

State of California  
THE RESOURCES AGENCY  
Department of Fish and Game

DISTRIBUTION, REPRODUCTIVE SUCCESS AND IMPACT OF NEST  
PARASITISM BY BROWN-HEADED COWBIRDS ON LEAST BELL'S VIREOS <sup>1/</sup>

by

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Photo by Karla Kramer.

ABSTRACT

A study was conducted from April to July 1978 to determine the distribution and reproductive success of Least Bell's Vireos, and to assess the impact of Brown-headed Cowbirds on vireos. Eighty-nine territorial males or pairs and one unmated male were found at 30 of 84 sites surveyed along 21 streams and rivers in seven southern California counties. Observed nesting, hatching, fledging and breeding success were 33%, 32%, 58% and 58% respectively. Less than one offspring was fledged per pair. Nest parasitism by Brown-headed Cowbirds is greatly reducing reproductive success, and more than 50% of pairs, whose nesting history was known, were parasitized. The future of this subspecies appears doubtful if parasitism continues at its present rate. Endangered species status is recommended.

<sup>1/</sup> Supported by Federal Aid in Wildlife Restoration, Project W-54-K-10, Wildlife Management Branch, Nongame Wildlife investigations, Job IV - 1.5.1, Final Report (July 1978).

## RECOMMENDATIONS

Based on the results of this study, the following recommendations are made to stop the decline of and provide for the survival of the Least Bell's Vireo:

1. Give the Least Bell's Vireo the status of Endangered and the protection of that status.
2. Inventory additional habitat within the range of the Least Bell's Vireo that were not checked during this study and qualitatively and quantitatively describe this species' habitat.
3. Inform landowners of the presence of, or recent historical occupation of, riparian habitats occupied by Least Bell's Vireos, and encourage the protection and preservation of this habitat.
4. Provide habitat protection of Least Bell's Vireo populations on public lands through habitat management agreements and plans.
5. Initiate Brown-headed Cowbird control in areas where three or more pairs of Least Bell's Vireos are known to breed.
6. Prohibit the collecting, banding or handling of Least Bell's Vireos except under specific permit by the Department.

## INTRODUCTION

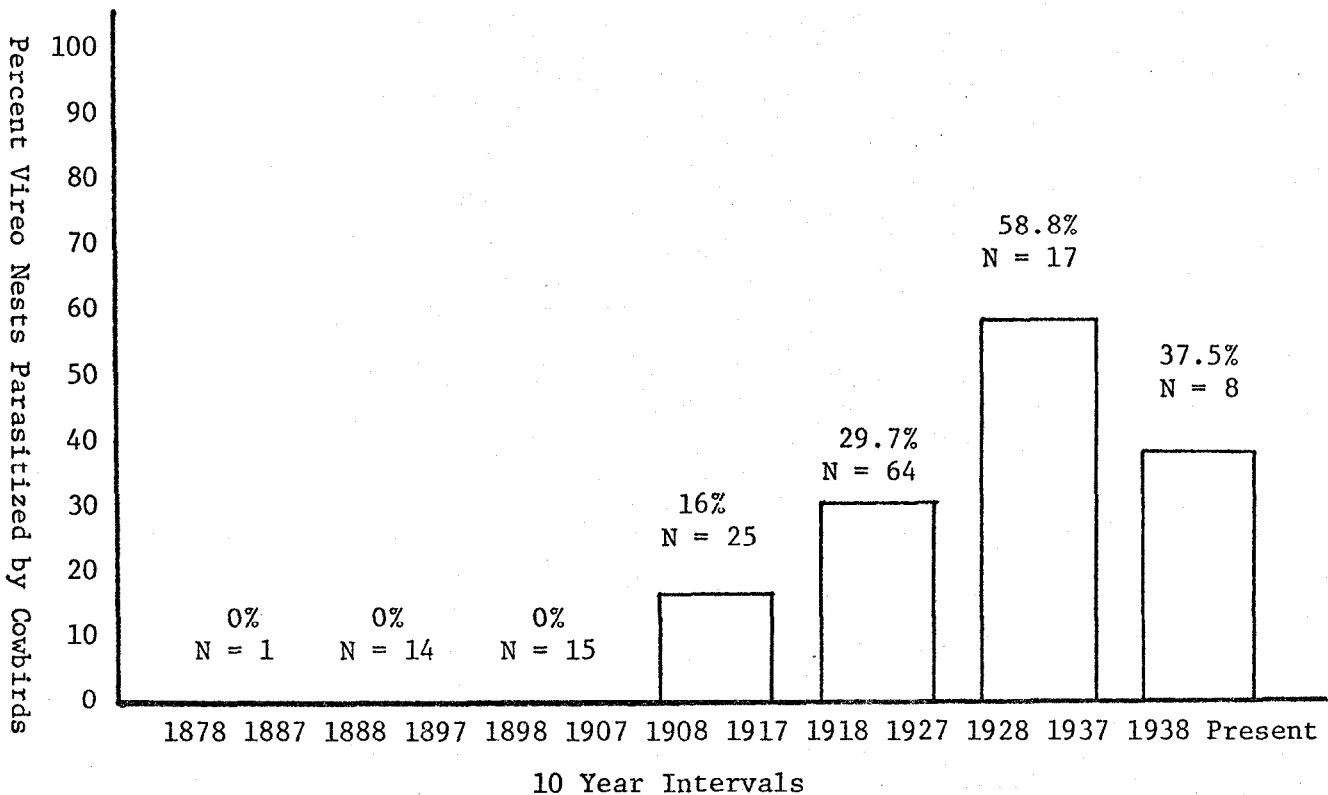
The Least Bell's Vireo (*Vireo bellii pusillus*) is a subspecies whose breeding range is limited to California and northwestern Baja California. Formerly, it inhabited dense willow thickets along streams throughout California's interior valleys and southern coastal region. A population decline was observed prior to 1944 (Grinnell and Miller 1944) and has continued. The paucity of recent observations suggests that the species has disappeared from much of its former range.

The decline of the Least Bell's Vireo has been attributed to the widespread destruction of riparian habitat and the increasing pressure of nest parasitism by Brown-headed Cowbirds (*Molothrus ater*) (Grinnell and Miller 1944, McCaskie 1969, Gaines 1977, Goldwasser 1978). Nest parasitism on Least Bell's Vireos by Brown-headed Cowbirds was first recorded in a nest along Sespe Creek, Ventura County in 1908 (Western Foundation of Vertebrate Zoology 84897). Parasitism was often observed over the following decades (Hanna 1918, 1928; Rowley 1930) and increased in frequency as well (Figure 1).

A 1977 Department of Fish and Game survey of the status of selected riparian birds in California revealed the presence of only a few Least Bell's Vireos, and recent reports indicated that as few as thirty breeding pairs remained in the State. The severity of the situation prompted the California Department of Fish and Game to determine the abundance, distribution, nesting chronology and reproductive success of the Least Bell's Vireo during the 1978 breeding season and to assess the impact of Brown-headed Cowbirds on the vireos.

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Figure 1. Incidence of Cowbird parasitism in nests of Bell's Vireos.  
(Based on museum and published records of nests in California.)



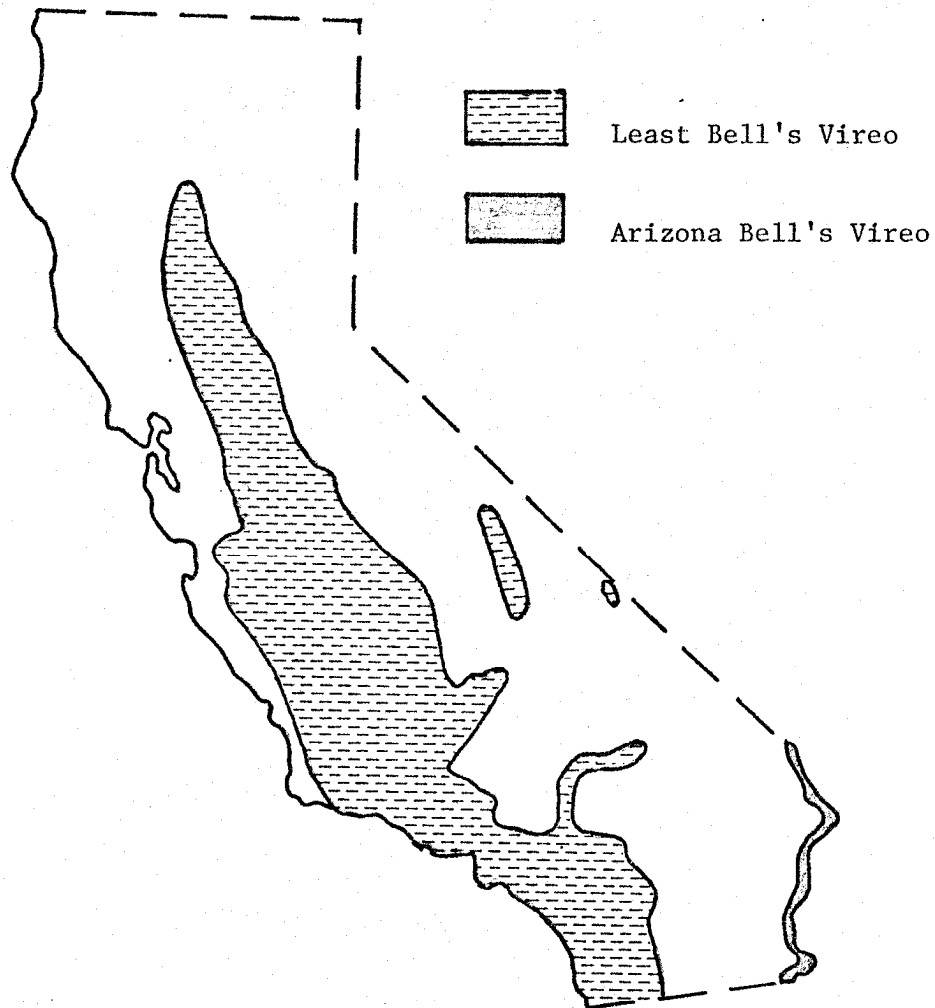
Overall 25% Rate of Parasitism

## HISTORY OF OCCURRENCE

Historical range of the Least Bell's Vireo in California extended from San Diego northwest along the coast, into the warmer interior valleys of the central coast region to southern Santa Clara County and the length of the San Joaquin and Sacramento valleys (Figure 2). East of the Sierra Nevada, these vireos inhabited the Owens and Death valleys as well as desert oases and riparian canyons from the Mojave Desert south along the eastern slopes of the Transverse and Peninsular ranges (Grinnell and Miller 1944). The Arizona Bell's Vireo (V. b. arizonae), a subspecies distinguished on the basis of color, occurs along the Colorado River (Grinnell and Miller 1944, A.O.U. Checklist 1957).

\* \* \*

Figure 2. Historical distribution of Bell's Vireos in California (Grinnell and Miller 1944).



Least Bell's Vireos were considered common to locally abundant throughout their range until the mid-Twentieth Century (Fisher 1893, Tyler 1913, Willet 1933, Grinnell and Miller 1944). By the early 1940's, a population decline had been observed in parts of southern California and in the Central Valley (Grinnell and Miller 1944). Observations on nesting Least Bell's Vireos have become increasingly rare in California since that time. The last breeding pair in the San Joaquin Valley was seen in 1956 (R. Hanson fide Dave Gaines) and the last known nesting pair in the Sacramento Valley was observed in 1958 (Cogswell 1958). With few exceptions, nearly all recent sightings have come from sites in San Diego County and a few scattered locations elsewhere in southern California (Table 1).

\* \* \*

Table 1. Probable nesting records (based on behavior, song, site attachment, etc.) of the Least Bell's Vireo in California between 1970 and 1977. <sup>1/</sup>

<u>Locality</u>	<u>Year(s)</u>	<u># Terr. Males</u>	<u>Source</u>
Pinnacles National Monument, San Benito Co.	1972	1	DeSante and LeValley 1972
Big Morongo Wildlife Preserve, San Bernardino Co.	1970-77	2-3	McCaskie 1974; Goldwasser 1978
San Timoteo Canyon, Riverside Co.	1977	1	Goldwasser 1978
Bautista Canyon, Riverside Co.	1973 1976	1-2	S. Cardiff pers. comm.
Mouth of Van Tassel Canyon, Los Angeles Co.	1970-75	1-2	M. San Miguel pers. comm. to D. Gaines
Mouth of Fish Canyon, Los Angeles Co.	1970-74	2-3	Ibid,
Near Chatsworth, Los Angeles Co.	1977	1	L. Kiff, pers. comm.
Near Arvin, Kern Co.	1973 or 74	1	Ibid.
San Juan Creek, Orange Co.	1976	1	A. Fries, pers. comm.
Camp Pendleton, San Diego Co.	1975	1	Ibid.
Kit Carson Park, San Diego Co.	1976	1	Ibid.
San Luis Rey River, Oceanside, San Diego Co.	1 9 7 7	1	P. Unitt, pers. comm.
Jamul Creek, San Diego Co.	1977	1	Ibid.
Mission Dam Park, San Diego River, San Diego Co.	1970-77	4-14	Ibid.
Mission Valley, San Diego Co.	1975, 77	1-2	P. Unitt, pers. comm.
Campo Creek, San Diego Co.	1977	1	Ibid.

<sup>1/</sup> Revised from Gaines 1977.

## METHODS

Census sites were chosen on the basis of museum records of skins and eggs, recent observations and the recommendations of other field ornithologists. Locality data were obtained from specimens housed in the collections of the California Academy of Sciences, Los Angeles County Museum, Museum of Vertebrate Zoology (U. C. Berkeley), San Bernardino County Museum, San Diego County Museum, San Diego Museum of Natural History, University of California at Los Angeles, and the Western Foundation of Vertebrate Zoology.

Historical locations were first surveyed by car to determine the extent of suitable habitat, if any. Sites were censused by walking through or along-side riparian vegetation, looking and listening for singing males. Bell's Vireos are most easily located by their diagnostic song. Males sing nearly incessantly from their arrival in late March or early April until mid-summer, and more sporadically until they migrate south in late August and September. Males singing on territory were assumed to belong to a nesting pair. When individuals or pairs were found, their location was noted. If habitat was not impenetrable, an attempt was made to locate the nest. Information recorded for each site included date, time, habitat description, number of cowbirds, if any, and observations of other riparian species of special concern, particularly Yellow Warbler (Dendroica petechia) and willow Flycatcher (Empidonax traillii).

## RESULTS

### Distribution and Abundance

Eighty-nine territorial males or pairs of Least Bell's Vireos and one apparently unmated male were observed or reported by reliable observers. These vireos were found along twenty-one streams and rivers, or at 30% of the sites checked in San Diego, Riverside, San Bernardino, Los Angeles, Ventura, Santa Barbara and Inyo counties (Figure 3, Table 2). These include individuals located during a concurrent study sponsored by the U. S. Fish and Wildlife Service which concentrated on historical localities of Least Bell's Vireos from Ventura County north (Table 3). No vireos were found north of Santa Barbara County (S. Wilbur, pers. comm.).

Population densities vary from location to location. Where multiple territories existed, territories were spaced as close as fifty yards or as wide as 300 or more yards apart. Two individuals could usually be heard simultaneously in the densely concentrated populations at Mono Creek, Mission Dam Park, Coyote Creek and the San Luis Rey River. At Coyote Creek, eight pairs occupied about 9.7 ha (0.82/ha, 0.30/ac), closely approximating Grinnell's 1930 estimate of thirty pairs per 40 ha (0.75/ha, 0.33/ac) in the Sacramento Valley.

Bell's Vireos were most frequently observed in willow thickets along permanent or nearly permanent streams (Figures 4 & 5). Vireos were absent from riparian associations which did not include a dense to broken understory of shrub species such as willows (Salix spp.) and mule fat (Baccharis glutinosa). In desert drainages, honey mesquite (Prosopis juliflora) was an important constituent of the understory vegetation.

Figure 3. Sites surveyed for Least Bell's Vireos in 1978.

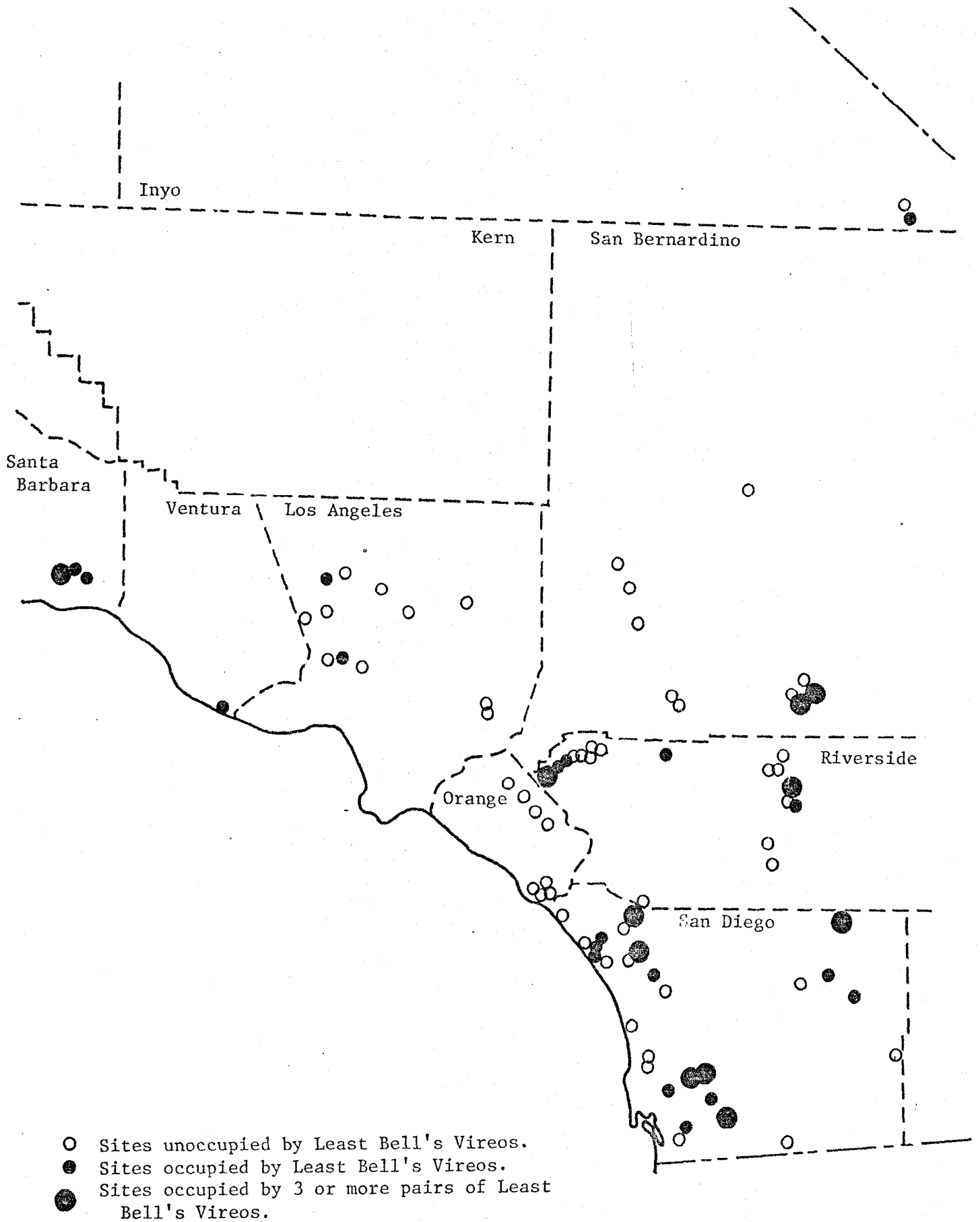


Table 2. Sites censused for Least Bell's Vireos in San Diego, Orange, Riverside, San Bernardino, Los Angeles, Ventura, Santa Barbara and Inyo counties during 1978 breeding season.

<u>Locality</u>	<u>Dominant Vegetation</u>	<u>Date</u>	<u># Terr. Males</u>
<u>San Diego County</u>			
(1) Campo Creek	<u>Salix</u> , <u>Populus</u>	4/22/78	-
(2) Jamul Creek	<u>Salix</u> , <u>Populus</u>	4/21/78	4
		6/5/78	9
(3A) Sweetwater River, Bonita <sup>1/</sup>	<u>Salix</u>	4/25/78	1
(3B) Sweetwater River, Rte. 94	<u>Salix</u> , <u>Populus</u> , <u>Baccharis</u>	5/14/78	-
		6/6/78	1
(4) Carrizo Marsh	<u>Prosopis</u> , <u>Tamarix</u>	5/6/78	-
(5) Vallecito Creek	<u>Prosopis</u> , <u>Chilopsis</u>	5/6/78	-
		5/13/78 <sup>2/</sup>	1
(6) Descanso	<u>Populus</u> , <u>Quercus</u>	4/21/78	-
(7) Otay River	<u>Salix</u> , <u>Baccharis</u>	6/13/78	-
		7/12/78	-
(8) Sorrento Valley	<u>Salix</u>	6/26/78	-
(9) San Clemente Canyon	<u>Platanus</u> , <u>Salix</u>	6/29/78	-
(10) Rose Canyon	<u>Platanus</u> , <u>Salix</u>	6/29/78	
(11A) San Diego River, Mission Dam Park	<u>Salix</u> , <u>Populus</u> , <u>Baccharis</u>	4/20/78	3
		4/21/78	5
		4/29/78	8
(11B) San Diego River west of Santee	<u>Salix</u> , <u>Populus</u>	4/29/78	3
(11C) San Diego River, Mission Valley	<u>Salix</u>	4/20/78	1
(12) San Felipe Creek	<u>Salix</u> , <u>Prosopis</u>	4/30/78	-
		5/7/78	1
(13) Banner Creek	<u>Populus</u> , <u>Alnus</u> , <u>Salix</u>	4/30/78	-
(14) Moosa Canyon <sup>2/</sup>	<u>Salix</u> , <u>Populus</u>	5/?/78	1
(15) Kit Carson Park	<u>Salix</u> , <u>Populus</u> , <u>Baccharis</u>	4/19/78	-
		4/29/78	-
(16A) San Luis Rey River, Oceanside Airport	<u>Salix</u> , <u>Populus</u>	5/13/78	
(16B) San Luis Rey River, Bonsall area	<u>Salix</u> , <u>Populus</u>	4/28/78	
		5/12/78	-
		6/4/78	-
		6/12/78	-
San Luis Rey River, 3-4 mi. west of I-15	<u>Salix</u> , <u>Populus</u>	5/12/78	3
		6/4/78	5
Santa Margarita River, Stagecoach Rd.	<u>Salix</u> , <u>Baccharis</u>	4/27/78	1
		6/3/78	5
Santa Margarita River, De Luz	<u>Salix</u> , <u>Populus</u> , <u>Baccharis</u>	4/28/78	-
		6/3/78	2
Santa Margarita River, 9 mi. east of main gate Camp Pendleton	<u>Salix</u> , <u>Baccharis</u>	6/12/78	2
(17D) Santa Margarita River 5 mi. east of main gate Camp Pendleton	<u>Salix</u>	7/14/78	2

1/ Censused by Phil Unitt

2/ Censused by Paul Jorgenson



Table 2. (cont.)

	<u>Locality</u>	<u>Dominant Vegetation</u>	<u>Date</u>	<u># Terr. Males</u>
(17E)	Santa Margarita River 3 mi. east of main gate Camp Pendleton	<u>Salix</u>	6/25/78	1
(18)	Las Pulgas Creek	<u>Salix</u> , <u>Baccharis</u>	4/28/78	-
(19)	Coyote Creek Canyon	<u>Salix</u> , <u>Prosopis</u>	6/29/78 5/7/78	- 5
(20)	Mouth of San Mateo Creek	<u>Salix</u>	7/1/78 6/19/78	8
<u>Orange County</u>				
(21)	Christianitos Creek	<u>Salix</u> , <u>Platanus</u>	5/18/78	-
(22)	San Juan Creek	<u>Salix</u> , <u>Baccharis</u>	5/18/78	-
(23)	Aliso Creek	<u>Salix</u>	5/18/78	-
(24)	Oso Creek	<u>Salix</u>	5/19/78	-
(25)	Santiago Creek	<u>Salix</u> , <u>Baccharis</u>	6/19/78	-
(26)	Modjeska Canyon	<u>Platanus</u> , <u>Quercus</u>	6/19/78	-
(27)	Trabuco Canyon	<u>Platanus</u> , <u>Quercus</u>	6/19/78	-
(28)	Featherly Park	<u>Salix</u> , <u>Baccharis</u> , <u>Populus</u>	5/17/78 6/19/78	- -
<u>Riverside County</u>				
(29)	Temecula Creek	<u>Salix</u> , <u>Populus</u>	4/27/78	-
(30)	Bautista Creek	<u>Populus</u> , <u>Salix</u> <u>Baccharis</u>	4/24/78 5/8/78	- -
(31)	San Jacinto River	<u>Populus</u> , <u>Salix</u> <u>Alnus</u> , <u>Baccharis</u>	4/27/78 5/8/78	- -
(32)	Palm Canyon	<u>Washingtonia</u> , <u>Prosopis</u> <u>Salix</u>	4/18/78 4/25/78	1 1
(33)	Murray Canyon	<u>Washingtonia</u>	5/3/78	-
(34)	Andreas Canyon	<u>Populus</u> , <u>Salix</u> , <u>Alnus</u> <u>Washingtonia</u> , <u>Prosopis</u>	4/18/78 4/25/78	1 1
(35)	Whitewater Canyon	<u>Populus</u> , <u>Salix</u> , <u>Prosopis</u>	5/3/78 5/26/78 4/18/78	1 4 -
(36)	Millard Canyon	<u>Alnus</u> , <u>Populus</u>	5/8/78	-
(37)	Mission Creek	<u>Prosopis</u> , <u>Populus</u> , <u>Salix</u>	6/7/78	-
(38)	San Timoteo Canyon	<u>Salix</u> , <u>Populus</u> , <u>Baccharis</u>	4/17/78 4/26/78 5/8/78 6/17/78	- 1 1 1
(39A)	Santa Ana River, Rubidoux Nature Center	<u>Salix</u> , <u>Populus</u> , <u>Baccharis</u>	4/13/78 7/16/78	- -
(39B)	Santa Ana River, Hamner Avenue	<u>Salix</u> , <u>Baccharis</u>	5/9/78 5/16/78 6/6/78	1 2 1

Table 2. (cont.)

	<u>Locality</u>	<u>Dominant Vegetation</u>	<u>Date</u>	<u># Terr. Males</u>
(39C)	Santa Ana River, Van Buren Avenue	<u>Salix</u> , <u>Populus</u>	5/16/78 6/10/78	- -
(39D)	Santa Ana River, Hidden Valley	<u>Salix</u> , <u>Baccharis</u>	5/16/78	-
(39E)	Santa Ana River, Etiwanda Avenue	<u>Salix</u> , <u>Populus</u>	6/11/78	1
(39F)	Santa Ana River, 64th Street	<u>Salix</u>	6/22/78	-
(39G)	Santa Ana River, Prado Park	<u>Salix</u> , <u>Populus</u> , <u>Baccharis</u>	5/16/78 7/6/78 7/9/78	- 2 3
(40)	Fairmount Park	<u>Populus</u> , <u>Vitis</u>	6/22/78	-

San Bernardino County

(41)	Big Morongo Wildlife Preserve	<u>Populus</u> , <u>Salix</u>	4/6/78 5/4/78 5/10/78 6/19/78	2 3 4 3
(42)	Upper Big Morongo Creek	<u>Populus</u> , <u>Baccharis</u>	6/1/78	-
(43)	Little Morongo Canyon	<u>Populus</u> , <u>Salix</u> , <u>Baccharis</u>	5/10/78 5/25/78	3 1
(44)	Upper Little Morongo Creek	<u>Populus</u> , <u>Baccharis</u>	6/7/78	-
(45)	City Creek	<u>Populus</u> , <u>Platanus</u>	4/10/78	-
(46)	Mouth Santa Ana River Canyon	<u>Salix</u> , <u>Alnus</u> , <u>Populus</u> <u>Baccharis</u>	4/3/78	-
(47A)	Mojave River, Mojave Narrows Park	<u>Populus</u> , <u>Salix</u> , <u>Prosopis</u>	4/10/78 5/12/78	- -
(47B)	Mojave River, Oro Grande	<u>Populus</u> , <u>Salix</u>	5/11/78 5/24/78	- -
(47C)	Mojave River, Silver Lakes	<u>Populus</u>	5/24/78	-
(47D)	Mojave River, Camp Cady	<u>Prosopis</u> , <u>Salix</u> , <u>Tamarix</u> , <u>Populus</u>	5/11/78	-

Los Angeles County

(48)	Mouth of Fish Canyon	<u>Salix</u> , <u>Alnus</u> , <u>Baccharis</u>	5/2/78	-
(49)	Mouth of Van Tassel Canyon	<u>Salix</u> , <u>Baccharis</u>	5/2/78 5/23/78	- -
(50)	Hansen Dam	<u>Salix</u> , <u>Baccharis</u>	5/22/78	-
(51)	Whittier Narrows Park	<u>Salix</u> , <u>Baccharis</u>	6/11/78	-
(52)	Van Norman Dam	<u>Salix</u>	7/12/78	2
(53)	Bell Canyon	<u>Salix</u> , <u>Baccharis</u>	7/2/78	-
(54)	Little Rock Creek	<u>Populus</u> , <u>Salix</u> , <u>Alnus</u>	5/23/78	-
(55)	Soledad Canyon	<u>Populus</u> , <u>Baccharis</u>	5/21/78	-
(56A)	Santa Clara-River, Valencia	<u>Salix</u> , <u>Populus</u> , <u>Baccharis</u>	5/22/78	-

Table 2. (cont.)

	<u>Locality</u>	<u>Dominant Vegetation</u>	<u>Date</u>	<u># Terr. Males</u>
(56B)	Santa Clara River, 3 mi. west of Ventura Co. line	<u>Salix</u> , <u>Populus</u> , <u>Baccharis</u>	5/22/78	-
(57)	Bouquet Canyon	<u>Salix</u>	6/23/78	-
(58)	Agua Dulce Canyon	<u>Populus</u> , <u>Salix</u>	6/23/78	-
(59)	San Fransisquito Canyon	<u>Salix</u> , <u>Populus</u>	5/21/78 <sup>1/</sup>	-
			6/15/78	1
			6/23/78	1
			7/2/78	1
<u>Ventura County</u>				
(60)	La Jolla Canyon <sup>2/</sup>	<u>Platanus</u> , <u>Rhamnus</u>	6/15/78	1
<u>Santa Barbara County</u>				
(61)	Santa Ynez River, Juncal Campground <sup>3/</sup>	<u>Salix</u>	6/21/78	1
			7/12/78	1
(62)	Mono Creek <sup>4/</sup>	<u>Salix</u>	6/21, 25/78	13
			7/16/78	8
(63)	Agua Caliente Creek <sup>5/</sup>	<u>Salix</u>	5/21/78	1
<u>Inyo County</u>				
(64)	China Ranch	<u>Salix</u> , <u>Prosopis</u>	5/29/78	1
(65)	Amargosa River, Tecopa	<u>Salix</u> , <u>Prosopis</u>	5/29/78	1

1/ Found by Kimball Garrett.

2/ Censused by Paul Lehman.

3/ Censused by Janet Hamber and Jim Greaves on 6/21, and by Paul Lehman and Jon Dunn on 7/12.

4/ Censused by Janet Hamber and Jim Greaves on 6/21 and 6/25.

5/ Censused by Bill Sheehan.

Table 3. Sites surveyed during concurrent survey of Least Bell's Vireos by Sanford Wilbur, U. S. Fish and Wildlife Service, April - July 1978.

<u>Locality</u>	<u># Terr. Males</u>
<u>Los Angeles County</u>	
Soledad Canyon	0
Mint Canyon	0
Bouquet Canyon	0
Elizabeth Lake	0
<u>Ventura County</u>	
San Antonio Creek, Ojai	0
Agua Blanca Creek	0
Ventura River, Ojai	0
Sisar Creek, Ojai	0
Santa Clara River, Santa Paula	0
Santa Clara River, Piru	1 <sup>1/</sup>
La Jolla Canyon, Pt. Mugu State Park	1 <sup>1/</sup>
<u>Santa Barbara County</u>	
Alisal Creek, Solvang	0
Foxen Canyon Road	0
Santa Ynez River at Mono Creek	8 <sup>1/</sup>
Happy Creek Canyon	0
Santa Ynez River, below Gibraltaz <sup>2/</sup>	0
Santa Ynez River, Juncal Campground <sup>2/</sup>	1 <sup>1/</sup>
Agua Caliente Creek <sup>2/</sup>	1 <sup>1/</sup>
<u>San Luis Obispo County</u>	
Santa Maria River, Santa Maria	0
Trout Creek, Santa Margarita	0
Salinas River, Santa Margarita	0
Estrella River, Estrella	0
Salinas River, Paso Robles	0
<u>Kern County</u>	
Buena Vista Lagoon (no habitat)	0
Tupman (no habitat)	0
Kern River Channel, Lost Hills	0
Fort Tejon	0
Caliente Creek, Caliente	0
<u>Monterey County</u>	
Salinas River, King City	0
Salinas River, San Ardo	0
Salinas River, San Lucas	0

Table 3. (cont.)

<u>Locality</u>	# Terr. <u>Males</u>
<u>Fresno County</u>	
Worthen Creek, Coalinga	0
Mill Creek, Piedra	0
San Joaquin River, San Joaquin	0
Lost Lake Recreation Area, Friant	0
<u>Kings County</u>	
San Joaquin River, Firebaugh	0
Kings River, Tivy Valley	0
Little Dry Creek, Millerton	0
<u>Tulare County</u>	
Kaweah River, Three Rivers	0
<u>San Benito County</u>	
Bear Gulch, Pinnacles National Monument	0
Chalone Creek, Pinnacles National Monument	0
Bear Valley, just, outside Pinnacles National Monument	0
<u>Merced County</u>	
Merced River, Snelling	0
Ingalsebe Slough, Snelling	0
McConnell State Park, Delhi	0
<u>Stanislaus County</u>	
Del Puerto Canyon	
<u>San Joaquin County</u>	
Corral Hollow	
Stanislaus River, Caswell State Park	

1/ Included on Table 2 also.

2/ Censused by Bill Sheehan for Sanford Wilbur.

Figure 4. Breeding habitat of Least Bell's Vireo at Mission Dam Park, San Diego County, California, 1978.

Figure 5. Breeding habitat of Least Bell's Vireo along Coyote Creek, Anza-Borrego State Park, San Diego County, California, 1978.

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Of approximately 129 km (80 mi) of riparian habitat censused by this researcher on foot, 111 km (69 mi), or 86% contained potential nesting habitat for Bell's Vireos. A little more than 24 km (15 mi) of habitat (19% of potential habitat) was occupied. Roughly 60% of the known or suspected potential habitat in San Diego, Riverside, Orange, Los Angeles and San Bernardino counties was surveyed. Ventura, Santa Barbara, San Luis Obispo and Inyo counties received less complete coverage, with censusing focusing on localities for which historical records of Bell's Vireos exist. Bell's Vireos were not found in many areas of extensive riparian habitat where they formerly nested (Table 4). Only 46% of former nesting sites which were included in the survey were occupied in 1978.

\* \* \*

Table 4. Former nesting localities of Least Bell's Vireos visited during 1978.

Locality	Date of Historical Occurrence	Date of Recent Occurrence	# Terr. Males	1978 Occurrence # Terr. Males
Campo Creek		1977	7	0
Otay River	1915			0
Sweetwater River	1915	1968	1	2
San Diego River	1895, 1911, 1920-22	1970-77	5-14	12
Rose Canyon	1921			0
Hodges Lake-Escondido	1915, 1932	1976	1	0
San Luis Rey River	1904-1919	1975-76	1-2	5
Santa. Margarita River	1919	1975	1	12
Jamul Creek		1975-76	2-4	9
San Juan Creek		1976	1	0
San Timoteo Canyon		1968, 1977	1	1
Bautista Canyon		1975, 1976	1-2	0
San Jacinto River	1908			0
Coyote Creek		1968	10	8
Vallecito Creek	1909			1
East Highlands		1965	1	0
Fish Canyon		1970-75	1-2	0
Van Tassel Canyon		1970-74	2-3	0
Morong Valley		1970-77	2-3	3
Palm Canyon	1908			1
Murray Canyon	1908			0
Mojave River	1867.			0
Santa Ana River	1891-92, 1916-1949			6
San Gabriel River	1927, 1929			0

\* \* \*

#### Nesting Chronology and Reproductive Success

Least Bell's Vireos begin to arrive by late March. Three males were heard singing on territory at Old Mission Dam on 26 March 1978 (G. McCaskie fide P. Unitt). First nesting attempts are initiated in mid-April or early May. Each pair spends four to five days constructing a cup-shaped nest composed of leaves, bark, willow catkins, spider webs and other materials. Nest height averages two to four feet above the ground. Eleven of fifteen nests observed in 1977 and 1978 fell within this range, two were slightly lower, and two others were respectively six and eight feet off the ground. Nests are usually constructed in a clump of dense understory vegetation, although they sometimes hang in an area clear of leaves, under the canopy of a low tree or shrub.

A complete clutch usually contains four small, white oval eggs, lightly spotted with red-brown at one end. Eggs are laid on successive days following completion of the nest. Incubation is shared by both parents and begins after the third or fourth egg is laid. Nestlings hatch after about fourteen days. Chicks fledge ten to twelve days after hatching (Nolan 1960). If a nest fails, construction on a new nest usually begins within one or two days.

Reaction of Bell's Vireos to the appearance of a cowbird egg varies. Vireos may desert the nest after a cowbird egg is deposited (Pitelka and Loestner 1942), but frequently they raise a cowbird. Cowbirds often puncture or remove vireo eggs, so the total number of eggs present in a nest does not change. In one instance, a cowbird egg was found on the ground beneath a vireo nest, presumably expelled by the vireos.

The reproductive success of eleven pairs was documented from nesting through fledging (Table 5). These eleven pairs nested at least once, and four attempted to nest a second time. The major causes of nesting failures were cowbird parasitism and predation, accounting for 46% and 27% respectively, of the failures noted. Nesting success was greater on second attempts than first attempts, 50% vs. 18%, but only four of the eleven pairs were successful in hatching young.

\* \* \*

Table 5. Reproductive success of Least Bell's Vireo nests observed during the 1978 breeding season.

A. No. of nesting pairs observed	11	
B. No. of known nesting attempts	15	(11-4) <sup>1/</sup>
C. Failure due to predation	3	(2-1)
D. Failure due to cowbird parasitism	3	(3-0)
E. Failure due to cowbird parasitism and subsequent predation	2	(1-1)
F. Failure due to unknown causes	3	(3-0)
G. Total nests known hatching only vireo eggs	4	(2-2)
		Nesting success, 1st attempt = $B_1/G_1 = 18\%$
		Nesting success, 2nd attempt = $B_2/G_2 = 50\%$
		Overall nesting success = $B/G = 36\%$
H. No. of eggs laid	38	(12) <sup>2/</sup>
I. No. of eggs hatched	12+	(12) <sup>2/</sup>
		Hatching success = $I/H = 31\%$
J. No. of young fledged	7+	(12) <sup>2/</sup>
K. No. of pairs with fledglings	4	
		Fledging success = $J/I = 58\%$
		Breeding success = $J/A = 63\%$

<sup>1/</sup> Paranthetical values indicate data for initial and subsequent nesting attempts respectively.

<sup>2/</sup> No. of nesting attempts for which clutch size is known in parentheses.

\* \* \*

Due to parasitism and predation only 31% of the eggs hatched and the fledging success, the number of hatchlings which fledge, was only 58%. The overall breeding success, the number of young fledged per pair, was exceedingly low, 0.63 per pair. Cowbird parasitism was recorded in 7 of 12 nests, (58%). One of these nests successfully fledged young vireos after the cowbird egg was removed.

In addition to the four successful broods whose entire nesting history was documented, eight other broods were located (Table 6). Fifty percent of those broods consisted solely of Brown-headed Cowbird chicks.



Table 6. Brood composition of vireos with young.

Broods with vireo chicks	8
Broods with cowbird chicks	4
Nesting success of pairs with young	67%

\* \* \*

#### DISCUSSION

Prior to this survey, the population of Least Bell's Vireos in California was estimated to be as low as thirty pairs (Gaines 1977, Remsen 1978). The nearly ninety territorial males or pairs located during this study reflect the results of intensive searching of potential habitat and should not be construed as an indication of a population increase.

The distribution of Least Bell's Vireos within their present range is uneven at best. Disturbance or destruction of habitat explains the absence of the vireos from many previously recorded nesting localities. But, they are missing from numerous locations where apparently suitable habitat still remains. Least Bell's Vireos are also absent from extensive areas of riparian vegetation adjacent to seemingly identical habitat occupied by one or more pairs. The total breeding population is apparently too small to occupy most of the available nesting habitat.

Densities in most populations consisting of four or more pairs are about three to five vireos per kilometer (5 to 8 per mile) of habitat. This is much lower than those reported by Grinnell and Storer (1924) who observed three vireos along 300 yards of the Tuolumne River below LaGrange and eight vireos along an equal length of the Merced River at Snelling. As mentioned previously, only the density of Least Bell's Vireos in Coyote Creek Canyon was very close to density figures from populations in the Sacramento Valley.

The exact habitat requirements of Least Bell's Vireos have not been precisely delineated. Historical accounts describe the vireos as inhabitants of "low riparian growth" (Grinnell and Miller 1944) and "dense thickets of willows and other plants" (Grinnell and Storer 1924). Dense understory vegetation is an essential structural component of Bell's Vireo habitat, since the species only occasionally forages, and rarely nests more than six feet above the ground. Most accounts link the vireos with the presence of willows, but the association is not obligatory. Vegetation structure appears equally important as species composition in determining preferred habitat. Several territories were located where willows comprised little or none of the vegetation.

Two Bell's Vireos were found singing in recently established riparian vegetation behind the old Van Norman Dam. This reservoir was drained following damage by an earthquake in 1971. The appearance of vireos in newly created habitat (less than eight years old) suggests that restoration of riparian vegetation could provide new nesting habitat for the birds if other factors limiting the population were removed.

During the 1978 nesting season, reproductive success of Least Bell's Vireos was extremely low. Less than one fledgling per pair was produced. Hatching success may have been greater than 36% because clutches were incomplete or

vireo eggs were removed by cowbirds or predators before nests were located. If all fledglings in each brood were not observed, then fledging and breeding success may also have been underestimated. Up to six additional fledglings may have gone undetected, increasing the breeding success to about one fledgling per pair.

Similar studies of the nominate race of Bell's Vireos (V. b. bellii) in Indiana (Nolan 1960) and Oklahoma (Overmire 1962) indicate higher reproductive success. Nesting, hatching and breeding success in the Oklahoma study were 48, 46, and 77 percent respectively. These are somewhat higher than the corresponding success rates found; however, the 60% fledging success agrees with the 58% fledging success determined in my study. Nolan reported slightly higher nesting and fledging success than Overmire. In Nolan's study, hatching success was more than twice as great as I observed for Least Bell's Vireos, and breeding success was about three times higher than my results. Both Nolan and Overmire recorded lower rates of nest parasitism by cowbirds than I found in southern California. Nolan recorded only 13% and Overmire found 30% of the vireo nests had been parasitized by cowbirds.

Since habitat does not appear to be limiting vireo numbers, predation and nest parasitism by Brown-headed Cowbirds are the major factors reducing nesting success. Bell's Vireos are especially vulnerable to predation because they nest close to the ground. By doing so, the nests are within easy reach of mammals and snakes, as well as avian predators such as crows and jays. The male frequently sings near the nest, and may sing directly from the nest (E. A. Cardiff, pers. comm.). Predators responsible for the removal of eggs or nestlings during this study were not identified although predation accounts for a high number of the nesting failures observed during this study, all songbirds including Bell's Vireos are able to sustain losses to predators and still raise sufficient young to maintain their populations. Additional nesting failures caused by nest parasitism by cowbirds apparently is reducing nesting success to a level below that needed to maintain a stable vireo population. Least Bell's Vireos have been exposed to nest parasitism for a relatively short period of time, since the arrival and expansion of cowbird populations in California during the early Twentieth Century (Gaines 1977, Goldwasser 1978). The vireos have been unable to adapt to the increasing pressure from cowbird parasitism and, as a result, have suffered severe population declines. The high incidence of nest parasitism by cowbirds observed during this study corroborates the theory that this factor is probably the primary cause of the catastrophic decline of Least Bell's Vireos in California.

#### ACKNOWLEDGEMENTS

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## APPENDIX A

### Descriptions of Sites Occupied by Least Bell's Vireos, April-July 1978.

#### San Diego County

Jamul Creek. Jamul Creek joins Dulzura Creek in the Jamul Valley, flowing west into Lower Otay Lake. Continuous riparian vegetation dominated by willows and mule fat lines the creek for over two miles, east of Lower Otay Lake. Scattered habitat also grows along Dulzura Creek east to Dulzura. Habitat formerly (1977) occupied by four pairs of Least Bell's Vireos was flooded in 1978 by an increase in the level of Lower Otay Lake. Nine vireos were located in Jamul Valley. Cowbirds are common here.

Sweetwater River. The Sweetwater River flows southwest from the Cuyamaca Mountains into San Diego Bay. Extensive cottonwood-willow habitat, accompanied by luxurious undergrowth, begins at the Route 94 bridge at Jamacha Jct. and continues along 1.5 miles of the river. One vireo was found here. Broken riparian occurs west of the Sweetwater Reservoir, between Willow Road and I-805. Most of the habitat has been removed upstream from Bonita. One vireo was found at Bonita. Cowbirds are abundant along this river.

San Diego River. The San Diego River flows from the Cuyamaca Mountains southwest into Mission Bay. A narrow strip of willows gradually widens into dense cottonwood-willow woodland between Santee and Mission Dam Park, then narrows again. Riparian vegetation occurs for more than four miles. Eight vireos were concentrated in the densest thickets near the dam, and three more were spread out further upstream. Another vireo was found in Mission Valley, in a stand of tall willows between I-15 and I-805. Cowbirds are fairly common along this river.

San Luis Rey River. The San Luis Rey River begins on the slopes of Palomar Mountain above Lake Henshaw, and flows into the Pacific Ocean at Oceanside. Several scattered stands of willows occur east of I-15. Dense riparian vegetation dominated by cottonwoods (*Populus fremontii*) and willows occurs nearly continuously between Gird Road and County Road S-13, a distance of about six miles. Five vireos were singing between Gird Road and Via Monserate. Good riparian habitat extends over another mile or more near the Oceanside Airport. Cowbirds are abundant here.

Moosa Canyon. Moosa Canyon flows west from Oat Hills to Bonsall, where it joins the San Luis Rey River. Willow thickets occupy about a mile from just east of I-15 west to Camino El Rey. Two individuals (a pair?) were seen together here by Paul Jorgenson. Cowbirds are present in small numbers here.

Santa Margarita River. This river has some of the most extensive riparian habitat in southern California. Nearly continuous riparian vegetation dominated by willows and accompanied by substantial understory thickets extends from east of I-15 through Temecula Canyon, to Fallbrook and across Camp Pendleton. Below the Naval Hospital, the vegetation is discontinuous, but still able to support Bell's Vireos in many places. Seven vireos were found between Stagecoach Road and Fallbrook and five more were along the lower Santa Margarita River in Camp Pendleton. Cowbirds are fairly common along this river.

Vallecito Creek. Vallecito Creek is mainly a desert wash, but a very dense thicket of mesquite (Prosopis juliflora) and desert willow (Chilopsis linearis) above Campbell Grade has sufficient moisture and vegetation to prove attractive to a Bell's Vireo. One male was found here by Paul Jorgenson.

San Felipe Creek. San Felipe Creek flows southeast from the San Felipe Hills, then turns northeast after entering Sentenac Canyon. A small freshwater marsh is replaced by riparian vegetation after the creek enters the canyon. Willows grow along a little more than a mile of the creek. One vireo was singing here and no cowbirds were observed.

Coyote Creek Canyon. Coyote Creek runs southeast from the Santa Rosa Mountains into the Borrego Valley north of Borrego Springs. Approximately one mile of riparian habitat grows along the creek at Lower Willows. Willows predominate, but the understory is also composed of mesquite, Arrowweed, and tamarisk. Eight vireos had established territories at Lower Willows. Cowbirds are common in this canyon.

#### Riverside County

Palm Canyon. Palm Canyon is located seven miles south of Palm Springs. A palm oasis with some willows, cottonwoods and mesquite thickets extend several miles up the canyon. One vireo was located here. No cowbirds were seen in the canyon.

Andreas Canyon. Andreas Canyon is situated four miles south of Palm Springs, at the eastern base of the San Jacinto Mountains. Over a mile of cottonwood-willow and palm oasis are found along the stream near the canyon mouth. Similar habitat may be present further upstream, but the canyon is strictly controlled by the Agua Caliente Indians and was not open. Four vireos had territories in suitable habitat checked. No cowbirds were observed here.

San Timoteo Canyon. San Timoteo Canyon lies about three miles south of Redlands, and runs southeast to northwest from Beaumont. Riparian vegetation extends for approximately six miles, from three miles west of I-10 to Redlands Boulevard. Dominant vegetation includes willows, cottonwoods and mule fat. One Bell's Vireo was found in the canyon, across from Fisherman's Retreat resort. Cowbirds are a common species here.

Santa Ana River. The Santa Ana River originates in the San Bernardino Mountains and flows south and west through the San Bernardino Valley, across Riverside and into the Prado Flood Control Basin. Several miles downstream, the river is channelled and continues west to the Pacific Ocean. Although much of the original riparian habitat along the river has been altered or destroyed, extensive willow thickets are still found along about six or eight miles of the riverbanks east of the Prado Basin. The Prado Basin, over five miles wide in some places, contains extensive willow forests. Three vireos were observed along the river near Norco, and three more were located in Prado Regional Park. Cowbirds are one of the most abundant bird species along this river.

#### San Bernardino County

Big Morongo Wildlife Preserve. Big Morongo Creek is a desert oasis located 0.5 miles east of the town of Morongo Valley. The riparian habitat

is slightly more than one mile in length and runs north to south. Cottonwood and willows are dominant species in the oasis. Three territorial males and an apparently unmated male were observed here, along with several cowbirds.

Little Morongo Canyon. Little Morongo Canyon is a desert oasis three miles northeast of the town of Morongo Valley. Cottonwood, willow, mesquite and mule fat are common plant species along the creek. Three Bell's Vireos were heard singing here in early May, but only one pair was seen in June. No cowbirds were observed here.

#### Ventura County

La Jolla Canyon. La Jolla Canyon is on the coast at Point Mugu State Park. A streambed (dry in June) supports sycamores and several species of shrubs, but no willows. This habitat is atypical compared to other locations where Bell's Vireos were found. One pair of vireos nested here, and was parasitized by cowbirds, although no cowbirds were seen.

#### Santa Barbara County

Mono Creek. This tributary of the Santa Ynez River is located west of the Pendola Forest Service Station. Dense thickets of willows line the lower creek, below the debris dam. Above the debris dam, cottonwoods and willows are spread over a larger area. Thirteen vireos were found here by Janet Hamber and Jim Greaves. A few cowbirds were present here.

Santa Ynez River. Much of the riparian vegetation along this creek received extensive flood damage from the heavy winter rains of 1977-1978, but habitat at the Juncal Campground was sufficient to support one Bell's Vireo. Willows and other low riparian vegetation are present.

Agua Caliente Creek. This creek, also a tributary of the Santa Ynez River, was visited by Bill Sheehan, who found one vireo singing in dense willows and Lavatera sp.

#### Inyo County

China Ranch. Willow Spring at China Ranch drains into the Amargosa River south of Tecopa. A lush stand of willows, mesquite and cottonwoods extends for over a mile downstream from the spring. The habitat is densest at the upper end of the oasis. One Bell's Vireo was found singing in low willows and mesquite across from a residence. Cowbirds are common in the canyon.

## APPENDIX B

### Descriptions of Surveyed Sites Unoccupied by Least Bell's Vireos.

#### San Diego County

Campo Creek. Campo Creek, west of Campo, has about three miles of willows and other vegetation that appears suitable for Bell's Vireos.

Carrizo Marsh. Bow Willow, Vallecito and Carrizo Creeks meet near the Imperial County line. Mainly mesquite and salt cedar grow along the wash, and recent floods have influenced vegetation. No habitat suitable for Bell's Vireos exists, but willows seem to be sprouting near the marsh.

Descanso. Narrow riparian habitat lines the Sweetwater River in Descanso, but the elevation (3600 ft) seems higher than most localities where Bell's Vireos were observed.

Otay River. Narrow but dense willow thickets grow along the Otay River east of I-5, along a mile of the river, Upstream the river is lined with occasional willows and low tamarisks for at least four miles.

Sorrento Valley. Sorrento Valley, just south of Del Mar, supports nearly a mile long stand of willows west of I-5.

San Clemente Canyon. The section of San Clemente Canyon surveyed, at San Clemente Park, contained predominantly sycamores and live oaks, with a few willows. Not enough understory vegetation was present in most places for Bell's Vireos.

Rose Canyon. The half-mile section of Rose Canyon that was surveyed supported willow thickets along half of that distance. The remainder of the area surveyed was clear or channelled. More riparian vegetation may be present further upstream.

Banner Creek. Banner Creek at Banner has nearly one mile of riparian vegetation consisting primarily of cottonwood and alder. The understory is sparse and the elevation is near the upper limit of Bell's Vireos' range.

Kit Carson Park. Kit Carson Park in Escondido has about one mile of riparian habitat, primarily willow and mule fat. It appears ideal for Bell's Vireos.

Las Pulgas Creek. Las Pulgas Creek, west of Basilone Road, has nearly three miles of willow riparian habitat which closely resembles habitat occupied by Bell's Vireos on the nearby Santa Margarita River.

#### Orange County

San Mateo Creek. Dense willow thickets grow at the mouth of San Mateo Creek, near San Onofre.

Christianitos Creek. Sycamores and willow thickets grow along the section of Christianitos Creek that was surveyed. The extent of the habitat could not be determined.



San Juan Creek. Riparian vegetation in San Juan Creek received flood damage from heavy winter rains of 1977-1978. Several thickets of willows and mule fat grow along the stream east of San Juan Capistrano.

Aliso Creek. Aliso Creek, where it was surveyed near Laguna Niguel, supports a narrow strip of willows about one mile in length.

Oso Creek. Riparian vegetation along Oso Creek at Mission Viejo grows for at least a mile, parallel to I-5. Willows and mule fat predominate in the narrow thickets.

Santiago Creek. One mile of riparian habitat was surveyed along this creek. Willow and mule fat are common plant species. Dense thickets of grapevines and other plants occur in a few places, but most of the habitat is too sparse to support Bell's Vireos.

Modjeska Canyon. A narrow strip of riparian vegetation, dominated by sycamores with a sparse understory, is found along the stream. The habitat is not suitable for Bell's Vireos to nest in.

Trabuco Canyon. Trabuco Canyon is similar to Modjeska Canyon. Sycamores and live oaks are common in the canyon, and no nesting habitat for Bell's Vireos is present.

Featherly Park. Several miles of cottonwood, willow and mule fat thickets grow along the Santa Ana River in the vicinity of Featherly Park. The dense willow thickets are narrow, but probably could support Bell's Vireos.

#### Riverside County

Temecula Creek. Temecula Creek, east of I-15, supports two miles of willow and cottonwood riparian vegetation.

Bautista Creek. Nearly three miles of cottonwoods, mule fat, willows and other riparian species grow in Bautista Canyon, about twelve miles south-east of Hemet. Bell's Vireos have nested here recently (1976).

San Jacinto River. About four miles of riparian vegetation, consisting of cottonwoods, alders, willows and sycamores grows along the San Jacinto River east of San Jacinto. Willows, blackberry, and poison oak bushes form a dense understory in scattered areas along the river.

Murray Canyon. Palm oasis with scattered willows and mesquite grows in the mile of Murray Canyon that was surveyed.

Mission Creek. Two short sections of Mission Creek support riparian vegetation. A small grove of cottonwoods occurs several miles up the canyon, and a thicket of cottonwoods draped with grapevines, and a few mesquite and willow plants grow further downstream.

Millard Canyon. No habitat suitable for Bell's Vireos was found here. A short stand of alders and scattered cottonwoods grow along the stream.

Whitewater Canyon. More than a mile of cottonwood, willow, mesquite and mule fat dominated vegetation grows along the Whitewater River.

Fairmount Park. A large grove of cottonwoods draped with grapevines, and some willows and mule fat are found west of Lake Evans.

#### San Bernardino County

Upper Big Morongo Creek. Scattered thickets of willows, alders, cottonwoods and mule fat occur along two miles of the creek upstream from the town of Morongo Valley.

Upper Little Morongo Creek. One grove of cottonwoods, willows and mule fat grows near a private residence in the canyon.

City Creek. At the mouth of City Creek Canyon, there are sycamores, mule fat, and a few willows. Along the creek there is a short stretch of willows and alders.

Santa Ana River Canyon. Vegetation at the mouth of the Santa Ana River Canyon is similar to that at City Creek, but more extensive. Upstream, alders predominate.

Mojave River. Extensive riparian habitat occurs along the Mojave River at Mojave Narrows. A cottonwood forest, accompanied by dense willow thickets is present at Mojave Narrows and near Oro Grande. Cottonwoods line many miles of the riverbanks, but understory vegetation is sparse or absent in most of those areas. Near Camp Cady, thickets of mesquite and tamarisks are accompanied by willows and a few cottonwoods.

#### Los Angeles County

Fish Canyon. The mouth of Fish Canyon supports a small area of alders, willows and mule fat. Habitat may have been altered by recent heavy rains. Bell's Vireos were seen here recently (1974).

Van Tassel Canyon. Willows and mule fat predominate in the riparian vegetation that grows at the mouth of Van Tassel Canyon. The habitat grows along one half-mile or more of the creek and recently (1975) supported two to three pairs of Bell's Vireos.

Hansen Dam. Scattered clumps of willows extend around the perimeter of the lake behind Hansen Dam. The habitat may not be continuous enough to support Bell's Vireos.

Whittier Narrows Park. The Whittier Narrows Park and nearby nature sanctuary do not contain habitat suitable for Bell's Vireos. The nearby river channel, which was not surveyed, apparently does have potential Bell's Vireo habitat, but is not occupied at present (K. Garrett, pers. comm.).

Bell Canyon. Bell Canyon, at the northeast corner of the San Fernando Valley, has nearly a mile of willows and mule fat. The vegetation is narrow, but includes a dense understory.

Soledad Canyon. Spotchecks were made along the length of this canyon. The riparian vegetation extends for more than ten miles, but is primarily cottonwood with very little undergrowth.

Santa Clara River. The Santa Clara River near Valencia supports a very lush growth of cottonwoods, willows, and other riparian species. Width of the vegetation exceeds three hundred feet in many places. This habitat is comparable to many localities where Bell's Vireos nest.

Little Rock Creek. Below Little Rock Dam, nearly a mile of willows, cottonwoods and alders line Little Rock Creek. Several thickets appeared to have potential Bell's Vireo habitat.

Bouquet Canyon. Bouquet Canyon has a narrow strip of riparian vegetation, composed of willows and live oaks. Understory vegetation is sparse.

Agua Dulce Canyon. Less than a mile of riparian vegetation grows along this stream west of Vasquez Rocks County Park. Cottonwoods, willows and mule fat are dominant plant species here.

#### Inyo County

Amargosa River. A short section of the Amargosa River south of Tecopa was surveyed. A series of springs supports several clumps of willows. More extensive habitat further downstream was not censused.

APPENDIX D

Recommended Sites for Cowbird Control Programs.

Jamul Creek, San Diego County.

Mission Dam Park, San Diego County.

San Luis Rey River, San Diego County.

Santa Margarita River, San Diego County.

Coyote Creek, San Diego County.

Mono Creek and Santa Ynez River, Santa Barbara County.

APPENDIX E

Areas to be Censused in Future Surveys.

San Diego County

San Luis Rey River between S.D. County Rd. S-13 and San Luis Rey.

Santa Margarita River, Temecula Canyon and between Fallbrook and the Naval Hospital on Camp Pendleton.

Coyote Creek Canyon, Middle Willows.

Riverside County

Taquhitz Canyon.

Palm Canyon (only lower one mile of canyon was checked in 1978).

Prado Flood Control Basin, downstream from Prado Regional Park.

Andreas Canyon above fenced area if permission can be obtained.

Santa Barbara County

Twitchell Reservoir

Vandenburg Air Force Base.

Kelly Creek.

Inyo County

Amargosa River south of Tecopa.

JOB FINAL REPORT

State: California

Project Number: W-54-R-11 Project Title: Nongame Wildlife Investigations

Job Number: IV - 1.5.1 Job Title: Least Bell's Vireo Study

Period Covered: July 1, 1978 - June 30, 1979 Job Type: Survey & Inventory

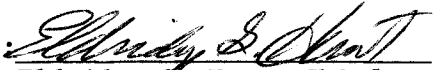
SUMMARY: See Job IV - 1.5.1 Final Report, W-54-R-10 (1977-78).

FINDINGS: Job Final Report submitted October 12, 1978. See Job IV - 1.5.1 Final Report, W-54-R-10 (1977-78).

ANALYSIS: Field work on this study was completed in July, 1978. The Job Final Report was prepared in August and September, 1978 and submitted in October, 1978 as a part of project W-54-R-10. This report fully covered the work done on this job during FY 1978-79.

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Date: July 30, 1979