

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—2018 Data Summary



Data Series 1109

Cover. Photograph showing Least Bell's Vireo (*Vireo bellii pusillus*). Photograph by Devin Taylor, U.S. Geological Survey.

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By Lisa D. Allen and Barbara E. Kus

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Conversion Factors

International System of Units to U.S. customary units

Multiply	By	To obtain
Length		
meter (m)	3.281	foot (ft)
kilometer (km)	0.6214	mile (mi)

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

$$^{\circ}\text{F} = (1.8 \times ^{\circ}\text{C}) + 32.$$

Datum

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

Abbreviations

LSLR	lower San Luis Rey River
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

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Executive Summary

We surveyed for Least Bell's Vireos (*Vireo bellii pusillus*; vireo) and Southwestern Willow Flycatchers (*Empidonax traillii extimus*; flycatcher) along the San Luis Rey River, between College Boulevard in Oceanside and Interstate 15 in Fallbrook, California (middle San Luis Rey River), in 2018. Surveys were conducted from April 17 to July 16 (vireo) and from May 16 to July 27 (flycatcher). We found 148 vireo territories, at least 90 of which were occupied by pairs. Six additional transient vireos were detected. Vireos used six different habitat types in the survey area: mixed willow, willow-cottonwood, riparian scrub, willow-sycamore, upland scrub, and non-native habitat. Forty-one percent of the vireos were detected in habitat characterized as mixed willow, and 97 percent of the vireos were detected in habitat with greater than 50 percent native plant cover. Of 10 banded vireos detected in the survey area, 5 had been given full color-band combinations prior to 2018. Four other vireos with single (natal) federal bands were recaptured, identified, and color banded in 2018. One vireo with a single dark blue federal band, indicating that it was banded as a nestling on the lower San Luis Rey River, could not be recaptured for identification.

One resident flycatcher and eight transient flycatchers of unknown subspecies were observed in the survey area in 2018. The resident flycatcher (male) was detected in a territory of mixed willow habitat with greater than 95 percent native plant cover. He was detected as a single male from May 24 to July 17, 2018, and no evidence of pairing or nesting was observed. The male flycatcher, detected with a single natal band, was recaptured, identified, and given a unique color combination in 2018. The male flycatcher was originally banded as a nestling on the middle San Luis Rey River in 2016. The eight transient flycatchers were detected from May 25 to June 8, 2018, in mixed willow riparian,

willow-cottonwood, and riparian scrub habitat with greater than 95 percent native plant cover.

Introduction

The Least Bell's Vireo (*Vireo bellii pusillus*; 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 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 1986, 1998; Franzreb, 1989; Kus, 1998, 1999; Riparian Habitat Joint Venture, 2004; Kus and others, 2010). By 1986, the vireo population in California numbered just 300 territorial males (U.S. Fish and Wildlife Service, 1986).

In response to the considerable decline in numbers of vireos in California, the California Fish and Game Commission listed the species as endangered in 1980, and the U.S. Fish and Wildlife Service (USFWS) followed suit in 1986. Since listing, the vireo 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 vireo 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*; 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 parts of Nevada and Utah, and western Texas (Hubbard, 1987; Unitt, 1987). Restricted to riparian habitat for breeding, the flycatcher 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 flycatcher was listed as endangered by the State of California in 1992 and by the USFWS in 1995.

Flycatchers in southern California co-occur with vireos. However, unlike the vireo, which has increased 10-fold since the mid-1980s in response to management practices alleviating these threats (U.S. Fish and Wildlife Service, 2006), the number of flycatchers has remained low. Currently, most flycatchers 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 (Clark and others, 2014). Outside of these sites, flycatchers occur as small, isolated populations of one to six 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 and others, 2003; Kus and Whitfield, 2005).

The purpose of this study was to document the status of vireos and flycatchers along an 18kilometer (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](#)).

Our goals for vireos were to (1) determine abundance and distribution of vireos on the middle San Luis Rey River to facilitate population trend analyses and (2) collect information on dispersal and site fidelity of banded vireos. Our goals for flycatchers were to (1) determine the size and composition of the flycatcher population on the middle San Luis Rey River, (2) document and monitor nesting activities of resident flycatchers, and (3) band and re-sight all flycatchers to facilitate the estimation of flycatcher 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

U.S. Geological Survey (USGS) biologists conducted vireo and flycatcher surveys on the middle San Luis Rey River, following standard survey techniques for vireos (U.S. Fish and Wildlife Service, 2001) and flycatchers (Sogge and others, 2010). Four surveys for vireos were conducted between April 17 and July 16, 2018, and four surveys for flycatchers were completed between May 16 and July 27, 2018. Observers walked slowly through or adjacent to suitable riparian habitat, listening and searching for vireos and flycatchers, occasionally playing a recording of a vireo or flycatcher 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 vireo or flycatcher encountered, observers recorded age (adult or juvenile), sex, breeding status (paired, single, undetermined, or transient), and whether the bird was banded. A vireo or flycatcher 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. The vireo and flycatcher locations were mapped using ESRI Collector (ESRI, 2018) on an Android phone with 1- to 15-meter (m) accuracy to determine geographic coordinates (WGS 84). Dominant native and exotic plants were recorded at each territory location, and percent cover of native vegetation was estimated using cover categories of 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 Goodding's black willow (*Salix gooddingii*), 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 Fremont's 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 coast 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 adjacent to riparian habitat.

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

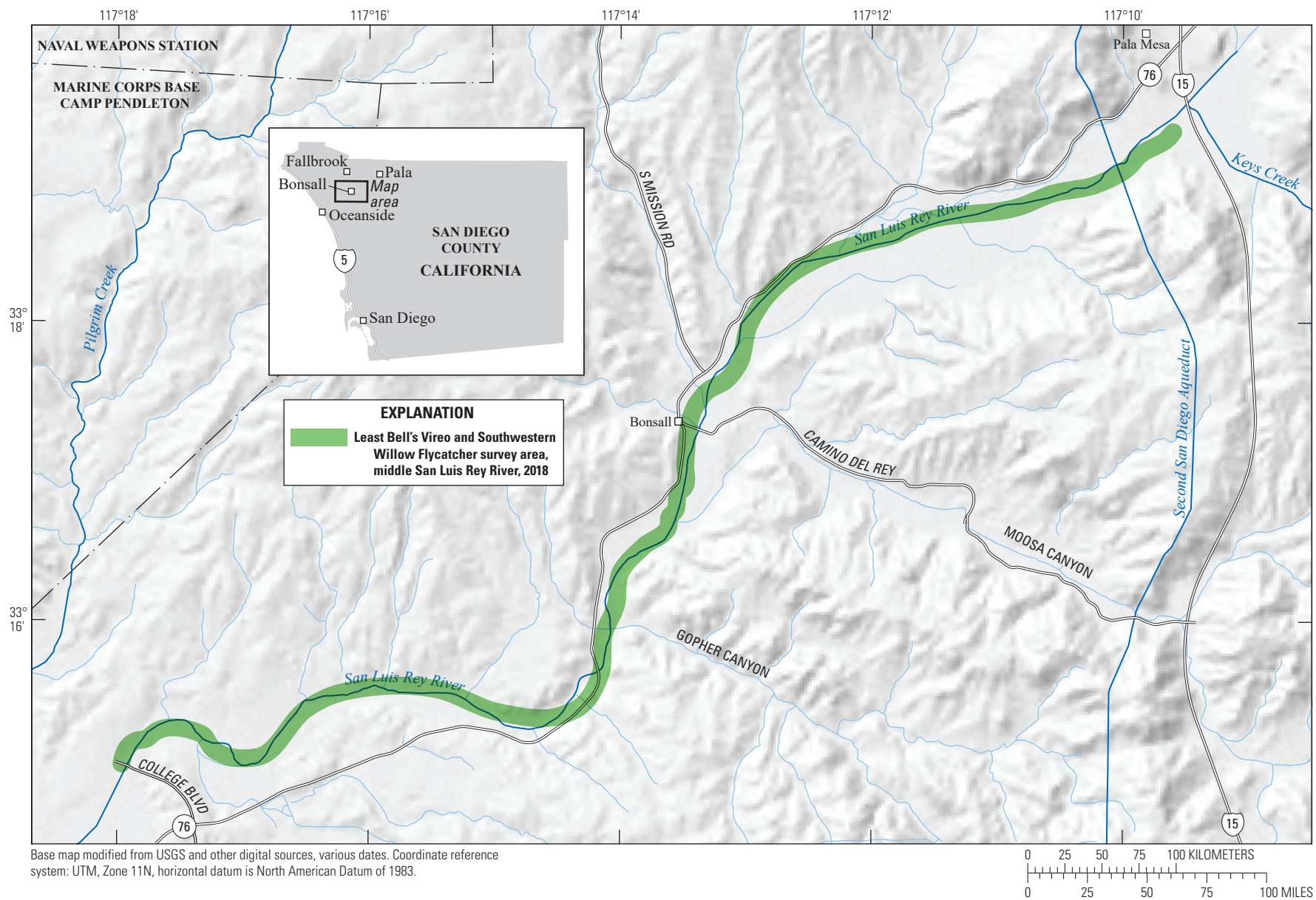


Figure 1. Location of Least Bell's Vireo (*Vireo bellii pusillus*) and Southwestern Willow Flycatcher (*Empidonax traillii extimus*) survey area on the middle San Luis Rey River, San Diego County, southern California, 2018.

Nest Monitoring

The flycatchers observed during protocol surveys that were suspected to be resident birds (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 next to confirm hatching and age of young, and the last 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 flycatcher 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 flycatchers were not found tending fledgling(s) were considered depredated.
3. Previously active nests that were subsequently abandoned by adult flycatchers 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 flycatcher 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 flycatcher eggs and (or) nestlings were classified as having failed because of unknown causes.

Banding

Mist nets were used to recapture adult vireos and flycatchers 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 flycatchers. Flycatcher nestlings, when present, were banded at 7–10 days of age. Each flycatcher 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 2017 used in comparisons with current (2018) data are available in Allen and others (2017, 2018); Ferree and Kus (2008); Ferree and others (2012, 2015); Houston and Kus (2011, 2012, 2013, 2014); Houston and others (2015a, 2015b, 2016, 2017, 2018); Howell and Kus (2015, 2017); Howell and others (2018); Lynn and Kus (2008, 2010); and Lynn and others (2011, 2016, 2017, 2018).

Least Bell's Vireo

Distribution and Abundance

A total of 148 vireo territories (90 pairs, 58 undetermined) and 6 vireo transients were detected on the middle San Luis Rey River in 2018 (table 1 and fig. 2). This was a 1 percent population size increase in the survey area, relative to 2017, and well above the 10-year average (2008–17) of 130 ± 22.

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, 2008–18.

[*Number of single males:* Least Bell's Vireo nest monitoring did not occur in 2008, 2011, and 2015–18; 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). **Abbreviation:** 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	134	33	1	NA
2015	141	92	49	NA	2
2016	142	106	36	NA	6
2017	146	107	39	NA	5
2018	148	90	58	NA	6

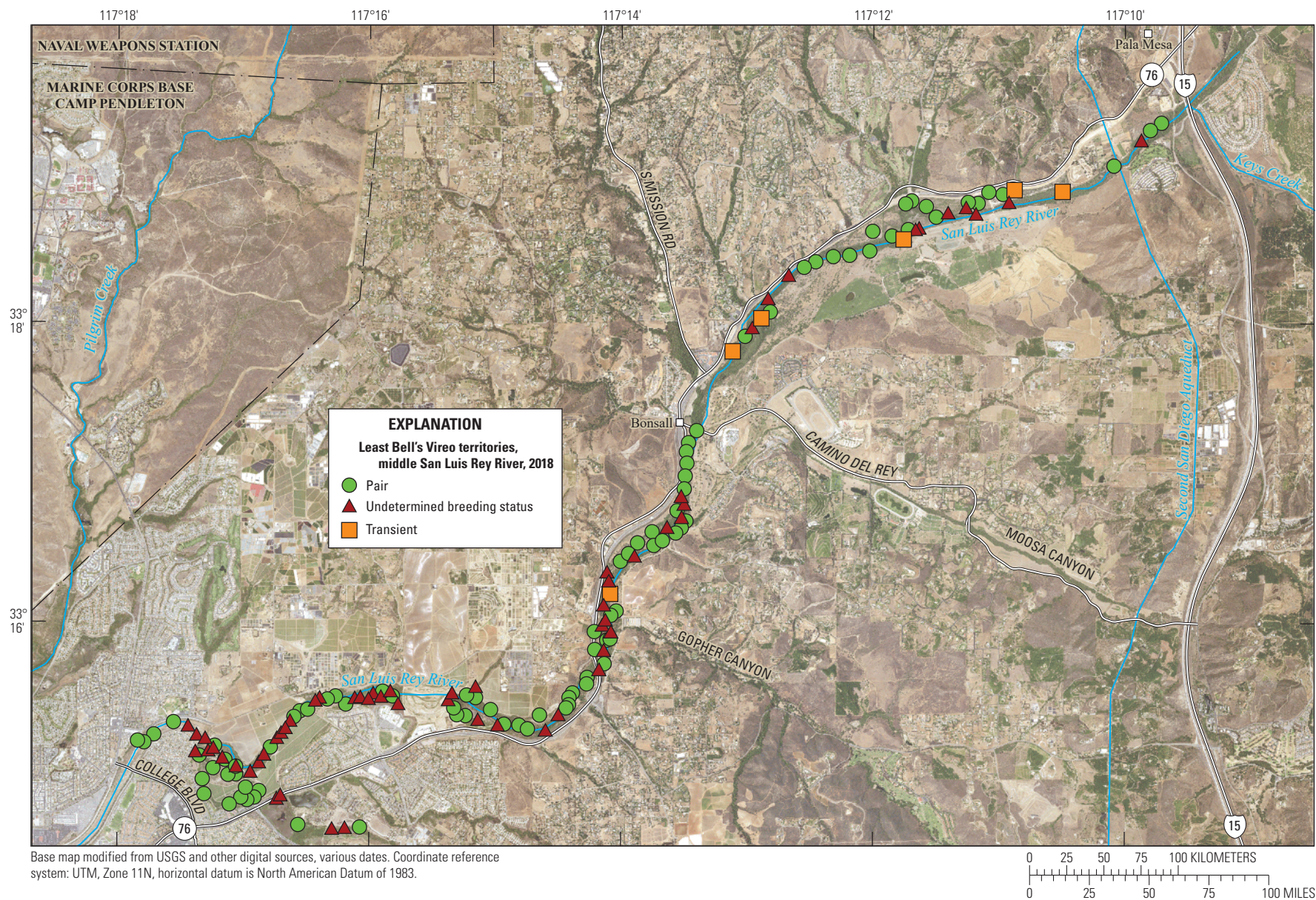


Figure 2. Least Bell's Vireo detections (*Vireo bellii pusillus*) and breeding status on the middle San Luis Rey River, San Diego County, southern California, 2018.

Least Bell's Vireos used six different habitat types in the survey area. Forty-one percent of the vireos were detected in habitat characterized as mixed willow, 35 percent were detected in willow-cottonwood, 20 percent were detected in riparian scrub, 2 percent were detected in habitat dominated by non-native vegetation, 1 percent were detected in upland scrub, and 1 percent were detected in willow-sycamore habitat. Ninety-seven percent (144/148) of vireo territories were detected in habitat with greater than 50 percent native plant cover (table 2).

The most commonly reported dominant species at vireo territories included Goodding's black willow (*Salix gooddingii*), red or arroyo willow (*Salix laevigata* or *Salix lasiolepis*), Fremont's cottonwood (*Populus fremontii*), and mule fat (*Baccharis salicifolia*). The most prevalent exotic species were poison hemlock (*Conium maculatum*) and black mustard (*Brassica nigra*).

Banded Birds

Ten banded vireos were detected on the middle San Luis Rey River in 2018 (tables 3 and 4). The oldest identified vireo was a 10-year-old male that was banded in 2008 as a nestling on the lower San Luis Rey River (Interstate 5 to College Boulevard). This male has occupied a territory on the middle San Luis Rey River for multiple years (table 4). Nine vireos had unique color-band combinations and could be identified, five of which were color-banded on the middle San Luis Rey River prior to 2018 (table 3).

Five banded vireos immigrated to the middle San Luis Rey River in 2018, all from the lower San Luis Rey River (LSLR). Four vireos (three males, one female) detected with only a single (natal) dark blue federal band were recaptured in 2018; they were originally banded as nestlings on the LSLR (table 4). One vireo (female) with a single, natal dark blue federal band, indicating that it was originally banded as a nestling on the LSLR, was detected in 2018 but not recaptured.

All five of the color-banded male vireos that were detected on the middle San Luis Rey River in both 2017 and 2018 moved 100 m or less from their 2017 territories (table 4). The four natal vireos that were recaptured on the middle San Luis Rey River dispersed from 2.1 to 11.1 km from their natal territories.

Southwestern Willow Flycatcher

Distribution and Abundance

One resident male flycatcher was observed on the middle San Luis Rey River from May 24 to July 17, 2018. This was consistent with the population in 2017, when one resident male flycatcher was observed. The male flycatcher established a territory in mixed willow habitat with greater than 95 percent native plant cover, but he never paired with a female. Eight transient flycatchers that could not be identified to subspecies were detected from May 25 to June 8, 2018 (fig. 3). Transient flycatchers occupied habitat characterized as either willow-cottonwood, mixed willow riparian, or riparian scrub. Seven of the transient flycatcher territories occurred in habitat with greater than 95 percent native plant cover.

Nest Monitoring

No nesting activities were observed on the middle San Luis Rey River in 2018.

Banded Birds

One banded flycatcher (male) with a single (natal) silver federal band was recaptured on the middle San Luis Rey River in 2018. The male flycatcher (BO01F) was originally banded as a nestling on the middle San Luis Rey River in 2016 at BO02F territory and given a unique color combination in 2018 (table 4).

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, 2018.

[*Mixed willow riparian*: Habitat dominated by one or more willow species, including Goodding's black willow, arroyo willow, and red willow, with mule fat as frequent co-dominant. *Willow-cottonwood*: Willow riparian habitat in which Fremont's 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. *Willow-sycamore*: Willow riparian habitat in which California sycamore is a co-dominant. *Non-native*: Areas vegetated exclusively with non-native species, such as giant reed and tamarisk. **Abbreviation**: >, greater than]

Habitat type	Number of Least Bell's Vireo territories			Total	Percentage of total
	>95 percent native plant cover	50–95 percent native plant cover	5–50 percent native plant cover		
Mixed willow riparian	40	21	0	61	41
Willow-cottonwood	34	16	1	51	35
Riparian scrub	23	7	0	30	20
Upland scrub	2	0	0	2	1
Willow-sycamore	1	0	0	1	1
Non-native	0	0	3	3	2
Total	100	44	4	148	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, 2018.

Band status	Previously identified on the middle San Luis Rey River ¹		Immigrants		Total
	Male	Female	Male	Female	
Uniquely banded prior to 2018	4	1	0	0	5
Natal recaptured in 2018	0	0	3	1	4
Natal not recaptured	0	0	0	1	1
Total	4	1	3	2	10

¹All 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.

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, 2018.

[2017 and 2018 territory: LSLR, lower San Luis Rey River (Interstate 5 to College Boulevard); Natal, natal vireos 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; pupu, purple band. *Plastic Band acronyms*: BPST, black-pink striped; BWST, blue-white striped; DPDP, dark pink; DPWH, dark pink-white split; LPBK, light pink-black split; PUWH, purple-white split; WHDB, white-dark blue split; WHDP, white-dark pink split; WHPU, white-purple split; YEBK, yellow-black split; YEYE, yellow. *Pin-striped metal band acronyms*: rprp, royal purple. *Sex*: F, female; M, male. **Abbreviation**: km, kilometer]

Year originally banded	2017 territory	2018 territory	Distance moved (km)	Color-band combination	Sex	Minimum age in 2018 (years)
Least Bell's Vireos						
2008	MSL116	MSL128	0.0	WHDB Mdb : LPBK	M	10
2012	MSL113	M131	0.1	BWST Mdb : WHDP	M	6
2015	MSL109	MSL112	0.0	WHDB : WHPU Mdb	M	3
2015	MSL109	MSL112	0.0	WHDB Mdb : DPDP	F	3
2016	DT06	DT01	0.1	WHDP Mgo : DPWH	M	2
2016	WBON (LSLR Natal)	MSL063	11.1	YEBK Mdb : DPDP	F	2
2016	CJAS (LSLR Natal)	MSL215	5.1	BPST Mdb : YEYE	M	2
2017	CCOT (LSLR Natal)	MSL351	7.5	PUWH : WHDB Mdb	M	1
2017	CSAN (LSLR Natal)	M121	2.1	BPST pupu : Mdb	M	1
Unknown	LSLR	MSL109	Unknown	Mdb : -	F	1
Southwestern Willow Flycatchers						
2016	BO02F (Natal) ¹	BO01F	0.1	Msi : rprp	M	2

¹Single male, originally banded as a nestling on the middle San Luis Rey River in 2016.

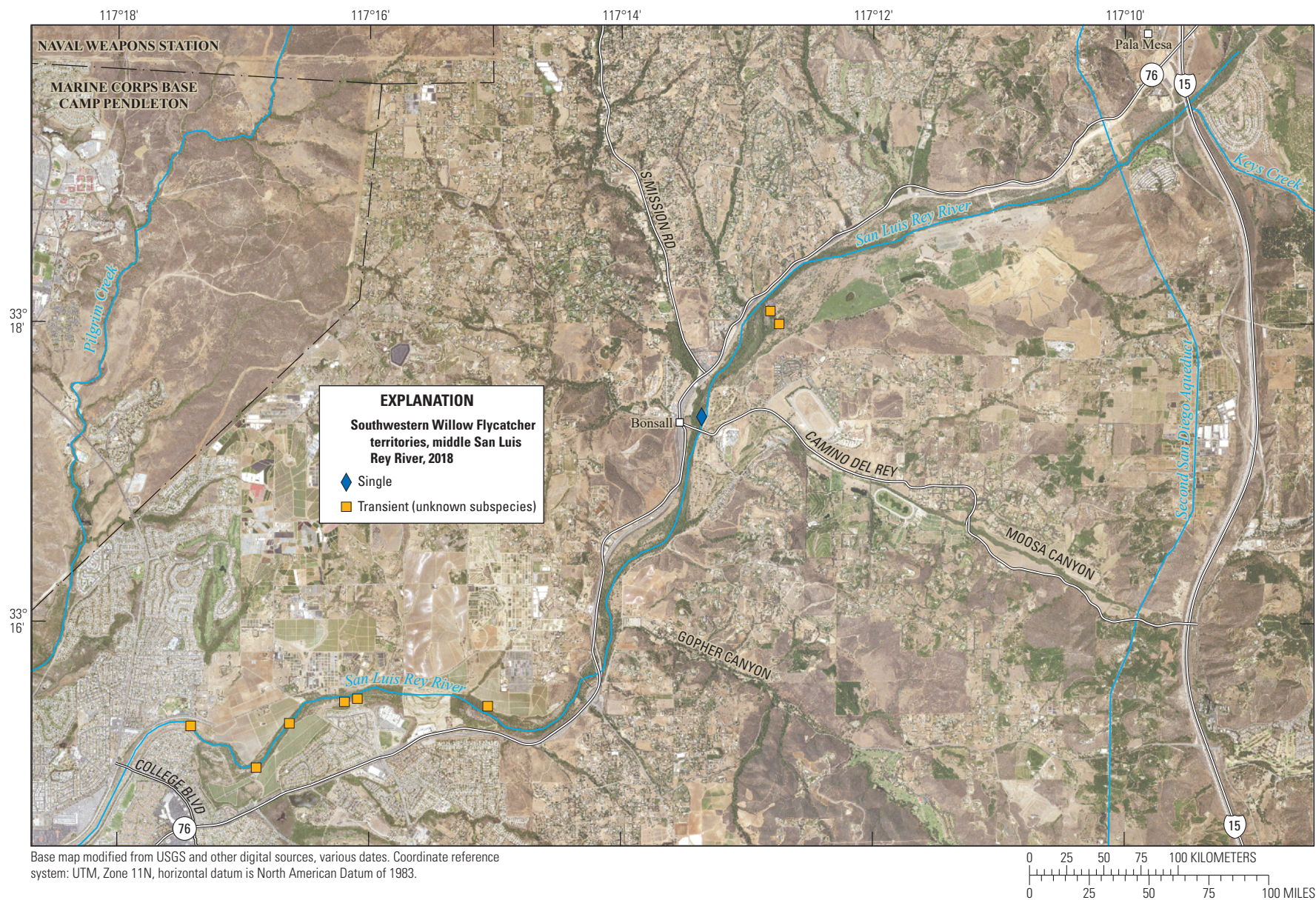


Figure 3. Southwestern Willow Flycatcher (*Empidonax traillii extimus*) detections and breeding status on the middle San Luis Rey River, San Diego County, southern California, 2018.

Summary

The number of Least Bell's Vireo (vireo) territories on the middle San Luis Rey River remained stable from 2017 (146) to 2018 (148), increasing by just 1 percent. In contrast, vireos increased by 40 percent downstream on the lower San Luis Rey River and increased by 45 percent on Marine Corps Base Camp Pendleton in 2018 (Houston and others, 2018; Lynn and others, 2018).

The number of vireo territories on the middle San Luis Rey River has fluctuated between 100 and 168 since 2008, with a peak in 2014. The vireo population remained high in 2018, exceeding the 10-year mean (130 ± 22).

In 2018, we documented vireos immigrating to the survey area from the lower San Luis Rey River. Five natal vireos that were originally banded as nestlings on the lower San Luis Rey River immigrated to the middle San Luis Rey River in 2018.

Southwestern Willow Flycatcher (flycatcher) territories were consistent with 2017; one resident male was detected on the middle San Luis Rey River, with no successful breeding documented in 2018. In contrast, the flycatcher population on Marine Corps Base Camp Pendleton increased from 2017 to 2018; three resident flycatchers were detected, and two breeding territories were established in 2018 (Howell and others, 2018).

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