

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

2015 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 28 July 2015. Eighty-nine transient Willow Flycatchers of unknown subspecies were observed during Base-wide surveys. Transients occurred on 10 of the 16 drainages surveyed in 2015. No Willow Flycatchers were detected at Aliso Creek, Cocklebur Canyon, De Luz Creek, French Creek, Roblar Creek, or Windmill Canyon. Transients occurred in a range of habitat types including mixed willow (*Salix* spp.) riparian, riparian scrub, willow-sycamore (*Platanus racemosa*) dominated riparian, willow-cottonwood (*Populus fremontii*) dominated riparian, and upland scrub.

In 2015, the resident Southwestern Willow Flycatcher population on Base consisted of one male and four females. No single males or non-territorial floaters were observed in 2015. Four breeding territories were established, consisting of four pairs (one polygynous group consisting of one male pairing with four different females). The resident population of Southwestern Willow Flycatchers on Camp Pendleton in 2015 (five individuals) declined by 44% from 2014 (nine individuals) and was the smallest documented since monitoring began in 2000. Resident flycatchers were restricted to the Santa Margarita River. Flycatcher distribution on the Santa Margarita River was restricted to the Treatment Ponds breeding area. All resident territories were located in mixed willow riparian habitat. Exotic vegetation including black mustard (*Brassica nigra*) and poison hemlock (*Conium maculatum*) was present in the majority of the territories.

Fifty percent (2/4) of Southwestern Willow Flycatcher pairs successfully fledged at least one young during the 2015 breeding season. Nesting was initiated in late May and continued into late July. Five nesting attempts were documented, of which 40% (2/5) were successful. Predation accounted for all nest failures. Eight fledglings were produced, yielding a seasonal productivity of 2.0 young/pair. No instances of Brown-headed Cowbird (*Molothrus ater*) parasitism were observed. Flycatchers placed nests in three species of plants, all native species, including sandbar willow (*S. exigua*), red/arroyo willow (*S. laevigata*/*S. lasiolepis*), and stinging nettle (*Urtica dioica*).

Five birds (one male and four females) that were banded in previous years were present at Camp Pendleton in 2015. Of the nine banded adult flycatchers present during the 2014 breeding season, 33% (1/3) of males and 50% (3/6) of females returned to Camp Pendleton in 2015; 75% (3/4) of those returned to the same breeding area they occupied in 2014. One additional natal banded adult female was resident at Camp Pendleton in 2015, but was not captured to confirm origin or identity. None of the seven nestlings banded in 2014 returned to Camp Pendleton in 2015, and none were detected off Base. Fifteen nestlings from four nests were banded in 2015, of which eight survived to fledging. None of the transients observed during surveys were seen to carry bands.

One Camp Pendleton natal bird, a female from 2013, emigrated to the Upper San Luis Rey River downstream of Lake Henshaw and was discovered in 2015.

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 three sites: the Owens River valley in Inyo County (Lacey Greene, pers. comm.), the South Fork of the Kern River in Kern County (Mary Whitfield, pers. comm.), and the Upper San Luis Rey River, including a portion of the Cleveland National Forest in San Diego County (Clark et al. 2014). 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) 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 during the study 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 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.

STUDY AREAS AND METHODS

Field Surveys

All of Camp Pendleton's major drainages, and several minor ones supporting riparian habitat, were surveyed for flycatchers between 15 May and 28 July (Fig. 1; Appendix A, Figs. 4-9). Field work was conducted by United States Geological Survey (USGS) personnel Katherine Allen, Lisa Allen, Andrea Bowling, Rachel del Rio, Patience Falatek, Aaron Gallagher, Sarah Harris, Scarlett Howell, Angela Johnson, Barbara Kus, Melanie Madden, Ryan Pottinger, Lea Squires, Devin Taylor, Jared Taylor, and Charles Vettes. The specific areas surveyed are as follows:

Santa Margarita River: between Stuart Mesa Road and the Base boundary, including Ysidora Basin and Stagecoach Canyon (Appendix A, Figs. 4, 5).

De Luz Creek: between the confluence with the Santa Margarita River and the Base boundary (Appendix A, Fig. 4).

Roblar Creek: from the confluence with De Luz Creek to a point approximately 1.5 km upstream (Appendix A, Fig. 4).

Fallbrook Creek: around Lake O'Neill as well as along the creek between the lake and the Base boundary (Appendix A, Fig. 4).

Newton Canyon: between the confluence with the Santa Margarita River and the upstream limit of riparian habitat (Appendix A, Fig. 5).

Cockleburr Canyon: between the Pacific Ocean and 0.25 km upstream of Interstate 5 (Appendix A, Fig. 5).

French Creek: between the Pacific Ocean and the Edson Range Impact Area (Appendix A, Fig. 5).

Aliso Creek: between the Pacific Ocean and 0.5 km upstream of the electrical transmission lines (Appendix A, Fig. 5).

Las Flores Creek: between the Pacific Ocean and a point approximately 800 m upstream of Basilone Road (Appendix A, Fig. 6).

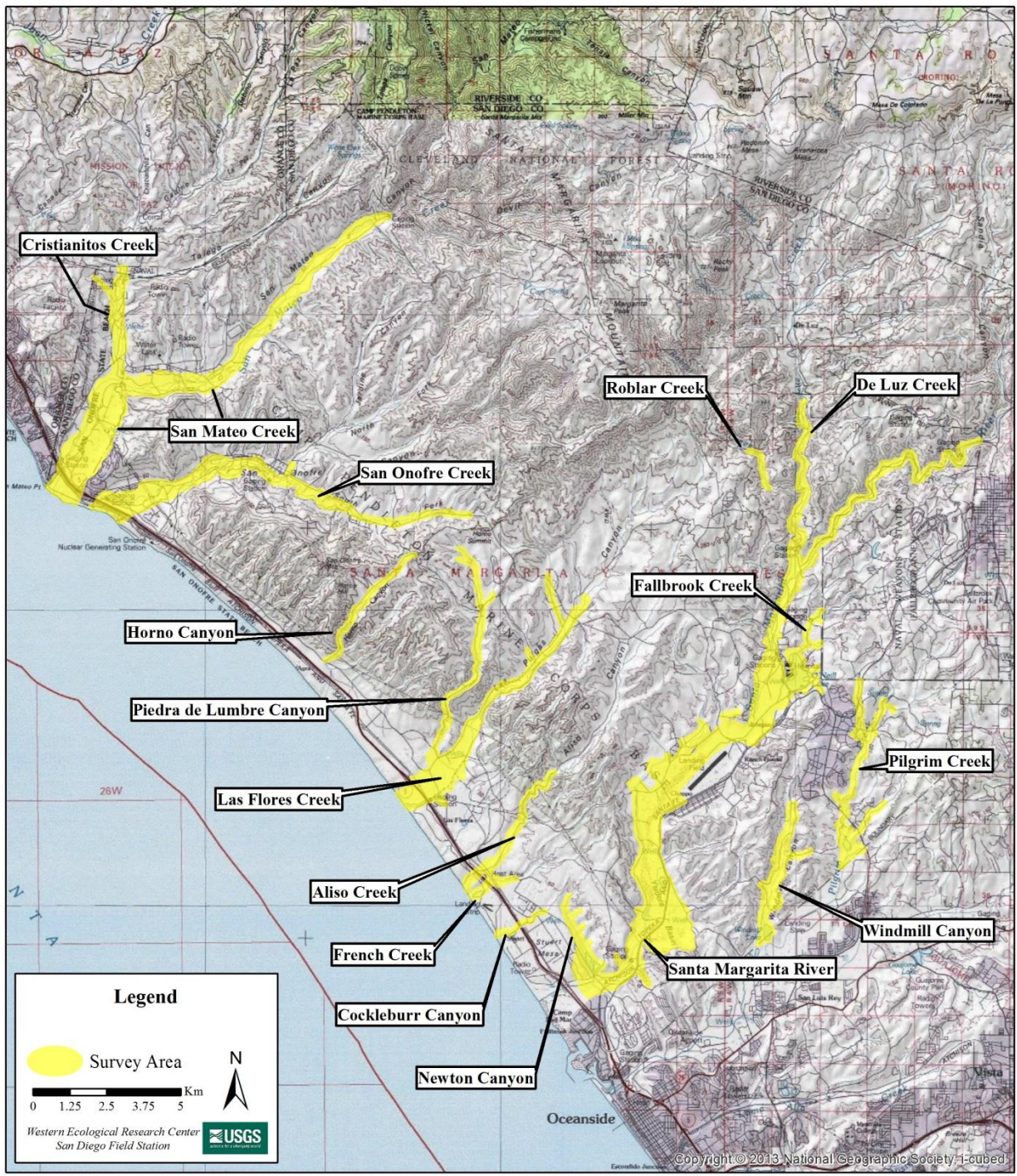


Fig. 1. Willow Flycatcher survey areas at Marine Corps Base Camp Pendleton, 2015.

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. 6).

Horno Canyon: between Old Highway 101 and the upstream limit of riparian habitat (Appendix A, Fig. 6).

San Onofre Creek: between the Pacific Ocean and the access road to Range 219 (Appendix A, Figs. 7, 8).

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. 7, 8).

Cristianitos Creek: between the confluence with San Mateo Creek and the Base boundary (Appendix A, Fig. 7).

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. 9).

Windmill Canyon: from the Base boundary to the golf course entrance (Appendix A, Fig. 9).

Drainages were surveyed two to four times at least 7 days apart. The majority of drainages were surveyed four times, with the exception of the upper portion of the Santa Margarita River which was surveyed twice based on prior agreement with the Base.

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 Garmin 60 Global Positioning System (GPS) or Trimble Juno SB GPS 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":12,000" 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, except for those pairs that included polygynous males, in which case habitat type was assessed within the females' use areas. 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 (i.e. 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 F, 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.

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

Nestlings were banded at 7-10 days of age. Each bird received a silver aluminum federal numbered band on the right leg. When possible, returning second-year birds banded as nestlings in 2014, 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, 2010a, 2011, 2012, 2013, and 2014.

RESULTS

Population Size and Distribution

Transients

Eighty-nine Willow Flycatchers of unknown subspecies were observed during Base-wide surveys (Appendix B, Figs. 10-19). All transients were detected between 15 May and 11 June. Transients occurred on 10 of the 16 drainages surveyed in 2015. No Willow Flycatchers were detected at Aliso Creek, Cockleburr Canyon, De Luz Creek, French Creek, Roblar Creek, or Windmill Canyon.

Residents

Five Southwestern Willow Flycatchers, including one male and four females, were detected throughout the 2015 breeding season (Appendix B, Fig. 12; Appendix C, Fig. 20). The polygynous male established pair bonds with all four females, for a total of four breeding territories. No single males or non-territorial floaters were observed in 2015. Overall, the resident flycatcher population on Base decreased by 44% from 2014 to 2015 (Fig. 2).

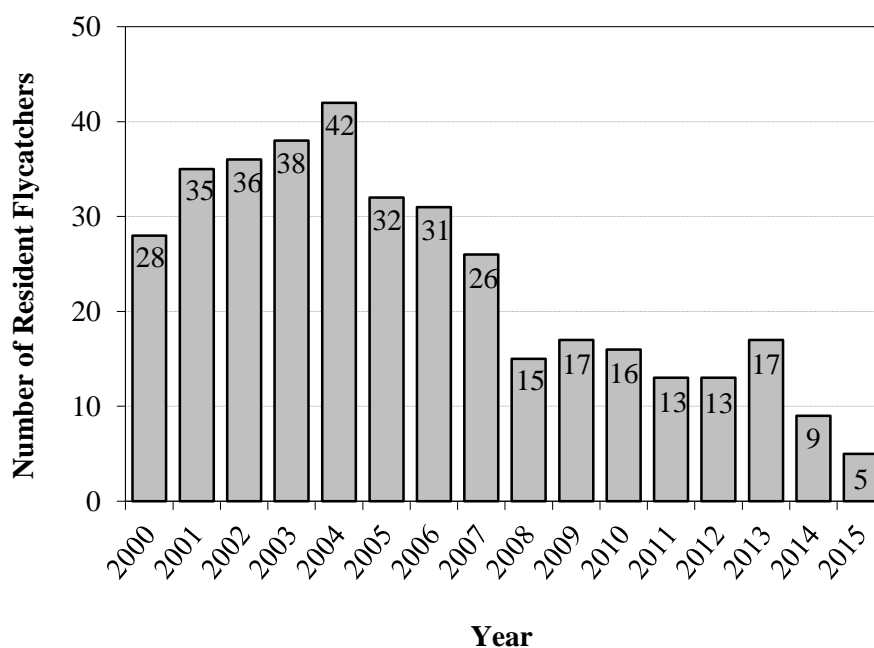


Fig. 2. Southwestern Willow Flycatcher population estimates for Marine Corps Base Camp Pendleton, 2000-2015.

Resident flycatchers were restricted to the Santa Margarita River (Appendix B, Fig. 12; Appendix C, Fig. 20). The quantity of suitable flycatcher breeding habitat along the Santa

Margarita River was substantially reduced by the 2014 Las Pulgas fire, which burned approximately 350 ha of the Santa Margarita River. Two of the core flycatcher breeding areas (those annually supporting multiple flycatcher territories) occupied between 2008 and 2013 were burned: Pump Road and Air Station (Fig. 3; Table 1). In 2015, only two flycatcher breeding areas along the Santa Margarita River were occupied: Pueblitos and Treatment Ponds. The Treatment Ponds breeding area supported the largest concentration of breeding flycatchers with three pairs, and the northern portion of the Pueblitos breeding area supported one breeding pair. Overall, flycatcher distribution on the Santa Margarita River contracted relative to previous years. Multiple breeding areas along the Santa Margarita River that historically supported resident flycatchers (Vine, Bell, Ysidora Ponds, Pump Road, Air Station, and the southern portion of Pueblitos; see Fig. 3) were devoid of flycatcher territories in 2015 (Table 1).

Habitat Characteristics

Seventy-four percent (69/93) of all flycatcher sightings occurred in habitat classified as mixed willow riparian, 62% (43/69) of which occurred along the Santa Margarita River (Appendix D). Seventeen percent (16/93) of locations were in riparian scrub, dominated by mule fat and/or sandbar willow. The remaining detections were located either in willow habitat co-dominated by sycamore or cottonwood (5%; 5/93), or upland coastal sage scrub (3%; 3/93). While transients used all habitat types, resident flycatchers were found exclusively in mixed willow riparian.

The most common exotic plant in habitat used by flycatchers in 2015 was black mustard (*Brassica nigra*), followed by poison hemlock (Appendix D). Sixty-one percent (57/93) of flycatcher locations were composed of 5-50% exotic vegetation, primarily black mustard. Eleven percent (10/93) of sites were dominated by exotic vegetation (percent cover of exotics >50%).

Breeding Activities

Nesting was observed for all four pairs and was initiated in late May (Table 2). The earliest confirmed lay date was 24 May and the latest was 29 June. One pair attempted a second nest following an unsuccessful initial attempt. The last young fledged on 29 June, while unsuccessful nesting attempts continued into July. Of the four breeding pairs, 50% (2/4) fledged young during the 2015 breeding season.

Five nesting attempts by Southwestern Willow Flycatchers were documented during the 2015 breeding season, two of which successfully fledged at least one flycatcher young (40%). Although no predation events were witnessed, predation was believed to be the primary source of nest failures. All three predation events took place during the nestling stage, with the nestlings disappearing several days before the earliest possible fledge date. Initial nesting attempts were unsuccessful at two territories. At one of these territories, a second nest was attempted but was depredated. At the second territory, the female disappeared following her initial nest failure. Mean clutch size, calculated from five nests known to have full clutches, was 3.8 ± 0.4 eggs. Eight fledglings were produced, yielding an average seasonal productivity of 2.0 young/pair.

Table 1. Distribution of territorial Willow Flycatchers at Marine Corps Base Camp Pendleton, 2000-2015.

		2000		2001		2002		2003		2004		2005		2006		2007		2008		2009		2010		2011		2012		2013		2014		2015			
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				
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	-	-		
	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	2	1	3	1	2	1	3
	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	4	2	4	4	2	2	2	2	2	4	4	5	2	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
	Bell	2	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			

^a Sex: M = male, F = female.

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

Table 2. Nesting activity of Southwestern Willow Flycatchers at Marine Corps Base Camp Pendleton in 2015.

Breeding Territory ID	Lay Date	# Eggs	# Nestlings	# Fledglings	Nest Fate ^a	Comments
ETC	27-May-15	4	4	4	SUC	
THN	24-May-15	4	4	0	PRE	Nest intact but empty.
	29-Jun-15	3	3	0	PRE	Nest intact but empty.
TLM	27-May-15	4	4	4	SUC	
TOR	16-Jun-15	4	4	0	PRE	Nest intact but empty.

^a PRE = Nest failed as a result of assumed predation, SUC = Nest fledged at least one young.

Nest Site Characteristics

Flycatchers placed nests in three species of plants (Table 3), including sandbar willow, red or arroyo willow, and stinging nettle (*Urtica dioica*). Sixty percent (3/5) of nests were placed in willow. No nests were placed in exotic species in 2015. Nest height averaged 2.3 ± 1.9 m, while host height averaged 3.7 ± 3.3 m.

Table 3. Nest site characteristics of Southwestern Willow Flycatchers at Marine Corps Base Camp Pendleton in 2015. All measurements are in meters.

Pair ID	Nest ID	Host Species	Host Height	Nest Height	Distance to the edge of:	
					Host Plant	Clump
ETC	1	Sandbar Willow	3.4	2.3	0.4	1.8
THN	1	Sandbar Willow	1.7	1.5	0.3	1.7
THN	2	Stinging Nettle	2.3	1.1	0.1	1.1
TLM	1	Stinging Nettle	1.8	1.1	0.1	1.8
TOR	1	Red/Arroyo Willow	9.5	5.7	0.7	1.0

Cowbird Parasitism

All nests were checked for the presence of cowbird eggs. No nest parasitism of Southwestern Willow Flycatcher nests by Brown-headed Cowbirds was documented in 2015.

Banded Birds

All resident Southwestern Willow Flycatchers were observed closely enough to determine with confidence whether they were banded (Table 4). All five resident males and females were banded in previous years. Of these, four birds (one male and three females) had been banded with unique color combinations prior to 2015. The remaining female was banded with a single federal band on the right leg, suggesting that she was a returning nestling from

2013; however we were unable to capture her to confirm identity. All known and confirmed banded birds were originally banded on Camp Pendleton.

Fifteen Southwestern Willow Flycatcher nestlings from four nests were banded in 2015 (Appendix E); eight nestlings from two nests successfully fledged.

Table 4. Band status of Southwestern Willow Flycatchers at Marine Corps Base Camp Pendleton in 2015.

Territory / Bird ID	Status ^a	Male Band Combination ^b	Female Band Combination ^b	# Nestlings Banded	Comments ^c
ETC	P	dbye : Msi	Msi : orpu	4	Male banded in 2013 as an adult at Treatment Ponds. Female banded in 2010 as an adult at Pump Road. Male polygynous with three other females (THN/TLM/TOR).
THN	P	dbye : Msi	Msi : yedb	7	Female banded in 2008 as a nestling at Treatment Ponds. Male polygynous with three other females (ETC/TLM/TOR).
TLM	P	dbye : Msi	yepu : Msi	4	Female banded in 2013 as an adult at Treatment Ponds. Male polygynous with three other females (ETC/THN/TOR).
TOR	P	dbye : Msi	- : Msi		Female likely banded as a nestling in 2013, but could not be recaptured to confirm identity. Male polygynous with three other females (ETC/THN/TLM).

^a P = breeding pair.

^b Band combinations: left leg : right leg; Msi = federal numbered aluminum band. *Metal bands*: dbye = dark blue-yellow split, orpu = orange-purple split, yedb = yellow-dark blue split, yepu = yellow-purple split.

^c See Fig. 3; Appendix B, Fig. 12; Appendix C, Fig. 20 for breeding area and territory locations.

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 2015. 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 nine uniquely banded adult flycatchers present during the 2014 breeding season, 33% (1/3) of males and 50% (3/6) of females returned to Camp Pendleton in 2015. Overall, adult survivorship from 2014 on Camp Pendleton was 44% (4/9).

None of the seven nestlings banded in 2014 that survived to fledge were resighted or recaptured at Camp Pendleton in 2015, yielding a minimum first-year survivorship estimate of 0% (0/7). One female last seen as a nestling in 2013 was captured off Base in 2015, increasing the first-year survivorship estimate of the 2013 cohort to 22% (2/9). The 2013 bird established a breeding territory on the Upper San Luis Rey River downstream of Lake Henshaw, approximately 55 km away (Howell and Kus 2015).

Willow Flycatchers at Camp Pendleton generally settle into breeding concentrations or areas where groups of birds establish territories (Fig. 3). Resighting banded birds allowed us to identify individuals that returned to the same area they used the previous year. Three of the four banded adults seen in both 2014 and 2015, one male and two females, returned to the same breeding area they last occupied (Table 5). The male returned to the same territory used in 2014, and expanded his use area northward to encompass three additional female territories. One female occupied the same territory as in 2014 (TLM), and the other female (ETC) moved a short distance within the same breeding area, but to a different territory.

The remaining banded adult seen in both 2014 and 2015, a female, moved to a different breeding area. The THN female moved from the Air Station breeding area that she had occupied for the past five breeding seasons to the Treatment Ponds breeding area, a distance of 1.4 km. The average distance moved by adult flycatchers between the 2014 and 2015 breeding seasons was 0.4 ± 0.7 km.

No instances of movement by adult Southwestern Willow Flycatchers within the 2015 breeding season were observed.

Table 5. Between-year, between-area movement of Southwestern Willow Flycatchers at Marine Corps Base Camp Pendleton in 2015.

Year Last Detected	Breeding Area ^a (Territory Last Detected)	Breeding Area (Territory in 2015)	Distance Moved (km)	Band Combination ^b	Age in 2015	Sex ^c
2014	Pueblitos (ETA)	Pueblitos/Treatment Ponds (ETC/THN/TLM/TOR)	0.0	dbye : Msi	≥ 3 yrs	M
2014	Air Station (ARC)	Treatment Ponds (THN)	1.4	Msi : yedb	7 yrs	F
2014	Pueblitos (ETA)	Pueblitos (ETC)	0.1	Msi : orpu	≥ 6 yrs	F
2014	Treatment Ponds (TLM)	Treatment Ponds (TLM)	0.0	yepu : Msi	≥ 3 yrs	F

^a See Fig. 3; Appendix B, Fig. 12; Appendix C, Fig. 20 for breeding area and territory locations.

^b Band combinations: left leg : right leg; Msi = federal aluminum band. *Metal bands*: dbye = dark blue-yellow split, orpu = orange-purple split, yedb = yellow-dark blue split, yepu = yellow-purple split.

^c Sex: M = male, F = female.

One instance of between-year emigration was seen in 2015 (Fig. 3), the aforementioned female originally banded as a nestling in 2013 in the Treatment Ponds breeding area that established a territory on the Upper San Luis Rey River downstream of Lake Henshaw. The female had not been seen since 2013.

Human Activities in Riparian Habitat

No evidence of human activities in riparian habitat occupied by Willow Flycatchers was witnessed during the 2015 breeding season.

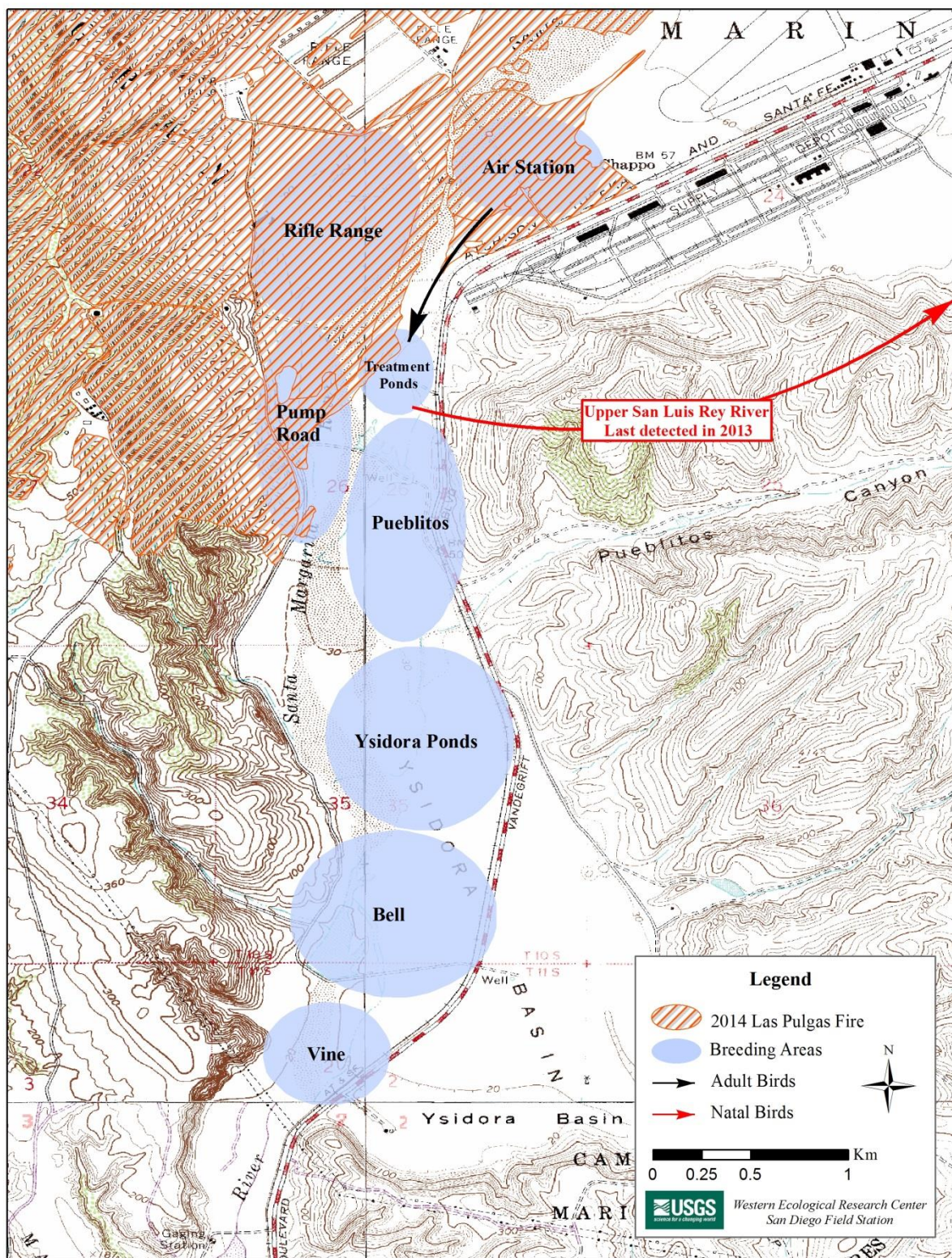


Fig. 3. Between-year, between-area movement by adult and natal Southwestern Willow Flycatchers at Marine Corps Base Camp Pendleton, 2015. Includes some 2015 non-Pendleton data, but may not represent a complete picture of emigration off Base.

DISCUSSION

Continued declines in the Southwestern Willow Flycatcher population were seen during the 2015 breeding season, and were likely influenced by two extreme events, fire and drought. Southwestern Willow Flycatchers continued to be affected by the 2014 Las Pulgas fire in the form of habitat loss. The remaining flycatcher breeding habitat was also likely affected by the arid conditions that continued to plague southern California, with rainfall well below average for the fourth year in a row (OWR 2015).

The number of transient flycatchers detected in 2015 (89) was comparable to numbers seen in 2014 (97). The number of transients detected annually since 2002 has varied greatly, despite consistent survey scope and effort, from a high of 102 in 2002, to a low of 25 in 2010. Drought conditions may have played a role in the number of transient flycatchers using the Base as a stop-over during migration. Although factors influencing the migratory route of transient Willow Flycatchers are unclear, it is possible that they are responding to ecological variables such as precipitation when choosing a migration route. In years with low rainfall (ie. 2002, 2007, 2014, 2015), it appears that more Willow Flycatchers migrate through Camp Pendleton, whereas fewer birds were detected in years with higher precipitation (ie. 2005, 2010). 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. 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 from low precipitation may be more pronounced along inland migration routes.

The resident population of Southwestern Willow Flycatchers on Camp Pendleton in 2015 (five individuals) declined by 44% from 2014 (nine individuals) and was the smallest documented since monitoring began in 2000. The decrease was a result of the net loss of three breeding females and two breeding males between 2014 and 2015. In addition, there were no unpaired males or non-territorial floaters detected on Base during the 2015 breeding season. Breeding flycatchers were limited to the Santa Margarita River in 2015, and the number of breeding territories (four) decreased relative to 2014 (five). It is probable that some of the overall population decline in 2015 was related to the loss of breeding habitat along the Santa Margarita River from the 2014 wildfires. The only remaining unburned habitats on Base that have been occupied in recent years (2008-2015) were the Treatment Ponds and the northern portion of the Pueblitos breeding areas. Historically these areas have only supported between three and seven individual flycatchers annually (Table 1; Fig. 3), which may constitute the carrying capacity associated with the remaining available habitat, preventing additional settlement on Base until more habitat becomes available.

The proximity among the breeding areas on the Santa Margarita River facilitates movement between areas annually, and often within breeding seasons. Between-year site fidelity in 2015 was the same as in 2014 (75%) with the majority of adult flycatchers returning to the same breeding area that they used in 2014. Only one flycatcher seen in both 2014 and 2015 established a territory in a different breeding area in 2015, moving from the Air Station breeding area to the Treatment Ponds area, as a result of habitat loss from the 2014 Las Pulgas fire. Between-year site fidelity has been highly variable, ranging from a low of 40% in 2008 to a high

of 100% in 2012 and 2013. High site fidelity since 2009 (75 -100%) suggests that the occupied areas represent the most suitable, or possibly the only habitat currently available on Base.

Prior to the 2014 wildfires, two additional historic breeding areas were occupied: Air Station and Pump Road. These areas will be unsuitable for breeding until the vegetation recovers, which will likely take a minimum of 3-5 years (Paxton et al. 2007). However, burned areas may take up to a decade or more to recover 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). Habitat recovery after fire depends on many factors including good hydrologic conditions during regrowth; conditions such as drought, reduced groundwater, and altered river flow may impede recovery.

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 (*Arundo donax* and *Tamarisk* spp.) 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 has impacted habitat recovery. 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 after exotic vegetation removal within 5-7 years: 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 five post-removal precipitation years for Pump Road, Air Station, and Treatment Ponds breeding areas was 41.9 ± 23.9 cm, 42.8 ± 29 cm, and 40.5 ± 29.9 cm, respectively (OWR 2015). In contrast, the mean annual precipitation for the first five post-removal precipitation years following exotics removal in 2008 and 2009 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.

The sex ratio in 2015 was skewed towards females, and the only male was polygynous with multiple females. The rate of polygyny among males has ranged from 0-100% since monitoring began in 2000 and fluctuates in association with the sex ratio in the breeding population. In the occupied breeding areas along the Santa Margarita River (Treatment Ponds and Pueblitos), females outnumbered males by 4:1, and the high degree of polygyny in the population reflects this. The proportion of females sharing males increased to 100%, compared to 80% in 2014, matching the record high set in 2013 when females outnumbered males 5:1. Southwestern Willow Flycatchers appear to readily adapt to skewed sex ratios by adopting a polygynous breeding strategy where all females have the opportunity to breed by sharing males. Continued monitoring at Camp Pendleton, combined with information from other polygynous populations of Willow Flycatchers (Davidson and Allison 2003; Pearson et al. 2006) should enhance our understanding of the basis for polygyny in this species, and its implications for genetic viability and persistence of the population.

The prolonged drought occurring in San Diego for the past four years also appears to be impacting overall nest success. While nest success increased to 40% during the 2015 breeding season, slightly higher than that seen in 2014 (38%), there is still a downward trend evident in the mean annual nest success in the last four drought years ($31 \pm 9\%$; 2012-2015) when compared to the years prior to the drought ($61 \pm 13\%$; 2001-2010, excluding the partial 2011 season). The biggest factor contributing to the decline in overall nest success is increased predation, with the mean percentage of nests depredated in the last four drought years higher ($58 \pm 5\%$; 2012-2015) when compared to the years prior to the drought ($26 \pm 8\%$; 2001-2010). The majority of depredated nests appeared to be the result of avian or snake predation. It is possible that prolonged drought conditions have reduced other food sources used by these predators (i.e. small mammals, acorns), causing an increase in nest predation. Higher than average predation may also be attributed to the increased rate of male polygyny in recent years ($70 \pm 31\%$; 2008-2015 vs. $35 \pm 25\%$; pre-2008); an individual male may simply be stretched too thin to provide adequate nest defense to multiple females.

Although the prolonged drought may have negatively affected overall nest success, the timing of several unusual summer rain events appeared to positively influence the flycatcher breeding season. Precipitation was higher than average in May, June, and July which likely translated into an increased prey base for adult flycatchers, and increased overall fitness allowing for larger clutch sizes and adequate food sources for flycatcher nestlings. Seasonal productivity increased to 2.0 young/pair, well above the record low set in 2013 (0.9 young/pair), and was just above the annual mean (1.9 young/pair) from 2001 to 2014. Average clutch size was at a record high of 3.8 eggs/nest, following a record low in 2014 of 2.4 eggs/nest, well above the annual mean clutch size (3.1 eggs/nest). Despite these increases compared to 2014, only eight young were confirmed fledged in 2015. Average nest height (2.3 ± 1.9 m) was higher than the annual mean (1.7 ± 0.6 m) with a larger variance as the result of a single observed nest at 5.7 m, the highest nest observed on Base since monitoring began in 2000.

The return rate of banded adults between 2014 and 2015 (44%) was lower than the return rate in 2014 (57%), and less than the average return rate between 2001 and 2014 (48%). The return rate has fluctuated from a low of 25% in 2001 to a high of 70% in 2002. In contrast to banded adults, none of the seven fledglings banded as nestlings in 2014 were detected on Base (or anywhere off Base) in 2015. Fewer fledglings were produced in 2014, so fewer would be expected to return. This is the second year in a row that no first-year birds returned to Camp Pendleton to breed, although one probable 2013-fledged female established a territory on Base in 2015. The dearth of returning first-year birds could also be the result of reduced habitat availability stemming from the 2014 Las Pulgas fire, or perhaps that the lack of standing water on Base in a continued drought deemed the habitat less attractive than areas off Base with water present. One 2013 Camp Pendleton fledgling, a female, was discovered on the Upper San Luis Rey River near Lake Henshaw, holding a territory that contained flowing water throughout the breeding season.

As the flycatcher population on Camp Pendleton decreases, the risk of inbreeding will likely increase (Meffe and Carroll 1997). However, the potential for inbreeding is reduced through immigration and emigration. Although no instances of immigration on Base were noted

in 2015, one instance of emigration off Base was observed, the aforementioned 2013 Camp Pendleton female discovered on the Upper San Luis Rey River. Emigration of birds off Base to the Bonsall area on the San Luis Rey River has been documented seven times since 2010; however, this is the first time that a Camp Pendleton bird has been discovered in the Upper San Luis Rey River population. This detection is an encouraging sign that movement between regional flycatcher populations may not be limited to sources close to Camp Pendleton. From 2001-2008, eight birds immigrated onto Camp Pendleton from nearby habitat along the San Luis Rey River and entered the breeding population. With these nearby historical sources such as Whelan Lake and Guajome Regional Park now defunct (no birds present since 2008), long distance dispersal will become increasingly important in maintaining genetic diversity in the Camp Pendleton population. Further banding and resighting of flycatchers throughout their range will allow a better determination of the extent of movement between populations and the role such movement plays in maintaining genetic diversity and persistence in these populations.

CONCLUSIONS

The Southwestern Willow Flycatcher population in California appears to be experiencing a statewide decline not isolated to Camp Pendleton. Populations on the Kern River (Mary Whitfield, pers. comm.) and the lower San Luis Rey River (Houston et al. 2015) have experienced steep declines or have been extirpated in recent years. The exception appears to be the Upper San Luis Rey population, where the number of territories declined only slightly between 1999 (18; Kus et al. 1999) and 2009 (15; Howell and Kus 2010b). The population on Marine Corps Base Camp Pendleton is reaching a critical low, and the reduction in suitable breeding habitat from the 2014 Las Pulgas fire was extremely detrimental to the long term persistence of this endangered species on Base. It is unlikely that the population on Base will persist unless additional habitat becomes available. Until that time, careful consideration should be given to any projects that alter the habitat in currently occupied areas. Additionally, restoration activities such as planting and watering of burned habitats in historically occupied areas may be warranted to enhance recovery and increase the chances of recolonization by Southwestern Willow Flycatchers. As demonstrated by the emigration of birds to areas off Base with water, water is becoming more important as drought conditions continue. The creation or restoration of water features such as holding ponds on Base near historically occupied areas may increase the retention of Southwestern Willow Flycatchers leading to an increase in the population and enhancing recovery of flycatchers on Base and in the region.

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 contributing to flycatcher recovery:

1. 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.
2. Conduct habitat restoration in burned (Air Station and Pump Road) breeding areas.

3. 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 currently occupied habitat.
4. Create or restore water features 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)

With the continued decline of Southwestern Willow Flycatchers on Base, communication between the Assistant Chief of Staff (AC/S), Environmental Security and other military departments will become increasingly important. Coordination of maintenance activities such as vegetation clearing through AC/S, Environmental Security will minimize impacts in active territories. Coordination and cooperation among the various departments will help maintain a balance between the sometimes competing land uses on Base including military activities, recreation, habitat protection, and endangered species management.

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APPENDIX A

**SOUTHWESTERN WILLOW FLYCATCHER SURVEY AREAS AT MARINE CORPS
BASE CAMP PENDLETON, 2015**

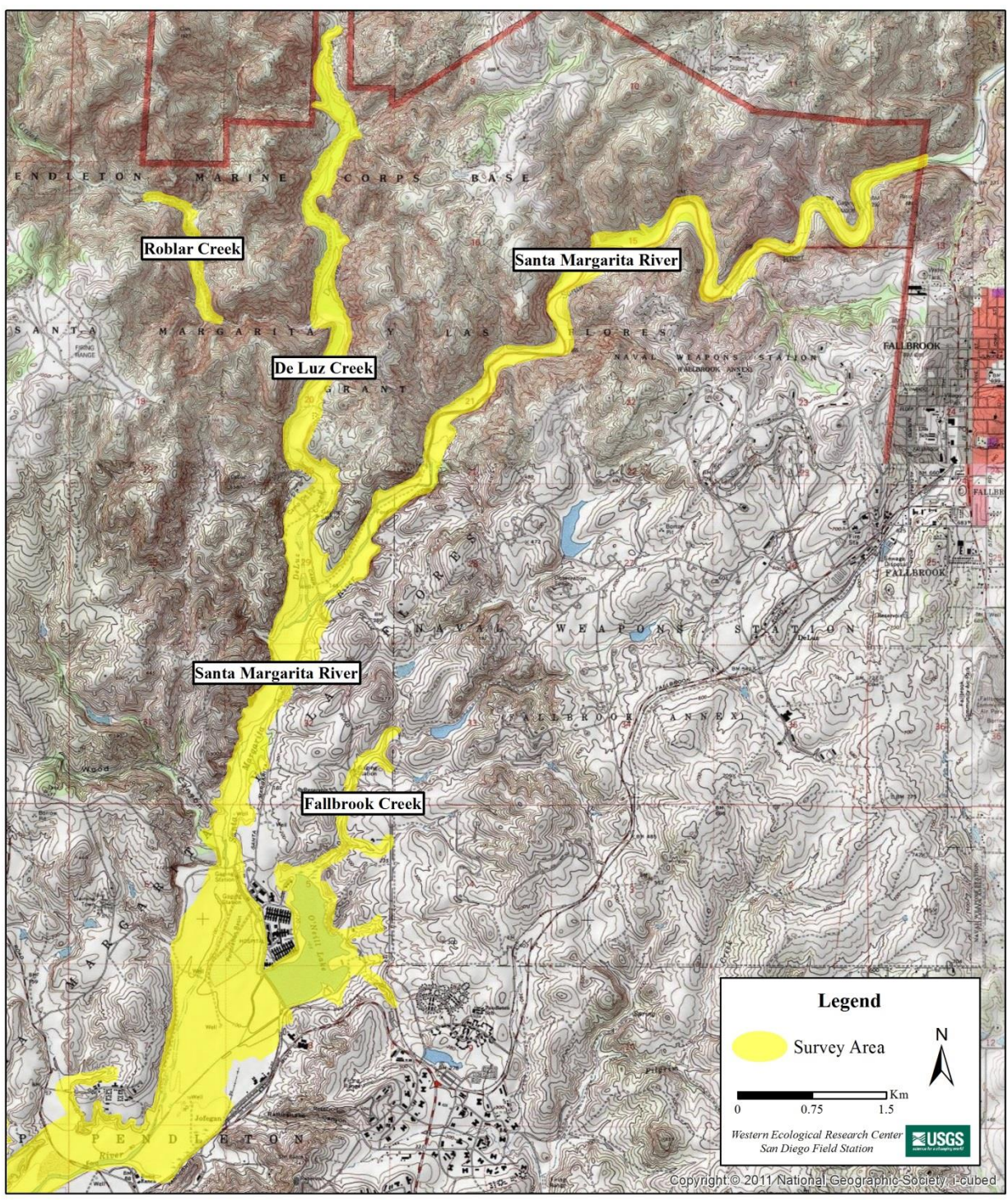


Fig. 4. Willow Flycatcher survey areas at Marine Corps Base Camp Pendleton, 2015: Santa Margarita River, Fallbrook Creek, De Luz Creek and Roblar Creek.

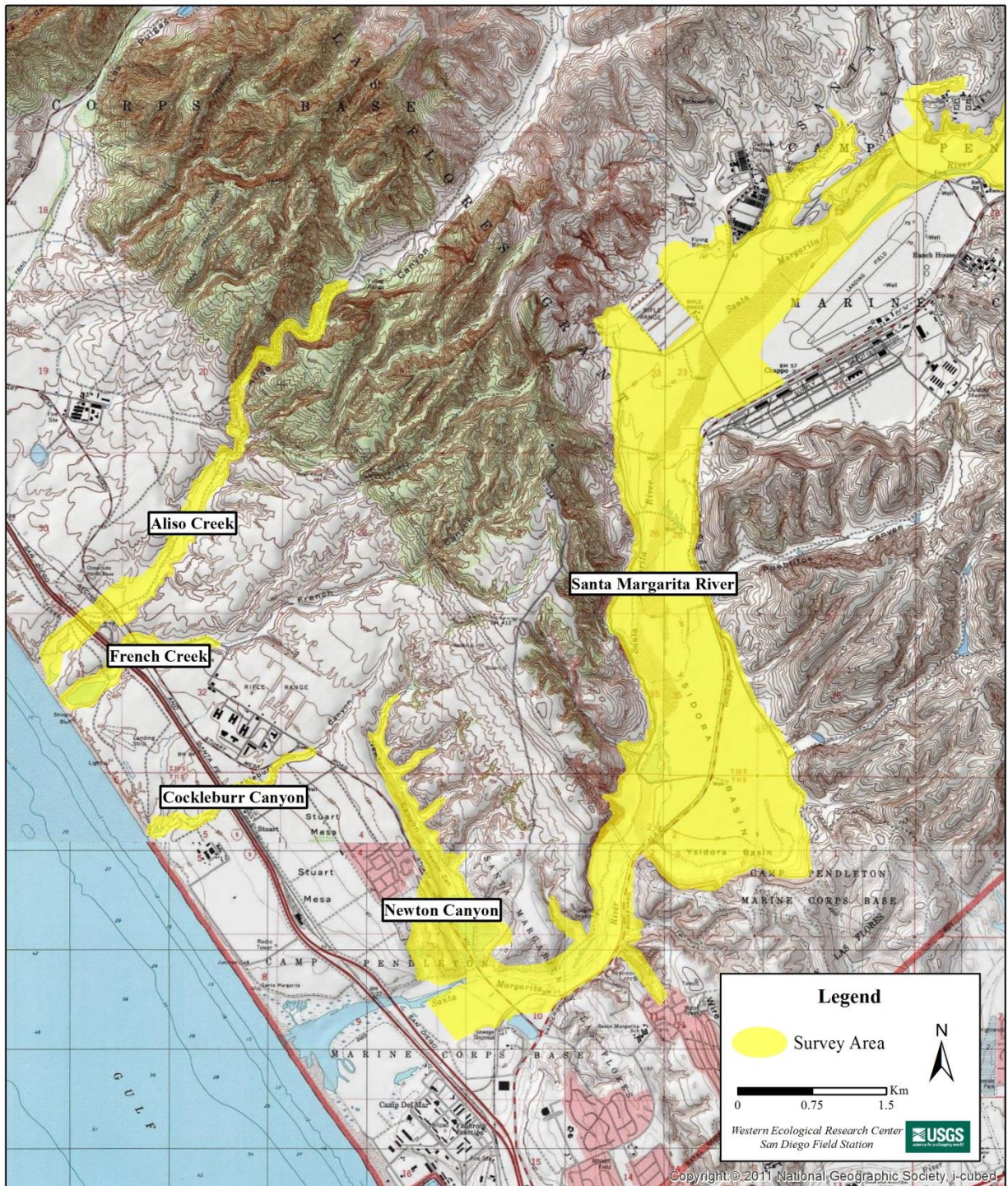


Fig. 5. Willow Flycatcher survey areas at Marine Corps Base Camp Pendleton, 2015: Santa Margarita River, Newton Canyon, Cocklebur Canyon, French Creek, and Aliso Creek.

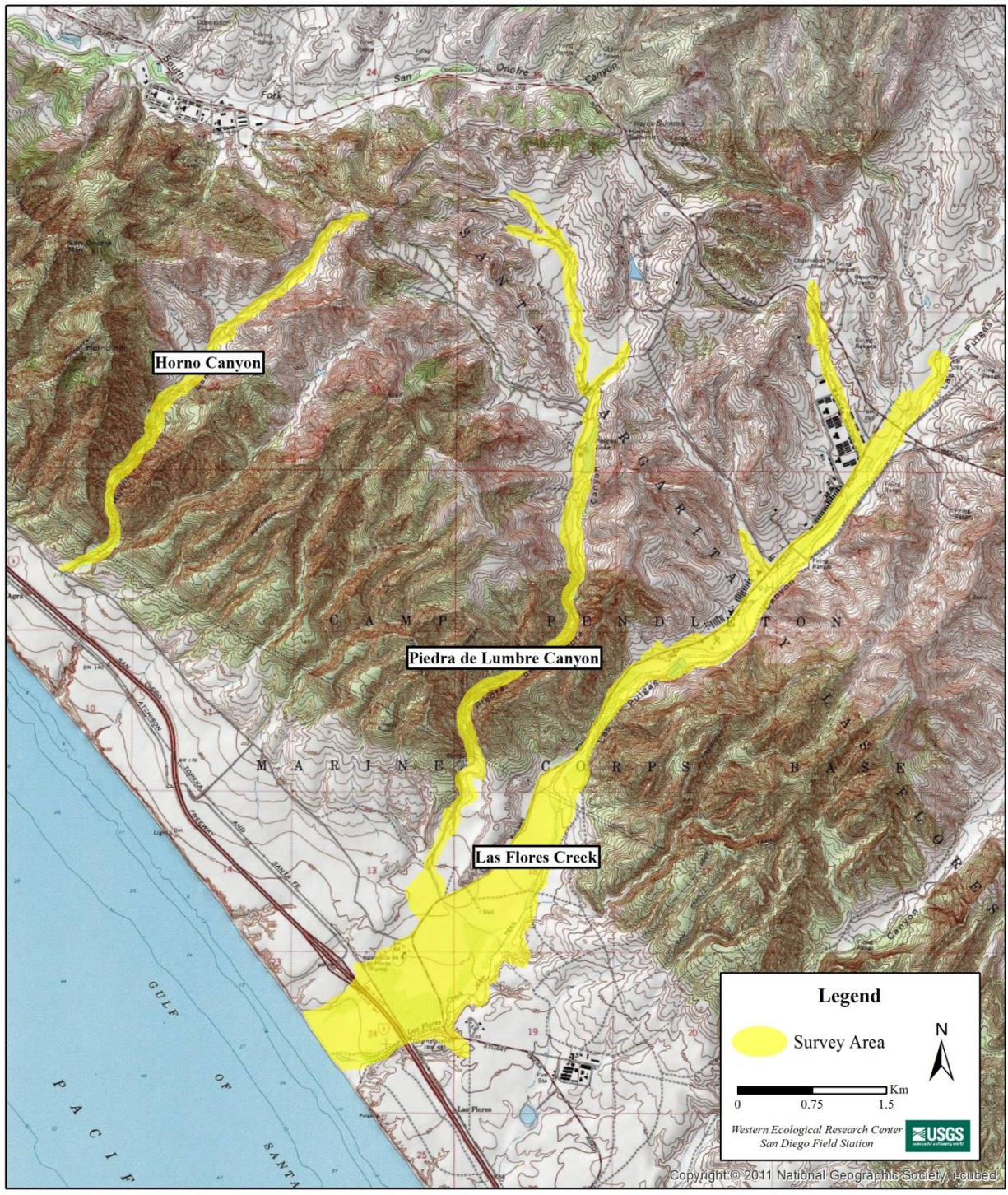


Fig. 6. Willow Flycatcher survey areas at Marine Corps Base Camp Pendleton, 2015: Las Flores Creek, Piedra de Lumbre Canyon, and Horno Canyon.

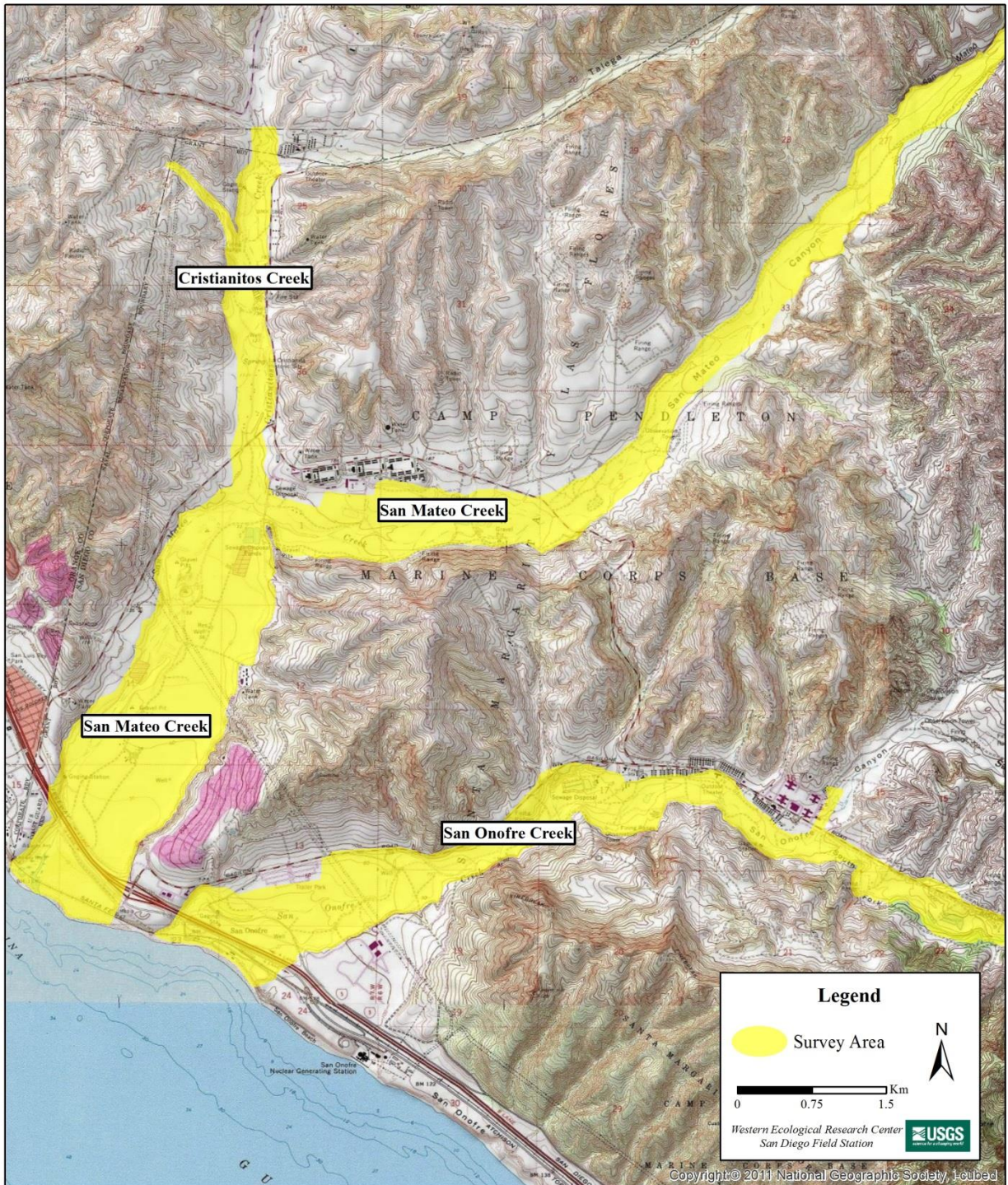


Fig. 7. Willow Flycatcher survey areas at Marine Corps Base Camp Pendleton, 2015: Cristianitos Creek, San Mateo Creek and San Onofre Creek.

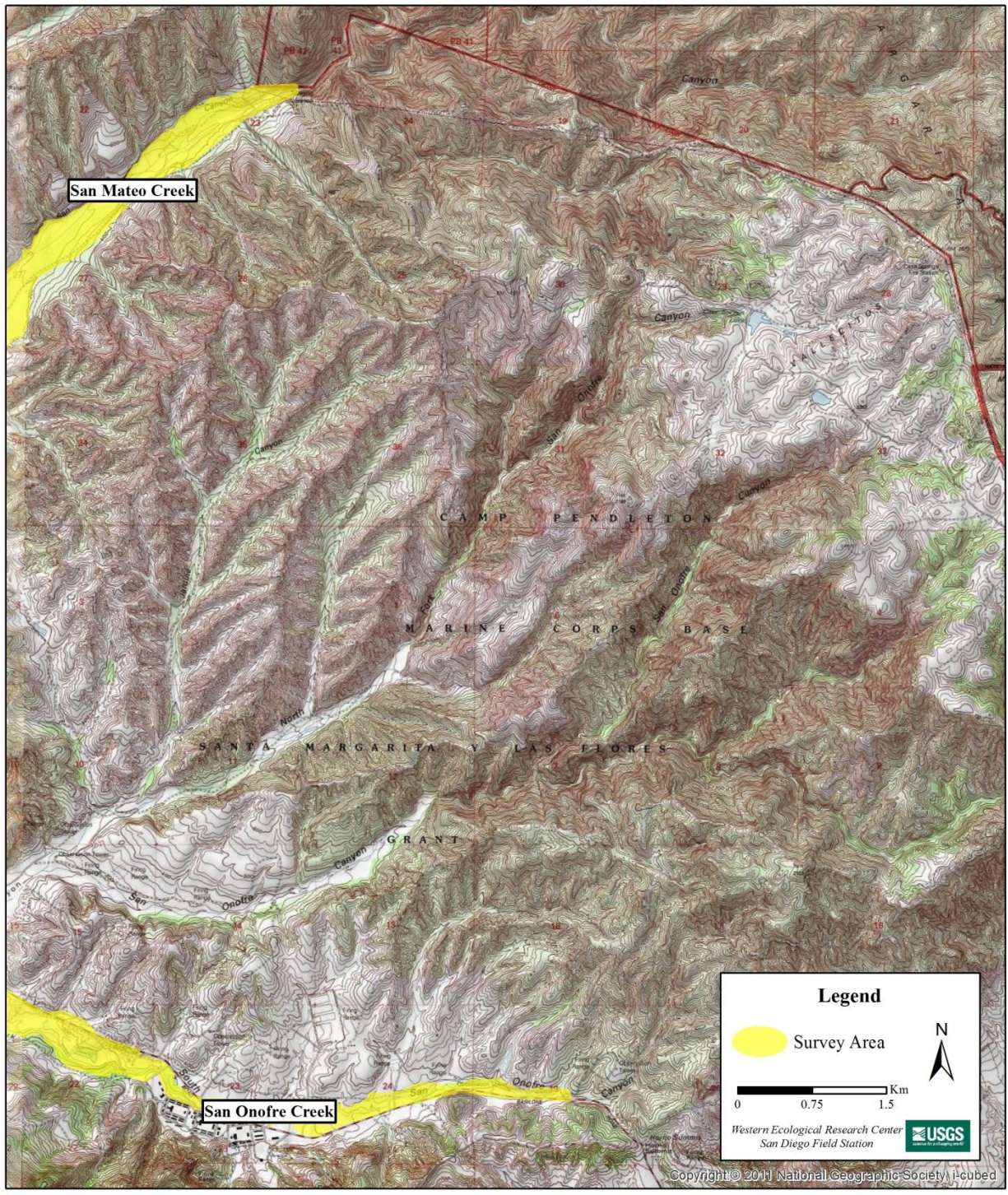


Fig. 8. Willow Flycatcher survey areas at Marine Corps Base Camp Pendleton, 2015: San Mateo Creek and San Onofre Creek.

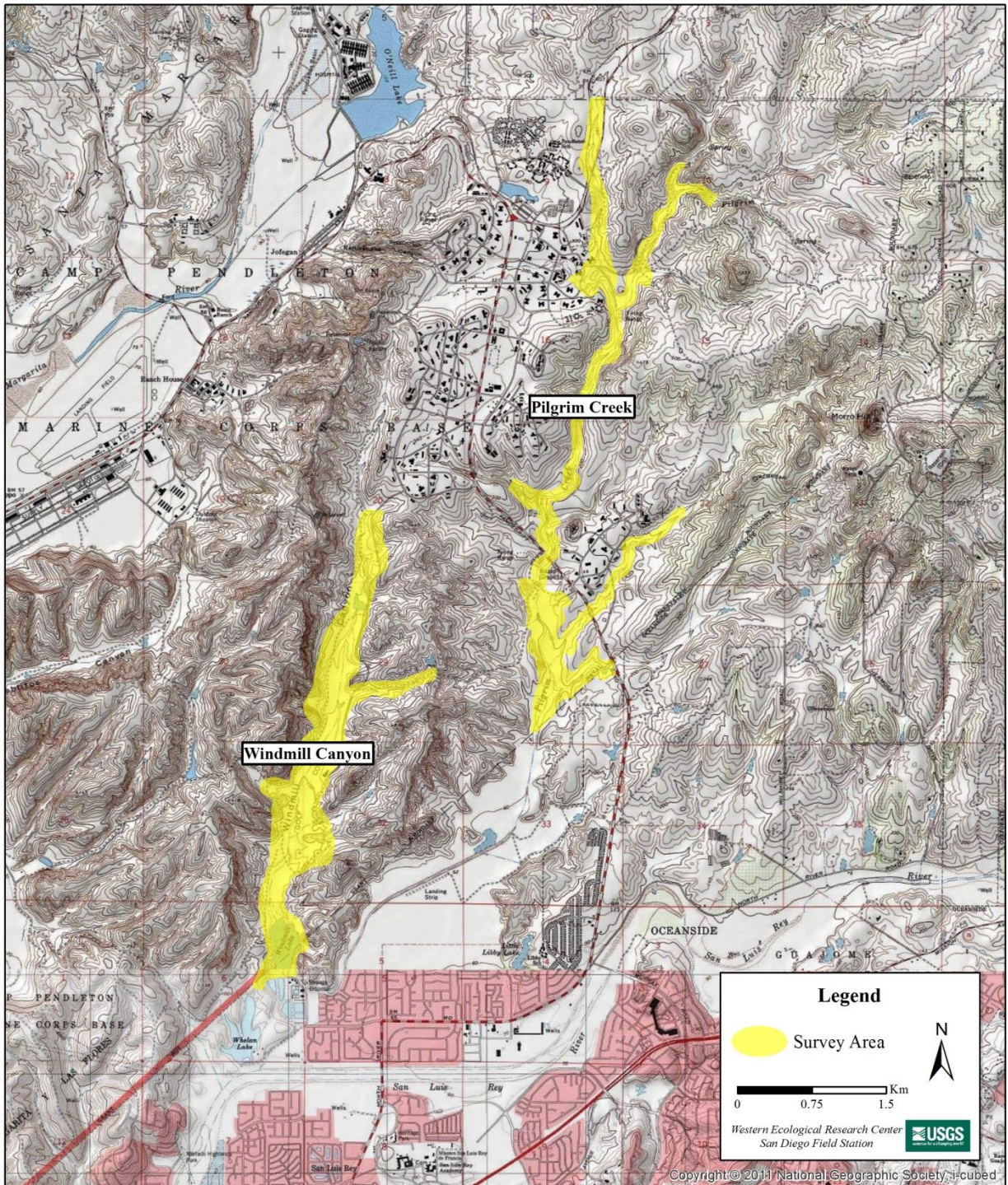


Fig. 9. Willow Flycatcher survey areas at Marine Corps Base Camp Pendleton, 2015: Windmill Canyon and Pilgrim Creek.

APPENDIX B

**LOCATIONS OF WILLOW FLYCATCHERS AT MARINE CORPS BASE CAMP
PENDLETON, 2015**

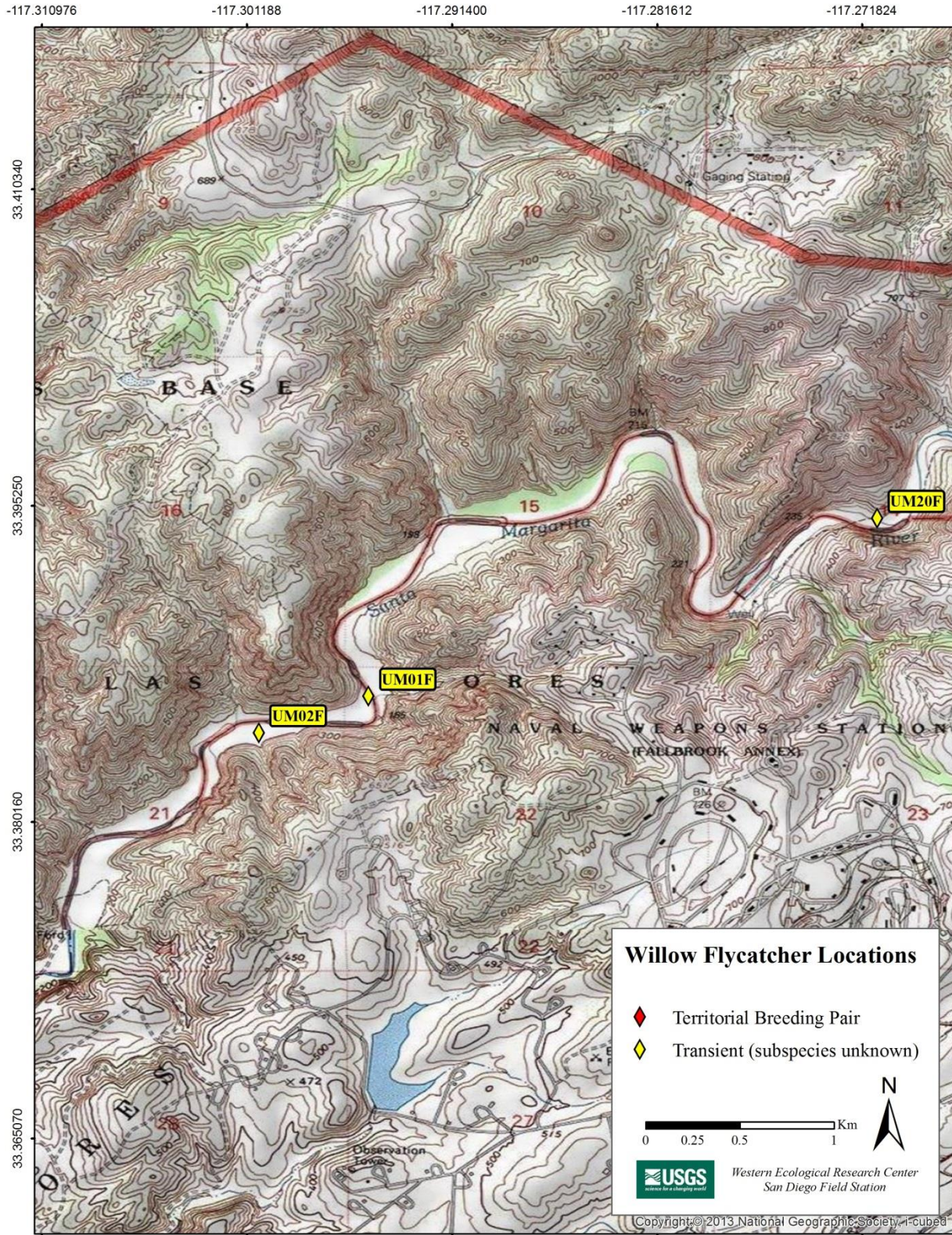


Fig. 10. Locations of Willow Flycatchers at Marine Corps Base Camp Pendleton, 2015: Upper Santa Margarita River.

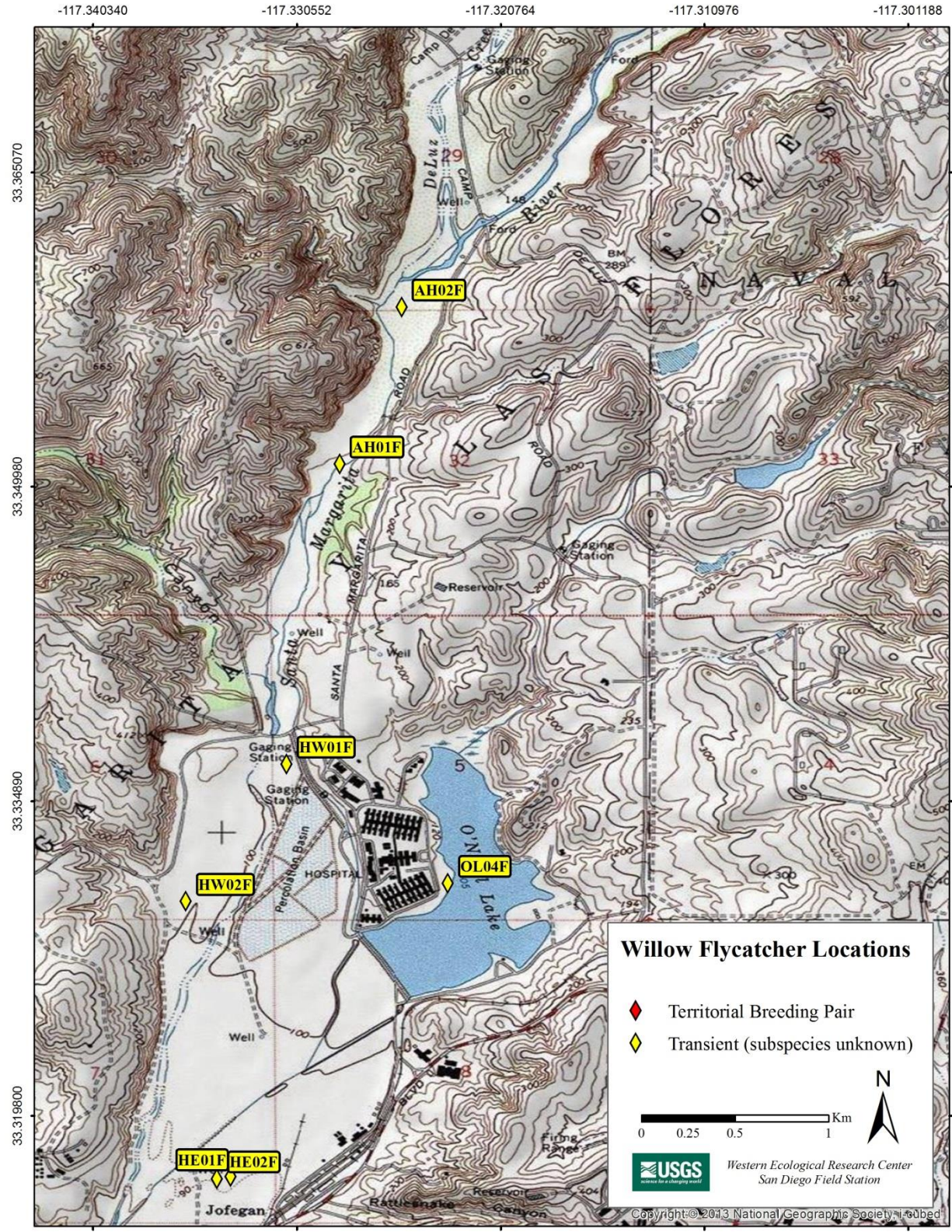


Fig. 11. Locations of Willow Flycatchers at Marine Corps Base Camp Pendleton, 2015: Santa Margarita River (upstream) and Fallbrook Creek.

*Southwestern Willow Flycatchers at Camp Pendleton in 2015
Howell and Kus, USGS Western Ecological Research Center*

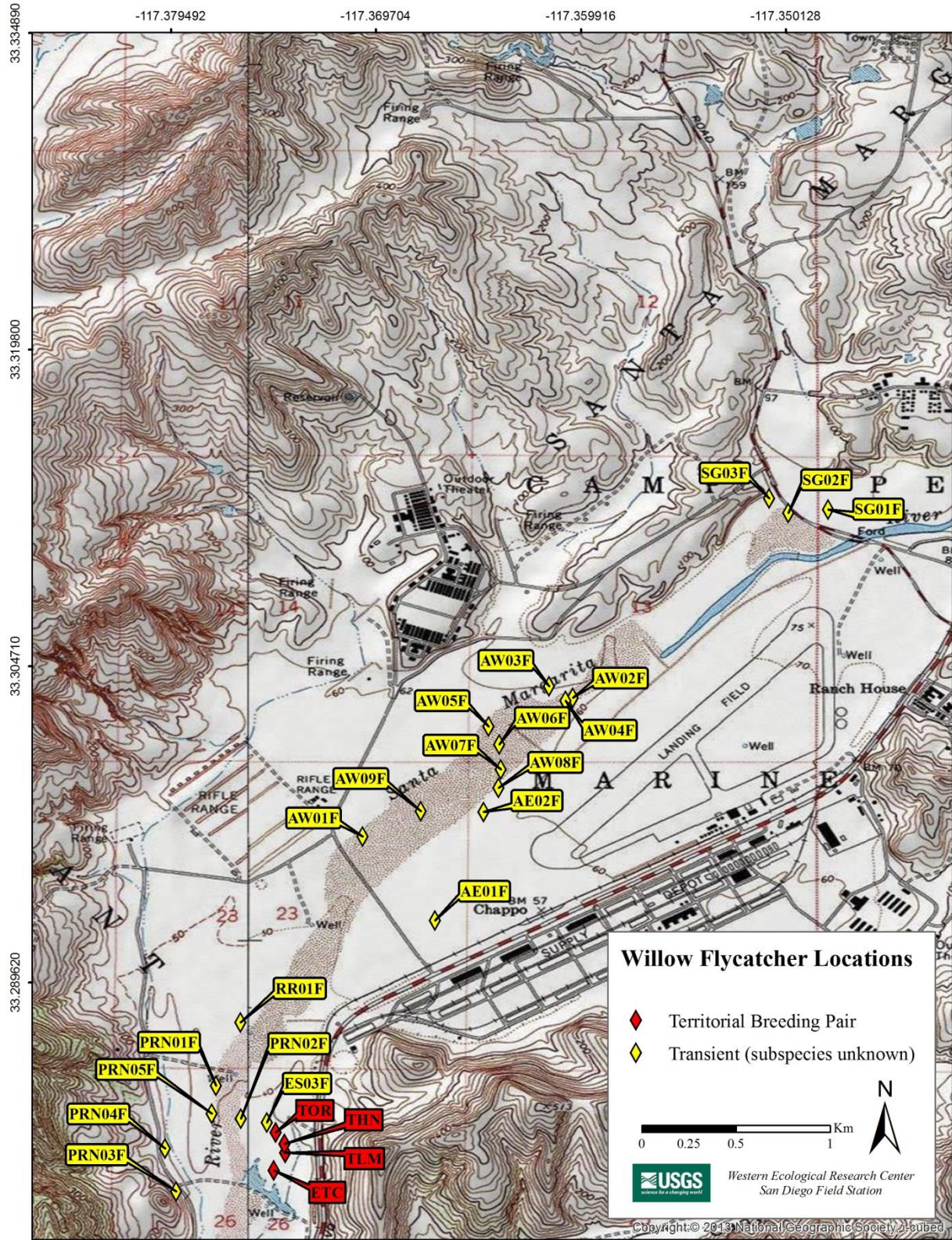


Fig. 12. Locations of Willow Flycatchers at Marine Corps Base Camp Pendleton, 2015: Santa Margarita River (midstream).

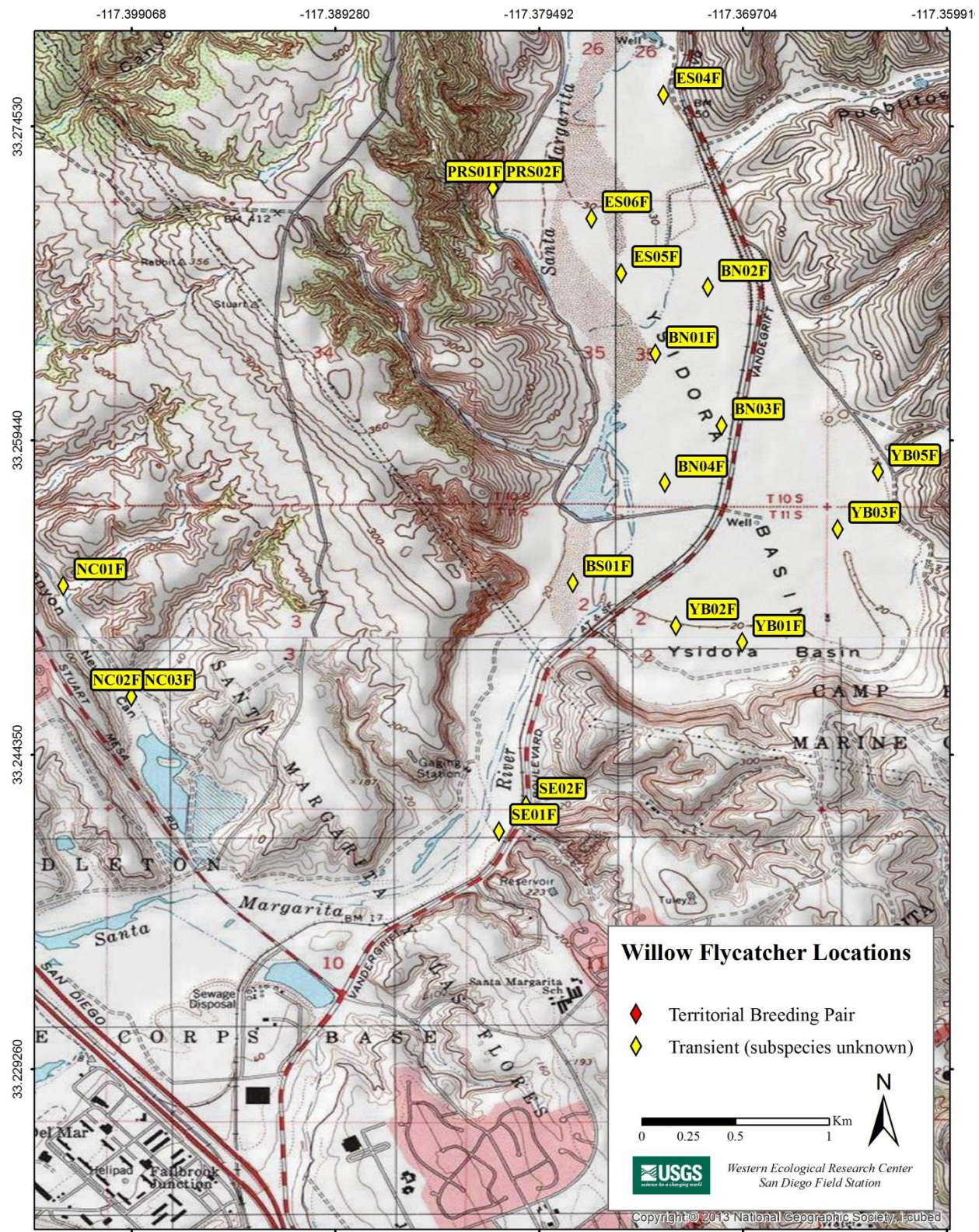


Fig. 13. Locations of Willow Flycatchers at Marine Corps Base Camp Pendleton, 2015: Newton Canyon and Santa Margarita River (downstream).

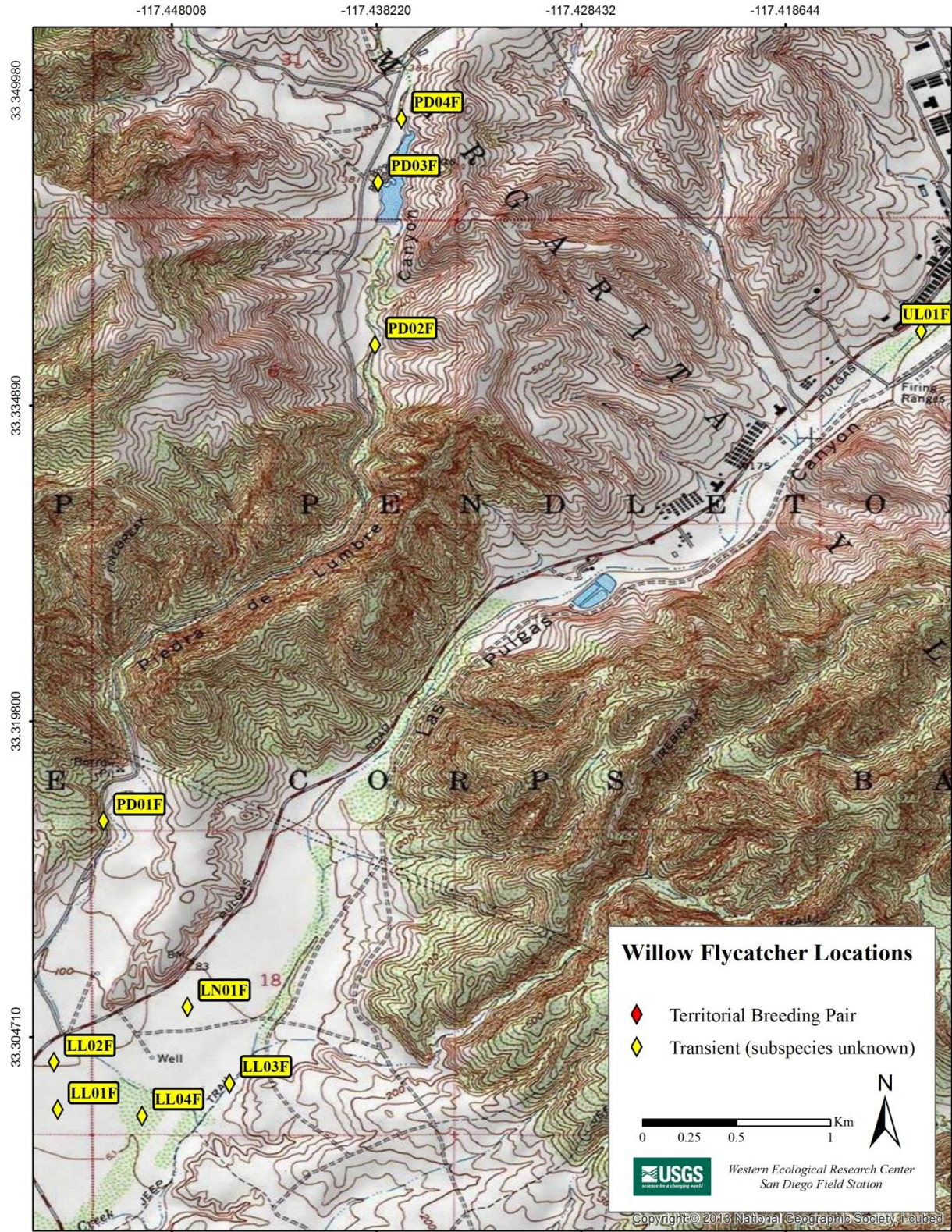


Fig. 14. Locations of Willow Flycatchers at Marine Corps Base Camp Pendleton, 2015: Las Flores Creek and Piedra de Lumbre Canyon.



Fig. 15. Locations of Willow Flycatchers at Marine Corps Base Camp Pendleton, 2015: San Onofre Creek (upstream) and Horno Canyon.

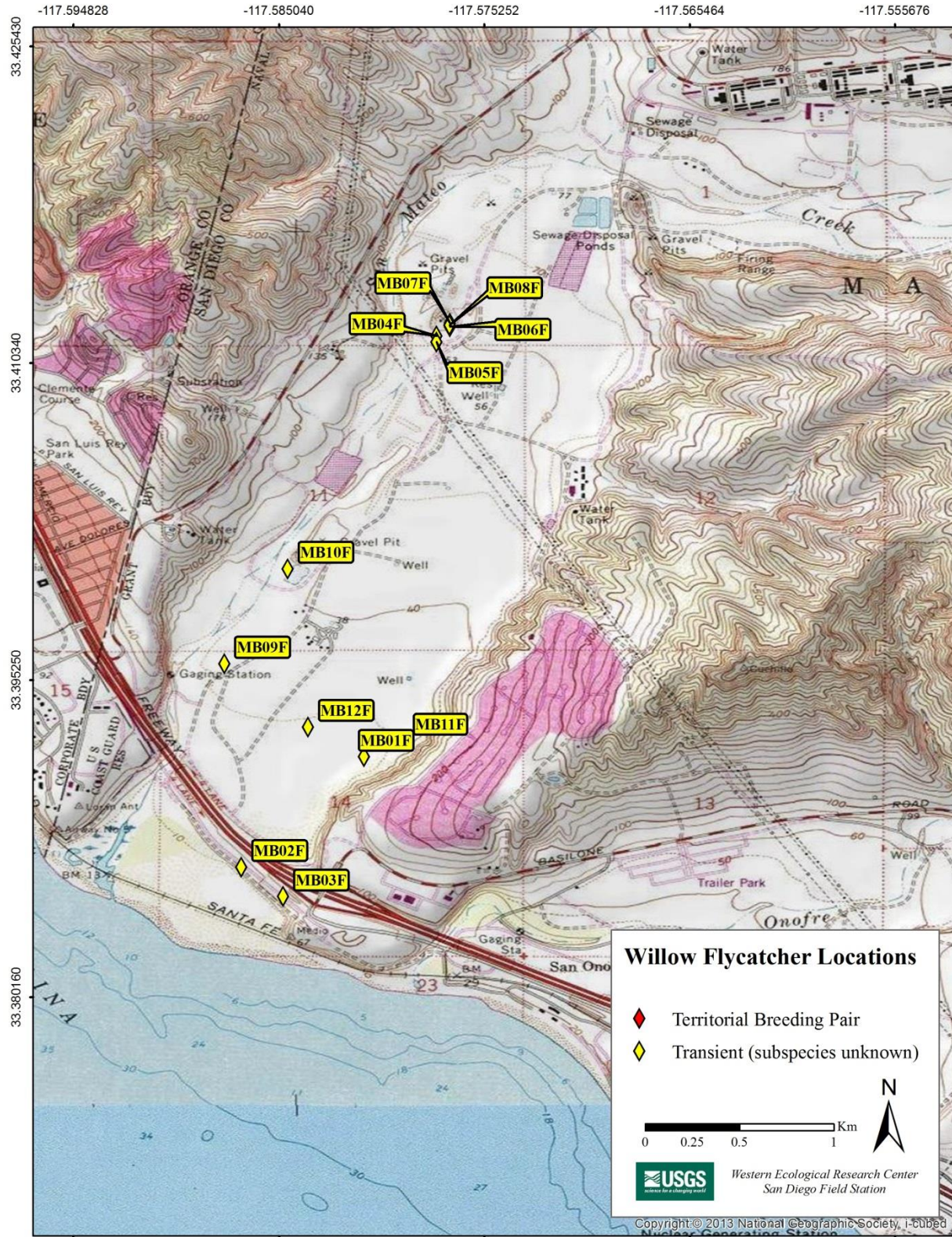


Fig. 16. Locations of Willow Flycatchers at Marine Corps Base Camp Pendleton, 2015: San Mateo Creek (downstream).

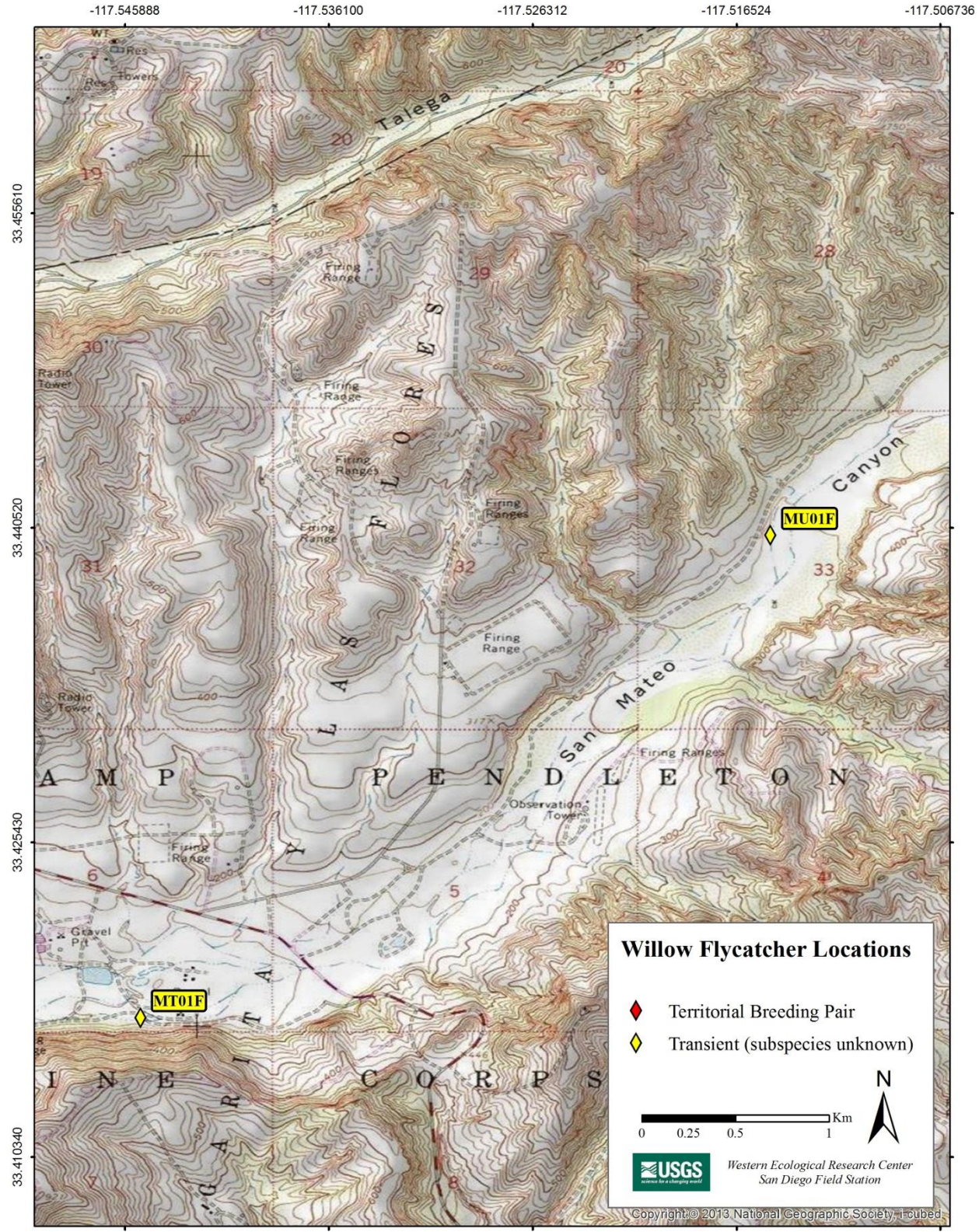


Fig. 17. Locations of Willow Flycatchers at Marine Corps Base Camp Pendleton, 2015: San Mateo Creek (upstream).

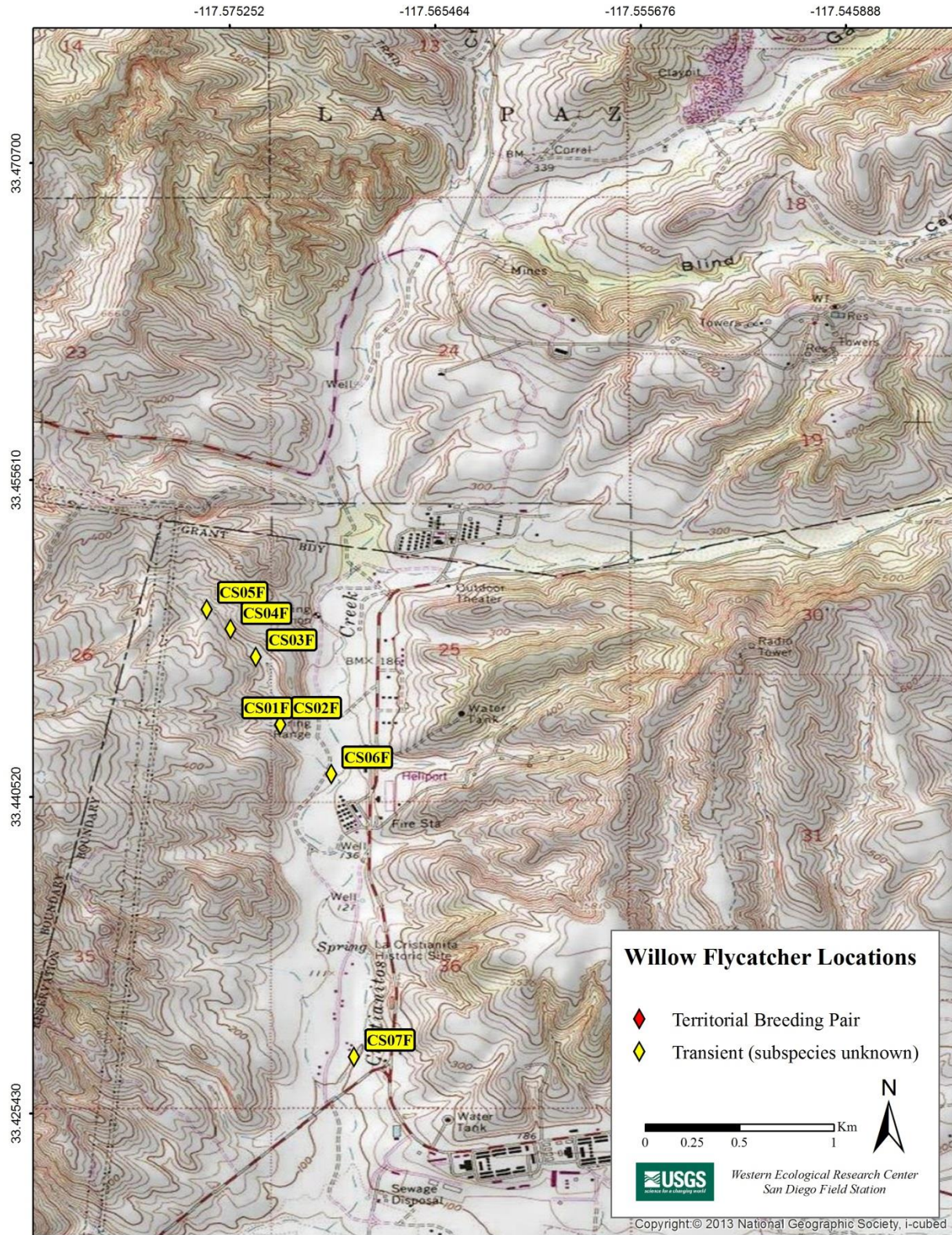


Fig. 18. Locations of Willow Flycatchers at Marine Corps Base Camp Pendleton, 2015: Cristianitos Creek.

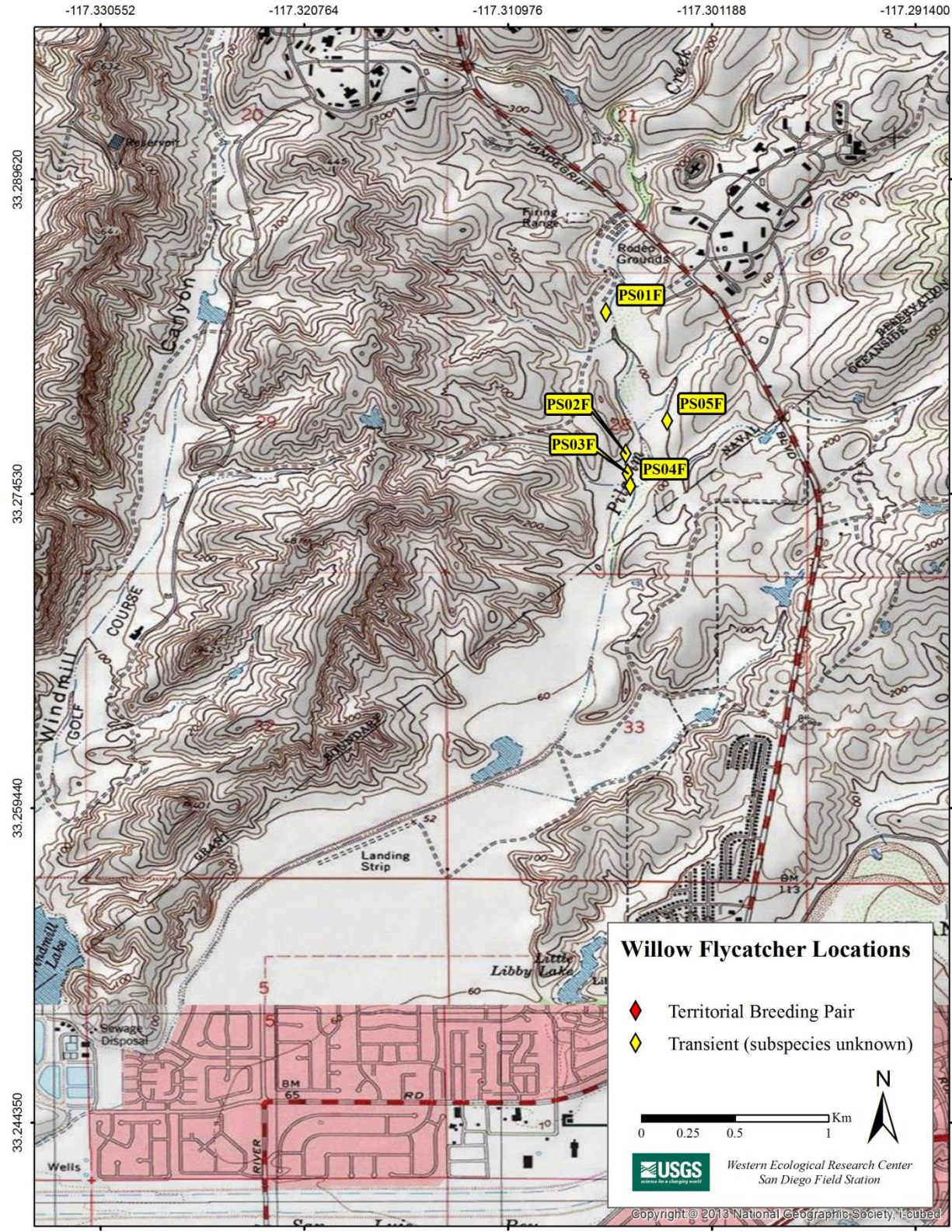


Fig. 19. Locations of Willow Flycatchers at Marine Corps Base Camp Pendleton, 2015: Pilgrim Creek and Windmill Canyon.

APPENDIX C

**SOUTHWESTERN WILLOW FLYCATCHER TERRITORY LOCATIONS AT
MARINE CORPS BASE CAMP PENDLETON, 2015**

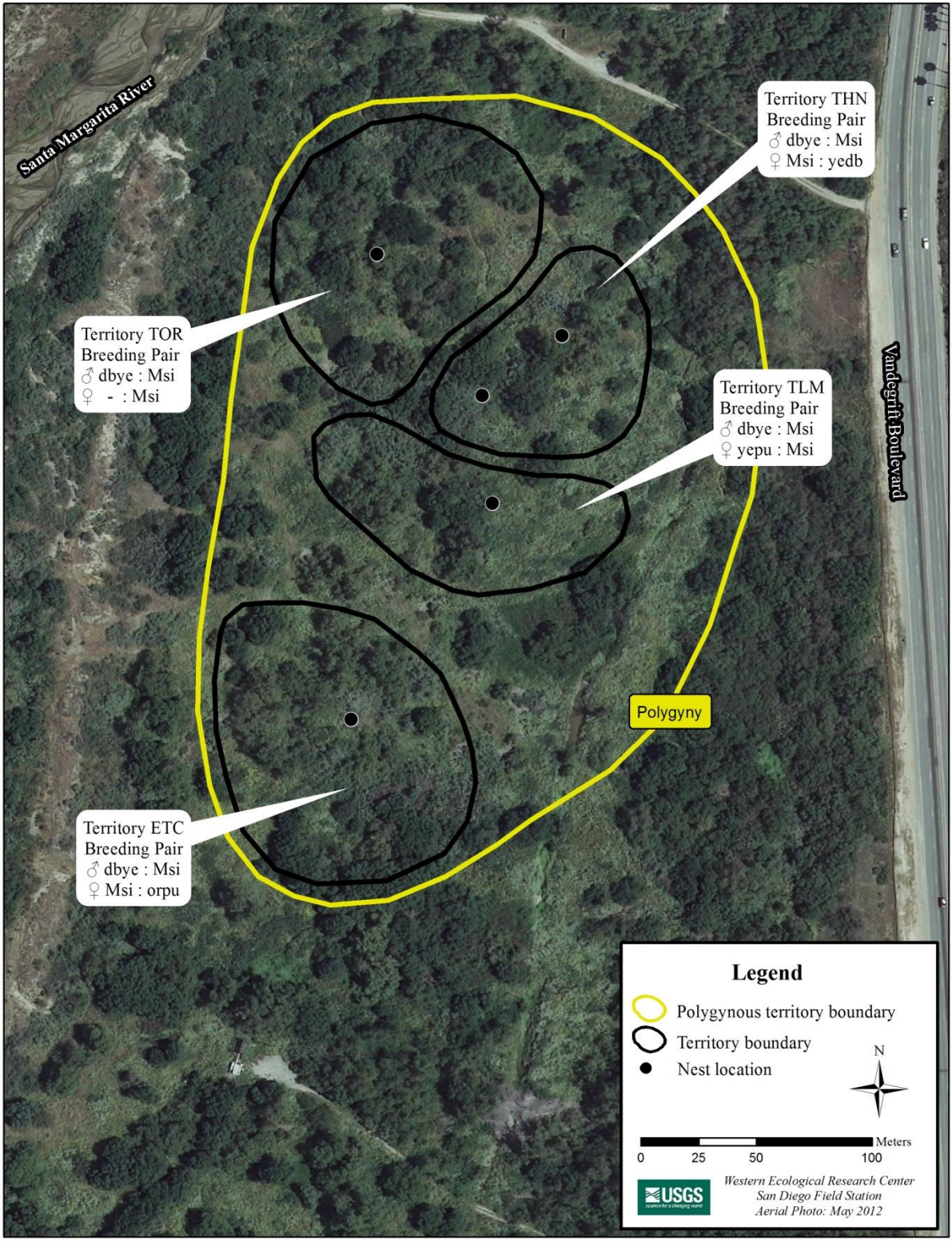


Fig. 20. Southwestern Willow Flycatcher territories at Marine Corps Base Camp Pendleton, 2015: Treatment Ponds and Northern Pueblitos Breeding Areas, Santa Margarita River.

APPENDIX D

**HABITAT CHARACTERISTICS OF WILLOW FLYCATCHER LOCATIONS AT
MARINE CORPS BASE CAMP PENDLETON, 2015**

Bird ID	Drainage	Status^a	Habitat Type^b	Exotic Cover Class^c	Dominant Exotics^d
CS01F	Cristianitos Creek	T	Mixed Willow	1	-
CS02F	Cristianitos Creek	T	Mixed Willow	1	-
CS03F	Cristianitos Creek	T	Mixed Willow	2	BRA
CS04F	Cristianitos Creek	T	Mixed Willow	2	TAM
CS05F	Cristianitos Creek	T	Mixed Willow	2	TAM
CS06F	Cristianitos Creek	T	Riparian Scrub	1	-
CS07F	Cristianitos Creek	T	Riparian Scrub	2	FOE
OL04F	Fallbrook Creek	T	Riparian Scrub	2	BRA, EUC
HO01F	Horno Canyon	T	Riparian Scrub	1	-
LL01F	Las Flores Creek	T	Mixed Willow	2	BRA
LL02F	Las Flores Creek	T	Mixed Willow	2	BRA
LL03F	Las Flores Creek	T	Mixed Willow	2	BRA
LL04F	Las Flores Creek	T	Mixed Willow	2	BRA
LN01F	Las Flores Creek	T	Riparian Scrub	3	BRA
UL01F	Las Flores Creek	T	Mixed Willow	2	BRA
NC01F	Newton Canyon	T	Riparian Scrub	2	BRA
NC02F	Newton Canyon	T	Riparian Scrub	2	BRA, CON
NC03F	Newton Canyon	T	Riparian Scrub	2	BRA, CON
PD01F	Piedra de Lumbre Canyon	T	Mixed Willow	2	BRA, FOE, SIL
PD02F	Piedra de Lumbre Canyon	T	Mixed Willow	3	BRA, FOE, SIL
PD03F	Piedra de Lumbre Canyon	T	Mixed Willow	3	FOE, SIL
PD04F	Piedra de Lumbre Canyon	T	Mixed Willow	2	BRA
PS01F	Pilgrim Creek	T	Mixed Willow	2	CON, PIC
PS02F	Pilgrim Creek	T	Mixed Willow	1	-
PS03F	Pilgrim Creek	T	Mixed Willow	1	-
PS04F	Pilgrim Creek	T	Mixed Willow	1	-
PS05F	Pilgrim Creek	T	Mixed Willow	1	-
MB01F	San Mateo Creek	T	Mixed Willow	1	-
MB02F	San Mateo Creek	T	Willow/Sycamore	1	-
MB03F	San Mateo Creek	T	Mixed Willow	1	-
MB04F	San Mateo Creek	T	Willow/Sycamore	1	-
MB05F	San Mateo Creek	T	Willow/Sycamore	1	-
MB06F	San Mateo Creek	T	Upland Scrub	1	-
MB07F	San Mateo Creek	T	Upland Scrub	1	-
MB08F	San Mateo Creek	T	Upland Scrub	1	-
MB09F	San Mateo Creek	T	Mixed Willow	2	BRA, CON
MB10F	San Mateo Creek	T	Willow/Cottonwood	2	BRA, CON
MB11F	San Mateo Creek	T	Mixed Willow	2	BRA, CON
MB12F	San Mateo Creek	T	Mixed Willow	2	BRA
MT01F	San Mateo Creek	T	Riparian Scrub	1	-

Bird ID	Drainage	Status^a	Habitat Type^b	Exotic Cover Class^c	Dominant Exotics^d
MU01f	San Mateo Creek	T	Riparian Scrub	1	-
FW06F	San Onofre Creek	T	Mixed Willow	1	-
FW07F	San Onofre Creek	T	Mixed Willow	1	-
AE01F	Santa Margarita River	T	Mixed Willow	2	CON
AE02F	Santa Margarita River	T	Riparian Scrub	2	BRA
AH01F	Santa Margarita River	T	Mixed Willow	1	-
AH02F	Santa Margarita River	T	Willow/Sycamore	2	BRA
AW01F	Santa Margarita River	T	Riparian Scrub	2	BRA
AW02F	Santa Margarita River	T	Mixed Willow	2	BRA
AW03F	Santa Margarita River	T	Mixed Willow	2	BRA
AW04F	Santa Margarita River	T	Mixed Willow	2	BRA
AW05F	Santa Margarita River	T	Mixed Willow	2	BRA
AW06F	Santa Margarita River	T	Mixed Willow	2	BRA
AW07F	Santa Margarita River	T	Mixed Willow	2	BRA
AW08F	Santa Margarita River	T	Mixed Willow	2	BRA
AW09F	Santa Margarita River	T	Mixed Willow	2	BRA
BN01F	Santa Margarita River	T	Riparian Scrub	3	BRA
BN02F	Santa Margarita River	T	Mixed Willow	2	BRA
BN03F	Santa Margarita River	T	Riparian Scrub	2	BRA
BN04F	Santa Margarita River	T	Riparian Scrub	2	BRA, CON
BS01F	Santa Margarita River	T	Mixed Willow	3	ARU, CON
ES03F	Santa Margarita River	T	Mixed Willow	2	BRA, CON
ES04F	Santa Margarita River	T	Mixed Willow	2	CON
ES05F	Santa Margarita River	T	Mixed Willow	2	BRA, CON
ES06F	Santa Margarita River	T	Mixed Willow	2	BRA, CON
ETC	Santa Margarita River	P	Mixed Willow	2	CON
HE01F	Santa Margarita River	T	Mixed Willow	2	BRA
HE02F	Santa Margarita River	T	Mixed Willow	2	BRA
HW01F	Santa Margarita River	T	Mixed Willow	1	-
HW02F	Santa Margarita River	T	Riparian Scrub	2	BRA
PRN01F	Santa Margarita River	T	Mixed Willow	3	BRA, CON
PRN02F	Santa Margarita River	T	Mixed Willow	1	-
PRN03F	Santa Margarita River	T	Mixed Willow	3	BRA, CON, PIC
PRN04F	Santa Margarita River	T	Mixed Willow	3	FOE, PIC
PRN05F	Santa Margarita River	T	Mixed Willow	3	BRA, CON
PRS01F	Santa Margarita River	T	Mixed Willow	2	CON
PRS02F	Santa Margarita River	T	Mixed Willow	2	CON
RR01F	Santa Margarita River	T	Mixed Willow	2	CON, SIL
SE01F	Santa Margarita River	T	Mixed Willow	2	BRA
SE02F	Santa Margarita River	T	Mixed Willow	2	BRA
SG01F	Santa Margarita River	T	Mixed Willow	2	BRA
SG02F	Santa Margarita River	T	Mixed Willow	2	BRA

Bird ID	Drainage	Status^a	Habitat Type^b	Exotic Cover Class^c	Dominant Exotics^d
SG03F	Santa Margarita River	T	Mixed Willow	3	BRA
THN	Santa Margarita River	P	Mixed Willow	2	BRA, CON
TLM	Santa Margarita River	P	Mixed Willow	2	BRA, CON
TOR	Santa Margarita River	P	Mixed Willow	2	BRA, CON
UM01F	Santa Margarita River	T	Mixed Willow	1	-
UM02F	Santa Margarita River	T	Mixed Willow	1	-
UM20F	Santa Margarita River	T	Mixed Willow	1	-
YB01F	Santa Margarita River	T	Mixed Willow	2	BRA, CON
YB02F	Santa Margarita River	T	Mixed Willow	2	CON
YB03F	Santa Margarita River	T	Mixed Willow	2	BRA
YB05F	Santa Margarita River	T	Mixed Willow	2	BRA

^aP = breeding pair, T = transient.

^bFor paired birds, habitat type is assessed within the male's territory boundary, except for those pairs that include polygynous males, in which case habitat type is assessed within the females' use areas.

^c1 = <5%, 2 = 5-50%, 3 = 51-95%.

^dARU = giant reed, BRA = black mustard, CON = poison hemlock, EUC = Eucalyptus (*Eucalyptus* sp.), FOE = fennel (*Foeniculum vulgare*), PIC = ox-tongue (*Helminthotheca echioides*), SIL = milk thistle (*Silybum marianum*), TAM = saltcedar.

APPENDIX E

**BAND COMBINATIONS AND IDENTIFICATION OF SOUTHWESTERN WILLOW
FLYCATCHER NESTLINGS BANDED ON MARINE CORPS BASE CAMP
PENDLETON, 2015**

Territory ID	Nest ID	Nestling Band Combination^a	Federal Band Number	Nestling Fledged?
THN	1	none : Msi	271029341	No
THN	1	none : Msi	271029342	No
THN	1	none : Msi	271029343	No
THN	1	none : Msi	271029344	No
TLM	1	none : Msi	271029345	Yes
TLM	1	none : Msi	271029346	Yes
TLM	1	none : Msi	271029347	Yes
TLM	1	none : Msi	271029348	Yes
ETC	1	none : Msi	271029349	Yes
ETC	1	none : Msi	271029350	Yes
ETC	1	none : Msi	271029351	Yes
ETC	1	none : Msi	271029352	Yes
THN	2	none : Msi	271029356	No
THN	2	none : Msi	271029357	No
THN	2	none : Msi	271029358	No

^a Band combinations: left leg : right leg, Msi = federal numbered aluminum band, none = no bands present.

APPENDIX F

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
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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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RECOMMENDED CITATION

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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 permittees 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, McCarthy 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, McCarthy and others 1998, Paradzick and others 1999).

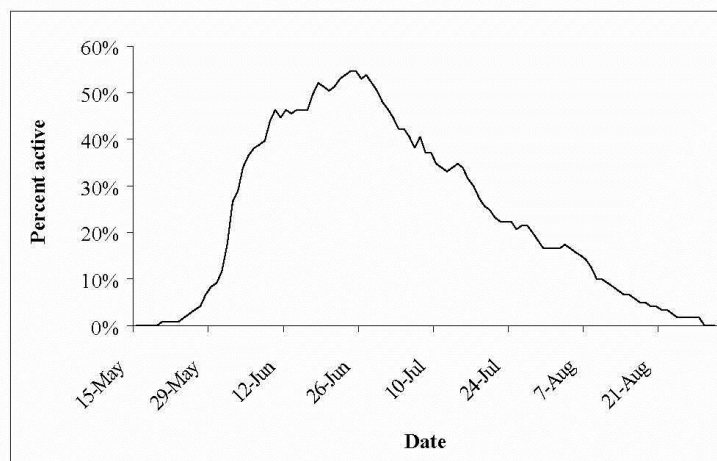


Figure 1. The percentage of southwestern willow flycatcher nests active throughout the 1997 and 1998 breeding seasons at 11 AGFD sites, $n = 121$ (AGFD unpublished data). This figure only includes nests that were located during the nest building or egg laying stages and subsequently monitored until young 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 ^c	76 (54)	7.4 m (45)
California ^c	Willow ^f	71 (176)	2.2 m (134)

^aArizona Game and Fish Department - unpublished data, San Pedro and Gila Rivers, and Roosevelt Lake.

^bSkaggs (1995), Gila River

^cWhitfield 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, McCarthy 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, McCarthy 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, McCarthy 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 "burring" 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, McCarthy 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 than 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 sheaths 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 tract 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. Most 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. Mon. Method	June			July																
	28	29	30	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
13	*				*				▲				<i>M</i>							
9A		3		3		0WE	<i>HD</i>	<i>R</i>					⊗						<i>M</i>	
MP		WE		WE		PE		▲					B							
6A	3		HD, 1WE		3				3				<i>M</i>		<i>FD</i>					
VC	WE		2WN		WN				WN											
11A	3WN		FD		E				3						<i>R</i>					
TH			3WN		2WF				WF											
7A	2WE		2WE		2WE	HD	2WN					1CN				<i>M</i>		<i>M</i>	<i>FD</i>	
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 reneat; 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 fledging(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 re-nesting 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	Eggs	Transition dates	Number	Eggs
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			Additional Bbird Codes	
(WIFL) Period	# Exposure days	Success code	(BB) timing of cowbird fate:	(BB) exact nestling period:
Egg Laying			(BB) exact laying period:	(BB) number fledged:
Incubation			(BB) exact incubation period:	(BB) exact number fledged:
Nestling			(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 than predation; A= abandoned with host egg(s) or young; Z= abandoned, no (zero) eggs laid.

Figure 7. Willow flycatcher Nest Record Form (front)

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 researcher's 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

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

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

$$S^d = (1-r)^d$$

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 $(1-r)$ 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 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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