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Distribution and Abundance of Least Bell's Vireos (*Vireo bellii pusillus*) and Southwestern Willow Flycatchers (*Empidonax traillii extimus*) on the Middle San Luis Rey River, San Diego County, Southern California—2017 Data Summary

Data Series 1082

U.S. Department of the Interior
U.S. Geological Survey

Cover: Least Bell's Vireo (*Vireo bellii pusillus*). Photograph by Alexandra Houston, U.S. Geological Survey.

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Conversion Factors

International System of Units to U.S. customary units

Multiply	By	To obtain
	Length	
meter	1.094	yard (yd)
kilometer (km)	0.5400	mile, nautical (nmi)

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as:

$$°F = (1.8 \times °C) + 32.$$

Datum

Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83).

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Executive Summary

We surveyed for Least Bell's Vireos (LBVI) (*Vireo bellii pusillus*) and Southwestern Willow Flycatchers (SWFL) (*Empidonax traillii extimus*) along the San Luis Rey River, between College Boulevard in Oceanside and Interstate 15 in Fallbrook, California (middle San Luis Rey River), in 2017. Surveys were conducted from April 13 to July 11 (LBVI) and from May 16 to July 28 (SWFL). We found 146 LBVI territories, at least 107 of which were occupied by pairs. Five additional transient LBVIs were detected. LBVIs used five different habitat types in the survey area: mixed willow, willow-cottonwood, willow-sycamore, riparian scrub, and upland scrub. Forty-four percent of the LBVIs occurred in habitat characterized as mixed willow and 89 percent of the LBVI territories occurred in areas with greater than 50 percent native plant cover. Of 16 banded LBVIs detected in the survey area, 8 had been given full color-band combinations prior to 2017. Four other LBVIs with single (natal) federal bands were recaptured and banded in 2017. Three LBVIs with single dark blue federal bands indicating that they were banded as nestlings on the lower San Luis Rey River and one LBVI with a single gold federal band indicating that it was banded as a nestling on Marine Corps Base Camp Pendleton (MCBCP) could not be recaptured for identification. One banded LBVI emigrated from the middle San Luis Rey River to the lower San Luis Rey River in 2017.

One resident SWFL territory and one transient Willow Flycatcher of unknown subspecies (WIFL) were observed in the survey area in 2017. The resident SWFL territory, which was comprised of mixed willow habitat (5–50 percent native plant cover), was occupied by a single male from May 22 to June 21, 2017. No evidence of pairing or nesting activity was observed. The SWFL male was banded with a full color-combination indicating that he was originally banded as a nestling on the middle San Luis Rey River in 2014 and successfully bred in the survey area in 2016. The male SWFL left the middle San Luis Rey River after June 21, 2017 and subsequently was detected on the San Dieguito River on June 26, 2017, by USGS biologists. The transient WIFL was detected on May 30, 2017, in mixed willow habitat comprised of 50–95 percent of native plant cover.

Introduction

The Least Bell's Vireo (*Vireo bellii pusillus*; LBVI) 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, LBVI populations began declining in the late 1900s as a result of multiple anthropogenic factors, including habitat loss and alteration associated with urbanization and agricultural conversion of land adjacent to rivers, the expansion in range of the brood-parasitic Brown-headed Cowbird (*Molothrus ater*; hereinafter "cowbird"), and the introduction of invasive exotic plant species such as giant reed (*Arundo donax*) into riparian systems (U.S. Fish and Wildlife Service [USFWS] 1986, 1998; Franzreb, 1989; Kus, 1998, 1999; Riparian Habitat Joint Venture, 2004; Kus and others, 2010]. By 1986, the LBVI population in California numbered just 300 territorial males (U.S. Fish and Wildlife Service, 1986).

In response to the considerable decline in numbers of LBVIs in California, the California Fish and Game Commission listed the species as endangered in 1980, and the USFWS followed suit in 1986. Since listing, the LBVI population in southern California has rebounded, largely

in response to cowbird control and habitat restoration and preservation (Kus and Whitfield, 2005). As of 2006, the statewide LBVI population was estimated to be approximately 2,500–3,000 territories (U.S. Fish and Wildlife Service, 2006), of which approximately 10 percent occurred along the San Luis Rey River between Interstate 15 and Interstate 5.

The Southwestern Willow Flycatcher (*Empidonax traillii extimus;* SWFL) is one of four subspecies of Willow Flycatcher (WIFL) in the United States, with a breeding range including southern California, Arizona, New Mexico, extreme southern parts of Nevada and Utah, and western Texas (Hubbard, 1987; Unitt, 1987). Restricted to riparian habitat for breeding, the SWFL has declined in recent decades in response to widespread habitat loss throughout its range and, possibly, brood-parasitism by cowbirds (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 SWFL was listed as endangered by the State of California in 1992 and by the USFWS in 1995.

SWFL in southern California co-occur with the LBVI. However, unlike the LBVI, which has increased 10-fold since the mid-1980s in response to management practices alleviating these threats (U.S. Fish and Wildlife Service, 2006), numbers of SWFL have remained low. Currently, most SWFLs in California are concentrated in two sites—the Owens River Valley in Inyo County (Lacey Greene, California Department of Fish and Wildlife, written commun., 2015) and the Upper San Luis Rey River, including a part of the Cleveland National Forest in San Diego County (Howell and Kus, 2016). Outside of these sites, SWFLs occur as small, isolated populations of 1–6 pairs. Data on the distribution and demography of the SWFL, as well as identification of factors limiting the species, are critical information needs during the current stage of recovery planning (Kus and others, 2003; Kus and Whitfield, 2005).

The purpose of this study was to document the status of LBVIs and SWFLs along an 18-kilometer (km) stretch of the San Luis Rey River from College Boulevard in Oceanside, California, east to Interstate 15 (middle San Luis Rey River; fig 1). For LBVIs, the goals were to (1) determine abundance and distribution of LBVIs on the middle San Luis Rey River to facilitate population trend analyses and (2) collect information on dispersal and site fidelity of banded LBVIs. For SWFLs, the goals were to (1) determine the size and composition of the SWFL population on the middle San Luis Rey River, (2) document and monitor nesting activities of resident SWFLs, and (3) band and re-sight all SWFLs to facilitate the estimation of SWFL survivorship and movement.

These data, when compared with data from other sites, will inform natural resource managers about the status of these endangered species on the San Luis Rey River and guide modification of land-use and management practices as appropriate to ensure the species' continued existence.

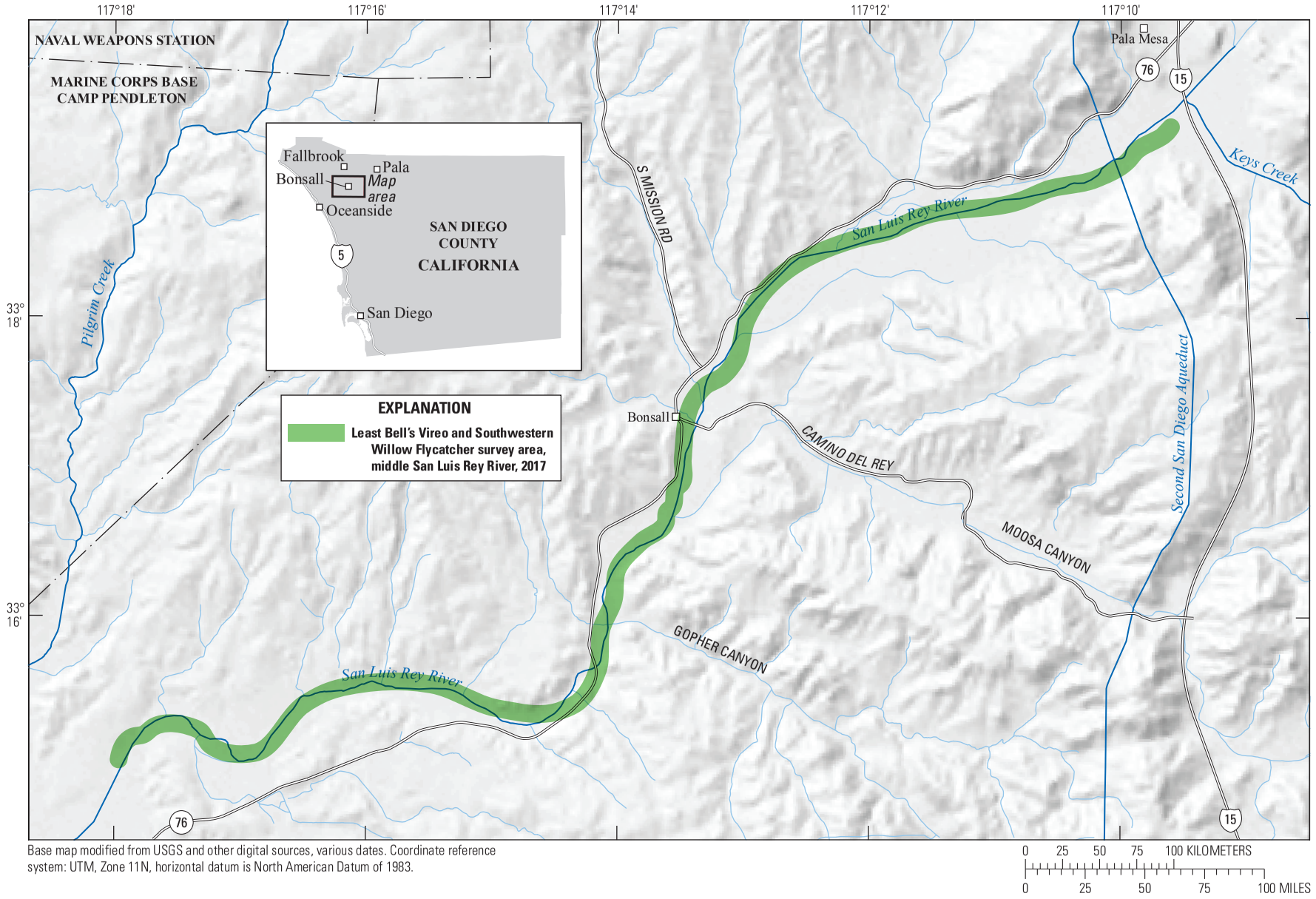
Methods

Surveys

Biologists from USGS surveyed for LBVIs and SWFLs on the middle San Luis Rey River following standard survey techniques (U.S. Fish and Wildlife Service, 2001; Sogge and others, 2010). Four surveys for LBVIs were completed between April 13 and July 11, 2017, and four surveys for SWFLs were completed between May 16 and July 28, 2017. Observers walked slowly through or adjacent to suitable riparian habitat, listening and searching for LBVIs and SWFLs, occasionally playing a recording of a LBVI or SWFL song to elicit a territorial response. Surveys typically began at sunrise and were completed by early afternoon, depending on wind and weather conditions.

For each LBVI or WIFL encountered, observers recorded age (adult or juvenile), sex, breeding status (paired, single, undetermined, or transient), and whether the bird was banded. A LBVI or WIFL was considered transient if detected only once, or if more than once, detections were less than 2 weeks apart. Transient status was assigned only in years with more than three surveys. LBVI, SWFL, and transient WIFL locations were mapped using a Trimble Juno® SB with 2–5 m accuracy to determine geographic coordinates (WGS84). Dominant native and exotic plants were recorded at each territory location and percent cover of native vegetation was estimated using cover categories less than 5 percent, 5–50 percent, 51–95 percent, and greater than 95 percent. Overall habitat type was specified according to the following categories:

- ***Mixed willow riparian***: Habitat dominated by one or more willow species, including black willow (*Salix gooddingi*), arroyo willow (*Salix lasiolepis*), and red willow (*Salix 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 California sycamore (*Platanus racemosa*) is a co-dominant.
- ***Sycamore-oak***: Woodlands in which California sycamore and coastal live oak (*Quercus agrifolia*) occur as co-dominants.
- ***Riparian scrub***: Dry and/or sandy habitat dominated by sandbar willow (*Salix exigua*) or mule fat, with few other woody species.
- ***Upland scrub***: Coastal sage scrub habitat adjacent to riparian habitat.
- ***Non-native***: Areas vegetated exclusively with non-native species, such as giant reed (*Arundo donax*) and tamarisk (*Tamarix ramosissima*).



Base map modified from USGS and other digital sources, various dates. Coordinate reference system: UTM, Zone 11N, horizontal datum is North American Datum of 1983.

Figure 1. Location of Least Bell's Vireo (*Vireo bellii pusillus*) and Southwestern Willow Flycatcher (*Empidonax traillii extimus*) survey area on the middle San Luis Rey River, San Diego County, southern California, 2017.

Nest Monitoring

During protocol surveys, observed WIFLs that were suspected to be resident birds ([SWFLs] for example, observed in more than one survey period, pair vocalizations heard, or evidence of nesting observed) were revisited within 3 days of the detection date. When present, resident birds were observed for evidence of nesting and nests were located and monitored following standard protocol (Rourke and others, 1999). To minimize the chances of leading predators or cowbirds to nest sites, nests were visited only as frequently as needed to collect sufficient data. Typically, there were three to four visits per 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 second visit was to confirm hatching and age of young, and the third visit was to band the nestlings. After a nest became inactive, six possible nest fates were assigned based on the following parameters.

1. Nests that fledged at least one SWFL young were considered successful. Fledging was confirmed by detection of young outside the nest.

2. Nests found empty or destroyed prior to the estimated fledge date and where the adult SWFLs were not found tending fledgling(s) were considered depredated.

3. Previously active nests that were subsequently abandoned by adult SWFLs after one or more cowbird eggs were laid in the nest were considered to have failed because of nest parasitism. Any nests that fledged cowbird young without fledging SWFL young were also considered to have failed because of nest parasitism.

4. Nests that were seen under construction, but were never completed, were classified as incomplete.

5. Nests failing for reasons such as poor nest construction, the collapse of a host plant that caused a nest's contents to be dumped onto the ground, or the presence of a clutch of infertile eggs, were classified as failing because of other causes that were known.

6. Nests that appeared intact and undisturbed but were abandoned with SWFL eggs and (or) nestlings were classified as having failed because of unknown causes.

Banding

Mist nets were used to recapture adult LBVIs and SWFLs previously banded as nestlings with a single metal band (natal) to determine their original banding location. When captured, birds were fitted with colored leg bands in a unique color-band combination so that individuals could be identified in the future without recapture. Additionally, attempts were made to capture and color-band unbanded adult SWFLs. SWFL nestlings, when present, were banded at 7–10 days of age. Each SWFL nestling received a silver aluminum federal numbered band on the left leg.

All summary data are presented as mean (±) standard deviation. Data from 2008 to 2016 used in comparisons with current (2017) data are available in Allen and others (2017); Ferree and Kus (2008); Ferree and others (2010, 2012, 2013, 2015); Houston and Kus (2011, 2012, 2013, 2014); Houston and others (2015a, 2015b, 2016, 2017); Howell and Kus (2014, 2016, 2017); Lynn and Kus (2008, 2010); Lynn and others (2011, 2016, 2017).

Least Bell's Vireo

Distribution and Abundance

A total of 146 LBVI territories (107 pairs) and 5 LBVI transients were detected on the middle San Luis Rey River in 2017 (table 1 and fig. 2). This was a 3 percent population size increase in the survey area relative to 2016 and well above the 9-year average (2008–16) of 128 ± 23.

Least Bell's Vireos used five different habitat types in the survey area. Forty-three percent of the LBVIs occurred in habitat characterized as mixed willow, 26 percent occurred in willow-cottonwood, 24 percent occurred in riparian scrub vegetation, 6 percent in upland scrub, and 1 percent occupied sycamore-oak habitat. Eighty-nine percent (130/146) of LBVI territories occurred in habitat comprised of greater than 50 percent native plant cover (table 2).

The most commonly reported dominant species at LBVI territories included black willow, red or arroyo willow, Fremont cottonwood, and mule fat. The most prevalent exotic species were poison hemlock (*Conium maculatum*), milk thistle (*Silybum marianum*), and black mustard (*Brassica nigra*).

Table 1. Total number of Least Bell's Vireo (*Vireo bellii pusillus*) territories detected and breeding status in the study area on the middle San Luis Rey River, San Diego County, southern California, 2008–17.

[**Number of single males:** Least Bell's Vireo nest monitoring did not occur in 2008, 2011, and 2015–17; therefore the number of times a territory was visited was not sufficient to determine whether the territory contained a pair or a single male. **Transients:** Transients not included in the total number of territories. Transient status not assigned in years when fewer than four surveys were conducted (2008–14). NA, not applicable]

Year	Total number of territories	Number of pairs	Number of birds with undetermined status	Number of single males	Transients
2008	100	47	53	NA	NA
2009	115	67	48	NA	NA
2010	146	115	30	1	NA
2011	126	69	57	NA	NA
2012	101	66	29	6	NA
2013	110	69	39	2	NA
2014	168	132	33	3	NA
2015	141	92	49	NA	2
2016	142	106	36	NA	6
2017	146	107	39	NA	5

Banded Birds

Sixteen banded LBVIs were detected on the middle San Luis Rey River in 2017 (table 3 and 4). The oldest identified LBVIs were two 9-year-old males that were banded in 2008 as nestlings on the lower San Luis Rey River (Interstate 5 to College Boulevard). Both have occupied territories on the middle San Luis Rey River for multiple years (table 4). Twelve LBVIs had unique color-band combinations and could be identified, eight of which were color-banded on the middle San Luis Rey River prior to 2017.

Eight banded LBVIs immigrated to the middle San Luis Rey River in 2017: five from the lower San Luis Rey River, and three from Marine Corps Base Camp Pendleton (MCBCP). Two LBVIs (both female) detected with only a single (natal) dark blue federal band were recaptured in 2017; they were originally banded as nestlings on the lower San Luis Rey River. Two LBVIs (one male, one of unknown sex) detected with only a single (natal) gold federal band were recaptured in 2017; they were originally banded on MCBCP. Four LBVIs with a single, natal band were detected in 2017, but not recaptured; three female LBVIs were detected with a single dark blue federal band, indicating that they were originally banded as nestlings on the lower San Luis Rey River, and one male was detected with a single gold federal band, indicating that it was originally banded on MCBCP. One LBVI (female), originally color-banded as an adult on the middle San Luis Rey River in 2014, emigrated to the lower San Luis Rey River in 2017.

Four of the five color-banded male LBVIs detected on the middle San Luis Rey River in both 2016 and 2017 moved 100 m or less from their 2016 territories (table 4). The remaining LBVI moved 500 m from its 2016 territory. Two male LBVIs that were not observed in 2016 moved 200 m or less from their 2015 territories. One female LBVI that was not observed in 2016 moved to the lower San Luis Rey River, 8.3 km from its 2014 territory. The four natal LBVIs that were recaptured on the middle San Luis Rey River dispersed from 3.9 to 13.4 km from their natal territories.

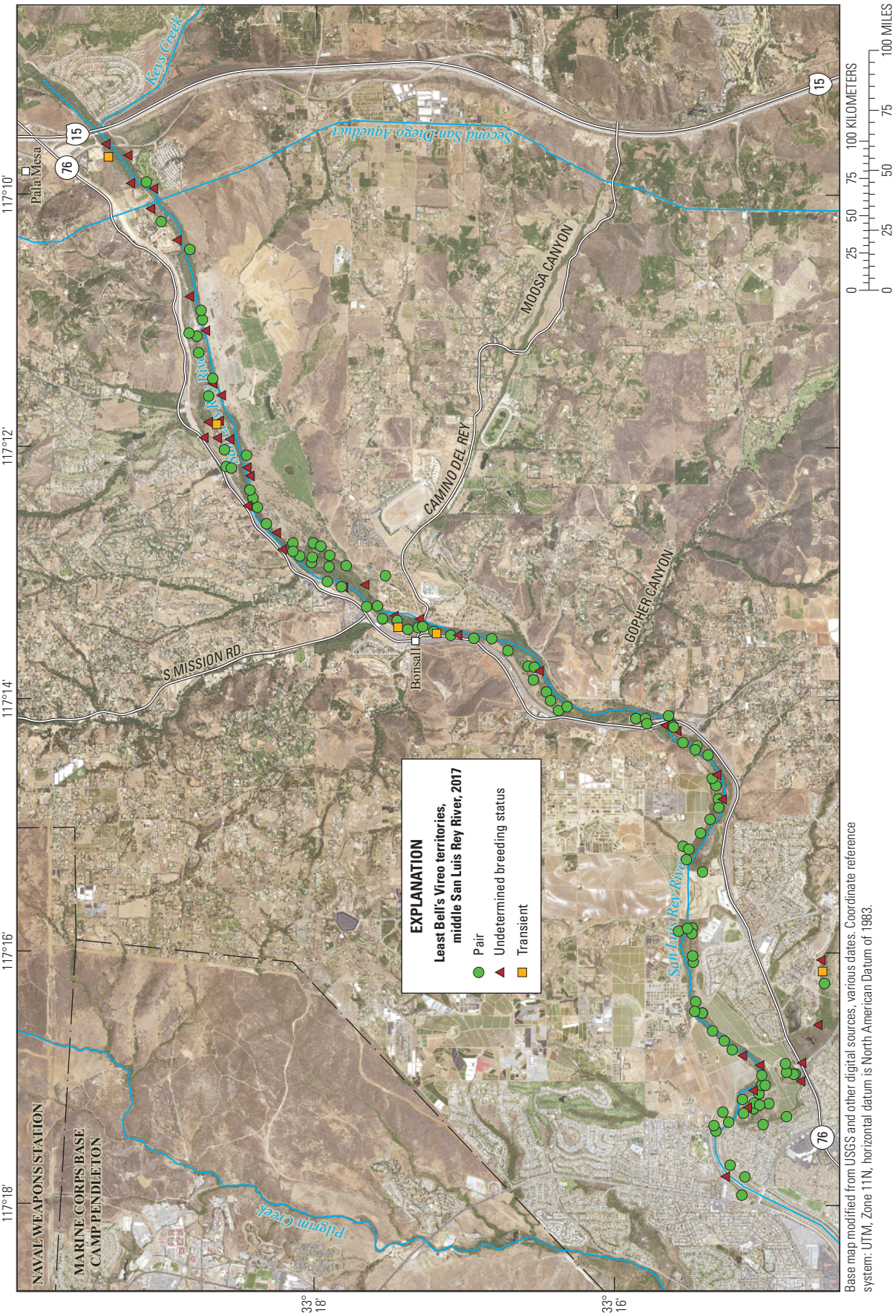


Figure 2. Least Bell's Vireo detections (*Vireo bellii pusillus*) and breeding status on the middle San Luis Rey River, San Diego County, southern California, 2017.

Table 2. Habitat types used by Least Bell's Vireos (*Vireo bellii pusillus*) on the middle San Luis Rey River, San Diego County, southern California, 2017.

[**Habitat type:** Mixed willow riparian: Habitat dominated by one or more willow species, including black willow, arroyo willow, and red willow, with mule fat as frequent co-dominant. Willow-cottonwood: Willow riparian habitat in which cottonwood is a co-dominant. Riparian scrub: Dry and (or) sandy habitat dominated by sandbar willow or mule fat, with few other woody species. Upland scrub: Coastal sage scrub adjacent to riparian habitat. Sycamore-oak: Woodlands in which California sycamore and coast live oak occur as co-dominants. >,greater than]

Habitat type	Number of territories				
	>95 percent native	50–95 percent native	5–50 percent native	Total	Percentage of total
Mixed willow riparian	28	31	4	63	43
Willow-cottonwood	13	21	4	38	26
Riparian scrub	3	26	6	35	24
Upland scrub	1	6	2	9	6
Sycamore-oak	0	1	0	1	1
Total	45	85	16	146	100

Table 3. Band status of Least Bell's Vireos (*Vireo bellii pusillus*) detected on the middle San Luis Rey River, San Diego County, southern California, 2017.

[**Color-banded:** All birds were originally banded as nestlings or adults outside of the study area, but have had established territories in the study area for multiple years.

Band status	Color-banded on the middle San Luis Rey River		Immigrants			Total
	Male	Female	Male	Female	Unknown	
Uniquely banded prior to 2017	7	1	0	0	0	8
Natal recaptured in 2017	0	0	1	2	1	4
Natal not recaptured	0	0	1	3	0	4
Total	7	1	2	5	1	16

Table 4. Movement of banded Least Bell's Vireos (*Vireo bellii pusillus*) and Southwestern Willow Flycatchers (*Empidonax traillii extimus*) detected on the middle San Luis Rey River, San Diego County, southern California, 2017.

[**2016 and 2017 territory:** LSLR, lower San Luis Rey River (Interstate 5 to College Boulevard); MCBCP, Marine Corps Base Camp Pendleton; Natal, Natal LBVIs were originally banded as nestlings with a single numbered federal band. **Color-band combination**: Left Leg: Right Leg (colors read top to bottom). Metal band acronyms: Mdb, numbered dark blue band; Mgo, numbered gold band; Msi, numbered silver band; gogo, gold band. Plastic Band acronyms: BKBK, black; BPST, black-pink striped; BWST, blue-white striped; DBDP, dark blue-dark pink split; DBWH, dark blue-white split; DPDP, dark pink; DPWH, dark pink-white split; LPBK, light pink-black split; WHDB, white-dark blue split; WHDP, white-dark pink split; WHPU, white-purple split; YEPU, yellow-purple split; YEYE, yellow. **Pin-striped metal band acronyms:** bkye, black-yellow split. **Sex:** F, female; M, male; U, unknown. km, kilometer]

Year originally banded	2016 territory	2017 territory	Distance moved (km)	Color-band combination	Sex	Minimum age in 2016 (years)
Least Bell's Vireos						
2008	MSL113	MSL116	0.0	WHDB Mdb : LPBK	M	9
2008[1]	MSL104	MSL102	0.1	YEPU Mdb : LPBK	M	9
2012	MSL123	MSL208	0.1	DBWH Mdb : DBDP	M	5
2012	MSL104	MSL122	0.0	BKBK Mdb : WHDB	M	5
2012	MSL107	MSL113	0.1	BWST Mdb : WHDP	M	5
2013[1]	MSL123	MSL123	0.2	DPDP Mdb :	M	4
2013	DTOS (LSLR Natal)	MSL123	3.9	DPDP : DBDP Mdb	F	4
2014[2]	MSL31	BWAL (LSLR)[3]	8.3	WHDP : WHDB Mdb	F	3
2015	MSL131	MSL109	0.5	WHDB Mdb : DPDP	F	2
2015	MSL110	MSL109	0.1	WHDB : WHPU Mdb	M	2
2015	CWIL (LSLR Natal)	MSL223	6.0	gogo : BPST Mdb	F	2
2016	WISP (MCBCP Natal)	BO13	10.8	YEYE Mgo : BKBK	U	1
2016	REM (MCBCP Natal)	DT06	13.4	WHDP Mgo : DPWH	M	1
Unknown	MCBCP	MSL107	Unknown	Mgo : -	M	1
Unknown	LSLR	MSL105	Unknown	- : Mdb	F	1
Unknown	LSLR	MSL205	Unknown	Mdb : -	F	1
Unknown	LSLR	MSL127	Unknown	- : Mdb	F	1
Southwestern Willow Flycatchers						
2014[4]	BO02F	BO01F	0.1	Msi : bkye	M	3

[1]Not detected in 2016; last detected in 2015.

[2]Not detected in 2016; last detected in 2014.

[3]Not included in the total number of banded birds in the survey area. Originally banded as an adult on the middle San Luis Rey River in 2014; emigrated to the lower San Luis Rey River in 2017.

[4]Single male, moved to San Dieguito River on June 26, 2017.

Southwestern Willow Flycatcher

Distribution and Abundance

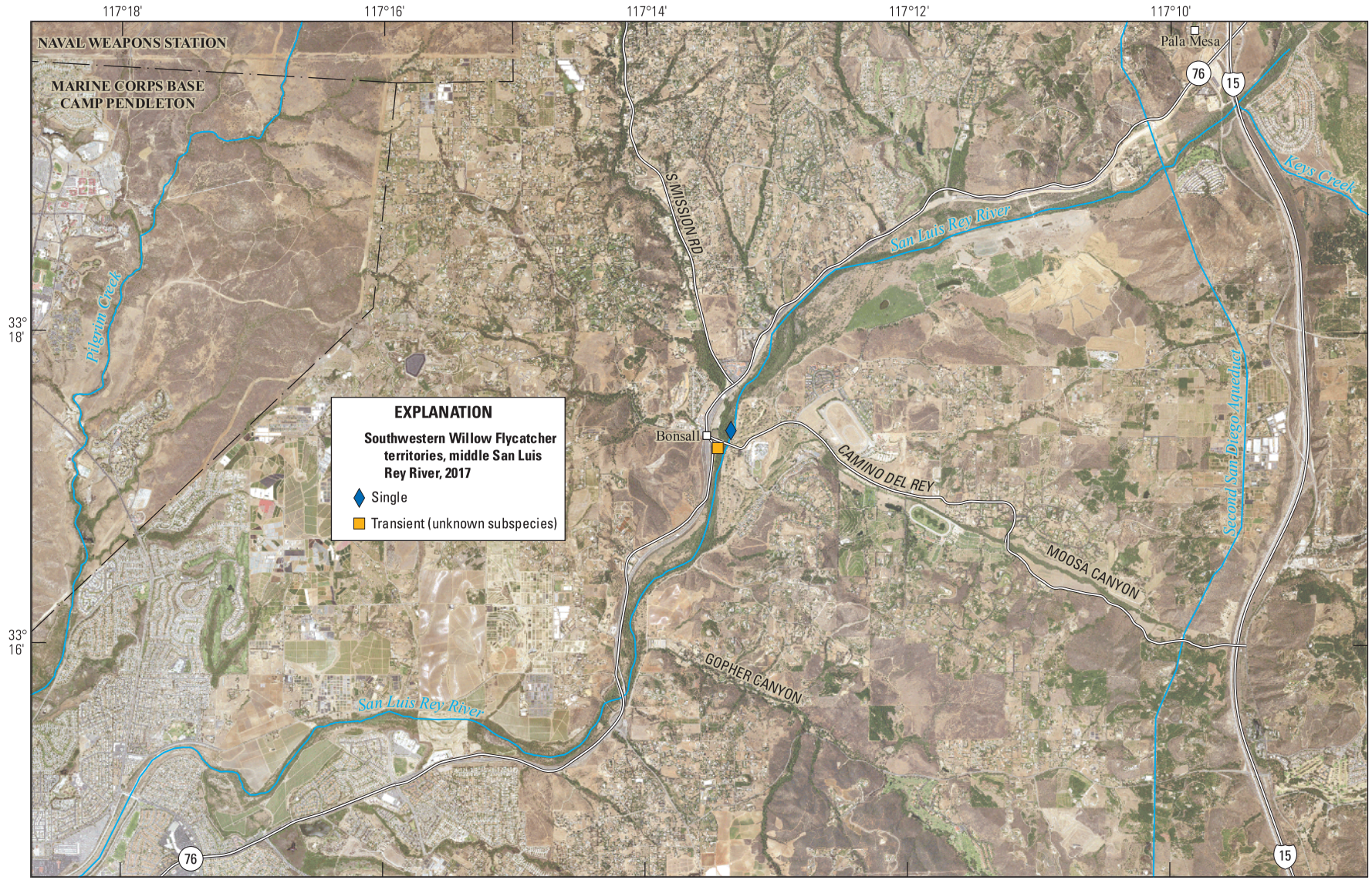
One resident male SWFL was observed on the middle San Luis Rey River from May 22 to June 21, 2017. This was a 67 percent decrease in the population relative to 2016 (three territories). The male SWFL established a territory in mixed willow habitat comprised of 5–50 percent native plant cover, but never paired with a female. This male was later detected on the San Dieguito River on June 26, 2017 (table 4). One transient WIFL that could not be identified to subspecies was detected on May 30, 2017 (fig. 3). The transient WIFL occupied mixed willow habitat comprised of 50–95 percent native plant cover.

Nest Monitoring

No nesting activities were observed on the middle San Luis Rey River in 2017.

Banded Birds

One banded SWFL (male) with a unique color-band combination was detected on the middle San Luis Rey River in 2017. The male SWFL (BO01F) was originally banded as a nestling on the middle San Luis Rey River in 2014 and successfully bred on the middle San Luis Rey River in 2016 (table 4). This male was detected on the middle San Luis Rey River for only part of the breeding season before it left to breed on the San Dieguito River.



Base map modified from USGS and other digital sources, various dates. Coordinate reference system: UTM, Zone 11N, horizontal datum is North American Datum of 1983.

Figure 3. Southwestern Willow Flycatcher (*Empidonax traillii extimus*) detections and breeding status on the middle San Luis Rey River, San Diego County, California, 2017.

Summary

The number of Least Bell's Vireo territories on the middle San Luis Rey River essentially remained stable from 2016 (142) to 2017 (146, changing by just 3 percent. In contrast, LBVIs increased by 19 percent downstream on the lower San Luis Rey River in 2017, whereas the population on Marine Corps Base Camp Pendleton decreased by 10 percent.

The number of LBVI territories on the middle San Luis Rey River has fluctuated between 100 and 168 since 2008, with a peak in 2014. The LBVI population remained high in 2017, exceeding the 9-year mean (128 ± 23).

We have documented LBVIs immigrating to the survey area from the lower San Luis Rey River and Marine Corps Base Camp Pendleton. Eight natal LBVIs that were originally banded as nestlings on the lower San Luis Rey River and at Marine Corps Base Camp Pendleton immigrated to the middle San Luis Rey River in 2017. We have also documented LBVI emigration from the survey area. One LBVI that was originally banded on the survey area emigrated to the lower San Luis Rey River in 2017.

Southwestern Willow Flycatcher territories decreased from 2016 by 67 percent (from three territories to one) on the middle San Luis Rey River, with no successful breeding documented in 2017. SWFLs also declined on Marine Corps Base Camp Pendleton from 2016 to 2017 and have been extirpated from that previously large breeding site.

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