Southwestern Willow Flycatcher Surveys and Nest Monitoring along the Gila River between Coolidge Dam and South Butte, 2011

Prepared for

U.S. Bureau of Reclamation, Phoenix Area Office

Prepared by

SWCA Environmental Consultants

January 2012

SOUTHWESTERN WILLOW FLYCATCHER SURVEYS AND NEST MONITORING ALONG THE GILA RIVER BETWEEN COOLIDGE DAM AND SOUTH BUTTE, 2011

CONTRACT # GS10F0209L

Prepared for

U.S. Bureau of Reclamation
Phoenix Area Office
6150 West Thunderbird Road
Glendale, Arizona 85306

Prepared by

SWCA Environmental Consultants
114 North San Francisco Street, Suite 100
Flagstaff, Arizona 86001
(928) 774-5500
www.swca.com

SWCA Project No. 14178

January 2012

RECOMMENDED CITATION:

Graber, A.E., T.J. Koronkiewicz, and J.L. Granger. 2012. *Southwestern Willow Flycatcher Surveys and Nest Monitoring along the Gila River between Coolidge Dam and South Butte, 2011*. Annual summary report submitted to U.S. Bureau of Reclamation, Glendale, Arizona. Flagstaff, Arizona: SWCA Environmental Consultants.

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EXECUTIVE SUMMARY

The Southwestern willow flycatcher was federally listed as endangered in 1995. Probable factors contributing to population declines were believed to be loss, alteration, and fragmentation of native riparian breeding habitat, loss of wintering habitat, and brood parasitism by brown-headed cowbirds (*Molothrus ater*; USFWS 1995). Prompted by concern for population declines, from 1997 to 2007 surveys and nest monitoring were conducted along the Gila River by the Arizona Game and Fish Department under a cooperative agreement with the U.S. Bureau of Reclamation. From 2008 to 2011, Reclamation contracted SWCA Environmental Consultants to continue to survey and monitor the Gila River downstream of Coolidge Dam to document flycatcher abundance and distribution in relation to Coolidge Dam operations. Results of the 2011 survey and nest monitoring effort are summarized in this report.

In 2011, we used recorded broadcasts of willow flycatcher song and calls to elicit responses from willow flycatchers at 53 sites along the Gila River, Arizona, from Dripping Springs Wash to South Butte. We spent 367 hours surveying the sites covering approximately 100 linear km of riparian habitat. We detected 183 flycatcher pairs that had a total of 274 nesting attempts at 27 sites; 202 nests were monitored to determine annual flycatcher productivity. Of nests with known outcomes, 36% were successful. Mayfield nest success was 36%.

We estimated 159 young fledged from 82 monitored nests. Average seasonal flycatcher fecundity was 1.26 and average seasonal productivity was 0.78. Brown-headed cowbird parasitism was higher (10%) than other years of the study and was documented for the third consecutive year after not being documented since 2004. Nesting substrate was documented for 262 nests: all nests were placed in tamarisk.

We continued the streamflow analyses conducted from 1998 to 2009 by Weddle et al. (2007) and Graber and Koronkiewicz (2009*a*, 2009*b*, and 2011). We found that increased streamflow positively correlated with flycatcher numbers within the study area. Specifically, we found that increased streamflow annually (May–April) from April–June of the previous year had the strongest relationships to the number of flycatcher territories from 1998–2011 at the Gila River study area.

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INTRODUCTION

PROJECT HISTORY

The Southwestern willow flycatcher (*Empidonax traillii extimus*; hereafter, flycatcher) was listed as endangered in 1995 (U.S. Fish and Wildlife Service [USFWS] 1995). Critical habitat—designated in 1997 (USFWS 1997) and 2005 (USFWS 2005)—is currently proposed for revision (USFWS 2011). A recovery plan was published in 2002 (USFWS 2002).

From 1996 to 2005, the Arizona Game and Fish Department (AGFD) conducted flycatcher surveys and nest monitoring along the Gila and San Pedro rivers and Roosevelt Lake as part of a long-term demographic study under a cooperative agreement with the U.S. Bureau of Reclamation (Reclamation) regarding the 1996 Biological Opinion on Roosevelt Dam (USFWS 1996; Ellis et al. 2008). At the request of Reclamation, this effort continued in 2006, with the exception that no studies were conducted along the San Pedro River, and nest monitoring effort was reduced along the Gila River. In 2007, AGFD did not conduct studies along the San Pedro River or Roosevelt Lake, and nest monitoring effort along the Gila was similar to 2006. From 2008 to 2011, Reclamation contracted SWCA Environmental Consultants (SWCA) to continue to survey and monitor the Gila River downstream of Coolidge Dam to document flycatcher abundance and distribution in relation to Coolidge Dam operations. These surveys have provided Reclamation with baseline flycatcher abundance and distribution data.

Results of the 2011 survey and nest monitoring effort are summarized in this report. Specifically, this document summarizes: 1) surveys and area searches: the systematic search of riparian habitat to record the presence/absence and abundance of flycatchers; and 2) nest monitoring: the estimation of flycatcher nest success and productivity. SWCA's contract specifies the following tasks associated with this report:

At approximately 50 sites, complete the following:

a. surveys of suitable and potentially suitable habitat (where landowner permission can be obtained);
b. presence/absence surveys, as recommended in the USFWS Southwestern willow flycatcher survey protocol (USFWS 2000), and general survey methods outlined in Sogge et al. (2010);
c. resighting, determining whether flycatchers are color banded, and recording color combinations (per permitting requirements);
d. nest searches (if territorial flycatchers are located) and monitoring; calculation of Mayfield nest success (Mayfield 1961, 1975) for the study area;
e. documentation of the presence/absence of brown-headed cowbirds (*Molothrus ater*) at survey sites;
f. general site descriptions for each site, recording and providing all required information on standardized survey and detection forms;
g. documentation of regeneration and/or loss of flycatcher habitat, highlighting the response of flycatchers to habitat change;
h. acquisition of photo points at a subset of known flycatcher breeding sites to further examine future losses and/or regeneration of habitat, and any corresponding fluctuations in flycatcher numbers;
i. compilation of all data into an annual report.

SPECIES INTRODUCTION

The Southwestern willow flycatcher is one of four subspecies of willow flycatcher currently recognized (Unitt 1987), although Browning (1993) posits a fifth subspecies (*E. t. campestris*) occurring in the central portions of the United States (Figure 1). The Southwestern willow flycatcher breeds from near sea level to over 8,500 feet in dense, mesic riparian habitats at scattered, isolated sites in New Mexico, Arizona, southern California, southern Nevada, southern Utah, southwestern Colorado, and, at least historically, extreme northwestern Mexico and western Texas (Unitt 1987; Durst 2008). While other subspecies of 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).

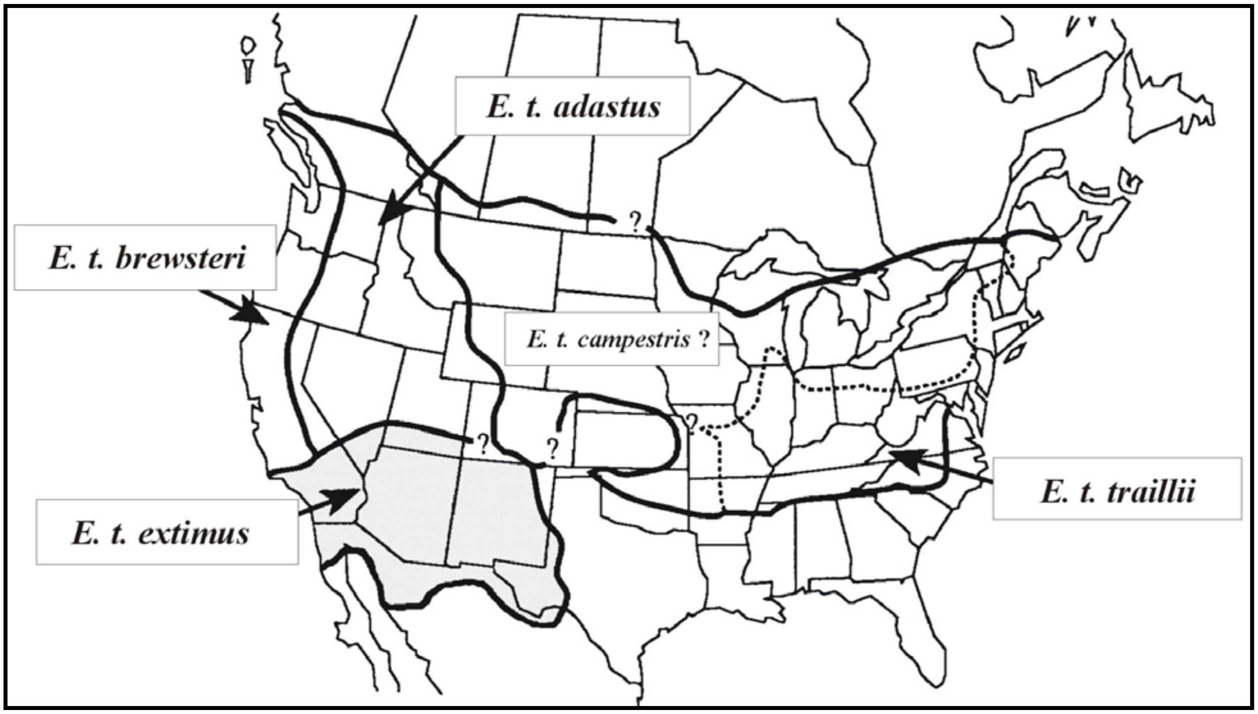

Figure 1. Breeding distribution of willow flycatcher subspecies. Question marks represent areas where actual location of the subspecies boundary is unknown. Adapted from Unitt (1987), Browning (1993), and Paxton (2008).

In the Southwest, most willow flycatcher breeding territories are found within small breeding sites containing five or fewer territories. As of 2007, 1,300 territories were estimated—distributed among 280 sites (Durst et al. 2008). One of the last long-distance Neotropical migrants to arrive in North America in spring, Southwestern willow flycatchers have a short, approximately 100-day breeding season, with individuals typically arriving in May or June and departing in August or September (Sogge et al. 2010). All four subspecies of willow flycatchers spend the non-breeding season in portions of southern Mexico, Central America, and northwestern South America (Stiles and Skutch 1989; Ridgely and Tudor 1994; Howell and Webb 1995; Unitt 1997), with wintering ground habitat similar to the breeding grounds (Lynn et al. 2003). Willow flycatchers have been recorded on the wintering grounds from central Mexico to southern Central America as early as mid-August (Stiles and Skutch 1989; Howell and Webb 1995), and wintering, resident individuals have been recorded in southern Central America as late as the end of May (Koronkiewicz, Sogge et al. 2006).

METHODS

STUDY AREA

The Gila River study area (Figures 2 through 4) is located approximately 20 km below San Carlos Reservoir, extending from Dripping Springs Wash (upstream of the town of Winkelman) approximately 71 km downstream to South Butte and the Ashurst-Hayden Diversion Dam. Flows are variable on the Gila River, regulated by releases from Coolidge Dam and natural inflows from the San Pedro River. The Gila Water Commissioner is appointed by the U.S. District Court to administer the Globe Equity 59 Decree, which controls use of the waters of the Gila River in the reach from above Virden, New Mexico, downstream to the confluence with the Salt River west of Phoenix. The Bureau of Indian Affairs operates Coolidge Dam based on downstream water orders. Flycatcher breeding season (May–August) streamflow below Coolidge Dam averaged 560 cubic feet per second (cfs) from 1996–2001, but from 2002–2004 periods of little or no streamflow (average of 95 cfs) were recorded due to drought conditions and Central Arizona Project water exchanges (Weddle et al. 2007). From 2005 to present, streamflow has averaged 555 cfs during the breeding season (U.S. Geological Survey [USGS] 2012). Riparian habitat within the study area varies from monotypic tamarisk (*Tamarix* spp.) to mixed exotic/native vegetation (primarily tamarisk, Goodding's willow [*Salix gooddingii*], and Fremont cottonwood [*Populus fremontii*]). Riparian habitat is surrounded by Arizona Upland, a subdivision of the Sonoran Desertscrub biome (Turner and Brown 1994). The study area is subdivided into survey sites of distinct habitat patches 0.18–9.69 km long. Elevation at survey sites range from 485 m to 622 m, and average canopy height ranges from 5 to 9 m.

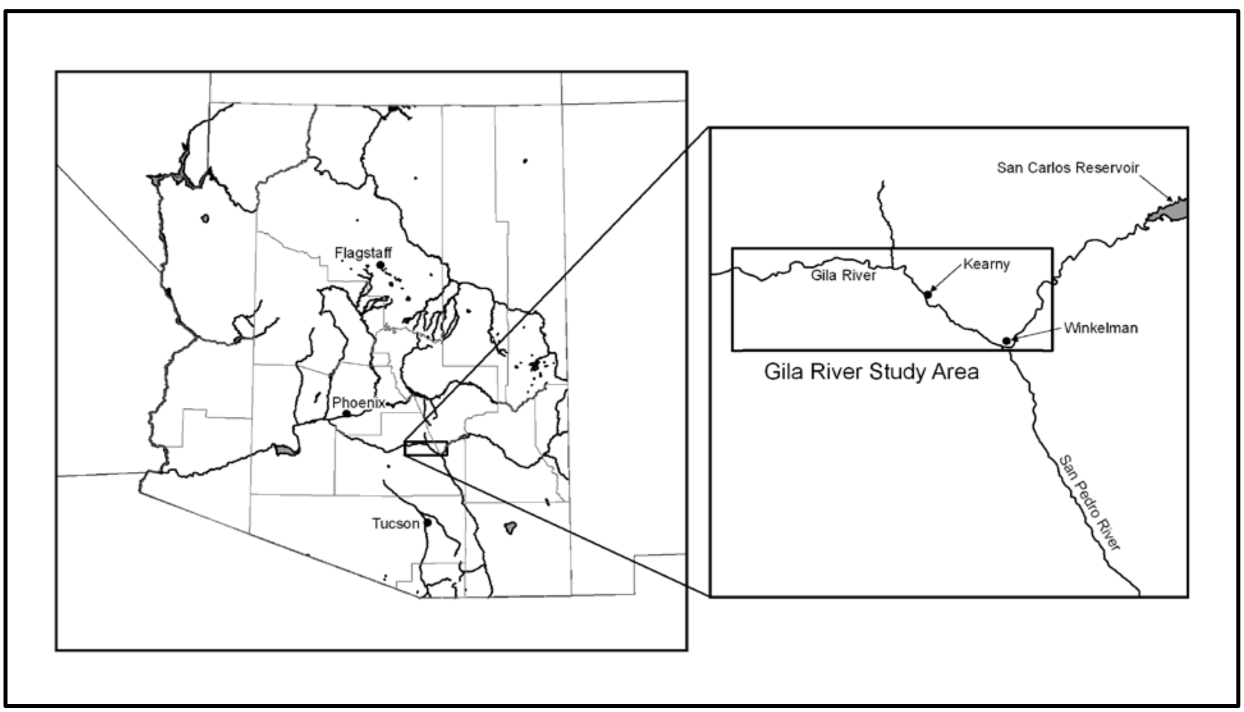

Figure 2. Project area for 2011 Southwestern willow flycatcher surveys, Gila River, Arizona.

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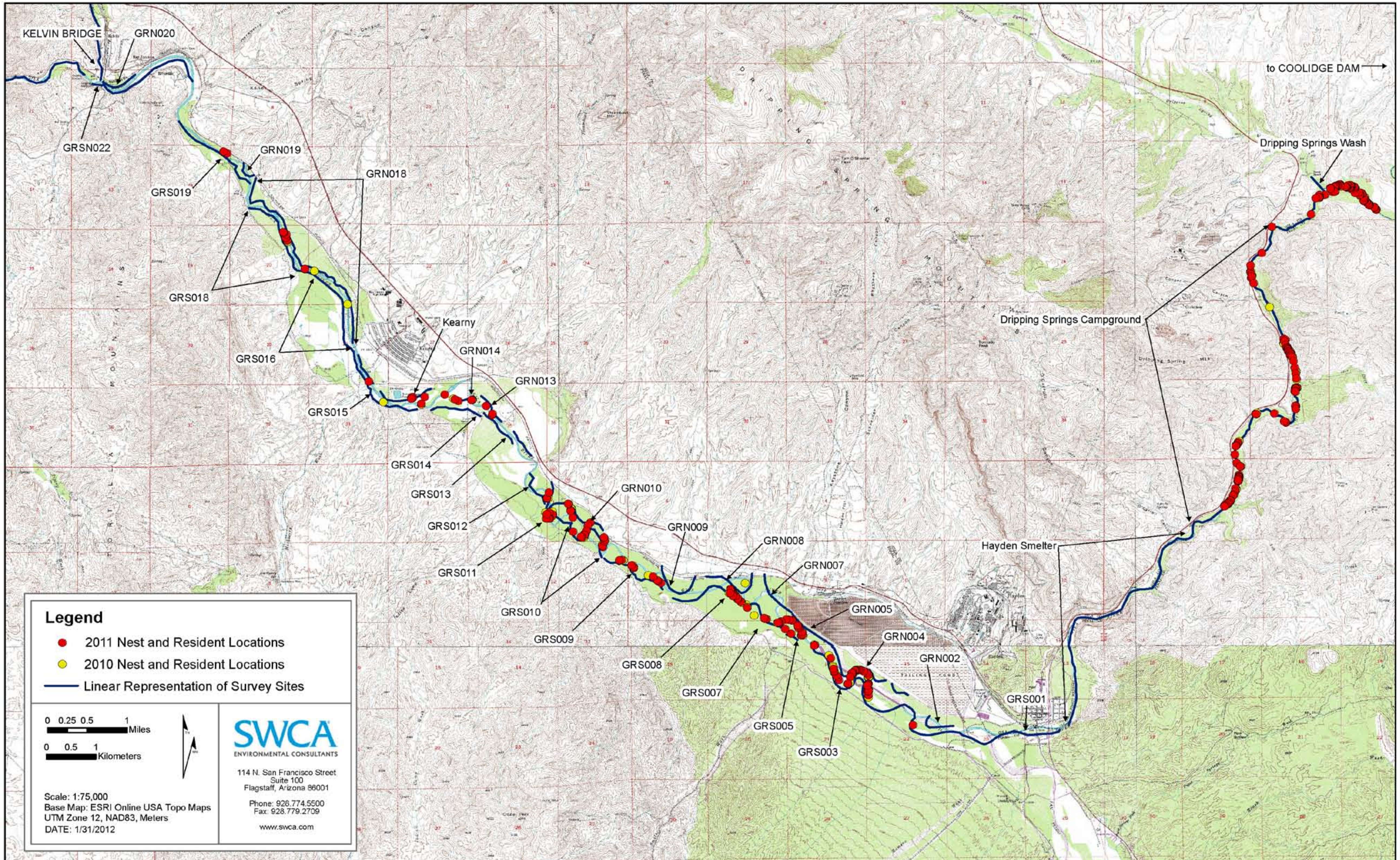

Figure 3. Gila Study Area between Dripping Springs Wash and the Kelvin Bridge depicting 2010-2011 nest and resident locations.

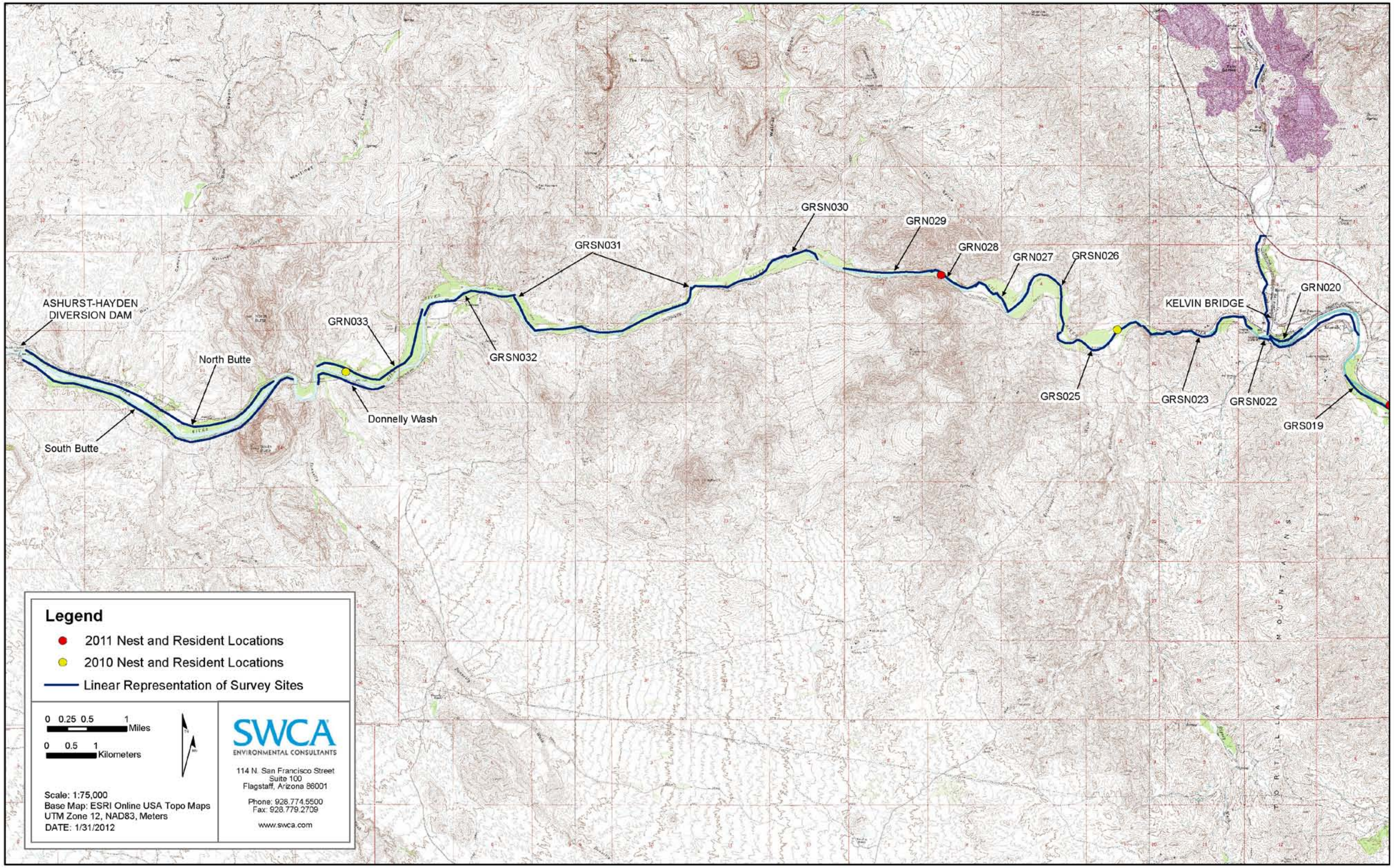

Figure 4. Gila Study Area between the Kelvin Bridge and the Ashurst-Hayden Diversion Dam depicting 2008-2011 nest and resident locations.

SURVEYS, DETECTIONS, AND DISTRIBUTION

Site Selection

Prior to the initiation of field studies, Reclamation sent letters to private landowners requesting access. Landowner permission was acquired for all survey sites and access points.

In coordination with Reclamation, survey sites were evaluated and selected using a combination of existing knowledge, field reconnaissance, and high-resolution aerial photographs. Surveys were not conducted in habitat determined to be unsuitable for flycatchers after initial field reconnaissance. All sites within the project area were visited at least once, with habitat assessments conducted to determine suitability for flycatchers. Sites were determined to be unsuitable if vegetation clearly lacked the structural complexity necessary to support flycatchers (e.g., vegetation was dead or habitat was too narrow, such as 1–2 trees wide with sparse foliage). Sites consisting of mature native or exotic woody riparian vegetation with high canopy closure (> 50%), dense mid-story vegetation in the 2- to 5-m range, and standing water or saturated soil under or adjacent to the vegetation were considered to be the most suitable habitats for flycatchers (Sogge et al. 2010). Early successional stands of young riparian vegetation ≥ 3 m in height in proximity to surface water or saturated soil were also considered suitable flycatcher habitat (Sogge et al. 2010).

Survey Technique

For most sites, we completed a minimum of three broadcast surveys at each site deemed potentially suitable, as recommended in the USFWS Southwestern Willow Flycatcher Protocol (USFWS 2000), and general survey methods outlined in Sogge et al. (2010). Exceptions included sites deemed marginally suitable for supporting flycatchers and/or sites inaccessible on foot or by boat (e.g., low streamflows, flooding). For the sites for which at least three surveys were completed, surveys were conducted as follows: at least one survey between 15 and 31 May, at least one survey between 1 and 21 June, and at least one survey between 22 June and 17 July. All complete-site surveys were spaced a minimum of 5 days apart; within a survey period, several sites required partial surveys over multiple consecutive days. We conducted additional site visits as part of territory/nest monitoring throughout the breeding season—with some sites visited more frequently than others—to determine territory numbers and locations, and the presence of pairs.

To minimize time-of-day effect (i.e., varying rates of detectability due to changes in activity levels or other behavioral traits), surveys were conducted primarily between 60 minutes before sunrise and 10:00 am, and we used broadcasts of recorded conspecific vocalizations to elicit responses from flycatchers. The standard broadcast used for flycatcher surveys consisted of a series of *fitz-bew* (primary song) and *britt* calls. The call sequence at each survey point consisted of a 10- to 20-second pre-broadcast listening period, a 15- to 30-second broadcast period, and a 1- to 2-minute listening period. Additional vocalizations (*whitt*, *wheeo*, *brrr/kitter*, and interaction calls) were also included on the survey recording. These vocalizations were used to try to elicit a *fitz-bew* response, which was used to confirm the bird as a willow flycatcher, from *Empidonax* flycatchers that were silent or that had not given a diagnostic *fitz-bew* call (Sogge et al. 2010). Wherever possible, surveys were conducted from the interior of the site, with broadcasts occurring approximately every 30 m. In the few cases where surveys within the site were difficult or inefficient because of extremely dense vegetation, surveys occurred along the periphery of the site.

Field personnel combined walking and boat (kayak) survey transects in all potentially suitable flycatcher habitats adjacent to and on the terrace above the Gila River. Sites away from the river's edge were surveyed on foot alone, sites with substantial interior habitat as well as habitat adjacent to the river were surveyed on foot and by boat, and sites consisting of only narrow and linear riparian vegetation (3–6 trees wide) along the river were surveyed by boat alone. For broadcast surveys conducted by boat, fast-moving current in some areas precluded broadcasts every 30 m; in these instances, we ensured full survey coverage by conducting supplemental foot surveys and additional site visits.

Although we attempted to locate all flycatchers within the Gila River study area, detection of all individuals is not the goal of the standardized survey protocol; the goal is to determine presence or absence and breeding status of flycatchers at a site. Detection probability may vary temporally, spatially, and with level of survey effort (Rosenstock et al. 2002; Thompson 2002). Therefore, our numbers may not reflect all individuals present in the population. By combining standardized surveys with territory/nest monitoring (see 'Nest Monitoring' methods below) with the expanded goal of determining distribution and abundance at the study area, our results are more detailed (i.e., higher detection probability) relative to the majority of other surveys conducted in the flycatcher's range—which typically adhere to the minimum requirements of the survey protocol. Combining methods allows for comparisons of territory, lone male, and pair numbers in 2011 with previous years of this study (with the assumption that search area, surveyor skill, and effort were similar in other years of the study).

Flycatcher Residency and Breeding Status

When a willow flycatcher was detected, field personnel attempted to locate the bird visually, focusing on determining whether the bird had leg bands, and recording the band combination if the bird was banded. Field personnel also noted general behavior of the bird, focusing on documenting evidence of territorial and breeding behavior (e.g., extended, unsolicited song; counter-singing with a neighboring male; pair interaction twitter calls or presence of an unchallenged flycatcher within a known male territory [indicating female present]; soft *whitt* calls between two flycatchers; or any behavior that would indicate nesting, such as a flycatcher repeatedly *whitting* in a specific location or carrying nesting material or food). Using a handheld global positioning system (GPS) unit, field personnel recorded the Universal Transverse Mercator (UTM) coordinates of each flycatcher detected, or, if the location of the flycatcher was not accessible, the location of the observer along with distance and direction to the responding bird; a flag was also placed in a visible location for ease in locating the territory in subsequent visits. Wherever a territorial flycatcher was detected, further visits to that area focused on territory and nest monitoring (see below). Subsequent broadcast surveys were not conducted in that immediate area to minimize disturbance to known territorial or breeding birds; we continued to survey portions of a site not determined to be occupied by territorial flycatchers.

Flycatchers were considered territorial or resident within a site if detected within the 15 June and 20 July "residency window," regardless of whether a possible or known mate was observed. Additionally, flycatchers were considered territorial if observations of nesting activity or nests were found before or after the "residency window." Flycatchers documented prior to 15 June but not detected in subsequent visits were considered migrants.[1] Flycatchers detected during the first few days of the "residency window" were also considered migrants based on additional field observations (i.e., they were not seen on repeated visits). An "unknown" designation was given to birds if not enough information was available to determine resident or migrant status or if questions arose regarding inability to distinguish neighboring territories.[2] In instances where polygyny[3] was detected, we considered each female to be a distinct "territory."

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[1] This definition for "migrant" could also include resident floaters (non-territorial adults) or adults that are later detected as residents in the study area at a different location after they settle at a site.

[2] This definition for "unknown" could also include resident floaters or territorial flycatchers detected outside the bounds of their known territory.

Site Descriptions

For each survey site, surveyors recorded and provided all required information on standardized USFWS-approved survey and detection forms (Sogge et al. 2010; Appendix A). Surveyors recorded the overall vegetation type of the site (native broadleaf, > 90% native; mixed native and exotic, 50%–90% native; mixed exotic and native, 50%–90% exotic; or exotic, > 90% exotic); management authority, entity, or owner of survey site; length of area surveyed; 2–3 predominant trees/shrubs; and average canopy height. Site descriptions included a detailed narrative description of the site and surrounding areas. Per Sogge et al. (2010), surveyors also noted potential threats to flycatcher habitat and breeding activities (e.g., presence of livestock, brown-headed cowbirds, or tamarisk beetles [*Diorhabda* spp.]).

Interim Survey Updates

At the end of each of the three survey periods, we submitted typewritten reports summarizing all field and post-field activities to Reclamation. These reports were in the form of an e-mail field update and summarized flycatcher detections, residency, and breeding data by site, as well as any issues or concerns (e.g., loss of sites due to fire).

Survey Data

All survey data were recorded on standardized USFWS-approved survey and detection forms (Appendix A). Site names remained consistent with those used during previous years of the study, and all sites were geographically defined using start and stop UTM coordinates and previously used site codes and names. Copies of completed survey and detection forms were submitted to USFWS and AGFD.

NEST MONITORING

Nest Monitoring Technique

Once a territorial flycatcher was detected as part of surveys, territory and nest monitoring commenced following methods described by Rourke et al. (1999) and Martin et al. (1997). In general, at select sites, territories consisting only of a lone male were monitored every 4 days, whereas territories consisting of pairs were monitored every 2–8 days, depending on nest stage and logistics. In 2011, we focused territory/nest monitoring efforts at a subset of sites supporting the highest densities of flycatchers: Dripping Springs Wash, Dripping Springs Campground, GRS003, GRN008, GRS010, GRN010, GRS011, GRN011, and GRS012; territories at other sites were monitored opportunistically (every 4–20 days). This change in effort relative to previous years of the study—when most territories and nests were monitored consistently to determine residency, pair, and breeding status and nest success—was due to the early detection in 2011 of a large increase in flycatcher territories relative to personnel hours available (see ‘Nest Monitoring’ discussion); this change in effort was coordinated with Reclamation in early June when flycatchers were still arriving from the wintering grounds.

Nests were located primarily by observing adult flycatchers return to a nest or by systematically searching suspected nest sites (most often indicated by *whitts* or pair interaction twitter calls). Nest stage was generally determined by observing female behavior from a distance with binoculars—such observations allowed us to narrow down stages to early building, late building or laying, incubation, young nestling

[3] Polygyny was defined as one male associated with two or more nesting females; the presence of only one male in the female territories was confirmed throughout multiple nest monitoring visits.

(< 8 days old), and old nestling (> 8 days old). Observing nests from afar reduced the risk of depredation (Martin et al. 1997), brood parasitism by the brown-headed cowbird, and premature fledging of young (Rourke et al. 1999). During incubation and after hatching, specific nest contents (i.e., number of eggs, number and age of nestlings) were observed directly using a telescoping mirror pole to determine nest contents and transition dates unless nestling(s) > 8 days old were expected based on previous nest monitoring visits or observed from afar when the nest was found. Nest monitoring during nest building and egg laying stages was limited—if the pre-incubation stage was unclear (i.e., late building or laying), nests were checked quickly when the female was out of sight—to reduce the chance of abandonment during these periods. Nests too high to be monitored with a mirror pole were observed with binoculars, and adult behavior, along with observation of any young in the nest, were used to determine nest stage. If no activity was observed at a previously occupied nest, the nest was checked directly to determine nest contents and cause of failure. If no activity was observed at a nest close to or on the estimated fledge date, we conducted a systematic search of the area to locate possible fledglings.

A nest was considered successful if any of the following four conditions were documented: 1) one 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 dependent young were nearby (feeding trips, defensive behavior, and/or adults agitated) when the nest was empty; or 4) nestlings were observed in the nest within two days of the estimated fledge date (Rourke et al. 1999). Conditions three and four were not upheld if subsequent visits to the territory provided evidence that fledging did not occur. Two of the four conditions for success (three and four) could lead to overestimates of nest success; however, not including these conditions could lead to underestimations. To minimize differences between actual and predicted nest fates, we made every attempt to locate fledglings during follow up visits and planned visits around estimated fledge dates.

A nest was considered failed if any of the following six outcomes were documented: 1) depredated: the nest was found empty or destroyed more than 2 days prior to the estimated fledge date; 2) parasitized: the nest fledged no flycatcher young but contained cowbird eggs or young (parasitized nests were called depredated if the depredated definition was met, unless host eggs or nestlings failed presumably due to parasitism prior to the depredation event); 3) deserted: the nest was deserted with eggs remaining; 4) abandoned: the nest was abandoned prior to documented egg laying; 5) weather: the nest was destroyed, eggs addled, or nestlings dead due to storm, flooding, fire, or heat exposure; or 6) infertile: the entire clutch was incubated unsuccessfully for more than 20 days.

An "unknown outcome" was designated if success or failure could not be determined. All failed nests were inspected to determine the condition of the nest and to record the presence of eggs, eggshells, or dead nestlings in or around the nest. These data were used to aid in determining the stage and cause of nest failure.

Mayfield nest success (Mayfield 1961, 1975) was calculated for the study area. Exposure days were determined using the midpoint method for failed and successful nests and the last active date for nests of unknown fate, because this method has been demonstrated to provide the least biased Mayfield estimate (Manolis et al. 2000).

We calculated female productivity and fecundity for the study area. We excluded females that 1) were not monitored consistently throughout the breeding season, and/or 2) had a first nesting attempt with an estimated first-egg day after 11 June. Excluding these females provided a sub-sample for which we could be confident that no successful nesting attempts were missed. We used an 11 June cutoff date because Ellis et al. (2008) reported 10 June ± 1.2 days as a 10-year mean first-egg day for first nesting attempts (Ellis et al.'s [2008] study included Gila and San Pedro rivers and Roosevelt Lake populations). Ellis et al. (2008) reported 12 June as the earliest fledge date in their long-term study.

Nest Monitoring Data

All nest monitoring data were recorded on standardized data sheets (territory/nest record forms; Appendix A). Site names remained consistent with those used during previous years of the study, and all nest locations were recorded using UTM coordinates. Copies of the territory/nest record forms were submitted to USFWS and AGFD.

DOCUMENTATION OF REGENERATION AND LOSS OF FLYCATCHER HABITAT

For several years, documentation of the regeneration and loss of flycatcher habitat within the project area has been a part of annual reporting (see Graber et al. 2007; Weddle et al. 2007; Graber and Koronkiewicz 2009*a*, 2009*b*, 2011). We followed up on these topics, highlighting the response of flycatchers to any habitat change within the project area. In 2008, we implemented photo points at a subset of known flycatcher breeding sites to further examine future losses and regeneration of habitat and corresponding fluctuations in flycatcher numbers. From 2009–2011, we continued this effort.

HYDROLOGIC CHARACTERISTICS

Per the methods of Weddle et al. (2007), we evaluated the influence of variation in streamflow on the abundance of flycatchers in the Gila River study area. This enabled comparisons of hydrologic and flycatcher occupancy data from previous years of study (1997–2010) within the study area with 2011 data. We performed a series of linear regressions on the number of flycatcher territories per breeding season in relation to Gila River streamflow from 1997 to 2010.

Condition of habitat at the time of flycatcher settlement (late April to early June) is likely an important determining factor of flycatcher occupancy at sites. The Arizona Sonoran Desert experiences a bimodal rainfall pattern 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; Diem and Brown 2006); at least 50% of this region's annual precipitation occurs between July and September (Adams 1997). Surface water and groundwater availability (influenced by rainfall and dam discharge) have been found to 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 concur with Weddle et al. (2007) that there could be cumulative improvement of riparian habitat along the Gila River with increased streamflow prior to flycatcher settlement that could make the habitat more appealing to flycatchers and increase occupancy. However, the exact time period of increased streamflow that is important for the development and persistence of suitable flycatcher habitat is unknown. Therefore, we performed regressions on streamflow over a variety of time periods:

a. Annual streamflow (i.e., May 1997–April 1998, May 1998–April 1999, etc.);

b. Beginning of previous monsoon season to the beginning of the flycatcher breeding season (i.e., July 1997–April 1998, July 1998–April 1999, etc.);

c. Streamflow during flycatcher settlement/migration (April–June) for the current and previous year;

d. Breeding season streamflow (April–August) for the current and previous year;

e. Winter and spring streamflow (December–March);

f. Fall through winter streamflow (October–March); and

g. Fall streamflow (October–November).

We used mean monthly Gila River streamflow data collected at USGS gaging stations located upstream (Gaging Station #09469500, Gila River Below Coolidge Dam; USGS 2012) and downstream (Gaging Station #09474000, Gila River at Kelvin; USGS 2012) of breeding flycatchers. When mean monthly data was not available, we calculated monthly means using daily data provided on the USGS site. Mean monthly streamflow data collected at each of the two gaging stations were averaged per month yielding combined mean monthly streamflow (Appendix B). To perform linear regressions, combined mean monthly streamflow was summed for each of the above delineations of time.

RESULTS

SURVEYS, DETECTIONS, AND DISTRIBUTION

From 15 May to 17 July 2011, SWCA biologists spent 367 hours[4] surveying 53 sites covering approximately 100 linear km of riparian habitat. One of the sites, Hayden Smelter, was established as a new survey site for the study area (Figure 3). We detected 359 resident flycatchers occupying 188 territories (183 pairs) at 30 sites (Table 1; Appendix C). Resident flycatchers were detected for the first time—since surveys began in the late 1990s—at six sites: GRN002, GRS006, GRN013, GRN019, GRS019, and GRN028. Among sites that were surveyed in both 2010 and 2011, there were three sites that had at least one resident flycatcher in 2010 but no residents in 2011 (GRS016, GRS025, and GRN033), and seven sites that had at least one resident flycatcher in 2011 but no residents in 2010 (GRN002, GRS006, GRN013, GRS014, GRN019, GRS019, and GRN028). We detected 13 migrant flycatchers at 10 sites: Dripping Springs Campground, GRS001, GRS003, GRS004, GRN005, GRN008, GRN009, GRS014, GRS016, and GRN018 (Appendix C). Eight of the 10 sites where migrant flycatchers were detected also supported breeding flycatchers (Dripping Springs Campground, GRS003, GRS004, GRN005, GRN008, GRN009, GRS014, GRS016, and GRN018). There were 14 flycatchers of unknown status documented at nine sites: Dripping Springs Wash, Dripping Springs Campground, GRN004, GRS004, GRN005, GRS007, GRN009, GRS011, and GRS018 (Appendix C).

As required by the survey protocol (USFWS 2000; Sogge et al. 2010), we documented potential threats at each survey site during surveys. We documented cowbirds and livestock (or signs of livestock) at each of the 53 survey sites. Tamarisk beetles were not detected in the study area. Additional threats—including raptor species and other nest predators detected at each site—are included in the survey forms submitted to USFWS and AGFD.

Table 1. Southwestern Willow Flycatcher Survey Effort, Detections, and Nesting Attempts at the Gila River Study Area, 2011

Survey hours	367
Sites surveyed	53
Linear km of habitat covered	100
Sites with resident flycatchers	30
Sites with documented pairs	29
Sites with documented breeding	27
Resident flycatchers	359
Territories	188
Pairs	183
Nesting attempts	274
Sites with cowbirds detected	53
Breeding sites with cowbirds detected	27

[4] Flycatchers are also detected during nest/territory monitoring visits. In 2011, we detected 148 territories during 367 hours of standardized surveys and 40 additional territories during approximately 2,213 additional hours of territory/nest monitoring.

NEST MONITORING

From 15 May to 22 August 2011 SWCA biologists spent approximately 2,213 hours monitoring territories and nests. We detected 274 nesting attempts at 27 sites (Table 2; Appendix C); 158 nests were found in building stage, 26 in laying stage, 56 in incubation stage, seven in nestling stage, 14 after fledging, one immediately after failure, and 12 with stage unknown. Of the 274 nesting attempts, 202 nests were documented containing flycatcher eggs or nestlings and were used in calculating nest success and productivity; four additional nests contained a flycatcher and/or cowbird egg but were not monitored effectively to be included in nest success and productivity calculations. For nests where complete clutches could be confirmed (155), mean flycatcher clutch size was 2.52 eggs. The earliest observed occurrence of egg-laying was on 19 May at Dripping Springs Wash. The first hatching event was on 8 June at Dripping Springs Campground, followed by the first fledging event on 23 June at the same nest. The last documented fledging event occurred on 22 August at Dripping Springs Wash. There was one nest still active on the last day of monitoring (22 August); the nest contained nestlings and was projected to fledge on 27 August.

Nest Success

Of the 202 monitored nests, 82 (41%) fledged, 116 (57%) failed, and four (2%) had unknown outcomes. We were able to determine exposure days to calculate Mayfield nest survival probability (Mayfield 1961, 1975; Manolis et al. 2000) for each of the 202 monitored nests. We calculated[5] a 36% chance that a flycatcher nest fledged at least one young (Appendix D).

Depredation was the major cause of nest failure, accounting for 55% of all failed nests (Table 3). More predation events occurred in egg (55%) than nestling stage (45%); however, several nests were depredated close to the predicted hatching date, and some of the nests estimated to be in egg stage may have been in nestling stage at the time of the predation event. Specific nest predators were not identified.

Nest and Female Productivity

We estimated 159 young fledged from 82 of 202 nests used for calculating Mayfield nest success (Appendix D). This fledgling total excludes those associated with nests (n = 13) found after a fledging event (25 additional confirmed fledglings). Of the young presumed to have fledged, we were able to confirm 85% left the nest (i.e., confirmed fledglings were either seen leaving the nest, seen in the area directly around the nest, or seen associating with adults from the nest). The remaining fledglings (15%) were presumed fledged if they were siblings of confirmed fledglings (and were alive prior to the outcome determination) or the nest they were associated with met the conditions for success (e.g., defensive or feeding behavior by adults, nestlings observed 2 days prior to the estimated fledge date).

Average seasonal fecundity (mean fledges per monitored female) was 1.26 and average seasonal productivity (mean fledges per nesting attempt per monitored female) was 0.78. Among 65 monitored females, we documented 13 (20%) with one nesting attempt, 33 (51%) with two nesting attempts, 17 (26%) with three nesting attempts, and two (3%) with four nesting attempts. Two females (one monitored and one non-monitored) renested in the same nest cup as an earlier attempt. Of the 52 females with renesting attempts, four attempted a double-brood (nesting attempt following a successful nest); one of the four double-brooded successfully (one non-monitored female also double-brooded successfully). Twenty-seven of the 65 monitored females failed to fledge any young.

[5] Daily survival probability = 1 – (failed nests/exposure days). Survival probability for nesting period = daily survival probability$^{\text{nesting period}}$; nesting period = 28 days (Ellis et al. 2008).

Table 2. Results of Nesting Attempts at the Gila River Study Area, 2011

Site	Pairs	Nests	Successful Nests	Failed Nests	Unknown Outcome*
GRS019	1	1	1	0	0
GRN019	1	1	1	0	0
GRN018	2	2	2	0	0
GRS018	3	5	1	3	1
GRS015	1	1	1	0	0
Kearny	1	2	0	1	1
GRS014	2	2	1	1	0
GRN014	4	4	2	2	0
GRN013	1	2	0	2	0
GRS012	2	3	1	2	0
GRN011	3	3	0	2	1
GRS011	4	4	0	4	0
GRN010[§]	2	5	0	5	0
GRS010	9	9	3	6	0
GRS009	4	3	0	3	0
GRN009	3	4	1	3	0
GRS008	2	0	0	0	0
GRN008	7	12	2	10	0
GRS007	2	2	1	1	0
GRN007	5	5	3	2	0
GRS006	1	0	0	0	0
GRS005	2	1	0	1	0
GRN005[†‡]	5	8	1	6	1
GRS004	1	1	1	0	0
GRN004	8	11	1	9	1
GRS003	13	22	4	18	0
GRN002	1	1	0	1	0
Dripping Springs Campground	59	92	47	44	1
Dripping Springs Wash	34	68	21	46	1
Total	**183**	**274**	**95**	**172**	**7**

Table note: Includes non-monitored nests.
***** Nests monitored for only a portion of the nesting cycle or insufficient evidence for determining outcome.
[†] A nesting pair assigned to GRS004 (territory 39) placed nests at both GRS004 and GRN005; this pair is not counted under the column for 'Pairs' for GRN005 to avoid double counting.
[‡] A nesting pair assigned to GRS005 (territory 107) placed nests at both GRS005 and GRN005; this pair is not counted under the column for 'Pairs' for GRN005 to avoid double counting.
[§] A nesting pair assigned to GRS010 (territory 3) placed nests at both GRS010 and GRN010; this pair is not counted under the column for 'Pairs' for GRN010 to avoid double counting.

Table 3. Causes of Nest Failure at the Gila River Study Area, 2011

Site	Depredated	Deserted*	Abandoned[†]	Parasitized	Other[‡]
GRS018	0	0	0	1	2
Kearny	1	0	0	0	0
GRS014	1	0	0	0	0
GRN014	0	0	0	0	2
GRN013	2	0	0	0	0
GRS012	1	1	0	0	0
GRN011	1	0	0	0	1
GRS011	1	1	0	0	2
GRN010	3	0	0	0	2
GRS010	2	0	0	0	4
GRS009	2	0	0	1	0
GRN009	2	0	0	0	1
GRN008	6	0	2	0	2
GRS007	1	0	0	0	0
GRN007	2	0	0	0	0
GRS005	1	0	0	0	0
GRN005	3	2	1	0	0
GRN004	2	1	2	0	4
GRS003	12	0	2	0	4
GRN002	1	0	0	0	0
Dripping Springs Campground	23	1	10	1	9
Dripping Springs Wash	28	5	6	3	4
Total	**95**	**11**	**23**	**6**	**37**

Table note: Includes non-monitored nests; monitored nests that failed include the “Deserted” and “Parasitized” categories, 93 nests in the “Depredated” category and six nests in the “Other” category; categories defined above in Methods: Nest Monitoring.
* Nest deserted after egg-laying.
[†] Nest abandoned prior to egg-laying.
[‡] Nest failed due to unknown causes or failure cannot be categorized (i.e., unclear whether abandoned or depredated).

Parasitism

Brown-headed cowbird parasitism was confirmed for the third consecutive year at the Gila River study area after not being confirmed since 2004 (Ellis et al. 2008). Parasitism was confirmed at 21 (10%) of the 202 monitored nests; there was one additional monitored nest for which a possible cowbird egg could not be confirmed. Among the 21 monitored nests for which parasitism was confirmed, nest outcomes were: depredated (n = 6), deserted due to parasitism (n = 6), failure due to other, or unknown, causes (n = 3), fledged host young (n = 5), and unknown outcome (n = 1). Among the four nests for which host young fledged, two also fledged a cowbird young, two contained an un-hatched cowbird egg, and one contained a cowbird nestling which may have fledged but the fledgling could not be confirmed. Additionally, among monitored nests, we detected two instances in which a cowbird egg was laid post-failure. Cowbird eggs were also detected in non-monitored nests (n = 2) and possible nesting attempts (n = 3) that may have been earlier failed attempts. A cowbird nestling, cowbird fledgling, and a possible cowbird egg were also detected in non-monitored nests. Cowbirds may have contributed to nest failures (e.g., abandonment, desertion, and depredation) at other nests, but direct evidence was not found.

While bronzed cowbirds (*Molothrus aeneus*) were detected within flycatcher territories along the Gila River study area in 2011, including within a territory documented with brown-headed cowbird parasitism, we did not detect bronzed cowbird parasitism of flycatcher nests.

HABITAT AND HYDROLOGIC CHARACTERISTICS

General vegetation characteristics at breeding sites were characterized as mixed native and exotic associations; however, the amount of tamarisk varied within and among sites. Most breeding sites were composed of dense monotypic stands of tamarisk (> 90% exotic); however, territories were often situated in areas consisting of mixed native and tamarisk trees (50%–90% exotic). Older breeding sites (e.g., Kearny, GRS018, and GRN018) contained mature tamarisk, Goodding's willow, and Fremont cottonwood (50%–90% exotic), forming a nearly continuous closed canopy (overstory), while newer breeding sites (e.g., Dripping Springs Wash, GRS003, and GRN008) were primarily composed of dense young tamarisk lacking a mature overstory. Although vegetation composition and structure varied, all sites were adjacent to flowing or standing water during the breeding season.

Nesting Substrate Characterization

Nesting substrate was documented for 262 of the 274 nesting attempts at the Gila River study area. All nests were placed in tamarisk. Mean nest height was 3.7 m.

Streamflow and Number of Flycatcher Territories

All linear regressions showed a positive relationship between Gila River streamflow and the number of flycatcher territories. Two time periods shared the strongest relationship to the number of territories: annual streamflow (May–April; R^2 = 0.36, t = 2.62, P = 0.02) and April–June streamflow from the previous year (R^2 = 0.36, t = 2.58, P = 0.02), both explaining 36% of the variation in flycatcher territories from 1998 to 2011. The 10-month period from the beginning of the previous monsoon season to the beginning of the breeding season (July–April) had a fairly strong relationship to the number of territories (R^2 = 0.33, t = 2.46, P = 0.03), as did breeding season (April–August) streamflow from the previous breeding season (R^2 = 0.31, t = 2.32, P = 0.04).

Fall streamflow (October–November) and fall through winter streamflow (October–March) each had a comparatively weak relationship with the number of territories (R^2 = 0.27, t = 2.11, P = 0.06; R^2 = 0.25, t = 2.01, P = 0.07. Winter–spring streamflow (December–March), streamflow during flycatcher settlement in spring (April–June), and breeding season streamflow (April–August), had no relationship on the number of territories (R^2 = 0.18, t = 1.64, P = 0.13; R^2 = 0.03, t = 0.61, P = 0.55; R^2 = 0.01, t = 0.44, P = 0.67).

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DISCUSSION

For the third consecutive year, we documented the largest number of resident territories and young produced at the Gila River study area. Since studies related to the 1996 Biological Opinion on Roosevelt Dam (USFWS 1996) ended in 2006, we have observed a 382% increase in territories, highlighting the importance of continuing to monitor this population. Continued monitoring effort will assist in assessing further flycatcher response to variable annual and seasonal streamflow on the Gila River. Flycatcher habitat historically scours out and regenerates frequently (USFWS 2002). As we have observed at several sites at the Gila River study area, unsuitable habitat may become suitable within a few years with an increase of streamflow. Habitat at sites now occupied by flycatchers was considered unsuitable as recently as 2004. If streamflow continues to be favorable on the Gila River, future surveys may document flycatchers returning to previously occupied or new sites as habitat develops. Alternatively, reduced streamflow may result in lower nesting success and fewer territories and occupied sites as habitat conditions worsen.

SURVEYS, DETECTIONS, AND DISTRIBUTION

Future water exchanges involving the San Carlos Apache Tribe and downstream water users and construction activities near the Ashurst-Hayden Diversion Dam have the potential to decrease releases from Coolidge Dam that would otherwise flow downstream in the Gila River study area. Decreased Gila River streamflow can modify existing and potential flycatcher breeding habitat and therefore has the potential to modify flycatcher abundance, distribution, and nesting success (Graf et al. 2002). From 2002 to 2004, decreased releases from Coolidge Dam resulted in the Gila River drying by June each year, and the number of flycatcher territories declined by nearly half each year (43% decline from 2002 to 2003 [46 to 26 territories], 46% decline from 2003 to 2004 [26 to 14 territories]; Munzer et al. 2005).[6] From 2005 to 2011, flows within the study area have been relatively consistent annually and throughout the flycatcher breeding season[7] (but see 'Nest Monitoring' discussion below). The number of flycatcher territories doubled from 2004 to 2005 (14 to 28 territories) and have continued to increase, with 39, 62, 63, 96, 138, and 188 territories recorded from 2006 to 2011, respectively. An overall increase of 174 flycatcher territories has been recorded since 2004 (Appendix E; Weddle et al. 2007, Graber and Koronkiewicz 2009*a*, 2009*b*, 2011), and this increase may be attributed to higher and more consistent annual flows over the past 7 years.

We detected more flycatcher territories in 2011 (188) than in any previous year of this study (surveys began in the early 1990s); previous highs were 138, 96, and 69 territories detected in 2010, 2009, and 1999, respectively (Appendix E). In 2011, we detected resident flycatchers at 30 sites, exceeding the previous high of 26 sites occupied in 2010. The largest increases were at Dripping Springs Campground (increased by 27 territories), Dripping Springs Wash (increased by six territories), GRS010 (increased by four territories), and GRS009 (increased by three territories) (Appendix F). The only decreases greater than one territory were at GRS011, GRN008, and GRS018 (decreased by three, two, and two territories, respectively; see 'Habitat and Hydrologic Characteristics' below regarding possible factors related to shifts in flycatcher abundance at specific sites).

In 2009, we suggested three factors related to annual flycatcher distribution and abundance driving the recent pattern of population growth within the study area (there are likely other environmental and

[6] Breeding season (May–August) mean streamflow at the Gila River study area from 2002–2004 was 95 cfs, compared with 560 cfs from 1997–2001 (see Appendix B for monthly mean data; USGS 2012).

[7] Breeding season (May–August) mean streamflow at the Gila River study area from 2005–2011 was 555 cfs (see Appendix B for mean monthly data; USGS 2012).

demographic factors contributing to the recent trend). Assuming annual survivorship remains constant, factors that stand out include 1) sustained annual productivity driving increased flycatcher recruitment, 2) continued habitat regeneration within the study area related to consistent and increased flows since 2005, and 3) potential decreased suitable flycatcher habitat in nearby locations.

While formal source-sink population studies were not conducted, intensive nest monitoring at the study area suggests sustained annual productivity may be driving consistent flycatcher recruitment. From 2002–2004, a time period when the lowest breeding season streamflows were recorded for this study, Mayfield nest success averaged 47% (with an average of 24 fledglings produced). In recent years (2005–2010) when steady and increased streamflows were recorded, Mayfield nest success was consistently above 60% (average 65%; with an average of 121 fledglings produced). The highest number of fledglings was produced for the fourth consecutive year in 2010 (Appendix D). While dispersal of first-year flycatchers is more extensive than adult birds (Sogge et al. 2010), we assume some of these birds are contributing to the continued population growth observed in 2011 along this 71-km stretch of river.

Only minor changes in habitat have been qualitatively observed within the study area since 2005. We assume the continued presence of surface water has aided subtle habitat regeneration directly adjacent to the main river channel at some sites, contributes to high fledgling production, and, hence, increased recruitment at the study area, and has potentially attracted flycatchers from other drainages or other reaches within the Gila River drainage.

Overall habitat condition and flycatcher population trend at historic breeding sites surrounding the study area is largely unknown as consistent and comprehensive area-wide surveys have not occurred in recent years at these locales (e.g., Roosevelt Lake and sites adjacent to Roosevelt Lake within the Tonto and Salt river drainages, San Carlos Reservoir and sites adjacent to the reservoir within the Gila River drainage [upstream of the Gila River study area], and sites downstream of the San Pedro River/Gila River confluence within the San Pedro River drainage). Limited data suggests that worsening conditions at some sites—combined with improving conditions along the Gila River study area—may be facilitating immigration into the study area. For example, Dudleyville Crossing, a site situated on The Nature Conservancy's San Pedro River Preserve 5 km south of the Gila River study area, supported 15 territories in 2005 (English et al. 2006). In recent years, the site has been drying atypically by June—apparently due to increased groundwater pumping adjacent to the preserve—and only four territories were documented in 2011 (personal communication, Celeste Andresen, The Nature Conservancy 2012). However, at sites farther upstream (south) along the San Pedro River, both increases and decreases in flycatcher territories have been recorded in recent years. Examples include Capgage Wash, a site located 23 km south of the Gila River study area, which has increased from 0–23 territories from 2005 to 2011 and San Manuel Crossing, a site located 35 km south of the Gila River study area, where drying of the river and a corresponding decline in flycatcher numbers has been observed at portions of the site (the site supported 67 territories in 2005; English et al. 2006; personal communication, R. Valencia, Salt River Project 2012).

Meanwhile, roughly 35 survey sites adjacent to Roosevelt Lake, situated 60 km north of the Gila River study area, supported 153 territories in 2005; this population has declined by roughly 50% as of 2011 (English et al. 2006; personal communication, A. Madara, U.S. Forest Service 2012). However, surveys in recent years, including in 2011, at these sites have not been comprehensive with far less survey effort (16 vs. 1–4 surveyors) relative to surveys in 2005 and prior to 2005. It is assumed that the decline at Roosevelt Lake is real and attributable to flooding of habitat associated with recent lake level increases. The lake was near full capacity during the 2011 breeding season, and flycatchers have been newly detected at some sites farther away from the lake within the Tonto and Salt river drainages (personal communication, R. Valencia, Salt River Project 2012; personal communication A. Madara, U.S. Forest Service 2012). No recent data exists for several historically occupied sites, as well as for sites assumed to support breeding flycatchers, in the vicinity of the Gila River study area. Ultimately, the extent of flycatcher emigration from nearby drainages, within the Gila River drainage, or even from sites farther away within the subspecies' range is unknown.

At the Gila River study area, in 2011, it is worth noting that our survey hours increased substantially relative to 2010 (174-hour increase; Graber and Koronkiewicz 2011). This was partially due to how survey hours are calculated for kayak surveys: when surveyors are spaced apart (> 100 m) and visiting different territories, then man hours for each surveyor are summed. Whereas, when surveyors are primarily working together, man hours for each survey team are summed. The increase in territories in 2011 dictated a need for surveyors to work more independently. Additionally, several kayak stretches that had been one-day surveys in recent years were split into two or more days in 2011 to account for requirements of the survey protocol (e.g., conduct surveys prior to 10:00 am). We also used an additional surveyor in 2011 during a portion (3 weeks) of the breeding season.

NEST MONITORING

From 2009 to 2011, we conducted intensive flycatcher nest searching and monitoring until the end of the flycatcher breeding season (22 August), allowing us to determine total number of nesting and renesting attempts, nest fate (success or failure), causes of nest failure, brood parasitism rate, Mayfield nest success, seasonal fecundity, and average seasonal productivity. It is worth noting that nest monitoring effort in 2007 and 2008 was abbreviated relative to other years of the study: occurring until 31 July rather than when the last nest fledged or failed (typically in late August). Therefore, nest monitoring metrics collected in 2007 and 2008 are not directly comparable with results from previous years and are not presented in this discussion. It is also worth noting that among other years of the study (1997–2006 and 2009–2011), precision in data collection—for both survey and nest data—has undoubtedly varied from year to year, dictated by such variables as observer experience, observer skill, in-season data management and organization, crew leadership, logistics implemented to conduct data collection (i.e., kayak vs. pedestrian surveys), and effort (i.e., survey and nest monitoring hours vs. number of actual territories and nests); this subject is expanded upon in the 'Considerations' discussion below. Regardless, it is assumed that data collected from 1997–2006 and 2009–2011 are comparable.

Intensive territory and nest monitoring in 2011 resulted in the recording of 274 flycatcher nesting attempts, more than in any previous year of this study; previous highs were 206, 133, and 95 nesting attempts detected in 2010, 2009, and 2008, respectively.

Results of several productivity measures calculated for 2011 were low, relative to those documented in recent years and by a 10-year flycatcher study by Ellis et al. (2008) that combined multiple study areas, including the Gila River study area: simple nest success, Mayfield nest success, average seasonal fecundity, double-brood attempts, hatching success, and mean clutch size. Ellis et al. (2008) reported an average 56% simple nest success over 10 years (range: 24%–68%); and we recorded simple nest success of 64% and 66% in 2009 and 2010, respectively (Graber and Koronkiewicz 2009*b*, 2011). In 2011, simple nest success was 36%, which is also below the reported range for open-cup nesting songbirds (40%–77%; reviewed in Nice 1957). Mayfield nest success in 2011 was 36%, also well below the 10-year mean reported by Ellis et al. (2008) and by Graber and Koronkiewicz (2009*b*, 2011) in recent years. Mayfield nest success over 10 years ranged from 35% to 100% (mean 62%); and we reported 66% and 62% in 2009 and 2010, respectively (Graber and Koronkiewicz 2009*b*, 2011).

Average seasonal fecundity in 2011 was 1.26, lower than the 10-year mean (1.96) and well lower than that recorded in recent years (2.82 in 2010, 2.40 in 2009, and 2.80 in 2007). Mean number of young fledged per nest (0.79) and mean number of young fledged per successful nest (1.94) in 2011 were the lowest documented for this study area (Appendix D). Mean number of young fledged per nest was < 1 in only one other year of the study: 2002, and mean number of young fledged per successful nest was < 2 for the first time.

In 2011, 20% of females with a successful first attempt made a double-brood attempt (only one female successfully double-brooded). Ellis et al. (2008) reported, on average, 44% of females with a successful first attempt made a double-brood attempt (among Gila River study area females over 10 years). Hatching success for eggs that survived incubation period—an indicator of resource availability—was 78% in 2011. Ellis et al. (2008) reported hatching success averaged 86% (for all AGFD study sites over 10 years), and we reported an average of 88% in recent years (Graber and Koronkiewicz 2009*b*, 2011). Another indicator of resource availability, mean clutch size, was slightly lower in 2011 (2.52), compared with the 10-year mean reported by Ellis et al. (2008; 2.80) and in recent years of this project (2.74 and 2.81 in 2009 and 2010, respectively; Graber and Koronkiewicz 2009*b*, 2011).

For the eighth consecutive year, there was no brown-headed cowbird trapping at the Gila River study area. Cowbird parasitism was confirmed for the third consecutive year after no cowbird eggs or nestlings were confirmed from 2005 to 2008 (i.e., 0% parasitism from 2005 to 2008; Weddle et al. 2007; Ellis et al. 2008; Graber and Koronkiewicz 2009*a*). In 2011, 10% of monitored nests were parasitized (documented with cowbird eggs or nestlings)—the highest parasitism rate recorded for this study area—and 27% of parasitized nests failed due to parasitism. Parasitism rates at the Gila River study area have been low in other years of the study (3% overall parasitism rate among AGFD study populations; Ellis et al. 2008). Moderate to high parasitism rates have been documented in other populations (e.g., 11% at Elephant Butte in New Mexico in 2006; 15%–32% on the Lower Colorado River in Arizona from 2003–2008; 43% at the Roosevelt Lake Salt River and Tonto Creek study areas in Arizona in 2002; 16%–64% at the Kern River in California from 1989–1995; Koronkiewicz et al. 2004; Koronkiewicz, McLeod et al. 2006; McLeod et al. 2005, 2007; McLeod, Koronkiewicz, Nichols et al. 2008; McLeod, Koronkiewicz, Brown et al. 2008; McLeod and Koronkiewicz 2009; Moore and Ahlers 2006; Schuetz and Whitfield 2007; Ellis et al. 2008). However, parasitism is not considered to be a pervasive problem or among the primary rangewide threats to flycatcher conservation (USFWS 2002; USFWS 2011; Sogge et al. 2010). USFWS (2002) considers "high" parasitism to be > 20%, a threshold at which cowbird trapping could be considered.

Clearly, in 2011, several measures of productivity were low—with some measures of productivity the lowest recorded at the study area since nest monitoring began in the late 1990s—and cowbird parasitism rate was the highest on record. It is possible that this was due in part to drought, in the form of decreased streamflow, decreased precipitation, or a combination of the two related factors. While flows in 2011 were relatively consistent throughout the breeding season (relative to 2002 to 2004), mean monthly streamflow was < 400 cfs for the entire breeding season, including < 150 cfs in August (Appendix B). From 2005–2010, mean monthly streamflow was < 400 cfs during only one breeding season month: June 2009. In our experience, at the Gila River study area, when mean monthly streamflow is > 400 cfs, habitat at two densely occupied sites (Dripping Springs Wash and Dripping Springs Campground) becomes uniformly inundated with ankle- to waist-deep water, and other sites contain overall more saturated soils and stagnant ankle-deep water in scattered low-lying areas. In contrast, when mean monthly streamflow is < 400 cfs, sites become dry with fewer ponded or saturated soils and more exposed banks throughout. In addition to relatively low streamflow, winter precipitation was low in 2011 (0.71 inches), compared with 2008 to 2010 (mean: 8.32 inches; years for which precipitation data could be readily obtained). Such decreased water availability at sites could result in reduced vegetation vigor and density, reduced prey availability, and increased nest predator access (and increased depredation) (Durst 2004; Hoover 2006; Paxton et al. 2007; Reclamation 2009).

Several measures of productivity in 2011 compared similarly with 2002 and 2004 when mean monthly streamflow during breeding months averaged 52 cfs (range: 1–230 cfs); for instance, Mayfield nest success in both years was the lowest on record (35%) and the second (0.83 in 2002) and third (1.00 in

2004) lowest mean number of young fledged per nest were recorded (the lowest was documented in 2011: 0.73). However, Mayfield nest success in 2003, when mean monthly breeding season streamflow averaged 45 cfs, was 70% and mean number of young fledged per nest was 2.00—both among the highest recorded for the study area. This 2003 data indicates that there may be other variables (e.g., precipitation)—rather than or in addition to breeding season streamflow—driving measures of productivity. It should also be noted that large fluctuations in measures of productivity from 2002 to 2004 may be the result of small sample sizes (a time period when the fewest nests were found relative to other years of the study; Appendix E).

Ellis et al. (2008) reported that the extreme drought of 2002 caused near complete reproductive failure at Roosevelt Lake; among approximately 150 breeding territories, only two nests successfully fledged young in that year (Ellis et al. 2008). Ellis et al. (2008) attributed their lowest recorded simple nest success (24% at all sites, including Roosevelt Lake) and their highest rate of cowbird parasitism (43% at Roosevelt Lake) to extreme drought conditions. At the opposite end of the spectrum, at Dripping Springs Wash from 2008 to 2010, when habitat was inundated in ankle- to waist-deep water through all or most of the breeding seasons, simple nest success averaged 73%, respectively, compared with 31% in 2011. Mean clutch size at the site from 2008 to 2010 was 3.02 (range: 2.95-3.09); whereas mean clutch size in 2011 was 2.57.

Further modeling using additional explanatory variables (e.g., precipitation, water depth) is necessary to determine the relationship between seasonal and annual fluctuations of streamflow and measures of productivity.

HABITAT AND HYDROLOGIC CHARACTERISTICS

The flycatcher occupies a variety of riparian habitats across its range (Sogge and Marshall 2000; USFWS 2002, 2005). Like the Gila River study area, many occupied sites in Arizona are mixed exotic and native vegetation, with tamarisk stands being the dominant vegetation type. The importance of high-quality riparian vegetation for this species has continuously been at the forefront of recovery discussions (USFWS 2002). Diversity in species composition within occupied habitats suggests that flycatchers rely on structure of vegetation as much as, or more than, specific species of vegetation. Recent studies of flycatcher physiology, immunology, site fidelity, productivity, and survivorship suggest native and exotic habitats do not differ in quality for flycatchers (Owen et al. 2005; Sogge et al. 2006; Paxton et al. 2007; McLeod et al. 2008).

The presence of water and/or saturated soil immediately adjacent to and/or under river bank vegetation is likely the primary habitat feature that drives flycatcher colonization and breeding. For the seventh consecutive year, mean monthly streamflow within the Gila River study area was > 300 cfs when flycatchers arrived to the study area in May and June. However, compared with recent years (2005 to 2010), streamflow was markedly lower in 2011 when flycatchers arrived. Despite this, population growth at the study area continued (36% increase). As the breeding season progressed, streamflows remained relatively low which, as described above, may have contributed to low measures of productivity. Unlike 2009 when we noted desiccation to tamarisk within known territories due to lack of precipitation, tamarisk remained vibrant with normal monsoon rains in 2011. Sites were not subjected to significant flooding or drying events in 2011.

Sustained flycatcher occupancy within the Gila River study area is largely dependent on continued streamflow. The affinity of breeding flycatchers with standing water and saturated soil is noted consistently in the literature, and presence of water may be a factor in sustaining particular vegetation features at breeding sites (Paradzick 2005) and providing a more suitable microclimate for raising offspring (Sogge and Marshall 2000; McLeod, Koronkiewicz, Brown et al. 2008). Moreover, the availability of surface water at flycatcher breeding sites is likely the primary factor influencing residency and breeding at a site in any given year, with flycatchers breeding in years when sites contain standing water (Weddle et al. 2007; McLeod, Koronkiewicz, Brown et al. 2008).

We found that annual streamflow (May–April) and April–June streamflow from the previous year had the strongest relationship to the number of territories, both explaining 36% of the variation in flycatcher territories from 1998–2011. Similar to previous years, when this analysis was conducted, the 10-month period from the beginning of the previous monsoon season to the beginning of the breeding season (July–April) had a fairly strong relationship. In general, we concur with Weddle et al. (2007) that there is a cumulative effect of increased streamflow during the approximately 10 months prior to flycatcher settlement. Although breeding season streamflow (April–August) had no relationship to the number of territories, this result is likely a function of how annual streamflow was categorized. It is likely that adequate streamflow during the flycatcher breeding season is also important to breeding flycatchers, but flycatcher responses may only be apparent once certain low streamflow thresholds are reached. It is important to note that the variability in the number of flycatcher territories as related to streamflow in this analysis explains only the variability in the number of flycatcher territories per time period and streamflow ranges analyzed. Although it can be theorized that a significant increase in annual streamflow and April–June streamflow would likely result in more flycatcher territories, quantifiable predictions are difficult and highly contingent on multiple environmental and demographic factors.

The specific time period that is most important to predicting flycatcher abundance has not been consistent when this analysis has been conducted from 2008 to 2011; however, the same time periods continue to show strong or relatively strong relationships to the number of territories. It is important to note that finding significance—using this type of simple regression analysis—does not indicate a biologically valid pattern or explanation. Further modeling using additional explanatory variables (e.g., precipitation) is necessary to determine the relationship between seasonal fluctuations of streamflow and flycatcher numbers.

Presence of groundwater and surface water (using streamflow as a relative indicator at the Gila River study area) may also influence factors such as food abundance and riparian microclimate conditions (Reitan and Thingstad 1999). Flycatchers typically complete their first nesting attempt in early July (Ellis et al. 2008); therefore, monsoon rains and the subsequent increase in streamflow and prey abundance are more likely to have an immediate positive effect on fledgling survival and second nesting attempt success. Increased streamflow annually will have a long-term positive effect by encouraging suitable habitat to develop and support pre-existing habitat adjacent to the river, which may encourage immigration and support more flycatchers. Other variables such as rainfall, food abundance, and breeding success, may interact and contribute to the number of flycatcher territories each year. Paxton et al. (2007) found habitat type (native, exotic, or mixed) in which flycatchers breed along the San Pedro and Gila rivers does not appear to influence adult survivorship. However, Paxton et al. (2007) did find the breeding status of an individual did, with successful breeders having higher survivorship than non-successful breeders, unpaired individuals, and those of unknown status. Sedgwick (2004) found that willow flycatchers maintain a higher rate of site and territory fidelity when they have greater breeding success, which may be directly (e.g., food abundance) or indirectly (e.g., vegetation and habitat quality) affected by increased streamflow and/or moisture availability.

As the flycatcher population has consistently increased at the study area since 2004, corresponding changes to vegetation structure and habitat quality have been subtle. Though not measured, each site within the study area appears similar from 2005 to 2011 in average canopy height, mature vs. young tree composition, and overall density. However, portions of sites (e.g. Dripping Springs Wash, Dripping Springs Campground), especially those portions on banks directly adjacent to the river channel, have been regenerating (i.e., growing in height and density) since breeding season streamflows have been consistent and higher since 2004. Vegetation associated with banks adjacent to the river and on several islands is also rebounding at sites (e.g., GRS003, GRS010) impacted by a 2006 flood (described in Graber et al. 2007).

Subtle habitat improvement since 2004 has been noted at sites primarily composed of younger regenerating tamarisk (characterized by a height of 4–6 m) on banks and islands adjacent to the river: Dripping Springs Wash, Dripping Springs Campground, GRS003, GRN008, GRS009, and GRS010. Flycatcher territories at these sites have increased from a combined 0 flycatcher territories in 2004 to 127 flycatcher territories in 2011; flycatcher territories increased at each of these sites, except for GRS003 and GRN008, from 2010 to 2011. GRS003 supported 13 territories in both years and may have reached capacity. GRN008 decreased by two territories and may be maturing past suitability in relation to nearby sites. Dripping Springs Wash and Dripping Springs Campground have shown the greatest increase in flycatcher territories since increased and constant streamflow has been restored. These sites are the only sites upstream of Gila River's confluence with the San Pedro River and are, therefore, the areas likely experiencing the greatest benefits from increased discharges from Coolidge Dam. This could explain the noticeable improvement in habitat at these sites and the larger increase in flycatcher occupancy, compared with smaller, more widely distributed increases at other sites in the study area.

Survey sites within the Gila River study area are dominated by tamarisk (50%–90% or > 90% exotic). Occupied sites generally consist of young tamarisk intertwined with *Baccharis* spp. in the understory, scattered Goodding's willow in the mid-story and canopy, and scattered Fremont cottonwood in the canopy. In general, young tamarisk is situated directly adjacent to the main river channel, including on small islands, with mature tamarisk (6–10 m in height) set approximately 20–50 m to the interior or on steep eroded banks abutting the floodplain. In 2011, the majority of territories (95%) were situated in areas dominated by young tamarisk. In 2011, average canopy height varied among sites, with the densest canopy layer varying between 4 and 9 m. All nests were placed in tamarisk. Young tamarisk used by flycatchers was associated with drier soils in 2011 relative to recent years, but was closer to surface water than mature tamarisk. Occupied mature tamarisk stands were associated with high profile banks adjacent to the river, with an understory of sparse or dying tamarisk. Two of these sites (i.e., Kearny and GRS018) supported fewer territories in 2011, compared with 2010, while two of these sites (i.e., GRS008 and GRN018) supported one more territory in 2011, compared with 2010.

With tamarisk such an important component of this large and centrally-located flycatcher population, potential future infestation of the tamarisk leaf beetle (*Diorhabda spp.*) is a concern (Paxton et al. 2011). The beetle repeatedly defoliates tamarisk over several years eventually leading to decreased root mass and possible mortality (Tamarisk Coalition 2012). Following tamarisk stand mortality, conversion to native vegetation is not assured; in many areas existing soil chemistry and hydrology may hinder native plant growth in absence of extensive restoration (Bay and Sher 2008; Shafroth et al. 2008). Since its recent release, tamarisk beetles have dispersed from release sites in Colorado and Utah faster than predicted (Bean et al. 2007) and currently occupies segments of the Colorado and Virgin rivers in Arizona and San Juan and Rio Grande rivers in New Mexico (personal communication, M. McLeod, SWCA 2011). The beetle is likely to reach additional breeding areas, including the Gila River study area, in the near future (personal communication, M. McLeod, SWCA 2011). Defoliation by beetles could impact breeding flycatchers by altering prey availability, increasing nest abandonment and predation, and reducing the quantity of suitable habitat (Paxton et al. 2011). Data from breeding flycatchers in St. George, Utah suggest that reproductive success in tamarisk stands defoliated by tamarisk beetles is poor, but that flycatcher may move into nearby native vegetation in subsequent years (personal communication, M. McLeod, SWCA 2011). Therefore, existing or restored stands of native vegetation that can serve as refugia may be critical to the persistence of the Gila River study area population; proactive actions to minimize negative consequences are prudent for the study area (Paxton et al. 2011).

CONSIDERATIONS

As the Gila River study area population has increased substantially in recent years, SWCA, together with Reclamation, has developed strategies to maintain accurate estimates of migrant, lone male, pair, and nest numbers—and their distribution within the study area. Maintaining accurate estimates is imperative when comparing flycatcher numbers and distribution from previous years of the study. Strategies have included adding additional field personnel (i.e., one additional field biologist was added for the 2010 and 2011 breeding seasons), identifying new kayak put-in and take-out locations to split kayak surveys from one to two or more survey days, and balancing data collection priorities (e.g., sampling a subset of sites for territory and nest monitoring while prioritizing survey data at all sites in 2011).

Because flycatchers are not banded at our sites, and several sites or segments within sites, are densely populated we have found that consistently monitoring all territories within sites—focusing on locating and monitoring nests, has maintained the precision of our survey (and nest) data. By consistently monitoring territories and simultaneously active nests, we are able to effectively distinguish neighboring territories, identify instances of polygyny, and accurately determine residency and pair status.

While detection probability, used to account for birds present but not detected on surveys, has not been measured for this study, we assume that as the population increases to a certain threshold, detection probability decreases as survey and nest monitoring effort remains constant (i.e., available field personnel hours). We believe this threshold was reached in 2009 when the population increased from 63 to 96 territories (Graber and Koronkiewicz 2009*b*); therefore, predicting stable or increased population growth, one additional field biologist was proactively added in 2010. We believe this threshold was reached again in 2011 when the population increased from 138 territories to 188 territories. This threshold is difficult to quantify; however in both 2009 and 2011, we had more late-season (August) newly-detected territories—indicating some territories may have been missed—and more instances of monitors visiting territories every 4–20 days rather than the suggested 4–8 days (suggested by Martin 1997). Specific project objectives, population trend, and corresponding benefit of adding or subtracting field personnel to obtain meaningful between year comparisons should be considered in future years of this study.

Several interesting future research questions could be investigated using the Gila River study area as a case study or part of a larger study. Several of these questions could be investigated using existing datasets. For example, our survey and nest monitoring work during recent years of this study have led to the following questions:

1) What observer variables influence detection probability? Given there are differing goals and budgets for projects range-wide, what is the minimum number of field biologists, man hours, and/or field days necessary to maintain survey and nest monitoring data precision and meaningful comparisons between projects and years?
2) What measures of water availability are important for predicting flycatcher numbers? Nest success? Or other measures of productivity? What other variables (e.g., microclimate, arthropod abundance) might be at play? Measures of water availability that could be considered include annual streamflow, breeding season streamflow, streamflow when the nest was active, water depth, distance of nest to standing or flowing water, annual precipitation, and breeding season precipitation.
3) Does water availability (e.g., streamflow, precipitation) influence rates of cowbird parasitism?
4) What level and seasonal timing of streamflow is important to predict flycatcher abundance?
5) If restoration efforts are considered proactively prior to tamarisk beetle infestation, what measures of vegetation (i.e., patch size, species composition, age, height, density, proximity to nearby territories) influence colonization?

More in-depth scientific investigations and annual comparisons between years at the Gila River study area could be aided by combining AGFD and SWCA datasets. Ellis et al. (2008; AGFD) primarily reported 10-year means combining the Roosevelt Lake and Winkelman (included the Gila River and San Pedro River study areas) study areas; separating Gila River study area data for all years of the study could prove useful for future investigations.

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ACKNOWLEDGEMENTS

This project was made possible by the support of many persons, agencies, private landowners, and our dedicated staff and crew. Work was conducted under the auspices of Federal Fish and Wildlife Threatened and Endangered Species Permit TE-028605-4 and Arizona Game and Fish Scientific Collecting Permit SP701396. Funding was provided by the U.S. Bureau of Reclamation (Reclamation; Contract No. # GS10F0209L).

We thank all cooperators and landowners, including Arizona Game and Fish Department, ASARCO, Copper Basin Railway, Inc., Carol and Ralph DuBois, III, Town of Kearny, The Nature Conservancy, Tony and Carol Moreno, U.S. Bureau of Land Management (BLM), Reclamation, U.S. Fish and Wildlife Service (USFWS), and Morris Wilkins. Thanks also to Frank Giroux for allowing us access through his property.

Many thanks to Alex Smith of Reclamation and Greg Beatty of USFWS for valuable advice and project support. We appreciate Gary Eide of the Town of Kearny, Jake Jacobsen of Copper Basin Railway, Inc., Brian Bellew of BLM, and Jack Garrity of ASARCO for their assistance and access to their properties. Thanks to Alex Smith of Reclamation for reviewing the report and providing valuable comments.

A very special thanks to Jeff Lark, Molly Hanson, Celeste Andresen, and Dan Wolgast of The Nature Conservancy for assisting with logistics, providing hospitality and facilities, and allowing us to invade their workspace at the San Pedro River Preserve. The Nature Conservancy personnel readily assisted our crew with several vehicle transfers for putting in and taking out kayaks and volunteered their time and skill for project data collection.

This project would not be a success without our dedicated staff and field personnel. Many, many thanks to Kimberly MacMillan and Jessica Maggio who went beyond their administrative duties and coordinated permitting, payroll, vehicles, computers, equipment purchases, and telecommunications. Thanks also to Ken Houser, Mike Lanin, Jana Sterling, Anne Pellegrini, and Mary Anne McLeod for assistance with project logistics and support. And sincere thanks to the 2011 field personnel for hard work, dedication, flexibility, skill, humor, sweat, bruises, and general tolerance of harsh field conditions. Thanks to Jamie Granger, Andrew Tillinghast, Emily Strelow, and Richard Aracil.

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APPENDIX A

2011 Field Data Forms

Willow Flycatcher (WIFL) Survey and Detection Form (revised April, 2010)

Site Name: ______________________ State: ____________ County: ______________

USGS Quad Name: ______________________ Elevation: __________ (meters)

Creek, River, or Lake Name: ______________________

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

Survey Coordinates: Start: E __________ N __________ UTM Datum: __________ (See instructions)

Stop: E __________ N __________ UTM Zone: __________

If survey coordinates changed between visits, enter coordinates for each survey in comments section on back of this page.

*****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 If Yes, number of nests	Comments (e.g., bird behavior; evidence of pairs or breeding; potential threats [livestock, cowbirds, *Diorhabda* spp.]). If *Diorhabda* found, contact USFWS and State WIFL coordinator.	GPS Coordinates for WIFL Detections (this is an optional column for documenting individuals, pairs, or groups of birds found on each survey). Include additional sheets if necessary.			
Survey # 1 Observer(s):	Date: Start: Stop: Total hrs:						# Birds	Sex	UTM E	UTM N
Survey # 2 Observer(s):	Date: Start: Stop: Total hrs:						# Birds	Sex	UTM E	UTM N
Survey # 3 Observer(s):	Date: Start: Stop: Total hrs:						# Birds	Sex	UTM E	UTM N
Survey # 4 Observer(s):	Date: Start: Stop: Total hrs:						# Birds	Sex	UTM E	UTM N
Survey # 5 Observer(s):	Date: Start: Stop: Total hrs:						# Birds	Sex	UTM E	UTM N
Overall Site Summary Totals do not equal the sum of each column. Include only resident adults. Do not include migrants, nestlings, and fledglings. Be careful not to double count individuals. Total survey hrs:		Total Adult Residents	Total Pairs	Total Territories	Total Nests	Were any WIFLs color-banded? Yes ____ No ____ If yes, report color combination(s) in the comments section on back of form and report to USFWS.				

Reporting Individual: ______________________ Date Report Completed: __________

US Fish & Wildlife Service Permit #: ______________________ State Wildlife Agency Permit #: __________

<u>Submit</u> form to USFWS and State Wildlife Agency by September 1st. Retain a copy for your records.

Fill in the following information completely. Submit form by September 1st. Retain a copy for your records.

Reporting Individual ______________________ Phone # ______________

Affiliation ______________________ E-mail ______________

Site Name ______________________ Date report Completed ______________

Was this site surveyed in a previous year? Yes____ No____ Unknown____

Did you verify that this site name is consistent with that used in previous yrs? Yes _____ No ________ Not Applicable _________

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 below.

Did you survey the same general area during each visit to this site this year? Yes _____ No ________ If no, summarize below.

Management Authority for Survey Area: Federal ________ Municipal/County _____ State ________ Tribal _____ Private _________

Name of Management Entity or Owner (e.g., Tonto National Forest) ______________________

Length of area surveyed: ______________________ (km)

Vegetation Characteristics: Check (only one) category that best describes the predominant tree/shrub foliar layer at this site:

___________ Native broadleaf plants (entirely or almost entirely, > 90% native)

___________ Mixed native and exotic plants (mostly native, 50 - 90% native)

___________ Mixed native and exotic plants (mostly exotic, 50 - 90% exotic)

___________ Exotic/introduced plants (entirely or almost entirely, > 90% exotic)

Identify the 2-3 predominant tree/shrub species in order of dominance. Use scientific name.

Salix Gooddingii, Populus spp., Tamarix spp.

Average height of canopy (Do not include a range): ______________________ (meters)

Attach the following: 1) copy of USGS quad/topographical map (REQUIRED) of survey area, outlining survey site and location of WIFL detections; 2) sketch or aerial photo showing site location, patch shape, survey route, location of any detected WIFLs or their nests; 3) photos of the interior of the patch, exterior of the patch, and overall site. Describe any unique habitat features in Comments.

Comments (such as start and end coordinates of survey area if changed among surveys, supplemental visits to sites, unique habitat features. Attach additional sheets if necessary.

Territory Summary Table. Provide the following information for each verified territory at your site.

Territory Number	All Dates Detected	UTM E	UTM N	Pair Confirmed? Y or N	Nest Found? Y or N	Description of How You Confirmed Territory and Breeding Status (e.g., vocalization type, pair interactions, nesting attempts, behavior)

Attach additional sheets if necessary

Territory Summary Table, continued

Reporting Individual ______________________ Phone # ______________

Affiliation ______________________ E-mail ______________

Site Name ______________________ Date report Completed ______________

Territory Number	All Dates Detected	UTM E	UTM N	Pair Confirmed? Y or N	Nest Found? Y or N	Description of How You Confirmed Territory and Breeding Status (e.g., vocalization type, pair interactions, renesting attemps, behavior)

Comments

WILLOW FLYCATCHER TERRITORY & NEST MONITORING CARD   Circle One: Nest   Lone Male   Pair   Migrant   Unknown

Site Name:____________________**Territory/Nest no:**______________   Polygyny with another territory? Which? Terr.____________

Nest* UTM's:_____________E/____________________N

♂combo:____________ to ⊗:______

♀combo:____________ to ⊗:______

Est. HD:______ **Est. FD:**______

Date	Time In	Time Out	Observer	Mon Type (O/M)	Stage	# Adult pres	# WF Egg	# CB Egg	# WF Nstl	# CB Nstl	# WF Fldg	Age of Young (WN Description in Comments)	Field Tasks
Behaviors & Comments:													
Behaviors & Comments:													
Behaviors & Comments:													
Behaviors & Comments:													
Behaviors & Comments:													
Behaviors & Comments:													
Behaviors & Comments:													

Exact written description on OP flag

Estimated tree height from water or land (m).

Draw the nest tree (include tree species)

Site Name:______________________ **Territory/Nest no:**________ **Monitored / Non-monitored**

Directions and map to the territory

Date	Time In	Time Out	Observer	Mon Type (O/M/V)	Stage	# Adult pres	# WF Egg	# CB Egg	# WF Nstl	# CB Nstl	# WF Fldg	Age of Young (WN Description in Comments)	Field Tasks
Behaviors & Comments:													
Behaviors & Comments:													
Behaviors & Comments:													
Behaviors & Comments:													
Behaviors & Comments:													
Behaviors & Comments:													
Behaviors & Comments:													

Date: Date checked. **Time:** The time in and out of the terr. **Obs:** Observers initials. **Mon Type:** M = mirrored; V = video camera; O = observation with binoculars. **Stage:** ∗ = Single Male, Δ = Pair, B-# = building-number of days completed; L = egg laying; I = incubating; N = nestling, F = fledgling, NA = No activity. **#Adult pres:** Number of adults present in territory. **#WF Egg:** Number of willow flycatcher eggs. **#CB Egg:** Number of cowbird eggs. **#WF Nstl:** Number of willow flycatcher nestlings. **#CB Nstl:** Number of cowbird nestlings. **Age Yng:** Visual estimate of willow flycatcher nestling age; estimate age in days and write a description in comments (DO NOT just add days on to age at last visit). **Comments (mandatory):** Record any additional info used to determine the stage and/or activity of the nest (e.g. evidence of predation, description of nestlings, feeding of fledglings, etc.). **Field Tasks:** RSM = Resight male, RSF = Resight female, RSB = Resight both, CP = Confirm pair, LN = Locate nest/renest, CI = Confirm Incubation, MP = Mirror pole nest, VP = Video pole nest, MP/VP if I = Mirror/Video Pole Nest if incubating, ON = observe nest, CA = confirm activity or stage, VN# = Verify nestling number, VF# = Verify fledgling number.

Chronology: Nest Building ~ 6 d. - Egg laying ~ 3 d. - Incubation ~ 12 d. - Nestling ~ 13 d.

***If no nest found, use utm coordinates for center of territory or main activity area.**

Willow Flycatcher Nest Record Form (2011)

Nest ID:____________

Substrate:______________________

Nest Found: ____________________

First Egg:______________________

Clutch Completion:__________________

Hatching:____________________

Fledged or Failed:___________________

Outcome:______________________

	Presumed	Confirmed
Eggs		
Nestlings		
Fledglings		

Date	Contents	Exposure Days
Total Exposure Days		

Outcome codes:
UN= unknown; **FY**= fledged young, with at least one young seen leaving or in the vicinity of nest; **FP**= fledged young, as determined by parents behaving as if dependent fledgling(s) nearby; **FU**= suspected fledging of at least one young; **FC**= fledged at least one host young with cowbird parasitism; **FD**= Nest partially depredated with confirmed fledging of at least one young; **PO**= predation observed; **PE**= probable predation, nest empty and intact; **PD**= probable predation, damage to nest structure; **PC**= probable predation by cowbird; **AB**= nest abandoned prior to egg(s) being laid; **DC**= deserted with egg(s) or young due directly to cowbird **DE**= deserted with egg(s) or young; **AC**= nest abandoned due to cowbird; **CO**= failure due to cowbird, host attempted to raise cowbird young. No host young were fledged from the nest; **WE**= failure due to weather; **HA**= failure due to human activities; **IN**= failure, entire clutch infertile; **OT**= failure due to other, or unknown, causes.

Appendix B

Table of the Mean Monthly Streamflow at the Gila River Study Area

Table B.1. Combined Mean Monthly Streamflow (cfs) for Two Gages at the Gila River Study Area, Arizona, 1997–2011

Year	Territories	Combined 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
2008	62	334	240	548	666	511	569	629	411	241	242	6	231
2009	96	161	245	498	569	606	374	457	562	199	199	3	57
2010	138	273	195	529	588	610	800	860	636	405	262	10	321
2011	188	56	244	374	377	359	340	316	131	22	1	1	35

[a]Combined mean monthly streamflow calculated by averaging mean monthly streamflow recorded at two U.S. Geological Survey gaging stations: #09469500 (Gila River Below Coolidge Dam; USGS 2012) and #09474000 (Gila River at Kelvin; USGS 2012). Per USGS, mean monthly streamflow for October 2010 to December 2011 are preliminary (i.e., are provisional data and are subject to revision) at the time of the publication of this report.

APPENDIX C

Willow Flycatcher Survey Results by Site in the Gila River Study Area

Table C.1. Willow Flycatcher Survey Results by Site in the Gila River Study Area, Arizona, 2011

Site name County, Elevation (m), Survey Hours	Individual Surveys		Site Summary						
	Survey Date	WIFL[a]	Resident Adult WIFL	Territories	Pairs	Nests	Unknown Status WIFL[b]	Migrant WIFL[c]	BHCO Present[d]
South Butte [e, g, j] Pinal, 485, 1.92	6/21/2011	0	0	0	0	0	0	0	Y
North Butte [e, g, j] Pinal, 491, 1.90	6/21/2011	0	0	0	0	0	0	0	Y
GRN033 [e, g, j] Pinal, 494, 1.26	6/21/2011	0	0	0	0	0	0	0	Y
Donnelly Wash [e, g, j] Pinal, 495, 0.62	6/21/2011	0	0	0	0	0	0	0	Y
GRS032 [e, g, j] Pinal, 494, 1.24	6/21/2011	0	0	0	0	0	0	0	Y
GRSN031 [e, g, j] Pinal, 506, 2.08	6/20/2011	0	0	0	0	0	0	0	Y
GRSN030 [e, g, j] Pinal, 506, 1.40	6/20/2011	0	0	0	0	0	0	0	Y
GRN029 [e, g, j] Pinal, 515, 0.88	6/20/2011	0	0	0	0	0	0	0	Y
GRN028 [e, g, j] Pinal, 518, 2.20	6/20/2011	1	1	1	0	0	0	0	Y
GRN027 [e, g, j] Pinal, 521, 0.92	6/20/2011	0	0	0	0	0	0	0	Y
GRSN026 [e, g, j] Pinal, 536, 0.92	6/20/2011	0	0	0	0	0	0	0	Y
GRS025 [e, g, j] Pinal, 536, 1.18	6/20/2011	0	0	0	0	0	0	0	Y
GRSN023 [e, g, j] Pinal, 536, 1.40	6/20/2011	0	0	0	0	0	0	0	Y
GRSN022 [e, g, j] Pinal, 540, 0.14	6/20/2011	0	0	0	0	0	0	0	Y
GRS020 [e, g] Pinal, 543, 0.82	5/17/2011 6/19/2011 6/28/2011	0 0 0	0	0	0	0	0	0	Y
GRN020 [e, g] Pinal, 549, 2.55	5/17/2011 6/19/2011 6/28/2011	0 0 0	0	0	0	0	0	0	Y
GRS019 [e, g] Pinal, 555, 5.24	Monitored 6/28–8/14	N/A	2	1	1	1	0	0	Y
GRN019 [e, g] Pinal, 549, 1.86	Monitored 6/5–8/14	N/A	2	1	1	1	0	0	Y
GRN018 [e, g] Pinal, 561, 8.70	Monitored 5/17–8/14	N/A	4	2	2	2	0	1	Y
GRS018 [e, g] Pinal, 543, 5.64	Monitored 5/17–8/14	N/A	6	3	3	5[h]	1	0	Y
GRS016 [e, g] Pinal, 549, 3.60	Monitored 6/5–7/18	N/A	0	0	0	0	0	1	Y
GRS015 [e, g] Pinal, 555, 3.95	Monitored 5/19–8/15	N/A	3	2	1	1	0	0	Y

Table C.1. Willow Flycatcher Survey Results by Site in the Gila River Study Area, Arizona, 2011 (Continued)

Site name County, Elevation (m), Survey Hours	Individual Surveys		Site Summary						
	Survey Date	WIFL[a]	Resident Adult WIFL	Territories	Pairs	Nests	Unknown Status WIFL[b]	Migrant WIFL[c]	BHCO Present[d]
GRN015 [e, g] Pinal, 550, 0.63	5/19/2011 6/5/2011 6/24/2011	0 0 0	0	0	0	0	0	0	Y
Kearny [f, g] Pinal, 555, 8.44	Monitored 5/18–8/11	N/A	3	2	1	2	0	0	Y
GRS014 [e, g] Pinal, 555, 3.48	Monitored 6/5–7/26	N/A	4	2	2	2	0	1	Y
GRN014 [e, g] Pinal, 558, 2.78	Monitored 5/19–8/15	N/A	8	4	4	4	0	0	Y
GRN013 [e, g] Pinal, 558, 0.80	Monitored 6/5–8/15	N/A	2	1	1	2	0	0	Y
GRS013 [e, g] Pinal, 558, 0.80	5/19/2011 6/5/2011 6/24/2011	0 0 0	0	0	0	0	0	0	Y
GRN012 [e, g] Pinal, 579, 0.82	5/19/2011 6/5/2011 6/24/2011	0 0 0	0	0	0	0	0	0	Y
GRS012 [e, g] Pinal, 555, 2.78	Monitored 5/15 - 8/13	N/A	4	2	2	3	0	0	Y
GRN011 [e, g] Pinal, 579, 2.96	Monitored 5/15–8/13	N/A	6	3	3	3	0	0	Y
GRS011 [e, g] Pinal, 561, 6.44	Monitored 5/15–7/28	N/A	8	4	4	4	1	0	Y
GRN010 [e, g] Pinal, 573, 3.31	Monitored 5/15–7/28	N/A	5	3	2	5[k]	0	0	Y
GRS010 [e, g] Pinal, 561, 6.50	Monitored 5/15–8/17	N/A	18	9	9	9	0	0	Y
GRS009 [e, g] Pinal, 567, 8.15	Monitored 5/21–8/12	N/A	8	4	4	3	0	0	Y
GRN009 [e, g] Pinal, 579, 9.59	Monitored 5/21–8/12	N/A	6	3	3	4	3	1	Y
GRS008 [e, g] Pinal, 567, 4.74	Monitored 5/21–8/1	N/A	4	2	2	0	0	0	Y
GRN008 [f] Pinal, 579, 19.44	Monitored 5/19–8/1	N/A	14	7	7	12	0	1	Y
GRS007 [f, g] Pinal, 573, 15.36	Monitored 5/20–8/1	N/A	4	2	2	2	1	0	Y
GRN007 [e, g] Pinal, 579, 10.46	Monitored 5/20–8/12	N/A	10	5	5	5[h]	0	0	Y
GRS006 [e, g] Pinal, 567, 1.79	Monitored 5/20–8/1	N/A	2	1	1	0	0	0	Y
GRS005 [e, g] Pinal, 567, 5.74	Monitored 5/20–8/16	N/A	4	2	2	1	0	0	Y
GRN005 [e, g] Pinal, 579, 10.68	Monitored 5/20–8/16	N/A	10	5	5	8[h, k]	1	1	Y

Table C.1. Willow Flycatcher Survey Results by Site in the Gila River Study Area, Arizona, 2011 (Continued)

Site name County, Elevation (m), Survey Hours	Individual Surveys		Site Summary						
	Survey Date	WIFL[a]	Resident Adult WIFL	Territories	Pairs	Nests	Unknown Status WIFL[b]	Migrant WIFL[c]	BHCO Present[d]
GRS004 [e, g] Pinal, 600, 5.30	Monitored 5/25–8/1	N/A	2	1	1	1[h]	1	1	Y
GRN004 [e, g] Pinal, 585, 18.62	Monitored 5/20–8/12	N/A	16	8	8	11	2	0	Y
GRS003 [e, g, i] Pinal, 585, 26.75	Monitored 5/20–8/12	N/A	25	13	13	22	0	1	Y
GRN003 [e, g] Pinal, 585, 0.84	5/20/2011 6/3/2011 6/30/2011	0 0 0	0	0	0	0	0	0	Y
GRN002 [e, g] Pinal, 585, 1.39	Monitored 6/3–7/31	N/A	2	1	1	1	0	0	Y
GRS002 [e, g] Pinal, 585, 1.51	5/20/2011 6/3/2011 6/30/2011	0 0 0	0	0	0	0	0	0	Y
GRS001 [e, g, j] Pinal, 585, 1.36	Monitored 6/15–7/31	N/A	0	0	0	0	0	2	Y
Hayden Smelter Pinal and Gila, 600, 1.03 [e, j]	6/30/2011	0	0	0	0	0	0	0	Y
Dripping Springs Campground [e, i] Pinal and Gila, 610, 96.30	Monitored 5/22–8/22	N/A	111	60	59	92[h]	3	3	Y
Dripping Springs Wash [f, i] Gila, 621, 38.19	Monitored 5/16–8/22	N/A	65	34	34	68[h]	1	0	Y
Total	**–**	**–**	**359**	**188**	**183**	**274**	**14**	**13**	**–**

[a] WIFL = adult willow flycatcher (*Empidonax traillii extimus*).

[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, lack of survey data, or confusion with distinguishing neighboring territories.

[c] Maximum number of migrant willow flycatchers detected during any single survey event.

[d] BHCO = brown-headed cowbirds (*Molothrus ater*).

[e] Surveys were conducted by kayak.

[f] Surveys were conducted by foot and by kayak.

[g] Survey hours estimated because site was part of a multiple-site kayak survey.

[h] Total nest number includes at least one instance where fledglings were found and confirmed to a territory but no actual nest was found before fledglings were discovered.

[i] Number of territories + number of pairs does not equal number of residents due to polygyny (one male associated with two or more females).

[j] Survey did not meet 3-survey period USFWS protocol guidelines due to ‘unsuitable habitat’ determination, accessibility constraints, or time constraints.

[k] A pair or pairs assigned to a different site attempted a nest at this site.

APPENDIX D

Willow Flycatcher Nest Success and Productivity of Monitored Nests at the Gila River Study Area

Table D.1. Willow Flycatcher Nest Success and Productivity of Monitored Nests at the Gila River Study Area, Arizona, 1996–2011

Year	Mayfield nest success, % (exposure days)	Number of young fledged	Mean number of young fledged per nest (*n*)[a]	Mean number of young fledged per successful nest (*n*)
1996	100 (20)	2	2.00 (1)	2.00 (1)
1997	71 (163)	16	1.60 (10)	2.00 (8)
1998	61 (1096)	75	1.39 (54)	2.27(33)
1999	48 (777)	41	1.08 (38)	2.41 (17)
2000	70 (620)	42	1.62 (26)	2.33 (18)
2001	52 (1134)	74	1.32 (56)	2.47 (30)
2002	35 (404)	19	0.83 (23)	2.38 (8)
2003	70 (394)	40	2.00 (20)	2.86 (14)
2004	35 (214)	13	1.00 (13)	2.60 (5)
2005	77 (654)	57	1.90 (30)	2.71 (21)
2006	53 (709)	52	1.27 (41)	2.36 (22)
2007[b]	72 (838)	82	1.86 (44)	2.73 (30)
2008[b]	67 (1576)	90	1.08 (83)	2.31 (38)
2009	66 (2337)	176	1.53 (115)	2.38 (74)
2010	62 (3447)	266	1.50 (177)	2.42 (110)
2011	36 (3248)	159	0.79 (202)	1.94 (82)

[a] n = number of nests used for calculating Mayfield nest survival estimates (Mayfield 1961, 1975) including nests with unknown outcomes.
[b] Productivity estimates in 2007 and 2008 should not be directly compared to other years because nest monitoring ceased July 31, rather than until the last nest fledged or failed (typically in late-August).

APPENDIX E

Willow Flycatcher Survey Results for the Gila River Study Area

Table E.1. Willow Flycatcher Survey Results for the Gila River Study Area, Arizona, 1996–2011

Year	No. Sites Surveyed	Survey Hours	Residents[a]	Territories	Pairs	Nests
1996	15	126	13	10	3	4
1997	48	715	63	33	30	26
1998	42	575	94	48	46	71
1999	34	544	119	69	58	94
2000	37	578	97	52	48	69
2001	21	83	77	40	40	63
2002	24	120	88	46	43	45
2003	18	134	49	26	23	24
2004	15	106	26	14	12	14
2005	15	142	54	28	26	34
2006	22	148	73	39	34	54
2007	22	149	119	62	57	54
2008	52	176	120	63	60	95
2009	52	250	183	96	93	133
2010	51	193	255	138	133	206
2011	53	367	359	188	183	274

[a] Number of territories + number of pairs may not equal total number of residents due to polygyny and non-territorial floaters.

APPENDIX F

Willow Flycatcher Territories by Site within the Gila River Study Area

Table F.1. Willow Flycatcher Territories by Site[a] within the Gila River Study Area

Site	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
North Butte	–	0	0	0	0	–	–	–	–	–	0[b]	–	1[b]	0[b]	0[b]	0[b]
GRN033	1	0	0	0	0	–	–	–	–	–	0[b]	–	0[b]	0[b]	1[b]	0[b]
GRSN031	1	0	0	–	–	–	–	–	–	–	0[b]	–	0[b]	0[b]	0[b]	0[b]
GRN028	0	0	0	0	0	–	–	–	–	–	0[b]	–	0[b]	0[b]	0[b]	1[b]
GRS025	0	0	0	–	–	–	–	–	–	–	0[b]	–	0[b]	1[b]	1[b]	0[b]
GRN020	2	2	2	5	0	0	0	0	0	0	1	0	0[b]	0[b]	0[b]	0[b]
GRS019	–	0	0	0	0	–	–	–	–	–	0	–	0[b]	0[b]	0[b]	1[b]
GRN019	–	0	0	0	0	–	–	–	–	–	–	–	0[b]	0[b]	0[b]	1[b]
GRS018	–	1	1	4	4	2	7	4	2	9	7	6	4	4[b]	5[b]	3[b]
GRN018	–	2	2	5	4	9	7	5	3	6	5	6	3	2[b]	1[b]	2[b]
GRS016	–	0	–	–	–	–	–	1	0	1	1	2	0	1[b]	1[b]	0[b]
GRN015	–	–	–	–	1	0	0	0	–	–	–	–	0[b]	0[b]	0[b]	0[b]
GRS015	–	1	1	1	1	0	0	0	–	–	–	–	0[b]	0[b]	1[b]	2[b]
Kearny	6	8	25	23	19	14	14	9	5	3	5	4	4	3	3	2
GRN014	–	0	0	0	0	–	–	–	–	–	–	–	0[b]	0[b]	2[b]	4[b]
GRS014	–	0	0	0	0	0	0	–	–	–	0	0	1[b]	1[b]	0[b]	2[b]
GRN013	–	0	0	0	0	–	0	0	–	–	–	–	0[b]	0[b]	0[b]	1[b]
GRS013	–	1	0	0	0	–	0	0	–	–	–	–	1[b]	0[b]	0[b]	0[b]
GRS012	–	4	6	8	7	5	3	1	0	0	0	0	0	1[b]	1[b]	2[b]
GRN011	–	2	0	0	0	–	–	–	–	–	–	–	1[b]	0[b]	1[b]	3[b]
GRS011	–	0	0	1	2	1	1	0	0	0	0	1	3	5[b]	7[b]	4[b]
GRN010	–	5	4	4	2	1	1	0	0	0	0	0	0	2[b]	2[b]	3[b]
GRS010	–	3	0	4	0	0	0	0	0	1	1	2	3	3[b]	5[b]	9[b]
GRS009	–	0	0	–	–	–	–	–	–	–	1	0	0	2[b]	1[b]	4[b]
GRN009	–	0	0	0	0	1	2	0	0	0	1	2	2	3[b]	3[b]	3[b]
GRS008	–	0	0	0	0	0	0	–	–	–	1[b]	3[b]	4[b]	5[b]	1[b]	2[b]
GRN008	–	0	0	0	0	0	2	0	0	0	1	4	5	8	9	7
GRS007	–	3	6	11	10	5	7	5	4	6	4	6	2	3	3	2
GRN007	–	0	0	0	0	0	0	–	–	–	1[b]	2[b]	0[b]	0[b]	5[b]	5[b]
GRS006	–	0	0	–	–	–	–	–	–	–	–	–	0[b]	0[b]	0[b]	1[b]
GRS005	–	0	0	–	–	–	–	–	–	–	1[b]	0[b]	0[b]	1[b]	1[b]	2[b]
GRN005	–	0	0	–	0	–	–	–	–	–	–	–	1[b]	1[b]	4[b]	5[b]
GRS004	–	0	0	0	0	0	0	–	–	–	–	–	0[b]	0[b]	2[b]	1[b]
GRN004	–	1	1	2	2	2	2	1	0	0	1[b]	1[b]	0[b, c]	4[b]	4[b]	8[b]
GRS003	–	0	–	–	–	–	–	–	–	–	0[b]	0[b]	3[b]	7[b]	13[b]	13[b]
GRN002	–	–	0	0	0	0	0	0	–	–	–	–	0[b]	0[b]	0[b]	1[b]
Dripping Springs Campground	–	–	0	0	0	0	0	0	0	1	5[b]	14[b]	11[b]	21[b]	33[b]	60[b]
Dripping Springs Wash	–	–	0	1	0	0	0	0	0	1	3[b]	9[b]	14[b]	18[b]	28[b]	34[b]
Yearly sum	10	33	48	69	52	40	46	26	14	28	39	62	63	96	138	188
# of sites with territories	4	12	9	12	10	9	10	7	4	8	16	14	17[c]	21	26	30

[a] Sites ordered downstream to upstream; only sites with documented flycatcher residents between 1996 and 2010 are included.
[b] Known kayak-only survey.
[c] A nesting pair associated with GRS003 placed nests at both GRS003 and GRN004 in 2008; this territory was designated to GRS003. Both sites were included in the final “sites with territories” number.

APPENDIX G

AGFD and Rangewide Site Names with Total Site Number, Management Unit, and County for the Gila River Study Area

Table G.1. AGFD and Rangewide Site Names with Total Site Number, Management Unit, and County for the Gila River Study Area

AGFD Site Name	Total Site Number	Rangewide Site Name[a]	Management Unit	County
GRN033	AZGI098	Gila River GRN033	Middle Gila/San Pedro	Pinal
GRSN031	AZGI096	Gila River GRSN031	Middle Gila/San Pedro	Pinal
GRN020	AZGI087	Gila River GRN020 (Kelvin Bridge)	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
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
GRS013	AZGI076	Gila River GRS013	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
GRS005	AZGI061	Gila River GRS005	Middle Gila/San Pedro	Pinal
GRN004	AZGI060	Gila River GRN004	Middle Gila/San Pedro	Pinal
Dripping Springs Campground	AZGI036	Gila River – Dripping Springs Wash	Middle Gila/San Pedro	Pinal, Gila
Dripping Springs Wash	AZGI004	Gila River – Dripping Springs Wash	Middle Gila/San Pedro	Gila

[a] Rangewide site names were only created for sites where flycatchers were detected prior to 2008.