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Distribution and Breeding Activities of the Least Bell's Vireo and Southwestern Willow Flycatcher at the San Luis Rey River, San Diego County, California

2006 Annual Data Summary

Prepared for:

State of California
Department of Transportation
District 11
San Diego, California

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

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By James W. Rourke and Barbara E. Kus

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EXECUTIVE SUMMARY

Surveys and monitoring for least Bell's vireos (*Vireo bellii pusillus*) and southwestern willow flycatchers (*Empidonax traillii extimus*) were conducted on the San Luis Rey River, San Diego County CA, between 1 April and 21 August 2006. Vireo surveys were conducted from Interstate 15 west approximately 6.5 km to Mission Road. Southwestern willow flycatchers were surveyed in the same area, as well as downstream between Sante Fe Road and a point approximately 1 km upstream on the San Luis Rey River (Guajome Regional Park).

Fifty-three territorial male least Bell's vireos were observed within the study area, 50 of which (94 percent) were confirmed as paired. Nine transient male vireos were also detected. Within the section of river consistently monitored since 2003, vireo numbers declined from 46 territories in 2005 to 31 in 2006. For the three years prior to 2006 the number of resident territorial males had remained relatively constant, varying from 40 to 46 territorial males.

Nesting activity at 99 nests within 43 vireo territories was monitored. Thirty-six percent of nests were successful, fledging at least one vireo young, while 64 percent failed. Sixty percent of vireo nests whose contents were observed were parasitized by brown-headed cowbirds (*Molothrus ater*). Nest predation and cowbird parasitism accounted for 66 and 21 percent of failures, respectively. However, biologists "rescued" parasitized nests by removing cowbird eggs shortly after they were laid, allowing some to fledge young. Without “rescuing” it is likely that nest success would have been only 15 percent. In total, 86 vireo young fledged from 35 nests, and pairs fledged on average 2.2 young by the end of the breeding season.

Thirteen least Bell's vireos banded prior to the 2006 breeding season were resighted within the study area. All had been banded as nestlings on the San Luis Rey River. Eight of the thirteen possessed a unique combination of color bands or were recaptured during the 2006 season and therefore could be identified to individual. Two of the eight were banded as nestlings outside of the study area and dispersed 14 and 4.9 km into the study area. All other uniquely color banded vireos fledged from and dispersed within the study area. The extent of their dispersal ranged from 0.8 to 4.4 km. Five other adult vireos that had been banded as nestlings with a single federal band were target netted, but attempts to recapture them were unsuccessful. Two additional adult vireos were captured in 2006 while target netting another bird in the territory and were banded with a unique color combination. Eighty-six nestlings were banded with a single dark blue numbered federal band during the 2006 breeding season.

Fourteen different plant species were used by least Bell's vireos as nest substrates, with 74 percent of nests built in *Salix lasiolepis*, *S. exigua,* or *Baccharis salicifolia*. Host plant species had no apparent effect on nest fate as the majority of successful and unsuccessful nests were built in the same species, in roughly the same proportions.

A single southwestern willow flycatcher pair and two transient willow flycatchers of unknown subspecies were documented on the San Luis Rey River within the upper study area during the 2006 breeding season. No flycatchers were documented within the lower study area. The pair built three nests, the first two of which failed because of cowbird parasitism. The third nesting attempt fledged two flycatcher young. The female of the pair was caught and color banded. Two nestlings were banded with a single silver federal band on the left leg.

INTRODUCTION

This report summarizes the results of least Bell's vireo (*Vireo bellii pusillus*, hereafter "vireo") and southwestern willow flycatcher (*Empidonax traillii extimus*, hereafter "flycatcher") monitoring conducted in 2006 along the San Luis Rey River in San Diego County, California. The primary objectives of this study were to: 1) document the abundance and distribution of least Bell's vireos and southwestern willow flycatchers, and 2) monitor nesting activity of the species within the study areas.

The least Bell's vireo is a small, migratory songbird that breeds in southern California and northwestern Baja California, Mexico from April through July. Historically abundant within lowland riparian ecosystems, vireo populations began declining in the late 1900's as a result of habitat loss and alteration associated with urbanization and conversion of land adjacent to rivers to agriculture, and by 1986 numbered just 300 territorial males statewide (Franzreb 1989, U.S. Fish and Wildlife Service 1998, RHJV 2004). Additional factors influencing the decline have been the expansion in range of the brown-headed cowbird (*Molothrus ater*), a brood parasite, to include the Pacific coast (U.S. Fish and Wildlife Service 1986; Franzreb 1989; Brown 1993; Kus 1998, 1999). In response to the dramatic reduction in numbers of the vireo in California, the California Fish and Game Commission listed the species as endangered in 1980, with the U.S. Fish and Wildlife Service (USFWS) following suit in 1986. Since listing, the vireo population in southern California has rebounded, largely in response to cowbird control, and habitat restoration and preservation. As of 2004, the statewide vireo population was estimated to be approximately 2,500 territories (USGS, unpublished data).

The southwestern willow flycatcher 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, Colorado and Utah, and western Texas (Hubbard 1987, Unitt 1987). Similar to the vireo, the southwestern willow flycatcher has declined in recent decades in response to widespread habitat loss throughout its range and, possibly, cowbird 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 (U.S. Fish and Wildlife Service 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 within riparian systems with the least Bell's vireo. However, unlike the vireo, which has increased eight-fold in response to management alleviating threats, willow flycatcher numbers remain low (Kus and Whitfield 2005). Currently, the majority of southwestern willow flycatchers in California are concentrated in three sites: the South Fork of the Kern River in Kern County (Whitfield 2002), the Upper San Luis Rey River, including a portion of the Cleveland National Forest in San Diego County (Varanus Biological Services 2001), and Marine Corps Base Camp Pendleton in San Diego County (Kus and Kenwood 2006). Outside of these sites, southwestern willow flycatchers occur as small, isolated populations of one to half a dozen pairs (Kus et al. 2003). 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.

STUDY AREAS AND METHODS

Study Areas and Surveys

Surveys and monitoring of least Bell's vireos were conducted on the San Luis Rey River, San Diego County, from Interstate 15 west approximately 6.5 km to Mission Road (Figure 1). Typically, the entire site was surveyed over a number of days, as surveys were often paired with nest monitoring to maximize the probability of detecting vireos. This methodology ensured the site was surveyed in its entirety every three to four weeks between 1 April and 31 July. Biologists followed standard survey techniques described in the Least Bell's Vireo Working Group and U.S. Fish and Wildlife Service's least Bell's vireo survey guidelines (U.S. Fish and Wildlife Service 2001).

The southwestern willow flycatcher study areas were located within the least Bell's vireo survey and monitoring area described above and between Sante Fe Road and a point approximately 1 km upstream on the San Luis Rey River (Figure 1). Four protocol surveys (Sogge *et al*. 1997) of each site were conducted from 18 May to 25 July to locate male flycatchers actively defending territories. Extra effort was made in areas occupied by flycatchers in previous years to ensure no flycatchers went undetected. Surveys were conducted by moving slowly 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 in a way that permitted detection of all birds throughout its extent.

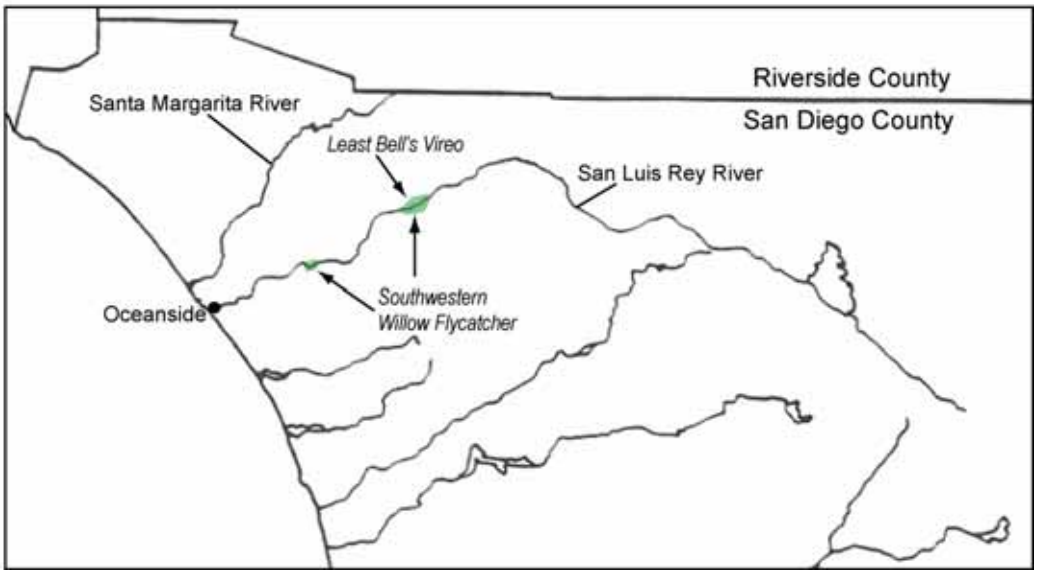

Figure 1. Location of least Bell's vireo and southwestern willow flycatcher study sites in San Diego County, California.

Surveys were conducted between dawn and early afternoon, depending on wind and weather conditions. For each bird encountered (whether vireo or flycatcher), investigators recorded age (adult or juvenile), sex, breeding status (paired, unpaired, or undetermined), and whether the bird was banded. Birds were considered transients if they were detected in an area for less than three weeks. Bird locations were mapped on 1":12,000" aerial photographs as well as 1":24,000" USGS topographic maps, using a Garmin 12 Global Positioning System (GPS) unit with 1-15 m positioning accuracy to determine geographic coordinates (WSG84).

Nest Monitoring

Forty-three vireo territories and all flycatcher territories (1) were monitored to document breeding activity during the 2006 season. Pairs were observed for evidence of nesting, and their nests were located. Nests were visited as infrequently as possible to minimize the chances of leading predators or brown-headed cowbirds to nest sites; typically, there were three to five visits per nest. The first visit was timed to determine the number of eggs laid, the next few visits to determine hatching and age of young, and the last to band nestlings. Brown-headed cowbird eggs and nestlings were removed from host nests as they were found. Characteristics of nests, including height, host species, host height, and the distance nests were placed from the edge of the host plant, and to the edge of the vegetation clump in which they were placed were recorded following abandonment or fledging of young from nests for both focal species. For willow flycatchers only, to characterize a nest's placement within the riparian system the distance from each nest to the closest edge of riparian habitat and to surface water or moist soil were also recorded.

Banding

Least Bell's vireo nestlings were banded at 6-7 days of age with a single anodized dark blue aluminum numbered federal band on the left leg. Returning adult vireos previously banded with a single federal numbered band were target netted to learn their identity and banded with a unique combination of colored plastic and anodized metal bands.

Nestling southwestern willow flycatchers were banded at 7-10 days of age with an aluminum numbered federal band on the left leg. Unbanded adult flycatchers and returning flycatchers with a single federal band were target netted and banded with a unique combination of colored aluminum bands. Flycatchers were banded with a maximum of one band on each leg.

RESULTS

Least Bell's Vireo

Population Size and Distribution

Although least Bell's vireos had begun arriving at the study site by the first week in April, arrival of the majority of vireos was delayed considerably (Figure 2). Within the section of river monitored in both 2005 and 2006, between Gird Road and Interstate 15, surveys during the first week of April detected only two territories in 2006 compared to 30 in 2005. By 15 April, 19 territories had been established in 2006 while there had been 39 established in 2005. This lag

in territory establishment continued throughout the 2006 breeding season, and it was not until mid-June 2006 that the number of territories detected in early April the preceding year was established. Vireo numbers in 2006 failed to achieve the numbers documented at the site in 2005 (see below).

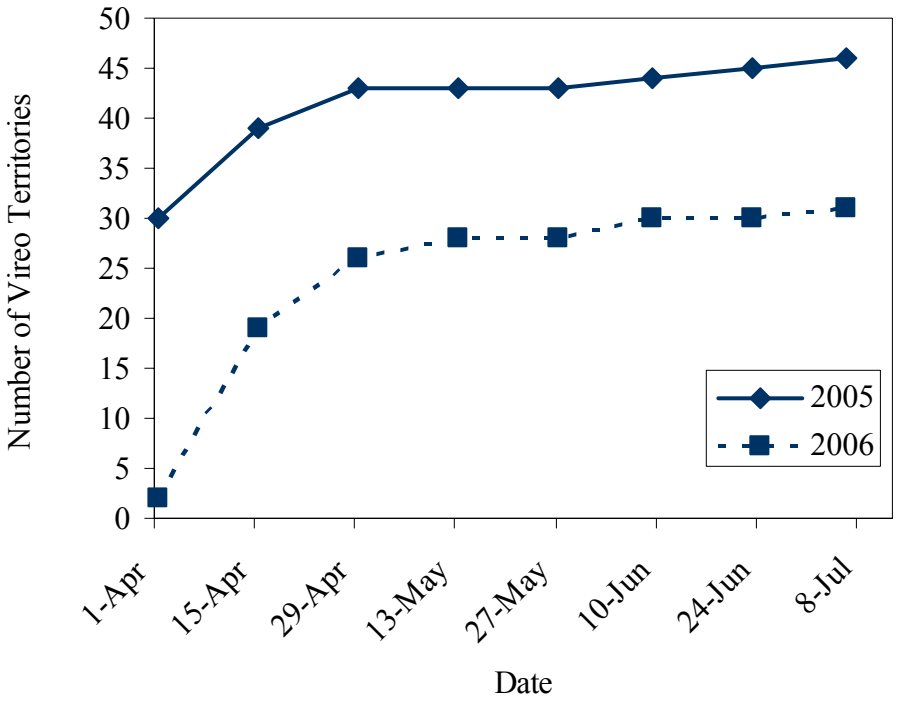

Figure 2. Territory establishment of least Bell's vireos at the San Luis Rey River in 2005 and 2006.

Within the entire study sites 53 territorial male least Bell's vireos were observed in 2006, 50 of which (94 percent) were confirmed as paired (Figure 3; Table 1). The only single male vireo was first observed at the site on 5 June after all other vireos had found mates. Through subsequent monitoring it was determined that this bird did not pair during the 2006 season. The breeding status of two territorial males was undetermined. Nine transient male vireos were also detected during the 2006 breeding season.

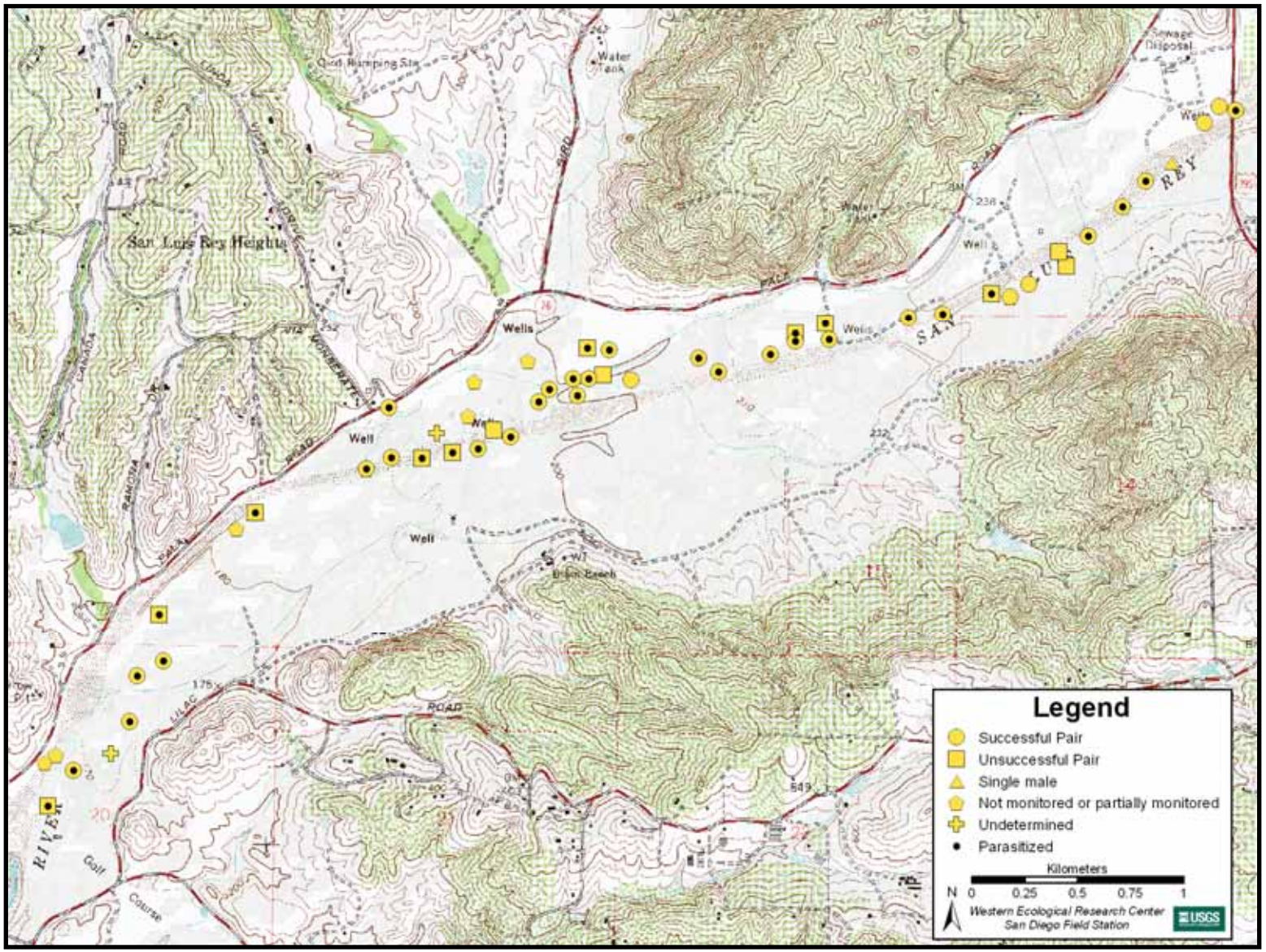

Figure 3. Least Bell's vireo locations and breeding status along the upper San Luis Rey River, 2006.

Table 1. Status and nesting activities of least Bell's vireos at the San Luis Rey River, 2006.

Territory	Status	Nest	Nest fate[a]	# Young fledged	Nest parasitized?	# BHCO eggs removed[b]	Comments
AVO	Pair	1	SUC	4	N	-	
		2	SUC	3	Y	2	
BBK	Pair	-	-	-	-	-	Not monitored.
BRN	Pair	1	PRE	0	Y	1	
		2	PRE	0	Y	1	
		3	PRE	0	Y	1	
		4	PAR	0	Y	0	Nest parasitized early in cycle and abandoned before BHCO egg could be removed.
CAS	Pair	1	SUC	4	Y	1	
		2	PRE	0	N	-	
CAT	Transient	-	-	-	-	-	Not detected after 6 April
CAC	Pair	1	SUC	2	Y	1	
CWB	Pair	1	OTH	0	N	-	Possible BHCO predation of egg(s).
		2	PRE	0	N	-	
		3	PAR	0	Y	1	
DDT	Pair	-	-	-	-	-	Not monitored.
DEW	Pair	-	-	-	-	-	Not monitored.
DME	Pair	1	PRE	0	Y	1	
		2	INC	0	-	-	Nest building begun, but not completed.
		3	PRE	0	Y	1	
		4	SUC	3	N	-	
DSH	Pair	1	SUC	2	Y	1	
		2	PRE	0	Y	1	
DOZ	Pair	1	PRE	0	N	-	
		2	SUC	3	Y	1	
EVR	Pair	1	PRE	0	N	-	
		2	PRE	0	Y	1	
		3	UNK	0	-	-	Depredated or abandoned prior to egg laying; eggs not confirmed in nest.
		4	PAR	0	Y	1	
ELV	Transient	-	-	-	-	-	Late season movement, first detected in July.
FEF	Pair	1	SUC	3	Y	1	
		2	PAR	0	Y	0	Nest parasitized early in cycle and abandoned before BHCO egg could be removed.
FLY	Pair	1	OTH	0	-	-	Nest drenched in storm and abandoned prior to egg laying. Territory partially monitored.
		2	PRE	0	Y	1	

Table 1 (*continued*). Status and nesting activities of least Bell's vireos at the San Luis Rey River, 2006.

Territory	Status	Nest	Nest fate[a]	# Young fledged	Nest parasitized?	# BHCO eggs removed[b]	Comments
FRK	Pair	-	-	-	-	-	Not monitored.
GAT	Transient	-	-	-	-	-	Late season movement, first detected in July.
GMP	Unknown	-	-	-	-	-	Not monitored.
HDZ	Pair	1	PRE	0	N	-	
JMS	Pair	1	PAR	0	Y	0	Nest parasitized during egg laying. BHCO egg left in nest until laying was complete, but was subsequently abandoned.
		2	PAR	0	Y	2	
LGL	Pair	1	PRE	0	N	-	
		2	PRE	0	N	-	
		3	PRE	0	N	-	
		4	SUC	2	Y	2	
LLT	Pair	1	UNK	0	-	-	Depredated or abandoned prior to egg laying; eggs not confirmed in nest.
		2	SUC	2	Y	1	
LOC106	Transient	-	-	-	-	-	Detected once on 11 May.
LOR	Transient	-	-	-	-	-	Not detected after 6 April.
LTO	Pair	1	PRE	0	N	-	
		2	SUC	4	N	-	
LKN	Pair	1	UNK	0	N	-	Depredated or abandoned prior to egg laying; eggs not confirmed in nest.
		2	SUC	2	N	-	
LUS	Pair	1	INC	0	-	-	Nest building begun, but not completed. Territory partially monitored.
MYD	Pair	1	INC	0	-	-	Nest building begun, but not completed.
		2	SUC	1	N	-	
NWB	Pair	1	PAR	0	Y	0	Four BHCO eggs laid in nest; all vireo eggs were removed by cowbird.
		2	SUC	1	N	-	
		3	SUC	2	Y	1	
NB2	Transient	-	-	-	-	-	Late season movement, first detected in July.
NKL	Unknown	-	-	-	-	-	Not monitored.
NOM	Pair	-	-	-	-	-	Not monitored.
OFT	Pair	1	PRE	0	N	-	
		2	SUC	3	Y	1	
PAC	Transient	-	-	-	-	-	Detected over a 10-day period in June.

Table 1 (*continued*). Status and nesting activities of least Bell's vireos at the San Luis Rey River, 2006.

Territory	Status	Nest	Nest fate[a]	# Young fledged	Nest parasitized?	# BHCO eggs removed[b]	Comments
PCK	Pair	1	PRE	0	Y	1	
		2	SUC	4	N	-	
		3	PRE	0	N	-	
PNY	Pair	1	UNK	0	N	-	Possible BHCO predation of nestlings.
		2	PRE	0	Y	1	
		3	UNK	0	Y	0	Possible BHCO predation of eggs. Nest parasitized late in cycle.
		4	PRE	0	Y	3	
PTG	Pair	1	PRE	0	N	-	
		2	PRE	0	N	-	
PGH	Pair	1	SUC	2	Y	1	
		2	PRE	0	N	-	
		3	SUC	4	Y	1	
PNT	Pair	1	SUC	3	N	-	
PSR	Pair	1	SUC	1+	-	-	Not monitored. Male observed with fledgling.
QTH	Pair	1	PAR	0	Y	0	Possible BHCO predation of eggs. Nest abandoned before BHCO egg could be removed.
		2	PRE	0	Y	1	
		3	PRE	0	N	-	
RTL	Pair	1	SUC	4	N	-	
		2	PRE	0	Y	1	
RAY	Pair	1	PRE	0	N	-	
		2	PRE	0	Y	2	
RDA	Pair	1	PRE	0	Y	1	
		2	PRE	0	Y	1	
		3	SUC	3	N	-	
RVO	Pair	1	PAR	0	Y	0	Nest too high to remove egg.
		2	SUC	1	N	-	
		3	PRE	0	N	-	
RKR	Pair	1	PAR	0	Y	1	
		2	SUC	1	Y	1	
		3	PRE	0	N	-	
RVR	Pair	1	PAR	0	Y	3	Vireo was incubating a clutch of 3 BHCO eggs when found.
		2	SUC	2	N	-	
SDP	Pair	1	PAR	0	Y	0	Nest abandoned before BHCO egg could be removed.
		2	SUC	1	Y	3	

Table 1 (*continued*). Status and nesting activities of least Bell's vireos at the San Luis Rey River, 2006.

Territory	Status	Nest	Nest fate[a]	# Young fledged	Nest parasitized?	# BHCO eggs removed[b]	Comments
SHW	Pair	1	SUC	1	Y	1	Territory partially monitored.
SSH	Pair	1	SUC	2	Y	1	
		2	PRE	0	Y	1	
SKN	Transient	-	-	-	-	-	Late season movement, first detected in July.
SPN	Pair	-	-	-	-	-	Not monitored.
SWT	Single	-	-	-	-	-	
TIN	Transient	-	-	-	-	-	Detected over an 18-day period in May.
TIR	Pair	1	SUC	2	Y	1	
TWB	Pair	1	PRE	0	N	-	Territory partially monitored.
VS1	Pair	1	PAR	0	Y	0	Nest found after abandonment.
		2	SUC	3	N	-	
WDG	Pair	1	PRE	0	Y	1	
		2	OTH	0	Y	2	Vireo clutch was infertile and never hatched.
WG2	Pair	1	INC	0	-	-	Nest building begun, but not completed.
		2	SUC	3	Y	1	
		3	SUC	3	Y	2	
WG3	Pair	1	SUC	3	N	-	
		2	PRE	0	Y	1	
WRF	Pair	1	PRE	0	N	-	
		2	PRE	0	Y	1	
		3	SUC	3	Y	1	

[a] Nest fate: INC = nest not completed; SUC = fledged at least one least Bell's vireo young; PRE = nest failure caused by predation event; PAR = failure/abandonment caused by brown-headed cowbird parasitism event; OTH = reason for nest failure known, such as substrate failure; UNK = reason for nest failure/abandonment unknown.

[b] Brown-headed cowbird (BHCO) eggs were removed from active nests in attempt to "rescue" nest.

Within the section of river consistently monitored since 2003, between Gird Road and Interstate 15, least Bell's vireo numbers declined from 46 territories in 2005 to 31 in 2006 (Figure 3). For the three years prior to 2006 the number of resident territorial males had remained relatively constant. In 2003 the reach contained 40 territorial male vireos. This number increased by six territories in 2004 and was unchanged in 2005.

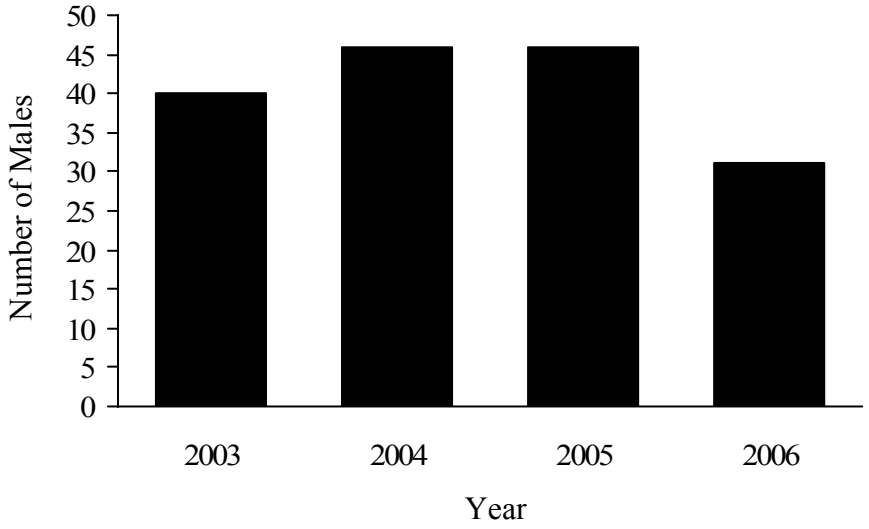

Figure 3. Number of singing male least Bell's vireos detected between Interstate 15 and Gird Road along the San Luis Rey River, 2003-2006.

Banded Birds

Thirteen least Bell's vireos banded prior to the 2006 breeding season were resighted within the study area (Table 2). All had been banded as nestlings on the San Luis Rey River. Eight of the thirteen possessed a unique combination of color bands or were recaptured during the 2006 season and therefore could be identified to individual. Two of the eight were females banded as nestlings in 2004. The female occupying PNT territory in 2006 was banded in 2004 outside of the study area, approximately 14 km downstream. In 2005, she dispersed into the study area, paired with a male in PNT territory, and fledged three young. The RTL female was also banded as a nestling outside the study area in 2004, approximately 4.9 km upstream. Her location in 2005 was unknown. All other uniquely color banded vireos, which were originally banded as nestlings, fledged from and dispersed within the study area. The extent of their dispersal ranged from 0.8 to 4.4 km. Three of these birds had been banded as nestlings in 2005 and were recaptured in 2006 and given unique color combinations. Five other adult vireos that had been banded as nestlings with a single federal Mdb band were target netted, but were not recaptured. Therefore, their age and natal locations were unknown. Two additional adult vireos were captured in 2006 while target netting another bird in the territory and were banded with a unique color combination. Eighty-six nestlings were banded with a single dark blue numbered federal band during the 2006 breeding season.

Table 2. Banded adult least Bell's vireos at the San Luis Rey River, 2006.

		Band combination[a]				
Territory	Sex	Left leg	Right leg	Age[b]	Distance (km)[c]	Comments
DEW	M	Mdb	-	AHY	-	Banded prior to 2006 as a nestling.
ELV	M	DPDB / pupu	Mdb	1 yr	4.4	Banded as a nestling at the San Luis Rey River - DOZ territory.
HDZ	M	DPDB	Mdb	1 yr	1.7	Banded as a nestling at the San Luis Rey River - AIR territory.
LLT	M	pupu	BKBK / Mdb	AHY	-	Banded in 2006.
OFT	M	Mdb	LPBK	≥ 2 yrs	-	
PTG	M	Mdb	WHWH	AHY	-	Banded in 2006.
PNT	F	BWST / Mdb	-	2 yrs	14.0	Banded as a nestling at the San Luis Rey River - COL3 territory.
PSR	M	-	Mdb	AHY	-	Banded prior to 2006 as a nestling.
RTL	F	Mdb	PUWH / pupu	2 yrs	4.9	Banded as a nestling at the San Luis Rey River - EFO territory.
RAY	M	-	Mdb	AHY	-	Banded prior to 2006 as a nestling.
RVO	M	pupu	BYST / Mdb	1 yr	2.1	Banded as a nestling at the San Luis Rey River - GAT territory.
SSH	M	Mdb	LPLP	2 yrs	0.8	Banded as a nestling at the San Luis Rey River - GAT territory.
SPN	M	-	Mdb	AHY	-	Banded prior to 2006 as a nestling.
SWT	M	DPWH / pupu	Mdb	1 yr	3.0	Banded as a nestling at the San Luis Rey River - GME territory.
TIN	M	-	Mdb	AHY	-	Banded prior to 2006 as a nestling.

[a] Band colors: Mdb = dark blue numbered federal band; DPDB = plastic dark pink-dark blue split band; pupu = metal purple; BKBK = plastic black; LPBK = plastic light pink-black split; WHWH = plastic white; BWST = plastic blue-white striped; PUWH = plastic purple-white split; BYST = plastic black-yellow striped; LPLP = plastic light pink; DPWH = plastic dark pink-white split.

[b] Age: AHY = after hatch year.

[c] Dispersal distance from natal site to current location.

Nest Monitoring

Nesting activity was monitored in a total of 43 least Bell's vireo territories. Of these, 39 were "fully" monitored, meaning that all nests within the territory were found and documented during the breeding season (Table 3). Pairs within the remaining four territories were documented nesting; however, only a subset of their nests were found and monitored (= "partially monitored territories"). A total of 99 nests were monitored during the breeding season, however four nests were abandoned in the building stage and were excluded from nest success and productivity calculations. An additional four nests were known to have failed, but because the specific causes of failure were uncertain and/or it was uncertain whether eggs were laid in the nests, they were included in nest success calculations (n = 95), but excluded from productivity calculations (n = 91). One nest was drenched in a spring storm prior to eggs being laid and was subsequently abandoned; three other nests failed prior to eggs being confirmed in the nest and

may have been depredated or abandoned (Table 1). Within fully monitored territories, pairs averaged 2.3 ± 0.8 (std) nesting attempts over the course of the 2006 breeding season, including four pairs that nested four times without fledging young.

Table 3. Number of least Bell's vireo territories and nests monitored, San Luis Rey River, 2006.

	Total number
Territories fully monitored	39
Nests in fully monitored territories	91
Nests in partially monitored territories	4
Completed nests per pair (fully monitored territories only)	2.3
Total # of nests monitored[a]	99

[a] Includes four nests that were abandoned during nest building (see Table 1. "INC" nests) and were excluded from nest success and productivity calculations.

Nest Success

Thirty-six percent (34/95) of all vireo nests monitored were successful, fledging at least one young (Table 4). Nest predation and brown-headed cowbird nest parasitism were believed to be the primary sources of nest failure, accounting for 66 and 21 percent of failures, respectively. Overall, 42 (40/95) and 14 (13/95) percent of completed vireo nests were lost to predation and cowbird parasitism, respectively. It is possible that predation may have accounted for as much as 45 percent of all nest failures as three completed nests failed prior to eggs being confirmed in the nest and could have been the result of predation. The affects of cowbirds on vireo nest success may have extended beyond parasitism as four least Bell's vireo nests showed signs of cowbird predation. In three instances, two in which the nests were parasitized and one in which it was not, vireo eggs were punctured and/or ejected from the nests, but the contents were not consumed. In the remaining instance, nestlings were ejected from an active, unparasitized nest. Some nestlings had lacerations and/or puncture marks on their heads.

Table 4. Fate of least Bell's vireo nests at the San Luis Rey River, 2006.

Nest Fate	**Number[a]**
Successful	34 (36)
Failed	
Predation	40 (42)
Parasitism	13 (14)
Other/Unknown	8 (7)
Total failed nests	61 (64)
Total completed nests[b]	95 (100)

[a] Numbers in parentheses are the percent of total nests.
[b] Does not include four nests abandoned during building.

In addition to the 13 nests that failed after receiving cowbird eggs, 42 other nests were documented as parasitized by the presence of cowbird eggs, yielding a total of 60 percent (55/91) of vireo nests whose contents were observed being parasitized. These nests remained active

following the removal of cowbird eggs by nest monitors, and while half eventually failed to predation, 52 percent (20/42) subsequently fledged young. Had this intervention not occurred, it is likely that vireo nest success would have been only 15 percent (14/91), as vireo nestlings are unable to fledge in the presence of cowbird young.

To a small degree nest fate influenced the likelihood that pairs would renest. While 96 percent (27/28) of pairs whose initial nests failed attempted second nests, only 73 percent (8/11) of pairs renested after they had successfully fledged at least one young. During the course of the 2006 breeding season, 74 percent (29/39) of fully monitored pairs successfully fledged young. Four pairs fledged young from two separate nesting attempts.

Productivity

Average clutch size of non-parasitized nests was 3.5 ± 0.7 eggs per nest while that of parasitized nests, from which female cowbirds typically removed a host egg when depositing their own, was 1.9 ± 1.0 eggs per nest (Table 5). Overall, the average vireo clutch size at this site was 3.0 eggs per nest, 14 percent lower than that expected in the absence of parasitism. Fifty-three percent of all eggs hatched, while 57 percent (49/86) of nests documented with eggs eventually supported nestlings. In total, 64 percent (86/135) of nestlings successfully fledged from 35 nests in 2006, averaging over two young per pair.

Table 5. Reproductive success and productivity of nesting least Bell's vireos at the San Luis Rey River, 2006.

Parameter	Number
Nests with eggs	86
Eggs laid	255
Average clutch size:[a]	
Non-parasitized nests	3.5 ± 0.7 (std)
Parasitized nests	1.9 ± 1.0 (std)
Nests with hatchlings	49
Hatchlings	135
Hatching success:	
Eggs[b]	53%
Nests[c]	57%
Nests with fledglings	34
Fledglings	86
Fledgling success:	
Hatchlings[d]	64%
Nests[e]	69%
Fledglings per egg	0.3
Fledglings per nest[f]	0.91
Average number of young fledged per pair[g]	2.2 ± 1.8 (std)
Pairs fledging ≥ one young[g]	29 (74%)

[a] Based on 24 non-parasitized nests with a full clutch and 8 parasitized nests.
[b] Percent of all eggs that hatched.
[c] Percent of all nests with eggs in which at least one egg hatched.
[d] Percent of all nestlings that fledged.
[e] Percent of all nests with nestlings in which at least one young fledged.
[f] Based on 95 monitored nests.
[g] Based on 39 pairs whose territories were fully monitored.

Nest Characteristics

The placement of vireo nests that fledged young compared to those that did not fledge young were very similar. Successful and unsuccessful nests did not differ statistically in the height of the nest, the height of the host plant, the distance the nest was placed from the edge of the host, or from the edge of the vegetation clump (Table 6).

Table 6. Least Bell's vireo nest characteristics and results of two-sample unequal variance t-tests of successful vs. unsuccessful nesting attempts at the San Luis Rey River, 2006.

	Nest Fate				
Nest Characteristic	**Successful**	**Unsuccessful**	**df**	**t**	***P***
Average Nest Height (m)	0.9	1.0	79	-1.17	0.25
Average Host Height (m)	2.9	3.4	82	-1.10	0.28
Average Distance to Edge of Host (m)	0.4	0.4	75	0.64	0.52
Average Distance to Edge of Vegetation Clump (m)	2.5	2.0	57	0.56	0.58

Fourteen different plant species were used by least Bell's vireos as nest substrates during the 2006 breeding season, with 74 percent of nests built in *Baccharis salicifolia, Salix lasiolepis*, or *S. exigua* (Table 7). Host plant species had no apparent effect on nest fate as the majority of successful and unsuccessful nests were built in the same species, in roughly the same proportions. However, even though the numbers of nests placed in *Artemisia douglasiana*, *Quercus* sp., *Sambucus mexicana*, and *Toxicodendron* sp. were small (8 percent of nests), none successfully fledged young.

Table 7. Host plant species used by least Bell's vireos at the San Luis Rey River, 2006.

Host Species	**Successful**	**Unsuccessful**	**Total**
Baccharis salicifolia	12 (0.35)	12 (0.21)	24 (0.26)
Salix lasiolepis	7 (0.20)	17 (0.30)	24 (0.26)
S. exigua	6 (0.17)	14 (0.25)	20 (0.22)
Populus fremontii	3 (0.08)	3 (0.05)	6 (0.06)
Alnus rhombifolia	1 (0.02)	1 (0.01)	2 (0.02)
Arundo donax	1 (0.02)	1 (0.01)	2 (0.02)
Rubus ursinus	1 (0.02)	0 (0.00)	1 (0.01)
S. gooddingii	1 (0.02)	2 (0.03)	3 (0.03)
Tamarix sp.	1 (0.02)	0 (0.00)	1 (0.01)
Vitis californica	1 (0.02)	0 (0.00)	1 (0.01)
Artemisia douglasiana	0 (0.00)	1 (0.01)	1 (0.01)
Quercus agrifolia	0 (0.00)	1 (0.01)	1 (0.01)
Sambucus mexicana	0 (0.00)	2 (0.03)	2 (0.02)
Toxicodendron diversilobum	0 (0.00)	2 (0.03)	2 (0.02)

[a] Host species for one nest not known.

[b] Numbers in parentheses are proportions of total nests.

Southwestern Willow Flycatcher

Population Size and Distribution

A single southwestern willow flycatcher pair was documented on the San Luis Rey River adjacent to the eastern border of the upper study area during the 2006 breeding season (Figure 4). Two transient willow flycatchers of unknown subspecies were also documented within the upper study area. The first was observed on 24 May approximately 350 m east of Gird Road. The second was observed on 1 June, 1.6 km west of Interstate 15. After their initial detections, neither flycatcher was detected throughout the remainder of the breeding season. No flycatchers were documented within the lower study area.

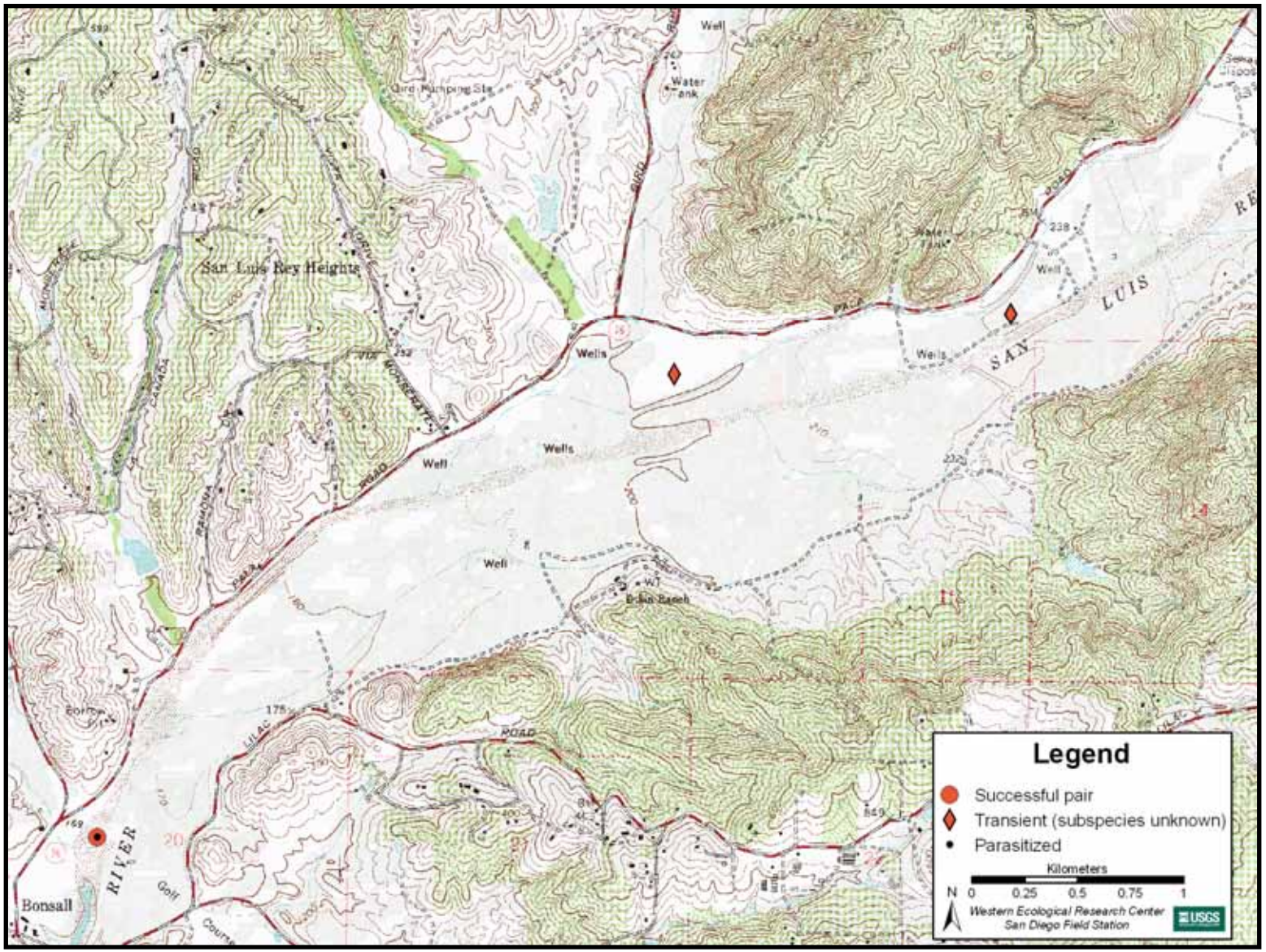

Figure 4. Southwestern willow flycatcher locations and breeding status along the upper San Luis Rey River, 2006.

Banded Birds

A single adult southwestern willow flycatcher was banded in 2006 (Table 8). The female of the pair occupying the WRRN territory was unbanded at the start of the breeding season. It was subsequently target netted, captured, and banded with a Msi:orre color combination. It is unknown whether the male flycatcher occupying the WRRN territory was banded. Numerous unsuccessful attempts were made to resight and/or capture the male. Two nestlings from the pair's third nesting attempt were also banded with a single federal Msi band on the left leg.

Table 8. Banded adult southwestern willow flycatchers at the San Luis Rey River, 2006.

		Band Combination[a]			
Territory	**Sex**	**Left Leg**	**Right Leg**	**Age[b]**	**Comments**
WRRN	F	Msi	orre	AHY	Banded as an adult in 2006.

[a] Band colors: Msi = silver numbered federal band; orre = metal orange-red split band.
[b] Age: AHY = after hatch year.

Nesting

The WRRN pair nested three times during the 2006 breeding season. The first nest was abandoned with one willow flycatcher and one brown-headed cowbird egg following the parasitism event. The second nest was also parasitized and contained one willow flycatcher and one cowbird egg when found. To avoid the possibility of abandonment associated with a change in egg volume, the cowbird egg was not immediately removed by nest monitors. The cowbird egg hatched prior to the flycatcher egg and the nestling was removed at two days of age. After removal, the pair continued to tend the nest and the female was observed incubating the remaining egg. Four days later, on day 18 of incubation, when the flycatcher egg still had not hatched it was examined and determined to be inviable. The egg was removed in an attempt to stimulate the pair to renest. The pair's third nest was found one week later, on 21 July. This nest was not parasitized and eventually fledged two flycatcher young.

Nest placement of the three nests built by the WRRN pair were very similar (Table 9). All nests were constructed within the same stand of monotypic *S. exigua* that ranged from 3-6 m in height. Nest height and host height were remarkably similar between nests, ranging from 2.2 to 2.5 m and 3.2 to 5.0 m in height, respectively. The distance between adjacent nests ranged from 55 to 70 m.

Table 9. Southwestern willow flycatcher nest characteristics and placement at the San Luis Rey River, 2006.

	WRRN Territory		
Parameter	**Nest 1**	**Nest 2**	**Nest 3**
Nest Height (m)	2.2	2.5	2.2
Host Species	*S. exigua*	*S. exigua*	*S. exigua*
Host Height (m)	4.0	5.0	3.2
Distance (m) to:			
Edge of Host Plant	2.5	0.1	0
Vegetation Clump	2.5	3	15
Riparian Habitat	30	20	30
Surface Water/Moist Soil (Early Season)[a]	40	3	20
Surface Water/Moist Soil (Late Season)[b]	40	3	20

[a] Early season, 15 May to 15 June, corresponding with flycatcher arrival and territory selection.

[b] Late Season, 15 July to 15 August, corresponding with the end of flycatcher nesting.

DISCUSSION

One of the most striking features of the 2006 breeding season was a delay in the arrival of the majority of vireos at the breeding site. The late arrival of vireos observed on the San Luis Rey River was also documented throughout a large part of its range at other sites (Ferree and Kus 2007, Rourke and Kus 2007, J. Pike pers. comm.). Migration was delayed by at least two weeks compared to previous years. However, once vireos started arriving on site the rate of territory establishment was similar to other years (Figure 2). It is unclear why vireo arrival was delayed in 2006 or what effect, if any, the delay had on the overall population size.

Fifty-three resident male least Bell's vireos were observed within the upper study area during the 2006 breeding season. However, within the reach of river monitored over the past eight years, between Gird Road and Interstate 15, the population declined by 32 percent compared to the previous year. The cause of the decline is unknown, but parallels similar decreases in population size observed in other parts of the vireo's range in 2006 (Rourke and Kus 2007). For example, at Marine Corps Base Camp Pendleton the overall least Bell's vireo population declined by 13 percent from 2005 to 2006. Population declines were documented on 14 of the 23 drainages surveyed (61 percent) and ranged from 11 to 100 percent loss. Annual vireo productivity during the previous breeding season did not explain the observed decreases, as sites with high (e.g. 2.8 young per year, Santa Margarita River study sites, Camp Pendleton, Rourke and Kus 2006b) and low productivity (e.g. 1.6 young per pair, San Luis Rey River study site, Rourke and Kus 2006a) experienced population declines in 2006. Moreover, no change in the distribution of birds within the site was observed, as might be expected from a large scale change in habitat quality. The extent of the decline in the vireo population along the San Luis Rey River is unknown, as further downstream no decrease in vireo numbers was documented between 2005 and 2006 within another population of monitored vireos (Ferree and Kus 2007).

Brown-headed cowbird nest parasitism has fluctuated during the years since cowbird trapping was discontinued (1998), averaging 50% ± 20 (std) of vireo nests annually (1999-2005). Parasitism of vireo nests in 2006 (60%) was slightly higher than this average, but below the peak rate of 76% observed in 2004, and 68% documented in 2005. Seasonal productivity of vireos in 2006 was relatively high (2.2 young per pair), and comparable to that at sites in which cowbird parasitism has been effectively removed through trapping (e.g. 2.4 young per pair, Camp Pendleton, Rourke and Kus 2007). The high productivity at the San Luis Rey study site is largely attributable to the practice of removing cowbird eggs from vireo nests, which allowed roughly half of them eventually to fledge young . Without cowbird egg removal it is likely that no young would have fledged from parasitized nests. This would have reduced vireo productivity to 1.0 young fledged per pair, a value that may be more representative of vireo productivity on the San Luis Rey River as a whole in the absence of trapping and nest manipulation (removal of cowbird eggs). Although nest monitoring is a very intensive practice, monitors "rescuing" nests by removing cowbird eggs appears to be an effective method of countering the effects of nest parasitism (Kus and Whitfield 2005).

Rourke and Kus (2006a) speculated that the vireo population at the site may not be self sustaining and was likely supported by immigration from other population(s); the most probable being the vireo population on Marine Corps Base Camp Pendleton, 13 km distant. To date no vireos have been documented dispersing between the upper San Luis Rey River and the Base. However, given that the majority of the San Luis Rey River is not trapped for cowbirds, annual vireo productivity over a large portion of the River may be close to one young per pair. It is therefore a strong possibility that the vireo population is supported to some degree by immigration. In 2005, USGS initiated an intensive vireo banding and nest monitoring study on Camp Pendleton. Through this program, in conjunction with the existing banding and monitoring programs at the San Luis Rey River study site, we hope to collect data to understand the roles the San Luis Rey River and Marine Corps Base Camp Pendleton play in vireo persistence in San Diego County.

For the first time in eight years, southwestern willow flycatchers did not establish territories within the lower San Luis Rey study site. From 1999 to 2005 the population there fluctuated between one and six territories. In 2005, two pairs established territories and bred. Because of the small population size of southwestern willow flycatchers in southern California, the cause of the decline of this species in the study area is difficult to determine. However, because flycatchers typically demonstrate high site fidelity (USFWS 2002), two possible factors may explain their absence: 1) the death of individual flycatchers that previously nested within the study area, and 2) the dispersal of birds to sites containing more suitable habitat. The second factor is worth addressing further as it can be considered within a management context. The possible emigration of willow flycatchers from the study site is not unreasonable as habitat adjacent to the river was extensively altered and/or removed by heavy winter rains and spring flooding in 2005. Young trees with vertical structure preferred by flycatchers were uprooted and/or "laid over", forming dense thickets no longer suitable for nesting willow flycatchers. It is possible that some flycatchers that would have nested within the study area dispersed to other more suitable habitats within the San Luis Rey River or to nearby drainages. Three of the four flycatchers that nested within the lower San Luis Rey River study area in 2005 were banded, however, none were resighted in 2006.

In 2006, for the first time, a pair of southwestern willow flycatchers was documented nesting in the upper San Luis Rey study site. It is possible that at least one of the 2005 lower San Luis Rey flycatchers dispersed to colonize the upper site, 7.2 km distant. However, this could not be confirmed as the female at the upper San Luis Rey site was unbanded at the beginning of the 2006 breeding season, and the male's banding status remained undetermined throughout the 2006 season. It is also possible that the flycatchers at the upper site in 2006 were different birds than those nesting within the lower site in 2005. The flycatchers on the upper San Luis Rey River were located at the western survey limit of the site, in an area not surveyed since 2004. It is possible that one or more southwestern willow flycatchers had established territories within the upper portion of the San Luis Rey River in the intervening year as new habitat, like the patch of *S. exigua* where the WRRN territory was located, became established and matured.

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