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Distribution, Abundance, and Breeding Activities of the Southwestern Willow Flycatcher at Marine Corps Base Camp Pendleton, California

2017 Annual Data Summary

Prepared for:

Assistant Chief of Staff, Environmental Security
U.S. Marine Corps Base Camp Pendleton

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY
WESTERN ECOLOGICAL RESEARCH CENTER

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By Scarlett L. Howell and Barbara E. Kus

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EXECUTIVE SUMMARY

Surveys for the endangered Southwestern Willow Flycatcher (*Empidonax traillii extimus*) were conducted at Marine Corps Base Camp Pendleton, California, between 15 May and 31 July 2017. Twenty-one transient Willow Flycatchers of unknown subspecies were observed during Base-wide surveys. Transients occurred on 5 of the 16 drainages surveyed in 2017. No Willow Flycatchers were detected at Aliso Creek, Cockleburr Canyon, Fallbrook Creek, French Creek, Horno Canyon, Piedra de Lumbre Canyon, Pilgrim Creek, Roblar Creek, San Mateo Creek, San Onofre Creek, or Windmill Canyon. Transients occurred in a range of habitat types including mixed willow (*Salix* spp.) riparian, riparian scrub, willow-sycamore (*Platanus racemosa*), and sycamore-oak (*Quercus agrifolia*) dominated riparian vegetation. Exotic vegetation including black mustard *(Brassica nigra*) and poison hemlock (*Conium maculatum*) was present in the majority of flycatcher locations.

In 2017, for the first time since monitoring began in 2000, no resident Southwestern Willow Flycatchers were detected breeding on Marine Corps Base Camp Pendleton. The decline is not one isolated to Marine Corps Base Camp Pendleton; similar declines have been documented across California in recent years.

None of the three uniquely banded adult flycatchers present during the 2016 breeding season returned to Marine Corps Base Camp Pendleton in 2017. None of the three nestlings banded in 2016 returned to Marine Corps Base Camp Pendleton in 2017, and none were detected off Base. None of the transients observed during surveys were seen to carry bands.

One Marine Corps Base Camp Pendleton natal female, last seen as a nestling on the Santa Margarita River in 2010, dispersed 41.4 km to the San Dieguito River, where she bred successfully.

INTRODUCTION

The Southwestern Willow Flycatcher (*Empidonax traillii extimus*) is one of four subspecies of Willow Flycatcher in the United States, with a breeding range including southern California, Arizona, New Mexico, extreme southern portions of Nevada and Utah, and western Texas (Hubbard 1987, Unitt 1987). Restricted to riparian habitat for breeding, the Southwestern Willow Flycatcher has declined in recent decades in response to widespread habitat loss throughout its range and, possibly, Brown-headed Cowbird (*Molothrus ater*) parasitism (Wheelock 1912; Willett 1912, 1933; Grinnell and Miller 1944; Remson 1978; Garrett and Dunn 1981; Unitt 1984, 1987; Gaines 1988; Schlorff 1990; Whitfield and Sogge 1999). By 1993, the species was believed to number approximately 70 pairs in California (USFWS 1993) in small disjunct populations. The Southwestern Willow Flycatcher was listed as endangered by the State of California in 1992 and by the U.S. Fish and Wildlife Service in 1995.

Willow Flycatchers in southern California co-occur with the Least Bell's Vireo (*Vireo bellii pusillus*), another riparian obligate endangered by habitat loss and cowbird parasitism. However, unlike the vireo, which has increased ten-fold since the mid-1980's in response to management alleviating these threats (USFWS 2006), Willow Flycatcher numbers have remained low. Currently, the majority of Southwestern Willow Flycatchers in California are concentrated in two sites: the Owens River valley in Inyo County (Lacey Greene, pers. comm.) and the Upper San Luis Rey River, including a portion of the Cleveland National Forest in San Diego County (Howell and Kus 2017). Outside of these sites, Southwestern Willow Flycatchers occur as small, isolated populations of one to half a dozen pairs. Data on the distribution and demography of the flycatcher, as well as identification of factors limiting the species, are critical information needs during the current stage of recovery planning (Kus et al. 2003, Kus and Whitfield 2005).

Male Southwestern Willow Flycatchers typically arrive in southern California at the end of April while females arrive approximately 1 week later. Males sing repeatedly from exposed perches while on the breeding grounds. Once the pair bond is established, the female builds an open-cup nest usually placed in a branch fork of a willow (*Salix* spp.) or plant with a similar branching structure approximately 1-3 m above the ground. The typical clutch of 3-4 eggs is laid in May-June. Females incubate for approximately 12 days and nestlings fledge within 12-15 days in early July. Adults usually depart from their breeding territory in mid-August/early September to their wintering grounds in central Mexico, and northern South America.

The purpose of this study was to document the status of Southwestern Willow Flycatchers at Marine Corps Base Camp Pendleton (MCBCP or "Base") in San Diego County, California. Specifically, our goals were to (1) determine the size and composition of the Willow Flycatcher population at the Base, (2) document survivorship and movement of resident flycatchers, (3) document nesting activities, and (4) characterize habitat used by flycatchers. In addition, we report the ongoing effects of a series of major wildfire events that occurred in 2014 on Willow Flycatchers and their habitat. These data, when combined with data from other years, will inform natural resource managers about the status of this endangered species at Marine Corps Base Camp Pendleton, and guide modification of land use and management practices as appropriate to ensure the species' continued existence.

This work was funded by the Assistant Chief of Staff, Environmental Security, Resources Management Division, Marine Corps Base Camp Pendleton, California. All activities were conducted under 10(a)1(A) Recovery Permit #TE-829554-17.4.

STUDY AREAS AND METHODS

Field Surveys

All of Marine Corps Base Camp Pendleton's major drainages, and several minor ones supporting riparian habitat, were surveyed for flycatchers between 15 May and 31 July (Fig. 1; Appendix A, Figs. 3-8). Field work was conducted by United States Geological Survey (USGS) personnel Lisa Allen, Armand Amico, Thane Carstens, Collin Farmer, Jonathan Gunther, Katie Hall, Scarlett Howell, Angela Johnson, Barbara Kus, Michael Lester, Rachel MacNutt, Ryan Pottinger, Michelle Treadwell, Charles Vettes, and Jill Wussow. The specific areas surveyed are as follows:

Santa Margarita River: between Stuart Mesa Road and the Base boundary, including Stagecoach Canyon, Ysidora Basin, and the unnamed drainage between Ysidora Basin and Windmill Canyon (Appendix A, Figs. 3, 4).

De Luz Creek: between the confluence with the Santa Margarita River and the Base boundary (Appendix A, Fig. 3). In 2017, approximately 1.0 km of the upper section of this area was not surveyed because of access restrictions.

Roblar Creek: from the confluence with De Luz Creek to a point approximately 1.5 km upstream (Appendix A, Fig. 3).

Fallbrook Creek: around Lake O'Neill as well as along the creek between the lake and the Base boundary (Appendix A, Fig. 3).

Newton Canyon: between the confluence with the Santa Margarita River and the upstream limit of riparian habitat (Appendix A, Fig. 4).

Cockleburr Canyon: between the Pacific Ocean and 0.3 km upstream of Interstate 5 (Appendix A, Fig. 4).

French Creek: between the Pacific Ocean and the Edson Range Impact Area (Appendix A, Fig. 4).

Aliso Creek: between the Pacific Ocean and 0.5 km upstream of the electrical transmission lines (Appendix A, Fig. 4).

Las Flores Creek: between the Pacific Ocean and a point approximately 800 m upstream of Basilone Road (Appendix A, Fig. 5).

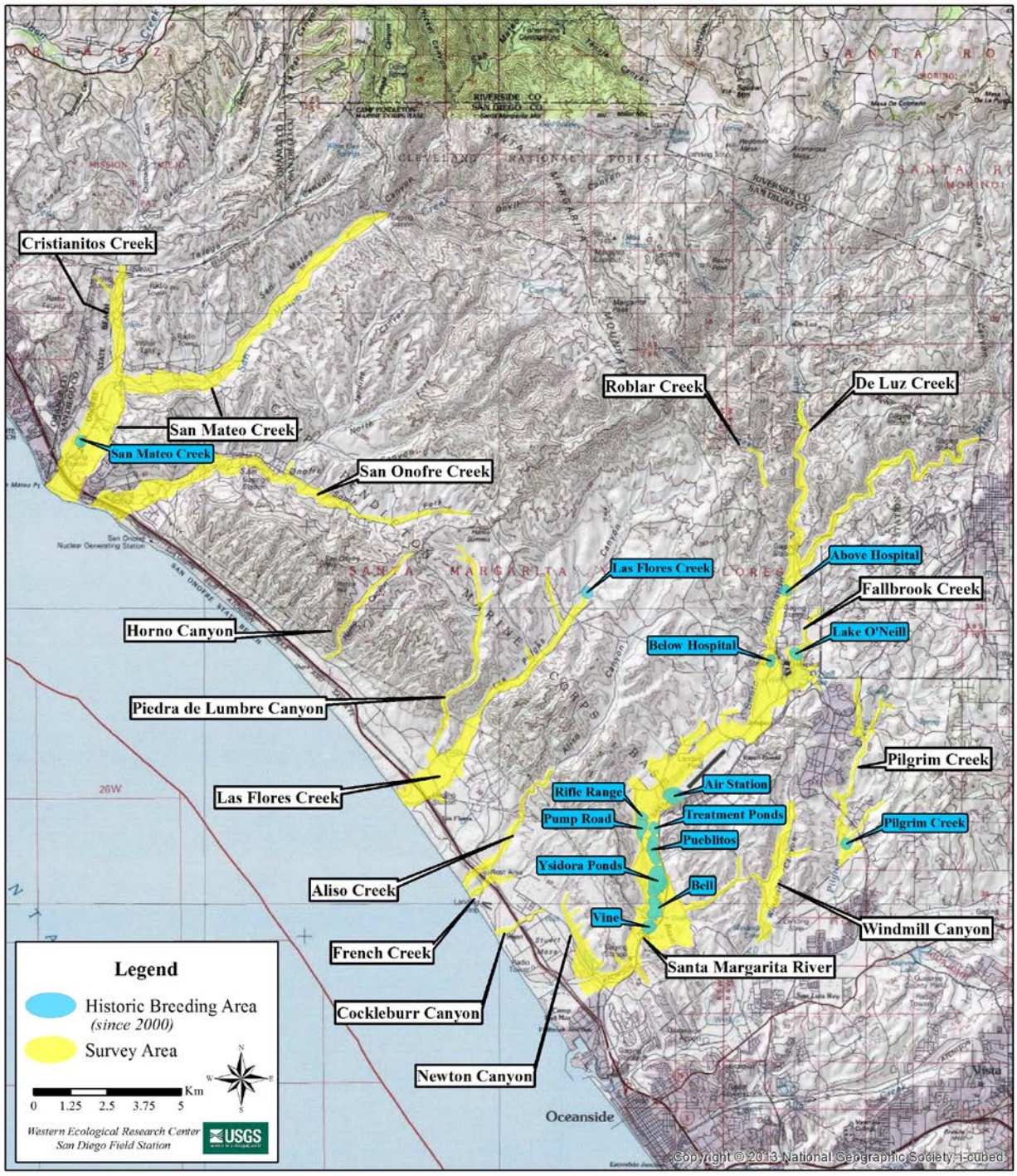

Fig. 1. Willow Flycatcher survey and historic breeding areas at Marine Corps Base Camp Pendleton, 2017.

Piedra de Lumbre Canyon: between the confluence with Las Flores Creek and the upstream limit of riparian habitat, approximately 2.7 km upstream of Las Pulgas Lake (Appendix A, Fig. 5).

Horno Canyon: between Old Highway 101 and the upstream limit of riparian habitat (Appendix A, Fig. 5).

San Onofre Creek: between the Pacific Ocean and the access road to Range 219 (Appendix A, Figs. 6, 7).

San Mateo Creek: between the Pacific Ocean and the Base boundary, including habitat south of the creek and south of the agricultural fields (Appendix A, Figs. 6, 7).

Cristianitos Creek: between the confluence with San Mateo Creek and the Base boundary (Appendix A, Fig. 6).

Pilgrim Creek: between the Base boundary and the limit of habitat upstream of Sewage Treatment Plant 1, including two side drainages between Pilgrim Creek and the southern Base boundary (Appendix A, Fig. 8).

Windmill Canyon: from the Base boundary to the golf course entrance (Appendix A, Fig. 8).

Drainages were surveyed one to four times at least 7 days apart. The majority of drainages were surveyed four times (12/16). In 2017, three drainages were limited by access restrictions; the reduced portion of De Luz Creek and Piedra de Lumbre Canyon were surveyed three times, and Roblar Creek was only surveyed once. The upper portion of the Santa Margarita River was surveyed twice based on prior agreement with the Base. Additional area searches were performed in historically occupied flycatcher breeding areas.

Investigators followed standard survey protocol (Sogge et al. 2010), moving slowly (approximately 2 km/hour) through the riparian habitat while searching and listening for Willow Flycatchers. Observers walked along the edge(s) of the riparian corridor on the upland and/or river side where habitat was narrow enough to detect a bird on the opposite edge. In wider stands, observers traversed the habitat, choosing routes that permitted detection of all birds throughout its extent. Surveys were conducted between dawn and early afternoon, depending on wind and weather conditions.

For each bird encountered, investigators recorded age (adult or juvenile), breeding status (paired, unpaired, or transient), and whether the bird was banded. Flycatcher locations were mapped on 1:12,000 aerial photographs as well as 1:24,000 USGS topographic maps, using a Trimble Juno SB (Sunnyvale, CA) unit with 1-15 m positioning accuracy to determine geographic coordinates (WGS84). For all resident flycatchers, territory boundaries were approximated by mapping singing perches and the extent of the male's and female's use area on 1": 2,000" aerial photographs. Habitat was characterized by visual inspection at each flycatcher location. For all resident flycatchers, habitat type was assessed at the territory level. For paired

birds, habitat type was assessed within the male's territory boundary. Habitat type was recorded according to the following categories based on dominant vegetation:

Mixed willow riparian: Habitat dominated by one or more willow species including black willow (*S. gooddingii*), arroyo willow (*S. lasiolepis*), and red willow (*S. laevigata*), with mule fat (*Baccharis salicifolia*) as a frequent co-dominant.

Willow-cottonwood: Willow riparian habitat in which cottonwood (*Populus fremontii*) is a co-dominant.

Willow-sycamore: Willow riparian habitat in which sycamore (*Platanus racemosa*) is a co-dominant.

Sycamore-oak: Woodlands in which sycamore and oak (*Quercus agrifolia*) occur as co-dominants.

Riparian scrub: Dry and/or sandy habitat dominated by sandbar willow (*S. exigua*) or mule fat, with few other woody species.

Upland scrub: Coastal sage scrub adjacent to riparian habitat.

Non-native: Sites vegetated exclusively with non-native species such as giant reed (*Arundo donax*) and saltcedar (*Tamarix ramosissima*).

Percent cover of exotic vegetation at each location was estimated using cover categories of <5%, 5-50%, 51-95%, and > 95%, and the dominant exotic species recorded.

Nest Monitoring

Flycatchers observed during protocol surveys that were suspected to be resident birds (e.g., observed in more than one survey period, pair vocalizations heard, evidence of nesting seen, etc.) were revisited within 3 days of detection date. Resident birds were observed for evidence of nesting and nests were located and monitored following standard protocol (Appendix D, Rourke et al. 1999). Nests were visited as infrequently as possible to minimize disturbance and reduce the chances of leading predators or Brown-headed Cowbirds to nest sites. Typically, there were 3-4 visits/nest, spaced approximately 5-10 days apart, depending on the stage of the nest when initially detected. The first visit was timed to determine the number of eggs laid, the next to confirm hatching and age of young, and the last to band nestlings. After a nest became inactive, six possible nest fates were assigned based on the following parameters:

(SUC) Successful: Nest fledged at least one young. Fledging was confirmed by detection of young outside the nest.

(PRE) Nest failed as a result of predation: This includes (1) nests seen in the process of ant or other predation, (2) nests found with evidence such as eggshell fragments, feathers, or partially consumed nestlings in or below the nest, (3) nests with eggs or nestlings later found empty and torn from supporting branch, either partially or completely, typically indicative of mammal

predation (Peterson et al. 2004), and (4) nests that had eggs or nestlings but were later found intact and empty before the expected fledge date with no evidence of eggs or nestlings on the ground, consistent with snake and bird predation which typically leave no sign (Peterson et al. 2004).

(PAR) Nest failed as a result of parasitism: This includes (1) nests that were abandoned with one or more cowbird eggs in the nest, and (2) nests that were tended by the host but contained only cowbird eggs.

(INC) Incomplete: Nests that were seen under construction, but were never completed.

(OTH) Nest failed for other reasons that are known: This includes nests that failed for reasons such as host plant failure, surrounding vegetation falling and crushing a nest, inviable eggs that did not hatch after more than 2 weeks, and human disturbance such as mowing or weed-whacking. This category also includes nests that appeared to have failed as a result of cowbird "predation" such as (1) abandoned nests containing punctured eggs in or below the nest, (2) nests where nestlings were killed by a puncture wound to the skull, or (3) nests where nestlings were ejected from the nest and found on the ground.

(UNK) Nest failed for unknown reasons: This designation is used when no other reason could be confirmed. In many instances, the fate "UNK" was assigned to nests that were likely depredated, but because we could not confirm egg-laying did not fit the criteria of the "PRE" fate (above). These are explained more fully in results, when applicable.

Nest site characteristics were recorded following the abandonment or fledging of nests. Measurements included nest height, host species, host height, distance from the nest to the edge of the host species, and distance from the nest to the edge of the clump of riparian vegetation (Rourke et al. 1999). Distance to edge of clump was expressed as a negative number if the nest was not located in a clump of riparian vegetation. For example, if the nest was located in a field of poison hemlock (*Conium maculatum*) without any other non-hemlock vegetation present, the distance to the nearest clump of riparian vegetation was measured, and the value expressed as a negative number.

Banding

In the event that resident birds occurred on MCBCP, we were prepared to band all nestlings and adults. Nestlings were to be banded at 7-10 days of age with a silver aluminum federal numbered band on the right leg. When possible, returning second-year birds banded as nestlings in 2016, with a single silver aluminum federal numbered band on the left leg, were recaptured in their territories using mist nets and banded with a colored metal band on the right leg to yield a full, unique combination. Attempts were also made to capture and band unbanded adults within their territories with a numbered federal band on one leg and a solid or bi-colored metal band on the other.

Data Comparisons

All data from previous years at Marine Corps Base Camp Pendleton used in comparisons with current data can be found in Kus 2001; Kus and Ferree 2002; Kus and Kenwood 2003, 2005, 2006a, b; Kenwood and Kus 2007; Rourke et al. 2008; Howell and Kus 2009a, b, 2010, 2011, 2012, 2013, 2014, 2015, and 2016.

RESULTS

Population Size and Distribution

Residents

No resident Southwestern Willow Flycatchers were detected in 2017. Overall, the resident flycatcher population on Base decreased by 100% from 2016 to 2017 (Fig. 2, Table 1).

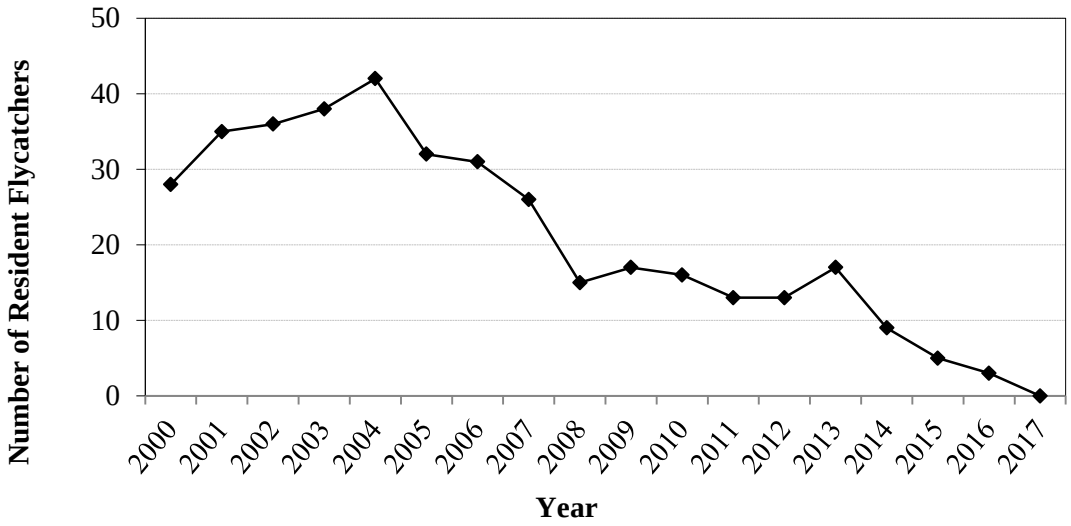

Fig. 2. Southwestern Willow Flycatcher population estimates for Marine Corps Base Camp Pendleton, 2000-2017.

Transients

Twenty-one Willow Flycatchers of unknown subspecies were observed during Base-wide surveys (Appendix B, Figs. 9-15). All transients were detected between 16 May and 21 June. Transients occurred on 5 of the 16 drainages surveyed in 2017. No Willow Flycatchers were detected at Aliso Creek, Cockleburr Canyon, Fallbrook Creek, French Creek, Horno Canyon, Piedra de Lumbre Canyon, Pilgrim Creek, Roblar Creek, San Mateo Creek, San Onofre Creek, or Windmill Canyon.

Table 1. Distribution of territorial Willow Flycatchers at Marine Corps Base Camp Pendleton, 2000-2017.

		2000		2001		2002		2003		2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014		2015		2016		2017	
Santa Margarita River		M[a]	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
SWFL Breeding Areas	Above Hospital	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Below Hospital	-	-	-	-	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Air Station	3	3	2	3	1	1	-	-	1	1	-	-	-	-	2	2	2	2	1	4	2	4	2	3	1	5	1	4	1	2	-	-	-	1	-	-
	Rifle Range	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Pump Road	1	1	3	3	3	3	2	3	5	6	3	6	2	4	3	5	2	1	2	1	1	2	1	1	-[b]	1	-	2	-	-	-	-	-	-	-	-
	Treatment Ponds	1	-	1	-	-	-	-	-	-	-	1	-	1	4	2	2	1	1	2	2	2	2	1	2	1	2	1	3	1	2	1	3	1	1	-	-
	Pueblitos	4	-	3	4	3	3	4	5	4	4	1	3	3	6	1	1	2	3	2	1	-[b]	1	1	-	-	-	-[b]	1	1	1	-[b]	1	-	-	-	-
	Ysidora Ponds	3	2	4	4	2	2	2	2	2	4	4	5	2	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Bell	3	1	2	2	3	3	1	2	4	6	2	3	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Vine	2	2	1	1	2	2	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Stuart Mesa	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lake O'Neill		1	1	1	1	1	1	2	1	1	1	1	-	2	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Las Flores Creek		-	-	-	-	-	-	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pilgrim Creek		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-
San Mateo Creek		-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	1	-	1	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-
Total		**18**	**10**	**17**	**18**	**17**	**16**	**16**	**16**	**18**	**22**	**12**	**17**	**12**	**19**	**12**	**14**	**7**	**7**	**8**	**8**	**6**	**9**	**6**	**6**	**4**	**8**	**3**	**10**	**3**	**6**	**1**	**4**	**1**	**2**	**0**	**0**

[a] Sex: M = male, F = female.

[b] One male's territory overlapped two breeding areas, Pueblitos and Treatment Ponds; included in Treatment Ponds total.

Habitat Characteristics

Sixty-two percent (13/21) of all flycatcher sightings occurred in habitat classified as mixed willow riparian, 62% (8/13) of which occurred along the Santa Margarita River (Appendix C). Twenty-four percent (5/21) of locations were in riparian scrub, dominated by mule fat and/or sandbar willow. Two detections were located in more arid habitats consisting of sycamore co-dominated by willow or oak, and one flycatcher was detected in non-native habitat, consisting of black mustard (*Brassica nigra*) and poison hemlock.

The most common exotic plant in habitat used by flycatchers in 2017 was black mustard, followed by poison hemlock (Appendix C). The majority of flycatcher locations contained exotic vegetation, with 52% (11/21) of flycatcher locations containing 5-50% exotic vegetation, and 43% (9/21) of locations containing >50% exotic vegetation. Only one flycatcher location contained <5% exotic vegetation cover.

Breeding Activities

No breeding activities were observed on Base in 2017.

Banded Birds

The majority of Willow Flycatchers were seen closely enough to determine if they were banded; no banded birds were detected (71%; 15/21).

Survivorship, Site Fidelity, and Movement

The recapture and resighting of banded birds allowed us to determine the proportion of flycatchers previously documented on Base that returned to hold territories in 2017. Although this is the minimum number of flycatchers known to survive, and does not include all birds that dispersed off Base or that we may have failed to detect/resight, it can be used as an estimate to calculate minimum annual survivorship for the flycatcher population on Base. Of the three uniquely banded adult flycatchers present during the 2016 breeding season (one male and two females), none returned to Marine Corps Base Camp Pendleton in 2017. Overall, adult survivorship from 2016 on Base was 0% (0/3).

None of the three nestlings banded in 2016 that survived to fledge were resighted or recaptured on Base in 2017, yielding a minimum first-year survivorship estimate of 0% (0/3). One bird, a female banded in 2010 as a nestling at Pueblitos breeding area on the Santa Margarita River was detected 41.4 km away; the female bred successfully at San Dieguito River (USGS Western Ecological Research Center, San Diego Field Station unpubl. data).

Human Activities in Riparian Habitat

No disturbances were witnessed in riparian habitat in 2017.

DISCUSSION

For the first time since monitoring began in 2000, no resident Southwestern Willow Flycatchers were detected breeding at Marine Corps Base Camp Pendleton in 2017. Following a record high of 40 individuals in 2004, an overall downward trend began in 2005, characterized by several stepwise population declines where the resident population dropped more than 25% from one year to the next (2004-2005, 28%; 2007-2008, 46%; 2013-2014, 31%; 2014-2015, 44%; and 2015-2016, 40%). These steep declines appear to coincide with years of extreme precipitation at both ends of the scale; drought likely played a role in declines occurring from 2007-2008, 2013-2014, 2014-2015, and 2015-2016, while flood conditions occurring over the winter of 2004-2005 appeared to have a drastic impact on habitat structure, according to habitat comments recorded that year. In addition to the extended drought conditions seen in recent years, the effect of a reduction in suitable breeding habitat resulting from the 2014 Las Pulgas wildfire likely put additional pressure on an already declining population.

No banded adults that bred on Base in previous years returned to breed in 2017. The return rate has fluctuated from a low of 25% in 2001 to a high of 70% in 2002, with an average return rate between 2001 and 2016 of 48%. Two of the three banded adults on Base in 2016 were at least 7 years old, so their failure to return in 2017 is not surprising; however, the third banded bird present on Base in 2016 was a second-year male immigrant from the nearby San Luis Rey River, with a higher expectation of return. None of the three fledglings banded as nestlings in 2016 were detected on Base (or anywhere off Base) in 2017. This is the fourth year in a row that no MCBCP fledglings have recruited into the breeding population, and the lack of recruitment has played a large role in the decline of the Marine Corps Base Camp Pendleton population. The overall recruitment rate on Base has averaged 20 ± 7% of the young fledged the previous year (2001-2012; adjusted for birds that returned in later years). The lack of recruitment to MCBCP for the past 5 years may be a result of low overwinter survivorship or young birds dispersing elsewhere. For example, a female banded in 2010 as a nestling on Base was detected 41.4 km away at San Dieguito River; the female bred successfully with a male that was unpaired at Bonsall on the San Luis Rey River early in the breeding season before moving late in the season to San Dieguito River (USGS Western Ecological Research Center, San Diego Field Station unpubl. data). This illustrates that not only young birds, but also adults can move long distances between and during breeding seasons to locate suitable habitat and potential mates.

The number of transient flycatchers detected in 2017 reached a record low (21), just below the previous record set in 2010 (25). The number of transients detected annually since 2002 has varied greatly, despite consistent survey scope and effort, from a high of 107 in 2016, to a low of 21 in 2017. Although factors influencing the migratory route of transient Willow Flycatchers are unclear, it is possible that birds are responding to environmental variables such as precipitation when choosing a migration route. In years with low rainfall the preceding winter (ie. 2001-2002, 2006-2007, 2013-2014), it appears that more Willow Flycatchers migrate through Camp Pendleton, whereas fewer birds were detected in years with higher precipitation (ie. 2004-2005, 2009-2010, 2016-2017). This may be related to differences in food availability in coastal environments; it is possible that coastal vegetation is less affected by fluctuations in precipitation and supports a more reliable prey base for migrating flycatchers during drier years. A Willow Flycatcher diet study in Arizona found a five-fold difference in arthropod biomass collected during

a drought year (2002) compared to the following higher precipitation year (Durst 2004). Effects of low precipitation may be more pronounced along inland migration routes.

In 2017, the only remaining recently occupied breeding area on Base, Treatment Ponds, was devoid of resident flycatchers for the first time since occupation by breeding birds in that area in 2006. It is possible that the habitat may have reached a stage of ecological succession that is unsuitable to breeding flycatchers.

In the 2014 Las Pulgas wildfire, two historic breeding areas were burned: Air Station and Pump Road. Based on previous fires in Southwestern Willow Flycatcher-occupied habitat, it was thought that it would take a minimum of 3-5 years to become suitable for breeding again (Paxton et al. 2007). However, the Air Station breeding area was reoccupied in 2016 by an unpaired female, just 2 years post-fire. Although there were no breeding birds occupying the Air Station breeding area in 2017, it is probable that this area may be recolonized in the future. The Air Station site is currently undergoing restoration and irrigation, which will likely shorten the vegetation recovery period. Habitat recovery after fire depends on many factors including hydrologic conditions during regrowth; conditions such as drought, reduced groundwater, and altered river flow may impede recovery. Burned areas may take up to a decade or more to regain suitability for flycatchers following catastrophic wildfire: a site along the San Pedro River in Arizona burned in June 1996, and still had not been reoccupied after 10 years (Durst et al. 2008), with the lack of suitable habitat regeneration suggested as the reason for extirpation (English et al. 2006).

Three historically occupied breeding areas along the Santa Margarita River (Vine, Bell, and Ysidora Ponds) have been unoccupied since 2004, 2007, and 2008, respectively. There are many possible hypotheses explaining why breeding flycatchers moved out of these areas: overgrowth of exotic vegetation, habitat senescence, changes in vegetation composition and structure, and/or hydrologic changes. Exotic vegetation (giant reed and saltcedar) was removed from these areas in 2008 and 2009; however, breeding willow flycatchers have not yet reoccupied them. It is possible that the extended drought experienced in southern California has slowed habitat recovery following exotic removal. A visual comparison of aerial photographs of the breeding areas in 2003 and 2014 shows a dramatic reduction in overall vegetation cover, which may be precluding birds from recolonizing the areas. In the past, flycatchers have reoccupied areas on Base within 5-7 years following exotic vegetation removal: the Pump Road area had removal in 1996, and supported multiple breeding pairs by 2001; the Air Station area had removal in 2000, and had returned to pre-removal occupancy by 2007; and the Treatment Ponds area had removal in 2001, with recolonization by 2006. Mean annual precipitation for the first 5 years post-removal for Pump Road, Air Station, and Treatment Ponds breeding areas was 41.9 ± 23.9 cm, 42.8 ± 29.0 cm, and 40.5 ± 29.9 cm, respectively (OWR 2015). In contrast, the mean annual precipitation for the first 5 years post-removal in 2008 (Ysidora Ponds) and 2009 (Bell and Vine) was 33.7 ± 13.3 cm and 31.8 ± 12.2 cm, respectively. Reduced precipitation in the post-removal years may have suppressed natural regrowth of riparian vegetation following removal, especially regrowth of herbaceous plants. Herbaceous plants appear to be an important component of suitable nesting habitat for breeding flycatchers; from 2001-2005, flycatchers placed 43 ± 25% (n=122) of nests in herbaceous plants including stinging nettle and poison hemlock, compared to 19 ± 11% (n=117) of nests from 2006-2016 (excluding the partial 2011 season). While more precipitation was seen in

the 2016 and 2017 rainfall years suggesting an end to the extended drought, it will likely take additional years with adequate rainfall for the vegetation to regrow to levels sufficient for breeding flycatchers.

CONCLUSIONS

The Southwestern Willow Flycatcher population in California appears to be experiencing a statewide decline not isolated to MCBCP. Populations on the Kern River (Mary Whitfield, pers. comm.) and the lower San Luis Rey River (Houston et al. 2017) have experienced steep declines or have been extirpated in recent years. Declines were also seen in 2017 at Bonsall on the San Luis Rey River, which had no breeding territories for first time since 2006, and at the Upper San Luis Rey River near Lake Henshaw, where the number of territories declined by 18% between 2016 (28) and 2017 (23; Howell and Kus 2017). At least temporarily, the breeding population on MCBCP appears to have succumbed to the forces of prolonged drought, habitat loss from the 2014 Las Pulgas fire, slow recovery from exotic vegetation removal, and possibly unknown pressures on the wintering grounds.

Based upon our long-term observations of Southwestern Willow Flycatchers breeding under a variety of environmental conditions, the following actions have high potential for enhancing habitat suitability and availability on Base and thereby encouraging flycatcher recovery and recolonization:

1. Evaluate the use of conspecific broadcasts to attract a new cohort of breeding flycatchers.
2. Evaluate potential changes in vegetation structure and composition that may have reduced the suitability of historically occupied areas by comparing vegetation data collected previously (in 2003 and 2004) with new data describing current habitat conditions.
3. Conduct habitat restoration in burned (Air Station and Pump Road) breeding areas.
4. Conduct habitat restoration in historically occupied breeding areas (Vine, Bell, and Ysidora Ponds) where exotic removal took place but the vegetation has not yet regenerated, with priority given to areas closest to recently occupied habitat.
5. In areas currently undergoing habitat restoration (Bell), consider planting stinging nettle to increase the herbaceous component when exotic poison hemlock is treated, as opposed to leaving bare ground.
6. Create or restore water sources at the following locations (WGS84) in or adjacent to historically occupied breeding areas, and consider controlled release to mimic seasonal flooding.
    a. Settling Ponds (33.28351, -117.37373; 33.26235, -117.37162)
    b. Canal/Ditch (33.28053, -117.37371; 33.27817, -117.37476; 33.25122, -117.37616)
    c. Pooling (33.29325, -117.36784; 33.27908, -117.37424; 33.27874, -117.37338; 33.28443, -117.37991; 33.25797, -117.37241)

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APPENDIX A

SOUTHWESTERN WILLOW FLYCATCHER SURVEY AREAS AT MARINE CORPS BASE CAMP PENDLETON, 2017

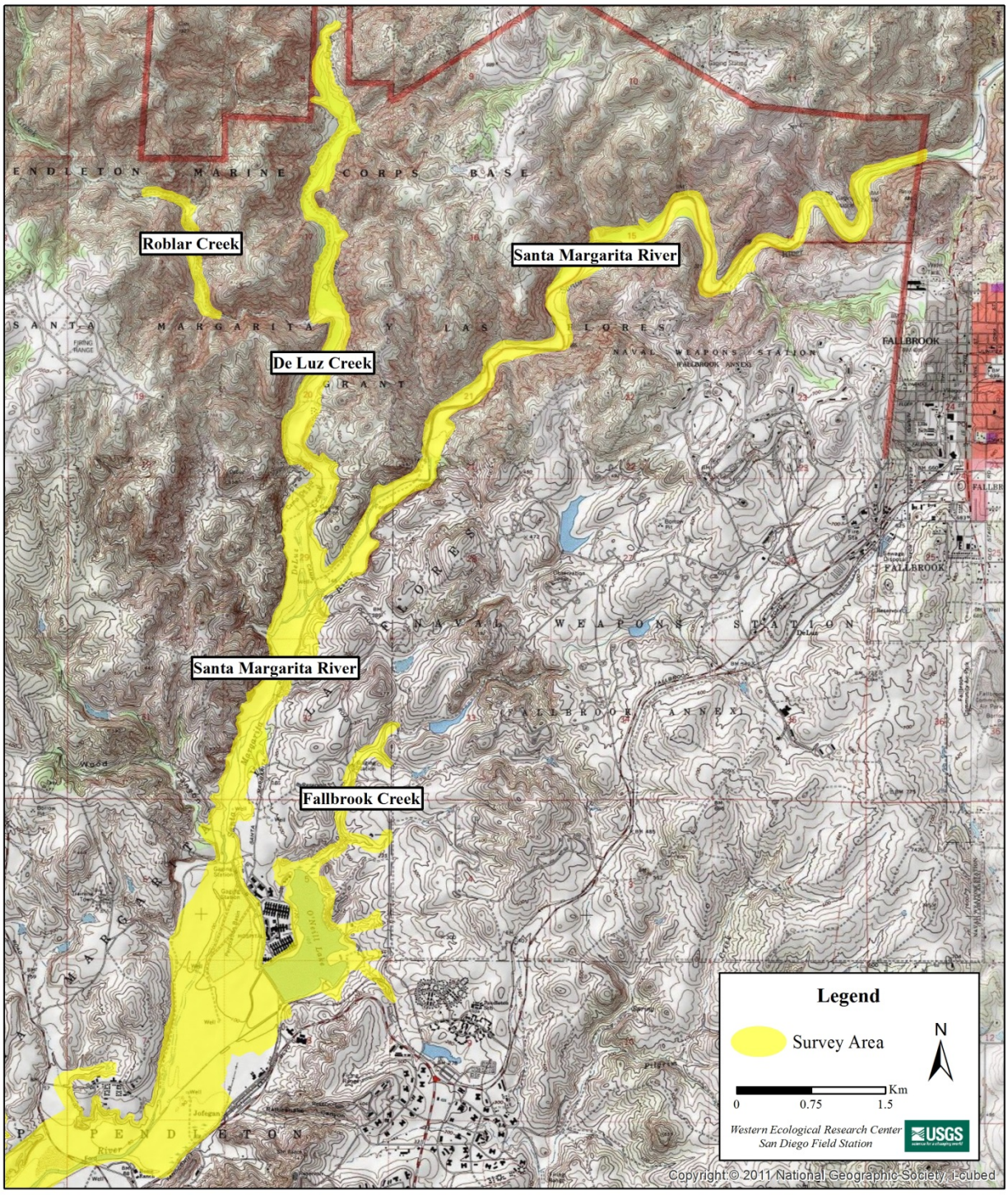

Fig. 3. Willow Flycatcher survey areas at Marine Corps Base Camp Pendleton, 2017: Santa Margarita River, Fallbrook Creek, De Luz Creek and Roblar Creek.

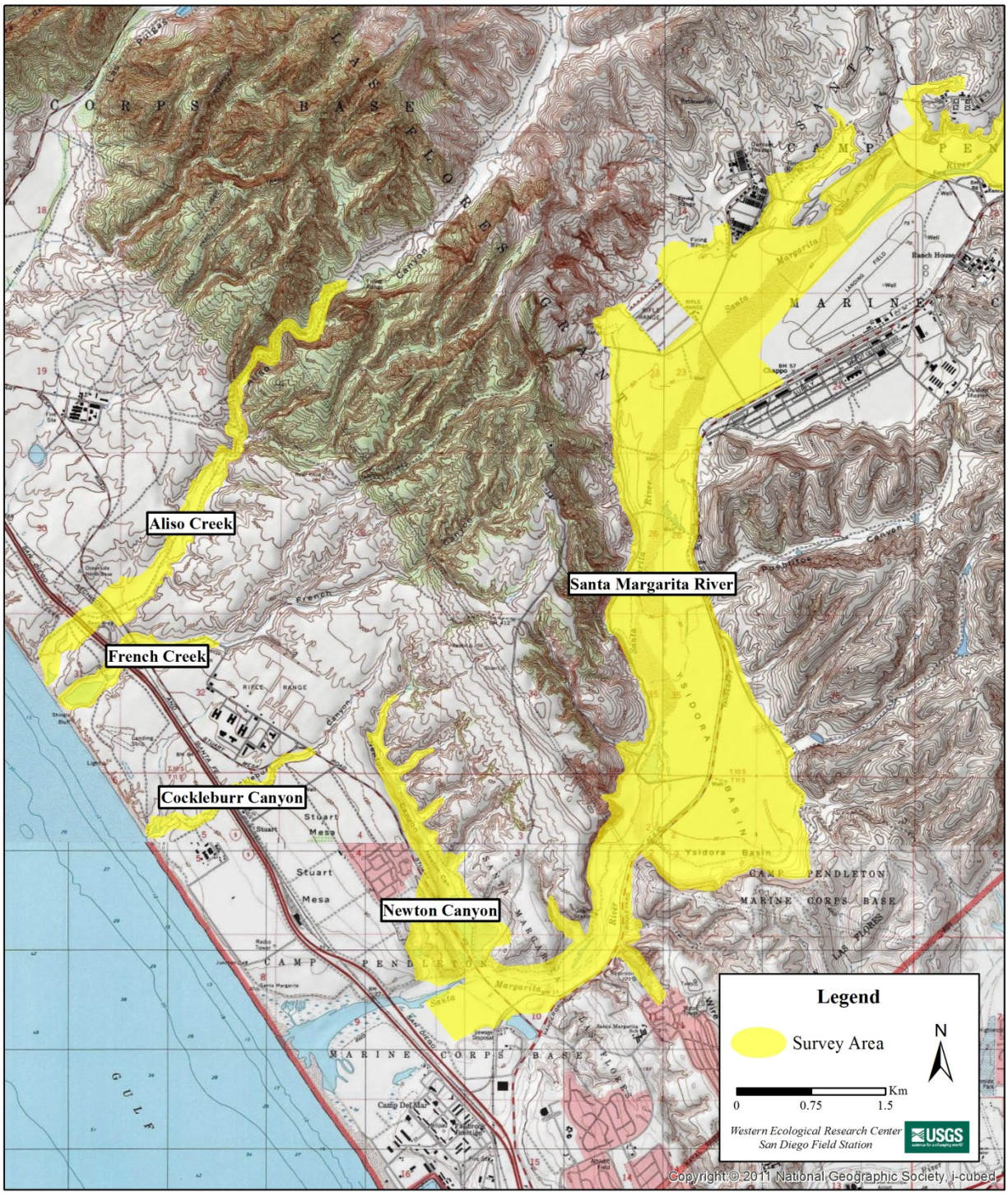

Fig. 4. Willow Flycatcher survey areas at Marine Corps Base Camp Pendleton, 2017: Santa Margarita River, Newton Canyon, Cockleburr Canyon, French Creek, and Aliso Creek.

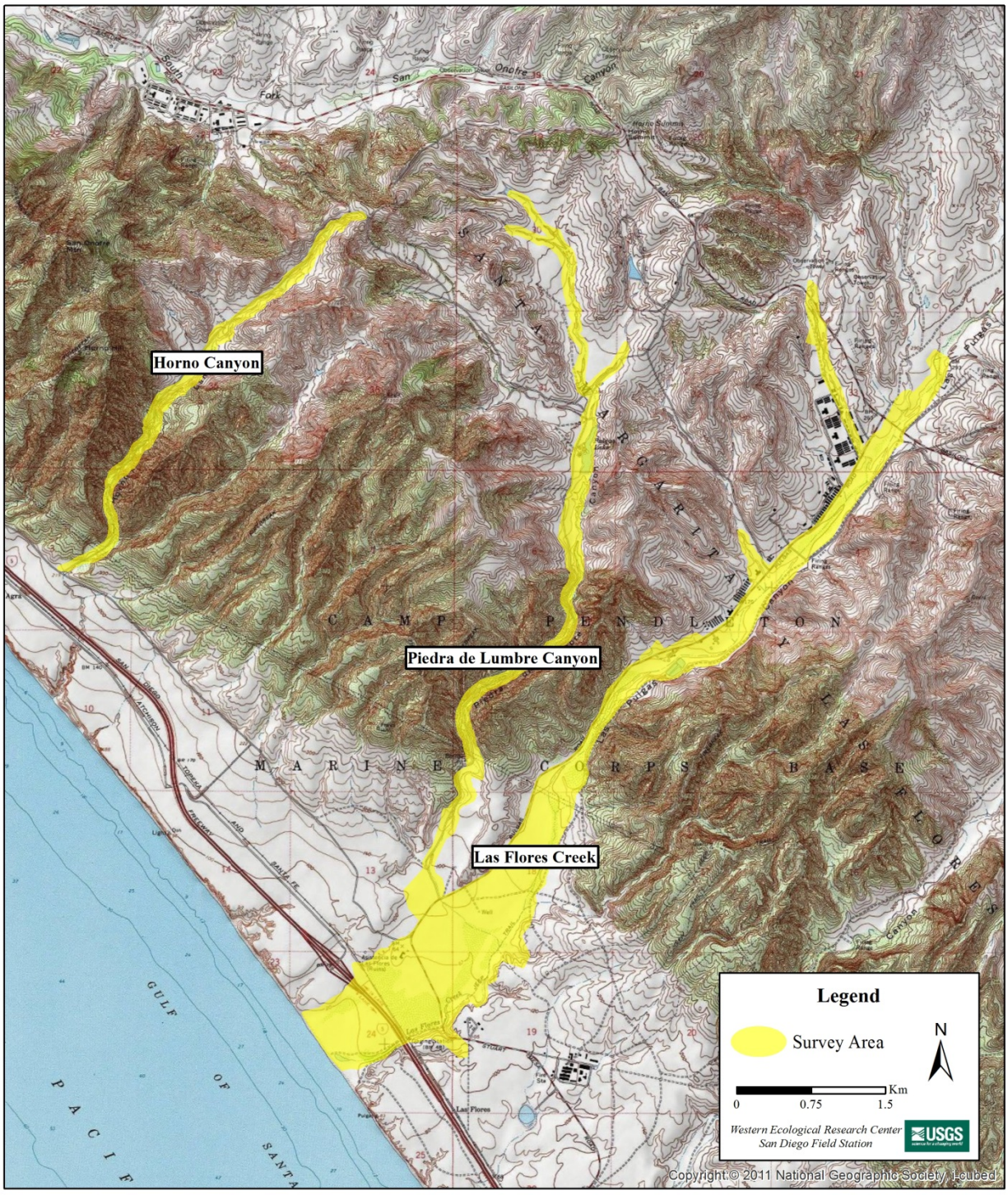

Fig. 5. Willow Flycatcher survey areas at Marine Corps Base Camp Pendleton, 2017: Las Flores Creek, Piedra de Lumbre Canyon, and Horno Canyon.

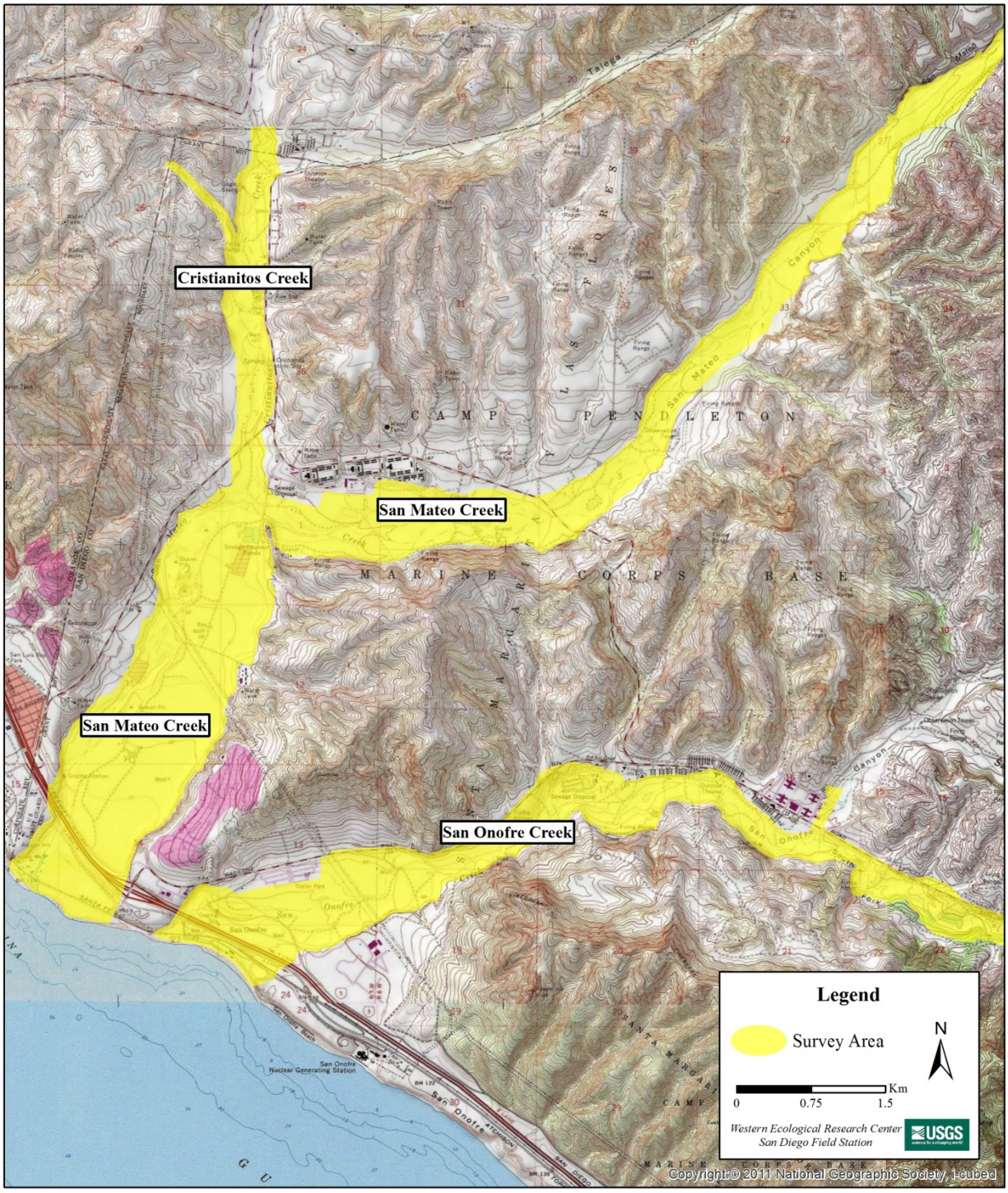

Fig. 6. Willow Flycatcher survey areas at Marine Corps Base Camp Pendleton, 2017: Cristianitos Creek, San Mateo Creek and San Onofre Creek.

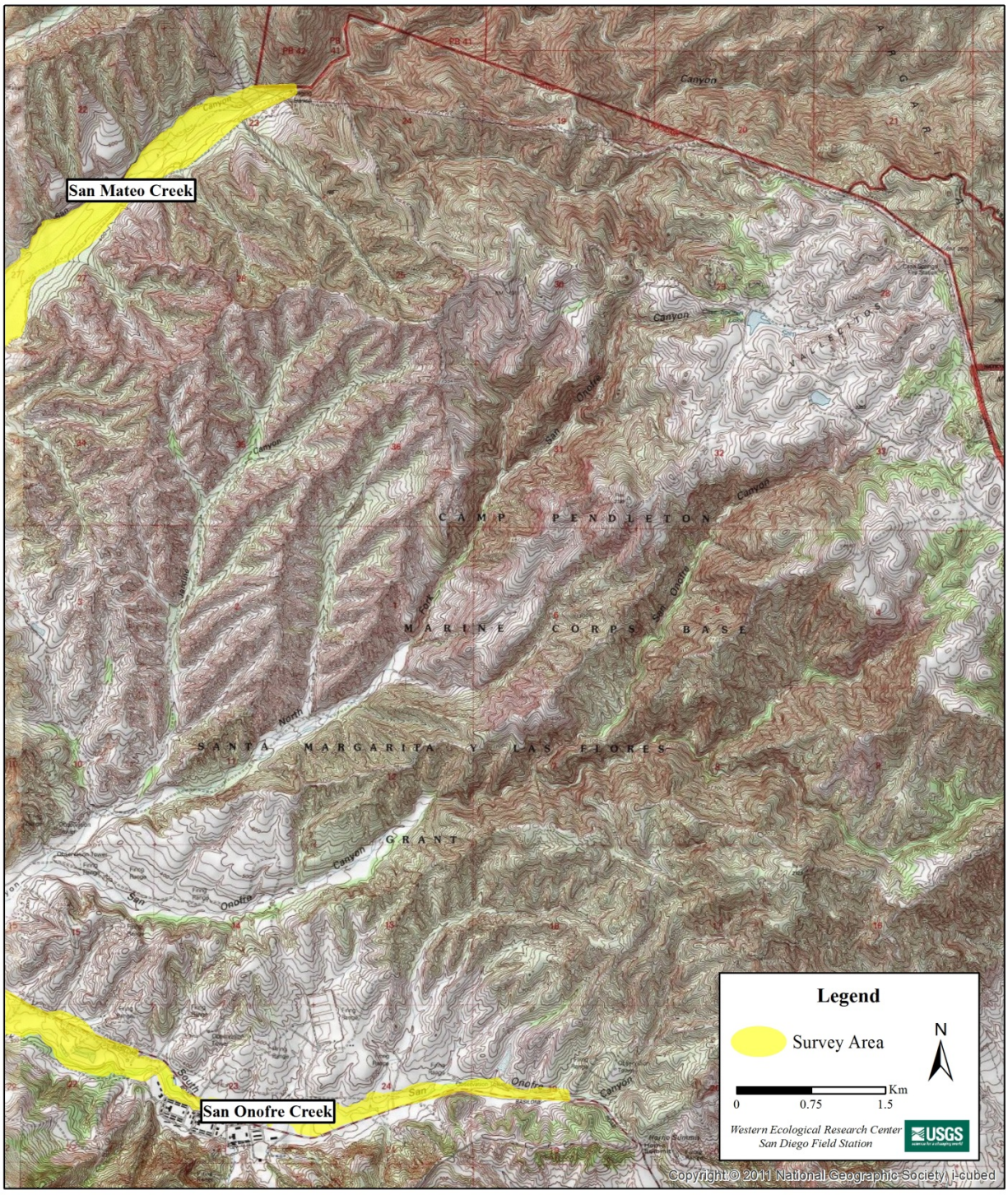

Fig. 7. Willow Flycatcher survey areas at Marine Corps Base Camp Pendleton, 2017: San Mateo Creek and San Onofre Creek.

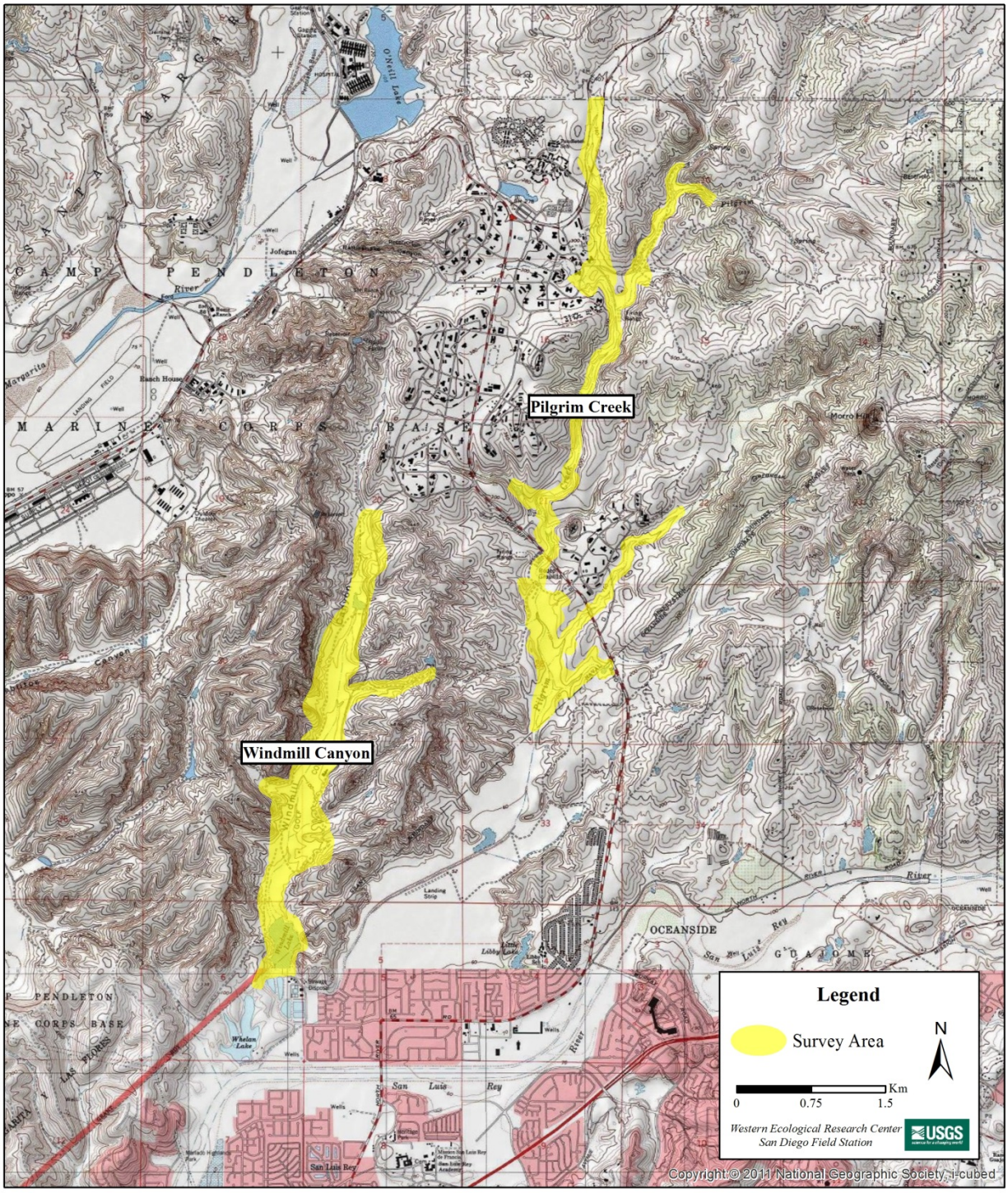

Fig. 8. Willow Flycatcher survey areas at Marine Corps Base Camp Pendleton, 2017: Windmill Canyon and Pilgrim Creek.

APPENDIX B

LOCATIONS OF WILLOW FLYCATCHERS AT MARINE CORPS BASE CAMP PENDLETON, 2017

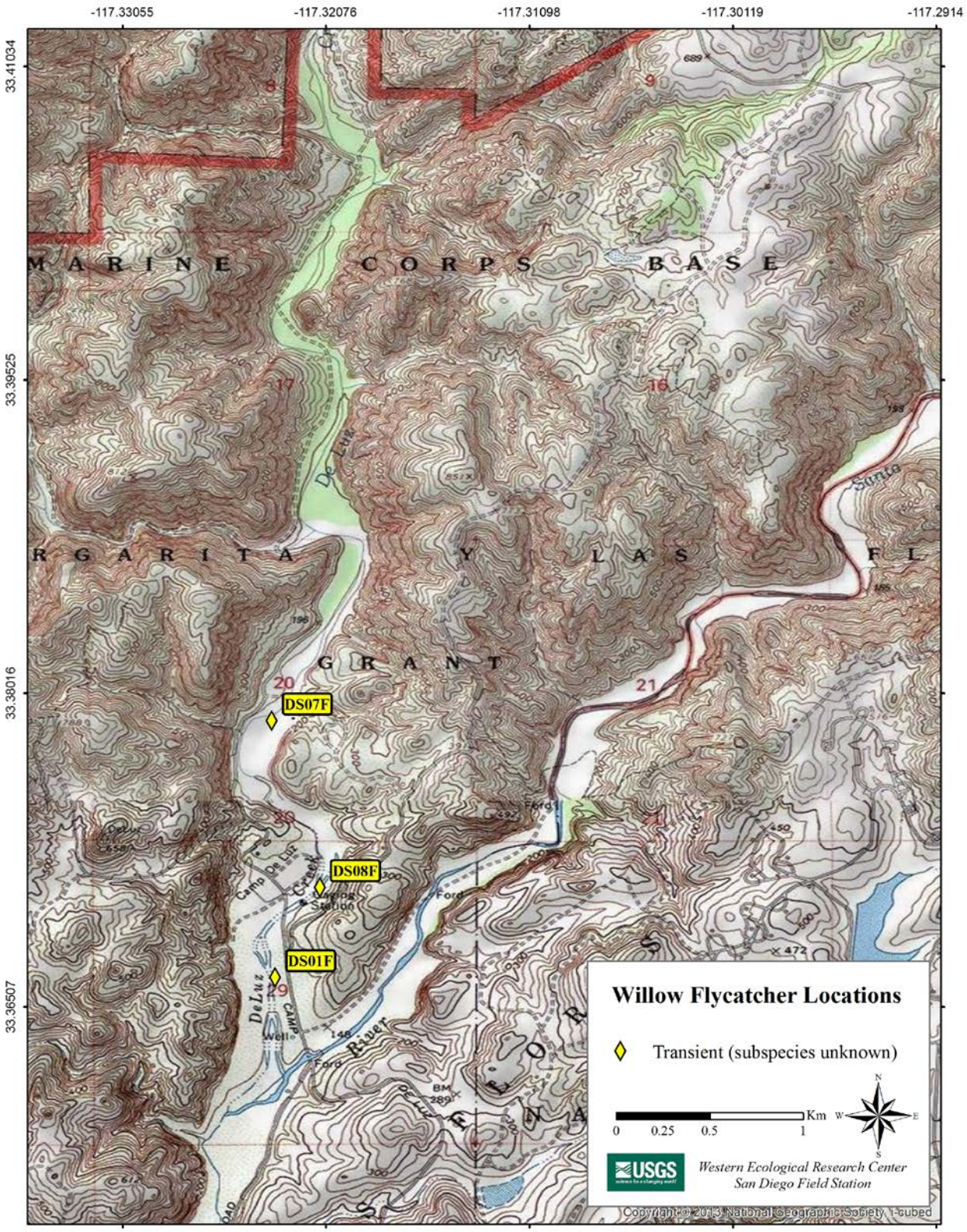

Fig. 9. Locations of Willow Flycatchers at Marine Corps Base Camp Pendleton, 2017: De Luz Creek and Upper Santa Margarita River.

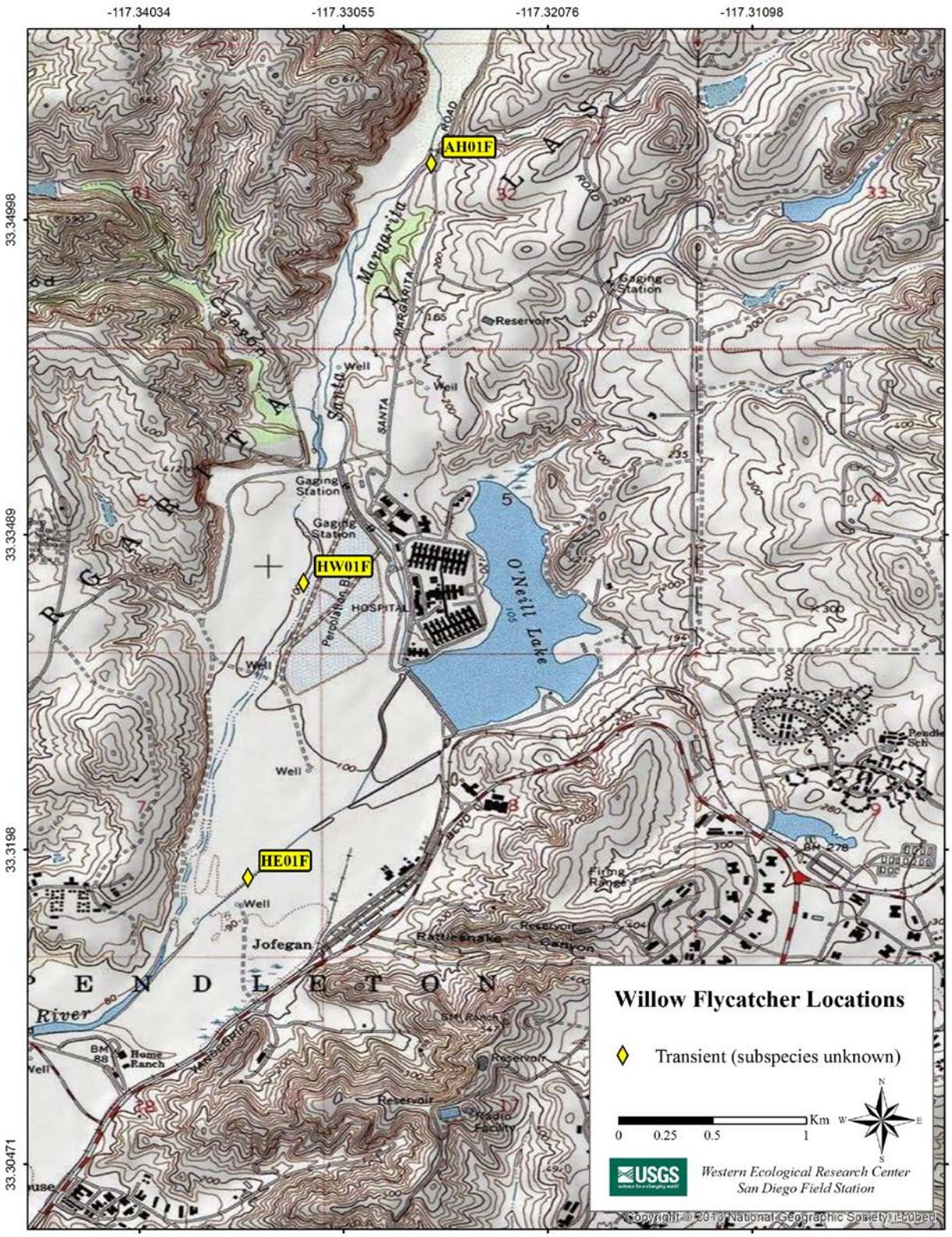

Fig. 10. Locations of Willow Flycatchers at Marine Corps Base Camp Pendleton, 2017: Santa Margarita River (upstream) and Fallbrook Creek.

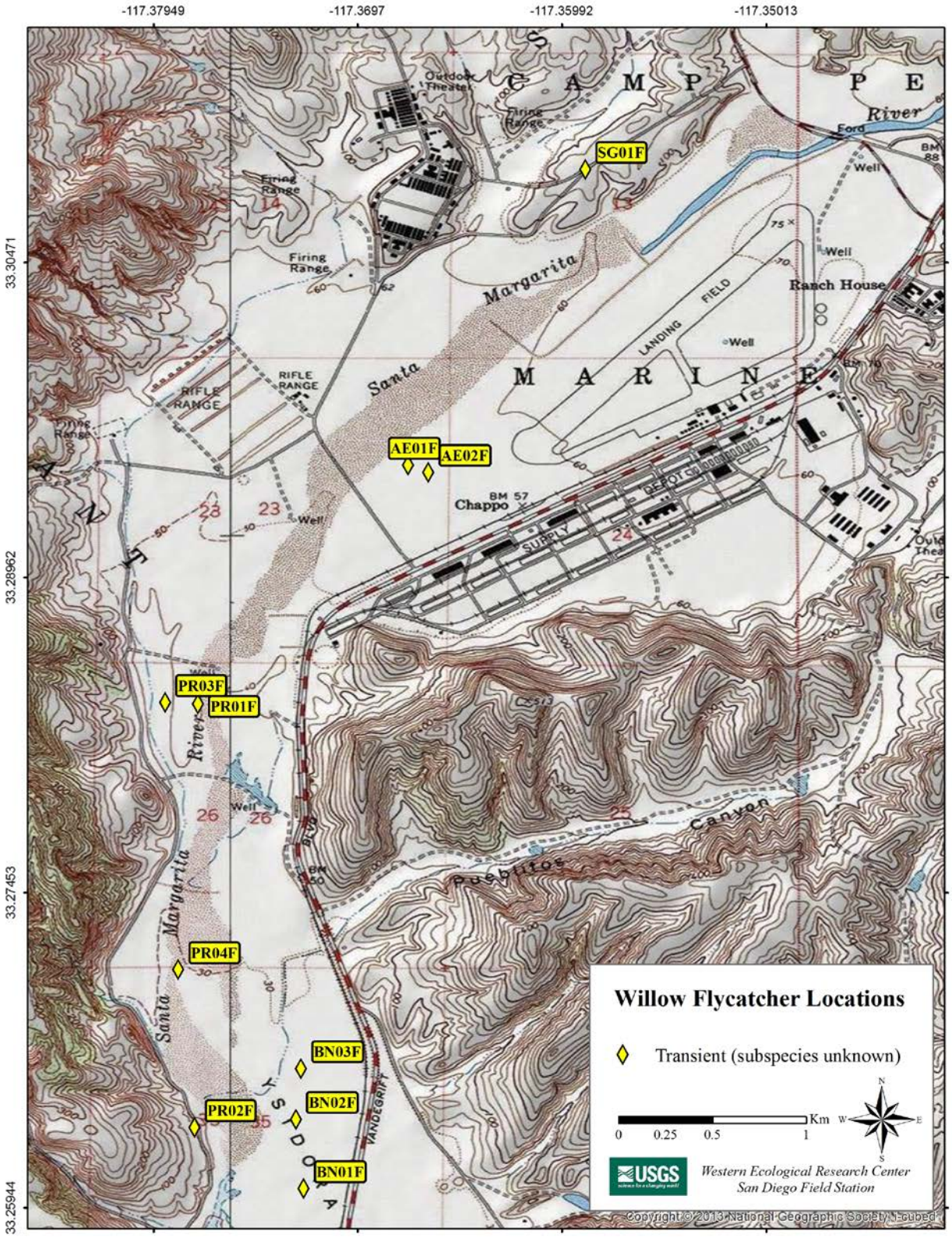

Fig. 11. Locations of Willow Flycatchers at Marine Corps Base Camp Pendleton, 2017: Santa Margarita River (midstream).

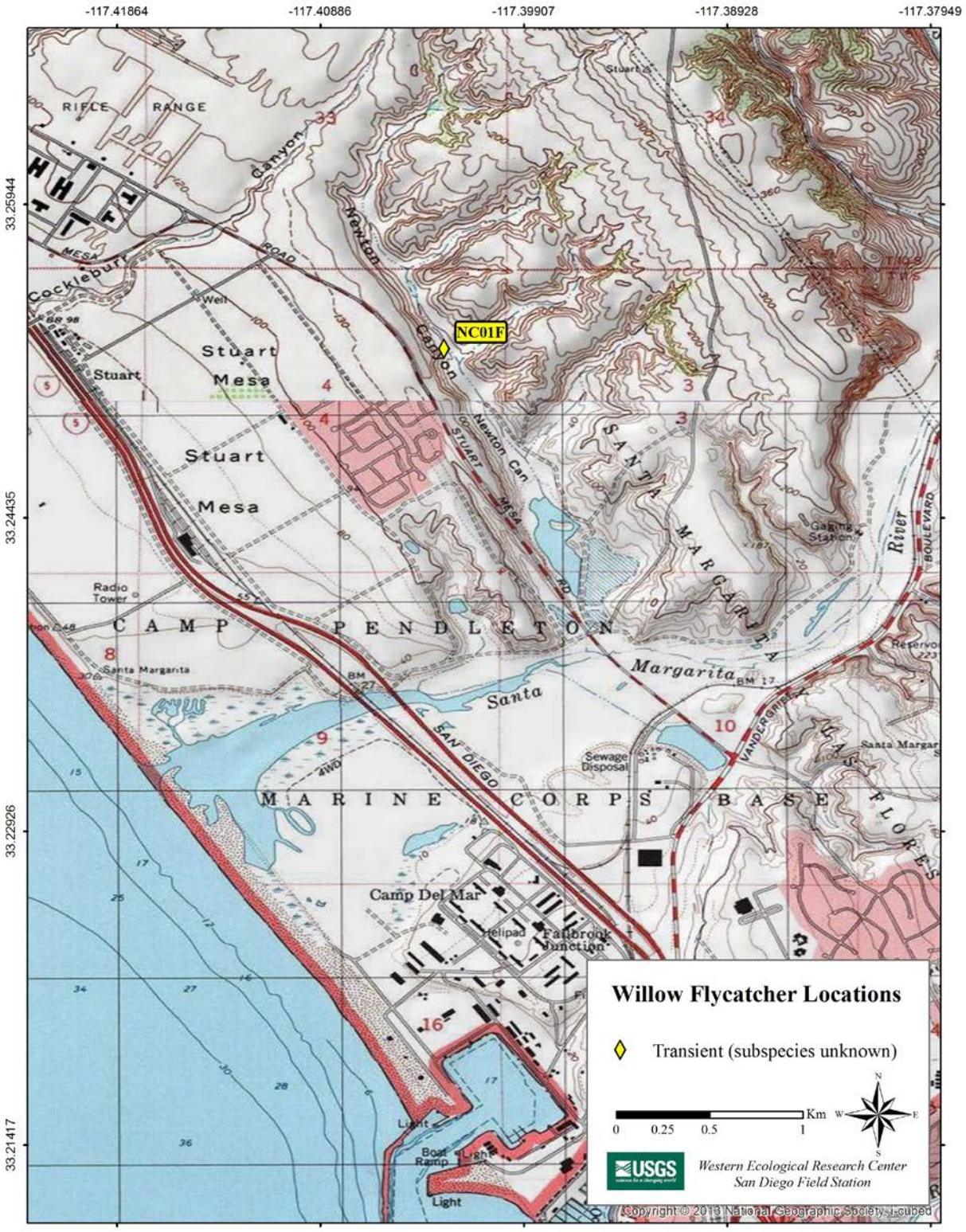

Fig. 12. Locations of Willow Flycatchers at Marine Corps Base Camp Pendleton, 2017: Santa Margarita River (downstream) and Newton Canyon.

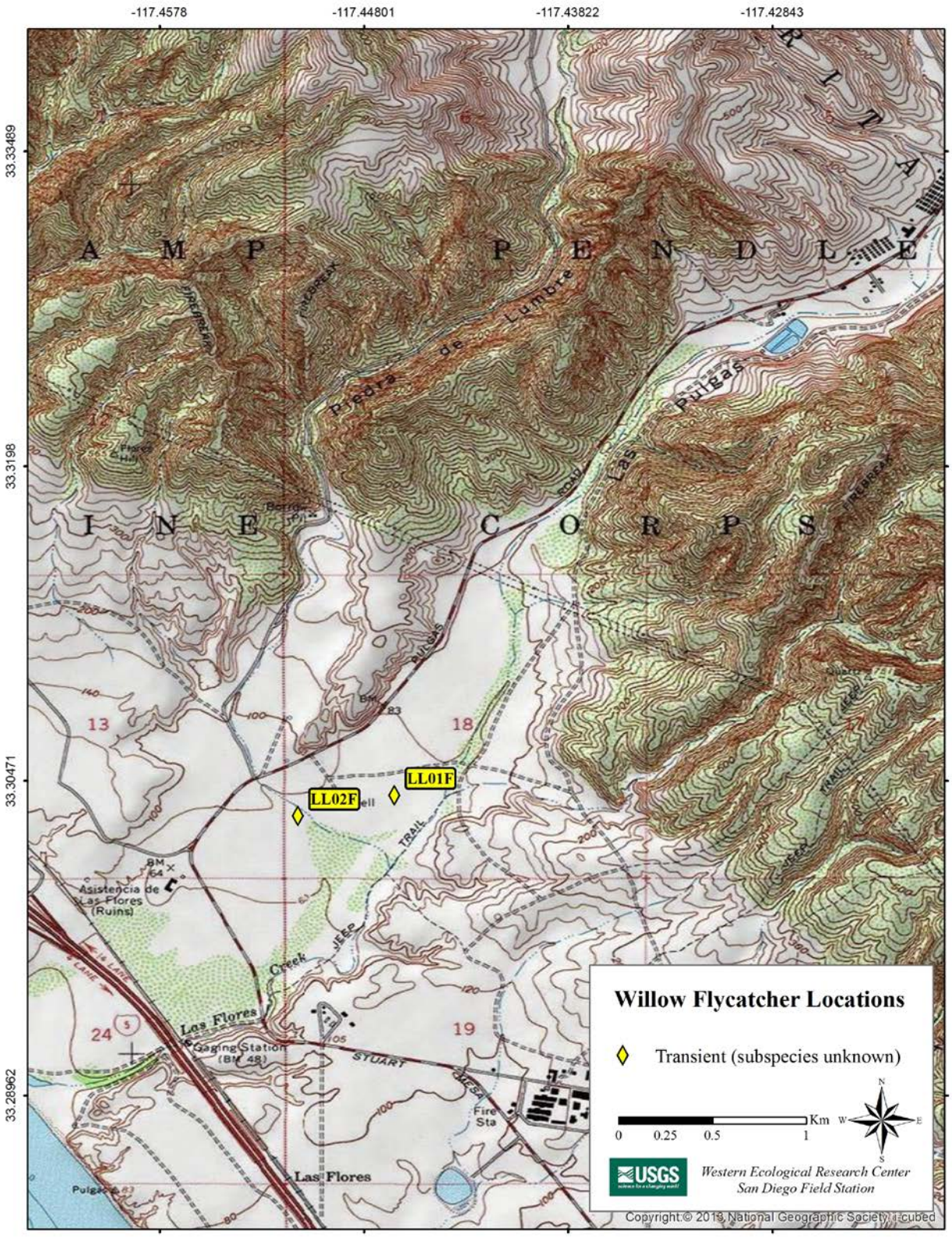

Fig. 13. Locations of Willow Flycatchers at Marine Corps Base Camp Pendleton, 2017: Las Flores Creek (downstream).

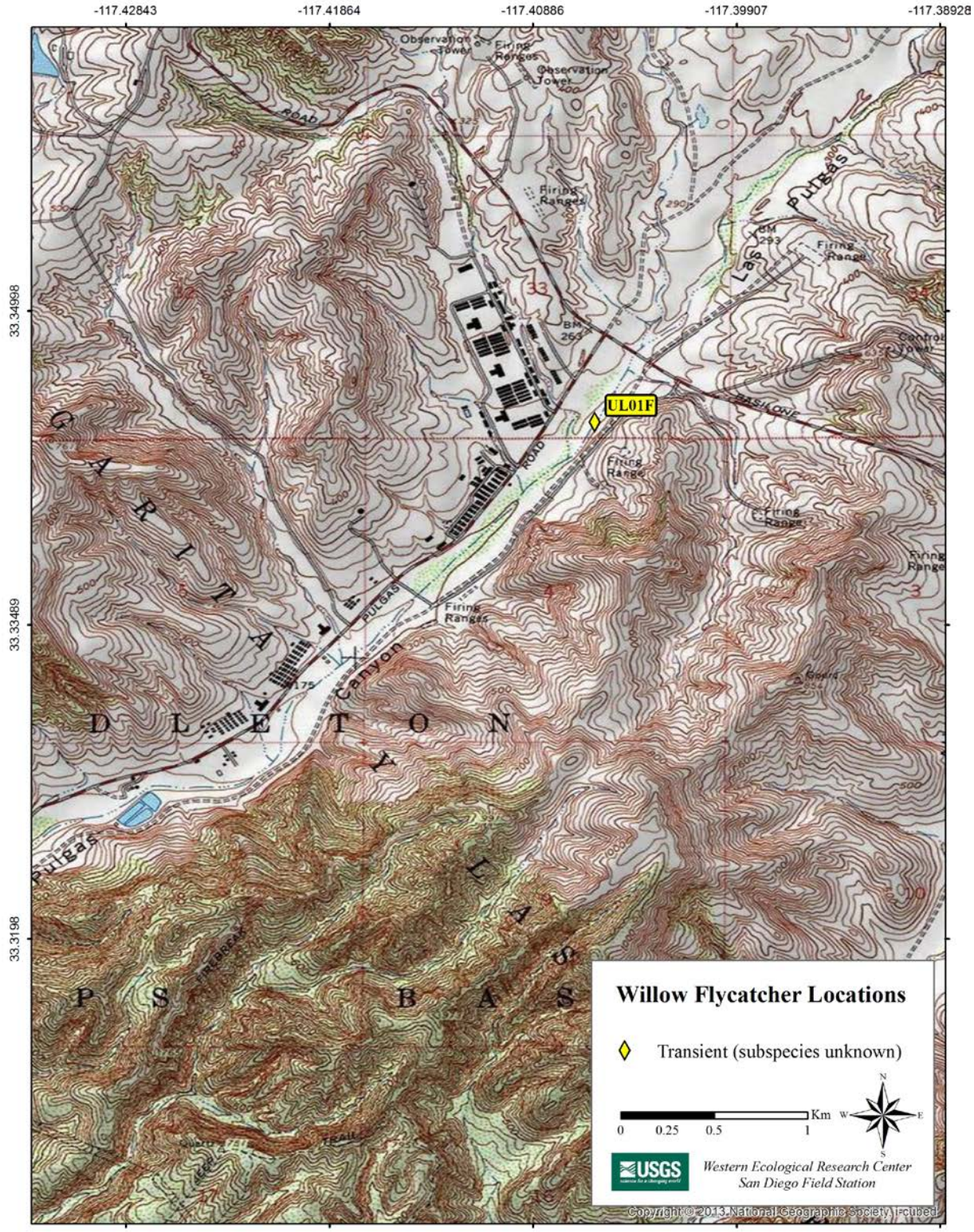

Fig. 14. Locations of Willow Flycatchers at Marine Corps Base Camp Pendleton, 2017: Las Flores Creek (upstream).

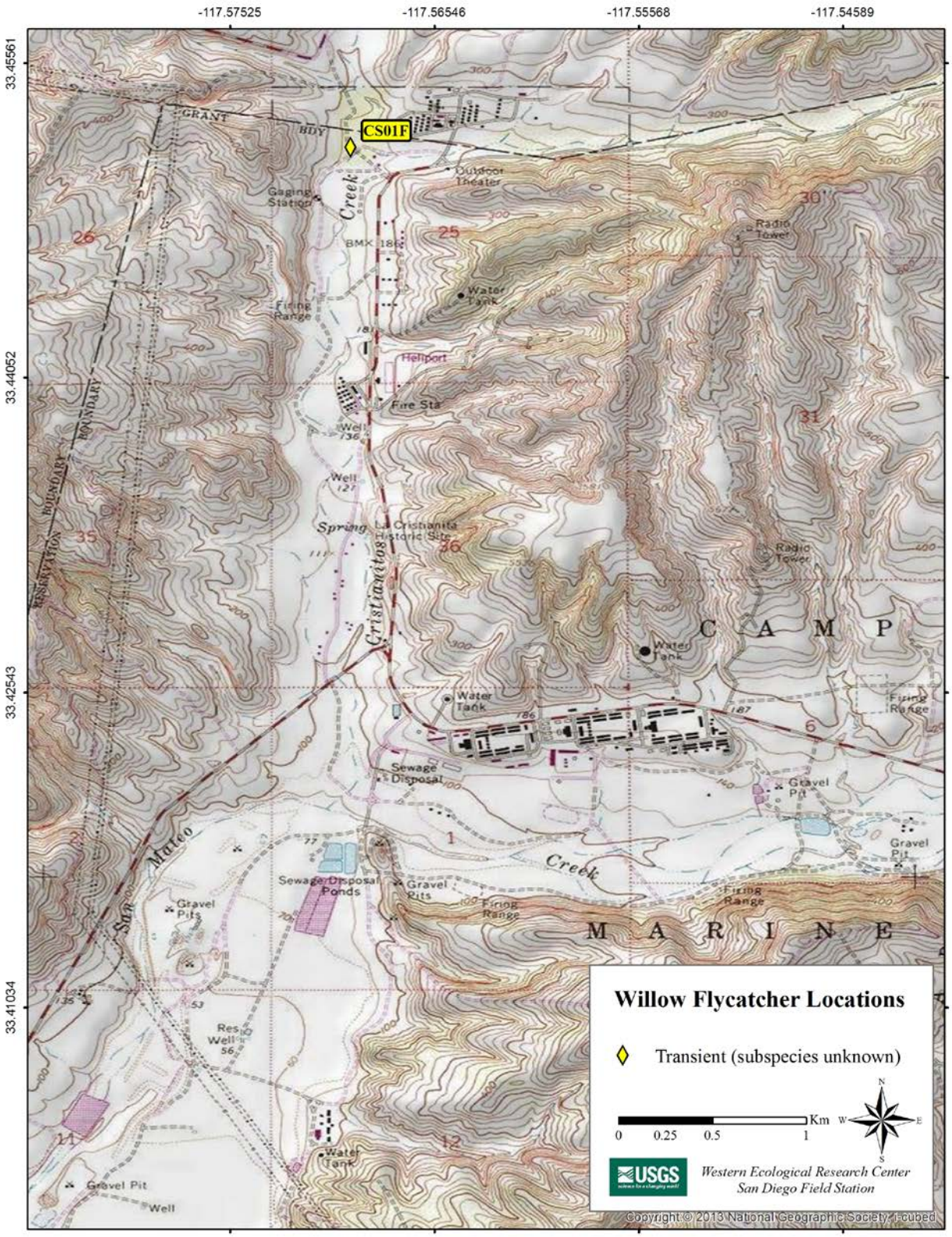

Fig. 15. Locations of Willow Flycatchers at Marine Corps Base Camp Pendleton, 2017: Cristianitos Creek.

APPENDIX C

HABITAT CHARACTERISTICS OF WILLOW FLYCATCHER LOCATIONS AT MARINE CORPS BASE CAMP PENDLETON, 2017

Bird ID	Drainage	Status[a]	Habitat Type	Exotic Cover Class[b]	Dominant Exotics[c]
CS01F	Cristianitos Creek	T	Mixed Willow	1	-
DS01F	De Luz Creek	T	Mixed Willow	2	BRA
DS07F	De Luz Creek	T	Riparian Scrub	3	CON
DS08F	De Luz Creek	T	Mixed Willow	2	BRA
LL01F	Las Flores Creek	T	Mixed Willow	2	BRA
LL02F	Las Flores Creek	T	Mixed Willow	3	BRA, CON
UL01F	Las Flores Creek	T	Willow/Sycamore	3	BRA
NC01F	Newton Canyon	T	Riparian Scrub	2	BRA, FOE
AE01F	Santa Margarita River	T	Mixed Willow	3	BRA, SIL
AE02F	Santa Margarita River	T	Mixed Willow	3	BRA, SIL
AH01F	Santa Margarita River	T	Oak/Sycamore	2	SIL
BN01F	Santa Margarita River	T	Riparian Scrub	2	BRA
BN02F	Santa Margarita River	T	Non-native	3	BRA, CON
BN03F	Santa Margarita River	T	Mixed Willow	2	BRA, CON
HE01F	Santa Margarita River	T	Mixed Willow	2	BRA
HW01F	Santa Margarita River	T	Mixed Willow	2	BRA, CON
PR01F	Santa Margarita River	T	Mixed Willow	3	BRA, CON
PR02F	Santa Margarita River	T	Mixed Willow	3	BRA
PR03F	Santa Margarita River	T	Riparian Scrub	2	CON
PR04F	Santa Margarita River	T	Riparian Scrub	3	BRA, CON
SG01F	Santa Margarita River	T	Mixed Willow	2	BRA

[a] T = transient.

[b] 1 = <5%, 2 = 5-50%, 3 = 51-95%.

[c] BRA = black mustard, CON = poison hemlock, FOE = fennel (*Foeniculum vulgare*), SIL = milk thistle (*Silybum marianum*).

APPENDIX D

SOUTHWESTERN WILLOW FLYCATCHER NEST MONITORING PROTOCOL

SOUTHWESTERN WILLOW FLYCATCHER NEST MONITORING PROTOCOL

James W. Rourke, Nongame Birds Biologist
Tracy D. McCarthey, Southwestern Willow Flycatcher Coordinator
Rebecca F. Davidson, Nongame Birds Biologist
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Nongame Branch, Wildlife Management Division
Arizona Game and Fish Department

Technical Report 144
Nongame and Endangered Wildlife Program
Program Chief: Terry B. Johnson
Arizona Game and Fish Department
2221 West Greenway Road
Phoenix, Arizona 85023-4399

May 1999

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SOUTHWESTERN WILLOW FLYCATCHER NEST MONITORING PROTOCOL

James W. Rourke, Tracy D. McCarthey, Rebecca F. Davidson, Angela M. Santaniello

INTRODUCTION

The southwestern willow flycatcher (*Empidonax traillii extimus*) is a neotropical migrant that breeds primarily from New Mexico through Arizona, and into southern California, Utah, southwestern Nevada, and possibly into western Texas. Though the flycatcher's current distribution is thought to be almost identical to its historic range, its population has declined to less than 500 pairs range-wide. The decline is thought to have resulted primarily from the loss and degradation of high quality breeding habitat throughout the Southwest. Potential factors contributing to habitat loss include the disruption of natural flow regimes within river systems, overgrazing of riparian areas by cattle, inundation of habitat, and ground water withdrawal and diversion. Other potential factors contributing to population declines include nest predation, and brown-headed cowbird (*Molothrus ater*) brood parasitism. The southwestern willow flycatcher was federally listed as an endangered species in February 1995 [USFWS, Federal Register 60 (38): 10694].

Since 1995, the Arizona Game and Fish Department (AGFD), in concert with Arizona Partners in Flight cooperators, have been monitoring nest productivity and recording nesting habitat variables throughout the state. These data are essential to determine if annual southwestern willow flycatcher reproduction is sufficient to maintain a biologically viable population. However, results from data collected or analyzed using different methodologies can cause reproductive estimates to vary greatly. It is crucial from a management and conservation standpoint that data collection, analysis and reporting methodologies be standardized if results are to be compared at any spatial or temporal scale.

This protocol is intended to provide a consistent and standardized method for collecting, analyzing, and reporting nest monitoring data for the southwestern willow flycatcher. It is based on and follows the same format as the Montana Cooperative Wildlife Research Unit's BBIRD Field Protocol (Martin and others 1997) and will allow willow flycatcher nest data to be incorporated into the BBIRD national database for nongame birds. This nest monitoring protocol is to be used in conjunction with *A Southwestern Willow Flycatcher Natural History and Survey Protocol* (Sogge and others 1997).

To reduce disturbance and ensure that high quality data are collected, individuals monitoring nests must be highly experienced and possess advanced birding skills. Researchers should be familiar with *Empidonax* flycatchers and be able to distinguish between *Empidonax* and non-*Empidonax* species. Additionally, monitors need to be able to recognize and interpret the variety of vocalizations elicited by the southwestern willow flycatcher.

Enclosed in this protocol is a summary of techniques, methodologies, data forms and southwestern willow flycatcher natural history information that AGFD has developed and/or found useful when monitoring flycatcher nests. Researchers monitoring nests in Arizona must

return a completed ***Nest Record Form*** and ***Nest Site Data Form*** for **EACH** nest monitored to AGFD for entry into the state Willow Flycatcher Information Management System.

PERMITS

All persons working with southwestern willow flycatchers are required to obtain a federal endangered species permit from the United States Fish and Wildlife Service (USFWS). All pemittees conducting surveys or monitoring nests must attend a USFWS sanctioned southwestern willow flycatcher survey training workshop. State permits may also be required. Contact the respective state wildlife agency for more information. Also, it is necessary for all researchers to obtain permission from private landowners or government agencies prior to conducting research on their land.

WILLOW FLYCATCHER IDENTIFICATION

The southwestern willow flycatcher is one of 4 (or 5) subspecies of willow flycatcher (Phillips 1948, Unitt 1987, Browning 1993), and one of 10 species of *Empidonax* flycatchers found in North America. *Empidonax* flycatchers look very much alike and can be extremely difficult to identify by sight. All are small (5-6" in length), drab, olive green, and relatively nondescript. Distinguishing morphological characteristics include such things as small variations in bill shape and tail length, and the presence, absence, or gradations there of, of an eye-ring or wing-bars. Differences in plumage characteristics maybe useful when birds are freshly molted, but as plumage wares, distinct wing-bars or eye-rings can fade and indistinct markings may disappear. As a result, the use of morphological traits alone to differentiate between *Empidonax* species can lead to questionable results. Fortunately, the willow flycatcher can be distinguished from all other flycatchers by its characteristic "sneezy" *fitz-bew* song. For this protocol, researchers must hear the *fitz-bew* song for an *Empidonax* to be considered a willow flycatcher.

Differentiating between subspecies of willow flycatcher is even more difficult. Though the southwestern willow flycatcher is often paler than other subspecies, reliable subspecies determination based on morphological traits is impossible without taking direct measurements in the hand and comparing plumage to voucher specimens (Unitt unpublished data). Due to the impracticality of this method, accurate subspecies identification cannot be determined until after the migration period. AGFD identifies any willow flycatcher documented in Arizona between June 15 and July 25 as *E.t. extimus*.

LOCATING TERRITORIES

Surveys conducted for southwestern willow flycatchers use a tape-playback technique, a proven method of eliciting vocalizations from flycatchers (Sferra and others 1995, Sogge and Tibbitts 1994, Sogge and others 1997). All persons surveying for southwestern willow flycatchers must follow procedures describe in *A Southwestern Willow Flycatcher Natural History and Survey Protocol* (Sogge and others 1997). This protocol includes a detailed description of techniques and equipment necessary to perform surveys. What follows here is a summary of the pertinent information needed to locate territories and track data on territorial flycatchers within nest monitoring study sites.

Southwestern willow flycatchers start arriving on territory in late April and early May (Skaggs 1996, Sferra and others 1997, McCarthey and others 1998, Paradzick and others 1999). Presumably, males arrive first with females following about a week to two weeks later. At this time in the breeding season males can be found singing conspicuously, atop trees or shrubs, from approximately one half-hour before sunrise to mid-morning. Pair bonding takes place and nest building commences. Typically, the first nests of the season are initiated in late May, with nesting continuing into August (Fig. 1) (Sferra and others 1997, SWCA, Inc., Environmental Consultants 1997, McCarthey and others 1998, Paradzick and others 1999).

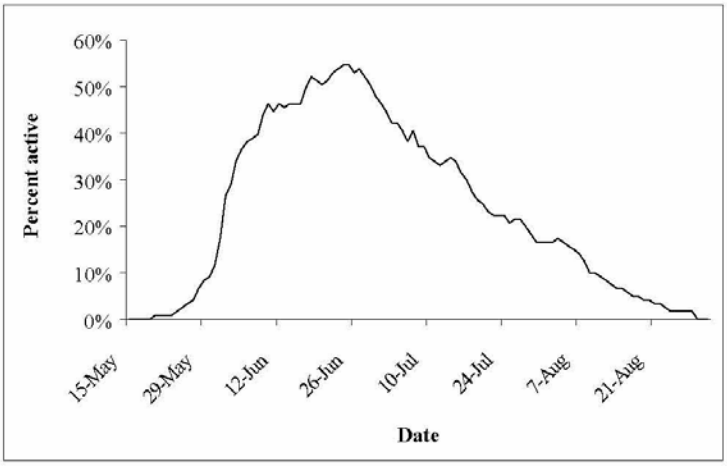

Figure 1. The percentage of southwestern willow flycatcher nests active throughout the 1997 and 1998 breeding seasons at 11 AGFD sites, n = 121 (AGFD unpublished data). This figure only includes nests that were located during the nest building or egg laying stages and subsequently monitored until young were fledged or the nest failed.

Willow flycatchers are most vocal, and thus most easily detected, early in the breeding season. Surveys conducted during this time (mid-May) allow researchers to locate territories in which

nesting may later occur. As the breeding season progresses female flycatchers begin to incubate eggs. Correspondingly, male flycatchers vocalize less frequently (AGFD unpublished data, Yard pers. comm.). During the peak-breeding season males may only sing in the earliest hours of the morning. However, after the termination of a nesting attempt, the male will begin to vocalize more frequently. Researchers working with willow flycatchers will find that males who were vocal early in the breeding season become very quiet once nesting has commenced, only to find the male singing strongly again later, after a nesting attempt has fledged young or failed (AGFD unpublished data).

When performing initial surveys of an area, concentrate on covering the entire site and documenting the location of all territorial flycatchers. A territorial flycatcher is defined here as any willow flycatcher that is actively singing or defending a territory. Biologists should be aware that migrant flycatchers can act territorial and are impossible to differentiate from resident birds. Do not concern yourself with trying to determine the breeding status of any birds at this time. As you detect flycatchers, mark your position with flagging, record the location in your field notebook/topographic map and move on. During the periods between broadcasts, listen for vocalizing flycatchers in the distance. Resident birds may only vocalize in response to other flycatcher calls, rather than leaving their territories to investigate tape playback. Broadcasting the survey tape for approximately 10 to 20 seconds every 25 to 50 m and listening for responses for 1 to 2 minutes should be sufficient to detect most flycatcher territories within a site.

GUIDELINES FOR DOCUMENTING TERRITORIES

1. Start a Territory/Nest Monitoring Card for EACH territory you locate (refer to page 16 for instructions). Use the codes at the bottom of the card to record if the territory contained an unpaired or paired flycatcher (Appendix B).
2. If a nest was located, refer to the section on Monitoring Nests in this protocol for instructions (page 8).
3. Enter the territory onto the Territory/Nest Monitoring Calendar (Appendix C) (refer to page 17 for instructions).

WILLOW FLYCATCHER NEST DESCRIPTION

Southwestern willow flycatchers build compact, tightly woven, open-cup nests measuring approximately 8 cm high by 8 cm in diameter (Harris 1991, Sogge and others 1997, AGFD unpublished data). Nests are constructed from plant fiber and/or dry grasses and lined with hair, spider webs, plant down and feathers. In general, flycatchers place nests within the fork of a vertical or slanting tree branch. Typically, flycatchers will select the densest layer of vegetation in which to construct a nest. As a result, the height at which nests are built can vary dramatically depending on the plant substrate (Table 1). For example, in Arizona nests have been found as low as 1 m in Geyer willow (*Salix geyeriana*), and as high as 11.8 m in mature Goodding willow (*Salix gooddingii*). Additionally, flycatchers appear to select morphological attributes of a plant, such as high foliage density and appropriate twig structure for nest placement, over a particular plant species.

Table 1. Dominant willow flycatcher nesting substrates, percent of nests placed in dominant substrate, and average height of nests placed within the dominant substrate for Arizona, New Mexico, and California.

State	Dominant nest substrate	Percent of nests placed in dominant species (n)	Average height of nest (n)
Arizona[a]	Tamarisk[d]	75 (642)	4.7 m (303)
New Mexico[b]	Boxelder[e]	76 (54)	7.4 m (45)
California[c]	Willow[f]	71 (176)	2.2 m (134)

[a]Arizona Game and Fish Department - unpublished data, San Pedro and Gila Rivers, and Roosevelt Lake.
[b]Skaggs (1995), Gila River
[c]Whitfield and Strong 1995, Kern River
[d]*Tamarisk* spp
[e]*Acer negundo*
[f]*Salix* spp.

Willow flycatchers initiate nest building in mid-May (Sferra and others 1997, McCarthey and others 1998, Paradzick and others 1999). Typically, nests are built within 4 to 7 days, but flycatchers have been known to construct nests in as little as 3 days (Table 2) (McCabe 1991, AGFD unpublished data). In Arizona, flycatchers have been documented reusing nest cups within the same breeding season (SWCA, Inc., Environmental Consultants 1997, McCarthey and others 1998, Paradzick and others 1999). This behavior is usually seen toward the end of a breeding season and is presumably used to shorten the breeding cycle in an attempt to fledge young prior to the end of the season. Generally, flycatchers will continue to initiate nesting attempts until young are successfully fledged or the season ends. In some cases, when young are fledged early in the breeding season, willow flycatchers will attempt to raise a second brood (Whitfield 1990, Paradzick and others 1999). This appears to be a rare phenomenon associated with nests that fledge young on or before the first week of July (Whitfield pers. comm.). Annual variation in the number of double brooding attempts may also be related to differences in water abundance, as AGFD documented 24 double broods during the 1998 El Nino breeding season and only one in 1996 and 1997 (Paradzick and others 1999).

Table 2. Southwestern willow flycatcher nesting chronology (AGFD unpublished data).

Nesting stage			
Building	Egg laying	Incubation	Nestling
3-7 days	3-5 days	11-14 days	10-15 days

In Arizona, the average clutch size for flycatchers is 2 to 3 eggs (Sferra and others 1997, McCarthey and others 1998, Paradzick and others 1999). First clutches are usually the largest, typically composed of 3 or 4 eggs, with the clutch size decreasing with subsequent nesting attempts. One egg is usually laid per day, with four egg clutches taking up to five days to lay. Eggs are incubated for 11 to 14 days (Ehrlich and others 1988, AGFD unpublished data). Willow flycatchers demonstrate asynchronous hatching, with all eggs in a clutch hatching within 1 to 2 days. Nestlings fledge when 10 to 15 days of age, with a mean fledging age of 12.5 days (AGFD unpublished data).

LOCATING NESTS

Patience, alertness, and a familiarity with a species' natural history and behavior are the greatest assets when locating nests (Martin and Geupel 1993). For southwestern willow flycatchers, more than one long, quiet, nearly motionless observation period may often be necessary to locate a nest. Frequently, the adult's behavior will lead you to a nest. Therefore, nest searching should be conducted in the early morning when willow flycatchers are most active, before monitoring known nests or resighting banded birds.

Listening for the characteristic "fitz-bew" song of the male willow flycatcher will aid in the initial location of territories, but researchers must familiarize themselves with the entire range of vocalizations elicited by both sexes if they are to locate nests effectively (a cassette tape of willow flycatcher vocalizations is available from the USGS Colorado Plateau Research Station, Flagstaff AZ 86011, (520) 556-7466). Typically, the female will lead you to the nest, but because *Empidonax* flycatchers are not sexually dimorphic, gender determination must be based on behavior. Early in the morning male flycatchers tend to remain high in the canopy, singing from exposed branches. The male will spend short periods of time at numerous locations throughout its territory, singing from its boundaries. Keep the locations of the most frequently used singing perches in mind when looking for nests. A male passerine will often sing in view of the nest, periodically looking down at it (Martin and Geupel 1993). In general, females are quieter and more elusive, but still may exhibit territorial behavior. Though females can sing strongly, with the characteristic "fitz-bew" song, they do so less frequently (Seutin 1987, AGFD unpublished data). Listen for soft "witt" communication calls and high-pitched squeaking/squealing interaction displays between the pair. Other vocalizations to listen for are "wheoo" vocalizations elicited by one or both adults, bill-snapping, soft nervous "burrring" vocalizations given by the adults when disturbed, and high pitched, nasal food begging calls elicited by nestlings and fledglings. The "wheoo" vocalization and bill-snapping behavior have been frequently documented in association with breeding willow flycatchers and are extremely good behaviors to focus on when searching for nests (Whitfield pers. comm., Yard pers. comm., AGFD unpublished data). Flycatchers will commonly bill-snap when chasing other birds away from a nest, while the "wheoo" vocalization is believed, by some, to be a communication call between the male and the female when the female is on the nest.

Once a territory is located, stay on its edge for five to ten minutes and listen to the birds. Note areas of concentrated activity and pay close attention to all interaction calls. Once you have determined one or more centers of activity quietly enter the territory. Look for the female, as she will be making periodic trips to and from the nest to forage or gather nesting material. Upon reaching a center, sit down, remain motionless, and observe. When looking for nests it is recommended that you do not try to resight color bands or follow a bird with binoculars. Doing either of these can cause you to periodically lose sight of the flycatcher(s), prolonging your observation in the territory. Continue to look for areas of concentrated activity and patterns of movements that could indicate potential nest sites. As you observe you will eliminate some areas as nest sites and refine others. Move to new locations as deemed necessary, but be aware that each position change can alert the birds to your presence and prolong your time in the territory.

Typically, if you get too close to the nest, the female will become agitated and elicit high pitched, nervous, hard "witt" alarm calls (adults will also elicit alarm calls if fledglings are in the area). If this happens, quickly survey the surrounding trees for a nest. Note probable nest locations and slowly back away. The female should resume her normal behavior as the distance between you and the nest increases. At this point, make yourself inconspicuous by sitting, lying down and/or positioning yourself so that vegetation is between you and the nest. Typically, after a disturbance the female will return to the nest. If you are still too close or conspicuous she may approach the nest but will not land on it. Often she will hover within a meter of the nest or perch next to it, periodically looking at it. If the female continues to do this, slowly back away keeping the potential nest in view and repeat the above procedure. If you have been in the territory for an extended period of time, the female may not return to the nest as long as you are present. If this happens, document the location of the "potential" nest and return later to confirm nesting. Because willow flycatcher nests can remain in the habitat for many years and other species construct nests that look similar to flycatcher nests, AGFD does not consider a "potential" southwestern willow flycatcher nest active until evidence of use is documented (that is, an adult on or building a nest or eggs/nestlings in the nest).

It is recommended that researchers check nests with a mirror or camera only after incubation has been initiated. Therefore, the nesting stage should be determined by observing the nest from a distance and documenting the adult flycatcher's behavior prior to initially approaching any nest. An adult making frequent trips to the nest with plant fibers, feathers, or spider webs indicates nest building. An adult sitting on a nest for extended periods of time indicates the incubation of eggs or brooding of nestlings. Adults making frequent trips to the nest with food indicates the feeding of young.

It should be mentioned that some female flycatchers begin incubating eggs prior to the completion of their clutch, causing the egg laying and incubation periods to overlap by a day or more. Therefore, at times, it can be difficult to discern between the termination of egg laying and initiation of the incubation stage. As a result, it is recommended that biologists be cautious when nests are first located and confirm incubation over two visits prior to first using a mirror or video camera to monitor a nest.

Biologists should always try to minimize the level and duration of disturbance to nesting willow flycatchers. During the incubation stage and early in the nestling stage the thermoregulation of eggs and young is dependent on the adults' behavior (Gill 1995). Extended periods of disturbance can prevent adults from incubating eggs, brooding nestlings or shading a nest's contents, causing partial or total mortality to a clutch or brood.

NERVOUS FLYCATCHERS

When dealing with very nervous or "skittish" flycatchers (that is, flycatchers that won't resume their normal activities as long as a potential predator [you] is in the territory), the following technique can be employed. Have a partner enter the territory with you. Proceed to the area where you believe the nest is located and sit down. Try to conceal yourself as much as possible and when you are in position have your partner leave the area. Often willow flycatchers will return to their normal behavior once one observer has left. Try to remain motionless. If you are

detected prior to locating the nest leave the territory and try again later. For an excellent review of general nest finding techniques consult Martin and Geupel (1993).

GUIDELINES FOR DOCUMENTING NESTING ATTEMPTS

In the field:

1. Although it is possible to successfully check nests during the egg laying stage it is recommended, due to the willow flycatchers' endangered status, that researchers avoid disturbing birds during the nest building and egg laying stages when they are more likely to abandon.

2. Mark the area so you can relocate the nest, but as far from the nest as possible. Try not to place flagging closer than 5 meters to any nests. Predators can learn to associate markers with nests. Also, since monitoring is usually repeated annually, it helps to write the year on the markers and remove them at the end of the season.

3. If the nest was located in a territory that had been documented previously, complete the next available line on the Territory/Nest Monitoring Card indicating that a nest was found.

In the office/camp:

1. If a nest was found in a newly located territory, start a Territory/Nest Monitoring Card and complete the top (site name, territory number, nest number and site number) and first row of the form. Indicate that a nest was located.

2. Start a Nest Record Form (consult the Nest Record Form section in this protocol for instructions and field definitions). Always begin a Nest Record Form for each nest found, regardless if the territory is new or had been monitored previously.

3. Transfer all breeding biology information from the Territory/Nest Monitoring Card to the back of the Nest Record Form.

4. Enter the nest on the Territory/Nest Monitoring Calendar. Using the calendar to plan periodic visits ensures that critical transition dates between stages are not missed (that is, the onset of incubation, hatching and fledging). Estimate future transition dates when possible (Consult the transition date section in this protocol for more information).

MONITORING NESTS

Southwestern willow flycatchers are most likely to abandon nests due to disturbance during the nest building and egg laying stages (AGFD unpublished data). Consequently, it is recommended that nests initially located while under construction not be monitored until they have entered the incubation stage. In this situation, typical time intervals between the first observation of the nest in the building stage, to the second nest check at the onset of incubation, can range from 5 to 10 days. Subsequent nest checks can be scheduled by estimating the amount of time it will take a flycatcher to complete a nest and then adding 4 days (equaling the maximum number of eggs

possible in a clutch) to the estimate. For example, if a nest is located and judged to be half complete, the nest would not need to be monitored again for 7 to 8 days (3 to 4 to complete construction + 4 days to lay eggs).

After the onset of incubation, monitor nests every four days, but as transition dates approach check nests every two days to verify the beginning of the next stage. If future transition dates cannot be estimated, check the nest every two days. To reduce the probability of researcher activities alerting cowbirds to the location of nests, nests should be monitored late in the morning when cowbirds have moved from breeding grounds to feeding areas. Never approach a nest when a cowbird is in the area.

During the incubation stage, check the contents of the nest directly with a mirror or miniature video camera (If a nest is too high to monitor using a mirror or video camera, observe the nest with binoculars). After the eggs have hatched and the number of young has been confirmed, monitor nests from a distance with binoculars, determining nest activity through the parents' behavior. This reduces the likelihood of force-fledging young. As the nestlings age, verify the number of young by counting beaks. If no activity is observed at the nest for 30 to 45 minutes and the adults are not disturbed by your presence, check the nest directly to assess its contents. If a nest is found empty and is suspected to have fledged young, perform a 30 to 45 minute observation to confirm fledglings. Fledgling willow flycatchers are dependent upon their parents for food for approximately two weeks after leaving the nest. If young are fledged early in the breeding season, flycatchers may attempt to raise a second brood (Whitfield 1990, Paradzick and others 1999). Therefore, biologists should begin to look for renesting attempts within 14 days after a nest has successfully fledged young.

AGFD considers a nest successful when one of 4 conditions is met: 1) one or more young are confirmed visually fledging from the nest or are located near the nest; 2) color banded adult flycatchers are seen feeding fledglings; 3) parents behave as if dependent young are nearby when the nest is empty (that is, defensive behavior and/or adults agitated by human presence); and 4) nestlings are observed within two days of the estimated fledge date. This last condition is an assumption that is based upon observations of southwestern willow flycatchers fledging at 10 days of age (AGFD unpublished data). Additionally, similar methodologies for determining passerine nest outcomes are used by other researchers (Conner and others 1986, Patnode and White 1992, Martin and others 1997, Drobney and others 1998, Clotfelter and Yasukawa 1999). Nests meeting conditions 1 and 2 are preferable to conditions 3 and 4. Therefore, we recommend that researchers conduct follow-up visits to visually confirm fledglings.

At 10 to 12 days of age, fledglings are fully feathered with only the tail needing further development (Fig. 4F). At this time they are capable of making short, sporadic flights. Initially, young will remain close to the nest, and may even return to the nest for short periods of time. As they age and their tail feathers emerge fledglings can roam far from the nest. We have documented color-banded adults feeding two-week-old young up to 150 meters from their nest (AGFD unpublished data). Researchers should be aware of the possibility that adults and fledglings may move into areas where flycatchers had not been previously documented. If this occurs, data from surrounding nests should be reviewed and the adults resighted for color bands, prior to assuming that a nesting attempt had been overlooked. To avoid this confusion it is

essential for researchers to confirm the presence of fledglings as close to the estimated fledge date as possible.

If a nest is suspected to have been abandoned prior to the laying of eggs or deserted with eggs or young, at least two nest checks should be performed to confirm abandonment. One of the checks should include a 30 to 45 minute observation within the territory without confirming the presence of adults around the nest on either check. When a nest is found empty prior to the expected fledge date, check the area around the nest tree for signs of predation (for example, egg shell fragments or young on the ground). After a nest has failed, the territory should be visited every four days to check for renesting. It is possible for willow flycatchers to build a nest and initiate a second clutch within three to ten days of the initial nest failure (McCabe 1991, Holcomb 1972, AGFD unpublished data). Look for subsequent nesting attempts in the same territory and within 50 meters of the initial nesting event (McCabe 1991). In addition, periodically monitor old nests, as flycatchers have been documented reusing previously active nests within the same breeding season (SWCA, Inc., Environmental Consultants 1997, McCarthey and others 1998, Paradzick and others 1999). If no sign of renesting has been documented after 12 days, the territory can be considered inactive, but should be rechecked periodically.

INTERPRETING ALARM CALLS

Southwestern willow flycatchers demonstrate numerous behaviors that biologists can use to evaluate the status of a nest or territory. Specifically, how a flycatcher reacts to the presence of a potential predator, in this case a human, can be very useful. During the breeding season, flycatchers will elicit alarm calls (that is, high-pitched, hard "witt" vocalizations) when potential predators are too close to an active nest or fledglings. Researchers that are aware of the significance and meaning of alarm calls can make informed procedural decisions that can facilitate nest monitoring and reduce disturbance. For example, the above mentioned alarm calls should indicate to a researcher that they are close to fledglings or an active nest.

Situations where adult flycatchers are not disturbed by the presence of humans indicate one of two things; 1) that the flycatcher(s) are not actively defending a territory, nest or young, or 2) that the researcher is not close enough to an active nest or fledglings to cause the birds concern. In cases such as this, observing the flycatchers from a distance, and moving quietly and slowly through the territory in search of a nest or young are two methods of determining a territory's status.

NEST CHECKING GUIDELINES

Wear drab, earth tone colored clothing that blends with the surrounding habitat when searching for or monitoring nests. Bright colors can disturb and alert the birds to your presence.

In the field, record the following information for each nest check on the appropriate Territory/Nest Monitoring Card:

- date
- time of observation

- observer name
- method used to monitor the nest
- nesting stage
- nest number
- nest contents
- age of young (if applicable)
- if adult(s) were present while the nest was checked
- adult(s) behavior
- distance to water or saturated soil

Incubation Stage

During the incubation stage all nest monitoring should be performed using a mirror pole or miniature video camera (very high nests can be monitored with binoculars from a distance).

1. Do not approach the nest when possible predators/cowbirds are in the area.

2. Approach the nest quietly.

3. As you approach, mirror/video camera clumps of vegetation in trees other than the nest tree. If a predator/cowbird is in the area this behavior may prevent it from following your movements to locate the nest.

4. Monitor nests using a mirror or video camera. Assess the nest contents and estimate the age of any young.

5. Leave the area via a different route than which you came and mirror/video camera additional vegetation as you exit. Avoid creating dead end trails that lead directly to the nest. This makes it more difficult for predators to locate the nest by following your scent trail.

6. Once out of the territory, record the contents of the nest, and any data used to make your assessment, on the Territory/Nest Monitoring Card and in your field notebook. For example:
   - Nest active- adults agitated, three willow flycatcher eggs.
   - Three willow flycatcher young- small, downy, approximately 1 to 2 days old.
   - Nest failed- nest empty, possible predation, damage to nest cup, eggshell fragments present.
   - Nest abandoned?, no sign of adults, performed a 45 minute observation of the nest.

7. When you return to camp/office transcribe all monitoring data onto the appropriate Nest Record Form and Territory/Nest Monitoring Calendar. The Nest Record Form serves as the permanent record for each nest and should never be taken into the field.

Nestling Stage

1. If the number of nestlings has not been confirmed use a mirror or miniature video camera to monitor the nest. Follow the procedure for checking nests outlined in the incubation stage. To reduce the likelihood of force-fledging young, never mirror/camera a nest that contains nestlings older than 7 to 8 days.

2. Once the number of nestlings has been confirmed, monitor the nest by observation to confirm activity. During each visit, monitor the nest until activity is confirmed or 30 to 45 minutes have passed.

3. Enter the territory and approach the nest quietly. Sit or lay down in view of the nest and begin observing. Positioning yourself as far from the nest as possible, with vegetation between you and the nest, often helps reduce/avoid disturbance.

4. If the adult(s) are agitated by your presence and do not quiet down within five minutes, slowly back away from the nest. As you increase the distance between yourself and the nest the adults should become less agitated and begin to feed the young. A second option is to exit the territory and wait for the adults to quiet down. If you do this, leave something (for example, your backpack or flagging) to mark the position from where you can view the nest. This will decrease the time it takes for you to become situated when you return. Wait approximately five minutes and reenter the territory (refer to the section on "Nervous Flycatchers" for other monitoring techniques).

5. Resight color banded birds while performing a nest observation.

6. Record all data confirming nest activity in your field notebook and on the Territory/Nest Monitoring Card. Transcribe all monitoring data onto the appropriate Nest Record Form and Nest Calendar when you return to camp/office. For example:
   - Three willow flycatcher young - all in pinfeathers, approximately 5-6 days old.
   - Nest fledged- two fledglings seen in territory, parents acting as if dependent young are in area.
   - Nest failed- nest empty, possible predation, damage to nest cup, adults not in area, performed a 40 minute observation.

7. Once a nest is no longer active, complete the Nest Record Form (refer to page 20 for instructions).

WILLOW FLYCATCHER AND BROWN-HEADED COWBIRD EGG AND NESTLING IDENTIFICATION

Brown-headed cowbird nest parasitism rates of southwestern willow flycatcher nests can vary widely from site to site. However, approximately 75 percent of all parasitized nests and 82 percent of all nests containing cowbird nestlings fail to fledge southwestern willow flycatcher young (AGFD unpublished data). To assess the impact of nest parasitism on flycatchers it is necessary to be able to distinguish between cowbird and willow flycatcher eggs and nestlings. Fortunately, several characteristics can be used to differentiate between the two.

Egg Identification

Willow flycatcher eggs are buffy white with brown spots near the larger end, while brown-headed cowbird eggs are white or bluish to greenish in color and are generally completely mottled with small brown spots (Fig. 2). Also, willow flycatcher eggs (18 x 13 mm) are smaller than cowbird eggs (21 x 16 mm), making this a good field mark when comparing the eggs of the two species within the same nest. Though eggs of both species tend to be elliptical, cowbird eggs can vary considerably from this shape (Baicich and Harrison 1997).

A) Willow flycatcher eggs

B) Brown-headed cowbird eggs

Figure 2. Eggs of the southwestern willow flycatcher (A) and brown-headed cowbird (B). Eggs and photographs from the Western Foundation of Vertebrate Zoology collections.

Nestling Identification

Both willow flycatcher and cowbird nestlings are altricial and downy when hatched, however the two species can be differentiated using other morphological features. The most distinguishing characteristics include differences in the color of the bill, mouth, and gape flanges. Willow flycatcher young possess yellow mouth and gape flanges and a pale pink upper mandible, while cowbirds have a pink mouth and cream colored flanges. It is advisable for monitors to focus on the color of the mouth when identifying cowbird young, as the color of the gape flanges can vary depending on the subspecies of cowbird.

Additionally, nestling size can often be a defining characteristic (Fig. 3). Brown-headed cowbird young grow rapidly, quickly dwarfing flycatcher nestlings. A nest containing all willow flycatchers will generally show only slight differences in nestling development within a brood, while cowbird nestlings can be easily differentiated from flycatchers on size alone as they age. Monitors should be aware that as nestlings age and the nest becomes cramped, young will periodically sit on top of each other causing flycatchers to look larger then they truly are. Individuals unaware of this possibility may report mature cowbird young in nests that previously showed no signs of parasitism. If this occurs, the nest should be observed as soon as possible to confirm the identity of the "large" nestling.

AGING YOUNG

All persons monitoring willow flycatcher nests need to be able to accurately age nestlings. The aging of young not only increases the knowledge of natural history parameters influencing flycatcher productivity, but can also reduce future disturbance by minimizing the number of visits necessary to accurately determine nest outcomes. Monitors should become familiar with Table 3 and Figure 4, and take a copy with them into the field so comparisons can be quickly made with the young observed in nests. Nest monitors may never use the level of detail provided in Table 3, but should concentrate on gross morphological features (such as the size of nestlings and feather development).

Figure 3. Eight day old willow flycatcher (bottom) and brown-headed cowbird (top) nestlings. Photograph by Jim Sedgewick.

Table 3. Willow flycatcher nestling development as documented (McCabe 1991 and King 1955).

Day	Description
1	**About the size of a thumbnail; long gray down on crown, and tufts of shorter down on spinal (back) and alar (wing) tracts**; yellow gape; unable to hold up its head.
2	Down predominant around the eyes, wings and legs; head can not be held upright Down covers 30% of body.
3	**Feather sheathes for secondaries have broken through surface or are about to**. Feather papillae dark especially on the wings; feet and legs extended forward; bird rests on abdomen.
4	**All feather tracts easily visible**. This will appear as a dark line along the spinal track of the nestlings. Wing quills discernible as small bumps or points.
5-6	**Most quills have elongated into pin feathers**; spinal tract (back) clear and distinct.
7	Most quills ruptured, feather ends protrude about 1 to 2 mm; head well covered with quills.
8	**Most of body appears covered by feathers**. More of feather sheath shed; legs and feet drawn back under the body in support as in perching. Nestlings are able to fold wings and perch erect.
9	Feathers of the spinal tract (back) dark and well developed so that the quills at the base of the feathers do not show; two-tone aspect of the secondary feathers (buff and slate colored) now apparent.
10	**Nestlings are well feathered. Wings appear whole**. Feathers more extruded; buff edging (wing bars) on secondaries and coverts becoming more pronounced.
11	**Feathers cover body completely**. Birds are actively preening. Most quills covered by adjacent feathers particularly on the dorsal surface and wing, giving smoother appearance.
12	Nestling appears fully feathered, with only tail clearly in need of further development. Some down feathers still obvious around eyes (by day 14 down is virtually gone).

Figure 4A. One day old willow flycatcher. Photograph by Sean Rowe.

Figure 4D. Eight day old willow flycatcher. Photograph by Sean Rowe.

Figure 4B. Three day old willow flycatcher. Photograph by Sean Rowe.

Figure 4E. Ten day old willow flycatcher. Photograph by Eben Paxton

Figure 4C. Five day old willow flycatcher. Photograph by Sean Rowe.

Figure 4F. Twelve day old willow flycatcher. Photograph by Eben Paxton

Figure 4A -F. Willow flycatcher nestling development from hatching to 12 days of ages, shown in 2 to 3 day increments.

DATA MANAGEMENT

AGFD primarily uses three forms (the Territory/Nest Monitoring Card, the Nest Record Form, and the Territory/Nest Monitoring Calendar) to track and manage nest-monitoring data and one form (the Nest Site Data Form) to record general habitat variables around nest sites. Though at times the forms may seem redundant, all serve a different purpose. We have found these forms to be essential in managing data for sites containing numerous breeding pairs.

TERRITORY/NEST MONITORING CARD

Both a Territory/Nest Monitoring Card (Fig. 5) and Nest Record Form should be completed for all nests and territories located. The Nest Record Form serves as a permanent record for each nest, while the Territory/Nest Monitoring Card duplicates the history section on the Nest Record Form and serves as a copy to be taken into the field. Thus, the researcher can identify possible inconsistencies in a nest's chronology (for example, an empty nest that should have contained nestlings) while in the field and make an informed decision on how to proceed (for example, to look for possible fledglings in the area or label the nest as depredated). Monitoring data from territories containing unpaired flycatchers are also tracked to determine when and if flycatchers become paired and begin nesting.

Each time a nest or territory is monitored, complete a new line on the appropriate Territory/Nest Monitoring Card while in the field. When you return to camp transcribe all data from each card onto the appropriate record form. Be as detailed as possible when completing the cards in the field. They serve as the first level of data collection and can greatly facilitate the eventual determination of nest outcomes.

Site name:_____ Territory no.:___ Nest no.:_____ AGFD Site no.:_____

Date	Time	Obs	Mon Type	Stage	Adult pres	# WF Egg	# CB Egg	# WF Nstl	# CB Nstl	# WF Fldg	Age Yng	Dist Wat	Field Tasks	Comments

Figure 5. Top portion of the Territory/Nest Monitoring Card.

FIELD DEFINITIONS

Complete immediately after locating a nest or territory:

Site name: Unique name assigned to each site (if in Arizona contact AGFD at (602) 789-3583 for the correct site name).

Territory no.: Territory number. An unique number assigned to each territory located within a site (for example, 1, 2, 3, and so forth). No two territories within a site should be assigned the same number.

Nest no.: A letter designation indicating an individual nesting attempt within a territory (for example, A, B, C, and so forth). Nests assigned with the letter "A" indicate the first

nesting attempt within a territory, while the letter "B" indicates a second nesting attempt within a territory. Letters should be assigned in a sequential order starting with "A".

Each nest should be assigned a unique identifying number (territory number) and letter (nest number) designation. The number indicates the territory in which the nest was located, while the letter indicates the nesting attempt. For example: 2A signifies the first nesting attempt within territory two; 2B signifies the second nesting attempt within territory two regardless of whether the first attempt was successful. If a previously active nest is reused, add an additional number to indicate the reuse. For example, 3B2, indicates the reuse (2) of the second nest (B) in territory three (3).

AGFD Site no.: A unique identifying number assigned to each site by the Arizona Game and Fish Department. Contact AGFD at (602) 789-3583 for the site number. Ignore if the site is outside Arizona.

Complete in the field, each time a nest or territory is monitored:

Date: The date the nest was initially found or subsequently checked.

Time: The time the nest was monitored.

Obs: Name or initials of the individual observing/performing the nest check.

Mon Type: The type of method used to monitor the nest. Record "M" if the nest was mirrored, "V" if a video camera was used, and "O" if an observation with binoculars was performed.

Stage: The breeding stage of the nest. Record "B" for nest building, "L" for possible egg laying, "I" if the nest is in the incubation stage, "N" for the nestling stage, and "F" if fledglings were observed in the territory.

Adult pres.: Were either or both of the adults present when the nest was monitored? Enter "Y" if adults were present and "N" if they were absent.

 # WF Egg: The number of willow flycatcher eggs in the nest.

 # CB Egg: The number of cowbird eggs in the nest.

 # WF Yng: The number of willow flycatcher young in the nest.

 # CB Yng: The number of cowbird young in the nest.

Age Yng: Age of willow flycatcher nestlings. Estimate the age in days (For example, record "8" for eight day old nestlings).

Dist Wat: The horizontal distance, in meters, from the nest to water or saturated soil. If the nest is built over water record zero.

Comments: Record any additional information used to determine the stage or status of the nest.

TERRITORY/NEST MONITORING CALENDAR

The Territory/Nest Monitoring Calendar (Appendix C) provides an excellent means of tracking daily nest monitoring data and greatly simplifies the planning of future nest visits for an entire site, especially if there are a large number of nests to be monitored. Additionally, the calendar ensures that critical transition dates between stages are not missed (that is, the onset of incubation, hatching, and the fledging of young) by displaying the entire breeding season (May through August) on a single form. At a glance, you can assess which nests are active and which

need to be monitored on a specific day. However, researchers should not depend solely on the calendar to monitor nests. The calendar's purpose is to facilitate the scheduling of nest/territory visits and does not provide space to track all the data necessary to determine nest outcomes.

As territories/nests are found, assign each a number and enter it in the left most column of the form (Fig. 6). Below the territory/nest number, record the preferred method for monitoring each nest. Typically, using a mirror attached to a pole (MP) is the quickest and easiest way to assess the contents of a nest. A miniature video camera (VC) can also be used, but has drawbacks. The video camera takes time to setup and breakdown, cords can snag on branches, and camera systems can be temperamental, making them not as reliable as mirror poles. If a nest is too high (TH) to use a mirror or video camera, observe the nest from a distance with binoculars, determining the stage of the nest from the parents' behavior.

Researchers should use the codes at the bottom of the form to indicate a nest's stage and contents (Fig. 6). For example, if a nest contained two willow flycatcher eggs (WE) and one brown-headed cowbird egg (CE), record 2WE/1CE in the appropriate cell.

Plan future visits to all nests by writing an "M", in pencil, under the appropriate date when the nest must be monitored again. When you subsequently return from the field erase the appropriate "M"(s), write in the codes corresponding to the nest's contents, and then mark an "M" under the appropriate date when the nest must be monitored again. Record when transitions between each stage occur (that is, from egg laying to incubation (CC), from incubation to nestling (HD), and from nestling to fledged young (FD)) when observed, and estimate any future transition dates when appropriate.

Terr./Nest no.	June			July															
Mon. Method	28	29	30	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
13	✳				✳				▲				*M*						
9A		3		3		0WE	*HD*	*R*				⊗						*M*	
MP		WE		WE		PE		▲				B							
6A	3		HD, 1WE		3				3				*M*		*FD*				
VC	WE		2WN		WN				WN										
11A	3WN		FD		E				3						*R*				
TH			3WN		2WF				WF										
7A	2WE		2WE		2WE	HD	2WN				1CN				*M*		*M*	*FD*	
VC	1CE		1CE		1CE		1CN												

Monitoring methods: MP = mirror pole; VC = video camera; TH = nest too high, observe only.
Stage: B = building nest; L = egg laying; I = incubating; N = nestlings in nest.
Daily Summary Codes: ✳ = lone territorial bird; ▲ = pair; ⊗ = nest found; M = monitor territory/nest; E = nest empty; NC = nest not checked; CC = clutch completed; HD = hatch date; FD = fledge date; R = look for renest; WE = willow flycatcher egg(s) seen; CE = cowbird egg(s) seen; WN = willow flycatcher nestling(s) seen; CN = cowbird nestling(s) seen; WF = willow flycatcher fledging(s) observed; CF = cowbird fledgling(s) observed; FN = feeding nestling(s); FF = feeding fledglings; NS = nest presumed successful; J = jumplings (nestlings forced fledged); PE = nest depredated; AB = nest abandoned; OT = nest failed due to unknown causes, W = failure due to weather; NF = nest failed (general); LF = look for fledglings; NA = No activity in territory or at nest, adults not present; X = inactive territory, birds absent, no visits needed to territory; NB = Nestlings banded; GPS = Nest GPS'ed; V = vegetation measurements taken.

Figure 6. Cutout of the Nest Calendar with summary codes. Codes written in italics indicate upcoming transition or monitoring dates.

TRANSITION DATES

Transition dates between stages should be calculated directly from data collected in the field. Once one transition date has been determined, all future transition dates can be estimated and all past dates back-calculated for a particular nest. Estimating future transition dates facilitates the planning of nest visits, ensuring that transition events are not missed. Back-calculated transition dates increases our general natural history knowledge of the species. Once confirmed through observations in the field, actual transition dates between stages should replace estimated dates on data forms (that is, the Territory/Nest Monitoring Calendar and the Nest Record Form [front page]) as they are determined.

Determining transition dates

After the onset of incubation, determining subsequent transition dates from observational data is simple if transition events (that is, eggs hatching or young fledging) are assumed to occur on the midpoint between nest checks. For example, if a nest contained 3 eggs on 1 July and 3 nestlings on 5 July then the hatch date would be estimated as 3 July, halfway between the two nest checks. Exceptions to this rule are as follows:

1) Determining the date that incubation was initiated from observational data is possible if the contents of a nest are checked during the egg laying stage and an increase in egg number is observed on a subsequent visit. In these cases, the initiation of incubation is calculated by adding the change in egg number to the first check date. For example, a nest found with 3 eggs when first monitored on 15 June and 4 eggs when monitored on 19 June indicates that one egg was laid between nest checks. Assuming that willow flycatchers lay one egg per day, we would predict that the fourth egg was laid on 16 June, upon which incubation of the full clutch was initiated.

   It is worth reiterating the recommendation to not approach or monitor nests with a mirror-pole or video camera until after the onset of incubation. This reduces the likelihood that the nest will be abandoned by allowing the female to invest more time into the breeding attempt. It is also worth reiterating that some female flycatchers begin incubating eggs prior to the completion of their clutch, causing the egg laying and incubation periods to overlap by a day or more. Therefore, at times, it can be difficult to discern between the termination of egg laying and the initiation of the incubation stage. As a result, biologists should be cautious when nests are first located, and confirm incubation over two visits prior to first using a mirror or video camera to monitor a nest.

2) At times, aging young in the nest can refine hatch dates that were calculated from observational data. In the above example, using the midpoint method the hatch date was estimated to be 3 July. However, if the young were determined to be 3 to 4 days old when monitored on 5 July, the estimated hatch date could be refined to 2 July by subtracting the nestlings' age from the second check date (5 July).

Estimating transition dates between nesting stages

If a transition date is known, estimating past and future transition dates is easily accomplished by adding or subtracting fixed estimates of the length of each stage in the nesting cycle (Table 4)

from the known date. For example, if the hatch date (signifying the end of the incubation stage) for a particular nest is determined to be 2 July, the subsequent fledge date can be estimated by adding 12 days (the average length of the nestling stage) to the hatch date (14 July). Furthermore, the initiation of the incubation stage (signifying the end of the egg laying stage and the clutch completion date) can be back-calculated by subtracting 12 days from the hatch date (20 June). If the clutch size is known (for example, 3 eggs) the date the first egg was laid can be estimated by subtracting the number of eggs from the clutch completion date (17 June). As these values are calculated they should be entered onto the Nest Calendar and the front of the Nest Record Form.

Table 4. Length of nesting stages (in days) used to estimate transition dates (AGFD unpublished data).

Nesting stage	Average length of stage (days)
Nest building	6
Egg laying	Number of eggs in a clutch
Incubation	12
Nestling	12

NEST RECORD FORM

The Nest Record Form (Fig. 7 and 8) serves as the permanent record for all nest monitoring and productivity data and should never be taken into the field. The form not only duplicates the history section on the Territory/Nest Monitoring Card, but also contains fields summarizing data necessary to compute reproductive summary statistics, transition dates and Mayfield success estimates. All daily nest monitoring data should be transcribed from Nest Monitoring Cards onto the back of the appropriate Nest Record Form. The information on the back of the form will be used to determine the outcome of each nest. Therefore, it should be as complete and detailed as possible. It is better to record too much information than leave critical details out. Always record the status and contents (if known) of a nest, the age of any young seen, and if the adults were present when the nest was monitored. After a nest is no longer active complete the summary fields on the reverse side of the form.

FIELD DEFINITIONS

Complete immediately after locating a nest:

AGFD Site no.: Refer to the Territory/Nest Monitoring Card for definition.

Site name: Refer to the Territory/Nest Monitoring Card for definition.

Nest no.: Each nest should be assigned a unique identifying number and letter combination. The number indicates in which territory the nest was located, while the letter indicates the nesting attempt. For example: 2A, the first nesting attempt within territory two; 2B, the second nesting attempt within territory two (2B could be the first nesting attempt after a successful first nest or the first renesting attempt after a failed first attempt). If a previously active nest is reused within the same season, add an additional number to indicate the reuse. For example, 3B2, indicates the reuse (2) of the second nest (B) in territory three (3).

How was nest located: Use the location codes provided on the form to identify how you found the nest.

Elusiveness: (Ranking one to 4, 1 = very shy, 4 = very conspicuous) This is a measure of how shy vs. conspicuous the parents are when a potential predator (you) is in the area. Make the ranking based on the parents' behavior when you were initially locating the nest (that is, before you approached or mirrored the nest). This information will be used to determine if we are only locating the nests of the most conspicuous birds.

Complete when appropriate:

Color band combination: Prior to recording a band combination on the record form, confirm the combination with the appropriate agency or individuals conducting banding, to ensure legitimacy. If either of the birds associated with a nest were banded, record the appropriate color combinations. Be aware that some willow flycatchers are color banded on both legs. If either of the flycatchers was not banded, write "unbanded" in the appropriate space. If it is unknown whether a flycatcher is banded, write "undetermined" in the appropriate space. For more information on resighting color banded birds, see the "Protocol for Resighting Color Banded Willow Flycatchers" (USGS 1999).

Nestling band combinations: Record the band combination of any nestlings that were banded. The optimum time for banding nestlings is when they are 8 days old. To reduce the chance of force-fledgling young, it is recommended that nestlings not be banded in the nest when they are 10 or more days old.

Complete after the nest is no longer active:

Transition date: Refer to the transition date section in this document for definition and methods of estimation.

Found: The date the nest was found.

First egg: The date the first willow flycatcher egg was laid. For cowbirds, this is the date the first cowbird egg was deposited in the nest.

Clutch Completion: The date the last willow flycatcher egg of the clutch was laid.

Hatching date: Record the date that the FIRST willow flycatcher egg hatched and the date that the FIRST cowbird egg hatched in the appropriate boxes.

Fledged or Failed: Record the date that the FIRST willow flycatcher nestling fledged and/or the date that the FIRST cowbird nestling fledged; or the date that the nest failed.

Eggs: Willow flycatcher - the largest number of willow flycatcher eggs recorded in the nest during the season. If the nest was parasitized do not assume that an egg was removed by the cowbird and add an egg to the total observed. Cowbird - The total number of cowbird eggs found in that nest.

Nestlings: Willow flycatcher - the number of willow flycatcher eggs that hatched. Cowbird - the number of cowbird eggs that hatched. Do not assume that all of the eggs hatched. Record only the number of nestlings observed.

Fledglings (Presumed): The number of willow flycatcher and/or cowbird young that fledged from the nest. Fill in the appropriate box. Assume that young fledged successfully if nestlings were observed within two days of the expected fledge date and there was no sign of predation (nest missing or badly damaged, and so forth.).

Fledglings (Confirmed): The number of willow flycatcher fledglings confirmed by sight.

Outcome: Record the outcome of the nest using the outcome codes provided and give a short description.

Willow Flycatcher Nest Record Form

Return form to the AGFD (2221 W. Greenway Rd., Phoenix, AZ 85023) and keep a copy for your files, if in AZ.

AGFD site no.:_____ Site name:_____ Nest no.:_____

1) How was nest located:_____ (Location codes: **PB**= parent behavior, **F**= flush, **NBC**= non-behavior cue, **SS**= systematic search, **L**= luck, **PY**= from previous yrs nest, **YB**= young behavior, **O**= other)

2) Elusiveness:_____ (Rank adult behavior 1-4, 1= shy/elusive 4= very conspicuous)

Bird 1: Color band combination: Left leg:_____ Right leg:_____
Bird 2: Color band combination: Left leg:_____ Right leg:_____
Nestling band combinations:_____

In the space above provide directions to the nest. Sketch prominent landmarks, water courses, veg. patch borders, etc. Also, indicate North in relation to the nest and include a topographic map with nest location marked.

Willow Flycatcher				Cowbird	
Transition dates		Number		Transition dates	Number
	Found		Eggs	First egg	Eggs
	First egg		Nestlings	Hatching	Nestlings
	Clutch completion		Fledglings (Presumed)	Fledged	Fledglings
	Hatching		Fledglings (Confirmed)		
	Fledged or Failed				

Outcome (Record code & describe):_____:_____

Mayfield Success

(WIFL) Period	# Exposure days	Success code
Egg Laying		
Incubation		
Nestling		

Additional Bbird Codes

(BB) timing of cowbird fate:	(BB) exact nestling period:
(BB) exact laying period:	(BB) number fledged:
(BB) exact incubation period:	(BB) exact number fledged:
(BB) non-final clutch size:	

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 depredated, the confirmed fledging of at least one young; **PO**= predation observed; **PE**= probable predation, nest empty and intact. Fledging of young unlikely; **PD**= predation, damage to nest structure; **PC**= probable predation by cowbird; **AB**= nest abandoned prior to egg(s) being laid; **DE**= deserted with egg(s) or young; **AC**= nest abandoned due to cowbird, cowbird egg(s) found in nest that was absent on previous nest check; **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; **OT**= other.
Mayfield success codes: **S**= successful; **D**= depredated; **N**= status unknown/nest not occupied; **U**= status unknown/nest occupied- fate unknown; **M**= mortality other that predation; **A**= abandoned with host egg(s) or young; **Z**= abandoned, no (zero) eggs laid.

Figure 7. Willow flycatcher Nest Record Form (front)

Willow Flycatcher Nest Record Form (continued)

Site name:___________________________ Nest no.:__________ AGFD site no.:__________

Date	Time	Obs	Mon Type	Stage	Adult pres.	# WF Egg	# CB Egg	# WF Nstl	# CB Nstl	#WF Fldg	Age Yng	Comments

Return form to the AGFD (2221 W. Greenway Rd., Phoenix, AZ 85023) and keep a copy for your files.

Figure 8. Willow flycatcher Nest Record Form (back)

NEST SITE DATA FORM

The Nest Site Data Form contains fields for nest-site-specific habitat data that should be collected at the end of the field season when the territory is no longer active.

FIELD DEFINITIONS

AGFD site no.: Refer to the Territory/Nest Monitoring Card for definition.
Site name: Refer to the Territory/Nest Monitoring Card for definition.
Nest no.: Refer to the Nest Record Form for definition.
Biologist(s) name: Name of the biologist(s) taking the habitat measurements. Record the name of the individual recording the data first. Include a phone number where the individual(s) can be reached.
Nest Substrate spp.: The species of the plant in which the nest was built.
Tree Health: Using the codes provided, characterize the health of the nest tree and placement of nest within the tree.
Substrate Ht: The height of the plant in which the nest was built, measured in meters.
Nest Ht: The vertical height of the nest, perpendicular to the ground, measured in meters.
Canopy Ht.: Choose a point in the canopy that represents the average of the top of the canopy within an 11.3 meter circle around the nest, ignoring lone trees that emerge above the main canopy. Measure this point with a survey rod or clinometer.
Distance to foliage edge: Horizontal distance, in meters, from the center of the nest to the nearest break/gap in the foliage.
Distance to water: Record the horizontal distance from the nest to the nearest water or saturated soil, in meters, when the nest was found and when it was last active.
Water type: Record whether the nearest water source is a moving (for example, a river or stream), standing (for example, a pond, lake or ceinega), or saturated soil. Also, indicate if the hydrological conditions changed at the site during the breeding season.
Percent plant species composition within 5 meters: Visually estimate plant species abundance within a 5 meter radius centered on the nest tree using the Braun-Blanquet Cover-Abundance Scale (Bonham 1989) (Table 5) for the following three height classes (adapted from Anderson and Ohmart 1986): 0.0-4.5 m, 4.5-7.5 m, >7.5 m. Record plant species name and rating in the spaces provided.

Table 5. The Braun-Blanquet cover-abundance scale.

Rating	Area occupied by a species
1	1-10%
2	11-25%
3	26-50%
4	51-75%
5	>76%

DBH: Diameter of the nest tree 1.4 meters (4.5 ft) from the base of the tree up along the trunk. This does not imply that the measurement will be taken 1.4 meters above the ground, but

depends on the growth form of the nest tree. If the nest substrate is a shrub, such as Geyer willow, measure the circumference of the entire plant at breast height (1.4 m).

Number of supporting branches: Number of branches giving vertical support to the nest. Do not count branches that are only providing lateral support (that is, perfectly vertical branches). Include twigs and large branches.

UTM coordinates or GPS-unit file name (if available): Location of nest, in Universal Transverse Mercator (UTM) coordinates (specify what zone the coordinates are in). Coordinates should be taken from a GPS-unit. If the UTM coordinates are stored in a GPS file, that can be accessed later, record the GPS file name.

Comments: Submit additional comments in the space provided.

WILLOW FLYCATCHER NEST SITE DATA FORM

(Do not approach an active nest or nest tree without obtaining appropriate state and federal permits)

AGFD site number:_____ **Site name:**_____ **Nest #:**_____

Biologist(s) name:_____ Phone:_____

Nest substrate spp:_____

Tree Health:____ (Codes: **L**= live, **PD-NL**= partly dead, nest in live portion, **PD-ND**= partly dead, nest in dead portion, **D**= dead)

Substrate Ht (m):_____

Nest Ht (m):_____

Canopy Ht (m):_____

Distance to foliage edge (m):_____

Distance to water (m) when the nest was first found:_____, when the nest was last active:_____

Water type:_____

DBH:_____Circle one: cm in

Number support branches:_____

Percent plant species composition within 5 meters:

0-4.5 m Height category		4.5-7.5 m Height category		> 7.5 m Height category	
Species	Rating	Species	Rating	Species	Rating
Ratings: 1 = 1-10% (area occupied by species), 2 = 11-25%, 3 = 26-50%, 4 = 51-75%, 5 > 76%					

UTM coordinates or file name (if available):_____

Comments:_____

Return form to the AGFD, Willow Flycatcher Project, 2221 W. Greenway Rd., Phoenix, AZ 85023 and keep a copy for your files.

Figure 9. Nest Site Data Form.

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Appendix A. Mayfield nest success.

MAYFIELD NEST SUCCESS

Calculations of nest success rates in conjunction with other reproductive parameters are usually reported as measures of overall productivity in passerine birds. While some parameters such as average clutch or brood size are straightforward to calculate, a number of factors have been shown to confound nest success calculations (usually calculated by dividing the number of successful nests by all nests with known outcome) (Mayfield 1961, Mayfield 1975). For example, the frequency that a nest is monitored can influence a researchers ability to determine a nest's outcome. Large intervals between nest checks can make it impossible to reliably determine a nest's fate. Typically, nests with unknown outcomes are removed from success calculations, reducing the sample size of estimates. Additionally, estimates are calculated from nests that were located, not all nests that were built by a species in a season. This subset tends to be skewed toward nests that were found later in the nesting cycle (that is, most nests are located in the nestling stage, fewer in the incubation stage and even less while under construction). The skewed nature of most data sets indicate that a percentage of nests fail prior to being located and are absent from calculations. This phenomenon tends to inflate traditional nest success calculations.

In an attempt to remedy this problem Mayfield (1961, 1975) developed a method for calculating nest success based on the amount of time nests are under observation within each stage of the nesting cycle. Daily mortality rates (that is, estimates of the probability of a nest failing on any given day) are calculated for each stage from observed data. The mortality rates are then converted into daily success rates. The individual success rates for each stage are then multiplied together to calculate an overall success rate. Mathematically, the Mayfield method can be expressed as follows

$$\text{Mayfield nest success rate} = \underset{\text{egg laying stage}}{S^d} \times \underset{\text{incubation stage}}{S^d} \times \underset{\text{nestling stage}}{S^d}$$

The probability of a nest surviving for an entire stage S^d, is equal to

$$S^d = (1\text{-}r)^d$$

where r is the daily mortality rate of a particular stage (defined further below) and d is the average number of days within the stage. Since $(1\text{-}r)$ is the survival rate S, this expression can be represented as S^d.

The daily mortality rate r of a particular stage can be calculated by dividing the total number of nests that failed within a stage m, by the total number of days all active nests were under observation (referred to hereafter as exposure days) D.

$$r = m/D$$

CALCULATING EXPOSURE DAYS

The calculation of the total number of exposure days within a stage *D*, could use further clarification. Each day a nest is known to be active after it is initially located is considered one exposure day. For example, if a nest is found in the incubation stage and when visited again 4 days later is still active and still in the incubation stage, then 4 exposure days would be added to the total number of exposure days *in the incubation stage*. If when the nest was visited 4 days later it had been found to be active, but now in the nestling stage, then the transition date between stages would be determined and the appropriate number of exposure days would be added to each stage. For example, if the eggs were determined to have hatched on the midpoint between nest checks, 2 days would be added to both the incubation and nestling stages.

For standardization purposes, it is suggested that when a nest fails, exposure days be counted only up until the last day the nest was observed active. Calculating exposure days in this way differs from the methods outlined by Mayfield (1961, 1975), but yields more conservative estimates of nest success than assuming that the nest failed on the midpoint between nest checks or just prior to when it was found inactive.

An advantage to using the Mayfield method, over traditional techniques to compute nest success, is that data from nests with unknown outcomes can be used to refine nest success estimates. Since the daily mortality rate for each stage is calculated in part from the total number of days nests were observed to be active, all exposure days should be included in calculations, even those from nests with unknown outcome.

DETERMINING THE LENGTH OF EACH STAGE

The value for the length of a particular nesting stage *d*, used to calculate the overall success rate for each individual stage, must be standardized if success rates between flycatcher studies are to be compared. Since *d* is an exponent in Mayfield calculations, small differences in initial values can quickly lead to large discrepancies in nest success estimates. Below are listed the values for *d*, for three stages of the nesting cycle, that the Arizona Game and Fish Department uses when calculating Mayfield nest success rates. These values have been calculated from observational data and represent average nesting stage lengths (AGFD unpublished data).

- Egg laying stage = 2.6 days
- Incubation stage = 12 days
- Nestling stage = 12.5 days

For greater clarification of Mayfield calculations see Mayfield 1961 and 1975.

Appendix B. Willow flycatcher Territory/Nest Monitoring Card.

(Front) Willow Flycatcher Territory/Nest Monitoring Card

Site name:_____ Territory no:_____ Nest no.:_____

Date	Time	Obs	Mon Type	Stage	Adult pres	# WF Egg	# CB Egg	# WF Nstl	# CB Nstl	# WF Fldg	Age Yng	Dist Wat	Field Tasks	Comments

(Back) Willow Flycatcher Territory/Nest Monitoring Card (Continued)

Date	Time	Obs	Mon Type	Stage	Adult pres	# WF Egg	# CB Egg	# WF Nstl	# CB Nstl	# WF Fldg	Age Yng	Dist Wat	Field Tasks	Comments

Date: The date you checked the nest. **Time:** The time you checked the nest. **Obs:** Observers initials. **Mon Type:** M = mirrored; V = video camera; O = observation with binoculars. **Stage:** B = building; L = egg laying; I = incubating; N = nestling, F = fledgling. **Adult pres:** Adults present when nest checked; Y or N. **#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:** Age of willow flycatcher nestlings; estimate age in days. **Comments:** Record any additional info used to determine the stage and/or activity of the nest (e.g. evidence of predation, feeding of fledglings, etc.).

Field Tasks: RSM = Resight male, RSF = Resight female, RSB = Resight both, OT = Observe in territory, CP = Confirm pair, FN = Find nest/renest, PN = Pole nest, ON = observe nest, CA = confirm activity or stage, CN# = Confirm nestling number, CF# = Confirm fledgling number.

Aging: Egg-sized, eyes closed ~ 2 d. old - Bare skin, w/some down ~ 4-5 d. old - Mostly downy < 1 wk. old - Fully feathered ~ 2 wk. old

Chronology: Nest Building ~ 1 wk. - Egg laying ~ 4 d. - Incubation ~ 12 d. - Nestling ~ 12 d.

Appendix C. Southwestern willow flycatcher Territory/Nest Monitoring Calendar.

Territory/Nest Monitoring Calendars are not included in all protocols. If this protocol does not contain a calendar and you would like to receive one, contact the Arizona Game and Fish Department's Southwestern Willow Flycatcher Project at (602) 789-3583.

Additions of the Lit. Cit. that are not in procite (paste these into the lit. cit.)

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