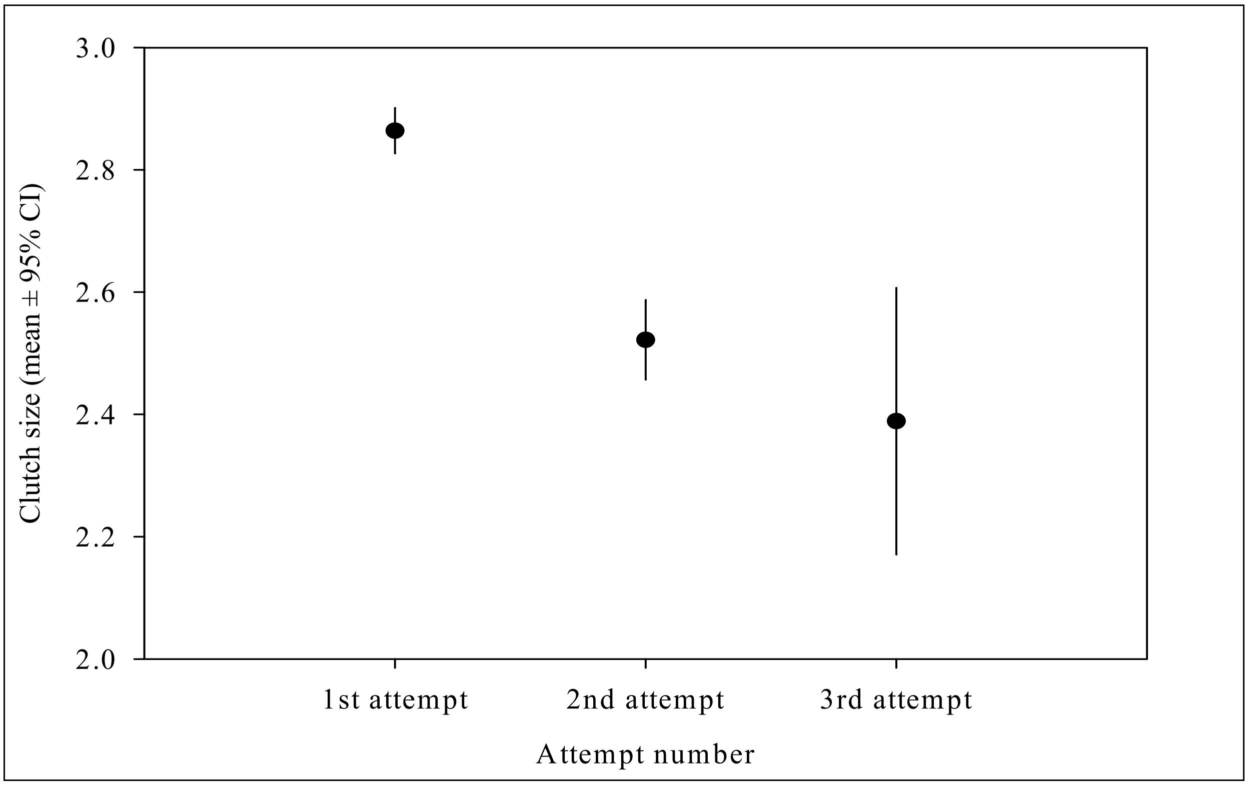

Figure 3. Southwestern willow flycatcher clutch size by nesting attempt number.

Hatching success. The mean yearly hatching success for all eggs laid was 65.2% ± 0.06. This was highly variable among years from 45.4% ± 0.07 in 2002 to a high of 72.5% ± 0.05 in 2003. Mean hatching success for eggs that survived the incubation period was 86.3% ± 0.08. The mean hatching success for eggs that survived the incubation period was less variable than the mean yearly hatching success for all eggs laid from a low of 76.4% ± 0.07 in 1997 to a high of 89.6% ± 0.04 in 2000 (Table 3).

Table 3. Mean hatching success for willow flycatchers, Arizona, 1996–2005.

Year	Mean hatching success of all eggs laid ± CI (*n*)	Mean hatching success of eggs that survived incubation ± CI (*n*)
1996	52.9% ± 0.17 (29)	76.7% ± 0.15 (20)
1997	60.7% ± 0.09 (73)	76.4% ± 0.07 (58)
1998	69.0% ± 0.07 (128)	84.0% ± 0.04 (104)
1999	71.6% ± 0.06 (158)	89.7% ± 0.04 (126)
2000	65.7% ± 0.07 (157)	89.6% ± 0.04 (114)
2001	71.7% ± 0.05 (264)	88.0% ± 0.03 (215)
2002	45.4% ± 0.07 (137)	79.7% ± 0.05 (78)
2003	72.5% ± 0.05 (233)	89.4% ± 0.03 (188)
2004	59.5% ± 0.05 (270)	87.8% ± 0.03 (181)
2005	65.2% ± 0.05 (259)	81.6% ± 0.03 (207)
Overall	**65.2% ± 0.06 (1708)**	**86.3% ± 0.08 (1291)**

For the analysis of hatching success based on all eggs laid, there was a significant effect of year indicating that hatching success varied among years ($\chi^2_9 = 101.6$, $P < 0.001$; Figure 4). For the analysis of hatching success based only on the eggs that survived incubation, there was also a significant effect of year ($\chi^2_9 = 45.4$, $P < 0.001$; Figure 5).

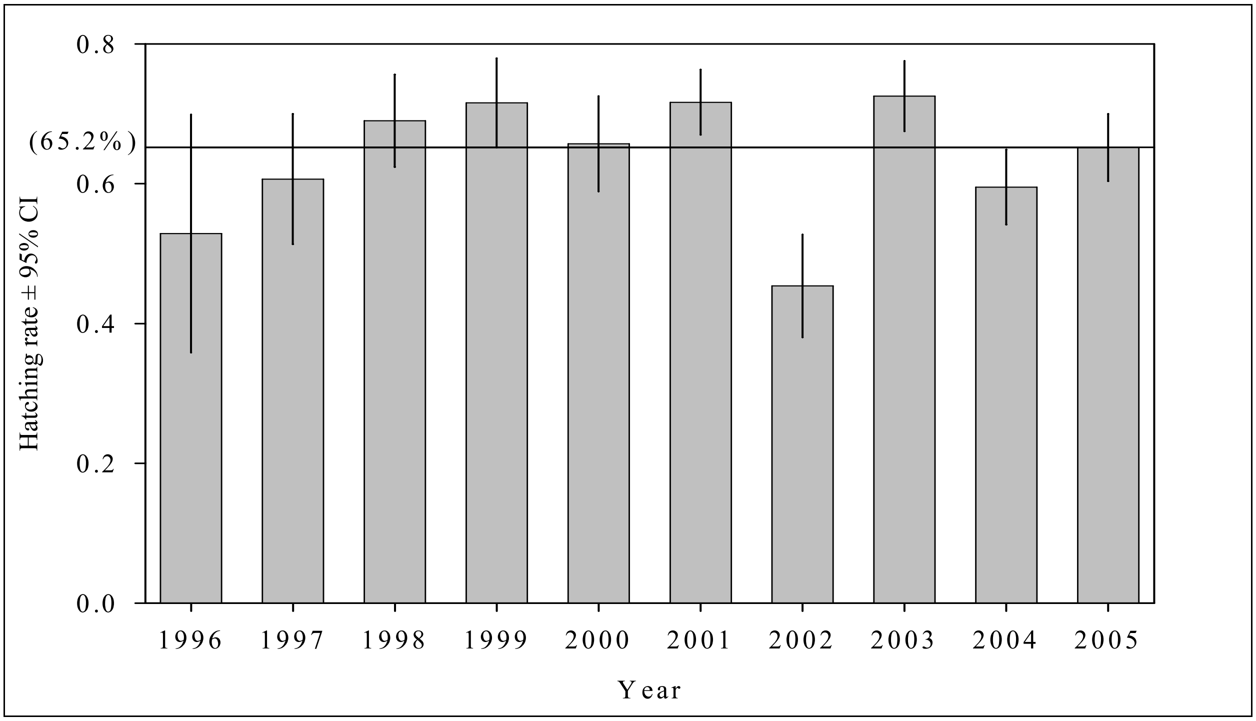

Figure 4. Mean hatch rate (number of nestlings hatched compared to all eggs laid) by year, includes overall yearly mean hatch rate (straight line).

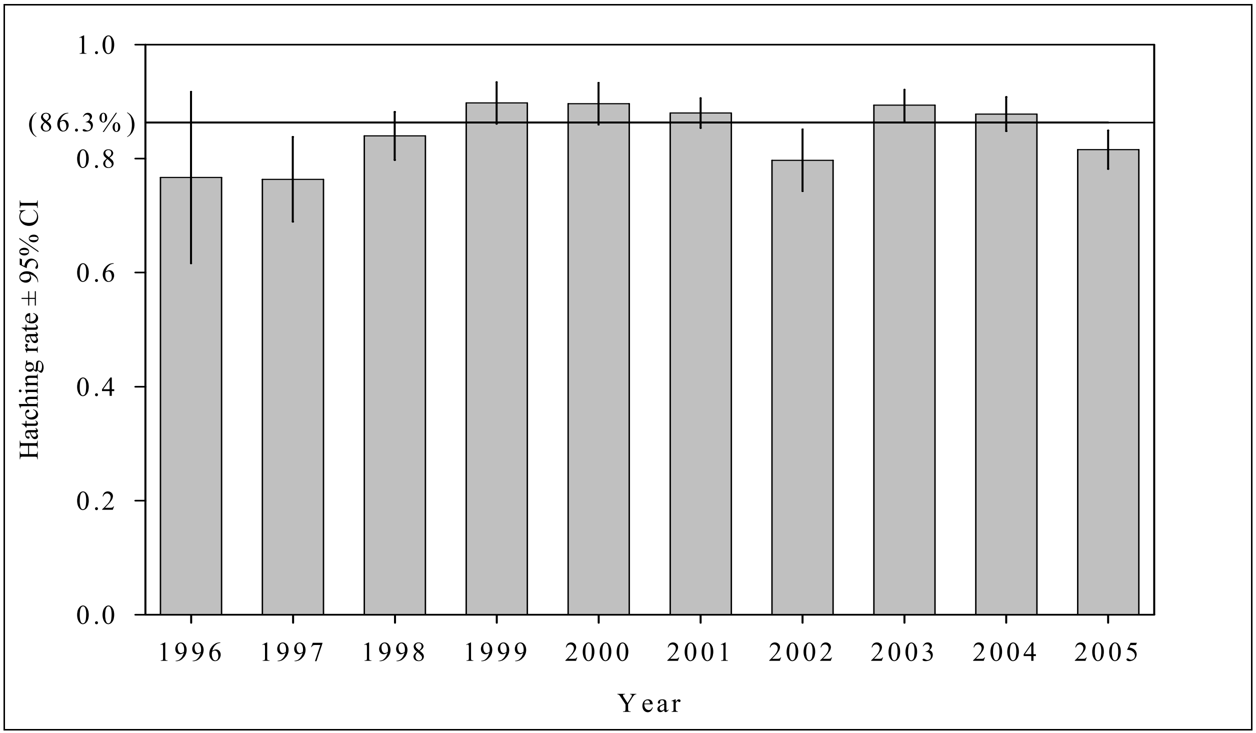

Figure 5. Mean hatch rate (number of nestlings hatched compared to eggs that survived incubation) by year, includes overall yearly mean hatch rate (straight line).

Fledge day. The mean fledge day was 14 July ± 1.2 days (13 July in leap years; n = 1046). The earliest fledge day documented was 12 June on the Salt River in 2003 and the latest was 2 September on the Gila River in 2005, the same nest with the latest first-egg day. There was a significant year effect indicating that fledge day varied over time ($F_{9,\ 1036} = 7.4$, $P < 0.001$; Figure 6). Distribution of fledge day showed a left-skewed distribution with a peak before the mean (Figure 7).

Nesting cycle length. The average nesting cycle was 27.9 days for the nesting cycle (1.9 day laying period, 12.4 day incubation period, and 13.6 day nestling period; n = 298).

Nest outcomes and simple nest success. We determined outcomes (success or failure) for 96.5% of all monitored nesting attempts; 3.5% of nesting attempts had unknown outcomes (Table 4).

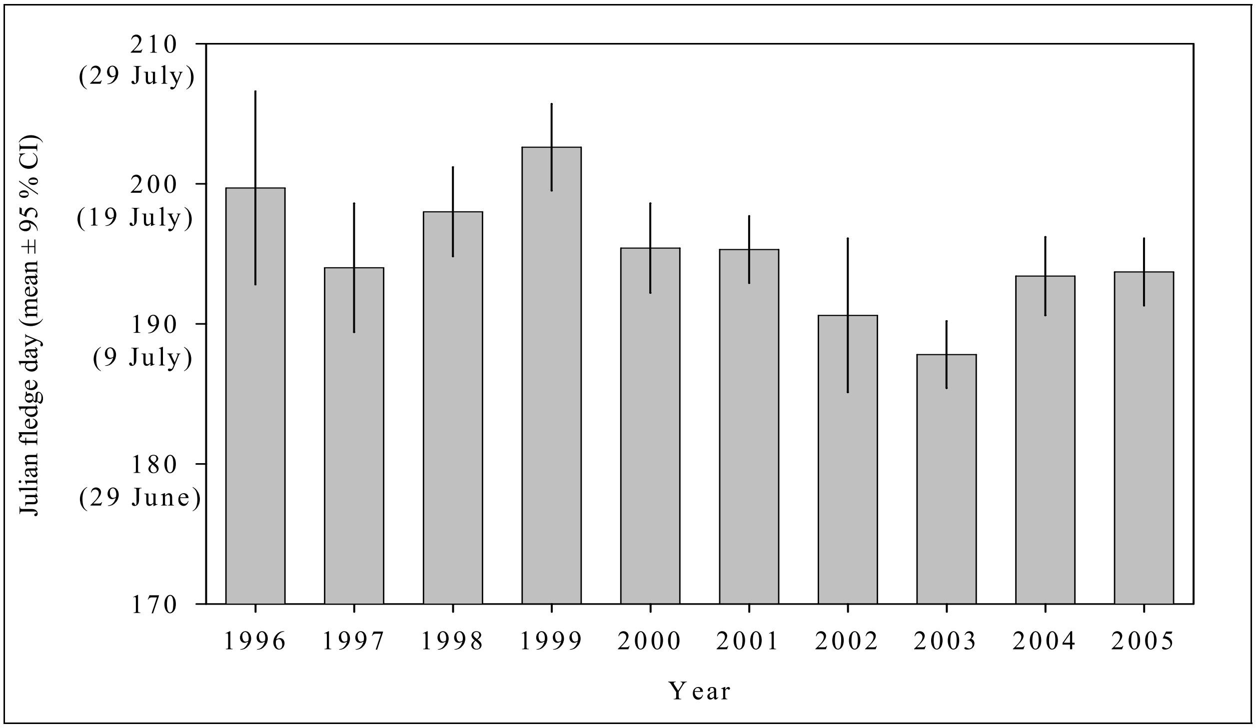

Figure 6. Mean fledge day by year, includes all nesting attempts regardless of order.

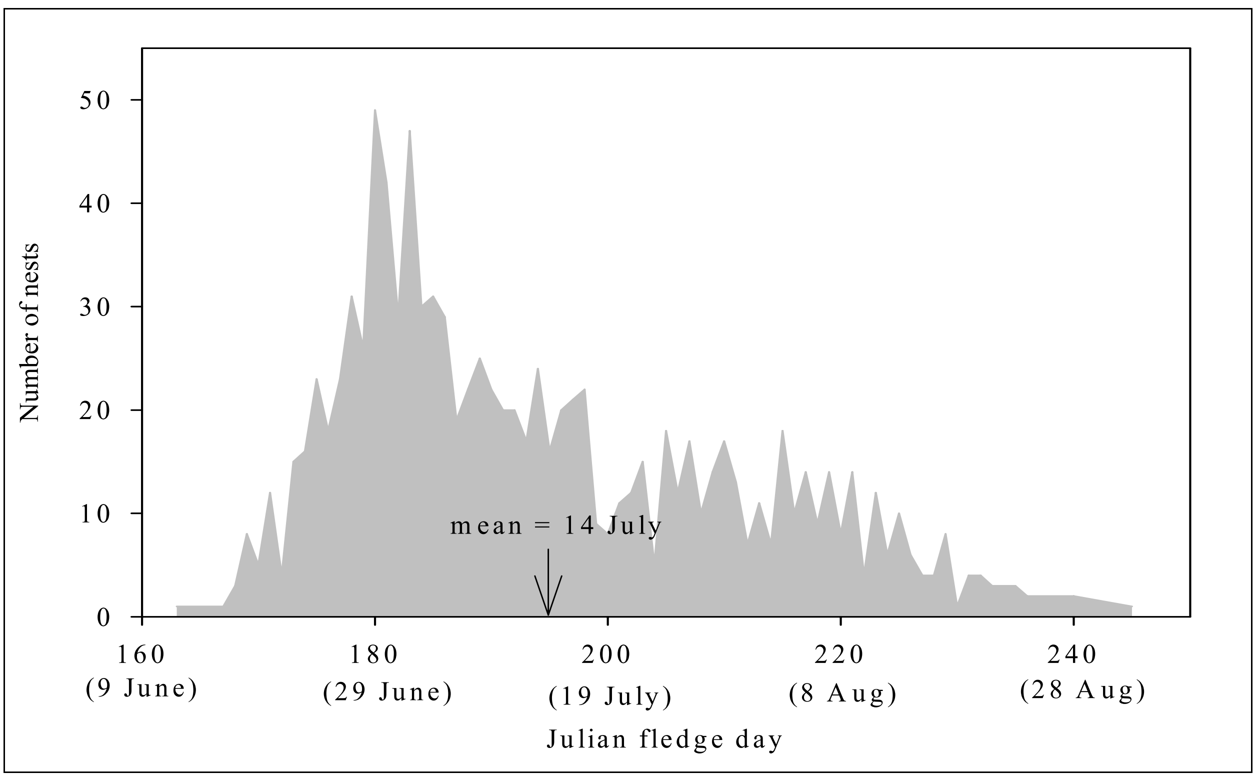

Figure 7. Distribution of fledge day, includes all years and nesting attempts regardless of order, and overall mean fledge day.

Table 4. Nest outcomes for southwestern willow flycatchers by study area, Arizona, 1996–2005.

Year	Study area	Number of nests	Successful (%)	Failed (%)	Unknown (%)	Parasitized (%)
1996	Salt River[a]	10	2 (20.0%)	8 (80%)	0	1 (10%)
	Tonto Creek[a]	7	6 (85.7%)	1 (14.3%)	0	0
	San Pedro River	25	12 (48.0%)	9 (36%)	4 (16%)	1 (4%)
	Gila River	1	1 (100.0%)	0	0	0
1997	Salt River[a]	17	8 (47.1%)	9 (52.9%)	0	0
	Tonto Creek[a]	23	14 (60.9%)	9 (39.1%)	0	1 (4.5%)
	San Pedro River[a]	35	17 (48.6%)	18(51.4%)	0	1 (2.9%)
	Gila River	10	8 (80%)	2 (20%)	0	1 (10%)
1998	Salt River[a]	25	15 (60%)	10 (40%)	0	0
	Tonto Creek[a]	25	19 (76%)	6 (24%)	0	0
	San Pedro River[a]	47	28 (59.6%)	19 (40.4%)	0	0
	Gila River[a]	54	33 (61.1%)	19 (35.2%)	2 (3.7%)	1 (1.9%)
1999	Salt River[a]	63	42 (66.7%)	21 (33.3%)	0	1 (1.6%)
	Tonto Creek[a]	23	15 (65.2%)	8 (34.8%)	0	0
	San Pedro River[a]	51	28 (54.9%)	23 (45.1%)	0	1 (1.9%)
	Gila River[a]	38	17 (44.7%)	20 (52.6%)	1 (2.6%)	0
2000	Salt River[a]	67	42 (62.7%)	24 (35.8%)	1 (1.5%)	1 (3%)
	Tonto Creek[a]	31	18 (58.1%)	13 (41.9%)	0	0
	San Pedro River[a]	43	17 (39.5%)	26 (60.5%)	0	2 (4.7%)
	Gila River[a]	26	18 (69.2%)	8 (30.8%)	0	0
2001	Salt River[a]	79	43 (54.4%)	18 (22.8%)	18 (22.8%)	0
	Tonto Creek	33	24 (72.7%)	9 (27.3%)	0	2 (6.3%)
	San Pedro River[a]	112	70 (62.5%)	41 (36.6%)	1 (0.9%)	1 (0.9%)
	Gila River[a]	56	30 (53.6%)	26 (46.4%)	0	7 (12.5%)
2002	Salt River	28	2 (7.1%)	26 (92.9%)	0	12 (42.9%)
	Tonto Creek	7	0	7 (100%)	0	3 (42.9%)
	San Pedro River[a]	83	23 (27.7%)	59 (71.1%)	1 (1.2%)	2 (2.4%)
	Gila River[a]	23	8 (34.8%)	15 (65.2%)	0	1 (4.3%)
2003	Salt River	109	71 (65.1%)	36 (33%)	2 (1.8%)	5 (4.6%)
	Tonto Creek	26	16 (61.5%)	10 (38.5%)	0	1 (3.8%)
	San Pedro River[a]	118	76 (64.4%)	34 (28.8%)	8 (6.8%)	0
	Gila River[a]	20	14 (70%)	5 (25%)	1 (5%)	0
2004	Salt River	92	40 (43.5%)	51 (55.4%)	1 (1.1%)	2 (2.2%)
	Tonto Creek	39	8 (20.5%)	29 (74.4%)	2 (5.1%)	1 (2.6%)
	San Pedro River	160	77 (48.1%)	74 (46.3%)	9 (5.6%)	3 (1.9%)
	Gila River	13	5 (38.5%)	8 (61.5%)	0	1 (7.7%)
2005	Salt River	55	25 (45.5%)	28 (51%)	2 (3.6%)	0
	Tonto Creek	81	34 (42%)	44 (54.3%)	3 (3.7%)	4 (4.9%)
	San Pedro River	156	99 (63.4%)	48 (30.8%)	9 (5.8%)	0
	Gila River	30	21 (70%)	6 (20%)	3 (10%)	0
Total	Salt River	545	290 (53.2%)	231 (42.4%)	24 (4.4%)	22 (4%)
	Tonto Creek	295	153 (52.0%)	135 (46.0%)	6 (2.0%)	12 (4.1%)
	San Pedro River	830	447 (53.9%)	351 (42.3%)	32 (3.8%)	10 (1.2%)
	Gila River	271	155 (57.2%)	109 (0.2%)	7 (2.6%)	11 (4.1%)
	Total	**1941**	**1046 (53.9%)**	**827 (42.6%)**	**68 (3.5%)**	**55 (2.8%)**

[a]Brown-headed cowbird traps operated at some sites within the study area.

Overall simple nest success for all years combined was 55.8% (n = 1873), but this varied significantly among years (Table 5 and Figure 8). In all years, more nests were successful than failed with the exception of 2002 when more nests failed than were successful. Nest success was 23.6% in 2002. The highest nest success was in 2003 when 67.6% of nests were successful.

Table 5. Simple nest success of southwestern willow flycatchers, Arizona, 1996–2005.

Year	Simple success %	(*n*)
1996	53.8%	39
1997	55.3%	85
1998	63.8%	149
1999	58.6%	174
2000	57.2%	166
2001	64.0%	261
2002	23.6%	140
2003	67.6%	262
2004	44.5%	292
2005	58.7%	305
Total	**55.8%**	**1873**

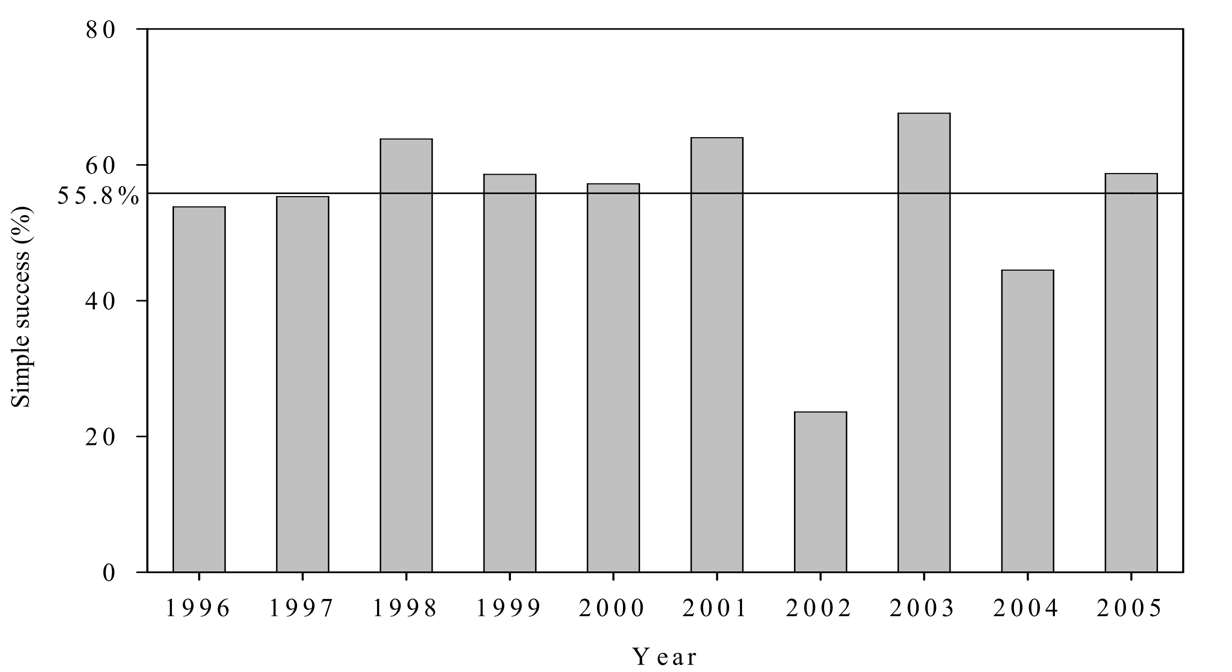

Figure 8. Simple nest success by year, including mean across all years (straight line).

Nest parasitism. Rates of brown-headed cowbird parasitism were low overall (2.8%), but varied by year and drainage (Table 4). The highest rate of parasitism (42.9%) occurred in 2002 at both the Salt River and Tonto Creek study areas. Most years and study areas had rates between 0%

and 10.0%. Brown-headed cowbird trapping at some sites between 1996 and 2003 may have influenced parasitism rates. Of 55 parasitized nests, 11 (20.0%) successfully produced flycatcher fledglings (Table 6).

Table 6. Nest outcomes of parasitized nests for southwestern willow flycatchers by study area, Arizona, 1996–2005.

Study Area	Number of Nests	Depredated	Deserted	Fledged only cowbird	Fledged flycatcher and cowbird	Fledged only flycatcher	Other failure
Salt River	22	11	4	2	1	2	2
Tonto Creek	12	8	2	1	0	1	0
San Pedro River	10	4	1	0	0	2	3
Gila River	11	3	1	0	1	4	2
Total	**55**	**26**	**8**	**3**	**2**	**9**	**7**

<u>Nest failure.</u> Although there was some variation by year, the dominant cause of nest failure was depredation (80.7% of nest failures, 35.6% of nests with known outcome; Table 7). Depredation caused 50.0% and 69.2% of nest failures during laying and incubation stages, respectively, but increased to 95.1% in the nestling stage. Desertion and infertility of entire clutches were the next greatest causes of failure, 11.0% and 3.0% of failures, respectively. Although 2.8% of nests were parasitized, parasitism accounted for only 1.6% of failures (24.5% of parasitized nests failed directly due to parasitism). The remaining (3.7%) nests failed due to other causes (e.g., weather, human disturbance).

Table 7. Causes of nest failure for southwestern willow flycatchers by study area, Arizona, 1996–2005.

Year	Study area	Number of nests	Depredated (%)	Deserted (%)	Parasitism (%)[a]	Infertile (%)	Other (%)
1996	Salt River	8	4 (50.0%)	2 (25.0%)	1 (12.5%)	0	1 (12.5%)
	Tonto Creek	1	0	0	0	0	1 (100.0%)
	San Pedro River	9	8 (88.9%)	0	1 (11.1%)	0	0
	Gila River	0	0	0	0	0	0
1997	Salt River	9	8 (88.9%)	1 (11.1%)	0	0	0
	Tonto Creek	9	5 (62.5%)	1 (12.5%)	1 (12.5%)	0	2 (12.5%)
	San Pedro River	18	16 (88.8%)	0	1 (5.6%)	1 (5.6%)	0
	Gila River	2	2 (100.0%)	0	0	0	0
1998	Salt River	10	8 (80.0%)	2 (20.0%)	0	0	0
	Tonto Creek	6	6 (100%)	0	0	0	0
	San Pedro River	19	17 (89.4%)	1 (5.3%)	0	0	1 (5.3%)
	Gila River	19	16 (84.2%)	0	0	1 (5.3%)	2 (10.5%)
1999	Salt River	21	14 (66.6%)	3 (14.3%)	1 (4.8%)	2 (9.5%)	1 (4.8%)
	Tonto Creek	8	6 (75.0%)	1 (12.5%)	0	1 (12.5%)	0
	San Pedro River	23	20 (87.0%)	2 (8.7%)	0	1 (4.3%)	0
	Gila River	20	17 (85.0%)	1 (5.0%)	0	2 (10.0%)	0
2000	Salt River	24	20 (83.4%)	2 (8.3%)	0	0	2 (8.3%)
	Tonto Creek	13	9 (69.2%)	4 (30.8%)	0	0	0
	San Pedro River	26	14 (53.8%)	9 (34.6%)	0	2 (7.7%)	1 (3.9%)
	Gila River	8	6 (75.0%)	1 (12.5%)	0	1 (12.5%)	0
2001	Salt River	18	16 (88.8%)	1 (5.6%)	0	0	1 (5.6%)
	Tonto Creek	9	6 (66.7%)	1 (11.1%)	1 (11.1%)	1 (11.1%)	0
	San Pedro River	41	32 (78.1%)	6 (14.6%)	0	3 (7.3%)	0
	Gila River	26	19 (73.1%)	5 (19.2%)	1 (3.8%)	1 (3.8%)	0
2002	Salt River	26	19 (73.1%)	4 (15.4%)	1 (3.8%)	0	2 (7.7%)
	Tonto Creek	7	4 (57.1%)	2 (28.6%)	0	0	1 (14.3%)
	San Pedro River	59	56 (94.9%)	2 (3.4%)	1 (1.7%)	0	0
	Gila River	15	13 (86.6%)	0	1 (6.7%)	0	1 (6.7%)
2003	Salt River	36	23 (63.9%)	10 (27.8%)	1 (2.8%)	2 (5.6%)	0
	Tonto Creek	10	10 (100.0%)	0	0	0	0
	San Pedro River	34	26 (76.5%)	7 (20.6%)	0	1 (2.9%)	0
	Gila River	5	5 (100.0%)	0	0	0	0
2004	Salt River	51	43 (84.3%)	3 (5.9%)	1 (2%)	0	4 (7.8%)
	Tonto Creek	29	27 (93.1%)	1 (3.4%)	0	0	1 (3.4%)
	San Pedro River	74	64 (86.5%)	5 (6.8%)	0	1 (1.4%)	4 (5.4%)
	Gila River	8	5 (62.5%)	0	1 (12.5%)	0	2 (25.0%)
2005	Salt River	28	23 (82.1%)	3 (10.7%)	0	1 (3.6%)	1 (3.6%)
	Tonto Creek	44	34 (77.3%)	7 (15.9%)	0	2 (4.5%)	1 (2.3%)
	San Pedro River	48	41 (85.4%)	4 (8.3%)	0	2 (4.2%)	1 (2.1%)
	Gila River	6	5 (83.3%)	0	0	0	1 (16.7%)
Total	Salt River	231	178 (77.1%)	31 (13.4%)	5 (2.2%)	5 (2.1%)	12 (5.2%)
	Tonto Creek	136	108 (79.4%)	17 (12.5%)	2 (1.5%)	4 (2.9%)	5 (3.7%)
	San Pedro River	351	294 (83.8%)	36 (10.3%)	3 (0.8%)	11 (3.1%)	7 (2.0%)
	Gila River	109	87 (79.8%)	7 (6.4%)	3 (2.8%)	5 (4.6%)	7 (6.4%)
	Total	**827**	**667 (80.7%)**	**91(11%)**	**13 (1.6%)**	**24 (2.9%)**	**31 (3.7%)**

[a] Includes only those nests that failed directly due to cowbird parasitism (nests subsequently deserted s or fledged only cowbird young).

Habitat type and nest tree species: Overall, nests were predominately found in mixed native and exotic habitat (71.2%), which was also the case for individual study areas (Table 8). Nests in entirely or almost entirely exotic (18.5%) and native (10.5%) habitat were less common. Of all the study areas, the San Pedro River study area had the greatest proportion of nests in native habitat (22.0%); the Salt River study area was the only other study area with nests in native habitat (3.9%). Of all the study areas, the Gila River study area had the greatest proportion of nests in exotic habitat (30.6%) and the San Pedro study area the lowest proportion (9.5%).

Tamarisk was the most common nest tree species at all study areas (75.7% overall; 87.9% at Salt River, 87.0% at Tonto Creek, 56.3% at San Pedro River, and 98.9% at Gila River; Table 9). Goodding's willow was the next most common nest tree species at all study areas (19.7% overall; 11.7% at Salt River, 11.3% at Tonto Creek, 33.9% at San Pedro, and 1.1% at Gila River). Cottonwood (3.3%) and other species (including snags of unknown species; 1.2%) were uncommon.

Table 8. Habitat type used by flycatchers for nesting, Arizona, 1996–2005.

Study area	Habitat type	Number of nests (%)
Salt River	Native (>90%)	21 (3.9%)
	Mixed native and exotic	374 (68.6%)
	Exotic (>90%)	150 (27.5%)
Tonto Creek	Native (>90%)	0
	Mixed native and exotic	252 (85.4%)
	Exotic (>90%)	43 (14.6%)
San Pedro River	Native (>90%)	183 (22.0%)
	Mixed native and exotic	568 (65.5%)
	Exotic (>90%)	79 (9.5%)
Gila River	Native (>90%)	0
	Mixed native and exotic	188 (69.4)
	Exotic (>90%)	83 (30.6%)
Overall	**Native (>90%)**	**204 (10.5%)**
	Mixed native and exotic	**1382 (71.2%)**
	Exotic (>90%)	**355 (18.3%)**

Table 9. Tree species used by southwestern willow flycatchers nesting in Arizona by study area, 1996–2005.

Tree species	Salt River (%)	Tonto Creek (%)	San Pedro River (%)	Gila River (%)	Total Nests
tamarisk (*Tamarix* spp.)	474 (87.9%)	253 (87.0%)	466 (56.3%)	264 (98.9%)	1457 (75.7%)
Goodding's willow (*Salix gooddingii*)	63 (11.7%)	33 (11.3%)	281 (33.9%)	3 (1.1%)	380 (19.7%)
Fremont cottonwood (*Populus fremontii*)	0	5 (1.7%)	59 (7.1%)	0	64 (3.3%)
common buttonbush (*Cephalanthus occidentalis)*	0	0	8 (1%)	0	8 (0.4%)
mesquite (*Prosopis* spp.)	2 (0.4%)	0	2 (0.2%)	0	4 (0.2%)
willow (*Salix* spp.)	0	0	4 (0.5%)	0	4 (0.2%)
snag	0	0	4 (0.5%)	0	4 (0.2%)
desert broom (*Baccharis sarothroides*)	0	0	1 (0.1%)	0	1 (<0.1%)
seep willow (*Baccharis* spp.)	0	0	1 (0.1%)	0	1 (<0.1%)
coyote willow (*Salix exigua*)	0	0	1 (0.1%)	0	1 (<0.1%)
graythorn (*Ziziphus obtusifolia*)	0	0	1 (0.1%)	0	1 (<0.1%)
Total	**539**	**291**	**828**	**267**	**1925**

DISCUSSION

The willow flycatcher has a wide distribution and considerable data exists for the species and various subspecies (e.g., King 1955, McCabe 1991, Sedgwick 2000, Durst et al. 2007). Most data available for *E. t. extimus* are from study populations in New Mexico, California, and Arizona due to the subspecies' limited range and distribution (e.g., Stoleson and Finch 1999, Cain et al. 2003, Durst et al. 2007, Schuetz and Whitfield 2007). The data collected during our long-term study is some of the most extensive on flycatcher breeding biology.

We found that first-egg day at our study areas varied between years and nesting attempt number. Further, the difference between the mean first-egg of first clutches and the mean first-egg of second clutches varied differently among years. The mean first-egg day at our study areas was 10 June, but varied widely from 14 May to 17 August. Unitt (1987) found that *E. t. extimus*' mean first-egg day was 16 June, but varied between 24 May and 30 July. Other subspecies with documented first-egg day have a more restricted range in dates, starting later and ending earlier. In Michigan, mean first-egg day for a population of *E. t. traillii* was 17 June (n = 23; range 6–28

June; Walkinshaw 1966). In northern California, a population of possible hybrids between *E. t. brewsteri* and *E. t. adastus* had a range of first-egg days from 25 June through 19 July (King and King 2003). Variations in first-egg day between subspecies may be attributed to sample size and study length. Other factors, such as a shorter breeding season in the northern latitudes may be influencing a shorter first-egg day range in the other subspecies.

The mean clutch size of 2.8 (± 0.1) eggs is comparable to other clutch sizes reported for the subspecies. These include means of 3.0 eggs (*n* = 3) in the Grand Canyon (Arizona), 2.67 eggs (*n* = 21) at the Cliff-Gila Valley (New Mexico), and 3.3 eggs (*n* = 154) at the Kern River (California; Skaggs 1996; Sogge et al. 1997*b*; M. Whitfield unpublished data in Stoleson et al. 2000). As noted by Sogge (2000), birds in Arizona and New Mexico seem to have slightly smaller clutches than birds in California. Throughout the range of *E. t. extimus*, clutches are slightly smaller than some other willow flycatcher subspecies (*E. t. adastus*: 3.42 eggs, *n* = 33; *E. t. traillii*: 3.59, *n* = 415, and 3.41 eggs, *n* = 91; King 1955, Holcomb 1974), but similar to *E. t. brewsteri* (2.82 eggs, *n* = 11; Walkinshaw 1966). Although smaller clutch size in the southwestern subspecies could be considered problematic or a contributing factor to its endangered status, an increase in clutch size with increasing latitude has been demonstrated within many species, with suggested reasons such as increased day length, variation in seasonal food resources, and climatic stability (Lack 1954, Cody 1966, Ricklefs 1980, Hussell 1985).

As with other willow flycatcher subspecies and many Neotropical migrants, we found that clutches of first nesting attempts are larger than clutches of later nesting attempts (Holcomb 1974, Petit 1989, McCabe 1991, Holmes et al. 1992, Brown and Roth 2002). This may be due to time or resource restrictions such as the female not having enough resources to produce additional eggs, timing of the nestling phase to ensure adequate food resources for nestlings, or time restraints before migration (Lack 1966, Holcomb 1974, McCabe 1991).

We found that hatching success varied among years. Hatching success could be influenced by many factors varying between years (e.g., temperature fluctuations effecting ambient temperature of eggs, food supplies effecting female condition and time spend foraging versus incubating eggs, depredation and desertion rates, or an interaction of factors). Hatching success was higher with less variation among years when the proportion of eggs hatched of all eggs that survived incubation was compared to the proportion of eggs hatched of all eggs laid. This indicates that much of the year to year variation is tied to variations in rates of depredation and desertion during incubation. Our mean yearly hatching success for all eggs laid (65.2%) was similar to the Kern River (California) population's range 61.5–96.4% from 1993 to 2006 (Schuetz and Whitfield 2007). Studies of other subspecies have reported hatch rates of 54.8 % (*n* = 272) in Ohio and Nebraska and 73.8% (n = 302) in Michigan for *E. t. traillii*, 92.6% (*n* = 67) in Washington for *E. t. adastus*, and 60.2% (*n* = 3,537) in Oregon for *E. t. adastus* (King 1955, Wilkinshaw 1966, Holcomb 1972, Sedgwick and Iko 1999).

The mean fledge day of flycatchers at our study areas varied among years. Grouping all nesting attempts in our analysis showed the full range of fledge days, regardless of attempt number. The mean, range, and distribution of fledge days reflects yearly variation in nest initiation and the number and timing of renests and double-brooding attempts. As with mean first-egg day, our mean fledge day ranged over a wider distribution (12 June–2 September) than the reported range of *E. traillii*; 22 July–17 August was reported in a population of possible hybrids between *E. t. brewsteri* and *E. t. adastus* in northern California (King and King 2003).

Our average laying stage of 1.9 days corresponds well with our average clutch size of 2.8 eggs (under the assumption that females typically begin incubation on the penultimate egg). Our 12.4 day incubation period and 13.6 day nestling period agree with the limited historical data available for *E. traillii* flycatchers (incubation: *E. t. brewsteri*: 12 days, *n* = not provided and *E. t. campestris*: 14.3 days, *n* = 7; nestling: *E. t. brewsteri;* 12–13, days, *n* = 3 and *E. t. campestris*: 13 days, *n* = 13; King 1955, Walkinshaw 1966). The number of days for each period also fall within nesting chronology estimates given in the original AGFD nest monitoring protocol (incubation: 11–14 days; nestling stage: 10–15 days; average fledge age: day 12; Rourke et al. 1999).

Overall simple nest success for all years combined was 55.8%, which is within the reported range of simple nest success for open-cup nesting songbirds (39.5–76.6%, reviewed in Nice 1957; 1–82%, reviewed in Best and Stauffer 1980). Simple nest success was close to the mean in most years, but fell to a low of 23.6% in 2002, which may be attributed to long-term drought conditions in the study areas. In 2003, however, simple nest success increased to a high of 67.6%. Simple success for other *E. t. extimus* populations range from 15.8% (*n* = 19) at the Kern River (California), to 66.0% (*n* = 70) at the San Luis Rey River (California; Harris 1991; W. Haas personal communication in Stoleson et al. 2000). However, data restricted to 1 year or a small number of nesting attempts is unlikely to reflect the long-term nest success of a population because success can vary greatly among years, as demonstrated by our 10-year study. Simple nest success along the Lower Colorado River in Arizona ranged from 37–64% from 2003 to 2006 (Koronkiewicz et al. 2004, 2006; McLeod et al. 2005, 2007). Nest monitoring at the Elephant Butte Reservoir in New Mexico had an 11-year (1996–2006) nest success average very similar to our observations in Arizona of 58.6% (*n* = 655; Moore and Ahlers 2006). Whitfield's long-term study at the Kern River (California; 1989–1997) had a simple nest success of 36.4% (*n* = 324; Whitfield unpublished data in Stoleson et al. 2000). Lower nest success at the Kern River is likely due to higher rates of parasitism at the Kern River (1989–2006: range 0–78%, 63% before cowbird trapping and 19% post-trapping; Whitfield and Strong 1995; Schuetz and Whitfield 2007) compared to our study average (2.8%). Other willow flycatcher subspecies have similar simple nest success (*E. t. adastus*: 40.7%, *n* = 27; *E. t. traillii*: 39.5%, *n* = 459 and 39.5% *n* = 91; *E. t. brewsteri: 58.5%, n* = 147*;* King 1955, Holcomb 1972, Altman et al. 2003).

With an overall parasitism rate of 2.8%, our study populations do not appear to be under stress from brown-headed cowbird parasitism. Moore and Ahlers (2006) found that 11% of nests (*n* = 168) were parasitized in 2006 at Elephant Butte Reservoir in New Mexico and 40% (*n* = 10) of non-manipulated parasitized nests (nests where brown-headed cowbird eggs were not removed), failed due to parasitism in 2006. Only 24.5% of parasitized nests failed due to the parasitism in our study populations. Although the overall parasitism rate and nest failure rate due to parasitism at our study areas were low, parasitism rates were high in 2002, especially at the Salt

River and Tonto Creek study areas (42.9%). The high rate was likely related to extreme drought conditions. Vegetation in 2002 was less vigorous and may have provided less cover for nests. Food resources were reduced in 2002 (Durst 2004), perhaps requiring females to spend additional time foraging, leaving the nest unattended and vulnerable to parasitism. The population size of cowbirds and availability of nests of other host species may also have influenced parasitism rates on flycatcher nests.

The U.S. Bureau of Reclamation conducted cowbird trapping at some of our sites during some years, but baseline data was not collected, making pre- and post-trapping comparisons impossible. Parasitism rates remained low at our study areas after trapping was discontinued, suggesting that cowbird trapping did not reduce parasitism rates at our study areas. Although parasitism is not currently a major concern for our populations; other populations clearly experience detrimental effects from parasitism. The Southwestern Willow Flycatcher Recovery Plan recommends considering cowbird trapping if rates exceed 20–30% (USFWS 2002). If rates are >20%, USFWS should be contacted to discuss the implementation of a cowbird trapping program (USFWS 2002). Cowbird trapping does not always reduce parasitism or increase flycatcher population levels (reviewed in Rothstein et al. 2003). The parasitism rate on the Lower Colorado River in Arizona ranged between 15% and 32% from 2003 to 2006 (Koronkiewicz et al. 2004, 2006; McLeod et al. 2005, 2007) and cowbird trapping (2003–2005) did not decrease parasitism rates compared to pre-trapping (1997–2002). Conversely, parasitism at the Kern River decreased from 63.5% (1989–1992) to 15.6% following implementation of a cowbird trapping program (1993–1995). Although nest success increased from 26% to 48% during the same period, the flycatcher population did not increase during trapping (Schuetz and Whitfield 2007). The degree and impact of brown-headed cowbird parasitism is highly variable among populations of *E. t. extimus* and require continuous monitoring, evaluation, and potential intervention to attempt to reduce negative impacts.

Depredation was the leading cause of nest failure during our study. Likewise, other studies of *E. t. extimus* have found depredation to cause the greatest number of nest failures among populations (e.g., 14–57% at the Kern River, California from 1989 to 2006, 47–64% at the Colorado River, Arizona from 2003 to 2006, 37.3% at the Cliff-Gila Valley in New Mexico; Stoleson and Finch 1999; Koronkiewicz et al. 2004, 2006; McLeod et al. 2005, 2007; Schuetz and Whitfield 2007). Additionally, several authors (Nice 1957; Ricklefs 1969; Best and Stauffer 1980; Martin 1992, 1993) report depredation as the leading cause of failure for most open-cup nesting birds.

The increase in depredation rates as nest stages progress could be due to an increase in activity at the nest during later stages, especially the nestling stage. Skutch (1949) hypothesized that as activity at the nest increases during the nestling stage, depredation rates also increase. During our time-lapse camera study (Chapter 6), we found that depredation occurred more often later in the nestling stage (≥6 days) than earlier (≤5 days). Variation in survival rates across nest stages has been documented as both increasing and decreasing with nest age, although few studies have sufficient data from the laying stage and are limited to incubation and nestling stages. Martin et al. (2000) found that once nest site was factored out, depredation rates increased as activity at the nest increased during the nestling stage. Burhans et al. (2002) found higher rates of depredation in the nestling stage than the incubation stage for indigo buntings (*Passerina cyanea*). Likewise, lark bunting (*Calamospiza melanocorys*) nest survival decreases with nest age (Jehle et al. 2004). However, some studies (e.g., Brown and Roth 2002) have found the opposite; wood thrush (*Hylocichla mustelina*) nests were more likely to fail during laying than any other stage.

Flycatchers nest predominately in mixed native and exotic habitat at all of our study areas. Habitat use is likely reflective of the availability of habitat type which varied by year. Some sites that were native-dominated at the beginning of the study were mixed native and exotic by the end of the study. The San Pedro River study area had the greatest proportion of nests in native habitat and had more native-dominated sites than other study areas. The Gila, with no native-dominated sites, had the greatest proportion of nests in exotic habitat.

Although tamarisk is an exotic invasive species, flycatchers readily use it as a nest tree. Tamarisk was the most common nest tree species used by flycatcher at our study areas (75.7%), followed by Goodding's willow (19.7%), with Fremont cottonwood (3.3%) and other species (1.2%) rarely being used as nest trees. Although availability of tree species was not measured, tamarisk was very prevalent at all of our study areas. McLeod et al. (2007) found a similar pattern in 2006 in Arizona (61% tamarisk, 24% Goodding's willow, 10% coyote willow, 1% Fremont cottonwood, 1% mesquite, and 3% snags). Owen et al. (2005) did not find evidence that flycatchers breeding in tamarisk-dominated habitat were of poorer physiological condition than those breeding in native-dominated habitat. Further, Durst (2004) found that the flycatcher's main food base, arthropods, did not differ in abundance between tamarisk-dominated habitat and native-dominated habitat, although composition was different. No difference in productivity has been detected between flycatchers nesting in tamarisk-dominated and native-dominated habitat (Sogge et al. 2005, Chapter 5).

Estimation of demographic parameters (e.g., clutch size, fledge date) of our study populations fall within the reported norm of other populations of willow flycatchers and other *Empidonax* flycatchers. Demographic modeling by Paxton et al. (2007) found observed and estimated lambda (an estimation of population growth) of these populations to be positive. Based on our 10-year study, the demographic parameters of these populations fluctuate in response to changing environmental conditions. Sequential years of low productivity, comparable to that observed in 2002, may have detrimental long-term effects on the populations. However, the populations appear to have recovered quickly from the isolated year of reproductive failure in 2002. These populations continue to comprise a large portion of the territory numbers needed for recovery goals for the Gila Recovery Unit and the management units (Roosevelt Management Unit and Middle Gila/San Pedro Management Unit) in which these populations are located. The Gila Recovery Unit is the most stable of all recovery units in the flycatcher's range because of these populations, though continued development and water usage are likely to threaten this stability.

As in many demographic studies, we found that traits vary greatly between years (e.g., Moore and Ahlers 2006, Schuetz and Whitfield 2007). Comparisons with flycatchers in California and

New Mexico, as well as with other willow flycatcher subspecies, also show variation. Yearly and geographic variation can be caused by many factors such as rainfall, temperature, and disturbance events (e.g., floods, human activity). These factors in turn can influence the availability of food resources, predation rates, and parasitism rates, which impact nest success, productivity, and survivorship. Underlying causes in variations of demographic parameters may not always be apparent, making long-term studies over a wide geographic range essential to accurately estimate demographic parameters.

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CHAPTER 5

RIVER AND RESERVOIR NESTING

INTRODUCTION

The southwestern willow flycatcher (*Empidonax traillii extimus*, flycatcher), a subspecies of the willow flycatcher, was listed as federally endangered in 1995 (USFWS 1995) due to declines in populations over the past 100–150 years (Harris et al. 1987, Unitt 1987). These declines have largely been attributed to loss and degradation of breeding habitat throughout its breeding range (Unitt 1987; Whitfield 1990; Harris 1991; USFWS 1995, 2002).

The flycatcher is an obligate riparian breeder that prefers to breed in dense, contiguous vegetation or a mosaic of dense vegetation interspersed with multiple small openings along waterways or near saturated soil (Sogge and Marshall 2000; USFWS 2002, 2005; Paradzick and Woodward 2003; Allison et al. 2003). Historically, breeding sites were dominated by willow (*Salix* spp.), cottonwood (*Populus* spp.), and other native vegetation along streams, rivers, cienegas, and other natural bodies of water (Monson and Phillips 1981, Hunter et al. 1987, Unitt 1987, Sogge and Marshall 2000). Riparian systems in the Southwest are naturally rare and vulnerable to human-caused disturbance. The availability of unaltered native riparian habitat has declined greatly due to the management of waterways through dams and groundwater pumping, land-use practices such as farming and cattle grazing, and the invasion of tamarisk (*Tamarix* spp.; USFWS 2002). Riparian systems in the Southwest have been further stressed by long-term drought conditions for much of the last decade, which are expected to continue (McCabe et al. 2004, McPhee et al. 2004, Seager et al. 2007).

Throughout their range, flycatchers have been documented inhabiting riparian habitat in a variety of systems ranging from free-flowing rivers to reservoirs (e.g., Durst et al. 2007, Graber et al. 2007). As unaltered riparian systems become increasingly rare, flycatchers frequently breed at reservoirs in high numbers in Arizona (Roosevelt Lake, Horseshoe Lake, Alamo Lake, Lake Mead), New Mexico (Elephant Butte), and California (Lake Isabella; Marshall and Stoleson 2000; Moore and Ahlers 2006; Graber et al. 2007). Approximately 39% of flycatcher territories (190 territories) in Arizona in 2005 were associated with reservoirs, which has increased slowly from 31% of territories (47 territories) in Arizona in 1996 when this project began (Sferra et al. 1997, English et al. 2006).

While the reservoir may be the most apparent result of a dam, downstream habitat is often greatly impacted, depending on water release regimes (Poff et al. 1997, Levine and Stromberg 2001). Dams modify flow rates, flood periodicity, sediment and nutrient transport, and native plant recruitment (Levine and Stromberg 2001). Exotic tamarisk has become a dominant plant at reservoirs (Warren and Turner 1975, Glenn and Nagler 2005), and may benefit from release patterns downstream of reservoirs, altering the vegetative composition of riparian systems downstream of dams (Stromberg et al. 2005, Beauchamp and Stromberg 2007).

Comparisons of nest success and productivity of flycatchers at rivers and reservoirs with differing habitat composition and water regimes can provide information on the relative quality of flycatcher habitat in differing systems. As with other species, flycatchers may occupy less suitable habitat (i.e., disturbed) if less disturbed habitat of higher quality is unavailable, but they may be subject to additional pressures potentially resulting in reduced nest success, reduced survivorship, lower productivity, or fewer nesting attempts (Van Horne 1983, Virkkala 1990, Holmes et al. 1996). Understanding variations in demographic parameters among populations in differing habitats and their response to environmental conditions is necessary in order to make management decisions that will positively affect populations and ultimately assist with reaching recovery goals.

Here, we assess relative habitat quality by comparing nesting success, number of second nesting attempts, and productivity of flycatchers nesting at study areas along 4 drainages: the Salt River, Tonto Creek, the San Pedro River, and the Gila River. These 4 drainages vary in the degree of water regulation and prevalence of tamarisk. In cooperation with U.S. Geological Survey (USGS) Southwest Biological Science Center, we initiated a demographic study of flycatcher populations along these drainages. Together, these populations account for approximately 70% of the flycatcher territories in Arizona (English et al. 2006) and 30% of the rangewide territories (Durst et al. 2005). We monitored nests to describe flycatcher nesting biology and factors influencing nest survival. Although nest monitoring was conducted from 1996 to 2005, only 2001 to 2005 are reported here due to procedural changes in 2001.

STUDY AREAS

This study was conducted at 4 breeding areas in central Arizona: Salt River, Tonto Creek, San Pedro River, and Gila River. The Salt River and Tonto Creek are located 25 km apart and are the primary inflows to Roosevelt Lake, a reservoir, within Tonto National Forest in Gila County. The Salt River study area is a perennial 15 km reach that flows into the southeastern end of Roosevelt Lake. The Tonto Creek study area is a 16 km reach that flows into the northwestern end of Roosevelt Lake; flows are intermittent and dependent on spring snowmelt and summer monsoon rains, causing it to frequently dry late in the breeding season. Study areas are comprised of U.S. Forest Service (Tonto National Forest) and private land. The San Pedro River flows into the Gila River near Winkelman, AZ. The San Pedro River study area is a 45 km reach of the San Pedro River upstream of Winkelman; flows are perennial in some areas and intermittent in others, largely influenced by precipitation and groundwater pumping. The Gila River study area is a 40 km reach of the Gila River upstream and downstream of Winkelman; flows along the Gila River are variable, largely influenced by regulated releases from the San Carlos Reservoir's Coolidge Dam with some natural flow from the San Pedro River. Study areas are composed of private, municipal, state, and federal (U.S. Bureau of Land Management and U.S. Bureau of Reclamation) lands (see Chapter 1 for more information).

Each study area is composed of numerous discrete vegetation patches that vary in vegetation composition and age. We labeled discrete habitat patches or groups of patches in close proximity of each other with a survey site (site) name. The riparian habitat is classified as Sonoran Riparian Deciduous Forest (Minckley and Brown 1994) and the habitat composition of each site ranges from monotypic stands of native broadleaf trees, to stands of mixed native and exotic, to nearly monotypic stands of exotic tamarisk (see Chapter 1 for more information).

METHODS

LOCATING AND MONITORING NESTS

Each year (1996–2006), we surveyed all suitable breeding habitat within each study area for which we obtained landowner permission. Suitable breeding habitat is defined as contiguous riparian forest with dense interior vegetation or an aggregate of dense vegetation patches interspersed with multiple small openings (creating a mosaic of forest and openings) located near surface water or saturated soil (Sogge and Marshall 2000; USFWS 2002, 2005; Paradzick and Woodward 2003; Allison et al. 2003). Surveys followed a standardized tape-playback protocol using the flycatcher's song to elicit responses (Tibbitts et al. 1994, Sogge et al. 1997). We performed 1 tape-playback survey at each site in each of the following 3 survey periods: 15 May–31 May, 1 June–21 June, and 22 June–10 July. We performed surveys at least 5 days apart, from 1 hour prior to sunrise to 1000 hrs, the time of day when the birds were most active. We collected Universal Transverse Mercator (UTM) coordinates of all territories.

We located and monitored nests using the Southwestern Willow Flycatcher Nest Monitoring Protocol (Rourke et al. 1999). Once we detected a flycatcher on a survey, we visited the territory every 4 days in an attempt to locate a nest. Nests were located by watching adults return to a nest or by systematically searching suspected nest areas. Once a nest was located, we visited the territory every 2 to 4 days to confirm incubation, defined as the female sitting on the nest for a minimum of 10 minutes. We monitored nests every 2 to 4 days after incubation was confirmed. During incubation, we observed nest contents directly using a mirror-pole or miniature video camera. After hatching, we confirmed the number of nestlings using these same techniques, with the exception of nests that were too high to safely use a mirror-pole or camera. When nests were too high for the use of a mirror-pole or camera, we visually confirmed the number of nestlings with binoculars (i.e., beaks visible above rim of the nest). Once we confirmed nestlings, we observed nests from a distance to reduce the risk of attracting predators or causing premature fledging. If we observed no activity at a previously active nest, we checked the nest directly to determine nest contents and searched the general area to locate possible fledglings or evidence of depredation.

We considered a nest successful if any of 4 conditions was documented: 1) 1 or more young were visually confirmed fledging from the nest or located near the nest; 2) adults were seen feeding fledglings; 3) parents behaved as if dependant young were nearby (defensive behavior or adults agitated) when the nest was empty; or, 4) nestlings were observed in the nest within 2 days of the estimated fledge date (fledging considered to occur at 12 days; Rourke et al. 1999). Assuming that nestlings successfully fledged if observed in the nest within 2 days of the estimated fledge date is based on observations of southwestern willow flycatchers successfully fledging at 10 days of age during this study. This assumption was not upheld if subsequent visits to the territory provided evidence that fledging did not occur (e.g., building or incubation dates for a renest contradicted the estimated fledge date). The first 2 of these 4 conditions were considered confirmed fledging, while the last 2 were considered presumed fledging; all were designated as successful for these analyses.

We considered a nest to have failed if any of 5 outcomes was documented: 1) the nest was found empty or destroyed more than 2 days prior to the estimated fledge date (depredated); 2) the nest fledged no flycatcher young but contained cowbird eggs or young (parasitized); 3) the nest was deserted with eggs or nestlings remaining (deserted); 4) the entire clutch was incubated unsuccessfully for more than 20 days (infertile); or, 5) the nest failed due to other reasons such as weather or human disturbance (other). We designated an "unknown outcome" if success or failure could not be determined (generally due to infrequent visits to a nest).

We labeled a subset of females as 'monitored females' if we had a high level of confidence that all nesting attempts were monitored during a breeding season. Because flycatchers often renest after a failed nesting attempt, it is possible to miss a first attempt and mislabel a second attempt as a first, or to not detect a second attempt after a failure. We restricted analyses to monitored females when calculating the number of second nesting attempts, renesting attempts (a second attempt after a failed attempt), and double-brooding (a second attempt after a success attempt), and estimating seasonal fecundity.

HABITAT AND VEGETATION CHARACTERISTICS

We collected general habitat characteristics and vegetation data of survey areas and nests. Habitat information included classification of vegetation composition at sites as 1) native broadleaf vegetation (entirely or almost entirely native, >90% native, includes high-elevation willow); 2) mixed native broadleaf and exotic, 50–90% native; 3) mixed native broadleaf and exotic, 50–90% exotic; and 4) exotic vegetation (entirely or almost entirely exotic, >90% exotic). Because of the difficulty surveyors had in distinguishing between categories 2 and 3, these categories were combined for analyses. For each nest, we recorded height of nest (m) and species of nest tree.

DATA ANALYSIS

Mayfield nest success and explanatory variables. We estimated daily nest survival and examined relationships between nest success and explanatory variables using a Mayfield logistic regression (Mayfield 1961, 1975; Hazler 2004; Hazler et al. 2006; Corcoran et al. 2007). We used the events-trials syntax where events were success or failure and trials were the number of exposure days for each nest. Explanatory variables were rainfall (total inches during the previous winter and spring from November through May), study area (drainage), nest height, nesting attempt number, habitat class (native broadleaf vegetation, mixed native broadleaf and exotic vegetation, exotic vegetation), and nest tree species. We included an interaction term between rainfall and study area as a way to explore if rainfall had a different effect on populations nesting on the 4 drainages. Given this list of exploratory variables, we used a stepwise variable selection to determine which variables best explain variation (i.e., best model selection) in Mayfield nest success. We set the significance level for variables to enter and remain in the model at 0.15.

Because of the close proximity of the Salt River and Tonto Creek study areas and the close proximity of the Gila and San Pedro rivers study areas, a single Western Regional Climate Center (WRCC 2007) weather station was used for each group to calculate winter rainfall. The Punkin Center weather station at Roosevelt Lake was used for collecting rainfall data for the Salt River and Tonto Creek study areas and the San Manuel weather station near the San Pedro River was used for the Gila River and San Pedro River study areas. These 2 stations had the most complete regional data during our time period.

After the model's intercept and coefficients were estimated, we calculated daily survival rate ($\hat{S}$) as:

$$\hat{S} = \{1 + \exp\{-(ß_0 + ß_1X_1 + ß_2X_2 + \ldots ß_nX_n)]\}^{-1}$$

where $ß_0$ is the model intercept, $ß_i$ are coefficients, and X_i are measured covariates (Hazler 2004). Nest success was calculated for each study area by year using the null model (the basic Mayfield model with no explanatory value). We calculated nest success by raising the daily survival rate to the average nesting cycle length of 27.9 days (see Chapter 4).

<u>Renesting and double-brooding.</u> Rates of overall second nesting attempts were calculated for monitored females for each population. Second attempts were further divided into rates of renesting (a nesting attempt after a failed nesting attempt) and double-brooding (a nesting attempt after a successful nesting attempt) rates for monitored females in each population. Years were pooled to increase sample size. We explored if there were differences among populations in the rates of second nesting attempts, renesting, and double-brooding using χ^2-tests. There were too few successful double-broods or third attempts to test statistically for differences.

<u>Seasonal fecundity.</u> Seasonal fecundity (number of fledges produced during entire breeding season) was calculated for monitored females for each population. Number of fledges was summed for all nesting attempts made by an individual female per season. We combined all years due to small sample size. We explored if there were differences among study areas, number of nesting attempts (1 attempt compared to multiple attempts), and their interaction using a 2-way ANOVA. We repeated the same analysis using only females with all successful nesting attempts.

<u>Nest height.</u> We compared mean nest height between study areas with an ANOVA. We explored if the probability of depredation varied with nest height using a logistic regression.

Data analyses were done in SPSS ver. 14.0 (2005) and SAS ver. 9.1 (2004). SigmaPlot ver. 8.0 (2004) was used for all graphs. Mean ± half-widths of the 95% confidence interval are reported. Significance level was set at $P \leq 0.05$.

RESULTS

We monitored 1,320 nesting attempts from 2001 to 2005 (Table 1). This included 363 attempts on the Salt River, 186 attempts on Tonto Creek, 629 attempts on the San Pedro River, and 142 nesting attempts on the Gila River.

Table 1. Number of southwestern willow flycatcher nesting attempts by study area for 2001–2005.

Year	Study area	First nesting attempt	Second nesting attempt	Third nesting attempt	Total nesting attempts
2001	Salt River	65	14	0	79
	Tonto Creek	21	10	2	33
	San Pedro River	64	42	6	112
	Gila River	34	16	6	56
2002	Salt River	27	1	0	28
	Tonto Creek	7	0	0	7
	San Pedro River	72	11	0	83
	Gila River	22	1	0	23
2003	Salt River	89	20	0	109
	Tonto Creek	21	5	0	26
	San Pedro River	94	24	0	118
	Gila River	17	3	0	20
2004	Salt River	71	20	1	92
	Tonto Creek	30	8	1	39
	San Pedro River	113	45	2	160
	Gila River	10	2	1	13
2005	Salt River	47	8	0	55
	Tonto Creek	66	15	0	81
	San Pedro River	115	41	0	156
	Gila River	18	12	0	30
All years	Salt River	299	63	1	363
	Tonto Creek	145	38	3	186
	San Pedro River	458	163	8	629
	Gila River	101	34	7	142
	Total	**1003**	**298**	**19**	**1320**

Mayfield nest success and explanatory variables. The stepwise Mayfield logistic regression identified nest height, winter rainfall, and the interaction between study area (drainage) and winter rainfall as the variables having the greatest influence on nest success (Table 2). No effect of study area was detected, but it remained in the model because the interaction term was significant. All other explanatory variables (nesting attempt number, habitat class, or nest tree species) did not meet the 0.15 significance criteria required to be included in the model.

For every 1-m increase in nest height, the probability of a nest surviving 1 day was predicted to increase by 0.09%, all else being equal. Flycatchers nesting at the different study areas responded differently to increases in winter rainfall. For every 1-in increase in winter rainfall, the probability of a nest surviving 1 day was predicted to increase by 20.7% at the San Pedro River study area, 18.5% at the Gila River study area, 5.4% at the Salt River study area, and 4.1% at the Tonto Creek study area, all else being equal. Nest success from 2001 through 2005 varied between years and drainages; overall mean nest success was 51.5% at the Salt River study area, 43.3% at the Tonto Creek study area, 55.2% at the San Pedro River study area, and 53.8% at the Gila River study area (Figure 1).

Table 2. Results of stepwise Mayfield logistic regression test for the effects of rainfall, drainage, nest height, nesting attempt number, habitat class, and nest tree species. Nest height, winter rainfall, and the interaction between drainage and winter rainfall were identified as the variables having the greatest influence on nest success.

Source	χ^2	df	*P*
Nest height	12.54	1	< 0.001
Winter rainfall	4.24	1	0.040
Study area	1.61	3	0.657
Study area * winter rainfall	13.68	3	0.003

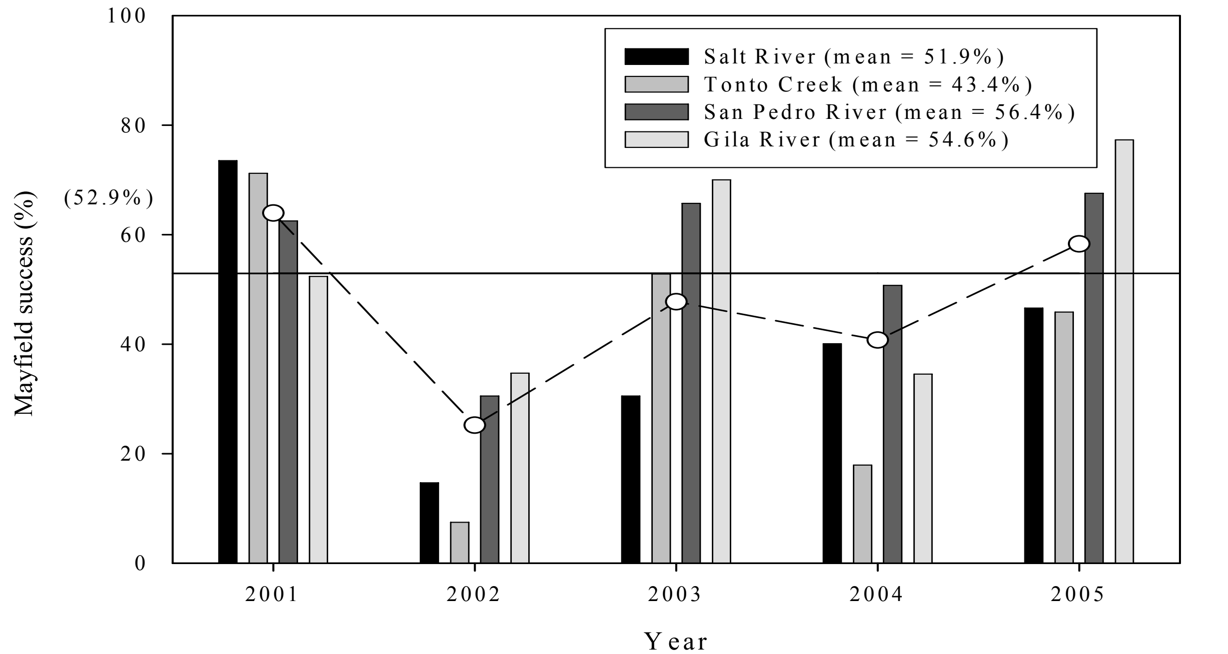

Figure 1. Mayfield nest success by year and study area, including yearly average for all sites (dashed line) and average across all years (straight line).

Renesting and double-brooding. Overall, 32.7% of monitored females attempted a second nest; 53.4% of females with a failed first attempt renested and 20.8% of females with a successful first attempt made a double-brood attempt (Table 3). Rates of second nesting attempts varied significantly among populations ($\chi^2_3 = 24.50$, $P < 0.001$). Females at the Gila River study area had the highest rate of second nesting attempts, followed by the San Pedro River study area, the Tonto Creek study area, and the Salt River study area with the lowest rate. Rates of renesting did not vary significantly among populations ($\chi^2_3 = 7.77$, $P = 0.051$), although females at the Gila River and San Pedro River study areas tended to have higher rates of renesting than females at the Salt River and Tonto Creek study areas. Rates of double-brooding varied significantly among populations ($\chi^2_3 = 26.72$, $P < 0.001$). Females at the Gila River study area had the highest rate of double-brooding, followed by the San Pedro River study area, the Tonto Creek study area, and the Salt River study area with the lowest rate.

Table 3. Overall occurrence of second nesting attempts, occurrence of renesting attempts (after a failed attempt), and occurrence of double-brooding attempts (after a successful attempt) by monitored females for each study area. Females with unknown outcome of first nesting attempt are not included.

Study area	Overall proportion of females with second nesting attempts (*n*)	Females that renested after a failed first nesting attempt (*n*)	Females that attempted double-brooding (*n*)
Salt River	22.4% (38)	46.0% (29)	8.4% (9)
Tonto Creek	32.7% (32)	44.1% (26)	15.4% (6)
San Pedro River	42.4% (70)	64.3% (45)	26.3% (25)
Gila River	51.4% (36)	63.0% (17)	44.2% (19)
Overall	**32.7% (176)**	**53.4% (117)**	**20.8% (59)**

Seasonal fecundity: Average seasonal fecundity of monitored females was 1.96 ± 0.14 fledges (1.83 ± 0.15 fledges for females making 1 nesting attempt and 2.23 ± 0.30 fledges for females making multiple nesting attempts). There were significant effects of drainage and number of nesting attempts, but no interaction between number of nesting attempts and drainage (Table 4; Figure 2). Females at the San Pedro River study area had the highest seasonal fecundity, followed by females at the Gila River study area, then females at the Salt River study area followed by the females at the Tonto Creek study area with the lowest seasonal fecundity. Females with multiple nesting attempts had higher seasonal fecundity than females with only 1 nesting attempt.

Table 4. Results of 2-way ANOVA to test for the effects of drainage, number of nesting attempts, and interaction on seasonal fecundity.

Source	*F*	df	*P*
Drainage	6.965	3, 487	< 0.001
Number of nesting attempts	5.143	1, 487	0.024
Drainage * number of nesting attempts	1.020	3, 487	0.383

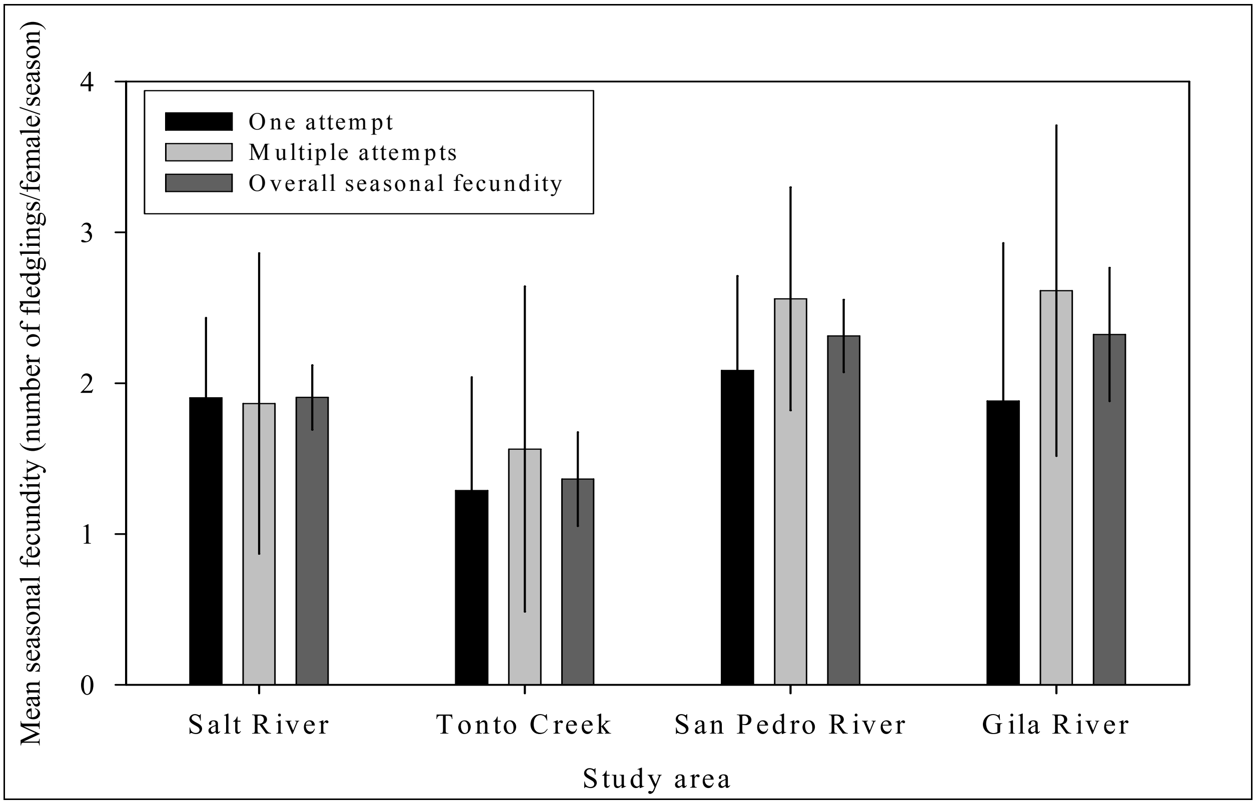

Figure 2. Mean seasonal fecundity (number of fledglings/female/season) by study area and number of nesting attempts for monitored females.

Average seasonal fecundity of monitored females with all successful nesting attempts was 2.99 ± 0.14 fledges (2.66 ± 0.09 fledges for females with 1 successful nesting attempt and 5.42 ± 0.33 fledges for females with multiple successful nesting attempts). There was a significant effect of number of nesting attempts, but no effect of drainage or an interaction between number of nesting attempts and drainage (Table 5; Figure 3). Females with multiple successful nesting attempts had higher seasonal fecundity than females with only 1 successful nesting attempt.

Table 5. Results of 2-way ANOVA to test for the effects of drainage, number of nesting attempts, and interaction on seasonal fecundity using only females with successful nesting attempts.

Source	*F*	df	*P*
Drainage	0.789	3, 248	0.496
Number of nesting attempts	333.085	1, 248	< 0.001
Drainage * number of nesting attempts	2.099	3, 248	0.101

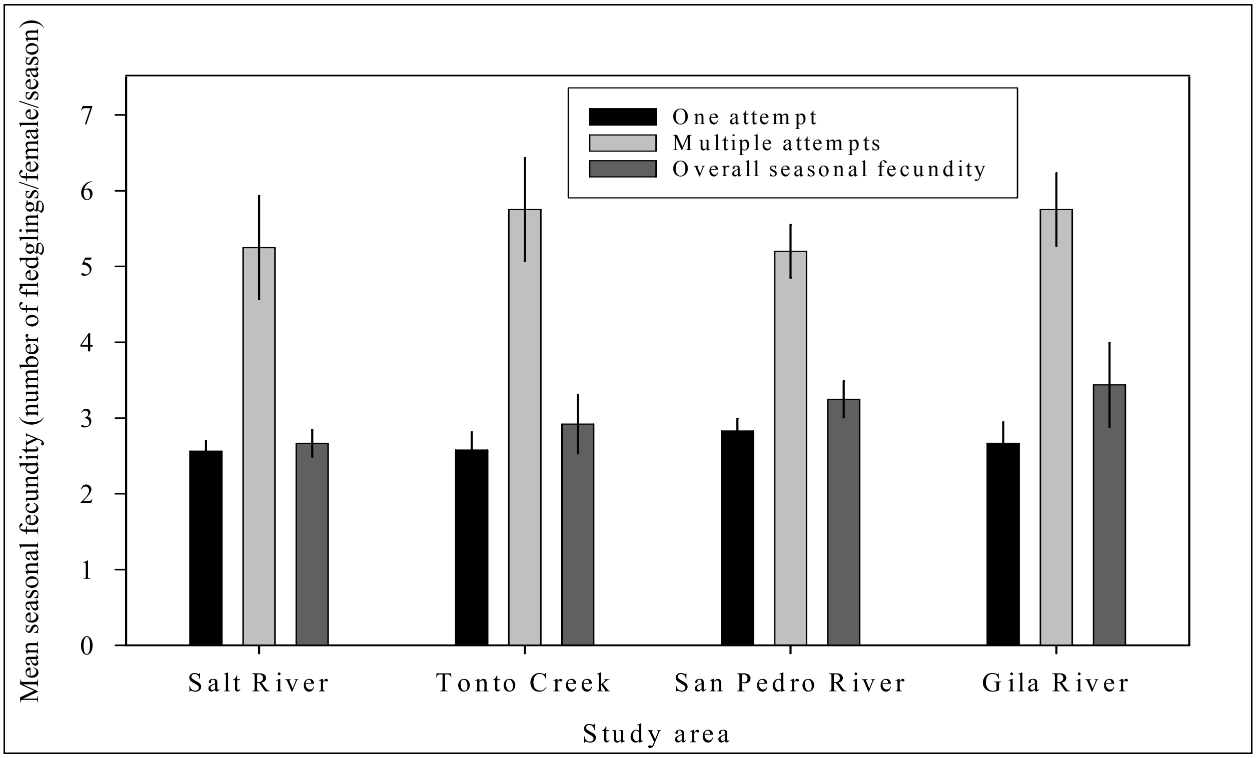

Figure 3. Mean seasonal fecundity (number of fledglings/female/season) by study area and number of nesting attempts for females with all successful nesting attempts.

Nest height. Overall, mean nest height of all study areas was 4.5 m ± 0.1 (*n* = 1314). A significant difference in nest height was found between study areas. Nests were highest at the Gila River study area, then the San Pedro River study area, the Tonto Creek study area, and lowest at the Salt River study area ($F_{3,1310}$ = 71.93, P < 0.001; Figure 4). The probability of depredation decreased with nest height (χ^2_1 = 9.3, *P* = 0.002). For every 1-m increase in nest height, the probability of depredation decreased by 9%.

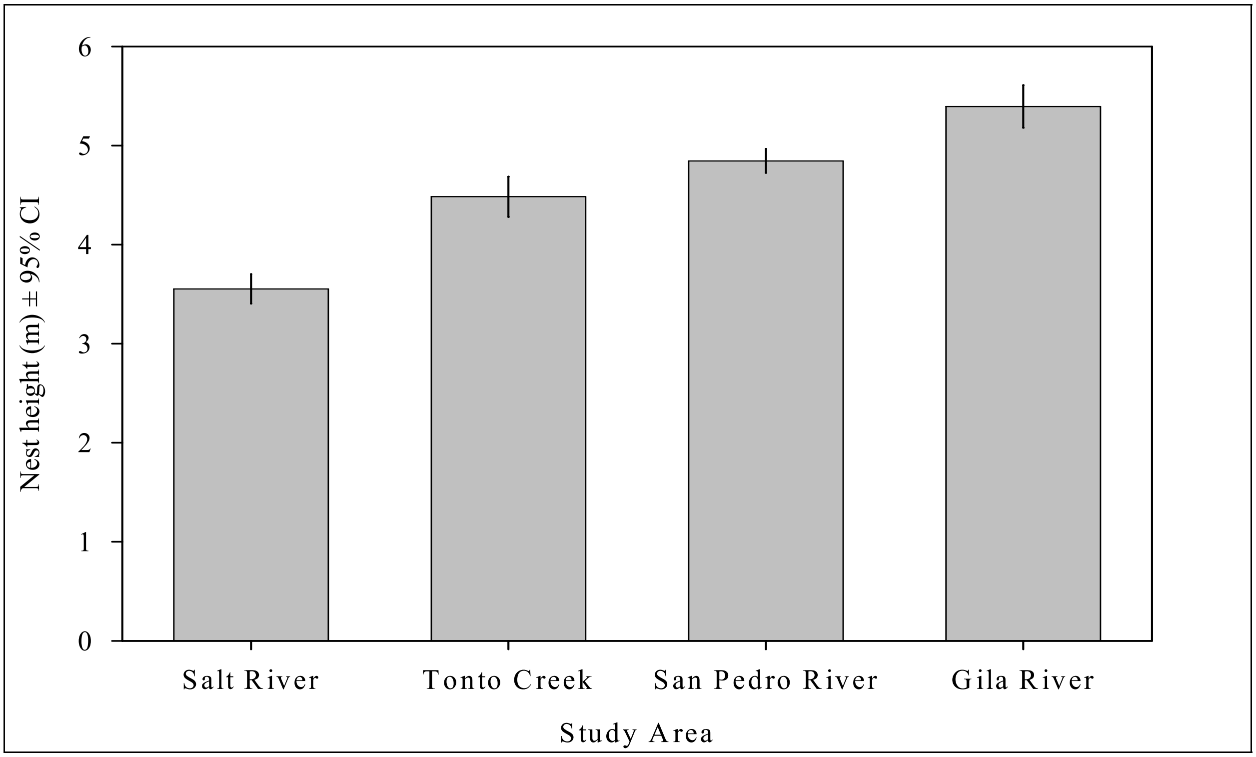

Figure 4. Mean nest height by study area.

DISCUSSION

Comparing demographic traits of flycatchers between river study areas (San Pedro River and Gila River study areas) and reservoir study areas (Roosevelt lake: Salt River and Tonto Creek study areas) assists in providing insight into the stability of populations and the quality of habitat within the different systems at our study areas. Habitat associated with reservoirs and rivers may be impacted differently by environmental conditions (e.g., rainfall and drought), which in turn may impact flycatcher populations at these areas. Understanding the different effects of environmental conditions on demographic parameters may help determine management strategies appropriate for these different areas.

Rainfall affected nest success at the study areas (drainages) differently, as indicated by the significant interaction between winter rainfall and study area. Winter rainfall had the greatest positive effect on nest success at the San Pedro River study area, slightly less on nests at the Gila River study area, and the least effect on nests at the Salt River and Tonto Creek study areas. In 2005, winter and spring rainfall was high and we saw a positive response in Mayfield nest success along the Gila and San Pedro rivers, but not a comparable response along the Salt River or Tonto Creek. This was due to inundation at Roosevelt Lake; rather than rainfall having a positive effect on habitat quality or quantity, inundation reduced the amount and quality of previously occupied habitat (see Chapter 3). Inclusion in the analysis of a year when the reservoir was inundated may mask the positive effects of years with more moderate rainfall on the reservoir; however, inundation is an important component of the reservoir system and its effects on the flycatcher are biologically significant. The differing effects of rainfall between the reservoir and river study areas suggest that rainfall has a greater positive influence on the river study areas than the reservoir study areas.

In 2002, drought conditions were especially severe causing water shortages, increases in vegetation lost to wildfire, and vegetation and wildlife mortality (McCabe et al. 2004). Nesting attempts and nest success decreased at all study areas from 2001 to 2002. Because the flycatcher's food source (arthropods) is dependent on the availability of water, a reduced food supply during drought years may account for the reduced nesting attempts and nest success. Durst (2004) found that fewer arthropods were present at Roosevelt Lake in 2002 than in 2003. The proportion of first attempts versus additional attempts may provide additional evidence that flycatchers were food limited in 2002; for example, Nagy and Holmes (2005*a*) found that females that initiated multiple broods had greater food availability than females that did not have multiple broods. Over the period of this study (2001–2005), 76% of nesting attempts were first attempts (the remaining 24% of nesting attempts were second and third attempts). In 2002, the proportion of nesting attempts that were first attempts was 90% (only 10% were second and third attempts); fewer females initiated a second attempt. Nagy and Holmes (2005*b*) found that supplementing black-throated blue warbler (*Dendroica caerulescens*) females with food increased the probability that they would initiate a second brood during years of low or average food availability. Conversely, food stressed females are less likely to initiate a second brood.

Although all drainages experienced extreme drought conditions in 2002, decreases in nesting attempts were greater at the Salt River and Tonto Creek study areas (65% and 79%, respectively) than at the Gila and San Pedro rivers study areas (59% and 26%, respectively). The Tonto Creek study area experienced complete reproductive failure in 2002 with no documented fledges. At the Salt River study area, only 2 nests fledged young. Roosevelt Lake's elevation decreased 27 ft, from 2076 ft in 2001 to 2049 ft in 2002 (Appendix E and F). With decreasing water levels and limited amounts of rainfall, habitat at the reservoir study areas may have been impacted more than habitat at the river study areas. The drought may have changed the microclimate and altered the inherent benefits of riparian habitat (i.e., evaporation from moist soil cooling the area and reducing the temperature within the habitat). Although Koronkiewicz et al. (2006) did not compare microclimates at successful and failed nests, they found that temperature was lower and humidity higher at nest sites compared to non-use sites along the Colorado River. Since flycatchers selected locations with lower temperature and higher humidity, these factors likely influence nest success. Lower nest success could be the result of nesting in overall less optimal conditions. Combined with decreasing reservoir levels, the microhabitat may have been affected more adversely at the reservoir study areas than the river study areas during the drought.

The greater impact of increased rainfall in 2005 and extreme drought conditions in 2002 at the reservoir study areas compared to the river study areas indicate that the habitat at the reservoir study areas respond differently to extreme environmental conditions. Although water level fluctuations at reservoirs mimic river flow regimes in that inundation recycles vegetation and encourages habitat regeneration, fundamental differences between the systems exist. Reservoir and river systems differ in geomorphology, floodplain width, and water table levels. An important component of suitable flycatcher habitat is maintenance of a mosaic of habitat patches of varying ages and structure, which allows suitable habitat to be present at all times, though the location of that habitat shifts within the drainage. The type and timing of the events that maintain the mosaic of habitat patches differs between rivers and reservoirs. While rivers experience periods of low (or no) flows and floods, reservoirs experience water drawdowns and inundation. The effect of low flows or flooding differs along different parts of the river due to channel width, floodplain width, water velocity, and other factors (e.g., the degree of scouring by a flood varies along the river). Reservoir inundation and drawdown may affect habitat more uniformly than flow on a river depending on habitat elevation within the conservation pool. At reservoirs, habitat structure and age may be more uniformly stratified along an elevation gradient than at rivers. As water levels at reservoirs recede, new habitat develops along the water's edge. Older, taller, and perhaps water-stressed habitat is farther from the water's edge, which may make it less appealing to flycatchers. They may choose to nest in younger, healthier habitat at the water's edge that may not be as tall or provide as much cover from the sun or predators. During inundation in 2005, flycatchers nested in partially inundated habitat and older habitat at higher elevations that may have been less vigorous or had less favorable microclimate conditions, resulting in reduced nest success (see Chapter 3).

Females at all 4 study areas were more likely to renest after a failed first attempt than to attempt a double-brood. However, females at the Gila River and San Pedro River study areas were more likely to attempt a double-brood (following success of the first attempt), than females at the Salt River and Tonto Creek study areas. This may indicate that females at the reservoir study areas were under constraints that females at the river study areas were not experiencing. The river habitat may supply a greater food base or a better quality food base than the reservoir habitat. Monsoon rains may improve female body condition or food available for nestlings. Monsoon rainfall influences the growth of insect populations (prey base), which may enhance the quality of the overall habitat and influence female physiological condition (Ligon 1971, Thompson 1991, Brown and Li 1996). The reservoir study areas receive monsoon rain, but they also experience the effects of reservoir drawdown during late summer when most second nesting attempts occur. Reservoir levels at Roosevelt Lake decrease during the summer months (the period of peak water usage) even with monsoon rain (mean decrease of 17 ft from April to August 1996–2006; Appendix E and F). As the edge of the water recedes away from occupied habitat during the breeding season, habitat quality may decline, reducing food sources and discouraging second nesting attempts at the Salt River and Tonto Creek study areas.

Seasonal fecundity was higher at the river study areas than the reservoir study areas, which is not surprising considering the combination of higher nest success and the higher occurrence of double-broods at the river study areas. However, this effect was not present when only females with successful nesting attempts are considered. This indicates that variation in seasonal fecundity was due largely to nest success, which was higher at the river study areas than the reservoir study areas. Given that nesting attempts are successful, females were able to produce a comparable number of fledglings regardless of study area, but females were more likely to have a successful nesting attempt at our river study areas than our reservoir study areas.

We found a significant difference in mean nest height among study areas. Nest height was greatest at the Gila River study area, then the San Pedro River study area, the Tonto Creek study area, and lowest at the Salt River study area. We also found an increased probability of nest success with increased nest height in our populations, which other songbird studies have documented (Best and Stauffer 1980, Wilson and Cooper 1998, Burhans et al. 2002). The probability of depredation also decreased as nest height increased. The difference in mean nest height is most likely due to differences in the height and density of trees available at the different study areas since nests are often placed in the densest strata of vegetation (i.e., if mean canopy height is greater, nests are likely to be placed higher).

Although tamarisk is frequently faulted for reducing the quality of riparian habitat, we found no effect of habitat class (native broadleaf vegetation, mixed native broadleaf and exotic, entirely or almost entirely exotic) or nest tree species on nest success. Further, nest success at the Gila River study area, the area with greatest concentration of tamarisk in our study areas, had the second greatest nest success and highest mean nest height. Although flycatchers used a variety of nest tree species (Chapter 4, Table 9), there was no effect of nest tree species on nest success. Differences between habitats along rivers and at reservoirs that affected nesting success are more likely microhabitat features (i.e., humidity, temperature), or structural and age differences than vegetation composition.

Although nest success was lower at the Salt River (51.2%) and Tonto Creek (43.3%) study areas than at the San Pedro River (55.5%) and Gila River (53.8%) study areas, this comparison should not be interpreted in isolation. Nest success rates at all of our sites were highly variable among years (Figure 1). Nest success at the Salt River and Tonto Creek study areas are still comparable to, and even higher than some other flycatcher populations (e.g., 2006 Mayfield nest success at the Kern River [California] was 36%, with an 18 year average of 42.5%; 2003–2006 Mayfield nest success was 37–56% at sites along the Colorado River [Arizona]; Koronkiewicz et al. 2004, 2006; McLeod et al. 2005, 2007; Schuetz and Whitfield 2007). In light of these comparisons with other populations, it appears that flycatchers at our study areas on rivers and reservoirs are doing well. Flycatchers at our reservoir study areas have successfully adjusted to nesting at Roosevelt Lake, though they may be more vulnerable to decreases in habitat quality due to environmental conditions. Although they have lower nest success and are less likely to attempt a double-brood than flycatchers at our river study areas, these parameters may be improved through water management by maintaining water or saturated soil at nesting sites throughout the breeding season and providing enough water to allow the regeneration, growth, and maintenance of vegetation.

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CHAPTER 6

MONITORING NEST PREDATORS WITH TIME-LAPSE VIDEO

INTRODUCTION

Nest depredation is the leading cause of nest failure for many open-cup nesting songbirds (Nice 1957; Ricklefs 1969; Best and Stauffer 1980; Martin 1993*a*, *b*) and can have major impacts on populations of endangered or threatened species (Schaub et al. 1992, Witmer et al. 1996, Stake and Cimprich 2003, Smith et al. 2004*b*, Stake et al. 2004). Nest depredation is the leading cause of nest failure for the federally endangered southwestern willow flycatcher (*Empidonax traillii extimus*, flycatcher) in Arizona (McCarthey et al. 1998; Paradzick et al. 1999*b*, 2000, 2001; Smith et al. 2002, 2003, 2004*a*; Munzer et al. 2005; English et al. 2006; Graber et al. 2007; Chapter 4). However, only 8 nest depredation events have been directly observed and reported in Arizona (Paxton et al. 1997, Arizona Game and Fish Department [AGFD] unpublished data). In place of limited observational data, specific nest predators or predator classes have been traditionally identified using physical evidence (damaged or displaced nests, shell fragments, hair, etc.; Thompson and Nolan 1973, Best and Stauffer 1980, Haskell 1994, Keyser et al. 1998). However, inferring nest predators from nest remains may be biased toward those predators that leave evidence and may not account for all potential predators.

Point counts, tracking stations, hair snares, predator surveys, and incidental records are inexpensive methods used to assist in identifying potential nest predators (Schaub et al. 1992, Heske et al. 1997, Larivière 1999, Cain et al. 2003, Peterson et al. 2004). AGFD and cooperating agencies incidentally identified potential flycatcher nest predators during statewide flycatcher surveys conducted from 1993 to 1996. Potential nest predators in Arizona documented in or near flycatcher territories included: long-tailed weasel (*Mustela frenata*), rock squirrel (*Spermophilus variegatus*), Sonoran whipsnake (*Masticophis bilineatus*), common kingsnake (*Lampropeltis getula*, kingsnake), and wandering gartersnake (*Thamnophis elegans vagrans*; Sferra et al. 1997). Brown-headed cowbirds (*Molothrus ater*), a brood parasite and potential nest predator (Arcese et al. 1996, Woodward and Stoleson 2002), were documented at 256 of 361 flycatcher sites surveyed between 1993 and 1996 (Sferra et al. 1997). Nest predators and potential nest predators documented during surveys and nest monitoring were likely biased toward diurnal, common, and conspicuous species. In addition, potential predators documented during flycatcher surveys or monitoring were not necessarily present in all flycatcher habitat statewide as predator communities and depredation rates vary geographically and between habitat types (Miller and Knight 1993, Picman and Schriml 1994).

After obtaining these incidental reports, we wanted to further investigate flycatcher nest depredation by obtaining unambiguous data on the identity of predators to aid in making informed management recommendations. Many studies have used still cameras (Hussell 1974, Danielson et al. 1996, Farnsworth and Simons 2000) or time-lapse video cameras at nests (Thompson et al. 1999, McQuillen and Brewer 2000, Pietz and Granfors 2000, Stake 2000, King et al. 2001, McCallum and Hannon 2001) to identify nest predators. Some camera studies (reviewed in Larivière 1999) have shown that traditional methods of nest predator identification can be unreliable or inaccurate. Whereas using physical evidence to identify nest predators may be inconclusive, nest cameras can provide indisputable evidence of nest predators at flycatcher nests.

We conducted a remote time-lapse video camera pilot study in 1997 and a larger scale study between 1998 and 2001 to identify flycatcher nest predators. We evaluated camera system acceptance by female flycatchers to ensure that cameras did not result in elevated rates of nest desertion, documented nest outcomes and nest success at camera-monitored nests, and documented and described predators and their habits.

STUDY AREAS

This study was conducted at 4 breeding areas in central Arizona: Salt River, Tonto Creek, San Pedro River, and Gila River. The Salt River and Tonto Creek are located 25 km apart and are the primary inflows to Roosevelt Lake, a reservoir, within Tonto National Forest in Gila County. The Salt River study area is a perennial 15 km reach that flows into the southeastern end of Roosevelt Lake. The Tonto Creek study area is a 16 km reach that flows into the northwestern end of Roosevelt Lake; flows are intermittent and dependent on spring snowmelt and summer monsoon rains, causing it to frequently dry late in the breeding season. Study areas are comprised of U.S. Forest Service (Tonto National Forest) and private land. The San Pedro River flows into the Gila River near Winkelman, AZ. The San Pedro River study area is a 45 km reach of the San Pedro River upstream of Winkelman; flows are perennial in some areas and intermittent in others, largely influenced by precipitation and groundwater pumping. The Gila River study area is a 40 km reach of the Gila River upstream and downstream of Winkelman; flows along the Gila River are variable, largely influenced by regulated releases from the San Carlos Reservoir’s Coolidge Dam with some natural flow from the San Pedro River. Study areas are composed of private, municipal, state, and federal (U.S. Bureau of Land Management and U.S. Bureau of Reclamation) lands (see Chapter 1 for more information).

Each study area is composed of numerous discrete vegetation patches that vary in vegetation composition and age. We labeled discrete habitat patches or groups of patches in close proximity of each other with a survey site (site) name. The riparian habitat is classified as Sonoran Riparian Deciduous Forest (Minckley and Brown 1994) and the habitat composition of each site ranges from monotypic stands of native broadleaf trees, to stands of mixed native and exotic, to nearly monotypic stands of exotic tamarisk (see Chapter 1 for more information).

METHODS

Nests were located and monitored prior to camera set up using the Southwestern Willow Flycatcher Nest Monitoring Protocol (Rourke et al. 1999). We set up remote time-lapse video camera systems at the Salt River and Tonto Creek study areas (Roosevelt Lake complex) and the San Pedro River and Gila River study areas (San Pedro River/Gila River complex) between 1998 and 2001 at 57 nests.

During the 1997 pilot study and the first year (1998) of the larger scale study, AGFD developed and improved upon the Southwestern Willow Flycatcher Remote Time-lapse Video Camera Protocol (Paradzick et al. 1999*a*) to minimize nest desertion caused by camera use. Criteria for deciding which nests to record included: 1) female lacked agitated behavior during nest monitoring visits; 2) nest stage was between day 6 of incubation and day 7 of the nestling stage when set up; 3) nest location was conducive for quick (≤15 min) installation with an optimal view of the nest from the installment point (nests ≤5 m high, minimal vegetation at nest height); and 4) the female returned to the nest and displayed "normal" behavior within 1.5 hr of camera set up. We removed cameras if the last criterion was not met. Batteries and video tapes were changed and nest activity assessed via handheld monitor once every 24 hrs. Cameras remained at nests for 48 hrs once nests were determined inactive.

Time-lapse video camera system components were modified and improved upon from 1997 to 2001, but the basic system included a camera head, camera arm, VHS variable time-lapse video recorder (20 frames per second), small video monitor, power source, and camouflage covering ("blind"; Figure 1). The video camera head contained 6 infrared light emitting diodes (LED) for nocturnal recording and was housed in a Fuhrman Diversified Inc. 3.2 cm x 3.2 cm x 6.2 cm weatherproof housing. A Supercircuits model PC63XP color pinhole micro video camera head was also used on some systems. The camera head was positioned approximately 0.5 m from the nest on a camouflaged arm or adjacent tree and then connected via coaxial cable to a Sony VHS variable time-lapse video recorder (Model SVT-DL224). The video recorder was housed in a weatherproof case located approximately 30 m from the nest tree next to a power source. The power source was either a 12-Volt deep cycle marine battery or a gel cell battery combined with a Siemans model SP75 photovoltaic (solar) panel with Morning Star Sun Saver 6 charge controller. A small monitor with video input was used to quickly review videotapes in the field and assess the status of the nest. We added camouflage coverings in 1998 to hide camera heads and arms from nest predators and flycatchers.

In 1998 and 1999, nests of additional open-cup nesting songbirds were also camera-monitored to document potential flycatcher nest predators not detected at camera-monitored flycatcher nests. We limited additional camera-monitored nests to open-cup nesting songbird nests within 20 m of a flycatcher nest in an effort to document potential predators in riparian habitat in close proximity to flycatcher nests. Additional open-cup nesting songbird species monitored included common yellowthroat (*Geothlypis trichas*), song sparrow (*Melospiza melodia*), and yellow-breasted chat (*Icteria virens*).

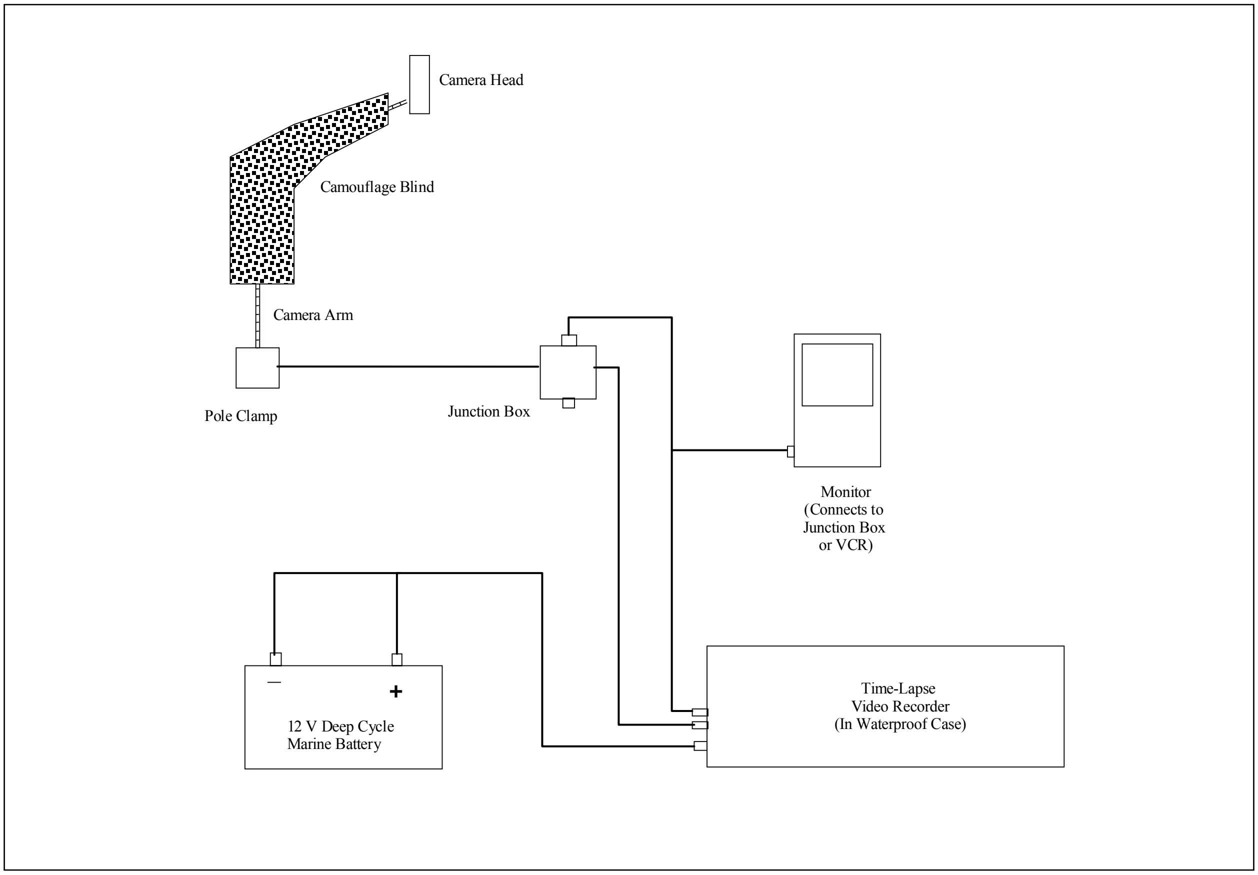

Figure 1: Remote time-lapse video camera system configuration (figure not to scale).

CAMERA SYSTEM ACCEPTANCE BY FEMALE FLYCATCHERS

We assessed flycatcher acceptance of time-lapse video cameras by evaluating nest desertion, including human-caused nest desertion. We defined human-caused desertion as desertion immediately following disturbance to the nest or nest area. We included nests deserted within 1 day of camera set up, even if we removed the camera, as human-caused desertion. Additional activities at camera-monitored nests such as camera set up and camera maintenance may have contributed to human-caused desertion. Visits to camera monitored nests occurred more frequently than visits to non-camera monitored nests, but were often less intrusive because visits only lasted long enough to replace batteries and quickly check nest status. Banding efforts and nest monitoring may have contributed to human-caused desertion at both camera-monitored and non-camera monitored nests; human-caused desertion was assigned as a cause of failure when desertion occurred following research-related activities at the nest.

Camera system modifications and protocol improvements in 1998 included using camouflaged covers to hide cameras and monitoring female flycatchers following camera set up. Prior to protocol improvements in 1998, covers were not used at all nests and females were not monitored for camera acceptance following camera set up; therefore, cameras were not removed until after the nest was already deserted. We compared human-caused desertion rates at camera-monitored nests before and after these changes to evaluate their effectiveness in reducing desertion. We also compared the human-caused desertion rate at camera-monitored nests and at non-camera monitored nests from the same sites during the same years to evaluate the effect of camera monitoring on human-caused desertion.

Because non-camera monitored nests were not under constant observation, we were not always able to identify the cause of desertion. In the absence of direct evidence of human-caused desertion at non-camera monitored nests, we assigned desertion as the cause of failure. Therefore, human-caused desertion at non-camera monitored nests may have occurred at a higher rate than was attributed. Overall desertion included nest desertion caused by human activity and desertion with an unknown cause. Since we were often unable to differentiate between causes of nest desertion at non-camera monitored nests, we compared the overall desertion rate at camera-monitored nests with the overall desertion rate at non-camera monitored nests from the same sites during the same years.

NEST OUTCOMES AND NEST SUCCESS AT CAMERA-MONITORED NESTS

We located and monitored nests using the Southwestern Willow Flycatcher Nest Monitoring Protocol (Rourke et al. 1999). Once we detected a flycatcher on a survey, we visited the territory every 4 days in an attempt to locate a nest. Nests were located by watching adults return to a nest or by systematically searching suspected nest areas. Once a nest was located, we visited the territory every 2 to 4 days to confirm incubation, defined as the female sitting on the nest for a minimum of 10 minutes. We monitored nests every 2 to 4 days after incubation was confirmed. During incubation, we observed nest contents directly using a mirror-pole or miniature video camera. After hatching, we confirmed the number of nestlings using these same techniques, with the exception of nests that were too high to safely use a mirror-pole or camera. When nests were too high for the use of a mirror-pole or camera, we visually confirmed the number of nestlings with binoculars (i.e., beaks visible above rim of the nest). Once we confirmed nestlings, we observed nests from a distance to reduce the risk of attracting predators or causing premature fledging. If we observed no activity at a previously active nest, we checked the nest directly to determine nest contents and searched the general area to locate possible fledglings or evidence of depredation.

We considered a nest successful if any of 4 conditions was documented: 1) 1 or more young were visually confirmed fledging from the nest or located near the nest; 2) adults were seen feeding fledglings; 3) parents behaved as if dependant young were nearby (defensive behavior or adults agitated) when the nest was empty; or, 4) nestlings were observed in the nest within 2 days of the estimated fledge date (fledging considered to occur at 12 days; Rourke et al. 1999). Assuming that nestlings successfully fledged if observed in the nest within 2 days of the estimated fledge date is based on observations of southwestern willow flycatchers successfully fledging at 10 days of age during this study. This assumption was not upheld if subsequent visits to the territory provided evidence that fledging did not occur (e.g., building or incubation dates for a renest contradicted the estimated fledge date). The first 2 of these 4 conditions were considered confirmed fledging, while the last 2 were considered presumed fledging; all were designated as successful for these analyses.

We considered a nest to have failed if any of 6 outcomes was documented: 1) either a depredation event was directly observed or the nest was found empty or destroyed more than 2 days prior to the estimated fledge date (depredated); 2) the nest fledged no flycatcher young but contained cowbird eggs or young (parasitized); 3) the nest was deserted with eggs or nestlings remaining (deserted); 4) the nest was destroyed due to weather (weather); 5) the entire clutch was incubated unsuccessfully for more than 20 days (infertile); or 6) nest was deserted due to human activity in the vicinity of the nest, including desertion due to camera set up (human activity). For non-camera monitored nests, we designated an "unknown outcome" if success or failure could not be determined (generally due to infrequent visits to a nest).

We calculated the average age of depredated nestlings and divided the nestling stage into 2 categories (old: ≥6-day-old and young: ≤5-day-old) based on the average fledging age of 12 days. Skutch (1949) found that older nestlings have greater depredation rates than younger nestlings because activity at the nest increases as nestlings age. To determine if this pattern of age-dependant depredation occurred at our study nests, we conducted a 1-tailed χ^2-test and predicted that depredation rates would be higher in the older age class. We used only nests with the entire nestling stage recorded in our analysis to avoid biasing data towards nests that succeeded during the early portion of the nestling stage. Analyses were done in SPSS 14.0 (2005). Results are given as the mean ± half width of 95% confidence interval.

NEST PREDATORS AND PREDATOR HABITS

Predator Identification. We identified flycatcher nest predators and potential flycatcher nest predators by reviewing time-lapse video recorded at flycatcher and additional open-cup songbird nests. A predator visit was defined as each time a predator visited a nest, whether or not the nest was depredated. A depredation event was defined as each time a predator depredated or removed an egg or nestling; therefore, a single nest may have experienced multiple depredation events. Unsuccessful attempts by predators to depredate or remove nestlings (e.g., force-fledging nestlings) were classified as predator visits rather than depredation events. If multiple predator visits were recorded at the same nest by the same predator species, we assumed that it was the same individual predator visiting the nest unless we could confidently identify multiple individuals.

Predator Habits. Predator habits were summarized for each species (or family if grouped) for the timing of depredation events (classified as diurnal or nocturnal), mean (± half width of 95% confidence interval) duration of predator visits and depredation events, percentage of visits resulting in depredation, average number of nestlings depredated per depredation event, and stage of nest at time of depredation. We also summarized typical predator and flycatcher behavior during depredation events. Predators documented depredating additional open-cup songbird nests within 20 m of flycatcher nests are included for discussion, but are not included in summary information.

Evidence Left at Nests by Predators. Once a nest became inactive, we searched the nest and the surrounding area for evidence of depredation (nest damaged, missing, or knocked out of tree, egg fragments or dead nestling in nest or on ground beneath nest, etc.). We also searched for evidence of fledging once a nest became inactive (e.g., parents defending territory with empty nest). We calculated the percentage of depredation events where predators left evidence. If the camera malfunctioned at a nest with evidence of depredation and we were unable to record the predator on film, we assigned a single predator visit and a single depredation event by a single predator to that nest.

RESULTS

CAMERA SYSTEM ACCEPTANCE BY FEMALE FLYCATCHERS

We removed cameras from 20 of 57 nests because females failed to return to the nest and behave "normally" within 1.5 hr of camera set up. Once we removed cameras, 14 females returned and their nests were monitored using our regular protocol. Of the 6 females that did not return once cameras were removed, 5 renested (Table 1). The human-caused desertion rate prior to protocol improvements was 33.3% (n = 15), which was reduced to 2.4% (n = 42) following protocol improvements. This rate was eventually reduced to 0% (n = 18) in 2000 and 2001.

For the entire study, the human-caused desertion rate for nests used in the camera study was 10.5% (n = 57) and the human-caused desertion rate at non-camera monitored nests at the same sites during the same years (1998–2001) was 1.7% (n = 229).

The overall desertion rate at camera-monitored nests was 12.3% (n = 57) compared to 4.8% (n = 229) at non-camera monitored nests at the same sites during the same years.

Table 1. Summary of camera set ups at southwestern willow flycatcher nests in Arizona, 1998–2001.

Year	Total camera set ups (successful set ups)	Removed cameras (returned females)	Human-caused deserted nests[a] (renesting females[b])
1998	15 (7)	8 (3)	5 (4)
1999	24 (14)	10 (9)	1 (4)
2000	11 (10)	1 (1)	0 (0)
2001	7 (6)	1 (1)	0 (0)
All Years	57 (37)	20 (14)	6 (5)

[a] Nest deserted because of camera set up, i.e. female failed to return to nest even if camera was removed within 1.5 hr of set up.
[b] Female renested following desertion caused by camera set up at first nest.

NEST OUTCOMES AND NEST SUCCESS AT CAMERA-MONITORED NESTS

Overall, 20 of 37 camera-monitored nests successfully fledged 1 or more young (54.1%, Table 2). We recorded the entire nestling stage at 21 flycatcher nests. Of these 21 nests, 66.7% were successful and 33.3% failed due to depredation. Only 2 nests were recorded for the entire incubation stage, of which 1 was infertile and 1 was successful (although partially depredated during the nestling stage with the remaining nestlings force-fledged).

The average age of depredated nestlings at camera-monitored nests was 10.2 days. For nests that were recorded for the entire nestling stage, the average age of depredated nestlings was 9.1 ± 2.73 days (n = 10). Nest depredation occurred at nests with older flycatcher nestlings (≥6-day-old) more frequently than nests with younger flycatcher nestlings (≤5-day-old; $\chi^2_1 = 6.4$, P = 0.006).

Table 2. Outcomes of camera-monitored flycatcher nests in Arizona, 1998–2001.

Outcome	Number of nests (%)
Fledged[a]	18 (48.7%)
Fledged, but partially depredated[b]	2 (5.4%)
Depredated[c]	13 (35.1%)
Infertile[d]	3 (8.1%)
Deserted[e]	1 (2.7%)
Total camera-monitored nests	37

[a] 1 nest fledged with brown-headed cowbird and 1 nest was designated fledged but not recorded due to camera failure.
[b] Nest partially depredated, but still successfully fledged 1 or more young.
[c] 1 nest had 2 separate observed depredation events and 1 unobserved depredation event.
[d] 1 nest was depredated after nest determined infertile and failed.
[e] 1 nest was deserted for unknown reasons 4 days after camera set up.

NEST PREDATORS AND PREDATOR HABITS

Predator Identification. Throughout the camera study, we identified 5 nest predator species depredating 15 flycatcher nests (Table 3, Appendix J) and 4 nest predator species depredating 5 additional open-cup songbird nests (Appendix K). Cooper's hawks (*Accipiter cooperii*) were the primary predator documented at flycatcher nests, depredating or partially depredating 7 flycatcher nests and accounting for 52.9% (n = 17) of depredation events and 55.6% (n = 27) of predator visits. The California kingsnake was the second most frequently recorded predator at flycatcher nests between 1998 and 2001, depredating or partially depredating 4 flycatcher nests and accounting for 23.5% of depredation events and 29.6% of predator visits (Figure 2). A western screech owl (*Otus kennicotti*), yellow-breasted chat (*Icteria virens*), Sonoran gophersnake (*Pituophis catenifer affinis*), and an unknown predator accounted for the remaining 23.5% of depredation events and 14.8% of predator visits at flycatcher nests (Table 3).

We observed a California kingsnake, yellow-breasted chat, Clark's spiny lizard (*Sceloporus clarkii*), and western spotted skunk (*Spilogale gracilis*) depredating additional open-cup songbird nests in 1998 and 1999 (Appendix K). Details on additional open-cup songbird nest predators are included below for nest predators not documented depredating flycatcher nests (i.e., Clark's spiny lizard and western spotted skunk).

Table 3. Number of depredation events and predator visits at flycatcher nests, 1998–2001[a].

Predator species	Number of nests					
	Recorded			Unrecorded due to camera failure		
	Number of events	Number of visits	Number of predators	Number of events	Number of visits	Number of predators
Cooper's hawk	8	14	7[b]	1	1	0[b]
Western screech owl	1	1	1	0	0	0
Yellow-breasted chat	1	1	1	0	0	0
California kingsnake	4	8	6	0	0	0
Sonoran gophersnake	1	1	1	0	0	0
Unknown [c]	0	0	0	1	1	1
Total	15	25	16	2	2	1

[a] See Appendix J for details on depredation events.
[b] We assumed same Cooper's hawk at all recorded and unrecorded predator visits and depredation events at a single nest (4 predator visits and 3 depredation events total); therefore, did not count unrecorded event as a unique predator.
[c] An unidentified songbird (likely a Bell's vireo [*Vireo bellii*]) visited a flycatcher nest at 1348, several hours before the unrecorded depredation event. The unidentified songbird was not defined as a nest predator since it was not observed depredating the nest and was not calculated in the total number of predator visits or depredation events.

Figure 2: Still frame from time-lapse video camera 1997 video footage documenting a California kingsnake depredating flycatcher nestlings.

Cameras failed to capture 2 depredation events on tape. The first camera system failure occurred at night when LEDs failed to illuminate a depredation event. Three flycatcher eggs were found below the nest with small puncture holes. We assumed a single predator was responsible for puncturing and removing the eggs from the nest in a single visit, but were unable to identify a nest predator since rodents and birds have been documented leaving small holes in eggs during nest depredation (reviewed in Larière 1999). An unidentified songbird thought to be a Bell's vireo (*Vireo bellii*) visited the nest earlier in the day, but we did not designate the bird as a nest predator since it was not recorded depredating the nest and may not have the bill morphology necessary to depredate an egg. The second camera system failure occurred at dusk when the system's battery died. The next day a 7-day-old nestling was missing. We attributed this unrecorded depredation event to a Cooper's hawk observed visiting the same nest on 3 prior occasions on 3 different days, 2 of which resulted in nestling depredation.

<u>*Avian Predators and Predator Habits.*</u> Cooper's hawk visits were diurnal and occurred between 0800 hrs and 1900 hrs. Visits had a mean duration of 0.3 min (± 0.25; $n = 4$) while depredation events had a mean duration of 12.0 min (± 12.14; $n = 8$). Cooper's hawks typically landed on the nest and left with nestlings, leaving the nest intact; most hawks took 1 nestling at a time with several minutes in between visits. We did not observe parents defending nests from Cooper's

hawks. Depredation events occurred during 60% of Cooper's hawk visits with an average of 2 nestlings taken per depredation event. Although most Cooper's hawks took an average of 2 nestling per event, 1 depredated 3 force-fledged nestlings during a single visit. Force-fledging occurs when nestlings are physically developed enough to leave or fly from the nest (typically beginning around developmental stage day 8, AGFD unpublished data), but before they would naturally fledge. We observed the hawk chasing and catching 2 of the force-fledged nestlings in-flight and watched it chase the third out of view; we assume the hawk successfully caught the third fledgling. At another nest, a Cooper's hawk captured 2 flycatcher nestlings during a single visit, knocking the third nestling out of the tree along with the nest. The average age of nestlings taken by Cooper's hawks was 9.5 ± 3.7 days (n = 9). Cooper's hawks were not observed depredating eggs (Appendix J).

We set up cameras at 2 nests following the removal of eggs or nestlings in an attempt to record additional nest predators. A single, possibly deserted egg remained in each nest, which we recorded being depredated by a western screech owl and a yellow-breasted chat. The western screech owl depredation event was nocturnal (0348 hrs) and lasted 0.28 min. Prior to camera set up, 2 eggs and one 2-day-old nestling were removed by an unknown predator. The yellow-breasted chat depredation event was diurnal (1414 hrs) and lasted 4 min. Prior to camera set up, 1 egg was removed.

Reptile Predators and Predator Habits. California kingsnake and Sonoran gophersnake visits were diurnal and nocturnal and occurred between 1021 hrs and 0024 hrs. The mean duration of kingsnake visits was 42.0 min (± 23.57; n = 4) while the mean duration of depredation events was 35.3 min (± 22.4; n = 4). Snakes typically consumed nestlings at the nest and some snakes remained at the nest after consuming nestlings. The kingsnake visit at 0024 hrs resulted in the kingsnake flushing a brooding female. We observed parents defending nestlings from a kingsnake at 1 nest (parents approached the snake within 10 cm), but we did not observe parents during other snake visits. Depredation events occurred during 56% of snake visits with an average of 3 nestlings depredated per depredation event. We observed snakes either making 2 visits to depredate a nest or revisiting empty nests once consuming or force-fledging nestlings. Kingsnakes force-fledged nestlings at 2 nests (partially depredating 1 nest) and completely depredated broods at 2 other nests by pinning nestlings in the nest with their bodies while consuming 1 nestling at a time. The gophersnake consumed three 11-day-old nestlings; we did not record the duration of the visit. The average age of nestlings depredated by snakes was 11.4 ± 1.5 days (n = 5). Snakes were not observed depredating eggs (Appendix J).

Clark's spiny lizards were not documented at flycatcher nests. However, we observed a Clark's spiny lizard removing a single 3-day-old yellow-breasted chat nestling. The depredation event was diurnal (0654 hrs) and lasted 0.5 min (Appendix K).

Mammal Predators and Predator Habits. No mammals were documented at flycatcher nests. However, we observed a western spotted skunk flush a brooding common yellowthroat female and take three 5-day-old nestlings from a single nest. The depredation event was nocturnal (2000 hrs) and lasted 5 min (Appendix K).

Evidence Left at Nests by Predators. Predators left physical evidence at flycatcher nests during 17.6% of depredation events (*n* = 17). We recorded a Cooper's hawk tearing nest lining with its talon during depredation, ultimately pulling the nest from the tree. We found the nest on the ground with an intact dead nestling. Another nest contained egg fragments in the nest after a yellow-breasted chat depredation event. The video camera failed to observe the depredation event at another nest, but 3 eggs with puncture holes were found below the nest.

DISCUSSION

CAMERA SYSTEM ACCEPTANCE BY FEMALE FLYCATCHERS

Time-lapse video camera recording proved a valuable technique for identifying nest predators and documenting activity at flycatcher nests. Camera acceptance by females greatly improved in 1998 when covers were added to camera heads and the camera system was camouflaged. Further, we were able to reduce nest desertion by monitoring female behavior after the camera was set up. As a result, in 2000 and 2001, no nests failed due to camera activity. We recognize potential protocol biases (e.g., females more accepting of camera set up may also be more accepting of nest predators, nests selected for camera set up may be less cryptic and more susceptible to depredation), but our protocol's primary design was to document depredation events while minimizing nest abandonment.

Although a human-caused desertion rate of 0% was eventually achieved, the initial rate before protocol improvements (33.3%) and the overall (1998–2001) human-caused desertion rate (10.5%) at camera-monitored nests was less than optimal. Initial and overall human-caused desertion rates were within the range reported in camera studies involving other songbird species (9–34%; Farnsworth and Simons 2000, Pietz and Granfors 2000, Williams and Wood 2002, Liebezeit and George 2003, Renfrew and Ribic 2003, Thompson and Burhans 2003, Small 2005) and the overall human-caused desertion rate was similar to a comparable study of the federally endangered black-capped vireo (*Vireo atricapillus*; 10.5%) in Texas (Stake 2000). Human-caused and overall desertion at camera-monitored nests was greater than human-caused and overall desertion at non-camera monitored nests at the same sites during the same years.

Although our expected values were too low to perform a χ^2-test, we do see a striking difference between the expected values for human-caused desertion at camera-monitored nests (6 observed vs. 1.9 predicted if desertion is equally distributed between camera-monitored and non-camera monitored nests) and non-camera monitored nests (4 observed vs. 8 predicted). This indicates that we did increase human-caused nest desertion by setting up cameras. However, this problem was ultimately corrected with our protocol improvements. Observed and expected non-human-caused desertion rates were almost identical (camera nests: 1 observed vs. 1.1 predicted; non-camera nests: 7 observed vs. 6.9 predicated) indicating that the effect was restricted to set up activities rather than a lasting effect or an overall presence of camera effect.

NEST OUTCOMES AND NEST SUCCESS AT CAMERA-MONITORED NESTS

Simple nest success at camera-monitored nests (excluding those abandoned due to camera set up) that were recorded for the entire nestling stage (66.7%) was higher than our 10-year average of simple nest success at monitored nests 55.8% (*n* = 1,873; Table 5 in Chapter 4), but the camera-monitored sample size was small (*n* = 21). Depredation is the leading cause of flycatcher nest failure in several studies of flycatchers (e.g., Whitfield and Enos 1996, Stoleson and Finch 1999, Whitfield 1990, Schuetz and Whitfield 2007), including our camera study (35.1%). The depredation rate at camera-monitored nests was similar to our 10-year average (35.6%, *n* = 1,873; Table 7 in Chapter 4) and within annual averages at our study population (24.0–55.0 %, McCarthey et al. 1998, Paradzick et al. 1999*b*, 2000, 2001, Smith et al. 2002, 2003, 2004*a*, Munzer et al. 2005, English et al. 2006, and Graber et al. 2007), suggesting that cameras neither attracted nor deterred nest predators. Stoleson and Finch (1999) and Whitfield (1990) reported similar depredation rates at flycatcher nests in New Mexico (37.3%) and California (29.4–42.2%).

Some studies have reported higher depredation rates at camera-monitored nests because some nest predators (e.g., corvids or mammals) may learn to associate cameras with nests while others have reported lower depredation rates when cameras seem to deter predators (reviewed in Herranz et al. 2002). We did not observe overly inflated or abnormally low rates of nest depredation at camera-monitored flycatcher nests, again suggesting that cameras neither attracted nor deterred predators, although our sample size was small.

We analyzed time budgets at flycatcher nests recorded during the 1997 AGFD time-lapse video camera pilot study (*n* = 2) and found that activity at the nest (e.g., parental visits) increased as nestlings matured. Skutch (1949) theorized that increased activity at the nest during the nestling stage contributes to an increase in depredation rates in the nesting stage at some open-cup songbird nests. Martin et al. (2000) found evidence of increased depredation during the second half of the nestling stage consistent with Skutch's hypothesis. The age-related pattern of nestling depredation during our study also supports Skutch's hypothesis. Predators documented depredating flycatcher nests may rely on visual cues to hunt, which may increase with increased parental nest visits during the nestling stage. Nestling vocalizations increase as nestlings age, which may provide additional cues to auditory predators. Weatherhead and Blouin-Demers (2004) and Stake et al. (2005) suggest that olfactory cues may also increase during the nestling stage thus attracting snakes, even with parents removing fecal sacs. Considering the high rate of depredation we documented during the second half of the nestling stage, our assumption that nests are successful if found empty within 2 days of a brood's estimated fledge date may overestimate fledge rates and underestimate depredation rates.

NEST PREDATORS AND PREDATOR HABITS

<u>*Predator Identification.*</u> Primary flycatcher nest predators identified at our study areas were Cooper's hawks and California kingsnakes. A western screech owl, yellow-breasted chat, and Sonoran gophersnake were also recorded depredating flycatcher nests. Cooper's hawks,

California kingsnakes, and yellow-breasted chats were reported in or adjacent to flycatcher territories prior to this study by AGFD and U.S. Geological Survey researchers, although Cooper's hawks and chats were not identified as potential nest predators during early flycatcher surveys (Sferra et al. 1997). Although common in our study areas, we do not have conclusive evidence that yellow-breasted chats are a major flycatcher nest predator. We recommend that researchers be aware of nest predators in flycatcher habitat and wait for potential nest predators to leave the territory before approaching flycatcher nests so that they do not learn to associate human activity (e.g., nest checks) with nests.

We identified 2 potential nest predators beyond those actually observed at flycatcher nests. A western spotted skunk depredated a common yellowthroat nest and a Clark's spiny lizard depredated a yellow-breasted chat nest. AGFD researchers rarely reported spotted skunks in our study areas, presumably because they are nocturnal, but Clark's spiny lizards were often seen in our study areas. Spotted skunks are unlikely predators of flycatcher nests, because flycatchers nests are placed high in trees (mean nest height 4.5 m; Chapter 5), unlike common yellowthroats, which typically nest on or near the ground in grass-like vegetation (Guzy and Ritchison, 1999). *Sceloporus* lizards were not previously documented depredating nestlings (*Sceloporus* diet reviewed in Stebbins 1985, Ballinger et al. 1997, and Ortiz et al. 2001), but our observation of a Clark's spiny lizard depredating a 3-day-old yellow-breasted chat nestling suggests that lizards are a potential flycatcher nest predator of hatchlings and small nestlings.

We identified 5 flycatcher nest predator species and 2 potential nest predator species, but recognize our list of flycatcher nest predators is incomplete. Our camera systems failed to record 2 depredation events, 1 of which was by an unknown predator possibly undocumented at other depredated nests. Researchers in California documented Argentine ants (*Linepithema humili*) and a red-tailed hawk (*Buteo jamaicensis*) depredating flycatcher nests (Stoleson and Finch 1999, Lynn and Whitfield 2000, and Kus personal communication in USFWS 2002) and researchers documented a great horned owl (*Bubo virginianus*) depredating a nest in New Mexico (Famolaro 1998). Although red-tailed hawks and great horned owls may hunt flycatchers in Arizona, none were documented in this study. McCabe (1991) documented a milksnake (*Lampropeltis triangulum*) depredating willow flycatcher eggs in Wisconsin, but flycatchers have never been documented breeding within the limited range of milksnakes in Arizona. Common kingsnakes (*Lampropeltis getula*), which are closely related to milksnakes, may also eat flycatcher eggs even though we did not document them doing so on camera. AGFD researchers observed a brown-headed cowbird, yellow-breasted chat, and great-tailed grackle (*Quiscalus mexicanus*) depredating or removing flycatcher eggs at the Roosevelt Lake complex between 2002 and 2006 (n = 6), none of which were documented depredating nests during our time-lapse video camera study. Potential flycatcher nest predators in Arizona may also include woodrats (Kirkpatrick and Conway 2006), mice, foxes, long-tailed weasels, opossums, coatis, raccoons, ring-tailed cats, ravens, hawks, owls, and other snakes. A follow-up study encompassing different areas rangewide and with a larger sample size would help determine if and to what extent each of these predators impact flycatcher nest success.

Predators and Predator Habits. Our camera study documented Cooper's hawks, yellow-breasted chats, kingsnakes, gophersnakes, and lizards hunting diurnally and kingsnakes, western screech owls, and western spotted skunks hunting nocturnally. We assume that hunting activity is similar for kingsnakes and gophersnakes as both species are ectothermic and rely on olfactory and visual cues to locate prey (Weatherhead and Blouin-Demers 2004, Stake et al. 2005). We also assume that snakes perceive cues similarly (e.g., increased activity at the nest during the nestling stage, scent trails leading to nests). Avian predators rely more on visual and auditory than olfactory cues to locate nests so researchers should wear neutral colors, be quiet in flycatcher territories, and avoid approaching a nest when an avian predator is in the area. Researchers are not likely to observe nocturnal predators (e.g., western screech owls, western spotted skunks) during surveying or nest monitoring, but should attempt to not to leave a scent trail to the nest for them to follow.

Evidence Left at Nests by Predators. Few predators in our study left the type of physical evidence traditionally used to assign an outcome of depredated to a nest. Researchers need to observe parental behavior to determine if young have fledged or have been depredated. Relying on the presence or absence of physical evidence at a nest near fledging age to determine nest outcome may contribute to incorrect identification of nest predators and inaccurate estimates of depredation rates and nest success.

Physical evidence left at nests may bias estimates of species-specific nest depredation rates in favor of predator species that leave distinct evidence. Traditional methods used by researchers to designate predators to nests typically attributed holes in nests to snakes, undamaged nests to birds, and dislodged or destroyed nests to large predators (Thompson and Nolan 1973, Best and Stauffer 1980, Haskell 1994). We only observed 3 instances of evidence left at nests post-depredation (17.6% of nests). Not all predator species left evidence consistent with traditional assignments. For example, we did not observe snakes leaving holes in nests (evidence expected from a snake) and we did observe a Cooper's hawk dislodge a nest (evidence that would traditionally be assigned to a large predator). Pietz and Granfors (2000) also found that not all nest predators leave signs of depredation and that outcome assignment using traditional methods may be misleading or biased toward species that leave evidence. Even among species that leave evidence, high intraspecific variation in the signs left at the nest can contribute to misidentification of nest predators. It is also possible for multiple predators to visit a nest and leave conflicting evidence (Hernandez et al. 1997, Larivière 1999). Williams and Wood (2002) misidentified predator classes 57% of the time using traditional methods when compared to video review, sometimes because a second predator (often a rodent) altered the nest appearance following the original depredation.

Relying on physical evidence left at the nest may also influence interpretation of nest outcomes. Female flycatchers have been observed altering the appearance of abandoned or depredated nests by taking nesting material for a second nesting attempt, which may give an abandoned or deserted nest the appearance of being depredated. Female flycatchers may also remove shell fragments and dead nestlings from depredated nests, which may give a depredated nest the appearance of being abandoned if eggs were never confirmed or cause an inaccurate prediction of the type of nest predator.

According to nest monitoring protocol (Rourke et al. 1999), we assumed that nests were successful if occupied within 2 days of the estimated fledge date and contrary evidence was not found. Without time-lapse video cameras, up to 8 depredated nests (62%, *n* = 13 depredated nests) in our study may have been given the outcome of "suspected fledging of at least 1 young" because they were depredated within 2 days of their estimated fledge dates and nests looked unaltered. Based on our findings, it is likely that some non-camera monitored nests designated as successful during the study failed within the last 2 days of the nestling stage and that some estimates of nest success were overestimated. We tried to correct for this error by visiting nests daily or every other day as the estimated fledge date approached.

We developed an effective protocol for monitoring nests with cameras that minimized human-caused desertion, and gained valuable knowledge of nest predators and their habitats by using cameras during this study. Depredation was the leading cause of nest failure during our camera study and accounted for approximately 35% of failed camera-monitored flycatcher nests; though this is a normal rate for open-cup nesting birds (39.5–76.6%, reviewed in Nice 1957; 1–82, reviewed in Best and Stauffer 1980; 14.1–78.6%, reviewed in Martin 1993*b*). Depredation rates in our study also fall within rates documented in Arizona and in other flycatcher populations (Stoleson and Finch 1999, USFWS 2002, Koronkiewicz et al. 2006, Schuetz and Whitfield 2007). Depredation rates increased in the latter part of the nestling period, perhaps due to increased activity at the nest. Cooper's hawks and California kingsnakes were the 2 main predators documented, although we also documented a gophersnake, western screech owl, and yellow-breasted chat depredating flycatcher nests. Determining the identity of specific predator species would have been impossible without the use of cameras in this study. We also determined that basing nest outcomes on the presence or absence of physical evidence left at a nest may bias nest success results.

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CHAPTER 7

MANAGEMENT RECOMMENDATIONS

The Southwestern Willow Flycatcher Recovery Plan provides a comprehensive summary of the species' status, threats to habitat, management requirements, recovery objectives, actions needed, and papers on management issues (USFWS 2002). The ultimate recovery objective is to assure the long-term existence of metapopulations rangewide by conserving the ecosystems on which the southwestern willow flycatcher (*Empidonax traillii extimus*, flycatcher) depends.

The recovery plan includes specific downlisting and delisting objectives and criteria. Criteria to downlist to threatened requires meeting and maintaining target population sizes within the bounds of a defined distribution among recovery and management units that ensure functioning metapopulations (USFWS 2002). Under Criteria A to downlist, 1,950 territories with management units at 80% of target population sizes and recovery units at 100% of target must be maintained for 5 years. Under Criteria B to downlist, 1,500 territories with management units at 50% of target population sizes and recovery units at 75% of target must be maintained for 3 years. Additionally, because Criteria B requires fewer territories than Criteria A, it requires that occupied habitat must be protected into the foreseeable future through the development of conservation management agreements.

For delisting, Criteria A must be met and conservation management agreements (agreements) must be developed and implemented. The agreements need to provide protection from threats and secure sufficient habitat. These agreements will need to create a network of conservation areas on federal, state, tribal, and other public and private lands. The management agreements must:

1. Minimize the major stressors to the flycatcher and its habitat (including, but not limited to flood plain and watershed management, groundwater and surface water management, and livestock management);

2. Ensure that natural ecological processes or active human manipulation needed to develop and maintain suitable habitat prevail in areas critical to achieving metapopulation stability; and

3. Ensure that the amount of suitable breeding habitat available within each management unit is at least double the amount required to support the target number of flycatchers described under reclassification to threatened (USFWS 2002).

Below, we summarize the results of each of our chapters and discuss them in the context of meeting the goals and objectives of the recovery plan, and future management and research needs. We also include a section on general management recommendations.

SURVEYS

STATEWIDE SURVEYS

Accurate estimates of population sizes and distribution are essential for the flycatcher's recovery because downlisting requires meeting and maintaining target population sizes that are geographically distributed among management and recovery units. These data are most accurately obtained through on-the-ground surveys and this project compiled an extensive data set on the size and distribution of populations in Arizona. We observed flycatchers responding to changes in riparian habitat, exemplifying the need for continued population and habitat monitoring.

Surveys are important for determining the status of riparian habitat, flycatcher movements, and general presence absence trends to monitor species recovery. Surveys can also help managers identify areas for conservation or management actions. The surveys conducted throughout the state the past 12 years provided excellent data on habitat quality and distribution of flycatchers in response to habitat changes. Without large-scale survey efforts by Arizona Game and Fish Department (AGFD) and other agencies, the selection and prioritization of areas to survey becomes central to meeting recovery and management goals. Mackenzie and Royle (2005) suggest that it may be most efficient to survey more areas less intensively to determine occupancy by rare species. The use of habitat models may be an effective method to monitor changes in the quantity of suitable habitat (Hatten and Paradzick 2003, Dockens and Paradzick 2004, Paxton et al. 2007). Models are useful to locate areas with suitable habitat that are not being surveyed. Surveys can be prioritized based on model predictions of areas likely undergoing changes in suitable habitat that may impact flycatcher populations. Further, these habitat models can aid in prioritizing areas for restoration, mitigation, and long-term habitat management.

Goals of future statewide surveys should be to:

1. Monitor habitat status of areas with large (>10 territories) or small (≤10 territories) flycatcher populations and survey when necessary. Annual surveys may not be necessary at all sites depending on habitat conditions. Habitat evaluation should occur annually to gauge suitability for flycatchers and ensure the availability of suitable habitat. While site visits are necessary in some years to ground truth model predictions, habitat models can be used to assess areas that have been affected by recent large-scale disturbance events. Sites that are undergoing large-scale changes (e.g., flooding, inundation, fire) that may negatively impact flycatcher populations should be surveyed during and following the event to determine population and habitat status. Adjacent areas should be surveyed to determine if dispersal has occurred due to habitat changes. Areas with populations not undergoing major habitat changes may only require surveying every 2–4 years.

Areas with known large territorial populations include:

a. Salt River and Tonto Creek upstream from Roosevelt Lake (Roosevelt Lake complex);
b. San Pedro River from Benson downstream to its confluence with the Gila River and the Gila River from the San Carlos Reservoir downstream to the Kelvin Bridge (includes San Pedro River/Gila River complex and Three Links site);
c. Big Sandy River downstream from US 93 to Alamo Dam (includes Big Sandy River Downstream US 93 and Alamo Lake – Brown's Crossing sites);
d. Colorado River at Topock Marsh;
e. Gila River from Safford downstream to San Carlos Reservoir (includes Gila-Safford area); and
f. Verde River from Sheep Bridge downstream to Horseshoe Dam (includes Horseshoe North site).

Areas with known small territorial populations include:

a. Bill Williams River (includes Monkey's Head site), Colorado River from river mile 259 downstream to Topock Marsh (includes Lake Mead sites) and Topock Marsh downstream to Yuma;
b. Little Colorado River and tributaries (includes high-elevation sites: Greer Townsite and River Reservoir); and
c. San Francisco River from the New Mexico border to Clifton (includes the high-elevation site Alpine Horse Pasture).

2. Monitor habitat status in areas with historically suitable or potentially suitable habitat. Determine if restoration efforts would encourage greater flycatcher occupancy, focusing on management units where territory goals have not been achieved.

   Areas with historically or potentially suitable habitat or that have been occupied intermittently include:

   a. Agua Fria River downstream from Lake Pleasant (Waddell Dam);
   b. Big Sandy River upstream from US 93;
   c. Hassayampa River downstream from Wickenburg (Hassayampa River Preserve);
   d. Gila River from the New Mexico border downstream to Safford, from the Kelvin Bridge downstream to the Ashurst-Hayden Diversion Dam, and from the confluence with the Salt River to Gillespie Dam;
   e. Colorado River between river mile 246 and 259;
   f. Santa Cruz River from Rio Rico to Tubac and tributaries (e.g., Cienega Creek);
   g. Lower Santa Maria River;
   h. Queen Creek (Whitlow Dam, Gila River drainage);
   i. San Pedro River upstream from Benson;
   j. Verde River from Cottonwood downstream to Sheep Bridge and downstream from Horseshoe Dam to the confluence with the Salt River; and
   k. Virgin River.

3. Use habitat models to locate suitable habitat in areas throughout the state that may be occupied but are not currently being surveyed. Conduct surveys and evaluate habitat in these areas, focusing on management units where territory goals have not been achieved. Conservation management agreements should be developed with private landowners, tribal governments, and other entities to survey lands previously not surveyed in order to assure comprehensive coverage of the state's riparian habitat and to assess connectivity of breeding populations.

4. Stress standardization of surveys across survey periods and among sites and years, and determine detection probability and observer bias to better estimate population size. Include area as a measurement for each survey site in order to estimate flycatcher density and quantify changes in available habitat.

MIGRATORY CORRIDORS AND STOPOVER SITES

A comprehensive conservation plan should include the identification and protection of major migratory corridors and specific important stopover sites (USFWS 2002). We have identified areas frequented by migrant willow flycatchers, though areas used by each subspecies have not been determined. Because we did not quantify migrants during this study, we do not know the relative importance of all drainages and sites to migrating willow flycatchers in Arizona. Greater survey effort by cooperators along the lower Colorado and Bill Williams rivers has shown that these areas are important for migrating flycatchers (Koronkiewicz et al. 2006). Other drainages throughout the state may also be used extensively by migrating willow flycatchers; migrants were detected along almost every drainage (15 of 19) surveyed in Arizona.

Goals related to migratory corridors and stopover sites should be to:

1. Determine subspecies use of stopover sites on the Colorado and Bill Williams rivers (and other drainages identified as migration corridors) based on morphological and genetic differentiation. Determine migrant use of major drainages used by breeding southwestern willow flycatchers in Arizona, as flycatchers use the same major drainages for migration and breeding (USFWS 2005).

2. Identify and protect habitat along the major migratory corridors used in spring and fall by *E. t. extimus* in Arizona. Protect existing habitat at known stopover sites used by migrating flycatchers.

3. Establish cooperative relationships with managers in Mexico and Central America to determine and protect routes south of Arizona.

4. Determine variation in migratory habitat use between sexes and age classes. Determine body condition related to habitat features (e.g., native vegetation, mixed native and exotic, exotic vegetation, size of patch). Determine critical times when *E. t. extimus* is present at migratory stopover sites.

AGFD STUDY AREAS

Territories at AGFD study areas (Salt River, Tonto Creek, Gila River, and San Pedro River study areas) accounted for approximately 70% of the flycatcher territories in Arizona (English et al. 2006) and 30% of the rangewide territories (Durst et al. 2006) in 2005. The protection and maintenance of habitat in these areas should be a priority since flycatchers in these areas may function as source populations to smaller populations in the region.

During this study, we evaluated natural habitat succession and the effects of fire and fluctuations in water on habitat and flycatcher distribution at AGFD study areas. Information obtained during this study highlights the dynamic nature of riparian habitat and emphasizes the need to protect and encourage habitat at varying stages of succession. With reduced survey effort, determining the effects of large-scale disturbance events (e.g., fire, flood, inundation) on habitat and flycatcher distribution at these study areas will be difficult. Habitat models may be useful for determining the extent of changes to habitat, and determining which areas should be surveyed to evaluate habitat and population status.

Goals related to the future of these study areas should be to:

1. Monitor habitat recovery at Roosevelt Lake. Protect young regenerating habitat from human disturbance (e.g., off-road vehicles; see Inundation recommendations).

2. Implement a groundwater monitoring program along the San Pedro River. Where feasible, develop conservation agreements and implement management practices that increase the availability of water for flycatcher habitat.

3. Monitor the response of habitat, population size, and distribution to flow releases from Coolidge Dam along the Gila River.

INUNDATION

Inundation of Roosevelt Lake in 2005 drastically changed the habitat on the landscape level and nest level at the Salt River and Tonto Creek study areas. At the landscape level, large areas of trees died and sections of banks eroded, changing the quantity and location of breeding habitat. The structure of habitat also changed. After inundation, we found that breeding habitat in areas occupied prior to inundation were thinner with less canopy cover, more canopy gaps, a lower canopy, and farther from the nearest native broadleaf tree. The flycatcher population at Roosevelt Lake declined 47% between 2004 and 2006 in response to changes in habitat. Areas with the highest concentrations of occupied habitat were inundated, which displaced flycatchers to habitat upstream. The biological opinion related to increasing the height of Roosevelt Dam states that reducing adult productivity or survivorship long-term, or eliminating both in the short-term, may result in partial or complete loss of the Roosevelt Lake flycatcher population (USFWS 1996). We were not able to document long-term effects of inundation during this study, but we did document short-term effects. The populations' productivity decreased, but territory numbers are still high enough that the population may not suffer long-term effects if more habitat regenerates at the reservoir.

Goals related to Roosevelt Lake inundation should be to:

1. Monitor habitat recovery. Protect areas with regenerating habitat from damage due to recreational use (e.g., off-road vehicles, accidental fire). The rapid growth of habitat we observed as the lake receded in the earlier years of this study is encouraging; if the same pattern occurs as the lake recedes following inundation, flycatcher numbers and nest success should increase. If downed trees covering large portions of an area inhibit regenerating habitat or increase fire risk, removal of dead trees may aid vegetative growth and protect habitat in the future.

2. Survey the Salt River and Tonto Creek study areas to ensure recovery plan goals for the Roosevelt Management Unit continue to be met. The loss or further reduction of the Roosevelt Lake flycatcher population could affect the species rangewide by reducing survivorship or productivity.

3. Monitor nests annually to document the long-term impacts of inundation on the demographics (nest success, productivity) of the Salt River and Tonto Creek populations. Nest monitoring should occur annually until nest success reaches pre-inundation levels. This baseline data can be used to assess future population status and may reduce the need for annual nest monitoring in these areas after subsequent inundation events. Monitoring occupancy, nest success, and productivity as new habitat develops will help determine the population's ability to recover following a large-scale inundation event. Annual monitoring of the population may not be necessary in non-inundation years if habitat regeneration is occurring.

4. Develop dam management guidelines that reduce damage to habitat, encourage habitat growth, and mimic the dynamic nature of unaltered riparian habitat. These guidelines can be implemented, as appropriate, at reservoirs throughout the flycatcher's range. Some of the largest populations of flycatchers are at reservoirs (e.g., Roosevelt Lake in Arizona, Lake Isabella in California, and Elephant Butte Reservoir in New Mexico), making these systems a priority in the flycatcher's recovery. Knowledge of the effects of inundation gained by the inundation of Roosevelt Lake has the potential to influence flycatcher management at other reservoirs with flycatcher populations (e.g., Horseshoe Lake and Alamo Lake in Arizona).

NESTING BIOLOGY

Understanding demographic parameters that may affect population growth can aid conservation and recovery efforts (USFWS 2002). Knowledge of basic nesting biology is important to accurately assess the status of a population and evaluate population trends over time. Our long-term study documented variations between years and allows comparisons with other populations that yield valuable knowledge on the status of our study populations. Estimates of demographic parameters (e.g., clutch size, nest success, nest cycle length) and causes of nest failure in our study populations were similar to those reported in other populations of willow flycatchers and other songbirds (King 1955, Best and Stauffer 1980, Moore and Ahlers 2006, Schuetz and Whitfield 2007).

<u>Goals related to flycatcher nesting biology should be to:</u>

1. Monitor nests in areas determined to be critical for flycatcher recovery, such as large populations that are potential source populations. In areas with relatively stable populations, (e.g., San Pedro River) only periodic monitoring (e.g., once every 3–5 years) may be necessary. Areas affected by large-scale habitat changes (e.g., inundation at Roosevelt Lake) should be monitored as necessary depending on the severity of the habitat change to assure the population is stable and successfully nesting. Following large-scale habitat change, habitat regeneration will occur at varying rates in different systems and will depend on several variables including the geomorphology and hydrology of the system and the degree of human-impact. We recommend that adaptive management be implemented as appropriate.

2. Monitor nests of small populations (e.g., River Reservoir [Lower Colorado River], Alpine Horse Pasture [San Francisco River], and Pinal Creek [Salt River]) to determine if demographic traits and population dynamics of small populations are similar to those of large populations. If small populations are found to have low nest success and productivity, efforts should be made to identify limiting factors, and increase connectivity with larger or more stable populations to encourage immigration (see General recommendations for connectivity).

3. Monitor nests in areas where cowbird parasitism is prevalent or may be a significant threat to flycatcher nest success and productivity. The degree and impact of brown-headed cowbird parasitism is highly variable among populations of *E. t. extimus* and requires continuous monitoring, evaluation, and potential intervention to attempt to reduce negative impacts. Cowbird trapping may be necessary if nest parasitism is likely to endanger populations, especially small, isolated populations. If parasitism rates exceed 20–30%, contact USFWS to discuss the implementation of a cowbird trapping program (USFWS 2002). Reducing parasitism rates alone may not increase flycatcher population numbers if other factors that may be negatively affecting the population are not alleviated (e.g., lack of suitable breeding habitat; reviewed in Rothstein et al. 2003, Schuetz and Whitfield 2007).

RIVER AND RESERVOIR NESTING

Throughout their range, flycatchers have been documented inhabiting riparian habitat in a variety of systems ranging from free-flowing rivers to reservoirs (USFWS 2002, Durst et al. 2007, Graber et al. 2007). Comparisons of nest success and productivity of flycatchers at rivers and reservoirs with differing habitat composition and water regimes can provide information on the relative quality of habitat in the differing systems. We found that Mayfield nest success (Mayfield 1961, 1975) was greater at the river study areas than the reservoir study areas and that winter rainfall had a greater positive effect on nest success at the river study areas than the reservoir study areas. Seasonal fecundity was higher at the river study areas than the reservoir study areas. Although there were differences between river and reservoir populations, flycatchers at our reservoir study areas have successfully adjusted to nesting at Roosevelt Lake, though they may be more vulnerable to decreases in habitat quality due to environmental conditions. We found no difference in nest success among habitat classes (native broadleaf vegetation, mixed native broadleaf and exotic, entirely or almost entirely exotic vegetation) or nest tree species. Differences between habitats along rivers and reservoirs that affected nesting success are more likely microhabitat features (i.e., humidity, temperature), or structural and age differences than vegetation composition.

<u>Goals related to river and reservoir nesting biology should be to:</u>

1. Identify specific habitat (including microhabitat) differences between river and reservoir systems and determine how these differences may affect nest success and productivity (i.e., fecundity). Investigate differences in food resources (quality, quantity, and influential factors), nest tree height, and nest cover at river and reservoir systems. Investigate the impacts of reservoir drawdown during the flycatcher breeding season on flycatcher food resources and nest success.

2. Develop methods to improve habitat quality on reservoirs and other altered systems. Methods to improve habitat quality in riparian systems may include mimicking natural flow regimes (e.g., flooding events) or timing dam releases and reservoir drawdown to coincide with riparian tree seed dispersal.

3. Preserve riparian habitat, including tamarisk-dominant habitat, occupied by flycatchers or that has the potential for occupancy. Several studies have found no difference in the suitability of native and exotic habitat for flycatchers (e.g., Durst 2004, Owen et al. 2005, Sogge et al. 2005, Chapter 5). Removal of tamarisk should not be considered for an occupied area.

NEST DEPREDATION

Approximately 35% of camera-monitored flycatcher nests were depredated, accounting for the largest proportion of nest failure; however, this is a normal rate for open-cup nesting birds (39.5–

76.6%, reviewed in Nice 1957; 1–82%, reviewed in Best and Stauffer 1980; 14.1–78.6%, reviewed in Martin 1993). Depredation rates in our study fall within rates documented in Arizona and in other flycatcher populations (Stoleson and Finch 1999, USFWS 2002, Koronkiewicz et al. 2006, Graber et al. 2007, Schuetz and Whitfield 2007).

Goals related to flycatcher biology and nest depredation should be to:

1. Avoid leaving trails or scents while surveying or nest monitoring that lead directly to the nest ("trail dead-ends") that predators can follow. Avoid approaching nests and minimize length of visits when it is necessary to approach a nest. Surveyors should walk around known nests (>4 m), not under them. Nest monitors should take different routes to the nest during nest visits and alter exit routes after checking nest contents. When surveying or nest monitoring, minimize disturbance to the nest tree, nest, or vegetation surrounding the nest. Avoid direct contact with nestlings or fledglings. Some research activities require nestlings or fledglings to be handled (e.g., banding), but care should be taken to minimize contact. Follow the Southwestern Willow Flycatcher Nest Monitoring Protocol (Rourke et al. 1999).

2. Conduct camera studies if warranted in areas where nest depredation is a concern (as determined through nest monitoring) to determine if a unique predator (e.g., feral cat, snake, corvid) is at fault. Without cameras, identification of nest predators is difficult due to insufficient or inconclusive evidence left at nests.

3. Research patterns of nest depredation in relation to: spatial and temporal differences in habitats; fragmented and non-fragmented habitat; nest location; and anthropogenic land use.

General Management Recommendations

1. Maintaining existing populations should be the highest priority. Protect areas with extant flycatcher populations through conservation management agreements (e.g., Conservation Easements, Safe Harbor Agreements, Landowner Incentive Program) to support recovery plan downlisting and delisting criteria (USFWS 2002). Focus on areas and drainages in the state that are lacking protected southwestern willow flycatcher habitat.

2. Develop a surveying schedule that allows managers to estimate population sizes, which may eliminate the need for expensive annual surveys. Habitat models can be used, especially after large-scale disturbance events (e.g., fire, flood, inundation), to determine the amount and availability of suitable habitat and determine if surveys are warranted.

3. Evaluate flycatcher distribution to determine which recovery and management units are meeting recovery goals. Currently, the only 2 management units in Arizona meeting recovery criteria are the Roosevelt and Gila – San Pedro management units. Focus new surveys in management units deficient in territories, but with suitable habitat or habitat not previously surveyed (e.g., the Verde, Upper Gila, Bill Williams management units).

Consider habitat restoration in areas that have a high potential for colonization (i.e., near other populations).

4. Manage riparian systems at the drainage and landscape scale, in addition to managing individual habitat patches (USFWS 2002). Preservation of existing habitat patches is beneficial on the local scale, but limited if not extended to the entire riparian system. Anthropogenic actions that modify river flow and riparian habitat can occur off-site (e.g., groundwater pumping, releases from dams); therefore, more comprehensive plans protecting the entire system are needed to ensure long-term availability of habitat system-wide. Develop partnerships with water users to restore natural flow regimes, which are imperative to the health and maintenance of riparian habitat (Poff et al. 1997, Levine and Stromberg 2001).

5. Maintain a statewide willow flycatcher database to track all surveys conducted in Arizona to evaluate the effectiveness of recovery efforts. Develop a method to track the amount of habitat required to support the target number of flycatchers designated for downlisting within each management unit. Develop conservation agreements to ensure twice the amount of habitat required is available. Identify areas where this goal is unrealistic.

6. Increase the connectivity of known breeding populations within recovery units. Widely distributed yet connected populations throughout the state and range should minimize the risk of simultaneous catastrophic loss and genetic isolation of populations (USFWS 2002). Mitigation and restoration efforts should focus on increasing connectivity between large and small populations by adding more suitable breeding habitat between occupied sites for dispersing flycatchers to use (USFWS 2002). Connectivity between sites may be increased by improving habitat suitability at existing sites within close proximity to isolated sites or by locating and securing new suitable habitat. Promote land acquisition or conservation management agreements near occupied habitat to provide habitat for dispersal. Dispersal habitat is essential near areas with routinely disturbed habitat (due to flooding or inundation), habitat maturing beyond suitability, or habitat subject to stochastic events (e.g., fire). Mitigation property should be purchased as close as possible to lost habitat (or habitat at risk), preferably within the same management unit to encourage colonization by the displaced population. Annual re-evaluation will be required to prioritize breeding populations requiring increased connectivity.

   Currently isolated sites with populations that could be better connected within recovery units and management units include:

   a. Gila Recovery Unit
      1. Verde Management Unit – Horseshoe North and Camp Verde
      2. Middle–Gila/San Pedro Management Unit – Three Links and Hereford Bridge
      3. Roosevelt Management Unit – Pinal Creek
      4. Hassayampa/Agua Fria Management Unit – Hassayampa River Preserve
      5. San Francisco Management Unit – Alpine Horse Pasture
   b. Lower Colorado Recovery Unit

   1. Bill Williams Management Unit – Alamo Lake – Brown's Crossing and Big Sandy River Downstream of US 93
   2. Hoover–Parker Management Unit – Topock Marsh
   3. Little Colorado Management Unit – Greer Townsite and River Reservoir

7. Promote healthy watersheds and water conservation throughout the flycatcher's range. Identify opportunities to retire water rights and establish in-stream flow rights. Conserve groundwater; encourage water catchments, cisterns, graywater systems, and low water intensity crops and water use practices.

8. Focus nest monitoring efforts on areas with a high potential to be impacted by anthropogenic disturbance and changes in flow regimes. These areas include: reservoirs (e.g., Roosevelt Lake, Horseshoe Lake, Alamo Lake), river stretches downstream from reservoirs (e.g., Gila River downstream from Coolidge Dam, Verde River downstream of Horseshoe Dam), sites with potential development (e.g., San Manuel Crossing on the San Pedro River), and sites with potential for disturbance due to recreation (e.g., Salt River upstream from Roosevelt Lake). Ensure that refugia habitat exists in these areas. Create and enforce exclosures on flycatcher breeding areas where feasible to eliminate or minimize impacts of land uses (e.g., grazing, off-highway vehicle use) on flycatcher breeding habitat.

9. Conduct a population viability analysis using the most recent population numbers and productivity data. The most recent demographic analysis was conducted in 2000 using data from the Kern River in California, with limited comparisons of Arizona populations due to the unavailability of long-term reproductive data at most sites (USFWS 2002). The large amount of data collected during this study can be used to more accurately determine life history aspects that have the greatest effects on population growth. Results from models developed using the incidence function analysis predicted that sites <15 km apart with 10–25 territories each would provide the greatest stability among metapopulations within a recovery unit (USFWS 2002). Movement data collected by USGS will be useful in developing new models to update optimal distances for connectivity.

10. Identify areas at risk of fire, including areas with increased fuels and large concentrations of tamarisk. Reduce the risk of fire where feasible (e.g., camp fire restrictions) and restore areas where fire has destroyed habitat by encouraging habitat regeneration. While flycatchers readily use tamarisk-dominated habitat and suffer no decrease in nest success, tamarisk increases fuel loads and the risk of fire.

11. When feasible, work with dam managers and other interested parties to increase the suitability of flycatcher habitat that exists downstream. Monitor the timing and amount of flows to determine when releases would be most beneficial to flycatcher habitat. Modify dam operations to increase flows at times that are most beneficial to flycatcher habitat. Release water surpluses to simulate overbank flood flows to reset the successional stage of habitat as necessary and when feasible. Determine the appropriate amount and timing of

water releases from reservoirs that encourage growth of native species downstream and discourage the spread of tamarisk into new areas.

12. Continue training workshops to improve surveyor knowledge of survey techniques and to standardize data reporting, protocol adherence, and interagency communication.

13. Work with the Arizona Bird Conservation Initiative (a multi-agency association dedicated to the conservation of all birds in Arizona) to encourage and create private and public partnerships for fencing and habitat restoration through federal, state, and non-government programs (e.g., U.S. Fish and Wildlife Service Partners for Wildlife, the AGFD Stewardship Program, and the Federal Landowner Incentive Program).

14. Encourage federal, state, tribal, and private partners to maintain or increase funding for statewide surveys and develop partnerships with private landowners to survey suitable habitat. Develop educational programs and resources to encourage private landowner partnerships.

15. Develop educational programs and resources highlighting the importance of tamarisk habitat for flycatcher recovery in the absence of native riparian habitats. In areas where tamarisk is removed, pre-action plans for immediate native replacement should be developed, and pre- and post-action monitoring conducted to determine if goals are being met (USFWS 2002). Removal of tamarisk in current flycatcher breeding sites is not recommended.

This project has provided us with extensive knowledge of the flycatcher's distribution throughout Arizona as well as flycatcher nesting biology and habitat dynamics. Additionally, we were able to document the Roosevelt Lake population's response to habitat inundation and major flycatcher nest predators. Although we gained a great deal of information from this study, further actions are required in order to meet recovery objectives. Habitat protection and restoration should be major components of recovery, accompanied by statewide surveys to document population levels. Extensive cooperation among federal, state, tribal, non-profits, and private entities is also necessary to accomplish sufficient connectivity within recovery units to establish and maintain functioning metapopulations.

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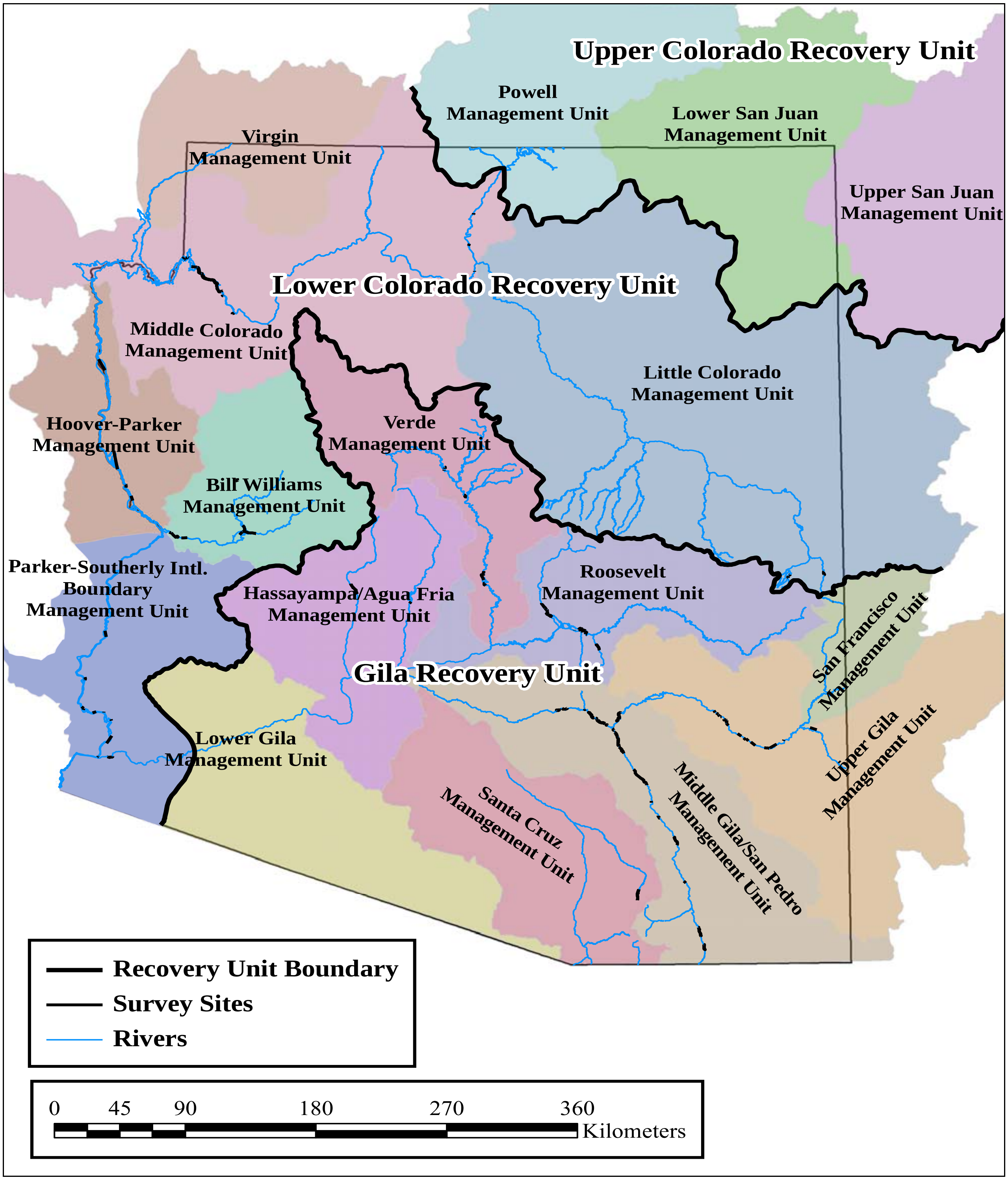
Appendix A. Map of southwestern willow flycatcher recovery units with corresponding management units in Arizona as defined by the Southwestern Willow Flycatcher Recovery Plan (USFWS 2002).



Appendix B. Survey and detection form for Arizona southwestern willow flycatcher surveys.

Willow Flycatcher Survey and Detection Form (revised April, 2004)

Site Name____ State______ County ________________________
USGS Quad Name _________________________________ Elevation _____________________ feet / meters (circle one)

Is copy of USGS map marked with survey area and WIFL sightings attached (as required)? ☐ ***Yes*** ☐ ***No***

Site Coordinates: Start: N_________________ E_____________________ UTM Datum _______(NAD27 preferred)
Stop: N_________________ E_____________________ UTM Zone ________

***** Fill in additional site information on back of this page *****

Survey # Observer(s) (Full Name)	Date (m/d/y) Survey time	Number of Adult WIFLs	Estimated Number of Pairs	Estimated Number of Territories	Nest(s) Found ? Y or N	Cowbirds Detected? Y or N	Presence of Livestock, Recent sign, If Yes, Describe Y or N	Comments about this survey (e.g., bird behavior, evidence of pairs or breeding, number of nests, nest contents or number of fledges seen; potential threats)
1__________	Date Start Stop Total hrs ____							
2__________	Date Start Stop Total hrs ____							
3__________	Date Start Stop Total hrs ____							
4__________	Date Start Stop Total hrs ____							
5__________	Date Start Stop Total hrs ____							
Overall Site Summary (Total **resident** WIFLs only) Total survey hrs__________		Adults	Pairs	Territories	Nests	Were any WIFLs color-banded? Yes No If yes, report color combination(s) in the comments section on back of form		

Reporting Individual ____ Date Report Completed ___________________
US Fish and Wildlife Service Permit #_____________ AZ Game and Fish Department (or other state) Permit # ____________

<u>Submit original</u> form by August 1st. Retain a copy for your records.

Appendix B (continued). Survey and detection form for Arizona southwestern willow flycatcher surveys.

Fill in the following information completely. __Submit original__ form by August 1st. Retain a copy for your records.

Reporting Individual ______________________________ Phone # ________________
Affiliation ______________________________ E-mail ________________
Site Name ______________________________ Date Report Completed __________

Did you verify that this site name is consistent with that used in previous years? Yes / No (circle one)
If name is different, what name(s) was used in the past? ______________________________
If site was surveyed last year, did you survey the same general area this year? Yes / No If no, summarize in comments below.
Did you survey the same general area during each visit to this site this year? Yes / No If no, summarize in comments below.

Management Authority for Survey Area (circle one): Federal Municipal/County State Tribal Private
Name of Management Entity or Owner (e.g., Tonto National Forest) ______________________________

Length of area surveyed: __________ (specify units, e.g., miles = mi, kilometers = km, meters = m)

Vegetation Characteristics: Overall, are the species in tree/shrub layer at this site comprised predominantly of (check one):

☐ Native broadleaf plants (entirely or almost entirely, includes high-elevation willow)

☐ Mixed native and exotic plants (mostly native)

☐ Mixed native and exotic plants (mostly exotic)

☐ Exotic/introduced plants (entirely or almost entirely)

Identify the 2-3 predominant tree/shrub species: ______________________________

Average height of canopy (Do not put a range): ______________________ (specify units)

Was surface water or saturated soil present at or adjacent to site? Yes / No (circle one)
Distance from the site to surface water or saturated soil: __________ (specify units)

Did hydrological conditions change significantly among visits (did the site flood or dry out)? Yes / No (circle one)
If yes, describe in comments section below.

Remember to attach a copy of a USGS quad/topographical map (REQUIRED) of the survey area, outlining the survey site and location of WIFL detections. Also include a sketch or aerial photograph showing details of site location, patch shape, survey route in relation to patch, and location of any willow flycatchers or willow flycatcher nests detected. Such sketches or photographs are welcomed, but DO NOT substitute for the required USGS quad map. Please include photos of the interior of the patch, exterior of the patch, and overall site and describe any unique habitat features.

Comments (attach additional sheets if necessary)

____
____
____
____
____
____
____

WIFL Detection Locations:

Date Detected	N UTM	E UTM	Date Detected	N UTM	E UTM

Appendix C1. AGFD site name, AGFD site number, rangewide site name, Southwestern Willow Flycatcher Recovery Plan management unit, and county for sites within the Gila Recovery Unit in Arizona (USFWS 2002).

AGFD site name	AGFD site number	Rangewide site name[a]	Management unit	County
Agua Fria River				
Agua Fria MC 85 Bridge	AZAF017		Hassayampa/Agua Fria	Maricopa
Luke Riparian Corridor	AZAF006		Hassayampa/Agua Fria	Maricopa
Waddell Dam	AZAF001	Agua Fria River – Waddell Dam	Hassayampa/Agua Fria	Maricopa
Morgan City	AZAF018		Hassayampa/Agua Fria	Maricopa
Confluence of Humbug Creek & Cow Creek	AZAF008		Hassayampa/Agua Fria	Yavapai
Gillette Ruins	AZAF005		Hassayampa/Agua Fria	Yavapai, Maricopa
Agua Fria Near Black Mesa	AZAF009		Hassayampa/Agua Fria	Yavapai
Lousy Canyon	AZAF010		Hassayampa/Agua Fria	Yavapai
Black Canyon Creek	AZAF011		Hassayampa/Agua Fria	Yavapai
Agua Fria Below Bloody Basin	AZAF012		Hassayampa/Agua Fria	Yavapai
Silver Creek	AZAF013		Hassayampa/Agua Fria	Yavapai
Indian Creek	AZAF004		Hassayampa/Agua Fria	Yavapai
Cordes Jct.	AZAF003		Hassayampa/Agua Fria	Yavapai
Ash/Little Ash/Dry Creeks	AZAF002		Hassayampa/Agua Fria	Yavapai
Little Ash Creek	AZAF014		Hassayampa/Agua Fria	Yavapai
Horner Gulch	AZAF015		Hassayampa/Agua Fria	Yavapai
Yellow Jacket Creek	AZAF016		Hassayampa/Agua Fria	Yavapai
Grapevine Canyon – Agua Fria River	AZAF007		Hassayampa/Agua Fria	Yavapai
Black River				
Wildcat Point	AZBL005		Roosevelt	Greenlee
PS Ranch	AZBL002		Roosevelt	Apache
Buffalo Crossing – Black River	AZBL004		Roosevelt	Apache
Diamond Rock Campground	AZBL006		Roosevelt	Apache
Thompson Ranch	AZBL001		Roosevelt	Apache
Burro Mountain	AZBL003		Roosevelt	Apache

Appendix C1. AGFD site name, AGFD site number, rangewide site name, Southwestern Willow Flycatcher Recovery Plan management unit, and county for sites within the Gila Recovery Unit in Arizona (USFWS 2002).

AGFD site name	AGFD site number	Rangewide site name[a]	Management unit	County
Blue River				
Confluence SF	AZBU006		Upper Gila	Greenlee
Pat Mesa	AZBU005		Upper Gila	Greenlee
Blue River Crossing	AZBU004		Upper Gila	Greenlee
Blue School	AZBU002		Upper Gila	Greenlee
Upper Blue River Campground	AZBU001		Upper Gila	Greenlee
Bobcat Flat – Blue River	AZBU003		Upper Gila	Greenlee, Catron
CAP Canal				
56th St. along CAP Canal	AZCP001		Roosevelt	Maricopa
Gila River				
Tacna Marsh – Quigley Wildlife Area	AZGI015		Lower Gila	Yuma
Pole Site	AZGI053		Lower Gila	Yuma
Painted Rock Dam	AZGI006		Lower Gila	Maricopa
Gillespie Dam	AZGI013		Hassayampa/Agua Fria	Maricopa
Arlington Valley – Pond & Slough	AZGI012		Hassayampa/Agua Fria	Maricopa
Arlington South	AZGI108		Hassayampa/Agua Fria	Maricopa
Arlington North	AZGI109		Hassayampa/Agua Fria	Maricopa
Robbins Butte	AZGI011		Hassayampa/Agua Fria	Maricopa
Buckeye East of Powerline	AZGI010		Hassayampa/Agua Fria	Maricopa
Buckeye	AZGI123		Hassayampa/Agua Fria	Maricopa
West of Airport Road	AZGI009		Hassayampa/Agua Fria	Maricopa
Jackrabbit Trail East – Gila River	AZGI017		Hassayampa/Agua Fria	Maricopa
Goodyear KR – West	AZGI120		Hassayampa/Agua Fria	Maricopa
Goodyear KR	AZGI112		Hassayampa/Agua Fria	Maricopa
Estrella	AZGI110		Hassayampa/Agua Fria	Maricopa

Appendix C1. AGFD site name, AGFD site number, rangewide site name, Southwestern Willow Flycatcher Recovery Plan management unit, and county for sites within the Gila Recovery Unit in Arizona (USFWS 2002).

AGFD site name	AGFD site number	Rangewide site name[a]	Management unit	County
Estrella GC	AZGI121		Hassayampa/Agua Fria	Maricopa
N.E. Goodyear Butte	AZGI008		Hassayampa/Agua Fria	Maricopa
Dysart Road	AZGI107	Gila River – Dysart Road	Middle Gila/San Pedro	Maricopa
Gila River 123rd to 107th Ave.	AZGI007		Hassayampa/Agua Fria	Maricopa
Picacho Lake	AZGI014		Middle Gila/San Pedro	Pinal
Whitlow Dam	AZGI034	Gila River – Whitlow Dam	Middle Gila/San Pedro	Pinal
South Butte	AZGI019		Middle Gila	Pinal
North Butte	AZGI099		Middle Gila/San Pedro	Pinal
GRN033	AZGI098	Gila River GRN033	Middle Gila/San Pedro	Pinal
Donnelly Wash	AZGI100		Middle Gila/San Pedro	Pinal
GRS032	AZGI097		Middle Gila/San Pedro	Pinal
GRSN031	AZGI096	Gila River GRSN031	Middle Gila/San Pedro	Pinal
GRSN030	AZGI095		Middle Gila/San Pedro	Pinal
GRN029	AZGI094		Middle Gila/San Pedro	Pinal
GRN028	AZGI093		Middle Gila/San Pedro	Pinal
GRN027	AZGI092		Middle Gila/San Pedro	Pinal
GRSN026	AZGI091		Middle Gila/San Pedro	Pinal
GRS025	AZGI090		Middle Gila/San Pedro	Pinal
GRSN023	AZGI089		Middle Gila/San Pedro	Pinal
GRSN022	AZGI088		Middle Gila/San Pedro	Pinal
Mineral Creek – Gila River	AZGI020		Middle Gila	Pinal
Mineral Creek at Twin Domes	AZGI105		Middle Gila/San Pedro	Pinal
Mineral Creek at Lake Flat	AZGI106		Middle Gila/San Pedro	Pinal
GRS020	AZGI086		Middle Gila/San Pedro	Pinal
GRN020	AZGI087	Gila River GRN020 (Kelvin Bridge)	Middle Gila/San Pedro	Pinal
GRS019	AZGI084		Middle Gila/San Pedro	Pinal
GRN019	AZGI085		Middle Gila/San Pedro	Pinal
GRN018	AZGI083	Gila River GRN018	Middle Gila/San Pedro	Pinal
GRS018	AZGI082	Gila River GRS018	Middle Gila/San Pedro	Pinal
GRS016	AZGI081	Gila River GRS016	Middle Gila/San Pedro	Pinal

Appendix C1. AGFD site name, AGFD site number, rangewide site name, Southwestern Willow Flycatcher Recovery Plan management unit, and county for sites within the Gila Recovery Unit in Arizona (USFWS 2002).

AGFD site name	AGFD site number	Rangewide site name[a]	Management unit	County
GRS015	AZGI080	Gila River GRS015	Middle Gila/San Pedro	Pinal
GRN015	AZGI113	Gila River GRN015	Middle Gila/San Pedro	Pinal
Kearny	AZGI042	Gila River Kearny Sewage Ponds	Middle Gila/San Pedro	Pinal
GRS014	AZGI078		Middle Gila/San Pedro	Pinal
GRN014	AZGI079		Middle Gila/San Pedro	Pinal
GRN013	AZGI077		Middle Gila/San Pedro	Pinal
GRS013	AZGI076	Gila River GRS013	Middle Gila/San Pedro	Pinal
GRN012	AZGI075		Middle Gila/San Pedro	Pinal
GRS012	AZGI074	Gila River GRS012	Middle Gila/San Pedro	Pinal
GRN011	AZGI073	Gila River GRN011	Middle Gila/San Pedro	Pinal
GRS011	AZGI072	Gila River GRS011	Middle Gila/San Pedro	Pinal
GRN010	AZGI071	Gila River GRN010	Middle Gila/San Pedro	Pinal
GRS010	AZGI070	Gila River GRS010	Middle Gila/San Pedro	Pinal
GRS009	AZGI068	Gila River GRS009	Middle Gila/San Pedro	Pinal
GRN009	AZGI069	Gila River GRN009	Middle Gila/San Pedro	Pinal
GRS008	AZGI066	Gila River GRS008	Middle Gila/San Pedro	Pinal
GRN008	AZGI067	Gila River GRN008	Middle Gila/San Pedro	Pinal
GRS007	AZGI064	Gila River GRS007	Middle Gila/San Pedro	Pinal
GRN007	AZGI065	Gila River GRN007	Middle Gila/San Pedro	Pinal
GRS006	AZGI063		Middle Gila/San Pedro	Pinal
GRS005	AZGI061	Gila River GRS005	Middle Gila/San Pedro	Pinal
GRN005	AZGI062		Middle Gila/San Pedro	Pinal
GRS004	AZGI059		Middle Gila/San Pedro	Pinal
GRN004	AZGI060	Gila River GRN004	Middle Gila/San Pedro	Pinal
GRS003	AZGI057		Middle Gila/San Pedro	Pinal
GRN003	AZGI058		Middle Gila/San Pedro	Pinal
GRN002	AZGI056		Middle Gila/San Pedro	Pinal
GRS002	AZGI055		Middle Gila/San Pedro	Pinal
GRS001	AZGI054		Middle Gila/San Pedro	Pinal
Dripping Springs Campground	AZGI036	Gila River – Dripping Springs Wash	Middle Gila/San Pedro	Pinal, Gila

Appendix C1. AGFD site name, AGFD site number, rangewide site name, Southwestern Willow Flycatcher Recovery Plan management unit, and county for sites within the Gila Recovery Unit in Arizona (USFWS 2002).

AGFD site name	AGFD site number	Rangewide site name[a]	Management unit	County
Dripping Springs Wash	AZGI004	Gila River – Dripping Springs Wash	Middle Gila/San Pedro	Gila
Mescal Creek	AZGI040		Middle Gila/San Pedro	Gila
Coolidge Dam	AZGI033		Middle Gila/San Pedro	Gila
Carland Wash	AZGI038		Upper Gila	Graham
Fort Thomas – Geronimo	AZGI044	Gila River – Fort Thomas, Geronimo	Upper Gila	Graham
Porter Wash Ponds	AZGI039	Gila River – Porter Wash Ponds	Upper Gila	Graham
Fort Thomas MS	AZGI045	Gila River – Fort Thomas MS	Upper Gila	Graham
Fort Thomas Bridge	AZGI037	Gila River – Fort Thomas Bridge	Upper Gila	Graham
Charley Thompson Springs – Clay Mine	AZGI051		Middle Gila/San Pedro	Graham
Teague	AZGI052	Gila River – Teague	Upper Gila	Graham
Simon Spring	AZGI021		Upper Gila	Graham
Pima Bridge	AZGI018	Gila River Pima Bridge	Upper Gila	Graham
Cottonwood Wash	AZGI022		Upper Gila	Graham
Cluff Reservoir 1 – Ash Creek	AZGI032		Middle Gila/San Pedro	Graham
Cluff Reservoir 3 – Ash Creek	AZGI041		Middle Gila/San Pedro	Graham
Pima East	AZGI043	Gila River Pima East	Upper Gila	Graham
Watson Wash	AZGI029	Gila River – Watson Wash	Upper Gila	Graham
Watson Spring	AZGI030		Upper Gila	Graham
Thatcher	AZGI027		Upper Gila	Graham
Smithville Canal	AZGI026	Gila River – Smithville Canal	Upper Gila	Graham
Safford	AZGI023		Upper Gila	Graham
Solomon Northwest	AZGI031	Gila River – Solomon NW	Upper Gila	Graham
San Simon to Gila	AZGI124		Upper Gila	Graham
San Simon River Barrier	AZGI049		Upper Gila	Graham
Sanchez Road	AZGI024	Gila River – Sanchez Road	Upper Gila	Graham
San Jose	AZGI028	Gila River – San Jose	Middle Gila/San Pedro	Graham
Southwest Sanchez	AZGI025		Upper Gila	Graham
Earven Flat	AZGI050	Gila River – Earven Flat	Upper Gila	Graham
Spring Canyon	AZGI122		Upper Gila	Graham
Northwest of Rail End Canyon	AZGI047		Upper Gila	Graham

Appendix C1. AGFD site name, AGFD site number, rangewide site name, Southwestern Willow Flycatcher Recovery Plan management unit, and county for sites within the Gila Recovery Unit in Arizona (USFWS 2002).

AGFD site name	AGFD site number	Rangewide site name[a]	Management unit	County
Bonita Creek	AZGI046		Upper Gila	Graham
Upper Bonita Creek	AZGI016		Upper Gila	Graham
Double Circle	AZGI117		Upper Gila	Greenlee
7 Cross A	AZGI116		Upper Gila	Greenlee
Eagle Creek	AZGI114		Upper Gila	Greenlee
Half Mile	AZGI005		Upper Gila	Greenlee
Gutherie	AZGI048	Gila River – Gutherie	Upper Gila	Greenlee
Duncan	AZGI104	Gila River – Duncan	Upper Gila	Greenlee
Hassayampa River				
Hassayampa at Arlington Canal	AZHA010		Hassayampa/Agua Fria	Maricopa
Johnson Road	AZHA011		Hassayampa/Agua Fria	Maricopa
Hassayampa River Preserve	AZHA001	Hassayampa Preserve	Hassayampa/Agua Fria	Maricopa
Box Canyon Area	AZHA002		Hassayampa/Agua Fria	Yavapai
King Solomon Gulch	AZHA003		Hassayampa/Agua Fria	Yavapai
O'Brien	AZHA004		Hassayampa/Agua Fria	Yavapai
Seal Mountain	AZHA005		Hassayampa/Agua Fria	Yavapai
Crook's Canyon	AZHA006		Hassayampa/Agua Fria	Yavapai
Hassayampa River – Climax Mine	AZHA007		Hassayampa/Agua Fria	Yavapai
Wolf Creek Campground	AZHA009		Hassayampa/Agua Fria	Yavapai
Salt River				
Salt River 91st to 107th Ave.	AZSA014		Roosevelt	Maricopa
Salt River 83rd Ave	AZSA013		Roosevelt	Maricopa
Salt River 67th Ave.	AZSA012		Roosevelt	Maricopa
Salt River 59th Ave.	AZSA011		Roosevelt	Maricopa
Tempe Town Lake	AZSA031		Roosevelt	Maricopa
Cave Creek	AZSA021		Roosevelt	Maricopa
Granite Reef	AZSA010		Roosevelt	Maricopa
Coon's Bluff	AZSA004		Roosevelt	Maricopa

Appendix C1. AGFD site name, AGFD site number, rangewide site name, Southwestern Willow Flycatcher Recovery Plan management unit, and county for sites within the Gila Recovery Unit in Arizona (USFWS 2002).

AGFD site name	AGFD site number	Rangewide site name[a]	Management unit	County
Stewart Mountain Dam	AZSA026		Roosevelt	Maricopa
Alder Creek – Apache Lake	AZSA006		Roosevelt	Maricopa
Lower Parker Creek	AZSA002		Roosevelt	Gila
Upper Parker Creek	AZSA001		Roosevelt	Gila
Grapevine	AZSA032	Salt River Inflow – Roos. Lk: Lakeshore	Roosevelt	Gila
Lake Shore	AZSA028	Salt River Inflow – Roos. Lk: Lakeshore	Roosevelt	Gila
School House Point North	AZSA022	Salt River – School House Point North	Roosevelt	Gila
School House Point South	AZSA027	Salt River – School House Point South	Roosevelt	Gila
Pinto Creek Near School House	AZSA033		Roosevelt	Gila
Pinto Creek	AZSA008		Roosevelt	Gila
Salt River Inflow	AZSA007	Salt River Inflow – Roosevelt Lake	Roosevelt	Gila
Cottonwood Acres II	AZSA018	Salt River – Cottonwood Acres I	Roosevelt	Gila
Cottonwood Acres I	AZSA017	Salt River – Cottonwood Acres I	Roosevelt	Gila
Meddler Point	AZSA009	Salt River Inflow – Cottonwood Acres I	Roosevelt	Gila
Eads Wash	AZSA023		Roosevelt	Gila
Roosevelt Diversion Dam	AZSA024		Roosevelt	Gila
Salt River at State Route 288 Bridge	AZSA003		Roosevelt	Gila
Horseshoe Bend to State Route 288	AZSA019		Roosevelt	Gila
Pinal Creek	AZSA020	Salt River – Pinal Creek	Roosevelt	Gila
Lost Gulch	AZSA025		Roosevelt	Gila
Coon Creek	AZSA005		Roosevelt	Gila
Upper Salt River – Cherry Crk to Horseshoe	AZSA016		Roosevelt	Gila
Cherry Creek South	AZSA029		Roosevelt	Gila
Cherry Creek North	AZSA030		Roosevelt	Gila
Canyon Creek at O.W. Bridge	AZSA015		Roosevelt	Gila
San Francisco River				
South of Clifton	AZSF007		San Francisco	Greenlee
Clifton Peak	AZSF009		San Francisco	Greenlee

Appendix C1. AGFD site name, AGFD site number, rangewide site name, Southwestern Willow Flycatcher Recovery Plan management unit, and county for sites within the Gila Recovery Unit in Arizona (USFWS 2002).

AGFD site name	AGFD site number	Rangewide site name[a]	Management unit	County
Sycamore Gulch	AZSF006		San Francisco	Greenlee
Lower San Francisco River	AZSF005		San Francisco	Greenlee
White Rock	AZSF011		San Francisco	Greenlee
Dix Creek	AZSF008		San Francisco	Greenlee
Upper San Francisco River	AZSF003		San Francisco	Apache
Alpine Horse Pasture	AZSF001	San Francisco Cr. – Alpine Horse Pasture	San Francisco	Apache
Pheasant Farm	AZSF002		San Francisco	Apache
San Francisco River South of Alpine	AZSF004		San Francisco	Apache
Triangle Patch	AZSF010		San Francisco	Apache
San Pedro River				
CB Crossing Northeast	AZSP030	San Pedro River – CB Crossing	Middle Gila/San Pedro	Pinal
CB Crossing West	AZSP031	San Pedro River – CB Crossing	Middle Gila/San Pedro	Pinal
CB Crossing Southeast	AZSP029	San Pedro River – CB Crossing	Middle Gila/San Pedro	Pinal
Indian Hills	AZSP006	San Pedro River – Indian Hills	Middle Gila/San Pedro	Pinal
Dudleyville Crossing	AZSP001	San Pedro R. – Dudleyville Crossing	Middle Gila/San Pedro	Pinal
Malpais Hill	AZSP002	San Pedro River – Malpais Hill	Middle Gila/San Pedro	Pinal
PZ Ranch	AZSP003	San Pedro River – PZ Ranch	Middle Gila/San Pedro	Pinal
PZ Ranch West	AZSP037	San Pedro River – PZ Ranch	Middle Gila/San Pedro	Pinal
Cook's Lake Cienega/Seep	AZSP004	San Pedro River – Cooks Lake	Middle Gila/San Pedro	Pinal
Aravaipa Inflow North	AZSP038	San Pedro River – Aravaipa Inflow North	Middle Gila/San Pedro	Pinal
San Pedro/Aravaipa Confluence	AZSP007	San Pedro River – Aravaipa Cr. Confluence	Middle Gila/San Pedro	Pinal
Aravaipa Canyon	AZSP027		Middle Gila/San Pedro	Graham, Pinal
Aravaipa Inflow South	AZSP039	San Pedro River – Aravaipa Inflow South	Middle Gila/San Pedro	Pinal
Wheatfields	AZSP033	San Pedro River – Wheatfields	Middle Gila/San Pedro	Pinal
Wheatfields South	AZSP040	San Pedro River – Wheatfields	Middle Gila/San Pedro	Pinal
Capgage Wash	AZSP042	San Pedro River – Capgage Wash	Middle Gila/San Pedro	Pinal
Cronley Wash	AZSP041		Middle Gila/San Pedro	Pinal
Cronley Wash South	AZSP052		Middle Gila/San Pedro	Pinal
Mammoth North	AZSP044		Middle Gila/San Pedro	Pinal

Appendix C1. AGFD site name, AGFD site number, rangewide site name, Southwestern Willow Flycatcher Recovery Plan management unit, and county for sites within the Gila Recovery Unit in Arizona (USFWS 2002).

AGFD site name	AGFD site number	Rangewide site name[a]	Management unit	County
Mammoth Sewage Ponds	AZSP043		Middle Gila/San Pedro	Pinal
Mammoth South	AZSP045		Middle Gila/San Pedro	Pinal
San Manuel Crossing	AZSP008	San Pedro River – San Manuel Crossing	Middle Gila/San Pedro	Pinal
Catalina Wash	AZSP047	San Pedro River – Catalina Wash	Middle Gila/San Pedro	Pinal
South Catalina Wash	AZSP009	San Pedro River – Catalina Wash	Middle Gila/San Pedro	Pinal
Peck Canyon South	AZSP046		Middle Gila/San Pedro	Pima
Bingham Cienega	AZSP048	San Pedro River – Bingham Cienega	Middle Gila/San Pedro	Pima
Swamp Springs Canyon	AZSP014		Middle Gila/San Pedro	Graham
Soza Wash	AZSP011	San Pedro River – Soza Wash	Middle Gila/San Pedro	Cochise
Cascabel	AZSP010		Middle Gila/San Pedro	Cochise
Bass Canyon	AZSP012		Middle Gila/San Pedro	Cochise
Hookers Hot Springs	AZSP015		Middle Gila/San Pedro	Cochise
Three Links	AZSP055	San Pedro – 3 Links	Middle Gila/San Pedro	Cochise
Paige Creek	AZSP024		Middle Gila/San Pedro	Pima
Ash Creek II	AZSP026		Middle Gila/San Pedro	Pima
Ash Creek I	AZSP025		Middle Gila/San Pedro	Pima
Apache Powder Rd.	AZSP013	San Pedro River – Apache Powder Rd.	Middle Gila/San Pedro	Cochise
Miller Water Gap	AZSP049		Middle Gila/San Pedro	Cochise
St. David Cienega	AZSP051		Middle Gila/San Pedro	Cochise
Summers	AZSP018		Middle Gila/San Pedro	Cochise
SPRNCA – Contention	AZSP022		Middle Gila/San Pedro	Cochise
Fairbank to Contention	AZSP016		Middle Gila/San Pedro	Cochise
Babocomari	AZSP054		Middle Gila/San Pedro	Cochise, Santa Cruz
SPRNCA – Boquillas	AZSP019		Middle Gila/San Pedro	Cochise
SPRNCA – 9	AZSP053		Middle Gila/San Pedro	Cochise
Charleston Bridge North	AZSP034		Middle Gila/San Pedro	Cochise
Escapula Wash North	AZSP035		Middle Gila/San Pedro	Cochise
Escapula Wash South	AZSP036		Middle Gila/San Pedro	Cochise
State Route 90 Bridge	AZSP028	San Pedro River, SR 90	Middle Gila/San Pedro	Cochise
SPRNCA – Carr to Hunter	AZSP020		Middle Gila/San Pedro	Cochise

Appendix C1. AGFD site name, AGFD site number, rangewide site name, Southwestern Willow Flycatcher Recovery Plan management unit, and county for sites within the Gila Recovery Unit in Arizona (USFWS 2002).

AGFD site name	AGFD site number	Rangewide site name[a]	Management unit	County
Hereford Bridge	AZSP050	San Pedro River – Hereford Bridge	Middle Gila/San Pedro	Cochise
SPRNCA – Palominas	AZSP017		Middle Gila/San Pedro	Cochise
Santa Cruz River				
Santa Cruz River, Upstream Trig Rd Bridge	AZSC022		Santa Cruz	Pima
Avra Valley Bridge S.	AZSC007		Santa Cruz	Pima
Ina Bridge	AZSC019		Santa Cruz	Pima
Lower Sabino Canyon	AZSC005		Santa Cruz	Pima
Upper Tanque Verde	AZSC006		Santa Cruz	Pima
Empire/Cienega – Cienega Creek	AZSC004		Santa Cruz	Pima
Cienega Creek Near Cross Hill	AZSC015		Santa Cruz	Pima
Cienega Narrows	AZSC020		Santa Cruz	Pima
Cienega Creek – Narrows to Coldwater	AZSC023		Santa Cruz	Pima
Cienega Creek	AZSC001	Santa Cruz River – Cienega Creek	Santa Cruz	Pima
Chavez Siding Rd. – Santa Cruz River	AZSC009		Santa Cruz	Santa Cruz
Anza Trail	AZSC010		Santa Cruz	Santa Cruz
Arivaca Creek	AZSC011		Santa Cruz	Pima
Santa Gertrudis South	AZSC016		Santa Cruz	Santa Cruz
Peck Canyon Bridge	AZSC017		Santa Cruz	Santa Cruz
Rio Rico	AZSC008		Santa Cruz	Santa Cruz
Cuates Buttes	AZSC021		Santa Cruz	Santa Cruz
Patagonia Lake – Sonoita Creek	AZSC002		Santa Cruz	Santa Cruz
Sanford Butte	AZSC018		Santa Cruz	Santa Cruz
Patagonia – Sonoita Creek Preserve	AZSC003		Santa Cruz	Santa Cruz
Cottonwood Spring	AZSC014		Santa Cruz	Santa Cruz
Ruby Rd. Bridge – Santa Cruz River	AZSC012		Santa Cruz	Santa Cruz
Bog Hole Wildlife Area	AZSC013		Santa Cruz	Santa Cruz

Appendix C1. AGFD site name, AGFD site number, rangewide site name, Southwestern Willow Flycatcher Recovery Plan management unit, and county for sites within the Gila Recovery Unit in Arizona (USFWS 2002).

AGFD site name	AGFD site number	Rangewide site name[a]	Management unit	County
Tonto Creek				
Orange Peel	AZTO012	Tonto Creek Inflow – Roosevelt Lk.	Roosevelt	Gila
Tonto Creek Inflow	AZTO001	Tonto Creek Inflow – Roosevelt Lk.	Roosevelt	Gila
A-Cross Road South	AZTO010	Tonto Creek Inflow – Roosevelt Lk.	Roosevelt	Gila
A-Cross Road North	AZTO011	Tonto Creek Inflow – Roosevelt Lk.	Roosevelt	Gila
Bar-X Road	AZTO009	Tonto Creek Inflow – Roosevelt Lk.	Roosevelt	Gila
Punkin Center	AZTO017		Roosevelt	Gila
Del Shay	AZTO014		Roosevelt	Gila
Rye Creek	AZTO005		Roosevelt	Gila
Gisela South	AZTO013		Roosevelt	Gila
Tonto Creek – Gisela	AZTO002		Roosevelt	Gila
Gibson Creek – Round Valley	AZTO007		Roosevelt	Gila
Spring Creek – Buzzard Roost Mesa	AZTO004		Roosevelt	Gila
Bear Hide Spring	AZTO006		Roosevelt	Gila
Christopher Creek	AZTO003		Roosevelt	Gila
Indian Gardens	AZTO008		Roosevelt	Gila
Bermuda Flats	AZTO015	Tonto Creek Inflow – Roosevelt Lk.	Roosevelt	Gila
Haufer Wash	AZTO016		Roosevelt	Gila
Verde River				
Rock Creek – Beeline	AZVE079		Verde	Maricopa
Needle Rock	AZVE074		Verde	Maricopa
Bartlett Dam	AZVE078		Verde	Maricopa
Bartlett North	AZVE077		Verde	Maricopa
Davenport	AZVE072	Verde River – Davenport	Verde	Maricopa
Horseshoe Dam	AZVE045	Verde River – Horseshoe Reservoir	Verde	Yavapai
Horseshoe North	AZVE071	Verde River – Horseshoe Reservoir	Verde	Yavapai
Ister Flat	AZVE043	Verde River – Ister Flat	Verde	Yavapai

Appendix C1. AGFD site name, AGFD site number, rangewide site name, Southwestern Willow Flycatcher Recovery Plan management unit, and county for sites within the Gila Recovery Unit in Arizona (USFWS 2002).

AGFD site name	AGFD site number	Rangewide site name[a]	Management unit	County
Ister Flat West	AZVE052	Verde River – Ister Flat	Verde	Yavapai
Mile 9 R	AZVE076		Verde	Yavapai
Sycamore Creek At Sheep Bridge	AZVE044		Verde	Yavapai
Junkyard to Sheep Bridge	AZVE082		Verde	Yavapai
Junkyard	AZVE069		Verde	Yavapai
Tangle Peak R	AZVE063		Verde	Yavapai
Mile 16.5 L	AZVE024		Verde	Yavapai
Mile 16.5 R	AZVE075		Verde	Yavapai
Mile 18.0 R	AZVE062		Verde	Yavapai
Mile 18.5 L	AZVE060		Verde	Yavapai
Mile 18.5 R	AZVE061		Verde	Yavapai
Wet Bottom Creek L	AZVE050		Verde	Gila
Palo Verde Spring	AZVE056		Verde	Yavapai
Red Creek	AZVE025		Verde	Yavapai
Cow Flop Spring R	AZVE059		Verde	Yavapai
Pete's cabin Mesa L	AZVE068		Verde	Yavapai
Pete's Cabin Mesa R	AZVE032		Verde	Yavapai
Mile 29.5 R (ROG)	AZVE026		Verde	Yavapai
Goat Camp	AZVE067		Verde	Yavapai
Mile 31.75 R	AZVE058		Verde	Yavapai
Mile 32.75 L	AZVE027		Verde	Gila
Mile 33.25 R	AZVE020		Verde	Yavapai
Squaw Butte R	AZVE028		Verde	Yavapai
Houston Creek	AZVE029		Verde	Yavapai
Mile 34.5 R	AZVE055		Verde	Yavapai
Mile 34.75 L	AZVE057		Verde	Gila
East Verde – Verde Confluence L	AZVE030		Verde	Gila, Yavapai
East Verde – Verde Confluence R	AZVE066		Verde	Yavapai
East Verde – Doll Baby Ranch	AZVE049		Verde	Gila
Lost Shirt Bend	AZVE031		Verde	Gila

Appendix C1. AGFD site name, AGFD site number, rangewide site name, Southwestern Willow Flycatcher Recovery Plan management unit, and county for sites within the Gila Recovery Unit in Arizona (USFWS 2002).

AGFD site name	AGFD site number	Rangewide site name[a]	Management unit	County
Childs to Lost Shirt	AZVE081		Verde	Yavapai
Stehr Lake	AZVE041		Verde	Yavapai
Fossil Creek	AZVE035		Verde	Yavapai
Aqueduct Spring	AZVE034		Verde	Yavapai
Bridge to Irving Powerplant	AZVE006		Verde	Yavapai, Gila
Fossil Springs	AZVE036		Verde	Yavapai
West Clear Creek Near Shill's Crossing	AZVE051		Verde	Yavapai
East Wingfield Mesa – West Clear Creek	AZVE013		Verde	Yavapai
West Clear Creek Campground	AZVE047		Verde	Yavapai
Hance Springs	AZVE042		Verde	Yavapai
Bull Pen	AZVE048		Verde	Yavapai
Pivot Rock Canyon	AZVE053		Verde	Coconino
Rancho Rio Verde	AZVE054		Verde	Yavapai
Ryal Canyon – Verde River	AZVE064		Verde	Yavapai
Copper Canyon	AZVE040		Verde	Yavapai
White Bridge	AZVE010		Verde	Yavapai
Wet Beaver Creek	AZVE021		Verde	Yavapai
Red Tank Draw	AZVE022		Verde	Yavapai
Stoneman Lake	AZVE037		Verde	Coconino
Winter Cabin Tank – Dry Beaver Creek	AZVE015		Verde	Yavapai
Stage Stop – Dry Beaver Creek	AZVE014		Verde	Yavapai
Camp Verde	AZVE046	Verde River – Camp Verde	Verde	Yavapai
Cornville Bridge – Oak Creek	AZVE016		Verde	Yavapai
Sheepshead Canyon	AZVE033		Verde	Yavapai
Mormon Crossing – Oak Creek	AZVE019		Verde	Yavapai
Turkey Creek	AZVE065		Verde	Yavapai
Red Rock Crossing – Oak Creek	AZVE017		Verde	Coconino
West Fork – Oak Creek	AZVE018		Verde	Coconino
Spring Creek	AZVE011		Verde	Yavapai
Bignotti Beach	AZVE012		Verde	Yavapai

Appendix C1. AGFD site name, AGFD site number, rangewide site name, Southwestern Willow Flycatcher Recovery Plan management unit, and county for sites within the Gila Recovery Unit in Arizona (USFWS 2002).

AGFD site name	AGFD site number	Rangewide site name[a]	Management unit	County
Bridgeport	AZVE083		Verde	Yavapai
Mingus Ave. – Rocking Chair Road	AZVE001		Verde	Yavapai
Cottonwood	AZVE084		Verde	Yavapai
Dead Horse State Park	AZVE009		Verde	Yavapai
Mescal Gulch	AZVE004	Verde River – Tuzigoot Bridge	Verde	Yavapai
Upstream 10th St R and L	AZVE085		Verde	Yavapai
Tavasci Marsh	AZVE002	Verde River – Tavasci Marsh	Verde	Yavapai
Verde Outflow	AZVE008		Verde	Yavapai
Tuzigoot Gallery Forest	AZVE007		Verde	Yavapai
Tuzigoot Bridge	AZVE003	Verde River – Tuzigoot Bridge	Verde	Yavapai
Tapco	AZVE005		Verde	Yavapai
Verde @ Powerline	AZVE070		Verde	Yavapai
Sycamore Canyon	AZVE023		Verde	Coconino
Near Muldoon Canyon	AZVE080		Verde	Yavapai
Granite – Verde	AZVE073		Verde	Yavapai
Granite Creek	AZVE039		Verde	Yavapai
Confluence of Apache Creek & Walnut Creek	AZVE038		Verde	Yavapai

[a]Rangewide site names were only created for sites where willow flycatchers were detected. Names originate from the Rangewide Southwestern Willow Flycatcher database (USGS unpublished data) and Southwestern Willow Flycatcher Recovery Plan (2002).

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
Agua Fria River										
Agua Fria MC 85 Bridge	1	1999	2	4.3	0	0	0	0	0	0
Luke Riparian Corridor	2	1994	1	2	0	0	0	0	0	0
Waddell Dam	3	1999	1	1.5	0	0	0	0	0	0
		2000	2	2	0	0	0	0	0	0
		2001	3	4.75	0	0	0	0	0	0
		2002	3	4.25	0	0	0	0	0	1
		2003	3	8	0	0	0	0	0	0
		2004	3	5.25	1	1	0	0	0	2
		2005	3	2.6	0	0	0	0	0	0
		2006	3	12.25	1	1	0	0	0	0
Morgan City	3.5	2001	3	4.75	0	0	0	0	0	0
		2002	3	4.25	0	0	0	0	0	0
		2003	3	8	0	0	0	0	0	0
		2004	2	2.75	0	0	0	0	0	0
		2005	3	7.74	0	0	0	0	0	0
Confluence of Humbug Creek & Cow Creek	4	1993	2	9.7	0	0	0	0	0	0
Gillette Ruins	5	1995	1	1.5	0	0	0	0	0	0
Agua Fria Near Black Mesa	6	1993	1	5	0	0	0	0	0	0
Lousy Canyon	7	1993	1	5	0	0	0	0	0	0
Black Canyon Creek	8	1993	2	8.3	0	0	0	0	0	0
Agua Fria Below Bloody Basin	9	1993	1	6.5	0	0	0	0	0	0
Silver Creek	10	1993	1	7.5	0	0	0	0	0	0
Indian Creek	11	1993	1	6	0	0	0	0	0	0
Cordes Jct.	12	1993	1	6	0	0	0	0	0	0
Ash/Little Ash/Dry Creeks	13	1993	1	7	0	0	0	0	0	0
Little Ash Creek	14	1996	1	1.3	0	0	0	0	0	0

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
Horner Gulch	15	1996	1	0.5	0	0	0	0	0	0
Yellow Jacket Creek	16	1996	1	0.3	0	0	0	0	0	0
Grapevine Canyon – Agua Fria River	17	1994	1	3	0	0	0	0	0	0
Black River										
Wildcat Point	55	1997	1	3	0	0	0	0	0	0
PS Ranch	56	1994	3	11.3	0	0	0	0	0	0
		1997	2	3.6	0	0	0	0	0	0
		1998	1	2.5	0	0	0	0	0	0
		2000	4	7.5	0	0	0	0	0	0
Buffalo Crossing – Black River	57	1994	1	1.5	0	0	0	0	0	0
Diamond Rock Campground	59	1997	2	14	0	0	0	0	0	0
Thompson Ranch	61	1995	1	1	0	0	0	0	0	0
		1997	3	14.5	0	0	0	0	0	0
		1998	3	11.3	0	0	0	0	0	0
Burro Mountain	62	1994	1	0.3	0	0	0	0	0	0
Blue River										
Confluence SF	63	2003	1	2	0	0	0	0	0	0
Pat Mesa	63.5	2002	3	20	0	0	0	0	0	0
		2003	3	35.5	0	0	0	0	0	0
Blue River Crossing	65	1994	1	0	0	0	0	0	0	0
Blue School	66	1994	2	19.3	0	0	0	0	0	0
Upper Blue River Campground	67	1994	3	14.7	0	0	0	0	0	0
Bobcat Flat – Blue River	68	1994	1	9	0	0	0	0	0	0
CAP Canal										
56th St. along CAP Canal	72	1997	3	8.4	0	0	0	0	0	0

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
Gila River										
Tacna Marsh – Quigley Wildlife Area	323	1994	3	11.3	0	0	0	0	0	11
		1997	2	2.5	0	0	0	0	0	0
		2005	3	3.1	0	0	0	0	0	1
		2006	3	5.72	0	0	0	0	0	22
Pole Site	325	1997	3	2.7	0	0	0	0	0	1
		1998	3	2.5	0	0	0	0	0	0
		1999	3	2.1	0	0	0	0	0	4
Painted Rock Dam	330	1996	1	0.5	0	0	0	0	0	0
Gillespie Dam	335	1994	1	3.5	0	0	0	0	0	0
		1996	3	5	0	0	0	0	0	0
		1999	3	6	0	0	0	0	0	0
		2006	5	141.5	0	0	0	0	0	1
Arlington Valley – Pond & Slough	336	1994	1	2	0	0	0	0	0	0
		1996	1	1.3	0	0	0	0	0	0
Arlington South	337	1999	3	13.5	0	0	0	0	0	0
		2002	3	12.25	0	0	0	0	0	0
		2003	5	18.75	0	0	0	0	0	0
		2004	5	11.5	0	0	0	0	0	0
		2005	5	13.3	0	0	0	0	0	0
		2006	3	10.2	0	0	0	0	0	0
Arlington North	338	1999	3	18	0	0	0	0	0	1
Robbins Butte	340	1993	1	4	0	0	0	0	0	0
		1994	1	2	0	0	0	0	0	0
		1996	1	6	0	0	0	0	0	0
		1999	2	26	0	0	0	0	0	0

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
Buckeye East of Powerline	341	1996	1	1	0	0	0	0	0	0
		1997	3	33	0	0	0	0	0	1
		1998	3	24.6	0	0	0	0	0	0
		1999	2	12.5	0	0	0	0	0	0
Buckeye	341.5	2005	3	3.74	0	0	0	0	0	0
West of Airport Road	342	1996	2	16.5	0	0	0	0	0	1
		1997	3	16	0	0	0	0	0	1
		1998	3	11	0	0	0	0	0	1
		1999	3	13.3	0	0	0	0	0	0
		2000	3	9.6	0	0	0	0	0	2
		2001	3	8.25	0	0	0	0	0	0
		2002	3	5.75	0	0	0	0	0	0
Jackrabbit Trail East – Gila River	343	1993	1	1	0	0	0	0	0	0
		1994	1	4.5	0	0	0	0	0	0
Goodyear KR – West	344	2005	5	1.48	0	0	0	0	0	0
Goodyear KR	345	2000	3	7.5	0	0	0	0	0	0
		2004	5	13.25	0	0	0	0	0	0
		2005	5	6.45	0	0	0	0	0	0
Estrella	346	1999	3	9.3	0	0	0	0	0	0
Estrella GC	346.5	2005	5	4.09	0	0	0	0	0	0
N.E. Goodyear Butte	347	1996	2	6	0	0	0	0	0	0
		1999	3	26.3	0	0	0	0	0	0
		2004	5	9.24	0	0	0	0	0	0
Dysart Road	348	1999	3	87.3	0	0	0	0	0	1
		2002	4	79.5	2	2	0	0	0	0
		2003	5	37.25	0	0	0	0	0	1

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
Gila River 123rd to 107th Ave.	349	1994	5	24	0	0	0	0	0	0
		1995	1	16	0	0	0	0	0	0
		1996	2	9.3	0	0	0	0	0	1
		1997	3	12	0	0	0	0	0	0
		1998	4	26.5	0	0	0	0	0	0
		1999	3	63.8	0	0	0	0	0	0
		2000	3	3	0	0	0	0	0	0
		2002	5	38.75	0	0	0	0	0	0
		2003	5	4.5	0	0	0	0	0	0
Picacho Lake	352	1994	1	1	0	0	0	0	0	0
		1995	1	1.5	0	0	0	0	0	0
Whitlow Dam	356	1994	1	3.8	0	0	0	0	0	0
		1996	1	7	0	0	0	0	0	0
		1998	3	8.5	0	0	0	0	0	0
		2005	3	11.06	1	1	0	0	0	1
		2006	3	9.42	0	0	0	0	0	0
South Butte	360	1993	2	5.5	0	0	0	0	0	0
		1994	1	5.7	0	0	0	0	0	0
		1995	1	0.9	0	0	0	0	0	0
		1998	3	19.5	0	0	0	0	0	0
		2006	2	3.16	0	0	0	0	0	0
North Butte	361	1995	1	0.9	0	0	0	0	0	0
		1997	2	22.5	0	0	0	0	0	0
		1998	3	18.5	0	0	0	0	0	0
		1999	3	12.8	0	0	0	0	0	0
		2000	3	13.5	0	0	0	0	0	0
		2006	2	3.16	0	0	0	0	0	0

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
GRN033	363	1995	1	0.8	0	0	0	0	0	0
		1996	2	9.5	1	1	0	0	0	0
		1997	2	12	0	0	0	0	0	0
		1998	3	15.5	0	0	0	0	0	0
		1999	3	11.5	0	0	0	0	0	0
		2000	3	5.5	0	0	0	0	0	0
		2006	2	1.7	0	0	0	0	0	0
Donnelly Wash	364	1995	1	0.8	0	0	0	0	0	0
		1996	2	9.5	0	0	0	0	0	0
		1997	2	10	0	0	0	0	0	0
		1998	1	0.7	0	0	0	0	0	0
		2006	2	0.77	0	0	0	0	0	0
GRS032	365	1995	1	0.8	0	0	0	0	0	0
		1996	2	13	0	0	0	0	0	0
		1997	2	10	0	0	0	0	0	0
		1998	1	0.7	0	0	0	0	0	0
		2006	2	1.05	0	0	0	0	0	0
GRSN031	366	1995	1	1.7	0	0	0	0	0	0
		1996	2	18	1	1	0	0	0	0
		1997	2	32	0	0	0	0	0	0
		1998	1	11.5	0	0	0	0	0	0
		2006	2	2.22	0	0	0	0	0	0
GRSN030	367	1995	2	3	0	0	0	0	0	0
		1996	2	8.5	0	0	0	0	0	6
		1997	1	16	0	0	0	0	0	0
		1998	1	0.8	0	0	0	0	0	0
		2000	3	3	0	0	0	0	0	0
		2006	2	1.48	0	0	0	0	0	0

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
GRN029	368	1993	1	1.7	0	0	0	0	0	0
		1995	1	0.8	0	0	0	0	0	0
		1996	2	8.5	0	0	0	0	0	0
		1997	2	32	0	0	0	0	0	0
		1998	3	23.6	0	0	0	0	0	0
		1999	3	18	0	0	0	0	0	0
		2000	3	10.5	0	0	0	0	0	0
		2006	2	0.91	0	0	0	0	0	0
GRN028	369	1993	1	1.7	0	0	0	0	0	0
		1995	1	0.8	0	0	0	0	0	0
		1996	2	8.5	0	0	0	0	0	0
		1997	2	18	0	0	0	0	0	0
		1998	3	12.8	0	0	0	0	0	0
		1999	3	8.1	0	0	0	0	0	0
		2000	3	7.25	0	0	0	0	0	0
		2006	2	0.53	0	0	0	0	0	0
GRN027	370	1993	1	1.7	0	0	0	0	0	0
		1995	1	0.8	0	0	0	0	0	0
		1996	2	8.5	0	0	0	0	0	0
		1997	2	7	0	0	0	0	0	0
		1998	3	12.8	0	0	0	0	0	0
		1999	3	12	0	0	0	0	0	0
		2000	3	5.95	0	0	0	0	0	0
		2006	2	0.91	0	0	0	0	0	0

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.										
AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
GRSN026	371	1993	1	1.7	0	0	0	0	0	0
		1995	1	0.8	0	0	0	0	0	0
		1996	2	4.9	0	0	0	0	0	0
		1997	1	14	0	0	0	0	0	0
		1998	1	0.6	0	0	0	0	0	0
		2006	2	0.88	0	0	0	0	0	0
GRS025	372	1995	1	0.8	0	0	0	0	0	0
		1996	2	4.9	0	0	0	0	0	0
		1997	2	6.5	0	0	0	0	0	0
		1998	1	3.6	0	0	0	0	0	0
		2006	2	1.13	0	0	0	0	0	0
GRSN023	373	1995	1	0.8	0	0	0	0	0	0
		1996	2	4.9	0	0	0	0	0	0
		1997	2	6.5	0	0	0	0	0	0
		1998	3	12.1	0	0	0	0	0	0
		1999	3	11	0	0	0	0	0	0
		2000	3	4	0	0	0	0	0	0
		2001	3	1.75	0	0	0	0	0	0
		2002	3	4.83	0	0	0	0	0	0
		2006	2	1.38	0	0	0	0	0	0
GRSN022	374	1996	2	4.9	0	0	0	0	0	0
		1997	2	4.5	0	0	0	0	0	0
		1998	1	0.6	0	0	0	0	0	0
		2003	5	4.25	0	0	0	0	0	0
		2004	5	2.5	0	0	0	0	0	0
		2005	2	0.6	0	0	0	0	0	0
		2006	3	0.57	0	0	0	0	0	0
Mineral Creek – Gila River	375	1998	3	6.9	0	0	0	0	0	0

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
Mineral Creek at Twin Domes	377	1998	3	1.5	0	0	0	0	0	0
Mineral Creek at Lake Flat	379	1998	3	12.1	0	0	0	0	0	0
		1999	3	67.5	0	0	0	0	0	0
		2000	3	22.5	0	0	0	0	0	0
		2001	5	21.35	0	0	0	0	0	0
		2004	5	17.09	0	0	0	0	0	0
GRS020	382	1996	2	4.9	0	0	0	0	0	0
		1997	2	3.6	0	0	0	0	0	0
		1998	1	0.6	0	0	0	0	0	4
		2005	2	0.2	0	0	0	0	0	0
GRN020	383	1996	2	4.9	2	2	0	0	0	0
		1997	2	38.5	4	2	2	1	0	2
		1998	4	20.6	4	2	2	2	0	0
		1999	3	13.5	8	5	4	5	0	0
		2000	3	4.75	0	0	0	0	0	0
		2001	3	3.25	0	0	0	0	0	0
		2002	3	3.68	0	0	0	0	0	1
		2003	3	2.32	0	0	0	0	0	0
		2004	3	5.05	0	0	0	0	0	0
		2005	5	6.2	0	0	0	0	0	1
		2006	5	7.46	2	1	1	1	0	0
		2007	3	5.05	0	0	0	0	0	0
GRS019	384	1997	1	6.5	0	0	0	0	0	0
		1998	3	16.9	0	0	0	0	0	0
		1999	3	12.5	0	0	0	0	0	0
		2000	4	9.25	0	0	0	0	0	1
		2006	3	1.9	0	0	0	0	0	1
		2007	3	2.73	0	0	0	0	0	0

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
GRN019	385	1997	3	18.5	0	0	0	0	0	3
		1998	3	15	0	0	0	0	0	0
		1999	3	1.75	0	0	0	0	0	0
		2000	3	2.5	0	0	0	0	0	1
GRN018	386	1997	2	40.4	4	2	2	0	0	3
		1998	3	38.5	4	2	2	3	0	0
		1999	4	33.25	10	5	5	8	0	0
		2000	5	32.15	8	4	4	5	0	0
		2001	3	14.25	18	9	9	19	0	0
		2002	3	8	14	7	7	10	0	1
		2003	3	14.5	9	5	4	5	0	2
		2004	3	31.56	6	3	3	3	0	3
		2005	3	50.59	12	6	6	6	0	0
		2006	3	37.87	10	5	5	6	0	0
		2007	3	33.01	12	6	6	6	0	0
GRS018	387	1997	3	26	2	1	1	0	0	0
		1998	4	28	2	1	1	1	0	0
		1999	5	32	6	4	2	0	0	0
		2000	4	22.75	6	4	2	2	0	0
		2001	3	11.5	4	2	2	1	0	0
		2002	3	13.25	14	7	7	3	0	3
		2003	3	9	8	4	4	3	0	0
		2004	3	7.38	4	2	2	1	0	0
		2005	3	18.7	18	9	9	12	0	0
		2006	3	15.7	12	7	5	9	0	0
		2007	3	18.6	11	5	6	6	0	0

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.										
AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
GRS016	388	1997	1	1.5	0	0	0	0	0	0
		2003	2	10.5	2	1	1	1	0	0
		2004	3	8.09	0	0	0	0	0	2
		2005	4	16.48	2	1	1	1	0	0
		2006	3	13.56	2	1	1	2	0	0
		2007	3	8.72	4	2	2	0	0	0
GRS015	389	1997	2	7	2	1	1	1	0	0
		1998	4	8.8	2	1	1	1	0	0
		1999	5	10.75	2	1	1	2	0	0
		2000	4	12.8	2	1	1	1	0	1
		2001	3	3.25	0	0	0	0	0	0
		2002	3	1	0	0	0	0	0	0
		2003	3	1.5	0	0	0	0	0	0
GRN015	389.5	2000	5	6	2	1	1	1	0	0
		2001	3	3	0	0	0	0	0	0
		2002	3	4.75	0	0	0	0	0	0
		2003	2	3.75	0	0	0	0	0	0

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
Kearny	390	1994	3	28	1	1	0	0	0	0
		1996	3	13	9	6	3	4	0	0
		1997	3	22.3	16	8	8	10	0	0
		1998	3	36.25	49	25	24	42	0	0
		1999	3	79.5	38	23	22	42	0	0
		2000	3	15.5	38	19	19	32	0	0
		2001	3	4.2	25	14	14	21	0	0
		2002	3	10	27	14	14	18	0	2
		2003	3	17.33	18	9	9	12	0	1
		2004	3	2.88	10	5	5	8	0	2
		2005	3	3.11	6	3	3	6	0	2
		2006	3	2.27	10	5	5	13	0	0
		2007	3	4.7	8	4	4	6	0	0
GRS014	391	1997	4	20	0	0	0	0	0	1
		1998	3	3.5	0	0	0	0	0	0
		1999	3	6.5	0	0	0	0	0	0
		2000	3	21	0	0	0	0	0	0
		2001	3	1.02	0	0	0	0	0	0
		2002	3	2	0	0	0	0	0	0
		2006	3	5.3	0	0	0	0	1	0
		2007	3	2.66	0	0	0	0	0	0
GRN014	392	1997	3	6	0	0	0	0	0	0
		1998	3	6	0	0	0	0	0	0
		1999	3	3.3	0	0	0	0	0	0
		2000	3	2.41	0	0	0	0	0	0

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
GRN013	393	1997	2	9	0	0	0	0	0	0
		1998	3	7	0	0	0	0	0	0
		1999	3	3	0	0	0	0	0	0
		2000	3	15.5	0	0	0	0	0	1
		2002	2	2.75	0	0	0	0	0	0
		2003	3	8.3	0	0	0	0	0	0
GRS013	394	1997	3	25.5	2	1	1	0	0	0
		1998	3	13.8	0	0	0	0	0	0
		1999	3	13.3	0	0	0	0	0	3
		2000	3	58.8	0	0	0	0	0	0
		2002	3	7	0	0	0	0	0	0
		2003	1	0.75	0	0	0	0	0	0
GRN012	395	1997	3	5	0	0	0	0	0	0
		1998	3	8	0	0	0	0	0	0
		2000	3	3	0	0	0	0	0	1
GRS012	396	1997	3	27	7	4	3	3	0	0
		1998	3	32	11	6	5	5	0	0
		1999	3	55.3	15	8	7	10	0	0
		2000	5	37.5	13	7	7	10	0	0
		2001	3	3.3	10	5	5	9	0	0
		2002	3	6.5	5	3	2	2	0	0
		2003	3	5.32	1	1	0	0	0	0
		2004	3	3.63	0	0	0	0	0	0
		2005	3	6.77	0	0	0	0	0	0
		2006	3	6.66	0	0	0	0	0	0
		2007	3	5.2	0	0	0	0	3	0

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
GRN011	397	1997	3	30.5	3	2	1	1	0	1
		1998	3	13	0	0	0	0	0	0
		1999	3	2.8	0	0	0	0	0	0
		2000	3	5	0	0	0	0	0	0
GRS011	398	1997	3	6.5	0	0	0	0	0	0
		1998	3	4.3	0	0	0	0	0	0
		1999	3	12.3	2	1	1	2	0	2
		2000	3	21.08	4	2	2	3	0	0
		2001	3	3	2	1	1	1	0	0
		2002	3	1.75	2	1	1	1	0	0
		2003	3	2.85	0	0	0	0	0	0
		2004	3	3.73	0	0	0	0	0	0
		2005	3	2.64	0	0	0	0	0	0
		2006	3	1.9	0	0	0	0	0	0
		2007	3	3.7	2	1	1	0	0	0
GRN010	399	1997	4	35.5	10	5	5	4	0	0
		1998	4	44.5	8	4	4	5	0	0
		1999	3	28.5	8	4	4	6	0	0
		2000	4	43.5	4	2	2	2	0	0
		2001	3	5.25	2	1	1	1	0	0
		2002	3	6.4	1	1	0	0	0	0
		2003	3	7.8	0	0	0	0	0	0
		2004	3	4.8	0	0	0	0	0	0
		2005	3	4.84	0	0	0	0	0	0
		2006	3	3.92	0	0	0	0	0	0
		2007	3	4.85	0	0	0	0	0	0

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
GRS010	400	1997	4	29	6	3	3	2	0	0
		1998	4	6	0	0	0	0	0	0
		1999	5	16.2	5	4	1	1	0	0
		2000	3	21.38	0	0	0	0	0	4
		2001	3	3	0	0	0	0	0	2
		2002	3	1.5	0	0	0	0	0	0
		2003	3	4.15	0	0	0	0	0	0
		2004	3	2.73	0	0	0	0	0	0
		2005	4	2.47	2	1	1	1	0	0
		2006	3	3.93	2	1	1	2	0	0
		2007	3	2.8	4	2	2	1	0	0
GRS009	401	1997	1	1	0	0	0	0	0	0
		1998	1	2.8	0	0	0	0	0	0
		2006	3	0.9	1	1	0	0	0	0
		2007	3	0.99	0	0	0	0	0	0
GRN009	402	1997	5	45.6	0	0	0	0	0	0
		1998	3	22	0	0	0	0	0	0
		1999	3	4.8	0	0	0	0	0	0
		2000	3	4.75	0	0	0	0	0	0
		2001	3	3.5	2	1	1	1	0	1
		2002	3	4.3	4	2	2	2	0	0
		2003	3	5.84	0	0	0	0	0	1
		2004	3	7.51	0	0	0	0	0	0
		2005	3	3.27	0	0	0	0	0	0
		2006	3	4.77	2	1	1	1	0	0
		2007	3	5.08	4	2	2	0	0	0

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
GRS008	403	1997	1	1	0	0	0	0	0	0
		1998	3	8.8	0	0	0	0	0	0
		1999	2	3.3	0	0	0	0	0	0
		2000	3	32	0	0	0	0	0	0
		2001	3	0.92	0	0	0	0	0	0
		2002	3	5.83	0	0	0	0	0	0
		2006	3	1.01	2	1	1	1	0	0
		2007	3	1.55	6	3	3	6	0	0
GRN008	404	1997	2	17	0	0	0	0	0	0
		1998	3	15	0	0	0	0	0	0
		1999	3	4.8	0	0	0	0	0	0
		2000	3	5.75	0	0	0	0	0	1
		2001	3	2.5	0	0	0	0	0	0
		2002	3	5.17	3	2	1	1	0	0
		2003	3	5	0	0	0	0	0	0
		2004	3	6.44	0	0	0	0	0	0
		2005	3	3.7	0	0	0	0	0	0
		2006	3	5.4	2	1	1	2	0	0
		2007	3	7.65	6	2	4	4	1	0

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
GRS007	405	1997	4	50	6	3	3	4	0	0
		1998	5	33.8	12	6	6	10	0	0
		1999	3	86.2	21	11	10	17	0	0
		2000	5	99.25	18	10	10	13	0	0
		2001	3	5.6	10	5	5	10	0	0
		2002	3	8	14	7	7	6	0	0
		2003	3	15.02	10	5	5	3	0	0
		2004	3	13.91	6	4	2	2	0	3
		2005	5	16.59	11	6	5	8	0	1
		2006	3	16.48	8	4	4	4	0	0
		2007	3	13.23	12	6	6	9	0	0
GRN007	406	1997	1	8	0	0	0	0	0	0
		1998	3	13	0	0	0	0	0	0
		1999	3	8.5	0	0	0	0	0	1
		2000	3	21.5	0	0	0	0	0	0
		2001	2	2	0	0	0	0	0	0
		2002	2	4.75	0	0	0	0	0	0
		2006	3	0.43	2	1	1	3	0	0
		2007	3	0.64	4	2	2	0	0	0
GRS006	407	1997	1	1	0	0	0	0	0	0
		1998	1	1.25	0	0	0	0	0	0
GRS005	408	1997	1	0.5	0	0	0	0	0	0
		1998	1	0.75	0	0	0	0	0	0
		2006	3	0.26	1	1	0	0	0	0
		2007	3	0.77	0	0	0	0	0	0
GRN005	409	1997	1	0.7	0	0	0	0	0	0
		1998	3	9	0	0	0	0	0	0
		2000	3	1.5	0	0	0	0	0	0

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
GRS004	410	1997	3	5.5	0	0	0	0	0	0
		1998	3	4.3	0	0	0	0	0	0
		1999	3	3.4	0	0	0	0	0	0
		2000	3	4.67	0	0	0	0	0	1
		2001	3	0.61	0	0	0	0	0	0
		2002	3	2.25	0	0	0	0	0	0
GRN004	411	1997	4	17	1	1	0	0	0	3
		1998	5	22.5	2	1	1	2	0	0
		1999	3	13.75	3	2	1	1	0	0
		2000	4	11.5	2	2	0	0	0	0
		2001	3	7.02	4	2	2	0	0	0
		2002	3	10	4	2	2	2	0	2
		2003	3	15	1	1	0	0	0	0
		2004	3	4.75	0	0	0	0	0	1
		2005	3	2.28	0	0	0	0	0	0
		2006	3	2.77	2	1	1	1	0	0
		2007	3	1.11	2	1	1	1	0	0
GRS003	412	1997	1	1.5	0	0	0	0	0	0
		2006	3	1.46	0	0	0	0	1	0
		2007	3	0.44	0	0	0	0	0	0
GRN003	413	1997	3	5.2	0	0	0	0	0	0
		1998	3	8	0	0	0	0	0	0
		1999	3	3	0	0	0	0	0	0
		2000	3	2.33	0	0	0	0	0	0

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
GRN002	414	1997	4	4.2	0	0	0	0	0	0
		1998	3	8	0	0	0	0	0	0
		1999	3	2.8	0	0	0	0	0	0
		2000	3	2.33	0	0	0	0	0	0
		2001	3	1.1	0	0	0	0	0	0
		2002	3	2.25	0	0	0	0	0	0
GRS002	415	1997	1	1	0	0	0	0	0	0
GRS001	416	1997	3	6	0	0	0	0	0	0
Dripping Springs Campground	420	1996	1	9	0	0	0	0	0	0
		1997	3	15.2	0	0	0	0	0	1
		1998	3	5.5	0	0	0	0	0	0
		1999	3	2	0	0	0	0	0	0
		2000	3	3.66	0	0	0	0	0	0
		2001	3	3	0	0	0	0	0	0
		2002	3	2.41	0	0	0	0	0	0
		2004	3	2.75	0	0	0	0	0	0
		2005	1	3	1	1	0	0	0	0
		2006	3	12.8	10	5	5	5	0	0
		2007	5	22.89	26	14	12	3	1	3
Dripping Springs Wash	423	1998	3	7	0	0	0	0	0	0
		1999	4	14	1	1	0	0	0	0
		2000	3	4	0	0	0	0	0	0
		2002	3	1.75	0	0	0	0	0	0
		2003	3	4.75	0	0	0	0	0	0
		2004	3	0.87	0	0	0	0	0	0
		2005	3	0.95	2	1	1	0	0	0
		2006	3	1.18	5	3	2	4	0	0
		2007	3	2.26	18	9	9	12	0	1

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
Mescal Creek	426	1993	1	7	0	0	0	0	0	0
Coolidge Dam	429	1993	1	6	0	0	0	0	0	0
		1995	1	19.5	0	0	0	0	0	0
		1996	3	33.4	0	0	0	0	0	0
Carland Wash	440	1993	1	0.5	0	0	0	0	0	0
		1994	1	8.5	0	0	0	0	0	0
		1997	2	3	0	0	0	0	0	0
		1998	3	2.5	0	0	0	0	0	0
		1999	3	1.8	0	0	0	0	0	0
Fort Thomas – Geronimo	441	1994	1	8	0	0	0	0	0	0
		1997	3	5.3	2	2	0	0	0	0
		1998	3	8.4	4	2	2	0	0	1
		1999	3	4.8	4	2	2	0	0	8
		2001	3	3.45	13	7	6	1	0	0
		2002	3	3.67	11	10	1	1	0	19
		2003	3	5.25	30	22	8	0	0	11
		2005	3	5	8	5	3	0	0	0
		2006	3	4.5	2	2	0	0	0	1
Porter Wash Ponds	442	1993	1	1.2	0	0	0	0	0	0
		1997	3	3	0	0	0	0	0	0
		2005	3	3.77	3	2	1	0	0	0
		2006	3	4.34	3	2	1	0	0	1
Fort Thomas MS	443	1998	3	9.4	3	2	1	0	0	2
Fort Thomas Bridge	444	1993	3	5.2	1	1	0	0	0	2
		1994	2	5	0	0	0	0	0	0
Charley Thompson Springs – Clay Mine	445	1997	2	3	0	0	0	0	0	0

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
Teague	446	1997	2	1.8	0	0	0	0	0	0
		1998	3	3.3	0	0	0	0	0	0
		1999	3	1.8	0	0	0	0	0	0
		2005	3	36.08	40	22	18	10	0	0
		2006	3	115.75	108	59	49	38	0	7
Simon Spring	447	1993	1	1	0	0	0	0	0	0
		1994	1	8.5	0	0	0	0	0	0
Pima Bridge	448	1993	1	2.5	0	0	0	0	0	0
		1994	1	8.5	0	0	0	0	0	0
		1997	3	8.3	4	2	2	0	0	2
Cottonwood Wash	449	1993	1	1	0	0	0	0	0	0
		1994	1	4	0	0	0	0	0	0
Cluff Reservoir 1 – Ash Creek	452	1993	2	9.8	0	0	0	0	0	0
		1994	1	9.3	0	0	0	0	0	0
		1997	2	2	0	0	0	0	0	0
Cluff Reservoir 3 – Ash Creek	454	1993	1	3.5	0	0	0	0	0	0
		1994	1	1.8	0	0	0	0	0	0
Pima East	456	1997	3	13.6	23	12	11	4	0	3
		1998	3	17.2	10	5	5	0	0	4
		1999	3	7.8	5	4	1	0	0	10
		2000	3	33	30	15	15	15	0	0
		2001	3	5.45	28	14	14	14	24	0
		2002	3	36.07	17	9	8	8	0	4
		2003	3	3.5	2	1	1	0	0	9
		2004	3	21.34	6	3	3	4	0	0

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
Watson Wash	457	1996	3	6.9	0	0	0	0	0	0
		1997	3	7.8	0	0	0	0	0	0
		2005	3	2.25	3	2	1	0	0	0
		2006	3	0.9	2	2	0	0	0	0
Watson Spring	458	1996	3	1.4	0	0	0	0	0	0
Thatcher	459	1996	3	6.7	0	0	0	0	0	0
Smithville Canal	460	1996	4	19.6	1	1	0	0	0	0
		1997	3	10.5	0	0	0	0	0	0
Safford	461	1996	4	35.8	0	0	0	0	0	0
		1997	4	23.5	0	0	0	0	1	0
		1998	3	6	0	0	0	0	0	0
		2006	5	11.21	0	0	0	0	0	0
Solomon Northwest	462	1996	3	6.8	3	3	0	0	0	0
		1997	1	5.5	0	0	0	0	0	0
		1998	3	7	3	2	1	1	0	0
		2006	5	11.21	0	0	0	0	0	1
San Simon to Gila	463	2006	5	22.41	0	0	0	0	0	0
San Simon River Barrier	464	1997	1	2.5	0	0	0	0	0	0
Sanchez Road	466	1995	2	19.5	4	2	2	0	0	0
		1996	3	9.8	8	4	4	6	0	0
		1997	3	46.5	2	1	1	1	0	0
		1998	3	9	0	0	0	0	0	2

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
San Jose	467	1995	1	1.5	0	0	0	0	0	0
		1996	3	11	0	0	0	0	0	0
		1997	2	22.3	0	0	0	0	0	1
		1998	5	49.3	1	1	0	0	0	4
		1999	3	14	0	0	0	0	0	0
		2000	3	7	0	0	0	0	0	0
		2001	3	12.45	0	0	0	0	0	0
Southwest Sanchez	468	1993	1	4	0	0	0	0	0	0
		1995	1	1.2	0	0	0	0	0	0
Earven Flat	469	1997	3	9.5	0	0	0	0	0	0
		1998	3	11.3	0	0	0	0	0	0
		1999	3	3	0	0	0	0	0	4
		2001	3	3.25	0	0	0	0	0	0
		2002	3	3.17	0	0	0	0	0	5
		2003	3	4	4	2	2	0	0	3
		2005	3	5	0	0	0	0	0	0
Spring Canyon	469.5	2005	3	1.75	0	0	0	0	0	0
		2006	3	1.5	0	0	0	0	0	0
Northwest of Rail End Canyon	470	1997	1	0	0	0	0	0	0	0
Bonita Creek	471	1997	1	0	0	0	0	0	0	0
		2004	5	14.33	0	0	0	0	0	0
		2005	5	14.71	0	0	0	0	0	0
		2006	5	14.05	0	0	0	0	0	0
Upper Bonita Creek	474	1993	1	15	0	0	0	0	0	0
		1997	1	7.5	0	0	0	0	0	0
Double Circle	474.25	2003	3	28.5	0	0	0	0	0	0
7 Cross A	474.5	2003	3	28.5	0	0	0	0	0	0

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
Eagle Creek	475	2002	3	20	0	0	0	0	0	0
		2003	3	28.5	0	0	0	0	0	0
Half Mile	480	1998	3	1.6	0	0	0	0	0	0
		1999	3	1	0	0	0	0	0	0
Gutherie	481	1997	1	1	0	0	0	0	0	0
		1998	3	1.3	0	0	0	0	0	0
		1999	3	1.3	0	0	0	0	0	3
		2001	3	1.5	0	0	0	0	0	0
		2002	3	3.25	3	3	0	0	0	2
		2003	3	3.5	0	0	0	0	0	0
		2005	3	3	0	0	0	0	0	0
		2006	3	1.58	0	0	0	0	0	0
Duncan	495	1998	3	10.5	3	2	1	1	0	0
		1999	3	15	7	4	3	1	0	0
		2000	3	17.25	1	1	0	0	0	1
		2001	5	25.31	1	1	0	0	0	1
		2002	5	21.58	3	2	1	1	0	0
Hassayampa River										
Hassayampa at Arlington Canal	503	1993	1	1	0	0	0	0	0	0
		1999	3	13.5	0	0	0	0	0	0
Johnson Road	505	2003	5	15	0	0	0	0	0	0
		2004	5	17.92	0	0	0	0	0	0
		2005	5	10.09	0	0	0	0	0	0

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
Hassayampa River Preserve	510	1993	2	20.5	0	0	0	0	0	0
		1994	2	11.3	0	0	0	0	0	0
		1996	4	57.5	0	0	0	0	0	0
		1997	3	40	2	1	1	1	0	0
		1998	3	17	4	3	1	1	0	0
		1999	3	12	2	2	0	0	0	1
		2000	1	11.5	0	0	0	0	3	0
		2001	5	11.25	0	0	0	0	0	0
		2002	2	22	4	3	1	0	0	0
		2006	3	30	2	2	0	0	0	0
Box Canyon Area	512	1995	1	6.5	0	0	0	0	0	0
King Solomon Gulch	513	1995	1	2.3	0	0	0	0	0	0
O'Brien	514	1995	1	8	0	0	0	0	0	0
Seal Mountain	515	1995	1	4	0	0	0	0	0	0
Crook's Canyon	517	1994	1	0	0	0	0	0	0	0
Hassayampa River – Climax Mine	519	1993	2	15.1	0	0	0	0	0	0
Wolf Creek Campground	522	1993	1	7	0	0	0	0	0	0
Salt River										
Lower Parker Creek	695	1994	1	8	0	0	0	0	0	0
Upper Parker Creek	696	1994	1	4	0	0	0	0	0	0
Salt River 91st to 107th Ave.	670	1994	2	3.5	0	0	0	0	0	0
		1996	3	28.6	0	0	0	0	0	0
		1999	3	13	0	0	0	0	0	0
		2003	3	26	0	0	0	0	0	0
Salt River 83rd Ave	671	1996	3	5.5	0	0	0	0	0	0
		2003	5	7.75	0	0	0	0	0	0
Salt River 67th Ave.	672	1996	3	3	0	0	0	0	0	0

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
Salt River 59th Ave.	673	1996	3	1.8	0	0	0	0	0	0
Tempe Town Lake	676	2004	1	1	0	0	0	0	0	0
Cave Creek	678	1997	3	8.2	0	0	0	0	0	0
Granite Reef	680	1994	1	4	0	0	0	0	0	0
		1999	2	5	0	0	0	0	1	0
		2005	3	12.16	0	0	0	0	0	0
		2006	3	5.9	0	0	0	0	0	0
Coon's Bluff	683	1994	2	8	0	0	0	0	0	0
Stewart Mountain Dam	688	1999	2	4.8	0	0	0	0	0	0
		2002	2	4.33	0	0	0	0	0	0
Alder Creek – Apache Lake	690	1994	1	0	0	0	0	0	0	0
Grapevine	697	2005	2	4.08	1	1	0	0	0	0
		2006	3	0.95	0	0	0	0	0	0
Lake Shore	698	2000	3	21.25	30	17	13	13	0	0
		2001	3	11.5	37	20	19	23	0	1
		2002	3	18	33	19	14	13	0	4
		2003	3	9.6	18	9	9	9	0	1
		2004	3	18.83	26	15	11	14	0	3
School House Point North	699	1997	1	3	0	0	0	0	0	0
		1998	3	12	0	0	0	0	0	0
		1999	3	11.8	4	2	2	1	0	0
		2000	3	82.25	9	5	4	2	0	0
		2001	3	88	35	19	17	14	0	3
		2002	3	99	78	45	33	16	0	0
		2003	3	243.1	97	52	46	55	0	3
		2004	3	220.75	157	84	74	69	0	10
		2005	3	6	0	0	0	0	0	1
		2006	1	4.6	0	0	0	0	0	0

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
School House Point South	700	1999	3	12.5	9	5	4	4	0	0
		2000	3	12.3	13	7	6	3	0	0
		2001	3	12	16	9	7	8	0	0
		2002	3	15.75	13	7	6	7	0	2
		2003	3	27.5	13	7	6	8	0	2
		2004	3	11.27	9	5	4	5	0	1
		2005	3	4.75	4	2	2	2	0	0
		2006	1	1.7	0	0	0	0	0	0
Pinto Creek Near School House	701	2005	1	3.25	0	0	0	0	0	0
		2006	3	4.3	0	0	0	0	0	0
Pinto Creek	702	1993	2	18	0	0	0	0	0	0
		1994	1	8	0	0	0	0	0	0
		2003	3	14.5	0	0	0	0	0	0
		2004	3	14.75	0	0	0	0	0	0
		2005	3	40.26	0	0	0	0	0	0
		2006	3	20.61	0	0	0	0	0	0

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
Salt River Inflow	702.5	1993	1	7	3	2	1	0	0	0
		1994	3	95.8	43	25	15	10	0	0
		1995	3	66	21	12	9	10	0	0
		1996	3	13	40	22	18	14	0	0
		1997	3	132	35	18	17	22	0	0
		1998	3	108	40	20	20	27	0	0
		1999	3	108	82	45	45	66	0	4
		2000	3	96.25	106	57	54	76	0	0
		2001	3	99.5	121	66	64	79	0	1
		2002	3	139.83	93	48	45	21	0	3
		2003	3	90.25	82	43	40	51	0	2
		2004	3	127.75	62	36	29	32	1	3
		2005	3	108.99	36	22	17	21	0	2
		2006	4	42.3	8	4	4	8	0	1
Cottonwood Acres II	703	1994	2	21.8	0	0	0	0	0	0
		1996	1	1	0	0	0	0	0	0
		1997	3	16.5	0	0	0	0	0	0
		1998	3	21.5	0	0	0	0	0	0
		1999	3	25	0	0	0	0	0	0
		2000	3	21	0	0	0	0	0	0
		2001	3	24	0	0	0	0	0	0
		2002	3	21.83	0	0	0	0	0	0
		2003	3	17.2	0	0	0	0	0	0
		2004	3	25.83	0	0	0	0	0	0
		2005	3	37.24	7	6	1	1	0	1
		2006	3	18.54	12	7	5	5	0	1

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
Cottonwood Acres I	704	1993	1	2	0	0	0	0	0	0
		1994	2	7.7	0	0	0	0	0	0
		1997	3	9.5	0	0	0	0	0	0
		1998	3	10.5	0	0	0	0	0	0
		1999	3	13.5	2	1	1	1	0	0
		2000	3	23	2	1	1	1	0	1
		2001	3	24	0	0	0	0	0	0
		2002	3	21.33	0	0	0	0	0	0
		2003	3	16	0	0	0	0	0	0
		2004	3	15.17	0	0	0	0	0	0
		2005	3	45.4	74	38	36	44	0	2
		2006	3	53.95	73	38	36	36	0	1
Meddler Point	705	1994	1	1	0	0	0	0	0	0
		1995	1	5	0	0	0	0	0	0
		1998	3	9.5	0	0	0	0	0	0
		2000	3	4	0	0	0	0	0	0
		2001	3	2.5	0	0	0	0	0	0
		2002	3	3.33	0	0	0	0	0	0
		2003	3	4	0	0	0	0	0	0
		2004	3	3.19	0	0	0	0	0	0
		2005	3	5.38	0	0	0	0	0	0
		2006	3	6.92	1	1	0	0	0	0

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
Eads Wash	708	1998	1	4	0	0	0	0	0	0
		2000	3	4	0	0	0	0	0	0
		2001	3	3.05	0	0	0	0	0	0
		2002	3	6	0	0	0	0	0	0
		2003	3	4	0	0	0	0	0	0
		2004	3	3.3	0	0	0	0	0	0
		2005	3	3.5	0	0	0	0	0	0
		2006	3	17.99	0	0	0	0	0	0
Roosevelt Diversion Dam	709	1998	1	2.5	0	0	0	0	0	0
		2000	3	3.5	0	0	0	0	0	0
		2001	3	3	0	0	0	0	0	0
		2002	3	5.67	0	0	0	0	0	0
		2003	3	13	0	0	0	0	0	0
		2004	3	4.42	0	0	0	0	0	0
		2005	3	3.92	0	0	0	0	0	0
		2006	3	4.76	0	0	0	0	0	1
Salt River at State Route 288 Bridge	710	1994	1	1	0	0	0	0	0	0
		1997	2	20.5	0	0	0	0	0	0
		1998	3	6.8	0	0	0	0	0	0
		1999	3	9.2	0	0	0	0	0	0
		2000	3	8.5	0	0	0	0	0	0
		2001	3	3.3	0	0	0	0	0	0
		2002	3	6.33	0	0	0	0	0	0
		2003	3	10.5	0	0	0	0	0	0
		2004	3	5.36	0	0	0	0	0	0
		2005	3	8.61	0	0	0	0	0	1
		2006	3	1.35	0	0	0	0	0	0

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
Horseshoe Bend to State Route 288	711	1997	3	49	0	0	0	0	0	0
		1998	3	15.8	0	0	0	0	0	0
		2003	1	2.25	0	0	0	0	0	0
Pinal Creek	712	1997	3	24	0	0	0	0	0	0
		1998	3	24	0	0	0	0	0	0
		2002	4	17.5	0	0	0	0	0	0
		2003	5	40	0	0	0	0	0	0
		2004	5	20.47	2	1	1	0	0	0
		2005	5	54.84	14	7	7	8	0	0
		2006	5	44.34	10	6	4	6	0	1
Lost Gulch	714	1998	3	7.8	0	0	0	0	0	0
Coon Creek	717	1994	1	3	0	0	0	0	0	0
		2005	3	8.16	0	0	0	0	0	0
		2006	3	1.76	0	0	0	0	0	0
Upper Salt River – Cherry Crk to Horseshoe	718	1997	1	10	0	0	0	0	0	0
Cherry Creek South	719	2001	1	1.5	0	0	0	0	0	0
		2005	3	8.6	0	0	0	0	0	0
		2006	3	3.83	0	0	0	0	0	0
Cherry Creek North	719.5	2001	1	1.5	0	0	0	0	0	0
		2005	3	6.46	0	0	0	0	0	0
		2006	3	3.22	0	0	0	0	0	0

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
Canyon Creek at O.W. Bridge	720	1993	1	6	0	0	0	0	0	0
		1994	1	4.3	0	0	0	0	0	0
		1996	3	9.3	0	0	0	0	0	1
		1997	3	6.3	0	0	0	0	0	0
		1998	3	6	0	0	0	0	0	0
		1999	3	4	0	0	0	0	0	0
		2000	3	3	0	0	0	0	0	0
San Francisco River										
South of Clifton	725	1997	2	0	0	0	0	0	0	0
Clifton Peak	726	2003	5	32.5	0	0	0	0	0	0
		2004	5	15.75	0	0	0	0	0	0
		2005	5	34	0	0	0	0	0	0
Sycamore Gulch	728	1997	1	1	0	0	0	0	0	0
Lower San Francisco River	729	1996	1	8	0	0	0	0	0	0
White Rock	729.5	2003	1	2	0	0	0	0	0	0
Dix Creek	730	2002	3	29.75	0	0	0	0	0	0
		2003	3	31	0	0	0	0	0	0
Upper San Francisco River	732	1994	2	6.5	0	0	0	0	0	0

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
Alpine Horse Pasture	735	1993	2	4.5	8	5	3	3	0	0
		1994	2	13	10	5	5	5	0	0
		1995	2	22	7	4	3	3	0	0
		1996	3	16.9	4	3	3	3	0	0
		1997	3	20	4	2	2	3	0	1
		1998	3	20	4	3	3	5	1	0
		1999	3	20	5	3	3	4	0	0
		2000	3	28.3	4	2	2	2	0	1
		2001	3	8.4	2	1	1	1	0	0
		2002	2	3.1	2	1	1	0	1	0
		2003	3	3.3	2	1	1	1	0	0
		2004	3	3.63	2	1	1	1	0	0
		2005	2	*	1	1	0	0	0	0
		2006	3	11.5	1	1	0	0	0	0
Pheasant Farm	736	1993	1	1.5	0	0	0	0	0	0
		1995	1	1	0	0	0	0	0	0
San Francisco River South of Alpine	737	1993	1	0.7	0	0	0	0	0	0
Triangle Patch	738	2003	3	0.65	0	0	0	0	0	0
San Pedro River										
CB Crossing Northeast	745	1997	3	10	0	0	0	0	0	1
		1998	3	17.5	0	0	0	0	0	0
		1999	3	17.5	0	0	0	0	0	0
		2000	3	21.75	0	0	0	0	0	0

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
CB Crossing West	746	1997	3	11.8	0	0	0	0	0	0
CB Crossing West	746	1998	3	12.6	0	0	0	0	0	0
CB Crossing West	746	1999	3	10	0	0	0	0	0	0
CB Crossing West	746	2000	3	23	0	0	0	0	0	0
CB Crossing West	746	2001	3	4.33	0	0	0	0	0	0
CB Crossing West	746	2002	3	5.58	0	0	0	0	0	0
CB Crossing Southeast	747	1997	3	30	10	5	5	7	0	0
CB Crossing Southeast	747	1998	3	54	8	4	4	4	0	0
CB Crossing Southeast	747	1999	3	45.2	12	7	5	7	0	1
CB Crossing Southeast	747	2000	3	12.5	11	6	6	8	0	0
CB Crossing Southeast	747	2001	3	6	6	3	3	5	0	0
CB Crossing Southeast	747	2002	3	2.83	2	1	1	3	0	0
CB Crossing Southeast	747	2003	3	7.08	0	0	0	0	0	1
CB Crossing Southeast	747	2004	3	3.3	3	2	1	0	0	0
CB Crossing Southeast	747	2005	3	4.07	2	1	1	2	0	1
Indian Hills	748	1994	2	15.5	10	5	5	3	0	0
Indian Hills	748	1995	1	8	4	3	1	1	0	0
Indian Hills	748	1996	3	22	6	3	3	3	0	0
Indian Hills	748	1997	3	47	30	15	15	22	0	0
Indian Hills	748	1998	3	21	24	12	12	23	0	0
Indian Hills	748	1999	3	44	19	12	12	20	0	0
Indian Hills	748	2000	3	31	18	9	9	13	0	0
Indian Hills	748	2001	3	8	0	0	0	0	0	3
Indian Hills	748	2002	3	9.5	2	1	1	0	0	0
Indian Hills	748	2003	3	20	0	0	0	0	0	0
Indian Hills	748	2004	3	6.79	0	0	0	0	0	0
Indian Hills	748	2005	3	22.68	0	0	0	0	0	0

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
Dudleyville Crossing	750	1993	2	44.8	6	4	2	1	0	0
		1994	1	59	0	0	0	0	0	0
		1995	1	5	0	0	0	0	0	0
		1996	3	47.5	2	1	1	1	0	0
		1997	3	28	6	3	3	3	0	0
		1998	3	112.35	12	6	6	10	0	0
		1999	3	160	18	10	10	12	0	1
		2000	3	79.25	23	14	10	19	0	5
		2001	3	30.93	27	14	13	21	0	2
		2002	3	60.93	51	26	25	19	0	4
		2003	3	89.95	13	8	5	4	0	3
		2004	3	48.81	16	9	7	6	0	1
		2005	3	61.32	24	15	9	9	0	2
		2006	3	110	10	5	5	4	6	3
Malpais Hill	751	1996	1	2	0	0	0	0	0	0
		1997	2	15	0	0	0	0	0	0
		1998	3	13.3	1	1	0	0	0	0
		1999	5	34.5	4	2	2	1	0	0
		2000	3	26.75	5	3	2	3	0	0
		2001	3	8	3	2	1	2	0	0
		2002	3	11.67	16	8	8	8	0	1
		2003	3	8.6	21	11	10	10	0	0
		2004	3	4.25	3	2	2	2	0	0
		2005	3	2.56	0	0	0	0	0	1

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.										
AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
PZ Ranch	753	1994	3	42.5	39	21	18	11	0	0
		1995	3	69.5	26	14	12	11	0	0
		1996	3	26.6	16	8	8	15	0	0
		1997	3	28	9	5	4	6	0	0
		1998	3	48	2	1	1	1	0	0
		1999	3	43.5	1	1	0	0	0	1
		2000	3	23.5	0	0	0	0	0	0
		2001	3	1	0	0	0	0	0	0
		2002	3	2.17	0	0	0	0	0	0
		2003	3	8.75	0	0	0	0	0	0
		2004	3	6.5	0	0	0	0	0	0
		2005	3	3.88	0	0	0	0	0	0
Cook's Lake Cienega/Seep	756	1993	2	18	8	7	1	0	0	0
		1994	3	38.5	25	18	7	4	0	0
		1995	3	59	28	15	13	12	0	0
		1996	3	41.5	32	17	15	23	0	0
		1997	3	49.5	25	13	12	9	0	0
		1998	3	43.4	21	13	8	13	0	0
		1999	3	51	21	11	11	10	0	0
		2000	3	40.25	12	7	5	0	0	1
		2001	3	8.25	8	5	3	2	0	0
		2002	3	17.42	27	15	12	3	0	1
		2003	3	17.5	14	10	4	1	0	0
		2004	3	20.62	24	12	12	8	0	1
		2005	3	22.41	17	11	6	8	0	1
		2006	3	40.5	19	10	9	3	1	0

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
San Pedro/Aravaipa Confluence	759	1993	2	8.5	0	0	0	0	0	0
		1998	3	12.5	12	6	6	7	0	0
		1999	3	73	27	14	14	18	0	0
		2000	3	30.75	16	8	8	16	0	2
		2001	3	7	15	8	8	17	0	4
		2002	3	14.5	14	7	7	9	0	0
		2003	3	28	14	7	7	11	0	1
		2004	3	13.66	15	9	6	8	0	1
		2005	3	14.53	19	10	9	11	0	1
		2006	2	6	19	10	9	8	0	0
Aravaipa Canyon	762	1997	2	4	0	0	0	0	0	0
San Manuel Crossing	778	1993	1	0.5	0	0	0	0	0	0
		1994	1	3	0	0	0	0	0	0
		1996	3	11.7	0	0	0	0	0	1
		1998	2	3.8	0	0	0	0	0	0
		1999	3	8.5	0	0	0	0	0	0
		2000	3	5.75	0	0	0	0	0	0
		2002	3	17.5	11	7	4	3	0	2
		2003	3	15.08	65	35	30	43	0	1
		2004	3	15.27	114	59	55	83	0	3
		2005	3	53.14	107	55	52	67	0	1
South Catalina Wash	785	1994	1	10	0	0	0	0	1	0
		1995	1	6	0	0	0	0	0	0
		1996	2	12.8	0	0	0	0	1	0
		1998	1	1	0	0	0	0	0	0
Swamp Springs Canyon	794	1993	1	9	0	0	0	0	0	0

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
Soza Wash	798	1993	2	32	0	0	0	0	10	0
		1995	1	10.8	0	0	0	0	0	0
		1996	3	19.5	0	0	0	0	0	1
		1997	1	1.2	0	0	0	0	0	0
		1998	3	6.5	0	0	0	0	0	0
		1999	3	16	0	0	0	0	0	0
		2000	3	14.5	0	0	0	0	0	1
		2001	1	2.5	0	0	0	0	0	0
		2002	2	12	2	1	1	1	0	0
		2003	3	6.5	0	0	0	0	0	0
Cascabel	799	1993	1	7	0	0	0	0	0	0
		1995	1	5	0	0	0	0	0	0
		1997	1	5	0	0	0	0	0	0
		1998	1	3	0	0	0	0	0	0
		2001	1	1.75	0	0	0	0	1	0
		2002	1	1.67	0	0	0	0	0	0
Bass Canyon	802	1993	2	9	0	0	0	0	0	0
		1995	1	5	0	0	0	0	0	0
Hookers Hot Springs	803	1994	1	3	0	0	0	0	0	0
Paige Creek	806	1994	1	1	0	0	0	0	0	0
		1995	2	4.3	0	0	0	0	0	0
Ash Creek II	812	1995	1	0.8	0	0	0	0	0	0
Ash Creek I	813	1995	1	2	0	0	0	0	0	0
Apache Powder Rd.	818	1996	3	7	3	2	1	1	0	0
		2003	5	32.25	0	0	0	0	0	0
		2004	5	16	0	0	0	0	0	1

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
Summers	820	1994	1	5.3	0	0	0	0	0	0
		1995	1	4	0	0	0	0	0	0
		1996	1	5	0	0	0	0	0	0
SPRNCA – Contention	822	1995	1	5	0	0	0	0	0	0
		1997	3	10.5	0	0	0	0	0	0
Fairbank to Contention	823	1996	1	4	0	0	0	0	0	0
		1997	1	5	0	0	0	0	0	0
SPRNCA – Boquillas	827	1995	1	2.5	0	0	0	0	0	0
		1997	3	15.5	0	0	0	0	0	0
		2000	3	14.25	0	0	0	0	0	0
		2001	3	10.5	0	0	0	0	0	0
State Route 90 Bridge	834	1997	4	22.5	2	1	1	2	0	2
		1998	5	9.8	0	0	0	0	0	0
		1999	3	19.2	0	0	0	0	0	2
		2000	3	9.5	0	0	0	0	0	0
		2001	5	24.25	0	0	0	0	0	0
		2002	5	34.39	0	0	0	0	0	0
		2003	3	36.83	0	0	0	0	0	0
		2004	3	27.79	0	0	0	0	0	0
		2005	3	18.44	0	0	0	0	0	0
		2006	3	18.5	0	0	0	0	0	0

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
SPRNCA – Carr to Hunter	835	1994	1	3.5	0	0	0	0	0	0
		1995	1	0	0	0	0	0	0	0
		1999	5	25.4	0	0	0	0	0	0
		2000	3	23.5	0	0	0	0	0	0
		2001	3	8.25	0	0	0	0	0	0
		2002	3	12.89	0	0	0	0	0	0
		2003	3	17.83	0	0	0	0	0	0
		2004	3	5.93	0	0	0	0	0	0
		2005	3	5.5	0	0	0	0	0	0
		2006	3	13.5	0	0	0	0	0	0
SPRNCA – Palominas	845	1995	1	5.3	0	0	0	0	0	0
		2000	3	24	0	0	0	0	0	0
		2001	3	15	0	0	0	0	0	0
		2002	4	22.83	0	0	0	0	0	0
		2003	3	21.33	0	0	0	0	0	0
		2004	3	17.46	0	0	0	0	0	0
		2005	3	22.08	0	0	0	0	0	0
		2006	3	14.5	0	0	0	0	0	0
PZ Ranch West	754	1998	3	8	0	0	0	0	0	0
		1999	3	11	0	0	0	0	0	0
		2000	3	20.25	0	0	0	0	0	0
		2002	3	1.08	0	0	0	0	0	0
		2003	3	7.75	6	3	3	2	0	0
		2004	3	6.5	4	2	2	1	0	0
		2005	3	3.13	2	1	1	2	0	0

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
Aravaipa Inflow North	758	1998	3	14.8	0	0	0	0	0	0
		1999	3	40	12	7	5	3	0	0
		2000	4	86.25	21	11	10	12	0	0
		2001	3	31.5	42	22	20	34	0	0
		2002	3	20.48	72	36	36	46	0	2
		2003	3	33.75	53	28	25	35	0	5
		2004	3	15.11	44	23	21	29	0	1
		2005	3	18.19	32	18	14	24	0	1
Aravaipa Inflow South	764	1998	3	12.5	0	0	0	0	0	3
		1999	3	11.7	0	0	0	0	0	2
		2000	3	15	6	3	3	2	0	0
		2001	3	21	12	7	5	9	0	0
		2002	3	10.6	8	4	4	7	0	0
		2003	3	26	10	5	5	5	0	1
		2004	3	26.71	24	13	11	14	0	0
		2005	3	21.61	32	16	16	19	0	2
Wheatfields	765	1997	4	17.5	3	2	1	0	0	0
		1998	5	26	2	1	1	1	0	0
		1999	3	19	4	2	2	2	0	0
		2000	3	29	14	7	7	7	0	0
		2001	2	15.25	28	14	14	26	0	0
		2002	3	7.17	26	13	13	16	0	1
		2003	3	9	36	18	18	23	0	1
		2004	3	7.33	34	18	16	23	0	2
		2005	3	10.23	24	12	12	18	0	1

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
Wheatfields South	768	1998	3	9.3	0	0	0	0	0	0
		1999	3	8.5	0	0	0	0	0	0
		2000	3	8.8	0	0	0	0	0	0
		2002	3	8.25	0	0	0	0	0	1
		2003	3	8.25	4	2	2	3	0	0
		2004	3	11.43	18	9	9	14	0	0
		2005	3	15.41	28	14	14	16	0	0
Capgage Wash	770	1998	3	13.5	0	0	0	0	0	0
		1999	3	8.7	0	0	0	0	0	0
		2000	3	5.25	0	0	0	0	0	0
		2001	3	2.16	0	0	0	0	0	0
		2002	3	4.5	4	2	2	2	0	0
		2003	3	12.66	0	0	0	0	0	0
		2004	3	11.09	0	0	0	0	0	0
		2005	3	2.64	0	0	0	0	0	0
Cronley Wash	771	1998	1	1	0	0	0	0	0	0
Cronley Wash South	772	2001	3	1.5	0	0	0	0	0	0
		2002	2	0.5	0	0	0	0	0	0
Mammoth North	773	1998	1	1	0	0	0	0	0	0
Mammoth Sewage Ponds	774	1998	1	0.1	0	0	0	0	0	0
Mammoth South	775	1998	1	1	0	0	0	0	0	0

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
Catalina Wash	784	1993	1	4	0	0	0	0	1	0
		1998	1	3.75	0	0	0	0	0	0
		1999	3	8.25	0	0	0	0	0	0
		2000	3	11.25	0	0	0	0	0	1
		2001	3	6.5	4	2	2	2	0	0
		2002	3	6.2	5	3	3	3	0	0
		2003	3	16.75	25	13	12	12	0	0
		2004	3	5.03	12	6	6	8	0	1
		2005	3	12.3	7	4	3	1	0	1
		2006	3	7.25	5	3	2	1	0	0
Peck Canyon South	788	1998	1	2	0	0	0	0	0	0
Bingham Cienega	790	1998	3	21.5	2	2	0	0	0	0
		1999	3	3.5	0	0	0	0	0	0
		2000	4	5.75	0	0	0	0	0	2
		2001	3	2.3	1	1	0	0	0	0
		2002	3	5.92	3	2	1	1	0	3
		2004	3	2.41	3	2	1	0	0	0
		2005	3	2.25	0	0	0	0	0	1
Three Links	805	2004	3	29	12	6	6	5	0	4
		2005	3	32.25	13	7	6	8	1	1
		2006	3	30.75	20	12	8	7	0	2
Miller Water Gap	819	1998	3	6	0	0	0	0	0	0
St. David Cienega	819.5	2000	3	14.5	0	0	0	0	0	0
Babocomari	825	2003	3	9.53	0	0	0	0	0	0
		2004	3	6.5	0	0	0	0	0	0
		2005	3	8.91	0	0	0	0	0	0
		2006	3	9.4	0	0	0	0	0	0

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
SPRNCA – 9	827.5	2002	3	12.8	0	0	0	0	0	0
		2003	3	14.67	0	0	0	0	0	0
		2004	3	17	0	0	0	0	0	0
		2005	3	8.95	0	0	0	0	0	0
		2006	3	9	0	0	0	0	0	0
Charleston Bridge North	828	1997	3	12.8	0	0	0	0	0	0
		2000	3	30	0	0	0	0	0	0
		2001	4	21	0	0	0	0	0	0
		2002	3	33.47	0	0	0	0	0	0
		2003	3	19.13	0	0	0	0	0	0
		2004	3	21.5	0	0	0	0	0	2
		2005	3	17.56	0	0	0	0	0	0
		2006	3	17.35	0	0	0	0	0	0
Escapula Wash North	830	1997	3	17.5	0	0	0	0	0	0
		2000	3	18.5	0	0	0	0	0	0
		2001	3	4.5	0	0	0	0	0	0
		2002	3	7.17	0	0	0	0	0	0
		2003	3	9.17	0	0	0	0	0	0
		2005	3	3.55	0	0	0	0	0	0
		2006	3	4.62	0	0	0	0	0	0
Escapula Wash South	832	1997	3	17	0	0	0	0	0	0
		1998	2	4	0	0	0	0	0	0
		2001	3	4.5	0	0	0	0	0	0
		2002	3	7.17	0	0	0	0	0	0
		2003	3	9.17	0	0	0	0	0	0
		2004	3	8.7	0	0	0	0	0	0
		2005	3	6.89	0	0	0	0	0	0
		2006	3	4.13	0	0	0	0	0	0

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
Hereford Bridge	840	1998	3	7.5	0	0	0	0	0	1
		1999	3	14.3	0	0	0	0	0	3
		2000	3	18	0	0	0	0	0	0
		2001	3	11.5	0	0	0	0	0	0
		2002	3	16.17	0	0	0	0	0	0
		2003	3	18.17	0	0	0	0	0	0
		2004	3	16.16	0	0	0	0	0	0
		2005	4		2	1	1	1	0	0
		2006	3	20.99	0	0	0	0	0	0
Santa Cruz River										
Santa Cruz River, Upstream Trig Rd Bridge	853	2006	5	11.62	0	0	0	0	0	0
Avra Valley Bridge S.	855	1993	1	7.7	0	0	0	0	0	0
		1994	1	2.2	0	0	0	0	0	0
		1996	1	2.1	0	0	0	0	0	0
Ina Bridge	857	2002	2	6	0	0	0	0	0	0
		2003	5	23	0	0	0	0	0	0
		2004	5	14.75	0	0	0	0	0	0
Lower Sabino Canyon	860	1994	1	1.3	0	0	0	0	0	0
Upper Tanque Verde	865	1994	1	1.2	0	0	0	0	0	0
Empire/Cienega – Cienega Creek	870	1994	1	7	0	0	0	0	0	0
Cienega Creek Near Cross Hill	871	1993	1	14.5	0	0	0	0	0	0
Cienega Narrows	873	2003	1	4	0	0	0	0	0	0
Cienega Creek – Narrows to Coldwater	874	2006	3	21.6	0	0	0	0	0	0

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
Cienega Creek	875	1994	1	1.7	0	0	0	0	0	0
		1995	1	7	0	0	0	0	0	0
		1997	3	10.5	0	0	0	0	0	0
		1998	3	6	0	0	0	0	0	0
		1999	3	7.8	0	0	0	0	0	1
		2001	1		2	1	1	1	0	0
		2003	0	0	0	0	0	0	0	1
		2006	3	17.5	0	0	0	0	0	0
Chavez Siding Rd. – Santa Cruz River	885	1993	1	0.5	0	0	0	0	0	0
Anza Trail	886	1993	1	1.5	0	0	0	0	0	0
		1995	1	7.5	0	0	0	0	0	0
		1999	3	35	0	0	0	0	0	1
		2002	3	13.1	0	0	0	0	0	0
Arivaca Creek	888	1993	2	5.8	0	0	0	0	0	0
		2002	3	19	0	0	0	0	0	0
Santa Gertrudis South	890	1999	3	42.2	0	0	0	0	0	3
Peck Canyon Bridge	892	1999	3	3.6	0	0	0	0	0	0
Rio Rico	895	1994	1	1	0	0	0	0	0	0
		1999	3	13	0	0	0	0	0	1
Cuates Buttes	897	2005	2	4.61	0	0	0	0	0	0
		2006	3	13.23	0	0	0	0	0	0
Patagonia Lake – Sonoita Creek	900	1996	5	23.5	0	0	0	0	0	0
		1997	1	7	0	0	0	0	0	0
		2005	3	12.96	0	0	0	0	0	0
		2006	3	27.7	0	0	0	0	0	0
Sanford Butte	901	2000	3	11.32	0	0	0	0	0	0
Patagonia – Sonoita Creek Preserve	902	1994	1	7	0	0	0	0	0	0
Cottonwood Spring	904	1995	1	2	0	0	0	0	0	0

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AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
Ruby Rd. Bridge – Santa Cruz River	910	1993	1	3.2	0	0	0	0	0	0
Bog Hole Wildlife Area	915	1993	1	5	0	0	0	0	0	0
Tonto Creek										
Bermuda Flats	948	2004	3	0	67	40	27	20	0	0
Orange Peel	949	2000	3	27	12	7	5	6	0	0
		2001	3	31	24	13	11	12	0	0
		2002	3	41.2	38	19	19	10	0	2
		2003	3	26.1	30	15	15	20	0	1
		2004	3	35.33	36	19	17	31	0	1
		2005	3	1.42	9	5	4	4	0	0
		2006	3	2.27	3	2	1	3	0	0
Tonto Creek Inflow	950	1993	3	11.4	4	3	1	1	0	0
		1994	3	52.8	15	8	7	9	0	0
		1995	3	89.3	17	9	8	8	0	0
		1996	3	55.9	28	16	11	12	0	0
		1997	3	180	39	21	18	25	0	0
		1998	3	162	51	28	23	31	0	0
		1999	3	187	42	24	22	25	0	6
		2000	3	62.66	34	20	19	31	0	0
		2001	3	26.65	22	11	11	21	0	1
		2002	3	28.25	16	8	8	6	0	5
		2003	3	39.6	11	6	5	6	0	0
		2004	3	23.86	0	0	0	0	0	0
		2005	3	22.49	65	37	32	44	0	3
		2006	3	21.5	36	20	16	19	0	1

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
A-Cross Road South	952	1998	1	1.5	0	0	0	0	0	0
		2000	3	8	2	1	1	1	0	0
		2001	3	9	6	3	3	4	0	1
		2002	3	9.25	0	0	0	0	0	1
		2003	3	11.7	0	0	0	0	0	0
		2004	3	9.33	0	0	0	0	0	0
		2005	3	20.66	40	20	20	27	0	1
		2006	3	20.84	22	11	11	13	0	1
A-Cross Road North	953	1998	2	8	0	0	0	0	0	0
		2000	3	8	0	0	0	0	0	0
		2001	3	10.25	0	0	0	0	0	2
		2002	3	7.17	0	0	0	0	0	0
		2003	3	11.75	0	0	0	0	0	0
		2004	3	11.03	0	0	0	0	0	0
		2005	3	20.66	20	10	10	13	0	1
		2006	3	29.59	16	8	8	7	0	2
Bar-X Road	957	1997	1	3	0	0	0	0	0	0
		1998	1	14.5	0	0	0	0	0	0
		2000	3	18.75	0	0	0	0	0	0
		2001	3	22.5	0	0	0	0	0	0
		2002	3	18.5	0	0	0	0	0	0
		2003	3	25.5	4	2	2	2	0	0
		2004	3	22.42	18	10	8	9	0	0
		2005	4	27.16	21	12	10	14	0	1
		2006	3	18.02	40	20	20	28	0	1
Punkin Center	958	2005	5	10.36	0	0	0	0	0	0
		2006	5	12.49	0	0	0	0	0	0
Haufer Wash	958.5	2004	2	1	0	0	0	0	0	0

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AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
Del Shay	960	2003	2	2	0	0	0	0	0	2
		2004	2	0.45	0	0	0	0	0	0
		2005	3	4.9	0	0	0	0	0	0
		2006	3	2.74	0	0	0	0	0	0
Rye Creek	962	1995	1	4	0	0	0	0	0	0
		1996	3	4.5	0	0	0	0	0	0
		2005	3	11.33	0	0	0	0	0	0
		2006	3	1.74	0	0	0	0	0	0
Gisela South	964	2001	1	1.75	0	0	0	0	0	0
		2004	2	2.3	0	0	0	0	0	0
		2005	5	15.34	0	0	0	0	0	0
		2006	5	12.5	0	0	0	0	0	0
Tonto Creek – Gisela	965	1995	1	1.3	0	0	0	0	0	0
		2005	3	10.66	0	0	0	0	0	0
		2006	3	1.6	0	0	0	0	0	0
Gibson Creek – Round Valley	968	1995	2	5.7	0	0	0	0	0	0
Spring Creek – Buzzard Roost Mesa	970	1993	1	3	0	0	0	0	0	0
Bear Hide Spring	973	1995	1	0.5	0	0	0	0	0	0
Christopher Creek	974	1993	1	11.3	0	0	0	0	0	0
		1994	1	0	0	0	0	0	0	0
Indian Gardens	975	1993	1	10	0	0	0	0	0	1
		1994	2	5	0	0	0	0	0	0
Verde River										
Rock Creek – Beeline	976	2005	3	4	0	0	0	0	0	0
		2006	3	2.08	0	0	0	0	0	0

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AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
Needle Rock	977	2003	3	5.25	0	0	0	0	0	0
		2004	3	2.89	0	0	0	0	0	0
		2005	3	3.36	0	0	0	0	0	0
		2006	3	5.86	0	0	0	0	0	0
Bartlett Dam	978	2005	3	10.07	0	0	0	0	0	0
		2006	3	5.86	0	0	0	0	0	0
Bartlett North	979	2005	3	11.77	0	0	0	0	0	0
		2006	3	11.55	0	0	0	0	0	0
Davenport	980	2002	3	4.5	9	5	4	0	0	0
		2003	3	20.75	3	2	1	2	0	0
		2004	3	14.25	0	0	0	0	0	1
		2005	2	2.91	0	0	0	0	0	0
		2006	3	4	0	0	0	0	0	0
Horseshoe Dam	985	1994	1	7	0	0	0	0	0	0
Horseshoe North	986	2002	3	83.5	8	6	2	0	0	8
		2003	4	53.5	19	11	8	5	0	0
		2004	3	61.75	24	17	7	0	0	4
		2005	3	10	34	20	14	22	0	1
		2006	3	32.07	30	18	12	23	0	4

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AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
Ister Flat	987	1993	1	9.3	1	1	0	0	0	0
		1994	2	10	0	0	0	0	0	0
		1997	3	8	3	2	1	0	0	0
		1998	3	17.5	0	0	0	0	0	2
		1999	3	17.5	0	0	0	0	0	2
		2000	3	27	0	0	0	0	0	0
		2001	2	8.32	0	0	0	0	0	0
		2002	2	2.25	0	0	0	0	0	0
		2003	1	4	0	0	0	0	0	0
		2004	1		0	0	0	0	0	0
		2005	3	4	4	3	1	1	0	0
		2006	3	9	0	0	0	0	0	1
Ister Flat West	988	1999	3	5.8	0	0	0	0	0	0
Mile 9 R	989	2004	1	0	0	0	0	0	0	0
		2005	3	4	0	0	0	0	0	0
		2006	3	7	0	0	0	0	0	0
Sycamore Creek At Sheep Bridge	990	1994	1	3	0	0	0	0	0	0
		1998	2	1.5	0	0	0	0	0	0
		2001	3	2.5	0	0	0	0	0	0
Junkyard to Sheep Bridge	990.5	2006	1	3.53	0	0	0	0	0	0
Junkyard	991	2001	3	2.5	0	0	0	0	0	0
		2006	1	0.12	0	0	0	0	0	0
Tangle Peak R	993	1998	1	0.2	0	0	0	0	0	0
		2006	1	0.16	0	0	0	0	0	0

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AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
Mile 16.5 L	994	1994	1	0.8	0	0	0	0	0	0
		1998	1	0.2	0	0	0	0	0	0
		1999	1	0.3	0	0	0	0	0	1
		2001	3	2.5	0	0	0	0	0	0
		2004	1		0	0	0	0	0	0
		2006	1	0.8	0	0	0	0	0	0
Mile 16.5 R	994.5	2004	1	0	0	0	0	0	0	0
		2006	1	0.19	0	0	0	0	0	0
Mile 18.0 R	995	1998	1	0.2	0	0	0	0	0	0
		2006	1	0.36	0	0	0	0	0	0
Mile 18.5 L	996	1998	1	0.2	0	0	0	0	0	0
		2006	1	0.25	0	0	0	0	0	0
Mile 18.5 R	997	1998	1	0.2	0	0	0	0	0	0
		2006	1	0.15	0	0	0	0	0	0
Wet Bottom Creek L	999	1994	1	12	0	0	0	0	0	0
		1996	1	2	0	0	0	0	0	0
		1997	1	1	0	0	0	0	0	0
		1998	1	0.2	0	0	0	0	0	0
		2004	1		0	0	0	0	0	0
Palo Verde Spring	1000	1997	1	1.5	0	0	0	0	0	0
		2001	3	2.5	0	0	0	0	0	0
		2006	1	0.97	0	0	0	0	0	0
Red Creek	1002	1994	1	4	0	0	0	0	0	0
		2001	3	2.5	0	0	0	0	0	0
		2004	1		0	0	0	0	0	0
		2006	1	1.12	0	0	0	0	0	0
Cow Flop Spring R	1004	1998	1	0.5	0	0	0	0	0	0

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AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
Pete's Cabin Mesa L	1005	2001	3	2.5	0	0	0	0	0	0
		2004	1		0	0	0	0	2	0
		2006	1	0.67	0	0	0	0	0	0
Pete's Cabin Mesa R	1006	1993	1	1.3	0	0	0	0	0	0
		1998	1	0.5	0	0	0	0	0	0
		2001	3	2.5	0	0	0	0	0	0
		2004	1		0	0	0	0	0	0
		2006	1	0.48	0	0	0	0	0	0
Mile 29.5 R (ROG)	1007	1994	1	4	0	0	0	0	0	0
		1998	1	0.2	0	0	0	0	0	0
		2006	1	0.31	0	0	0	0	0	0
Goat Camp	1007.5	2001	3	2.5	0	0	0	0	0	0
		2006	1	0.14	0	0	0	0	0	0
Mile 31.75 R	1008	1998	1	0.2	0	0	0	0	0	0
		2006	1	0.23	0	0	0	0	0	0
Mile 32.75 L	1010	1994	1	0.8	0	0	0	0	0	0
		1998	1	0.2	0	0	0	0	0	0
		2001	3	2.5	0	0	0	0	0	0
		2006	1	0.22	0	0	0	0	0	0
Mile 33.25 R	1011	1998	1	0.2	0	0	0	0	0	0
		2006	1	0.21	0	0	0	0	0	0
Squaw Butte R	1012	1993	1	1	0	0	0	0	0	0
		1994	2	11	0	0	0	0	0	0
		1998	1	0.2	0	0	0	0	0	0
		2001	3	2.5	0	0	0	0	0	0
		2004	1		0	0	0	0	0	0
		2006	1	0.7	0	0	0	0	0	0
Houston Creek	1013	1993	1	2	0	0	0	0	0	0

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
Mile 34.5 R	1014	1998	1	0.2	0	0	0	0	0	0
Mile 34.75 L	1015	1998	1	0.2	0	0	0	0	0	0
		2004	1		0	0	0	0	0	0
		2006	1	0.36	0	0	0	0	0	0
East Verde – Verde Confluence L	1016	1994	1	4	0	0	0	0	0	0
		1998	1	0.2	0	0	0	0	0	0
		2001	3	2.5	0	0	0	0	0	0
		2004	1		0	0	0	0	0	0
		2006	1	0.55	0	0	0	0	0	0
East Verde – Verde Confluence R	1017	2001	3	2.5	0	0	0	0	0	0
		2004	1		0	0	0	0	0	0
		2006	1	0.21	0	0	0	0	0	0
East Verde – Doll Baby Ranch	1022	1994	1	10	0	0	0	0	0	0
		1996	3	6.3	0	0	0	0	0	0
		1997	3	6	0	0	0	0	0	0
		1999	3	5.5	0	0	0	0	0	0
Lost Shirt Bend	1026	1993	1	0.5	0	0	0	0	0	0
		2006	1	0.27	0	0	0	0	0	0
Childs to Lost Shirt	1027	2006	1	4	0	0	0	0	0	0
Stehr Lake	1030	1994	1	5	0	0	0	0	0	0
Fossil Creek	1032	1994	1	0.8	0	0	0	0	0	0
Aqueduct Spring	1033	1994	1	0.3	0	0	0	0	0	0
		1998	3	12	0	0	0	0	0	0
		2002	1	0.5	0	0	0	0	0	0
Bridge to Irving Powerplant	1034	1998	3	9.8	0	0	0	0	0	0
Fossil Springs	1036	1994	1	6	0	0	0	0	0	0
West Clear Creek Near Shill's Crossing	1040	1996	1	2	0	0	0	0	0	0
East Wingfield Mesa – West Clear Creek	1042	1994	2	5	0	0	0	0	0	0

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
West Clear Creek Campground	1044	1993	2	14.1	0	0	0	0	0	0
		1994	2	8	0	0	0	0	0	0
		1995	1	1.3	0	0	0	0	0	0
		1996	2	19.3	0	0	0	0	0	1
		1997	1	0.8	0	0	0	0	0	0
Hance Springs	1046	1994	1	0.3	0	0	0	0	0	0
Bull Pen	1048	1994	2	2.3	0	0	0	0	0	0
		1995	1	1.5	0	0	0	0	0	0
		1996	1	0.8	0	0	0	0	0	0
		1997	4	12.5	0	0	0	0	0	0
		1998	3	9.8	0	0	0	0	0	0
		1999	3	9.8	0	0	0	0	0	0
		2000	2	2	0	0	0	0	0	0
		2001	3	2	0	0	0	0	0	0
		2002	1	1	0	0	0	0	0	0
Rancho Rio Verde	1060	1996	3	18.5	0	0	0	0	0	0
Copper Canyon	1064	1994	1	4.5	0	0	0	0	0	0
White Bridge	1066	1994	2	5.3	0	0	0	0	0	0
		1995	1	0.8	0	0	0	0	0	0
		1996	2	20	0	0	0	0	0	0
		1997	3	3	0	0	0	0	0	0
		1998	3	3.5	0	0	0	0	0	0
		1999	3	2.5	0	0	0	0	0	0
		2000	3	3	0	0	0	0	0	0
		2001	5	18	0	0	0	0	0	0
Wet Beaver Creek	1072	1994	2	10.3	0	0	0	0	0	0
		1996	1	1.5	0	0	0	0	0	0
Red Tank Draw	1077	1994	2	3.3	0	0	0	0	0	0

Appendix C2. Southwestern willow flycatcher survey results by site within the Gila Recovery Unit, Arizona, 1993–2006 (includes 2007 data for Gila River study area). Cells empty if no information is available.

AGFD site name	Site order[a]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[b]	Migrants[c]
Stoneman Lake	1079	1994	1	3	0	0	0	0	0	0
Winter Cabin Tank – Dry Beaver Creek	1085	1994	2	6.5	0	0	0	0	0	0
		1997	2	1.5	0	0	0	0	0	0
Stage Stop – Dry Beaver Creek	1086	1993	2	7.2	0	0	0	0	0	1
		1994	4	11	0	0	0	0	0	0
		1995	1	2.5	0	0	0	0	0	0
		1996	2	3.8	0	0	0	0	0	0
		1997	3	5	0	0	0	0	0	0
		1998	3	3	0	0	0	0	0	0
		1999	3	2.5	0	0	0	0	0	0
		2000	2	3.25	0	0	0	0	0	0
		2001	3	1.5	0	0	0	0	0	0
		2002	3	4	0	0	0	0	0	0
		2003	3	3.5	0	0	0	0	0	0
		2004	2	2.5	0	0	0	0	0	0
		2005	2	3.25	0	0	0	0	0	0
		2006	1	1.75	0	0	0	0	0	0
Camp Verde	1095	1994	1	22	12	7	5	6	0	0
		1996	3	20	11	6	5	13	0	0
		1997	3	12	20	10	10	19	0	0
		1998	3	20	13	7	7	16	0	0
		1999	3	25.2	8	6	2	7	0	3
		2000	3	4.46	9	5	4	6	0	0
		2003	2	1.95	2	2	0	0	0	0
		2004	3	24.75	4	2	2	1	0	1
		2005	3	14.48	0	0	0	0	0	0
Cornville Bridge – Oak Creek	1100	1994	1	1	0	0	0	0	0	0

[a]Order of sites along drainages used to differentiate among sites and determine relative positions along drainage. Sites are ordered from least to greatest from downstream to upstream.
[b]Estimated number of willow flycatchers that could not be classified as resident or migrant due to brief appearance at the site during the breeding season or lack of survey data.
[c]Maximum number of migrant willow flycatchers detected during any single survey event.

Appendix C3. AGFD site names, habitat type, and UTMs for sites within the Gila Recovery Unit, Arizona. Cells blank if no information is available.						
AGFD site name	Site order[a]	Habitat type[b, c]	Start		Stop	
			Northing	Easting	Northing	Easting
Agua Fria River						
Agua Fria MC 85 Bridge	1	3	3699800	376000	3700450	376440
Luke Riparian Corridor	2	1	3710860	377605	3711340	377340
Waddell Dam	3	2	3744051	381803	3745402	382959
Morgan City	3.5	2	3744376	381896	3745308	380888
Confluence of Humbug Creek & Cow Creek	4	1	3759705	380580	3760550	379975
Gillette Ruins	5	1	3761890	390105	3768610	392925
Agua Fria Near Black Mesa	6	1	3775410	398675	3778805	398700
Lousy Canyon	7	1	3779395	399845	3779500	401115
Black Canyon Creek	8	3	3783015	392400	3784300	392050
Agua Fria Below Bloody Basin	9	1	3789275	401325	3791100	402315
Silver Creek	10	1	3790990	407190	3790890	409260
Indian Creek	11	1	3795950	409050	3795100	406050
Cordes Jct.	12	1	3795950	402840	3797450	401900
Ash/Little Ash/Dry Creeks	13	1	3800525	401050	3802633	403162
Little Ash Creek	14	1	3804705	404710	3804860	405750
Horner Gulch	15	1	3804600	407130	3804375	407725
Yellow Jacket Creek	16	1	3805400	407095	3805520	407710
Grapevine Canyon – Agua Fria River	17	1	3809380	380260	3810480	377300
Black River						
Wildcat Point	55	1	3730929	644220	3729435	642693
PS Ranch	56	1	3736725	650080	3739932	646956
Buffalo Crossing – Black River	57	1	3737000	652425	3737595	652360
Diamond Rock Campground	59	1	3743140	657340	3742822	657332
Thompson Ranch	61	1	3749750	641980	3750720	640660
Burro Mountain	62	1	3754740	642195	3754595	642465
Blue River						
Confluence SF	63	1	3675764	668490	3676509	668223
Pat Mesa	63.5	1	3682500	668200	3691300	669200
Blue River Crossing	65	1	3722090	676705		
Blue School	66	1	3725900	676790	3726780	677360
Upper Blue River Campground	67	1	3728375	677835	3729630	678675
Bobcat Flat – Blue River	68	1	3731690	680090	3733100	681125
CAP Canal						
56th St. along CAP Canal	72	1	3723800	411590	3724100	410200
Gila River						
Tacna Marsh – Quigley Wildlife Area	323	X	3624859	222046	3624138	222601
Pole Site	325	3, 2	3629777	231776	3629800	232300
Painted Rock Dam	330	3	3663150	310460	3662950	310875

Appendix C3. AGFD site names, habitat type, and UTMs for sites within the Gila Recovery Unit, Arizona. Cells blank if no information is available.

AGFD site name	Site order[a]	Habitat type[b, c]	Start		Stop	
			Northing	Easting	Northing	Easting
Gillespie Dam	335	4, 3	3677590	334910	3677660	335560
Arlington Valley – Pond & Slough	336	3	3680200	334260	3680920	334320
Arlington South	337	4, 3	3681196	335299	3682875	334936
Arlington North	338	3	3682854	334824	3684991	335436
Robbins Butte	340	3, 2	3687780	343860	3689980	347920
Buckeye East of Powerline	341	3	3689030	347850	3690010	350400
Buckeye	341.5	3	3691749	352852	3691959	353221
West of Airport Road	342	3, 2	3690075	353760	3692122	360130
Jackrabbit Trail East – Gila River	343	2	3691500	362560	3692860	363290
Goodyear KR – West	344	3	3693131	365106	3692981	365051
Goodyear KR	345	4	3694081	366701	3695001	369492
Estrella	346	4	3695250	369000	3695150	370060
Estrella GC	346.5	4	3694938	370189	3694884	369878
N.E. Goodyear Butte	347	x	3694942	372179	3694646	373686
Dysart Road	348	3	3694359	373809	3694279	377018
Gila River 123rd to 107th Ave.	349	3, 2	3694360	377000	3694260	380160
Picacho Lake	352	1, 3	3636400	454890	3634060	455560
Whitlow Dam	356	2, 3	3683560	476640	3685440	475140
South Butte	360	3	3662029	477114	3661616	482592
North Butte	361	4, 3	3662223	477169	3661606	482185
GRN033	363	x	3661900	483088	3663050	485218
Donnelly Wash	364	3	3661540	483106	3661500	484440
GRS032	365	3	3662939	485269	3663355	487104
GRSN031	366	3	3663310	487087	3663495	490682
GRSN030	367	4, 3	3663466	490687	3664076	493258
GRN029	368	4, 3	3663895	493785	3663842	495583
GRN028	369	4, 3	3663822	495571	3663571	496488
GRN027	370	4, 3	3663532	496477	3663600	497571
GRSN026	371	3	3663555	497568	3662425	498457
GRS025	372	3	3662590	498199	3662725	499826
GRSN023	373	3	3662832	499785	3662665	502080
GRSN022	374	3	3662471	502234	3662450	502445
Mineral Creek – Gila River	375	2	3662558	502402	3664552	502359
Mineral Creek at Twin Domes	377	2	3667580	502171	3668024	502315
Mineral Creek at Lake Flat	379	1, 2	3672160	500520	3674421	500066
GRS020	382	3	3662471	502453	3662544	504257
GRN020	383	3, 4	3662527	502452	3662662	503098
GRS019	384	3, 4	3661721	503986	3660469	505425
GRN019	385	3, 4	3660885	505294	3660635	505505
GRN018	386	4, 3	3660573	505546	3657229	507355
GRS018	387	3, 4	3659971	505400	3658634	506675
GRS016	388	3, 4	3658644	506685	3657100	507573
GRS015	389	3	3657073	507526	3655900	508800
GRN015	389.5	3	3656995	507616	3656420	507916
Kearny	390	3, 4	3656345	508157	3656307	509084
GRS014	391	3, 2	3655890	509090	3655760	510090

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AGFD site name	Site order[a]	Habitat type[b, c]	Start		Stop	
			Northing	Easting	Northing	Easting
GRN014	392	3, 4	3656103	509620	3656112	509873
GRN013	393	3, 4	3656160	510100	3655620	510460
GRS013	394	3	3655820	510160	3655206	510740
GRN012	395	3, 4	3655445	510760	3654957	511115
GRS012	396	3, 2	3654597	511082	3653979	511396
GRN011	397	2, 4	3654423	511530	3653996	511795
GRS011	398	x	3653896	511526	3653594	511936
GRN010	399	3	3653920	511979	3653453	512562
GRS010	400	x	3653580	511980	3652900	512540
GRS009	401	3, 4	3652885	512593	3652255	513771
GRN009	402	3	3652722	513758	3652507	514430
GRS008	403	3, 4	3652082	513981	3651954	515350
GRN008	404	3, 2	3652517	514649	3652566	515583
GRS007	405	4, 3	3651981	515359	3651504	516114
GRN007	406	3, 4	3652554	515831	3652159	516813
GRS006	407	3	3651491	516156	3651407	516275
GRS005	408	3, 4	3651343	516283	3651240	516500
GRN005	409	3, 4	3652089	516652	3651112	517217
GRS004	410	x	3651150	516787	3650661	517151
GRN004	411	3, 4	3651102	517207	3650416	518285
GRS003	412	3	3650800	516980	3649690	518870
GRN003	413	3, 4	3650346	518415	3650120	518735
GRN002	414	4, 3	3649700	519173	3649494	519654
GRS002	415	3	3649659	518877	3649290	519867
GRS001	416	2	3649304	519863	3649420	521819
Dripping Springs Campground	420	2, 3	3653380	524500	3660200	527120
Dripping Springs Wash	423	3	3660257	527210	3660597	526907
Mescal Creek	426	1	3666990	534550	3669380	532760
Coolidge Dam	429	2, 3	3668200	540940	3670000	543820
Carland Wash	440	3, 4	3661890	590840	3661754	591497
Fort Thomas – Geronimo	441	3, 4	3661450	591685	3660160	592480
Porter Wash Ponds	442	3, 4	3659560	593380	3658620	594690
Fort Thomas MS	443	2	3658544	594650	3657086	595457
Fort Thomas Bridge	444	4, 3	3656940	596120	3656940	596860
Charley Thompson Springs – Clay Mine	445	3	3656777	597251	3655604	598481
Teague	446	3	3654992	598501	3652195	600289
Simon Spring	447	3	3643375	603560	3642450	603425
Pima Bridge	448	3	3643800	607860	3641820	610300
Cottonwood Wash	449	2	3640310	608860	3639540	608495
Cluff Reservoir 1 – Ash Creek	452	2	3631940	607860	3630000	606500
Cluff Reservoir 3 – Ash Creek	454	3, 2	3630165	606425	3629785	606625
Pima East	456	x	3640500	612060	3639040	613370
Watson Wash	457	2, 3	3639852	613707	3638400	615510
Watson Spring	458	3	3640820	615720	3641020	616270
Thatcher	459	2	3638100	615760	3637440	616940
Smithville Canal	460	3	3637480	617000	3634740	620160

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AGFD site name	Site order[a]	Habitat type[b, c]	Start		Stop	
			Northing	Easting	Northing	Easting
Safford	461	3, 2	3634740	620250	3633260	625650
Solomon Northwest	462	3, 2	3633140	626120	3632660	628200
San Simon to Gila	463	3	3629980	627273	3632722	626633
San Simon River Barrier	464	3	3627500	630100	3626960	630240
Sanchez Road	466	2	3632920	628110	3632600	629715
San Jose	467	2, 3	3632737	630181	3635654	634776
Southwest Sanchez	468	2, 3	3635500	635120	3636740	636330
Earven Flat	469	2, 1	3638120	639380	3639100	639900
Spring Canyon	469.5	1, 2	3639501	640538	3639728	640663
Northwest of Rail End Canyon	470	2	3639290	641960	3639176	642260
Bonita Creek	471	1, 2	3640280	642340	3644460	640460
Upper Bonita Creek	474	2, 1	3652900	635600	3655860	634320
Double Circle	474.25	1	3688749	640258	3690541	640929
7 Cross A	474.5	1	3694261	639903	3695910	640776
Eagle Creek	475	1	3697600	640500	3704800	641250
Half Mile	480	2	3648441	656710	3648745	657202
Gutherie	481	1, 2	3648613	657689	3646730	662495
Duncan	495	3, 2	3622496	677787	3621600	678600
Hassayampa River						
Hassayampa at Arlington Canal	503	3, 2	3687886	341125	3689405	340482
Johnson Road	505	4	3696569	340564	3697882	339833
Hassayampa River Preserve	510	x	3751125	345790	3759135	341375
Box Canyon Area	512	2	3766985	339655	3768225	343690
King Solomon Gulch	513	1	3769160	346090	3771225	348100
O'Brien	514	1	3771920	350740	3776210	356930
Seal Mountain	515	1	3777225	358110	3784575	358105
Crook's Canyon	517	1	3795038	363645	3801521	369934
Hassayampa River – Climax Mine	519	1	3808575	359715	3813004	364779
Wolf Creek Campground	522	1	3813013	364806	3811404	367201
Salt River						
Salt River 91st to 107th Ave.	670	3, 2	3694204	380198	3694950	383360
Salt River 83rd Ave	671	3, 2	3694910	384990	3695460	385750
Salt River 67th Ave.	672	3	3695720	386915	3695850	387625
Salt River 59th Ave.	673	3	3696360	388925	3696450	390575
Tempe Town Lake	676	1	3699731	416457	3699628	415793
Cave Creek	678	1	3748760	410530	3751250	412510
Granite Reef	680	2, 3	3708400	436180	3709120	437690
Coon's Bluff	683	3	3712150	439400	3712325	440275
Stewart Mountain Dam	688	2	3713060	450820	3713931	450380
Alder Creek – Apache Lake	690	1	3717560	470140		
Lower Parker Creek	695	1	3732000	500500		
Upper Parker Creek	696	1	3737500	502300		
Grapevine	697	2	3723389	495624	3723255	495664

Appendix C3. AGFD site names, habitat type, and UTMs for sites within the Gila Recovery Unit, Arizona. Cells blank if no information is available.						
AGFD site name	Site order[a]	Habitat type[b, c]	Start		Stop	
			Northing	Easting	Northing	Easting
Lake Shore	698	2, 1	3723454	498531	3724056	499908
School House Point North	699	3, 2	3724575	498275	3723480	501450
School House Point South	700	4, 3	3724241	500045	3722298	500159
Pinto Creek Near School House	701	4, 3	3721656	500519	3721252	500233
Pinto Creek	702	1	3713560	500825	3693110	502200
Salt River Inflow	702.5	3, 4	3722716	500321	3722910	503234
Cottonwood Acres II	703	4, 3	3722910	503240	3721520	503000
Cottonwood Acres I	704	4, 3	3722327	503938	3720390	503200
Meddler Point	705	x	3719966	503289	3719799	503986
Eads Wash	708	2, 3	3719952	504423	3720636	505696
Roosevelt Diversion Dam	709	4, 3	3721042	505330	3720247	506770
Salt River at State Route 288 Bridge	710	4, 3	3720160	506400	3719720	507300
Horseshoe Bend to State Route 288	711	3	3719740	507325	3721580	518720
Pinal Creek	712	3, 2	3713000	510600	3708040	512670
Lost Gulch	714	2	3699440	509000	3699100	510080
Coon Creek	717	x	3727707	514450	3727027	514595
Upper Salt River – Cherry Cr. to Horseshoe	718	2	3721580	518700	3725600	518610
Cherry Creek South	719	2, 1	3726681	517848	3727998	517591
Cherry Creek North	719.5	2, 1	3728184	517531	3728561	517064
Canyon Creek at O.W. Bridge	720	1	3791920	518550	3793482	518072
San Francisco River						
South of Clifton	725	3	3649650	652420	3653280	657890
Clifton Peak	726	2, 3	3659753	658386	3660666	658712
Sycamore Gulch	728	1	3667460	660660	3669300	661230
Lower San Francisco River	729	1	3669174	661316	3672640	665075
White Rock	729.5	1	3675788	668514	3675667	669495
Dix Creek	730	1	3679150	681000	3675600	671400
Upper San Francisco River	732	1	3744100	680820	3744445	678950
Alpine Horse Pasture	735	1	3745454	673562	3745426	673409
Pheasant Farm	736	1	3745880	672789	3745900	672480
San Francisco River South of Alpine	737	1	3746200	671750	3746600	671300
Triangle Patch	738	1	3748406	668516	3748472	668451
San Pedro River						
CB Crossing Northeast	745	2, 4	3649236	520525	3648095	521886
CB Crossing West	746	3, 2	3648502	521109	3645897	522656
CB Crossing Southeast	747	3, 2	3647949	521990	3647546	522051
Indian Hills	748	3	3647308	522011	3646140	522820
Dudleyville Crossing	750	3, 2	3645010	523071	3640993	525408
Malpais Hill	751	2, 3	3640969	525227	3639210	525684
PZ Ranch	753	3, 2	3639282	526125	3636431	525704
PZ Ranch West	754	3, 2	3639175	525620	3635535	525403
Cook's Lake Cienega/Seep	756	2, 1	3635976	526000	3635254	526029
Aravaipa Inflow North	758	2, 1	3635538	525399	3633718	526355

Appendix C3. AGFD site names, habitat type, and UTMs for sites within the Gila Recovery Unit, Arizona. Cells blank if no information is available.

AGFD site name	Site order[a]	Habitat type[b, c]	Start		Stop	
			Northing	Easting	Northing	Easting
San Pedro/Aravaipa Confluence	759	x	3633715	526356	3632448	527329
Aravaipa Canyon	762	1	3641690	546490	3639550	554850
Aravaipa Inflow South	764	3, 2	3632448	527324	3632405	527297
Wheatfields	765	3, 4	3630303	528236	3630454	528160
Wheatfields South	768	2, 3	3630453	528161	3630291	528244
Capgage Wash	770	x	3629597	529179	3628560	529630
Cronley Wash	771	3	3627432	529764	3626831	530328
Cronley Wash South	772	3	3625962	530707	3625613	530963
Mammoth North	773	2	3623979	531494	3622996	532425
Mammoth Sewage Ponds	774	2	3622660	532812		
Mammoth South	775	2	3620300	534196	3616392	536139
San Manuel Crossing	778	x	3606861	543607	3609926	541497
Catalina Wash	784	2, 1	3606878	543617	3606845	543650
South Catalina Wash	785	2, 3	3603862	545617	3603025	546385
Peck Canyon South	788	2	3594455	548026	3593939	547900
Bingham Cienega	790	1, 2	3592073	548589	3590772	548540
Swamp Springs Canyon	794	1	3588810	563975	3588350	568610
Soza Wash	798	2, 1	3580610	553080	3578650	554315
Cascabel	799	x	3578000	554850	3573360	557470
Bass Canyon	802	1	3579600	571055	3581300	572840
Hookers Hot Springs	803	1	3578030	571225	3578340	571190
Three Links	805	2	3564524	564288	3557950	566007
Paige Creek	806	1	3555598	548993	3556992	551564
Ash Creek II	812	1	3551720	549825	3552098	549450
Ash Creek I	813	1	3550420	551175	3551075	550810
Apache Powder Rd.	818	2, 3	3529073	572298	3530714	570930
Miller Water Gap	819	1	3524422	574480	3523158	574630
St. David Cienega	819.5	2	3523821	573887	3522303	573561
Summers	820	1	3522240	574200	3517050	573600
SPRNCA – Contention	822	2, 1	3517050	573600	3513875	575420
Fairbank to Contention	823	2	3514660	575625	3509748	576854
Babocomari	825	2	3499365	552258	3499699	551515
SPRNCA – Boquillas	827	2, 1	3509818	576428	3506604	577284
SPRNCA – 9	827.5	2	3505175	577065	3506529	577533
Charleston Bridge North	828	2	3505055	577114	3499250	578254
Escapula Wash North	830	2, 1	3498348	579101	3497488	579253
Escapula Wash South	832	2, 1	3497457	579235	3496320	580567
State Route 90 Bridge	834	2, 1	3495050	580918	3488000	582900
SPRNCA – Carr to Hunter	835	2, 1	3488004	582853	3481659	584636
Hereford Bridge	840	2, 1	3481665	584677	3477514	585268
SPRNCA – Palominas	845	2, 1	3471840	584600	3466780	580800
Santa Cruz River						
Santa Cruz River, Upstream Trig Rd Bridge	853	2	3591905	472314	3592494	471684
Avra Valley Bridge S.	855	1, 2	3584800	486320	3583680	488050
Ina Bridge	857	2	3579346	490995	3576897	492676

Appendix C3. AGFD site names, habitat type, and UTMs for sites within the Gila Recovery Unit, Arizona. Cells blank if no information is available.

AGFD site name	Site order[a]	Habitat type[b, c]	Start		Stop	
			Northing	Easting	Northing	Easting
Lower Sabino Canyon	860	1	3575175	517805	3575930	517950
Upper Tanque Verde	865	1	3570775	539115	3571470	539980
Empire/Cienega – Cienega Creek	870	2	3542400	533500		
Cienega Creek Near Cross Hill	871	3	3541795	535500	3540550	537625
Cienega Narrows	873	1	3528553	543057	3527610	542661
Cienega Creek – Narrows to Coldwater	874	1	3523969	539881	3528343	542714
Cienega Creek	875	1, 2	3523910	539950	3515745	538830
Chavez Siding Rd. – Santa Cruz River	885	1	3501000	495560	3500775	495680
Anza Trail	886	2, 1	3497825	496100	3491700	495690
Arivaca Creek	888	1	3492676	469507	3497698	461713
Santa Gertrudis South	890	2	3491689	495600	3487933	498514
Peck Canyon Bridge	892	1	3486073	498908	3485939	498506
Rio Rico	895	1	3481375	500870	3480875	501475
Cuates Buttes	897	1	3482696	507496	3482027	509100
Patagonia Lake – Sonoita Creek	900	1, 2	3484831	514759	3484995	517020
Sanford Butte	901	1	3485772	518807	3486321	519270
Patagonia – Sonoita Creek Preserve	902	1	3487790	521275	3488450	522290
Cottonwood Spring	904	1	3501500	527300	3501820	527810
Ruby Rd. Bridge – Santa Cruz River	910	1	3477620	505790	3475075	509990
Bog Hole Wildlife Area	915	1	3482310	536260		
Tonto Creek						
Bermuda Flats	948	2	3733797	480228	3734518	478449
Orange Peel	949	x	3734921	478450	3735765	476771
Tonto Creek Inflow	950	2, 3	3735774	476894	3737338	476683
A-Cross Road South	952	2, 3	3737176	476827	3739131	476491
A-Cross Road North	953	3, 2	3738835	476107	3740730	475194
Bar-X Road	957	2	3740752	475177	3744198	472805
Punkin Center	958	3, 2	3747486	471457	3747800	471461
Haufer Wash	958.5	1	3751776	471733	3752217	471799
Del Shay	960	1, 2	3764827	473826	3765639	473495
Rye Creek	962	2, 1	3766325	472315	3766600	471900
Gisela South	964	x	3770603	473756	3772992	474518
Tonto Creek – Gisela	965	2	3775260	475150	3775550	475620
Gibson Creek – Round Valley	968	1	3783100	472550	3783425	472000
Spring Creek – Buzzard Roost Mesa	970	1	3773685	491960	3771075	493060
Bear Hide Spring	973	1	3794240	492650	3794390	492575
Christopher Creek	974	1	3796160	496530	3796620	498000
Indian Gardens	975	1	3797853	490527	3797999	491465
Verde River						
Rock Creek – Beeline	976	2	3732484	452789	3732446	452212
Needle Rock	977	2, 1	3737059	438650	3730610	439517
Bartlett Dam	978	2	3740981	440240	3730610	439479
Bartlett North	979	2	3757834	434952	3753630	437964

Appendix C3. AGFD site names, habitat type, and UTMs for sites within the Gila Recovery Unit, Arizona. Cells blank if no information is available.

AGFD site name	Site order[a]	Habitat type[b, c]	Start		Stop	
			Northing	Easting	Northing	Easting
Davenport	980	2, 1	3757875	434334	3759524	433543
Horseshoe Dam	985	3	3759560	433560	3760310	434640
Horseshoe North	986	2	3766718	433209	3763947	432850
Ister Flat	987	x	3766900	433415	3768880	432980
Ister Flat West	988	3	3767710	432840	3768460	432770
Mile 9 R	989	2, 1	3770789	434810	3768921	432947
Sycamore Creek At Sheep Bridge	990	1, 2	3770644	434928	3771370	435810
Junkyard to Sheep Bridge	990.5	2	3773968	433776	3770785	434768
Junkyard	991	2, 1	3774070	433877	3774243	433926
Tangle Peak R	993	2, 1	3776724	432863	3776691	433155
Mile 16.5 L	994	2, 1	3777025	433550	3778088	433100
Mile 16.5 R	994.5	2, 1	3777174	433171	3777535	433045
Mile 18.0 R	995	2, 1	3778347	433571	3778432	433967
Mile 18.5 L	996	2, 1	3778432	434162	3778627	434435
Mile 18.5 R	997	2, 1	3778581	434149	3778711	434331
Wet Bottom Creek L	999	1	3779315	434311	3779412	434863
Palo Verde Spring	1000	2, 1	3778881	434426	3779900	433640
Red Creek	1002	2, 1	3780221	433654	3781317	434736
Cow Flop Spring R	1004	1	3782921	434632	3782864	434510
Pete's cabin Mesa L	1005	2, 1	3785681	435692	3786101	435169
Pete's Cabin Mesa R	1006	2, 1	3786631	435208	3787305	435192
Mile 29.5 R (ROG)	1007	2, 1	3787700	435640	3788133	435517
Goat Camp	1007.5	2, 1	3789238	436131	3789374	435995
Mile 31.75 R	1008	2, 1	3790536	436385	3790796	436434
Mile 32.75 L	1010	2, 1	3791194	437360	3791470	437490
Mile 33.25 R	1011	2, 1	3791738	437563	3791998	437636
Squaw Butte R	1012	2, 1	3792431	437335	3793354	436997
Houston Creek	1013	1	3793340	436960	3794660	435700
Mile 34.5 R	1014	1	3793557	437092	3793557	437092
Mile 34.75 L	1015	2, 1	3793405	437084	3793500	437555
East Verde – Verde Confluence L	1016	2, 1	3793567	438063	3793841	438855
East Verde – Verde Confluence R	1017	2, 1	3793790	438620	3793957	438811
East Verde – Doll Baby Ranch	1022	1	3786753	454851	3786800	456875
Lost Shirt Bend	1026	2, 1	3794890	439045	3795210	438895
Childs to Lost Shirt	1027	2	3801950	434627	3795053	438537
Stehr Lake	1030	1	3802420	438595	3802925	438825
Fossil Creek	1032	2	3804800	439510	3805070	439700
Aqueduct Spring	1033	1	3805490	440440	3805850	442140
Bridge to Irving Powerplant	1034	1	3805850	442140	3806840	443240
Fossil Springs	1036	1	3808800	447025	3809420	447440
West Clear Creek Near Shill's Crossing	1040	2	3818640	424100	3819375	424777
East Wingfield Mesa – West Clear Creek	1042	2	3819325	424810	3820290	426760
West Clear Creek Campground	1044	1	3820145	426890	3819595	433560
Hance Springs	1046	1	3824175	432195	3824320	432160
Bull Pen	1048	1, 2	3820655	434254	3821980	436960
Rancho Rio Verde	1060	2	3818262	423630	3819650	423170

Appendix C3. AGFD site names, habitat type, and UTMs for sites within the Gila Recovery Unit, Arizona. Cells blank if no information is available.

AGFD site name	Site order[a]	Habitat type[b, c]	Start		Stop	
			Northing	Easting	Northing	Easting
Copper Canyon	1064	1	3821695	416420	3820975	412850
White Bridge	1066	2, 3	3822900	421440	3824507	422211
Wet Beaver Creek	1072	1	3835415	433965	3836940	438625
Red Tank Draw	1077	1	3836625	432850	3837520	433810
Stoneman Lake	1079	1	3848000	452705	3848925	452700
Winter Cabin Tank – Dry Beaver Creek	1085	1	3838175	427975	3839375	428290
Stage Stop – Dry Beaver Creek	1086	2, 1	3839560	428280	3841200	428100
Camp Verde	1095	3, 2	3825860	421490	3827350	419465
Cornville Bridge – Oak Creek	1100	2	3841870	416270	3842125	416145
Sheepshead Canyon	1102	1	3844140	415100	3845120	414660
Mormon Crossing – Oak Creek	1104	1	3844750	417320	3844750	418120
Turkey Creek	1106	1	3851841	422948	3852361	423977
Red Rock Crossing – Oak Creek	1108	1	3853700	426130	3853850	427285
West Fork – Oak Creek	1112	1	3871710	431995	3873140	430025
Spring Creek	1115	1	3845545	416500	3847140	416320
Bignotti Beach	1120	1	3837690	413590	3837845	412575
Bridgeport	1122	2	3843625	408551	3842463	409303
Mingus Ave. – Rocking Chair Road	1123	2, 3	3843823	408511	3845620	408380
Cottonwood	1124	2	3845591	406531	3845580	408216
Dead Horse State Park	1124	1, 2	3845566	406045	3845566	406045
Mescal Gulch	1126	3	3846075	405700	3846595	405600
Upstream 10th St R and L	1127	2	3845604	406465	3847033	406512
Tavasci Marsh	1128	1, 2	3847420	406450	3848950	406350
Verde Outflow	1129	3	3847240	405830	3847195	405600
Tuzigoot Gallery Forest	1130	2	3847375	405715	3847440	405210
Tuzigoot Bridge	1132	2, 3	3847403	404990	3847606	404761
Tapco	1134	3, 4	3848930	403825	3850915	403000
Verde @ Powerline	1138	1, 2	3855263	403363	3855705	403474
Sycamore Canyon	1140	1, 3	3858170	401900	3862745	402820
Near Muldoon Canyon	1143		3861050	374742	3861053	374561
Granite – Verde	1145	1	3857251	369338	3859594	372434
Granite Creek	1150	1	3830410	370100	3825410	367490
Confluence of Apache Creek & Walnut Creek	1160	1	3865575	331045	3865625	331575

[a]Order of sites along drainages used to differentiate among sites and determine relative positions along drainage. Sites are ordered from least to greatest from downstream to upstream.

[b]Habitat type was categorized as 1 = native broadleaf vegetation (entirely or almost entirely native [>90% native]); 2 = mixed native broadleaf and exotic vegetation (50–90% native); 3 = mixed exotic and native broadleaf vegetation (50–90% exotic); 4 = entirely or almost entirely exotic (>90% exotic); and x = inconsistent habitat type due to observer bias or area surveyed.

[c]Multiple habitat types reflect continuous succession throughout study period.

Appendix D1. AGFD site name, AGFD site number, rangewide site name, Southwestern Willow Flycatcher Recovery Plan management unit, and county for sites within the Lower and Upper Colorado Recovery Units in Arizona (USFWS 2002)[a].

AGFD site name	AGFD site number	Rangewide site name[b]	Management unit	County
Big Sandy River				
Lower Big Sandy River	AZBS001	Big Sandy River, Lower	Bill Williams	Mohave
Signal Canyon	AZBS006		Bill Williams	Mohave
Madril Wash	AZBS007		Bill Williams	Mohave
Six Mile Crossing – Burro Creek	AZBS005		Bill Williams	Mohave
Francis Creek	AZBS003		Bill Williams	Mohave
Gray Wash #2	AZBS013		Bill Williams	Mohave
Gray Wash	AZBS012		Bill Williams	Mohave
BSR Dack	AZBS014		Bill Williams	Mohave
Big Sandy River Downstream US93 – 2	AZBS011		Bill Williams	Mohave
Big Sandy River Downstream US 93	AZBS002	Big Sandy River – US 93	Bill Williams	Mohave
Big Sandy River Upstream US 93	AZBS010	Big Sandy River – US 93	Bill Williams	Mohave
Cottonwood Creek	AZBS004		Bill Williams	Mohave
Bill Williams River				
Bill Williams River Delta – Marsh Edge	AZBW004	Bill Williams Delta Marsh Edge	Bill Williams	La Paz, Mohave
Monkey's Head	AZBW002	Bill Williams River – Monkey's Head	Bill Williams	La Paz
Gemini	AZBW001	Bill Williams Gemini	Bill Williams	La Paz, Mohave
Cave Wash 1	AZBW005	Bill Williams – Cave Wash	Bill Williams	La Paz, Mohave
Cave Wash 2	AZBW012	Bill Williams – Cave Wash	Bill Williams	La Paz, Mohave
Buckskin	AZBW003	Bill Williams Buckskin	Bill Williams	La Paz, Mohave
Bill Williams Pipeline	AZBW009		Bill Williams	La Paz, Mohave
Lincoln Ranch	AZBW013		Bill Williams	La Paz, Mohave
Alamo Dam	AZBW006		Bill Williams	La Paz, Mohave
Alamo Lake – Brown's Crossing	AZBW007	Bill Williams Alamo Lake	Bill Williams	La Paz, Mohave
Colorado River				
Hunter's Hole	AZCO002		Parker – Southerly International Boundary	Yuma

Appendix D1. AGFD site name, AGFD site number, rangewide site name, Southwestern Willow Flycatcher Recovery Plan management unit, and county for sites within the Lower and Upper Colorado Recovery Units in Arizona (USFWS 2002)[a].

AGFD site name	AGFD site number	Rangewide site name[b]	Management unit	County
Gadsden Pond	AZCO003		Parker – Southerly International Boundary	Yuma
Gadsden Bend	AZCO004		Parker – Southerly International Boundary	Yuma
Cocopah	AZCO046		Parker – Southerly International Boundary	Yuma
County 14th St. to County 13th St.	AZCO112		Parker – Southerly International Boundary	Yuma
County 13th St. to County 12th St.	AZCO005		Parker – Southerly International Boundary	Yuma
County 11th St. to County 10th St.	AZCO110		Parker – Southerly International Boundary	Yuma
County 10th St. to County 9th St.	AZCO109		Parker – Southerly International Boundary	Yuma
County 9th St. to Morelos Dam	AZCO010		Parker – Southerly International Boundary	Yuma
Lower Yuma Division #2	AZCO107		Parker – Southerly International Boundary	Yuma
Yuma Division	AZCO001		Parker – Southerly International Boundary	Yuma
Fort Yuma 1 & 2	AZCO009		Parker – Southerly International Boundary	Yuma
Yuma Territorial Prison	AZCO115		Parker – Southerly International Boundary	Yuma
2 East to Gila River	AZCO008		Parker – Southerly International Boundary	Yuma
Fort Yuma 3	AZCO014		Parker – Southerly International Boundary	Yuma
Gila/Colorado Confluence 3	AZCO035	Colorado River – Gila Confluence	Parker – Southerly International Boundary	Yuma
Gila/Colorado Confluence 1	AZCO011	Colorado River – Gila Confluence 1	Parker – Southerly International Boundary	Yuma
Gila/Colorado Confluence 2	AZCO090		Parker – Southerly International Boundary	Yuma

Appendix D1. AGFD site name, AGFD site number, rangewide site name, Southwestern Willow Flycatcher Recovery Plan management unit, and county for sites within the Lower and Upper Colorado Recovery Units in Arizona (USFWS 2002)[a].

AGFD site name	AGFD site number	Rangewide site name[b]	Management unit	County
Bruce	AZCO143		Parker – Southerly International Boundary	Yuma
Mittry Lake	AZCO006	Colorado River – Mittry Lake	Parker – Southerly International Boundary	Yuma
Castle Dome	AZCO088		Parker – Southerly International Boundary	Yuma
Martinez Lake	AZCO015	Colorado River – Martinez Lake	Parker – Southerly International Boundary	Yuma
Imperial HQ 2	AZCO113		Parker – Southerly International Boundary	Yuma
IB	AZCO026		Parker – Southerly International Boundary	Yuma
IS	AZCO025		Parker – Southerly International Boundary	Yuma
Farmfield #20	AZCO119		Parker – Southerly International Boundary	Yuma
Killdeer	AZCO027		Parker – Southerly International Boundary	Yuma
Dredge Channel	AZCO024		Parker – Southerly International Boundary	Yuma
Farm Field	AZCO028		Parker – Southerly International Boundary	Yuma
Cottonwood Nursery	AZCO030		Parker – Southerly International Boundary	Yuma
Flycatcher	AZCO029		Parker – Southerly International Boundary	Yuma
Triangle	AZCO118		Parker – Southerly International Boundary	Yuma
Cattail	AZCO032		Parker – Southerly International Boundary	Yuma
Firebreak	AZCO031		Parker – Southerly International Boundary	Yuma
Imperial HQ 1	AZCO012		Parker – Southerly International Boundary	Yuma

Appendix D1. AGFD site name, AGFD site number, rangewide site name, Southwestern Willow Flycatcher Recovery Plan management unit, and county for sites within the Lower and Upper Colorado Recovery Units in Arizona (USFWS 2002)[a].

AGFD site name	AGFD site number	Rangewide site name[b]	Management unit	County
Ironwood	AZCO021		Parker – Southerly International Boundary	La Paz
Smoke Tree	AZCO022		Parker – Southerly International Boundary	La Paz
Clear Lake	AZCO017	Colorado River – Clear Lake	Parker – Southerly International Boundary	La Paz
Picacho East (Island Lake)	AZCO018	Colorado River – Picacho East	Parker – Southerly International Boundary	La Paz
Picacho West	AZCO023		Parker – Southerly International Boundary	La Paz
Picacho Island	AZCO121		Parker – Southerly International Boundary	Yuma, Imperial
Nortons Landing	AZCO086		Parker – Southerly International Boundary	La Paz
Adobe Lake	AZCO019	Colorado River – Adobe Lake	Parker – Southerly International Boundary	La Paz
Hoge	AZCO085	Colorado River – Hoge	Parker – Southerly International Boundary	La Paz
Paradise Valley South	AZCO116		Parker – Southerly International Boundary	La Paz
Paradise Valley North	AZCO117		Parker – Southerly International Boundary	La Paz
Clip Wash Mine	AZCO042		Parker – Southerly International Boundary	La Paz
Cibola Lake Overlook	AZCO020		Parker – Southerly International Boundary	La Paz
Cibola Lake	AZCO038	Colorado River – Cibola Lake	Parker – Southerly International Boundary	La Paz
SW of Landing Strip – Cibola	AZCO036	Colorado River – Cibola SW Landing Strip	Parker – Southerly International Boundary	La Paz
Cibola #2	AZCO122		Parker – Southerly International Boundary	La Paz
Arnet Ditch/Tieback Levee	AZCO039		Parker – Southerly International Boundary	La Paz

Appendix D1. AGFD site name, AGFD site number, rangewide site name, Southwestern Willow Flycatcher Recovery Plan management unit, and county for sites within the Lower and Upper Colorado Recovery Units in Arizona (USFWS 2002)[a].

AGFD site name	AGFD site number	Rangewide site name[b]	Management unit	County
Cibola Reveg Flat	AZCO132		Parker – Southerly International Boundary	La Paz
Cibola Island Unit	AZCO033		Parker – Southerly International Boundary	La Paz
High Levee East	AZCO040		Parker – Southerly International Boundary	La Paz
Farm Unit 1 Reveg.	AZCO041		Parker – Southerly International Boundary	La Paz
Cibola Restoration	AZCO142		Parker – Southerly International Boundary	La Paz
Palo Verde	AZCO034		Parker – Southerly International Boundary	La Paz, Imperial
A-10 Backwash	AZCO016		Parker – Southerly International Boundary	La Paz
Ehrenberg	AZCO007	Colorado River – Ehrenberg	Parker – Southerly International Boundary	La Paz
Anjohns	AZCO126		Parker – Southerly International Boundary	La Paz
Horse Island	AZCO125		Parker – Southerly International Boundary	La Paz
Noname Lake	AZCO124		Parker – Southerly International Boundary	La Paz
Hidden Valley Island	AZCO133		Parker – Southerly International Boundary	La Paz
Calzona	AZCO127		Parker – Southerly International Boundary	La Paz, Riverside
Twelvemile Slough	AZCO123		Parker – Southerly International Boundary	La Paz
Ahakhav Preserve	AZCO106		Parker – Southerly International Boundary	La Paz
Cienega Springs	AZCO094		Parker – Southerly International Boundary	
Parker Strip	AZCO054		Parker – Southerly International Boundary	La Paz, San Bernardino

Appendix D1. AGFD site name, AGFD site number, rangewide site name, Southwestern Willow Flycatcher Recovery Plan management unit, and county for sites within the Lower and Upper Colorado Recovery Units in Arizona (USFWS 2002)[a].

AGFD site name	AGFD site number	Rangewide site name[b]	Management unit	County
Disneyland	AZCO114		Hoover – Parker	Mohave
Standard Wash	AZCO093		Hoover – Parker	Mohave
Beaver Island to Thompson Bay	AZCO092		Hoover – Parker	Mohave
Neptune – North Lake Havasu	AZCO045	Colorado River – Lake Havasu – Neptune	Hoover – Parker	Mohave
Blankenship	AZCO044	Colorado River Blankenship	Hoover – Parker	Mohave
Pulpit Rock	AZCO146		Hoover – Parker	Mohave
Topock Marsh	AZCO052	Colorado River Topock Marsh	Hoover – Parker	Mohave
Waterwheel Cove	AZCO058	Colorado River – Waterwheel Cove	Hoover – Parker	Mohave
Chuckwalla Cove	AZCO158	Colorado River – Lake Mead Delta	Middle Colorado	Mohave
Bradley Bay	AZCO157		Middle Colorado	Mohave
Driftwood Island	AZCO156		Middle Colorado	Mohave
Raven's Nest Beach – Lake Mead	AZCO153	Colorado River – Lake Mead Delta	Middle Colorado	Mohave
Snake Beach – Lake Mead	AZCO154	Colorado River – Lake Mead Delta	Middle Colorado	Mohave
Grand Wash Bay	AZCO159	Colorado River – Lake Mead Delta	Middle Colorado	Mohave
Lake Mead Delta	AZCO080	Colorado River – Lake Mead Delta	Middle Colorado	Mohave
Miles 277.0 to 274.0 R GC	AZCO101	Colorado River – Grand Cyn RM 277–274 R	Middle Colorado	Mohave
Miles 277.0 to 273.5 L GC	AZCO082	Colorado River – Grand Cyn RM 277–273 L	Middle Colorado	Mohave
Miles 273.5 to 273.0 R GC	AZCO105		Middle Colorado	Mohave
Miles 273.5 to 270.0 L GC	AZCO100	Colorado River – Grand Cyn RM 273–270 L	Middle Colorado	Mohave
Miles 272.0 to 268.0 R GC	AZCO099	Colorado River – Grand Cyn RM 272–268 R	Middle Colorado	Mohave
Miles 270.0 to 268.0 L GC	AZCO098	Colorado River – Grand Cyn RM 270–268 L	Middle Colorado	Mohave
Miles 268.0 to 265.0 L GC	AZCO096	Colorado River – Grand Cyn RM 268–265 L	Middle Colorado	Mohave
Miles 268.0 to 264.0 R GC	AZCO097	Colorado River – Grand Cyn RM 268–264 R	Middle Colorado	Mohave
Miles 265.0 to 263.5 L GC	AZCO095	Colorado River – Grand Cyn RM 265–263 L	Middle Colorado	Mohave
Miles 263.5 to 262.5 L GC	AZCO079	Colorado River – Grand Cyn RM 263 – 262 L	Middle Colorado	Mohave
Miles 262.8 to 261.8 R GC – Wards Cave Rapid	AZCO136		Parker – Southerly International Boundary	Mohave
Miles 262.5 to 259.5 L GC	AZCO087	Colorado River – Grand Cyn RM 259.5L	Middle Colorado	Mohave
Miles 261.2 to 260.5 R GC	AZCO059		Middle Colorado	Mohave
Mile 260.0 R GC	AZCO102		Middle Colorado	Mohave

Appendix D1. AGFD site name, AGFD site number, rangewide site name, Southwestern Willow Flycatcher Recovery Plan management unit, and county for sites within the Lower and Upper Colorado Recovery Units in Arizona (USFWS 2002)[a].

AGFD site name	AGFD site number	Rangewide site name[b]	Management unit	County
Mile 260.0 L Quartermaster GC	AZCO081		Middle Colorado	Mohave
Mile 259.5 L	AZCO137	Colorado River – Grand Cyn RM 259.5 L	Middle Colorado	Mohave
Mile 259.5 R Waterfall Rapid GC	AZCO053	Colorado River – Grand Cyn RM 259 R	Middle Colorado	Mohave
Miles 257.5 to 257.0 R GC	AZCO051	Colorado River – Grand Cyn RM 257–257 R	Middle Colorado	Mohave
Miles 257.2 to 256.6 L GC	AZCO120		Middle Colorado	Mohave
Mile 255.5 R Devils Slide Rapids GC	AZCO050		Middle Colorado	Mohave
Mile 252.9 L GC	AZCO084		Middle Colorado	Mohave
Mile 252.3 R GC – Reference Point Rapid	AZCO138		Middle Colorado	Mohave
Mile 252.2 L GC	AZCO083		Middle Colorado	Mohave
Mile 251 R GC	AZCO152		Middle Colorado	Mohave
Mile 251.8 L GC	AZCO061		Middle Colorado	Mohave
Mile 251.3 L GC	AZCO060		Middle Colorado	Mohave
Mile 251.0 L GC	AZCO057		Middle Colorado	Mohave
Mile 249.5 R GC	AZCO151		Middle Colorado	Mohave
Mile 249.5 L GC	AZCO150		Middle Colorado	Mohave
Mile 249.0 L Lost Creek GC	AZCO135		Middle Colorado	Mohave
Mile 248.3 R Surprise Canyon GC	AZCO134		Middle Colorado	Mohave
RM 247 L GC	AZCO149		Middle Colorado	Mohave
Mile 246.0 L GC	AZCO104	Colorado River – Grand Cyn RM 246 L	Middle Colorado	Mohave
Mile 243.0 L GC	AZCO103		Middle Colorado	Mohave
Separation Canyon R GC	AZCO147		Middle Colorado	Mohave
Miles 204.8 to 204.7 L GC	AZCO078		Middle Colorado	Coconino
Mile 204.5 R Spring Canyon GC	AZCO108		Middle Colorado	Mohave
Miles 199.0 to 196.0 R Parashant Camp GC	AZCO077		Middle Colorado	Mohave
Miles 198.0 to 196.0 L GC	AZCO130		Middle Colorado	Coconino
Miles 196.0 to 195.1 L GC	AZCO129		Middle Colorado	Coconino
Miles 196.0 to 191.0 R GC	AZCO076		Middle Colorado	Mohave
Mile 195.0 L GC	AZCO013		Middle Colorado	Coconino
Miles 194.9 to 191.2 L GC	AZCO131		Middle Colorado	Coconino
Mile 168.0 R Fern Glen GC	AZCO037		Middle Colorado	Mohave

Appendix D1. AGFD site name, AGFD site number, rangewide site name, Southwestern Willow Flycatcher Recovery Plan management unit, and county for sites within the Lower and Upper Colorado Recovery Units in Arizona (USFWS 2002)[a].

AGFD site name	AGFD site number	Rangewide site name[b]	Management unit	County
Miles 143.5 to 143.0 R GC	AZCO075		Middle Colorado	Mohave
Jensen Canyon – Kanab Creek	AZCO056		Middle Colorado	Mohave, Coconino
Little Spring – Kanab Wilderness	AZCO055		Middle Colorado	Mohave, Coconino
Clear Water Spring – Kanab Creek	AZCO047		Middle Colorado	Mohave
Mile 136.0 R GC	AZCO074		Middle Colorado	Mohave
Mile 133.7 R Tapeats Creek GC	AZCO043		Middle Colorado	Coconino
Miles 72.2 to 72.0 R GC – Unkar	AZCO139		Middle Colorado	Coconino
Miles 71.3 to 71.0 L Cardenas GC	AZCO073	Colorado River – Grand Canyon RM 71 L	Middle Colorado	Coconino
Miles 67.1 to 66.8 L GC	AZCO140		Middle Colorado	Coconino
Mile 65.3 L Lava Chuar GC	AZCO072	Colorado River – Grand Canyon RM 65.3 L	Middle Colorado	Coconino
Miles 56.5 to 56.0 R Kwagunt Marsh GC	AZCO071		Middle Colorado	Coconino
Mile 52.7 R Lower Nankoweap Camp GC	AZCO070		Middle Colorado	Coconino
Mile 52.0 L GC	AZCO062		Middle Colorado	Coconino
Mile 53.3 R GC – Nankoweap Main Camp	AZCO155		Middle Colorado	Coconino
Miles 51.5 to 50.5 L GC	AZCO069	Colorado River – Grand Canyon RM 50–51 L	Middle Colorado	Coconino
Mile 50.0 L GC	AZCO049	Colorado River – Grand Canyon RM 50–51 L	Middle Colorado	Coconino
Miles 50.0 to 49.0 R GC	AZCO144		Middle Colorado	Coconino
Miles 46.9 to 46.6 R GC	AZCO068		Middle Colorado	Coconino
Miles 43.8 to 38.8 L GC	AZCO141		Middle Colorado	Coconino
Miles 29.0 to 28.0 L GC	AZCO145	Colorado River – Grand Canyon RM 28–29	Middle Colorado	Coconino
Mile 5.2 R GC	AZCO128		Middle Colorado	Coconino
Miles 0.5 to 0.2 R Lees Ferry GC	AZCO048		Middle Colorado	Coconino
Miles 2.9 to 3.4 R GC	AZCO065		Middle Colorado	Mohave
Mile 6.1 R GC	AZCO066		Middle Colorado	Mohave
Miles 8.3 to 8.5 R GC	AZCO067		Middle Colorado	Mohave
Mile 9 Marsh GC	AZCO063		Middle Colorado	Mohave
Chaol Canyon – Lake Powell	AZCO091		Middle Colorado	Coconino
Gila River				
North Gila Valley Site 1	AZGI002		Middle Gila/San Pedro	Yuma

Appendix D1. AGFD site name, AGFD site number, rangewide site name, Southwestern Willow Flycatcher Recovery Plan management unit, and county for sites within the Lower and Upper Colorado Recovery Units in Arizona (USFWS 2002)[a].

AGFD site name	AGFD site number	Rangewide site name[b]	Management unit	County
North Gila Valley Site 2	AZGI003		Middle Gila/San Pedro	Yuma
Yuma Lake	AZGI119		Parker – Southerly International Boundary	Yuma
Fortuna Wash	AZGI001	Gila River – Fortuna Wash	Parker – Southerly International Boundary	Yuma
Fortuna North	AZGI118		Parker – Southerly International Boundary	Yuma
Gila River at US Route 95	AZGI103		Parker – Southerly International Boundary	Yuma
Dome Powerline	AZGI115		Parker – Southerly International Boundary	Yuma
Dome Slough	AZGI102		Parker – Southerly International Boundary	Yuma
Ligurta	AZGI101		Parker – Southerly International Boundary	Yuma
West Pond – Quigley Wildlife Area	AZGI111		Parker – Southerly International Boundary	Yuma
Little Colorado River				
Moenkopi Wash	AZLC052		Little Colorado	Coconino
Tanner's Crossing	AZLC054		Little Colorado	Coconino
Pasture Canyon	AZLC027		Little Colorado	Coconino
Begashibito Canyon	AZLC037		Little Colorado	Coconino
Blue Canyon	AZLC036		Little Colorado	Coconino
Cameron	AZLC049		Little Colorado	Coconino
Dinnebito	AZLC046		Little Colorado	Navajo
Grand Falls – North of 70 Bridge	AZLC029		Little Colorado	Coconino
Yung-pi	AZLC048		Little Colorado	Navajo
Kykotsmovi	AZLC047		Little Colorado	Navajo
Coyote Spring	AZLC042		Little Colorado	Navajo
Polacca Wash	AZLC039		Little Colorado	Navajo
Polacca Sewer Pond	AZLC038		Little Colorado	Navajo

Appendix D1. AGFD site name, AGFD site number, rangewide site name, Southwestern Willow Flycatcher Recovery Plan management unit, and county for sites within the Lower and Upper Colorado Recovery Units in Arizona (USFWS 2002)[a].

AGFD site name	AGFD site number	Rangewide site name[b]	Management unit	County
Lower Keams Canyon	AZLC041		Little Colorado	Navajo
Keams Canyon – Beaver Dam	AZLC040		Little Colorado	Navajo
Kalbito Springs	AZLC045		Little Colorado	Navajo
Sawmill	AZLC010		Little Colorado	Coconino
SR 87 Bridge	AZLC051		Little Colorado	Navajo
I-40 Cottonwood Bridges	AZLC053		Little Colorado	Navajo
Enchinique	AZLC009		Little Colorado	Coconino
Leonard Point – Clear Creek	AZLC002		Little Colorado	Coconino
East Clear Creek	AZLC001		Little Colorado	Coconino
Rock Tank – Willow Creek	AZLC003		Little Colorado	Coconino
Wiggins Crossing – Willow Creek	AZLC006		Little Colorado	Coconino
Chevelon Wildlife Area	AZLC035		Little Colorado	Coconino
Gauging Station	AZLC004		Little Colorado	Coconino
Chevelon Crossing North	AZLC005		Little Colorado	Coconino
Hubbell	AZLC050		Little Colorado	Apache
Fools Hollow Lake – Show Low	AZLC007		Little Colorado	Navajo
Billy Creek	AZLC008		Little Colorado	Navajo
Mineral Springs	AZLC028		Little Colorado	Apache
Springer/Round Valley Crossing	AZLC043		Little Colorado	Apache
Wenima Ranch	AZLC011		Little Colorado	Apache
South Fork Campground	AZLC026		Little Colorado	Apache
Hall Creek Near Greer	AZLC025		Little Colorado	Apache
Hall Creek	AZLC018		Little Colorado	Apache
Benny Creek	AZLC020		Little Colorado	Apache
River Reservoir Spillway	AZLC024		Little Colorado	Apache
Wonderland Trap	AZLC034		Little Colorado	Apache
Tunnel Reservoir	AZLC019		Little Colorado	Apache
River Reservoir	AZLC023	Little Colorado at Greer River Reservoir	Little Colorado	Apache
Greer Trout Ponds	AZLC017		Little Colorado	Apache
Greer Townsite	AZLC022	Little Colorado at Greer Township	Little Colorado	Apache

Appendix D1. AGFD site name, AGFD site number, rangewide site name, Southwestern Willow Flycatcher Recovery Plan management unit, and county for sites within the Lower and Upper Colorado Recovery Units in Arizona (USFWS 2002)[a].

AGFD site name	AGFD site number	Rangewide site name[b]	Management unit	County
Upper West Fork	AZLC021		Little Colorado	Apache
Government Spring	AZLC030		Little Colorado	Apache
Sheep Crossing	AZLC012		Little Colorado	Apache
Amberon Flat	AZLC044		Little Colorado	Apache
Church Camp	AZLC031		Little Colorado	Apache
Phelps Cabin	AZLC013		Little Colorado	Apache
Sipe Wildlife Area	AZLC033		Little Colorado	Apache
Rudd Creek	AZLC015		Little Colorado	Apache
Nelson Reservoir	AZLC014	Nelson Reservoir	Little Colorado	Apache
Nutrioso	AZLC016		Little Colorado	Apache
Colter Creek	AZLC032		Little Colorado	Apache
San Juan River[a]				
Canyon Del Muerto	AZSJ001		San Juan	Apache
Santa Maria River				
Lower Santa Maria River	AZSM009	Santa Maria River, Lower	Bill Williams	Mohave, La Paz
Yerba Mansa Spring	AZSM010		Bill Williams	La Paz
Tres Alamos Falls	AZSM008		Bill Williams	La Paz
Date Creek – Cottonwood Canyon	AZSM005		Bill Williams	Yavapai
Billingsley Spring	AZSM006		Bill Williams	Yavapai
Big Stick Mine and downstream	AZSM003		Bill Williams	Yavapai
Santa Maria River at US Route 93 Bridge	AZSM004		Bill Williams	Yavapai
Date Creek Beaver Ponds	AZSM007		Bill Williams	Yavapai
Cottonwood Canyon	AZSM011		Bill Williams	Yavapai
Virgin River				
Nevada Border	AZVI007		Virgin	Mohave
Little Bend	AZVI006		Virgin	Mohave

Appendix D1. AGFD site name, AGFD site number, rangewide site name, Southwestern Willow Flycatcher Recovery Plan management unit, and county for sites within the Lower and Upper Colorado Recovery Units in Arizona (USFWS 2002)[a].

AGFD site name	AGFD site number	Rangewide site name[b]	Management unit	County
Big Bend	AZVI005		Virgin	Mohave
Corral Bluff	AZVI004		Virgin	Mohave
Littlefield	AZVI001	Virgin River – Littlefield	Virgin	Mohave
Spring Arroyo	AZVI008		Virgin	Mohave
Big Spring	AZVI009		Virgin	Mohave
AF 628	AZVI010		Virgin	Mohave
Black Rock Gulch	AZVI002		Virgin	Mohave

[a] The San Juan River is the only drainage within the Upper Colorado Recovery Unit. The other drainages are all located within the Lower Colorado Recovery Unit.

[a] Rangewide site names were only created for sites where willow flycatchers were detected. Names originate from the Rangewide Southwestern Willow Flycatcher database (USGS unpublished data) and Southwestern Willow Flycatcher Recovery Plan (2002).

Appendix D2. Southwestern willow flycatcher survey results by site within the Lower and Upper Colorado Recovery Unit, Arizona, 1993–2006[a]. Cells empty if no information is available.

AGFD site name	Site order[b]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[c]	Migrants[d]
Big Sandy River										
Lower Big Sandy River	21	2005	2	9	8	5	3	0	0	0
		1994	2	23.5	4	4	0	0	0	0
		1995	2	6	6	4	2	2	0	2
		1996	3	35.5	0	0	0	0	0	1
		1997	3	53	5	4	1	0	0	1
		1998	3	64.8	12	6	6	6	0	1
		1999	2	32.5	14	8	7	6	0	1
		2000	5	57.75	13	7	6	7	0	2
		2001	4	34.5	5	3	2	4	2	2
		2002	1	4.5	2	1	1	1	10	0
		2003	3	15.33	12	7	5	3	0	0
		2004	3	23.9	14	7	7	5	2	0
Signal Canyon	22	1998	2	1.5	0	0	0	0	0	0
Madril Wash	23	1998	2	2.8	0	0	0	0	0	0
Six Mile Crossing – Burro Creek	25	1993	1	5.5	0	0	0	0	0	0
		1994	1	3	0	0	0	0	0	0
		1995	1	11	0	0	0	0	0	0
		1998	3	11.8	0	0	0	0	0	0
Francis Creek	28	1993	2	6	0	0	0	0	0	0
		1994	2	4	0	0	0	0	0	0
		1995	1	1.8	0	0	0	0	0	0
		1999	2	9	0	0	0	0	0	0
Gray Wash #2	29	2001	2	5	0	0	0	0	0	0
Gray Wash	29.25	2001	1	3	0	0	0	0	0	0
BSR Dack	29.5	2001	2	5	0	0	0	0	0	0
BSR Downstream US93 – 2	29.75	2001	2	15.4	0	0	0	0	5	0

Appendix D2. Southwestern willow flycatcher survey results by site within the Lower and Upper Colorado Recovery Unit, Arizona, 1993–2006[a]. Cells empty if no information is available.

AGFD site name	Site order[b]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[c]	Migrants[d]
Big Sandy River Downstream US 93	30	1994	2	11.8	1	1	0	0	0	1
		1997	3	32	1	1	0	0	0	0
		2000	5	36.14	18	13	5	0	0	0
		2001	5	32.75	14	10	5	5	0	0
		2002	5	44.58	24	21	3	1	0	0
		2003	5	34.75	29	15	14	17	0	1
		2004	5	34.61	54	28	26	28	1	1
		2005	3	12.81	62	33	29	44	0	0
		2006	3	11.03	44	24	20	30	0	6
Big Sandy River Upstream US 93	30.5	2000	5	17.68	5	3	2	0	0	0
		2001	3	17.85	0	0	0	0	0	0
		2006	3	7.54	0	0	0	0	0	1
Cottonwood Creek	34	1996	1	2.5	0	0	0	0	0	0
Bill Williams River										
Bill Williams River Delta – Marsh Edge	36	1993	1	2	0	0	0	0	0	0
		1995	4		1	1	0	0	0	0
		1996	3	6	0	0	0	0	1	0
		1997	4	43.1	0	0	0	0	1	0
		1998	4	88.3	0	0	0	0	0	2
		1999	5	46	0	0	0	0	0	1
		2000	5	23.5	0	0	0	0	0	2
		2001	5	28.42	0	0	0	0	0	2
		2003	5	37.92	1	1	0	0	0	4
		2004	5	28.24	0	0	0	0	0	2
		2005	5	20.33	0	0	0	0	0	1
		2006	5	18.37	0	0	0	0	0	2

Appendix D2. Southwestern willow flycatcher survey results by site within the Lower and Upper Colorado Recovery Unit, Arizona, 1993–2006[a]. Cells empty if no information is available.

AGFD site name	Site order[b]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[c]	Migrants[d]
Monkey's Head	38	1994	1	4.5	0	0	0	0	0	0
		1995	3	5.7	0	0	0	0	0	0
		1996	2	7.7	0	0	0	0	0	2
		1997	3	48	0	0	0	0	0	5
		1998	5	45.8	0	0	0	0	0	0
		1999	5	93.3	2	1	1	1	0	1
		2000	3	10.5	2	1	1	1	0	0
		2001	5	102.96	4	2	2	5	0	0
		2002	5	168.6	17	9	8	7	0	4
		2003	5	44.34	9	6	3	2	0	0
		2004	3	65.22	2	2	0	0	0	1
		2005	5	18.5	4	2	2	2	0	0
		2006	5	22.37	4	3	3	5	0	1
Gemini	39	1993	1	3	0	0	0	0	0	0
		1994	1	13.8	2	1	1	1	0	0
		1995	2	4	0	0	0	0	0	0
		1996	4	35	1	1	0	0	0	1
		1997	4	41.2	0	0	0	0	0	3
		1998	5	82	1	1	0	0	0	0
		1999	5	45.25	0	0	0	0	0	0
		2000	3	13	0	0	0	0	0	1
		2001	4	27.66	0	0	0	0	0	0
		2003	5	10.77	0	0	0	0	0	0
		2004	5	11.23	0	0	0	0	0	1
		2005	5	6.05	0	0	0	0	0	0
		2006	4	6.87	0	0	0	0	0	0

Appendix D2. Southwestern willow flycatcher survey results by site within the Lower and Upper Colorado Recovery Unit, Arizona, 1993–2006[a]. Cells empty if no information is available.

AGFD site name	Site order[b]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[c]	Migrants[d]
Cave Wash 1	40	1994	1	10	0	0	0	0	0	0
		1995	2	7.2	0	0	0	0	0	0
		1996	2	6.3	0	0	0	0	0	0
		1997	3	11.4	0	0	0	0	0	0
		1998	3	40.5	0	0	0	0	0	0
		1999	5	117.3	0	0	0	0	0	4
		2000	3	20.5	0	0	0	0	0	4
		2001	4	23.75	0	0	0	0	0	6
		2002	5	79.25	10	6	4	3	0	2
		2003	3	28.45	0	0	0	0	0	0
		2004	5	35.32	0	0	0	0	0	1
		2005	5	16.74	0	0	0	0	1	0
		2006	4	13.5	0	0	0	0	0	0
Cave Wash 2	42	1993	1	3.8	0	0	0	0	0	0
		1994	1	2	0	0	0	0	0	0
		1999	5	68.8	0	0	0	0	0	0
		2000	4	10	0	0	0	0	0	1
		2003	3	4.84	0	0	0	0	0	1
		2004	5	13.13	0	0	0	0	0	2
		2005	3	2.85	0	0	0	0	0	0
		2006	2	1.25	0	0	0	0	0	0

Appendix D2. Southwestern willow flycatcher survey results by site within the Lower and Upper Colorado Recovery Unit, Arizona, 1993–2006[a]. Cells empty if no information is available.

AGFD site name	Site order[b]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[c]	Migrants[d]
Buckskin	43	1993	1	5	0	0	0	0	0	0
		1994	2	38	0	0	0	0	0	0
		1996	1	2.3	0	0	0	0	0	0
		1998	5	50.5	1	1	0	0	0	0
		1999	5	53.8	0	0	0	0	0	0
		2000	3	12.25	0	0	0	0	0	2
		2001	1	6	0	0	0	0	0	0
		2003	5	24.62	0	0	0	0	0	1
		2004	5	19.37	0	0	0	0	0	1
		2005	5	10.31	0	0	0	0	0	1
		2006	5	68.9	0	0	0	0	0	1
Bill Williams Pipeline	45	1994	1	1.5	0	0	0	0	0	0
		1996	1	6	0	0	0	0	0	0
		1998	2	3.2	0	0	0	0	0	0
		1999	3	4.7	0	0	0	0	0	0
		2000	1	2.62	0	0	0	0	0	0
		2006	5	12.5	0	0	0	0	0	0
Lincoln Ranch	47	2006	5	9	0	0	0	0	0	0
Alamo Dam	48	1993	1	3.5	0	0	0	0	0	0
		1996	1	8	0	0	0	0	0	0
		1997	1	12	0	0	0	0	0	0

Appendix D2. Southwestern willow flycatcher survey results by site within the Lower and Upper Colorado Recovery Unit, Arizona, 1993–2006[a]. Cells empty if no information is available.

AGFD site name	Site order[b]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[c]	Migrants[d]
Alamo Lake – Brown's Crossing	49	1996	3	79.5	7	5	2	2	0	0
		1997	4	96	9	5	4	1	0	0
		1998	5	23.6	7	5	2	1	0	0
		1999	2	40	20	10	10	12	0	0
		2000	5	46.25	23	12	11	13	0	0
		2001	3	51	31	16	15	24	0	0
		2002	1	12	24	12	12	12	14	0
		2003	3	30	43	24	19	15	0	0
		2004	2	20.75	37	24	13	10	0	0
		2005	3	15.5	18	9	9	9	0	0
		2006	5	54	12	11	1	0	0	0
Colorado River										
Hunter's Hole	75	1993	1	13.4	0	0	0	0	3	0
		1994	3	34.5	0	0	0	0	0	6
		1995	2	11.9	0	0	0	0	0	8
		1996	3	42	0	0	0	0	0	11
		1997	3	10	0	0	0	0	0	5
		1998	4	11	0	0	0	0	0	7
		1999	5	25.7	0	0	0	0	0	16
		2000	5	17.5	0	0	0	0	0	5
		2001	4	16.3	0	0	0	0	0	5
		2002	5	15	0	0	0	0	0	4
		2003	3	36.45	0	0	0	0	0	16
		2004	5	15.33	0	0	0	0	0	37
		2005	5	26.33	0	0	0	0	0	6
		2006	5	28.58	0	0	0	0	0	26

Appendix D2. Southwestern willow flycatcher survey results by site within the Lower and Upper Colorado Recovery Unit, Arizona, 1993–2006[a]. Cells empty if no information is available.

AGFD site name	Site order[b]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[c]	Migrants[d]
Gadsden Pond	76	1993	1	1	0	0	0	0	0	1
		1994	1	4.3	0	0	0	0	0	2
		1995	1	1.8	0	0	0	0	0	2
		1996	2	0.8	0	0	0	0	0	2
		1997	1		0	0	0	0	0	0
		1998	3	10.9	0	0	0	0	0	8
		1999	4	14.88	0	0	0	0	0	5
		2000	5	30.16	0	0	0	0	0	6
		2003	4	14.27	0	0	0	0	0	25
		2004	5	16.27	0	0	0	0	0	22
		2005	5	22.96	0	0	0	0	0	7
		2006	5	38.75	0	0	0	0	8	19
Gadsden Bend	77	1993	2	1.8	0	0	0	0	0	0
		1994	2	17.3	0	0	0	0	0	3
		1995	1	5	0	0	0	0	0	2
		1996	2	2.3	0	0	0	0	0	13
		1997	1		0	0	0	0	0	0
		1998	3	20.5	0	0	0	0	1	2
		1999	5	27.6	0	0	0	0	0	18
		2000	5	10.16	0	0	0	0	0	5
		2001	2	19.5	0	0	0	0	0	5
		2002	5	22.33	0	0	0	0	0	6
		2003	4	10.68	0	0	0	0	0	9
		2004	5	9.89	0	0	0	0	1	8
		2005	5	16.85	0	0	0	0	0	6
		2006	2	4.4	0	0	0	0	0	22
Cocopah	79	1998	3	6.3	0	0	0	0	0	5
		2000	3	3.16	0	0	0	0	0	6

Appendix D2. Southwestern willow flycatcher survey results by site within the Lower and Upper Colorado Recovery Unit, Arizona, 1993–2006[a]. Cells empty if no information is available.

AGFD site name	Site order[b]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[c]	Migrants[d]
County 14th St. to County 13th St.	80	1997	1	2	0	0	0	0	0	0
		2000	2	3.16	0	0	0	0	0	0
County 13th St. to County 12th St.	81	1993	2	1.3	0	0	0	0	0	0
		1995	1	1	0	0	0	0	0	0
		1997	1	5	0	0	0	0	0	0
		1999	3	5.5	0	0	0	0	0	7
		2000	3	4.75	0	0	0	0	0	1
		2001	3	4.2	0	0	0	0	0	4
		2002	3	1.8	0	0	0	0	0	1
		2003	3	1.7	0	0	0	0	0	2
County 12th St. to County 11th St.	82	1997	1	1	0	0	0	0	0	2
		1998	3	2	0	0	0	0	0	0
		1999	3	4.2	0	0	0	0	0	13
		2000	3	2	0	0	0	0	0	2
		2001	3	3.2	0	0	0	0	0	1
		2002	3	2.8	0	0	0	0	0	0
		2003	3	2.5	0	0	0	0	0	1
County 11th St. to County 10th St.	83	1997	2	4.5	0	0	0	0	0	1
		1998	3	2.2	0	0	0	0	0	0
		1999	3	2.9	0	0	0	0	0	3
		2005	5	1.54	0	0	0	0	0	1
County 10th St. to County 9th St.	84	1997	1	3	0	0	0	0	0	0
		1998	3	2.3	0	0	0	0	0	0
		1999	3	1.7	0	0	0	0	0	0
		2005	5	2.25	0	0	0	0	0	0

Appendix D2. Southwestern willow flycatcher survey results by site within the Lower and Upper Colorado Recovery Unit, Arizona, 1993–2006[a]. Cells empty if no information is available.

AGFD site name	Site order[b]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[c]	Migrants[d]
County 9th St. to Morelos Dam	85	1993	2	1	0	0	0	0	0	0
		1997	1	8	0	0	0	0	0	0
		1998	3	2.3	0	0	0	0	0	1
		1999	3	1.7	0	0	0	0	0	0
		2005	5	1.55	0	0	0	0	0	0
Lower Yuma Division #2	86	1997	3	5.8	0	0	0	0	0	3
		1998	3	6.5	0	0	0	0	0	9
		1999	4	20.55	0	0	0	0	1	9
		2000	5	3.5	0	0	0	0	0	5
		2001	5	15.75	0	0	0	0	0	1
		2002	5	12	0	0	0	0	0	3
		2005	5	2.25	0	0	0	0	0	0
		2006	5	13.96	0	0	0	0	0	0
Yuma Division	87	1994	1	1	0	0	0	0	0	0
		1996	2	18	0	0	0	0	0	4
		1997	4	7	0	0	0	0	0	0
		1998	3	4.3	0	0	0	0	0	4
		1999	3	32.4	0	0	0	0	0	6
		2000	3	37.71	0	0	0	0	0	2
		2001	5	42.7	0	0	0	0	0	1
		2002	5	10	0	0	0	0	0	7
		2003	5	12	0	0	0	0	0	3

Appendix D2. Southwestern willow flycatcher survey results by site within the Lower and Upper Colorado Recovery Unit, Arizona, 1993–2006[a]. Cells empty if no information is available.

AGFD site name	Site order[b]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[c]	Migrants[d]
Fort Yuma 1 & 2	88	1995	3	34	0	0	0	0	0	0
		1997	3	6.3	0	0	0	0	0	0
		1998	5	9.5	0	0	0	0	0	0
		1999	4	24.3	0	0	0	0	0	1
		2000	5	11.35	0	0	0	0	0	2
		2001	5	28.12	0	0	0	0	0	2
		2002	5	79.75	0	0	0	0	0	38
		2003	2	6.9	0	0	0	0	0	0
		2004	5	15	0	0	0	0	0	2
		2005	4	20.04	0	0	0	0	0	1
		2006	5	37.8	0	0	0	0	0	4
Yuma Territorial Prison	89	1999	3	3	0	0	0	0	0	0
		2004	5	18.75	0	0	0	0	0	28
		2005	5	16.07	0	0	0	0	0	0
		2006	5	5.22	0	0	0	0	0	0
2 East to Gila River	90	1996	1	2	0	0	0	0	0	0
		1998	4	4.8	0	0	0	0	0	0
		1999	3	7	0	0	0	0	0	3
		2000	5	15.75	0	0	0	0	0	5
		2003	5	43.49	0	0	0	0	0	6
		2004	5	101.32	0	0	0	0	0	29
		2005	5	91.16	0	0	0	0	0	4
		2006	5	55.48	0	0	0	0	0	7
Fort Yuma 3	91	1997	3	5	0	0	0	0	0	4
		1998	4	6.8	0	0	0	0	0	0
		2000	5	13.5	0	0	0	0	0	0
		2006	5	5.83	0	0	0	0	0	1

Appendix D2. Southwestern willow flycatcher survey results by site within the Lower and Upper Colorado Recovery Unit, Arizona, 1993–2006[a]. Cells empty if no information is available.

AGFD site name	Site order[b]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[c]	Migrants[d]
Gila/Colorado Confluence 3	92	1997	3	3.56	0	0	0	0	0	2
		2001	3	12	0	0	0	0	0	1
Gila/Colorado Confluence 1	93	1997	3	8.5	0	0	0	0	0	3
		1999	4	13.25	3	2	1	0	0	1
		2000	5	10.25	0	0	0	0	0	2
		2001	3	40.2	0	0	0	0	0	3
		2002	5	26.5	0	0	0	0	0	5
		2003	5	13.4	0	0	0	0	0	1
		2004	5	14.19	0	0	0	0	0	14
		2005	5	35.82	0	0	0	0	0	5
		2006	5	16.73	0	0	0	0	2	4
Gila/Colorado Confluence 2	94	1997	3	5.5	0	0	0	0	0	5
		1998	4	11.3	0	0	0	0	0	2
		1999	4	11	0	0	0	0	0	7
		2000	5	11	0	0	0	0	0	7
		2004	5	10.66	0	0	0	0	0	9
		2006	5	10.1	0	0	0	0	0	1
Bruce	95	2002	3	0.75	0	0	0	0	0	0

Appendix D2. Southwestern willow flycatcher survey results by site within the Lower and Upper Colorado Recovery Unit, Arizona, 1993–2006[a]. Cells empty if no information is available.

AGFD site name	Site order[b]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[c]	Migrants[d]
Mittry Lake	96	1993	1	10.3	0	0	0	0	0	0
		1994	2	6	0	0	0	0	0	0
		1996	4	25.8	3	2	1	0	0	4
		1997	3	15	0	0	0	0	0	7
		1998	3	14.65	0	0	0	0	0	0
		1999	4	27.5	0	0	0	0	0	2
		2000	4	27.9	0	0	0	0	0	1
		2001	5	65	0	0	0	0	0	2
		2002	5	56.7	0	0	0	0	0	5
		2003	5	43.8	1	1	0	0	0	2
		2004	4	37.09	0	0	0	0	0	15
		2005	4	25.32	0	0	0	0	0	5
		2006	5	19.65	0	0	0	0	0	1
Castle Dome	98.75	2004	5	6.77	0	0	0	0	0	2
Martinez Lake	99	1994	1	0.5	0	0	0	0	1	0
		1995	3	6	0	0	0	0	0	2
		1996	5	7.3	0	0	0	0	0	1
		2001	4	15.75	0	0	0	0	0	2
		2002	5	28	0	0	0	0	0	4
		2003	5	57.1	0	0	0	0	0	7
		2004	4	58.03	0	0	0	0	0	36
		2005	5	59.74	0	0	0	0	0	7
		2006	5	47.44	1	1	0	0	0	18
Imperial HQ 1	102	1998	5	11.5	0	0	0	0	0	2
IB	104	1994	2	0.8	0	0	0	0	0	1
		1995	2	2.2	0	0	0	0	0	1
		1996	3	1.6	0	0	0	0	0	0

Appendix D2. Southwestern willow flycatcher survey results by site within the Lower and Upper Colorado Recovery Unit, Arizona, 1993–2006[a]. Cells empty if no information is available.

AGFD site name	Site order[b]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[c]	Migrants[d]
IS	105	1994	2	1.5	0	0	0	0	0	2
		1995	2	0.5	0	0	0	0	0	0
		1996	3	0.8	0	0	0	0	0	0
Farmfield #20	106	1999	5	9.8	0	0	0	0	0	0
Killdeer	107	1995	1	0.7	0	0	0	0	0	0
Dredge Channel	108	1995	1	0.7	0	0	0	0	0	0
		1996	3	2.9	0	0	0	0	0	3
Farm Field	109	1995	1	0.3	0	0	0	0	0	0
Cottonwood Nursery	110	1995	1	0.2	0	0	0	0	0	0
		1996	3	0.6	0	0	0	0	0	0
		1999	4	9.75	0	0	0	0	0	0
		2000	5	20	0	0	0	0	0	1
		2003	5	7.5	0	0	0	0	0	0
		2004	5	7.12	0	0	0	0	0	4
		2005	5	5.21	0	0	0	0	0	2
		2006	5	11.14	0	0	0	0	0	4
Flycatcher	111	1995	2	1.2	0	0	0	0	0	1
		1996	3	0.6	0	0	0	0	0	0
Triangle	112	1999	3	3	0	0	0	0	0	1
		2001	5	7.75	0	0	0	0	0	1
		2002	5	8	0	0	0	0	0	2
		2006	4	7.3	0	0	0	0	0	4
Cattail	113	1995	2	5.5	0	0	0	0	0	1
Firebreak	114	1995	2	1.8	0	0	0	0	0	0
		2004	1	0.75	0	0	0	0	11	0
Imperial HQ 2	115	1997	3	10.3	0	0	0	0	0	5
Ironwood	116	1996	3	5.5	0	0	0	0	0	2
Smoke Tree	117	1996	2	2	0	0	0	0	0	2

Appendix D2. Southwestern willow flycatcher survey results by site within the Lower and Upper Colorado Recovery Unit, Arizona, 1993–2006[a]. Cells empty if no information is available.

AGFD site name	Site order[b]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[c]	Migrants[d]
Clear Lake	118	1996	2	2.8	2	1	1	0	0	0
		1998	4	4.8	0	0	0	0	0	2
		1999	3	13.95	0	0	0	0	0	3
		2000	4	7.5	0	0	0	0	0	3
		2001	3	12.75	0	0	0	0	0	2
		2003	5	25.3	0	0	0	0	0	1
		2004	5	8.89	0	0	0	0	0	3
		2005	5	7.78	0	0	0	0	0	0
		2006	5	8.59	1	1	0	0	0	0
Picacho East (Island Lake)	119	1994	1	1	0	0	0	0	0	0
		1996	3	2.6	2	1	1	0	0	0
		2000	3	6.75	0	0	0	0	0	3
		2001	3	14.8	0	0	0	0	0	3
Picacho West	121	1994	1	1	0	0	0	0	0	0
		1996	1	1.7	0	0	0	0	0	0
		1997	2	3	0	0	0	0	0	0
		1998	4	9.8	0	0	0	0	0	6
		1999	4	13.8	0	0	0	0	0	5
		2000	4	14.75	0	0	0	0	0	0
		2001	4	19.8	0	0	0	0	0	3
		2002	5	14.5	0	0	0	0	0	3
		2003	5	15	0	0	0	0	0	2
		2004	2	1.77	0	0	0	0	0	2
Nortons Landing	125.75	2004	3	7.51	0	0	0	0	0	0
		2005	5	22.51	0	0	0	0	0	4
		2006	5	16.99	0	0	0	0	0	3
Picacho Island	124	1999	4	11.5	0	0	0	0	0	5

Appendix D2. Southwestern willow flycatcher survey results by site within the Lower and Upper Colorado Recovery Unit, Arizona, 1993–2006[a]. Cells empty if no information is available.

AGFD site name	Site order[b]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[c]	Migrants[d]
Adobe Lake	126	1996	2	5.1	4	2	2	0	0	0
		1997	2	7	2	1	1	0	0	1
		1998	4	5.85	0	0	0	0	0	1
		1999	4	18.45	0	0	0	0	0	4
		2000	3	19.5	0	0	0	0	0	1
		2001	3	9.75	0	0	0	0	0	2
		2003	5	9.8	0	0	0	0	0	3
		2004	5	3.19	0	0	0	0	0	5
		2005	5	8.75	0	0	0	0	1	15
		2006	5	4.65	0	0	0	0	0	1
Hoge	126.25	2002	5	14.25	0	0	0	0	0	4
		2003	5	12.3	1	1	0	0	0	1
		2004	5	13.79	0	0	0	0	0	16
		2005	5	35.91	0	0	0	0	0	10
		2006	5	21.72	0	0	0	0	0	9
Paradise Valley South	127	1999	1	1	0	0	0	0	0	0
Paradise Valley North	131	1999	1	2.5	0	0	0	0	0	0
Clip Wash Mine	133	1998	2	1.3	0	0	0	0	0	0
		2001	5	8.5	0	0	0	0	0	3
Cibola Lake Overlook	135	1999	3	2.55	0	0	0	0	0	0

Appendix D2. Southwestern willow flycatcher survey results by site within the Lower and Upper Colorado Recovery Unit, Arizona, 1993–2006[a]. Cells empty if no information is available.

AGFD site name	Site order[b]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[c]	Migrants[d]
Cibola Lake	136	1995	2	4.3	0	0	0	0	0	0
		1996	2	4	0	0	0	0	0	0
		1997	3	13	0	0	0	0	0	2
		1998	5	27	0	0	0	0	0	3
		1999	5	10.75	0	0	0	0	0	1
		2000	5	21.5	0	0	0	0	0	5
		2001	2	20.4	0	0	0	0	0	1
		2002	4	12.2	0	0	0	0	0	1
		2003	5	31.67	0	0	0	0	0	1
		2004	5	46.69	0	0	0	0	0	13
		2005	5	54.89	0	0	0	0	0	1
		2006	5	39.4	0	0	0	0	0	3
SW of Landing Strip – Cibola	137	1994	2	1.5	0	0	0	0	0	0
		1995	2	4.8	0	0	0	0	0	0
		1996	3	9.2	2	1	1	0	0	0
		1997	3	20	0	0	0	0	0	4
		1998	5	39.3	0	0	0	0	2	0
		1999	4	13	0	0	0	0	0	1
		2003	5	47.13	0	0	0	0	0	5
		2004	5	35.63	0	0	0	0	0	5
		2005	5	25.62	0	0	0	0	0	6
		2006	4	25.35	0	0	0	0	0	2
Cibola #2	138	1999	5	14.4	0	0	0	0	0	2
		2000	5	12.1	0	0	0	0	0	0
		2001	3	22.5	0	0	0	0	0	1

Appendix D2. Southwestern willow flycatcher survey results by site within the Lower and Upper Colorado Recovery Unit, Arizona, 1993–2006[a]. Cells empty if no information is available.

AGFD site name	Site order[b]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[c]	Migrants[d]
Arnet Ditch/Tieback Levee	140	1993	1	1.2	0	0	0	0	0	0
		1996	3	6.3	0	0	0	0	0	3
		1998	3	5.75	0	0	0	0	0	0
		2003	5	27.03	0	0	0	0	0	1
		2004	5	17.5	0	0	0	0	0	14
		2005	5	24.25	0	0	0	0	0	7
		2006	3	12.8	0	0	0	0	0	0
Cibola Reveg Flat	140.25	1999	0		0	0	0	0	0	1
Cibola Island Unit	141	1998	5	10.5	0	0	0	0	0	0
High Levee East	142	1994	1	0.8	0	0	0	0	0	0
		1996	3	9	0	0	0	0	0	2
Farm Unit 1 Reveg.	144	1994	1	0.8	0	0	0	0	0	0
		1995	2	2.5	0	0	0	0	0	0
Palo Verde	145	1996	4	5.5	0	0	0	0	0	0
		2003	5	10.5	0	0	0	0	0	1
A-10 Backwash	147	1998	4	10.4	0	0	0	0	0	1
Ehrenberg	148	1993	2	0.3	0	0	0	0	1	0
		1994	1		0	0	0	0	0	0
		1996	3	11.5	2	1	1	0	0	3
		1997	3	11.5	0	0	0	0	0	8
		1998	4	18.4	0	0	0	0	0	1
		1999	5	47.37	0	0	0	0	0	2
		2000	5	27	0	0	0	0	0	1
		2001	5	17.7	0	0	0	0	0	1
		2002	5	20.5	0	0	0	0	0	2
		2003	5	9.49	0	0	0	0	0	1
		2004	5	14.37	0	0	0	0	0	2
		2005	4	18.25	0	0	0	0	0	3
		2006	5	8.16	1	1	0	0	0	0

Appendix D2. Southwestern willow flycatcher survey results by site within the Lower and Upper Colorado Recovery Unit, Arizona, 1993–2006[a]. Cells empty if no information is available.

AGFD site name	Site order[b]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[c]	Migrants[d]
Cibola Restoration	144.5	2001	2	10	0	0	0	0	0	0
		2002	5	35.6	0	0	0	0	0	1
		2003	5	20	0	0	0	0	0	1
		2004	4	22.8	0	0	0	0	0	12
		2005	5	21.72	0	0	0	0	1	5
		2006	5	11.86	0	0	0	0	0	4
Anjohns	151	1999	3	5.4	0	0	0	0	0	0
Horse Island	151.75	1999	3	10.6	0	0	0	0	0	1
Noname Lake	152.5	1998	2	0.6	0	0	0	0	0	2
		1999	3	4.5	0	0	0	0	0	0
Hidden Valley Island	152.63	1998	2	2.5	0	0	0	0	0	1
Calzona	152.75	1999	1	3	0	0	0	0	0	0
Twelvemile Slough	152.88	1999	3	7.1	0	0	0	0	0	0
Ahakhav Preserve	154	1997	2	16	0	0	0	0	0	0
		1998	3	8	0	0	0	0	0	2
		1999	3	53.4	0	0	0	0	0	0
		2001	3	38	0	0	0	0	0	10
		2005	3	26.75	0	0	0	0	0	0
Cienega Springs	157	1997	1	0.3	0	0	0	0	0	0
Parker Strip	159	1996	1	1.8	0	0	0	0	0	0
Disneyland	161	1999	3	1.5	0	0	0	0	0	0
		2000	2	1.18	0	0	0	0	0	0
Standard Wash	163	1997	1	0.4	0	0	0	0	0	0
		1998	1	0.4	0	0	0	0	0	0
		1999	3	1.5	0	0	0	0	0	0
		2000	2	1.38	0	0	0	0	1	0
Beaver Island to Thompson Bay	165	1997	1	1.1	0	0	0	0	0	0
		1998	2	1.3	0	0	0	0	0	0
		1999	3	5.2	0	0	0	0	0	5
		2000	3	5.81	0	0	0	0	0	0

Appendix D2. Southwestern willow flycatcher survey results by site within the Lower and Upper Colorado Recovery Unit, Arizona, 1993–2006[a]. Cells empty if no information is available.

AGFD site name	Site order[b]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[c]	Migrants[d]
Neptune – North Lake Havasu	167	1996	5	43	1	1	0	0	0	16
		1997	2	26.6	0	0	0	0	0	3
		1998	3	25	0	0	0	0	0	0
		1999	5	31	0	0	0	0	1	2
		2000	2	13.5	0	0	0	0	0	6
		2001	2	32	0	0	0	0	0	2
		2003	5	46.5	0	0	0	0	0	6
		2004	5	9.45	0	0	0	0	0	1
		2005	5	16.31	0	0	0	0	0	0
		2006	5	13	0	0	0	0	0	0
Blankenship	170	1996	3	6.5	0	0	0	0	1	0
		1997	3	22.4	1	1	0	0	1	0
		1998	3	7.6	0	0	0	0	0	1
		2003	5	32.9	0	0	0	0	0	0
		2004	4	12.03	0	0	0	0	0	2
		2005	5	28.99	0	0	0	0	0	0
		2006	5	17.46	0	0	0	0	0	0
Pulpit Rock	172	2003	5	5	0	0	0	0	0	0
		2004	4	3.46	0	0	0	0	0	0
		2005	5	3.3	0	0	0	0	0	0
		2006	5	2.6	0	0	0	0	0	1

Appendix D2. Southwestern willow flycatcher survey results by site within the Lower and Upper Colorado Recovery Unit, Arizona, 1993–2006[a]. Cells empty if no information is available.

AGFD site name	Site order[b]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[c]	Migrants[d]
Topock Marsh	173	1993	2	7.2	0	0	0	0	0	0
		1994	2	12.5	0	0	0	0	0	0
		1995	3	5.2	4	2	2	0	0	2
		1996	3	53.7	6	3	3	1	0	5
		1997	5	231.9	24	12	12	9	0	3
		1998	5	102.95	27	14	13	21	0	0
		1999	5	536.31	29	15	15	20	0	1
		2000	5	190.5	25	15	10	19	0	2
		2001	5	300.2	26	15	12	20	0	2
		2002	5	522	30	20	10	10	0	2
		2003	5	197	21	12	9	8	0	2
		2004	5	125.39	57	34	29	43	2	2
		2005	5	132.2	36	21	18	38	2	3
		2006	5	129.54	26	13	13	17	3	2
Waterwheel Cove	179	1995	2	7	0	0	0	0	0	0
		1996	3	6.5	0	0	0	0	0	0
		1998	3	37.6	0	0	0	0	0	1
		1999	5	90	0	0	0	0	0	1
		2000	5	121.5	5	3	2	0	0	1
		2001	5	90.6	0	0	0	0	0	2
		2003	5	66.4	0	0	0	0	0	2
		2004	2	3.75	0	0	0	0	0	0
		2005	3	22.2	2	2	0	0	0	0
		2006	3	12.8	0	0	0	0	0	2
Chuckwalla Cove	186	2006	5	18.95	4	3	1	0	0	0
Bradley Bay	186.25	2006	4	9.5	0	0	0	0	0	0
Driftwood Island	186.5	2006	4	6.08	0	0	0	0	0	0
Raven's Nest Beach – Lake Mead	187	2005	4	5.5	0	0	0	0	0	0
		2006	5	9.05	1	1	0	0	0	0

Appendix D2. Southwestern willow flycatcher survey results by site within the Lower and Upper Colorado Recovery Unit, Arizona, 1993–2006[a]. Cells empty if no information is available.

AGFD site name	Site order[b]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[c]	Migrants[d]
Snake Beach – Lake Mead	187.5	2005	4	3.5	0	0	0	0	0	0
		2006	5	10.27	1	1	0	0	0	0
Grand Wash Bay	187.7	2006	5	13.26	4	2	2	2	0	1
Lake Mead Delta	188	1995	1	11.5	1	1	0	0	0	0
		1996	4	32.75	18	10	8	9	0	0
		1997	4	92.5	12	6	6	3	0	4
		1998	4	6	0	0	0	0	0	0
		2002	5	76	0	0	0	0	0	8
		2003	1	1.5	0	0	0	0	0	0
		2006	2	1	0	0	0	0	0	0
Miles 277.0 to 274.0 R GC	189	1993	2		1	1	0	0	0	0
		1996	2	4	0	0	0	0	0	1
		1997	3	28	0	0	0	0	0	0
		1998	4	10.4	0	0	0	0	0	0
		2002	5	18.25	0	0	0	0	0	0
		2003	5	14.9	0	0	0	0	0	0
		2004	5	80.85	2	1	1	1	0	0
		2005	5	86.98	0	0	0	0	1	0
		2006	5	37.08	2	1	1	1	0	1
Miles 277.0 to 273.5 L GC	190	1997	3	20.6	0	0	0	0	0	0
		1998	5	29.6	1	1	0	0	0	0
		1999	5	11.7	0	0	0	0	0	0
		2002	5	15.75	0	0	0	0	0	0
		2003	5	15.3	0	0	0	0	0	0
		2004	5	30.7	0	0	0	0	0	0
		2005	5	42.21	0	0	0	0	0	0
		2006	4	18	0	0	0	0	0	0
Miles 273.5 to 273.0 R GC	191	1998	4	3.1	0	0	0	0	0	0

Appendix D2. Southwestern willow flycatcher survey results by site within the Lower and Upper Colorado Recovery Unit, Arizona, 1993–2006[a]. Cells empty if no information is available.

AGFD site name	Site order[b]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[c]	Migrants[d]
Miles 273.5 to 270.0 L GC	192	1997	4	27.9	0	0	0	0	0	0
		1998	5	56.9	3	2	1	0	0	0
		1999	4	21.2	0	0	0	0	0	2
		2001	3	11	0	0	0	0	0	0
		2002	5	33.5	0	0	0	0	0	0
Miles 272.0 to 268.0 R GC	193	1997	3	16.5	0	0	0	0	0	0
		1998	4	18.3	3	2	1	0	0	1
		1999	4	41.75	2	1	1	0	0	2
		2001	5	39.5	4	2	2	0	0	0
		2002	4	44.25	0	0	0	0	0	0
		2004	2	3.31	0	0	0	0	0	0
Miles 270.0 to 268.0 L GC	194	1997	4	17.2	3	2	1	1	0	0
		1998	5	10.6	1	1	0	0	0	2
		1999	3	10.3	0	0	0	0	0	0
		2000	3	8.5	0	0	0	0	0	0
		2001	4	15.55	0	0	0	0	0	0
		2002	4	9.62	0	0	0	0	0	0
		2003	3	9.7	0	0	0	0	0	0
Miles 268.0 to 265.0 L GC	195	1997	4	14	0	0	0	0	0	0
		1998	4	56.1	9	5	4	2	0	0
		1999	5	123.95	9	5	5	3	0	0
		2000	5	155.4	5	3	2	1	0	3
		2001	5	79.32	5	3	2	1	0	1
		2002	4	58.87	0	0	0	0	0	0
		2003	3	46.3	0	0	0	0	0	0

Appendix D2. Southwestern willow flycatcher survey results by site within the Lower and Upper Colorado Recovery Unit, Arizona, 1993–2006[a]. Cells empty if no information is available.

AGFD site name	Site order[b]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[c]	Migrants[d]
Miles 268.0 to 264.0 R GC	196	1997	5	17.1	0	0	0	0	1	0
		1998	5	36.2	1	1	0	0	0	1
		1999	5	70.2	0	0	0	0	1	0
		2000	4	36	0	0	0	0	0	0
		2001	4	21.55	0	0	0	0	0	0
		2003	2	4.4	0	0	0	0	0	0
		2004	2	2.01	0	0	0	0	0	0
Miles 265.0 to 263.5 L GC	197	1997	4	8	0	0	0	0	0	0
		1998	4	44.45	2	1	1	1	0	0
		1999	5	43.05	0	0	0	0	2	0
		2000	4	12.75	0	0	0	0	0	0
		2001	4	20.5	0	0	0	0	0	1
		2002	3	9	0	0	0	0	0	0
		2003	2	8	0	0	0	0	0	0
Miles 263.5 to 262.5 L GC	198	1998	3	8.6	0	0	0	0	1	0
		1999	3	21.35	2	1	1	0	0	0
		2000	5	51.4	2	1	1	1	0	0
		2001	5	57.55	2	1	1	1	0	0
		2002	5	23.25	0	0	0	0	0	1
		2003	5	15.3	0	0	0	0	0	0
		2004	1	1	0	0	0	0	0	0
Miles 262.8 to 261.8 R GC – Wards Cave Rapid	198.5	2000	4	20	0	0	0	0	0	0
		2001	4	10.25	0	0	0	0	0	0
Miles 262.5 to 259.5 L GC	201	1997	3	10.5	0	0	0	0	0	1
		2001	2	6.5	2	1	1	2	0	1
		2002	3	11.75	0	0	0	0	0	0
		2004	2	4.39	0	0	0	0	0	0

Appendix D2. Southwestern willow flycatcher survey results by site within the Lower and Upper Colorado Recovery Unit, Arizona, 1993–2006[a]. Cells empty if no information is available.

AGFD site name	Site order[b]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[c]	Migrants[d]
Miles 261.2 to 260.5 R GC	202	1998	4	6.8	0	0	0	0	0	0
		1999	3	8.8	0	0	0	0	0	0
		2000	4	29.5	0	0	0	0	0	0
		2003	5	4.7	0	0	0	0	0	0
		2004	5	14.7	0	0	0	0	0	0
		2005	1	1.53	0	0	0	0	0	0
Mile 260.0 R GC	205	1997	4	6.3	0	0	0	0	0	0
		2000	3	2	0	0	0	0	0	0
		2001	4	2.25	0	0	0	0	0	0
		2002	2	2	0	0	0	0	0	0
Mile 260.0 L Quartermaster GC	206	1993	1		0	0	0	0	1	0
		1997	4	16	0	0	0	0	0	0
		2000	4	8	0	0	0	0	0	0
		2001	4	4	0	0	0	0	0	0
		2002	2	7.75	0	0	0	0	0	0
		2003	5	9.5	0	0	0	0	0	0
		2004	4	11.39	0	0	0	0	0	0
		2005	5	21.44	0	0	0	0	0	0
		2006	4	10.5	0	0	0	0	0	0
Mile 259.5 L	206.5	2000	4	22	1	1	0	0	0	0
Mile 259.5 R Waterfall Rapid GC	207	1998	5	8.5	0	0	0	0	0	0
		1999	5	28.2	2	1	1	1	0	0
		2000	5	115.8	0	0	0	0	0	4
		2001	5	45.3	2	2	0	0	0	0
		2002	2	6	0	0	0	0	0	0
		2003	5	22.15	0	0	0	0	0	0
		2004	5	40.44	1	1	0	0	0	0
		2005	5	34.98	0	0	0	0	0	0
		2006	5	10.9	0	0	0	0	0	0

Appendix D2. Southwestern willow flycatcher survey results by site within the Lower and Upper Colorado Recovery Unit, Arizona, 1993–2006[a]. Cells empty if no information is available.

AGFD site name	Site order[b]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[c]	Migrants[d]
Miles 257.5 to 257.0 R GC	208	1998	4	4.8	0	0	0	0	0	0
		1999	5	23.5	0	0	0	0	0	1
		2000	5	21	2	1	1	0	0	0
		2001	3	15	0	0	0	0	0	0
		2003	5	6	0	0	0	0	0	0
		2004	5	18.8	0	0	0	0	0	0
		2005	5	13.44	0	0	0	0	0	0
Miles 257.2 to 256.6 L GC	209	1999	5	16.9	0	0	0	0	0	0
		2000	4	20	0	0	0	0	0	0
Mile 255.5 R Devils Slide Rapids GC	210	1998	4	4.75	0	0	0	0	0	0
Mile 252.9 L GC	211	1997	3	3	0	0	0	0	0	0
Mile 252.3 R GC – Reference Point Rapid	211.5	2000	4	16.75	0	0	0	0	0	0
		2003	5	8.76	0	0	0	0	0	0
Mile 252.2 L GC	212	1997	3	2.3	0	0	0	0	0	0
		2000	4	24.95	0	0	0	0	0	1
		2004	4	17.8	0	0	0	0	0	0
		2005	5	25.26	0	0	0	0	0	0
		2006	4	5	0	0	0	0	0	0
Mile 251.8 L GC	213	1997	3	2	0	0	0	0	0	0
Mile 251 R GC	213	2004	3	2.78	0	0	0	0	0	0
		2006	2	0.83	0	0	0	0	0	0
Mile 251.3 L GC	214	1997	3	3	0	0	0	0	0	0
Mile 251.0 L GC	215	1997	3	2.5	0	0	0	0	0	0
Mile 249.5 R GC	215.5	2004	5	4.15	0	0	0	0	0	0
		2005	5	21.12	0	0	0	0	0	0
Mile 249.5 L GC	215.6	2004	5	3.16	0	0	0	0	0	0
		2005	5	12.39	0	0	0	0	0	0

Appendix D2. Southwestern willow flycatcher survey results by site within the Lower and Upper Colorado Recovery Unit, Arizona, 1993–2006[a]. Cells empty if no information is available.

AGFD site name	Site order[b]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[c]	Migrants[d]
Mile 249.0 L Lost Creek GC	215.75	2000	5	3.5	0	0	0	0	0	0
		2001	4	2.5	0	0	0	0	0	0
		2003	5	4.2	0	0	0	0	0	0
		2004	5	2.23	0	0	0	0	0	0
Mile 248.3 R Surprise Canyon GC	216	2000	4	4	0	0	0	0	0	0
		2001	5	2.5	0	0	0	0	0	0
		2002	2	5.5	0	0	0	0	0	0
		2003	3	5	0	0	0	0	0	0
		2004	5	16.35	0	0	0	0	0	0
		2005	5	18.92	0	0	0	0	0	0
RM 247 L GC	216.75	2004	3	1.01	0	0	0	0	0	0
Mile 246.0 L GC	217	1997	4	7	0	0	0	0	0	0
		1998	4	10.95	3	2	1	1	0	0
		1999	4	53.2	6	3	3	2	0	0
		2000	5	131.9	4	2	2	1	0	0
		2001	5	81.15	6	3	3	1	0	0
		2002	5	71.5	0	0	0	0	0	0
		2003	5	22.2	0	0	0	0	0	0
		2004	4	24.58	0	0	0	0	0	0
		2005	4	34.32	0	0	0	0	0	0
		2006	5	10.2	0	0	0	0	0	0
Mile 243.0 L GC	220	1997	4	5.3	0	0	0	0	0	0
		2003	5	9.6	0	0	0	0	1	0
		2004	4	17.76	0	0	0	0	0	0
		2005	5	15.09	0	0	0	0	0	0
		2006	5	6	0	0	0	0	0	0

Appendix D2. Southwestern willow flycatcher survey results by site within the Lower and Upper Colorado Recovery Unit, Arizona, 1993–2006[a]. Cells empty if no information is available.

AGFD site name	Site order[b]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[c]	Migrants[d]
Separation Canyon R GC	221	2003	5	12.1	0	0	0	0	0	0
		2004	5	9.8	0	0	0	0	0	0
		2005	5	10.61	0	0	0	0	0	0
		2006	2	2	0	0	0	0	0	0
Miles 204.8 to 204.7 L GC	225	1995	1	0.1	0	0	0	0	0	0
Mile 204.5 R Spring Canyon GC	226	1998	2	6	0	0	0	0	0	0
		1999	2	2	0	0	0	0	0	0
		2000	3	3	0	0	0	0	0	0
		2001	2	2.45	0	0	0	0	0	0
		2002	3	2.35	0	0	0	0	0	0
		2003	2	2.51	0	0	0	0	0	0
		2004	1	0.75	0	0	0	0	0	0
Miles 199.0 to 196.0 R Parashant Camp GC	228	1995	2	4.8	0	0	0	0	0	0
		1996	2	2.7	0	0	0	0	0	0
		1998	3	8	0	0	0	0	0	0
		1999	2	2.5	0	0	0	0	0	0
		2000	3	3	0	0	0	0	0	0
		2002	3	2.95	0	0	0	0	0	0
		2003	2	2.12	0	0	0	0	0	0
		2004	1	0.75	0	0	0	0	0	0
Miles 198.0 to 196.0 L GC	228.25	1999	1	1.7	0	0	0	0	0	0
		2000	3	3	0	0	0	0	0	0
		2003	1	1	0	0	0	0	0	0
Miles 196.0 to 195.1 L GC	228.75	1999	1	1	0	0	0	0	0	0
		2000	3	2.5	0	0	0	0	0	0
		2002	3	2	0	0	0	0	0	0
		2004	1		0	0	0	0	0	0

Appendix D2. Southwestern willow flycatcher survey results by site within the Lower and Upper Colorado Recovery Unit, Arizona, 1993–2006[a]. Cells empty if no information is available.

AGFD site name	Site order[b]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[c]	Migrants[d]
Miles 196.0 to 191.0 R GC	229	1995	1	4.2	0	0	0	0	0	0
		1996	2	2.3	0	0	0	0	0	0
		1998	3	13.5	0	0	0	0	0	0
		1999	2	5	0	0	0	0	0	0
		2000	3	2.5	0	0	0	0	0	1
		2002	2	0.65	0	0	0	0	0	0
		2003	2	0.5	0	0	0	0	0	0
		2004	1	4.1	0	0	0	0	0	0
Mile 195.0 L GC	230	1998	2	4.3	0	0	0	0	0	0
		1999	1	1	0	0	0	0	0	0
		2002	2	2	0	0	0	0	0	0
		2004	1		0	0	0	0	0	0
Miles 194.9 to 191.2 L GC	230.25	1999	2	4	0	0	0	0	0	0
		2000	3	2.5	0	0	0	0	0	0
		2002	3	3.9	0	0	0	0	0	0
		2003	1	0.15	0	0	0	0	0	0
		2004	1		0	0	0	0	0	0
Mile 168.0 R Fern Glen GC	235	1998	1	1	0	0	0	0	0	0
Miles 143.5 to 143.0 R GC	240	1995	1	2.7	0	0	0	0	0	0
		1998	2	3.5	0	0	0	0	0	0
		1999	1	0.3	0	0	0	0	0	0
		2000	3	1.5	0	0	0	0	0	0
		2001	1	0.25	0	0	0	0	0	0
		2002	3	0.85	0	0	0	0	0	0
		2003	1	1	0	0	0	0	0	0
		2004	1	0.33	0	0	0	0	0	0
Jensen Canyon – Kanab Creek	242	1996	2	2.5	0	0	0	0	0	0
Little Spring – Kanab Wilderness	243	1995	1	2.2	0	0	0	0	0	0

Appendix D2. Southwestern willow flycatcher survey results by site within the Lower and Upper Colorado Recovery Unit, Arizona, 1993–2006[a]. Cells empty if no information is available.

AGFD site name	Site order[b]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[c]	Migrants[d]
Clear Water Spring – Kanab Creek	244	1998	3	7	0	0	0	0	0	0
		1999	3	7.25	0	0	0	0	0	0
		2000	3	6.7	0	0	0	0	0	0
		2001	2	5.5	0	0	0	0	0	0
		2002	3	13.25	0	0	0	0	0	0
		2003	3	17	0	0	0	0	0	0
Mile 136.0 R GC	248	1995	1	2	0	0	0	0	0	0
Mile 133.7 R Tapeats Creek GC	249	1998	1	4.6	0	0	0	0	0	0
		2000	3	1.5	0	0	0	0	0	0
Miles 72.2 to 72.0 R GC – Unkar	253	2000	3	4	0	0	0	0	0	1
Miles 71.3 to 71.0 L Cardenas GC	254	1993	5		2	1	1	1	0	0
		1995	4	8.8	0	0	0	0	0	0
		1996	3	8.5	0	0	0	0	0	1
		1997	3	9.5	0	0	0	0	0	0
		1998	2	11.3	0	0	0	0	0	0
		1999	3	5.5	0	0	0	0	0	0
		2000	3	5	0	0	0	0	0	0
		2001	2	1.1	0	0	0	0	0	0
		2002	3	2.9	0	0	0	0	0	0
		2003	2	1.3	0	0	0	0	0	0
		2004	1	0.5	0	0	0	0	0	0
		2005	4	5.82	0	0	0	0	0	0
Miles 67.1 to 66.8 L GC	255	2000	3	2.5	0	0	0	0	0	0

Appendix D2. Southwestern willow flycatcher survey results by site within the Lower and Upper Colorado Recovery Unit, Arizona, 1993–2006[a]. Cells empty if no information is available.

AGFD site name	Site order[b]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[c]	Migrants[d]
Mile 65.3 L Lava Chuar GC	256	1994	3		1	1	0	0	0	0
		1995	4	13	1	1	0	0	0	0
		1996	3	2	0	0	0	0	0	0
		1997	3	1.4	0	0	0	0	0	0
		1998	2	5.5	0	0	0	0	0	0
		1999	2	4	0	0	0	0	0	0
		2000	2	3	0	0	0	0	0	0
		2001	2	2	0	0	0	0	0	0
		2002	3	0.8	0	0	0	0	0	0
		2003	2	1.12	0	0	0	0	0	0
		2004	1	0.5	0	0	0	0	0	0
Miles 56.5 to 56.0 R Kwagunt Marsh GC	258	1996	1	5.5	0	0	0	0	0	1
		1998	2	5.6	0	0	0	0	0	0
		1999	2	2	0	0	0	0	0	0
		2000	3	3	0	0	0	0	0	0
		2001	2	1.2	0	0	0	0	0	0
		2002	3	1.1	0	0	0	0	0	0
		2003	2	1.67	0	0	0	0	0	0
		2005	4	2.21	0	0	0	0	0	0
Mile 52.7 R Lower Nankoweap Camp GC	260	1996	1	0.8	0	0	0	0	0	0
Mile 52.0 L GC	261	1995	1	0.7	0	0	0	0	0	0
Mile 53.3 R GC – Nankoweap Main Camp	262	2005	4	2.07	0	0	0	0	0	0

Appendix D2. Southwestern willow flycatcher survey results by site within the Lower and Upper Colorado Recovery Unit, Arizona, 1993–2006[a]. Cells empty if no information is available.

AGFD site name	Site order[b]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[c]	Migrants[d]
Miles 51.5 to 50.5 L GC	263	1993	4	0.2	2	1	1	2	0	0
		1994	3		8	4	4	8	0	0
		1995	4	19	4	3	1	0	0	0
		1996	3	11.1	4	3	1	2	0	1
		1997	3	55.6	3	2	1	1	0	1
		1998	3	47.7	2	1	1	1	0	0
		1999	3	20.5	2	1	1	1	0	0
		2000	3	22	2	1	1	1	0	0
		2001	2	1.4	2	1	1	1	0	0
		2002	3	2.6	2	1	1	0	0	0
		2003	3	8.16	2	1	1	1	0	0
		2004	1	1.75	0	0	0	0	1	0
		2005	4	6.76	0	0	0	0	0	0
Mile 50.0 L GC	263.33	1998	2	1.3	0	0	0	0	0	0
		2000	4	1	0	0	0	0	0	0
		2005	4	3.41	0	0	0	0	0	0
Miles 50.0 to 49.0 R GC	263.66	2002	3	1.2	0	0	0	0	0	0
Miles 46.9 to 46.6 R GC	264	1993	3		0	0	0	0	0	0
		1995	4	14.5	0	0	0	0	0	0
		1996	2	5.3	0	0	0	0	0	1
		1998	2	7	0	0	0	0	0	0
		1999	2	5.5	0	0	0	0	0	0
		2000	2	3.9	0	0	0	0	0	0
		2001	2	2	0	0	0	0	0	0
		2002	3	1.2	0	0	0	0	0	0
		2003	2	2	0	0	0	0	0	0
		2004	1	0.75	0	0	0	0	0	0

Appendix D2. Southwestern willow flycatcher survey results by site within the Lower and Upper Colorado Recovery Unit, Arizona, 1993–2006[a]. Cells empty if no information is available.

AGFD site name	Site order[b]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[c]	Migrants[d]
Miles 43.8 to 38.8 L GC	266	2000	2	3.25	0	0	0	0	0	0
		2001	2	1.25	0	0	0	0	0	0
		2002	3	2.85	0	0	0	0	0	0
		2003	1	0.3	0	0	0	0	0	0
Miles 29.0 to 28.0 L GC	266.5	2003	2	4.13	2	1	1	1	0	0
		2005	4	1.29	0	0	0	0	0	0
Mile 5.2 R GC	267	1999	3	5.5	0	0	0	0	0	0
		2000	3	3	0	0	0	0	0	0
		2001	2	1.1	0	0	0	0	0	1
		2002	3	1.3	0	0	0	0	0	0
		2003	2	1.25	0	0	0	0	0	0
		2004	1	0.25	0	0	0	0	0	0
Miles 0.5 to 0.2 R Lees Ferry GC	268	1998	1	3	0	0	0	0	0	0
		1999	2	2	0	0	0	0	0	0
		2000	2	3.5	0	0	0	0	0	0
Miles 2.9 to 3.4 R GC	269	1995	1	0.2	0	0	0	0	0	0
Mile 6.1 R GC	270	1995	1	0.1	0	0	0	0	0	0
Miles 8.3 to 8.5 R GC	271	1993	1		0	0	0	0	1	0
		1995	1	0.2	0	0	0	0	0	0
Mile 9 Marsh GC	273	1993	1		0	0	0	0	2	0
Chaol Canyon – Lake Powell	274	1997	1	2.5	0	0	0	0	0	0
Little Colorado River										
Moenkopi Wash	525	2003	5	15.25	0	0	0	0	0	0
Tanner's Crossing	528	2005	5	17.5	0	0	0	0	0	1

Appendix D2. Southwestern willow flycatcher survey results by site within the Lower and Upper Colorado Recovery Unit, Arizona, 1993–2006[a]. Cells empty if no information is available.

AGFD site name	Site order[b]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[c]	Migrants[d]
Pasture Canyon	530	1995	1	0.15	0	0	0	0	1	0
		1996	2	2.4	0	0	0	0	0	0
		1998	4	4	0	0	0	0	0	0
		1999	4	4.3	0	0	0	0	0	3
Begashibito Canyon	532	1998	4	10.7	0	0	0	0	0	0
		1999	4	15.2	0	0	0	0	0	2
Blue Canyon	533	1998	4	13	0	0	0	0	0	0
		1999	3	15.3	0	0	0	0	0	1
Cameron	536	2002	5	14.4	0	0	0	0	0	0
		2003	5	18.52	0	0	0	0	0	1
Dinnebito	540	1999	4	17	0	0	0	0	0	3
Grand Falls – North of 70 Bridge	545	1997	3	6	0	0	0	0	0	0
Yung-pi	547	1999	5	2.9	0	0	0	0	0	0
Kykotsmovi	550	1999	4	4.3	0	0	0	0	0	0
Coyote Spring	552	1998	4	4	0	0	0	0	0	0
		1999	3	4.64	0	0	0	0	0	0
Polacca Wash	554	1998	1	0.3	0	0	0	0	0	0
Polacca Sewer Pond	555	1998	1	0.5	0	0	0	0	0	0
Lower Keams Canyon	557	1998	1	0.5	0	0	0	0	0	0
Keams Canyon – Beaver Dam	559	1998	4	5.2	0	0	0	0	0	0
		1999	4	4.74	0	0	0	0	0	1
Kalbito Springs	564	1999	2	2.3	0	0	0	0	0	0
Sawmill	568	1995	1	4	0	0	0	0	0	0
SR 87 Bridge	569	2003	5	15	0	0	0	0	0	1
		2004	5	16.7	0	0	0	0	0	0
I-40 Cottonwood Bridges	570	2005	5	11.99	0	0	0	0	0	0
Enchinique	572	1995	1	7	0	0	0	0	0	0
Leonard Point – Clear Creek	573	1994	1	8	0	0	0	0	0	0

Appendix D2. Southwestern willow flycatcher survey results by site within the Lower and Upper Colorado Recovery Unit, Arizona, 1993–2006[a]. Cells empty if no information is available.

AGFD site name	Site order[b]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[c]	Migrants[d]
East Clear Creek	574	1993	1	5	0	0	0	0	0	0
		1994	2	14	0	0	0	0	0	0
		1998	2	21	0	0	0	0	0	0
Rock Tank – Willow Creek	576	1994	1	7	0	0	0	0	0	0
Wiggins Crossing – Willow Creek	577	1994	1	8	0	0	0	0	0	0
Chevelon Wildlife Area	582	1998	1	3.3	0	0	0	0	0	0
		1999	3	17	0	0	0	0	0	0
Hubbell	586	2003	5	13.9	0	0	0	0	0	0
Gauging Station	584	1995	1	4.5	0	0	0	0	0	0
Chevelon Crossing North	585	1993	1	13.5	0	0	0	0	0	0
		1994	1	8	0	0	0	0	0	0
		1995	1	3.5	0	0	0	0	0	0
Fools Hollow Lake – Show Low	590	1993	2	5.8	0	0	0	0	0	0
		1994	1	9	0	0	0	0	0	0
Billy Creek	593	1993	1	3.8	0	0	0	0	0	0
		1994	1	4.8	0	0	0	0	0	0
Mineral Springs	600	1997	1	4	0	0	0	0	0	0
Springer/Round Valley Crossing	610	1998	1	3	0	0	0	0	0	0
Wenima Ranch	611	1994	2	4.8	0	0	0	0	0	0
		1995	1	4.3	0	0	0	0	0	0
		1996	2	11.3	0	0	0	0	0	0
		1997	3	27.3	0	0	0	0	0	2
		1998	3	9.8	0	0	0	0	0	0
		1999	2	8.8	0	0	0	0	0	0
		2000	3	8.3	0	0	0	0	0	0
		2001	3	6	0	0	0	0	0	0
		2003	3	12.3	0	0	0	0	0	0
South Fork Campground	614	1993	1	7	0	0	0	0	0	0
		1994	1	5.3	0	0	0	0	0	0

Appendix D2. Southwestern willow flycatcher survey results by site within the Lower and Upper Colorado Recovery Unit, Arizona, 1993–2006[a]. Cells empty if no information is available.

AGFD site name	Site order[b]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[c]	Migrants[d]
Hall Creek Near Greer	616	1994	1	1.5	0	0	0	0	0	0
Hall Creek	618	1994	1	4	0	0	0	0	0	0
		1996	2	1.2	0	0	0	0	0	0
		1997	3	3.5	0	0	0	0	0	0
		1998	3	6.3	0	0	0	0	0	0
		1999	3	1.5	0	0	0	0	0	0
		2000	4	2.25	0	0	0	0	0	0
Benny Creek	620	1993	1	4	0	0	0	0	0	0
		1994	1	6	0	0	0	0	0	0
		1995	1	5.5	0	0	0	0	0	0
		1996	3	9.6	0	0	0	0	0	0
		1997	3	7.8	0	0	0	0	0	0
		1998	2	7.5	0	0	0	0	0	0
		1999	3	8.5	0	0	0	0	0	0
		2000	4	13.75	0	0	0	0	0	0
		2001	3	7.5	0	0	0	0	0	0
		2003	3	5.17	0	0	0	0	0	0
		2004	3	3.5	0	0	0	0	0	0
River Reservoir Spillway	621	1996	2	6	0	0	0	0	0	0
Wonderland Trap	622	1998	3	2.5	0	0	0	0	0	0
		1999	3	1.8	0	0	0	0	0	0
		2000	3	0.6	0	0	0	0	0	0
Tunnel Reservoir	623	1995	1	1.5	0	0	0	0	0	0
		1996	3	3.9	0	0	0	0	0	0
		1997	2	5.7	0	0	0	0	0	0
		1998	3	10.3	0	0	0	0	0	0

Appendix D2. Southwestern willow flycatcher survey results by site within the Lower and Upper Colorado Recovery Unit, Arizona, 1993–2006[a]. Cells empty if no information is available.

AGFD site name	Site order[b]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[c]	Migrants[d]
River Reservoir	624	1993	2	5.7	9	5	4	1	0	0
		1994	2	16.5	10	5	5	9	0	0
		1995	3	26.5	16	9	7	7	0	0
		1996	3	33.3	13	7	6	7	0	0
		1997	3	25	6	4	2	3	0	0
		1998	3	25	5	3	2	5	0	0
		1999	3	22.3	1	1	0	0	0	1
		2000	5	28.2	1	1	0	0	0	0
		2001	3	17.2	3	2	1	1	0	0
		2002	2	6.44	1	1	0	0	0	0
		2003	3	7	2	2	0	0	0	0
		2004	3	10	5	3	2	0	0	0
		2005	2		3	2	1	0	0	0
		2006	4	13.92	5	4	1	2	0	2
Greer Trout Ponds	625	1993	1	6.8	0	0	0	0	0	0
		1994	1	5	0	0	0	0	0	0
		1995	2	11	0	0	0	0	0	0
		1996	3	9.4	0	0	0	0	0	0
		1997	3	10.5	0	0	0	0	0	0

Appendix D2. Southwestern willow flycatcher survey results by site within the Lower and Upper Colorado Recovery Unit, Arizona, 1993–2006[a]. Cells empty if no information is available.

AGFD site name	Site order[b]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[c]	Migrants[d]
Greer Townsite	626	1993	1	9.5	0	0	0	0	0	0
		1994	1	25.5	0	0	0	0	0	0
		1995	1	9.5	0	0	0	0	0	0
		1996	3	22.5	8	4	4	3	0	0
		1997	3	17.5	6	3	3	5	0	0
		1998	3	20	6	4	2	3	0	0
		1999	3	18.3	6	4	2	2	0	0
		2000	5	35.95	3	2	1	1	0	0
		2001	3	25	0	0	0	0	0	1
		2002	2	3.58	0	0	0	0	2	0
		2003	3	5.5	0	0	0	0	0	0
		2004	3	6.6	0	0	0	0	0	0
		2005	2		0	0	0	0	0	0
		2006	3	12	2	2	0	0	0	0
Upper West Fork	627	1995	1	2.2	0	0	0	0	0	0
Government Spring	628	1997	2	5	0	0	0	0	0	0
		1998	1	5.5	0	0	0	0	0	0
Sheep Crossing	630	1994	1	2.5	0	0	0	0	0	0
		1996	1	3.3	0	0	0	0	0	0
		1997	3	6	0	0	0	0	0	0
		1998	3	10.5	0	0	0	0	0	0
		1999	3	3	0	0	0	0	0	0
		2000	4	4.5	0	0	0	0	0	0
		2001	3	4	0	0	0	0	0	0
		2003	5	4.5	0	0	0	0	0	0
Amberon Flat	632	1999	3	3	0	0	0	0	0	0
Church Camp	633	1997	2	5.5	0	0	0	0	0	0
		1998	1	2.5	0	0	0	0	0	0

Appendix D2. Southwestern willow flycatcher survey results by site within the Lower and Upper Colorado Recovery Unit, Arizona, 1993–2006[a]. Cells empty if no information is available.

AGFD site name	Site order[b]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[c]	Migrants[d]
Phelps Cabin	636	1993	1	3	0	0	0	0	0	0
		1994	1	1.8	0	0	0	0	0	0
		1996	1	2.8	0	0	0	0	0	0
		1997	3	4.8	0	0	0	0	0	0
		1998	3	11.4	0	0	0	0	0	0
		1999	1	1	0	0	0	0	0	0
		2000	4	2.25	0	0	0	0	0	0
Sipe Wildlife Area	642	1997	1	0.8	0	0	0	0	1	0
Rudd Creek	643	1993	1	2.8	0	0	0	0	0	0
		1994	1	1.5	0	0	0	0	0	0
Nelson Reservoir	648	1993	1	2	0	0	0	0	0	0
		1994	1	3	1	1	0	0	0	0
		1995	2	4.7	0	0	0	0	0	0
		1996	3	5	0	0	0	0	0	0
		1998	5	7	0	0	0	0	0	0
		1999	3	2	0	0	0	0	0	0
		2000	4	2.5	0	0	0	0	0	0
		2001	3	3	0	0	0	0	0	0
		2003	3	0.9	0	0	0	0	0	0
		2004	3	0.93	0	0	0	0	0	0
		2006	3	11	0	0	0	0	0	0
Nutrioso	652	1993	1	2	0	0	0	0	0	0
		1994	1	2.3	0	0	0	0	0	0
Colter Creek	654	1997	1	1.5	0	0	0	0	0	0
		1998	1	2.3	0	0	0	0	0	0
San Juan River[a]										
Canyon Del Muerto	744	2003	5	6.7	0	0	0	0	0	0

Appendix D2. Southwestern willow flycatcher survey results by site within the Lower and Upper Colorado Recovery Unit, Arizona, 1993–2006[a]. Cells empty if no information is available.

AGFD site name	Site order[b]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[c]	Migrants[d]
Santa Maria River										
Lower Santa Maria River	920	1993	2	30.8	0	0	0	0	1	0
		1994	2	10.8	1	1	0	0	0	0
		1995	2	19.5	0	0	0	0	1	0
		1996	3	37.3	6	4	2	0	0	0
		1997	2	39.5	2	1	1	0	0	0
		1998	3	25	2	1	1	1	0	1
		1999	1	36.5	9	5	4	2	0	0
		2000	3	60.5	8	5	3	2	0	0
		2001	3	23.75	3	2	1	2	0	2
		2002	1	3.58	0	0	0	0	5	0
		2003	3	13.75	1	1	0	0	0	1
		2004	3	11	0	0	0	0	0	2
		2005	2	10	0	0	0	0	0	0
Yerba Mansa Spring	921	1995	1	3	0	0	0	0	0	0
Tres Alamos Falls	925	1994	1		0	0	0	0	0	0
Date Creek – Cottonwood Canyon	928	1993	1	4	0	0	0	0	0	0
Billingsley Spring	930	1995	2	4	0	0	0	0	1	0
		1997	3	8.8	0	0	0	0	0	0
Big Stick Mine and downstream	936	1995	1	6	0	0	0	0	0	0
Santa Maria River at US Route 93 Bridge	938	1996	1	5	0	0	0	0	0	0
		1997	3	21	0	0	0	0	0	0
		1998	3	12.8	0	0	0	0	0	0
		1999	3	3.6	0	0	0	0	0	0
Date Creek Beaver Ponds	945	1995	1	2	0	0	0	0	0	0
Cottonwood Canyon	947	1993	1	2.5	0	0	0	0	0	0

Appendix D2. Southwestern willow flycatcher survey results by site within the Lower and Upper Colorado Recovery Unit, Arizona, 1993–2006[a]. Cells empty if no information is available.

AGFD site name	Site order[b]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[c]	Migrants[d]
Virgin River										
Nevada boundary	1186	1998	3	7	0	0	0	0	0	0
		1999	3	8	0	0	0	0	0	0
		2000	5	8.69	0	0	0	0	0	0
		2002	2	6.16	0	0	0	0	0	0
Little Bend	1190	1998	3	4.8	0	0	0	0	0	0
		1999	3	8.25	0	0	0	0	0	0
		2000	4	5.5	0	0	0	0	0	0
		2001	4	12.25	0	0	0	0	0	0
		2002	3	9.84	0	0	0	0	0	0
		2006	3	3	0	0	0	0	0	0
Big Bend	1194	1998	1	1.5	0	0	0	0	0	0
		2000	4	11.27	0	0	0	0	0	0
		2001	4	10.83	0	0	0	0	0	0
		2002	3	9.83	0	0	0	0	0	0
Corral Bluff	1196	1998	3	3.3	0	0	0	0	0	0
		1999	3	11	0	0	0	0	0	0
		2000	4	8.5	0	0	0	0	0	0
		2001	4	9.75	0	0	0	0	0	0
		2002	3	9.67	0	0	0	0	0	0

Appendix D2. Southwestern willow flycatcher survey results by site within the Lower and Upper Colorado Recovery Unit, Arizona, 1993–2006[a]. Cells empty if no information is available.

AGFD site name	Site order[b]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[c]	Migrants[d]
Littlefield	1204	1994	3	15.9	0	0	0	0	0	0
		1995	2	8.5	0	0	0	0	0	0
		1996	1	2	0	0	0	0	0	0
		1997	4	50	0	0	0	0	1	0
		1998	5	22.5	0	0	0	0	0	0
		2000	5	21.76	0	0	0	0	0	0
		2001	4	17.28	1	1	0	0	0	0
		2002	3	10.24	0	0	0	0	0	0
		2003	5	54.9	0	0	0	0	0	1
		2004	3	33.3	3	2	1	2	0	0
		2005	2	4.07	0	0	0	0	0	0
		2006	3	1.78	0	0	0	0	0	0
Spring Arroyo	1206	1996	2	1.2	0	0	0	0	0	0
Big Spring	1208	1996	1	1.8	0	0	0	0	0	0
AF 628	1209	1996	1	0.7	0	0	0	0	0	0
Black Rock Gulch	1218	1998	4	8.5	0	0	0	0	0	3
		1999	3	7	0	0	0	0	0	0
		2000	4	15.24	0	0	0	0	0	0
		2001	3	24.06	0	0	0	0	0	0
		2002	3	31.32	0	0	0	0	0	0
		2003	3	9	0	0	0	0	1	0
		2004	2	5	0	0	0	0	0	0
		2005	2	5.41	0	0	0	0	0	0

Appendix D2. Southwestern willow flycatcher survey results by site within the Lower and Upper Colorado Recovery Unit, Arizona, 1993–2006[a]. Cells empty if no information is available.

AGFD site name	Site order[b]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[c]	Migrants[d]
Gila River										
North Gila Valley Site 1	310	1996	3	2.3	0	0	0	0	0	1
		1997	3	4.5	0	0	0	0	0	5
		1998	5	13.8	0	0	0	0	0	2
		1999	5	36.5	0	0	0	0	0	7
		2000	5	17.75	0	0	0	0	0	8
		2003	5	11.99	0	0	0	0	0	4
		2004	2	4.95	0	0	0	0	8	2
		2006	5	9.8	0	0	0	0	0	2
North Gila Valley Site 2	311	1996	3	2.5	0	0	0	0	0	0
		1997	4	4.8	0	0	0	0	0	8
Yuma Lake	311.9	2004	5	2.83	0	0	0	0	0	0
Fortuna Wash	312	1996	4	20	2	1	1	0	0	0
		1997	4	3.3	0	0	0	0	0	2
		1998	5	4.5	0	0	0	0	0	4
		1999	4	35.8	0	0	0	0	0	11
		2000	5	19	0	0	0	0	0	3
		2003	5	19.28	0	0	0	0	0	16
		2004	5	19.57	0	0	0	0	0	4
		2005	4	12.81	0	0	0	0	0	0
		2006	5	15.9	0	0	0	0	0	19
Fortuna North	313	2003	5	17.96	0	0	0	0	0	5
		2004	5	10.64	0	0	0	0	0	5
		2005	5	11.77	0	0	0	0	0	2
		2006	5	16.63	0	0	0	0	1	3
Gila River at US Route 95	314	1998	3	36	0	0	0	0	0	1
		1999	3	40.6	0	0	0	0	0	3

Appendix D2. Southwestern willow flycatcher survey results by site within the Lower and Upper Colorado Recovery Unit, Arizona, 1993–2006[a]. Cells empty if no information is available.

AGFD site name	Site order[b]	Survey years	Surveys	Survey hours	Resident adults	Territories	Pairs	Nests	Unknown status[c]	Migrants[d]
Dome Powerline	315	2002	3	0.8	0	0	0	0	0	0
		2003	3	0.75	0	0	0	0	0	0
Dome Slough	316	1997	4	3.8	0	0	0	0	0	2
		1998	3	3.2	0	0	0	0	0	3
		1999	3	3.2	0	0	0	0	0	10
Ligurta	318	1997	3	2	0	0	0	0	0	2
		1998	3	1.5	0	0	0	0	0	0
		1999	3	2.3	0	0	0	0	0	2
West Pond – Quigley Wildlife Area	322	1999	3	4	0	0	0	0	0	0

[a] The San Juan River is the only drainage within the Upper Colorado Recovery Unit. The other drainages are all located within the Lower Colorado Recovery Unit.
[b]Order of sites along drainages used to differentiate among sites and determine relative positions along drainage. Sites are ordered from least to greatest from downstream to upstream..
[c]Estimated number of willow flycatchers that could not be classified as resident or migrant due to brief appearance at the site during the breeding season or lack of survey data.
[d]Maximum number of migrant willow flycatchers detected during any single survey event.

Appendix D3. AGFD site names, habitat type, and UTMs for sites within the Lower and Upper Colorado Recovery Units, Arizona[a]. Cells blank if no information is available.

AGFD site name	Site order[b]	Habitat type[c, d]	Start		Stop	
			Northing	Easting	Northing	Easting
Big Sandy River						
Lower Big Sandy River	21	2, 3	3799119	266922	3803980	267110
Signal Canyon	22	2	3811541	261689	3812515	261579
Madril Wash	23	2	3813928	260112	3814104	259863
Six Mile Crossing – Burro Creek	25	2, 3	3826507	284060	3827100	285057
Francis Creek	28	1	3846477	294647	3848060	293560
Gray Wash #2	29	4	3835084	265151	3835482	265129
Gray Wash	29.25	4	3835780	264540	3836000	264400
BSR Dack	29.5	2	3836320	264000	3836500	263840
Big Sandy River Downstream US93 – 2	29.75	4	3836616	263993	3837271	263909
Big Sandy River Downstream US 93	30	3	3837642	263402	3838532	263521
Big Sandy River Upstream US 93	30.5	3	3838543	263553	3840170	263226
Cottonwood Creek	34	1	3916405	261200	3916140	262590
Bill Williams River						
Bill Williams River Delta – Marsh Edge	36	2, 3	3798875	216342	3798348	217616
Monkey's Head	38	2, 3	3798439	217781	3797191	218549
Gemini	39	2, 3	3797163	218531	3796087	219592
Cave Wash 1	40	2, 3	3796047	219594	3794310	222887
Cave Wash 2	42	x	3794364	222900	3794182	224703
Buckskin	43	2, 3	3794240	224700	3794340	227770
Bill Williams Pipeline	45	3, 2	3791040	243580	3791771	246507
Lincoln Ranch	47	3	3788650	250650	3789450	249850
Alamo Dam	48	2	3788760	254000	3790620	260320
Alamo Lake – Brown's Crossing	49	2, 3	3796852	264671	3799086	266882
Colorado River						
Hunter's Hole	75	x	3603903	142864	3605141	143135
Gadsden Pond	76	x	3606494	143006	3608612	144091
Gadsden Bend	77	x	3608597	143973	3610460	144287
Cocopah	79	1	3611323	143153	3615829	145144
County 14th St. to County 13th St.	80	2	3615926	145148	3617476	146459
County 13th St. to County 12th St.	81	3, 2	3617468	146498	3619064	147451
County 11th St. to County 10th St.	83	3, 2	3620632	148878	3622204	149373
County 10th St. to County 9th St.	84	3, 2	3622193	149420	3623824	150327
County 9th St. to Morelos Dam	85	3, 2	3623818	150368	3624573	150370
Lower Yuma Division #2	86	x	3624503	150546	3625980	151372
Yuma Division	87	x	3627917	152563	3626798	160329
Fort Yuma 1 & 2	88	x	3627164	161253	3626274	164775
Yuma Territorial Prison	89	3	3626733	161294	3626393	161603
2 East to Gila River	90	x	3625561	163357	3625508	166844
Fort Yuma 3	91	3, 1	3626435	164800	3626048	165917

Appendix D3. AGFD site names, habitat type, and UTMs for sites within the Lower and Upper Colorado Recovery Units, Arizona[a]. Cells blank if no information is available.

AGFD site name	Site order[b]	Habitat type[c, d]	Start		Stop	
			Northing	Easting	Northing	Easting
Gila/Colorado Confluence 3	92	2, 3	3625908	166278	3625900	166397
Gila/Colorado Confluence 1	93	3, 2	3626496	167257	3626335	167509
Gila/Colorado Confluence 2	94	2, 1	3625604	166945	3624661	167232
Bruce	95	3	3629254	169743	3630912	169551
Mittry Lake	96	x	3636341	173341	3642109	176947
Castle Dome	98.75	4	3652854	176927	3652715	176409
Martinez Lake	99	2, 3	3653753	176618	3654953	176129
Imperial HQ 1	102	2	3659748	172561	3657372	172701
IB	104	2, 3	3654113	173482	3654746	173618
IS	105	2, 3	3654454	173822	3654706	173977
Farmfield #20	106	1	3654832	173808	3654940	174335
Killdeer	107	2	3655064	173496		
Dredge Channel	108	3	3655189	174285	3656087	173930
Farm Field	109	3	3655823	173364		
Cottonwood Nursery	110	1, 3	3655927	173483	3656391	173874
Flycatcher	111	2	3656110	173526	3656191	173410
Triangle	112	2, 3	3656385	173560	3656653	173312
Cattail	113	2	3656876	174414	3657003	174113
Firebreak	114	2	3656889	173338	3657520	173194
Imperial HQ 2	115	3	3655277	175895	3655436	175905
Ironwood	116	3	3659718	172415		
Smoke Tree	117	3	3659799	171705		
Clear Lake	118	4, 3	3659982	171389	3660730	171164
Picacho East (Island Lake)	119	2, 3	3660629	166091	3659804	163693
Picacho West	121	x	3659932	162498	3661228	160878
Picacho Island	124	3	3661586	160465	3661867	160236
Nortons Landing	125.75	2	3662520	159836	3662388	159235
Adobe Lake	126	x	3661959	157125	3664139	156562
Hoge	126.25	3, 2	3664630	156169	3663091	157399
Paradise Valley South	127	3	3667959	154162	3668118	154217
Paradise Valley North	131	3	3674752	156992	3674850	157047
Clip Wash Mine	133	3, 4	3677236	157461	3678085	157535
Cibola Lake Overlook	135	3	3681702	158024	3682008	158019
Cibola Lake	136	x	3682014	157873	3684788	158059
SW of Landing Strip – Cibola	137	x	3685299	158229	3687326	158153
Cibola #2	138	3	3686365	157969	3686867	157729
Arnet Ditch/Tieback Levee	140	3, 2	3685137	158200	3689933	157722
Cibola Reveg Flat	140.25		3688173	156549	3688195	156550
Cibola Island Unit	141	2	3689590	156736	3690158	156644
High Levee East	142	2, 3	3694446	155728	3695722	155942
Farm Unit 1 Reveg.	144	3, 2	3696944	156230	3697561	156117
Cibola Restoration	144.5	1, 2	3697220	157274	3698383	157888
Palo Verde	145	3, 2	3699902	154833	3701206	154752

Appendix D3. AGFD site names, habitat type, and UTMs for sites within the Lower and Upper Colorado Recovery Units, Arizona[a]. Cells blank if no information is available.

AGFD site name	Site order[b]	Habitat type[c, d]	Start		Stop	
			Northing	Easting	Northing	Easting
A-10 Backwash	147	3	3713839	169203	3716131	170290
Ehrenberg	148	x	3718206	172915	3722878	172036
Anjohns	151	3	3732260	176084	3735092	176333
Horse Island	151.75	2	3751480	174096	3751750	175311
Noname Lake	152.5	2	3762408	175411	3763164	176889
Hidden Valley Island	152.63	2	3764023	177374	3764591	177958
Calzona	152.75	3	3766537	180276	3768306	179844
Twelvemile Slough	152.88	2	3767750	187358	3770147	186853
Ahakhav Preserve	154	x	3779596	186763	3782170	193750
Cienega Springs	157	3	3788740	202841	3788980	202685
Parker Strip	159	3	3791872	205466	3795250	211882
Disneyland	161	3	3803050	210210	3803275	209975
Standard Wash	163	3	3807962	203292	3808445	203403
Beaver Island to Thompson Bay	165	3, 2	3813837	197577	3817727	193633
Neptune – North Lake Havasu	167	2, 3	3823286	191117	3826618	190032
Blankenship	170	3, 2	3833137	186445	3835571	186639
Pulpit Rock	172	3, 4	3840729	184306	3841007	184019
Topock Marsh	173	x	3847155	180793	3861418	178303
Waterwheel Cove	179	2, 3	3923318	172181	3931797	167717
Chuckwalla Cove	186	2	4010053	226632	4009277	225620
Bradley Bay	186.25		4008887	226130	4008422	226518
Driftwood Island	186.5		4009459	227519	4008974	227149
Raven's Nest Beach – Lake Mead	187	2	4008539	227699	4008878	227192
Snake Beach – Lake Mead	187.5	2	4009889	228964	4009609	227638
Grand Wash Bay	187.7	2	4010264	229378	4009769	229843
Lake Mead Delta	188	2, 1	4003080	231505	4002650	235360
Miles 277.0 to 274.0 R GC	189	x	4002479	235873	3998106	238250
Miles 277.0 to 273.5 L GC	190	2, 1	4001418	236229	3997789	238656
Miles 273.5 to 273.0 R GC	191	1	3998085	238649	3997660	239386
Miles 273.5 to 270.0 L GC	192	2, 1	3997718	238705	3993784	241031
Miles 272.0 to 268.0 R GC	193	x	3996120	239800	3993100	244320
Miles 270.0 to 268.0 L GC	194	x	3993740	241040	3992864	244375
Miles 268.0 to 265.0 L GC	195	2	3992834	244376	3990392	248194
Miles 268.0 to 264.0 R GC	196	x	3993072	244694	3988790	249290
Miles 265.0 to 263.5 L GC	197	2, 3	3990440	248215	3989300	249080
Miles 263.5 to 262.5 L GC	198	3, 2	3989303	249037	3987023	249316
Miles 262.8 to 261.8 R GC – Wards Cave Rapid	198.5	2, 3	3987474	249528	3986204	249676
Miles 262.5 to 259.5 L GC	201	3, 2	3987023	249306	3983667	250934
Miles 261.2 to 260.5 R GC	202	3, 4	3985318	250132	3984006	250762
Mile 260.0 R GC	205	2, 4	3983880	251130	3983760	251640
Mile 260.0 L Quartermaster GC	206	3, 2	3983605	251230	3983210	251005
Mile 259.5 L	206.5	4	3983598	251518	3983479	252216

Appendix D3. AGFD site names, habitat type, and UTMs for sites within the Lower and Upper Colorado Recovery Units, Arizona[a]. Cells blank if no information is available.

AGFD site name	Site order[b]	Habitat type[c, d]	Start		Stop	
			Northing	Easting	Northing	Easting
Mile 259.5 R Waterfall Rapid GC	207	3, 2	3983938	252090	3984768	252999
Miles 257.5 to 257.0 R GC	208	3, 4	3981364	252964	3980601	253353
Miles 257.2 to 256.6 L GC	209	4, 3	3980401	253016	3980533	254074
Mile 255.5 R Devils Slide Rapids GC	210	3	3979990	255400	3979535	255267
Mile 252.9 L GC	211	2	3975650	255060		
Mile 252.3 R GC – Reference Point Rapid	211.5	4	3974769	255305	3974086	255357
Mile 252.2 L GC	212	x	3974620	254950	3974730	254410
Mile 251 R GC	213	3	3973653	256949	3973530	257225
Mile 251.8 L GC	213	2	3973640	255320		
Mile 251.3 L GC	214	2	3973360	256060		
Mile 251.0 L GC	215	2	3973260	257120		
Mile 249.5 R GC	215.5	3	3972537	258896	3972189	259161
Mile 249.5 L GC	215.6	3	3972208	258943	3971849	259202
Mile 249.0 L Lost Creek GC	215.75	3, 2	3971709	259251	3971635	258917
Mile 248.3 R Surprise Canyon GC	216	x	3970894	259698	3971161	260765
RM 247 L GC	216.75	3	3968771	260269	3968525	260349
Mile 246.0 L GC	217	x	3967435	260855	3966551	259907
Mile 243.0 L GC	220	4, 3	3969345	263803	3969675	263877
Separation Canyon R GC	221	3, 4	3967139	267847	3968342	268670
Miles 204.8 to 204.7 L GC	225		3987650	288700	3988000	288450
Mile 204.5 R Spring Canyon GC	226	3, 2	3988472	288228	3988290	288265
Miles 199.0 to 196.0 R Parashant Camp GC	228	3	3995886	290712	3997080	294150
Miles 198.0 to 196.0 L GC	228.25	3	3997169	291670	3996886	293906
Miles 196.0 to 195.1 L GC	228.75	2, 3	3996886	293985	3996709	295228
Miles 196.0 to 191.0 R GC	229	2, 3	3997070	294140	3997921	300515
Mile 195.0 L GC	230	x	3996700	295270	3996619	295386
Miles 194.9 to 191.2 L GC	230.25	2, 3	3996590	295419	3997498	300536
Mile 168.0 R Fern Glen GC	235	3	4014170	327550	4014170	327780
Miles 143.5 to 143.0 R GC	240	3, 4	4028400	353580	4028480	354200
Jensen Canyon – Kanab Creek	242	3	4052350	354950	4055950	354560
Little Spring – Kanab Wilderness	243	2	4054750	357410	4055055	358221
Clear Water Spring – Kanab Creek	244	2, 3	4068393	355734	4070879	356152
Mile 136.0 R GC	248		4027960	364580	4027860	364980
Mile 133.7 R Tapeats Creek GC	249	1	4025911	368293	4025919	368174
Miles 72.2 to 72.0 R GC – Unkar	253		3993457	420970	3993618	421022
Miles 71.3 to 71.0 L Cardenas GC	254	3	3993740	421980	3993740	422340
Miles 67.1 to 66.8 L GC	255		3996964	425620	3997471	425920
Mile 65.3 L Lava Chuar GC	256	x	3999060	426580	3999760	426760
Miles 56.5 to 56.0 R Kwagunt Marsh GC	258	3	4012777	425825	4013160	425670
Mile 52.7 R Lower Nankoweap Camp GC	260		4017480	423040		
Mile 52.0 L GC	261		4018170	423180		
Mile 53.3 R GC – Nankoweap Main Camp	262	3	4017395	423027	4017140	422851

Appendix D3. AGFD site names, habitat type, and UTMs for sites within the Lower and Upper Colorado Recovery Units, Arizona[a]. Cells blank if no information is available.

AGFD site name	Site order[b]	Habitat type[c, d]	Start		Stop	
			Northing	Easting	Northing	Easting
Miles 51.5 to 50.5 L GC	263	3, 4	4019060	422590	4020734	423106
Mile 50.0 L GC	263.33	3	4021269	422995	4021382	422958
Miles 50.0 to 49.0 R GC	263.66		4021456	422647	4022797	421733
Miles 46.9 to 46.6 R GC	264	3, 4	4025200	420035	4026160	420840
Miles 43.8 to 38.8 L GC	266		4027399	424139	4032166	422887
Miles 29.0 to 28.0 L GC	266.5	3, 4	4043114	425749	4044285	426110
Mile 5.2 R GC	267	3	4073585	443159	4073730	443357
Miles 0.5 to 0.2 R Lees Ferry GC	268	3	4080236	447065	4079958	448221
Miles 2.9 to 3.4 R GC	269		4077600	450200	4077650	450920
Mile 6.1 R GC	270		4080600	449460	4080700	449500
Miles 8.3 to 8.5 R GC	271	3	4081520	452900	4081300	453580
Mile 9 Marsh GC	273	2	4081420	454310	4081800	454200
Chaol Canyon – Lake Powell	274	3	4076500	480400	4078200	481200
Gila River						
North Gila Valley Site 1	310	x	3625808	169967	3625984	171922
North Gila Valley Site 2	311	2	3625976	171951	3626212	173798
Yuma Lake	311.9	3	3627995	173581	3628197	173759
Fortuna Wash	312	2, 3	3626385	173938	3626356	177511
Fortuna North	313	4, 3	3627439	177520	3627975	177619
Gila River at US Route 95	314	3, 2	3629683	179507	3629798	181938
Dome Powerline	315	3	3629690	183842	3629613	186113
Dome Slough	316	2	3629419	186166	3629651	186671
Ligurta	318	2	3621793	191029	3621801	191443
West Pond – Quigley Wildlife Area	322	4	3623450	221450	3623425	221700
Moenkopi Wash	525	4	3985617	463936	3986993	464820
Little Colorado River						
Tanner's Crossing	528	3	3968013	465687	3968755	465350
Pasture Canyon	530	2, 1	4000123	481168	4003400	482230
Begashibito Canyon	532	2	4000023	500000	4008338	501310
Blue Canyon	533	2	3999991	500015	4001286	513025
Cameron	536	4	3970353	462023	3969760	463640
Dinnebito	540	3	3953016	505020	3961614	508310
Grand Falls – North of 70 Bridge	545	3	3920700	482250	3920500	482450
Yung-pi	547	4	3941192	512856	3941738	513637
Kykotsmovi	550	3	3968594	535265	3970026	536188
Coyote Spring	552	3	3945503	539574	3947219	540379
Polacca Wash	554	4	3962444	554306	3962806	554775
Polacca Sewer Pond	555	2	3964461	555904	3964745	556160
Lower Keams Canyon	557	3	3966138	567907	3966292	568334
Keams Canyon – Beaver Dam	559	2	3962523	574087	3963328	575658
Kalbito Springs	564	3	3930829	551259	3930720	552055

Appendix D3. AGFD site names, habitat type, and UTMs for sites within the Lower and Upper Colorado Recovery Units, Arizona[a]. Cells blank if no information is available.

AGFD site name	Site order[b]	Habitat type[c, d]	Start		Stop	
			Northing	Easting	Northing	Easting
Sawmill	568	1	3854710	467210		
SR 87 Bridge	569	4	3874462	531781	3873091	532236
I-40 Cottonwood Bridges	570	4	3872914	535135	3873537	535864
Enchinique	572	1	3841850	503190	3841290	502900
Leonard Point – Clear Creek	573	1	3832275	496695	3831900	497400
East Clear Creek	574	1	3827600	488400	3823450	483220
Rock Tank – Willow Creek	576	1	3829350	503760	3829485	502820
Wiggins Crossing – Willow Creek	577	1	3820818	500873	3819264	501147
Chevelon Wildlife Area	582	4	3866579	544208	3864554	543068
Gauging Station	584	1	3832810	526380	3832320	523810
Chevelon Crossing North	585	1	3827745	519515	3819095	516095
Hubbell	586	3	3952762	631009	3953269	631964
Fools Hollow Lake – Show Low	590	1	3793510	584800	3793125	585350
Billy Creek	593	1	3777720	596915	3777010	599700
Mineral Springs	600	2	3779400	629484	3780275	628736
Springer/Round Valley Crossing	610	1	3787315	656387	3786348	656664
Wenima Ranch	611	2, 1	3785560	656820	3783086	656341
South Fork Campground	614	1	3773000	646390	3772570	646210
Hall Creek Near Greer	616	1	3769290	641550	3768525	641400
Hall Creek	618	1	3762700	637340	3762060	637210
Benny Creek	620	1	3768420	643290	3767090	642200
River Reservoir Spillway	621	1	3767620	644385	3767125	644475
Wonderland Trap	622	1	3766629	645287	3766361	645383
Tunnel Reservoir	623	1	3766125	643655	3766740	643855
River Reservoir	624	1	3765720	643190	3766000	643880
Greer Trout Ponds	625	1, 2	3765110	642620	3765720	643120
Greer Townsite	626	1	3764658	642696	3763699	642713
Upper West Fork	627	1	3763290	642300	3763000	642105
Government Spring	628	1	3763003	642072	3761590	641620
Sheep Crossing	630	1	3758831	638895	3757610	636360
Amberon Flat	632	1	3763365	642602	3763208	642538
Church Camp	633	1	3763122	642527	3761570	643000
Phelps Cabin	636	1	3755325	639975	3754280	637400
Sipe Wildlife Area	642	1	3767290	663790	3767194	663621
Rudd Creek	643	1	3766520	662725	3766115	662050
Nelson Reservoir	648	1	3768580	667375	3765720	667500
Nutrioso	652	1	3758680	665760	3757075	666820
Colter Creek	654	1	3758840	662480	3758024	665411
San Juan River[a]						
Canyon Del Muerto	744		4002831	642176	4002418	641401

Appendix D3. AGFD site names, habitat type, and UTMs for sites within the Lower and Upper Colorado Recovery Units, Arizona[a]. Cells blank if no information is available.

AGFD site name	Site order[b]	Habitat type[c, d]	Start		Stop	
			Northing	Easting	Northing	Easting
Santa Maria River						
Lower Santa Maria River	920	2, 3	3799257	268465	3797560	276170
Yerba Mansa Spring	921	2	3796310	277790	3796393	277949
Tres Alamos Falls	925	1	3787292	302115	3787587	301957
Date Creek – Cottonwood Canyon	928	1	3789800	314510	3790875	315825
Billingsley Spring	930	1	3794022	321204	3793330	323000
Big Stick Mine and downstream	936	2	3802790	293740	3804750	297725
Santa Maria River at US Route 93 Bridge	938	3, 4	3804837	298857	3805010	300000
Date Creek Beaver Ponds	945	1	3801700	320410	3801980	319980
Cottonwood Canyon	947	1	3842920	325325	3844425	326720
Virgin River						
Nevada Border	1186	3, 2	4076706	228066	4076651	229277
Little Bend	1190	3, 2	4079891	233454	4080260	233580
Big Bend	1194	3, 2	4081070	235090	4081780	235690
Corral Bluff	1196	3, 2	4082208	235840	4082484	236016
Littlefield	1204	3, 2	4086322	239270	4087450	239925
Spring Arroyo	1206	2	4087602	240439	4087593	240671
Big Spring	1208	2	4088455	241739	4088356	242005
AF 628	1209	3	4088662	242493	4088861	242918
Black Rock Gulch	1218	x	4094915	257035	4096689	258213

[a]The San Juan River is the only drainage within the Upper Colorado Recovery Unit. The other drainages are all located within the Lower Colorado Recovery Unit.

[b]Order of sites along drainages used to differentiate among sites and determine relative positions along drainage. Sites are ordered from least to greatest from downstream to upstream.

[c]Habitat type was categorized as 1 = native broadleaf vegetation (entirely or almost entirely native [>90% native]); 2 = mixed native broadleaf and exotic vegetation (50–90% native); 3 = mixed exotic and native broadleaf vegetation (50–90% exotic); 4 = entirely or almost entirely exotic (>90% exotic); and x = inconsistent habitat type due to observer bias or area surveyed.

[d]Multiple habitat types reflect continuous succession throughout study period.

Appendix E1. Monthly average Roosevelt Lake elevation in feet (with percent capacity) and annual and breeding season lake elevation averages[a], 1996–2006.

Month	Year										
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
January	2105.41 (50.7%)	2071.49 (26.2%)	2056.50 (18.9%)	2091.49 (39.4%)	2076.50 (29.8%)	2071.45 (26.2%)	2065.30 (22.9%)	2043.55 (13.6%)	2077.83 (30.4%)	2101.17 (47.3%)	2133.68 (79.3%)
February	2104.29 (49.8%)	2075.52 (29.2%)	2067.45 (23.9%)	2092.11 (40.1%)	2077.36 (29.8%)	2074.07 (27.9%)	2065.20 (22.9%)	2047.34 (14.7%)	2077.66 (30.4%)	2136.51 (82.7%)	2133.70 (79.3%)
March	2101.06 (47.3%)	2087.52 (37.2%)	2087.39 (36.5%)	2090.89 (39.4%)	2077.83 (30.4%)	2082.20 (33.0%)	2063.88 (22.3%)	2069.35 (25.0%)	2084.41 (34.4%)	2144.32 (91.1%)	2132.38 (77.0%)
April	2097.74 (44.8%)	2090.28 (38.6%)	2104.23 (49.8%)	2091.17 (39.4%)	2076.20 (29.2%)	2090.76 (39.4%)	2061.74 (21.3%)	2076.16 (29.2%)	2088.56 (37.9%)	2147.95 (96.1%)	2129.31 (73.8%)
May	2091.69 (40.1%)	2086.56 (36.5%)	2107.82 (53.3%)	2088.25 (37.2%)	2070.65 (26.2%)	2089.43 (37.9%)	2056.19 (18.5%)	2078.12 (30.4%)	2087.62 (37.2%)	2147.57 (96.1%)	2124.62 (69.5%)
June	2083.04 (33.7%)	2078.76 (31.1%)	2107.24 (52.4%)	2082.67 (33.7%)	2064.54 (22.9%)	2083.68 (34.4%)	2046.35 (14.3%)	2075.30 (28.5%)	2082.90 (33.7%)	2145.16 (92.4%)	2118.18 (62.5%)
July	2076.04 (29.2%)	2067.62 (24.5%)	2101.68 (48.1%)	2079.13 (31.1%)	2057.14 (18.9%)	2078.12 (30.4%)	2038.98 (11.9%)	2072.60 (27.3%)	2077.68 (30.4%)	2141.55 (88.7%)	2133.82 (79.3%)
August	2066.35 (23.4%)	2057.27 (18.9%)	2094.54 (42.4%)	2079.56 (31.7%)	2052.69 (17.2%)	2073.97 (27.9%)	2034.25 (10.3%)	2071.25 (26.2%)	2074.05 (27.9%)	2140.07 (86.3%)	2118.37 (62.5%)
September	2067.04 (23.9%)	2051.58 (16.7%)	2089.66 (38.6%)	2077.16 (29.8%)	2052.93 (17.2%)	2067.38 (23.9%)	2037.19 (11.2%)	2074.64 (28.5%)	2074.16 (27.9%)	2136.65 (82.7%)	2118.83 (63.5%)
October	2066.27 (23.4%)	2050.61 (16.3%)	2089.97 (38.6%)	2075.07 (28.5%)	2057.13 (18.9%)	2065.60 (23.4%)	2038.24 (11.6%)	2074.97 (28.5%)	2074.55 (28.5%)	2135.25 (80.4%)	2119.55 (64.5%)
November	2067.24 (23.9%)	2052.24 (16.7%)	2090.89 (39.4%)	2075.41 (28.5%)	2067.62 (24.5%)	2066.24 (23.4%)	2039.07 (11.9%)	2076.14 (29.2%)	2075.96 (29.2%)	2134.64 (80.4%)	2119.94 (64.5%)
December	2067.34 (23.9%)	2054.37 (17.6%)	2091.65 (40.1%)	2075.81 (29.2%)	2069.69 (25.6%)	2066.89 (23.9%)	2041.11 (12.6%)	2076.97 (29.8%)	2078.93 (31.1%)	2134.25 (79.3%)	2120.16 (64.5%)
Annual average	**2082.79 (33.7%)**	**2068.65 (25.0%)**	**2090.75 (39.4%)**	**2083.23 (33.7%)**	**2066.69 (23.9%)**	**2075.82 (29.2%)**	**2048.96 (15.5%)**	**2069.70 (25.6%)**	**2079.53 (31.7%)**	**2137.09 (82.7%)**	**2125.21 (69.5%)**
Breeding season average	**2082.97 (33.7%)**	**2076.10 (29.2%)**	**2103.1 (49.0%)**	**2084.16 (34.4%)**	**2064.24 (22.3%)**	**2083.19 (33.7%)**	**2047.50 (15.1%)**	**2074.69 (28.5%)**	**2082.16 (33.0%)**	**2144.46 (91.1%)**	**2124.86 (69.5%)**

[a] Breeding season averages are from April to August. Data provided by Salt River Project.

Appendix E2. Roosevelt Lake elevation in feet (with percent capacity) for 2004, 2005, 2006, and monthly averages from 1996 to 2003.

Month	1996 to 2003	2004	2005	2006
January	2071.66 (26%)	2077.01 (30%)	2081.40 (33%)	2134.24 (80%)
February	2072.82 (27%)	2077.87 (30%)	2101.55 (48%)	2133.69 (79%)
March	2075.60 (29%)	2077.66 (30%)	2136.87 (83%)	2133.69 (79%)
April	2082.74 (34%)	2084.56 (35%)	2144.48 (92%)	2132.33 (77%)
May	2086.02 (36%)	2088.62 (38%)	2147.99 (96%)	2129.18 (74%)
June	2083.47 (34%)	2087.50 (37%)	2147.55 (96%)	2124.50 (69%)
July	2077.63 (30%)	2082.71 (33%)	2145.04 (92%)	2117.92 (62%)
August	2071.29 (26%)	2077.44 (30%)	2141.46 (88%)	2114.11 (59%)
September	2066.17 (23%)	2073.95 (28%)	2139.95 (86%)	2118.27 (63%)
October	2064.65 (23%)	2074.15 (28%)	2136.54 (82%)	2118.85 (63%)
November	2065.59 (23%)	2074.58 (28%)	2135.26 (81%)	2119.56 (65%)
December	2066.44 (24%)	2076.01 (29%)	2134.65 (80%)	2119.95 (65%)
Annual average	2073.67 (28%)	2079.34 (31%)	2132.73 (80%)	2124.69 (70%)
Breeding season average[a]	2080.23 (32%)	2084.17 (35%)	2145.30 (93%)	2123.61 (68%)

Data provided by Salt River Project (Dallas Reigle and Tim Skarupa, SRP, personal communication).

[a] Breeding season averages include data from April to August.

Appendix F. Total monthly precipitation (inches) and annual total precipitation at Roosevelt Lake, 1996–2006.

Month	Year										
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
January	0.49	4.14	0.73	0.13	0.15	2.35	0.17	0.32	0.72	4.88	0.01
February	2.28	2.07	5.93	0.85	0.19	0.93	0	4.54	1.13	8.76	0
March	0.65	0	3.78	0.16	2.95	1.59	0.45	2.16	1.43	1.39	2.29
April	0	0.73	0.55	2.48	0.06	2.95	0.14	0.46	1.32	0.44	0.44
May	0	0.15	0	0	0	0.8	0	0	0	0	0
June	0	0	0	0	2.45	0	0	0	0	0	0.34
July	3.34	0.04	0.46	0	0.12	4.09	1.1	1.88	1.02	0.38	0.46
August	0.67	1.36	0.35	0	2.64	1.78	1	3.01	2.45	1.85	0
September	0	0	1.24	0	0	0.1	1.62	1.21	3.43	0.16	0
October	0.31	0	1.18	0	7.06	0.48	0.49	0.2	1.29	0.7	0
November	0.75	0.46	1.8	0	1.23	0.36	1.18	2.02	1.08	0	0
December	0	1.48	0.65	0	0	0.98	1	1.11	2.91	0	0.26
Annual total	**6.21**	**10.43**	**16.67**	**3.62**	**16.85**	**16.41**	**7.15**	**16.91**	**16.78**	**18.56**	**3.08**

Data from the Western Regional Climate Center website, Punkin Center data <http://www.wrcc.dri.edu/summary/Climsmaz.html>.

Appendix G. Southwestern willow flycatcher territories by year for the San Pedro River study area, 1996–2005. Sites ordered from downstream to upstream. Cells blank if surveys not performed.

AGFD site name	Year									
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
CB Crossing Southeast		5	4	7	6	3	1	0	2	1
Indian Hills	3	15	12	12	9	0	1	0	0	0
Dudleyville Crossing	1	3	6	10	14	14	26	8	9	15
Malpais Hill	0	0	1	2	3	2	8	11	2	0
PZ Ranch	8	5	1	1	0	0	0	0	0	0
PZ Ranch West			0	0	0		0	3	2	1
Cook's Lake Cienega/Seep	17	13	13	11	7	5	15	10	12	11
Aravaipa Inflow North			0	7	11	22	36	28	23	18
San Pedro/Aravaipa Confluence			6	14	8	8	7	7	9	10
Aravaipa Inflow South			0	0	3	7	4	5	13	16
Wheatfields		2	1	2	7	14	13	18	18	12
Wheatfields South			0	0	0		0	2	9	14
San Manuel Crossing	0		0	0	0		7	35	59	55
Catalina Wash			0	0	0	2	3	13	6	4
Territories	**29**	**43**	**44**	**66**	**68**	**77**	**121**	**140**	**164**	**157**
Number of sites surveyed	**6**	**7**	**14**	**14**	**14**	**11**	**14**	**14**	**14**	**14**
Number of sites with territories	**4**	**6**	**8**	**9**	**9**	**9**	**11**	**11**	**12**	**11**

Appendix H. Mean monthly streamflow (cfs) at the Gila River study area, Arizona, 1997–2007.

Year	Territories	Mean monthly streamflow (cfs)[a]											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1997	33	166	248	677	521	538	672	816	542	83	147	7	165
1998	48	110	208	493	441	610	699	852	923	443	153	44	320
1999	69	90	172	367	166	253	5	100	373	130	72	6	154
2000	52	81	144	278	340	118	8	5	70	22	190	80	216
2001	40	54	154	411	494	540	635	725	481	246	205	5	245
2002	46	107	138	243	25	14	1	1	52	56	103	8	108
2003	26	68	166	338	217	87	6	51	37	4	0	1	55
2004	14	85	141	297	382	230	3	6	110	84	37	11	122
2005	28	208	374	382	609	535	695	818	618	500	226	7	289
2006	39	177	234	224	403	479	480	650	722	351	236	11	294
2007	64	194	194	418	487	542	662	706	467	195	134	8	138

[a]Mean monthly streamflow calculated by averaging mean monthly streamflow recorded at 2 U.S. Geological Survey gauging stations: #09469500 (Gila River Below Coolidge Dam) and #09474000 (Gila River at Kelvin; USGS 2007). Mean monthly streamflow for Oct–Dec 2007 were unavailable at the time of publication.

Appendix I. Southwestern willow flycatcher territories by year for the Gila River study area, 1996–2007. Sites ordered from downstream to upstream. Cells blank if surveys not performed.

AGFD site name	Year											
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Donnelly Wash	0										0	
North Butte		0	0	0	0						0	
South Butte											0	
GRN033	1	0	0	0	0						0	
GRN032		0									0	
GRSN031	1	0	0								0	
GRSN030	0	0			0						0	
GRN029	0	0	0	0	0						0	
GRN028	0	0	0	0	0						0	
GRN027	0	0	0	0	0						0	
GRSN026	0	0									0	
GRS025	0	0	0								0	
GRSN023	0	0	0	0	0	0	0				0	
GRSN022	0	0	0								0	
GRN020	2	2	2	5	0	0	0	0	0	0	1	0
GRS020	0	0	0									
GRN019			0	0	0							
GRS019			0	0	0						0	0
GRS018		1	1	4	4	2	7	4	2	9	7	6
GRN018		2	2	5	4	9	7	5	3	6	5	5
GRS016		0						1	0	1	1	2
GRN015					1	0	0	0				
GRS015		1	1	1	1	0	0	0				
Kearny	6	8	25	23	19	14	14	9	5	3	5	4
GRN014		0	0	0	0							
GRS014		0	0	0	0	0	0				0	0
GRN013		0	0		0		0	0				
GRS013		1	0	0	0		0	0				
GRN012		0	0		0							

Appendix I. Southwestern willow flycatcher territories by year for the Gila River study area, 1996–2007. Sites ordered from downstream to upstream. Cells blank if surveys not performed.

AGFD site name	Year											
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
GRS012		4	6	8	7	5	3	1	0	0	0	0
GRN011		2	0	0	0							
GRS011		0	0	1	2	1	1	0	0	0	0	1
GRN010		5	4	4	2	1	1	0	0	0	0	0
GRS010		3	0	4	0	0	0	0	0	1	1	2
GRS009		0	0								1	0
GRN009		0	0	0	0	1	2	0	0	0	1	2
GRS008		0	0	0	0	0	0				1	4
GRN008		0	0	0	0	0	2	0	0	0	1	3
GRS007		3	6	11	10	5	7	5	4	6	4	6
GRN007		0	0	0	0	0	0				1	2
GRS006		0	0									
GRN005		0	0		0							
GRS005		0	0								1	0
GRN004		1	1	2	2	2	2	1	0	0	1	1
GRS004		0	0	0	0	0	0					
GRN003		0	0	0	0							
GRS003		0									0	0
GRN002		0	0	0	0	0	0					
GRS002		0										
GRS001		0										
Dripping Springs Campground			0	0	0	0	0		0	1	5	15
Dripping Springs Wash			0	1	0		0	0	0	1	3	11
Territories	**10**	**33**	**48**	**69**	**52**	**40**	**46**	**26**	**14**	**28**	**39**	**64**
Number of sites surveyed	**4**	**43**	**35**	**32**	**37**	**21**	**24**	**18**	**15**	**15**	**36**	**22**
Number of sites with territories	**4**	**12**	**9**	**12**	**10**	**9**	**10**	**7**	**4**	**8**	**16**	**14**

Appendix J. Details of depredation events at camera-monitored southwestern willow flycatcher nests, 1998–2001.

Stage at set up	Number depredated[a]	Number survivors[a]	Age (days)[b]	Nest outcome[c]	Time of event	Event duration (min)	Predator
Avian predators							
Incubation	1 WN	0	10	PO	825	≈ 0.8	Cooper's hawk
Incubation	3 WN	0	5	PO	1826	9	Cooper's hawk
Incubation	3 WN	0	13	PO	1022	32	Cooper's hawk
Nestling	3 WN	0	15	PO	1652	10	Cooper's hawk
Nestling	3 WN	0	10	PO	1900	7	Cooper's hawk
Nestling	2 WN	1 WF	16	FD	1718	37	Cooper's hawk
Nestling[d]	1 WN	2 WN	1	PO	1726	≈ 0.2	Cooper's hawk
Nestling[d]	1 WN	1 WN	7	PO	Unk	Unk	Cooper's hawk
Nestling[d]	1 WN	0	9	PO	1135	≈ 0.2	Cooper's hawk
Incubation[e]	1 WE	0	Unk	PO	1414	4	Yellow-breasted chat
Incubation[e]	1 WE	0	17	PO	348	≈ 0.3	Western screech owl
Snake predators							
Incubation	1 WN	1 WF	13	FD	1021	20	California kingsnake
Incubation	3 WN	0	10	PO	24	32	California kingsnake
Incubation	4 WN	0	11	PO	1918	35	California kingsnake
Incubation	4 WN	0	12	PO	2013	54	California kingsnake
Nestling	3 WN	0	11	PO	1614	Unk	Sonoran gophersnake
Unknown predators							
Incubation[f]	3 WE	0	9	PE	1614	Unk	Unrecorded

[a] WN = flycatcher nestling, WE = flycatcher egg, and WF = flycatcher fledgling.

[b] Age (days) = the age of nestlings at time of depredation or number of days since onset of incubation for depredated eggs.

[c] FD = fledged with partial depredation, PE = predation event not observed, failed due to depredation, PO = predation event observed, failed due to depredation.

[d] This nest experienced 3 predation events, 2 of which were documented on tape. The camera failed to record the second nestling depredated (7-day-old), but we assume that the same Cooper's hawk depredated it.

[e] Time-lapse video camera was set up after 1 or more eggs were already removed; therefore, it is inconclusive as to whether or not the owl and chat were responsible for the entire lost clutch or for only depredating the last egg. In the case of the western screech owl predation event, 1 egg and 1 1-day-old nestling were removed prior to camera set up.

[f] Camera failed to record predation event due to LED light malfunction.

Appendix K. Details of successful predation events at open-cup songbird nests, 1998–1999.

Stage at set up	Species depredated[a]	Number depredated[b]	Age (days)[c]	Time of event	Event duration (min)	Predator
Nestling	SOSP	1 N	10	1923	35	California kingsnake
Incubation[d]	SOSP	3 N	5	1151	4	California kingsnake
Unknown	YBCH	≥ 1 N	Unk	807	17	California kingsnake
Incubation	COYE	3 N	5	2000	5	Western spotted skunk
Incubation[e]	YBCH	2 N	3	1622	1.5	Yellow-breasted chat
Incubation[e]	YBCH	1 N	4	654	0.5	Clark's spiny lizard

[a] COYE = Common yellowthroat, SOSP = Song sparrow, YBCH = Yellow-breasted chat.

[b] N = nestling(s)

[c] Age (days) = the age of nestlings at time of depredation or number of days since onset of incubation for depredated eggs.

[d] Nest was visited by a second larger kingsnake 3 min after the first kingsnake depredated 3 5-day-old nestlings. The second snake stayed at the empty depredated nest for 31 min.

[e] YBCH nest experienced 2 predation events. During the first predation event 2 3-day-old nestlings were removed by YBCH and during the second predation event (24 hr later), a 4-day-old nestling was depredated by a Clark's spiny lizard.