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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—2019 Data Summary

Data Series 1122

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

Cover: Photograph showing Least Bell's Vireo (*Vireo bellii pusillus*). Photograph by Devin Taylor, U.S. Geological Survey, 2019.

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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)
hectare (ha)	2.471	acre (ac)

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

$$°C = (°F – 32) / 1.8.$$

Datum

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

Abbreviations

LSLR	lower San Luis Rey River
MCBCP	Marine Corps Base Camp Pendleton
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) along the San Luis Rey River, between College Boulevard in Oceanside and Interstate 15 in Fallbrook, California (middle San Luis Rey River), in 2019, and we surveyed and conducted nest monitoring for Southwestern Willow Flycatchers (*Empidonax traillii extimus*; flycatcher) in a survey area where breeding had historically been documented on the middle San Luis Rey River, in 2019. Surveys were conducted from April 11 to June 24 (vireo) and from May 16 to July 15 (flycatcher). We found 179 vireo territories, at least 124 of which were occupied by pairs. Vireo territories increased by 100 percent within the portion of the middle San Luis Rey River that burned as a result of a wildfire in 2017. In contrast, vireo territories increased by 5 percent within the unburned portion of the middle San Luis Rey River.

Vireos used five different habitat types in the survey area: mixed willow riparian, willow-cottonwood, riparian scrub, willow-sycamore, and upland scrub. Fifty-two percent of the vireos were detected in habitat characterized as mixed willow, and 92 percent of the vireos were detected in habitat with greater than 50 percent native plant cover. Of the 12 banded vireos detected in the survey area, 5 were resighted with a full color-band combination. One adult female with a unique color-band combination immigrated to the middle San Luis Rey River from Marine Corps Base Camp Pendleton (MCBCP). Five other vireos with single (natal) federal bands were recaptured, identified, and color banded in 2019. Two vireos with a single dark blue federal band, indicating that they were banded as nestlings on the lower San Luis Rey River (LSLR), could not be recaptured for identification. The five natal vireos that were recaptured on the middle San Luis Rey River dispersed from 1.4 to 8.3 kilometers (km) from their natal territories. Banded vireos with a known age ranged from 1 to 11 years old.

One resident flycatcher was observed in the survey area in 2019. The resident flycatcher (male) was detected in a territory of mixed willow habitat with greater than 50 percent native plant cover. He was detected as a single male from May 16 to July 17, 2019, and no evidence of pairing or nesting was observed. The male flycatcher with a unique color-band combination occupied the same territory in 2018 and 2019.

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*; 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.

Male vireos arrive on breeding grounds in southern California in mid-March. Male vireos are vocally conspicuous and frequently sing their diagnostic primary song from exposed perches throughout the breeding season. Females arrive approximately 1–2 weeks after males and are more secretive, but they are often seen early in the season traveling through habitat with the male. The female, with the male's help, builds an open cup nest in dense vegetation approximately 1 meter (m) above the ground. Nesting occurs from early April through July, but adults and juvenile birds remain on the breeding grounds into late September/early October before migrating to their wintering grounds in southern Baja California, Mexico.

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 tenfold since the mid-1980s in response to management practices alleviating 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 (S.L. Howell, U.S. Geological Survey, unpub. data, 2019). 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).

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

The purpose of this study was to document the status of vireos and flycatchers along an 18-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 (in a survey area where breeding had historically been documented) on the middle San Luis Rey River, (2) document and monitor the 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.

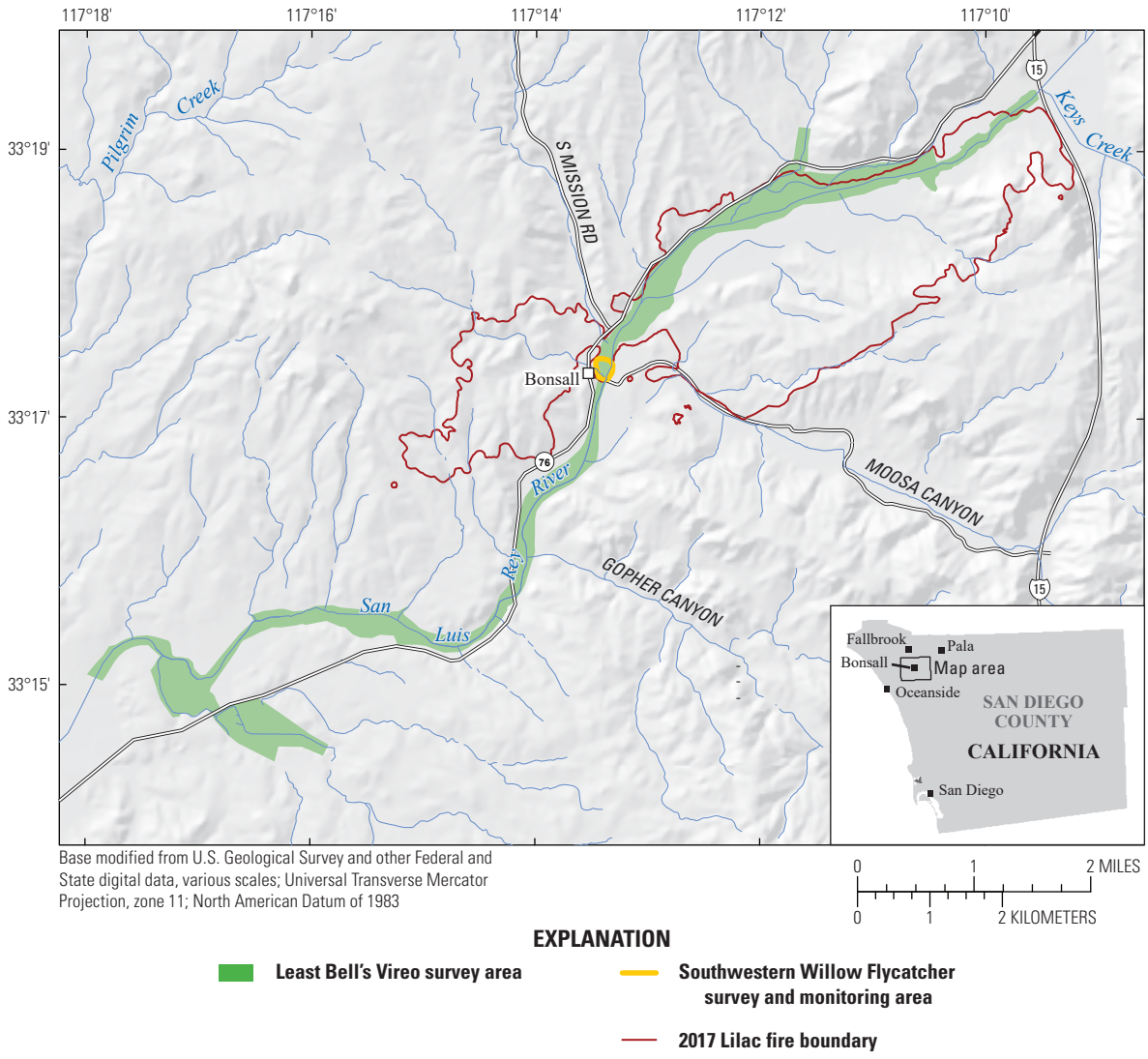

Figure 1. Location of Least Bell's Vireo (*Vireo bellii pusillus*) and Southwestern Willow Flycatcher (*Empidonax traillii extimus*) survey area and boundaries of the Lilac fire on the middle San Luis Rey River, San Diego County, southern California, 2019.

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). Vireo and flycatcher surveys were conducted under USFWS permit TE-829554-17.6. Three surveys for vireos were conducted throughout the study area between April 11 and June 24, 2019, and four surveys for flycatchers were completed in a small portion of the study area between May 16 and July 15, 2019. 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 the ESRI Collector (ESRI, 2018) on an Android phone with 1- to 15-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 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*).

A large wildfire event (Lilac Fire) occurred at the San Luis Rey River in December 2017, during the time of the year when vireos and flycatchers were not present. The wildfire burned approximately 1,651 hectares (ha), including 300 ha of riparian habitat within the middle San Luis Rey River study area (fig. 1).

Nest Monitoring

The flycatchers observed during 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 right leg.

All summary data are presented as mean ± standard deviation. Data from 2008 to 2018 used in comparisons with current (2019) data are available in Allen and others (2017, 2018), and Allen and Kus (2019).

Least Bell's Vireo

Distribution and Abundance

A total of 179 vireo territories (124 pairs, 55 undetermined status) were detected on the middle San Luis Rey River in 2019 (table 1 and fig. 2). Population size increased by 21 percent relative to 2018 and was well above the 11-year average (2008–18) of 135±25 territories. Within the burned area, the number of vireo territories dropped by 55 percent, from 56 in 2017 prior to the December fire to 25 territories in 2018. In 2019, the number of vireo territories within the burned area increased by 100 percent to 50 territories. In contrast, outside of the burned area the number of vireo territories increased by 37 percent from 2017 to 2018 (90–123 territories) and by 5 percent from 2018 to 2019 (123–129 territories).

Least Bell's Vireos used five different habitat types in the survey area. Fifty-two percent of the vireos were detected in habitat characterized as mixed willow riparian, 32 percent were detected in willow-cottonwood, 13 percent were detected in riparian scrub, 2 percent were detected in willow-sycamore habitat, and 1 percent were detected in upland scrub. Ninety-two percent (164/179) 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, red or arroyo willow, and Fremont cottonwood. The most prevalent exotic species were poison hemlock (*Conium maculatum*) and black mustard (*Brassica nigra*).

Table 1. Total number and breeding status of Least Bell's Vireo (*Vireo bellii pusillus*) males detected in the study area on the middle San Luis Rey River, San Diego County, southern California, 2008–19.

[Number of single males: Least Bell's Vireo nest monitoring did not occur in 2008, 2011, and 2015–19; therefore, the number of times a territory was visited was not sufficient to determine whether the territory contained a single male. Transients: Transients not included in the total number of territorial males. Transient status not assigned in years when fewer than four surveys were conducted (2008–14, 2019). **Abbreviation**: NA, not applicable]

Year	Total number of territorial males	Number of pairs	Number of birds with undetermined breeding status	Number of single males	Transient
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
2019	179	124	55	NA	NA

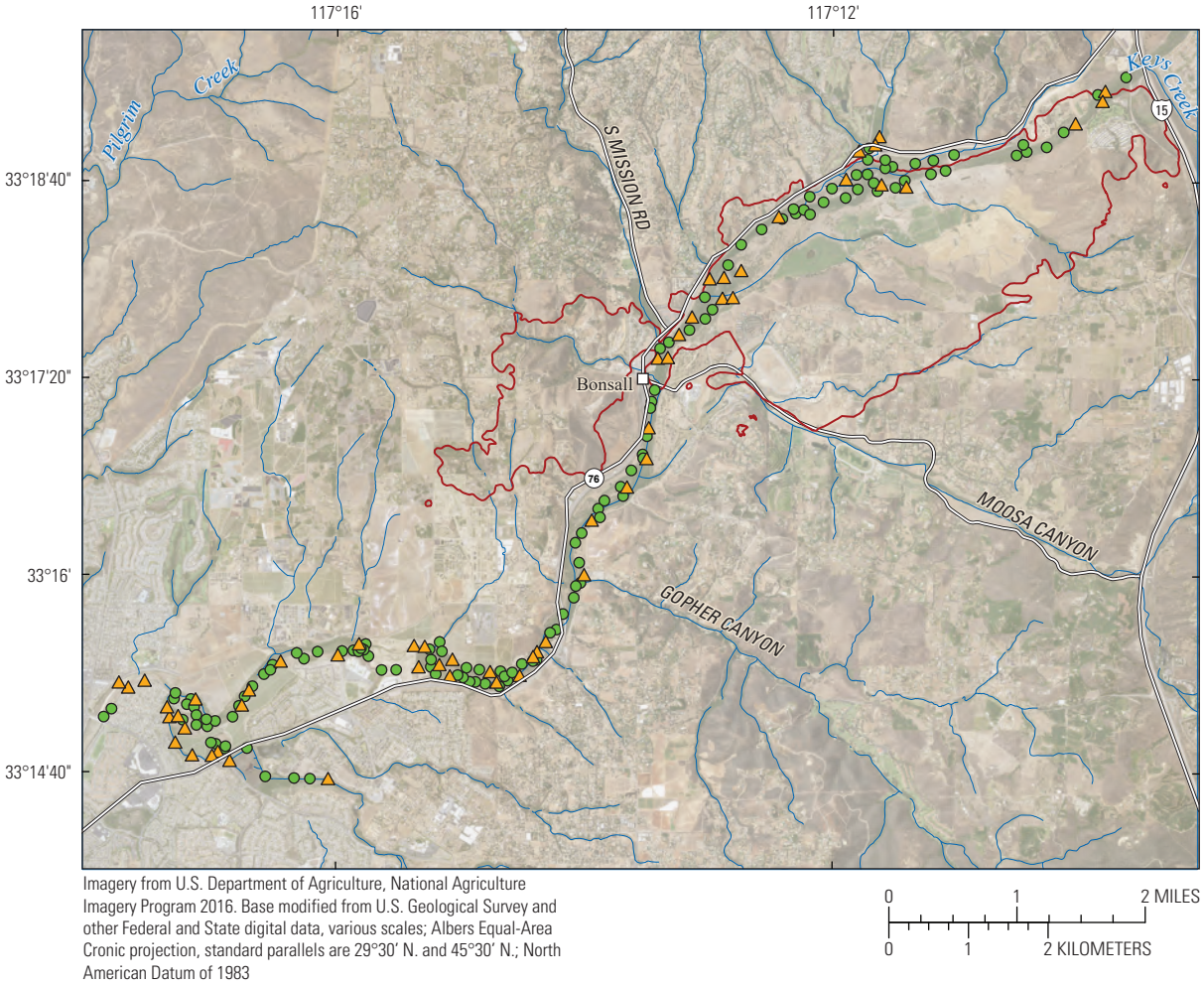

Figure 2. Least Bell's Vireo detections (*Vireo bellii pusillus*) and breeding status on the middle San Luis Rey River, San Diego County, southern California, 2019.

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, 2019.

[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 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. **Abbreviation**: >, greater than]

Habitat type	Number of Least Bell's Vireo territories				
	>95 percent native plant cover	50–95 percent native plant cover	5–50 percent native plant cover	Total	Percentage of total
Mixed willow riparian	44	40	8	92	52
Willow-cottonwood	39	15	3	57	32
Riparian scrub	7	14	3	24	13
Upland scrub	2	0	0	2	1
Willow-sycamore	3	0	1	4	2
Total	95	69	15	179	100

Banded Birds

Twelve banded vireos were detected on the middle San Luis Rey River in 2019 (tables 3 and 4). Five banded vireos (that were banded prior to 2019) had unique color-band combinations and could be identified, four (all male) of which were detected on the middle San Luis Rey River in 2018, and one (female) that immigrated from Marine Corps Base Camp Pendleton (MCBCP). All four of the color-banded male vireos that were detected on the middle San Luis Rey River moved 200 m or less from their 2018 territories (table 4).

Seven natal vireos (four males, three females) were detected with only a single (natal) dark blue federal band, indicating that they were originally banded as nestlings on the LSLR. Five of the natal vireos were recaptured, identified, and given a unique color-band combination; two vireos (females) were not recaptured (table 3). The five natal vireos that were recaptured on the middle San Luis Rey River dispersed from 1.4 to 8.3 km from their natal territories.

Banded vireos with a known age ranged from 1 to 11 years old. The oldest identified vireo was an 11-year-old male that was banded in 2008 as a nestling on the LSLR. This male has occupied a territory on the middle San Luis Rey River for multiple years (table 4).

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, 2019.

[Previously identified on the middle San Luis Rey River: 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	Previously identified on the middle San Luis Rey River	Immigrants		Total
	Male	Male	Female	
Uniquely banded prior to 2019	4	0	1	5
Natal recaptured in 2019	0	4	1	5
Natal not recaptured	0	0	2	2
Total	4	4	4	12

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, 2019.

[2018 and 2019 territory: MCBCP, Marine Corps Base Camp Pendleton; 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**: BKYE, black-yellow split; BPST, black-pink striped; BWST, blue-white striped; 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; YEBK, yellow-black split. Pin-striped metal band acronyms: rprp, royal purple. **Sex**: F, female; M, male. **Abbreviation**: km, kilometer; —, no band]

Year originally banded	2018 territory	2019 territory	Distance moved (km)	Color-band combination	Sex	Minimum age in 2019 (years)
Least Bell's Vireos						
2008	MSL128	MSL109	0.1	WHDB Mdb : LPBK	M	11
2012	MSL131	M121	0.1	BWST Mdb : WHDP	M	7
2016	DT01	DT01	0.1	WHDP Mgo : DPWH	M	3
2016	WC02 (MCBCP)	MSL108	6.4	DPWH Mdb : DPWH	F	3
2017	M121	MSL143	0.2	BPST pupu : Mdb	M	2
2017	CPUR (LSLR Natal)	MSL119	1.4	WHDP : BPST Mdb	F	2
2018	CEAS (LSLR Natal)	MSL157	1.7	BPST Mdb : DPDP	M	1
2018	CFLO (LSLR Natal)	MSL161	2.3	BPST Mdb : YEBK	M	1
2018	FO1 (LSLR Natal)	MSL141	6.4	WHDB Mdb : WHPU	M	1
2018	WDOC (LSLR Natal)	MSL212	8.3	BKYE Mdb : DPWH	M	1
Unknown	LSLR	EA03	Unknown	— : Mdb	F	1
Unknown	LSLR	MSL313V	Unknown	Mdb : —	F	1
Southwestern Willow Flycatchers						
2016	BO01F	BO01F	0.0	Msi : rprp	M	3

Southwestern Willow Flycatcher

Distribution and Abundance

One resident male flycatcher was observed (within the historical breeding area) on the middle San Luis Rey River from May 16 to July 15, 2019. This was consistent with the population in 2018, when one resident male flycatcher was observed. The male flycatcher established a territory in mixed willow habitat with greater than 50 percent native plant cover, but he never paired with a female (fig. 3).

Nest Monitoring

No nesting activities were observed on the middle San Luis Rey River in 2019.

Banded Birds

One resident flycatcher (male) with a unique color-band combination was detected (within the historical breeding area) on the middle San Luis Rey River in 2019. The male flycatcher occupied the same territory (BO01F) in 2018 and 2019. The flycatcher 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).

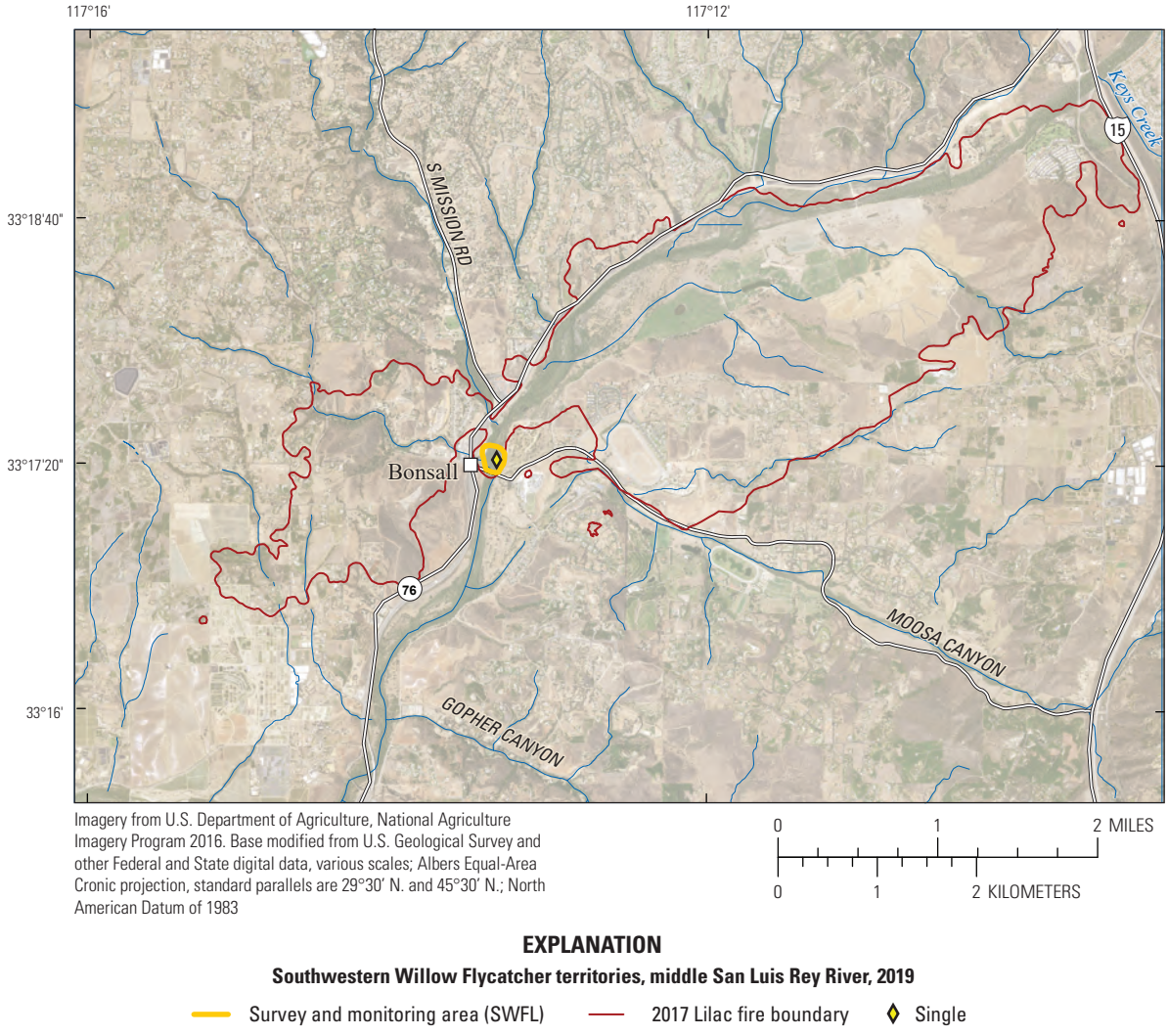

Figure 3. Southwestern Willow Flycatcher (*Empidonax traillii extimus*) detections and breeding status on the middle San Luis Rey River, San Diego County, southern California, 2019.

Summary

The number of Least Bell's Vireo territories on the middle San Luis Rey River increased by 21 percent from 2018 (148) to 2019 (179). The number of vireo territories on the middle San Luis Rey River has fluctuated between 100 and 179 since 2008. In 2019, the vireo population increased to its highest level since surveys began, exceeding the 11-year mean (135±25). This increase was likely driven by the recovery of the middle San Luis Rey area that burned in 2017. The number of vireo territories within the burned portion of the middle San Luis Rey River increased by 100 percent from 2018 (25) to 2019 (50) compared to the number of vireo territories outside of the burned area from 2018 (123) to 2019 (129). In contrast, vireos decreased by 2 percent downstream on the lower San Luis Rey River (A. Houston, U.S. Geological Survey, unpub. data, 2019) and decreased by 5 percent on Marine Corps Base Camp Pendleton in 2019 (S. Lynn, U.S. Geological Survey, unpub. data, 2019).

In 2019, we documented vireos immigrating to the survey area from the lower San Luis Rey River and Marine Corps Base Camp Pendleton. Seven natal vireos that were originally banded as nestlings on the lower San Luis Rey River and one adult female vireo from Marine Corps Base Camp Pendleton immigrated to the middle San Luis Rey River in 2019.

Southwestern Willow Flycatcher territories were consistent with 2018 (despite the fact that the area surveyed in 2018 was much larger); one resident male was detected on the middle San Luis Rey River, with no successful breeding documented in 2019. The flycatcher population on Marine Corps Base Camp Pendleton was also consistent with the 2018 population; three resident flycatchers were detected, and two breeding territories were established in 2019 (S.L. Howell, U.S. Geological Survey, unpub. data, 2019).

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