EXHIBIT D

Endangered Bird Species and California Bird Species of Special Concern within Hahamongna Watershed Park

C. Darren Dowell, Ph. D., Lance A. M. Benner, Ph. D., and Michael C. Long
on behalf of the Pasadena Audubon Society
April 24, 2015

Summary:

Hahamongna Watershed Park contains regionally-significant riparian habitat which is a critically-important breeding zone for a number of bird species, including three that are identified as vulnerable on Federal and State lists: the Least Bell's Vireo (federally endangered), the Yellow Warbler (a California bird species of special concern), and the Yellow-breasted Chat (also a California bird species of special concern). Using the eBird online database, we summarize observations of these three species within Hahamongna during the breeding seasons of recent years. The Yellow Warbler is present annually in large numbers, with observations establishing the high regional significance of Hahamongna as a breeding site. The Least Bell's Vireo and Yellow-breasted Chat have been present in low numbers during several summers, with strong breeding evidence. In addition, Hahamongna has provided winter habitat for Loggerhead Shrike, also a California bird species of special concern.

1. Introduction

Over 210 bird species have been seen at Hahamongna Watershed Park in Pasadena, California, and among those, approximately 55 are local breeders. Three known or suspected breeding birds at Hahamongna are classified as federally endangered or California Bird Species of Special Concern: Least Bell's Vireo, Yellow Warbler, and Yellow-breasted Chat. Another California Bird Species of Special Concern – Loggerhead Shrike – has been present during some winters over the last 25 years. This report summarizes recent observations of these species at Hahamongna using on-site photography and sound recording, as well as sightings submitted to the eBird[1] online database.

The eBird bar (abundance) charts in Figures 1 and 2 illustrate the four basic migration patterns for birds in Hahamongna: 1) summer visitors such as Yellow Warbler, present through June and July – in North America, almost always an indication of a bird on its breeding territory; 2) year-round residents such as Common Yellowthroat and Hutton's Vireo, which are also typically summer

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[1] eBird is a popular and powerful on-line tool developed by the Cornell Lab of Ornithology to archive and summarize bird surveys from both professional and amateur birders for locations around the world. To date, more than 100 million observations have been entered into eBird.

breeders; 3) winter visitors such as Yellow-Rumped Warbler which are non-breeders at that time of year; and 4) migrants such as Nashville Warbler seen only in spring and/or fall, and non-breeders at that time. *Multiple pairs of Yellow Warbler take advantage of the regionally-uncommon riparian habitat in Hahamongna for annual breeding. As indicated by their presence in summer, Least Bell's Vireo and Yellow-breasted Chat are also considered likely breeders in Hahamongna, although in lower number. All three species depend on riparian habitat for breeding and survival.*

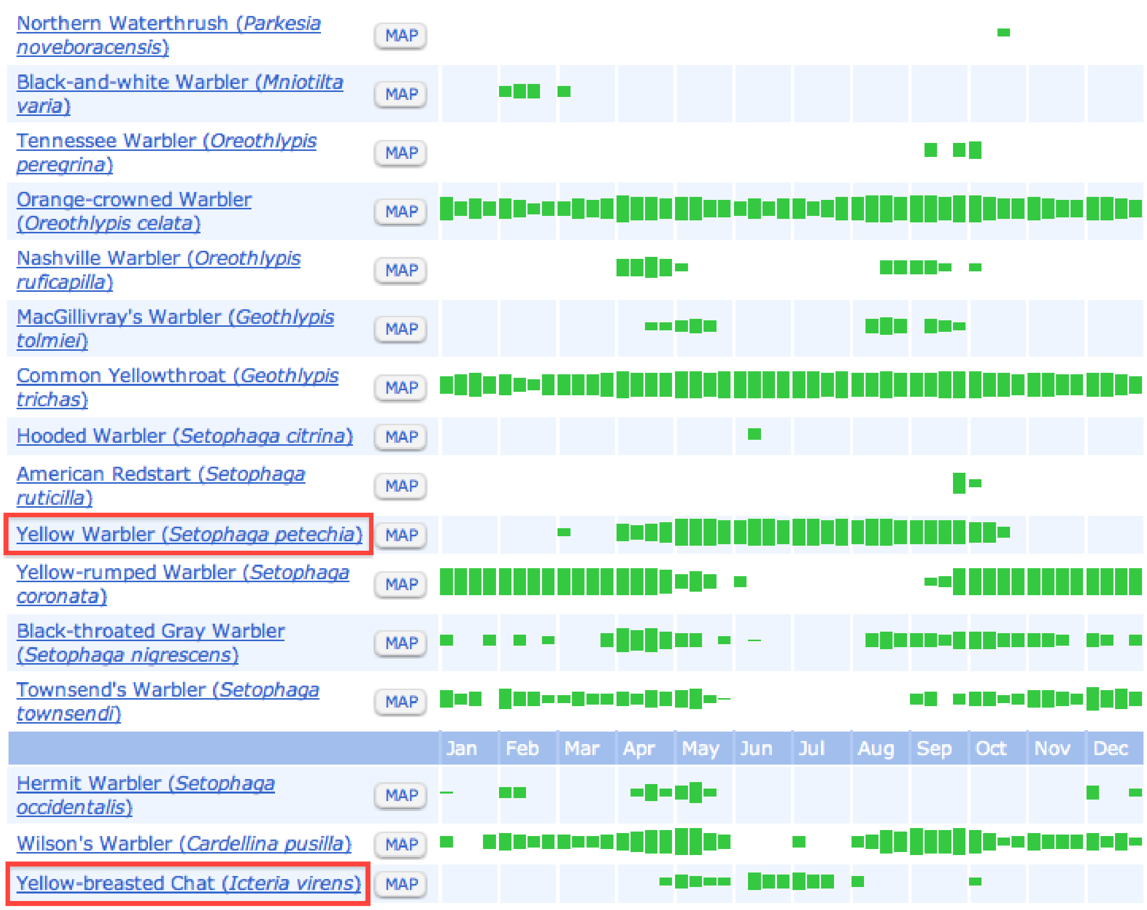

Figure 1: Bar charts for Warbler species generated (with eBird, in 2013) from sightings at Hahamongna. A green line or bar indicates presence of the indicated species for the time of year in which the mark is shown. The vertical width of the green mark indicates the fraction of bird surveys that detected the species. The two Warbler species that are California Bird Species of Special Concern are highlighted in red.

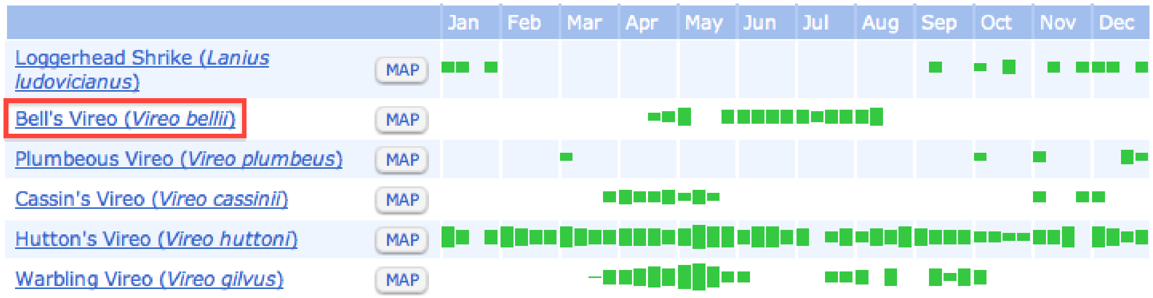

Figure 2: Similar to Figure 1, but shown for Vireo species, including the federally-endangered Bell's Vireo. (The subspecies designation "*Least*" Bell's Vireo does not show in the eBird chart.)

In Sections 2-4, we review the observations of the Least Bell's Vireo, Yellow Warbler, and Yellow-Breasted Chat found in Hahamongna that are officially identified for their vulnerability.

2. Least Bell's Vireo

The Least Bell's Vireo has been on the federal endangered species list since 1986 (e.g., U.S. Fish & Wildlife website ecos.fws.gov). The Least Bell's Vireo is an "obligate riparian species during the breeding season … [that] typically inhabits cottonwood-willow forests, oak woodlands, and mule fat scrub…. Extensive breeding habitat loss and degradation and brood parasitism by the brown-headed cowbird have resulted in a range-wide decline of the Least Bell's Vireo. These factors continue to be the most serious threats to the recovery of the Least Bell's Vireo." (Draft recovery plan for the Least Bell's Vireo, U. S. Fish and Wildlife Service, 1998.).

More specifically, nesting habitat for the Least Bell's Vireo has been described for the well-studied population at Prado Basin, Riverside County, a flood control basin behind Prado Dam, which can be reasonably assumed to represent habitat needs at Hahamongna. At Prado the birds "typically nest in dense riparian understory dominated by mulefat (*Baccharis salicifolia*), willows, mugwort (*Artemisia douglasiana*), *Bidens spp., Mexican tea (*Chenopodium abrosiodes*), Hooker's evening primrose (*Oenothera hookeri grisea*),* and stinging nettle *(Urtica holosericea),* among others . . . . . " (Least Bell's Vireo and Southwestern Willow Flycatchers in Prado Basin of the Santa Ana River Watershed, CA, J. Pike, G. Burchett,L. Hays, and R. Zembal 2004). Nests were placed, on average, just over 3 feet (1.1 m) off the ground and predominantly in Willows or Mule Fat (citation above). The birds depend on both a dense overstory of willow woodland and an understory of smaller shrubs. Black Willow and Mule Fat are dominant components of the riparian habitat at Hahamongna.

Least Bell's Vireos have been present in Hahamongna during the summer breeding seasons in 2007, 2012, 2013, 2014, and 2015 (Figure 3; Table 1). *The birds have been observed to cover a wide range in riparian willow forest and mule fat scrub in the* *southern half of the Hahamongna basin, with so far no observations in the surrounding oak woodland* (Figure 3).

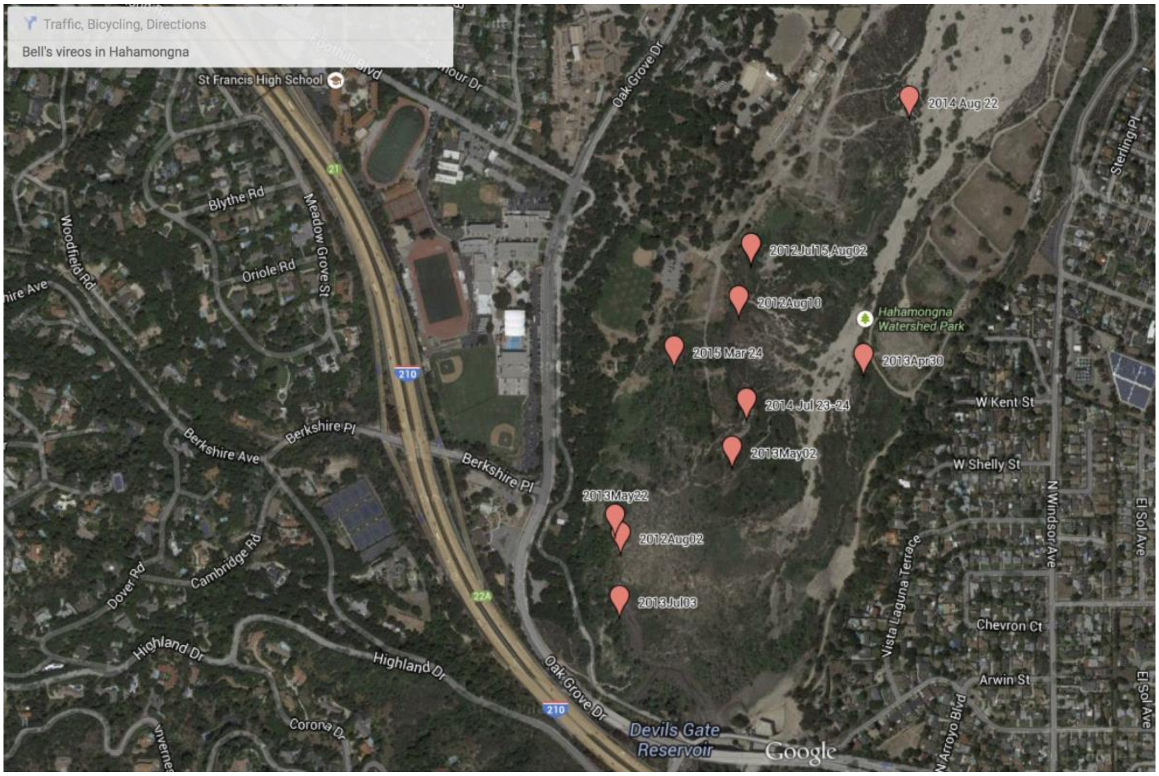

Figure 3: Map showing location of sightings of Least Bell's Vireo within Hahamongna during 2012-2015 breeding seasons.

Two Least Bell's Vireos – an apparent adult and juvenile traveling together, generally considered evidence of local breeding – were found in Hahamongna on July 15, 2012. Since then, Pasadena Audubon members and other local birders have intensified efforts to monitor the presence of this species in Hahamongna. Observations collected to date include visual sightings, photography, audio detections by ear, and sound recordings. Much of this information is being documented in the publically-accessible eBird.org and xeno-canto.org[2] databases.

[2] xeno-canto.org is an online database of worldwide bird vocalizations where more than 150,000 recordings of 8800+ species have been archived.

Figure 4: Photographs of Least Bell's Vireos within Hahamongna, both on Aug 2, 2012. The image at right is the only one available showing both individuals of this highly active species in the same frame.

Singing is used by adult male Least Bell's Vireos to establish and defend breeding territories (adult females do not sing; Brown 1993). Thus, the presence of singing Least Bell's Vireos is additional evidence for breeding. The audio recordings obtained in 2012-2015 all feature singing. The songs are complex (Figures 5-6) but are unlike those of other local birds and are thus easy to identify.

Table 1: Notable breeding season records of Least Bell's Vireo within Hahamongna.

date(s)	observer(s)	comments / field notes
1993 August 9	T. Alsobrook, E. Jackson	one individual heard
1993 August 23	T. Alsobrook	one individual
2007 April 21	J. Fenwick	two individuals
2007 April 28	J. Fenwick	one individual
2012 July 15 – August 10	7 different observers entered records into eBird	two individuals – one adult and one juvenile – present during breeding season
2012 July 15	D. Bell	birds first noticed; binocular observations and photography led this expert observer to conclude that one was an adult and the other was a juvenile, based on details of the edgings on the tertials and scapulars
2012 July 29	L. Benner	photographs; audio recordings of a singing adult male made, xeno-canto database records XC106462 and XC 106457
2012 August 2	D. Dowell	photograph of both individuals in the same frame (Figure 3 above)

2013 April 30 – July 14	14 different observers entered records into eBird	one individual, frequently singing so a presumed adult male, present during breeding season
2013 May 1, 24	L. Benner	photographs and audio recordings of a singing adult male, xeno-canto database records XC132023 and XC134888
2014 July 23-24	D. Dowell, L. Benner	photographs and recordings of singing adult male, xeno-canto database records XC188496, XC188497, and XC188498
2014 August 22	D. Dowell	visual observation, no vocalizations detected
2015 March 24	D. Dowell	recording of singing bird, xeno-canto database record XC233134

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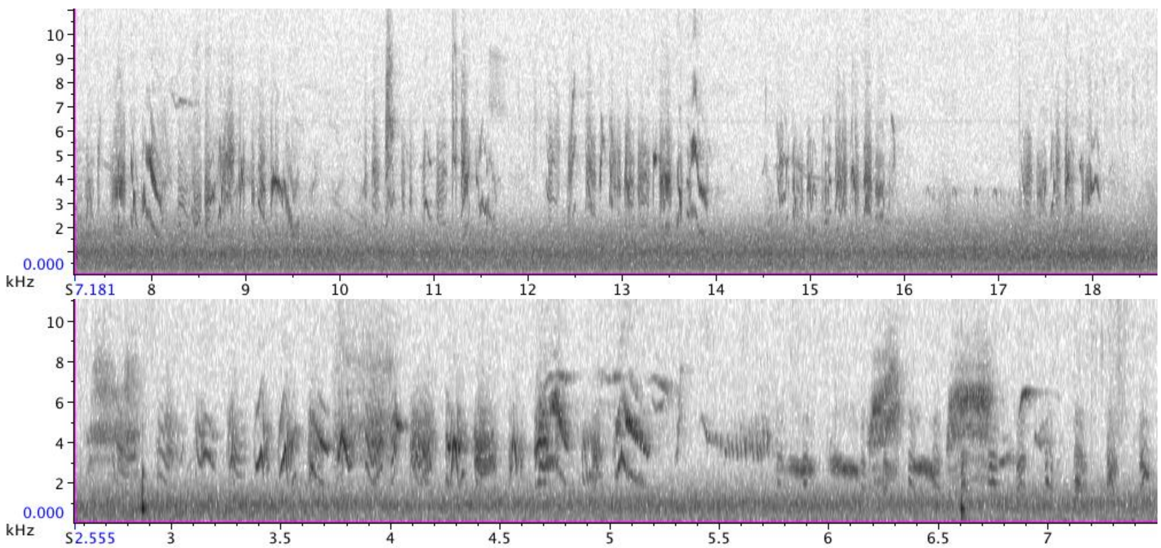


Figure 5: Audio spectrograms of an adult male Least Bell's Vireo at Hahamongna from July 29, 2012. In each spectrogram, the frequency (pitch) of the vocalizations is shown as a function of time. The highly complex pattern is characteristic of Least Bell's Vireo songs. The recordings are available on the Xeno-Canto database of worldwide bird vocalizations website at: http://www.xeno-canto.org/106462 (top) and http://www.xeno-canto.org/106457 (bottom).

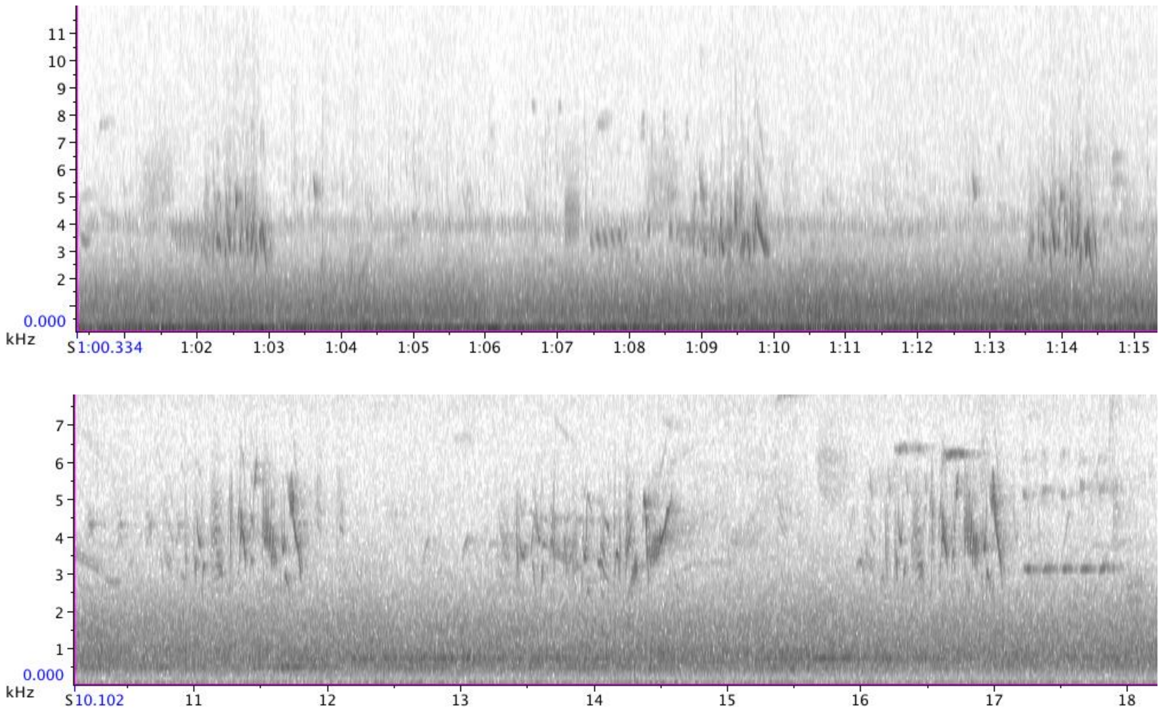


Figure 6: Audio spectrograms of an adult male Least Bell's Vireo at Hahamongna from May 1 (top; available on Xeno-Canto at http://www.xeno-canto.org/132023) and May 24 (bottom; available on Xeno-Canto at http://www.xeno-canto.org/134888), 2013.

3. Yellow Warbler

Figure 7: Yellow Warblers, Hahamongna Watershed Park. Left: adult (July 2011). Right: adult feeding fledgling (July 2012).

The Yellow Warbler (Figure 7) has been designated a California Bird Species of Special Concern by the California Department of Fish and Game and by Western Field Ornithologists due to overall range contraction within the state and vulnerability due to its need for specific, riparian breeding habitat (W.D. Shuford & T. Gardali, California Bird Species of Special Concern, 2008). Figure 8 and Table 2 below demonstrate that *Hahamongna Watershed Park is a key stronghold for the Yellow Warbler within the San Gabriel Valley*.

Yellow Warblers nest and forage almost exclusively within the willow forest at Hahamongna (Figures 8 and 90 below). Yellow Warblers arrive at Hahamongna in early April, nest in late spring or early summer, and then depart for wintering grounds with their young by early October. In general, Yellow Warblers exhibit a high degree of site fidelity (Shuford & Gardali, 2008), therefore the majority of Yellow Warblers (males especially) at Hahamongna return to this breeding ground year after year. Any loss of willow habitat at Hahamongna reduces the chance of survival of this local population through decreased availability of food and nesting sites, and increased threat from exposure to predators and human activities as they are pushed to marginal habitat.

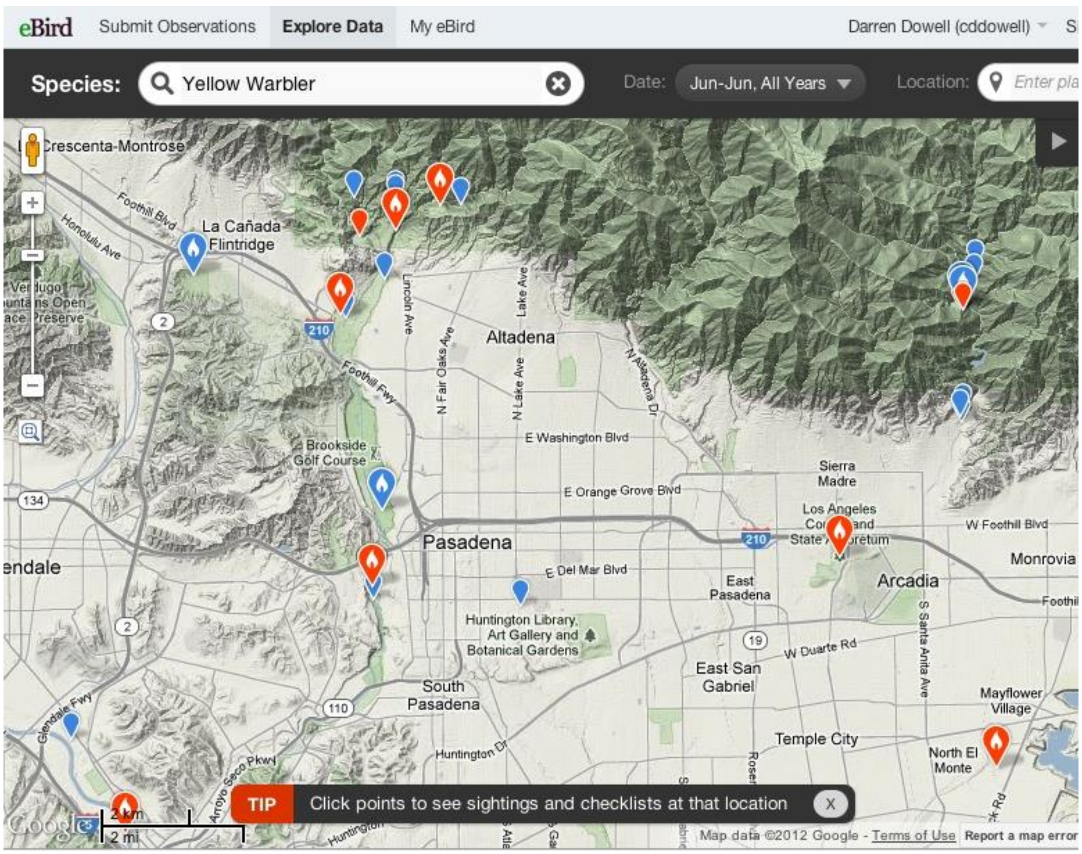


Figure 8: Distribution of Yellow Warblers in the San Gabriel Valley for the month of June (breeding season) for the past few years, generated with eBird (observations through 2012). Red and blue symbols show locations at which Yellow Warbler has been detected. Yellow Warblers breed only in riparian areas such as the Arroyo Seco, Big Santa Anita Canyon, Los Angeles River, and Rio Hondo; they do not breed in San Gabriel Valley neighborhoods or foothill chaparral, nor (apparently) in Eaton Canyon. Among the areas shown on this map, Hahamongna has the highest count of Yellow Warbler.

Figure 9. Yellow Warbler distribution from a survey of the Hahamongna *perimeter* in 2007 (from report by J. Feenstra). Yellow Warblers are relatively easy to survey, since the males sing a clear, unique song through the spring and summer months, and the chip calls of the females are fairly easy to detect once the spring migration period has passed. Yellow Warbler counts are shown on the map by the Yellow dots. All of the reported birds are within the willow forest at the wetter, southern end of the basin, except for one report in oak/sycamore habitat near the settling ponds at the north end.

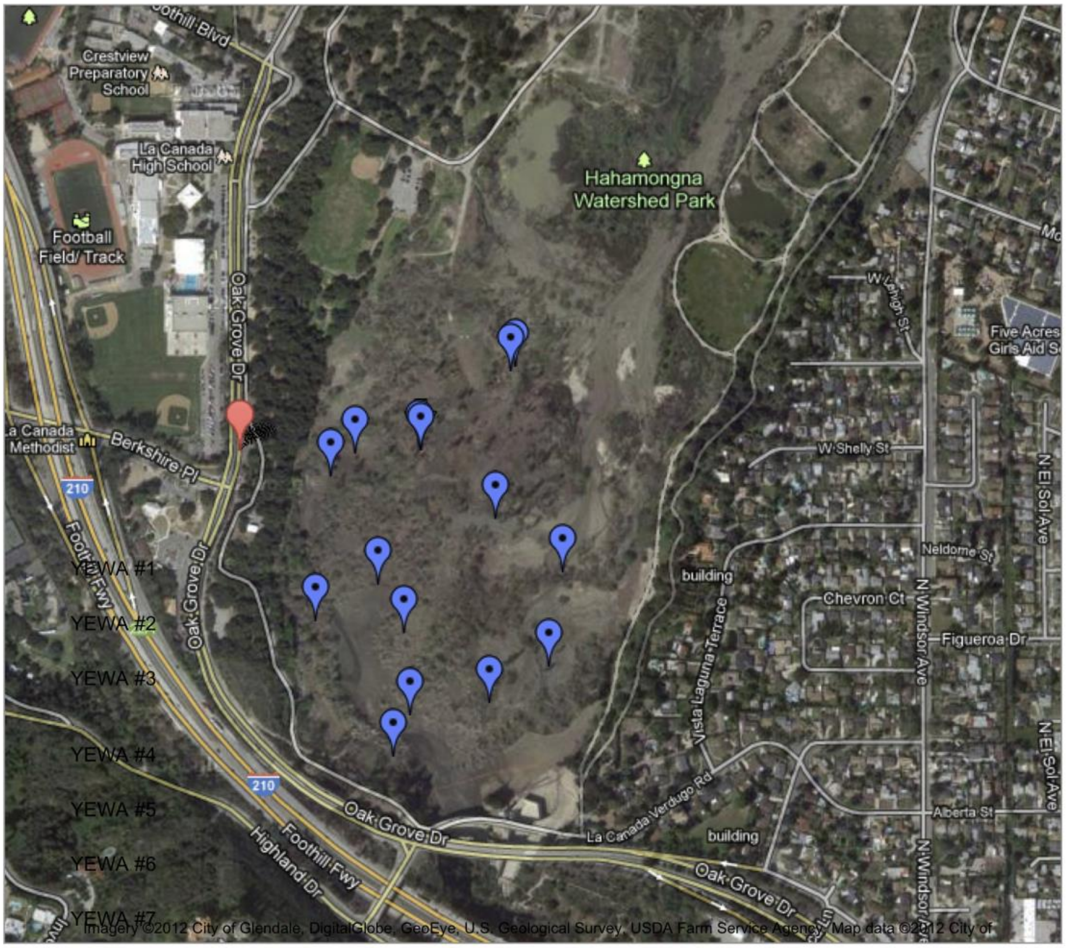


Figure 10. Yellow Warbler distribution at Hahamongna from a June 2012 survey of the willow forest (*perimeter and interior*). Blue symbols show individual detections of Yellow Warbler; 15 birds were detected, which is a typical count at Hahamongna mid-summer. In this satellite photo, it is possible to trace the boundary of the main riparian willow forest: adjoining the (darker) oak woodland at the west and east perimeter trails, extending northward to the Oak Grove parking area and southern spreading ponds, and filling in the southern region to near Devil's Gate Dam.

Table 2: Records of Yellow Warbler within Hahamongna during summer breeding season, for five most recent years.

summer	high count of Yellow Warblers detected during summer	count date	observer(s)
2014	20	June 28	D. Dowell
2013	13-15	May 4, July 26	D. Bell, D. Dowell
2012	15	June 30	D. Dowell
2011	30-32	May 20, June 4	D. Bell, D. Dowell
2010	12	August 27	D. Dowell
2009	20	June 12, 19	D. Dowell

4. Yellow-Breasted Chat

The Yellow-breasted Chat (Figure 11) has been designated a California Bird Species of Special Concern by the California Department of Fish and Game and by Western Field Ornithologists due to overall range contraction within the state and vulnerability due to its need for specific, riparian breeding habitat (W.D. Shuford & T. Gardali, California Bird Species of Special Concern, 2008). Male Yellow-breasted Chats within breeding territory are vocally conspicuous, but otherwise Chats are secretive and therefore difficult to detect in surveys. However, *a potential breeding pair or two have been present in Hahamongna for several summers within the past two decades*. Table 3 below lists summer (May – August) records of Yellow-breasted Chat in Hahamongna with 2 or more Chats detected by skilled observers, extracted from the eBird database.

Figure 11: Photograph of Yellow-breasted Chat in Hahamongna (August 2014, by G. Wu).

Table 3: Recent records of *multiple* Yellow-breasted Chats within Hahamongna during summer breeding season.

summer	minimum count of Chat during summer	sighting dates	observer(s)
2014	2	June 28	D. Dowell (simultaneous audio recording)
2013	2	July 11	D. Dowell
2009	2	June 12, 14	D. Dowell, J. Feenstra
2008	3	June 27	L. Benner, J. Feenstra
2002	2	May 8, June 14	M. San Miguel
1997	2	July 5, 19	K. Garrett

4. Loggerhead Shrike

The Loggerhead Shrike (Figure 12) has been designated a California Bird Species of Special Concern by the California Department of Fish and Game and by Western Field Ornithologists (W.D. Shuford & T. Gardali, California Bird Species of Special Concern, 2008). As stated in this source, "Loggerhead Shrike … numbers have declined greatly and the species is nearing extirpation in broad areas of coastal southern California…. The threats responsible for shrike declines in California and the West are poorly understood…. Habitat loss, on breeding and wintering grounds as well as along migratory routes, is undoubtedly a major threat to the species." The northern half of Hahamongna has the open woodland and shrubland that shrikes require. Records in eBird document at Hahamongna 2 individuals in winter 1991-1992 and single birds in winter 1992-1993, 1993-1994, 1995-1996, 2011-2012, 2012-2013. Not necessarily evident in those records, but very clear in the nearly 70 years of Pasadena/San Gabriel Valley Audubon Christmas Bird Counts is that the abundance of Loggerhead Shrike has declined to a remnant population in the San Gabriel Valley over the past few decades.

Figure 12: Photograph of Loggerhead Shrike in Hahamongna (December 2012).

Attached:

Draft recovery plan for the Least Bell's Vireo, U. S. Fish and Wildlife Service, 1998 (Exhibit A);

Least Bell's Vireo and Southwestern Willow Flycatchers in Prado Basin of the Santa Ana River Watershed, CA, J. Pike, G. Burchett,L. Hays, and R. Zembal 2004 (Exhibit B);

Xeno-canto Data (Exhibit C);

W.D. Shuford & T. Gardali, <u>California Bird Species of Special Concern</u>, 2008 (Exhibit D);

J. Feenstra, The Birds of the Arroyo Seco: Results of Surveys 2007 -2009 2010 (Exhibit E);

E-Bird Data (Exhibit F);

C. Darren Dowell, Ph.D. Resume (Exhibit G);

Lance A.M. Benner, Ph.D. Resume (Exhibit H);

Michael C. Long Resume (Exhibit I);

Kus, B. 2002. Least Bell's Vireo (*Vireo bellii pusillus*). *In* The Riparian Bird Conservation Plan: a strategy for reversing the decline of riparian associated birds in California. California Partners in Flight. http://www.prbo.org/calpif/html docs/riparian_v2.html (Exhibit J);

U.S. Fish & Wildlife Service, Least Bell's Vireo (Vireo bellii puysillus) 5-Year Review Summary and Evaluation, 2006 (Exhibit K);

Orange County Water District, Least Bell's Vireo, 2013 (Exhibit L); and

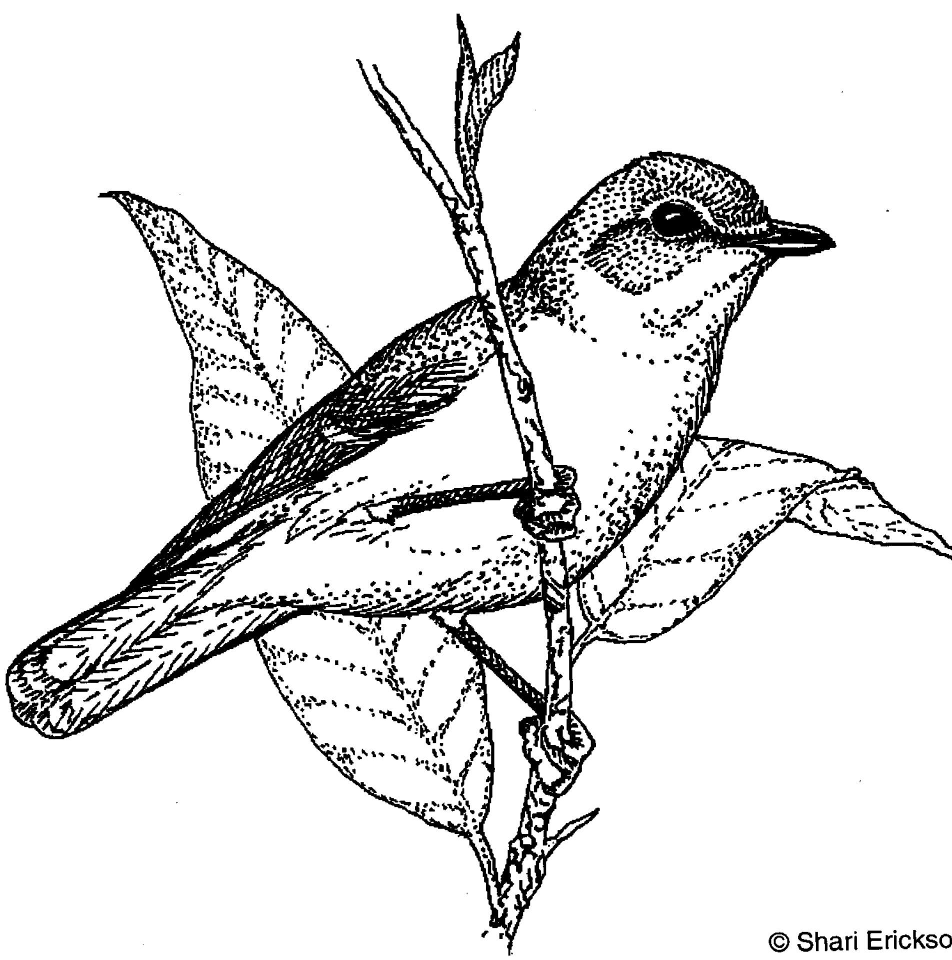
Thomas E. Olson and M. Violet Gray, Characteristics of Least Bell's Vireo Nest Sites Along The Santa Ynez River, USDA Forest Service General Tech Rep. 1989 (Exhibit M).

EXHIBIT A

U.S. Fish and Wildlife Service

Draft Recovery Plan

For the Least Bell's Vireo
(Vireo bellii pusillus)



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DRAFT RECOVERY PLAN

for the

LEAST BELL'S VIREO

(*Vireo bellii pusillus*)

Prepared for

Region 1
U.S. Fish and Wildlife Service
Portland, Oregon

Approved: ______________________________________
Regional Director, U.S. Fish and Wildlife Service

Date: ______________________________________

DISCLAIMER PAGE

Recovery plans delineate reasonable actions required to recover and/or protect listed species. Plans are published by the U.S. Fish and Wildlife Service (Service), sometimes prepared with the assistance of recovery teams, contractors, State agencies, and other affected and interested parties. Recovery teams serve as independent advisors to the Service. Objectives of the plan will be attained and any necessary funds made available, subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities. Recovery plans do not obligate other parties to undertake specific tasks and may not represent the views nor the official positions or approval of any individuals or agencies involved in the plan formulation, other than the Service. They represent the official position of the Service **only** after they have been signed by the Regional Director or Director as **approved**. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and the completion of recovery tasks.

Literature citation should read as follows:

Fish and Wildlife Service. 1998. Draft recovery plan for the least Bell's vireo. U.S. Fish and Wildlife Service, Portland, OR. 139 pp.

ACKNOWLEDGMENTS

This recovery plan was initially prepared by Dr. Barbara Kus of the Department of Biology, San Diego State University, San Diego, California with assistance from D. Ann Kreager, U.S. Fish and Wildlife Service, Carlsbad Fish and Wildlife Office, Carlsbad, California, and Jill Dye and Gary Waayers also of the Department of Biology, San Diego State University. Jon Avery, U.S. Fish and Wildlife Service, Carlsbad Fish and Wildlife Office, Carlsbad, California, assisted in final revisions and updating of this recovery plan.

Numerous individuals, organizations, jurisdictions, and agencies have contributed significantly to the development of the information contained in this recovery plan, as well as to the improved status of the least Bell's vireo from the time the species was federally listed as endangered. In addition to the individuals who over the years collected, analyzed, and disseminated data, further acknowledgments are extended to the United States Army Corps of Engineers (COE); United States Forest Service; United States Marine Corps, Camp Pendleton; Naval Facilities Engineering Command, Southwest Division; San Diego Association of Governments; California Department of Transportation, District 11; counties of San Diego, Orange, and Riverside; and Orange County Water District, for considerable financial assistance.

EXECUTIVE SUMMARY
OF THE
RECOVERY PLAN FOR THE LEAST BELL'S VIREO
(Vireo bellii pusillus)

Current Species Status:

The breeding distribution of the least Bell's vireo (*Vireo bellii pusillus*) is currently restricted to eight southern counties in California and portions of northern Baja California, Mexico. Available census data indicate that the least Bell's vireo population in southern California increased from an estimated 300 pairs in 1986 to an estimated 1346 pairs in 1996. Least Bell's vireos winter in southern Baja California, Mexico. The least Bell's vireo was listed as endangered on May 2, 1986. Critical habitat for the species was designated on February 2, 1994.

Habitat Requirements and Limiting Factors:

The least Bell's vireo is an obligate riparian species during the breeding season and is characterized as preferring early successional habitat. This species typically inhabits structurally diverse woodlands along watercourses, including cottonwood-willow forests, oak woodlands, and mule fat scrub. Little is known about their winter habitat requirements, but they are not exclusively dependent on willow-dominated riparian woodland habitat on their wintering grounds. Most least Bell's vireos in winter occur in mesquite scrub vegetation in arroyos, but some also use palm groves and hedgerows associated with agricultural fields and rural residential areas.

Extensive breeding habitat loss and degradation and brood parasitism by the brown-headed cowbird (*Molothrus ater*) have resulted in a rangewide decline of the least Bell's vireo. These factors continue to be the most serious threats to the recovery of the least Bell's vireo. Populations occurring in the Owens Valley, Death Valley, Sacramento-San Joaquin Valleys and Sierra Nevada foothills, and Tehama County have been completely extirpated. Vast portions of these areas are no longer available for recolonization or expansion.

Recovery Objective:

The objective of this plan is the reclassification of the least Bell's vireo to threatened and, ultimately, delisting through recovery.

Downlisting Criterion:

Reclassification to threatened may be considered when criterion 1 has been met for a period of 5 consecutive years.

Criterion 1: Stable or increasing least Bell's vireo populations/metapopulations, each consisting of several hundred or more breeding pairs, are protected and managed at the following sites: Tijuana River, Dalzura Creek/Jamul Creek/Otay River, Sweetwater River, San Diego River, San Luis Rey River, Camp Pendleton/Santa Margarita River, Santa Ana River, an Orange County/Los Angeles County metapopulation, Santa Clara River, Santa Ynez River, and an Anza Borrego Desert metapopulation.

Delisting Criteria:

Delisting may be considered when the species meets the criterion for downlisting and the following criteria have been met for 5 consecutive years.

Criterion 2: Stable or increasing least Bell's vireo populations/metapopulations, each consisting of several hundred or more breeding pairs, have become established and are protected and managed at the following sites: Salinas River, a San Joaquin Valley metapopulation, and a Sacramento Valley metapopulation.

Criterion 3: Threats are reduced or eliminated so that least Bell's vireo populations/metapopulations listed above are capable of persisting without significant human intervention, or perpetual endowments are secured for cowbird trapping and exotic plant control in riparian habitat occupied by least Bell's vireos.

Actions Needed:

The plan describes a strategy for reclassification, recovery, and delisting. Instrumental to this strategy is securing and managing riparian habitat within the historical breeding range of the least Bell's vireo, annual monitoring and rangewide surveys, and research activities necessary to monitor and guide the recovery effort.

Recovery Costs:

Costs of specific recovery actions will be determined as information is obtained and/or final actions are undertaken. These items are designated as "to be determined" (TBD) in the Implementation Schedule.

Total ($1000)	1999	2000	2001	2002	2003
8402 + TBD	1037	2080	2065	1705	1515

Date of Recovery: A delisting target date cannot be projected at this time.

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I. INTRODUCTION

The Ecosystem Approach

This recovery plan for the least Bell's vireo (*Vireo bellii pusillus*), if successfully implemented, will lead not only to the recovery of this species, but also assist in the recovery of one of the most critically endangered ecosystems in the United States: southwestern riparian habitat. Recovery of this ecosystem, through preservation and restoration, will constitute a significant contribution to protection of native North American wildlife.

It is impossible to manage some species in isolation from other species. Species are components of complex ecosystems, influencing and influenced by biotic and abiotic features of their environments. The current emphasis on multiple species protection and management reflects a more accurate recognition of the way organisms interact with their environments, thus enhancing the ability to reverse species' declines and potentially preventing the need for future listings.

The least Bell's vireo was one of the first members of the riparian ecosystem to be recognized as declining to the brink of extinction, partially in response to the decimation of its habitat. The precipitous decline of the least Bell's vireo portends the probable fate of other riparian species in the absence of remedial action to change the status quo of land use in California. Although this recovery plan focuses on the least Bell's vireo, achievement of its recovery will ensure protection to a suite of sensitive species also dependent upon the riparian ecosystem.

The least Bell's vireo is a recoverable species. It has survived extensive modification, degradation, and loss of the habitat, demonstrating its ability to rebound after management preserves or restores the conditions under which the species evolved. It is the goal of this recovery plan to guide such management, leading to the ultimate delisting of the species.

The Riparian Ecosystem. A riparian habitat is a plant community that develops along the margins of freshwater streams, lakes, and rivers where soils are damp and sandy. The structure and composition of riparian plant communities are related to the physiography and hydrology of each watershed and consequently vary throughout the range of the least Bell's vireo. Community types such as southern willow scrub, and mule fat scrub (scrub habitat dominated by *Baccharis glutinosa*), sycamore alluvial woodland, coast live oak riparian forest, arroyo willow riparian forest, and cottonwood bottomland forest (Holland 1986, Faber *et al.* 1989), exemplify least Bell's vireo habitats in California.

Although riparian vegetation comprises a small proportion of the California landscape relative to various other habitat types, the value of this habitat to wildlife is disproportionately high. Riparian habitats support more species of birds than any other habitat type in California; more than 140 species occur in riparian habitat, and 88 of these are obligate riparian species (Faber *et al.* 1989). Birds use riparian habitats for nesting, wintering, or both. The mammalian community is also diverse and consists of several species that are dependent upon riparian woodlands for water, forage, and cover, such as the long-tailed weasel (*Mustela frenata*) and bobcat (*Felis rufus*). Insects are abundant and play important ecological roles as both predators and prey. Many species of fish, reptiles, and amphibians occupy riparian habitats and contribute to its immense diversity. According to the U.S. Council on Environmental Quality (1978, as cited in Faber *et al.* 1989), "no ecosystem is more essential than the riparian system to the survival of the nation's fish and wildlife."

Part of the reason for the high diversity of the riparian community lies in its structural complexity, which allows for "niche partitioning" in which different species seeking food, nest sites, and cover in the same habitat evolve behaviors to use different resources or the same resources in different ways (e.g., different times or space) to avoid competition. The presence of tall trees and a diverse understory creates a microclimate that differs from that of adjacent upland habitats in its high humidity and cooler temperatures. Insects thrive in this environment and are an abundant and dependable food source for many insectivorous animals. Many animals in upland communities are attracted to riparian woodlands for access to water, shelter, and shade, particularly during the rainless southern California summers. The riparian zone also serves as a natural corridor, linking adjacent ecosystems and facilitating movement of animals between them. In these ways, the presence of riparian habitat significantly enriches regional biodiversity beyond what could otherwise be supported.

Not only are many riparian animals and plants listed as rare or endangered, the entire riparian community faces continual threats associated with human activities, including agriculture, flood control projects and channelization, livestock grazing, sand and gravel extraction, road construction, and residential and commercial development. Riparian habitat has been vanishing from the landscape of California at such a pace that today less than 10 percent of the riparian woodlands in existence at the time of the Gold Rush in the 1850's remain (Smith 1977), and those are but fragmented remnants. Faber *et al.* (1989) reported a 95–97 percent loss of naturally vegetated floodplains in southern California. Oberbauer (1990) reported a 61 percent loss of riparian habitat for San Diego County. The relatively higher proportion of riparian habitat remaining in San Diego County corresponds with the largest remaining least Bell's vireo populations, both at the time of listing and currently.

Fortunately, because of the dynamic aspect of riparian vegetation, riparian habitat is resilient and has high restoration potential, as long as the floodplain and fluvial processes (i.e., natural water flow and sedimentation regimes) are restored or intact. However, restoration ecology is in its infancy, and there is much yet to learn about how natural riparian ecosystems function. Until we perfect our ability to restore degraded environments to functioning, self-sustaining ecosystems, protection of existing habitat must be the conservation priority.

A. Brief Overview

The least Bell's vireo is a migratory songbird dependent upon riparian habitat for breeding. Historically, this species was widespread throughout riparian woodlands in the Central Valley and low elevation riverine valleys of California and northern Baja California (Figure 1). The least Bell's vireo was characterized by Grinnell as one of the most abundant birds in the state (Cooper 1861, Anthony 1893, 1895, Fisher 1893, Grinnell and Swarth 1913, Grinnell and Storer 1924, Grinnell and Miller 1944). In the last several decades, the species has undergone a precipitous decline in numbers, a decline attributable to the loss and degradation of riparian habitat throughout its range, as well as to the expansion in range of the brown-headed cowbird (*Molothrus ater*), a nest parasite (Garrett and Dunn 1981). Within California, least Bell's vireos are currently restricted in their distribution to eight southern counties (Figure 1), with the majority of birds occurring in San Diego County (RECON 1989, Appendix A).

In response to the dramatic reduction in numbers and range of the least Bell's vireo in California, the California Fish and Game Commission listed the species as endangered on June 27, 1980, under the California Endangered Species Act of 1970. The U.S. Fish and Wildlife Service proposed the least Bell's vireo for listing on May 3, 1985 (U.S. Fish and Wildlife Service 1985), and the species was subsequently federally listed as endangered on May 3, 1986 (U.S. Fish and Wildlife Service 1986), under the Endangered Species Act of 1973, as amended (Act). Critical habitat for the least Bell's vireo was designated on February 2, 1994 (U.S. Fish and Wildlife Service 1994). These designations afford a procedural process for protection of the least Bell's vireo under State and Federal laws. The species' recovery priority number is 3C, indicating it is a subspecies with a high degree of threat, has a high potential for recovery, and is in conflict with development activities.

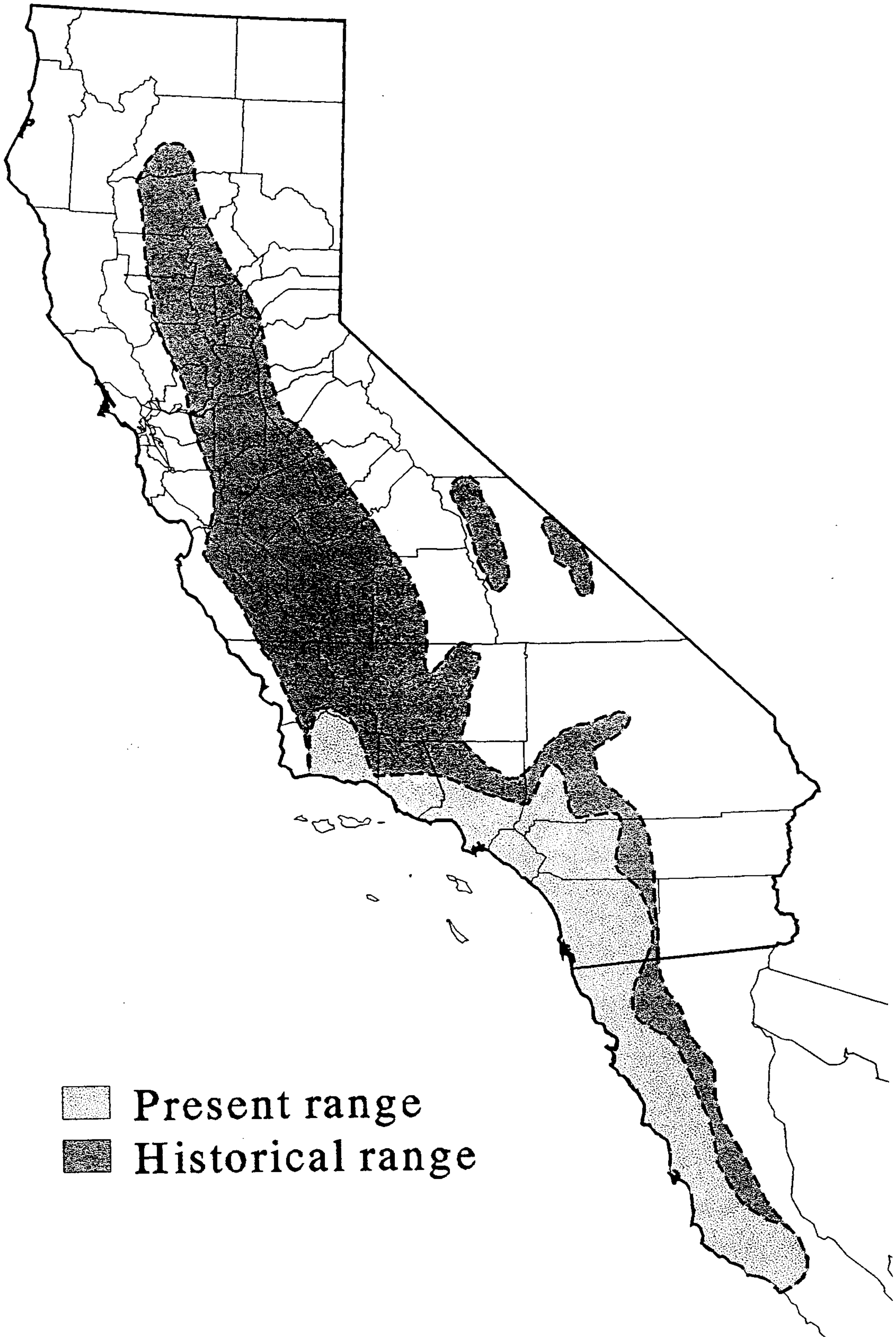

Figure 1. Historical and present ranges of least Bell's vireos.

B. Species Description

Apparently the first account of the least Bell's vireo was written by J. G. Cooper and was based on two specimens he collected in 1861 along the Mojave River near Manix in San Bernardino County, California (Cooper 1861). The original description of the least Bell's vireo (Coues 1866) states:

> The color of the upper parts is a plain dull ashy gray on the head; tinged with grayish olivaceous on the rest of the upper parts. Above grayish ash, becoming more or less ashy olivaceous on the back; not more so on the rump than elsewhere. Below pure white, including under wing coverts; on the breast sometimes a faint suffusion of the lightest possible shade of brownish gray; sides under the wings moderately tinged with sulphur yellow. A narrow short superciliary streak; edges of eyelids, two bands on wings and narrow margins of outer border of wings and tail, dull white; on the latter tinged with olivaceous.

The least Bell's vireo is easily recognized on the breeding grounds by its distinctive song (Coues 1903), characterized by Peterson (1961) as "husky, unmusical phrases at short intervals: cheedle cheedle chee? - cheedle cheedle chew! First phrase ends in rising inflection; second phrase, given more frequently, has downward inflection and sounds as if bird were answering its own question."

Although indistinguishable to the human ear, the least Bell's vireo actually possesses a repertoire of songs, variants of the "question" and "answer" components, through which males rotate (Beck 1996). Males possess individually unique repertoires of from 5 to 15 songs, which are evidently fixed by the first breeding season, providing a "vocal fingerprint" for identifying individual birds. Beck (1996) hypothesizes that the possession of unique repertoires may function in neighbor and/or mate recognition.

C. Taxonomy

Four subspecies of the Bell's vireo (American Ornithologists' Union 1957) have been recognized. Although all subspecies are similar in behavior and life history, they are isolated from one another on both the breeding and wintering grounds (Hamilton 1962) . The least Bell's vireo (*Vireo bellii pusillus*) breeds in California and northwestern Baja California, Mexico, and winters in southern Baja California (Howell and Webb 1995, Unitt 1984). The eastern Bell's vireo (*Vireo bellii bellii*) is found in the central United States from Colorado to Tennessee. The Texas vireo (*Vireo bellii medius*) is distributed in southwestern Texas and eastern Mexico, and the Arizona Bell's vireo (*Vireo bellii arizonae*) occurs in Arizona, Utah, Nevada, California (along the Colorado River), and Sonora, Mexico. The three latter species winter at different longitudes on mainland Mexico and thus, are apparently geographically segregated from one another on the wintering grounds.

D. Distribution

Historically, the least Bell's vireo was widespread and abundant, ranging from interior northern California near Red Bluff (Tehama County), south through the Sacramento-San Joaquin Valleys and Sierra Nevada foothills, and in the Coast Ranges from Santa Clara County south to approximately San Fernando, Baja California, Mexico. Populations also were found in the Owens Valley, Death Valley, and at scattered oases and canyons throughout the Mojave Desert.

No estimates of historical least Bell's vireo numbers were ever made, but workers in the early 19th century and even as late as the 1940's invariably described the subspecies as common to abundant and conspicuous (Cooper 1861, 1874, Anthony 1893 and 1895, Baird *et al.* 1874, Belding 1878, Fisher 1893, Grinnell and Swarth 1913, Grinnell and Storer 1924, Grinnell *et al.* 1930, Grinnell and Miller 1944). These historical accounts indicate that least Bell's vireos were present in considerable numbers wherever suitable habitat occurred.

In the decades following 1940, extensive habitat loss coupled with brood parasitism by the brown-headed cowbird decimated least Bell's vireo populations rangewide, and the decline has been well documented. In 1973, no least Bell's vireos were found during an intensive search in formerly occupied habitat between Red Bluff, Tehama County, and Stockton, San Joaquin County (Gaines 1974). By the early 1980's, the least Bell's vireo had been extirpated from the Sacramento and San Joaquin Valleys, once the center of its breeding range, and the species was restricted to two localities in the Salinas River Valley in Monterey and San Benito Counties (D. Roberson, pers. comm.), one locality along the Amargosa River (Inyo County), and numerous small populations in southern California south of the Tehachapi Mountains and in northwestern Baja California, Mexico (Gaines 1977, Goldwasser 1978, Goldwasser *et al.* 1980, Wilbur 1987, Unitt 1984). By the time the least Bell's vireo was federally listed in 1986, the statewide population was estimated at 300 pairs, with the majority concentrated in San Diego County (RECON 1989, Appendix A).

Breeding populations in northern Baja California apparently underwent similar declines during the same period. During a brief survey in 1980 of Baja California, Mexico, Wilbur (1981, 1987) found 40 pairs of least Bell's vireos distributed in six locations. Although he believed more birds were present than his incomplete survey found, Wilbur observed that habitat was limited and susceptible to many of the same development pressures present in the U.S. Least Bell's vireos were found more recently at five of the eight historical Mexican locations: San Fernando Mission, Valladores, Rancho San Jose (Meling Ranch), Las Cabras, and El Gato. In addition, one new breeding location, Erendira, was described. Subsequent visits to northern Baja California since the late 1980's have revealed that a least Bell's vireo population of 20 to 30 pairs continues to exist at Rancho San Jose (Kus, unpubl. data), and a large (as high as 75 pairs) concentration occurs along the Santo Tomas River (J. and J. Griffith; Kus, unpubl. data). Other sites supporting least Bell's vireo include Catavina, San Telmo Valley, and La Misión. Recent observations suggest that, unlike Wilbur's (1980a) earlier assessment, cowbird parasitism is currently a serious threat to least Bell's vireo breeding populations in Baja California.

Since the least Bell's vireo was federally listed in 1986 and intensive cowbird removal programs initiated, the species has undergone an increase almost as dramatic as its decline. While a few populations surviving the decline have generally stabilized in size (e.g., the Sweetwater, San Diego and Santa Ynez Rivers populations, Appendix A), most have undergone tremendous growth. For example, least Bell's vireos along the Santa Margarita River at Marine Corps Base Camp Pendleton (MCBCP) have increased in number from 15 males in 1980 (Salata 1980) to 523 males in 1996 (Griffith and Griffith 1997). Similar increases have occurred at the Prado Basin on the Santa Ana River, where the least Bell's vireo population grew from 12 males in 1985 (U.S. Fish and Wildlife Service 1986b) to 249 males in 1996 (Pike and Hays 1997) and at the Tijuana River, where the population expanded from 13 males in 1990 (Kus 1990c) to 142 males six years later (Kus 1996). A thorough rangewide survey has not been conducted since the 1986–1987 effort (RECON 1989), but available census data indicate that the least Bell's vireo population in southern California increased from an estimated 300 pairs in 1986 to an estimated 1346 pairs in 1996 (Appendix A).

In addition to population size increases, observations also indicate that least Bell's vireos are also expanding their range and recolonizing sites unoccupied for years or decades. Expansion is occurring both eastward in San Diego County as birds become reestablished in the more inland reaches of the coastal valleys and northward as birds disperse into Riverside and Ventura Counties. Observations of color-banded birds at these sites reveal that dispersal from the more southerly breeding populations is partially responsible for the recolonization (Greaves and Labinger 1997; L. Hays, U. S. Fish and Wildlife Service, pers. comm.; B. Kus, San Diego State University, unpubl. data). As populations continue to grow and least Bell's vireos disperse northward, it is anticipated they could reestablish in the central and northern portions of their historical breeding range.

E. Habitat Requirements

Least Bell's vireos are obligate riparian breeders, typically inhabiting structurally diverse woodlands along watercourses. They occur in a number of riparian habitat types, including cottonwood-willow woodlands/forests, oak woodlands, and mule fat scrub. Several investigators have attempted to identify the habitat requirements of the least Bell's vireo by comparing characteristics of occupied and unoccupied sites and have converged on two features that appear to be essential: (1) the presence of dense cover within 1–2 meters (3–6 feet) of the ground, where nests are typically placed and (2) a dense, stratified canopy for foraging (Goldwasser 1981, Gray and Greaves 1981, Salata 1981, 1983, RECON 1989). Although least Bell's vireos typically nest in willow-dominated areas, plant species composition does not appear to be as important a determinant of nesting site selection as habitat structure.

The selection of breeding sites by least Bell's vireos does not appear to be limited to riparian stands of a specific age, although least Bell's vireos are characterized as preferring early successional habitat. Again, vegetation structure more than simply age, appears to be the important determinant of site use. Early successional riparian habitat typically supports the dense shrub cover required for nesting and also a structurally diverse canopy for foraging. If permitted to persist, willows and other species form dense thickets in approximately 5–10 years and become suitable least Bell's vireo habitat (Goldwasser 1981, Kus in press). As stands mature, the tall canopy tends to shade out the shrub layer, making the sites less suitable for nesting. However, least Bell's vireos will continue to use such areas if patches of understory exist. In mature riparian habitat, the understory vegetation often consists of species such as California wild rose (*Rosa californica*), poison oak (*Toxicodendron diversiloba*), California blackberry (*Rubus ursinus*), grape (*Vitis californica*), and a variety of perennials that provide concealment for least Bell's vireo nests. In addition, least Bell's vireo nest placement tends to occur in openings and along the riparian edge, where exposure to sunlight allows the development of shrubs.

Within suitable riparian habitat, no features have been identified that distinguish least Bell's vireo nest sites from the remainder of the territory (RECON 1989, Hendricks and Rieger 1989, Olsen and Gray 1989). No significant differences have been found between habitat at the nest site and the surrounding habitat with regard to stem density, percent cover, percent open ground, and plant height and density (Hendricks and Rieger 1989). Nest site characteristics are highly variable, and nest success appears to be unrelated to nest height, host species, and amount and arrangement of foliage cover in the vicinity of the nest.

Although least Bell's vireos are tied to riparian habitat for nesting, they have been observed extending their activities into adjacent upland habitats. The arid nature of the southern California landscape typically results in the close proximity of riparian and nonriparian habitats, such as coastal sage scrub. Least Bell's vireos along the edges of riparian corridors maintain territories that incorporate both habitat types. Kus and Miner (1989) found that least Bell's vireos along the Sweetwater River in San Diego County traveled 3–61 meters (9–183 feet) from the riparian edge to reach upland areas. Upland habitat was used primarily by foraging adults and adults foraging with fledglings; however, 35 percent of the pairs whose territories included nonriparian habitat placed at least one nest there. Kus and Miner (1989) speculated that upland vegetation, in particular laurel sumac (*Malosma laurina*) and elderberry (*Sambucus mexicana*), may have provided important supplemental food resources for birds in marginal habitat. Use of upland vegetation has also been observed early in the spring when floodwaters inundate adjacent riparian habitat (J. Wells, TWB Consultants, pers. comm.; P. Ashfield, U.S. Fish and Wildlife Service, pers. comm.; J. and J. Griffith, Griffiths Wildlife Biology, pers. comm.). Under such conditions, least Bell's vireos may nest exclusively in the nonriparian habitat.

Little is known about the least Bell's vireo's wintering habitat requirements. It is known that least Bell's vireos are not exclusively dependent on riparian habitat on the wintering grounds (Kus, unpubl. data). Although wintering least Bell's vireos do occur in willow-dominated riparian woodlands, a greater proportion of the population appears to occur in mesquite scrub vegetation within arroyos (Kus, unpubl. data). During winter, least Bell's vireos also occur in shrubby areas associated with palm groves and along hedgerows associated with agricultural fields and rural residential areas (Kus, unpubl. data). The winter habitat selection of least Bell's vireo in southern Baja California appears more similar to that of breeding Arizona Bell's vireos than to its own breeding-season habitat selection (Kus, unpubl. data).

F. Critical Habitat

Critical habitat was designated for the least Bell's vireo on February 2, 1994 (U.S. Fish and Wildlife Service 1994a). The Service designated critical habitat for the least Bell's vireo at 10 areas encompassing about 15,200 hectares (38,000 acres) in Santa Barbara, Ventura, Los Angeles, San Bernardino, Riverside, and San Diego Counties. About 49 percent of the least Bell's vireo population in the United States occurred within these 10 areas in 1994 (U.S. Fish and Wildlife Service 1994a).

The Endangered Species Act defines critical habitat as areas containing physical or biological factors "essential to the conservation of the species" and that "may require special management considerations or protection." The Department of the Interior regulations (50 CFR 424.12) describe these features as including areas important for population growth, food and water resources, shelter, breeding and recovery sites, and habitats that "are representative of the historic distribution of the species."

The features or elements of habitat that are essential to the conservation of the least Bell's vireo can be described as riparian woodland vegetation that generally contains both canopy and shrub layers and includes some associated upland habitats. General activities that could cause destruction or adverse modification of least Bell's vireo habitat include the following: (1) removal or destruction of riparian vegetation; (2) thinning of riparian growth, especially near ground level; (3) removal or destruction of adjacent upland habitats used for foraging; and (4) increases in human-associated or human-induced disturbances. Specific actions that could adversely affect least Bell's vireo critical habitat include stream channelization, water impoundment or extraction, water diversion, intensive recreation, and development.

Because of the continued acceleration of these types of activities in remaining least Bell's vireo habitat, limited areas are available for expansion of the current distribution of least Bell's vireos. Nevertheless, these critical habitat areas are expected to support the core populations from which the least Bell's vireo will expand its distribution, particularly to the north. The core populations will have to increase in size to allow population expansion adequate for least Bell's vireo recovery to occur. These critical habitat areas are also expected to perform as refugia during periods of potential population declines following random naturally occurring events.

Protection provided by the critical habitat designation. Critical habitat identifies those areas essential for recovery, including areas currently unoccupied by the listed species. The designation of critical habitat serves to focus conservation activities by identifying areas that contain essential habitat features and may require special management consideration. Critical habitat as addressed under section 7 of the Endangered Species Act applies to actions by Federal agencies only. The Endangered Species Act does not provide any additional protection to lands designated as critical habitat: designating critical habitat does not create a management plan for the identified areas or prescribe specific management actions (inside or outside of critical habitat), establish numerical population goals, or have a direct effect on areas not designated as critical habitat. Specific management recommendations for critical habitat are addressed in recovery plans and management plans, as well as in section 7 consultations.

G. Life History and Ecology

Breeding Biology. Least Bell's vireo breeding biology has been well studied, and the following information summarizes the findings of many investigators, including Barlow (1962). Least Bell's vireos arrive on the southern California breeding grounds in mid-March to early April, with males arriving in advance of females by several days. Observations of banded birds suggest that returning adult breeders may arrive earlier than first-year birds by a few weeks (Kus, unpubl. data). Least Bell's vireos are generally present on the breeding grounds until late September, although they may begin departing by late July (Garrett and Dunn 1981, Salata 1983, Pike and Hays 1992). Stragglers have been noted in October and November (McCaskie and Pugh 1965; McCaskie 1969; K. Miner, California State Parks; J. Newman, U.S. Fish and Wildlife Service, pers. comm.), and occasionally individuals overwinter in California (McCaskie and Banks 1964; McCaskie 1970; L. Hays, pers. comm.).

Males establish and defend territories through counter-singing, chasing, and sometimes physically confronting neighboring males. Territory size ranges from 0.5 to 7.5 acres. Some average territory sizes are shown in Table 1. Newman (1992) investigated the relationship between territory size, vegetation characteristics, and reproductive success for populations of least Bell's vireos at the San Diego and Sweetwater Rivers, but found no significant factors that could account for the variability in territory size observed at his sites.

Spatial differences in riparian habitat structure, patch size, and numerous other factors result in differences in the density of territories within and between drainages such that males have varying numbers of neighbors against whom their territory must be defended. Embree (1992) hypothesized that, because singing is the primary form of territorial advertisement and defense in least Bell's vireos and singing may attract predators to nest sites, least Bell's vireos in dense concentrations might experience lower reproductive success than those with few

Table 1. Average sizes (acres) of least Bell's vireo territories.

Site	1987	1988	1991	1992	1993	Source
Prado Basin (Santa Ana River)	1.9±0.9	1.6±0.9				Hays 1987, 1988
San Diego River	2.1±1.0	1.7±0.9				Kus 1989a
Sweetwater River		1.4±0.8				Kus 1989b
Tijuana River			2.5 ±1.2	2.7 ±1.4	1.8 ±0.8	Kus 1991e, 1992c, 1993d

neighbors. Counter to the subjective impression of field investigators, least Bell's vireos with many (7–13) neighbors did not sing at statistically higher rates than did those with few (1–4) neighbors. Moreover, Embree (1992) did not find significant differences between the singing rates of successful and unsuccessful males. Embree concluded that patch size and crowding did not influence least Bell's vireo reproductive success, at least not through the mechanisms of singing rates and attraction of predators.

Nest building commences a few days after pair formation. The consistency of nest locations of color-banded females supports the supposition that the female selects the nest site (Pitelka and Koestner 1942, Barlow 1962). Both members of the pair construct the nest, a process that usually takes four to five days. The nest is cup-shaped and constructed of leaves, bark, willow catkins, spider webs, and other material (Bent 1950). It is typically constructed in the fork of a tree or shrub branch within 1 meter (3 feet) of the ground. Nests are placed in a wide variety of plant species including willows (*Salix* spp.), mule fat (*Baccharis glutinosa*), California wild rose, poison oak, grape, elderberry (*Sambucus mexicana*), Fremont's cottonwood (*Populus fremontii*), California sycamore (*Platanus* *racemosa*), coast live oak (*Quercus agrifolia*), and several herbaceous species. The majority of nests are placed in willows and mule fat.

Egg-laying begins one to two days after nest completion. Typically three to four eggs are laid, occasionally two, and rarely five. Average clutch sizes of nonparasitized nests observed with complete clutches have ranged from 3.1 to 3.9 during recent years. Long-term average clutch sizes have been determined at the best-studied populations (Table 2). Both parents share in incubation, which takes approximately 14 days. Upon hatching, nestlings are fed by both parents for 10–12 days until fledging.

Adults continue to care for the young for at least two weeks after fledging when territorial boundaries may be relaxed as family groups range over larger areas. Fledglings generally remain in the territory or its vicinity for most of the season, although the behavior of fledglings produced early in the year has not been well studied.

Predation is a major cause of nest failure in areas where brown-headed cowbird nest parasitism is infrequent or has been reduced by cowbird trapping programs (see "Brood Parasitism" under "H. Reasons for Decline"). Most predation occurs during the egg stage. Predators likely include western scrub-jays (*Aphelocoma californica*), Cooper's hawks (*Accipiter cooperii*), gopher snakes (*Pituophis melanoleucus*) and other snake species, raccoons (*Procyon lotor*), opossums (*Didelphis virginiana*), coyotes (*Canis latrans*), long-tailed weasels, dusky-footed woodrats (*Neotoma fuscipes*), deer mice (*Peromyscus maniculatus*), rats (*Rattus* spp.), and domestic cats (*Felis domesticus*) (Franzreb 1989). Other sources of nest failure are human disturbance (trampling of nest or nest site; clearing of vegetation), ant infestations, rainstorms, and unknown factors.

Least Bell's vireo pairs may attempt as many as five nests in a breeding season (B. Kus, pers. comm.), although most fledge young from only one or two nests. The

Table 2. Average reproductive success and productivity of least Bell's vireo.

Site	Average clutch size (# eggs)	Hatch Rate [a] (%)	Fledge Rate [b] (%)	Nests Successful (%)	Fledglings per Nest (#)	Fledglings per Pair (#)	Fledglings per egg (#)
Tijuana River	3.5	83	86	73	2.4	2.8	0.71
Sweetwater River	3.6	70	75	61	1.8	2.5	0.55
	3.7	66	74	51	1.6	2.8	0.49
San Luis Rey River	3.4	53	71	41	1.1	1.8	0.37
West San Luis Rey River	–	75	87	74	1.9	2.6	0.65
Santa Margarita River	3.4	83	91	66	2.1	2.7	0.75
Santa Ana River	3.7	–	–	46	1.8	2.4	–
Santa Ynez River	–	75	79	60	1.9	3.2	0.59

[a] Percent of eggs that hatch.
[b] Percent of nestlings that fledge.

likelihood of renesting depends on the time of season, the pair's previous reproductive effort, the success of previous efforts, and other factors. Few nests are initiated after mid-July.

Reproductive success has been calculated using a variety of different measures. Annual rates of hatching success (the percentage of eggs laid that hatch) have ranged from 38 to 92 percent over the past several years at the major study populations; long-term averages for those sites range from 53 percent at the San Luis Rey River to 83 percent at the Santa Margarita River and Tijuana River (Table 2). Lower hatching rates are characteristic of sites with heavy parasitism and inadequate cowbird control and/or high rates of egg predation. Fledging success (the percentage of nestlings that fledge) is typically higher than hatching success, unless predation on nestlings is high. Annual rates of fledging success during recent years have ranged from 59 to 100 percent, with long-term averages for individual sites falling between 71 and 91 percent (Table 2).

Reproductive success can also be calculated using the nest as the unit of measure. The annual percentage of nests that fledge at least one vireo young has ranged from a low of 33 percent to a high of 89 percent; long-term averages for individual sites show a similarly high degree of variability, ranging from 41 to 74 percent (Table 2). Annual average numbers of young fledged per nest has ranged between 0.7 and 3.3, with long-term averages falling between 1.1 and 2.4 fledged young per nest.

Productivity is a measure of reproductive performance that represents the total production of offspring over all nesting attempts within a season, and is expressed on a per pair basis. The annual average number of fledglings produced per pair has ranged from 0.9 to 4.5, with long-term averages ranging between 1.8 and 3.2.

An even more encompassing measure of productivity is the number of fledglings produced per egg laid. This measure combines the effort of egg production with the probability of hatching and fledging young from those eggs and hence incorporates the number of nesting attempts made by pairs. Annual averages have ranged from 0.31 to 0.85 fledglings per egg at the various sites with long-term averages of 0.37 to 0.75 fledglings per egg, reflecting the differential intensity of pressures such as egg predation, nestling predation, cowbird parasitism, and other sources of nest failure at those sites.

Diet and Foraging Behavior. Bell's vireos are insectivorous, preying on a wide variety of insects, including bugs, beetles, grasshoppers, moths, and particularly caterpillars (Chapin 1925, Bent 1950). They obtain prey primarily by foliage gleaning (picking prey from leaf or bark substrates) and hovering (removing prey from vegetation surfaces while fluttering in the air). Salata (1983) noted foliage gleaning during 93 percent and hovering during 30 percent of his observations of 131 foraging least Bell's vireos. In a study of least Bell's vireo foraging ecology at the Sweetwater River, Miner (1989) observed that 50.4 percent of 413 prey attacks consisted of foliage gleaning and 38.7 percent were hovering. Both Salata (1983) and Miner (1989) observed least Bell's vireos occasionally capturing prey by hawking (pursuit and capture of flying prey). Miner (1989) noted a behavior she called "clinging", which she described as hovering but with the feet in contact with the vegetation.

Foraging occurs at all levels of the canopy, but appears to be concentrated in the lower to mid-strata, particularly when pairs have active nests (Grinnell and Miller, 1944, Goldwasser 1981, Gray and Greaves 1981, Salata 1983, Miner 1989). Salata (1983) found that 69 percent of 131 foraging observations were within 4 meters (12 feet) of the ground. Miner (1989) found a similar peak in foraging activity in vegetation 3–6 meters (9–18 feet) in height. Moreover, she determined that the distribution of least Bell's vireo foraging time across all heights was not simply a function of the availability of vegetation at those heights, but rather represented an actual preference for the 3–6 meter zone.

Foraging occurs most frequently in willows (Salata 1983, Miner 1989). Miner (1989) observed that black willow (*Salix gooddingii*) was used preferentially relative to its cover within least Bell's vireo territories. Arroyo willow (*Salix lasiolepis*) was used preferentially in the 0–3 meter (0–12 feet) height range, possibly reflecting a tendency to forage close to nest sites. No other preferences were noted; other plant species were used proportionately to their availability. Insect sampling revealed that potential least Bell's vireo prey abundances were highest on black willow, arroyo willow, and mule fat.

Least Bell's vireos forage not only on a number of different riparian species, but also on nonriparian plants, particularly later in the season (Gray and Greaves 1981; Salata 1983; Kus and Miner 1989; Miner 1989; T. Keeney, U.S. Navy, pers. comm.). Miner (1989) found that insect abundance on one frequently used nonriparian species, laurel sumac, was lower than that on willows and mule fat. However, the proportion of large prey on this species was greater than on any other plant she studied, suggesting a high return per foraging effort.

Life History, Demography, and Dispersal. The least Bell's vireo is a sub-tropical migrant, traveling some two thousand miles annually between breeding and wintering grounds. Preliminary results of studies of color-banded birds (see Appendix C for sources) indicate that least Bell's vireos have a life span ranging to 7 years. A large proportion of the population dies before reaching the age of 1 year, as is typical of small migratory passerines. Banded bird returns suggest that between 5 and 29 percent of least Bell's vireos survive to their first breeding season, a wide range brought about by probable year-to-year differences in survivorship as well as differences in the effort devoted to reconnaissance for banded birds between sites, years, and observers. Moreover, reconnaissance is for the most part limited to a few well-studied populations; therefore, dispersers to other areas go undetected and are not factored into estimates of first-year survivorship. It is probable that, like other migratory passerines of similar size, roughly 25 percent of juveniles survive to their first breeding season. Resightings of adults suggest that once birds reach the age of 1 year, they exhibit an average annual survivorship of approximately 47 percent (Salata 1983; Kus, unpubl. data).

The average female survivorship appears to be lower than the average documented for males (44 versus 49 percent, respectively [Kus, unpubl. data]), presumably because of the toll that egg production takes on longevity.
While most first-time breeders return to their natal sites to nest, an average of approximately 20 percent disperse to other drainages (Kus, unpubl. data). This figure may be even higher and will require more extensive rangewide surveys to determine. Birds show evidence of an ability to disperse long distances between drainages, moving as far as 130 miles from the natal site (J. Greaves, private consultant, pers. comm., regarding a disperser from the San Luis Rey River to the Santa Clara River in 1994). On average, a greater proportion of males (22 percent) than females (13 percent) disperse from their natal sites (Kus, unpubl. data).

The earliest studies of color-banded least Bell's vireos suggested that they were strongly site tenacious; once birds selected a breeding site, they returned to it year after year (Greaves 1989, Salata 1983). Not only do least Bell's vireos return to the same drainage, they return to the same territory and even the same nest tree or shrub, a remarkable feat considering the terrain covered during the course of migration. More recent data obtained at several additional breeding sites suggest that site tenacity in least Bell's vireos may not be as strong as previously believed. Many banded birds are seen for the first time as 2-year-olds and sometimes older, indicating that they have changed breeding locations during their first few years. The factors promoting a switch in breeding location are not known at this time. Habitat loss, lack of success in obtaining a mate, or even failure to return to the breeding grounds may be possible causes.

Preliminary data analysis of age-specific reproductive activity suggests that first-year females may lay smaller clutches and average fewer young fledged than older females (Kus, unpubl. data). Generating the sample sizes of banded birds necessary for this type of analysis would require long-term effort and could be used for refinement of the population growth models presented in this plan. Expansion of the least Bell's vireo's range at the local and regional scale appears to be dependent on the existence of relatively large core populations that are producing sufficient numbers of juveniles that exploit previously unoccupied areas of their natal drainages or adjacent drainages with suitable habitat. As populations in these areas increase, further expansion occurs. Such expansion can be characterized as a "stepping stone" pattern. These core populations also serve to repopulate adjacent areas where small populations have been extirpated. A core population and the adjacent small populations with which it interacts forms a "metapopulation." This metapopulation concept must be considered in the development of a recovery strategy for the least Bell's vireo.

H. Reasons for Decline

Grinnell and Miller (1944) considered the least Bell's vireo still "common, even locally abundant under favorable conditions of habitat". However, they noted that in the "last fifteen years a noticeable decline has occurred in parts of southern California and in the Sacramento-San Joaquin Valley." That decline continued for four more decades, the combined result of habitat loss and degradation and nest parasitism by the brown-headed cowbird (Garrett and Dunn 1981).

Habitat Loss and Degradation. As human populations increased in California, riparian woodlands were cleared, primarily for agricultural purposes. Rivers were diked to prevent winter flooding of bottomlands. Dams were built to impound water for agricultural, industrial, and domestic use. As a result, large amounts of least Bell's vireo breeding habitat were inundated or removed. Impounding water upstream and diverting water to canals and cropland lowered water tables downstream so that dense vegetation could not grow or was reduced. Flood control projects and channelization of rivers further reduced available least Bell's vireo habitat. Livestock grazing destroyed the choice lower strata of vegetation preferred by the least Bell's vireo (Overmire 1962) and provided foraging areas for brown-headed cowbirds. As the state's human population continues to increase, highway projects and urban, commercial, and recreational developments continue to encroach on what little riparian habitat remains. Similar activities are responsible for the decline of riparian habitat in Baja California (Short and Crossin 1967).

Riparian habitat loss in the Central Valley, estimated at 95 percent of that present during the Gold Rush of the 1850's (Smith 1977), has resulted in the loss of the least Bell's vireos from an area that at one time supported an estimated 60–80 percent of the statewide population based on potentially available habitat. Habitat loss and fragmentation continues to threaten the remaining least Bell's vireo populations in southern California and Baja California. Faber *et al.* (1989) reported a figure of 95–97 percent loss of naturally vegetated floodplains in southern California.

The widespread and precipitous decline of the species left small populations in scattered and widely separated remnants of riparian habitat. These conditions make least Bell's vireo populations particularly vulnerable to local and possibly rangewide extinction (Wilcox 1980). Small populations are susceptible to catastrophic extinction where the entire population could be adversely affected as a result of events such as flooding, as well as demographic failure when the population fails to produce any or enough offspring to survive into the future. Large interpopulation distances reduce the opportunity for dispersal and resultant genetic exchange among populations, thus heightening the risk of deleterious inbreeding (Soulé 1980, Conway 1980, Senner 1980). Lack of available habitat to serve as "refuges" during years when floods and other processes eliminate breeding sites poses a serious threat to the continued survival of the species.

In addition to outright destruction of habitat, riparian woodlands have been degraded in ways that reduce their suitability as least Bell's vireo nesting areas. Many riparian corridors are lined by roads and highways, which generate noise and pollutants and fragment habitats.

Habitat fragmentation results in four major consequences for ecosystems: (1) loss of area-sensitive species whose occurrence and successful reproduction are highly dependent on the size of the habitat patch in which they occur; (2) the larger species (e.g., bobcats) that move widely and occur at low densities are lost as they are more exposed to the dangers of associated with human environments; (3) fragmented and human-subsidized landscapes, providing artificial sources of food and shelter, become dominated by alien (e.g., European starlings) or already common species (e.g., skunks and racoons); (4) inbreeding depression (loss of genetic vigor) is a logical consequence of low densities and isolated populations (Harris and Gallagher 1989).

Habitat fragmentation and roadkills from highways and roads likely change predator-prey relationships in the ecosystems used by breeding least Bell's vireos. Larger predators, such as bobcats, may be lost from the ecosystem. The resulting changes in predator-prey relationships may include an increase in medium-sized predators, such as weasels, raccoons, possums, and foxes, which are nest predators.

Urbanization adjacent to habitat increases human presence in least Bell's vireo nesting sites, raising the potential for inadvertent destruction of nests and disturbance of breeding birds. Free-roaming and feral pets pose a risk of predation to nesting birds, as do increased densities of scrub-jays, racoons, and other predators typically associated with urban landscaping and development. Homeless people living in riparian areas threaten least Bell's vireos through clearing of vegetation for campsites, trampling of nest sites, and their continuous presence in the vicinity of least Bell's vireo territories. Many southern San Diego

County drainages receive enormous foot traffic by persons entering California across the U.S.-Mexico border and following rivers for the safety of their concealment afforded by riparian vegetation.

Loss or degradation of adjacent upland habitat reduces available foraging areas for least Bell's vireos and limits the upland/riparian ecotone (the overlapping of adjoining plant communities). This juxtaposition of different habitats provides increased biological function when compared with the same habitats occurring separately, which is likely important from an ecosystem perspective. Upland areas converted to livestock grazing and agriculture provide foraging areas for brown-headed cowbirds, a brood parasite of least Bell's vireos.

Brood Parasitism. Declines in the least Bell's vireo population brought about by extensive habitat loss and degradation have been exacerbated by parasitism by the brown-headed cowbird (cowbird) (Franzreb 1989, Goldwasser 1978, Goldwasser *et al.* 1980, Garrett and Dunn 1981, Mayfield 1977). Cowbirds are distinguished by their unusual reproductive strategy of laying their eggs in the nests of other species, leaving the "host" to raise the cowbird young, generally at the expense of the host's own young. Cowbirds have been documented using at least 130 avian species as hosts (Friedmann *et al.* 1977).

The least Bell's vireo is a common host (Hanna 1928, Dawson 1923, Rowley 1930, Grinnell and Miller 1944, Goldwasser *et al.* 1980, Salata 1981) and readily accepts cowbird eggs, although it is a relatively poor host and does not fledge many cowbirds (Friedmann 1963). The first reported cowbird eggs in least Bell's vireo nests were discovered in 1907 (Linton 1908). Soon it was difficult to find nests of this species that had not been parasitized (Dawson 1923, Hanna 1928, Rowley 1930). The immediate impact of cowbird parasitism was probably great because the least Bell's vireo population had not previously been exposed to nest parasitism and, therefore, had not evolved defenses as have other species with a long evolutionary history of co-occurrence with nest parasites. The tendency of male least Bell's vireos to sing from the nest no doubt enhances vulnerability to parasitism, although cowbirds evidently locate most nests by observing the pair during nest construction.

At the time of laying, female cowbirds may remove a host egg and replace it with their own, and/or may damage host eggs by pecking them, although it is not known whether this behavior is intentional or coincidental to attempts to remove the egg from the nest. Cowbird eggs hatch sooner than host eggs, and the newly hatched chick may eject host eggs or young from the nest. Cowbird chicks grow more quickly and achieve a larger size than host young, effectively outcompeting them for parental attention and feeding. Few if any host young are fledged from parasitized nests.

Cowbird parasitism reduces least Bell's vireo productivity in several ways, even when nest monitoring is employed to remove cowbird eggs and young from least Bell's vireo nests. Removal of least Bell's vireo eggs from the nest by laying brown-headed cowbird females reduces least Bell's vireo clutch size, limiting potential productivity even if the nest is eventually successful. Some parasitized nests are abandoned outright, reducing overall nest success. The shorter incubation period of cowbird eggs means that some least Bell's vireo eggs may not receive adequate incubation and fail to hatch. Damage to eggs caused by cowbird females and/or chicks also reduces the hatch rate.

Collectively, these factors can lower nesting success (the proportion of nests with eggs that fledge at least one least Bell's vireo young) in heavily parasitized areas where up to four cowbird eggs may be found in least Bell's vireo nests (Salata 1983; B. Jones, Sweetwater Environmental Consultants, pers. comm.). For example, nest monitoring to remove cowbird eggs or young resulted in a 140 percent increase in the number of successful nests at the San Luis Rey site (RECON 1989). Rates of cowbird parasitism at the Santa Margarita and Santa Ynez Rivers during the early 1980's were documented to be between 20 and 47 percent of nests (Salata 1981, 1983, Gray and Greaves 1981). Rates as high as 80 percent of nests were reported for the San Luis Rey, Sweetwater, San Diego, and Santa Ana Rivers in 1984 (Jones 1985, U.S. Fish and Wildlife Service 1986b).

Cowbirds are native to the eastern U.S. and, with the exception of a few winter or vagrant records, were absent from most least Bell's vireo habitat prior to 1900. Subsequent increases in animal husbandry and irrigated agriculture in the West provided new foraging habitat for cowbirds and triggered an increase in cowbird range and numbers that has been described as "remarkable, in fact unparalleled by any of our native birds" (Willett 1933). Cowbirds have not only expanded generally into the western U.S., they achieve particularly high concentrations near least Bell's vireo breeding sites as a result of land-use practices. Dairies, livestock grazing, equestrian centers, and golf courses, all tending to be sited in rural areas along rivers, provide foraging areas for cowbirds in the vicinity of least Bell's vireo breeding habitat.

In one study of black-capped vireos (*Vireo atricapillus*) in Texas, cowbirds were feeding with cattle in 100 percent of the observations; cowbirds were not found in areas without cattle. Cowbird nest parasitism of black-capped vireos went from 35 percent in 1996 to 0 percent in 1997 when cattle were removed from the study area (Cook *et al.* 1997).

The distance to agriculture was the strongest predictor among all variables (landscape or habitat) in a study in Montana and Idaho. This study found landscape factors play a dominant role in predicting the distribution of cowbirds (Young and Hutto 1997). An Idaho study found cowbirds were often associated with horse herds, as well as game animals where salt blocks caused them to congregate. No cowbirds were detected in undeveloped (natural) habitat more than 20 kilometers from horse or mule herds (Wright 1997).

In a Michigan study, the probability that a cowbird would occur at any given site was 3–3.5 times greater when agricultural lands were present within 3 kilometers (2 miles) of the study site. This study found that where agriculture was lacking cowbird occurrence was low, regardless of surrounding habitat characteristics (Stribley and Haufler 1997).

Cowbirds have been documented traveling at least 7 kilometers (4 miles) between foraging and breeding areas (Rothestein *et al.* 1984; E. Berryman, U.S. Fish and Wildlife Service, pers. comm. 1997). A study in New Mexico found cowbirds commuting at least 4 kilometers (2.5 miles) between foraging and breeding areas; female cowbirds were feeding nearly exclusively (more than 98 percent of the time) on grazed sites with livestock (Goguen and Mathews 1997).

I. Conservation Measures

Regulatory Protection

Endangered Species Act. On May 2, 1986, the least Bell's vireo was listed as endangered under the Act. Listing as a federally endangered species includes a prohibition against take and possession, prohibits Federal activities that are likely to jeopardize the continued existence of the species or adversely affect its critical habitat, authorizes land acquisition and other Federal preservation activities, and enables cooperative Federal-State programs for conservation and recovery of the species.

The Endangered Species Act requires the Fish and Wildlife Service to designate critical habitat, to the maximum extent prudent and determinable, concurrently with listing a species as endangered or threatened. Critical habitat was designated for the least Bell's vireo on February 2, 1994 (U.S. Fish and Wildlife Service 1994a) and is discussed previously under "F. Critical Habitat."

Section 9 prohibits the take of any species listed as endangered or threatened under provisions of section 4 of the Endangered Species Act, including the least Bell's vireo. The definition of "take" includes to harass, harm, hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in any such conduct.

"Harm", in the definition of "take", includes significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavior patterns, including breeding, feeding, or sheltering (50 CFR 17.3). Sections 10(a)(1)(A) and 10(a)(1)(B) give the Fish and Wildlife Service the authority to issue permits to non-Federal and private entities for the take of least Bell's vireos, as long as such taking is incidental to, and not the purpose of, carrying out otherwise lawful activities.

Section 7(a)(2) requires all Federal agencies consult with the Fish and Wildlife Service on any action they authorize, fund, or carry out that may affect listed endangered or threatened species or critical habitat. Incidental take may also be permitted through the section 7 consultation process. Most take for least Bell's vireos is authorized through the section 7 process.

Section 4 of the Endangered Species Act requires the Department of the Interior and the Department of Commerce to develop and implement recovery plans for animal and plant species listed as endangered or threatened. In 1982, the Fish and Wildlife Service organized the Least Bell's Vireo Working Group, consisting of Federal, State, local government, and university representatives, as well as private individuals knowledgeable about the least Bell's vireo, to promote information exchange and interagency cooperation regarding conservation activities for the least Bell's vireo. While not a regulatory body, the Working Group was appointed to assist in development and implementation of recovery-oriented research and management plans. A draft recovery plan for the least Bell's vireo was prepared in 1988 but was never approved.

Habitat Conservation Plans. Most actions affecting least Bell's vireo habitat directly occur within waters of the U.S. and thus, require a permit from the U.S. Army Corps of Engineers under provisions of the Clean Water Act (discussed below). Activities and projects such as agriculture, dairy farming, flood damage reduction (including herbicidal spraying of riparian vegetation), groundwater pumping, sand and gravel mining, etc., occur with no obvious involvement of a

Federal agency. These actions should be performed in a manner consistent with the ecosystem (wetland and upland) needs of least Bell's vireos rangewide. Non-Federal (private and State) actions affecting least Bell's vireos may be subject to habitat conservation plan requirements of section 10(a)(1)(B) of the Endangered Species Act. Habitat conservation plans can and should effectively intermesh with the recovery goals of this recovery plan by conserving existing and restorable upland habitat, waters, and wetland habitat. Restorable habitat, such as in the Central Valley and along the Salinas River, should be conserved to allow reoccupation of former habitat by expanding least Bell's vireo populations.

Habitat conservation plans can address the problem of habitats that attract and support brown-headed cowbirds. The persistence of brown-headed cowbird foraging areas such as dairies, stables, and livestock grazing operations—and to a lesser extent, agriculture, turf parks and golf-courses, etc.—within 7 kilometers (4 miles) of existing and potential least Bell's vireo habitat reduces the capability of the species to recover and continues the need for cowbird control in perpetuity. Land use changes are needed to minimize the occurrence of cowbirds in riparian areas and allow least Bell's vireos the chance to be self-sustaining without cowbird trapping. Habitat conservation plans should address and, where possible, modify these land uses to reduce adverse effects of brown-headed cowbirds on least Bell's vireos. Draft habitat conservation plans for the least Bell's vireo were initiated on several drainages in San Diego County for the least Bell's vireo in the late 1980's but were later abandoned.

State Laws Protecting the Least Bell's Vireo. The least Bell's vireo is listed as an endangered species under the California Endangered Species Act of 1984. Similar to the Endangered Species Act, this legislation requires State agencies to consult with the California Department of Fish and Game (CDFG) on activities that may affect a State-listed species. The State law also requires State lead agencies as defined in the California Environmental Quality Act to consult with the California Department of Fish and Game regarding any project with potential impacts on State-listed species. Compensation is required by the California Department of Fish and Game for projects that result in least Bell's vireo habitat loss.

Section 2080 of the California Fish and Game Code (Code) prohibits the import, export, take, possession, purchase, or sale of any endangered, threatened, or candidate species listed by the California Fish and Game Commission. As defined in the Code, take means to hunt, pursue, catch, capture, or kill or attempt the same. Exceptions to the take prohibition are as stated in sections 2081 and 2835.

Section 2081 of the Code allows the California Department of Fish and Game to "authorize individuals, public agencies, universities, zoological gardens, and scientific or educational institutions to import, export or possess a listed species for scientific, educational or management purposes," under terms specified in Memoranda of Understanding between any of these groups, agencies, institutions, or individuals and the California Department of Fish and Game.

Clean Water Act Protection. Congress passed the Federal Water Pollution Control Act Amendments of 1972 and the Clean Water Act of 1977 to provide for the restoration and maintenance of the chemical, physical, and biological integrity of the Nation's lakes, rivers, streams, and coastal waters. Section 404 of the Clean Water Act is the principal Federal program that regulates activities affecting the integrity of wetlands. Specifically, section 404 prohibits the discharge of dredged or fill material into jurisdictional waters of the United States, unless permitted by section 404(a) (individual permits), 404(e) (general permits), or unless the discharge is exempt from regulation as designated in 404(f).

In most circumstances, riparian habitat is considered to be in jurisdictional waters of the United States, and disturbance of riparian habitat would be regulated by the Army Corps of Engineers. Additionally, if the affected riparian habitat is occupied by least Bell's vireo, the Army Corps of Engineers would consult with the Fish and Wildlife Service, pursuant to section 7 of the Endangered Species Act.

Migratory Bird Treaty Act. The Migratory Bird Treaty Act (MBTA) (16 U.S.C. 701–711) was implemented in 1918 between the governments of the U.S. and Great Britain (representing Canada) and subsequently Mexico in 1936, Japan in 1972, and in 1976 with the Union of Soviet Socialist Republics, which expanded the definition of migratory birds to include protection for virtually all birds found within the U. S., including the least Bell's vireo. The Migratory Bird Treaty Act establishes provisions regulating take, possession, transport, and import of migratory birds, including nests and eggs. This protection has been of limited importance because the species is not taken commercially or used for sport or food.

Other Regulatory Mechanisms. On July 9, 1986, a Memorandum of Understanding (MOU) was executed between the Fish and Wildlife Service and Marine Corps Base, Camp Pendleton for the purpose and objective of managing and perpetuating the least Bell's vireo on Camp Pendleton. On the basis of the special management considerations afforded the least Bell's vireo under this Memorandum of Understanding, the Fish and Wildlife Service determined that it was not necessary to designate critical habitat on the Base.

The Memorandum of Understanding specifically provides for removal of exotic plant species, annual cowbird trapping, research studies, annual least Bell's vireo censuses, and other management for the benefit of the species. The agreement does not remove the responsibilities of the Marine Corps Base, Camp Pendleton under the Endangered Species Act. The Base is required to consult on any and all activities that may affect the least Bell's vireo.

Conservation Efforts

Santa Clara River Enhancement and Management Plan. The Fish and Wildlife Service, the State Coastal Conservancy, and the counties of Ventura and Los Angeles are guiding the development of a long range conservation plan for the Santa Clara River, the largest unchannelized river in southern California. The plan emphasizes comprehensive planning to protect the substantial natural resources of the river and it will include high priority recovery actions for endangered species (least Bell's vireo and unarmored threespine stickleback) and prelisting recovery actions for numerous candidate species.

Brown-headed Cowbird Control. Probably the most effective management effort undertaken since the time of listing of the least Bell's vireo is cowbird control within least Bell's vireo breeding areas. Continuing cowbird removal programs have been funded by the California Department of Transportation, the Army Corps of Engineers, the International Boundary and Water Commission, the Marine Corps Base, Camp Pendleton, and the Fish and Wildlife Service. With the exception of the latter, most of the funding for cowbird control has been provided within the context of mitigation for projects adversely affecting least Bell's vireos.

Cowbird removal is accomplished through trapping birds in modified Australian crow traps. The traps have a slotted roof that allows birds to easily fly in, but flying out is difficult. These traps, which are large enough for a person to walk in and remove any trapped cowbirds, are baited with seed and live decoy birds and placed within and along the edges of riparian habitat. Traps are strategically placed in areas where cowbirds congregate for foraging, such as dairies and stables.

At Marine Corps Base, Camp Pendleton, the site of the longest continuously run cowbird removal program in the least Bell's vireo's range, nest parasitism dropped from a pretrapping rate of 47 percent of least Bell's vireo nests in the early 1980's to less than 1 percent by 1990 (Griffith and Griffith, in prep.). No cowbird parasitism of least Bell's vireo nests has been observed since 1990, although comprehensive nest monitoring ceased in 1992. As cowbird parasitism declined, least Bell's vireo productivity increased, resulting in the recruitment (increase in the numbers of birds) and expansion of the areas used by the least Bell's vireos observed at the Base since trapping was initiated. There are no cattle on the base, and only limited grazing of sheep and a very small number of bison are currently allowed. Cattle grazing occurs on the adjacent Fallbrook Naval Weapons Station.

Similarly dramatic reductions in the rate of nest parasitism coincidental with implementation of cowbird control programs, and associated increases in productivity, have been documented at the San Luis Rey River, San Diego River, Sweetwater River, and Santa Ana River. Modification and reduction of cowbird foraging areas near riparian zones, as noted above, will concomitantly reduce cowbird numbers (Stribley and Haufler 1997, Tewksbury *et al.* 1997, Young and Hutto 1997) and the need for cowbird trapping.

Monitoring and Research. In addition to cowbird removal, least Bell's vireo nest monitoring was one of the primary management actions called for by the Fish and Wildlife Service at the time of listing. Initially, the principal goal of the nest monitoring was to detect and remove cowbird eggs and/or young from least Bell's vireo nests, supplementing cowbird trapping and removal efforts. Nest monitoring has proven to be an effective backup to cowbird trapping, particularly in areas where trapping has been inadequate in scope and timing, and is useful in evaluating the effectiveness of trapping programs and providing guidance for their improvement. By itself, "rescue" of parasitized nests through removal of cowbird eggs has enhanced annual productivity by as much as 27 percent at the San Diego River (Kus 1992a) and as much as 44 percent at the San Luis Rey River (Kus 1991a,c, 1993b, 1995b).

In addition to its role in reducing nest parasitism, least Bell's vireo nest monitoring has provided an opportunity to collect long-term reproductive data. It has also facilitated color-banding of nestlings and adults for ongoing studies of demography, dispersal, and wintering site selection, which are summarized elsewhere in this plan.

Conservation-oriented research on least Bell's vireo breeding ecology has resulted in the completion of Master's theses describing foraging behavior (Miner 1989), the relationship between habitat patch size and reproductive success (Embree 1992), and the relationships of territory size, habitat quality, and reproductive success (Newman 1992). A fourth study investigated song type diversity and the function of song repertoires in least Bell's vireos (Beck 1996).

Habitat Creation and Restoration. Increasingly, habitat creation and restoration is being pursued as a means of mitigating the loss and degradation of riparian habitat. The majority of the restoration activity in southern California is driven by the requirement to mitigate losses of wetland habitat, which often support least Bell's vireos. Restoration may entail site preparation, including grading and soil amendment when necessary, and planting of either stem cuttings or nursery-grown container stock of a mix of native species selected to mimic the species composition of natural sites. The planted habitat is typically irrigated using overhead sprinklers or a drip system, weeded, and otherwise tended during the first few years of establishment. Other more experimental restoration attempts have used less intensive planting and irrigation efforts, but involved careful grading to restore/create proper hydrology for more passive restoration with an extensive exotics control component.

Considerable advances have occurred over the last ten years in the technical aspects of restoration site design and implementation (Baird 1989, Baird and Rieger 1989, Hendricks and Rieger 1989), and several restoration efforts in San Diego County have been successful both in producing riparian habitat with the structure of natural habitat and in attracting nesting least Bell's vireos (Kus, in press). In a long-term monitoring study of several sites in which restored habitat was quantitatively compared to natural reference habitat, Kus (in press) determined that the structural characteristics defining least Bell's vireo habitat can be achieved in 3–5 years with intensive effort, depending on site conditions and weather conditions, particularly the amount of winter rainfall and associated flooding. Vegetation development proceeds slowly during drought years, which are typical of the southern California climate, making it difficult to predict the time required to achieve certain structural conditions. Least Bell's vireos were observed using restored habitat within a year of planting, but this use was primarily foraging. Least Bell's vireos did not nest in restored habitat until it achieved certain structural conditions, including high cover in the nesting zone between the ground and 2 meters (6 feet) and a well-developed and stratified canopy where foraging is concentrated. Factors promoting the colonization of restoration sites included proximity to occupied natural habitat and adjacency of mature vegetation.

Despite these successes, many attempts at riparian restoration have failed, and there is a considerable need for increased scrutiny of mitigation/restoration plans, including increased monitoring of habitat restoration projects by regulatory agencies. Continued research is needed to develop techniques to improve site selection and site preparation, including grading. Planting techniques should be refined in terms of timing, stock, and subsequent care, including methods of irrigation and providing access to flooding. Other aspects of site maintenance, such as midterm protection from exotic plant invasion, vandalism, and control of pest outbreaks, should be addressed. Also needed is a comprehensive review of the "success" criteria used to evaluate restoration efforts, as well as of the methods used to generate data for such evaluations, particularly in projects where creation of least Bell's vireo nesting habitat is the goal.

Population Viability Analysis

Population viability analyses are important tools for attempting to quantify both the threats to a species and the consequences of conservation actions. Properly used, a population viability analysis incorporates what is known about a species' population dynamics into a model that will facilitate examination and testing of various hypotheses about the viability of small populations. This analysis can help identify critical factors for study, management, and monitoring. The result of the analysis is the determination of a theoretical population number, the minimum viable population; however, the process is instructive only and is not meant to provide an absolute answer. The strengths and weaknesses of population viability analyses have been reviewed (Lacy, in press; U.S. Fish and Wildlife Service 1997a).

When evaluating the results of a population viability analysis, the following should be considered (Lacy, in press):

> Natural systems are too complex for any existing model to accurately predict population dynamics, and our understanding of the extinction process is inadequate.
>
> Most models assume that population changes occur at discrete time steps, which does not accurately reflect all wild populations.
>
> The time span over which data has been collected may not be sufficient to estimate the amplitude of environmental fluctuations and its impact; even less data is available on the frequency and impacts of catastrophes, such as epidemic diseases and severe weather or other environmental phenomena (e.g., fires, drought, El Niño).

Population viability analysis is, by definition, the probability of persistence of a population over defined time frames; however, it may not accurately predict actual outcomes.

Population viability analysis is only as good as the parameter estimates and assumptions upon which it is built. Estimates of necessary parameters are usually incorporated into a population viability analysis; however small changes in these parameters can have profound changes in the estimated time to extinction.

Least Bell's Vireo Population Viability Analysis. Since the early 1980's data has been collected on least Bell's vireo distribution and breeding biology. The database includes information reported by a number of investigators working at least Bell's vireo breeding sites from the U.S.-Mexico border to Santa Barbara County and represents 68 "site-years" of data.

A population viability analysis was performed using data from eight populations (Tijuana, Sweetwater, San Diego, San Luis Rey, West San Luis Rey, and Santa Margarita Rivers in San Diego County; the Santa Ana River in Riverside County, and the Santa Ynez River in Santa Barbara County). These sites were selected for analysis because (1) they supported the few remaining least Bell's vireo populations in 1986 when the species was listed as endangered; (2) they have been monitored and managed annually from 5 to 15 consecutive years; and (3) long-term color-banding studies provided a substantial database. These attributes allow analysis of least Bell's vireo population dynamics, demography, and dispersal over a wide geographic area and a relatively long period of time.

Population data were entered into a statistical model, RAMAS/Space (Akcakaya and Ferson 1992), that simulates the future of the populations given theoretical or empirical values for variables specifying rates of population growth and migration. Questions regarding future population growth and risk of extinction can be addressed with this model. Definitions of terms and a discussion of the population viability analysis are provided in Appendix B.

The results of the computer simulations indicated the least Bell's vireo populations used in the analysis exceeded the minimum viable population size, commonly defined as a population with a less than a five percent probability of extinction over a 100-year period (Soulé 1987), and had a probability of zero of going extinct during the next century assuming the same population growth and dispersal rates. With the exception of one remote population (at the Santa Ynez River), each of the individual populations had an extinction probability of zero during the next 100 years because of the sizes and growth rates of each population, as well as their interconnectedness through dispersal.

The data used for the least Bell's vireo population viability analysis was relatively substantial compared to data available for analysis for many species, but the analysis still required the use of estimates and assumptions. For example, an annual reproductive rate of 2.6 young per pair was assumed, but annual average number of fledglings produced per pair has ranged from 0.9 to 4.5, with long-term averages ranging between 1.8 and 3.2.

The analysis also assumed continued intensive brown-headed cowbird control. It must be stressed that the least Bell's vireo population viability results assume intensive cowbird control, which is inconsistent with the recovery goals of self-sustaining populations. No evidence exists that least Bell's vireos are capable of sustaining their current rate of growth without widespread cowbird trapping. Under current conditions, without land use changes to minimize brown-headed cowbirds, when human intervention is removed it is likely that least Bell's vireo populations will return to the low numbers documented when the species was listed.

RAMAS models logistic growth: populations increase to the limit, or carrying capacity, of their environments and then persist at some equilibrium population size. However, prediction of these equilibrium sizes requires knowledge of the actual carrying capacity of each environment; information about the carrying capacities of least Bell's vireo habitats is not currently available.

Recovery of the least Bell's vireo extends beyond achieving a theoretical minimum viable population in each of the eight populations used in the population viability analysis. Recovery will require protection and management of 14 least Bell's vireo populations/metapopulations and restoration of least Bell's vireos to areas within the historical range. Protection and management actions must include the reduction and elimination of threats and assurances of long-term control of cowbirds, including assurances of modified land uses that contribute to cowbird foraging adjacent to least Bell's vireo breeding areas, and assurance of long-term control of exotic plants in riparian habitats. Completion of monitoring and research tasks will yield additional information regarding carrying capacity, dispersal patterns of birds away from their natal sites and the movements of adults, as well as other life history characteristics for use in refining the population viability analysis.

J. Conservation of Proposed and Candidate Species and Species of Concern

Least Bell's vireos occur with many sensitive species of amphibians, birds, fish, mammals, invertebrates, and plants (Table 3). Virtually all of these species are in peril as a result of the massive loss and degradation of the riparian habitat upon which they depend for survival. Declines in riparian songbirds, including many not listed in Table 3, have been exacerbated by cowbird parasitism. Although the number of sensitive species is, at first glance, intimidating when contemplating recovery of riparian fauna and flora, the fact that so many share the same threats suggests that management to reduce or eliminate those threats will benefit the entire suite of species and go far to restore ecosystem integrity. Cowbird control programs, for example, have already produced observable increases in southern California populations of yellow warblers (*Dendroica petechis*), yellow-breasted

Table 3. Sensitive species that may occur in Californian riparian habitats (California Department of Fish and Game 1996a, 1996b; U.S. Fish and Wildlife Service 1996).

Common Name	Scientific Name	Status [1]
<u>AMPHIBIANS/REPTILES</u>		
Arroyo toad	*Bufo microscaphus californicus*	FE, SC
California tiger salamander	*Ambystoma californiense*	C, SC
Mountain yellow-legged frog	*Rana mucosa*	SC
Yavapai (=lowland) leopard frog	*Rana yavapaiensis*	SC
Two-striped garter snake	*Thamnophis hammondii*	SC
Southwestern pond turtle	*Clemmys marmorata pallida*	SC
California red-legged frog	*Rana aurora draytonii*	FT, SC
<u>BIRDS</u>		
Least Bell's vireo	*Vireo bellii pusillus*	FE, SE
Southwestern willow flycatcher	*Empidonax traillii extimus*	FE, SE
Peregrine falcon	*Falco peregrinus*	FE, SE
Bald eagle	*Haliaeetus leucocephalus*	FT, SE
Western yellow-billed cuckoo	*Coccyzus americanus occidentalis*	SE
Bank swallow	*Riparia riparia*	ST
Black-crowned night heron	*Nycticorax nycticorax*	SC
Great egret (rookery)	*Casmerodius albus*	SC
Snowy egret (rookery)	*Egretta thula*	SC
Great blue heron (rookery)	*Ardea herodias*	SC
White-faced ibis	*Plegadis chihi*	SC
Black-shouldered kite	*Elanus caeruleus*	SC
Cooper's hawk	*Accipiter cooperii*	SC

Table 3. Sensitive species that may occur in Californian riparian habitats (California Department of Fish and Game 1996a, 1996b; U.S. Fish and Wildlife Service 1996).

Common Name	Scientific Name	Status [1]
Long-eared owl	*Asio otus*	SC
Yellow warbler	*Dendroica petechis brewsteri*	SC
Yellow-breasted chat	*Icteria virens*	SC
FISH		
Owens pupfish	*Cyprinodon radiosus*	FE
Owens tui chub	*Gila bicolor snyderi*	FE
Unarmored threespine stickleback	*Gasterosteus aculeatus williamsoni*	FE, SE
Tidewater goby	*Eucyclogobius newberryi*	FE
Santa Ana sucker	*Catastomus santaanae*	SC
Southern steelhead	*Oncorhynchus mykiss*	FT & FE[2], SC
INVERTEBRATES		
Valley elderberry longhorn beetle	*Desmocerus californicus dimorphus*	FT
MAMMALS		
Townsend's big-eared bat	*Plecotus townsendii townsendii*	SC
California leaf-nosed bat	*Macrotus californicus*	SC
Greater western mastiff bat	*Eumops perotis californicus*	SC
Occult little brown bat	*Myotis lucifugus occultus*	SC
Riparian brush rabbit	*Sylvilagus bachmani riparius*	SC

Table 3. Sensitive species that may occur in Californian riparian habitats (U.S. Fish and Wildlife Service 1996).

Common Name	Scientific Name	Status [1]
PLANTS		
Fish slough milk-vetch	*Astragalus lentiginosus* var. *piscinensis*	PE
Nevin's barberry	*Berberis nevinii*	PE
La Graciosa thistle	*Cirsium loncholepis*	C
Surf thistle	*Cirsium rhothophilum*	C
Southern spikeweed	*Hemizonia parryi* ssp. *australis*	1B
Smooth spikeweed	*Hemizonia parryi* ssp. *laevis*	1B
San Diego marsh elder	*Iva hayesiana*	2
Gambel's watercress	*Rorippa gambellii*	FE
Owens Valley checkerbloom	*Sidalcea covillei*	SE
Valley sagittaria	*Sagittaria sandfordii*	1B

[1] FE = federally endangered; FT = federally threatened; PE = federally proposed endangered; SE = State endangered; SC = California species of special concern; C = Federal candidate for listing (taxa for which the Fish and Wildlife Service has substantial information to support listing as threatened or endangered); 1A = California Native Plant Society (CNPS) List (plants presumed extinct in California); 1B = CNPS List (plants rare, threatened, or endangered in California and elsewhere); 2 = CNPS List (plants rare, threatened, or endangered in California but more common elsewhere).

[2] Species was listed by “Evolutionarily Significant Units” (ESU); two ESUs were listed as endangered (including Southern California) and three were listed as threatened (including Central California Coast and South-Central California Coast) (National Marine Fisheries Services 1997).

chats (*Icteria virens*), and southwestern willow flycatchers (*Empidonax trailli extimus*) in some areas. Modifications of land uses that create extensive foraging areas for cowbirds (e.g., minimization of available waste feed-seed and manure at dairies and livestock congregations) should benefit populations of riparian host-bird species in the long term.

K. Recovery Strategy

Recovery efforts will focus on addressing the two major causes of decline of the least Bell's vireo: (1) habitat loss and degradation and (2) brown-headed cowbird nest parasitism. Brown-headed cowbird removal programs, funded by several agencies and through mitigation for projects adversely affecting least Bell's vireos, have been the most effective short-term management effort since the species was listed as endangered. It is essential to continue, and expand where appropriate, brown-headed cowbird removal in least Bell's vireo habitat. Land uses that perpetuate cowbird foraging in the range of the least Bell's vireo should be modified for long-term benefits that reduce the need for human intervention. Establishing perpetual endowments to fund brown-headed cowbird removal, and possibly for exotic plant removal from riparian habitat, will be necessary if self-sustaining populations of least Bell's vireos are not possible without human intervention.

Nest monitoring programs will also be essential to determine levels of brown-headed cowbird parasitism and evaluate the effectiveness of brown-headed cowbird removal and management techniques. In addition to its role in reducing nest parasitism, least Bell's vireo nest monitoring will facilitate color-banding of nestlings and adults for ongoing studies of demography, dispersal, and wintering habitat selection.

The development of management plans for the 14 population/metapopulation units, and for any additional areas identified by completion of recovery tasks, will be supplemented with research on habitat needs and protection of habitat through conservation agreements, conservation easements, habitat conservation plans, and land acquisition. Protection and management of the 14 population/metapopulation units and stable or increasing populations are criteria for downlisting the least Bell's vireo to threatened status. Designation of each of the least Bell's vireo population/metapopulation units is based on drainages with available and restorable habitat within the present and historical ranges and will facilitate development of workable management plans. These population/metapopulation units are not the functional equivalents of recovery units as defined by current Service policy.

To ensure the recovery of the least Bell's vireo, a better understanding of the size, configuration, and location of habitat will be necessary. This information will be used to identify areas to be protected and managed for least Bell's vireos and will be useful in habitat restoration. This information will be particularly useful in identifying potential habitat to allow for recolonization within the historical range as least Bell's vireo populations recover; recolonization is one criterion for delisting least Bell's vireos. A statewide inventory of riparian habitat and rangewide surveys will identify additional and potential least Bell's vireo habitat within the species' historical range.

Although some natural expansion into suitable areas will occur in the least Bell's vireo's presently unoccupied historical range in southern California, it is unlikely that the species can return naturally to the Central Valley, which once supported the majority of the species' population and was the center of the breeding range (Franzreb 1989). The principal recovery strategy for restoring least Bell's vireos to historically occupied areas will focus on natural range expansion as habitat is restored and least Bell's vireo numbers increase under habitat management and restoration and threat management. However, because of the distances between current populations and the Central Valley, as well as the natural site tenacity of least Bell's vireos, reintroduction of the species using translocation of individuals may be necessary to reestablish populations of least Bell's vireos in the Central Valley.

Research tasks will address developing better restoration techniques and monitoring the results as habitat is restored. Research, with international cooperation with Mexico, will determine the extent of the wintering range and identify threats on the wintering grounds that, through their impact on annual survivorship, could threaten the breeding population.

The progress of recovery will be assessed through ongoing evaluations of the success of each of these recovery efforts. As additional information becomes available, management plans will be revised.

Descriptions of the 14 Population/Metapopulation Units

Tijuana River. The Tijuana River originates in the mountains of Baja California, with three-fourths of its watershed in Mexico. The total watershed is 448,323 hectares (1,107,806 acres). Seventy-eight percent of the watershed is behind three dams, two of which are in the U.S. The major portion of the watershed is behind Rodriquez Dam in Mexico. Much of the remaining riparian habitats are on lands managed by the San Diego County Parks Department.

In 1996, the Tijuana River drainage represented 7 percent of the least Bell's vireo pairs recorded in California (Appendix A). Critical habitat for the least Bell's vireo extends approximately 5 kilometers (3 miles) along the Tijuana River, west of Interstate 5 and extending east and west of Dairy Mart Road (Fish and Wildlife Service 1994).

Riparian communities in the Tijuana River are threatened by unauthorized clearing activities and placement of fill materials, off-road vehicle use, exotic species, and flood control projects and channelization. Considerable human foot and horse traffic traverses the riparian habitats of the Tijuana River, and equestrian corrals are common features within the surrounding floodplain and upland areas.

Land use, water, regulatory, and associated agencies include: U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, U.S. Navy, U.S. Environmental Protection Agency, U.S. Department of Agriculture Forest Service, Bureau of Land Management, International Boundary and Water Commission, U.S. Department of Justice/Border Patrol, California Regional Water Quality Control Board, California State Water Resources Control Board, California Department of Transportation, California Department of Fish and Game, California State Lands Commission, California Coastal Commission, County of San Diego, San Diego County Parks and Recreation Department, San Diego County Vector Control, San Diego Association of Governments, City of San Diego, City of San Ysidro, San Diego Gas and Electric, and Tijuana Valley Water Board.

Dulzura Creek/Jamul Creek/Otay River. The Otay River watershed originates in the coastal foothills near the community of Dulzura and extends west approximately 38 kilometers (24 miles) to San Diego Bay near the community of Palm City. Surface flow is controlled by two dams. Additional flow is added by an aqueduct, which transfers water from Cottonwood Creek (Tijuana River watershed) to Dalzura Creek.

In 1996, the Dulzura Creek/Jamul Creek/Otay River population of least Bell's vireos represented approximately 2 percent of the pairs recorded in California (Appendix A). Critical habitat for the least Bell's vireo has been designated on Jamul-Dulzura Creeks along the drainages approximately 5.5 kilometers (3.5 miles) upstream of the upper end of Lower Otay Reservoir.

Riparian communities in the Otay River watershed are threatened by sand and gravel mining, water supply projects, unauthorized clearing activities and placement of fill materials, exotic species, and flood control projects and channelization.

Land use, water, regulatory, and associated agencies include: U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Department of Agriculture Forest Service, Bureau of Land Management, California Regional Water Quality Control Board, California State Water Resources Control Board, California Department of Transportation, California Department of Fish and Game, California State Lands Commission, California Coastal Commission, County of San Diego, San Diego Association of Governments, San Diego County Parks and Recreation Department, San Diego County Vector Control, City of Chula Vista, San Diego County Water Authority, Otay Water District, and San Diego Gas and Electric.

Sweetwater River. The Sweetwater River watershed extends for about 64 kilometers (40 miles) from the headwaters of the river in Cuyamaca Rancho State Park to San Diego Bay in Chula Vista. Surface flow is controlled by two dams. Within the lower Sweetwater River (downstream of the Cleveland National Forest), San Diego Association of Governments (1991a) identified 371 hectares (917 acres) of existing riparian habitat and 566 hectares (1398 acres) of nonriparian land potentially reclaimable to riparian habitat. The surrounding areas are described as intense urbanization in the lower sections of the river to rapidly urbanizing areas in the middle sections to rural residential and large-scale open spaces in the upper sections of the river.

In 1996, the Sweetwater River population of least Bell's vireos represented approximately 3 percent of the pairs recorded in southern California (Appendix A). Critical habitat for the least Bell's vireo extends from about 1.6 kilometers (1 mile) upstream of Highway 94 downstream to Sweetwater Reservoir.

Threats to the riparian community include agriculture, flood control, sand and gravel mining, recreation, residential/commercial/industrial development, transportation, wastewater treatment, and water supply projects (San Diego Association of Governments 1991b). Equestrian facilities are adjacent to much of the lower Sweetwater River.

Land use, water, regulatory, and associated agencies include: U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Department of Agriculture Forest Service, Bureau of Indian Affairs, Sycuan Indian Reservation, California Regional Water Quality Control Board, California State Water Resources Control Board, California Department of Transportation, California Department of Fish and Game, California State Lands Commission, California Coastal Commission, County of San Diego, San Diego County Parks and Recreation Department, San Diego County Vector Control, San Diego Association of Governments, City of Chula Vista, City of National City, Sweetwater Authority, San Diego County Water Authority, Otay Water District, and San Diego Gas and Electric.

San Diego River. The San Diego River drains a watershed of approximately 1140 square kilometers (440 square miles). The watershed trends westward from the Laguna Mountains down to Mission Bay in San Diego, approximately 64 kilometers (40 miles) away. Five dams control surface flows in the watershed.

Downstream of the Cleveland National Forest and the upper end of El Capitan Reservoir, San Diego Association of Governments (1991b) identified 304 hectares (751 acres) of existing riparian habitat and 380 hectares (940 acres) of land with potential to support riparian habitat, if appropriately reclaimed. The surrounding areas are described as intense urbanization in the lower sections of the river to rapidly urbanizing areas in the middle sections to rural residential and large-scale open spaces in the upper sections (San Diego Association of Governments 1991b).

In 1996, the San Diego River population of least Bell's vireos represented approximately 3 percent of the pairs recorded in California (Appendix A). Critical habitat for the least Bell's vireo along the San Diego River near the City of Santee includes approximately 2.4 kilometers (1.5 miles) upstream and 5 kilometers downstream (3 miles) of the intersection of Big Rock Road and Mission Gorge Road.

Threats to the riparian community include agriculture, flood control, sand and gravel mining, recreation, residential/commercial/industrial development, transportation, wastewater treatment, and water supply projects (San Diego Association of Governments 1991b). Equestrian facilities are adjacent to portions of the San Diego River.

Land use, water, regulatory, and associated agencies include: U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Department of Agriculture Forest Service, Bureau of Land Management, Bureau of Indian Affairs, Capitan Grande Indian Reservation, California Regional Water Quality Control Board, California State Water Resources Control Board, California Department of Transportation, California Department of Fish and Game, California State Lands Commission, California Coastal Commission, San Diego Association of Governments, County of San Diego, San Diego County Parks and Recreation Department, San Diego County Vector Control, City of San Diego, City of Santee, City of Lakeside, City of San Diego Parks and Recreation Department, Metropolitan Transit Development Board, City of San Diego Water Utilities District, Helix Water District, Padre Dam Municipal Water District, San Diego County Water Authority, and San Diego Gas and Electric.

San Luis Rey River. The San Luis Rey River drains a watershed of approximately 1440 square kilometers (556 square miles). The watershed trends westward from the Laguna Mountains down to the Pacific Ocean in Oceanside, approximately 80 kilometers (50 miles) away. One dam exists on the San Luis River at Lake Henshaw. Approximately 14 kilometers (9 miles) downstream of this dam, the Escondido Canal diverts runoff from the San Luis Rey River southwest to Lake Wolford. Under typical conditions, little or no surface flow passes this diversion point.

Eleven kilometers (7 miles) of the downstream end of the San Luis Rey River have been channelized with soft-bottom and concrete levees. West of Lake Henshaw, the San Luis Rey River flows through oak woodlands, chaparral, and coastal sage scrub canyons as it passes through three Indian reservations. The native plant communities have been (and continue to be) gradually replaced by citrus and avocado orchards, cattle and horse ranches, golf courses, and resort condominiums (Faber *et al.* 1989). Farther west and downstream, much of the natural San Luis Rey River floodplain has been turned into truck farms and wheat and barley fields, high- and medium-density residential areas, commercial zones, and industrial parks. Sand mining operations were frequent along the lower reaches of the river in the late 1980's (Faber *et al.* 1989), but most are now inactive. At least one dairy operation, row-crop agriculture, livestock grazing, and horse pasturage are active in the middle portion of the San Luis Rey watershed. However, the San Luis Rey River is considered to be one of the least modified and most easily restorable rivers in urbanized southern California, despite extensive conversion of floodplain riparian habitat to agricultural and other uses (U.S. Army Corps of Engineers 1981).

In 1996, the San Luis Rey River population of least Bell's vireos represented approximately 8 percent of the pairs recorded in California (Appendix A). Critical habitat for the least Bell's vireo extends along the San Luis Rey River from the community of Pala approximately 35 kilometers (22 miles) downstream to Interstate 5 near Oceanside.

Threats to the riparian community include agriculture, flood control, water supply projects, sand and gravel mining, recreation, residential/commercial/industrial development, transportation, wastewater treatment projects (San Diego Association of Governments 1990), and unauthorized placement of fill materials, clearing, and herbiciding activities.

Land use, water, regulatory, and associated agencies include: U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Department of Agriculture Forest Service, U.S. Marine Corps, U.S. Navy, Bureau of Land Management, Bureau of Indian Affairs, California Regional Water Quality Control Board, California State Water Resources Control Board, California Department of Transportation, California Department of Fish and Game, California State Lands Commission, California Coastal Commission, San Diego Association of Governments, County of San Diego, San Diego County Parks and Recreation Department, San Diego County Vector Control, Pauma Indian Reservation, Rincon Indian Reservation, Pala Indian Reservation, La Jolla Indian Reservation, City of Oceanside, Pauma Mutual Water Company, Pauma Valley Community Services District, Rainbow Municipal Water District, San Diego County Water Authority, San Luis Rey Municipal Water District, Valley Center Municipal Water District, Escondido Municipal Water Company, Vista Irrigation District, and San Diego Gas and Electric.

Camp Pendleton/Santa Margarita River. The drainages on Camp Pendleton and Fallbrook Naval Weapons Station are varied and include the Santa Margarita River, Las Pulgas Creek, Fallbrook Creek, French Creek, Las Flores Creek, Pilgrim Creek, De Luz Creek, San Onofre Creek, San Mateo Creek, and others. These drainages have watersheds in Orange, Riverside, and San Diego Counties. Upstream of Camp Pendleton, the Santa Margarita River watershed includes Temecula Creek and Murrieta Creek, which drain from the Black Hills, Aqua Tibia Mountains, Santa Rosa Plateau, and Red Mountain through mostly private lands in Riverside County. Murrieta and Temecula Creeks join near Temecula and form the main stem of the Santa Margarita River, which is bounded within the Santa Rosa Plateau and Santa Rosa Mountains. The western extension of the river flows through Camp Pendleton to the Pacific Ocean at the Santa Margarita estuary (Lee *et al.* 1997). San Mateo Creek, San Onofre Creek, and Las Pulgas Creek watersheds are almost wholly within public ownership on Camp Pendleton and the Cleveland National Forest. The watershed for the Santa Margarita River (including Temecula Creek and Murrieta Creek) is 1927 square kilometers (744 square miles) with a total of 1930 stream kilometers (1200 stream miles) (Lee *et al.* 1997). The Santa Margarita River is the only major water course in southern California south of the Santa Clara River that does not suffer from impoundment or restriction by one or more dams.

Much of the middle and lower elevation watershed on the Santa Margarita River has been adversely affected by either development or agriculture, including farming and grazing (Lee *et al.* 1997). Subdivision of property, fire prevention, land clearing, water management, and urban development are increasingly important land- use trends on the Santa Margarita River (Lee *et al.* 1997). Much of Temecula Creek has been channelized near Temecula. Riparian ecosystems on Camp Pendleton/Fallbrook Naval Weapons Station are adversely affected by fire and fire prevention activities, military training activities, groundwater pumping and wastewater treatment, agriculture, and flood/sediment control projects (J. Avery, U.S. Fish and Wildlife Service, pers. obser.). Exotic species threaten riparian communities throughout the Santa Margarita watershed.

The least Bell's vireo breeding population on Camp Pendleton and Fallbrook Naval Weapons Station is the largest rangewide. In 1996, the Santa Margarita River population of least Bell's vireos represented approximately 34 percent of the pairs recorded in California, and the Camp Pendleton population of least Bell's vireos represented 56 percent of the pairs recorded in California (Appendix A). Critical habitat for the least Bell's vireo on the Santa Margarita River extends approximately 8 kilometers (5 miles) downstream from the Riverside/San Diego

County line to the Camp Pendleton boundary (Santa Margarita y Las Flores Rancho grant boundary). Critical habitat for the least Bell's vireo was not designated on Camp Pendleton under the terms of a Memorandum of Understanding between the U.S. Fish and Wildlife Service and U.S. Marine Corps (see "Other Regulatory Mechanisms" under "I. Conservation Measures").

Land use, water, regulatory, and associated agencies include: U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Department of Agriculture Forest Service, U.S. Marine Corps, U.S. Navy, Bureau of Land Management, Bureau of Indian Affairs, California Regional Water Quality Control Board, California State Water Resources Control Board, California Department of Transportation, California Department of Fish and Game, California State Parks and Recreation, San Diego Association of Governments, California State Lands Commission, San Diego Association of Governments, County of San Diego, Riverside County, Orange County, Cahuilla Indian Reservation, City of Oceanside, City of San Clemente, City of Temecula, City of Murrieta, Southern California Edison, San Diego County Water Authority, Rainbow Municipal Water District, and Fallbrook Utilities District.

Santa Ana River. The watershed for the Santa Ana River is 6346 square kilometers (2,450 square miles) and comprises the single largest river system in southern California. The headwaters are in the San Bernardino National Forest. Two dams ultimately control surface flow; Seven Oaks Dam is currently under construction, and the Prado Dam is 63 kilometers (39 miles) downstream. The Santa Ana River has been straightened and channelized from Weir Canyon Road near Yorba Linda to the mouth at the Pacific Ocean near the city of Newport Beach.

The Prado Basin proper is actually a reservoir located behind Prado Dam, which was constructed as a flood control measure in 1941. It is located about 70 kilometers (43 miles) east of Los Angeles and 8 kilometers (5 miles) north of the City of Corona in the northwesternmost corner of Riverside County, California. It is estimated that the Prado Basin encompasses some 4500 hectares (11,120 acres), which contains a maximum of 2400 hectares (5930 acres) having elements characteristic of wetland habitats (Zembal *et al.* 1985, Zembal 1986). The riparian woodland in Prado Basin is the largest in areal extent in southern California. Below Prado Dam only one large remnant of perennial stream riparian vegetation remains (Faber *et al.* 1989).

In 1996, the Santa Ana River population of least Bell's vireos represented approximately 15 percent of the pairs recorded in California (Appendix A). Critical habitat for the least Bell's vireo on the Santa Ana River extends from Rubidoux near Riverside downstream through Prado Basin. Much of the current habitat in the watershed for least Bell's vireo is found in Prado Basin.

Although willow woodlands and freshwater marshes and ponds comprise the majority of wetland habitats within the Prado Basin, a significant percentage of the woodland habitats are lacking or devoid of well-developed understories due to the expressed effects of plant community succession or the effects of prolonged inundation. In addition, large tracts of willow woodland habitat have been invaded (and therefore degraded or destroyed) by several nonnative plant species. Water conservation projects have substantially affected low elevation riparian communities within the Prado Basin; however, endowments and other mitigation measures have been established to ensure that revegetation and exotic plant control measures continue in perpetuity within the watershed.

Encroaching and potentially conflicting land uses within the Prado Basin include urban and suburban parks and developments, an airport, livestock grazing and dairy farming, agriculture, oil field operations, and industry. In addition, a large portion of the basin has been leased to hunting club operators and is used for waterfowl, pheasant, and dove hunting, shooting sports, sportsmen's fairs, and dog training.

Riparian communities on the Santa Ana River are threatened by water supply projects, exotic species, flood/sediment control and channelization projects, road projects, and sand and gravel mining. Riparian communities were once extensive along the Santa Ana River (Beattie and Beattie 1939). Because surface flows and ground water are currently heavily managed and diverted, much of the remaining riparian community remnants are now dependent upon wastewater flows and urban runoff.

Land use, water, regulatory, and associated agencies include: U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Department of Agriculture Forest Service, Bureau of Land Management, Federal Aeronautics Administration, State of California Department of Conservation Division of Oil, Gas, and Thermal Resources, California Regional Water Quality Control Board, California State Water Resources Control Board, California Department of Transportation, California Department of Fish and Game, California State Lands Commission, Riverside County, County of Riverside Parks and Open Space District, Riverside County Flood Control, Orange County, San Bernardino Association of Governments, San Bernardino County, San Bernardino County Flood Control, City of Corona, City of San Bernardino, City of Riverside, City of Redlands, City of Norco, Southern California Edison, Orange County Water District, Western Riverside County Regional Wastewater Authority, Western Municipal Water District, Santa Ana Water Project Authority, Northwest Mosquito Abatement District, West Valley Vector Control District, and Chino Basin Municipal Water District.

Orange County/Los Angeles County. As a direct or indirect result of urbanization, all of the drainages in these two counties have, to varying degrees, been impounded, channelized, or otherwise adversely affected. Most recently, preparations for anticipated El Niño-driven storm events in 1997–1998 have resulted in the clearing of hundreds of acres of stream course vegetation in Los Angeles County and, to a lesser extent, in Orange County. However, patches of suitable, important vireo habitat remain throughout the lower and middle elevations of both counties. Notable among these patches are Arroyo Trabuco, Bonita Canyon/Creek, Canada Gobernadora, Carbon Canyon, Huntington Central Park, Laguna Reservoir, Mason Park/Sand Canyon Wash and Reservoir, Peters Canyon, Rattlesnake Reservoir, San Diego Creek, San Joaquin Marsh, Santa Ana River (task 1.117), and Santiago Creek/Villa Park Flood Control Basin in Orange County, and Big Tujunga Wash/Hansen Dam, Los Angeles River, Santa Fe Dam, San Francisquito, San Gabriel River drainage/Fish Canyon, Big Santa Anita Debris Basin, Santa Clara River drainage/Castaic Creek (task 1.119), Van Norman Dam, and Whittier Narrows in Los Angeles County.

Most or all of these habitat patches were almost certainly occupied historically by vireos (Coues 1903, Hoffman 1927, Grinnell and Miller 1944) prior to the precipitous decline of this once abundant species (Garrett and Dunn 1981). These habitat patches have been selectively and gradually reoccupied by vireos only recently, following sustained and relatively intensive management of the species within its current range. Vireos remain almost entirely absent from the large majority of comparatively expansive riparian habitats to the north within the historic range of the species, and over 95 percent of the entire vireo population is still confined to a small southern portion of the species' documented range despite the recent reoccupation of numerous (southerly) locales. Consequently, the closely spaced habitat patches in Orange and Los Angeles Counties are likely important "stepping stones" to the continuing (northward) expansion and full recovery of the species.

In 1996, the population of least Bell's vireos in Los Angeles and Orange Counties represented approximately 0.5 percent of the pairs recorded in California (Appendix A). Critical habitat includes a portion of the Santa Clara River in Los Angeles County (task 1.119).

Land use, water, regulatory, and associated agencies include: U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, U.S. Department of Agriculture

Forest Service, U.S. Environmental Protection Agency, Bureau of Land Management, California Regional Water Quality Control Board, California State Water Resources Control Board, California Regional Water Quality Control Board, California Department of Transportation, California Department of Fish and Game, California State Lands Commission, California Coastal Commission, Los Angeles County, Los Angeles County Department of Public Works, Los Angeles Department of Water and Power, Los Angeles County Department of Health Services, County Sanitation Districts of Los Angeles County, Orange County, Orange County Water District, and Orange County Vector Control District.

Santa Clara River. The watershed of the Santa Clara River covers approximately 4,072 square kilometers (1,629 square miles) with headwaters in the Los Padres and Angeles National Forests. From headwaters in the San Gabriel Mountains, the main stem of the river flows approximately 135 kilometers (84 miles) to the Pacific Ocean. Flows on two principle tributaries of the river, Piru Creek and Castaic Creek, are controlled by dams that serve as both flood control and water supply reservoirs. Although there are no dams on the main stem of the Santa Clara, a large diversion structure on the main stem removes water for recharge of the aquifers underlying the Oxnard Plain. Approximately half of the main stem of the river is now constrained by engineered structures of various descriptions, primarily bank protection to prevent lateral migration of the river (Faber *et al.* 1989). Bank stabilization is particularly evident along the river in the rapidly urbanizing Santa Clarita area of Los Angeles County. The 23-million-liter-per-day (six million gallons) outfall from the Valencia Water Reclamation Plant augments surface flows along the river for several miles downstream of the Santa Clarita area.

Habitat for least Bell's vireos occurs in patches along much of the river, with location and quality varying from year to year as conditions in the river change following winter storm events. An exception is found in several areas along the river where, regardless of rainfall events, extensive riparian habitats persist due to rising groundwater.

In 1996, the Santa Clara River population of least Bell's vireos represented approximately 3 percent of the pairs recorded in southern California (Appendix A). Surveys conducted in 1997 located 60 pairs of least Bell's vireos along this stretch of the river (Jim Greaves, pers. comm. 1997). Critical habitat for the least Bell's vireo extends along Santa Clara River from approximately 2.4 kilometers (1.5 miles) east of its junction with Piru Creek and eastward to the intersection of Old Road and Rye Canyon Road.

The primary threats to native habitats within the river are associated with engineered solutions to flooding of both urbanized and agricultural land, pressure to provide opportunities to mine sand and gravel from the river, and the spread of invasive exotic vegetation, particularly giant reed grass (*Arundo donax*).

Land use, water, regulatory, and associated agencies include: U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, U.S. Department of Agriculture Forest Service, U.S. Environmental Protection Agency, Bureau of Land Management, California Department of Conservation Division of Oil, Gas, and Thermal Resources, California Department of Fish and Game, California State Lands Commission, California Department of Transportation, California Regional Water Quality Control Board, Ventura County Flood Control District, Los Angeles County, Los Angeles County Department of Health Services, Los Angeles County Department of Water and Power, Los Angeles County Department of Public Works, California State Water Resources Control Board, United Water Conservation District, County Sanitation Districts of Los Angeles County, and the cities of Santa Clarita, Santa Paula, and Fillmore.

Santa Ynez River. The watershed of the Santa Ynez River covers approximately 1,676 square kilometers (647 square miles) with its headwaters located in the Los

Padres National Forest. From its headwaters, and alternating between narrow canyons and broad valleys, the main stem of the river flows west approximately 158 kilometers (98 miles) between the Santa Ynez and San Rafael Mountain ranges. There are three dams on the main stem of the river: Jamison Dam, Gibralter Dam, and Bradury Dam. The Santa Ynez River empties into the Lompoc coastal plain through the Narrows into the Pacific Ocean

In 1996, the Santa Ynez River population of least Bell's vireos represented approximately 1.5 percent of the pairs recorded in southern California (Appendix A). Surveys conducted in 1997 located an estimated 20 pairs of least Bell's vireos on the river (Jim Greaves, pers. comm. 1997). Habitat for the least Bell's vireo occurs in scattered patches along most of the river, with quality varying from year to year as conditions in the river change following winter storms. Critical habitat for the least Bell's vireo exists along the Santa Ynez River from below Jamison Dam west to a point approximately 1.6 kilometers (1 mile) east of Gibralter Dam. The primary threats to native habitats within the river drainage are associated with dam construction, channelization, water diversions, agricultural and urban development, and wetland draining.

Land use, water, regulatory, and associated agencies include: U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, U.S. Air Force, U.S. Department of Agriculture Forest Service, U.S. Environmental Protection Agency, Bureau of Land Management, Bureau of Reclamation, California Department of Transportation, California Department of Fish and Game, California Regional Water Quality Control Board, California State Water Resources Board, Santa Barbara County, Santa Barbara County Water Agency, California State Lands Commission, California Department of Water Resources, and the cities of Lompoc and Buelton.

Anza Borrego Desert. The Anza Borrego Desert region includes Coyote Creek, San Felipe Creek, Vallecito Creek, Bow Willow Creek, Carrizo Creek, San Felipe

Creek, Borrego Palm Canyon Wash, Carrizo Marsh, Sheep Canyon Wash, Sentenac Canyon Wash, Tamarisk Grove, Yaqui Well Wash, Aqua Caliente Creek, Windmill Creek, and others. This desert area is approximately 100 kilometers (60 miles) long north-south, and 40 kilometers (25 miles) wide east-west, mostly in eastern San Diego County. Riparian elements in this desert region are rare with considerable distances between sites.

In 1996, the Anza Borrego Desert population of least Bell's vireos represented 0.1 percent of the pairs recorded in California; however, the pairs were minimally surveyed for in this area in 1996 (Appendix A). The number of territorial males documented in the Anza Borrego Desert population, which is likely a better reflection of the current proportional occupation of this area, represented 4 percent of the territorial males recorded in California.

Critical habitat for the least Bell's vireo is designated in the Anza Borrego Desert on approximately 3 kilometers (1.9 miles) of Coyote Creek near the town of Borrego. The largest concentration of least Bell's vireos within this unit is found on private property (Vallecitos Creek). Threats to the riparian community include cattle grazing and equestrian facilities in adjacent areas, exotic species, off-road vehicles, and road projects.

Land use, water, regulatory, and associated agencies include: U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Department of Agriculture Forest Service, Bureau of Land Management, Bureau of Indian Affairs, California Regional Water Quality Control Board, Bureau of Land Management, California State Parks and Recreation, California Department of Transportation, California Department of Fish and Game, California State Lands Commission Riverside County, County of San Diego, Imperial County, Los Coyotes Indian Reservation, Santa Rosa Indian Reservation, San Diego and Arizona Eastern Railroad, and San Diego Gas and Electric.

Salinas River. The watershed of the Salinas River, with headwaters located in the coastal mountains of the Los Padres National Forest, drains approximately 11,396 square kilometers (4,400 square miles). From its headwaters the river flows in a northwesterly direction into the Salinas Lagoon and then into the Pacific Ocean at Monterey Bay. The major plant communities of the Salinas River include coniferous forest, oak and foothill (gray) pine woodlands, riparian scrub and woodlands, marshland, valley and foothill grasslands, chaparral, coastal scrub and coastal dunes. One thousand two hundred and ninety five square kilometers (500 square miles) of the watershed is the relatively flat Salinas River Valley. which is primarily agricultural land. Three major reservoirs regulate the flow of the Salinas River: the Nacimiento, San Antonio, and Santa Margarita Lakes.

Habitat for the least Bell's vireo occurs in scattered patches along most of the river; however, the best habitat exists in the upper Salinas Valley, specifically a 6-mile stretch from Bradley to Camp Roberts. The last record of a least Bell's vireo on the Salinas River was a singing male in July of 1993 (Roberson and Tenny 1993). The primary threats to native habitats within the river drainage are associated with dam construction, channelization, water diversions, agricultural development, and grazing.

Land use, water, regulatory, and associated agencies include: U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, U.S. Forest Service, U.S. Environmental Protection Agency, California Department of Fish and Game, California State Water Resources Board, U.S. Bureau of Land Management, California State Lands Commission, Monterey County Water Resources Agency, U.S. Bureau of Reclamation, Monterey Peninsula Water Management District, Monterey County Parks Department, Northern Salinas Valley Mosquito Abatement District, California Regional Water Quality Control Board, Central Coast, King City, and City of Salinas.

San Joaquin Valley. The San Joaquin Valley watershed below the 152-meter (500-foot) contour encompasses approximately 3.4 million hectares (8.5 million acres) and extends about 415 kilometers (258 miles) north to south. The San Joaquin River basin is bounded on the west by the Coast Range, on the east by the Sierra Nevada, on the south by the Tehachapi Mountains, and in the north by the Sacramento/San Joaquin River Delta. The Tulare Lake basin to the south is often considered a separate drainage basin, but during wet years it has historically contributed occasional flood overflows and subsurface flows to the San Joaquin River. Numerous dams control surface flows in tributaries to the San Joaquin River, including the Merced, Tuolumne, Stanislaus, and Calaveras Rivers. Dams on the Kings, Kaweah, Kern and Tule Rivers control surface flows draining from the Sierras into the Tulare Lake basin. Agricultural activities and flood control projects are the primary threats to riparian habitats remaining within this basin.

Areas with potential least Bell's vireo habitat include the Kern River Preserve and Caswell Memorial State Park (Stanislaus River).

Land use, water, regulatory, and associated agencies include: U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Department of Agriculture, U.S. Forest Service, Bureau of Reclamation, Bureau of Land Management, Bureau of Indian Affairs, National Marine Fisheries Service, Natural Resources Conservation Service, Federal Energy Regulatory Commission, California Department of Water Resources, The Resources Agency, California Regional Water Quality Control Board, California State Water Resources Board, California Department of Transportation, California Department of Fish and Game, California Fish and Game Commission, California State Lands Commission, State Board of Forestry, California State Parks and Recreation, and numerous cities, counties, mosquito abatement districts, and water districts.

Sacramento Valley. The Sacramento Valley watershed below Shasta Dam encompasses approximately 3.2 million hectares (8 million acres) and extends about 310 kilometers (193 miles) north to south. The Sacramento River basin is bounded on the west by the Coast Range, on the east by the Sierra Nevada, on the north by the Cascade Range, and on the south by the Sacramento/San Joaquin River Delta. Shasta Dam controls flows in the Sacramento River. A number of dams control surface flows in tributaries to the Sacramento River, including the American River, Feather River, Bear River, and Stony Creek. Agricultural activities and flood control projects are the primary threats to riparian habitats remaining within this basin.

Areas of potential least Bell's vireo habitat include Cosumnes River Preserve, Bobelaine Sanctuary (Feather River), Butte Sink, Big Chico Creek to the mouth of Pine Creek, and the Sacramento River (Hanson Island to Parrot Landing, River Miles 170–181; Merrill's Landing at River Miles 212–215; Woodson Bridge-Kopta Slough at River Miles 218–220).

Land use, water, regulatory, and associated agencies include: U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Department of Agriculture, U.S. Forest Service, Bureau of Reclamation, Bureau of Land Management, Bureau of Indian Affairs, National Marine Fisheries Service, Natural Resources Conservation Service, Federal Energy Regulatory Commission, California Department of Water Resources, The Resources Agency, California Regional Water Quality Control Board, California State Water Resources Board, California Department of Transportation, California Department of Fish and Game, California Fish and Game Commission, California State Lands Commission, State Board of Forestry, California State Parks and Recreation, and numerous cities, counties, mosquito abatement districts, and water districts.

II. RECOVERY

A. Objective and Criteria

The objective of this recovery plan is to delist the least Bell's vireo when the five listing criteria no longer apply. Before delisting may occur, the Fish and Wildlife Service must determine that the following listing factors are no longer present or continue to adversely affect the least Bell's vireo: (1) the present or threatened destruction, modification, or curtailment of its habitat or range; (2) disease or predation; (3) the inadequacy of existing regulatory mechanisms; and (4) other natural or manmade factors affecting its continued existence (U.S. Fish and Wildlife Service 1985).

Downlisting Criterion:

Reclassification to threatened may be considered when criterion 1 has been met for a period of 5 consecutive years.

Criterion 1: Stable or increasing least Bell's vireo populations/metapopulations, each consisting of several hundred or more breeding pairs, are protected and managed at the following sites: Tijuana River, Dulzura Creek/Jamul Creek/Otay River, Sweetwater River, San Diego River, San Luis Rey River, Camp Pendleton/Santa Margarita River, Santa Ana River, an Orange County/Los Angeles County metapopulation, Santa Clara River, Santa Ynez River, and an Anza Borrego Desert metapopulation.

Delisting Criteria:

Delisting may be considered when the species meets the criterion for downlisting and the following criteria have been met for 5 consecutive years.

Criterion 2: Stable or increasing least Bell's vireo populations/metapopulations, each consisting of several hundred or more breeding pairs, have become established and are protected and managed at the following sites: Salinas River, a San Joaquin Valley metapopulation, and a Sacramento Valley metapopulation.

Criterion 3: Threats are reduced or eliminated so that least Bell's vireo populations/metapopulations listed above are capable of persisting without significant human intervention, or perpetual endowments are secured for cowbird trapping and exotic plant (*Arundo*) control in riparian habitat occupied by least Bell's vireos.

B. Narrative Outline for Recovery Actions

1. Protect and manage riparian and adjacent upland habitats within the least Bell's vireo's historical range.

Continued increases in least Bell's vireo populations and expansion throughout the historical range depend on the availability of suitable nesting habitat. Recent population trends indicate that overall habitat quality/function (predator/prey relationships, foraging and breeding areas, etc.), quantity, and management in southwestern United States portion of the least Bell's vireo's range have been sufficient to promote increases in the least Bell's vireo populations. As discussed in Part I ("D. Life History and Ecology"), expansion of the least Bell's vireo distribution has occurred in a "stepping stone" fashion (i.e., in response to increases in numbers in existing populations, least Bell's vireos expand their range by recolonizing sites that have been unoccupied for years or decades). Existing and restorable habitat within the least Bell's vireo's historic range should be protected. In order to continue progress towards recovery, not only must existing populations be protected and managed but the size, configuration, and location of habitat necessary to sustain new, self-perpetuating least Bell's vireo populations must be determined. These areas must be protected and managed through conservation agreements, habitat conservation plans, multiple species conservation plans, land acquisition and management, conservation easements, and interagency consultations under section 7 of the Endangered Species Act.

1.1 Develop management plans for the 14 population/metapopulation units.

Management plans must be developed and implemented for each of the 14 population/metapopulation units described under the downlisting and delisting criteria. These management plans are essential to the continued viability of the species once the protection afforded by the Endangered Species Act is removed. Moreover, they provide excellent opportunities for multiple species protection, which could preclude the need for Federal listing of other sensitive riparian species. At a minimum, the plans should detail management responsibilities and funding sources to provide for continuing habitat protection, including maintenance of hydrologic regimes necessary to sustain habitat, cowbird control, cowbird foraging area reduction, and control of invasive exotic vegetation. Future proposed projects and activities within the management areas should be designed and regulated in ways compatible with the goals of the management plans.

For each unit, develop a management plan that defines (1) the geographical limits of the habitat unit, (2) the jurisdiction(s) with land-use authority over the unit, (3) what constitutes a viable vireo population for the unit, (4) what is needed to achieve a viable vireo population for the unit, and (5) jurisdictional responsibilities and costs for achieving this objective.

1.111 Tijuana River

Major threats to be addressed include unauthorized clearing activities and placement of fill materials, off-road vehicle use, exotic species, and flood control projects and channelization. Considerable human foot and horse traffic traverses the riparian habitats of the Tijuana River, and equestrian corrals are common features within the surrounding floodplain and upland areas.

1.112 Dulzura Creek/Jamul Creek/Otay River

Major threats to be addressed include sand and gravel mining, water supply projects, unauthorized clearing activities and placement of fill materials, exotic species, and flood control projects and channelization.

1.113 Sweetwater River

Major threats to be addressed include agriculture, flood control, sand and gravel mining, recreation, residential/commercial/industrial development, transportation, wastewater treatment and water supply projects (San Diego Association of Governments 1991b) and equestrian facilities, adjacent to much of the lower Sweetwater River, and their attraction of brown-headed cowbirds.

1.114 San Diego River

Major threats to be addressed include agriculture, flood control, sand and gravel mining, recreation, residential/commercial/industrial development, transportation, wastewater treatment and water supply projects (San Diego Association of Governments 1991b), and equestrian facilities, which may attract brown-headed cowbirds, adjacent to the San Diego River.

1.115 San Luis Rey River

Major threats to be addressed include agriculture, flood control, water supply projects, sand and gravel mining, recreation, residential/commercial/industrial development, transportation, wastewater treatment projects (San Diego Association of Governments 1990), and unauthorized placement of fill materials, clearing, and herbiciding activities.

1.116 Camp Pendleton/Santa Margarita River

Major threats to be addressed include agriculture, fire and fire prevention, land clearing, channelization, water management, urban development, military training activities, groundwater pumping and wastewater treatment, flood/sediment control projects, and exotic species.

1.117 Santa Ana River.

Major threats to be addressed include encroachment and potentially conflicting land uses such as urban and suburban parks, developments, an airport, livestock grazing and dairy farming, agriculture, oil field operations, industry, channelization projects, road projects, sand and gravel mining, and impacts of wastewater flows and urban runoff to riparian communities.

1.118 Orange County/Los Angeles County

Major threats include impoundments, channelization, and removal of stream bank vegetation. Management planning should address the need to maintain the remaining patches of suitable, important least Bell's vireo habitat throughout the lower and middle elevations of both counties, and particulary, the closely spaced habitat patches that are likely important "stepping stones" to the continuing (northward) expansion and full recovery of the species.

1.119 Santa Clara River

Major threats to be addressed are associated with engineered solutions to flooding of both urbanized and agricultural land, pressure to provide opportunities to mine sand and gravel from the river, and the spread of invasive exotic vegetation, particularly giant reed grass (*Arundo donax*).

1.120 Santa Ynez River

Major threats to be addressed include dam construction, channelization, water diversions, agricultural and urban development, and wetland draining.

1.121 Anza Borrego Desert

Major threats to be addressed include cattle grazing and equestrian facilities in adjacent areas, exotic species, off-road vehicles, and road projects.

1.122 Salinas River

Major threats to be addressed include dam construction, channelization, water diversions, agricultural development, and grazing.

1.123 San Joaquin Valley

Major threats to be addressed include agricultural activities and flood control projects.

1.124 Sacramento Valley

Major threats to be addressed include agricultural activities and flood control projects.

1.2 Prepare management plans for least Bell's vireo habitats identified in Task 2.1.

As a result of a statewide inventory of riparian habitat (task 2.11) and statewide surveys (task 2.12) for least Bell's vireos, additional occupied or potential habitat may be found. Management plans should be developed and implemented for these areas to protect existing least Bell's vireos or to manage potential habitat (and adjacent land uses) that may be available for recolonization.

1.3 Establish a protocol for monitoring least Bell's vireo populations and habitat.

These data should provide estimates of population size and trends, demographic parameters, and habitat characteristics. Methods used should be standardized to ensure compatibility of data sets. Monitoring should be an intensive effort to obtain accurate information on population size, number of breeding pairs, nesting success and productivity, annual survivorship (of color-banded birds), dispersal (through resightings of color-banded birds), and rates of cowbird parasitism. Particular emphasis should be placed upon the detection and accurate identification of banded birds, as the linkage between least Bell's vireo populations produced by dispersal is one of the most important factors influencing metapopulation viability, and more data are needed to improve our estimates of this critical parameter. Standardized techniques for measuring vegetation and other habitat characteristics should be developed. Adjacent habitats and land uses should be described at each monitored site.

1.4 **Conduct annual monitoring of the 14 population/metapopulation units.**

Annual monitoring is needed to evaluate progress toward recovery and to identify any problems or threats that arise. Monitoring should follow the protocols established under Task 1.3.

1.411 **Tijuana River**
1.412 **Dulzura Creek/Jamul Creek/Otay River**
1.413 **Sweetwater River**
1.414 **San Diego River**
1.415 **San Luis Rey River**
1.416 **Camp Pendleton/Santa Margarita River**
1.417 **Santa Ana River**
1.418 **Orange County/Los Angeles County**
1.419 **Santa Clara River**
1.420 **Santa Ynez River**
1.421 **Anza Borrego Desert**
1.422 **Salinas River**
1.423 **San Joaquin Valley**
1.424 **Sacramento Valley**

1.5 **Continue cowbird removal.**

Nest parasitism by the brown-headed cowbird has been well-documented as a limiting factor on least Bell's vireo nesting success and productivity.

Extensive and continuous cowbird removal from the least Bell's vireo management areas during the last decade is probably the single most important factor reversing population declines and producing the recent population increases in the southwestern United States portion of the least Bell's vireo range. The recovery criteria outlined in this plan are derived from analysis of the performance of least Bell's vireo populations under a regime of cowbird removal; consequently, it will be necessary to continue such programs until it is determined that active cowbird removal is no longer necessary to maintain current levels of least Bell's vireo productivity, or long-term control measures are assured (task 1.8).

1.6 Develop alternative means of controlling cowbird parasitism.

Presently, cowbird control takes the form of trapping adults and juveniles and monitoring least Bell's vireo nests to remove any cowbird eggs or young. While nest monitoring is limited to least Bell's vireo nests, trapping reduces parasitism of other riparian birds, including the endangered southwestern willow flycatcher and several sensitive species, but also results in losses to nontarget native bird species caught incidentally in traps. The benefits of reducing cowbird numbers, along with the interest of land managers working with endangered species threatened by parasitism elsewhere such as the golden-cheeked warbler (*Dendroica chrysoparia*) and the black-capped vireo (U.S. Fish and Wildlife Service 1991, 1992), justify the need to develop cowbird control measures that are long term, less costly and time intensive, multispecies oriented, and cover a broader geographic area.

Modification of land uses adjacent to least Bell's vireo breeding areas is likely the only long-term method available to reduce cowbird numbers without cowbird removal and nest monitoring. Modification of land uses would involve avoiding or modifying types of land use (e.g., dairies, livestock pens, equestrian centers, and other cowbird feeding areas) within flood plains and adjacent lands that result in concentrations of cowbirds. Additionally, land use management practices (e.g., seasonal alteration of grazing regimes and feed-seed/manure management) can be used to discourage concentrations of cowbirds near riparian habitat during the breeding season. Unless land uses are modified to eliminate or greatly reduce cowbird numbers, trapping may be required in perpetuity.

1.7 Control nonnative plant species.

Availability and suitability of riparian habitat for nesting least Bell's vireos and other species is threatened by the invasion of nonnative (exotic) vegetation, including castor bean (*Ricinus communis*), cocklebur (*Xanthium strumarium*), tamarisk (*Tamarix* sp.), and giant reed (*Arundo donax*). *Arundo* is particularly threatening because of its rapid rate of growth and establishment, its ability to be dispersed widely throughout drainages during flooding, and its propensity to spread over large areas, especially following natural or artificial disturbances when it competes effectively against native vegetation. Literally miles of monotypic stands of *Arundo* exist on some southern California drainages, preventing reestablishment of native riparian habitat in those areas and promoting fragmentation of native vegetation stands. Eradication of *Arundo* and other exotic plants is essential to maintain the suitability of riparian habitat for least Bell's vireos, as well as to restore native habitat in areas now dominated by nonnative vegetation.

Current management of nonnative vegetation requires a considerable commitment to thoroughly removing or killing all above- and below-ground parts of the target species and follow-up in subsequent years to control any exotics outbreaks. Eradication of most exotic species currently requires a combination of mechanical and chemical control. Coordination throughout drainages is required to prevent situations where downstream eradication sites are repeatedly colonized by upstream sources of exotic plants.

The Bureau of Reclamation funded biological control research for *Tamarisk* spp., which resulted in the release of *Tamarisk*-specific chrysomelid beetles in the summer of 1997 (Dr. Bernd Blossey, Professor of Biology, Cornell University, pers. comm.). The use of this biocontrol method for *Tamarisk* in California should be implemented, and other methods of biocontrol for *Arundo* and other nonnative plant species should be developed (task 2.5).

1.8 Establish perpetual endowments for brown-headed cowbird control and/or exotic plant control in least Bell's vireo habitat.

Threats must be reduced or eliminated so that least Bell's vireo breeding populations are capable of persisting without significant human intervention. Perpetual endowments must be secured for brown-headed cowbird trapping and/or exotic plant control in riparian habitat occupied by the least Bell's vireo where persistence of least Bell's vireo populations require continuous management of these threats.

2. Conduct research.

2.1 Identify additional and potential least Bell's vireo breeding habitat within its historical range.

The goal of the this recovery plan is to ensure that the 14 least Bell's vireo populations/metapopulations are capable not only of self-perpetuation, but also of producing colonizers that will reestablish viable populations within the historical range. As least Bell's vireo populations recover under protection and management, their increased reproductive success, survivorship, and recruitment of new individuals will require expansion into historically occupied, but currently unoccupied habitat (i.e., the Central Valley). Management plans should be prepared and implemented for protection of areas identified under this task (task 1.2).

2.11 Conduct a statewide inventory of riparian habitat.

Despite wide interest in the current status of California's riparian habitat and its associated wildlife, to date no comprehensive statewide inventory of riparian habitat acreage and distribution has been conducted. Such an effort is needed for effective least Bell's vireo management. Accurate maps, acreages, and habitat type delineations (e.g., cottonwood-willow, mule fat scrub, alder riparian, oak riparian, etc.) would allow projections of the size and geometry of least Bell's vireo populations likely to be established as recovery proceeds. Adjacent land uses should also be examined. Such information would also help to evaluate the contribution of individual sites to the overall habitat base available to the least Bell's vireo. Entry of inventory data into a computer-based Geographic Information System (GIS) would permit retrieval of maps useful for surveys and monitoring. These data would be useful in analyzing the impacts of natural factors, which may vary spatially, and human activities on least Bell's vireo population viability.

2.12 Conduct thorough rangewide surveys.

In addition to annual monitoring of the population/metapopulation units, rangewide surveys of all potential least Bell's vireo habitat are necessary to assess population size and distribution, habitat availability and condition, and to document dispersal. A Fish and Wildlife Service biologist or their designee should assemble, train, and supervise a qualified team large enough to complete an intensive survey. The initial coordinator should identify and delineate survey areas and develop maps, directions, and survey materials for participants. Special effort should be devoted to resighting color-banded birds and obtaining accurate band combinations for contribution to the database on dispersal used in population viability analyses. Surveys should be conducted at least every five years and, preferably, every three years if funding is available.

2.2 Investigate the status of wintering habitat and identify current or potential threats.

A major factor contributing to population declines of neotropical migratory birds is loss of wintering habitat. Although least Bell's vireos are reported to winter throughout the Cape Region of Baja California, Mexico, investigators have had little success in locating specific wintering areas of color-banded least Bell's vireos that breed in California. Continued research is necessary to determine the actual location, extent, and function of the wintering range and to identify threats to birds on the wintering grounds that, through their impact on annual survivorship, could imperil the status of the breeding population.

2.21 Establish a cooperative agreement with Mexico to obtain information on vireo wintering grounds in Baja California, Mexico.

Such an agreement should be coordinated through the Fish and Wildlife Service's International Affairs Office and the Partners in Flight program.

2.3 Collect demographic data on least Bell's vireos.

2.31 Continue color-banding least Bell's vireos and collect data for demographic and dispersal analyses.

Color-banding of nestlings and adults, which has been essential to ongoing studies of demography, dispersal, and wintering site selection, must be continued to facilitate collection of data for additional analyses and to determine the effectiveness of management and recovery actions.

2.32 Determine the relationships between population density and reproductive characteristics.

Variation in demographic parameters as a function of population size is called density-dependent variation. As least Bell's vireos recover and approach the carrying capacity of their habitat, research is needed to determine whether any of their reproductive parameters (i.e., clutch size, hatching rate, fledging rate, predation and parasitism rates, and survival rates) change. Findings of such density-dependence would need to be incorporated into a population viability analysis to reflect its impact on population growth and persistence. Recovery criteria should be revised as necessary in light of any new data.

2.33 Determine the relationships between population density and dispersal.

Dispersal is another life history characteristic that may change as a function of population size, both natal (source) population and target population. As conditions in natal populations become more crowded, proportionately more birds may disperse to new areas. As target populations grow, they may become more attractive to dispersers than smaller populations. There are a number of scenarios possible, and each could produce a different effect on least Bell's vireo metapopulation dynamics. Research in this area will depend on continued intensive color-banding and resighting of color-banded least Bell's vireos.

2.4 Investigate the relationship between habitat characteristics and least Bell's vireo behaviors and access to necessary resources.

Least Bell's vireo habitat needs extend beyond defense of a territory, which can be readily measured in the field and used to quantify "occupied" habitat.

Many other least Bell's behaviors and access to necessary resources are influenced by habitat characteristics such as vegetation structure and species composition, size, age, adjacent land use, and proximity to other riparian habitat. Habitat characteristics can influence mate attraction, nesting and feeding of young, foraging, local post-breeding movements of juveniles, acquisition of territories by first-time breeders both within and outside of the natal drainage, and breeding site shifts prompted by natural disturbance processes. The relationships between these factors and the key components of least Bell's vireo population viability (productivity and dispersal) need to be better understood.

2.5 **Develop biocontrol methods for *Arundo* and other nonnative plant species.**

The development of biological control of *Arundo* and other nonnative plant species through U.S. Department of Agriculture, international, and university programs should be initiated. Biocontrol programs for some plant pest species have been developed, including the use of six insect species to control yellow-star thistle (*Centaurea* sp.), an exotic from southern Europe (Randall 1994); release of a *Tamarisk*-specific chrysomelid beetle in Texas (Dr. Bern Blossey, pers. comm.); and the release of European beetles in New York state for biological control of purple loosestrife (*Lythrum* sp.), an invasive exotic from Europe (U.S. Fish and Wildlife Service 1997). The International Institute of Biological Control headquartered in Switzerland has staff and facilities to perform the international research needed to perform the type of work needed for *Arundo* and other invasive species in the range of the least Bell's vireo (Dr. Bernd Blossey, pers. comm.). Biological control programs hold promise of long-term, self-sustaining, and very wide-range control of invasive plant species with relatively limited costs, but are not without the biological risks associated with releasing additional exotic species.

3. **<u>Develop and evaluate least Bell's vireo habitat restoration techniques</u>**.

Riparian habitat creation and restoration is becoming increasingly popular as a form of mitigation for the destruction or degradation of existing riparian habitat. Results are mixed as to whether suitable habitat is restored and subsequently occupied by nesting least Bell's vireos. While several San Diego County sites are promising examples of successfully colonized restored habitat, many other sites throughout southern California have failed. Long-term monitoring of restoration sites is essential. Existing habitat restoration techniques should be fully evaluated and new methods developed through cooperation between regulatory agencies and academic institutions.

3.1 **<u>Implement long-term monitoring of restoration sites and their use by least Bell's vireos and other riparian species</u>**.

Long-term monitoring of restoration sites and their use by least Bell's vireos and other riparian species is necessary to determine whether these sites can function as self-sufficient ecosystems and not simply human-tended native plant gardens. Monitoring of restoration sites established under mitigation agreements should be improved.

3.2 **<u>Develop less costly methods of creating sites with the vegetation composition and structure required by nesting least Bell's vireos</u>**.

Research is also needed on less costly methods of creating sites with the vegetation composition and structure required by nesting least Bell's vireos, such as the use of stem-cuttings rather than nursery stock. Research needs include finding ways to improve site selection and preparation, planting techniques (timing, stock, subsequent care, irrigation methods), and other aspects of site maintenance, such as protection from vandalism and controlling plant pests.

3.3 Evaluate restoration efforts and effectiveness of methods used.

Advances in restoration site design and implementation in the last 10 years have resulted in some successful restoration efforts. Riparian habitat with the structure of natural habitat and which attracts nesting least Bell's vireos has been produced. However, despite these successes, many attempts at habitat restoration have failed. The "success" criteria used to evaluate the effectiveness of past restoration efforts, as well as the methods used to generate the data for these evaluations, should be reviewed and revised.

3.4 Conduct habitat restoration.

Habitat restoration may be appropriate in areas of potential, or degraded, habitat identified as a result of the statewide inventory of riparian habitat (task 2.11) and rangewide surveys (task 2.12) for additional least Bell's vireos. As information is acquired through monitoring restored habitat and evaluating restoration efforts and techniques (tasks 3.1 and 3.3), and as restoration techniques are improved and costs reduced (task 3.2) habitat restoration should be conducted in such areas.

4. Reintroduce least Bell's vireos to unoccupied habitat in the historical range through translocation.

Translocation of least Bell's vireos may be necessary to reestablish populations in areas (i.e., Central Valley) that are too far from existing populations for natural reoccupation to occur. Evaluations of potential sites for reintroductions should include assessing habitat quality and suitability, assessing threats and determining methods of protecting and managing selected sites and reducing or eliminating threats, and assessing the likelihood of least Bell's vireo success in restored or managed areas. Habitat restoration should be completed before reintroductions are initiated, and all reintroduction sites should be protected and managed to maximize long-term survival of least Bell's vireos. A thorough evaluation of reintroduction techniques should include determining the best sources of individuals while considering genetics contributions of selected individuals to a new population. Least Bell vireo behaviors (e.g. song recognition, site fidelity) will also influence selection of individuals. Capture and release of juveniles may be the most feasible approach with the best chance of success. Any translocation efforts should involve public outreach.

5. **Evaluate progress of recovery, effectiveness of management and recovery actions, and revise management plans.**

This adaptive management approach ensures that the best available scientific information is used to guide recovery efforts. As more information becomes available through the completion of recovery tasks, recovery strategies and criteria should be reassessed. Management plans will be updated as management strategies are evaluated and research provides the basis for developing more effective management strategies.

6. **Provide public information and education.**

Public understanding, support, and involvement in the least Bell's vireo recovery efforts are critical to successfully reaching the delisting objective of the recovery plan. An effective public outreach program should be developed and implemented to inform and update local governments and interested members of local communities. An effective outreach program will be particularly essential should translocation of least Bell's vireos become necessary. Outreach activities could include producing brochures about least Bell's vireos, the value of riparian habitat and undeveloped floodplains, wetland functions and values, the effects of channelization, and providing information on the negative impacts of nonnative species. Other outreach activities could include posting signs in public use areas in least Bell's vireo habitat and making presentations to schools and clubs. Outreach activities will benefit the recovery effort and increase public awareness of the reasons for the endangered status of the least Bell's vireo and the value of particular recovery activities.

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IV. IMPLEMENTATION SCHEDULE

A summary of scheduled actions and costs associated with this recovery program follows. The scheduling priority for each task and the responsible agency is indicated. Implementation of all tasks listed in the Implementation Schedule will lead to recovery of the least Bell's vireo. Initiation of these actions is subject to availability of funds.

Priorities in column one of the implementation schedule are assigned as follows:

1. **Priority 1:** An action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.

2. **Priority 2:** An action that must be taken to prevent a significant decline in population or habitat quality, or some other significant negative impact short of extinction.

3. **Priority 3:** All other actions necessary to meet the recovery objective.

Acronyms used in the Implementation Schedule

*	Lead Agency
ATSFRR	Atchison Topeka and Santa Fe Railroad
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BR	Bureau of Reclamation
BRD	Biological Resources Division, U.S. Geological Survey
BUEL	City of Buelton
CBMWD	Chino Basin Municipal Water District
CCC	California Coastal Commission
CDC	California Department of Conservation Division of Oil, Gas, and Thermal Resources
CDFG	California Department of Fish and Game
CDSP	California Department of State Parks
CGIR	Capitan Grande Indian Reservation
CIR	Cahuilla Indian Reservation
COE	Army Corps of Engineers
COR	City of Corona
CORNELL	Cornell University

CRWQCB	California Regional Water Quality Control Board
CSDLA	County Sanitation Districts of Los Angeles County
CSLC	California State Lands Commission
CSPR	California State Parks and Recreation
CSWRCB	California State Water Resources Control Board
CV	City of Chula Vista
DOD	Department of Defense
DOJ	Department of Justice/Border Patrol
DOT	California Department of Transportation
DWR	California Department of Water Resources
EPA	Environmental Protection Agency
EMWC	Escondido Municipal Water Company
FAA	Federal Aeronautics Administration
FHWA	Federal Highway Administration
FIL	City of Fillmore
FUD	Fallbrook Utilities District
FWS	U.S. Fish and Wildlife Service
HWD	Helix Water District
IBWC	International Boundary and Water Commission
IIBC	International Institute of Biological Control
ICO	Imperial County
LADHS	Los Angeles County Department of Health Services
LADPW	Los Angeles County Department of Public Works
LACO	Los Angeles County
LADWP	Los Angeles Department of Water and Power
LAK	City of Lakeside
LCIR	Los Coyotes Indian Reservation
LJIR	La Jolla Indian Reservation
LOMPOC	City of Lompoc
MONCO	Monterey County
MTDB	Metropolitan Transit Development Board
MUR	City of Murrieta
NAVY	U.S. Navy
NC	City of National City
NMAD	Northwest Mosquito Abatement District
NORCO	City of Norco
OCO	Orange County
OCVCD	Orange County Vector Control District
OCWD	Orange County Water District

OCN	City of Oceanside
OWD	Otay Water District
PAIR	Pauma Indian Reservation
PDMWD	Padre Dam Municipal Water District
PIR	Pala Indian Reservation
PMWC	Pauma Mutual Water Company
PVCSD	Pauma Valley Community Services District
RCD	Resource Conservation District of Greater San Diego County
RCFC	Riverside County Flood Control
RCP	Riverside County Parks and Open Space District
RED	City of Redlands
RIR	Rincon Indian Reservation
RIV	City of Riverside
RIVCO	Riverside County
RMWD	Rainbow Municipal Water District
SAL	City of Salinas
SANBAG	San Bernardino Association of Governments
SANDAG	San Diego Association of Governments
SANTEE	City of Santee
SAWPA	Santa Ana Water Project Authority
SBACO	Santa Barbara County
SBCO	San Bernardino County
SBCFC	San Bernardino County Flood Control
SBCWA	Santa Barbara County Water Agency
SBECO	San Benito County
SBR	City of San Bernardino
SCE	Southern California Edison
SCL	City of San Clemente
SCLR	City of Santa Clarita
SD	City of San Diego
SDAERR	San Diego and Arizona Eastern Railroad
SDCO	San Diego County
SDCPR	San Diego County Parks and Recreation Department
SDCVC	San Diego County Vector Control
SDCWA	San Diego County Water Authority
SDGE	San Diego Gas and Electric
SDPR	City of San Diego Parks and Recreation Department
SDWUD	City of San Diego Water Utilities District,
SIR	Sycuan Indian Reservation

SLOCO	San Luis Obispo County
SLRMWD	San Luis Rey Municipal Water District
SPA	City of Santa Paula
SPRR	Southern Pacific Railroad
SRIR	Santa Rosa Indian Reservation
SWA	Sweetwater Authority
SYS	City of San Ysidro
TBD	To Be Determined
TEM	City of Temecula
TVWB	Tijuana Valley Water Board
USAF	U.S. Air Force
USDA	U.S. Department of Agriculture-Agronomy and Range Science
USFS	U.S. Forest Service
USMC	U.S. Marine Corps
UWCD	United Water Conservation District
VCFCD	Ventura County Flood Control District
VCMWD	Valley Center Municipal Water District
VID	Vista Irrigation District
WMWD	Western Municipal Water District
WRCRWA	Western Riverside County Regional Wastewater Authority
WVVCD	West Valley Vector Control District

Recovery Plan Implementation Schedule for the Least Bell's Vireo.

Priority #	Task #	Task Description	Task Duration (Years)	Responsible or Associated Parties	Total Estimated Cost ($1000's)	Costs (1000s) FY 99	FY 00	FY 01	FY 02	FY 03	Comments
1	1.5	Continue cowbird removal	Continuous	FWS*, NAVY, CDSP, USMC, DOD, DOT, FHWA, CDFG, USFS, COE, OCWD	500	100	100	100	100	100	Future costs to be determined if endowments are not established for the permanent monitoring and management of cowbirds
1	1.111	Prepare management plan for the Tijuana River population	1	FWS*, NAVY, COE, EPA, USFS, CSPR, BLM, BRD, IBWC, DOJ, CRWQCB, DOT, CDFG, CSLC, CCC, SDCO, SDCPR, SDCVC, SD, SANDAG, SYS, SDGE, TVWB	20	20					
1	1.112	Prepare management plan for the Dulzura Creek/Jamul Creek/Otay River population	1	FWS*, COE, EPA, USFS, BLM, BRD, CRWQCB, CSWRCB, DOT, CDFG, CSLC, CCC, SDCO, SANDAG, SDCPR, SDCVC, CV, SDCWA, OWD, SDGE	20		20				

Recovery Plan Implementation Schedule for the Least Bell's Vireo.

Priority #	Task #	Task Description	Task Duration (Years)	Responsible or Associated Parties	Total Estimated Cost ($1000's)	Costs (1000s)					Comments
						FY 99	FY 00	FY 01	FY 02	FY 03	
1	1.113	Prepare management plan for Sweetwater River population	1	FWS*, BLM, COE, EPA, USFS, BRD, BIA, SIR, CRWQCB, CSWRCB, DOT, CDFG, CSLC, CCC, SDCO, SDCPR, SDCVC, SANDAG, CV, NC, SWA, SDCWA, OWD, SDGE	20	20					
1	1.114	Prepare management plan for the San Diego River population	1	FWS*, FHWA, COE, EPA, USFS, BLM, BRD, BIA, CGIR, CRWQCB, CSWRCB, DOT, CDFG, CSLC, CCC, SANDAG, SDCO, SDCPR, SDCVC, SD, SANTEE, LAK, SDPR, MTDB, SDWUD, HWD, PDMWD, SDCWA, SDGE	20		20				

Recovery Plan Implementation Schedule for the Least Bell's Vireo.

Priority #	Task #	Task Description	Task Duration (Years)	Responsible or Associated Parties	Total Estimated Cost ($1000's)	Costs (1000s)					Comments
						FY 99	FY 00	FY 01	FY 02	FY 03	
1	1.115	Prepare management plan for the San Luis Rey River population	1	FWS*, COE, EPA, FHWA, USFS, USMC, NAVY, BLM, BIA, BRD, CRWQCB, CSWRCB, DOT, CDFG, CSLC, CCC, SANDAG, SDCO, SDCPR, SDCVC, PAIR, RIR, PAL, LJIR, OCN, PMWC, SDCWA, SLRMWD, VCMWD, EMWC, VID, FUD, SDGE	20		20				
1	1.116	Prepare management plan for the Camp Pendleton/Santa Margarita population	1	FWS*, USMC, NAVY, DOD, FAA, BRD, CSPR, COE, FHWA, EPA, USFS, BLM, BIA, CRWQCB, CSWRCB, DOT, CDFG, CSLC, CCC, SANDAG, SDCO, RIVCO, OCO, CIR, OCN, SCL, TEM, MUR, SCE, SDCWA, RMWD, FUD, ATSFRR	20		20				

Recovery Plan Implementation Schedule for the Least Bell's Vireo.

Priority #	Task #	Task Description	Task Duration (Years)	Responsible or Associated Parties	Total Estimated Cost ($1000's)	Costs (1000s)					Comments
						FY 99	FY 00	FY 01	FY 02	FY 03	
1	1.117	Prepare management plan for Santa Ana River population	1	FWS*, COE, EPA, USFS, BLM, FAA, BRD, CDC, CRWQCB, CSWRCB, DOT, CDFG, CSLC, CSPR, OCWD, RIVCO, RCP, RCFC, OCO, SANBAG, SBCO, SBCFC, COR, SB, RIV, RED, NORCO, SCE, WRCRWA, WMWD, SAWPA, NMAD, WVVCD, CBMWD, ATSFRR, SPRR	20		20				
1	1.118	Prepare management plan for the Orange County/Los Angeles County metapopulation	1	FWS*, COE, EPA, USFS, DOD, BLM, BRD, CDC, CRWQCB, CSWRCB, DOT, CDFG, CSLC, CSPR, OCO, OCWD, OCVCD, LACO, LADPW, LADWP, LADHS, CSDLA, SCE, SPRR	25		25				

Recovery Plan Implementation Schedule for the Least Bell's Vireo.

Priority #	Task #	Task Description	Task Duration (Years)	Responsible or Associated Parties	Total Estimated Cost ($1000's)	Costs (1000s)					Comments
						FY 99	FY 00	FY 01	FY 02	FY 03	
1	1.119	Prepare management plan for the Santa Clara River population	1	FWS*, DOD, COE, FHWA, EPA, USFS, BLM, BRD, CRWQCB, CSWRCB, DOT, CDFG, CSLC, CCC, CDC, CSPR, DWR, VCFCD, LACO, LADHS, LADWP, LADPW, UWCD, CSDLA, SCLR, SPA, FIL, SPRR	20		20				
1	1.120	Prepare management plan for the Santa Ynez River population	1	FWS*, DOD, COE, USAF, USFS, FHWA, EPA, BLM, BRD, CRWQCB, CSWRCB, DOT, CDFG, CSLC, CCC, CDC, CSPR, DWR, SBACO, SBCWA, LOMPOC, BUEL, SPRR	20			20			
1	1.121	Prepare management plan for the Anza Borrego Desert metapopulation	1	FWS*, DOD, COE, NAVY, USFS, FHWA, EPA, BLM, BRD, BIA, CSPR, CRWQCB, CSWRCB, DOT, CDFG, CSLC, CCC, CDC, RIVCO, SDCO, ICO, LCIR, SRIR, SDAERR, SDGE	30			30			

Recovery Plan Implementation Schedule for the Least Bell's Vireo.

Priority #	Task #	Task Description	Task Duration (Years)	Responsible or Associated Parties	Total Estimated Cost ($1000's)	Costs (1000s)					Comments
						FY 99	FY 00	FY 01	FY 02	FY 03	
2	1.122	Prepare management plan for the Salinas River population	1	FWS*, DOD, COE, USFS, FHWA, EPA, BLM, BRD, CSPR, CRWQCB, CSWRCB, DOT, CDFG, CSLC, CCC, CDC, SBECO, MONCO, SLOCO, SAL, SPRR	20			20			
2	1.123	Prepare management plan for the San Joaquin Valley population	1	FWS*, DOD, COE, USFS, FHWA, EPA, BLM, BRD, CSPR, CRWQCB, CSWRCB, DOT, CDFG, CSLC, CCC, CDC	20			20			
2	1.124	Prepare management plan for the Sacramento Valley population	1	FWS*, DOD, COE, USFS, FHWA, EPA, BLM, BRD, CSPR, CRWQCB, CSWRCB, DOT, CDFG, CSLC, CCC, CDC	20			20			
2	1.3	Establish monitoring protocol	1	FWS	2	2					
2	1.411	Conduct annual monitoring in the Tijuana River population	5	FWS*, COE, DOJ	250	50	50	50	50	50	monitoring will be required annually and 5 years beyond delisting

Recovery Plan Implementation Schedule for the Least Bell's Vireo.

Priority #	Task #	Task Description	Task Duration (Years)	Responsible or Associated Parties	Total Estimated Cost ($1000's)	Costs (1000s)					Comments
						FY 99	FY 00	FY 01	FY 02	FY 03	
2	1.412	Conduct annual monitoring in the Dulzura Creek/Jamul Creek/Otay River population	5	FWS*, FHWA, COE, BLM	250	50	50	50	50	50	
2	1.413	Conduct annual monitoring the Sweetwater River population	5	FWS*, FHWA, COE, BLM	250	50	50	50	50	50	
2	1.414	Conduct annual monitoring in the San Diego River population	5	FWS*, FHWA, COE	250	50	50	50	50	50	
2	1.415	Conduct annual monitoring in the San Luis Rey River population	5	FWS*, FHWA, COE, EPA, USFS	250	50	50	50	50	50	
2	1.416	Conduct annual monitoring in the Camp Pendleton/Santa Margarita River population	5	FWS*, DOD, EPA, COE, USFS	375	75	75	75	75	75	

Recovery Plan Implementation Schedule for the Least Bell's Vireo.

Priority #	Task #	Task Description	Task Duration (Years)	Responsible or Associated Parties	Total Estimated Cost ($1000's)	Costs (1000s) FY 99	FY 00	FY 01	FY 02	FY 03	Comments
2	1.417	Conduct annual monitoring in the Santa Ana River population	5	FWS*, COE, EPA, FHWA, OCWD, DOT	250	50	50	50	50	50	
2	1.418	Conduct annual monitoring in the Orange County/Los Angeles County population	5	FWS, COE, EPA, DOT							
2	1.419	Conduct annual monitoring in the Santa Clara River population	5	FWS*, COE, USFS, EPA	250	50	50	50	50	50	
2	1.420	Conduct annual monitoring in the Santa Ynez River population	5	FWS, DOD, USFS, USAF	100	20	20	20	20	20	
2	1.421	Conduct annual monitoring in the Anza Borrego Desert metapopulation	5	FWS, CSPR, BLM, DOD	250	50	50	50	50	50	
2	1.422	Conduct annual monitoring in the Salinas River population	Continuous	FWS, DOD, BLM, DOT	250	50	50	50	50	50	

Recovery Plan Implementation Schedule for the Least Bell's Vireo.

Priority #	Task #	Task Description	Task Duration (Years)	Responsible or Associated Parties	Total Estimated Cost ($1000's)	Costs (1000s) FY 99	FY 00	FY 01	FY 02	FY 03	Comments
2	1.423	Conduct annual monitoring in the San Joaquin Valley population	Continuous	FWS, BLM, DOT, COE,	250	50	50	50	50	50	
2	1.424	Conduct annual monitoring in the Sacramento Valley population	Continuous	FWS, BLM, DOT, COE, USAF	250	50	50	50	50	50	
2	1.6	Develop alternative means of controlling cowbird parasitism	3	FWS*, USDA, BLM, USFS, USMC, NAVY, DOT, COE, OCWD, SDCO, SD, RIVCO, SBCO	TBD						
2	2.1	Identify additional and potential habitat in historical range	3	FWS*, COE, CDFG, FHWA, BLM, CDSP, DOD	TBD			TBD	TBD	TBD	
2	1.2	Prepare management plans for areas identified in 2.1	1	TBD	TBD					TBD	
2	1.7	Control nonnative plant species	5	FWS*, USDA, FHWA, USMC, NAVY, COE, CDFG, USFS, CDSP DOT, OCWD, SDCO, RIVCO, RCP	500	100	100	100	100	100	Future costs to be determined if endowments are not established for the permanent monitoring and management of nonnative species

Recovery Plan Implementation Schedule for the Least Bell's Vireo.

Priority #	Task #	Task Description	Task Duration (Years)	Responsible or Associated Parties	Total Estimated Cost ($1000's)	Costs (1000s)					Comments
						FY 99	FY 00	FY 01	FY 02	FY 03	
2	2.5	Develop biocontrol methods for *Arundo* and other nonnative plant species	4	FWS*, USDA, COE, CORNELL, IIBC, USMC, BR, OCWD	1200		500	300	200	200	
3	1.8	Establish perpetual endowments for cowbird and exotic plant control	Continuous	FWS	TBD						
3	2.11	Conduct a statewide inventory of riparian habitat	2	FWS*, BRD, EPA, COE, USFS, DOD	300		150	150			
3	2.12	Conduct rangewide surveys	5	FWS*, BRD	250	50	50	50	50	50	
3	2.2	Investigate the status of wintering habitat and identify current or potential threats	2	FWS*, BRD	630		30	200	200	200	
3	2.31	Continue color-banding to provide demographic and dispersal data	5	FWS*, BRD	50	10	10	10	10	10	

Recovery Plan Implementation Schedule for the Least Bell's Vireo.

Priority #	Task #	Task Description	Task Duration (Years)	Responsible or Associated Parties	Total Estimated Cost ($1000's)	Costs (1000s) FY 99	FY 00	FY 01	FY 02	FY 03	Comments
3	2.32	Determine relationships between population density and reproductive characteristics	3	FWS*, BRD	225		75	75	75		
3	2.33	Determine relationships between population density and dispersal	3	FWS*, BRD	225		75	75	75		
3	2.4	Investigate relationship between habitat characteristics and least Bell's vireos behaviors and access to necessary resources	3	FWS*, BRD	120		40	40	40		
3	3.1	Implement long-term monitoring of restored sites	Continuous	FWS, COE, DOD	80		20	20	20	20	
3	3.2	Develop improved restoration techniques	4	FWS, COE, BRD, USFS, BR	200		50	50	50	50	

Recovery Plan Implementation Schedule for the Least Bell's Vireo.

Priority #	Task #	Task Description	Task Duration (Years)	Responsible or Associated Parties	Total Estimated Cost ($1000's)	Costs (1000s)					Comments
						FY 99	FY 00	FY 01	FY 02	FY 03	
3	3.3	Evaluate restoration efforts and effectiveness of methods used	3	FWS*, BRD, CDSP, USFS COE	150			50	50	50	
3	3.4	Conduct habitat restoration	Continuous	FWS, COE, BRD, USFS, BLM, DOD, USMC, NAVY	TBD	TBD	TBD	TBD	TBD	TBD	
3	5	Evaluate progress of recovery, management and recovery actions, and revise management plans	Continuous	FWS	150	30	30	30	30	30	
3	6	Provide public information and education	Continuous	FWS*, BRD, BLM, USFS	50	10	10	10	10	10	

V. APPENDICES

APPENDIX A. Numbers and Distribution of Least Bell's Vireos, 1986-1996: Number of Pairs (Territorial Males)

Site	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
San Diego County											
Agua Caliente County Park	- -	- -	- -	- -	- -	- -	- -	- -	- (1)	- -	- (2)
Agua Hedionda Creek	1 (1)	0 (0)	- -	- -	- -	- -	1 (2)	- -	- -	- -	- -
Alder Canyon	0 (0)	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Aliso Creek	- -	- -	- -	- -	- -	2 (2)	2 (2)	2 (5)[b]	- (9)[b]	6 (12)	10 (24)
Angelina Spring	- -	- -	- -	- -	- -	- -	- -	- -	- -	- (0)	- -
Borderfield	- -	- -	- -	- -	- -	- -	0 (1)	- -	- -	- -	- -
Borrego Palm Canyon	5 (7)	1 (2)	3 (6)	2 (4)	2 (4)	4 (4)	0+ (5)	? (5)	? (2)	? (3)	? (1)
Campbell Grade	- -	- -	- -	- -	- -	- -	- -	? (18)	? (12)	? (12)	? (19)
Campo Creek	- -	4 (5)	- -	- -	- -	- -	- -	- -	- -	- -	- -
Canebrake Canyon	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	? (1)
Carmel Valley	0 (0)	0 (0)	- -	- -	- -	- -	- -	- -	- -	- -	- -
Carrizo Creek	- -	- -	- -	- -	- -	- -	0 (3)	? (1)	0 (0)	- -	? (1)
Carrizo Marsh	- -	- -	- -	- -	- -	- -	- -	- -	- -	? (1)	? (1)
Cockleburr Canyon	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0 (0)
Cottonwood Creek	0 (0)	- -	- -	- -	3 (8)	- -	- -	- -	- -	- -	- -
Cougar Canyon	0 (0)	- -	- -	- -	0 (0)	- -	- -	0 (0)	0 (0)	- -	- -
Coyote Creek	8 (9)	2 (8)	0+ (8)	10 (11)	7 (10)	12 (13)	? (17)	5 (18)	? (22)	? (14)	? (20)

APPENDIX A. Numbers and Distribution of Least Bell's Vireos, 1986-1996: Number of Pairs (Territorial Males)

Site	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Cristianitos Creek	- -	- -	- -	- -	- -	- -	- -	- -	0 (0)	0 (1)	4 (5)
Culp Valley	- -	- -	- -	- -	- -	- -	- -	- -	- -	? (0)	? (0)
DeLuz Creek	1 (2)	0 (3)	2 (2)	1 (2)	0 (0)	1 (3)	2 (2)	? (3)	? (9)	17 (24)	24 (26)
Encinitas Creek	0 (0)	0 (0)	- -	- -	- -	- -	- -	- -	- -	- -	- -
Fallbrook Creek	- -	- -	- -	- -	- -	- -	1 (1)	4 (10)[b]	- (28)	9 (11)	12 (16)
French Creek	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (1)	0 (0)	- (1)[b]	? (4)	4 (7)	4 (10)
Hauser Creek	- -	- -	- -	- -	2 (3)	- -	- -	- -	- -	- -	- -
Hellhole Canyon	4 (5)	0 (1)	- (1)	1 (1)	2 (2)	0 (0)	0 (0)	- -	- -	? (0)	? (2)
Hidden Canyon	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	7 (10)
Horno Creek	- -	- -	- -	- -	- -	- -	- -	- -	0 (0)	0 (0)	0 (0)
Horse Canyon	- -	- -	- -	- -	- -	- -	- -	0 (0)	? (1)	? (1)	? (0)
Indian Canyon	1 (1)	- -	- -	- -	0 (0)	- -	- -	0 (0)	? (2)	- -	- -
Jamul/Dulzura Creeks	2 (8)	6 (11)	- -	6 (10)	- -	6 (9)	? (2)	7 (11)	4 (12)	- -	23 (24)
Key's Creek	0 (0)	0 (0)	- -	- -	- -	- -	- -	- -	- -	- -	- -
Kilo 1/Kilo 2 areas Camp Pendleton	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	2 (3)
Las Flores Creek	0 (0)	2 (4)	2 (3)	3 (4)	8 (8)	15 (19)	5 (9)	9 (59)[b]	? (50)	111 (125)	132 (148)
Lima/Mike/November areas Camp Pendleton	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	6 (6)

APPENDIX A. Numbers and Distribution of Least Bell's Vireos, 1986-1996: Number of Pairs (Territorial Males)

Site	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Live Oak Creek	0 (0)	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Los Penasquitos	0 (0)	0 (0)	- -	- -	- -	- -	- -	- -	- -	- -	- -
Moosa Creek	0 (0)	0 (0)	- -	- -	- -	- -	- -	- -	- -	- -	- -
Newton Canyon	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0 (3)
Otay River	- -	- -	- -	- -	- -	- -	1 (3)	1 (1)	4 (4)	- -	- -
Peterson Creek	0 (0)	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Piedra de Lumbre Canyon	- -	- -	- -	- -	- -	- -	- -	- -	0 (0)	0 (1)	1 (1)
Pilgrim Creek	2 (5)	1 (4)	3 (3)	3 (8)	6 (10)	9 (14)	13 (13)	5 (20)[b]	? (28)	35 (44)	62 (69)[g]
Proctor Valley	- -	- -	- -	- -	- -	- -	- -	- -	1 (1)	- -	- -
Pueblitos Canyon	- -	- -	- -	- -	- -	- -	- -	? (1)	- -	? (1)	2 (2)
Roblar Creek	- -	- -	- -	- -	- -	- -	- -	- -	- -	0 (0)	- -
San Diego River											
MissionValley	0 (0)	0 (0)	? (1)	- -	- -	? (1)	2 (2)	- -	- -	3 (4)	10 (11)
Mission Trails-Padre Dam	0 (0)	? (2)	1 (1)	- -	- -	4+ (5)	1+ (5)	- -	- -	- -	- -
Padre Dam-Carlton Hills Blvd	19 (21)	21 (27)	28 (31)	25 (26)	24 (28)	27 (29)	24 (32)	28 (32)	32 (36)	37 (42)	30 (33+)[h]
Carlton Hills Blvd-Lakeside	? (6)	4 (5)	? (2)	0 (1)	0 (0)[c]	? (1)[c]	? (1)[c]	- -	- -	- -	- -
El Capitan	8 (8)	- -	- -	- -	- -	0 (0)	0 (0)	- -	- -	- -	- -

APPENDIX A. Numbers and Distribution of Least Bell's Vireos, 1986-1996: Number of Pairs (Territorial Males)

Site	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
San Felipe Creek	0 (1)	- -	0+ (2+)	1+ (3)	- -	- -	2 (2)	2 (3)	- -	4 (?)	- -
San Luis Rey River											
Interstate 5-College	7 (9)	7 (9)	- -	4 (6)	7 (11)	7 (9)	21 (26)	25 (31)	40 (54)	41 (52)	42 (50)
College-Gird Rd.	19 (19)	26 (32)[d]	38 (44)	25 (32)	27 (43)	35 (39)	54 (59)	62 (76)	68 (89)	75 (104)	70 (90)
Upstream of Gird Rd.	- -	- -	- -	- -	- -	- -	- -	- -	1 (10)	6 (10)	- -
San Marcos Creek	0 (0)	0 (0)	- -	- -	- -	- -	- -	- -	- -	- -	- -
San Mateo Creek	0 (0)	2 (3)	1 (1)	0 (0)	1 (1)	1 (1)	1 (2)	1 (4)[b]	? (5)[b]	11 (17)	44 (48)
San Onofre Creek	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (3)[b]	? (7)	7 (15)	22 (27)
Santa Margarita River											
Camp Pendleton	68 (98)	97 (127)	167 (81)	122 (142)	168 (186)	138+ (212)	? (194)	132 (319)[b]	84 (336)[b]	352 (426)	456 (523)
Fallbrook	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	2 -
Santa Ysabel/ San Dieguito River	3 (13)	5 (18)	- -	4 (6)	10 (11)	9 (13)	17 (25)	21 (48)	31 (47)	- -	- -
Santa Ysabel/ Forest Service	- -	- -	- -	- -	- -	- -	4 (4)	- -	- -	- -	- -
Sentenac Canyon	4 (5)	1 (2)	- -	1 (2)	0 (2)	2 (2)	? (5)	4 (8)	? (4)	? (12)	? (13)
Sheep Canyon	0 (0)	0 (1)	- -	- -	0 (1)	- -	- -	0 (0)	? (1)	- -	- -
Stage Coach Canyon	- -	- -	- -	- -	- -	- -	- -	- -	0 (0)	0 (0)	- -

APPENDIX A. Numbers and Distribution of Least Bell's Vireos, 1986-1996: Number of Pairs (Territorial Males)

Site	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Sweetwater River											
Downstream of Reservoir	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (1)	1 (1)	1 (1)	- -	0 (0)
Reservoir-Rancho S. D. Golfcourse	48 (51)	60 (82)	54 (69)	40 (49)	41 (50)	36 (51)	49 (53)	50 (61)	29 + (41)[c]	29 (40)	33+ (51)
Upstream of Golfcourse	(1)	?(5)	- -	- -	- -	- -	? (4+)	- -	- -	- -	3+ (3+)
Talone Lake	- -	- -	- -	1 (2)	- -	1 (1)	1 (3)	- -	- -	- -	3 -
Tamarisk Grove	- -	- -	- -	- -	- -	- -	- -	- -	- -	? (1)	? (0)
Tecolote Canyon	2 (3)	0 (0)	- -	- -	- -	- -	- -	- -	- -	- -	- -
Tijuana River											
West of Dairymart Rd.	3 (5)	0+ (8)	0+ (3+)	3+ (5)	9 (13)	15 (22)	26 (27)	41 (49)	63 (79)	80 (112)	87 (134)
East of Dairymart Rd.	0 (0)	0 (0)	- -	- -	- -	? (2)	- -	- -	- -	2 (2)	2 (5)
Goat Canyon	- -	- -	- -	- -	- -	- -	2 (3)	2 (3)	1 (1)	0 (0)	1 (3)
Tecate Creek (Marron Valley)	- -	- -	- -	- -	- -	- -	0 (1)	- -	- -	- -	- -
Vallecito Creek	0+ (6)	0+ (7)	- -	10 (10)	3+ (10)	3+ (9)	? (18)	? (8)	? (14)	? (23)	? (33)
Windmill Canyon	- -	- -	- -	- -	- -	- -	- -	- -	0 (0)	0 (0)	2 (2)
Yaqui Well	- -	- -	- -	- -	- -	- -	- -	- -	- -	? (1)	? (1)
Orange County											

APPENDIX A. Numbers and Distribution of Least Bell's Vireos, 1986-1996: Number of Pairs (Territorial Males)

Site	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Anaheim Wetlands	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- (1)
Aliso Creek	0 (1)	0 (0)	- -	- -	- -	- -	- -	- -	- -	0 (1)	- -
Arroyo Trabuco	- -	- -	- -	- -	- -	0 (0)	- -	- -	- -	- -	- -
Bonita Canyon/Creek	- -	- -	- -	- -	0+ (1)	1 (1)	1 (2)	1 (2)	3 (3)	1 (1)	0 (3)
Brea Dam	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0 (1)
Canada Gobernadora	0 (0)	- -	- -	- -	- -	0 (0)	0 (0)	0 (2)	0 (0)	- -	- -
Carbon Canyon	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	1 (2)
Featherly Park	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- (0)
Green River	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- (0)
Huntington Beach Central Park	0 (1)[e]	- -	- -	- -	0 (2)[e]	0 (0)	0 (0)	0 (0)	0 (1)	0 (1)[g]	0 (0)
Sand Canyon Wash Mason Park/Upstream of Reservoir	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (1)	1 (1)	1 (1)	1 (1)	0 (4)	2 (7)
Peters Canyon Res.	- -	- -	- -	- -	- -	0 (1)	0 (0)	- -	1 (2)	1 (2)	1 (3)
Rattlesnake Res.	- -	- -	- -	- -	- -	0 (1)	0 (0)	- -	- -	- -	1 (2)
San Diego Creek	- -	- -	- -	- -	- -	- -	- -	- (1)	1 (3)	0 (1)	0 (4)
San Joaquin Marsh	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (1)	1 (2)	0 (2)
San Juan Creek	0 (0)	- -	0 (0)	0 (0)	0 (0)	- -	- -	- -	- -	0 (1)	- -

APPENDIX A. Numbers and Distribution of Least Bell's Vireos, 1986-1996: Number of Pairs (Territorial Males)

Site	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Santa Ana River (Gypsum Canyon)	0 (0)	0 (1)	0 (0)	0 (0)	- -	- -	- -	0 (2)	- -	0 (1)	1 (4)
Santiago Creek/Villa Park FCB/above Loma Street	0 (0)	- -	- -	0 (0)	0 (0)	1 (2)	0 (3)	1 (2)	0 (3)	0 (1)	1 (2)
Upper Newport Bay	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (1)	0 (0)	0 (0)	0 (1)	0 (1)	0 (1)
Riverside County											
Andreas	2 (2)	3 (3)	- -	- -	0 (2)	- -	- -	- -	- -	- -	- -
Auld Valley	0 (0)	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Bautista Creek	0 (0)	0 (0)	- -	- -	- -	- -	- -	- -	- -	- -	- -
Chino Canyon	4 (4)	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
March Air Force Base (unnamed tributary west of Interstate-215)	- -	- -	- -	- -	- -	- -	- -	1 (1)	0 (1)	- -	- -
Murrietta Creek	- -	- -	- -	- -	- -	- -	0 (1)	- -	- -	- -	- -
Murray Canyon	1 (2)	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Oasis de los Osos	0 (0)	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Palm Canyon	1 (1)	0 (1)	- -	- -	- -	- -	- -	- -	- -	- -	- -
Potero Creek? (Beumont/Lockheed)	- -	- -	- -	- -	- -	- -	- -	- -	- -	0 (0)	- -
San Jacinto Creek	0 (0)	0 (0)	- -	- -	- -	- -	- -	- -	- -	- -	- -
San Jacinto River (Route 74)	- -	- -	- -	- -	- -	- -	- -	- -	- -	? (0)	- -

APPENDIX A. Numbers and Distribution of Least Bell's Vireos, 1986-1996: Number of Pairs (Territorial Males)

Site	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Saint John's Canyon	0 (0)	0 (0)	--	--	--	--	--	--	--	--	--
San Timoteo	1 (3)	0 (1)	--	--	--	--	--	--	--	--	--
Santa Ana River											
Prado Basin[a]	19 (21)	20 (26)	30 (37)	31 (36)	42 (47)	64 (70)	99 (112)	123 (138)	149 (188)	164 (217)	195 (249)
Below Prado Dam	--	--	--	--	--	--	--	--	--	? (2+)	1 (4)
Temescal Wash	2 (3)	2 (3)	--	--	1 (1)	2 (3)	--	--	--	--	--
Hidden Valley	--	--	--	--	--	--	--	--	? (2)	1 (3)	2 (4)
Tonner Canyon	--	--	--	--	--	--	--	--	--	0 (0)	--
Warm Springs Valley (unnamed tributaries Lake Elsinore)	--	--	--	--	--	--	--	--	--	1 (1)	--
Whitewater Hole	0 (0)	0 (0)	--	--	--	--	--	--	--	--	--
Willow Hole	0 (0)	0 (1)	--	--	--	--	--	--	--	--	--
Wilson Creek	--	--	0 (1)	0 (1)	--	--	--	--	--	--	--
San Bernardino County											
Cajon Creek	--	--	--	--	0 (1)	--	--	--	--	--	--
Chino Creek	--	--	--	--	--	--	--	--	--	0 (1)	--
City Creek	--	--	--	--	--	--	--	--	--	0 (0)	--

APPENDIX A. Numbers and Distribution of Least Bell's Vireos, 1986-1996: Number of Pairs (Territorial Males)

Site	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Santa Ana River (Gypsum Canyon)	0 (0)	0 (1)	0 (0)	0 (0)	- -	- -	- -	0 (2)	- -	0 (1)	1 (4)
Santiago Creek/Villa Park FCB/above Loma Street	0 (0)	- -	- -	0 (0)	0 (0)	1 (2)	0 (3)	1 (2)	0 (3)	0 (1)	1 (2)
Upper Newport Bay	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (1)	0 (0)	0 (0)	0 (1)	0 (1)	0 (1)
Riverside County											
Andreas	2 (2)	3 (3)	- -	- -	0 (2)	- -	- -	- -	- -	- -	- -
Auld Valley	0 (0)	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Bautista Creek	0 (0)	0 (0)	- -	- -	- -	- -	- -	- -	- -	- -	- -
Chino Canyon	4 (4)	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
March Air Force Base (unnamed tributary west of Interstate-215)	- -	- -	- -	- -	- -	- -	- -	1 (1)	0 (1)	- -	- -
Murrietta Creek	- -	- -	- -	- -	- -	- -	0 (1)	- -	- -	- -	- -
Murray Canyon	1 (2)	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Oasis de los Osos	0 (0)	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Palm Canyon	1 (1)	0 (1)	- -	- -	- -	- -	- -	- -	- -	- -	- -
Potero Creek? (Beumont/Lockheed)	- -	- -	- -	- -	- -	- -	- -	- -	- -	0 (0)	- -
San Jacinto Creek	0 (0)	0 (0)	- -	- -	- -	- -	- -	- -	- -	- -	- -
San Jacinto River (Route 74)	- -	- -	- -	- -	- -	- -	- -	- -	- -	? (0)	- -

APPENDIX A. Numbers and Distribution of Least Bell's Vireos, 1986-1996: Number of Pairs (Territorial Males)

Site	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Saint John's Canyon	0 (0)	0 (0)	- -	- -	- -	- -	- -	- -	- -	- -	- -
San Timoteo	1 (3)	0 (1)	- -	- -	- -	- -	- -	- -	- -	- -	- -
Santa Ana River											
Prado Basin[a]	19 (21)	20 (26)	30 (37)	31 (36)	42 (47)	64 (70)	99 (112)	123 (138)	149 (188)	164 (217)	195 (249)
Below Prado Dam	- -	- -	- -	- -	- -	- -	- -	- -	- -	? (2+)	1 (4)
Temescal Wash	2 (3)	2 (3)	- -	- -	1 (1)	2 (3)	- -	- -	- -	- -	- -
Hidden Valley	- -	- -	- -	- -	- -	- -	- -	- -	? (2)	1 (3)	2 (4)
Tonner Canyon	- -	- -	- -	- -	- -	- -	- -	- -	- -	0 (0)	- -
Warm Springs Valley (unnamed tributaries Lake Elsinore)	- -	- -	- -	- -	- -	- -	- -	- -	- -	1 (1)	- -
Whitewater Hole	0 (0)	0 (0)	- -	- -	- -	- -	- -	- -	- -	- -	- -
Willow Hole	0 (0)	0 (1)	- -	- -	- -	- -	- -	- -	- -	- -	- -
Wilson Creek	- -	- -	0 (1)	0 (1)	- -	- -	- -	- -	- -	- -	- -
San Bernardino County											
Cajon Creek	- -	- -	- -	- -	0 (1)	- -	- -	- -	- -	- -	- -
Chino Creek	- -	- -	- -	- -	- -	- -	- -	- -	- -	0 (1)	- -
City Creek	- -	- -	- -	- -	- -	- -	- -	- -	- -	0 (0)	- -

APPENDIX A. Numbers and Distribution of Least Bell's Vireos, 1986-1996: Number of Pairs (Territorial Males)

Site	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
East Etiwanda Creek	- -	- -	- -	- -	- -	- -	1 (2)	- -	- -	- -	- -
Fort Paiute Creek	1 (1)	- -	- -	- -	- -	- -	- -	- (3)	0 (0)	- -	- -
Horsethief Creek	- -	- -	- -	- -	- -	- -	- -	- -	- -	0 (0)	- -
Los Serranos Channel	- -	- -	- -	- -	- -	- -	- -	- -	- -	0 (1)	- -
Mill Creek	- -	- -	- -	- -	- -	- -	- -	- -	- -	0 (0)	- -
Mojave River	0 (0)	- -	- -	0 (1)	- -	- -	- -	- -	- -	0 (0)	0 (1)
Morongo Creek[f]	0 (1)	0 (1)	0 (1)	0 (1)	- -	- -	- -	- -	- -	- -	- -
San Jacinto River	- -	- -	- -	- -	- -	- -	- -	- -	- -	0 (0)	- -
Santa Ana River	- -	- -	- -	- -	- -	- -	- -	- -	0 (1)	1 (1)	1 (1)
Wildhorse Canyon	- -	- -	- -	- -	- -	- -	- -	? (2)	- -	- -	- -
Los Angeles County											
Amargosa Creek (W of Palmdale)	- -	- -	- -	- -	- -	- -	- -	- -	- (1)	- (1)	- -
Big Tujunga	- -	- -	- -	- -	- -	- -	0 (1)	- -	- -	0 (2)	- -
Fish Canyon	0 (0)	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Las Brisas Ranch	- -	- -	- -	- -	- -	- -	- -	- -	? (1)	- -	- -
San Francisquito	0 (1)	0 (1)	- -	- -	- -	- -	- -	- -	1 (1)	- -	- -
San Gabriel River	0 (0)	0 (0)	- -	- -	- -	- -	- -	- -	- -	- (1)	- (1)
Santa Clara River	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	2 (4)

APPENDIX A. Numbers and Distribution of Least Bell's Vireos, 1986-1996: Number of Pairs (Territorial Males)

Site	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Van Norman Dam	0 (0)	0 (0)	- -	- -	- -	- -	- -	- -	- -	- -	- -
Ventura County											
Arroyo Simi	0 (0)	0 (0)	- -	- -	- -	- -	1 (3)	1 (2)	- (1)	- -	- -
La Jolla Canyon	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Piru Creek	0 (0)	0 (0)	- -	- -	- -	- -	- -	- -	- -	- -	- -
San Antonio Creek	0 (0)	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Santa Clara River	0+ (8)	0 (1)	- -	- -	- -	12 (17)	14 (20)	22 (26)	25 (27)	30+ (34+)	40+ (44+)
Santa Paula	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Ventura River	0 (0)	- -	- -	- -	- -	- -	- -	1 (2)	1 (2)	1 (1)	- -
Santa Barbara County											
Cuyama River	0 (0)	- -	- -	- -	- -	- -	- -	- (1)	- -	- -	- -

APPENDIX A. Numbers and Distribution of Least Bell's Vireos, 1986-1996: Number of Pairs (Territorial Males)

Site	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Santa Ynez River											
Upper (Gibralter Res./Mono Creek/Agua Caliente Creek.)	~30 (57)	19 (32)	21 (23)	14 (20)	17 (22)	17 (20)	16 (20)	29 (31)	20+ (20+)	1+ -	2 + -
Lower (Buellton/Lompoc)	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0 (2)
Inyo County											
Amargosa River	0 (0)	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
China Ranch Wash	1 (2)	2 (2)	- -	- -	- -	- -	- -	- -	? (1)	- -	- -
Scotty's Castle	- -	- -	- -	- -	- -	- -	- -	- -	? (1)	- -	- -
Tecopa	1 (2)	2 (2)	- -	- -	- -	- -	- -	- -	? (3)	- -	- -
Kern County											
South Fork Kern River	- -	- -	- -	- -	- -	- -	- (1)	- -	- (1)	- -	- -
Monterey County											
Salinas River	2 (3)	0 (0)	- -	- -	- -	- -	- -	- -	- -	- -	- -

Legend:

- \- No data.
- \+ Indicates that actual number could have been higher (field surveys were incomplete or noncomprehensive).
- ? Number of pairs unknown.
- ~ Approximately.
- a Prado Basin includes a small portion of San Bernardino County. See Riverside County data. 1970 to 1986 data include areas upstream and downstream from Prado Basin.
- b Territorial male data include the following numbers of males reported as "status unknown."

Year	Site	Number
1993	Aliso Creek	1
1993	Fallbrook Creek	4
1993	French Creek	1
1993	Las Flores Creek	19
1993	Pilgrim Creek	6
1993	San Mateo Creek	2
1993	San Onofre Creek	1
1993	Santa Margarita River	80
1994	Aliso Creek	3
1994	San Mateo Creek	1
1994	Santa Margarita	101

- c Indicates partial survey.
- d College-Gird Rd. and Upstream of Gird data combined in 1987.
- e Because of excellent coverage at this site, birds were known to be either migrants or wintering (winter of 1985-1986). Numbers not included in territorial male totals.
- f Data for Big Morongo Creek and Little Morongo Creek combined after 1986.
- g This data is for on and off Camp Pendleton, whereas most or all data for previous years is for on-base.
- h This survey area is from Padre Dam to Mast Blvd, a smaller survey area then in previous years.

APPENDIX B: POPULATION VIABILITY ANALYSIS FOR THE LEAST BELL'S VIREO

The following discussion uses several terms from population ecology, which are defined here:

Population: a group of interbreeding organisms of a single species in a particular geographical area.

Metapopulation: "a collection of interacting populations of the same species" *(*Akcakaya and Ferson 1992*).*

Viable population: a population that "maintains its vigor and its potential for evolutionary adaptation" (Soulé 1987) and that "is self-sustaining with minimal demographic or genetic intervention over the long term" (Wilcox *et al.*1986). Within the context of modeling, a viable population is one that has some probability of surviving (avoiding extinction) over some period of time, where the probability of extinction and the time span are specified. In this plan, "viable population" refers to one with a probability of 5 percent or less of going extinct during a 100-year period.

Minimum viable population size: the minimum size that a population must achieve to avoid extinction and thus remain viable, as defined above.

Recruitment: addition of new members into a breeding population through production of offspring.

Productivity: production of offspring; usually expressed as the number of young produced per pair.

Predicting the future of an endangered species such as the least Bell's vireo requires considerable information on its life history, demography, and current abundance and distribution. At the core of population ecology, the discipline upon which such an exercise draws, are fundamental principles which describe how populations behave over time. Put simply, individuals are added to a population through the production of offspring and immigration into the population from outside, and are lost from the population as a result of mortality (death) and emigration out of the population. The net effect of these processes determines whether populations grow or decline in size over time. Central to any recovery plan is a determination of the population size trend for the species of interest, accompanied by an analysis of which of these processes has been altered to produce the trend. While the first determination is comparatively straightforward, the second is not.

The processes of birth, death, and migration, and consequently population size trends, are influenced by many factors. These have been condensed into four general categories which describe the nature of factors creating a risk of extinction for endangered species (Shaffer 1981). Three of these are applicable to least Bell's vireos (the fourth pertains to species with mating systems not exhibited by the least Bell's vireo). ***Extrinsic forces*** include forces in the environment with which the species cannot contend. With regard to least Bell's vireos these include interactions with other organisms, such as exposure to brood parasitism by brown-headed cowbirds, a species with which the least Bell's vireo has not evolved, and possibly heightened rates of predation by native and non-native predators; random catastrophic events such as floods and droughts; and human-induced habitat loss and degradation. ***Demographic stochasticity*** refers to random events in the survival and reproduction of individuals in small populations, resulting in such problems as a skewed sex ratio leading to difficulty in finding a mate; total reproductive failure one year; death of the entire population, etc. ***Genetic deterioration*** can be both short-and long-term. Short-term genetic deterioration includes inbreeding depression, leading to reduced survival, skewed sex ratios and other problems, particularly in small populations. Long-term deterioration refers to the reduced ability of a population to adapt to environmental changes because of a loss of genetic variability. Both of these processes are linked to the amount of dispersal among populations of a species.

Increasingly, conservation biologists are using a tool called Population Viability Analysis (PVA) to project the future of populations or species. A PVA simulates the population's future given a set of current parameters describing birth, death, and migration, incorporating the complexities of the factors influencing these parameters. With this tool, investigators can ask questions such as "What is the probability that this population will go extinct within 20 years?", or "How long will it take for this population to reach 1000 individuals?", or "What effect on population growth rate would doubling the birth rate have?" A common goal of a PVA is to determine the conditions necessary for maintaining a viable population. A "viable population" is one capable of surviving (avoiding extinction) with some probability over some extended period of time. The term "viability" does not have universal meaning with regard to the time period involved or the acceptable probability of extinction; these must be specified based on the biology of the species of concern, and the context within which the PVA is being used.

Recovery plans are concerned with the management of species, and most species in nature occur in multiple populations. From the perspective of a recovery plan, then, a PVA must address not just the dynamics of individual populations, but the complex interactions among the populations as well. This is achieved by incorporating into the PVA information on the number of different populations, their geographic configuration, and the rate of migration between them.

A PVA was performed for the least Bell's vireo using RAMAS/Space (Akcakaya and Ferson 1992), a widely used modeling environment that allows the user to simulate population performance by inputting empirical and/or theoretical values for demographic parameters. Output of the simulations includes projections for each individual population as well as the network of populations, referred to as the metapopulation. Here, the term "metapopulation" is used for consistency with the terminology of the model, and is not meant to imply anything more than "a collection of interacting populations of the same species" (Akcakaya and Ferson 1992).

Empirical data used in the PVA were obtained from the results of long-term population monitoring conducted at eight major breeding sites in southern California, located at (from south to north) the Tijuana, Sweetwater, San Diego, San Luis Rey, West San Luis Rey, and Santa Margarita Rivers in San Diego County; the Santa Ana River in Riverside County, and the Santa Ynez River in Santa Barbara County (see Appendix C for site descriptions and sources of information). The sites were selected for analysis because (1) they supported the few remaining least Bell's vireo populations by the time the species was listed in 1986 and intensive monitoring and management initiated, (2) they have been monitored annually for from 5-15 consecutive years, and (3) long-term color-banding and resighting studies are being pursued at most sites. These attributes allow for analysis of least Bell's vireo population dynamics, demography and dispersal over a wide geographic area and a relatively long period of time. In 1994, these eight sites supported approximately 70 percent of the known least Bell's vireo population.

Empirical values were entered into the model parameters "R" (average population growth rate), standard deviation of R, density dependence, and migration rates between populations. These are discussed in turn below.

R: R symbolizes the average growth rate of a population, and is the proportion by which the population size changes each year. It is calculated as population size at time t+1/population size at time t. An R equal to 1.0 represents a stable population (neither growing nor declining). R greater than 1.0 represents a growing population, and less than 1.0 a declining population. Populations in which R is chronically less than 1.0 will eventually go extinct.

Most modeling exercises involving endangered species attempt to identify the conditions necessary to achieve an R of 1.0 or greater; that is, the model is used to specify values for demographic parameters needed to reverse an extinction-bound trend and achieve at a minimum a stable population. In simulating the least Bell's vireo metapopulation, this was not done. Analysis of the long-term data available for the eight core populations revealed average R's of greater than 1.0, indicating that reproductive output is currently adequate to maintain at least stable populations (Table 1).

Standard Deviation of R: The standard deviation of R is used to model fluctuations in the population growth rate from year to year, simulating the variability found in nature.

Density Dependence: Density dependence refers to the relationship between population growth and population size, and whether or not population growth is limited by any factors as a function of size. Populations that are density independent grow exponentially and are not limited by resources. Populations such as the least Bell's vireo, however, are eventually limited by habitat availability and resources critical to survival and reproduction. A logistic model of density dependent growth was used in the simulations. By this model, as populations grow and approach the limit, or carrying capacity, of their environment, their rate of growth slows and approximates 1.0. At this point, the population is in a stable equilibrium unless disrupted by a change in the environment or some demographic parameter.

Simulation of density dependent growth requires specification of K, the carrying capacity, for each population. The value of K is not known for least Bell's vireo populations. A crude estimate can be obtained by dividing the total habitat base by the average least Bell's vireo territory size, but this assumes the habitat to be homogenous in quality and considers only one potentially limiting resource (space). Moreover, average territory size at the breeding areas it has been studied at has declined over the years as least Bell's vireo abundance has increased, indicating that the minimum threshold in territory size has not yet been achieved. As a conservative estimate, the population sizes at each site in 1994 were used as values for K to simulate density dependent growth. This allowed an assessment of the metapopulation's future under the assumption that all suitable habitat is currently occupied and no further population growth at these sites is possible (a worst case scenario). These values were then increased by 50 percent in a separate simulation to determine the sensitivity of the results to K.

Migration Rates: Migration, which includes dispersal of birds away from their natal sites and movement between populations by adults, was modeled using data from color-banded birds of known origin. Return rates to the natal site, as well as observations of birds at sites other than their natal sites, allowed calculation of the proportion a given population that migrated to each of the other populations in the metapopulation, and vice versa. Migration between populations was not symmetrical; that is, the migration rate from Population A to Population B was not equivalent to the migration rate from Population B to Population A. Rather, a northward bias was detected, with birds more likely to change drainages by moving north than by moving south.

Migration rates are probably underestimated, because they rely on thorough examination of all individuals in a population to detect banded birds, and then depend on accurate determination of the band combination of any banded birds located. Canvassing an entire population for banded birds is more feasible in small populations than in large ones, and even then, obtaining clear views of females can be challenging. The opportunity for resighting banded birds was beyond the scope of some projects, given the person-power and funding available for such an effort.

Table 1. Empirical values used in least Bell's vireo PVA

Site	Average Growth Rate (R)	Standard Deviation of R	1994 Population Size (# males)
Tijuana River	1.60	0.33	80
Sweetwater River	1.05	0.25	61
San Diego River	1.08	0.13	36
San Luis Rey River	1.16	0.29	89
West San Luis Rey River	1.68	0.91	31[a]
Santa Margarita River	1.29	0.32	348
Santa Ana River	1.37	0.19	188
Santa Ynez River	1.02	0.27	31[a]

[a] *1993 data most recent available.*

To initiate the simulations, geographic coordinates are input for each site to establish spatial relationships, and initial population sizes specified. Population sizes during the first year of monitoring were used for these values, creating an opportunity to compare the results of the simulations with the past ten or so years of history. One hundred replications of each simulation were run, using a time frame of 100 years. Three questions were asked of the model:

1. What is the probability of extinction of the least Bell's vireo during the next 100 years?

The results of the simulations predict that the least Bell's vireo metapopulation as defined by the eight core sites has an extinction probability of zero during the next 100 years. Moreover, seven of the eight individual populations have extinction probabilities of zero over the same time period, indicating that they are unlikely to "blink out" and require re-colonization by migrants from another population. One population (at the Santa Ynez River), is at risk of extinction, however, as a result of small population size, a low rate of growth, and isolation from dispersers from other of the core populations, at least to the extent that such migration could be detected by observations of color-banded birds. The Santa Ynez population may in fact persist longer than predicted if it is experiencing immigration from other unknown or unbanded populations.

2. How long will it take for the least Bell's vireo population to reach carrying capacity?

The time required to reach carrying capacity, at which time the population becomes stable (R = 1.0) depended on the value of K input into the model. The metapopulation reached equilibrium within approximately 20 years when 1994 population sizes were used to estimate K; note that nearly half of this time has actually passed since the starting point of the simulations reflected population conditions during the mid-1980's. The time to achieve equilibrium for each of the seven individual populations that grew to carrying capacity ranged between 15 and 30 years, with a modal time of 20 years. One population, the Santa Margarita River, failed to reach the carrying capacity input into the model (348 pairs) and instead leveled off at approximately 220 pairs. This may be the result of overestimating migration away from the Santa Margarita by failing to detect birds remaining at their natal site, and of underestimating migration into the Santa Margarita population by a similar failure to detect color-banded immigrants.

When K is increased by 50 percent, the time to achieve equilibrium for the metapopulation increased from 20 years to 28 years, or by 40 percent (Figure 2). The differences for the individual populations ranged from zero to 30 percent (Figure 2).

3. What is the effect of migration rate on the time required to reach carrying capacity?

Migration rate was varied holding K constant at the larger of the two estimates, producing the result that time to achieve equilibrium under higher migration was virtually unchanged for those populations currently experiencing low migration rates, and increased for those with high rates, particularly those with emigration (migration out of the population) rates higher than immigration (migration into the populations), such as the San Diego and San Luis Rey Rivers (Figure 3). An exception to this was the Santa Margarita River, for which the simulations predicted a reduction in the time to achieve stability. This may be because the simulations also predicted a lower equilibrium population size at the Santa Margarita under conditions of higher migration.

Conclusions

The following conclusions are drawn from this modeling exercise:

1. Under current conditions, the least Bell's vireo is not at risk of extinction.

2. One population at the Santa Ynez River is at risk of extinction as a result of a low reproductive rate and no detectable migration into the population. However, this population should continue to be managed to preserve it as a "stepping stone" for future colonization to the north, and because establishment of breeding populations in the vicinity of the Santa Ynez River, such as those at the Ventura and Santa Clara Rivers, may facilitate migration into the population and provide a "rescue effect" from local extinction.

3. Although carrying capacity and hence potential maximum population size for the least Bell's vireo is not known at this time, at current rates of growth, least Bell's vireo populations have the capacity to achieve conservative estimates of carrying capacity within 20 years. In fact, least Bell's vireo at some sites, such as the Santa Margarita River, appear to be "out-performing" the simulations in actual population growth, achieving the predicted maxima rather than the averages.

4. Migration rates among populations influence the time required to achieve carrying capacity for those populations with a comparatively high rate of emigration. However, for a 50 percent increase in migration rate, time to reach equilibrium increases by less than ten years, a remarkably short period of time within the context of endangered species management. Further study is needed to improve estimates of migration among the eight core populations as well as other populations throughout the range of the least Bell's vireo.

APPENDIX C: SOURCES OF INFORMATION FOR THE POPULATION VIABILITY MODEL

Tijuana River:	RECON 1989; Kus 1990c; 1991e; 1992c,d; 1993d;1994b.
Sweetwater River:	Jones 1985b; Collier and Jones 1989; Kus and Collier 1988; Kus 1989b;Kus 1990b; Kus 1992b; Kus 1993b.
San Diego River:	Jones 1985; RECON 1989; Kus 1989a; Kus 1990a,b; Kus 1992a; Kus 1994a; Kus 1995a.
San Luis Rey River:	Jones 1985; RECON 1989; Kus 1989c,d; Kus 1991a; Kus 1993b; Kus 1995b.
West San Luis Rey River:	Jones 1985; RECON 1989; Kus 1989e; Kus 1991b,d; Kus 1992e; Kus 1993c; Griffith and Griffith 1995.
Santa Margarita River:	Salata 1980; Salata 1981; Salata 1982; Salata 1983; Salata 1984; Salata 1986; Salata 1987; Jones 1989a; Griffith and Griffith 1990a,b; Griffith and Griffith 1991; Sweetwater Environmental Biologists 1992a; USFWS 1994; USFWS 1995.
Santa Ana River:	USFWS 1986; Hays 1986; Hays 1987; Hays 1988; Hays 1989; Hays and Corey 1991; Pike and Hays 1992a,b; Pike and Hays 1993; Pike 1994.
Santa Ynez River:	RECON 1989; Greaves 1991; Greaves 1992; Greaves 1993; Greaves 1994.

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<u>EXHIBIT B</u>

LEAST BELL'S VIREOS AND SOUTHWESTERN WILLOW FLYCATCHERS IN PRADO BASIN OF THE SANTA ANA RIVER WATERSHED, CA

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ABSTRACT. Multiple partnerships have led to a program of resource management in southern California's largest coastal watershed. Annual grants and a perpetual endowment built with mitigation money have paid for 500 acres of habitat restoration, through control of invasive giant reed (*Arundo donax*) in part and successful management of beleaguered species. Populations of endangered least Bell's vireos (*Vireo bellii pusillus*) and southwestern willow flycatchers (*Empidonax traillii extimus*) were studied and managed for the nineteenth consecutive year in the Prado Basin and environs during the 2004 breeding season. Data were taken on status, distribution, breeding chronology, reproductive success, and nest site characteristics. Additionally, brown-headed cowbirds (*Molothrus ater*) were surveyed and removed from vireo and flycatcher territories. Four hundred and thirteen of 590 territorial male vireos detected in the Prado Basin were found to be paired in 2004, producing a minimum of 767 fledglings. This compares with 339 pairs recorded in 2003, 312 pairs in 2002, and just 19 pairs in 1986. One thousand three hundred and fifty three cowbirds were removed from vireo and flycatcher habitat during the nesting season, following the fall/winter removal of 6,527 cowbirds from adjacent cattle operations. Cowbird parasitism rates of vireo nests have decreased from 39% in 1986 and 57% in 1993, to a near record low of 5% in 2004. Six vireo nests were manipulated, cowbird eggs and young were removed, resulting in two vireo fledglings that almost certainly would not have survived. Seventy-nine percent of 306 vireo nests were placed in willows (*Salix* spp. – 4 species) and mulefat (*Baccharis salicifolia*). Successful breeding by willow flycatchers in 2004 was documented in two of 5 home ranges, with one case of polygny. Numerous other sensitive avian species have benefited from the habitat restoration and management efforts. For example, a minimum of 500 pairs of yellow warblers (*Dendroica petechia*) were estimated in the 4,500 ha (11,120 ac) study area. However, for the third consecutive year, no western yellow-billed cuckoo (*Coccyzus americanus occidentalis*) was detected.

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INTRODUCTION

The Santa Ana River Watershed Program. The waterways in the watershed of the Santa Ana River have been greatly altered and the floodplain reduced for flood control and other human induced purposes. As a result, riparian habitat and the diversity of wildlife it supports have been reduced to unsustainable levels for some species. This led to the listing under State and Federal Endangered Species Acts of those species most intimately dependent upon southern California's riparian systems.

The habitat degradation continues today with the edge effects associated with the adjacency and encroachment of the growing human population. One of the most immediate threats to the remaining riparian habitat is its invasion and destruction by giant reed (*Arundo donax*). This bamboo-like grass occupies more than half of the floodplain formerly vegetated by willows and other native wetland species. Giant reed has little redeeming value as wildlife food or for secure nest sites. It forms impenetrable thickets, carries fire, consumes several times more water than native habitat, interferes with flood control, produces massive quantities of debris that costs millions of dollars to clean off the coast, and driven by floods has caused bridge failure.

The Santa Ana River Watershed Program was initiated to restore the natural functions of the river. The current foci are control of giant reed and other invasives, restoration of habitat and beleaguered species, and investing the public. The principal partners include the Santa Ana Watershed Association of Resource Conservation Districts (the 5 RCDs in the watershed), the Orange County Water District, U.S. Fish and Wildlife Service, Regional Water Quality Control Board, county flood control agencies, Army Corps of Engineers, and many land owners and other agencies. Annual activities are funded in part with the proceeds of an endowment and through competitive grants. The endowment is being built with mitigation money from water development projects on the river. The program supporters recognize the ongoing need to counter-manage the effects of the burgeoning human population in order to recover endangered resources and perpetuate southern California's wildlife heritage.

Least Bell's Vireo. The Least Bell's Vireo (*Vireo bellii pusillus* [Coues]; "vireo") is a small, insectivorous bird of the family Vireonidae. This vireo was described by Dr. Elliot Coues (1903) and aspects of its life history are summarized in a recovery plan and final rule (U.S. Fish and Wildlife Service 1986a, 1986b).

Vireos typically occupy "[l]ow riparian growth either in the vicinity of water or in dry parts or river bottoms. The center of activity is within a few feet of the ground, in the fairly open twigs canopied above by the foliage of willows and cottonwoods. Foraging cruises may take the birds higher into the trees but territorial interest, with song perches and nest sites, is in the lowest stratum of vegetation. Nests frequently are placed along the margins of bushes or on twigs projecting into pathways. Most typical plants frequented are willows, guatemote [mulefat], and wild blackberry. Less commonly live and valley oaks, wild grape, poison oak and sumac in the margins of water courses are visited and may be nested in. On the desert slopes mesquite and arrowweed in canyon locations may be occupied" (Grinnell and Miller 1944).

The vireo was formerly described as common to abundant in riparian habitats from Tehama County, California to northern Baja California, Mexico (Grinnell and Storer 1924; Willett 1933; Grinnell and Miller 1944; Wilbur 1980). The vireo currently occupies a small fraction of its former range (Goldwasser *et al.* 1980; United States Fish and Wildlife Service 1986) and is a rare and local species. Grinnell and Miller (1944) noted that declines in southern California and the Sacramento-San Joaquin Valley coincided with increased cowbird parasitism. Numbers continued to decline until about 1986 when only 300 pairs were documented throughout the U. S. range (U. S. Fish and Wildlife Service 1986; RECON 1988).

The vireo's dramatic decline (Salata 1986; U. S. Fish and Wildlife Service 1986) has been attributed to the combined effects of the widespread loss of riparian habitat and brood parasitism by the Brown-headed Cowbird (*Molothrus ater*) (Garrett and Dunn 1981). The Least Bell's Vireo was listed as an endangered species by California in 1980 and by the U.S. Fish and Wildlife Service in 1986. Critical habitat was designated for the vireo in February 1994, including most of our study area. The enactment of protective measures and subsequent management led to steadily increasing vireo numbers and by 2000, there were approximately 2000 territorial male vireos (U.S. Fish and Wildlife Service, unpublished data).

Although known to be present along the middle reaches of the Santa Ana River much earlier (Goldwasser 1978), field studies of the vireo commenced in 1983 (Zembal *et al.* 1985; Zembal 1986) and continued annually (Hays 1986, 1987, 1988, 1989; Hays and Corey 1991; Pike and Hays 1992; The Nature Conservancy 1993a, 1993b, 1994, 1995, 1996, 1997; Pike and Hays 1998, 1999,2000; Pike *et al.*2001, 2002, 2003). This paper summarizes the results of intensive study and management, mostly since 1986.

Southwestern Willow Flycatcher. The Southwestern Willow Flycatcher (*Empidonax traillii extimus* [Phillips]) is a relatively small, insectivorous songbird. It is a recognized subspecies of the Willow Flycatcher (*Empidonax traillii*). Although previously considered conspecific with the Alder Flycatcher (*Empidonax alnorum*), the Willow Flycatcher is distinguishable from that species by morphology (Aldrich 1951), song type, habitat use, structure and placement of nests (Aldrich 1953), eggs (Walkinshaw 1966), ecological separation (Barlow and MacGillivray 1983), and genetic distinctness (Seutin and Simon 1988). The Southwestern Willow Flycatcher is one of five subspecies of the Willow Flycatcher currently recognized, primarily by differences in color and morphology (Hubbard 1987; Unitt 1987; Browning 1993).

The breeding range of the Southwestern Willow Flycatcher includes the southern third of California, southern Nevada, Arizona, New Mexico, and western Texas (Hubbard 1987; Unitt 1987; Browning 1993). The species may also breed in southwestern Colorado, but nesting records are lacking. Records of breeding in Mexico are few and confined to extreme northern Baja California and Sonora (Unitt 1987; Howell and Webb 1995). Willow Flycatchers winter in Mexico, Central America, and northern South America (Phillips 1948; Ridgely 1981; AOU 1983; Stiles and Skutch 1989; Ridgely and Tudor 1994; Howell and Webb 1995). They are generally gone from breeding grounds in southern California by late August (The Nature Conservancy 1994) and are exceedingly scarce in the United States after mid-October (Garrett and Dunn 1981).

Southwestern Willow Flycatchers occur in riparian habitats along watercourses where dense growth of willows *(Salix* sp.), *Baccharis*, arrowweed (*Pluchea* sp.), buttonbush (*Cephalanthus* sp.) and other wetland plants provide dense thickets. Nests are built in thickets, 4-7 meters (13-23 feet) or more in height. Occupied habitat is usually canopied in willows or cottonwoods (Phillips 1948; Grinnell and Miller 1944; Whitmore 1977; Hubbard 1987; Unitt 1987; Whitfield 1990; Brown 1991; and U.S. Fish and Wildlife Service, 1993, 1995). The subspecies of Willow Flycatcher generally prefer nesting sites with surface water nearby (Bent 1960; Stafford and Valentine 1985; and Harris *et al.* 1986) and in the Prado Basin they virtually always nest near surface water or saturated soil (e.g., The Nature Conservancy 1994).

Like the vireo, the Southwestern Willow Flycatcher has suffered extensive loss, degradation, and modification of essential riparian habitat due to grazing, flood control projects, urban developments, and other land use changes (Klebenow and Oakleaf 1984; Taylor and Littlefield 1986; and Dahl 1990). Estimated losses of wetlands between 1780 and the 1980's in the Southwest are: California 91%; Nevada 52%; Utah 30%; Arizona 36%; New Mexico 33%; and Texas 52% (Dahl 1990).

This species is also impacted by brood parasitism by cowbirds (Unitt 1987; Ehrlich *et al.* 1992; U.S. Fish and Wildlife Service 1993, 1995). Parasitism rates of Southwestern Willow Flycatcher nests have recently ranged from 50 to 80 percent in California (Whitfield 1990; M. Whitfield and S. Laymon, unpublished data), to 100% in the Grand Canyon in 1993 (U.S. Fish and Wildlife Service 1993). Mayfield (1977) thought that a species or population might be able to survive a 24% percent parasitism rate.

Willett (1933) considered the Willow Flycatcher to be a common breeder in coastal southern California. Unitt (1987) concluded that these birds were once fairly common in the Los Angeles basin, the San Bernardino/Riverside area, and San Diego County. More recently, *E. t. extimus* was documented only in small, disjunct nesting groups (e.g., Unitt 1987, U.S. Fish and Wildlife Service 1995). Status reviews done prior to State or Federal listing of the flycatcher considered extirpation from California to be possible, even likely, in the foreseeable future (Garrett and Dunn 1981; Harris *et al.* 1986). Unitt (1987) then reported the known population in California to be 87 pairs and estimated the total population of the subspecies to be under 1000 pairs, more likely 500. A total of only 104 pairs was recorded in California in 1996 (U.S. Fish and Wildlife Service, unpublished data).

With the decline in flycatcher numbers on the South Fork of the Kern River, only two California populations consisting of 15 or more pairs have been relatively stable in recent years, that being along the San Luis Rey River and the Santa Margarita River. Of eight other nesting groups known in southern California, all but one consisted recently of six or fewer nesting pairs (Unitt 1987, Fish and Wildlife Service, unpublished data).

The Southwestern Willow Flycatcher was listed as endangered on February 27, 1995 (59 *Federal Register* 10693) and critical habitat, which includes much of the Prado Basin, was designated for the species in 1997 (62 *Federal Register* 39129 and 44228). Breeding Willow Flycatchers were also State listed as endangered in California and Arizona.

Reported herein are the results of study and management of the vireo and flycatcher, mostly since 1986 in the Prado Basin and environs.

STUDY AREA

The Prado Basin is located behind Prado Dam about 40 miles from the Pacific Ocean. The dam was constructed for flood control on the Santa Ana River in 1941. The approximate center of the study area, 33 degrees and 55 minutes north latitude and 117 degrees and 38 minutes west longitude, is located about 70 kilometers east of Los Angeles and eight kilometers north of the City of Corona in the northwestern-most corner of Riverside County, California.

The climate is typically Mediterranean and consists of warm, dry summers and cool, wet winters. The weather during the most recent study period, March-September, 2004 was typical: early mornings were generally cool (approximately 13 degrees Celsius) in spring, increasing by about 3 degrees in later months, and ranging 29 to 35 degrees in midday. Winds typically began blowing around 10 a.m. and often reached a magnitude of Beaufort category four, or about 20 miles per hour by noon. Winds thereafter frequently continued unabated until sundown. Early mornings were occasionally cloudy or foggy and were frequently partly cloudy.

Prado Basin comprises some 4,500 ha (Zembal *et al.* 1985) including approximately 2,400 ha of wetland habitats (U. S. Fish and Wildlife Service 1986). Willow woodlands, freshwater marshes, and ponds dominate the Basin. However, understory is scarce in the lower elevations due to prolonged inundation. In addition, large tracts of willow woodland habitat have been invaded, degraded or destroyed by non-native plants, particularly giant reed (*Arundo donax*). Other potentially conflicting land uses in the Basin environs include: urban development, parks, an airport, livestock grazing, dairy farming, agriculture, oilfield operations, industry, and war games. In addition, much of the Basin is leased to hunting club operators for waterfowl, pheasant, and dove hunting, shooting sports, sportsmen's fairs, and dog training.

METHODS

Searches and monitoring visits were conducted almost daily for Least Bell's Vireos and Southwestern Willow Flycatchers in the Basin and environs, 9 March – 6 October 2004 for over 2,900 field-hours. Initially we concentrated in areas where vireos and flycatchers occurred in prior years, but suitable habitat over the entire accessible study area was eventually surveyed. The majority of the field time was spent at sites occupied in 2002 and 2003.

All individual birds or pairs were noted during each visit to each section of the Basin. Data were taken on bird location, movement, behavior, food preferences, nest placement, sex, and age. Singing vireos were identified as males. Non-singing, adult vireos were deemed to be females if they were either: 1) in the company of non-threatening males; or 2) conspicuously engaging with impunity in breeding behaviors within the boundaries of well-defended and well-defined home ranges. Fledgling young were identified on the bases of their plumages, behaviors, and vocalizations.

Nests of the endangered birds were intrusively monitored, although great care was taken to minimize visits, scent cues for predators, habitat damage, trailing, and disturbance. Nests were located from a distance when possible and the contents were checked with a mirror. Data were taken on reproductive timing and success, cowbird parasitism, and depredation. Cowbird eggs were removed or replaced with infertile ones and young cowbirds were removed. The eggs were taken with adhesive tape to avoid human contact with, and scent on the nest or contents. Nest monitoring was conducted as prescribed in memoranda and permits from the State and Federal wildlife agencies. However, no nest visits were conducted if: 1) there was a chance of inducing a nest "explosion" or premature departure by nestlings; 2) approaching the nest would result in habitat destruction or trailing; or 3) no additional significant information or benefit to the occupants would result from the visit.

Once fledglings had left a nest site or a nest was otherwise emptied or abandoned, data were taken on nest dimensions, placement, height above the ground, and supporting plant species. Unsuccessful nests were carefully examined for signs of parasitism or other disturbance. Nests were assumed depredated if all eggs or unfledged young were destroyed or removed. Cowbird parasitism events were classified as such only if a cowbird egg(s) or pieces were found in, or below, the affected nest.

Habitat management included trapping and removing cowbirds, 26 March - 6 August. Trapping continued through the winter season with at least four traps. Twenty modified Australian crow traps were deployed adjacent to habitats occupied by breeding vireos and flycatchers for a total of 1,883 trap-days. Each trap measured approximately 6' by 6' by 8' and superficially resembled a chicken coop (see Hays 1988). Cowbirds, attracted by live decoy cowbirds, ad libitum food and water, entered the traps through slots in the center of the traps' upper surfaces. Traps were checked 6-10 times per week, all non-target birds were released immediately, and cowbirds were humanely dispatched.

Several other beleaguered avian species occupied the Basin with the vireo and flycatcher and were studied opportunistically. Specific effort was made to census the Western Yellow-billed

Cuckoo (*Coccyzus americanus occidentalis*), a species designated as endangered by the State of California.

The standard definitions used herein of terms pertaining to avian breeding biology are those recommended by the Least Bell's Vireo Working Group: Adult, "an after hatch year bird"; Complete nest, "a nest built by a pair; capable of receiving young"; Expected fledglings, "number of nestlings seen on the last visit"; Failed nest, "a nest which had eggs but produced no known fledged young"; False or bachelor nest, "an incomplete nest built by a lone male"; Incomplete nest, "a nest built by a pair; abandoned prior to completion"; Juvenile, "a fledgling which has been out of the nest more than 14 days"; Known fledged young, "a fledgling seen out of the nest"; Manipulated nests, "... e.g., cowbird egg removed"; Presumed failure, "... apparently complete nest that did not receive an egg; no powdery pin feathers seen in the nest; adults seen without fledglings..."; Presumed successful (nest), "... powdery pin feathers seen in the nest; nest intact"; Productivity or breeding success (population), "the number of known fledglings divided by the number of known breeding (nesting) pairs..."; Successful nest, "a nest which fledged at least one known young"; Successful pair, "produced one [or more] successful nests".

Lastly, because "territory" has connotations not addressed in this study, we primarily use the broader term "home range" herein. "Territorial males", however, is commonly used in written reports of the vireo and retained herein, as well.

RESULTS AND DISCUSSION

Least Bell's Vireo. The first returning male vireo was detected on 15 March during the third focused survey of the season. By 31 March, a record 135 male vireos had been detected. This compares with 57 males being found by this date in 2003, and only 18 in 2002. By contrast, in 1998, 95 vireo males had been discovered by 31 March.

As in previous years, nearly all of the males discovered by 31 March were in home ranges that were occupied in 2003. Thus, the majority of vireos detected in the first few weeks of the season appeared to be 'returnees' and the majority thereafter was in previously unoccupied locales (Hays and Corey 1991; The Nature Conservancy 1993). Given the high degree of site tenacity exhibited by adult ("after second-year") male vireos (Pike and Hays 2000; Salata 1986), most of these "late" arrivals were probably first-time breeders. If so, second-year males comprised the most commonly represented age class in the breeding population.

The first female vireo was detected on 22 March, and a notable 127 were tallied by 16 April. In 2003, 95 females were detected by 16 April. By contrast, in 1999, the first female vireo was also detected on 22 March, but by 16 April only 5 had been discovered.

The first nest of the 2004 season was likely begun on 31 March. Nest building has been rarely observed during March, but in 1995 at least 13 nests were begun in March. Nestling young were first observed on 23 April and the first fledgling was found on 3 May. In 1991 – 1996, and 1998 – 2001, the last nests of the seasons were completed 2 –8 July. In 2002, the last completed nest was noted on 30 June; however, in 2003 and 2004, the last completed nests were 4 July and 3 July, respectively. Extreme dates for last completed nests within the Basin are 23 June in 1997 and 18 July in 1990. Vireos had departed the Basin by about 17 September 2004, when only one male could be found. However, there have been 4 probable instances of vireos over-wintering in the Basin (The Nature Conservancy 1994, 1995; Pike and Hays 1998). Exceptions as noted above notwithstanding, average arrival dates for our vireos were more than a month earlier than documented for the eastern subspecies and fall departures were quite similar (Barlow 1962; Garrett and Dunn 1981; Salata 1986, 1987; Hays 1987, 1988; Robbins 1991; Pike and Hays 1992).

Four hundred and thirteen pairs of Least Bell's Vireos, 177 unpaired males, and a minimum of 767 fledged young were detected in Prado Basin in 2004 (Table 1). The vireos were loosely congregated at 5 locales in 9 clusters. Further, as in 2001and 2002 (Pike *et al*. 2001, 2002), numerous additional vireos located along the Santa Ana River that would have been counted in the Basin tally in previous years were instead monitored by Riverside-Corona and Inland Empire West Resource Conservation District biologists in 2004. Nonetheless, the number of vireo males detected in 2004 easily surpasses all previous recruitment levels recorded within the Prado Basin (Table 1). This increase is all the more dramatic, recognizing that only 25 territorial males were detected in the Basin and environs in 1983 and only 20 were found in 1987 (Hays 1987). Significant recovery of the state's largest subpopulation on the Santa Margarita River (Salata 1987) and of the Prado subpopulation have been ascribed to effective wildlife management (Pike and Hays 2000).

One of the benefits of the expanding vireo population has been the colonization of adjacent unoccupied areas. For example, no vireo pairs were observed in the 12 km of habitat in Orange County just below Prado Dam during comprehensive surveys in 1986 and 1987 (Marsh 1987). They were at least uncommon there as recently as 1970. However, as the vireo population began recovering in the Prado Basin, vireos slowly spread throughout adjacent Orange County. By 2002, a minimum of 83 vireo males was detected there (Doug Willick, pers.comm.). Further, in 2002, in the stretch of river just below Prado Dam where only one vireo pair was detected during surveys in 1991 (Marsh 1991), there were 28 territorial males detected and 26 pairs of vireos fledged 56 young (Hoffman and Zembal 2002).

It should be noted that this is true expansion of the local, Prado population. Site fidelity is extremely strong in the vireo and of the hundreds of vireos banded at other locations, relatively few have been observed at Prado. Those that were include three color-banded males detected in the Basin during the 1992 breeding season, a male and a female in 1993, a male in 1994, and a female in 1995. All 7 were marked as nestlings in San Diego County: 2 were born on Marine Corps Base, Camp Pendleton; 2 came from the San Luis Rey River; and 3 fledged along the San Diego River. From 1996-2004, only six additional banded male vireos were detected. One of these males was present in a West Basin home range every breeding season from 1997 to 2002. Two other males found in 2002 had apparently been banded in Ventura County locales.

Table 1. Least Bell's Vireo status and distribution, Prado Basin, California, and environs, 1983-2004

SUBPOPULATION	**1983**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
SOUTH BASIN "Prado Dam" in Hays (1987)	0/0/0**[a][b]**	0/0/0	7/6/10+ **[c]**	9/8/30	8/8/40	13/11/50	17/15/70	27/23/57	30/29/69	35/30/101	43/36/78	35/32/87	42/32/78	49/41/96	38/27/73	38/30/59	39/31/ 64	45/24/ 38	50/33/ 68	52/34/60
CENTRAL BASIN "West Basin/Santa Ana River" in Hays (1986)	0/0/0	2/2/1	3/3/1+	1/0/0	0/0/0	2/1/2	3/3/11	7/7/19	4/2/5 **[d]**	18/12/20	17/8/14 **[d]**	21/12/7	26/11/13	27/20/27	34/17/17	32/20/31	38/21/ 31	42/25/ 64	43/29/ 59	57/46/77
NORTH BASIN "Mill Creek/South Santa Ana River" in Hays (1986)	4/--/--**[e]**	9/9/15+	10/7/21	13/11/37	11/8/27	9/7/29	7/5/17	10/10/21	16/13/21	23/19/22	28/2056	49/31/63	57/42/63	64/47/78	74/53/131	84/68/192	94/72/ 167	86/68/ 148	111/ 87/ 199**[h]**	165/121/273
WEST BASIN/ CHINO CREEK	0+/0+/0+	2+/0+/0+**[f]**	--/--/--	11/7/12+	12/10/27+	16/16/40+	31/31/60	48/44/98	62/57/118	71/58/123	69/52/108 **[g]**	71/62/76	79/65/134	102/85/143	99/67/151	110/97/249	197/ 156/ 348	190/ 146/ 281	177/ 143/ 284**[g]**	244/168/293
TEMESCAL CREEK (Prado Basin Reach)	12/--/--	8/8/4+	5/4/7	5/5/9	5/5/8	7/7/21	12/10/25	17/15/29	22/20/31	36/29/59	50/41/94	54/46/77	57/43/106	70/85/143	63/42/84	57/43/80	62/45/ 89	54/38/ 55	55/39/ 61	72/44/64
TOTAL	16/0/ 0	21/19/20+	25/20/ 39+	39/31/88+	36/31/102	47/42/142	70/64/183	109/ 99/ 224	134/ 121/ 365	183/ 148/ 325	207/ 157/ 350	230/ 183/ 310	261/ 193/ 394	312/ 278/ 487	308/ 206/ 456	321/ 258/ 611	430/ 325/ 699	417/ 301/ 586	436/ 331/ 671	590/413/767

[a] Entries correspond to numbers of territorial males/pairs/'known fledged young' for designated time and locale.
[b] All data in 1983 per Zembal *et al.* (1985).
[c] The "+" symbol indicates that actual count may have been somewhat higher; field census efforts were started late or were otherwise deemed to be incomplete.
[d] Numbers apparently decreased due to habitat damage resulting from an alteration in the course of the Santa Ana River.
[e] The "--" symbol indicates that no data were available.
[f] Data derived from Corps of Engineers surveys.
[g] Numbers decreased due to water retention behind the dam and resultant inundation of vireo habitat associated with Chino Creek.
[h] Numbers likely increased due to displacement of vireos from adjacent inundated areas due to water retention behind the dam.

Table 2. Least Bell's Vireo Status And Management, Prado Basin, CA, 1986-2004.

	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
A. Number of territorial males	19	26	37	36	47	70	112	138	188	217	249	274	345	336	357	444	429	447	590
B. Number of pairs	19	20	30	31	42	64	99	123	149	164	195	201	270	224	281	336	312	339	413
C. Number of fledged young observed [a]	20	39	88	102	142	183	224	247	327	355	318	410	450	489	649	718	598	688	767
D. Projected total recruitment of vireo young [b]	34	52	110	115	154	230	283	295	417	508	410	500	621	582	843	907	811	846	1115
E. Average number of fledglings per pair (C/B)	1.1	2.0	2.9	3.3	3.4	2.9	2.3	2.0	2.2	2.2	1.7	2.0	1.7	2.2	2.3	2.1	1.9	2.0	1.9
F. Projected number of fledglings per pair (D/B)	1.8	2.6	3.7	3.7	3.7	3.6	2.9	2.4	2.8	3.1	2.1	2.5	2.3	2.6	3.0	2.7	2.6	2.5	2.7
G. Rate of nest depredation	25%	41%	19%	26%	23%	36%	47%	41%	40%	41%	39%	40%	45%	36%	25%	34%	37%	40%	35%
H. Rate of cowbird nest parasitism [c]	39%	16%	32%	20%	36%	32%	29%	57%	36%	21%	35%	19%	13%	15%	8%	13%	7%	4%	5%
I. Numbers of cowbirds removed from study area	858	911	694	652	704	726	865	513	1068	888	1025	1314	2333	2860	2595	2785	2468	1810	1353
J. Number of cowbirds trapped in study area [d]	816	911	694	652	704	725	865	513	1068	888	1024	1312	2322	2839	2587	2780	2468	1810	1353
K. Number of trap days (1 operative trap in the field for 1 day=1 trap day)	725	826	790	704	859	924	909	1138	1091	1351	2060	2396	2265	2562	2623	2353	2769	2527	1883
L. Average number of cowbirds trapped per trap day (J/K)	1.1	1.1	0.9	0.9	0.8	0.8	1.0	0.5	1.0	0.7	0.5	0.5	1.0	1.1	1.0	1.2	0.9	0.7	0.7
M. Number of person hours in the field	650	800	800	715	850	900	1200	1240	1260	1350	2350	2200	2500	2100	2500	2600	2800	3000	2900

[a] Given the substantial increase in the number of breeding vireo pairs in recent years, a decision was made to place a high priority on nest monitoring and the removal of cowbird eggs at the expense, perhaps, of obtaining definitive fledgling counts. Therefore, a significant number of fledglings were not counted and are thus not represented in the recruitment totals reported in this category.

[b] Projected totals reflect the assumption that the average reproductive productivity of all pairs was equal to that of those select pairs that were regularly monitored throughout an entire breeding season. However, these totals may be somewhat inflated because well-monitored pairs tend to be in areas with cowbird traps and benefit from the removal of cowbird eggs and nestlings whenever present. In addition, the 1986 projection reflects the assumption that juveniles seen late in the breeding season fledged from unmonitored nests (the Fish and Wildlife Service suspended nest visitation privileges from early July of 1986 until the end of the breeding season.) In any case, the authors believe that the data reported in this category best estimates the total recruitment of the local vireo population.

[c] Reported data probably exceed the projected basin-wide average for each of the breeding seasons designated. The monitoring of nests has always been most intense in those locales (e.g., West Basin) where adult cowbirds have been most abundant.

[d] Totals reported from 1996-2004 reflect the number of cowbirds trapped and removed through early August (typically 2-4 August) of each respective season. Trapping was conducted after those dates during all nine years (see text). Four traps likely will continue in operation throughout the 2004-2005 fall and winter seasons.

Least Bell's Vireos typically nest in dense riparian understory dominated by mulefat (*Baccharis salicifolia*), willows, mugwort (*Artemisia douglasiana*), *Bidens* spp., mexican tea (*Chenopodium ambrosioides*), Hooker's evening primrose (*Oenothera hookeri grisea*), and stinging nettle (*Urtica holosericea*), among others (Wilbur 1980; Gray and Greaves 1981; Goldwasser 1981; Salata 1984, 1987; United States Fish and Wildlife Service 1986; Pike and Hays 2000). Extremely dense near-nest vegetation in the Prado Basin has occasionally precluded close examination of a nest (Pike and Hays 2000).Of the 306 nests that were examined in 2004, 88 (29%) were suspended in mulefat, 124 (41%) in black willow, 25 (8%) in arroyo willow (*Salix lasiolepsis*), and 14 (5%) in gum trees (*Eucalyptus* spp.). Overall, 51% (155 of 306) of vireo nests were placed in willows. On average, 52% (N=1,851) of all nests examined in the Basin, 1987-2004 were placed in willows and 36% (N=1,289) were in mulefat. Since 1987, 3,551 nests have been found in a minimum of 44 species of plants. Surprisingly, 150 of these nests have been placed in non-native gum trees and 28 in giant reed.

Nest cover was similar on the Santa Margarita River, Camp Pendleton where approximately 59% of 394 nests, 1981-1987 were located in willows (largely arroyo willow and sandbar willow, *Salix hindsiana*) (Salata 1987) and in the Gibraltar Reservoir Watershed of Santa Barbara County where 101 (47%) of 216 nests were also in willows (Gray and Greaves 1981). However, the vireo's preponderant use of black willow and mulefat was unique for the Prado Basin. The most inundation-tolerant of the willows is the black willow, which dominates the riparian habitat in Prado Basin because of the regularity of pooled water therein (Zembal et al. 1985). In some areas in the lower Basin there is little else growing that could provide suitable structure for nest support and cover. However, the consistent use of mulefat is disproportionate to its availability. Mulefat is not abundant in the Basin and occurs scattered in local stands (Zembal et al. 1985).

In years with heavy, late rainfall, water is conserved in Prado Basin and vireo habitat is inundated. Understory is submerged, and particularly if the water level varies, some of the vireos are forced into marginal habitat on the higher edges of their home ranges. In addition, given the strong breeding site fidelity of vireos (Pike and Hays 2000), some vireo males or pairs may elect to remain in territories that are substantially flooded for most, or even all, of the breeding season (Pike *et al.* 2003). Further, when a large volume of water is retained for a prolonged span of time, as occurred in 1998 (Pike and Hays 1998), the adverse affect on near-ground willow foliage can extend into subsequent breeding seasons. As regrowth and regeneration of lower elevation willows steadily progresses, as during the drier seasons from 1999 - 2002, nesting vireos increasingly gravitate to these sites. Thus, while only 20% of vireo nests were found in black willows in 1998 (Pike and Hays 1998), the percentages gradually increased to the record high of 53% tallied in 2002 (Pike *et al.* 2002).

Vireo nests in the Prado Basin are often placed at the lower edge of a horizontal belt of dense foliage volume at about 1 m from the ground (Zembal 1986). Mean nest heights were measured in 1990 and 1989 of 1.18 m and 1.13 m, respectively that are higher than the corresponding values of 0.87, 0.64, and 0.99 m reported from other areas (Wilbur 1980; Gray and Greaves 1981; and Salata 1987, respectively). Moreover, a 2004 nest in the Prado Basin was estimated at being 4.6 m above the ground and a 1995 nest was measured at about 4.3 m above ground, two of the highest of any vireo nest reported for any area. Other exceptional nest heights include 3.94 m in 1987, located within 10 m of the highest nest found during the 1988 breeding season at 2.32 m; two nests at 3.7 m and 3 m in 2004; 3.54 m in 1992 following an unsuccessful nest by the same pair located about 2 m above ground; and 6 nests at 2.1 to 2.9 m, 1995 – 2000. A 1998 nest was measured at 2.69 m above pooled water and may have exceeded 4m above ground.

The vireos have frequently used synthetic materials in their nests. In 1995, 179 nests were examined for content after they were abandoned. About 60% (107 of 179) of the nests contained thin, pliable plastics or papers, primarily on nest bottoms, and only 40% (72 of 179) included natural materials exclusively. Of the 107 nests containing synthetics, 89% (95) primarily used white plastic, and 11% (12) mostly contained other materials, usually clear plastic or white paper. Along Temescal Creek, where trash is very abundant, white plastics were incorporated into 88% (49 of 56) of all nests.

The mean clutch size was 3.6 eggs (N=195 clutches) in the Prado Basin in 2004 and 3.7 for 2,205 nests, 1986 – 2004. This is higher than reported for San Diego County sites with an average clutch size of 3.3 eggs in 303 clutches, 1981 – 1987 on the Santa Margarita River (Salata 1987), and an average of 3.4 eggs in 61 clutches on the Sweetwater River (Kus and Collier 1988). Barlow (1962) reported an average clutch size of 3.39 (N=25) for a population of *V. b. bellii* in northeastern Kansas. However, Greaves (1987) also reported an average clutch size of 3.7 for the Gibraltar Reservoir population during the 1987 breeding season.

In 1999, the mean clutch size in 97 nests found within the Basin in April and May was a high 3.88. Only 12 nests contained three eggs and no nest contained only two eggs. However, the vireos laid fewer eggs per nest during the second half of the breeding season. The average clutch in 62 nests in June and July, 1999 was 3.4, with 21 three-egg nests and 4 two-egg nests.

Although it is often difficult to document that nests containing two eggs represent completed clutches, only 57 two-egg nests have ever been found in Prado Basin. In contrast, 28 two-egg nests were found on the Santa Margarita River by 1987 (Salata 1987). In addition, 10 nests in the Basin have contained 5 vireo eggs but no five-egg nests were observed by Salata (1987). In one instance in the Basin, a 5-egg clutch with a cowbird egg was found in the home range of a male that was associated with two females over a 4-day period (Pike and Hays 1992).

A minimum of 767 fledged vireo young were produced in the Basin in 2004 (Table 2), an 11% increase from 2003 (Pike *et al*. 2003). Reproductive success was a relatively high 59% (164 of 280). This compares to the 60% recorded in 2001 (Pike *et al*. 2001), the 57% in both 2003 (Pike *et al*. 2003) and 2002 (Pike *et al*. 2002), and 41% in 1998 (Pike and Hays 1998).

The average number of fledglings per breeding pair (2.1) in 2004 is below the (2.3) average in 2003 (Pike *et al*. 2003). The highest productivity detected in the Basin was during 1988-1991 when the fledglings-per-pair average was 3.1. This apparent decline in productivity may be partly attributable to the substantial increase in the vireo population since 1989 and our diminished ability to track all nests closely enough to document all fledglings. However, any actual decline in productivity per pair may be associated with increased population density and reduced nesting attempts.

There was a minimum of 2.4 nests per pair in 1988 (Hays 1988), 2.1 nests in 1989 (Hays 1989), and 2.7 nests in 1990 (Hays and Corey 1991). However, in 1996 only 1.8 nests were built per well-monitored pair (The Nature Conservancy 1996), then 1.7 nests in 1997 (The Nature

Conservancy 1997), and by 1999 and 2000, the average number of nests built per pair was down to 1.3 and 1.2, respectively. Interestingly, the vireos even arrived an average of two weeks earlier in 2000 than in 1999. With adequate time available for multiple renests, the very high reproductive success rate of 70% in 2000 (Table 2) may have contributed to the observed decline in reproductive persistence. In 2004, the average was again1.2 nests per pair.

Eighteen of 31 pairs (58%) fledged young from two or three nests in 1989 (Hays 1989), 36 of 42 pairs (86%) fledged from two or three nests in 1990 (Hays and Corey 1991), and 23 of 64 pairs (36%) fledged from two or three nests in 1991 (Pike and Hays 1992). Whereas, from 1999-2001, only 4% of pairs in each season fledged from two nests (Pike *et al*. 2001). In year 2004, 11 of 401 pairs (3%) fledged from two nests. Additionally, in 1990 and 1991, young were fledged from third, fourth, or fifth nesting attempts in at least 15 and 16 home ranges, respectively. From 1996 to 2001 this occurred in just 7,5, 6, 5, 4, and 6 home ranges, respectively. While eight vireo pairs fledged from their third nesting attempt during the 2003 season (Pike *et al*. 2003), this occurred in only 2 home ranges in 2004. Finally, a minimum of four home ranges accommodated 4 or 5 nests in 1991, and just two home ranges accommodated 4 nests in both 1997 and 1998. Since then, only one home range in 2003 has accommodated four nests (Pike *et al*. 2003).

Although two vireo pairs built five nests each during both the 1993 and 1994 seasons, no known pairs have built five nests since. Fifth (or sixth) nesting attempts within a given home range are exceedingly rare elsewhere as well (Greaves *et al.* 1988; Kus and Collier 1988; Salata 1983a,b). Although the average number of vireo nests produced per pair in 1998 (1.75) was low for the Basin, it was similar to averages for other locales. For instance, 1.6 nesting attempts/pair (21 pairs and 34 nests) in the Gibraltar Reservoir area of Santa Barbara County in 1988 (Greaves *et al.* 1988) and 1.7 nests per pair (19 pairs and 33 nests) in 1987 (Greaves 1987). Similarly, vireos on the Sweetwater River in 1987 produced an average of 1.5 nests per pair (Kus and Collier 1988).

Vireos on the Santa Margarita River apparently rarely renest if successful in their first breeding attempt of the season (Larry Salata, pers. comm.). Conversely, vireos in the Prado Basin, 1986-1991 invariably renested after successfully fledging from their first nest. However, 4 pairs in the Basin did not renest in 1992 after fledging three young from their first nests (The Nature Conservancy 1993a) and 13 pairs in 1994 failed to renest after fledging 3 or 4 young each on their first attempts in May. Similarly, in 2000, of the 43 pairs that produced 4 fledglings from their first nesting attempt in May or early June, only 1 (2%) renested. Furthermore, all 10 of the pairs that fledged from two nests in 2000 had fledged only one or two young from their initial nesting effort.

Table 3. Least Bell' Vireo nest placement preferences, Prado Basin, 1987-2004.

Number of Plants Containing Nests

Plant Species	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Totals
Black Willow (*Salix gooddingii*)	11 (37%)	30[a] (63%)	14 (40%)	25 (36%)	27 (24%)	27 (17%)	56 (22%)	62[b] (26%)	43 (17%)	82[c] (32%)	69[c] (29%)	52[c,d] (20%)	71 (33%)	88 (37%)	124[a] (43%)	149[g] (53%)	105[g] (38%)	124 (41%)	1159 (33%)
Arroyo Willow (*Salix lasiolepsis*)	0	3 (6%)	2 (2%)	1 (1%)	6 (5%)	16 (10%)	57 (23%)	50 (21%)	55 (22%)	53 (21%)	52[a] (22%)	48[c] (18%)	18[a] (8%)	32 (13%)	20 (7%)	24 (9%)	15[h] (5%)	25 (8%)	477 (13%)
Red Willow (*Salix laevigata*)	0	0	0	0	5 (5%)	2 (1%)	7 (3%)	4 (2%)	7 (3%)	2 (1%)	3 (1%)	1 (<1%)	6 (3%)	2 (1%)	7 (2%)	8 (3%)	7 (3%)	4 (1%)	65 (2%)
Sandbar Willow (*Salix exigua*)	0	0	0	0	4 (4%)	0	3 (1%)	3 (1%)	2 (1%)	3 (1%)	4 (2%)	2 (1%)	2 (1%)	6 (3%)	2 (1%)	2 (1%)	2 (1%)	2 (1%)	37 (1%)
Yellow Willow (*Salix lucida* ssp. *lasiandra*)	0	0	0	0	0	0	0	3 (1%)	1 (<1%)	0	1 (<1%)	0	1 (<1%)	0	0	0	0	0	6 (<1%)
Unidentified willow species	3 (10%)	0	1 (3%)	0	0	0	0	1 (<1%)	0	1 (<1%)	0	0	2 (1%)	0	0	0	0	0	7 (<1%)
Fremont Cottonwood (*Populus fremontii*)	0	0	0	0	0	1 (1%)	1 (<1%)	1 (<1%)	0	0	0	0	0	0	1 (<1%)	0	0	0	4 (<1%)
Mulefat (*Baccharis salicifolia*)	15 (50%)	15 (31%)	15 (43%)	41 (59%)	53 (48%)	95 (60%)	82 (32%)	88[e] (37%)	99 (40%)	102 (40%)	96 (40%)	108 (42%)	85 (40%)	68 (28%)	93[a] (32%)	63[h] (22%)	83 (30%)	88 (29%)	1289 (34%)
Coyote Bush (*Baccharis pilularis*)	0	0	0	0	1 (1%)	4 (3%)	0	0	0	0	0	1 (<1%)	0	0	2 (1%)	0	1 (<1%)	0	9 (<1%)
Gum (*Eucalyptus* sp.)	1 (3%)	0	1 (3%)	0	9 (8%)	3 (2%)	32 (13%)	7 (3%)	22 (9%)	5 (2%)	3 (1%)	13 (5%)	6 (3%)	2 (1%)	7 (2%)	9 (3%)	16 (6%)	14[f] (5%)	150 (4%)
Giant Reed (*Arundo donax*)	0	0	1 (3%)	0	0	0	0	1 (<1%)	2 (1%)	2 (1%)	2 (1%)	4 (2%)	3 (1%)	3 (1%)	1 (<1%)	4 (1%)	3 (1%)	2 (1%)	28 (1%)

Table 3. Least Bell' Vireo nest placement preferences, Prado Basin, 1987-2004 (Continued).

Number of Plants Containing Nests

Plant Species	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Totals
Cocklebur (*Xanthium strumarium*)	0	0	1 (3%)	1 (1%)	0	0	0	1 (<1%)	0	0	0	0	0	2 (1%}	1 (<1%)	1 (<1%)	0	0	7 (<1%)
Elderberry (*Sambucus mexicana*)	0	0	0	1 (1%)	2 (2%)	3 (2%)	4 (2%)	2 (1%)	6 (2%)	2 (1%)	1 (<1%)	10 (4%)	5 (2%)	9 (4%)	6 (2%)	4 (1%)	11 (4%)	15 (5%)	81 (2%)
Wild Grape (*Vitis girdiana*)	0	0	0	0	1 (1%)	1 (<1%)	1 (<1%)	1 (<1%)	3 (1%)	0	0	4 (2%)	4 (2%)	9[f] (4%)	3 (1%)	4 (1%)	4 (1%)	6 (2%)	41 (1%)
Stinging Nettle (*Urtica holosericea*)	0	0	0	0	2 (2%)	0	0	0	0	1 (<1%)	0	0	0	0	2 (1%)	0	0	0	5 (<1%)
Blackberry (*Rubus* sp.)	0	0	0	0	1 (1%)	0	1 (<1%)	0	2 (1%)	0	2 (1%)	0	0	1 (<1%)	2 (1%)	2 (1%)	1 (<1%)	4 (1%)	16 (<1%)
Thistle (*Cirsium* sp.)	0	0	0	1 (1%)	0	0	0	0	1 (<1%)	0	0	0	0	3 (1%)	0	1 (<1%)	2 (1%)	2 (1%)	10 (<1%)
California Pepper (*Schinus molle*)	0	0	0	0	0	1 (<1%)	0	0	0	0	1 (<1%)	1 (<1%)	0	1 (<1%)	0	0	2 (1%)	3 (1%)	8 (<1%)
Chinese Elm (*Ulmus parvifolia*)	0	0	0	0	0	1 (<1%)	0	0	0	0	0	0	0	0	1 (<1%)	1 (<1%)	0	0	3 (<1%)
Sunflower (*Helianthus annuus*)	0	0	0	0	0	1 (<1%)	3 (<1%)	5 (2%)	0	0	0	0	1 (<1%)	0	2 (1%)	1 (<1%)	0	0	13 (<1%)
Mustard (*Brassica* sp.)	0	0	0	0	0	1 (<1%)	0	2 (1%)	0	2 (1%)	2 (1%)	7 (3%)	2 (1%)	4 (2%)	7 (2%)	0	5 (2%)	5 (2%)	37 (1%)
Tree Tobacco (*Nicotiana glauca*)	0	0	0	0	0	1 (<1%)	1 (<1%)	0	0	0	1 (<1%)	1 (<1%)	0	0	0	0	1 (<1%)	0	5 (<1%)

Table 3. Least Bell' Vireo nest placement preferences, Prado Basin, 1987-2004 (Continued).

Number of Plants Containing Nests

Plant Species	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Totals
Unidentified (dead material)	0	0	0	0	0	1 (<1%)	0	0	0	0	0	0	0	0	0	0	0	0	1 (<1%)
California Sagebrush (*Artemisia californica*)	0	0	0	0	0	0	2 (1%)	0	0	0	0	1 (<1%)	0	1 (<1%)	1 (<1%)	0	0	0	5 (<1%)
Toyon (*Heteromeles arbutifolia*)	0	0	0	0	0	0	1 (<1%)	0	1 (<1%)	0	0	1 (<1%)	0	1 (<1%)	0	0	0	0	4 (<1%)
Cherry (*Prunus* sp.)	0	0	0	0	0	0	1 (<1%)	0	0	0	0	0	0	0	0	0	0	0	1 (<1%)
California Walnut (*Juglans californica*)	0	0	0	0	0	0	1 (<1%)	0	1 (<1%)	0	0	0	0	0	1 (<1%)	1 (<1%)	1 (<1%)	1[i] (<1%)	5 (<1%)
Tamarisk (*Tamarix chinensis*)	0	0	0	0	0	0	0	2 (1%)	3 (1%)	1 (<1%)	1 (<1%)	0	2 (1%)	0	2 1%	4 (1%)	4 (1%)	1 (<1%)	17 (<1%)
Broad-leaved Peppergrass (*Lepidium latifoliuim)*	0	0	0	0	0	0	0	1 (<1%)	0	0	0	0	0	1 (<1%)	0	1 (<1%)	1	0	4 (<1%)
Mexican Tea (*Chenopodium ambrosioides*)	0	0	0	0	0	0	0	1 (<1%)	1 (<1%)	0	0	0	0	0	0	0	0	0	2 (<1%)
Arizona Ash *(Fraxinus velutina*)	0	0	0	0	0	0	0	1 (<1%)	0	0	0	1 (<1%)	0	3 (1%)	0	0	0	1 (<1%)	7 (<1%)
Box Elder (*Acer negundo* ssp. *californicum*)	0	0	0	0	0	0	0	0	1 (<1%)	0	0	0	0	0	1 (<1%)	3 (1%)	3 (1%)	4 (1%)	10 (<1%)
Brazilian Pepper (*Schinus terebinthifolius*)	0	0	0	0	0	0	0	0	0	1 (<1%)	0	0	0	0	0	0	0	0	1 (<1%)

Table 3. Least Bell' Vireo nest placement preferences, Prado Basin, 1987-2004 (Continued).

Number of Plants Containing Nests

Plant Species	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**Totals**
Castor Bean (*Ricinus communis*)	0	0	0	0	0	0	0	0	0	0	1 (<1%)	0	0	0	0	0	0	0	1 (<1%)
Wild Radish (*Raphanus sativus*)	0	0	0	0	0	0	0	0	0	0	0	1 (<1%)	0	0	0	0	1 (<1%)	0	2 (<1%)
Poison Hemlock (*Conium maculatum*)	0	0	0	0	0	0	0	0	0	0	0	1 (<1%)	3 (1%)	0	0	2 (<1%)	2 (1%)	3 (1%)	11 (<1%)
Western Sycamore (*Platanus racemosa*)	0	0	0	0	0	0	0	0	0	0	0	1 (<1%)	0	0	1 (<1%)	0	1 (<1%)	0	3 (<1%)
Olive (*Olea europaea*)	0	0	0	0	0	0	0	0	0	0	0	1 (<1%)	1 (<1%)	0	0	0	1 (<1%)	2 (1%)	5 (<1%)
Australian Pepper (*Schinus polygamus*)	0	0	0	0	0	0	0	0	0	0	0	1 (<1%)	0	0	0	0	0	0	1 (<1%)
Curly Dock (*Rumex crispus*)	0	0	0	0	0	0	0	0	0	0	0	0	0	3 (1%)	1 (<1%)	0	0	0	4 (<1%)
Wlld Rose (*Rosa californica*)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1 (<1%)	0	1 (<1%)	0	2 (<1%)
Clematis (*Clematis ligusticifloia*)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1 (<1%)	0	0	0	1 (<1%)
Western Ragweed (*Ambrosia psilostachya*)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1 (<1%)	0	0	1 (<1%)

Table 3. Least Bell' Vireo nest placement preferences, Prado Basin, 1987-2004 (Continued).

Number of Plants Containing Nests

Plant Species	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Totals
Coast Live Oak (*Quercus agrifolia*)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1 (<1%)	0	1 (<1%)
Bush Mallow (*Malacothamnus fasciculatus*)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1 (<1%)	0	1 (<1%)
Common Sow Thistle (*Sonchus oleraceus*)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1 (<1%)	0	1 (<1%)
TOTALS	30	48	35	70	111	158	253	236	250	257	239	260	212	239	290	281	276	306	3551

[a] One nest also attached to a strand of Stinging Nettle (*Urtica holosericea*).
[b] One nest also attached to a strand of Western Ragweed (*Ambrosia psilostachya*).
[c] One nest also attached to Wild Grape (*Vitis girdiana*).
[d] One nest also attached to a strand of Mulefat (*Baccharis salicifolia*)
[e] One nest also attached to a strand of Mexican Tea (*Chenopodium ambrosioides)*
[f] One nest also attached to Black Willow (*Salix gooddingii)*
[g] One nest also attached to Broad-leaved Peppergrass (*Lepidium latifolium)*
[h] One nest also attached to Blackberry (*Rubus* sp.)
[i] One nest also attached to Poison Hemlock (*Conium maculatum*)

In recent years, a number of unprecedented, breeding-related events have occurred in the Prado Basin. For example, in 1998 a nest on Temescal Creek containing 4 eggs on 3 May was found empty, depredated, but intact by 18 May. The affected pair moved to an adjacent area to renest. Then, by 29 May a second clutch of 4 eggs had been laid in the original nest by another, newly detected pair. Unfortunately, the nest was depredated for a second time. In 2001, another depredated nest that had been left empty and intact by 14 June was found to contain 4 eggs from the same vireo pair on 28 June. Once again, however, this nest was depredated. In 2003, a nest that had been used to fledge 4 vireo young in early May, was found to contain three eggs of the same pair on 25 June. In 2002, a Mill Creek pair that had failed on an initial nesting attempt, successfully raised young on the next attempt by reusing an intact, year 2001 nest. In 2004, a complete nest from the previous season was strangely incorporated into a new nest, with the mouth of the old, leaning nest being grafted onto the side of the new one. Lastly, a nest discovered in the South Basin in 1998 that had just fledged a vireo, still contained a large Brown-headed Cowbird nestling. Evidently this nest had been parasitized after incubation was well advanced. Otherwise, the likelihood of a vireo nestling surviving the competition with a much larger cowbird nestling would be extremely remote. This is the only observation of a vireo successfully fledging from a nest in the Basin that simultaneously contained a cowbird nestling.

Finally, a unique nesting predicament presented itself in 2002. The depredation of an adult female vireo at Mill Creek resulted in a detached nest containing four 5-day old nestlings landing upright in the vegetative substrate below. Prolonged observation revealed that the surviving vireo male was neither feeding nor brooding the young, either while the nest remained on the ground or after it had been replaced very near its original location. It was eventually determined that the best hope of survival for the nestlings was to individually place them in the nests of other vireo pairs. It was decided that candidate host nests should contain fewer than four nestlings and, ideally, that host nestlings should be of a similar age. Two of the Mill Creek nestlings were placed in two nests fitting these criteria, and one of the nestlings eventually fledged along with the 'foster' siblings. The remaining two nestlings were placed in an East Basin nest containing two older nestlings. Although the new arrivals were again apparently accepted by the vireo hosts, one nestling was evidently too weak to survive and the other was depredated on the nest subsequent to the fledging of the older 'foster' siblings.

Increasing breeding success and recruitment in the Prado Basin vireo population over the past 18 breeding seasons is probably due in large part to the active management program. Data collected in the Basin prior to the initiation of management efforts (Zembal *et al.* 1985; Zembal 1986) corroborate Jones' (1985) observations of extremely low reproductive success rates in 1984 at the unmanaged San Luis Rey, San Diego, and Sweetwater River sites. Jones (1985) reported an overall reproductive success of 14% for these three populations and average fledging rates of 0.25, 0.17, and 0.50 fledglings per nesting pair for the San Luis Rey, San Diego, and Sweetwater River locales, respectively. In the absence of effective cowbird control programs, cowbird parasitism rates ranged as high as 80% at these San Diego County sites (Jones 1985), to 77% (Zembal 1986) and even 100% (Zembal *et al.* 1985) in the Prado Basin.

By 6 August 2004, 1,353 (542 males, 614 females, 197 juveniles) Brown-headed Cowbirds had been trapped and removed from vireo and flycatcher habitats in the Prado Basin. This signifies a 25% decrease from the 1,810 removed in year 2003 (Pike *et al*. 2003), and is, in fact, the lowest total trapped since 1995 (Table 2). In addition, it follows the 27% decrease in trapped cowbird numbers when comparing year 2003 totals with those of year 2002 (Pike *et al*. 2003). Nonetheless, rather than a reflection of diminished success at trapping cowbirds in the Basin, it is instead regarded as evidence that years of increasingly effective trapping has likely resulted in the attrition of local, and possibly resident, cowbird numbers. In previous years, declines of this magnitude in trapped cowbird numbers coincided with dramatic increases in the cowbird parasitism rate of vireos. For example, average declines in trapped numbers of 24% and 41%, respectively, in 1988 and 1993, accompanied a virtual doubling of the vireo parasitism rates (Table 2). Conversely, in 2003, a decrease of 658 fewer trapped cowbirds from year 2002 coincided with a drop to 4% in the parasitism rate (Pike *et al*. 2003). In 2004, an additional decrease of 457 trapped cowbirds from the previous year coincided with a parasitism rate of 5% (11 of 243). Together, these parasitism rates are the lowest recorded since management and study began in 1986 (Table 2). Further, given the significant decline in numbers of adult (after second-year) cowbird males documented during recent breeding seasons (Pike *et al*. 2003) combined with the recent closure of numerous dairies in the nearby Chino basin, the data suggest that the local breeding populations of Brown-headed Cowbirds is to some degree being depleted.

A maximum of 20 traps were operated at any one time within the Basin in 2004. The most effective traps, by far, were those placed within four dairy operations. Cumulatively, these four traps captured 1,040 cowbirds. This accounts for 77% of all cowbirds removed during the 2004 breeding season. By contrast, sixteen ‘field traps’ (*i.e*., those situated in or near riparian habitat in close proximity to nesting vireos) accounted for the removal of only 313 cowbirds. Interestingly, the most effective of the ‘field’ traps was actually the holding pen adjacent to the OCWD office where large numbers of cowbirds were temporarily housed. Between 26 April and 23 May, this trap inadvertently captured an additional 91 cowbirds. Since 1986, 62,837 cowbirds have been trapped or otherwise collected in the Prado Basin.

Off-season cowbird trapping at dairies was first begun in August 1996 with the maintenance of two traps by OCWD personnel. This was the first time that trapping was conducted during the winter season and in locales removed from riparian habitats. During the first two winters of operation, a minimum of 5,682 cowbirds was removed. Five to six dairy traps were operated during the fall and winter of 2003/2004 and accounted for the removal of 6,527 cowbirds. Although it is not currently known what percentage of the wintering cowbird population remains to breed locally, continued winter trapping and a continuation of the eight-year decline in the parasitism rate of vireo nests may provide a partial answer.

Among 45 banded cowbirds discovered in the Basin through 2001, only 8 were females and most were banded in Riverside and San Diego Counties from about 76 km to 161 km away. A female and second-year male were recaptured in the Basin 4 days after they were banded on the coast, 40 km distant. The long-range record was a female banded in Ridgefield, Washington and recaptured in the Basin 2 months later on 18 April 1999.

Although the rate of cowbird parasitism of vireo nests has ranged from 4% to 57% within the Prado Basin since 1986, the rate declined significantly after the commencement of the cowbird trapping effort (Chi-square 2 x 2 contingency table; statistic = 20.3 [Yates correction factor applied]; $p < 0.00001$). It was also determined in 1996 that the parasitism rate for vireo nests on the fringes of the Basin, well removed from cowbird traps, was 85%. Basin-wide, the combined parasitism rate for vireo nests was 35% in 1996 (The Nature Conservancy 1996).

Based upon the current study and data collected elsewhere (Pitelka and Koestner 1942; Mumford 1952; Barlow 1962; Salata 1983a,b, 1984, 1986, 1987a, 1987b; Jones 1985; United States Fish and Wildlife Service 1986), we conclude that the Prado Basin population of vireos would have been subjected to much higher rates of cowbird parasitism and reproductive failure in the absence of an effective management program (Hays 1986, 1987, 1988, 1989, 1990; Hays and Corey 1991, Pike and Hays 1992, The Nature Conservancy 1993a, 1993b, 1994, 1995, 1996, 1997; Pike and Hays 1998, 1999, and 2000; Pike *et al*. 2001,2002,2003). Other recent, published accounts of the efficacy of cowbird trapping programs as part of comprehensive vireo and flycatcher management efforts corroborate this fundamental assumption (Kus 1999, Whitfield and Sogge 1999, and Whitfield *et al.* 1999).

Cowbirds are extremely plentiful in the Prado Basin, compared to many other sites managed for endangered birds. The adjacent cattle, dairy, and agricultural operations are conducive of a huge cowbird population and cowbird management is a relatively recent tool. Consequently, trapping techniques have been refined and improved over the course of this study. Optimum trapping results apparently are achieved if: 1) the appropriate ratio of male and female cowbirds are used in the decoy population; 2) field traps are placed in open areas immediately adjacent to occupied vireo habitats; 3) traps are placed in favored proximate cowbird feeding and roosting sites; and 4) the traps are free from disturbance. First, a maximum yield of female cowbirds is achieved if females comprise the large majority of the decoy population. We recommend the use of 4 or 5 females and 1 or 2 vocal males in a modified Australian crow trap, measuring 6’ X 6’ X 8’. Secondly, field traps should be positioned in the open, near riparian habitat but not enveloped in it. Third, as noted previously, significant decreases in cowbird parasitism can apparently be achieved by trapping in locales where cowbirds congregate, such as horse stables or dairy operations. Lastly, the traps must remain as undisturbed as possible (Hays 1986).

In addition to an ongoing effort to improve the methodology of removing cowbirds from the Prado Basin, an effort to age to the degree possible the population of male cowbirds captured in the traps was begun in 1996 and continued in 2004. Per Pyle (1997), “second-year males” were distinguished by pale brown to grayish greater underwing coverts, which contrast greatly with the adjacent blacker feathers. By contrast, those males with blackish greater underwing coverts showing only moderate contrasts between adjacent feathers were identified as “after second-year” males (*i.e*., adults) (Pyle 1997). As the prebasic molt in juvenile Brown-headed Cowbirds can rarely be complete, males with wholly blackish greater underwing coverts but also showing brownish, contrasty feathers on the upperparts were excluded from the data base (Pyle 1997; *pers. obs*.). The aging of male cowbirds was once again terminated on 11 July after it had become apparent that feather molt had obscured previously observed (and readily apparent) plumage differences. In 2003, of the 314 male cowbirds that could be reliably aged, 12% (38) were judged to be adults and 88% (276) were judged to be second-year birds. In 2004, of 235 males, 11% (27) were judged to be adults and 89% (208) were judged to be second-year birds This compares with years 1996 and 1997, when the recorded percentages for adult males were 29% and 30%, respectively (The Nature Conservancy 1997). The data thus suggest that well over half as many adult male cowbirds are currently being found in the Basin during the vireo

Table 4. Least Bell's Vireo reproductive success and breeding biology data, Prado Basin Study Area, 2004.

A. Number of pairs 413
B. Number of breeding (nesting) pairs 366
C. Number of breeding pairs that were well-monitored
throughout the breeding season 142
D. Number of `known fledged young' (a)...767
E. Number of `known fledged young' produced by pairs
monitored throughout the breeding season 385
F. Average number of fledglings produced per breeding pair (<u>minimum</u>; D/B; = `productivity or breeding success') 2.1
G. Average number of fledglings produced by pairs monitored
throughout the breeding season (E/C). 2.7
H. Number of nests that were discovered 306
I. Number of nests that were regularly monitored or"tracked" 280
J. Number of "tracked" nests that
were successful [%= J/I x 100]...164 [59%]
K. Number of "tracked" nests that
were depredated [%= K/I x 100] . ... 97 [40%]
L. Number of "tracked" nests that were parasitized by cowbirds [%= L/243 x 100]{b} ....11 [5%]
M. Number of nests that failed as a result of reproductive failure{c}…………………………………...13
N. Average clutch size (N=195) ……...……………………………………..………………… 3.6
O. Number of cowbird eggs found in or near vireo nests...12
P. Number of cowbird nestlings removed from "tracked" nests 2
Q. Number of cowbird young fledged by vireos 0
R. Number of `manipulated', parasitized nests 6
S. Number of `successful, manipulated' nests [%=S/R x 100]...1 [17%]
T. Number of vireos fledged from `manipulated', parasitized nests...2

{a} This is minimum recruitment corresponding to Least Bell's Vireo Working Group definition of `known fledged young'.
{b} Thirty-seven of the 280 "tracked" nests were depredated before it could be determined if they had been parasitized. Therefore, these 37 nests were excluded from the calculation of the rate of cowbird parasitism.
{c} Three nests failed as a result of a fire in West Basin.

breeding season than occurred as recently as 1997. Notably, this span of time coincides with the advent of year-round trapping in dairy operations and, concurrently, the lowest percentages for cowbird parasitism rates since studies began (Table 2). It is believed that the continuation of this study in forthcoming years will yield additional useful data regarding the long-term impact of trapping efforts on the demographics and reproductivity of the cowbird population within the Prado Basin and environs.

At least 35% (97 of 280) of all well tracked nests were predated during the 2004 breeding season. As nest contents are not checked on a daily basis, it is not always possible to determine at what stage of the nesting cycle predation occurred. Nonetheless, it was evident that 31% (16 of 52) of the nests were predated during the incubation phase, while 69% (36 of 52) of the nests were predated during the nestling phase. As in previous years, most of the depredated nests found were intact and relatively undisturbed. Of 91 depredated nests, only 12 (13%) were on the ground or severely damaged, and another 8 (9%) remained suspended with some damage to the nest and/or branch support. The cumulative evidence suggests that snakes, avian predators, and, especially, small rodents (Salata 1987b), not large mammalian predators, are the primary nest predators in the Basin (Pike and Hays 2000).

Mice and rats are probable nest predators based upon droppings left in depredated nests, small neat holes in nest bottoms, and nests being domed over (Hays 1986; The Nature Conservancy 1993a, 1997; Pike and Hays 2000). Further, a mound of adult vireo feathers was found below a recently depredated nest which contained a rat dropping in 2001. In 2003, two additional depredated nests were found with rodent droppings on the rim. A lack of evidence precludes an understanding of the amount of nest depredation for which reptiles are responsible. However, five species of snakes have been found in or near occupied vireo habitats. Additionally, in 2000, a Southern Alligator Lizard (*Elgaria multicarinata*) was detected on a branch directly above a recently depredated, intact vireo nest (Pike and Hays 2000).

The Greater Roadrunner (*Geococcyx californianus*), American Crow (*Corvus brachyrhynchos*), and Western Scrub-Jay (*Aphelocoma californica*) have been considered as the likeliest avian predators of vireo nests and fledglings. Among these three, the Greater Roadrunner is suspected of being responsible for the largest number of depredated nests. Crows, although plentiful in the Basin, most frequently hunt in more open habitat and are rarely observed in the riparian vegetation at the low height of a vireo nest. Scrub jays, although fairly common along much of the Santa Ana River, are only rarely found within the Basin, and then only around the periphery. Roadrunners on the other hand, are common throughout the Basin and have been implicated in repeated depredation events (Hays 1988). In 1991, for example, a roadrunner was probably responsible for the disappearance of two fledglings from a vireo home range and was observed pursuing the third, and only remaining fledgling of that brood (Pike and Hays 1992).

Southwestern Willow Flycatcher. Five Southwestern Willow Flycatcher home ranges were detected in the Prado Basin in 2004. This follows the record nine flycatchers recorded during the 2003 season (Pike *et al*. 2003). The first two male Willow Flycatchers of the season were detected on the extremely early date of 30 April. The additional 3 male flycatchers were detected between 6 - 12 May. The last flycatcher of the season was noted on 7 September.

All of the male flycatchers detected were in home ranges that were occupied during the previous season. Breeding was confirmed in 3 of the home ranges and two of the breeding attempts were successful, resulting in a total of four fledglings. This was only the nineteenth and twentieth times that successful flycatcher breeding has been documented in the Basin.

All known flycatcher territories in the Basin have been in close proximity to water-filled creeks or channels. In addition, territories have usually consisted of overgrown clearings containing varying amounts of nettles with a few to many moderately tall, often dense, willows. Of the 4 nests found in 2004, one was placed in stinging nettles (*Urtica holosericea*), one in tamarisk (*Tamarix chinensis*), and 2 in black willow (*Salix gooddingii*). Overall, of the twenty-nine nests discovered from 1996-2004, 13 (45%) have been found in willows, with 8 (32%) of these being in arroyo willow (*Salix lasiolepsis*). Interestingly, a total of 9 (31%) nests have been found in tamarisk, despite the fact that tamarisk is relatively scarce in those areas that the flycatchers have bred. The heights of 29 nests have ranged from 0.61 m to 4.27 m, with an average of 1.86 m. Although flycatcher home ranges have been detected nearly throughout the surveyed portions of the Basin, successful breeding prior to 1991 had been detected just once in the North Basin. Since then, successful breeding has been documented 19 times, with all but one of these nestings occurring in two particular locales in the South Basin and one locale in the West Basin. In 2003, an additional flycatcher pair fledged two young along Mill Creek in the North Basin.

As occurred in a South Basin territory in 2003 (Pike *et al*. 2003), it was discovered that a flycatcher male had paired with two females simultaneously within a Mill Creek territory in 2004. Neither pairing successfully produced young. This represents only the third time that bigyny among Willow Flycatchers has been recorded in the Basin (The Nature Conservancy 1996). Polygyny has previously been documented as a breeding strategy occasionally utilized by this species (Prescott 1986a; Sedgwick and Knopf 1989).

Given that 5 territorial Southwestern Willow Flycatchers produced just four young in 2004, and only 40 fledged young were observed over the past 16 breeding seasons, the continued presence of this species in the Basin remains tenuous, at best.

Other Sensitive Avian Species. For the third consecutive year, no state-endangered Western Yellow-billed Cuckoo was found in the Prado Basin during 2004.

Yellow-billed Cuckoos have not been a primary focus of this study. They are extremely secretive and little has been learned of the size, behavior, or reproductive success of this small population. However, prior to 1995, the small local population appeared somewhat stable, with 3 (Zembal 1985) to 7 (Hays 1987) cuckoos being recorded annually. Then, in 1995, a widespread portion of the Basin was inundated in the spring and since then, only one or two cuckoos has usually been detected each year. Hopefully, the fact that, once again, no cuckoo was recorded in 2004 doesn't signify that the Western Yellow-billed Cuckoo has been extirpated from the Prado Basin and environs.

Several other species designated by the California Department of Fish and Game as "Bird Species of Special Concern" (Remsen 1978) bred or attempted to breed within the Prado Basin and environs. Included among these were the Least Bittern (*Ixobrychus exilis*), Burrowing Owl (*Speotyto cunicularia*), Cooper's Hawk (*Accipiter cooperi*), Yellow Warbler *(Dendroica petechia*), Yellow-breasted Chat (*Icteria virens*) and White-faced Ibis (*Plegadis chihi*). These and several other local breeders, including the Common Ground Dove (*Columbina passerina*), Marsh Wren (*Cistothorus palustris*), Swainson's Thrush (*Catharus ustulatus*), Blue Grosbeak (*Guiraca caerulea*), and Lazuli Bunting (*Passerina amoena*) have declined in southern California as a result of habitat destruction and brood parasitism by the Brown-headed Cowbird (Garrett and Dunn 1981).

Many of these species may benefit from the management program that has been focused upon the vireo and flycatcher. For example, Yellow Warblers breed in proximity to the vireos and were also quite scarce in the Basin in the early 1980s (Zembal *et al*.1985). It is believed that fewer than 15 pairs occurred in the Basin as recently as 1987. However, a 1992 survey revealed 75 -100 pairs, and the 2004 estimate was 500 pairs.

The vireo population itself has increased from 19 to a high of 413 pairs over the course of this study, giving hope that this species may some day be recovered in this watershed. However, there is no reason to believe that the vireo would continue to prosper without these management efforts and little hope for the many other imperiled species receiving no effort. Most other vireo populations in the state are declining, maintaining, or just moderately increasing. Other than Prado, only the populations on the Santa Margarita and San Luis Rey Rivers have sustained significant increases in size due to intensive management since the Least Bell's Vireo was Federally listed.

The management of wildlife in southern California is lagging far behind critical needs. Many environmental advocates are busy trying to get land set aside and as important as those efforts are, they are very slow because of the great complexities and land costs. In the meantime the effects of so many millions of people cohabiting is eroding habitat carrying capacity and long term viability to such a daily degree that the potential for recovery and persistence of a full, intact southern California wildlife heritage is in question. The Santa Ana River Watershed Program and other similar programs demonstrate that wildlife management works for some species. Whether or not it will work for entire ecosystems remains to be determined over a very long period of time. The longer it takes us to prioritize habitat and wildlife restoration to the degree necessary to get on with ecosystem reparation, the less likely are the chances for ultimate success.

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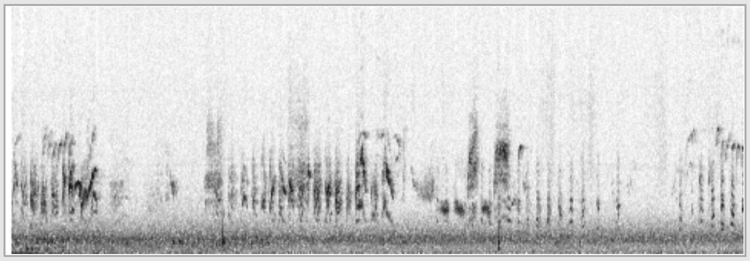
EXHIBIT C

XC106457 · Bell's Vireo · *Vireo bellii pusillus*

XC106457



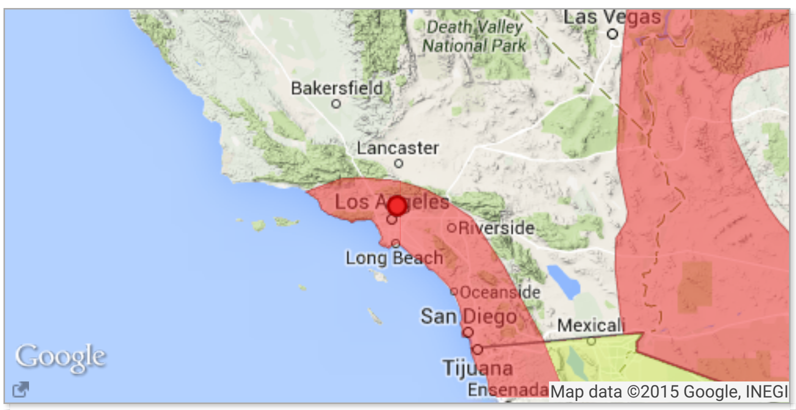
0:00 0:28

Bell's Vireo (Vireo bellii pusillus) · song
Lance A. M. Benner

Remarks from the Recordist

We saw the bird while I made the recording. Photographed. Highway noise is also audible. Western scrub-jay is also audible.

Location



Rating

Rate the quality of this recording (A is best, E worst):

A **B** C D E

Citation

Lance A. M. Benner, XC106457. Accessible at www.xeno-canto.org/106457.

License

Recording data

Recordist	Lance A. M. Benner
Date	2012-07-29
Time	7:58 PDT
Latitude	34.192
Longitude	-118.175
Location	Hahamongna Park, Pasadena, Los Angeles County, California
Country	United States
Elevation	340 m
Background	Bewick's Wren (*Thryomanes bewickii*) western scrub-jay

Actions

- Download audio file
- Download full-length sonogram
- Embed
- Discuss
- Edit
- Delete
- Add to Set

Audio file properties

Length	28 (s)
Sampling rate	44100 (Hz)
Bitrate of mp3	128000 (bps)
Channels	1 (mono)

Sound characteristics

Type	song
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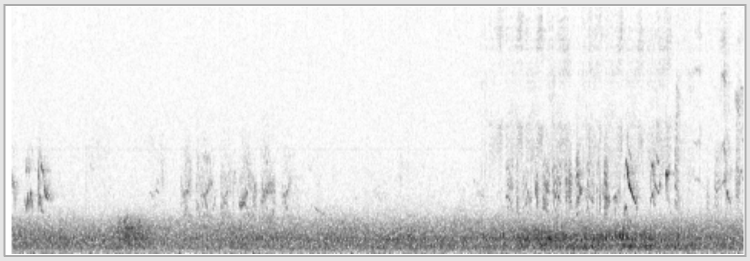
Speed	*Not specified*
Pitch	*Not specified*
Length	*Not specified*
Number of notes	*Not specified*
Variable	*Not specified*

XC106459 · Bell's Vireo · *Vireo bellii pusillus*

XC106459



0:00 0:20

Bell's Vireo (Vireo bellii pusillus) · song
Lance A. M. Benner

Recording data

Recordist	Lance A. M. Benner
Date	2012-07-29
Time	7:23 PDT
Latitude	34.192
Longitude	-118.175
Location	Hahamongna Park, Pasadena, Los Angeles County, California
Country	United States
Elevation	340 m
Background	Anna's Hummingbird (*Calypte anna*)

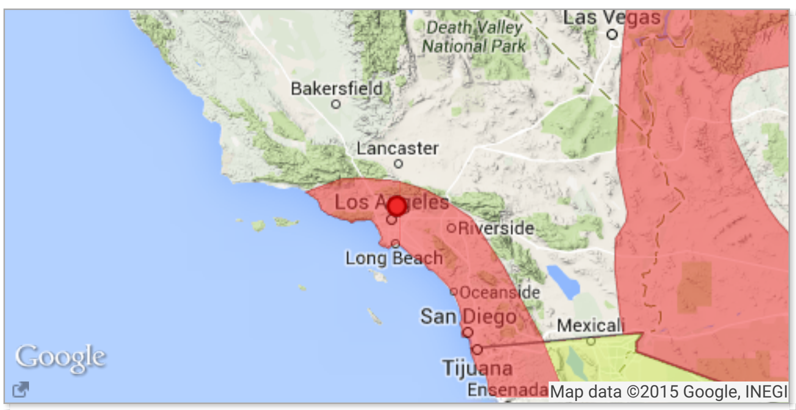
Actions

- Download audio file
- Download full-length sonogram
- Embed
- Discuss
- Edit
- Delete
- Add to Set

Remarks from the Recordist

We saw the bird while I made the recording. Photographed. Highway noise is also audible.

Location



Audio file properties

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Sampling rate	44100 (Hz)
Bitrate of mp3	128000 (bps)
Channels	1 (mono)

Rating

Rate the quality of this recording (A is best, E worst):

A B **C** D E

Sound characteristics

Type	song
Volume	*Not specified*
Speed	*Not specified*
Pitch	*Not specified*
Length	*Not specified*
Number of notes	*Not specified*
Variable	*Not specified*

Citation

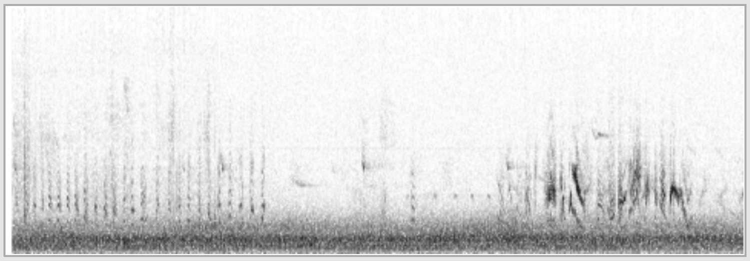
Lance A. M. Benner, XC106459. Accessible at www.xeno-canto.org/106459.

License

The Xeno-canto Foundation receives generous financial support from Naturalis Biodiversity Center

XC106462 · Bell's Vireo · *Vireo bellii pusillus*

XC106462



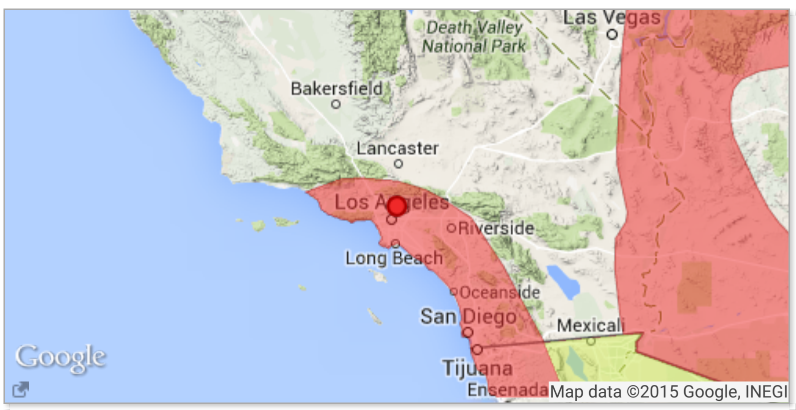
0:00 0:59

Bell's Vireo (Vireo bellii pusillus) · song
Lance A. M. Benner

Remarks from the Recordist

I saw the bird while I made the recording. Highway noise is also audible

Location



Rating

Rate the quality of this recording (A is best, E worst):

A **B** C D E

Citation

Lance A. M. Benner, XC106462. Accessible at www.xeno-canto.org/106462.

License

Recording data

Recordist	Lance A. M. Benner
Date	2012-07-29
Time	7:22 PDT
Latitude	34.192
Longitude	-118.175
Location	Hahamongna Park, Pasadena, Los Angeles County, California
Country	United States
Elevation	340 m
Background	California Towhee (*Melozone crissalis*) Wrentit (*Chamaea fasciata*)

Actions

- Download audio file
- Download full-length sonogram
- Embed
- Discuss
- Edit
- Delete
- Add to Set

Audio file properties

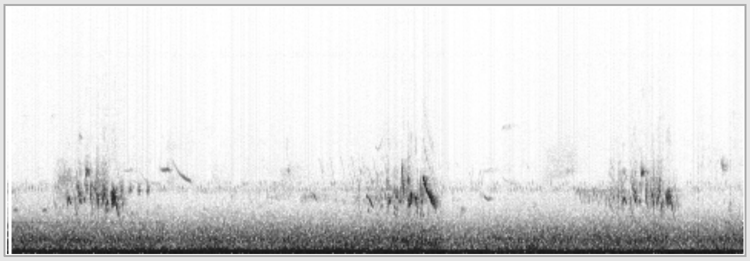
Length	59.6 (s)
Sampling rate	44100 (Hz)
Bitrate of mp3	128000 (bps)
Channels	1 (mono)

Sound characteristics

Type	song
Volume	*Not specified*
Speed	*Not specified*
Pitch	*Not specified*
Length	*Not specified*
Number of notes	*Not specified*
Variable	*Not specified*

XC132023 · Bell's Vireo · *Vireo bellii*

XC132023



0:00 0:28

Bell's Vireo (Vireo bellii) · song
Lance A. M. Benner

Recording data

Recordist	Lance A. M. Benner
Date	2013-05-01
Time	09:00
Latitude	34.192
Longitude	-118.175
Location	Hahamongna Park, Pasadena, Los Angeles County, California
Country	United States
Elevation	320 m
Background	Song Sparrow (*Melospiza melodia*) Bewick's Wren (*Thryomanes bewickii*) California Towhee (*Melozone crissalis*) Lesser Goldfinch (*Spinus psaltria*)

Remarks from the Recordist

Habitat: mulefat and willows; other low vegetation. The bird was about 200 meters east of the stables and a few tens of meters north of frisbee golf course hole 13. It was near a trail that crosses the wash. The bird moved while I was obtaining the recording--it got fainter, so I vignetted the end when the bird became difficult to hear. Recorded with a Marantz PMD670 equipped with a Sennheister ME67 shotgun microphone.

bird-seen:no

playback-used:no

Actions

- Download audio file
- Download full-length sonogram
- Embed
- Discuss
- Edit
- Delete
- Add to Set

Location

Audio file properties

Length	28.7 (s)
Sampling rate	48000 (Hz)
Bitrate of mp3	128000 (bps)
Channels	1 (mono)

Rating

Rate the quality of this recording (A is best, E worst):

A **B** C D E

Sound characteristics

Type	song
Volume	*Not specified*
Speed	*Not specified*
Pitch	*Not specified*
Length	*Not specified*
Number of notes	*Not specified*
Variable	*Not specified*

Citation

Lance A. M. Benner, XC132023. Accessible at www.xeno-canto.org/132023.

License

XC134888 · Bell's Vireo · *Vireo bellii pusillus*

XC134888

0:00 0:43

Bell's Vireo (Vireo bellii pusillus) · song
Lance A. M. Benner

Recording data

Recordist	Lance A. M. Benner
Date	2013-05-24
Time	10:24
Latitude	34.192
Longitude	-118.175
Location	Hahamongna Park, Pasadena, Los Angeles County, California
Country	United States
Elevation	320 m
Background	Song Sparrow (*Melospiza melodia*) Lesser Goldfinch (*Spinus psaltria*) Common Yellowthroat (*Geothlypis trichas*)

Remarks from the Recordist

I amplified the recording by a factor of four to make the vireo's songs more audible. There's also a lot of background noise from I-210, which is only a few hundred meters to the south and west. The bird was in an area with willows and thick undergrowth. Photographed. It often sang from near the tops of trees.

Recorded with an Olympus LS-10S equipped with a Sennheiser MKE-400 shotgun microphone.

bird-seen:yes

playback-used:no

Actions

- Download audio file
- Download full-length sonogram
- Embed
- Discuss
- Edit
- Delete
- Add to Set

Location

Audio file properties

Length	43.9 (s)
Sampling rate	44100 (Hz)
Bitrate of mp3	128000 (bps)
Channels	2 (stereo)

Rating

Rate the quality of this recording (A is best, E worst):

A B **C** D E

Sound characteristics

Type	song
Volume	*Not specified*
Speed	*Not specified*
Pitch	*Not specified*
Length	*Not specified*
Number of notes	*Not specified*
Variable	*Not specified*

Related Forum Topics

The following forum topics may have additional information or discussions about this recording:

6272. Confusion in subspecies (XC134888)

Citation

Lance A. M. Benner, XC134888. Accessible at www.xeno-canto.org/134888.

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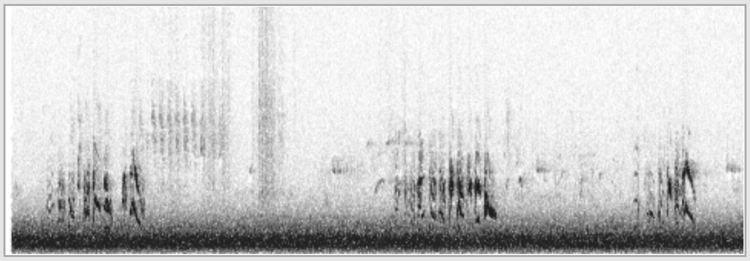
简体中文* 繁體中文

* Only species names are translated

XC188496 · Bell's Vireo · *Vireo bellii pusillus*

XC188496



0:00 0:44

Bell's Vireo (Vireo bellii pusillus) · song
Lance A. M. Benner

Recording data

Recordist	Lance A. M. Benner
Date	2014-07-24
Time	08:16
Latitude	34.192
Longitude	-118.175
Location	Hahamongna Park, Pasadena, Los Angeles County, California
Country	United States
Elevation	320 m
Background	California Towhee (*Melozone crissalis*) Bewick's Wren (*Thryomanes bewickii*) Anna's Hummingbird (*Calypte anna*) House Finch (*Haemorhous mexicanus*) Black-headed Grosbeak (*Pheucticus melanocephalus*) Spotted Towhee (*Pipilo maculatus*)

Remarks from the Recordist

Natural vocalizations in an area with extensive mule fat, non-native eucalyptus, cottonwoods, and other thick and mostly low vegetation.

Recorded less than 1 km from a major highway, which is audible in the background.

The bird was foraging in a eucalyptus during the recording at a distance of roughy 5 meters.

Equipment: Olympus LS-10 with a Telinga 22 inch paraboloid and a Sennheiser ME62 microphone.

Modifications to the file: cropped at the beginning and end.

Also photographed extensively with a 400 mm lens and a Canon 70D DSLR.

Uploaded primarily to document an endangered species in a location where the habitat is threatened with destruction.

bird-seen:yes

playback-used:no

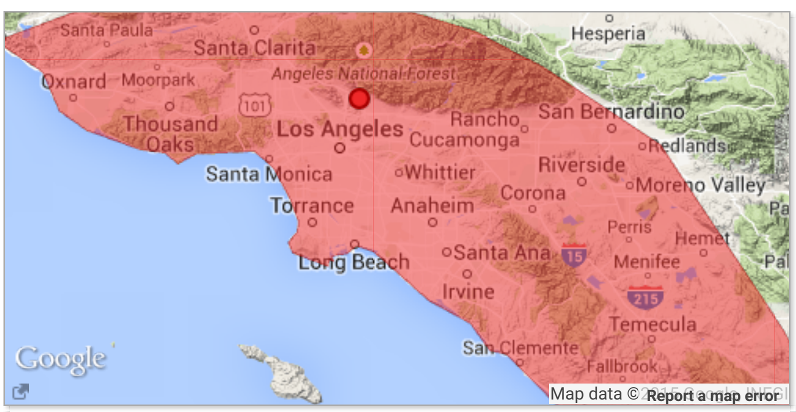
Actions

- Download audio file
- Download full-length sonogram
- Embed
- Discuss
- Edit
- Delete
- Add to Set

Audio file properties

Length	44.8 (s)
Sampling rate	44100 (Hz)
Bitrate of mp3	128000 (bps)
Channels	2 (stereo)

Location



Sound characteristics

Type	song
Volume	Not specified
Speed	Not specified
Pitch	Not specified
Length	Not specified
Number of notes	Not specified
Variable	Not specified

Rating

Rate the quality of this recording (A is best, E worst):

A B C D E

Citation

Lance A. M. Benner, XC188496. Accessible at www.xeno-canto.org/188496.

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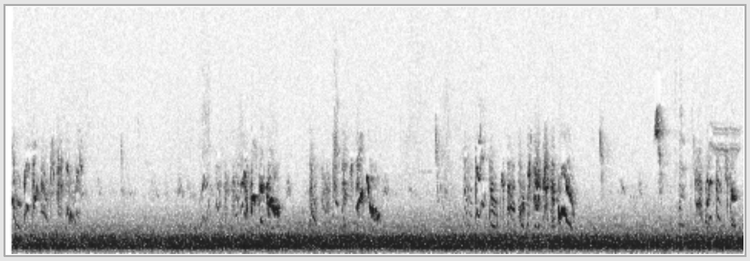
XC188497 · Bell's Vireo · *Vireo bellii pusillus*

XC188497



0:00 0:16

Bell's Vireo (Vireo bellii pusillus) · song
Lance A. M. Benner

Remarks from the Recordist

Natural vocalizations in an area with extensive mule fat, non-native eucalyptus, cottonwoods, and other thick and mostly low vegetation. Same bird as in **XC188496**.

Recorded less than 1 km from a major highway, which is audible in the background.

The bird was foraging in a eucalyptus during the recording at a distance of roughly 5 meters.

Equipment: Olympus LS-10 with a Telinga 22 inch paraboloid and a Sennheiser ME62 microphone.

Modifications to the file: None.

Also photographed extensively with a 400 mm lens and a Canon 70D DSLR.

Uploaded primarily to document an endangered species in a location where the habitat is threatened with destruction.

bird-seen:yes

playback-used:no

Location

Rating

Rate the quality of this recording (A is best, E worst):

A B C D E

Citation

Lance A. M. Benner, XC188497. Accessible at www.xeno-canto.org/188497.

License

Recording data

Recordist	Lance A. M. Benner
Date	2014-07-24
Time	08:12
Latitude	34.192
Longitude	-118.175
Location	Hahamongna Park, Pasadena, Los Angeles County, California
Country	United States
Elevation	320 m
Background	House Finch (*Haemorhous mexicanus*) Anna's Hummingbird (*Calypte anna*)

Actions

- Download audio file
- Download full-length sonogram
- Embed
- Discuss
- Edit
- Delete
- Add to Set

Audio file properties

Length	16.8 (s)
Sampling rate	44100 (Hz)
Bitrate of mp3	128000 (bps)
Channels	2 (stereo)

Sound characteristics

Type	song
Volume	*Not specified*
Speed	*Not specified*
Pitch	*Not specified*
Length	*Not specified*
Number of notes	*Not specified*
Variable	*Not specified*

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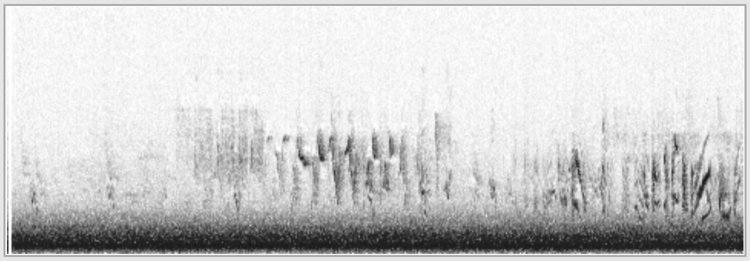
* Only species names are translated

XC188498 · Bell's Vireo · *Vireo bellii Pusillus*

XC188498



0:00 0:29

Bell's Vireo (Vireo bellii Pusillus) · song
Lance A. M. Benner

Recording data

Recordist	Lance A. M. Benner
Date	2014-07-24
Time	07:52
Latitude	34.192
Longitude	-118.175
Location	Hahamongna Park, Pasadena, Los Angeles County, California
Country	United States
Elevation	320 m
Background	American Yellow Warbler (*Setophaga aestiva*) House Finch (*Haemorhous mexicanus*) Anna's Hummingbird (*Calypte anna*) California Towhee (*Melozone crissalis*)

Remarks from the Recordist

Natural vocalizations in an area with extensive mule fat, non-native eucalyptus, cottonwoods, and other thick and mostly low vegetation.

Recorded less than 1 km from a major highway, which is audible in the background.

Equipment: Olympus LS-10 with a Telinga 22 inch paraboloid and a Sennheiser ME62 microphone.

Modifications to the file: none.

Also photographed extensively with a 400 mm lens and a Canon 70D DSLR.

Uploaded primarily to document an endangered species in a location where the habitat is threatened with destruction.

bird-seen:yes

playback-used:no

Actions

- Download audio file
- Download full-length sonogram
- Embed
- Discuss
- Edit
- Delete
- Add to Set

Location

Audio file properties

Length	29.6 (s)
Sampling rate	48000 (Hz)
Bitrate of mp3	128000 (bps)
Channels	2 (stereo)

Sound characteristics

Type	song
Volume	*Not specified*
Speed	*Not specified*
Pitch	*Not specified*
Length	*Not specified*
Number of notes	*Not specified*
Variable	*Not specified*

Rating

Rate the quality of this recording (A is best, E worst):

A B C D E

Citation

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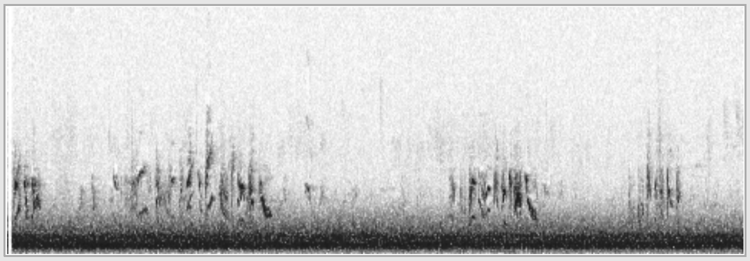
* Only species names are translated

XC188502 · Bell's Vireo · *Vireo bellii pusillus*

XC188502



0:00 0:35

Bell's Vireo (Vireo bellii pusillus) · song
Lance A. M. Benner

Recording data

Recordist	Lance A. M. Benner
Date	2014-07-24
Time	08:07
Latitude	34.192
Longitude	-118.175
Location	Hahamongna Park, Pasadena, Los Angeles County, California
Country	United States
Elevation	320 m
Background	House Finch (*Haemorhous mexicanus*) Black-headed Grosbeak (*Pheucticus melanocephalus*) American Yellow Warbler (*Setophaga aestiva*) Anna's Hummingbird (*Calypte anna*)

Remarks from the Recordist

Natural vocalizations in an area with extensive mule fat, non-native eucalyptus, cottonwoods, and other thick and mostly low vegetation.

Recorded less than 1 km from a major highway, which is audible in the background.

Equipment: Olympus LS-10 with a Telinga 22 inch paraboloid and a Sennheiser ME62 microphone.

Modifications to the file: None.

Also photographed extensively with a 400 mm lens and a Canon 70D DSLR.

Uploaded primarily to document an endangered species in a location where the habitat is threatened with destruction.

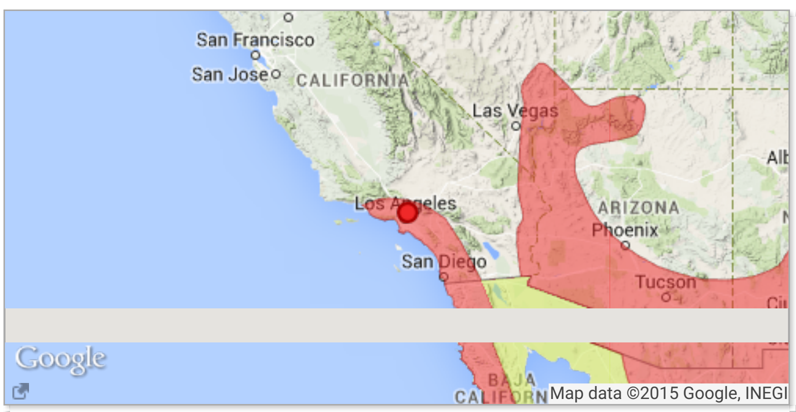
bird-seen:yes

playback-used:no

Actions

- Download audio file
- Download full-length sonogram
- Embed
- Discuss
- Edit
- Delete
- Add to Set

Location



Audio file properties

Length	35.2 (s)
Sampling rate	48000 (Hz)
Bitrate of mp3	128000 (bps)
Channels	2 (stereo)

Sound characteristics

Type	song
Volume	*Not specified*
Speed	*Not specified*
Pitch	*Not specified*
Length	*Not specified*
Number of notes	*Not specified*
Variable	*Not specified*

Rating

Rate the quality of this recording (A is best, E worst):

A B C D E

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简体中文* 繁體中文

* Only species names are translated

EXHIBIT D

California Bird Species of Special Concern

A Ranked Assessment of Species, Subspecies, and Distinct Populations of Birds of Immediate Conservation Concern in California

W. David Shuford and Thomas Gardali, Editors

With the Assistance of the Project Manager
Lyann A. Comrack

In Collaboration with the Bird Species of Special Concern Technical Advisory Committee
Edward C. Beedy, Bruce E. Deuel, Richard A. Erickson, Sam D. Fitton, Kimball L. Garrett, Kevin Hunting, Tim Manolis, Michael A. Patten, W. David Shuford, John Sterling, Philip Unitt, Brian J. Walton

Studies of Western Birds No. 1

Published by

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Camarillo, California

and

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Sacramento, California

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Studies of Western Birds, a monograph series of Western Field Ornithologists, publishes original scholarly contributions to field ornithology from both professionals and amateurs that are too long for inclusion in *Western Birds*. The region of interest is the Rocky Mountain and Pacific states and provinces, including Alaska and Hawaii, western Texas, northwestern Mexico, and the northeastern Pacific Ocean. Subject matter may include studies of distribution and abundance, population dynamics, other aspects of ecology, geographic variation, systematics, life history, migration, behavior, and conservation. Submit manuscripts to the editor, Kenneth P. Able, Bob's Creek Ranch, 535-000 Little Valley Rd., McArthur, CA 96056; we highly recommend discussing potential submissions with the editor prior to manuscript preparation (email: kenable@hughes.net).

Studies of Western Birds No. 1, issued 4 February 2008, is published jointly by:

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Editors: W. David Shuford and Thomas Gardali.

Project manager: Lyann A. Comrack.

Bird Species of Special Concern Technical Advisory Committee: Edward C. Beedy, Bruce E. Deuel, Richard A. Erickson, Sam D. Fitton, Kimball L. Garrett, Kevin Hunting, Tim Manolis, Michael A. Patten, W. David Shuford, John Sterling, Philip Unitt, and Brian J. Walton.

Map review team: Lyann A. Comrack, Richard A. Erickson, Thomas Gardali, Kevin Hunting, W. David Shuford, and John Sterling.

Principal cartographers: Kristi Fien, Nicholas Hansen, and Kiffanie Stahle.

Copy editor: David M. Compton.

Cover artist: Keith Hansen.

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Monograph designer and typographer: Timothy W. Brittain.

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For individual species accounts, please first cite the account author(s) and the species account name followed by information on the full volume.

Contents

Foreword

The publication of *Bird Species of Special Concern: A Ranked Assessment of Species, Subspecies, and Distinct Populations of Birds of Immediate Conservation Concern in California* marks the culmination of a synergistic collaboration among California's top field and museum ornithologists, wildlife biologists, and conservationists to produce a definitive treatment of the status of declining and vulnerable bird populations in California. Since 1978, when the Western Field Ornithologists' J. V. Remsen Jr. prepared the first report on bird species of special concern for the Department of Fish and Game, information on the state's bird populations has expanded exponentially. The current project grew out of recognition by the Department and its partners of the pressing need for a rigorous and comprehensive evaluation of this recent information. We offer this volume as a product of success in achieving that vision and believe it sets a new standard for assessing the status of bird populations in California.

Through commitment to technical excellence, this volume ties together the threads of bird conservation in California by capturing elements of the most important current bird conservation initiatives. From the habitat-based California Partners in Flight bird conservation plans to the fundamental baseline bird population studies conducted by the Department and its partners, *Bird Species of Special Concern* combines the best of our collective knowledge and stands as a testament to the enormous potential of collaboration.

In producing this monograph, the Department worked closely with PRBO Conservation Science and Western Field Ornithologists. This project would not have been completed, however, without the extraordinary dedication and participation of California's ornithological and birding communities.

The Department remains committed to a continued investment in population assessment and adaptive management as tools for effective conservation of the state's bird populations. *Bird Species of Special Concern* will focus these efforts on the varied, ongoing challenges facing at-risk birds and their habitats.

John McCamman
Acting Director
California Department of
Fish and Game

Western Field Ornithologists is proud to unveil the first volume of its new monograph series, *Studies of Western Birds*, particularly with a work dedicated to the conservation of at-risk birds within California. We hope that this will stimulate other comparable works on at-risk birds elsewhere or additional lengthy treatises on any aspect of field ornithology within the region of interest of the organization—the Rocky Mountain and Pacific states and provinces, including Alaska and Hawaii, western Texas, northwestern Mexico, and the northeastern Pacific Ocean. Western Field Ornithologists strives for excellence in its publications. Of primary concern is the advancement of the long tradition of field ornithology in this region, both for pursuit of scientific understanding and to promote conservation of the region's varied and stimulating avifauna. Such efforts, including the present publication, are possible only with the participation of our membership, readership, and many partners. We invite you to join us and we seek your insights and help to further these goals.

David Krueper
President
Western Field Ornithologists

Preface

The system used in this volume to rank the conservation needs of at-risk birds—*Bird Species of Special Concern*—in California is new for the state but builds on an impressive foundation of prior ranking schemes developed elsewhere in North America and the world. The diversity of such systems reflects not only the varying needs and scales for which they were devised but also the difficulty of crafting a system that will be universally accepted for any particular purpose. Just as gut-level impressions of what constitutes an at-risk bird in need of immediate conservation action can vary widely among knowledgeable biologists, so too can opinions of what elements are desirable in an objective ranking scheme meant to reduce the biases inherent in a purely subjective assessment of conservation need and priority. The present system, unlike most, supports the rankings by the inclusion of thorough species accounts for all birds on the ranked special concern list. Although the decision to include these accounts greatly lengthened the time required to prepare this document, we judge the extra effort well worth it, both to document the state of, and limits to, current knowledge relevant to the conservation of at-risk birds and to provide guidance in management, research, and monitoring that will enable effective actions beneficial to these birds and their habitats.

Serving as the technical editors of this volume has been a humbling experience on many levels. The knowledge contributed to this process by a technical advisory committee of our peers, dedicated managers and technical experts at California Department of Fish and Game, authors of species accounts, and a wide array of field, quantitative, and conservation biologists who provided unpublished information, insights, and thoughtful reviews has been deep and impressive, strengthening this document far beyond what our own capabilities would allow. Conversely, we have been struck by how limited our collective knowledge is for many at-risk birds in California, reflecting their biological characteristics—such as patchy distributions, occurrence in low densities, naturally fluctuating populations, or cryptic behaviors—and the limited resources allocated for their study or conservation.

During the course of the preparation of this document, climate change has become a household word and the dominant conservation issue discussed in the media. Although the present volume acknowledges the importance of the long-term effects of climate change on birds, it focuses rather on the short- and medium-term threats to birds, particularly habitat loss and degradation as the direct result of human endeavors. Such activities will continue to have readily visible and cumulatively enormous effects on many bird populations. To varying degrees, the predicted indirect effects of progressive climate change will further complicate and exacerbate matters.

Despite declining populations and continuing threats to many at-risk birds, there is cause for cautious optimism in the many new habitat- or taxonomic-based conservation initiatives for birds that have begun or expanded their reach in the last decade. In concert with these efforts, lists of at-risk species can be powerful drivers of conservation, especially when restoration and management measures take a species-to-ecosystem approach, the one typically championed by these newer initiatives. We hope this volume will support and inspire bold measures of conservation for at-risk birds and for others now less threatened so they will not one day too receive the dodoesque distinction of being of special concern in California.

W. David Shuford
Thomas Gardali
Inverness, California

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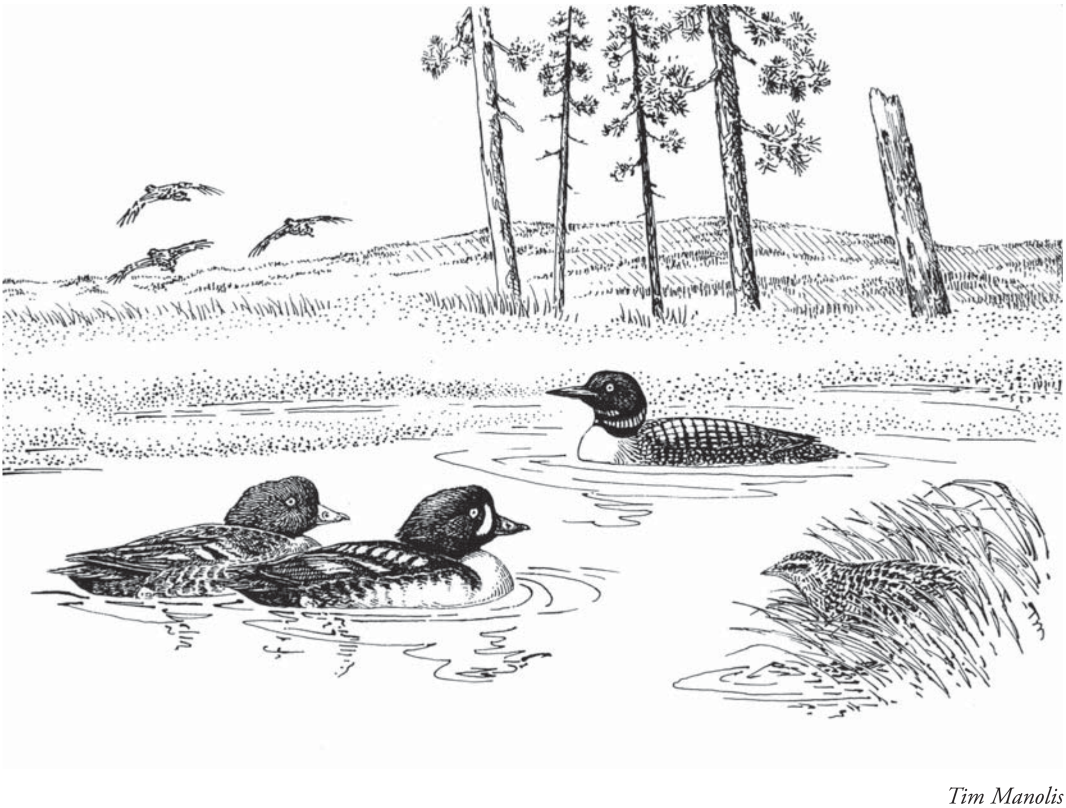
Acronyms and Abbreviations

AB	American Birds
AFN	Audubon Field Notes
AI scores	area importance scores
AOU	American Ornithologists' Union
BBA	breeding bird atlas
BBS	Breeding Bird Survey
BCR	Bird Conservation Region
BLM	Bureau of Land Management
BSSC	Bird Species of Special Concern
CalPIF	California Partners in Flight
CAS	California Academy of Sciences
CBC	Christmas Bird Count
CBRC	California Bird Records Committee
CDFG	California Department of Fish and Game
CEQA	California Environmental Quality Act
CWHR	California Wildlife Habitat Relationships
EN	percentage of entire range within California (ranking criterion)
HCP	Habitat Conservation Plan
IPCC	Intergovernmental Panel on Climate Change
GIS	Geographic Information System
LACM	Natural History Museum of Los Angeles County
MAPS	Monitoring Avian Productivity and Survivorship
MCZ	Museum of Comparative Zoology (Harvard University)
MPCR	Middle Pacific Coast (Northern California) region of NAB
MVZ	Museum of Vertebrate Zoology
NAB	North American Birds
NABCI	North American Bird Conservation Initiative
NASFN	National Audubon Society Field Notes
NCCP	Natural Community Conservation Planning (act/program)
NEPA	National Environmental Policy Act
NWR	National Wildlife Refuge
PC	population concentration (ranking criterion)
PIF	Partners in Flight
PRBO	PRBO Conservation Science (formerly Point Reyes Bird Observatory)
PS	population size (ranking criterion)
PT	population trend (ranking criterion)
RS	range size (ranking criterion)
RT	range trend (ranking criterion)
SBMNH	Santa Barbara Museum of Natural History
SDNHM	San Diego Natural History Museum
SPCR	Southern Pacific Coast (Southern California) region of NAB
THR	impact of threats (ranking criterion)
UCLA	University of California, Los Angeles
USDC	U.S. Department of Commerce
USDI	U.S. Department of Interior
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USNM	U.S. National Museum (Smithsonian National Museum of Natural History)
WA	(state) Wildlife Area
WFVZ	Western Foundation of Vertebrate Zoology

I

OVERVIEW

W. David Shuford and Thomas Gardali



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Abstract

To halt or reverse population declines of at-risk native birds, California Department of Fish and Game initiated a process to set conservation and research priorities by revising the initial California Bird Species of Special Concern document (Remsen 1978), which subjectively described declining or vulnerable species. Revision was needed to identify currently at-risk taxa that may warrant listing under the California Endangered Species Act as threatened or endangered if remedial actions are not taken. Working with an advisory committee, we considered 283 bird taxa as nominees for the special concern list, using published data, expert opinion, public input, and national and regional lists of priority or focal species for major conservation initiatives. Nominated taxa were scored for seven objective criteria: population size, range size, population trend, range trend, population concentration, percent of range or population within California, and threats. The Bird Species of Special Concern list was then prepared by evaluating taxa and assigning those qualifying to three levels of priority using both linear and categorical ranking schemes. This ranking process is dynamic, as it allows for scores to be updated as new data become available. The resulting prioritized list consists of 39 species and 24 subspecies or geographic populations. Although unranked, an additional 11 taxa also qualified either because they have been extirpated from the state or are listed as federally, but not state, threatened or endangered. We also developed a California Bird Responsibility List, intended as a tool for longer-term conservation planning, consisting of 125 taxa that qualified because all or a very high proportion of their global populations occur in the state. A taxon's co-occurrence on the special concern and responsibility lists indicates a particularly high level of conservation concern in California. Priority should also be raised for special concern taxa identified as globally vulnerable and for restoration, research, and monitoring projects that are habitat based and benefit multiple species.

Species accounts document the numerical scores for the seven ranking criteria and describe the status, population trends, ecological requirements, threats, and management, research, and monitoring needs for each special concern taxon. Habitats with high numbers of special concern taxa are wetlands, scrublands, grasslands, and riparian forests—all habitats with the highest rates of loss in California. Paralleling continental and worldwide trends, habitat loss and degradation is the greatest threat to California's at-risk birds. Geographic areas with the highest numbers of special concern taxa are southern and central coastal California, where pressures from high and expanding human populations are expected to intensify in coming decades. Currently, most special concern taxa are poorly monitored. Conservation and research efforts should focus on the identification of factors responsible for population declines and adaptive management actions, habitat acquisition, and stewardship that will reverse these declines. The special concern list, if used synergistically with laws, regulations, state policies, and various state or national conservation initiatives, will form an important conservation tool to protect, aid in recovery, and forestall listing actions for the state's at-risk birds. Success will be enhanced if conservation measures are intensified before populations decline further and if they emphasize voluntary rather than regulatory measures.

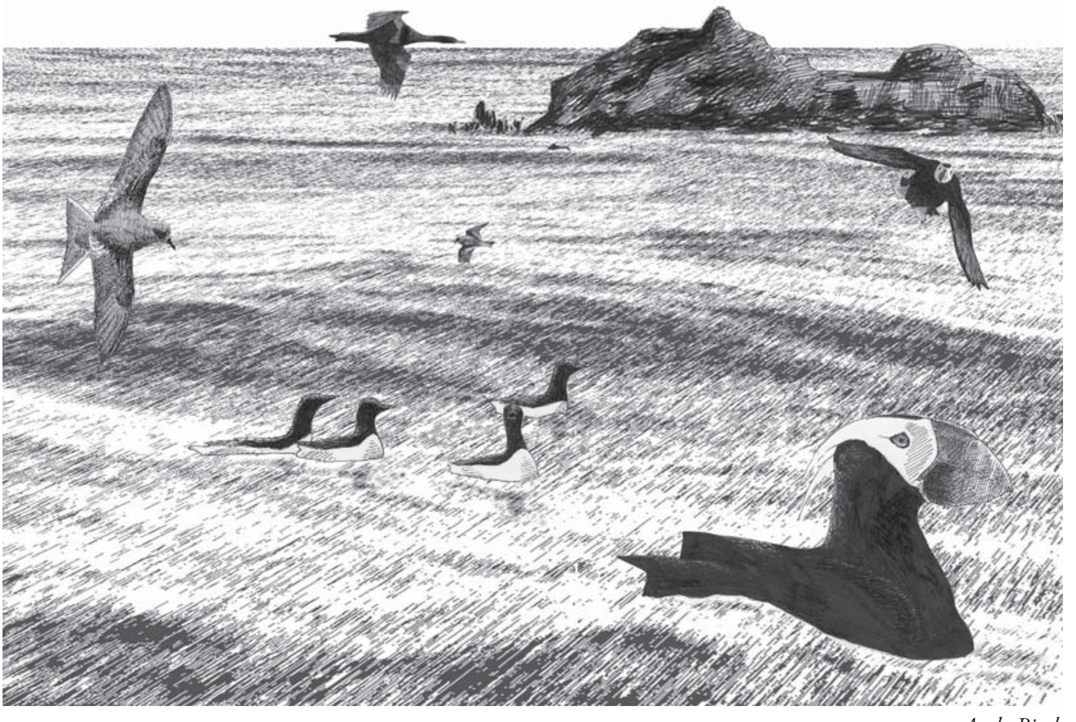
Recommendations for future improvement of the process include frequent review and update of the list, an online database to track new information, refinement of monitoring protocols and research needs, education of stakeholders of the need to protect at-risk birds, and coordination of monitoring efforts and conservation actions with other multispecies and habitat conservation initiatives.

Resumen

Para detener o revertir la disminución de poblaciones de aves nativas en peligro, el departamento de Pesca y Caza de California inició el proceso de establecer prioridades de conservación e investigación revisando la lista preliminar de Especies de Preocupación Especial de California (Remsen 1978) que, de manera subjetiva, describe especies en disminución o situación vulnerable. Se necesitó una revisión para identificar grupos taxonómicos que están actualmente en peligro y que justifican su inclusión en el Acta de Especies en Peligro de California, por estar amenazados o en peligro si no se toman las acciones necesarias. Trabajando con un comité de consulta, se consideraron 283 grupos taxonómicos de aves como candidatos para la lista de preocupación especial. Para tal consideración se usaron datos publicados, opinión de expertos, opinión del público y listas nacionales y regionales de especies de prioridad o especies focales para las iniciativas de conservación más importantes. Los grupos taxonómicos candidatos fueron evaluados utilizando siete criterios objetivos: tamaño de la población, rango de distribución, tendencia poblacional, tendencia de distribución, concentración poblacional, porcentaje del rango de distribución o de la población que ocurre en California y amenazas. La lista de Especies de Preocupación Especial fue entonces elaborada evaluando grupos taxonómicos y asignando los que calificaban a tres niveles de prioridad, utilizando esquemas de clasificación lineal y categórica. Este proceso de clasificación es dinámico, pues permite actualizar las evaluaciones a medida que nueva información se hace disponible. La lista de prioridades incluye 39 especies y 24 subespecies o poblaciones geográficas. A pesar de no haber sido evaluados, 11 grupos taxonómicos también calificaron, ya sea porque fueron extirpados del Estado o por estar listados por el Gobierno Federal, pero no por el Estado, como amenazados o en peligro. También se desarrolló la Lista de Aves de Responsabilidad de California con la intención de que sea una herramienta de largo alcance que se emplee en planeamiento de conservación. Consiste de 125 grupos taxonómicos que calificaron porque toda o una gran parte de su población global ocurre en el Estado. La co-ocurrencia de un grupo taxonómico en las Listas de Preocupación Especial y de Responsabilidad indica un nivel particularmente alto de preocupación sobre su conservación en California. También debe otorgarse prioridad a grupos taxonómicos de preocupación especial identificados como globalmente vulnerables y para proyectos de restauración, investigación y monitoreo que son orientados al hábitat y que beneficiarían a múltiples especies.

La narrativa de cada especie documenta la evaluación numérica de los siete criterios de clasificación y describe el estado de conservación, tendencia poblacional, requerimientos ecológicos, amenazas y el manejo de las investigaciones, además de las necesidades de monitoreo para cada uno de los grupos taxonómicos de preocupación especial. Los hábitats con elevado número de grupos taxonómicos de preocupación especial incluyen humedales, matorrales, pastizales, y bosques riparios—todos hábitats con rápidas tazas de pérdida en California. Comparable a las tendencias en el continente y en el mundo, la pérdida y degradación de hábitat son las mayores amenazas para las aves en peligro de California. Las áreas geográficas con mayor número de especies de preocupación especial se encuentran en las zonas sur y centro de la costa de California, donde se espera que la presión de la alta y creciente población humana se intensifique en las décadas futuras. Actualmente, los grupos taxonómicos de mayor preocupación están siendo pobremente monitoreados. Los esfuerzos de conservación e investigación deberían enfocarse en la identificación de los factores responsables de la disminución poblacional y en acciones de manejo adaptativo, compra de hábitat, y actividades que puedan revertir estas disminuciones. La lista de preocupación especial utilizada de manera conjunta con leyes, reglamentos, políticas de estado y diferentes iniciativas de conservación de nivel estatal y nacional, representa una herramienta importante de conservación para proteger, ayudar en la recuperación y anticipar acciones para listar las aves en peligro dentro del Estado. El éxito se verá enriquecido si las medidas de conservación se intensifican antes de que las poblaciones continúen declinando y si se enfatizan medidas de carácter voluntario en vez de reguladoras.

Las recomendaciones para futuras mejoras en este proceso incluyen una frecuente revisión y actualización de la lista, una base de datos 'en-línea' que permita monitorear nueva información, el refinamiento de los protocolos de monitoreo y requerimientos de investigación, la educación de las personas involucradas en la necesidad de proteger especies en peligro y la coordinación de los esfuerzos de monitoreo y acciones de conservación con otras iniciativas que incluyan la conservación de múltiples especies y de hábitats.



Andy Birch

Introduction

In 1978, California Department of Fish and Game (CDFG) published an annotated list of Bird Species of Special Concern (BSSC). This list summarized the status and range, causes of decline, potential threats, and management needs for 61 taxa (59 species, 2 subspecies) of California birds that had experienced severe population declines or were otherwise vulnerable to future extinction within the state (Remsen 1978). Species were subjectively placed on the list and assigned to three categories based on the perceived urgency of concern for their populations. Although inclusion on the special concern list did not confer legal status equivalent to taxa listed under the California Endangered Species Act, categorization of species was intended to provide guidance in setting priorities for expenditure of research funds, acquisition of habitat, and other management actions. In subsequent years, taxa were periodically added to, or removed from, the list, but no formal review was made of the state's at-risk birds. The last update of the Bird Species of Special Concern list, in 1992, containing 73 taxa (60 species, 13 subspecies), also was subjective, was not annotated, and did not categorize taxa by their level of concern (CDFG 1992).

Californians must overcome daunting problems to maintain the state's superlative biodiversity in the face of severe and ongoing habitat loss and degradation, which has led to population declines of many native species. To meet this challenge, in 1998 CDFG initiated a process to set conservation, research, management, and funding priorities for native birds by forming a Bird Species of Special Concern Technical Advisory Committee, composed of some of California's top field ornithologists, taxonomists, resource agency managers, and conservationists. The charge of the advisory committee was to guide CDFG in revising the original special concern document (Remsen 1978) by developing a scientifically defensible and repeatable method to set objective standards for inclusion of birds on the list, for assigning them to different levels of conservation priority, and for forming the basis for assigning them research priority. Revision was needed to incorporate over 20 years of data to enable identification of currently declining or vulnerable birds that may warrant listing as state threatened or endangered if present trends continue. As a regulatory tool, the special concern list is intended to guide state, federal, and local governments in defining the "sensitive" species under the California Environmental Quality Act, for which analysis of project impacts is required. The special concern list is also meant to stimulate further research on the status, distribution, ecology, and systematics of California's at-risk birds to better aid in their conservation.

The revision of the Bird Species of Special Concern list coincided with a period of rapidly increasing concern for global-to-local loss of biological diversity (e.g., Sisk et al. 1994, Poiani et al. 2000) and with the blossoming of objective schemes to prioritize conservation efforts (e.g., Millsap et al. 1990; IUCN 1994, 2001; Carter et al. 2000; Brown et al. 2000, 2001; Kushlan et al. 2002). The present document joins CDFG's recent special concern reports for amphibians and reptiles (Jennings and Hayes 1994), fishes (Moyle et al. 1995), and mammals (a revision of Williams 1986 is currently under review).

Here we present California's current list of Bird Species of Special Concern and describe the criteria and ranking scheme used to evaluate a large list of nominees and to assign qualifying at-risk species, subspecies, and distinct populations to three levels of conservation priority. We describe patterns of distribution of bird species of concern across habitats and geographic regions of California, rank the relative importance of various threats to all at-risk taxa, and evaluate the adequacy of current monitoring programs for these birds. We also make recommendations for ongoing evaluation of at-risk birds and broad management and research objectives needed to enable effective conservation. These analyses and recommendations are derived in part from individually authored species accounts. These accounts form the backbone of the document by describing the status, population trends, ecological requirements, threats, and management, research, and monitoring needs for each taxon. Finally, and most importantly, we make recommendations for how the special concern list can be used synergistically with laws, regulations, state policies, and various state or national conservation initiatives to protect and aid in recovery of the state's at-risk birds.

Methods

Process and Collaboration

The process of developing the current list of Bird Species of Special Concern was a collaborative one involving several key groups with overlapping membership. CDFG organized the entire effort and formed the technical advisory committee, which developed the definition of a species of special concern and the criteria and ranking scheme used to identify taxa warranting inclusion on the list. The two lead authors worked with CDFG's two-person management team to implement the system developed by the advisory committee; the senior author and one of the CDFG managers were members of the advisory committee. Two of the advisory committee members initially scored most of the nominees for the list. The lead authors scored additional taxa, with some help from other biologists at PRBO Conservation Science (PRBO), and refined many of the scores through the peer-review process. The management team and lead authors selected species account authors, including many advisory committee members, other experts, and themselves. The lead authors drafted the overview and analysis portions of the document and served as technical editors of the species accounts. CDFG organized the development and refinement of the range maps for all taxa, which involved the species account authors and a "map team" including two map editors from the advisory committee, the lead authors, and the management team. Because of the collaborative process and overlap in membership among the key groups, for convenience the collective "we" is often used below when attributing the source of the ideas and methods employed. Ultimately the text conforms with CDFG's overall viewpoint and policies as well as the opinions of the authors, both in the main body of the document and in the individual species accounts.

Context and Underlying Assumptions

Developing a framework for conservation of biodiversity necessarily involves identification of the units, scale, and context involved. Systems for identifying birds warranting conservation concern, however, do not always explicitly discuss these topics. A lack of expression of underlying assumptions can lead to confusion in the application of such schemes. To avoid this pitfall, we describe here our ranking scheme's underlying assumptions, which were developed via extensive discussions of other conservation ranking systems by the advisory committee and given a broader context by evaluation of additional conservation literature.

On this basis, we collectively defined a bird species of special concern, selected a pool of potential nominees to the special concern list, identified objective criteria to score nominated taxa, and developed a ranking scheme to discriminate taxa warranting inclusion on the list and their level of conservation priority within the list.

Units of Conservation

We conservatively defined our units of conservation as species, subspecies, and distinct populations, following the basic approach and intent of the U.S. Endangered Species Act, including its definition of a "distinct population segment" (USDI and USDC 1996, Pennock and Dimmick 1997). This implies a desire to protect species and the genetic diversity within them.

For convenience, throughout the text we refer to species, subspecies, and distinct populations collectively as "taxa" (taxon for singular), though technically "distinct populations" are not taxonomic units. We follow the biological species concept for species, which is adopted by the American Ornithologists' Union (1998). We also follow that source and its supplements (42nd–47th) for scientific names of species (see below for subspecies). Scientific names for all species and subspecies of birds are listed in the tables, except in a few cases when mention is made in the text of subspecies determinations that are not widely accepted.

Increasing advances in molecular genetics have led to considerable debate as to what constitutes a "distinct population segment" and a genetically defined "evolutionarily significant unit" (see overview by DeWeerdt 2002). Recognizing that traditional phenotypic and recent genetic assessments can lead to different conclusions about the distinctness of subspecies and populations (e.g., Zink et al. 2000), we still took the pragmatic approach that phenotypic subspecies are the most applicable unit of conservation below the species level (but see Zink 2004). This approach is based on both the assumption that phenotypic subspecies are likely to represent ecological adaptations and the assumption that genetic studies as yet have limited applicability to birds, given they have been conducted on relatively few polytypic species in California. The proportion of subspecies of birds considered to represent distinct phylogenetic lineages varied substantially between the broad-scale genetic studies of Zink (2004, 3%) and Phillimore and Owens (2006, 36%), yet both of these may be underestimates (Phillimore and Owens 2006). Complicating such assessments are higher rates of genetic distinctness in the Southern versus Northern Hemisphere and between island and continental taxa (Phillimore and Owens 2006).

Although there has not been a review of subspecific taxonomy of birds in North America or California since that of the AOU (1957), we decided to use that reference, as modified by subsequent published sources, as the basis for subspecific determinations and their scientific names. This recognizes, however, that future evaluation of the diagnosability of subspecies is likely to reduce the number of trinomials (Patten and Unitt 2002). The common names for subspecies used here generally follow those in Grinnell and Miller (1944), subsequent published literature, or those otherwise widely used. When an established common name for a subspecies was lacking, preference was given to one describing the region of geographic occurrence of the taxon or, secondarily, to a patronym mirroring the scientific name.

Including subspecies when prioritizing birds for special concern is consistent with the treatment of subspecies (some of uncertain taxonomic status) in CDFG's documents on amphibians and reptiles (Jennings and Hayes 1994) and mammals (Williams 1986) of special concern. Likewise, despite long-standing controversy about the definitions of subspecies and their taxonomic validity, currently 43% of birds on the federal threatened and endangered lists are included at the subspecies level (Haig et al. 2006). Considerations of subspecies and distinct populations in systems for ranking the conservation concern of birds at the national or continental scale have varied considerably, apparently reflecting different responses to the challenges to doing so mentioned above. For example, Brown et al. (2000) included "distinct population segments or recognized subspecies" when ranking the conservation needs of shorebirds, Carter et al. (2000) and Kushlan et al. (2002) did not when ranking landbirds and waterbirds, respectively, and the USFWS (2002) considered subspecies to only a limited degree when ranking all birds (though they plan to in the future; M. Green pers. comm.).

We restricted the use of distinct populations to ones that appear to be well isolated geographically (and likely genetically) from other large populations of the same species, such as coastal versus interior populations of the Snowy Plover.

California Focus

Given that the context was the conservation of the biodiversity of California's avifauna, we rejected the evaluation of biological factors expressed at the global or continental level. Hence, we did not score taxa on the magnitude of their global or U.S. populations, ranges, or threats as do some other schemes (Carter et al. 2000; Brown et al. 2000, 2001). This does not, of course, preclude additional prioritization on the basis of such factors, as discussed later. We did, however, strike some balance in this regard by deciding to score taxa on a scale from endemic to wide ranging on the assumption that, all else being equal, priority should be given to taxa with a high proportion of their North American population or range within the state. We realized that our California-centrism might lead to inclusion on the special concern list of a relatively high proportion of birds reaching the edge of their range in California and that such an approach has virtues and shortcomings (Hunter and Hutchinson 1994, Peterson 2001). Still, we wanted to emphasize the retention of the state's biodiversity and hence the conservation of all well-established bird populations. Although it can be difficult to define whether a taxon is "well-established," we judged that this category excluded birds occurring as rare migrants, irregular winter or postbreeding visitors, or breeders far from their core range or existing as part of very small populations on the fringe of their range that likely are maintained by recruitment from populations outside of California (e.g., the Laughing Gull, Northern Cardinal, and others in Appendix 1).

Immediate Conservation Concern

We also excluded from consideration most threats to birds that are global or continental in scale. Hence, though we recognize that global climate change is a pressing issue (e.g., IPCC 2007) that may have profound effects on the earth's ecosystems and birds (Moss 1998, McCarty 2001, Parmesan 2006), which may be expressed on California populations, we judged it best to focus on threats that likely can be offset by management actions at the state and local level in the relatively short term. This line of reasoning led to a ranking scheme emphasizing realized effects on birds (population declines, range retractions, and immediate threats) and, secondarily, factors that increase birds' vulnerability to decline or extinction (small population or range size, population concentration).

Nominations for the BSSC List

The advisory committee cast a wide net to ensure a robust list of taxa to evaluate for possible inclusion on the revised Bird Species of Special Concern list. The initial set of nominees included all bird taxa on prior special concern lists (Remsen 1978, CDFG 1992), all candidates to the original list (Remsen 1978), those birds among the "Special Animals" tracked by the California Natural Diversity Database (www.dfg.ca.gov/biogeodata/cnddb/animals.asp), species or subspecies recently considered candidates for listing as federally threatened or endangered (USFWS 1989), all federally threatened or endangered taxa (and populations), taxa nominated by contributors, species showing significant California declines on the Breeding Bird Survey (BBS; Sauer et al. 2001), and species or subspecies endemic to California. The committee excluded from consideration all taxa currently listed as state threatened or endangered by the California Fish and Game Commission (www.dfg.ca.gov/biogeodata/cnddb/animals.asp) because their listed status gives them greater (legal) protection than taxa on the special concern list. Federally listed species also have a high level of (legal) protection but nevertheless were considered further if they were *not* also state listed. Ultimately, each of these federally, but not state, listed taxa, by definition, was given special concern status, as otherwise they would not have received official state status of any kind though they clearly deserved it (see below). The committee also excluded from consideration for special concern status those species introduced to the state, as there is no evidence that such species should be of conservation concern in California (see Patten and Erickson 2001).

Later, PRBO biologists added as nominees species that had high rankings for conservation concern in any of the five Bird Conservation Regions (BCRs) that overlap with California (www.nabci-us.org/bcrs.html, U.S. NABCI Committee 2000; Figure 1). BCRs, as defined by the North American Bird Conservation Initiative (NABCI), are ecological units that provide a consistent spatial framework for bird conservation across North America (www.bsc-eoc.org/international/bcrmain.html). We considered species as having high rankings if for any California BCR they qualified for "Priority Pool Tiers" I or II of the National Partners in Flight (PIF) Rankings (Panjabi 2001; scores available at www.rmbo.org/pif/pifdb.html) or had Area Importance (AI) scores of 4 or 5 in the National Shorebird Conservation Assessment of the U.S. Shorebird Conservation Plan (Morrison et al. 2000). Nominees continued to be added in response to queries from knowledgeable biologists, particularly after a draft list, prepared by the process described below, was posted on the Internet for review. Although the conservation concern rankings of the North American Waterbird Conservation Plan (Kushlan et al. 2002) had not been published by the end of the period of solicitation of nominees for the special concern list, we judge that potential waterbird nominees were adequately scrutinized by the overall process outlined here. Ultimately, 283 taxa were nominated, scored for seven criteria, and ranked for conservation concern as described below.

Criteria and Ranking Scheme

As a means to identify birds that qualify for the special concern list and set levels of conservation priority within the list, the advisory committee debated at length the merits of various ranking schemes and the biological ranking criteria within them (see Ahern et al. 1985, Millsap et al. 1990, Reed 1992, IUCN 1994, Beissinger et al. 2000, Carter et al. 2000). Discussions led to the drafting of a definition of Bird Species of Special Concern in California and development of objective criteria used to score nominated taxa and a method to use the scores to discriminate taxa qualifying for the list and assign them to three levels of conservation priority.

Definition of a Bird Species of Special Concern

To ensure the ranking criteria and scheme would be consistent with the concept of a species of special concern, the advisory committee defined *Bird Species of Special Concern in California* as:

Those species, subspecies, or distinct populations of native birds that currently satisfy one or more of the following (not necessarily mutually exclusive) criteria:

- are extirpated from the state totally or in their primary seasonal or breeding role and were never listed as state threatened or endangered.
- are listed as federally, but not state, threatened or endangered.
- meet the state definition of threatened or endangered but have not formally been listed.
- are experiencing, or formerly experienced, serious (noncyclical) population declines

or range retractions (not reversed) that, if continued or resumed, could qualify them for state threatened or endangered status.

- have naturally small populations exhibiting high susceptibility to risk from any factor(s) that if realized could lead to declines that would qualify them for state threatened or endangered status.

As described below, nominee taxa meeting the first two criteria above qualified for inclusion on the Bird Species of Special Concern list, in a separate category, solely on the basis of meeting these specific definitions. By contrast, all other nominee taxa were judged to meet one or more of the remaining descriptive criteria for inclusion on the list if they met the test of obtaining sufficient total scores, or particular combinations of (fewer) scores, for the various ranking criteria. The latter criteria, by design, quantitatively gauge concern on the basis of characteristics expressed in the verbal definitions above.

Ranking Criteria

The advisory committee decided on seven objective criteria for scoring and ranking a set of nominee taxa: population trend, range trend, population size, range size, population concentration, percentage of entire range or population within California (endemism), and impact of threats. Exclusive of extirpated or federally, but not state, listed taxa, each nominated taxon was scored for all criteria as described below.

Because the distribution and abundance of many taxa in California vary greatly seasonally, and correspondingly in their level of conservation concern, almost all taxa were scored and ranked for their "season of concern" only. In rare cases, taxa (e.g., the Yellow Rail) were scored separately for two "seasons of concern," and thus there were two complete sets of criteria scores. For highly resident species, the season of concern was always "year round." For long-distance migrants, it typically was either "wintering" or "breeding," depending on when the taxon occurred for an extended period within a well-defined range in California. For short-distance migrants that occur year round but vary greatly seasonally in abundance and distribution in the state (e.g., the Northern Harrier), the breeding season typically was the season of concern for which they were scored.

For the population and range trend criteria (and corresponding sections in species accounts), we used the date of publication of Grinnell and Miller (1944) for separating the *historic* and *recent* periods and thus for gauging trends in these criteria for the latter period. This reference provides a convenient benchmark given it is the primary source summarizing the status and distribution of California's birds through the middle of the 20th century. Still, for purposes of scoring, 1944 is simply a cutoff date, and hence we used information from any source, not just Grinnell and Miller (1944), to gauge the status of a taxon at the transition between the historic and recent periods. So as not to prejudge all taxa restricted to marine or coastal habitats *a priori* as having small ranges in California, we set different baselines for marine (or coastal) and upland (or interior wetland) taxa against which to gauge the percent of California they occupied.

Descriptions of the seven criteria are:

Population Trend (PT). This criterion estimates the change in a taxon's population size from the time of the publication of Grinnell and Miller (1944) to the present. Scores are based on quantitative or anecdotal data on the magnitude of population change or, if these are lacking, data on changes in the availability or condition of a taxon's habitat. Taxa may be given a 0 for population trend, even if the California population is declining, if the overall population is stable or increasing and the decline in California results from a geographic shift in the range that was not caused by habitat loss or degradation or other threats in California (e.g., the *minima* subspecies of Cackling Goose).

Population size:	**Score**
seriously (>80%) reduced	20
greatly (>40–80%) reduced	15
moderately (>20–40%) reduced	10
slightly (>10–20%) reduced or suspected of having been reduced but trend unknown	5
stable (≤10% reduced) or increasing	0

Range Trend (RT). The range trend criterion estimates the change in the size of a taxon's breeding or wintering range in California from the time of publication of Grinnell and Miller (1944) to the present. Scores are based on gross changes to a taxon's range polygon (i.e., the outlying boundary of the range). Taxa that currently do not breed in the majority of years in an area where they formerly bred annually are treated as quasi-extirpated there, and hence the area is considered unoccupied for the purposes of calculating range trend (or size). When more thorough data are lacking, range trend can be inferred by loss of habitat. The trend does *not* estimate the extent of local extirpations within the overall range. Taxa may be given a 0 for range trend, even if the California population is declining, if the overall population is stable or increasing and the reduction in the California range results from a geographic shift in the range that was *not* caused by habitat loss or degradation or other threats in California.

Range size:

seriously (>80%) reduced	20
greatly (>40–80%) reduced	15
moderately (>20–40%) reduced	10
slightly (>10–20%) reduced or suspected of having been reduced but trend unknown	5
stable (≤10% reduced) or increasing	0

Population Size (PS). This criterion estimates the number of individuals of a taxon in California (during the season of concern).

Population size:

<1000 individuals	10
≥1000 but <10,000 individuals	7.5
≥10,000 but <100,000 individuals	5
≥100,000 but <1,000,000 individuals	2.5
>1,000,000 individuals	0

Range Size (RS). The range size criterion estimates the percentage of California occupied by a taxon, measured by the range polygon's outlying boundary, that is, *not* by summing the size of all areas of local occupation within the overall range. Taxa that currently do not breed in the majority of years in an area where they formerly bred annually are treated as quasi-extirpated there, and hence the area is considered unoccupied for the purposes of calculating range size (or trend). Seabirds or other waterbirds restricted solely to coastal estuarine, inshore, or pelagic waters are evaluated based on the marine environment from the California coastline west 200 mi (American Birding Association Checklist Area; ABA 2002). All other species are evaluated based on terrestrial California, that is, the political boundary of the state exclusive of ocean waters. This criterion is more difficult to apply for seabirds or waterbirds using ephemeral wetlands in the interior than for solely terrestrial taxa. Still, as the range is determined from the outlying boundary, estimation of its size need not take into account periodic or frequent local shifts in distribution reflecting patchy or ephemeral features in response to changing currents or upwelling patterns, or drying of wetlands during drought. Instead, it should focus on the broad pattern of distribution over a period of years representing the normal range of environmental variation.

Range size (% of California occupied):

≤10%	10
>10%–50%	5
>50%	0

Percentage of Entire Range within California (EN). This criterion measures what proportion of a taxon's North American range or population occurs within California. Taxa with a high proportion of their range or population within California are considered of greater concern than taxa with only a small proportion of their range or population in the state.

Proportion of North American range or population within California:

100% (endemic)	10
>80% but <100% (near-endemic)	7.5
>50%–80% (semi-endemic)	5
>20%–50%	2.5
≤20%	0

Population Concentration (PC). This criterion estimates how concentrated a taxon currently is within its California range during critical life stages (e.g., breeding, migration). Highly concentrated taxa generally are considered more vulnerable to habitat loss, predation, disease, or other catastrophic events than are widely dispersed taxa. For example, an endemic subspecies of a landbird might be very vulnerable to a catastrophic fire on one of the Channel Islands. This criterion defines a "site" as any more-or-less disjunct habitat island, including true islands (or offshore rocks) in the ocean or a lake or river, isolated headlands, well-bounded water bodies or wetlands (e.g., coastal estuary, lake, isolated salt marsh), "sky islands" (habitats high on mountain peaks and isolated from similar habitat on other distant peaks), or other well-isolated or fragmented habitat patches. The criterion should be used with caution for taxa that are not colonial breeders.

Majority (>50%) of population concentrated at:

1–3 sites	10
4–30 sites	5
>30 sites	0

Impact of Threats (THR). This criterion estimates the approximate impact of realized known threats and (secondarily) potential irregularly occurring catastrophic events (e.g., oil spills, disease events) known to periodically affect some taxa. Scores are based on projected long-term realized impacts of single or multiple threat factors and not on speculative threats for which there is no reasonable basis or historic precedent.

In the next 20 years, habitat loss, habitat degradation, or other human-induced threats are projected to:

seriously reduce (>20%) a taxon's population in California	20
greatly reduce (>15–20%) a taxon's population in California	15
moderately reduce (>10–15%) a taxon's population in California	10
slightly reduce (>5–10%) a taxon's population in California	5
have no substantial net impact, that is, a taxon's population should remain stable (≤5% reduced) or increase in the next 20 years	0

Scoring of Taxa

After the development of an initial list of nominee taxa, as described above, one or more biologists first scored each of these taxa (species, subspecies, or distinct population) on a scale of 0–10 for each of the seven criteria. For each taxon, biologists scored just the population in the season(s) for which the taxon is of concern in California. After considering various alternatives, the advisory committee ultimately doubled the population trend, range trend, and threats scores (to a scale of 0–20) to reflect the emphasis on population declines, range retractions, and threats in the definition of a bird species of concern. Biologists based scores on the best available information, including published papers, unpublished reports, BBS trend data, Christmas Bird Count (CBC) data, published and unpublished breeding bird atlas data, egg set or specimen data, unpublished field notes, and professional opinion. Many scores, however, were rough approximations of actual values, given the frequent lack of precise data. Once complete, the list of scores for all nominees was circulated to all members of the advisory committee for review. Not all members reviewed all scores, and hence, with few exceptions, preliminary scores represented the research or judgment of the initial scoring biologist. To further refine scores, we modified them for some taxa on the basis of outside reviewers' requests for reevaluation, suggestions for specific score changes, assessment by the authors of species accounts, or peer-review or editor evaluations of species accounts (see below). Scores for all nominated taxa are currently available from CDFG.

This scoring system allowed a taxon to be reevaluated for inclusion on, or removal from, the special concern list up to the time of completion of this document on the basis of a request for specific changes to criteria scores submitted by an advisory committee member or other expert. Requests had to be accompanied by substantive but brief written documentation of the reasons for the requested change. In cases of disagreements on scores upon which inclusion or exclusion from the list hinged, each of the authors and CDFG managers independently reevaluated scores then collectively reached consensus on their best judgment on the appropriate score. They then forwarded their recommendations on scores to the full technical advisory committee for final approval or further discussion.

Ranking Scheme

The advisory committee settled on two methods—one *linear*, the other *categorical*—to identify taxa for inclusion on the special concern list as a whole and within three levels of conservation priority. Two methods were used because of substantial controversy in the literature regarding the merits and shortcomings of these alternative approaches (e.g., Beissinger et al. 2000, Carter et al. 2000) and the belief that different methods might identify birds of conservation concern for different but complementary reasons.

The *linear* scheme sums scores for all seven criteria and ranks the nominee list by total score (higher scores indicating greater concern). For the linear scheme, we assigned three levels of priority by identifying natural breaks in the list of total scores. The *categorical* scheme identified taxa both for inclusion on the list and within three levels of priority based solely on one or a few criteria scores. We combined the results of the linear and categorical approaches, as described below, to obtain a final Bird Species of Special Concern list.

Whether scored or not, some additional taxa were added to the list solely on the basis of meeting one of the criteria in the definition of a species of concern. These included (1) taxa extirpated as breeders in California and (2) taxa listed as federally, but not state, threatened or endangered. These are listed in Table 1 in corresponding categories of special concern, but no species accounts were written for them. We judged accounts unnecessary for such taxa because they were not scored, and hence no documentation for scores was needed. Also, extensive documentation of status, threats, and management needs is readily available elsewhere for listed taxa, and accounts would be unlikely to benefit extirpated taxa.

Linear scheme. The linear scheme is a *weighted* one in that the population trend, range trend, and threat scores are doubled relative to other criteria, to emphasize the importance of declines over vulnerability. The scores for all criteria for each taxon were summed and arranged from highest to lowest. After inspection of the initial list of scored taxa, the advisory committee drew an arbitrary line, on the basis of collective professional judgment, thereby including on the linear ranked list all taxa with summed scores ≥37.5. Further, they used natural breaks in the data for all taxa to divide the linear list into three levels of priority: first priority, scores ≥60; second priority, scores ≥47.5 and <60; and third priority, scores ≥37.5 and <47.5.

Categorical scheme. Like the linear scheme, the categorical scheme outlined here emphasizes scores for population trend, range trend, and threats. Instead of adding all scores for all criteria, however, the categorical approach uses one or several scores to simultaneously develop the list and discriminate between three levels of priority. The criteria scores needed for inclusion in each of three (arbitrarily defined) priority levels and their verbal equivalents are:

First priority: PT or RT = 20, *or* THR = 20 and PT or RT = 15. Population or range size seriously reduced *or* population or range size greatly reduced and threats projected to seriously reduce the taxon's population in California in the next 20 years.

Second priority: PT or RT = 15, *or* THR = 15 and PT or RT = 10. Population or range size greatly reduced *or* population or range size moderately reduced and threats projected to greatly reduce the taxon's population in California in the next 20 years.

Third priority: PT or RT = 10 and PS, RS, or PC ≥7.5, *or* THR = 15 and PS, RS, or PC ≥7.5. Population or range size moderately reduced and population is at high risk because of at least one vulnerability factor, *or* threats projected to greatly reduce a taxon's population in California in the next 20 years and the taxon's population is at high risk because of at least one vulnerability factor.

Combining methods for the final list. We consolidated qualifying taxa into two main sections on the final list of Bird Species of Special Concern. The first included the taxa qualifying solely on the basis of the definition of a species of concern. The second included those qualifying on the basis of the final ranking scheme, which merged the linear and categorically ranked lists. We merged taxa on the linear and categorical lists by assigning each to one of three levels of priority using the higher of the two priority scores from the two schemes. For example, if a taxon had a priority level score of 2 on the linear list and 3 on the categorical list, we assigned it a 2 on the final list. If a taxon was on one list and not on the other, we assigned it a final priority by the single priority score originally assigned. For example, if a taxon scored a 2 on the linear list but was not on the categorical list, its priority level score on the final list was also 2. As with criteria scores, we adjusted the draft list and priority rankings on the basis of research by species account authors or external review. We solicited review of the list by sending copies directly to selected knowledgeable individuals and, more widely, by posting it on the PRBO website.

Analyses

We used a combination of statistical and descriptive analyses to look for patterns in the data used to classify species of special concern. For all analyses, we recognized that there are important limitations to available biological data and uncertainty as to how these limitations affected our results.

Statistical Analyses

Because scores among various criteria may be highly correlated, and therefore not independent, the validity of a ranking system that simply adds such scores together may be questioned (Beissinger et al. 2000). To address this concern, we looked for correlations among criteria scores for nominated taxa with the Spearman Rank Correlation test in the program STATA, version 8.0 (StataCorp. 2003). We also used this test to compare the concordance of the linear and categorical schemes in assigning taxa to three levels of conservation priority.

Descriptive Analyses

We made descriptive analyses of the patterns of distribution of bird species of concern across habitats and geographic regions of California, of the relative importance of various threats to all at-risk taxa, and of the adequacy of current monitoring programs for these birds. Analyses of geographic patterns were made on the basis of the BCR ecological units (www.nabci-us.org/bcrs.html, U.S. NABCI Committee 2000) and the Jepson geographic subdivisions of California (Hickman 1993; Figures 1 and 2).

Following Wilcove et al. (1998, 2000; D. Wilcove in litt.), we classified threats to special concern taxa into five major categories: habitat loss or degradation, alien species, pollution, overexploitation, and disease. For any actual or potential mortality factor to be considered a threat, it typically had to be anthropogenic (human-caused) in origin and to have a demonstrated capacity for population-level effects. Hence, mortality from native predators per se typically was not considered a "threat," although it might threaten the existence of individual birds or small local populations. Likewise, other natural mortality factors, such as inclement weather, tidal inundation, and earthquakes, typically were not considered threats. In extenuating circumstances, various natural mortality factors might be considered threats if substantially augmented by human activities or alterations of the environment or if such activities had reduced an overall population to such a low level that any mortality factor might lead to further declines or extirpation. As noted above, we did not evaluate the effects of global climate change as a threat to California birds, given the unlikelihood it can be offset by management actions within the next 20 years. Like Wilcove et al., in our overall analysis we did not distinguish between historic, ongoing, or current threats. By contrast, in scoring the "impacts of threats" criterion, as described above, the effect of threats was estimated over "the next 20 years." Unlike Wilcove et al., we did distinguish between major and minor threats. We considered major threats as realized threats known or strongly thought to have caused a substantial population decline or range retraction. We deemed minor threats as lesser realized threats or those potential threats that were not yet known or thought to have caused the population-level effects but appear to have the capacity to do so. We first evaluated threats on the basis of evidence available for California. We then considered evidence from other parts of North America if the threat was known or thought to have caused population-level effects on the taxon elsewhere, and if the lack of evidence for similar effects in California was judged most likely to reflect a lack of study rather than a lack of effect.

We considered habitat loss or degradation to include both the direct and indirect effects of human activities that might render a habitat unsuitable or less suitable for birds. Direct effects included removal of native habitat or alteration of its structure (e.g., logging) or resource base (e.g., overfishing) such that it no longer is capable of supporting bird populations of the size it did formerly. Indirect effects of habitat degradation included changes in conditions such as those leading to an increase in Brown-headed Cowbird (*Molothrus ater*) populations such that rates of brood parasitism by cowbirds would substantially lower reproductive rates of certain birds. We considered cowbird parasitism a form of habitat degradation for a particular taxon even if the habitat degradation that increased cowbird populations occurred in a habitat not occupied by the at-risk taxon in question. Degradation of habitat might also change the structure of habitat in a manner that would enhance predation rates by native or non-native predators. For example, degradation or elimination of transitional habitats at the upland edge of tidal marshes by diking might increase predation rates on Yellow Rails because they would no longer have adequate cover during very high tides. Habitat degradation might also include the *addition* of stationary objects, such as power lines, tall buildings, and lighthouses, that might greatly increase rates of mortality from bird collisions. We also considered all types of human disturbance to be forms of habitat degradation, except for cases clearly identified as overexploitation by means of direct and purposeful killing, as defined below. Thus, we considered human disturbance that indirectly reduces nesting success or increases adult mortality to be a form of habitat degradation rather than overexploitation. For example, we deemed the bright lights of squid fishing operations, which potentially may lead to burrow abandonment by storm-petrels or murrelets or may increase predation rates by owls on nocturnal seabirds, to be a form of habitat degradation via human disturbance.

We defined alien species as those with naturalized self-sustaining populations, thus excluding agricultural crops. We then considered alien species to be threats if they compete with birds directly for space, food, or other resources (e.g., European Starlings excluding Purple Martins from nesting cavities) or indirectly by altering their habitat (e.g., tamarisk reducing the suitability of riparian habitat), or if they directly prey on birds (e.g., feral cats killing various songbirds). In some cases, alien species might alternatively have been classified as a form of habitat degradation. For consistency with the Wilcove et al. classification, however, we followed their reasoning that in such cases the ultimate cause is the "alien species" rather than "habitat degradation," given the former is causing the latter (D. Wilcove in litt.).

We considered pollution to be a threat if there was evidence of substantial and relatively widespread mortality or reproductive harm from direct exposure or food chain accumulation of pesticides, heavy metals, metalloids (e.g., selenium), and other contaminants, or direct effects on birds or their prey from siltation or excess inputs of nutrients (e.g., hypereutrophication). Although contaminants potentially might harm any bird taxon, we did not consider pollution a minor direct threat unless there was clear evidence of low-level mortality, sublethal accumulation in tissues, or eggshell thinning. Pollution was also considered an indirect threat if it reduced the prey base of a bird taxon and thereby reduced the size of the population that could be supported by a given habitat.

We considered overexploitation to be primarily direct and purposeful (but overzealous) killing for commercial or sport hunting (food, plumes), for fear of competition with human interests (e.g., killing of fish-eating birds), for scientific collections, and for other purposes, as well as vandalistic killing. Hence, we generally restricted overexploitation to cases where the destruction of the taxon was the intent or the direct byproduct of the act. Although perhaps inconsistent with this rule, we categorized mortality of birds during gill-netting for fish harvest as overexploitation. Like Wilcove et al. (D. Wilcove in litt.), we felt less comfortable classifying such cases as habitat degradation.

We considered diseases to be threats if they had the capacity for population-level effects, particularly in cases of introduced diseases, natural diseases whose effects are augmented by human activities or alterations of the environment, or natural diseases affecting bird populations already at tenuously low levels.

Bird Responsibility List

Dunn et al. (1999) used responsibility scores to indicate a high degree of stewardship responsibility for the conservation of landbirds in Canada. In that vein, we developed a California Bird Responsibility List to highlight taxa for which the state should bear stewardship responsibility for conservation. We set the standard for inclusion on the list as those taxa with relatively high scores for the EN criterion: species or subspecies with scores of 10 or 7.5 (i.e., all endemic or "near-endemic" taxa) and additional species (but *not* subspecies) having scores of 5 (i.e., "semi-endemic" species). Thus, qualification for inclusion did not hinge on a taxon's current level of conservation concern.

Taxa to Watch

We also identified taxa for inclusion on a list of "Taxa to Watch" on the basis of prior concern for the well-being of their populations in California. We defined "Taxa to Watch" as those that are not on the current special concern list that (1) formerly were on the 1978 (Remsen 1978) or 1992 (CDFG 1992) special concern lists and are not currently listed as state threatened and endangered, (2) have been removed (delisted) from either the state or federal threatened and endangered lists (and remain on neither), or (3) are currently designated as "fully protected" in California (www.dfg.ca.gov/wildlife/species/t_e_spp/fully_pro.html).

Species Accounts

Numerous authors wrote species accounts that describe the status, population trends, ecological requirements, threats, and management, research, and monitoring needs for each taxon on the ranked list of Bird Species of Special Concern. These accounts provide scientific documentation for the criteria scores. This information justifies each taxon's inclusion and priority ranking within the special concern list and the biological underpinnings for recommendations to those responsible for making decisions that affect the conservation of these birds. Accounts summarize current knowledge and information gaps for special concern birds in a standard format with a range map and 11 sections, described below.

Criteria Scores

This is a table of the seven criteria scores for each taxon, presented with the range map for each taxon.

Special Concern Priority

This section describes the current level of special concern (conservation) priority and the season of concern (e.g., breeding, wintering, year round). If applicable, it also describes the priority in the original list (Remsen 1978) and whether the taxon was included on the most recent unprioritized list (CDFG 1992). Identification of the season of concern for each taxon focuses conservation efforts where they are most needed. Still, this should not be interpreted too rigidly. For example, although breeding is the season of concern for the Ashy and Black storm-petrels, this should not preclude conservation efforts at other seasons when large concentrations of individuals at sea may leave these species particularly vulnerable to catastrophic events. Particular vulnerabilities in California outside the season of concern, if applicable, generally are discussed in the threats section of accounts.

Breeding Bird Survey Statistics for California

This section presents a summary table of the most recent BBS data for the taxon when data for California are suitable for trend analysis (Sauer et al. 2005), which is not the case for any subspecies on the BSSC list. Descriptions of the BBS trend, or lack thereof, are included in the text of the section on "Recent Range and Abundance in California," according to the following standards and terminology. Statistical significance is defined as any trend with a P value of ≤ 0.10. Levels of significance (or near significance) are described verbally in the text (on the basis of the table's P values) as *highly significant* ($P < 0.01$), *significant* ($P = 0.01–0.05$), *marginally significant* ($P = 0.06–0.1$), and *approaching significance* ($P = 0.11–0.19$). Trend data are reported only if they meet the data credibility rankings of *high* (blue) or *medium* (yellow) as defined by Sauer et al. (2005). High credibility (blue) reflects data with at least 14 samples, of moderate precision, and of moderate abundance on survey routes; medium credibility (yellow) reflects data with a deficiency. Low (red) reflects data with an important deficiency, thus indicating that a taxon is not well sampled by the BBS in California.

General Range and Abundance

This section briefly and broadly describes the taxon's North American (and, if applicable, global) range and abundance, thereby justifying the endemism score. As applicable, it distinguishes between patterns of distribution for breeding, migration, and winter and for summering nonbreeders outside the breeding range; it does *not* describe patterns of extralimital occurrence. For polytypic species, the number of subspecies is described; this may include a range in the number of recognized subspecies if this varies according to different authorities. In accounts for subspecies, conflicting taxonomic treatments are described in more detail.

Seasonal Status in California

This section briefly describes the *primary* seasonal status and period of occurrence of the taxon in California. For nesting species, the period of the *breeding season* is defined as the time from the laying of the first eggs through the fledgling of the last young.

Historic Range and Abundance in California

The *historic* (vs. *recent*) period was defined as being up to, and including, the publication of Grinnell and Miller (1944). This section describes the abundance and distribution of a taxon in California prior to 1945, thereby establishing a baseline against which population trend, range trend, and, to a lesser degree, threats can be judged. It also describes features not easily mapped, such as any geographic or subspecific variation in status (e.g., clinal variation in abundance), particular dispersion patterns (e.g., patchy, clumped), or other distinctive patterns of distribution and abundance. The historic range is mapped only if it differs substantially from the current range (see below).

Recent Range and Abundance in California

This section describes the distribution and abundance of a taxon in California from 1945 to the present. Comparisons to the historic period to describe population and range trends serve to justify the criteria scores for population and range size and trend. The text on the current range complements the accompanying range map (see below) by describing the range relative to county boundaries, geographic areas (e.g., Sacramento Valley), or physiographic regions (e.g., Mojave and Colorado deserts). Like the previous section, this one describes patterns of geographic variation in status.

Ecological Requirements

This section discusses the habitat and other ecological requirements of the taxon in California, focusing on details of factors that may limit the taxon or that are otherwise particularly relevant to managers. As applicable, it describes or summarizes seral stage, dominant plants, and structure of habitats occupied; geographic or seasonal variation in habitat use; key habitat features (e.g., snags, cavities, canopy layers); noteworthy adaptations; known population-limiting factors; seasonal habitat use in terms of latitudinal and altitudinal range, climatic limits, and topography; and important components of food, cover, and nesting substrate.

Threats

This section describes the type and severity of threats known or highly suspected of causing population-level effects on a taxon in California.

Applicable threats elsewhere are described only when little information is available on these threats in California. Potential threats are clearly labeled as such. When possible, authors express judgments of the capability of current and future threats to reduce the population or range size or to alter distribution patterns or habitat use of the taxon in California.

Management and Research Recommendations

This section consists of a bulleted list of recommendations, including management measures to stem or reverse population declines, range retractions, or population threats, and research needed to better guide management and restoration efforts.

Monitoring Needs

This section assesses the adequacy of current statewide monitoring strategies (e.g., BBS, Monitoring Avian Productivity and Survivorship [MAPS] program, CBC) to detect changes in the population trend of each taxon. Although it is beyond the scope of each account to make detailed recommendations on specific monitoring protocols for each taxon, account authors do suggest ways of improving current monitoring methods or implementing new ones. In the process, they address the need for standardized protocols and the estimated frequency of monitoring.

Range Maps

Approach and considerations. Even when based on the same information, maps can vary enormously depending on the approach taken. In this document, we generally strove to map the "range" of each taxon rather than its local distribution. Thus, we have mainly mapped the broad region(s) in which a taxon occurs rather than its known occurrences or preferred habitats, which often are patchily distributed across broad areas. Even so, the maps for most taxa typically have several to many polygons—within which the birds are patchily distributed—separated from other polygons of occurrence by large blocks of unsuitable terrain, such as large mountain ranges or valleys. Such an approach worked well for most taxa, but had limitations for subspecies restricted to a tiny region of the state (e.g., the Clark's Marsh Wren) or for some species found mainly in the southern deserts, where they are restricted to widely separated montane islands (e.g., the Gray Vireo) or to extremely localized oases of riparian habitat in an overwhelmingly arid landscape (e.g., the Summer Tanager).

In such cases, we deviated from our overall approach to map these exceptions on the basis of occurrence of suitable habitat or local areas of occurrence. In the case of species with extremely localized distributions in the desert, it seemed misleading to map all of a broad area when only a very tiny fraction of it was occupied. For subspecies, the decision to map at this finer scale was done more for practical reasons. In the case of the three subspecies of the Song Sparrow occurring only in portions of the San Francisco Bay estuary, it was easier and more accurate to map the known extent of their preferred tidal marsh habitat. For these and other subspecies, we also judged that various stakeholders would be better served by having more rather than less information on the distribution of these highly restricted and hence vulnerable taxa. Again for practical reasons, we mapped the distribution of subspecies endemic to the Channel Islands on a whole-island basis, as even when the islands are projected at a relatively large size it is difficult, without exaggerated polygons, to see mapped occurrence on the smallest islands, let alone on just portions of them.

For breeding seabirds, we first mapped a buffer around colonies out in an arc representing the approximate maximum at-sea distance that most birds of a given species are known or estimated to travel normally from a colony to forage. We then considered the overall California range of each species to be the area along the coast bounded latitudinally by the outer arc of the buffer from the northern- and southernmost colonies in the state, and bounded longitudinally by the area from the coastline out at sea to the far edge of the buffer distance beyond colonies, or measured simply from the coastline seaward in areas where no active colonies were known. Maps extended to the northern or southern state boundary if the species' range extended beyond it. We judged that overall this was comparable to the method used in mapping the range of species distributed broadly but patchily in the interior of the state.

The range maps that accompany species accounts quickly convey each taxon's range in California, but *only during the season(s) of concern.* Thus, depending on the taxon's life history traits, the mapped season of concern may or may not depict its overall distribution in the state (see discussion above). In such cases, the map caption and the text of the account briefly describe the status and distribution of the taxon in California at other seasons.

Mapping process. Within the context described above, range maps were prepared by the following process (see Hollander et al. 1994). CDFG first plotted distribution data from various sources (BBS, CBC, California Natural Diversity Database, National Parks Occurrence Data, PIF, other CDFG data) on base range maps of full species initially developed in the mid-1980s as part of their California Wildlife Habitat Relationships (CWHR) system. Next, CDFG annotated these base maps with distribution information from key publications and reports. CDFG then provided account authors with copies of the annotated CWHR species map printed on semitransparent velum, a base map of California, and a map of Ecological Units of California (Goudey and Smith 1994), all at a scale of 1:1,000,000. Authors drew any needed changes on the annotated CWHR map, which they overlaid on the other maps to identify physical and ecological range boundaries when applicable. To ensure map accuracy, account authors used all readily available information to verify the extent of the range of each taxon. Only in a few cases, however, were authors able to obtain pertinent specimen and egg-set data from all major California museums. When they did, it usually was via their prior research on the taxon in question. For subspecies, account authors drew the initial range maps from scratch; otherwise the process for subspecies followed that for species. After authors submitted maps, CDFG reviewed all maps to clarify any questions, digitized them using ArcView GIS (geographic information system) software, returned them to the authors (as needed) for revision, made necessary corrections, then prepared maps at sizes and layouts appropriate for broader review and later publication.

Then the "map team" reviewed all first-draft digitized maps to ensure both the accuracy of individual maps and a consistent approach to the mapping of all taxa. Map team members also used readily available information to sketch the historic range polygons on maps for which the taxon's range had changed substantially since 1945. This enabled CDFG to calculate the size of the current and historic ranges of individual taxa, as applicable, and these numbers were used to verify the range size and range trend scores for all taxa. In a parallel and overlapping process of editing all species accounts, the senior author checked the text describing range in each account against the respective map, and vice versa, to ensure consistency in these two media, editing either as needed and often consulting additional sources or experts.

Because many range polygons were initially drawn on the basis of preexisting digitized ecological unit boundaries, often with very precise and complex edges, the map team reached consensus to smooth the polygon boundaries for the publication-scale maps, with CDFG retaining the original polygons for other uses. If the complex ecological unit boundaries had not been smoothed, they may have implied a level of precision not justified by actual distribution data. Conversely, many other of the original polygons were hand drawn with smooth edges because distributions did not correspond with ecological unit boundaries. Thus, smoothing the rough edges of the unit boundaries made the approach and precision of mapping more consistent across taxa.

The map team first evaluated various digital GIS solutions for smoothing the maps but ultimately rejected these in favor of one person (the senior author) hand drawing the smoothed polygon boundaries on hard copies of maps, which CDFG then digitized. Hand smoothing was done in concert with editing and adding historical polygons to maps. Maps were completed by a process of additional review by the map team, full technical advisory committee, and species account authors, with final corrections made by CDFG.

Relationship to criteria scores. We took the somewhat different approaches to mapping for more widely distributed versus very restricted taxa in full knowledge that, beyond the exception for seabirds and other waterbirds restricted to the immediate coast, criteria scores for range size and range trend for all taxa were based on the same definitions. Mapping at a finer scale for the very restricted taxa biased the calculations of their overall range size (sum of all polygons) to give a smaller value than if they had been mapped more liberally; but this had no practical effect, as all of these taxa already had the highest score of 10 for the range size criterion (small range size = high score). In interpreting the range trend score for such taxa, we considered the outlying boundary of the range to be an imaginary line connecting the outermost of the full set of widely spaced, small polygons (i.e., consistent with the typical treatment of historical data/maps). Hence, the loss of one or more scattered polygons to extirpation was not considered valid for assessing the range trend score unless the loss of polygons was substantial and concentrated in an outlying portion of the overall range. Likewise, for colonial seabirds, we did not consider the extirpation of one or more colonies as a valid measure for assessing the range trend score unless the loss of colonies was concentrated in an outlying portion of the overall range. Localized extirpations and consequent population reductions for all species were captured within the population trend score. This was consistent with a key precept of the ranking system to not score a taxon twice for essentially the same thing.

We judged that the approach and considerations described here were the best for the intended purpose and did not have any unintended effects on the scoring of the range size and range trend criteria, which were ultimately based on, and documented by, the maps.

Andy Birch

Results

Bird Species of Special Concern List

The criteria and ranking scheme identified 74 taxa that currently warrant designation as Bird Species of Special Concern in California (Table 1). Of these, 11 qualified solely on the basis of meeting one of the criteria of the definition of a species of concern: 5 because they had been extirpated from the state entirely or in their primary seasonal or breeding role, 6 because they had been listed as federally, but not state, threatened or endangered. These 11 taxa are not discussed further, as conservation efforts are already mandated for federally listed taxa and little can be done to benefit extirpated taxa, except perhaps to reintroduce the Sharp-tailed Grouse.

Sixty-three taxa warranted designation because they qualified for immediate conservation concern on the basis of their scores for seven biological criteria (Table 1). These taxa were placed within three categories of conservation concern: 11 as first priority, 27 as second priority, and 25 as third priority. Of the 63 taxa, 37 were full species (monotypic species or polytypic species represented by only one subspecies in California), 2 (the Loggerhead Shrike and Yellow Warbler) were polytypic species minus one isolated subspecies ranked separately as being of special concern (the Island Loggerhead Shrike, the Sonora Yellow Warbler), 21 were single subspecies (of species with multiple subspecies within California), and 3 were distinct populations of species. In the last category, the populations of the Le Conte's Thrasher (San Joaquin population) and the Song Sparrow ("Modesto" population) have been assigned subspecific rank by some authors (see accounts). Regardless, these populations and that of the Snowy Plover (interior population) show substantial or complete isolation from other populations of their respective species in California.

Linear versus Categorical Ranking Schemes

Correspondence between the linear and categorical schemes was modest with respect to the taxa each included on the special concern list but high in terms of the priority rankings within the list to which each assigned taxa. Of the 63 taxa on the ranked BSSC list, 42 (67%) were common to both the linear and categorical schemes. The linear scheme identified 55 taxa for inclusion, the categorical 50. Of the 13 taxa identified for inclusion by the linear scheme only, all had relatively high scores for criteria measuring factors that increase birds' vulnerability to decline or extinction and generally low scores for factors that measured realized effects on birds (Table 2). Of these 13, all had very small ranges (RS score of 10; 7 were endemic subspecies) and relatively concentrated populations (PC score $\geq$5), and 11 had small population sizes (PS $\geq$7.5). By contrast, all had low scores ($\leq$5) for population trend. Of the 8 taxa identified by the categorical scheme only, all had the lowest score possible for endemism and population concentration, and 7 had large to moderate range sizes (RS score $\leq$5). Conversely, all had relatively high scores ($\geq$10) for population trend (Table 2).

The linear and categorical schemes showed a relatively high degree of agreement in assigning taxa to three levels of priority within the BSSC list (Spearman Rank Correlation; rho = 0.48, P = 0.0001).

Correlation Among Scores

An analysis of possible correlations among criteria scores for all nominated taxa showed that several criteria were significantly positively correlated. We found that the strongest positive correlations were between RT and PT, RS and PS, PC and PS, PT and THR, RS and EN, RS and PC, and PC and THR (Table 3). For example, taxa that tend to score high on endemism also tend to score high on range size. There were also two significant negative correlations, though the relationships were never strong (i.e., rho for both $\leq$ -0.16). Strong correlations indicate that scores are not independent.

Occurrence by Habitat

The 63 ranked taxa occurred within nine broad habitat classes (Table 4; see also species accounts). Wetlands held 27 taxa, scrub habitats 13, grasslands 12, riparian forests 11, conifer forests 7, oak woodlands 6, marine waters 5, desert woodlands 5, and mixed evergreen forests 1. One species, the Black Swift, was not conveniently classified, as it is an aerial forager that nests very locally on moist sea bluffs or on cliffs behind or near waterfalls in deep canyons in the interior (Grinnell and Miller 1944). In their season of concern, 19 taxa use primarily

Table 1 California Bird Species of Special Concern[a]

Taxa (Species, subspecies, and distinct populations)	Season of Concern[b]
Taxa Assigned to the List Based Solely on the BSSC Definition	
Taxa Extirpated from the State Totally or in Their Primary Seasonal or Breeding Role (5 taxa)	
Barrow's Goldeneye (*Bucephala islandica*)	breeding
Sharp-tailed Grouse (*Tympanuchus phasianellus*)	year round
Common Loon (*Gavia immer*)	breeding
San Clemente Bewick's Wren (*Thryomanes bewickii leucophrys*)	year round
Santa Barbara Song Sparrow (*Melospiza melodia graminea, sensu* AOU 1957)[c]	year round
Taxa Listed as Federally, but Not State, Threatened or Endangered (6 taxa)	
Short-tailed Albatross (*Phoebastria albatrus*)	year round
Snowy Plover (coastal population) (*Charadrius alexandrinus*)	year round
Northern Spotted Owl (*Strix occidentalis caurina*)	year round
San Clemente Loggerhead Shrike (*Lanius ludovicianus mearnsi*)[d]	year round
Alta California Gnatcatcher (*Polioptila californica californica*)	year round
San Clemente Sage Sparrow (*Amphispiza belli clementeae*)[e]	year round
Taxa Assigned to the List by Ranking Schemes	
First Priority (11 taxa)	
Fulvous Whistling-Duck (*Dendrocygna bicolor*)	breeding
American White Pelican (*Pelecanus erythrorhynchos*)	breeding
Wood Stork (*Mycteria americana*)	postbreeding
Tufted Puffin (*Fratercula cirrhata*)	breeding
Island Loggerhead Shrike (*Lanius ludovicianus anthonyi*)	year round
San Diego Cactus Wren (*Campylorhynchus brunneicapillus sandiegensis*)	year round
Le Conte's Thrasher (San Joaquin population) (*Toxostoma lecontei*)	year round
Summer Tanager (*Piranga rubra*)	breeding
San Clemente Spotted Towhee (*Pipilo maculatus clementae*)	year round
Channel Island Song Sparrow (*Melospiza melodia graminea, sensu* Patten 2001)[f]	year round
Tricolored Blackbird (*Agelaius tricolor*)	breeding
Second Priority (27 taxa)	
Brant (*Branta bernicla*)	wintering, staging
Harlequin Duck (*Histrionicus histrionicus*)	breeding
Greater Sage-Grouse (*Centrocercus urophasianus*)	year round
Mount Pinos Sooty Grouse (*Dendragapus fuliginosus howardi*)	year round
Ashy Storm-Petrel (*Oceanodroma homochroa*)	breeding
Least Bittern (*Ixobrychus exilis*)	breeding
Yellow Rail (*Coturnicops noveboracensis*)	breeding, wintering
Mountain Plover (*Charadrius montanus*)	wintering
Black Tern (*Chlidonias niger*)	breeding
Burrowing Owl (*Athene cunicularia*)	breeding
California Spotted Owl (*Strix occidentalis occidentalis*)	year round
Vaux's Swift (*Chaetura vauxi*)	breeding
Olive-sided Flycatcher (*Contopus cooperi*)	breeding
Vermilion Flycatcher (*Pyrocephalus rubinus*)	breeding
Loggerhead Shrike (mainland populations) (*Lanius ludovicianus*)	breeding
Gray Vireo (*Vireo vicinior*)	breeding
Catalina Hutton's Vireo (*Vireo huttoni unitti*)	year round
Purple Martin (*Progne subis*)	breeding

(*continued*)

Table 1 (*continued*)

Taxa (Species, subspecies, and distinct populations)	Season of Concern[b]
Clark's Marsh Wren (*Cistothorus palustris clarkae*)	year round
Yellow Warbler (*Dendroica petechia*)	breeding
Sonora Yellow Warbler (*Dendroica petechia sonorana*)	breeding
Santa Cruz Island Rufous-crowned Sparrow (*Aimophila ruficeps obscura*)	year round
Oregon Vesper Sparrow (*Pooecetes gramineus affinis*)	wintering
Large-billed Savannah Sparrow (*Passerculus sandwichensis rostratus*)	nonbreeding
Grasshopper Sparrow (*Ammodramus savannarum*)	breeding
Alameda Song Sparrow (*Melospiza melodia pusillula*)	year round
Kern Red-winged Blackbird (*Agelaius phoeniceus aciculatus*)	year round
Third Priority (25 taxa)	
Tule Greater White-fronted Goose (*Anser albifrons elgasi*)	wintering
Redhead (*Aythya americana*)	breeding
Catalina California Quail (*Callipepla californica catalinensis*)	year round
Fork-tailed Storm-Petrel (*Oceanodroma furcata*)	breeding
Black Storm-Petrel (*Oceanodroma melania*)	breeding
Northern Harrier (*Circus cyaneus*)	breeding
Northern Goshawk (*Accipiter gentilis*)	year round
Lesser Sandhill Crane (*Grus canadensis canadensis*)	wintering
Snowy Plover (interior population) (*Charadrius alexandrinus*)	breeding
Gull-billed Tern (*Gelochelidon nilotica*)	breeding
Black Skimmer (*Rynchops niger*)	breeding
Cassin's Auklet (*Ptychoramphus aleuticus*)	breeding
Long-eared Owl (*Asio otus*)	breeding
Short-eared Owl (*Asio flammeus*)	breeding
Black Swift (*Cypseloides niger*)	breeding
Bendire's Thrasher (*Toxostoma bendirei*)	breeding
Crissal Thrasher (*Toxostoma crissale*)	year round
Lucy's Warbler (*Vermivora luciae*)	breeding
San Francisco Common Yellowthroat (*Geothlypis trichas sinuosa*)	year round
Yellow-breasted Chat (*Icteria virens*)	breeding
Bryant's Savannah Sparrow (*Passerculus sandwichensis alaudinus*)	year round
Song Sparrow ("Modesto" population)[g] (*Melospiza melodia*)	year round
Suisun Song Sparrow (*Melospiza melodia maxillaris*)	year round
Samuels Song Sparrow (*Melospiza melodia samuelis*)	year round
Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*)	breeding

[a]Subspecific taxonomy follows the AOU (1957) and subsequent revisions published in peer-reviewed journals; see species accounts for details. Boldfaced taxa also occur on the California Bird Responsibility List (Table 8).

[b]Given the distribution and abundance of many taxa in California vary greatly seasonally, the "season of concern" corresponds to the season, or seasons, for which a specific taxon is ranked for conservation priority on the BSSC list (see Methods).

[c]Subspecific validity is uncertain. This subspecies, now extinct, was recognized by the AOU (1957), but has been merged by Patten (2001) with the San Miguel (*M. m. micronyx*) and San Clemente (*M. m. clementae*) Song Sparrows as the [Channel] Island Song Sparrow (*M. m. graminea*).

[d]Subspecific identity of shrikes currently on San Clemente is uncertain. Mundy et al. (1997a, b) provided evidence *L. l. mearnsi* is genetically distinct from *L. l. gambeli* and *L. l. anthonyi*, whereas Patten and Campbell (2000) concluded, based on morphology, that the birds now on San Clemente are intergrades between *L. l. mearnsi* and *L. l. anthonyi.*

[e]Subspecific validity uncertain. Recognized by AOU (1957), but not by Patten and Unitt (2002).

[f]Subspecific validity uncertain; see comment above in footnote [c] regarding proposed merger of various island subspecies.

[g]Recognized by AOU (1957), but not by Patten (2001).

Table 2 Comparison of Criteria Scores and Priority Rankings for Taxa Assigned to the Bird Species of Special Concern List on the Basis of either the Linear or Categorical Ranking Schemes Only[a]

	Criteria Scores[b]							Ranking Scheme[c]	
Taxon	PT	RT	PS	RS	EN	PC	THR	Linear	Categorical
Included by Linear Ranking Only									
Tule Greater White-fronted Goose	5	0	7.5	10	10	5	5	3	–
Catalina California Quail	0	0	7.5	10	10	10	0	3	–
Black Storm-Petrel	0	0	10	10	0	10	10	3	–
Snowy Plover (interior population)	5	0	7.5	10	0	10	5	3	–
Gull-billed Tern	5	0	10	10	0	10	10	3	–
Black Skimmer	0	0	7.5	10	0	10	10	3	–
Black Swift	5	5	10	10	0	5	5	3	–
Catalina Hutton's Vireo	5	0	10	10	10	10	5	2	–
Bendire's Thrasher	5	0	10	10	0	5	10	3	–
Santa Cruz Island Rufous-crowned Sparrow	5	0	7.5	10	10	10	5	2	–
Suisun Song Sparrow	5	0	5	10	10	5	10	3	–
Samuels Song Sparrow	5	0	5	10	10	5	10	3	–
Kern Red-winged Blackbird	5	0	7.5	10	10	5	10	2	–
Included by Categorical Ranking Only									
Northern Harrier	10	0	7.5	5	0	0	10	–	3
Northern Goshawk	10	0	7.5	5	0	0	10	–	3
Long-eared Owl	10	5	7.5	0	0	0	10	–	3
Olive-sided Flycatcher	15	0	5	5	0	0	10	–	2
Loggerhead Shrike (mainland populations)	15	0	5	0	0	0	10	–	2
Lucy's Warbler	10	0	7.5	10	0	0	5	–	3
Yellow Warbler	15	5	2.5	0	0	0	5	–	2
Yellow-headed Blackbird	10	0	7.5	5	0	0	10	–	3

[a]See Methods for how the two ranking schemes each assign taxa to one of three priority categories. None of the taxa assigned to the list on the basis of just one scheme, however, qualified for the first priority category (see below).

[b]See Methods for definitions of criteria scores: PT, population trend; RT, range trend; PS, population size; RS, range size; EN, endemism; PC, population concentration; THR, impact of threats.

[c]Priority rankings assigned: 2, second priority; 3, third priority.

interior wetlands, 8 coastal or near-coastal (e.g., Salton Sea) saline (including estuarine) habitats; the San Francisco Common Yellowthroat uses a combination of saline and brackish estuarine marshes and near-coastal freshwater marshes, and the Bryant's Savannah Sparrow uses a combination of estuarine marshes and moist (upland) coastal grasslands. Of the 11 taxa occurring in riparian habitats, 5 use primarily desert riparian. All 7 taxa identified as being of concern in the nonbreeding season (the Wood Stork, Tule Greater White-fronted Goose, Brant, Lesser Sandhill Crane, Mountain Plover, Oregon Vesper Sparrow, and Large-billed Savannah Sparrow) use either wetlands, grasslands, or a combination of the two.

Table 3 Spearman Rank Correlations (rho) among Seven Criteria Scores for 283 Taxa Nominated for Possible Inclusion on the California Bird Species of Special Concern List[a]

	PT	RT	PS	RS	EN	PC	THR
Population Trend (PT)	—						
Range Trend (RT)	0.40**	—					
Population Size (PS)	0.06	0.03	—				
Range Size (RS)	-0.10	-0.10	0.49**	—			
Endemism (EN)	-0.06	-0.16*	-0.14*	0.33**	—		
Population Concentration (PC)	0.06	0.06	0.46**	0.40**	-0.02	—	
Impact of Threats (THR)	0.33**	0.17*	0.17*	0.02	-0.02	0.22**	—

*, $P < 0.05$; **, $P < 0.001$.

[a]Actually 280 taxa with 283 sets of scores, as 3 taxa scored for two separate seasons.

Table 4 Broadscale Habitat Affinities of Ranked Taxa on the List of California Bird Species of Special Concern[a]

Taxon	MA	WE	RI	CF	MF	OW	DW	SC	GR
Fulvous Whistling-Duck		x							
Tule Greater White-fronted Goose		x							
Brant		*X*							
Redhead		x							
Harlequin Duck		x							
Greater Sage-Grouse								x	
Mount Pinos Sooty Grouse				x					
Catalina California Quail								x	
Fork-tailed Storm-Petrel	x								
Ashy Storm-Petrel	x								
Black Storm-Petrel	x								
American White Pelican		x							
Least Bittern		x							
Wood Stork		*X*							
Northern Harrier		x							x
Northern Goshawk				x					
Yellow Rail		x							
Lesser Sandhill Crane		x							x
Snowy Plover (interior population)		x							
Mountain Plover									x
Gull-billed Tern		*X*							
Black Tern		x							
Black Skimmer		*X*							
Cassin's Auklet	x								
Tufted Puffin	x								
Burrowing Owl									x
California Spotted Owl				x	x				
Long-eared Owl			x	x		x	x		
Short-eared Owl		x							x
Black Swift									
Vaux's Swift				x					
Olive-sided Flycatcher				x					
Vermilion Flycatcher			*X*						
Loggerhead Shrike (mainland populations)						x	x	x	x
Island Loggerhead Shrike								x	x
Gray Vireo							x	x	
Catalina Hutton's Vireo						x			
Purple Martin			x	x		x			
San Diego Cactus Wren								x	
Clark's Marsh Wren		x							
Bendire's Thrasher							x	x	
Crissal Thrasher			*X*					x	
Le Conte's Thrasher (San Joaquin population)								x	
Lucy's Warbler			*X*				x		
Yellow Warbler			x						
Sonora Yellow Warbler			*X*						
San Francisco Common Yellowthroat		x	x						
Yellow-breasted Chat			x						
Summer Tanager			*X*						
San Clemente Spotted Towhee			x			x		x	
Santa Cruz Island Rufous-crowned Sparrow								x	
Oregon Vesper Sparrow									x
Bryant's Savannah Sparrow		x							x
Large-billed Savannah Sparrow		*X*						x	
Grasshopper Sparrow									x
Song Sparrow ("Modesto" population)		x							
Suisun Song Sparrow		*X*							
Samuels Song Sparrow		*X*							

(*continued*)

Table 4 (*continued*)

Taxon	MA	WE	RI	CF	MF	OW	DW	SC	GR
Alameda Song Sparrow		*x*							
Channel Island Song Sparrow								x	
Kern Red-winged Blackbird		x							x
Tricolored Blackbird		x				x			x
Yellow-headed Blackbird		x							

[a]Species classified on the basis of their primary use of various broad classes of habitats (see below); some species classified as having more than one primary habitat. One species, the Black Swift, was not conveniently classified, as it is an aerial forager that nests very locally on moist sea bluffs or on cliffs behind or near waterfalls in deep canyons in the interior (Grinnell and Miller 1944).

MA, marine (nearshore, offshore, and pelagic waters).

WE, wetlands (tidal flats, tidal marsh, freshwater marsh, wet meadows, vernal pools, flooded agricultural fields, and riverine, lacustrine, and estuarine waters). Italics indicate taxa that in their season of concern use primarily coastal or near-coastal (e.g., Salton Sea) saline habitats; all others use primarily interior wetlands, except for the San Francisco Common Yellowthroat and the Bryant's Savannah Sparrow, which use a combination of estuarine marshes and either freshwater marshes or moist upland grasslands, respectively.

RI, riparian forest and woodland. Italics indicate taxa that use primarily desert riparian habitats.

CF, coniferous forest.

MF, mixed evergreen hardwood forest.

OW, oak woodland and oak savanna.

DW, desert woodland (Joshua tree, fan palm, Mohave yucca, ocotillo, and pinyon-juniper).

SC, scrub habitats (chaparral, coastal scrub, desert scrub, and sagebrush scrub).

GR, grassland (native grassland, pastureland, grass-like crops, weedy fields, and sparsely-vegetated cultivated fields). The Gull-billed Tern forages partly in upland and dry agricultural fields, but we did not include it in this habitat category because its affinities generally are only marginally comparable to other species using grasslands.

Geographic Distribution

Ranked taxa were differentially distributed among the major geographic regions of the state (Table 5, Figures 1 and 2). Thirty-six taxa (57%), however, occurred only or mainly in one or two major geographic regions, making them more susceptible than widespread taxa to actual and potential threats. As expected, many of these taxa (16 of 36) with restricted distributions are also endemic or near-endemic subspecies. Of the remaining 20 species and subspecies with restricted distributions within California, 13 are part of more widespread populations to the south or southeast that reach the edge of their ranges in southern (9) or central (4) California, 6 are part of more widespread populations to the north or northeast that reach the edge of their ranges in northern or central California, and 1 is a distinct population of a species with a very widespread range.

The numerical occurrence of ranked taxa varied considerably among major geographic regions (Table 5, Figure 2). The highest total was 37 taxa in Southwestern California, where the list was bolstered by the occurrence of 6 endemic subspecies from the Channel Islands and 5 taxa reaching the northern or northwestern limits of their ranges in California. Central Western California held the next highest total with 30 taxa, the total elevated by 3 endemic subspecies of Song Sparrow in the San Francisco Bay estuary. Totals for all other regions ranged from 18 to 21.

At the level of ecologically defined Bird Conservation Regions (BCRs), the disparity in number of special concern taxa among regions was more striking. BCR 32 (Coastal California) held 52 taxa, whereas the number of taxa in the four other California BCRs ranged from 19 to 27 (Table 5, Figure 1). BCR 32, however, comprises about one-half of the state, including all of the Sacramento and San Joaquin valleys as well as the taxa-rich Central Western and Southwestern California geographic regions. BCR 33 (Sonoran and Mojave Deserts), with 25 taxa, comprises about one-quarter of the state. The remaining three BCRs, with their smaller totals of special concern taxa, combined comprise only about one-quarter of the state.

Threats

The number of taxa affected varied greatly among the five major categories of threats (Table 6). Sixty-one taxa (97%) were affected by habitat loss and degradation, 27 (43%) by alien species, 15 (24%) by pollution, 8 (13%) by overexploitation, and 3 (5%) by disease. Habitat loss and degradation also was considered a major (versus minor) threat in a greater proportion of cases (59 of 61) than was the

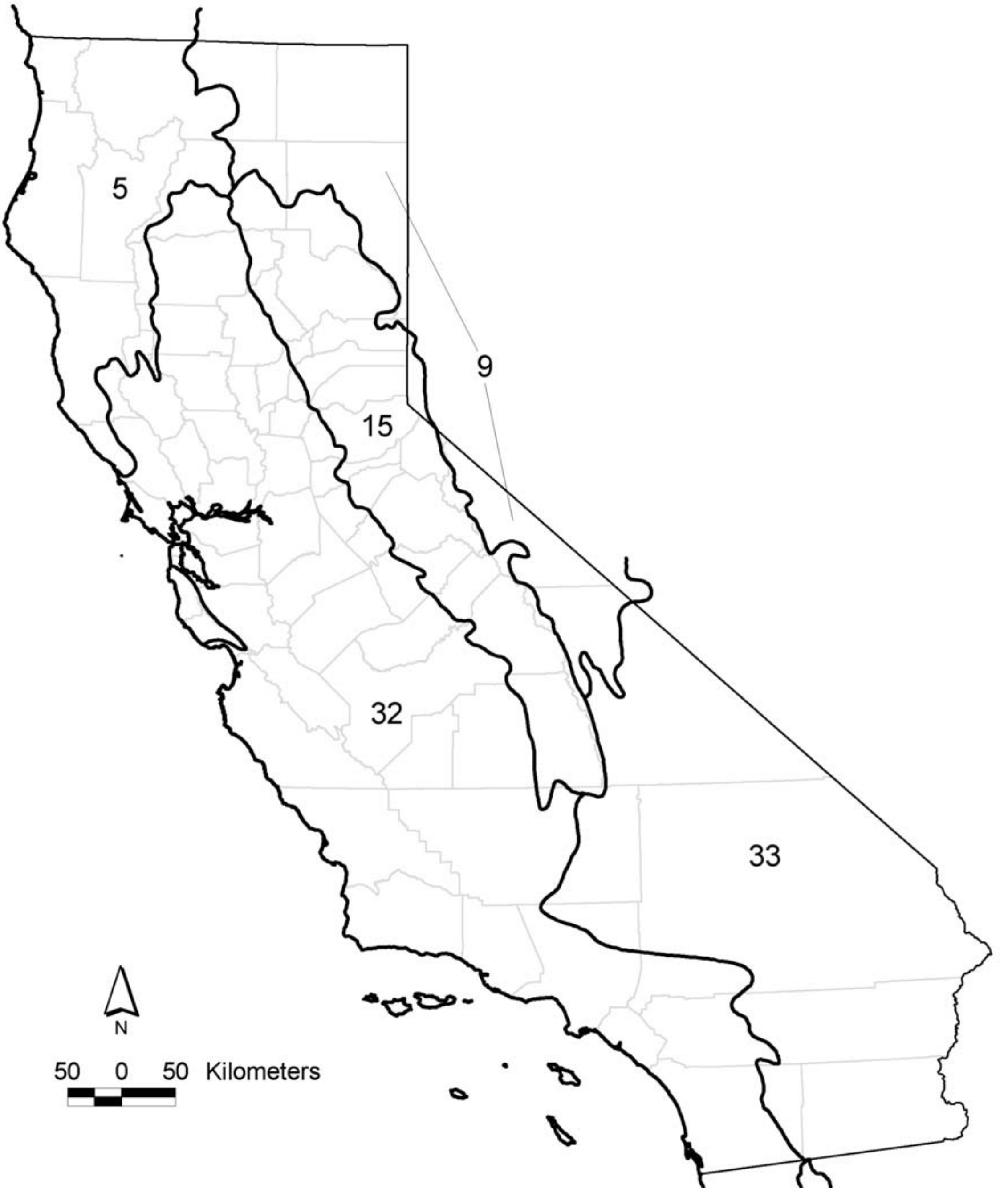


Figure 1. Bird Conservation Regions (BCRs) in California. BCR 5 = Northern Pacific Rainforest, BCR 9 = Great Basin, BCR 15 = Sierra Nevada, BCR 32 = Coastal California, and BCR 33 = Sonoran and Mojave Deserts.

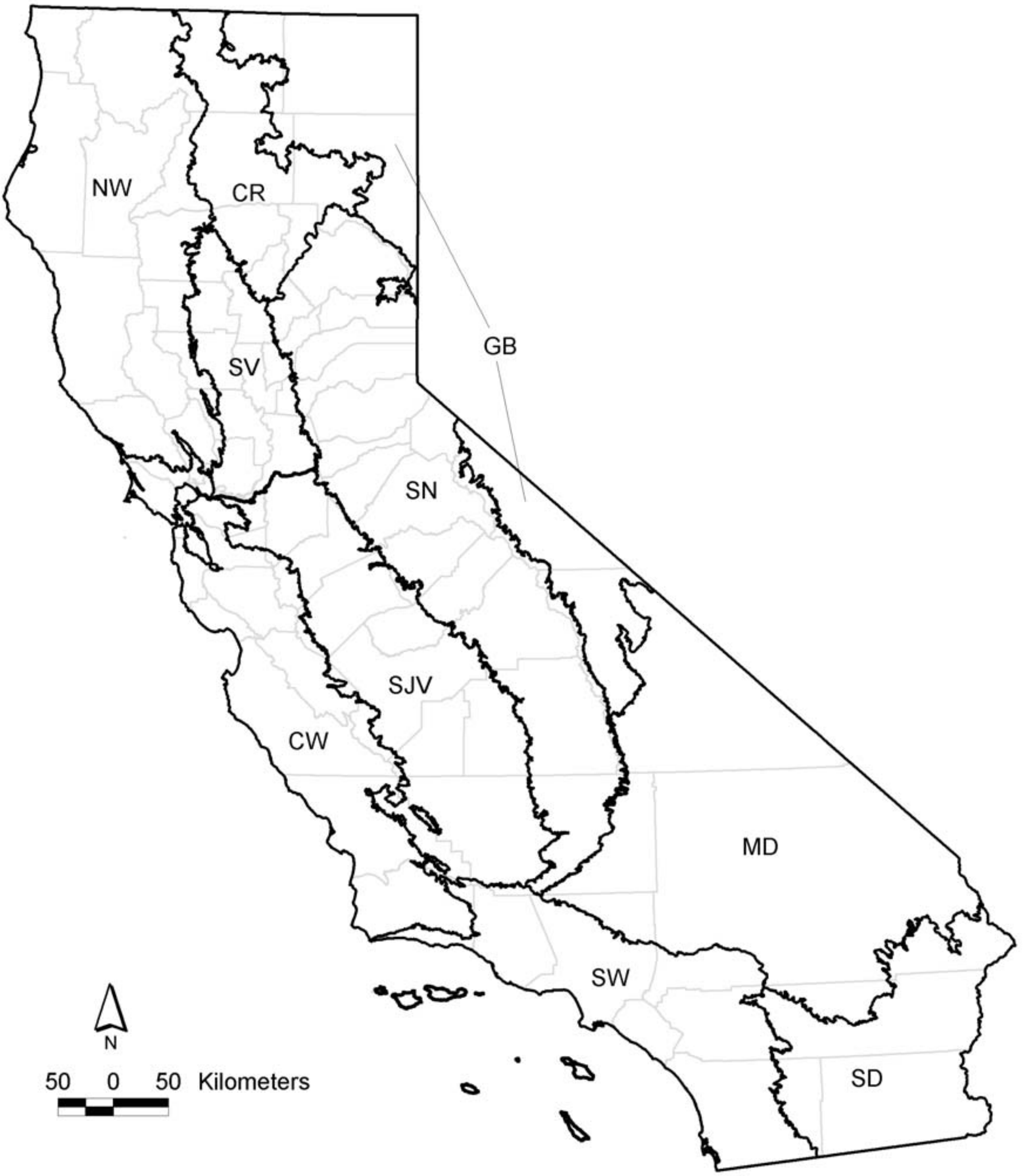


Figure 2. Geographic subdivisions of California adapted from Hickman (1993). NW = Northwestern California, CR = Cascade Range, SN = Sierra Nevada, SV= Sacramento Valley, SJV = San Joaquin Valley, CW = Central Western California, SW = Southwestern California, MD = Mojave Desert, SD = Sonoran (Colorado) Desert, GB = Great Basin.

Table 5 Patterns of Distribution of Ranked Taxa on the List of California Bird Species of Special Concern among Bird Conservation Regions (BCRs) and Geographic Subdivisions of California[a]

	BCR 5		BCR 9	BCR 15	BCR 32				BCR 33	
Taxon	NW	CR	GB	SN	SV	SJV	CW	SW	MD	SD
Fulvous Whistling-Duck[b, d]						x				X
Tule Greater White-fronted Goose[b, e]					X		x			
Brant	X						X	X		
Redhead		x	X		x	x		x	x	x
Harlequin Duck[b, c]				X						
Greater Sage-Grouse[b, c]			X							
Mount Pinos Sooty Grouse[b, e]				X						
Catalina California Quail[b, e]								X		
Fork-tailed Storm-Petrel[b, c]	X									
Ashy Storm-Petrel[b, d, e]	x						X	X		
Black Storm-Petrel[b, d]								X		
American White Pelican[b, c]			X							
Least Bittern	x	x	x		x	x	x	x	x	X
Wood Stork[b, d]										X
Northern Harrier	x	X	X	x	X	X	X	x	x	
Northern Goshawk	X	X	x	X			x	x		
Yellow Rail (breeding)[b, c]		x	x							
Yellow Rail (wintering)	x				x		X	x		
Lesser Sandhill Crane					x	X				x
Snowy Plover (interior population)			X			X			X	X
Mountain Plover					x	X		x	x	X
Gull-billed Tern[b, d]								X		X
Black Tern		X	X	x	X	x				
Black Skimmer[b, d]							x	X		X
Cassin's Auklet	X						X	X		
Tufted Puffin[b, c]	X						X			
Burrowing Owl		x	x		x	X	x	x	x	X
California Spotted Owl[e]		x		X			x	X		
Long-eared Owl	x	X	X	x	x	x	x	x	x	x
Short-eared Owl	x	x	X		x	x	x		x	
Black Swift	X	X		X			X	X		
Vaux's Swift	X	X	x	x			x			
Olive-sided Flycatcher	X	X	X	X			X	X		
Vermilion Flycatcher								x	x	X
Loggerhead Shrike (mainland populations)	x	x	X	x	X	X	X	X	X	X
Island Loggerhead Shrike[b, e]								X		
Gray Vireo[b, d]								X	X	
Catalina Hutton's Vireo[b, e]								X		
Purple Martin	X	X	x	X	x		X	x		
San Diego Cactus Wren[b, e]								X		
Clark's Marsh Wren[b, e]								X		
Bendire's Thrasher[b, d]									X	x
Crissal Thrasher[b, d]									x	X
Le Conte's Thrasher (San Joaquin population)[b, d]						X				
Lucy's Warbler[b, d]									x	X
Yellow Warbler	X	X	X	X	x	x	x	X	x	
Sonora Yellow Warbler[b, d]										X
San Francisco Common Yellowthroat[b, e]							X			
Yellow-breasted Chat	X	X	x	x	x	x	x	x	x	x
Summer Tanager			x	X				x	X	x
San Clemente Spotted Towhee[b, e]								X		
Santa Cruz Island Rufous-crowned Sparrow[b, e]								X		
Oregon Vesper Sparrow (wintering)[e]					X	X	x	x		
Bryant's Savannah Sparrow[b, e]	X						X			
Large-billed Savannah Sparrow[b, d]								X		X

(*continued*)

Table 5 (*continued*)

Taxon	BCR 5		BCR 9	BCR 15	BCR 32				BCR 33	
	NW	CR	GB	SN	SV	SJV	CW	SW	MD	SD
Grasshopper Sparrow	x	x		x		x	X	X		
Song Sparrow (“Modesto” population)[b]					X	X				
Suisun Song Sparrow[b, e]							X			
Samuels Song Sparrow[b, e]							X			
Alameda Song Sparrow[b, e]							X			
Channel Island Song Sparrow[b, e]								X		
Kern Red-winged Blackbird[b, e]				X						
Tricolored Blackbird	x		x	x	X	X	x	x		
Yellow-headed Blackbird		x	X	x	x	x	x	x	x	X

[a]BCR 5, Northern Pacific Rainforest; BCR 9, Great Basin; BCR 15, Sierra Nevada; BCR 32, Coastal California; and BCR 33, Sonoran and Mojave Deserts (www.nabci-us.org/bcrs.html, U.S. NABCI Committee 2000; Figure 1). Geographic subdivisions (adapted from Hickman 1993, Figure 2) are: NW, Northwestern California; CR, Cascade Range; SN, Sierra Nevada; SV, Sacramento Valley; SJV, San Joaquin Valley; CW, Central Western California; SW, Southwestern California; MD, Mojave Desert; SD, Sonoran (Colorado) Desert. X, the geographic subdivision indicated supports a substantial portion of the taxon’s population in California; x, the geographic subdivision indicated supports a low to modest portion of the taxon’s population in California.

[b]Taxa with restricted distribution, i.e., occurring in only (or mainly) one or two major biogeographic regions.

[c]Taxa currently reaching the southern limit of their breeding range in northern or central California.

[d]Taxa currently reaching the northern limit of their breeding range or postbreeding range (Wood Stork, Large-billed Savannah Sparrow) in southern or central California.

[e]Taxa endemic or near-endemic in California (see Table 8).

Table 6 Severity of Known Historic and Current Threats in California Affecting Ranked Taxa on the List of California Bird Species of Special Concern[a]

Taxon	Habitat Loss[b]	Alien Species[b]	Pollution[b]	Over-exploitation[b]	Disease[b]
Fulvous Whistling-Duck	X			x	X
Tule Greater White-fronted Goose	X				
Brant	X				
Redhead	X			x	
Harlequin Duck	X		x	X	
Greater Sage-Grouse	X	X	x		
Mount Pinos Sooty Grouse	X				
Catalina California Quail	X	x			
Fork-tailed Storm-Petrel	X	X	x		
Ashy Storm-Petrel	X	X	x		
Black Storm-Petrel		X			
American White Pelican	X		X	x	X
Least Bittern	X				
Wood Stork	X		x		
Northern Harrier	X		x		
Northern Goshawk	X		x		
Yellow Rail	X	x			
Lesser Sandhill Crane	X			x	x
Snowy Plover (interior population)	X			x	
Mountain Plover	X				
Gull-billed Tern	x			X	
Black Tern	X	x			
Black Skimmer	X		x		
Cassin’s Auklet		X	X	x	
Tufted Puffin	X		X		
Burrowing Owl	X		x		
California Spotted Owl	X				

(*continued*)

Table 6 (*continued*)

Taxon	Habitat Loss[b]	Alien Species[b]	Pollution[b]	Over-exploitation[b]	Disease[b]
Long-eared Owl	X				
Short-eared Owl	X				
Black Swift	x				
Vaux's Swift	X				
Olive-sided Flycatcher	X				
Vermilion Flycatcher	X				
Loggerhead Shrike (mainland populations)	X		x		
Island Loggerhead Shrike	X	X			
Gray Vireo	X				
Catalina Hutton's Vireo	X				
Purple Martin	X	X			
San Diego Cactus Wren	X				
Clark's Marsh Wren	X	X			
Bendire's Thrasher	X				
Crissal Thrasher	X	X			
Le Conte's Thrasher (San Joaquin population)	X	X			
Lucy's Warbler	X	X			
Yellow Warbler	X				
Sonora Yellow Warbler	X	X			
San Francisco Common Yellowthroat	X				
Yellow-breasted Chat	X				
Summer Tanager	X	X			
San Clemente Spotted Towhee	X	x			
Santa Cruz Island Rufous-crowned Sparrow	X	x			
Oregon Vesper Sparrow	X	x			
Bryant's Savannah Sparrow	X	X			
Large-billed Savannah Sparrow	X				
Grasshopper Sparrow	X	X			
Song Sparrow ("Modesto" population)	X	x			
Suisun Song Sparrow	X	x			
Samuels Song Sparrow	X	x			
Alameda Song Sparrow	X	x			
Channel Island Song Sparrow	X	x			
Kern Red-winged Blackbird	X	X			
Tricolored Blackbird	X		X		
Yellow-headed Blackbird	X		x		

[a]Severity of threats: X, a major realized threat known or strongly thought to have caused a substantial population decline or range retraction; x, a minor realized or potential threat that is not yet known or thought to have caused a substantial population decline or range retraction (see Methods).

[b]Categories of threats are those of Wilcove et al. (1998, 2000; see Methods); habitat loss also includes habitat degradation.

case for alien species (16 of 27), pollution (4 of 15), overexploitation (2 of 8), and disease (2 of 3).

Monitoring and Rangewide Surveys

Information presented in species accounts indicates that population trends of birds of special concern as a whole are poorly monitored. Of 56 special concern taxa with breeding populations in California, only 12 were adequately monitored in the state by the Breeding Bird Survey (Table 7). Another 4 breeding taxa are monitored annually or semiregularly by other methods or have de facto monitoring as a result of independent annual population censuses at all or most of their key nesting sites. The adequacy of these methods for detecting population trends, however, is unknown. Of the seven taxa of concern in the nonbreeding season, the Brant is the only one with an adequate program to monitor population trends. Three of the taxa of concern in the nonbreeding season are subspecies (the Tule Greater White-fronted Goose, Lesser Sandhill Crane, and Oregon Vesper Sparrow) that would need specialized monitoring

Table 7 Status of Monitoring Efforts and Rangewide Surveys for Ranked Taxa on the List of California Bird Species of Special Concern

Taxon	Breeding Bird Survey[a]	Other Monitoring Program[b]	Rangewide Population Survey[c]
Fulvous Whistling-Duck	**no**	no	no
Tule Greater White-fronted Goose	NA	no	yes
Brant	NA	yes	yes
Redhead	no	no	no
Harlequin Duck	**no**	no	no
Greater Sage-Grouse	no	yes	yes
Mount Pinos Sooty Grouse	no	no	no
Catalina California Quail	*no*	no	no
Fork-tailed Storm-Petrel	**no**	no	yes
Ashy Storm-Petrel	**no**	no	yes
Black Storm-Petrel	**no**	no	yes
American White Pelican	yes (*)	yes	yes
Least Bittern	**no**	no	no
Wood Stork	NA	no	*yes*
Northern Harrier	yes (*)	no	no
Northern Goshawk	no	no	no
Yellow Rail	**no**	no	no
Lesser Sandhill Crane	NA	no	no
Snowy Plover (interior population)	**no**	no	yes
Mountain Plover	NA	no	*yes*
Gull-billed Tern	**no**	*yes*	*yes*
Black Tern	no	no	yes
Black Skimmer	**no**	no	*yes*
Cassin's Auklet	**no**	no	yes
Tufted Puffin	**no**	no	yes
Burrowing Owl	yes (+)	no	yes
California Spotted Owl	**no**	yes	*yes*
Long-eared Owl	**no**	no	no
Short-eared Owl	**no**	no	no
Black Swift	no	no	no
Vaux's Swift	yes (*)	no	no
Olive-sided Flycatcher	yes (–)	no	no
Vermilion Flycatcher	**no**	no	no
Loggerhead Shrike (mainland populations)	yes (–)	no	no
Island Loggerhead Shrike	*no*	no	no
Gray Vireo	**no**	no	no
Catalina Hutton's Vireo	*no*	no	no
Purple Martin	yes (*)	no	yes
San Diego Cactus Wren	*no*	no	no
Clark's Marsh Wren	*no*	no	no
Bendire's Thrasher	no	no	yes
Crissal Thrasher	no	no	no
Le Conte's Thrasher (San Joaquin population)	*no*	no	no
Lucy's Warbler	**no**	no	no
Yellow Warbler	yes (*)	no	no
Sonora Yellow Warbler	*no*	no	no
San Francisco Common Yellowthroat	*no*	no	yes
Yellow-breasted Chat	yes (*)	no	no
Summer Tanager	no	no	no
San Clemente Spotted Towhee	*no*	no	no
Santa Cruz Island Rufous-crowned Sparrow	*no*	no	no
Oregon Vesper Sparrow	NA	no	no

(*continued*)

Table 7 (*continued*)

Taxon	Breeding Bird Survey[a]	Other Monitoring Program[b]	Rangewide Population Survey[c]
Bryant's Savannah Sparrow	*no*	no	no
Large-billed Savannah Sparrow	NA	no	no
Grasshopper Sparrow	yes (*)	no	no
Song Sparrow ("Modesto" population)	*no*	no	no
Suisun Song Sparrow	*no*	no	yes
Samuels Song Sparrow	*no*	no	yes
Alameda Song Sparrow	*no*	no	yes
Channel Island Song Sparrow	*no*	no	no
Kern Red-winged Blackbird	*no*	no	no
Tricolored Blackbird	yes (*)	yes	yes
Yellow-headed Blackbird	yes (*)	no	no

[a]Adequacy of the Breeding Bird Survey (BBS) for detecting trends in the California populations of each taxon are based on analyses for 1968 to 2004 (Sauer et al. 2005). Yes, if these authors assigned a "Regional Credibility Ranking" of yellow or blue (referred to here as medium and high); no, if they assigned a ranking of red (low). Such rankings are applied at the species level only. Population trends are reported if $P \leq 0.1$ (+, positive; –, negative; *, no positive or negative trend). There are two additional classes of inadequate data: **no**, no data reported for the species at all; *no*, a subspecies (or distinct population) is not, but the species as a whole is, well sampled in California. NA, does *not* breed in the state.

[b]Indicates whether other monitoring programs adequately assess trends of the entire California population of each taxon; monitoring of local populations only is not deemed adequate for a designation of "yes." Italics denote de facto monitoring such that censuses at individual sites can be added to obtain an estimate of the total nesting population; no mechanism is in place, however, to coordinate independent efforts or to ensure their long-term continuity. We do not consider the rangewide surveys of California seabirds that to date have been conducted twice (1975–1980, 1989–1991) as a monitoring program; see next footnote.

[c]Indicates whether rangewide surveys have been conducted for each taxon during the past 20 years. Such surveys may be attempts (not always successful) to directly census all or most of the statewide population; they may be estimates made by extrapolating sampled densities to the known or estimated total extent of suitable habitat. Italics denote a de facto survey such that censuses at individual sites, despite a lack of a prior coordination, can be added to obtain an estimate of the total nesting (or nonbreeding) population.

programs because of the difficulty of identifying these taxa in the field. Some other cryptic taxa, such as the Snowy and Mountain plovers, would need specialized monitoring schemes because of the difficulty of finding many individual birds. Some data are collected on numbers of Mountain Plovers in early winter in California by Christmas Bird Counts. These data, however, apparently are not adequate for trend assessment, and currently no up-to-date analyses are available for all species counted on CBCs (Sauer et al. 1996), in contrast to the regular updates of analyses of BBS data for breeding birds (Sauer et al. 2005).

At least 24 (38%) of the special concern taxa have been surveyed to determine population size throughout their California range in the past 20 years; many have never been surveyed in this manner (Table 7).

California Bird Responsibility List

One hundred twenty-five taxa qualified for a California Bird Responsibility List because all or a very high proportion of their global populations occur in the state (Table 8). Of these, 64 taxa are endemic, 54 near-endemic (>80% but <100% of entire range or population in California), and 7 semi-endemic (>50%–80% of entire range or population in California). Of the 18 species on the list, 3 are endemic (the California Condor, Island Scrub-Jay, and Yellow-billed Magpie), 8 near-endemic (the Ashy Storm-Petrel, Allen's Hummingbird, Nuttall's Woodpecker, Oak Titmouse, Wrentit, California Thrasher, Tricolored Blackbird, and Lawrence's Goldfinch), and 7 semi-endemic (the Brandt's Cormorant, Mountain Plover, Western Gull, White-headed Woodpecker, Le Conte's Thrasher, Hermit Warbler, and California Towhee). All the rest are endemic or near-endemic subspecies, demonstrating the very high rate of subspecific endemism in California and adjacent states. Twenty-one taxa occurred on both the (ranked) special concern and responsibility lists (Tables 1 and 8); 23 if the San Joaquin Le Conte's Thrasher (*Toxostoma lecontei macmillanorum*) and Modesto Song Sparrow (*Melospiza melodia mailliardi*) are considered valid subspecies. Co-occurrence on the two lists indicates a particularly high level of conservation concern in California. Not only are these taxa declining or vulnerable, but also the concentration of their populations here indicates that conservation actions must focus particularly on California if they are to be successful.

Taxa to Watch

We identified an additional 31 taxa, not included on the special concern list, as "Taxa to Watch" on the basis of prior concern for the well-being of their populations in California (Appendix 1).

Table 8 California Bird Responsibility List: Endemics, Near-Endemics, and Semi-Endemics

Endemics (EN score = 10; 64 taxa)	
Tule Greater White-fronted Goose	(*Anser albifroms elgasi*)
Mount Pinos Sooty Grouse	(*Dendragapus fuliginosus howardi*)
Little San Bernardino Mountain Quail	(*Oreortyx pictus russelli*)
Coast California Quail	(*Callipepla californica brunnescens*)
Inyo California Quail	(*Callipepla californica canfieldae*)
Catalina California Quail	(*Callipepla californica catalinensis*)
California Condor[b, c]	(*Gymnogyps californianus*)
California Clapper Rail[b, c]	(*Rallus longirostris obsoletus*)
California Spotted Owl	(*Strix occidentalis occidentalis*)
Nonmigratory Allen's Hummingbird	(*Selasphorus sasin sedentarius*)
Southern White-headed Woodpecker	(*Picoides albolarvatus gravirostris*)
Island Pacific-slope Flycatcher	(*Empidonax difficilis insulicola*)
Island Loggerhead Shrike	(*Lanius ludovicianus anthonyi*)
San Clemente Loggerhead Shrike[b]	(*Lanius ludovicianus mearnsi*)
Parkes's Hutton's Vireo	(*Vireo huttoni parkesi*)
Sierra Hutton's Vireo	(*Vireo huttoni sierrae*)
Monterey Hutton's Vireo	(*Vireo huttoni huttoni*)
Catalina Hutton's Vireo	(*Vireo huttoni unitti*)
Island Scrub-Jay	(*Aphelocoma insularis*)
Eagle Mountain Western Scrub-Jay	(*Aphelocoma californica cana*)
Yellow-billed Magpie	(*Pica nuttalli*)
Sierra Horned Lark	(*Eremophila alpestris sierrae*)
Island Horned Lark	(*Eremophila alpestris insularis*)
Ruddy Horned Lark	(*Eremophila alpestris rubea*)
Marin Chestnut-backed Chickadee	(*Poecile rufescens neglectus*)
Santa Cruz Chestnut-backed Chickadee	(*Poecile rufescens barlowi*)
California Oak Titmouse	(*Baeolophus inornatus inornatus*)
Little San Bernardino Oak Titmouse	(*Baeolophus inornatus mohavensis*)
Little San Bernardino Bushtit	(*Psaltriparus minimus sociabiliis*)
Monterey Pygmy Nuthatch	(*Sitta pygmaea pygmaea*)
Phillips's Brown Creeper	(*Certhia americana phillipsi*)
Nicasio Bewick's Wren	(*Thryomanes bewickii marinensis*)
Vigors's Bewick's Wren	(*Thryomanes bewickii spilurus*)
San Clemente Bewick's Wren[d]	(*Thryomanes bewickii leucophrys*)
Clark's Marsh Wren	(*Cistothorus palustris clarkae*)
California Swainson's Thrush	(*Catharus ustulatus oedicus*)
Ruddy Wrentit	(*Chamaea fasciata rufula*)
Monterey Wrentit	(*Chamaea fasciata fasciata*)
Northern California Thrasher	(*Toxostoma redivivum sonomae*)
San Joaquin Le Conte's Thrasher	(*Toxostoma lecontei macmillanorum*)
San Francisco Common Yellowthroat	(*Geothlypis trichas sinuosa*)
San Francisco Spotted Towhee	(*Pipilo maculatus falcifer*)
San Clemente Spotted Towhee	(*Pipilo maculatus clementae*)
Sacramento California Towhee[e]	(*Pipilo crissalis carolae*)
Inyo California Towhee[c, e, f]	(*Pipilo crissalis eremophilus*)
San Francisco California Towhee	(*Pipilo crissalis petulans*)
Vigors's California Towhee	(*Pipilo crissalis crissalis*)
California Rufous-crowned Sparrow	(*Aimophila ruficeps ruficeps*)

(*continued*)

Table 8 (*continued*)

Santa Cruz Island Rufous-crowned Sparrow	(*Aimophila ruficeps obscura*)
San Clemente Sage Sparrow[e, f]	(*Amphispiza belli clementeae*)
Bryant's Savannah Sparrow	(*Passerculus sandwichensis alaudinus*)
Yolla Bolly Fox Sparrow[e]	(*Passerella iliaca brevicauda*)
Marin Song Sparrow	(*Melospiza melodia gouldii*)
Suisun Song Sparrow	(*Melospiza melodia maxillaris*)
Samuels Song Sparrow	(*Melospiza melodia samuelis*)
Alameda Song Sparrow	(*Melospiza melodia pusillula*)
Channel Island Song Sparrow	(*Melospiza melodia graminea*)
Nuttall's White-crowned Sparrow	(*Zonotrichia leucophrys nuttalli*)
Point Pinos Dark-eyed Junco	(*Junco hyemalis pinosus*)
San Francisco Red-winged Blackbird	(*Agelaius phoeniceus mailliardorum*)
California Red-winged Blackbird	(*Agelaius phoeniceus californicus*)
Kern Red-winged Blackbird	(*Agelaius phoeniceus aciculatus*)
Sierra Nevada Gray-crowned Rosy-Finch	(*Leucosticte tephrocotis dawsoni*)
California Pine Grosbeak	(*Pinicola enucleator californica*)
Near-Endemics (EN score = 7.5; 54 taxa)	
Aleutian Cackling Goose	(*Branta hutchinsii leucopareia*)
Southern California Mountain Quail	(*Oreortyx pictus eremophilus*)
Ashy Storm-Petrel	(*Oceanodroma homochroa*)
Red-bellied Red-shouldered Hawk	(*Buteo lineatus elegans*)
California Black Rail[g]	(*Laterallus jamaicensis coturniculus*)
Light-footed Clapper Rail[b, c]	(*Rallus longirostris levipes*)
Yuma Clapper Rail[b, g]	(*Rallus longirostris yumanensis*)
Alaska Marbled Godwit	(*Limosa fedoa beringia*)
California Western Screech-Owl	(*Otus kennicottii bendirei*)
Pacific Great Horned Owl	(*Bubo virginianus pacificus*)
Dusky Common Poorwill	(*Phalaenoptilus nuttallii californicus*)
Allen's Hummingbird	(*Selasphorus sasin*)
Migratory Allen's Hummingbird	(*Selasphorus sasin sasin*)
California Acorn Woodpecker	(*Melanerpes formicivorus bairdi*)
Sierra Red-breasted Sapsucker	(*Sphyrapicus varius daggetti*)
Nuttall's Woodpecker	(*Picoides nuttallii*)
Cabanis's Hairy Woodpecker	(*Picoides villosus hyloscopus*)
California Horned Lark	(*Eremophila alpestris actia*)
Mohave Horned Lark	(*Eremophila alpestris ammophila*)
Bailey's Mountain Chickadee	(*Poecile gambeli baileyae*)
Oak Titmouse	(*Baeolophus inornatus*)
California Bushtit	(*Psaltriparus minimus californicus*)
San Diego Cactus Wren	(*Campylorhynchus brunneicapillus sandiegensis*)
Dotted Canyon Wren	(*Catherpes mexicanus punctulatus*)
Muir's Winter Wren	(*Troglodytes troglodytes muiri*)
Central California Winter Wren	(*Troglodytes troglodytes obscurior*)
Suisun Marsh Wren	(*Cistothorus palustris aestuarinus*)
Alta California Gnatcatcher[f]	(*Polioptila californica californica*)
Sierra Hermit Thrush	(*Catharus guttatus sequoiensis*)
Wrentit	(*Chamaea fasciata*)
Pallid Wrentit	(*Chamaea fasciata henshawi*)
California Thrasher	(*Toxostoma redivivum*)
Southern California Thrasher	(*Toxostoma redivivum redivivum*)
Dusky Orange-crowned Warbler	(*Vermivora celata sordida*)
Sacramento Spotted Towhee	(*Pipilo maculatus falcinellus*)
San Diego Spotted Towhee	(*Pipilo maculatus megalonyx*)
California Black-chinned Sparrow	(*Spizella atrogularis cana*)
Oregon Vesper Sparrow (wintering)	(*Pooecetes gramineus affinis*)
Intermediate Sage Sparrow	(*Amphispiza belli canescens*)
Bell's Sage Sparrow	(*Amphispiza belli belli*)

(*continued*)

Table 8 (*continued*)

Alberta Fox Sparrow (wintering)	(*Passerella iliaca altivagans*)
Shumagin Fox Sparrow (wintering)	(*Passerella iliaca unalaschcensis*)
Kodiak Fox Sparrow (wintering)	(*Passerella iliaca insularis*)
Yakutat Fox Sparrow (wintering)	(*Passerella iliaca annectens*)
Olivaceous Fox Sparrow (wintering)	(*Passerella iliaca olivacea*)
Stephens's Fox Sparrow	(*Passerella iliaca stephensi*)
Mendocino Song Sparrow	(*Melospiza melodia cleonensis*)
Heermann's Song Sparrow	(*Melospiza melodia heermanni*)
Sierra Nevada Dark-eyed Junco	(*Junco hyemalis thurberi*)
California Blue Grosbeak	(*Guiraca caerulea salicaria*)
Tricolored Blackbird	(*Agelaius tricolor*)
San Clemente House Finch	(*Carpodacus mexicanus clementis*)
Lawrence's Goldfinch	(*Carduelis lawrencei*)
Willow American Goldfinch	(*Carduelis tristis salicamans*)
Semi-endemics (EN = 5; 7 species)[h]	
Brandt's Cormorant	(*Phalacrocorax penicillatus*)
Mountain Plover (wintering)	(*Charadrius montanus*)
Western Gull	(*Larus occidentalis*)
White-headed Woodpecker	(*Picoides albolarvatus*)
Le Conte's Thrasher	(*Toxostoma lecontei*)
Hermit Warbler	(*Dendroica occidentalis*)
California Towhee	(*Pipilo crissalis*)

[a]Taxa are arranged taxonomically within each section; boldfaced taxa are also on the ranked portion of the BSSC List.
[b]Federally endangered.
[c]State endangered.
[d]Extinct.
[e]Validity of subspecies suspect (P. Unitt pers. comm.).
[f]Federally threatened.
[g]State threatened.
[h]This category includes only full species.

Discussion

Units of Conservation

Taxonomic concepts and hence the units considered for conservation are not stable, and even what constitutes a species is much debated (e.g., Rojas 1992, Peterson 1998, Sangster 2000 and references therein). There is even more disagreement as to what lower taxonomic levels (subspecies, "distinct population segments," "evolutionarily significant units") should be the focus of conservation efforts (e.g., Ryder 1986, Moritz 1994, Pennock and Dimmick 1997, Waples 1998, Crandall et al. 2000, DeWeerdt 2002, Zink 2004). Presumably because of these uncertainties, most lists developed for conservation prioritization focus on species (Appendix 2), despite the fact that many subspecies of birds have been listed as threatened or endangered at the state and federal level (see Haig et al. 2006). Given the widespread concern for the loss of both species and the genetic diversity within them, a focus solely on species is likely to be shortsighted. Populations are being lost worldwide at a much more rapid rate than are species (Hughes et al. 1997), and many subspecies undoubtedly contain novel adaptations that may be necessary to meet future environmental challenges (Crandall et al. 2000). Zink (2004), however, suggested that 97% of continentally distributed avian subspecies lack population genetic structure sufficient to be considered evolutionarily significant units, and thus the use of current subspecies designations is misleading conservation efforts. By contrast, Phillimore and Owens (2006) reported that at least 36% of the subspecies of birds they sampled worldwide represented distinct phylogenetic lineages. They opined that avian subspecies often provide a shortcut for estimating patterns of intraspecific genetic divergence and hence may serve as a useful tool for conservation.

Peripheral Populations

The primary arguments against paying special conservation attention to peripheral populations are that such efforts have little probability of success, given the marginal viability of populations at the edge of their range, and that it results in an allocation of funds out of proportion to need (Hunter and Hutchinson 1994, Peterson 2001). Likewise, many common bird species in North America undergoing declines have done so predominantly where abundances are highest, suggesting conservation efforts should focus on these high-abundance areas (Rodríguez 2002). Conversely, protecting peripheral populations may preserve genetic diversity that allows a population to shift its range in response to climate change, maintain the integrity of local ecosystems, assist many other species using the same habitat, and aid conservation on a broader scale by keeping taxa from reaching global endangerment (Hunter and Hutchinson 1994, Nielsen et al. 2001). Also, the protection of any population is a value judgment, and people and organizations, particularly those organized along political boundaries, are more apt to feel protective of local resources and to act locally in their defense. Conservation of peripheral populations in California may be particularly important when their ranges extend into Mexico or adjacent states that lack appropriate legislation or regulatory mechanism to protect at-risk species (see Abbitt et al. 2000). California, one of the most biologically diverse states, should protect all of its well-established populations, whether widespread, centrally clustered, or at the margins of the state.

Care must be taken in classifying "peripheral populations," as this is not always straightforward and risks marginalizing taxa that warrant protection (Nielsen et al. 2001). For example, two breeding species in California that currently can be classified as "peripheral"—the American White Pelican and Fulvous Whistling-Duck—were not always so restricted in range in the state. The pelican and the whistling-duck, now confined as breeders, respectively, to the northern margin of the state in the Klamath Basin and the southern margin in the Imperial Valley, once overlapped broadly in breeding distribution in south-central and southern California (see accounts). Hence their current peripheral status is the result of large-scale retractions of their ranges, which should be vigorously protected against further erosion. The standard of considering for special concern status only taxa with well-established populations in the state should counter any concerns that conservation efforts for peripheral populations will have little chance for success. Clearly, protection of well-established peripheral populations should help stem range retractions that would lead to further reduction of California's avian biodiversity.

Elusiveness of a Perfect Ranking Approach

In recent years, objective ranking schemes have been embraced as an important tool in conservation. In providing a scientific basis for identifying and highlighting at-risk taxa, they may reduce unpredictable biases from subjective expert input, make the logic behind assessments explicit, call attention to factors causing endangerment, support regulatory protection of taxa, constrain development and exploitation, and provide input into prioritization of conservation programs (Keith et al. 2004, O'Grady et al. 2004a). The proliferation of schemes reflects in part the different purposes and scales for which they are designed and applied.

Although there have been few comparisons of various ranking systems applied at different scopes and scales, it appears that the highest correspondence is found in the taxa identified in the highest or lowest categories of the respective systems (Mehlman et al. 2004, O'Grady et al. 2004a). If this pattern prevails in additional comparisons, it will be a bit troubling, as the taxa in the highest categories may already have been identified and listed as endangered and the ones in the lowest categories have a lower priority for conservation. What is needed is accurate prediction of those intermediate taxa that are most at risk of endangerment if current declines and threats continue. Some of the best predictors of extinction risk appear to be current population size and population trend (O'Grady et al. 2004b); systems using information on current and future threats are the most useful in identifying species that will be adversely affected by proposed management actions (Andelman et al. 2004).

Much of the difference in the correspondence of various categorization systems may justifiably reflect the purposes for which they are designed, in response to the different scales (time and space), the proposed management scenarios, or the ecological or political settings in which they were created (Andelman et al. 2004, O'Grady et al. 2004a). Common to all systems is the major problem of data scarcity in categorizing species. Still, many systems have serious defects, which vary among these systems, hence the recommendation that various countries use the same system or, at least, compatible ones (de Grammont and Cuarón 2006).

Disagreement over the type of scheme to use when the purpose and scale are the same (cf. Beissinger et al. 2000, Carter et al. 2000) appears to reflect the elusiveness of designing a system that can accurately measure the risks of extinction for a host of birds, each with unique ecological attributes, particularly given great variation in the knowledge of biological variables both within and across taxa. The problem of comparing oranges and apples is compounded manifold when extending the comparison from alcids to accipiters, bitterns to blackbirds, storm-petrels to swifts, and woodpeckers to wood-warblers. Consequently, virtually any ranking scheme has shortcomings.

Beissinger et al. (2000) argued for the use of a categorical rather than linear approach to ranking the conservation priority of birds in North America. They considered the appeal of linear ranking schemes to be the ease with which variables can be defined and the quantitative results with superficially unambiguous implications for management priorities. They listed major shortcomings of linear schemes to be that (1) incomplete data make it difficult to choose variables and to decide whether all should be weighted equally; (2) unintentional weighting can occur because of multicolinearity (or correlations) among variables; and (3) a lack of knowledge often exists about the relative relationships between different scores for each variable and the probability of extinction. In the third case, assigning scores for use in linear ranking presumes the same relationship to the probability of extinction for (1) the same value for the same variable for two different species and (2) the same value for two different variables for the same or different species. For example, in the former case a presumption would be that a species of warbler and a species of hawk both with population sizes of 2000 would have the same probability of going extinct on the basis of abundance. In fact, because of the energetics of body size, a certain extent of habitat would likely support far fewer hawks than warblers, and hence a population of 2000 might represent the maximum population size attainable for a hawk but a much depleted one for a warbler. In the case of (2), it is hard to imagine that the same scores for different variables would always bear the same relationship to the probability of extinction both for the same species and for different species.

Like Beissinger et al. (2000), we found many and strong correlations among the scores for criteria used to score potentially at-risk taxa (Table 3). In a similar analysis of scores for biological variables for Florida vertebrates, Millsap et al. (1990) found strong correlations between population size and range size and between population trend and distribution trend. Carter et al. (2000) countered that in their analysis comparing categorical and linear rankings of breeding bird species in New York State that Beissinger et al. (2000) found a strong correlation between categorical rank and the sum of the seven variables, and that both approaches identified the same species of greatest conservation concern. Carter et al. (2000) further judged that high scores for a species on multiple parameters (and thus high total scores) are compounding evidence of vulnerability. Still, the summing of scores in a linear scheme, to produce a list of taxa ranked in descending order from those with the highest to the lowest scores, gives a false sense of precision given the uncertainty of biological data and the difficulties of comparing across species with widely varying ecological characteristics. Linear schemes also suffer from the need to choose an arbitrary cutoff between the scores separating inclusion on (versus exclusion from) the list. This arbitrariness is compounded if the list is subdivided further into differing levels of conservation priority.

Categorical schemes have been criticized as being vague (Given and Norton 1993). Also, although they identify taxa both for inclusion on a list and within levels of priority based solely on one or a few criteria scores, the setting of the criteria that discriminate among categories is typically defined arbitrarily. Similarly, the difficulties of incomplete data presented above for linear schemes also apply to categorical ones.

Recognizing the limitations and strengths of both linear and categorical approaches to ranking birds for conservation concern, we ultimately ranked taxa in California using both approaches. When combining the results of both systems to produce a list with three levels of conservation priority, we gave each taxon the higher, rather than lower, of the priority rankings assigned by the two approaches. This was judged the best and most conservative approach; if mistakes were made it seemed better to rank (recommend) a taxon for too much conservation priority rather than for too little. The use of two approaches also yielded a list with more taxa than would have been the case if only one of the schemes had been used. Again, we judged it more conservative to assign conservation priority to slightly more versus less taxa. Along similar lines, PIF has recently begun to use "Priority Species Pools" (including tiers) to highlight species most in need of conservation attention, using a combination of linear scores and categories (Panjabi 2001).

Arbitrariness

No matter how carefully any ranking system is crafted, there will always be elements that can be considered arbitrary. For example, in the present system there is no magic formula for determining the numerical cutoff point between the various categories in the population size criterion because we knew of no way to set biologically meaningful or demonstrably superior cutoff points. These categories vary by multiples of 10, but there is no reason why they couldn't have been chosen instead to be multiples of 5, 7, 20, or some other number. Regardless of what multiples are chosen, cutoffs exhibit further arbitrariness. For example, the population size of two taxa may differ by only one individual (e.g., 999 and 1000) but still get a different score for the population size criterion (10 versus 7.5), though such a slim difference is unlikely to be a relevant predictor of the differential likelihood of the two taxa becoming extirpated in the state in the future. Conversely, it is not possible to have a series of mutually exclusive categories along a continuum of values without having sharp breaks between them. Still, because the categories are broad and information on the population sizes of many taxa are poorly known, we judged the approach taken was reasonable and generally consistent with that used for the scoring of comparable criteria in other ranking systems (e.g., Brown et al. 2000, Kushlan et al. 2002).

Other criteria were defined using similarly arbitrary values. Take the population trend and range trend criteria, which were estimated on the basis of changes from 1944 to the present. This period of measurement is, of course, arbitrary, but then so would have been any other. Under the period selected, some species would be handicapped in the scoring process if their populations declined or their range retracted substantially prior to rather than after 1944. Numbers of the Common Murre (*Uria aalge*) on the Farallon Islands were reduced by several hundred thousand from the mid-19th to early 20th centuries by commercial egg collecting (Ainley and Lewis 1974), and the species was extirpated from the Channel Islands sometime between 1913 and 1944 (Carter 2001). Hence, in scoring nominee taxa, neither the population decline nor the extirpation of the murre were considered because both occurred prior to 1944. If the criteria had been modified to set a period of measurement to accommodate the murre or other species with similar histories, it likely would have just shifted the bias to other species rather than eliminating it entirely. In choosing such a period, there appear to be some temporal biases that affect most species in a like manner but change over time. For example, scores for population and range trend based on a period including the distant past might be expected to be less accurate than those for a more recent period, when typically more information is available, whereas the effects of habitat loss and other threats on species' populations and ranges likely average greater in recent decades. These patterns reflect a progressive increase in ornithological study paralleling generally greater impacts on birds with the ongoing expansion of the human population and advances in technology.

Although arbitrary, the 1944 cutoff date does have advantages over others. This date was chosen because it corresponded to Grinnell and Miller's (1944) seminal book on the status and distribution of California birds. This was the first book, and it is still the only one, though it is now out of date, to accurately describe the relative abundance, distribution, historic trends, and habitat needs of all of the state's birds. Thus it is a convenient benchmark with which to gauge subsequent trends, even though knowledge at the time of its publication, as now, was not uniform across all species. Although much ecological damage from human activities occurred before 1944, this date corresponds with a relative lull before the great human population boom and attendant impacts that began in California shortly after World War II. Thus the period from 1944 to the present is a good period for gauging the modern-day effects of humans on the state's birds and habitats.

Other ranking schemes take a similar modern-day approach to gauging conservation concern. In ranking vertebrates in Florida, Millsap et al. (1990) gauged scores for population trend on patterns over the past 20 years, though one of the categories gave higher scores for a population that formerly experienced declines but was currently stable or increasing than for one with a comparable current trend but no prior record of declines. PIF's assessment process for conservation of landbirds in the United States bases scores for "Relative Abundance," "Population Trend," and "Area Importance" primarily on analyses of BBS data (Carter et al. 2000, Panjabi 2001, Panjabi et al. 2005), which are available for the period from 1966 to the present. When BBS data are unavailable, the PIF system substitutes other information (e.g., Christmas Bird Count data, expert opinion), and "all changes in population size are assessed over a 30-year period" (Panjabi 2001). Although most CBC data are available online (www.audubon.org/bird/cbc/), rigorous analyses of broad-scale patterns are currently available for the period 1959–1988 only (Sauer et al. 1996).

Subjectivity

Any so-called objective ranking system will still have subjective elements. In many cases, this will follow directly from limited knowledge, which will force a categorization on the basis of poor (anecdotal or indirect) or no data on a taxon's status or limiting factors. In almost any system, including the present one, the threats criterion is surely the most subjective (see Beissinger et al. 2000). This stems from a lack of knowledge of how much effect various threat factors currently are having on a particular taxon, compounded with the great difficulty of predicting the future course of events on the basis of present knowledge, which is the essence of our threat criterion at least. Still, the threats facing each taxon are the best indicator of the likelihood it will decline and ultimately face extirpation in the state, and hence must be evaluated, even if somewhat subjectively. Evaluation in this manner will likely continue indefinitely, as knowledge will always be limited and prediction of the future will remain risky. In this regard, refining techniques to track the population trends and distribution of all taxa will be beneficial, as "a demonstrated long-term negative population trend often is a more reliable cue that a species is in trouble than is information on known or theoretical threats" (Beissinger et al. 2000, p. 554). In the meantime, assessment of threats should be done cautiously to guard against either over- or underestimating the future effect of threats. Likewise, biologists should be circumspect when evaluating population trends, as in some cases declining trends may reflect plant succession and a return of bird numbers to lower levels representative of conditions before human activities altered their habitat (Beissinger et al. 2000).

Uncertainty

Uncertainty is a pervasive feature in all attempts to discern the truth about natural systems but is one not easily remedied (Regan et al. 2002). Akçakaya et al. (2000) concluded that any classification of conservation status involves several types of uncertainty: semantic (use of inexact definitions), measurement error (lack of precise information on some or most variables), and natural variability (temporal and spatial variation in population size and distribution). Objective ranking systems typically attempt to reduce the uncertainty in the prioritization of species for conservation by giving scores for multiple biological criteria, defining criteria exactly, and gathering all available data. Despite the best of efforts, some or all forms of uncertainty will remain.

Various approaches have been taken to accommodate uncertainty. The IUCN (2001, Annex 1) provided general guidelines for how assessors should handle uncertainty when assigning criteria scores, including ways to handle attitudes toward risk and uncertainty. As a last resort, they provided a category of "Data Deficient," that is, data are inadequate to determine the degree of threat faced by a taxon. Some ranking systems have designed one or more criteria such that a taxon is given a higher score of concern if there is uncertainty about the actual value for a criterion. For example, the PIF prioritization system links each population trend score with a supplemental score that assesses the quality of BBS data (Carter et al. 2000). In cases where the supplemental score leads to a categorization of "trend uncertain," the species is given a higher score than one known to be stable. The reasoning is that it is more conservative to weight the score toward the assumption the species might be declining rather than that it might be stable or increasing. PIF formerly assigned data quality scores to their "threats to breeding" and "threats to nonbreeding" criteria but dropped them, apparently because they were rarely used or caused confusion (Carter et al. 2000). Beissinger et al. (2000) recommended that PIF add a "separate overall uncertainty variable [that] would be helpful in assessing confidence in species' ranks and would assist in identifying research needs."

Knowledge of uncertainty can be useful in prioritizing management and research activities. For vertebrates in Florida, Millsap et al. (1990) ranked all taxa for a set of "action variables" as well as biological variables. The former scored taxa for the amount of knowledge available on distribution, population trend, and population limitations in Florida and also for the extent of ongoing management activities for these taxa in the state. In selecting priority taxa for management or research, they considered only taxa known or suspected to be declining. Then, taxa for which current knowledge of these action variables was adequate were considered strong candidates for management activities, and those for which limiting factors were poorly known were considered strong candidates for research.

The BSSC ranking system incorporates uncertainty in a limited fashion, but the species accounts in this document provide much information about the degree of knowledge available on special concern taxa. The population trend and range trend criteria incorporate uncertainty in a minor way by giving taxa whose populations or ranges are designated as "suspected of having been reduced but trend unknown" an equivalent score to ones for which there is evidence that these parameters are "slightly reduced," and a higher score than ones whose populations or ranges are known to be "stable or increasing." Suspicion of such trends, however, must be based on some biological knowledge of at least an anecdotal nature. We assessed the level of monitoring being conducted for all special concern taxa (Table 7), and the amount of knowledge available for scoring each of the seven criteria is presented in the species accounts, which also make recommendations for management, monitoring, and research needs.

Refinement of Ranking Schemes

Because of the uncertainty factors discussed above, there is pressure to refine ranking schemes to make them more biologically accurate and relevant to conservation. Refinement may involve improving the definitions of individual criteria, adding new criteria, or fine tuning the ranking system that uses the criteria scores to prioritize taxa for conservation. Examples of ongoing refinement are the ranking systems of the IUCN (e.g., IUCN 1994, 2001, 2006) and PIF (Carter et al. 2000, Panjabi 2001, Panjabi et al. 2005). There also is an extensive literature on ways to improve ranking systems (e.g., Todd and Burgman 1998, Colyvan et al. 1999, Akçakaya et al. 2000, de Grammont and Cuarón 2006). We suspect that some of these suggestions have not been widely adopted because they would be difficult to apply to a long list of taxa and may require sophisticated mathematical knowledge, or simply because of resistance to change once a particular system is in place. Although a good ranking system must address ecological complexity, it seems that to be widely used it must be relatively straightforward to understand and apply (especially by resource managers). Some practical suggestions for refining ranking protocols include providing training in their application, incorporating uncertainty in parameter estimates, and using consensus among multiple assessors (Keith et al. 2004).

During its deliberations to develop the present system, the technical advisory committee evaluated and rejected various additional criteria used by other ranking systems. For example, some systems include a criterion for "taxonomic (or phylogenetic) uniqueness," which places value on preserving unique lineages by, for example, giving a higher score to a lone representative of a monotypic family than for a race of a geographically widespread species or for a species within a diverse genus (see Beissinger et al. 2000). The advisory committee rejected such a criterion because it was considered *not* to be a core measure of a taxon's risk or likelihood of extirpation in the state but rather a *value* judgment of what taxonomic entities were more deserving of protection. Although rejecting the criterion as part of the ranking scheme, the advisory committee noted that various additional factors, including this criterion, could be used as further screens for prioritization on top of the primary ranking scheme (see below). This parallels the distinctions made by Millsap et al. (1990). They scored taxa for five supplemental variables, including "systematic significance of taxon," but did not use them to rank taxa for setting conservation priorities. Rather they used these variables to "answer specific biological and political questions."

Other criteria used by some ranking systems include "ecological specialization" (Millsap et al. 1990) or "habitat specificity" (Reed 1992). Although a majority of the advisory committee initially favored the inclusion of scores for "ecological specialization," we ultimately rejected this criterion because of our inability to define categories of specialization that would be objective to apply. Whereas Millsap et al. (1990) judged that an ecological specialization criterion was needed to measure vulnerability to environmental change, some advisory committee members judged that any such specialization or vulnerability would be taken into account in the scoring of the threats criterion (on the assumption that, all else being equal, specialized taxa would be more likely than generalists to be affected by threats) or reflected in the scores for population trend and range trend (assuming that specialists are the most likely to experience declines). Beissinger et al. (2000) recommended the inclusion of an ecological specialization criterion as one of several potential refinements to the PIF ranking system.

Comparison with 1978 List

Comparison of the 1978 list of birds of special concern with the current one is difficult because the former was derived subjectively, the latter via an objective ranking scheme. Still, there are some obvious explanations for why these lists differ (Appendix 2). The major reasons for the changes since 1978 are the removal of various taxa because of their listing as state threatened or endangered, the addition of more subspecies to the current list, changes in the status of various species in the intervening years, and the change in methods for deriving the list. Since 1978, eight taxa on the original special concern list have been listed as state threatened (the Swainson's Hawk, Greater Sandhill Crane, and Bank Swallow) or endangered (the Marbled Murrelet, Gila Woodpecker, Gilded Flicker [formerly a subspecies of the Common Flicker], Willow Flycatcher [all California subspecies], and Arizona Bell's Vireo). One species not on the 1978 list, the Xantus's Murrelet, was scored and placed on the recent draft list but was subsequently removed because it was listed as state threatened before the draft special concern list was made final. In 2000, the Short-tailed Albatross was listed as federally endangered. Hence by the present definition it qualified for special concern status as a federally, but not state, listed taxon; prior to that it would have qualified as a species that had been extirpated from California waters in its primary seasonal role. The 1978 list included two subspecies in the "highest priority" category, but explicitly excluded consideration of any subspecies for inclusion in the other two priority categories (Remsen 1978). As noted above, the two subspecies on the 1978 special concern list have both since been listed as state endangered. Still, 24 subspecies have been added to the special concern list from 1978 to the present (Table 1 and Appendix 2).

Reasons for other changes in the list since 1978 are less clear because it is not certain what would have been included on the 1978 list if it had used the same objective ranking criteria as used for the current list. In some cases, the ability to evaluate some taxa has been enhanced since 1978 by the recent availability of more or higher quality data (e.g., the Black Tern, Shuford et al. 2001). Regardless, the following species included on the 1978 but not the current list have all experienced recent population increases in California: the Double-crested Cormorant (Carter et al. 1992), White-faced Ibis (Shuford et al. 1996, Earnst et al. 1998), Osprey (Gould and Jurek 1988), Cooper's Hawk (California county atlas data), Merlin (A. Fish/Golden Gate Raptor Observatory unpubl. data), and Rhinoceros Auklet (Carter et al. 1992, McChesney et al. 1995). In addition to its increasing numbers, the California Gull was not included on the current list because the main threat to the breeding population was reduced by a state water board order that will maintain lake levels at Mono Lake that will protect the state's largest colony from ground predators (Shuford and Ryan 2000, Strong et al. 2004). The following taxa were added to the current list in part because of substantial recent population declines or range retractions in California: the Wood Stork, Mountain Plover, Olive-sided Flycatcher, Grasshopper Sparrow, and Tricolored Blackbird (see accounts). It is likely, however, that the reason that a large number of the 22 other taxa that were either removed from (12) or added to the list (10) from 1978 to the present was solely the application of the new ranking scheme. Thus, on biological grounds there may not have been much of a change in the conservation status of these taxa since 1978. Among those removed are six taxa (the Laughing Gull, Brown-crested Flycatcher, Virginia's Warbler, Hepatic Tanager, Gray-headed Junco, and Northern Cardinal) that reach the edge of their range in California. These taxa have either increased in population size (or colonized California) since the publication of Grinnell and Miller (1944), occur in such small numbers that their fate is likely greatly influenced by the dynamics of breeding populations in Arizona or Nevada (thus unlikely to benefit much from conservation efforts in California), or face no substantial threats to their well-being (see Appendix 1).

Habitat and Geographic Patterns

The high representation of special concern taxa within wetlands, scrublands, grasslands, and riparian forests (Table 4) is not surprising given these are the habitats with the highest rates of loss in California. Estimates indicate that California has lost over 90% of its original wetlands (Dahl et al. 1991), 95% of its riparian habitat (RHJV 2004), and 60% of its grasslands (CalPIF 2000). Although authors frequently emphasize these high rates, these percentages hide the true extent and complexity of the loss both in terms of structure and function. Degradation and fragmentation can have profound effects on biodiversity (Saunders et al. 1991, Debinski and Holt 2000). Among the greatest losses of ecosystem function affecting birds in California is that of our natural hydrology, which before human intervention greatly enhanced biological productivity both in space and time. The periodic flooding of areas such as the Central Valley and lower Colorado River valley formerly formed a diverse mosaic of permanent and ephemeral wetland and riparian habitats that depended on such perturbations for renewal (Rosenberg et al. 1991, Shuford et al. 2001). Restoring natural function to such habitats will be among the greatest conservation challenges in the state, though models exist for ways to meet human needs and also conserve the ecological integrity of riverine ecosystems (Richter and Richter 2000). Fortunately, efforts to conserve birds in the habitats mentioned have greatly increased recently via joint ventures and regional working groups of the North American Waterfowl Management Plan (e.g., USFWS 1990, CVJV 2006), U.S. Shorebird Conservation Plan (Brown et al. 2001, Hickey et al. 2003), and various California PIF bird conservation plans (e.g., CalPIF 2000, 2002; RHJV 2004).

The conservation of biodiversity in California faces great challenges because regions of the state with high numbers of special concern taxa (Table 5) also have the highest human population densities and projected future growth rates. From 1980 to 2003, California led all states in absolute coastal population growth, adding 9.9 million people to coastal areas, and ranked sixth in percent increase (47%) in coastal population (Crossett et al. 2004). In 2003, Los Angeles, Orange, and San Diego counties, respectively, were the first, fourth, and fifth most populous counties in the United States. Of the 10 coastal counties in the nation that experienced the greatest increases in population from 1980 to 2003, 6 were in California. Projections indicate that San Diego County will be the leading coastal county in population increase from 2003 to 2008. Along with Orange, San Bernardino, and Riverside counties, it will account for 12% of the nation's expected coastal population growth (Crossett et al. 2004). Projected growth will also be high in the San Francisco Bay region and the Sacramento-Yolo county area.

These areas seem to qualify as "hotspots of vulnerability," that is, areas with both restricted-range species and high projected rates of human population growth and development (Abbitt et al. 2000). On a broader scale, such hot spots correspond to many of the areas in the United States with large numbers of endangered species.

Likewise, urbanization continues to reduce agricultural lands in the Central Valley at a rate among the highest in North America (American Farmland Trust 1995, Sorensen et al. 1997). Also, housing densities are expected to increase greatly on private forests in some regions of California in the next three decades (Stein et al. 2005).

Changing Threats

Vigilance is needed as threats facing birds change over time. In the 19th and early 20th centuries, birds were heavily exploited for their feathers, meat, and eggs, but demand waned with legal regulations and changing attitudes (Wilcove et al. 2000). Similarly, in the past few decades reproductive impairment of birds has been greatly reduced by banning, regulating, and managing the use of toxic compounds (e.g., Boellstorff et al. 1985, Snyder-Conn et al. 1999). Today, birds in California face a variety of threats, but foremost among them is habitat loss and degradation, including fragmentation (Table 6). Habitat loss is also the single greatest threat to birds throughout the United States (Wilcove et al. 1998) and worldwide (Collar et al. 1994). Habitat loss also can explain much of the patterns of variation in numbers of at-risk species across entire countries and may be the leading factor inhibiting their recovery (Kerr and Deguise 2004). Thus, strategies to conserve at-risk birds in California must place a high priority on protection, restoration, and enhancement of their habitats.

Given the pervasiveness of habitat loss and degradation, conservationists should be constantly attuned to potential new threats to at-risk birds that might exacerbate current problems. Examples are transmission of long-standing diseases by novel mechanisms, as in the case of type C botulism killing thousands of pelicans and other fish-eating birds at the Salton Sea in the 1990s (Rocke et al. 2004), or the rapid spread of entirely new diseases such as West Nile virus, which has spanned North America since 1999, killing thousands of birds of a variety of species (Marra et al. 2004). Although future impacts are uncertain, this virus has been linked to local declines of birds, and it appears that corvids and some flocking waterbirds may be particularly susceptible. Biologists have already shown that West Nile virus has reduced late summer survival of Greater Sage-Grouse (Naugle et al. 2004). In addition to these grouse, California's endemic corvids (the Yellow-billed Magpie and Island Scrub-Jay) should be closely monitored for signs of large-scale mortality or reduced fitness from this virus.

Ways to Prioritize

The large number of prioritization schemes that are applicable to California at the state, national, or continental scale (Appendix 2) can confuse those attempting to set conservation priorities. Confusion may arise because various schemes are designed for different purposes, or when lists mix short- and long-term conservation goals without so stating. For the latter reason we developed two lists for California: the primary Bird Species of Special Concern list (Table 1) and a complementary but secondary Bird Responsibility List (Table 8). The former has regulatory implications and will serve best as a tool for short- to medium-term planning; the latter will serve best for medium- to long-term planning.

The species of concern list provides direction for conservation and research by identifying three levels of priority. Prioritization can be further refined by other factors. We recommend raising the priority of taxa that occur on both the special concern and responsibility lists (see Tables 1 and 8), as not only are these in immediate need of protection but also their continental or global conservation can be ensured only by actions taken mostly in California. Taxa warranting heightened consideration are ones on either of the two California lists that are also listed as "vulnerable" at the global scale by the IUCN (2006; see Appendix 2). The only such species on the current BSSC list is the Mountain Plover, though the Xantus's Murrelet, originally a nominee but since listed as state threatened, also meets the IUCN criterion. Priority might also be raised for funding for restoration, research, or monitoring if multiple species of special concern might benefit. Such a case might involve projects along the Colorado River that could simultaneously benefit special concern taxa such as the Vermilion Flycatcher, Crissal Thrasher, Lucy's Warbler, Sonora Yellow Warbler, and Summer Tanager, as well as threatened and endangered taxa such as the Western Yellow-billed Cuckoo, Elf Owl, Gila Woodpecker, Gilded Flicker, Southwestern Willow Flycatcher, and Arizona Bell's Vireo. Projects of this sort might have a very high rate of return relative to expenditure. Because today so much conservation planning is habitat based, efforts to prioritize for the protection of species of special concern should be coordinated with other California plans for habitats such as grasslands, oak woodlands, and riparian forests and woodlands (CalPIF 2000, 2002; RHJV 2004). Priorities sometimes may be superceded by opportunities, however, such that low priority species may fortuitously benefit from actions that occur in an area with no high priority species.

Evaluation of patterns of distribution of special concern taxa with respect to habitats and geographic areas of the state (Tables 4 and 5) provides some additional insight for prioritization at the local, regional, or statewide level. Recognition of distribution patterns by habitat will alert those with management responsibility for various habitats of the special concern taxa most in need of conservation when prioritizing restoration or land acquisition. Similarly, knowledge of the distribution of these taxa by geographic areas will help local and regional planners address both human needs and those of birds most in need of protection. This may be especially important in areas such as coastal southern California, which holds a high number of species of concern, has lost vast tracts of native habitat, and faces ongoing development. These pressures are expected to intensify on the basis of projected rates of future population increase.

Research and Monitoring

The need for research and monitoring to enable protection and recovery of birds of special concern has been recognized since the inception of the list (Remsen 1978). Our evaluation of the effectiveness of current monitoring programs for these taxa indicates that progress in this realm has been modest in the past two decades. Effective monitoring programs are also needed for all "Taxa to Watch" and all nominees to the current special concern list. Similarly, the many research needs listed in the species accounts highlight the importance of gathering more information to foster adaptive management for these birds by taking corrective action as new insights are gained (Walters 1986). We recommend that, when possible, monitoring programs be designed to encompass multiple species (both at-risk taxa and others) to economize effort and maximize benefit. Single-species monitoring will still be needed, however, as simulations of multispecies monitoring of vertebrate taxa in the Sierra Nevada indicate that detections would be inadequate for rare and endemic species and species of concern (Manley et al. 2004). Thus, monitoring programs for species of concern in California should overcome the difficulties of gathering suitable data on the many such taxa that have small populations or are very locally distributed.

Whenever possible, monitoring efforts for the state's special concern taxa should integrate and coordinate with regional or continental monitoring programs in existence (e.g., Pacific Flyway Council, http://pacificflyway.gov/Monitoring.asp, for waterfowl) or in development (e.g., Waterbird Monitoring Partnership, www.pwrc.usgs.gov/cwb/). Likewise, design and refinement of monitoring programs or research needs for special concern taxa in California should build on the coordinated efforts of continental assessments (e.g., Partners in Flight Research and Monitoring Needs Database, www.partnersinflight.org/pifneeds/).

Using the List to Foster Conservation

Stewardship Responsibility for a Rich Bird Fauna

California supports exceptional biodiversity because of its large size, diverse habitats and environmental heterogeneity, and relative isolation from the rest of the continent (Stein et al. 2000, Stein 2002). In terms of its flora and fauna, California leads the nation in overall species richness, number of state endemics, and rare species.

The state's avifauna is extraordinary at both national and global scales and thus deserves strong protection and conservation efforts on its behalf. As of 30 December 2006, the CBRC (2007) recognized 632 species of birds as having been documented for the state, including 283 regularly nesting native species. In terms of number of regularly occurring species of birds, California ranks among the top four states in the nation (Stein et al. 2000, Stein 2002); for number of subspecies of birds, it probably ranks at the very top (P. Unitt pers. comm.). On a global scale, it is the only mainland region of the United States recognized as an "Endemic Bird Area" by BirdLife International, because of its endemic and near-endemic bird fauna (Stattersfield et al. 1998). Along with the possession of such a rich and diverse bird fauna comes the responsibility for its conservation. The species of special concern list is one of several tools that can be used to help meet stewardship responsibility for the state's incredible bird life, and the habitat it depends on, and to foster conservation of its at-risk birds.

Legal and Regulatory Mandates

Although most birds in California are given protection by the federal Migratory Bird Treaty Act (MBTA; 16 U.S.C. 703–712) and its state counterpart, the Extension and State Codification of the MBTA (Fish and Game Code § 3513), few state or federal statutes have specific provisions requiring evaluation of the effects of detrimental actions on these species, and examples of enforcement of known destruction are exceptionally rare. Foremost among the statutes requiring strict evaluation of potential impacts are the federal (16 U.S.C. 1531–1543) and state (Fish and Game Code § 2050–2116) endangered species acts, which provide the highest level of protection to birds listed as threatened or endangered.

Other at-risk birds, such as species of special concern, may still obtain protection under other statutes. The California Environmental Quality Act (CEQA; California Public Resources Code § 21000–21177) requires state agencies, local governments, and special districts to evaluate and disclose impacts from "projects" in the state. Section 15380 of the CEQA Guidelines indicates that species of special concern must be treated as endangered, threatened, or rare if they meet the definitions. Of particular relevance to species of concern is section 15063 of the guidelines, which addresses mandatory findings of significance and the standards under which a lead agency determines if impacts to biological resources should be considered significant, thereby triggering preparation of an Environmental Impact Report under CEQA. Project-level impacts to listed (rare, threatened, or endangered) species are generally considered significant and thus require lead agencies to prepare an Environmental Impact Report to fully analyze and evaluate the impacts. In assigning "impact significance" to populations of nonlisted wildlife species, analysts usually consider factors such as population-level effects, proportion of the taxon's range affected by a project, and impacts to habitat features. Similarly, the National Environmental Policy Act (NEPA; 42 U.S.C. 4321–4347) requires federal agencies to consult with the U.S. Fish and Wildlife Service to avoid or mitigate impacts to sensitive species if a federal action would result in a "significant impact." The BSSC document contains sufficient detail to aid those determining and defending the assignment of impact significance under both CEQA and NEPA.

The Natural Community Conservation Planning (NCCP) Act (Fish and Game Code § 2800–2840) establishes a statewide program for the development of broad-based regional conservation plans. Its goals are to "provide for effective protection and conservation of the State's wildlife heritage while continuing to allow appropriate development and growth" (§ 2801). Administered by CDFG, the NCCP program promotes voluntary collaborative planning between CDFG and other state agencies, federal and local governments, property owners, developers, and environmental groups. NCCP plans seek to conserve ecosystems and their associated species. Some of these species are currently listed as threatened or endangered, but others are considered sensitive species with the potential to be listed in the future. Those deemed adequately conserved by an NCCP plan are called "covered species."

The U.S. Congress amended section 10 of the federal Endangered Species Act to authorize "incidental take" through the development and implementation of Habitat Conservation Plans (HCPs), which remain in effect through the life of the project (Nelson 1999). The HCP integrates the applicant's proposed project or activity with species' needs and describes, among other things, the anticipated effect of a proposed taking on affected species and how that take will be minimized and mitigated. HCPs also include conservation measures for other at-risk species, including candidate species, proposed species, and others of concern at the time an HCP is developed or a permit application is submitted. This process benefits the permittee by ensuring that the terms of an HCP will not change over time with subsequent species listings, while also providing early protection for many species, ideally preventing declines and, perhaps, the need to list them.

The BSSC document will serve an important function in providing planners with a list of important bird taxa to consider and prioritize for conservation when initiating and implementing NCCPs and HCPs.

Conservation Approaches: Single Species to Landscapes

Ongoing habitat loss and degradation from a rapidly expanding human population, coupled with limited resources to cope with attendant impacts, require a multitude of conservation actions, some regulatory, others voluntary. Conservation biologists have proposed a number of ways to design reserve networks and select areas that have the highest need for protection. These include selection of "hotspots"—geographic areas with high species numbers (richness), endemism, or rare or threatened species—which may vary over spatial and temporal scales (e.g., Williams et al. 1996, Flather et al. 1998, Reid 1998, Rutledge et al. 2001). Selection may also be based on surrogate species, including those with large range sizes whose protection may also mean protection of many other species (umbrella species) or ones that denote areas of high species richness (indicator species; Lambeck 1997, Caro 2000, Rubinoff 2001). Chase et al. (2000), however, suggested that efforts to conserve birds of coastal sage scrub in southern California should not focus exclusively on rare species or on areas with the highest species richness but on a diverse suite of species representative of the range of variation in communities found in sage scrub habitats. Furthermore, the inclusion of species that are relatively common or easily monitored can produce the necessary sample size to measure population response to habitat change or loss (Chase and Geupel 2005). This "focal-species" approach has been applied to planning efforts for California's major habitat types and is the foundation of California Partners in Flight, a statewide initiative to conserve birds and habitat.

While too great a focus on conservation of one or a few extremely rare species may be undesirable, a proactive approach that considers all native species equally may shift scarce resources away from species that could benefit the most from them (Cassidy et al. 2001). Multispecies planning efforts can also benefit from knowledge gained from single-species conservation plans (e.g., Shuford 1999), as areas managed for multiple species may not necessarily provide extensive habitat for species with restricted needs (e.g., Shuford et al. 2001).

Others have emphasized biodiversity conservation at a landscape, ecosystem, or habitat level that supports natural processes and their natural ranges of variability (e.g., Poiani et al. 2000). Efforts to identify optimal reserve networks over large landscapes are, of course, laudable, but these work best when the entire network can be implemented immediately. More simple decision rules, such as protecting the available site with the highest irreplaceability or species richness, may be more effective when implementation occurs over many years (Meir et al. 2004).

In summary, a high priority should be placed on protecting natural processes and species, subspecies, and distinct populations that are nearing endangerment because of declining populations or vulnerability to threats. The identification of such taxa by California's BSSC list provides a starting point from which to work regardless of the method of protection selected. Success will be enhanced if efforts are intensified before populations decline further and if they emphasize voluntary rather than regulatory measures.

Synergy via Partnerships and Approaches

Protection, restoration, and enhancement of habitats for at-risk species will of necessity take a multifaceted approach. The Department of Fish and Game already considers species of special concern during the processes of environmental review (e.g., CEQA), conservation planning, land acquisition, and preparation of management plans for department lands, and during inventories, surveys, and monitoring conducted by the department or its cooperators. Habitat Conservation Plans and Natural Community Conservation Plans are innovative approaches (O'Connell and Johnson 1997, Harding et al. 2001) and, as noted above, seem well suited to addressing the needs of species of special concern. To be effective, these efforts should be enhanced by the actions of other stakeholders, including other state, federal, and local agencies, nongovernmental organizations, and private landowners. Although regulatory actions afford some protection, other methods may prove more effective. Such methods include public and private land acquisition, conservation easements, tax incentives, and cost-share programs for habitat enhancement (Bean 2000). Cooperative and proactive efforts among agencies and other groups and between managers and scientists tend to be the most effective in sensitive species protection (Squires et al. 1998).

Knowledge of the distribution of at-risk taxa can be useful in identifying Important Bird Areas (Grimmett and Jones 1989; for California, Cooper 2004), thereby highlighting their need for protection. While creation of new reserves is highly desirable, an emphasis on terrestrial reserves may come at the expense of marine reserves (Lindholm and Barr 2001). There currently is a strong movement to establish fully protected marine reserves (Roberts and Hawkins 2000, National Research Council 2001), which are needed in California. There also is recognition that protection of many migratory species will require cooperation across international borders (Commission for Environmental Cooperation 2000).

State, Regional, and Continental Conservation Planning

Broad-scale habitat loss and declines in bird populations have stimulated the development of various national or continental, multipartner conservation initiatives in North America over the past two decades. The first of these focusing on wetland birds was the North American Waterfowl Management Plan in 1986 (updated three times; NAWMP Plan Committee 2004), implemented through regional joint ventures. Subsequent plans include the U.S. Shorebird Conservation Plan (Brown et al. 2001) and the North American Waterbird Conservation Plan (Kushlan et al. 2002). These plans implement conservation actions through their respective regional plans (e.g., Hickey et al. 2003, Ivey and Herziger 2006) and working groups (typically organized around Bird Conservation Regions), often in collaboration with joint ventures of the waterfowl plan.

Similar conservation initiatives for terrestrial landbirds have been developed since 1990 under the umbrella of Partners in Flight (Rich et al. 2004). Landbird conservation is being implemented by regional and state working groups, habitat-based conservation plans (e.g., CalPIF 2000, 2002), specific habitat joint ventures (e.g., California Riparian Habitat Joint Venture, RHJV 2004), and the joint ventures of the waterfowl plan. The latter have begun to consider conservation for all birds.

With an accelerated pace of conservation planning, there is an increasing need for integration of various plans at the state, regional, national, and international levels to catalyze efficient use of partnerships and resources. In 1999, the North American Bird Conservation Initiative (NABCI) formed to achieve integrated bird conservation to benefit all birds in all habitats. Its coalition of partners aim to "ensure the long-term health of North America's native bird populations by increasing the effectiveness of their bird conservation initiatives and programs, enhancing coordination among their initiatives and programs, and fostering greater cooperation among the continent's three national governments and their people" (www.nabci-us.org/nabci.html).

In California, the Department of Fish and Game recently met requirements of the federal State Wildlife Grants program by developing a state Comprehensive Wildlife Conservation Strategy under the California Wildlife Diversity Project (CDFG 2007). This effort reviewed wildlife species (invertebrates, vertebrates) of concern in each bioregion of the state to identify conservation challenges and develop a strategy or framework that will highlight stewardship activities necessary to halt species' declines and to maintain species diversity. The project acknowledges the importance of the approach used in the BSSC document in developing a rigorous and defensible assessment of factors responsible for the decline and vulnerability of many California bird taxa and considers many of the same recommendations in constructing the framework (K. Hunting pers. comm.).

The development of the ranking system of California Bird Species of Special Concern has benefited from extensive review of comparable ranking systems of the aforementioned conservation initiatives (e.g., Carter et al. 2000, Panjabi 2001). Conversely, a draft version of the BSSC system was consulted in development of U.S. Fish and Wildlife Service's national ranking of Birds of Conservation Concern 2002 (USFWS 2002, T. Zimmerman pers. comm.) and for the ranking of conservation concern for waterbirds in the Intermountain West (Ivey and Herziger 2006). The prior draft BSSC list has already been used as one element in the ranking of priority for on-the-ground restoration projects on private lands in California, for example, the California Landowner Incentive Program (D. Smith pers. comm.). Also, California Partners In Flight has been using the draft BSSC list as its primary reference for identifying species of concern in California and will use the published document for information on their current status and conservation issues (G. Geupel pers. comm.).

BSSC and the other conservation initiatives should prove to be synergistic over the long term. Other plans likely will benefit both from BSSC's detailed assessments of status and recommendations for research, management, and monitoring in its species accounts and from the overview analyses of the habitats and regions of the state where conservation of at-risk taxa is most needed. Likewise, subsequent updates of the BSSC list, and the taxa identified, will benefit enormously from the ongoing information gathering and implementation of the science-based conservation initiatives.

Recommendations

To promote advances in conservation of birds of special concern in California, we recommend the following:

- Establish a permanent Bird Species of Special Concern Technical Advisory Committee to meet annually to review the status of California's at-risk birds. The committee would vote on recommendations to CDFG on adding or removing taxa from the special concern list on the basis of documented information provided in support of requests for changes to specific scoring criteria.
- Update and thoroughly revise the special concern report every five years, or more frequently if circumstances warrant it. When possible, refine the ranking criteria and scheme to improve their ability to identify species of concern and place them within priority categories for conservation; also seek ways to reduce or better account for uncertainty of biological data.
- In future revisions of the California Bird Species of Special Concern list, highlight

increasing populations and any actions responsible for their recovery. This strategy can bolster optimism, an important component of effective conservation (Beever 2000), thereby strengthening public motivation and advancing the confidence of conservationists by quantifying and stressing successes and by showing promising possibilities for action (Gigon et al. 2000).

- Maintain an online database to track new information on special concern taxa and to document criteria scores and any changes made to them. The database's website should allow for online entry of new data on birds of special concern, following quality control protocols established by CDFG. Also, refine the database with scores for all nominee taxa to better document the sources of information forming the basis for scores so that scores can more readily be updated and new taxa added to the special concern list as warranted.
- Prepare a report to recommend specific, cost-effective protocols that can be used to monitor trends of all special concern taxa. Methods should strive to monitor multiple species simultaneously, produce statistically valid results with error estimates, and incorporate skilled volunteers and citizen scientists whenever possible to both lower costs and broaden the constituency for protection of at-risk birds. Monitoring goals should be well articulated to answer specific questions relevant to management (Noss 1990).
- Identify a volunteer coordinator to obtain and maintain volunteer support for monitoring programs of special concern birds.
- Prepare a report recommending research priorities for the next decade that will provide needed information to enable better management to protect and aid recovery of populations of at-risk birds (see Mace et al. 2001, Soulé and Orians 2001). Building on recommendations in the species accounts in this document, the report should prioritize research needs on not only the ecology of at-risk birds but also baseline distributional surveys needed to develop plans for habitat protection and taxonomic studies needed to broaden our understanding of what needs to be protected. Prioritization of research needs should stem from a ranking of the uncertainty of knowledge on which the various criteria scores for each taxon were based and on the likelihood of answering important questions relevant to management and recovery of declining or threatened populations. Research needs should be prioritized both for each taxon and across all taxa. Recommendations should include creative and novel approaches to fund such research.
- Prepare a report that predicts the impacts of climate change on both current BSSC taxa and those California bird taxa considered most sensitive to its effects but not yet at risk because current impacts are low (i.e., species that have a latent risk of extinction; Cardillo et al. 2006). Such an analysis should serve as an early warning system to guide managers in adopting a longer-term approach to conservation. Indeed, some climate scenarios, if realized, are expected to produce greater extinction rates than habitat loss, currently the top threat to biodiversity (see Wormworth and Mallon 2006).
- Prepare a training module for CDFG staff, other state, federal, and local agencies, private organizations, and private citizens to review the purpose and application of species of special concern lists and how they fit into impact analysis and land use planning.
- Develop an outreach program to inform biologists, land managers, and decision makers of the need to protect at-risk birds and of the best methods to do so. Materials should emphasize that money spent up front to protect and maintain self-sustaining ecosystems will be far less than that needed later to fund costly recovery and restoration programs.
- Identify a department liaison to coordinate with other multispecies conservation efforts (e.g., Partners in Flight, U.S. Shorebird Conservation Plan) to ensure these plans adequately address the needs of special concern taxa and, conversely, to gather information that can be used for multispecies planning for these at-risk birds. Efforts should strive as much as possible to achieve synergy and consistency between bird species of special concern protection and development and implementation of habitat- or taxonomic-based conservation plans.

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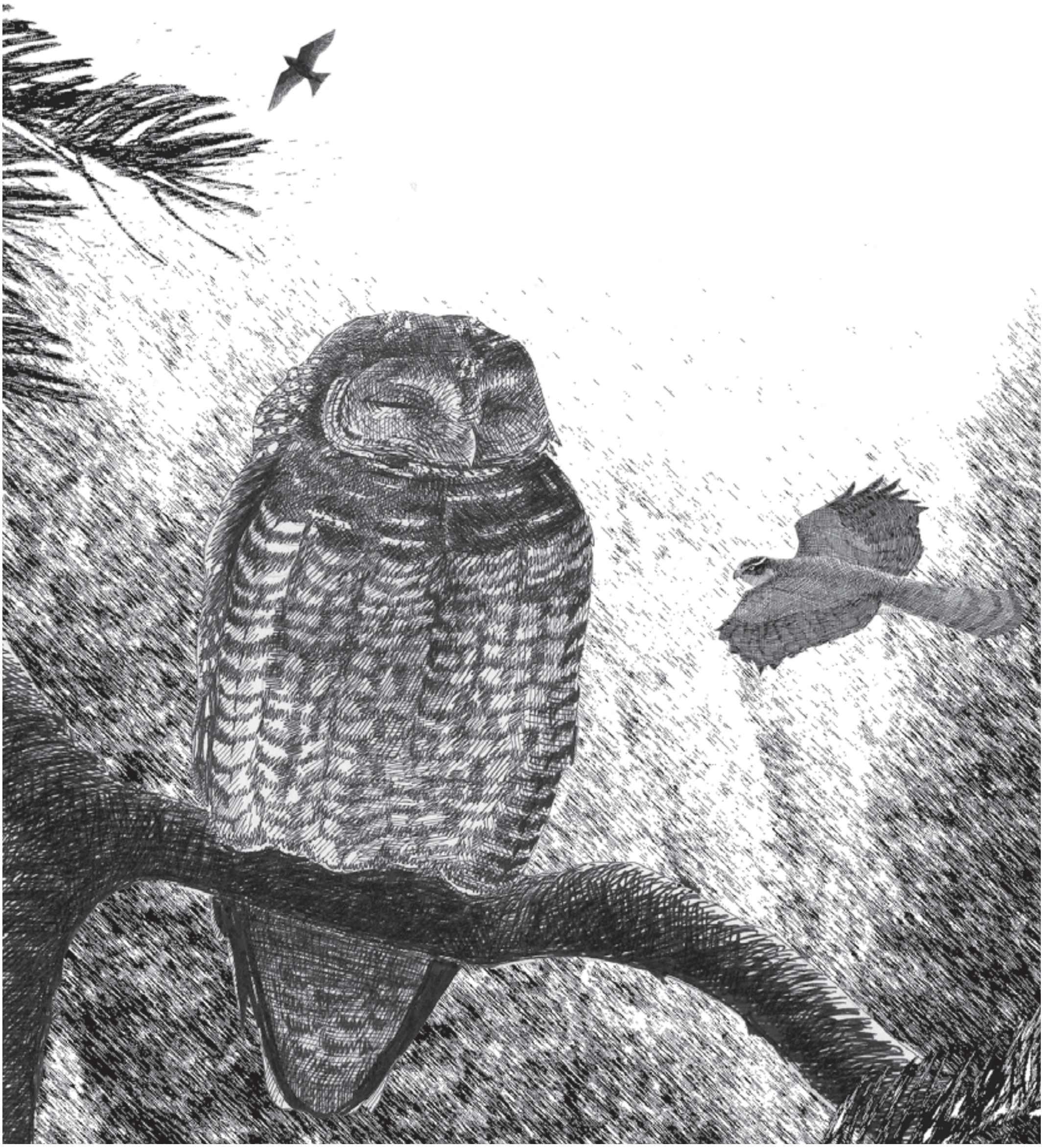


Andy Birch

Appendices

Appendix 1: Annotated List of Taxa to Watch

This list includes taxa that are not on the current special concern list that (1) formerly were on the prioritized 1978 (Remsen 1978) or unprioritized 1992 (CDFG 1992) special concern lists and are not currently listed as state threatened and endangered, (2) have been removed (delisted) from either the state or federal threatened and endangered lists (and remain on neither), or (3) are currently designated as "fully protected" in California (www.dfg.ca.gov/hcpb/species/species.shtml). Brief accounts are provided below for all such taxa; their criteria scores, which indicate lack of biological justification for inclusion on the current BSSC list, are available from CDFG.

Aleutian Cackling Goose

A very large proportion of this subspecies of the Cackling (formerly Canada) Goose stages during migration and winters in California. It was listed as federally endangered in 1967, downlisted to federally threatened in 1990, and delisted in 2001, when the population was considered recovered.

Trumpeter Swan

The Trumpeter Swan is currently considered a "fully protected" species in California. This species' historic status in California is unclear because of problems in identifying it. Grinnell and Miller (1944) reported that it was "believed to have been of regular occurrence, formerly, though in smaller numbers than Whistling [Tundra] Swan . . . [and had been] reported but once since 1900." This swan currently is so rare in California that all known records are evaluated by the California Bird Records Committee (CBRC). Beyond identification problems, the CBRC has struggled with records of this species because of the highly managed nature of many populations in the conterminous United States (especially eastern Washington and eastern Oregon). Some birds in California in winter may originate from populations introduced to, but not well established in, areas outside the species' historic breeding range and hence may not represent normal movements of birds from native or well-established introduced populations (McCaskie and San Miguel 1999).

Ruffed Grouse

Included on both prior special concern lists (Remsen 1978, 3rd priority; CDFG 1992). Although this species is considered a "rare" resident in northwestern California, there appears to be no evidence of population declines in this region (Harris 2005).

Double-crested Cormorant

Included on both prior special concern lists (Remsen 1978, 2nd priority; CDFG 1992). Coastal breeding populations have increased since at least the early 1980s (Carter et al. 1992); apparent increases in interior breeding populations are difficult to interpret because of limited historical data (W. D. Shuford unpubl. data). BBS data for the species in California showed a marginally significant positive trend for the period 1968–2004 (Sauer et al. 2005).

White-faced Ibis

Included on both prior special concern lists (Remsen 1978, highest priority; CDFG 1992). Both breeding and wintering populations have increased greatly in California since the 1980s (Shuford et al. 1996, Earnst et al. 1998).

Osprey

Included on both prior special concern lists (Remsen 1978, 2nd priority; CDFG 1992). Breeding populations have increased significantly in California in recent decades (Gould and Jurek 1988, Sauer et al. 2005).

White-tailed Kite

This kite is currently considered a "fully protected" species in California. Despite the difficulty of tracking the trends of a species that fluctuates greatly from year to year, numbers of kites on BBS routes in California have been relatively stable over the period 1968–2004 (Sauer et al. 2005).

Sharp-shinned Hawk

Included on both prior special concern lists (Remsen 1978, 3rd priority; CDFG 1992). There does not appear to be any evidence of persistent population decline in this species in California. BBS data (1968–2004) for California are inadequate for trend assessment (Sauer et al. 2005).

Cooper's Hawk

Included on both prior special concern lists (Remsen 1978, 3rd priority; CDFG 1992). Breeding populations have increased in California and expanded into urban areas (California county breeding bird atlas data). BBS data (1968–2004) for the species in California are inadequate for trend assessment (Sauer et al. 2005).

Harris's Hawk

Included on both prior special concern lists (Remsen 1978, highest priority; CDFG 1992). Occurrence of this hawk is cyclic in nature in extreme southern California, where it is on the fringe of its natural range (Patten and Erickson 2000). The most recent incursion into the state, apparently from Baja California, was relatively short lived. Beginning in 1994, nearly 50 individuals ranged into California, with most birds in eastern San Diego County. Numbers reached a peak rapidly, and despite nesting from 2000 to 2002—representing the first known successful nesting of wild Harris's Hawks in California for over 40 years—by 2003 the birds had disappeared (Unitt 2004). Incursions into California appear to be in response to conditions outside the state.

Ferruginous Hawk

Included on the previous special concern list (CDFG 1992). There appears to be no documented evidence of substantial declines in numbers of this hawk wintering in California. Expansion of urban development and of vineyards into former grasslands has reduced some foraging areas for the species.

Golden Eagle

Included on both prior special concern lists (Remsen 1978, 3rd priority; CDFG 1992); currently considered a "fully protected" species in California. Numbers of Golden Eagles on BBS routes in California have been relatively stable over the period 1968–2004 (Sauer et al. 2005).

Merlin

Included on both prior special concern lists (Remsen 1978, highest priority; CDFG 1992). Merlins have increased as migrants and wintering birds in California in recent decades (A. Fish/ Golden Gate Raptor Observatory unpubl. data).

Prairie Falcon

Included on both prior special concern lists (Remsen 1978, 3rd priority; CDFG 1992). Prior indications of declines of this species in California (Garrett and Mitchell 1973) have been balanced by more recent assessments of population stability (Boyce et al. 1986). Christmas Bird Count data for California, for this resident species, showed a statistically significant positive trend for the period 1959–1988 (Sauer et al. 1996). BBS data for this species in California are inadequate for trend assessment (Sauer et al. 2005).

Long-billed Curlew

Included on the previous special concern list (CDFG 1992). A small population of curlews breeds in the Great Basin Desert, Modoc Plateau, and Klamath Basin of northeastern California (Grinnell and Miller 1944, D. Shuford pers. obs.). BBS data (1968–2004) for California are inadequate for trend assessment (Sauer et al. 2005), and even anecdotal information on the status of curlews is limited for this remote region of the state.

Laughing Gull

Included on both prior special concern lists (Remsen 1978, highest priority; CDFG 1992). A few pairs of Laughing Gulls have bred sporadically at the Salton Sea from at least 1928 until the late 1950s, and one to two pairs since 1994 (Molina 2000). Breeding numbers at the Salton Sea are likely influenced by the dynamics of breeding populations in Mexico.

California Gull

Included on both prior special concern lists (Remsen 1978, 3rd priority; CDFG 1992). The main threat to the state's breeding population was eliminated by a state water board order in 1994, which will maintain lake levels at Mono Lake that will protect the state's largest colony from ground predators (Shuford and Ryan 2000). An increase in the statewide breeding population is being fueled mainly by exponential growth at the lone coastal breeding area in San Francisco Bay (Shuford and Ryan 2000, Strong et al. 2004).

Elegant Tern

Included on both prior special concern lists (Remsen 1978, 3rd priority; CDFG 1992). Elegant Terns first nested in California in the salt works at San Diego Bay in 1959 (Gallup and Bailey 1960). From the initial 31 pairs, the state's breeding population has increased exponentially and expanded to include additional colonies at Bolsa Chica, Orange County, in 1987 and the Los Angeles Harbor in 1998. While numbers have increased, the distinction of being the largest colony has traded back and forth among the three sites. The total number of breeding pairs exceeded 13,000 in 2003 and 11,000 in 2004, with >10,000 at San Diego Bay and Los Angeles Harbor in those years, respectively (B. Collins/USFWS, C. Collins, K. Keane unpubl. data). Although breeding sites are few, all are on human-created habitats in a region where suitable natural nesting habitat appears to have been very limited or nonexistent historically.

Rhinoceros Auklet

Included on both prior special concern lists (Remsen 1978, 3rd priority; CDFG 1992). The breeding population of the Rhinoceros Auklet has increased in number and expanded its range in California since the early 1970s, particularly since 1980 (Carter et al. 1992, McChesney et al. 1995). Despite suggestions of possible recent declines, threats to the species overall seem to be moderate and no greater than for most other seabirds in the state.

Brown-crested Flycatcher

Included on both prior special concern lists (Remsen 1978, 3rd priority; CDFG 1992). Grinnell and Miller (1944) considered this species a "marginal pioneer" on the basis of two specimens collected in the lower Colorado River valley near Bard, Imperial County, in 1921. The species apparently increased dramatically along the Colorado River after the 1940s, in spite of massive habitat loss, and spread west to Morongo Valley, San Bernardino County, and South Fork Kern River valley, Kern County (Banks and McCaskie 1964, Garrett and Dunn 1981, Rosenberg et al. 1991, Johnson 1994). Despite the prior population increase and recent range expansion, numbers along the Colorado River decreased from an estimated 800 individuals in 1976 to 435 by the mid-1980s (Rosenberg et al. 1991).

Eagle Mountain Western Scrub-Jay

Included on the previous special concern list (CDFG 1992). This subspecies, ascribed solely from Eagle Mountain, Riverside County (AOU 1957), is of questionable validity (P. Unitt pers. comm.). Regardless, there appears to be no evidence of a population decline within its limited described range.

California Horned Lark

Included on the previous special concern list (CDFG 1992). This subspecies of Horned Lark occurs on the state's central and southern coastal slope and in the San Joaquin Valley. Although BBS data showed a highly significant decline for this species as a whole in California from 1968 to 2004 (Sauer et al. 2005), there is only limited anecdotal evidence of recent declines in this subspecies, mainly from southern California (S. Myers pers. comm.).

Black-capped Chickadee

Included on both prior special concern lists (Remsen 1978, 3rd priority; CDFG 1992). Since at least the late 1980s, this species has expanded its range southward from its California stronghold in the Lake Earl-Smith River area, Del Norte County, to the Humboldt Bay area, Humboldt County (south to Ferndale; Harris 1996, Hunter et al. 2005). BBS data (1968–2004) for the species in California are inadequate for trend assessment (Sauer et al. 2005).

Black-tailed Gnatcatcher

Included on the initial special concern list (Remsen 1978, 2nd priority), particularly on the basis of declines of what was then considered a subspecies, the California Black-tailed Gnatcatcher (*Polioptila melanura californica*). This subspecies has since been classified as part of a separate species, the California Gnatcatcher (*Polioptila californica*), considered a species of concern (CDFG 1992); then in 1993 the Alta (coastal) California Gnatcatcher (*Polioptila californica californica*) was listed as federally endangered. Rosenberg et al. (1991) considered the Black-tailed Gnatcatcher a "common resident and breeder" that maintained "very stable" population sizes in the lower Colorado River valley from year to year. Numbers of Black-tailed Gnatcatchers on BBS routes in California showed a significant decline for the period 1968–1979 and nonsignificant declines from 1980 to 2004 and 1968 to 2004 (Sauer et al. 2005).

Le Conte's Thrasher

Included on both prior special concern lists (Remsen 1978, 3rd priority; CDFG 1992). Numbers of Le Conte's Thrashers on BBS routes in California showed a nonsignificant decline from 1968 to 2004 (Sauer et al. 2005). In addition to the relative stability of numbers, threats to the bulk of the population in the southern deserts appear to be low (but see the account for the San Joaquin population).

Virginia's Warbler

Included on both prior special concern lists (Remsen 1978, 3rd priority; CDFG 1992). This warbler breeds in arid mountain ranges mostly along the Nevada border and has expanded its range westward to the San Bernardino Mountains, San Bernardino County (Johnson and Garrett 1974), and to Glass Mountain, Mono County (Shuford and Metropulos 1996). Although the overall population in California appears to be small, there seems to be no evidence of population declines or major threats to its existence in the state.

Hepatic Tanager

Included on both prior special concern lists (Remsen 1978, 3rd priority; CDFG 1992). This species expanded its range into California in the late 1960s to early 1970s (Johnson and Garrett 1974, Johnson 1994). Garrett and Dunn (1981) considered this species a "rare" summer resident on arid mountain ranges in the Mojave Desert of San Bernardino County. Their estimate for population size in 1977 was two pairs on Clark Mountain, three pairs in the Kingston Mountains, and one pair in the New York Mountains; one to two pairs were in the northeastern San Bernardino Mountains sporadically from the late 1960s to 1980. As with several other species occurring in very small numbers in southeastern California, the size of this tanager's population in the state is likely affected by population dynamics in Arizona.

Southern California Rufous-crowned Sparrow

Included on the previous special concern list (CDFG 1992). Although BBS data are not available by subspecies, numbers of Rufous-crowned Sparrows overall (two mainland races) have been relatively stable on routes in California over the period 1968–2004 (Sauer et al. 2005). Although its spatial pattern of abundance in urban-fragmented habitat in southern California suggests it is sensitive to changes in habitat configuration or quality that occur with fragmentation, reproductive output did not differ between sparrows nesting in the interior of sage scrub patches and those breeding in habitat adjacent to urban edges (Morrison and Bolger 2002).

Bell's Sage Sparrow

Included on the previous special concern list (CDFG 1992). Concern has been expressed for populations of this sparrow in southern California (J. Lovio in litt.), but it seems to be holding its own in northern California and in the state as a whole (S. England in litt.).

Gray-headed Junco

Included on both prior special concern lists (Remsen 1978, 3rd priority; CDFG 1992). A rare breeder in the White and Inyo mountains, Inyo County; the Grapevine Mountains, Inyo County (or at least on Nevada side); and Clark Mountain, San Bernardino County (Grinnell and Miller 1944, Garrett and Dunn 1981, Johnson and Cicero 1986). This junco was unknown from the White-Inyos prior to 1954, when it was considered to be "fairly common"; recently it was reported to be a rare summer resident of the White-Inyos (Johnson and Cicero 1986). Fluctuations in junco numbers in mountains along the California border are likely affected by population dynamics of juncos in nearby mountains in Nevada.

Northern Cardinal

Included on both prior special concern lists (Remsen 1978, 3rd priority; CDFG 1992). Northern Cardinals became established along the lower Colorado River, San Bernardino and Imperial counties, in the mid-1940s (Garrett and Dunn 1981, Rosenberg et al. 1991). These authors, respectively, considered the species "very rare" on the California side of the river and "rare and local" along the lower river as a whole. The fluctuations of cardinal numbers along the California border are likely a result of dynamics of breeding populations in Arizona.

Appendix 2: Status Designations of Conservation Concern for California Birds from Various State, Regional, Continental, and Global Assessments[a]

Taxon	BSSC 2008[b]	BSSC 1992[c]	BSSC 1978[d]	T & E[e]	Fully Protected[f]	NatureServe[g]	USFWS 2002[h]	Audubon WatchList 2002	IUCN 2006[j]
Fulvous Whistling-Duck	1	x	1	–	–	S1	–	–	–
Tule Greater White-fronted Goose	3	–	–	–	–	–	–	–	–
Brant	2	–	–	–	–	–	–	Y	–
Aleutian Cackling Goose	–	–	–	–	–	S2	–	–	–
Trumpeter Swan (*Cygnus buccinator*)	–	–	–	–	–	–	–	Y	–
Canvasback (*Aythya valisineria*)	–	–	–	–	–	S2?	–	–	–
Redhead	2	–	–	–	–	–	–	–	–
Harlequin Duck	2	x	3	–	–	S2	–	–	–
Barrow's Goldeneye	EX	x	3	–	–	S1	–	–	–
Ruffed Grouse (*Bonasa umbellus*)	–	x	3	–	–	–	–	–	–
Greater Sage-Grouse	2	x	3	–	–	S3	–	Y	NT
Blue Grouse (*Dendragapus obscurus*) (now split as Dusky Grouse [*D. obscurus*] and Sooty Grouse [*D. fuliginosus*])	–	–	–	–	–	–	–	Y	–
Mount Pinos Sooty Grouse	2	–	–	–	–	S?	–	–	–
Sharp-tailed Grouse	EX	x	1	–	–	SX	–	–	–
Mountain Quail (*Oreortyx pictus*)	–	–	–	–	–	–	–	Y	–
Catalina California Quail	3	–	–	–	–	–	–	–	–
Common Loon	EX	x	1	–	–	S1	–	–	–
Laysan Albatross (*Phoebastria immutabilis*)	–	–	–	–	–	–	–	Y	VU
Black-footed Albatross (*Phoebastria nigripes*)	–	–	–	–	–	–	R, 5, 32	R	EN
Short-tailed Albatross	FNS	–	–	FE	–	–	–	R	VU
Cook's Petrel (*Pterodroma cookii*)	–	–	–	–	–	–	–	–	EN
Pink-footed Shearwater (*Puffinus creatopus*)	–	–	–	–	–	–	–	R	VU
Buller's Shearwater (*Puffinus bulleri*)	–	–	–	–	–	–	–	Y	VU
Sooty Shearwater (*Puffinus griseus*)	–	–	–	–	–	–	–	–	NT
Black-vented Shearwater (*Puffinus opisthomelas*)	–	–	–	–	–	–	–	R	NT
Fork-tailed Storm-Petrel	3	x	2	–	–	S1	–	–	–
Ashy Storm-Petrel	2	x	3	–	–	S2	R, 32	R	EN
Black Storm-Petrel	3	x	3	–	–	S1	–	Y	–
Least Storm-Petrel (*Oceanodroma microsoma*)	–	–	–	–	–	–	–	Y	–
American White Pelican	1	x	1	–	–	S1	–	–	–
California Brown Pelican (*Pelecanus occidentalis californicus*)	–	–	–	SE, FE	x	S1S2	–	–	–
Double-crested Cormorant (*Phalacrocorax auritus*)	–	x	2	–	–	S3	–	–	–
American Bittern (*Botaurus lentiginosus*)	–	–	–	–	–	S3	–	–	–

Least Bittern	2	x	3	–	–	S1	–	–	–
Black-crowned Night-Heron (*Nycticorax nycticorax*)	–	–	–	–	–	S3	–	–	–
White-faced Ibis (*Plegadis chihi*)	–	x	1	–	–	S1	–	–	–
Wood Stork	1	x	–	–	–	S2?	–	–	–
California Condor	–	–	–	SE, FE	x	S1	–	R	CR
Osprey (*Pandion haliaetus*)	–	x	2	–	–	S3	–	–	–
White-tailed Kite (*Elanus leucurus*)	–	–	–	–	x	S3	–	–	–
Bald Eagle (*Haliaeetus leucocephalus*)	–	–	–	SE	x	S2	–	–	–
Northern Harrier	3	x	2	–	–	S3	–	–	–
Sharp-shinned Hawk (*Accipiter striatus*)	–	x	3	–	–	S3	–	–	–
Cooper's Hawk (*Accipiter cooperii*)	–	x	3	–	–	S3	–	–	–
Northern Goshawk	2	x	3	–	–	S3	–	–	–
Harris's Hawk (*Parabuteo unicinctus*)	–	x	1	–	–	SH	–	Y	–
Swainson's Hawk (*Buteo swainsoni*)	–	–	1	ST	–	S2	R, 9, 32	Y	–
Ferruginous Hawk (*Buteo regalis*)	–	x	–	–	–	S3S4	9	Y	NT
Golden Eagle (*Aquila chrysaetos*)	–	x	3	–	x	S3	9	–	–
Merlin (*Falco columbarius*)	–	x	1	–	–	S3	–	–	–
American Peregrine Falcon (*Falco peregrinus anatum*)	–	–	–	SE	x	S2	R, 5, 9, 15, 32, 33	–	–
Prairie Falcon (*Falco mexicanus*)	–	x	3	–	–	S3	R, 9, 32	–	–
Yellow Rail	2	x	1	–	–	S1S2	R, 9	Y	–
Black Rail	–	–	–	–	–	–	–	R	NT
California Black Rail	–	–	–	ST	x	S1	R, 32, 33	–	–
California Clapper Rail	–	–	–	SE, FE	x	S1	–	–	–
Light-footed Clapper Rail	–	–	–	SE, FE	x	S1	–	–	–
Yuma Clapper Rail	–	–	–	ST, FE	x	S1	–	–	–
Sandhill Crane	–	–	3	–	–	–	–	–	–
Lesser Sandhill Crane	3	–	–	–	–	–	–	–	–
Greater Sandhill Crane (*Grus canadensis tabida*)	–	–	–	ST	x	S2	–	–	–
Snowy Plover	–	x	2	–	–	–	–	R	–
Western Snowy Plover (*Charadrius alexandrinus nivosus*) (coastal population)	FNS	–	–	FT	–	S2	–	–	–
Snowy Plover (interior population)	3	–	–	–	–	–	R, 9, 33	–	–
Mountain Plover	2	x	–	–	–	S2?	R, 32, 33	R	VU
Black Oystercatcher (*Haematopus bachmani*)	–	–	–	–	–	S2	R, 5, 32	Y	–
American Avocet (*Recurvirostra americana*)	–	–	–	–	–	–	9	–	–
Whimbrel (*Numenius phaeopus*)	–	–	–	–	–	–	R, 5, 32, 33	Y	–
Long-billed Curlew (*Numenius americanus*)	–	x	–	–	–	S2	R, 5, 9, 32, 33	R	NT
Marbled Godwit	–	–	–	–	–	–	R, 5, 9, 32, 33	Y	–
Black Turnstone (*Arenaria melanocephala*)	–	–	–	–	–	–	R, 5, 32	Y	–
Surfbird (*Aphriza virgata*)	–	–	–	–	–	–	5	Y	–

(*continued*)

APPENDIX 2 (*continued*)

Taxon	BSSC 2008[b]	BSSC 1992[c]	BSSC 1978[d]	T & E[e]	Fully Protected[f]	NatureServe[g]	USFWS 2002[h]	Audubon WatchList 2002	IUCN 2006[j]
Red Knot (*Calidris canutus*)	–	–	–	–	–	–	R, 5, 32, 33	Y	–
Rock Sandpiper (*Calidris ptilocnemis*)	–	–	–	–	–	–	5	Y	–
Short-billed Dowitcher (*Limnodromus griseus*)	–	–	–	–	–	–	R, 5, 32	Y	–
Wilson's Phalarope (*Phalaropus tricolor*)	–	–	–	–	–	–	9	Y	–
Laughing Gull (*Larus atricilla*)	–	x	1	–	–	SH	–	–	–
Heermann's Gull (*Larus heermanni*)	–	–	–	–	–	–	–	R	NT
California Gull (*Larus californicus*)	–	x	3	–	–	S2	–	–	–
Yellow-footed Gull (*Larus livens*)	–	–	–	–	–	–	–	Y	–
California Least Tern (*Sternula antillarum browni*)	–	–	–	SE, FE	x	S2S3	–	–	–
Gull-billed Tern	3	x	2	–	–	S1	R, 32, 33	–	–
Caspian Tern (*Hydroprogne caspia*)	–	–	–	–	–	–	5	–	–
Black Tern	2	x	–	–	–	S2	–	–	–
Arctic Tern (*Sterna paradisaea*)	–	–	–	–	–	–	5	–	–
Elegant Tern (*Thalasseus elegans*)	–	x	3	–	–	S1	R, 32	R	NT
Black Skimmer	3	x	3	–	–	S1S3	R, 32, 33	–	–
Marbled Murrelet (*Brachyramphus marmoratus*)	–	–	3	SE, FT	–	S1	–	R	EN
Xantus's Murrelet (*Synthliboramphus hypoleucus*)	–	x	–	ST	–	S3	R, 32	R	VU
Craveri's Murrelet (*Synthliboramphus craveri*)	–	–	–	–	–	–	–	R	VU
Cassin's Auklet	3	–	–	–	–	S?	32	–	–
Rhinoceros Auklet (*Cerorhinca monocerata*)	–	x	3	–	–	S3	–	–	–
Tufted Puffin	1	x	2	–	–	S2	–	–	–
Band-tailed Pigeon (*Patagioenas fasciata*)	–	–	–	–	–	–	–	Y	–
Western Yellow-billed Cuckoo (*Coccyzus americanus occidentalis*)	–	–	–	SE	–	S1	R, 5, 9, 32, 33	–	–
Flammulated Owl (*Otus flammeolus*)	–	–	–	–	–	S?	R, 5, 9, 15, 32	Y	–
Elf Owl (*Micrathene whitneyi*)	–	–	–	SE	–	S1	33	Y	–
Burrowing Owl	2	x	2	–	–	S2	R, 9, 32, 33	–	–
Spotted Owl	–	–	2	–	–	S3	–	R	NT
Northern Spotted Owl	FNS	–	–	FT	–	S2S3	–	–	–
California Spotted Owl	2	x	–	–	–	S3	15, 32	–	–
Great Gray Owl (*Strix nebulosa*)	–	–	–	SE	–	S1	–	–	–
Long-eared Owl	3	x	2	–	–	S3	–	–	–
Short-eared Owl	3	x	2	–	–	S3	–	Y	–
Black Swift	3	x	3	–	–	S2	R, 5, 15, 32	Y	–
Vaux's Swift	2	x	–	–	–	S3	–	–	–
White-throated Swift (*Aeronautes saxatalis*)	–	–	–	–	–	–	–	Y	–
Costa's Hummingbird (*Calypte costae*)	–	–	–	–	–	S3?	–	Y	–

Calliope Hummingbird (*Stellula calliope*)	–	–	–	–	–	–	–	Y	–
Rufous Hummingbird (*Selasphorus rufus*)	–	–	–	–	–	S1S2	5, 15	Y	–
Allen's Hummingbird (*Sealsphorus sasin*)	–	–	–	–	–	S?	–	Y	–
Lewis's Woodpecker (*Melanerpes lewis*)	–	–	–	–	–	S?	R, 5, 9, 15, 32	Y	–
Gila Woodpecker (*Melanerpes uropygialis*)	–	–	2	SE	–	S1S2	33	–	–
Williamson's Sapsucker (*Sphyrapicus thyroideus*)	–	–	–	–	–	–	R, 9, 15	–	–
Red-naped Sapsucker (*Sphyrapicus nuchalis*)	–	–	–	–	–	–	R	–	–
Red-breasted Sapsucker (*Sphyrapicus ruber*)	–	–	–	–	–	S?	–	–	–
Nuttall's Woodpecker (*Picoides nuttallii*)	–	–	–	–	–	S?	–	R	–
White-headed Woodpecker	–	–	–	–	–	S?	R, 5, 9, 15, 32	Y	–
Gilded Flicker (*Colaptes chrysoides*)	–	–	1	SE	–	S1	33	Y	–
Olive-sided Flycatcher	2	–	–	–	–	–	R, 5, 15	Y	NT
Willow Flycatcher (*Empidonax traillii*)	–	–	1	SE	–	S1S2	–	Y	–
Southwestern Willow Flycatcher (*E. t. extimus*)	–	–	–	FE	–	S1	–	–	–
Little Willow Flycatcher (*E. t. brewsteri*)	–	–	–	–	–	S1S2	–	–	–
Vermilion Flycatcher	3	x	1	–	–	S2S3	–	–	–
Brown-crested Flycatcher (*Myiarchus tyrannulus*)	–	x	3	–	–	S2S3	–	–	–
Loggerhead Shrike	2	x	–	–	–	–	R, 9, 32, 33	–	–
Island Loggerhead Shrike	1	–	–	–	–	S1?	32	–	–
San Clemente Loggerhead Shrike	FNS	–	–	FE	–	S1	–	–	–
Bell's Vireo (*Vireo bellii*)	–	–	–	–	–	–	–	R	NT
Least Bell's Vireo (*Vireo bellii pusillus*)	–	–	–	SE, FE	–	S2	–	–	–
Arizona Bell's Vireo (*Vireo bellii arizonae*)	–	–	1	SE	–	S1	33	–	–
Gray Vireo	2	x	2	–	–	S2	R, 33	Y	–
Catalina Hutton's Vireo	2	–	–	–	–	–	–	–	–
Island Scrub-Jay	–	–	–	–	–	S1	32	R	NT
Eagle Mountain Western Scrub-Jay	–	x	–	–	–	S1S2	–	–	–
Pinyon Jay (*Gymnorhinus cyanocephalus*)	–	–	–	–	–	–	–	Y	VU
Yellow-billed Magpie	–	–	–	–	–	S3?	–	Y	–
California Horned Lark	–	x	–	–	–	S3	–	–	–
Purple Martin	2	x	2	–	–	S3	–	–	–
Bank Swallow (*Riparia riparia*)	–	–	2	ST	–	S2S3	–	–	–
Black-capped Chickadee (*Poecile atricapillus*)	–	x	3	–	–	S3	–	–	–
Oak Titmouse	–	–	–	–	–	S3?	–	Y	–
Cactus Wren	–	–	–	–	–	–	32	–	–
San Diego Cactus Wren	1	x	–	–	–	S3	32	–	–
San Clemente Bewick's Wren	EX	–	–	–	–	–	–	–	–
Clark's Marsh Wren	2	–	–	–	–	–	–	–	–
California Gnatcatcher	–	x	–	–	–	–	–	R	–
Alta California Gnatcatcher	FNS	–	–	FT	–	S2	–	–	–

(*continued*)

Appendix 2 (*continued*)

Taxon	BSSC 2008[b]	BSSC 1992[c]	BSSC 1978[d]	T & E[e]	Fully Protected[f]	NatureServe[g]	USFWS 2002[h]	Audubon WatchList 2002	IUCN 2006[j]
Black-tailed Gnatcatcher (*Polioptila melanura*)	–	–	2	–	–	–	–	–	–
Wrentit	–	–	–	–	–	–	–	Y	–
Bendire's Thrasher	3	x	3	–	–	S3	33	R	VU
California Thrasher	–	–	–	–	–	S?	–	Y	–
Crissal Thrasher	3	x	3	–	–	S3	R, 33	–	–
Le Conte's Thrasher	–	x	3	–	–	S3	R, 33	Y	–
Le Conte's Thrasher (San Joaquin population)	1	–	–	–	–	–	32	–	–
Virginia's Warbler (*Vermivora virginiae*)	–	x	3	–	–	S2S3	9	Y	–
Lucy's Warbler	3	–	–	–	–	S2S3	–	Y	–
Yellow Warbler	–	x	2	–	–	S2	–	–	–
Yellow Warbler (*Dendroica petechia morcomi* [including subsumed *brewsteri*])	2	–	–	–	–	–	–	–	–
Sonora Yellow Warbler	2	–	–	–	–	S1	33	–	–
Hermit Warbler	–	–	–	–	–	S3?	–	Y	–
San Francisco Common Yellowthroat	3	x	–	–	–	S2	32	–	–
Yellow-breasted Chat	3	x	2	–	–	S3	–	–	–
Hepatic Tanager (*Piranga flava*)	–	x	3	–	–	S1	–	–	–
Summer Tanager	1	x	2	–	–	S2	–	–	–
San Clemente Spotted Towhee	1	x	–	–	–	S1	32	–	–
Inyo California Towhee	–	–	–	SE, FT	–	S1	–	–	–
Abert's Towhee (*Pipilo aberti*)	–	–	–	–	–	S2?	–	Y	–
Southern California Rufous-crowned Sparrow (*Aimophila ruficeps canescens*)	–	x	–	–	–	S2S3	–	–	–
Santa Cruz Island Rufous-crowned Sparrow	2	–	–	–	–	–	–	–	–
Chipping Sparrow (*Spizella passerina*)	–	–	–	–	–	S3S4	–	–	–
Brewer's Sparrow (*Spizella breweri*)	–	–	–	–	–	S3	R, 9	Y	NT
Black-chinned Sparrow	–	–	–	–	–	S3	32, 33	Y	–
Oregon Vesper Sparrow	2	–	–	–	–	–	5	–	–
Lark Sparrow (*Chondestes grammacus*)	–	–	–	–	–	S?	–	–	–
Sage Sparrow	–	–	–	–	–	–	9, 33	–	–
Bell's Sage Sparrow (*Amphispiza belli belli*)	–	x	–	–	–	S2?	–	–	–
San Clemente Sage Sparrow	FNS	–	–	FT	–	S1	–	–	–
Bryant's Savannah Sparrow	3	–	–	–	–	–	–	–	–
Belding's Savannah Sparrow (*Passerculus sandwichensis beldingi*)	–	–	–	SE	–	S3	–	–	–
Large-billed Savannah Sparrow	2	x	–	–	–	S2?	–	–	–
Grasshopper Sparrow	2	–	–	–	–	S2	–	–	–

Song Sparrow (“Modesto” population)	3	–	–	–	–	–	–	–	–
Suisun Song Sparrow	3	x	–	–	–	S2	32	–	–
Samuels Song Sparrow	3	x	–	–	–	S2?	32	–	–
Alameda Song Sparrow	2	x	–	–	–	S2?	32	–	–
Channel Island Song Sparrow	1	–	–	–	–	–	32	–	–
Santa Barbara Song Sparrow	EX	–	–	–	–	–	–	–	–
Gray-headed Junco (*Junco hyemalis caniceps*)	–	x	3	–	–	S1	–	–	–
Northern Cardinal (*Cardinalis cardinalis*)	–	x	3	–	–	S1	–	–	–
Kern Red-winged Blackbird	2	–	–	–	–	–	–	–	–
Tricolored Blackbird	1	x	–	–	–	S2	R, 9, 15, 32, 33	Y	EN
Yellow-headed Blackbird	3	–	–	–	–	S3S4	–	–	–
Cassin’s Finch (*Carpodacus cassinii*)	–	–	–	–	–	–	–	–	NT
Lawrence’s Goldfinch	–	–	–	–	–	S3	R, 32, 33	R	–

[a]Conservation status designations are provided for comparison of widely cited assessments at various scales, regional to global. Although not exhaustive, this comparison provides a framework for evaluation of the current status rankings of California’s Bird Species of Special Concern (BSSC). Taxa included on other lists are not included here if they occur in California (or the California portion of a relevant BCR) only as vagrants or rare migrants or visitors, unless they formerly were much more numerous in the state and have been greatly reduced in numbers by human activities (e.g., Short-tailed Albatross). For some taxa, rankings may apply to different seasonal or breeding roles on different lists.

[b]Species, subspecies, and distinct populations on the current list of BSSC in California (Table 1). Numbered designations indicate priority levels within the list (1, 2, or 3; highest to lowest). FNS, listed as federally, but not state, threatened or endangered; EX, taxon extirpated from the state totally or in its primary seasonal or breeding role but never listed as state threatened or endangered.

[c]x, species or subspecies on the 1992 unprioritized list of BSSC in California (CDFG 1992).

[d]Species or subspecies on the 1978 list of BSSC in California (Remsen 1978). 1, “highest priority”; 2, “second priority”; and 3, “third priority.” Subspecies were considered for inclusion only in the “highest priority” level (Remsen 1978).

[e]Species listed as threatened or endangered by state or federal law. ST, state threatened; SE, state endangered; FT, federally threatened; FE, federally endangered. The federal government no longer maintains a list of Category 1 and Category 2 candidates for consideration for possible addition to the List of Endangered and Threatened Wildlife (USFWS 1996). Taxa are now considered “candidates” only if a proposed listing is likely (equivalent to former Candidate 1 status). Taxa formerly listed as Category 2 candidates (of conservation concern but information not available to support listing) with populations in California are the Reddish Egret, White-faced Ibis, Fulvous Whistling-Duck (SW U.S. population), Ferruginous Hawk, Columbian Sharp-tailed Grouse, Mountain Plover, Elegant Tern, Long-billed Curlew, Spotted Owl, San Francisco (Salt Marsh) Common Yellowthroat, Large-billed Savannah Sparrow, Suisun Song Sparrow, Samuels (San Pablo) Song Sparrow, Alameda Song Sparrow, and Tricolored Blackbird. Several other former Category 2 taxa have been listed, and one former Category 1 taxon (the California Black Rail) has not been federally listed. See footnote [h] below for current USFWS designations for species of conservation concern at the federal level.

[f]x, species listed by California state law as “fully protected” (www.dfg.ca.gov/wildlife/species/t_e_spp/fully_pro.html).

[g]NatureServe Conservation Status (formally Natural Heritage) rankings at the S (subnational) level for California (see NatureServe 2006 for expanded definitions). Rankings for California are assigned by California Department of Fish and Game and tracked by their California Natural Diversity Database. Updated regularly, the ranks used here are from a list dated February 2006 downloaded on 7 January 2007 (www.dfg.ca.gov/whdab/pdfs/SPAnimals.pdf). S1, critically imperiled; S2, imperiled; S3, vulnerable to extirpation or extinction; ?, inexact or uncertain rank; SH, possibly extirpated; SX, presumed extirpated. Numeric range ranks (e.g., S2S3) indicate a range of uncertainty as to exact status. Ranks for populations that are “apparently secure” (S4) and “demonstrably widespread, abundant, and secure” (S5) are not reported here unless part of an uncertainty ranking (e.g., S3S4).

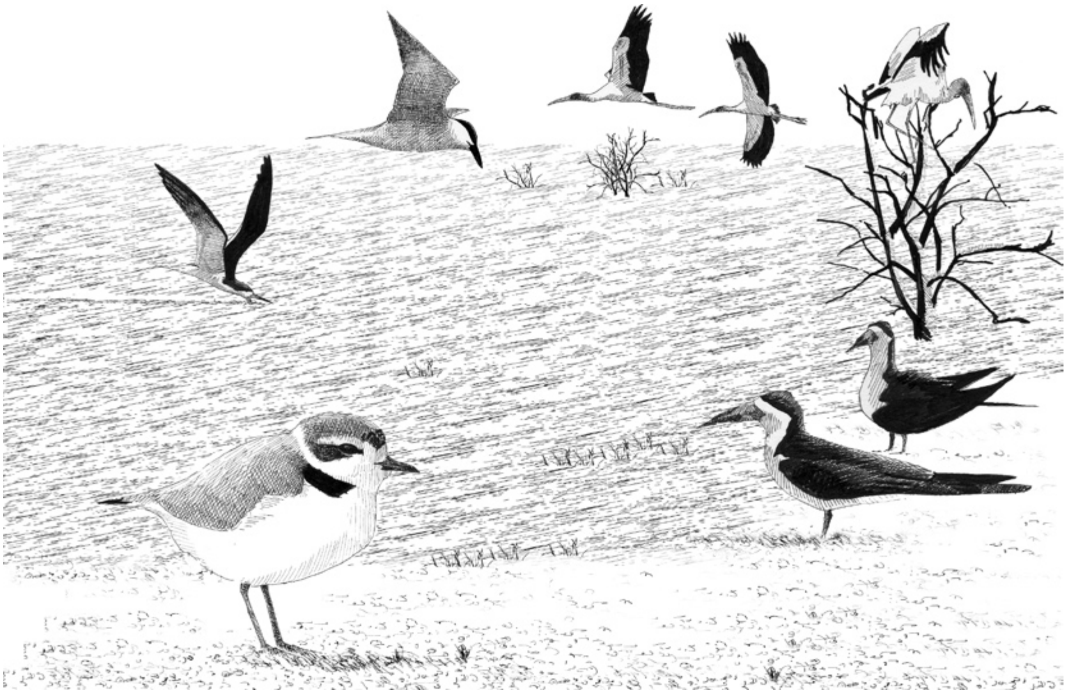
[h]Species or subspecies on the USFWS list of Birds of Conservation Concern 2002 (USFWS 2002), a revision of prior lists (USFWS 1987, 1995); includes taxa of lesser concern than those listed as federally threatened or endangered (see footnote [e] above). R, USFWS Region 1 (states of CA, HI, ID, NV, OR, and WA, plus other Pacific islands). Numbers refer to Bird Conservation Regions (BCRs) including at least part of California: 5, Northern Pacific Rainforest; 9, Great Basin; 15, Sierra Nevada; 32, Coastal California; 33, Sonoran and Mojave Deserts (Figure 1).

[i]The Audubon WatchList priority categories (www.audubon.org/bird/watch/): RED (R), species identified by BirdLife International as Threatened or Near-threatened at the global level and all species identified by Partners In Flight (PIF) as extremely high priority at the national level; YELLOW (Y), the remaining species identified by PIF as of moderately high priority or moderate priority at the national level. The 2002 WatchList and the 1996 WatchList (Carter et al. 1996) are preceded by several Audubon Blue Lists (Tate 1981, Tate and Tate 1982, Tate 1986).

[j]California species with IUCN Red List global conservation status ranks (listed here in descending order of conservation concern): CR, critically endangered; EN, endangered; VU, vulnerable; and NT, near threatened (IUCN 2006).

II

SPECIES ACCOUNTS



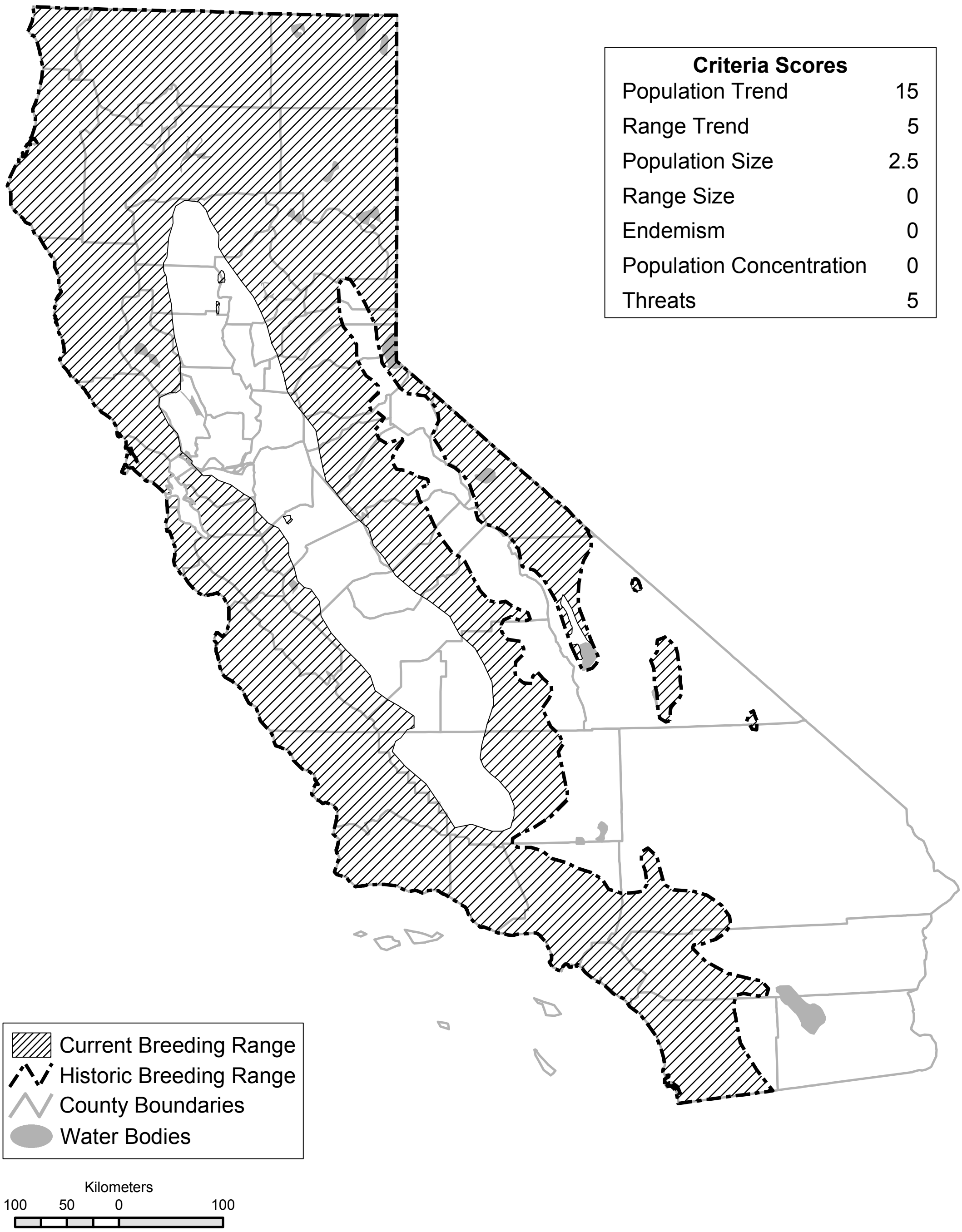
Andy Birch

PDF of Yellow Warbler account from:

Shuford, W. D., and Gardali, T., editors. 2008. California Bird Species of Special Concern: A ranked assessment of species, subspecies, and distinct populations of birds of immediate conservation concern in California. Studies of Western Birds 1. Western Field Ornithologists, Camarillo, California, and California Department of Fish and Game, Sacramento.

YELLOW WARBLER (*Dendroica petechia*)

Sacha K. Heath



Current and historic (ca. 1944) breeding range of the Yellow Warbler in California; occurs much more widely in migration. Breeding numbers have declined greatly, particularly in lowland areas west of the Cascade–Sierra Nevada axis, and the range has retracted broadly in the Central Valley and locally in the Owens Valley.

Special Concern Priority

Currently considered a Bird Species of Special Concern (breeding), priority 2. Included on both prior special concern lists (Remsen 1978, 2nd priority; CDFG 1992).

General Range and Abundance

Breeding widely in the New World, the Yellow Warbler comprises three subspecies groups: *aestiva* (continental North America), *petechia* (extreme southern Florida and Caribbean), and *erithachorides* (coastal Mexico to northern South America; Lowther et al. 1999). The *aestiva* group migrates to winter mainly from northern Mexico south to central South America. Overall considered one of the most abundant warblers in North America; published breeding density estimates range from 0.7 to 14.4 pairs per ha (Lowther et al. 1999).

Four subspecies of the *aestiva* group have previously been considered to occur in California: breeding *D. p. brewsteri*, *D. p. morcomi,* and *D. p. sonorana*, and transient *D. p. rubiginosa* (Grinnell and Miller 1944). Because *D. p. brewsteri* and *D. p. morcomi* are not consistently distinguishable (Patten et al. 2003), *brewsteri* is best considered synonymous with *morcomi* (P. Unitt pers. comm.). *Sonorana*, found only along the lower Colorado River and ranked independently as a species of special concern (see relevant account), is not considered further here.

Seasonal Status in California

Occurs principally as a migrant and summer resident from late March through early October; breeds from April to late July (Dunn and Garrett 1997).

Historic Range and Abundance in California

Grinnell and Miller (1944) described the Yellow Warbler as a "common" to "locally abundant" breeder throughout California, except for most of the Mojave Desert (it occurred locally only in the Panamint and Grapevine mountains and the Mojave River) and all of the Colorado Desert. Known elevational limits of breeding were 7000 ft (2134 m) on the western and 8500 ft (2591 m) on the eastern flank of the Sierra Nevada. With few exceptions, Grinnell and Miller (1944) mapped locations of individuals reported or collected during the breeding season in every county within this general range. Quantitative estimates of historic breeding abundance are scant and mostly unreliable. For example, estimates of 10 birds per 3 river mi (4.8 km) in the Sacramento Valley region (Grinnell et al. 1930) did not discern between singing migrants and breeders, both of which likely occurred during the late May surveys (T. Manolis in litt.).

Recent Range and Abundance in California

Despite many local declines, Yellow Warblers currently occupy much of their former breeding range, except in the Central Valley, where they are close to extirpation (see map). Broad-scale significant declines have been documented for the U.S. Pacific Northwest region (1979–1999, Ballard et al. 2003) and declines approaching significance in California (1968–2004, Sauer et al. 2005). Both local abundance and long-term trends, however, vary greatly by region.

Northwestern California. This species breeds locally throughout Del Norte, western Siskiyou, Humboldt, Trinity, Mendocino, and Sonoma counties, except at lower elevations along the coast in Mendocino and Sonoma (Bolander and Parmeter 2000, Harris 2005, Hunter et al. 2005, D. Tobkin pers. comm.). Breeding Bird Survey (BBS) averages vary widely, from 1.00 birds per route at Bartlett Springs, Lake County, to 71.89 birds per route at Horse Creek, Siskiyou County (Sauer et al. 2003). Breeding density was only 0.26 pair per ha at Clear Creek, Shasta County, in the northern interior Coast Ranges (PRBO unpubl. data). Breeding bird atlases found Yellow Warblers in 16% of blocks (66 of 425, 6 confirmed) in Humboldt County (Hunter et al. 2005) and in 43% of blocks (34 of 79, 11 confirmed) in Napa County (1989–1993; Berner et al. 2003). Recent

Breeding Bird Survey Statistics for California

1968–2004					1968–1979			1980–2004			All data from Sauer et al. (2005)
Trend	*P*	*n*	(95% CI)	R.A.	Trend	*P*	*n*	Trend	*P*	*n*	Credibility
–1.4	0.14	128	–3.3, 0.4	1.81	–4.4	0.11	75	–2.0	0.10	112	High

efforts in Napa, however, failed to locate the species at most of its historic breeding sites—most notably at Napa River, Mill Creek, and Suisun Creek—perhaps because of wine industry thinning of riparian habitat in the Napa Valley (R. Leong and B. Grummer pers. comm.).

Northeastern California. The species breeds widely in this region. In the Modoc National Forest, the Yellow Warbler was the most numerous species detected on breeding season surveys (T. Ratcliff in litt.); it is also numerous throughout Shasta County (B. Yutzy in litt.). BBS averages ranged from 0.56 to 4.67 birds per route where the species was sampled on the Modoc Plateau, Surprise Valley, and Madeline Plain (Sauer et al. 2003). The Susan River, Lassen County, held 1.05 birds per ha (PRBO unpubl. data). On Atastra Creek in the Bodie Hills, Mono County, density was 0.26 birds per ha in 1979 (Weston and Johnston 1980), but the species was absent in 2000–2003 (PRBO unpubl. data). At Mono Lake, densities on the lower reaches of Rush and Lee Vining creeks have been as high as 2.74 and 1.71 pairs per ha, respectively, and are increasing annually (PRBO unpubl. data), presumably as a result of rewatering, removal of livestock grazing, and riparian restoration. The Glass Mountain area and the White-Inyo Range hold small and localized breeding populations (PRBO unpubl. data, Johnson and Cicero 1991).

Central Valley. The Yellow Warbler is largely extirpated as a breeder in the Sacramento Valley. Numbers were already low by the 1970s, when Gaines (1974) found the species at only 4 of 20 sites in the upper, and at none in the lower, Sacramento Valley. Intensive coverage along the Sacramento River in Glenn, Butte, and Tehama counties from 1993 to 1999 found only five nests of three pairs (PRBO unpubl. data, T. Manolis in litt.). In Placer County, individuals occur on the valley floor during the breeding season (Webb 2003). Extensive surveys in 1998 and 1999, however, failed to locate breeding Yellow Warblers along the Sacramento River and its lower tributaries in Colusa, Sutter, Yolo, and Sacramento counties, and no breeding records exist for Sacramento County as a whole (PRBO unpubl. data, T. Manolis in litt.).

The species is largely extirpated as a breeder in the Sacramento–San Joaquin River Delta and San Joaquin Valley region. Extensive surveys in 1998 and 1999 failed to locate breeders along the San Joaquin River and its lower tributaries in San Joaquin, Stanislaus, Merced, Madera, Fresno, and Kings counties. In 2002 and 2003, however, five nests were located at Hospital Creek, Stanislaus County, on the San Joaquin River NWR (PRBO unpubl. data), and in 2005 one nest and at least three confirmed territories were found on San Luis NWR, Merced County (PRBO unpubl. data).

Cascade Range and Sierra Nevada. Yellow Warblers breed widely in this region in both riparian habitat and chaparral shrub fields (CalPIF 2003, J. Snowden and B. Williams in litt.). Abundance estimates ranged from 0.04 to 1.14 birds per ha among eight Sacramento River sites above Shasta Dam (PRBO unpubl. data) and 0.83 to 0.97 pairs per ha at one site along Gurnsey Creek, Tehama County (1998–1999; PRBO unpubl. data). A density of 0.95 birds per ha was found in xeric montane shrub fields of Lassen Volcanic National Park (PRBO unpubl. data).

On the west slope of the Sierra Nevada, Yellow Warblers breed from foothill woodlands up to the mixed-conifer zone, and at select sites in the north they may be as abundant in montane chaparral as in riparian habitat (B. Williams, J. Steele in litt.). Verner and Boss (1980) considered them "fairly common" summer residents in the late 1970s, and Beedy and Granholm (1985) reported declining numbers. They are increasing in postfire chaparral in El Dorado County (E. Harper in litt.) and have averaged 12.4 birds per BBS route since the 1992 fire (Sauer et al. 2003). In the southern Sierra, mixed-conifer forests at 5600–6601 ft (1707–2012 m) harbor small breeding populations (0.34 birds per ha; K. Purcell in litt.). Probable breeders occur in meadows around 7000 ft (2134 m) on Greenhorn Mountain, Kern County (J. Wilson in litt.). In the Kern River Valley, 142 males were counted on a valley-wide 10 July 1999 survey, far exceeding the estimated 14 pairs for the entire valley in 1985 (B. Barnes in litt.). Yellow Warblers have probably benefited from restoration and Brown-headed Cowbird (*Molothrus ater*) trapping to aid Southwestern Willow Flycatcher (*Empidonax traillii exitmus*) recovery in the area (B. Barnes and S. Laymon in litt.).

On the east slope of the northern Sierra, density was 0.29 pairs per ha in postfire chaparral and regenerating conifers at Sagehen Field Station, north of Truckee (Raphael et al. 1987); numbers are higher in riparian habitat nearby at Perazzo Meadows and the upper Truckee River system (Lynn et al. 1998, J. Steele in litt.). Gaines (1992) considered Yellow Warblers "common" summer residents in the eastern Sierra of Mono County, where surveys found them at 121 (54%) of 224 riparian stations along 12 streams (Heath and Ballard 2003b). Abundance estimates were

0.17–1.73, 0.22–0.83, and 0.48–1.64 birds per ha, respectively, at the headwaters of the West and East Walker rivers, at 7159–7799 ft (2182–2377 m) on Mono Lake's feeder streams, and at 9318 ft (2840 m) on tributaries of the Owens River (PRBO unpubl. data). At elevations <6634 ft (2022 m), mostly in Inyo County, only 15 (6%) of 256 riparian stations had breeding Yellow Warblers (Heath and Ballard 2003b). Not only were they less numerous at these elevations but they also bred inconsistently (Heath and Ballard 2003a).

Central and southern coast. Yellow Warblers breed locally in small numbers in Sonoma, Marin, Alameda, San Mateo, Santa Clara, Santa Cruz, Monterey, and San Luis Obispo counties, and there is some anecdotal evidence of historic declines (Roberson and Tenney 1993, Shuford 1993, Bolander and Parmeter 2000, Alameda, San Mateo, Santa Clara, San Luis Obispo unpubl. atlas data). Numbers have declined markedly on the Palo Alto Summer Bird Count (1981–2005), from as many as 15 during the first five years to 0 during the past two (W. G. Bousman in litt.). At several well-surveyed riparian sites in Marin County, observers found one nest and detected few to no individuals during the breeding season (PRBO unpubl. data), and Olema Marsh held 0.06 birds per ha (Evens and Stallcup 1992). Roberson and Tenney (1993) roughly estimated the total population in Monterey County at 500–900 pairs. Singing males are "locally common" on Pacheco Creek and the San Benito and Pajaro rivers, San Benito County (M. Paxton and K. Van Vuren in litt.). In Santa Barbara County, these warblers are widespread and vary by subregion from "uncommon" to "common"; numbers likely have declined historically (Lehman 1994). Densities in three drainages on Vandenberg Air Force Base, Santa Barbara County, ranged from 0.69 to 1.31 birds per ha (Gallo et al. 2000).

Yellow Warblers have been confirmed breeding widely in the Transverse and Peninsular ranges; they are less numerous overall in coastal lowlands, where they were nearly extirpated from that portion of Orange County by 1990 (Garrett and Dunn 1981, Gallagher 1997, Unitt 2004, Los Angeles County unpubl. atlas data). Density was 0.32 pairs per ha at Big Morongo Preserve, San Bernardino County (Cardiff 1992), and 1.79 pairs per ha at Fallbrook, San Diego County (Weaver 1992). In the latter county, Yellow Warblers have increased greatly on the coastal slope since the late 1980s, apparently in response to habitat restoration and cowbird trapping to aid Least Bell's Vireos (*Vireo bellii pusillus*; Unitt 2004). In Los Angeles County, the species expanded its range after the 1995–2000 atlas; as of 2005, there were 6–10 pairs nesting along the channelized Los Angeles River just northwest of downtown Los Angeles (K. Garrett in litt.). Similarly, the species' range has expanded in Orange County since the early 1990s (D. Erickson fide D. R. Willick pers. comm.).

Southern deserts. Yellow Warblers occur very locally in low densities on the Owens Valley floor, Inyo County. Extensive surveys along 113 km of the lower Owens River found no breeding Yellow Warblers downstream of the Los Angeles Aqueduct intake, but density upstream was 0.32 birds per ha (2001–2004; PRBO unpubl. data). Elsewhere, the species continues to breed extremely locally as in the past. Yellow Warblers are thought to breed in canyons of the Panamint Mountains (Garrett and Dunn 1981), but infrequent excursions to the mostly inaccessible Grapevine Mountains have failed to produce any recent breeding records (T. & J. Heindel in litt.). In Death Valley, three to four breeding pairs are found annually at Scotty's Castle, but other seemingly suitable habitat is unoccupied (T. & J. Heindel in litt.). Nesting densities were 0.18 pairs per ha along the Amargosa River, Inyo County, and 25–30 pairs along the Mojave River near Victorville, San Bernardino County (2005 PRBO unpubl. data, S. Koonce in litt.).

Ecological Requirements

Yellow Warblers generally occupy riparian vegetation in close proximity to water along streams and in wet meadows (Lowther et al. 1999). Throughout, they are found in willows (*Salix* spp.) and cottonwoods (*Populus* spp.), and in California they are found in numerous other species of riparian shrubs or trees, varying by biogeographic region (Grinnell and Miller 1944, Beedy and Granholm 1985, Lehman 1994, Harris 2005, PRBO unpubl. data). In northern California, willow cover and Oregon Ash (*Fraxinus latifolia*) are important predictors of high Yellow Warbler abundance (PRBO unpubl. data, Alexander 1999). East of the Sierra crest, the combined effect of elevation, percent riparian graminoid cover, and riparian corridor width was positively correlated with Yellow Warbler occurrence (Heath and Ballard 2003b).

In the Cascades and northern and western Sierra Nevada, Yellow Warblers also breed in xeric montane shrub fields and occasionally in the shrubby understory of mixed-conifer forest (Grinnell et al. 1930, Beedy and Granholm 1985, Raphael et al. 1987, Gaines 1992). Nests have been found in Bush Chinquapin (*Chrysolepis sempervirens*) nowhere near water in the Lassen region, and in Snow Bush (*Ceanothus cordulatus*) 30 m from water in the southern Sierra (PRBO unpubl. data, K. Purcell in litt.).

At Clear Creek, Shasta County, in the interior northern Coast Ranges, Yellow Warbler nests were more successful when surrounded by a high number of large White Alders (*Alnus rhombifolia*; PRBO unpubl. data). In willow meadows of the northern Sierra, nests were more successful the farther they were from forest edges or trees (Cain et al. 2003). East of the Sierra crest, 56%, 29%, and 6% of 1086 nests were in willow, Woods' Rose (*Rosa woodsii*), and Black Cottonwood (*P. trichocarpa*), respectively, but daily nest survival was significantly higher for rose nests (PRBO unpubl. data). It is likely that habitat features associated with higher nest success are reducing exposure to predators and cowbirds (Staab and Morrison 1999, Cain et al. 2003).

As a generalist, the Yellow Warbler appears to adapt its foraging to variation in local vegetation structure (Petit et al. 1990). Its diet in California contained over 97% animal matter, including ants, bees, wasps, caterpillars, beetles, true bugs, flies, and spiders (Beal 1907).

Yellow Warblers have shown a high degree of site fidelity, with 60%–64.5% of males and 32%–44% of females returning to their previous year's breeding grounds and many to the same territory (Studd and Robertson 1989, Knopf and Sedgwick 1992). In California, they will make several nesting attempts throughout the season and will typically produce only one brood per year, although double brooding has been documented (PRBO unpubl. data).

Annual apparent adult survival probability for Yellow Warblers was 48% for the southwest region of the United States and 57% for the northwest region (IBP 2005).

Threats

Human population growth and resulting habitat degradation in California will likely continue to pose a threat to Yellow Warblers given their sensitivity to decreases in deciduous habitat, riparian habitat heterogeneity, and riparian corridor width (Saab 1999, Tewksbury et al. 2002, Heath and Ballard 2003b). Large-scale habitat restoration projects in lowlands are sure to assist populations in the next few decades, and the warblers are reoccupying restoration sites with and without cowbird trapping (PRBO unpubl. data; S. Laymon, B. Barnes, and P. Unitt in litt.). Conversely, in heavily populated coastal areas, increasing human demands are taxing water resources and degrading riparian drainages (Gallagher 1997, R. Leong, B. Bousman, and M. Paxton in litt.). New human dwellings and associated fire prevention activities that clear or limit regrowth of montane chaparral will likely reduce Yellow Warbler numbers in that habitat.

Brown-headed Cowbird parasitism is a commonly reported cause of Yellow Warbler declines in California (e.g., Gaines 1974, Garrett and Dunn 1981, Beedy and Granholm 1985, Johnson and Cicero 1991), though this conclusion typically is not supported by regional data on cowbird parasitism or nest success rates. The dramatic recovery of Yellow Warbler numbers in San Diego County and the South Fork Kern River Valley has coincided with cowbird trapping and restoration efforts (Unitt 2004, S. Laymon in litt.). By contrast, Yellow Warbler densities at Mono Lake restoration sites are not only the highest recorded in the state but are steadily increasing despite relatively high parasitism rates and a lack of cowbird management (PRBO unpubl. data).

Cowbirds parasitized 49% of 836 Yellow Warbler nests east of the Sierra; a minimum of 20% of 51 at Clear Creek, Shasta County; 70% of 23 at Amargosa Canyon, Inyo County; and 9% of 78 in the northern Sierra (Cain et al. 2003, PRBO unpubl. data). Yellow Warblers are somewhat resistant to the demographic effects of brood parasitism, and California birds employ antiparasite strategies such as cowbird egg burial (Clark and Robertson 1981, Sealy 1995). East of the Sierra crest, Yellow Warbler young fledged from 36% of parasitized nests, and predation accounted for the loss of 38% of 412 of parasitized nests (PRBO unpubl. data). These data suggest that even where parasitism rates are relatively high, Yellow Warblers fledge young (though fewer than in unparasitized nests) and predation also limits productivity.

Predation was the leading cause of Yellow Warbler nest failure in the northern and eastern Sierra, accounting for 93% of 40 and 76% of 521 failed nests in those regions, respectively (Cain et al. 2003, PRBO unpubl. data). In the wet willow meadows of the northern Sierra, Yellow Warbler nest success was negatively associated with the activity indices of Douglas Squirrels (*Tamiasciurus douglasii*), Steller's Jays (*Cyanocitta stelleri*), and Brown-headed Cowbirds, and nest proximity to trees and forests edges likely increased exposure to predators (Cain et al. 2003).

Management and Research Recommendations

- Protect, manage, and restore dynamic riparian systems that provide the mechanisms (e.g., seasonal flooding) to create early successional as well as more structurally complex vegetative components (e.g., herbaceous cover, shrub cover, and riparian tree canopy).
- Focus management and restoration efforts primarily on identifying and maintaining source populations capable of producing young in excess of adult mortality.
- Eliminate or manage cowbird feeding sites near Yellow Warbler breeding habitat.
- Cowbird trapping may be a viable option to aid warblers in some areas, but criteria outlined by experts (e.g., Smith 1999) should be met prior to the initiation of any trapping program.
- In montane meadow willow habitats, actively flood meadows and restore water tables to limit access for predators (see Cain et al. 2003).
- Initiate landscape-level studies on the ecology of nest predators and parasitism within various habitat types (including chaparral) to identify the most effective management options for increasing reproductive output at a regional level.

Monitoring Needs

Because Yellow Warblers quickly respond to management (e.g., cowbird trapping, removal of livestock) and habitat restoration, monitoring is likely to validate the success of rehabilitation efforts (Taylor and Littlefield 1986, Krueper et al. 2003). Statewide BBS routes are effective but should be complemented by off-road standardized point counts and habitat assessments (Ralph et al. 1993) that target reference and restoration or managed sites. To avoid counting migrants, surveys should be conducted in June and coupled with documentation of breeding behaviors. Nest monitoring (e.g., Martin et al. 1997) should be conducted at reference sites of high warbler abundance stratified by bioregions to assess regional threats, and accompanied by assessments of habitat features at nest sites that may ease predation or parasitism pressures. If cowbird control measures are deemed necessary, they should be preceded by baseline studies and accompanied by concurrent nest monitoring.

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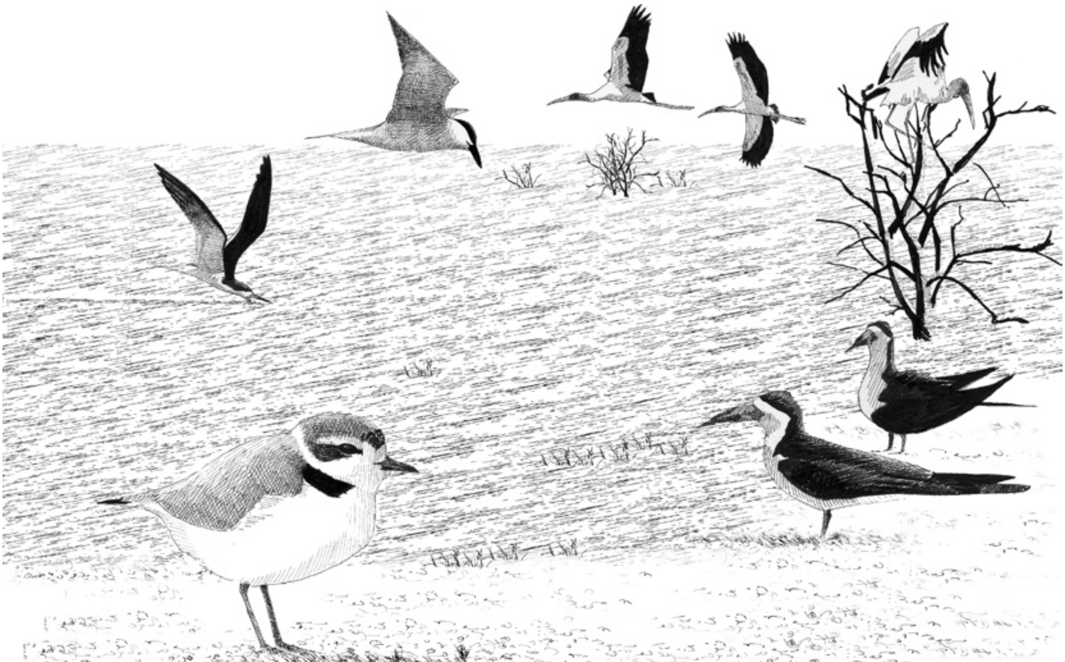
II

SPECIES ACCOUNTS



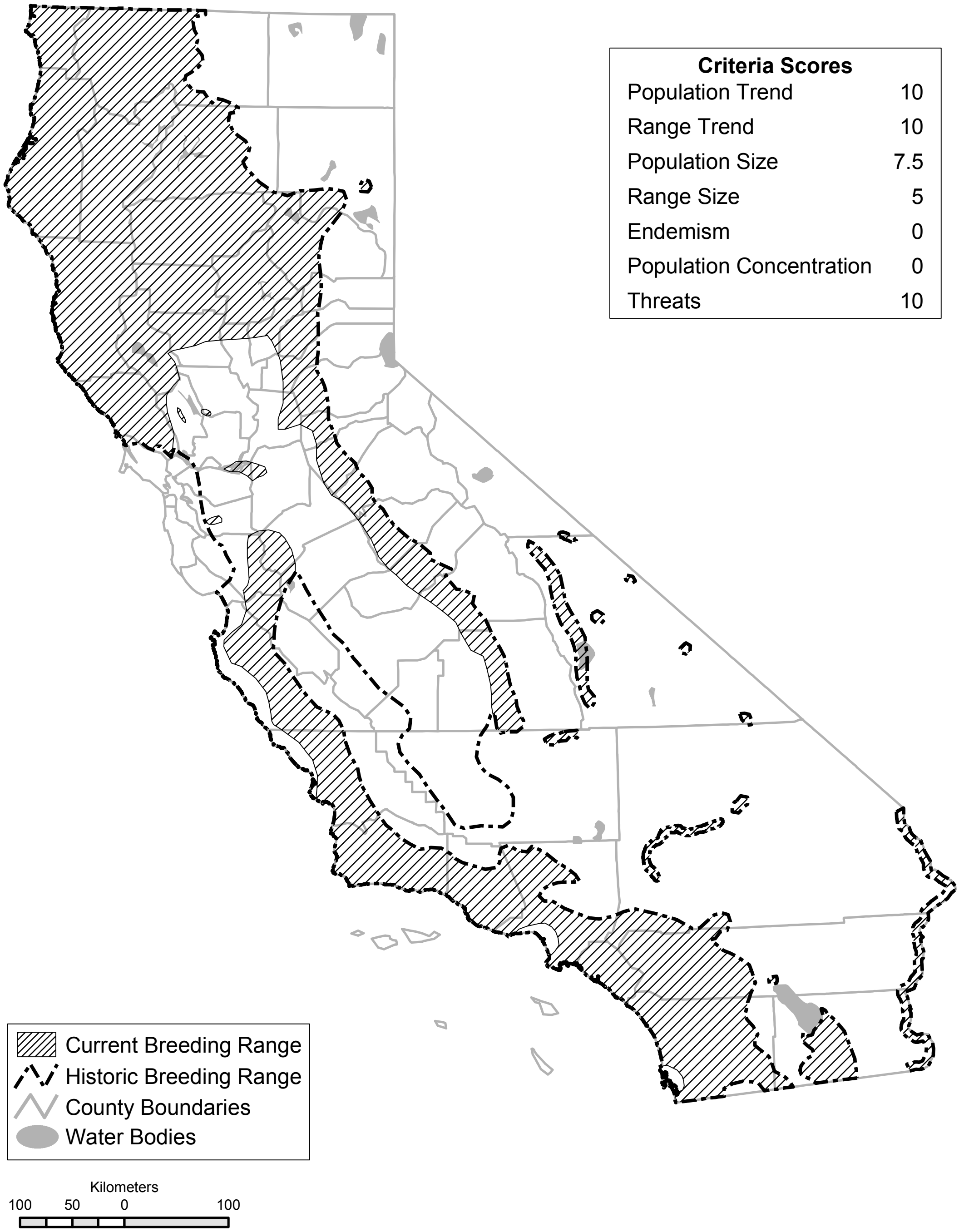
Andy Birch

PDF of Yellow-breasted Chat account from:

Shuford, W. D., and Gardali, T., editors. 2008. California Bird Species of Special Concern: A ranked assessment of species, subspecies, and distinct populations of birds of immediate conservation concern in California. Studies of Western Birds 1. Western Field Ornithologists, Camarillo, California, and California Department of Fish and Game, Sacramento.

YELLOW-BREASTED CHAT (*Icteria virens*)

Lyann A. Comrack



Current and historic (ca. 1944) breeding range of the Yellow-breasted Chat in California; occurs more widely, though secretively, during migration. Numbers have declined in many areas, and the species is extirpated from much of the floor of the Central (especially San Joaquin) Valley, and from parts of the central and southern coast.

Special Concern Priority

Currently considered a Bird Species of Special Concern (breeding), priority 3. Included on prior special concern lists (Remsen 1978, 2nd priority; CDFG 1992).

General Range and Abundance

Two subspecies restricted to the New World: *I. v. auricollis* nests in western and *I. v. virens* in eastern North America. *I. v. auricollis* breeds from southern British Columbia east to southern Saskatchewan and North Dakota, south to south-central Baja California, west Texas, and (at least formerly) southern Tamaulipas; winters from southern Baja California and south Texas south to western Mexico through central Guatemala (AOU 1957, Eckerle and Thompson 2001). Patchily distributed throughout its breeding range, with highest concentrations in the Klamath region of California and Oregon, southern Nevada, southeastern Arizona, southwestern Texas, and eastern Montana and western North Dakota (Sauer et al. 2005).

Seasonal Status in California

Occurs as a migrant and summer resident primarily from late March to late September (Garrett and Dunn 1981, Unitt 2004); breeds from late April through early August (Eckerle and Thompson 2001, Unitt 2004).

Historic Range and Abundance in California

Grinnell and Miller (1944) described the Yellow-breasted Chat as a "fairly common to common" summer resident that bred the length and breadth of mainland California up to about 5000 ft (1520 m) elevation. It was most numerous toward the interior, but status varied regionally and locally.

Northwestern California. Chats were reported widely in this region. Representative breeding season localities included Requa, Del Norte County; Hayfork, Trinity County; Scott River at Callahan, Siskiyou County; Ukiah, Mendocino County; Clear Lake, Lake County; and Sonoma and Santa Rosa, Sonoma County (Grinnell and Miller 1944, MVZ specimens or egg sets). Records extended east to Hornbrook, Siskiyou County, and the McCloud River, Shasta County.

Northeastern California. On the basis of recent information, chats observed at 4500 ft (1372 m) in Secret Valley, Lassen County (Grinnell et al. 1930), likely represented breeders, but individuals collected in late May and early August near Goose Lake and in the Surprise Valley, Modoc County (Mailliard 1927, MVZ specimens), likely represented migrants.

Central Valley and west slope of Sierra Nevada. Apparently numerous in the Sacramento Valley, chats were recorded at Paines Creek near Dale's, Tehama County; Rumsey and Woodland, Yolo County; Sacramento, Sacramento County; and elsewhere. They also were found throughout the San Joaquin Valley, where representative localities were the Tuolumne River near Modesto, Stanislaus County; Los Banos and Snelling (where 20 individuals were recorded in an hour-and-a-half survey of bottomlands), Merced County; near Tarpey, Fresno County; and Bakersfield, Kern County (Grinnell and Storer 1924, Grinnell and Miller 1944, Calif. Nat. Diversity Database [CNDDB] unpubl. data, MVZ and WFVZ egg sets). Chats were reported from several specific sites in the Sierra Nevada foothills (e.g., Nevada City, Nevada County; Smith River east of Coulterville, Mariposa County; Dry Creek near Badger, Tulare County) and were considered "common" along the west base of the Sierra Nevada and at Kernville, Kern County (Fisher 1893, Grinnell and Storer 1924, Grinnell and Miller 1944, CNDDB unpubl. data, MVZ specimens).

Central and southern coast. Grinnell and Wythe (1927) noted that chats were "fairly common in the warm interior valleys" of the San Francisco Bay region; many records exist for Solano, Contra Costa, Alameda, and Santa Clara counties (Grinnell and Miller 1944, CNDDB unpubl. data, MVZ egg sets). They were considered "rare" in any season in Marin County (Shuford 1993). Along the central coast, chats nested at San Lorenzo, Santa Cruz County; "North San Benito County"; and Paso Robles, San Luis Obispo

Breeding Bird Survey Statistics for California

1968–2004					1968–1979			1980–2004			All data from Sauer et al. (2005)
Trend	*P*	*n*	(95% CI)	R.A.	Trend	*P*	*n*	Trend	*P*	*n*	Credibility
0.4	0.60	60	–1.0, 1.7	0.78	5.0	0.20	26	–0.5	0.47	55	Medium

County (Grinnell and Miller 1944, MVZ and WFVZ egg sets). Pemberton and Carriger (1915) considered chats to be "fairly common" along the San Antonio River, Monterey County. The species was described as a "common" breeder in coastal southern California (Willett 1912), with records for Ventura, Ventura County; El Monte, Los Angeles County; near Colton, San Bernardino County; Temecula, Riverside County; and Campo, San Diego County (Unitt 1984, MVZ and WFVZ egg sets).

Southern deserts. Fisher (1893) described the chat as "moderately common" in the Owens Valley (e.g., Independence Creek, Olancha, Morans) and "tolerably common" in Death Valley; the species was also found in the Panamint (Willow Creek, 22 May, thus of uncertain breeding status) and Inyo (Hunter's arastra to the bottom of the Saline Valley) mountains, Inyo County. The chat occurred locally throughout the Mojave and Colorado deserts, with representative breeding sites including Yermo and Big Morongo Valley, San Bernardino County; Mecca, Riverside County; and Niland, Imperial County (CNDDB unpubl. data, MVZ egg sets). Grinnell (1914) considered it to be one of the five most common breeding bird species along the lower Colorado River.

Recent Range and Abundance in California

Although still widely distributed, the Yellow-breasted Chat is now rare or absent as a breeder in much of the Central Valley and parts of the southern coastal slope. The current breeding range is estimated to be about 35% reduced from its historic extent (see map). Chat populations may be rebuilding along the Colorado River, but this gain is more than offset by declines elsewhere. Numbers of Yellow-breasted Chats were relatively stable on Breeding Bird Survey (BBS) routes in California from 1968 to 2004 (Sauer et al. 2005). These data are of medium credibility, being deficient in having low abundance (<1.0 bird per route).

Northwestern California. Chats are still numerous in this region, especially in Humboldt and western Siskiyou and Shasta counties. BBS data indicate that northwestern rivers, including the Klamath and Trinity, support the highest densities in the state (Sauer et al. 2005). The Humboldt County breeding bird atlas found chats in 80 blocks (10 confirmed), representing 19% of all blocks surveyed (Hunter et al. 2005). Further, singing chats were recorded at all point count stations (n = 70) in a survey of gravel bars on the lower Eel River, Humboldt County in 1999 (R. Hewitt pers. comm.). Chats are regularly reported on BBS routes in Mendocino County (e.g., Longvale and Laytonville) and Lake County (e.g., Hullville, rarely Bartlett Springs; Sauer et al. 2005). The Sonoma County breeding bird atlas confirmed nesting only at Annadel State Park, but chats were also found in 18 other atlas blocks, suggesting breeding along Santa Rosa Creek at Spring Lake, Russian River at Guerneville, Rio Nido, Dry Creek, and elsewhere (Parmeter 1995, M. Ricketts pers. comm.).

Northeastern California. Chats were likely never established breeders in far northeastern California (see above). The few recent records for Modoc County (J. Sterling, B. Stovall pers. comm.) appear to represent migrants, though perhaps some remain to breed. Despite no confirmation of nesting in Lassen County, chats occurred regularly at about 4590 ft (1400 m) on Secret Creek between Ravendale and Litchfield in the 1970s (T. Manolis in litt.); a fire recently destroyed suitable habitat (B. Stovall in litt.). Chats used to occur annually in the Susan River Canyon above Susanville in the 1980s (B. Stovall pers. comm.), but they were not recorded on point counts there in 2002 and 2003 (D. Humple/PRBO unpubl. data). In Mono County, Gaines (1992) suggested possible sporadic breeding on the west shore of Mono Lake. Recent riparian bird surveys, however, did not find chats breeding in the Mono Basin or at 10 higher-elevation tributaries to the east and west of the Walker River drainage (Heath and Ballard 2002).

Central Valley and west slope of Sierra Nevada and Cascade Range. Yellow-breasted Chats have declined in the Sacramento Valley, with most recent confirmed nesting observations concentrated to the north, where the species still seems to be doing well. At Clear Creek, Shasta County, densities reach 6 territories per 10 ha (R. Burnett/PRBO unpubl. data; the 11 HY and 8 AHY birds caught during one year of mist-netting represented a high productivity ratio of 1.37; Gardali et al. 1999). Gaines (1974) found singing males to be "common" along the upper Sacramento River of Colusa County and "uncommon" on the Feather River from Oroville, Butte County, to Verona, Sutter County. Other recent locations with chats include Bidwell Park and Oroville WA, Butte County; Stillwater, Glenn County; and Little Stony Creek at East Park Reservoir, Colusa County (Holmes et al. 2000, PRBO unpubl. data 1998–1999). The Sacramento County breeding bird atlas estimated a total of 20–30 pairs of chats in 11 atlas blocks (T. Manolis pers. comm.), and the Contra Costa County atlas (unpubl. data) recorded chats in three blocks in the western Sacramento–San Joaquin River Delta. The species is now found in only a few places in the San Joaquin Valley (Small 1994), including White Slough and the Mokelumne River at the Camanche Reservoir dam, San Joaquin County, and the Stanislaus River at Horseshoe Bend Recreation Area, Stanislaus County (PRBO data 1998, D. Gifford pers. comm.).

Chats nest locally but regularly along low- and midelevation streams in the Sierra Nevada (e.g., South Yuba River, Nevada County; Tuolumne River downstream from Don Pedro Reservoir, Tuolumne County; Kaweah River west of Terminus Dam, Tulare County; T. Beedy pers. comm.). Two pairs on Finegold Creek northeast of O'Neals, Madera County, in 2006 were at a previously undocumented location (J. Davis in litt.). BBS data show them numerous only in the Gold Hills and Folsom areas of El Dorado County in the north (Sauer et al. 2005) and the South Fork Kern River Preserve, Kern County, in the south, where an estimated 30 to 45 nesting pairs occur (M. Whitfield pers. comm.). In the northern Sierra, a few chats are found east to 3300 ft (1006 m) on Spanish Creek in Quincy and at 3500 ft (1037 m) on Indian Creek in Indian Valley, Plumas County (H. Green in litt.). Lower down (mainly 400–2000 ft [122–610 m]), chats are more numerous. They are considered "very common" along Butte Creek, Chico Creek, and the Feather River drainage in the Oroville area (T. Manolis in litt.) and "fairly common" in the Lassen area of the Cascades on Battle, Dye, Deer, and Mill creeks and many other tributaries (R. Burnett in litt.). By contrast, Siegel and DeSante (1999) noted the drastic decline of the species on the west slope of the Sierra over the past 50 years and considered it "rare" at best.

Central and southern coast. In the San Francisco Bay region, there are relatively few records of chats from recent breeding bird atlas projects. They occurred in six atlas blocks (1 confirmed) in Napa County (mostly in Napa Valley, where numbers have declined since the 1980s; Berner et al. 2003), two in Marin County (Shuford 1993), and two in Alameda County (unpubl. data). By contrast, the Santa Clara County atlas confirmed breeding in 7 blocks distributed in two general areas: the southern Santa Clara Valley and the San Antonio Valley at 2000+ ft (610+ m) in the Diablo Range (W. G. Bousman in litt.). Chats also breed on the east slope of this range in Del Puerto Canyon, Stanislaus County (J. Gain in litt.). The chat is a rare and local breeder in Monterey County, where the current population of about 40 pairs is distributed patchily along the Salinas and Carmel river systems and along the San Antonio River where it enters San Antonio Reservoir (Roberson 1993). Chats are considered "uncommon to locally fairly common" in the interior of San Luis Obispo County, where breeding is highly likely along the Salinas River, Trout Creek, and Arroyo Grande Creek above Lopez Lake (T. Edell unpubl. atlas data). In Santa Barbara County, chats have declined markedly and now nest mainly at Barka Slough on Vandenberg Air Force Base, the Santa Ynez River, and Mono and Agua Caliente creeks (Lehman 1994).

Garrett and Dunn (1981) described the chat as having "greatly declined as a breeder in recent years" in southern California. On the basis of surveys during 1994–1999, the chat was judged to be a "fairly common" breeder on the Santa Clara River, where found consistently, in appropriate habitat, from east of Fillmore to Victoria Avenue in Ventura County, plus at a few locations eastward to Interstate 5 in Los Angeles County (J. Greaves in litt.). Chats remain rare and localized in Los Angeles (L. Allen unpubl. atlas data) and Orange (Hamilton and Willick 1996) counties. Chats have become "increasingly rare" in Orange County, where the atlas recorded them in 17 blocks (Gallagher 1997). Chats still nest locally in Riverside County, particularly at the Prado Basin, Santa Ana River, San Timoteo Creek, Temescal Canyon, Canyon Lake, Temecula Creek, and Vail Lake (L. Hays pers. comm.). Despite no formal census of the Prado Basin and adjacent Santa Ana River, L. Hays (pers. comm.) estimated that about 400 pairs occur there. In San Diego County, chats are faring better than elsewhere on the southern coast. Counts of 20 to 50 in a day have been made along the Santa Margarita River north of Fallbrook, along the San Luis Rey River between Interstate 15 and Pala, in the San Pasqual Valley down to Lake Hodges, in the lower Los Peñasquitos Canyon, along the Sweetwater River in the Jamacha area, and in the Tijuana River Valley. Chats occur locally along many small creeks as well as main rivers (Unitt 2004).

Southern deserts. In Inyo County, chats breed along the Owens River (north to Birchim Canyon; T. & J. Heindel in litt.), but were present at only 1 (Hogback Creek) of 18 of its tributaries surveyed in 1998–2000 (Heath et al. 2001). Chats are "rare and local" in the White Mountains, with an exceptionally high-elevation record of 6750 ft (2060 m) at Wyman Canyon (Johnson and Cicero 1986, 1991; MVZ specimens). Other current locations in Inyo County of known or probable chat breeding are the Deep Springs ponds, Saline Valley salt marsh, Scotty's Castle and Furnace Creek Ranch in Death Valley, and Tecopa/Amargosa River area (T. & J. Heindel in litt.). Breeding chats are few and widely scattered in the Mojave Desert of San Bernardino County (Myers 1998): Mojave River at Victorville (6–10 pairs), Morongo Valley (2–7 pairs), and Cushenberry Springs (1 pair). They also possibly nest in Afton Canyon and Camp Cady. Breeding chats have declined in the Salton Sea area, where in the 1990s a total of at most six pairs was known from only four sites (Patten et al. 2003). Rosenberg et al. (1991) estimated that chats numbered about 700 individuals along the lower Colorado River in 1986, representing a decline of 30% since 1976 attributable to habitat loss from flooding in the 1980s. While surveying Southwestern Willow Flycatchers (*Empidonax traillii extimus*) along the lower Colorado in 1996–2001, R. McKernan (pers. comm.) confirmed nesting by chats at Headgate Dam (15 pairs), San Bernardino County; Hall Island (15 pairs), Riverside County; and several sites in Imperial County, including Cibola NWR (10 pairs on California side), Walker Lake (15 pairs), Draper Lake (20 pairs), Paradise Valley (20 pairs), Clear Lake (15 pairs), Picacho State Recreation Area (30 pairs), Ferguson Lake (15 pairs), and below Laguna Dam (10 pairs). Chats' ability to nest in tamarisk (*Tamarix* spp.) accounts for recent population rebounds there of an unknown magnitude (Hunter 1984, S. Laymon pers. obs.).

Ecological Requirements

Nesting Yellow-breasted Chats occupy early successional riparian habitats with a well-developed shrub layer and an open canopy. Vegetation structure, however, more than age appears to be the important factor in nest-site selection (Eckerle and Thompson 2001). Nesting habitat is usually restricted to the narrow border of streams, creeks, sloughs, and rivers and seldom forms extensive tracts. Blackberry (*Rubus* spp.), wild grape (*Vitis* spp.), willow, and other plants that form dense thickets and tangles are frequently selected as nesting strata (Grinnell and Miller 1944). The nest is typically placed within 1 m of the ground but may range up to 2.4 m (Ehrlich et al. 1988). Taller trees, such as cottonwood (*Populus* spp.) and alder (*Alnus* spp.), are required for song perches (Dunn and Garrett 1997). Chats establish and defend individual territories, but pairs tend to congregate, suggesting loose coloniality (Eckerle and Thompson 2001).

Chats will nest in tamarisk, Himalayan Blackberry (*Rubus discolor*), Russian Olive (*Elaeagnus angustifolius*), and other non-native plants that provide dense shrub layers. Hunter et al. (1988) found chats using *Tamarix chinensis* preferentially to native vegetation along the Pecos River, Texas. Brown and Trosset (1989), however, reported that along the Colorado River in the Grand Canyon, Arizona, they nest in tamarisk and native shrubs in direct proportion to their frequency of occurrence in a given area. At Clear Creek, Shasta County, most chat nests found were in exotic Himalayan Blackberry rather than in the less abundant native California Blackberry (*R. ursinus*). Chat abundance was highly correlated with the presence of the native blackberry but not significantly with the exotic blackberry (Burnett and DeStaebler 2001).

Diet studies of chats are lacking in California. Elsewhere, adults feed predominantly on insects and spiders; wild fruits and berries are also important. Adults feed nestlings primarily soft-bodied insects (orthopterans and larval lepidopterans; Eckerle and Thompson 2001).

Threats

Destruction of riparian woodland was implicated in the early decline of the Yellow-breasted Chat in California (Remsen 1978), but the species' absence from seemingly suitable habitat suggests additional pressures. Chats are frequent hosts to nest parasitism by the Brown-headed Cowbird (*Molothrus ater*) through much of their range (Ehrlich et al. 1988). Hanna (1928) documented chat nests parasitized by cowbirds in southern California, but the extent of parasitism in the state is still poorly understood. Gaines (1974) supposed the chat's susceptibility to parasitism in the Sacramento Valley was moderate. At Clear Creek, Shasta County, the 1 of 14 chat nests parasitized still fledged three chats (Burnett and DeStaebler 2001). Chats have become quite numerous on Camp Pendleton, San Diego County, where intensive cowbird trapping has been conducted for years (P. Unitt pers comm.), suggesting a causal effect. Large-scale cowbird trapping at the Prado Basin, Riverside County, has likely increased its chat population (L. Hays pers. comm.). In each case, however, habitat restoration and exotic plant control may have played critical roles in enhancing conditions for chats.

Chats' dependence on understory and shrubby riparian vegetation for nesting makes them vulnerable to habitat loss from vegetation removal along river channels during flood-control maintenance and from urban and agricultural development. The species is sensitive to grazing and hence may be a good indicator of its effects on riparian birds (Sedgwick and Knopf 1987). Chat densities increased fourfold over a six-year period in response to the cessation of livestock grazing along the San Pedro River, Arizona (Ohmart 1994).

Management and Research Recommendations

- Preserve existing, and restore degraded, riparian habitat. Advocate a multispecies approach to restoration to help both chats and other riparian obligates (Brown and Trosset 1989, RHJV 2004).
- Manage riparian habitat to maintain and/or promote a dense shrub layer; install a shrub layer in the early stages of restoration projects.
- Time removal of exotic plants from riparian areas used by nesting chats to avoid disturbance during breeding, and proceed only after careful assessment and mitigation for any potential detrimental effects to chats.
- Identify and protect areas with healthy breeding populations of chats and conduct ecological studies needed to increase and expand their populations.
- Compare chats' reproductive success in native versus non-native vegetation.
- Examine the effects of cowbird nest parasitism, and its control, on chats by region, and take appropriate management actions as needed.

Monitoring Needs

The BBS is inadequate for monitoring fluctuations in populations of the Yellow-breasted Chat. BBS data are too few to detect population trends in the Great Basin, San Joaquin Valley, coastal southern California, and the Mojave and Sonoran deserts. Improved BBS coverage, while desirable, would not in itself be enough to monitor chats adequately in their linear or patchy habitats. A statewide population monitoring program should be conducted once every 3–5 years using standardized off-road point counts or constant-effort mist-netting (Ralph et al. 1993).

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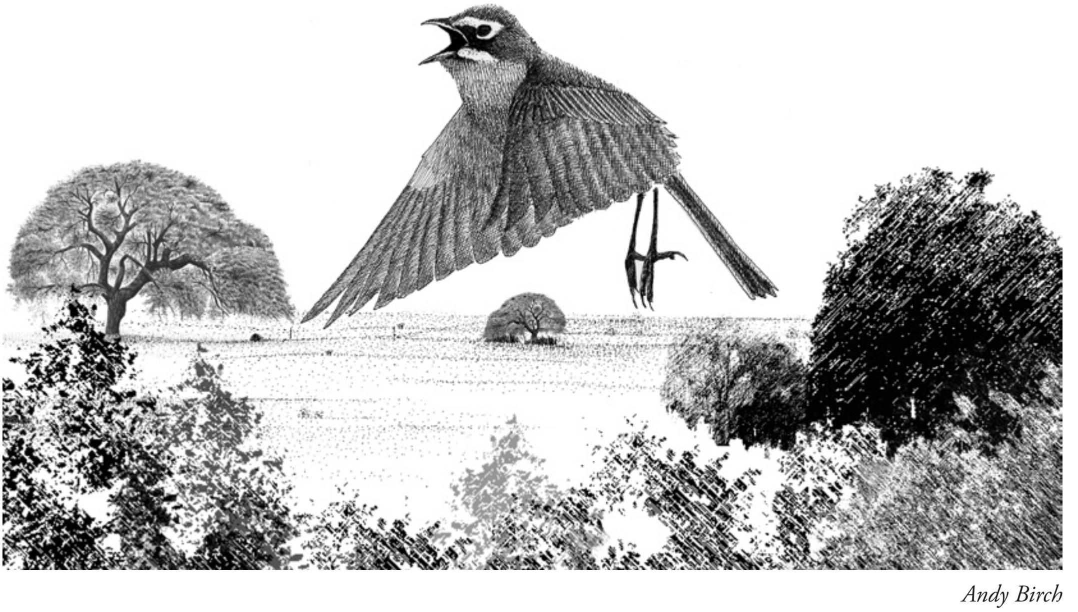
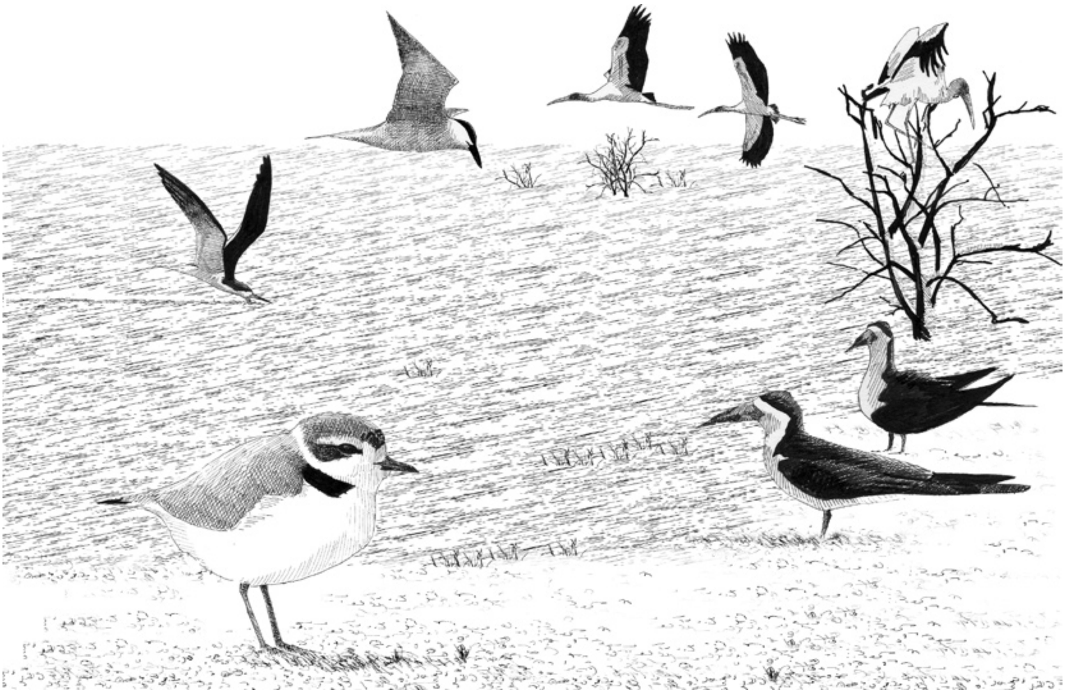


Andy Birch

II

SPECIES ACCOUNTS



Andy Birch

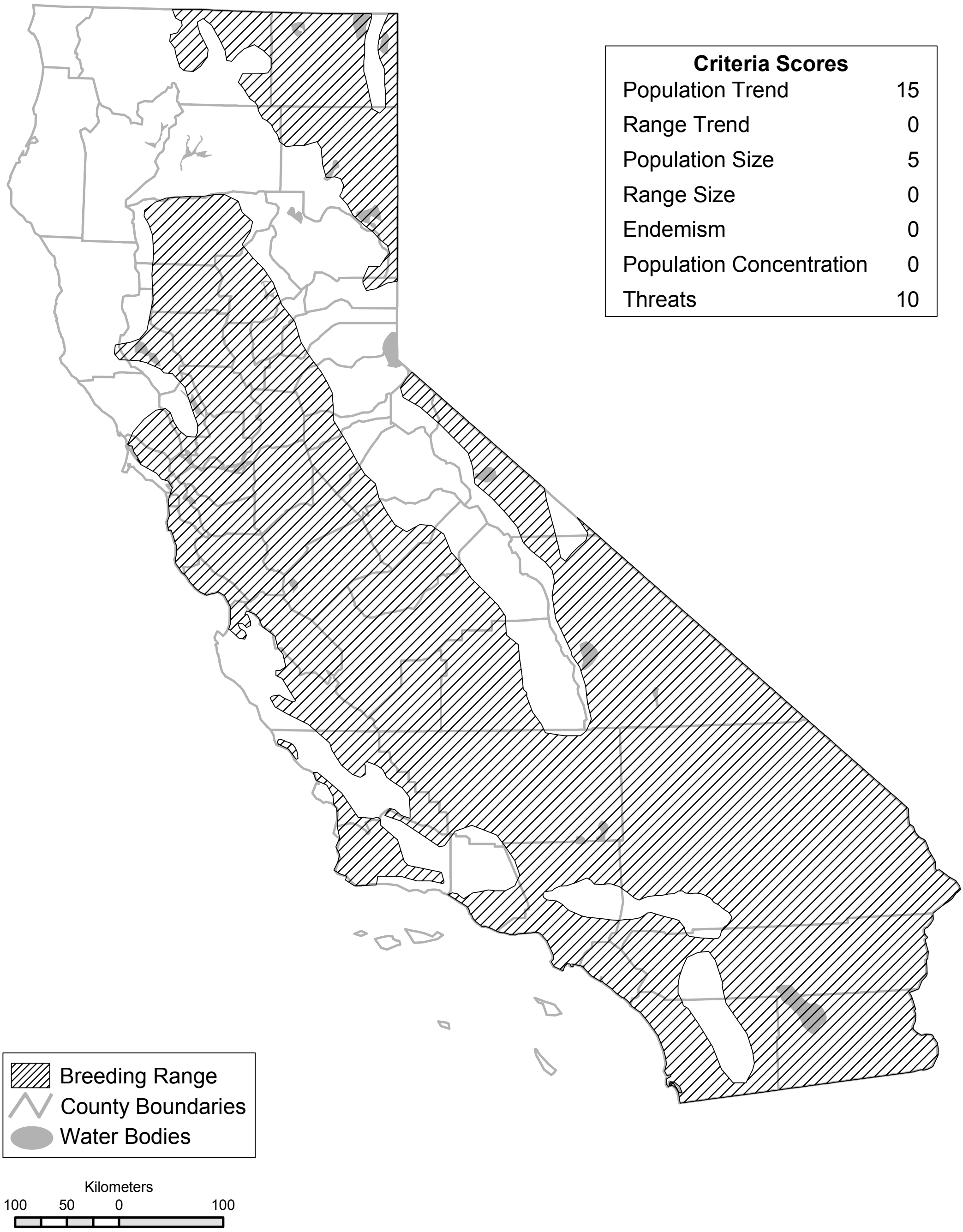
PDF of Loggerhead Shrike account from:

Shuford, W. D., and Gardali, T., editors. 2008. California Bird Species of Special Concern: A ranked assessment of species, subspecies, and distinct populations of birds of immediate conservation concern in California. Studies of Western Birds 1. Western Field Ornithologists, Camarillo, California, and California Department of Fish and Game, Sacramento.

LOGGERHEAD SHRIKE (*Lanius ludovicianus*) (mainland populations)

Diana Humple

Criteria Scores	
Population Trend	15
Range Trend	0
Population Size	5
Range Size	0
Endemism	0
Population Concentration	0
Threats	10



Breeding range of mainland populations of the Loggerhead Shrike in California. Although the outline of the overall range generally is stable, numbers have declined greatly and the species is nearing extirpation in broad areas of coastal southern California. Breeding populations in the north are migratory (entirely resident south of 39°), hence resident populations to south are augmented in winter, when some birds also occupy areas locally where none breed.

Special Concern Priority

Currently considered a Bird Species of Special Concern (breeding), priority 2. Not included on the original prioritized list (Remsen 1978), but the full species was included on CDFG's (1992) unprioritized list.

General Range and Abundance

Breeds in Canada in southern Alberta, Saskatchewan, and Manitoba; widely throughout the United States except portions of the Northwest, the Northeast, and higher elevations throughout; and in much of western Mexico (Phillips 1986, Howell and Webb 1995, Yosef 1996). Largest concentrations occur in areas of Texas and Louisiana. Winters throughout much of the United States, in portions of southern Canada (Sauer et al. 1996), and throughout much of Mexico (Howell and Webb 1995). Continent- and nationwide declines have been documented (Pruitt 2000, www.audubon.org/bird/cbc, Sauer et al. 2005).

Subspecies delineations have been much debated, with the number recognized ranging from 7 to 12 (summarized in Yosef 1996). Five subspecies occur in California. *L. l. excubitorides* is largely resident in southeastern California, *L. l. gambeli* is resident throughout much of state north and west of the range of *L. l. excubitorides*, and *L . l. grinnelli* is resident in coastal San Diego County. Island (*L. l. anthonyi*) and San Clemente (*L. l. mearnsi*) Loggerhead Shrikes are excluded from this account, which is restricted to mainland populations.

Seasonal Status in California

Present year round throughout most of the California range; breeds from as early as January or February in southern California to July (Unitt 2004, PRBO unpubl. data). Breeding populations in north and possibly elsewhere are migratory; other populations primarily resident (entirely resident south of 39º; Grinnell and Miller 1944, Yosef 1996). Wintering individuals augment resident populations and occupy nonforested areas locally where none breed (Grinnell and Miller 1944, Unitt 2004).

Historic Range and Abundance in California

Grinnell and Miller (1944) mapped the breeding distribution as most of the state except for the primarily forested coastal slope, the Coast Ranges, the Klamath and Siskiyou mountains of northwestern California, the Sierra Nevada and southern Cascades, and high elevations of the Transverse Ranges. Known nesting elevations ranged from –250 ft (–75 m, Death Valley) to 7500 ft (2300 m). They described shrikes as "common" to "abundant" and noted that the largest populations, at least of those west of the southern deserts, occurred in the San Joaquin Valley and in the south coast region. Grinnell and Wythe (1927) described the species as an "abundant" resident in the San Francisco Bay region, with lower numbers toward the coast. Willett (1933) likewise considered the species to be "abundant" in southern California from the coast to the base of the mountains.

Recent Range and Abundance in California

The overall breeding range currently remains similar to what it was in 1944 (see map), though birds have been extirpated locally, reduced in numbers by habitat loss, or documented nesting in some outlying areas where previously unknown. Breeding Bird Survey (BBS) data for California's mainland shrikes show a significant negative trend over the entire study period (1968–2004), reflecting a highly significant declining trend from 1968 to 1979 and relatively stable numbers from 1980 to 2004 (Sauer et al. 2005). Analyses of Christmas Bird Count (CBC) data documented a significant statewide decline from 1959 to 1988 (–1.3% annually; Sauer et al. 1996), which appears to have continued and to be accelerating in some regions (e.g., Hamilton and Willick 1996, Bolander and Parmeter 2000, Unitt 2004). Although Cade and Woods (1997) cautioned about possible problems with CBC data for this species, these trends for California are too strong to be ignored. Breeding abundance is highest in portions of the Central Valley, Coast Ranges, and the southeastern deserts

Breeding Bird Survey Statistics for California

1968–2004					1968–1979			1980–2004			All data from Sauer et al. (2005)
Trend	*P*	*n*	(95% CI)	R.A.	Trend	*P*	*n*	Trend	*P*	*n*	Credibility
–1.6	0.05	108	–3.2, 0.0	2.82	–7.5	0.00	75	0.4	0.71	94	Medium

(Sauer et al. 2005), and in winter throughout the San Joaquin Valley, the south-central and south coasts, and the southeastern deserts (Sauer et al. 1996).

Northeastern California. There has been an apparent increase in abundance in this region (BBS "trend map"; Sauer et al. 2005), though numbers can vary substantially by subregion. In shrub-steppe habitat in the Honey Lake basin, Lassen County, shrikes breed at a density of one pair per 61 ha (Humple et al. 2002), whereas in Sierra Valley, Plumas and Sierra counties, the species is a very rare breeder and not recorded most years at that season (W. D. Shuford pers. comm.). To the south in the Great Basin of Mono County, shrikes are "uncommon" breeders in the greater Mono Basin and Glass Mountain areas (Gaines 1992, Shuford and Metropulos 1996).

Central coast. Population declines have been observed in the San Francisco Bay region, including south of the bay (BBS "trend map"; Sauer et al. 2005), where oak savannah habitat in the foothills has been lost in recent years (CalPIF 2002). In southeastern Mendocino County, in 1981 a pair of shrikes nested in Crawford Valley between Hopland and Ukiah and another pair was present near Hopland (R. Keiffer in litt.); these outlying records have not been duplicated since. Loggerhead Shrikes are "uncommon" residents in Sonoma County, where numbers have been "considerably reduced" compared to their historic abundance (Grinnell and Wythe 1927, Stafford 1995, Bolander and Parmeter 2000), and they "maintain a tenuous presence" today in Napa County (Berner et al. 2003). Shrikes occur locally in Marin and San Mateo counties (Shuford 1993, Sequoia Audubon Society 2001). They are "uncommon" in Monterey County, especially from Greenfield south, and have declined seriously in the agricultural region of the Salinas Valley (Tenney 1993). Wintering numbers on San Francisco Bay area CBCs also have been reduced severely since the 1970s (Bolander and Parmeter 2000; R. Stallcup pers. comm.).

Central Valley. While overall abundance is relatively high in the Central Valley, BBS data show a significant decline throughout this region (Sauer et al. 2005).

Southern coast. In the early 1980s, shrikes were widespread residents throughout the open lowlands of the south coast region, though absent from heavily urbanized areas (Garrett and Dunn 1981, Unitt 1984), but they have been declining there since. They are "uncommon" to "rare" breeders and "uncommon to fairly common" winterers in Santa Barbara County (Lehman 1994). In Los Angeles County, shrikes have declined substantially on the coastal slope; though occurring fairly widely during breeding bird atlas surveys from 1995 to 2000, nesting is now known from only 2–3 localities per year on the coast and in the Los Angeles basin (L. Allen and K. Garrett pers. comm.). In Riverside County, shrikes have noticeably declined on the coastal slope both as a breeding and wintering bird (J. Green in litt.). In Orange County, they are "fairly common" in the remaining appropriate habitat on the coast and "uncommon" in the interior, with both areas showing declining winter trends on CBCs since the 1970s (Hamilton and Willick 1996). The loss of open and riparian habitat on the Santa Ana River is resulting in declines in the area (Gallagher 1997). Shrike populations are fragmented on the coastal slope of San Diego County, where a decline in numbers on CBCs since the 1980s "accelerated alarmingly" in the 1990s (Unitt 2004). Still, in winter the species occurs more widely than in summer, moving into many areas not occupied during the breeding season. BBS data suggest declines throughout the state's southern coastal region but not in the south-central region ("trend map"; Sauer et al. 2005). Likewise, CBC data reveal a precipitous decline in wintering numbers throughout the south coastal region (NAB 56:224), even in many undeveloped areas (Unitt 2004).

Southern deserts. Shrikes generally are much more numerous in the southern deserts than toward the southern coast. Surveys for the Los Angeles County breeding bird atlas in 1995–2000 found shrikes in almost every block in the Mojave Desert region of the Antelope Valley–Lancaster area (unpubl. atlas data). In Deep Canyon near Palm Springs, Weathers (1983) reported a density of about one pair per 20 ha. Unitt (2004) described shrikes as "uncommon" overall in San Diego County but most numerous in the Anza-Borrego Desert, where "widespread" both on the desert floor and in desert-edge scrub on the east slopes of the mountains. Patten et al. (2003) described shrikes in the Salton Sink as "fairly common" during the breeding season but "more numerous" in winter, when numbers of breeding residents are augmented by migrants from other regions. Status is similar along the lower Colorado River valley, where shrikes are considered "fairly common" breeders and "common" winter residents, and populations were apparently stable in recent years through the 1980s (Rosenberg et al. 1991). Regional BBS data show a significant decline in the Sonoran Desert but no trend in the Mojave Desert (Sauer et al. 2005).

Ecological Requirements

In California, Loggerhead Shrikes breed mainly in shrublands or open woodlands with a fair amount of grass cover and areas of bare ground. They require tall shrubs or trees (also use fences or power lines) for hunting perches, territorial advertisement, and pair maintenance; open areas of short grasses, forbs, or bare ground for hunting; and large shrubs or trees for nest placement. They also need impaling sites for prey manipulation or storage, which can include sharp, thorny, or multistemmed plants and barbed-wire fences (Yosef 1996, Pruitt 2000). These requirements are met on the east side of the Cascades and Sierra Nevada in shrub steppe and, to a lesser degree, in Western Juniper (*Juniperus occidentalis*) woodland; on the coastal slope and Coast Ranges in chaparral, oak woodland, or oak savannah (Bolander and Parmeter 2000, L. Allen pers. comm.); locally in the Central Valley in riparian edges and (in the south) desert scrub; in the southeastern deserts in desert scrub and sparse riparian woodland (Rosenberg et al. 1991); and occasionally throughout in rural and agricultural hedgerows.

Loggerhead Shrikes hunt by perching on appropriate substrates and scanning the area, taking prey primarily from the ground but occasionally in flight, and often impaling prey for easier manipulation or for storage for later consumption (Craig 1978, Morrison 1980, Yosef 1996). Consequently, their foraging habitat requirements are similar in the breeding and nonbreeding seasons. The diet of Loggerhead Shrikes varies seasonally and includes arthropods (especially grasshoppers, crickets, beetles and caterpillars), reptiles, amphibians, small rodents, and birds (Craig 1978, Yosef 1996).

In sagebrush steppe in northeastern California, Loggerhead Shrikes are most common in Wyoming Sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) and Big Sagebrush (*A. t.* ssp. *tridentata*) communities, and are less frequently encountered at higher elevations in Mountain Sagebrush (*A. t.* ssp. *vaseyana*; Humple et al. 2002). Densities are also high in this region in Greasewood (*Sarcobates vermiculatus*) communities (pers. obs.). In San Diego County, shrikes are found primarily in desert washes containing some trees or shrubs, or in areas with patches of mesquite (*Prosopis* spp.) or saltbush (*Atriplex* spp.), but are absent in areas of thick chaparral or forest (Unitt 2004). In the lower Colorado River valley, birds use appropriate agricultural areas during the nonbreeding season (Rosenberg et al. 1991), as in much of California.

Shrikes place their nests at variable heights above ground, generally 1 to 2 m (see Yosef 1996). In California, average nest heights are 0.95 m (n = 29) in sagebrush steppe in northeastern California, where Big Sagebrush is the most common substrate (PRBO unpubl. data), and 3.15 m (n = 12) in riparian habitat in the San Joaquin Valley, with willows (*Salix* spp.) the most common substrate (PRBO unpubl. data). In southern California, they nest in many substrates, especially thorny or spiny ones when available, but most commonly in mesquite (Unitt 2004). Shrikes will renest persistently after failure, and while generally thought to be single-brooded this appears to be highly variable between populations (see Yosef 1996 for summary).

Population limiting factors are complex (e.g., migratory versus nonmigratory populations) and not well understood. In general, it appears habitat loss and degradation play a role in shrikes' relatively low overwinter and postfledging survival (Brooks and Temple 1990, Yosef 1996, Pruitt 2000).

Threats

The threats responsible for shrike declines in California and the West are poorly understood (Pruitt 2000). Habitat loss, on breeding and wintering grounds as well as along migratory routes, is undoubtedly a major threat to the species. Loss of oak savannah, coastal scrub, and riparian habitats (CalPIF 2002, 2004; RHJV 2004) to agriculture that does not meet the ecological requirements of the species (e.g., vineyards, orchards, row crops) is a continued threat in many regions, as is habitat conversion from increasing urbanization. Exotic grasses and forbs introduced by livestock grazing pose the greatest threat to shrikes in sagebrush-steppe habitats in the northeastern part of the state; the presence of Cheat Grass (*Bromus tectorum*) often results in altered fire regimes by increasing fire frequency and sagebrush loss, and ultimately results in conversion from a shrub- to grassland-dominated landscape (Brooks and Pyke 2001). At an Oregon site, Humple and Holmes (2006) documented a 50% decline in a shrike population and a decline in nest survival after a fire destroyed much of the sagebrush cover. Increased fire frequency and resulting exotic grass invasion is also an increasing threat to desert-scrub habitats in the Mojave and Colorado deserts in the southern part of the state (Lovich 1998).

In some areas in North America, seemingly appropriate habitat is unoccupied (Cade and Woods 1997, Pruitt 2000, Unitt 2004, L. Allen pers. comm.), suggesting other limiting factors or a missing piece in our understanding of critical habitat features.

Diminished quality of winter habitat may be lowering overwinter survival in migrant populations (Brooks and Temple 1990, Yosef 1996, Pruitt 2000). Postfledging mortality appears to be high in most Loggerhead Shrike populations (see Pruitt 2000 for review), suggesting that this period might be limiting, but further study is needed.

Pesticides are considered by many to be a likely cause of shrike population declines, but evidence is mostly circumstantial and exact impacts are not understood. Shrikes have a diet of pure animal matter, making them more vulnerable to pesticide ingestion than most passerines (Kridelbaugh 1981, Stevenson and Anderson 1994, Pruitt 2000). Still, no effect on nesting success has been documented. Eggshell thickness was negatively correlated with DDE concentrations in Illinois (Anderson and Duzan 1978) but not in California, where there was no difference between eggs collected before or after the ban on DDT (Morrison 1979). Cadman (1985) noted that the greatest population declines in Canada were in agricultural regions, and Blumton et al. (1990) noted a correlation between widespread Loggerhead Shrike declines and widespread use of organochlorine pesticides from the 1940s to the 1970s. Organochlorines have largely been banned since the 1970s, suggesting that if it did cause a decline other factors prevented recovery. In a laboratory setting, there were direct effects of dieldrin on juvenile mortality and on the development of hunting skills; pesticide exposure may also lengthen postfledging dependency by inhibiting mental development (Busbee 1977). Additional studies have detected pesticide concentrations in shrikes or shrike eggs (see Pruitt 2000 for summary).

Fatalities from vehicle collisions may be threatening some already declining populations (Flickinger 1995). In Virginia, collisions were second to predation as a cause of winter mortality (Blumton 1989); in Texas, shrike numbers were overrepresented among roadside fatalities relative to their local abundance (Flickinger 1995).

Management and Research Recommendations

- Maintain and increase suitable habitat throughout the shrike's range for use during all seasons. For example, continue efforts to curb conversion of shrub steppe and desert scrub to exotic plant communities.
- Investigate the effects of altered fire cycles and exotic grass invasion on shrike habitat and populations in desert scrub and open juniper woodland.
- Examine effects of habitat fragmentation on Loggerhead Shrike populations (Yosef 1996, Pruitt 2000) in coastal scrub, chaparral, and other habitats incurring such pressure (e.g., effects on nest predation and site selection, effect of distance from parcels of continuous habitat on occupancy of fragmented or isolated habitat patches).
- Study the effects of pesticides (on breeding and wintering grounds) on nest success and adult and juvenile survivorship, and examine levels of contamination in eggs.
- Conduct studies on productivity, postfledging survival, and annual survivorship in relation to land use and habitat to help identify the life stages limiting populations.
- Conduct studies on wintering ecology, degradation of wintering habitat, and connections between breeding and wintering populations (e.g., through DNA studies, stable isotope analysis).

Monitoring Needs

The Breeding Bird Survey appears to sample shrike populations well in California, but data from additional, independent, off-road surveys (e.g., large-scale point counts) in areas not well covered by the BBS would be useful. The Christmas Bird Count also appears to provide good data on population dynamics for the shrike. However, Cade and Woods (1997) discussed potential problems with interpretation of these data. Hence, it would be good to establish a large-scale winter-season population monitoring project including the use of transects. Population declines would be better understood if additional monitoring programs focused on vital demographic rates were established.

The Loggerhead Shrike was recently chosen as one of 15 "transboundary/migratory species of concern" on a pilot Commission for Environmental Cooperation project, which, it is hoped, will result in more focused and increased conservation attention on this species in Mexico, the United States, and Canada (Pruitt 2000). Statewide, greater coordination is needed among biologists to compile and summarize data. As the shrike is a California Partners in Flight (CalPIF) focal species for both sagebrush-steppe and desert habitats, researchers collecting data will soon be able to contribute to the CalPIF database (www.prbo.org/calpif/data.html), which serves as a repository for breeding status information for the state.

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EXHIBIT E

The Birds of the Arroyo Seco

Results of Surveys 2007 – 2009

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Abstract

Since 2007, general bird species counts and point counts have been conducted in the City of Pasadena's Hahamongna Watershed Park and Lower Arroyo Park. The general bird survey data comprises a list of species in numbers typical of the habitat types present at each park. Among those, the Yellow Warbler (*Dendroica petechia*) and Yellow-breasted Chat (*Icteria virens*), species listed as Bird Species of Special Concern (BSSC) by the State of California are regularly found within the parks during the breeding season. Cooper's Hawk (*Accipiter cooperii*), also on the BSSC list, is occasionally observed in both parks with breeding confirmed in Hahamongna. Analysis of the point count data shows the distribution of habitat indicator species, the California Quail (*Callipepla californica*), the Oak Titmouse (*Baeolophus inornatus*), the Yellow Warbler (*Dendroica petechia*), and the Spotted Towhee (*Pipilo maculatus*) within both parks to match their specific habitat preferences. It is hoped that this information will provide a valuable biological baseline for both parks as modification and/or restoration occurs in the future.

Introduction

In early 2007, representatives from Pasadena Audubon, Audubon California's center at Debs Park, and the Arroyo Seco Foundation first met to formulate a plan by which the long-term effects of development and recreation on the birdlife in the parks of the Arroyo Seco watershed could be monitored. Within the urban floodplain of the Arroyo Seco as it drains from the San Gabriel Mountains toward its confluence with the Los Angeles River, the Hahamongna Watershed Park (Hahamongna) and the Lower Arroyo Park (Lower Arroyo) are popular locations serving the public of the western San Gabriel Valley and northeast Los Angeles (see Figure 1). In addition to their human uses, they are also refuges for nature in an urban landscape, possessing a high percentage of native plant species and serving as a corridor for wildlife between the urban lowlands and the extensive wilderness of the San Gabriel Mountains.

Hahamongna is the larger and more natural of the two parks containing: oak woodland mainly along its western edge, chaparral mostly in its northern and eastern portions, wetland and riparian areas in its central and southern areas (often flooded after rains), some flood control basins, and several open weedy spaces. The Arroyo Seco runs roughly through the center in a natural sand and gravel river channel. It is dry except after heavy winter rains. A public parking lot lies on the west side and provides access to the trails of the park as well as a ball field and Frisbee golf course. NASA's Jet Propulsion Laboratory (JPL) borders the park on the northwest and one of its parking lots borders on the northeast. With a dam across the outlet, and residential neighborhoods bordering most of the remainder, the only contact between Hahamongna and the San Gabriel Mountains wilderness is along the river channel that runs between JPL and its parking lot.

The Lower Arroyo is more developed and further detached from the nearby wilderness. Through this park the Arroyo Seco is largely confined to a concrete channel that runs through the center. A well-worn trail parallels its edges. Though some chaparral scrub and oak woodland are present in the canyon bottom, most is restricted to the steep canyon walls that are bounded by residential yards at the top. The northern part of the park near the 134 Freeway and Colorado Boulevard bridges contains willow riparian habitat in natural river bottom and small patches of wetland, some of which was improved by City of Pasadena restoration project completed in the spring of 2008.

Both Hahamongna and Lower Arroyo support populations of the expected bird species for the area. Nothing is static, however, and the area's demands on its open space change. Proposed "improvements" to these parks are just some of many things that could/will happen to our local wild patches in the coming years. It is clear that a scientific endeavor is needed to establish a baseline and to study what effects changing usage of the land will have on the birds that live there. This report provides details on the long-term, multi-season bird census of both Hahamonga and the Lower Arroyo that was initiated in February of 2007 and continued through 2008 and 2009.

Methods

The emphasis of this study has been on evaluating the integrity of the habitat for birds. The point count methodology was developed with particular focus on four target “indicator” species: California Quail as an indicator of habitat continuity and non-disturbance, Oak Titmouse as an indicator of oak woodland, Yellow Warbler as an indicator of riparian habitat, and Spotted Towhee as an indicator of chaparral habitat. Point count data is collected for all species. Seventeen points were assigned within Hahamongna and eighteen in the Lower Arroyo (see Figure 1). These points were chosen to sample the various habitats present at each park and were also placed with a mind to access and safety. On few occasions was rainfall enough that portions of Hahamongna (points 10, 12-16) became inaccessible due to flooding. The monitoring protocol also entails a full bird count of each park performed multiple times each year with emphasis in March when resident breeding birds are most actively displaying and defending territory, and in June after Yellow Warblers have arrived and begun breeding. The point counts and full bird counts are completed in the same visit. Surveys were all conducted on weekdays to minimize disturbance from weekend recreational traffic.

In three years of surveying (2007-2009), bird surveys and point counts were conducted by a dedicated group of volunteer biologists: Larry Allen (LA), Judy Bass (JB), Lance Benner (LB), Ron Cyger (RC), Darren Dowell (DD), Jon Feenstra (JF), John Garrett (JG) and Jenny Jones (JJ).

Results and Discussion

During each year of the project to date, surveys were conducted from February to December. The number of surveys conducted each year, the volunteer biologists, and the total species counts are shown in Table I.

The results of the point counts for the indicator species double as elegant maps of the habitats present in each park (see Figs. 2-4 for 2007-2009, respectively). Oak Titmouse, obligate to oak woodlands, shows a distribution among the points that matches the densest stands of Coast Live Oak. Likewise, Yellow Warbler, a riparian species, is also found to occur exactly where expected, in dense stands of riparian willows. It becomes less clear for Spotted Towhee, which seems to occur at every point. Indeed, the presence of brushy habitat nearly throughout both parks seems to be good enough to make this bird ubiquitous. Though its distribution in the Lower Arroyo makes a statement since most detections of this species from the points are from the canyon walls where brush is thicker and less disturbed. This disturbance is key in explaining the distribution of California Quail. The detections of California Quail are only in Hahamongna, and there only on the north and eastern edges. These edges are furthest from daily human disturbance (furthest from the public parking lot) and least impacted by park "improvement," being mostly brushy and natural. The requirement for access to undisturbed habitat with little human traffic is certainly why California Quail does not occur at all in the Lower Arroyo. The similar appearance of the distributional data through all three years of the survey is reinforcement of the lack of change that has occurred to those habitats in that time.

In addition to the species targeted as indicators, several others deserve additional attention. The parks of the Arroyo Seco are also at least the occasional home of several species noted as California Bird Species of Special Concern (BSSC)[1]. These species, though not listed with official state or federal status (*i.e*. Threatened or Endangered under the Endangered Species Act) are nonetheless scarce or declining within the state and worth noting whenever encountered. The Yellow Warbler is one such species. Also a BSSC is Cooper's Hawk, occasionally seen in both parks and confirmed as a breeder when a pair was seen with young in Hahamongna on June 23 and June 30, 2007 (LA). A pair were displaying there on March 25, 2008 (JF). Vaux's Swift was seen in migration over the Lower Arroyo in September of both 2007 and 2008. Yellow-breasted Chat has been present (at least 1 or 2 birds) in the willow forest at the south end of Hahamongna for all three years of the survey. Chats are present throughout the June surveys with on-site breeding assumed.

With the exception of Yellow Warbler, the four indicator species are year-round residents. Breeding is assumed for all species encountered in suitable habitat during their breeding seasons. However, further confirmation of breeding by observation of explicit breeding activity (nest building or food carrying) or the observation of young birds was noted for a number of species. Greater attention has been paid to this as the surveys have progressed.

Probable breeders noted at Hahamongna in 2007 included Red-tailed Hawk and White-tailed Kite, a species that has experienced a sharp decline in recent years. Breeding was confirmed for Western Bluebird, Song Sparrow, Black-headed Grosbeak, and Brown-headed Cowbird. A Spotted Sandpiper seen by LA on June 30, 2007 is intriguing as this species has very few breeding records in the county. In Hahamongna in 2008 breeding was probable (birds seen copulating or carrying nesting material) for: Red-shouldered Hawk, Bushtit, and Nutmeg Mannikin. Breeding was confirmed (adults carrying food or juveniles seen) for: Black Phoebe, Common Raven, Bewick's Wren, Wrentit, Spotted Towhee, California Towhee, and House Finch. In 2009 probable breeders were White-throated Swift and Common Raven. And,

[1] Shuford, W.D. and Gardali, T., *eds*. California Bird Species of Special Concern. Western Field Ornithologists and California Department of Fish and Game. 2008.

confirmed breeders were: Bushtit, Bewick's Wren, California Towhee, and House Finch. A stick nest found by DD near the Tom Sawyer camp in October 2009 may have been used by Common Raven, Red-tailed Hawk, Red-shouldered Hawk, or Cooper's Hawk, all known to breed in the area.

White-throated Swift was a probable breeder in the Lower Arroyo in 2007; difficult to assess as individuals are only seen entering dark crevices in the freeway overpass. Breeding was confirmed for Red-shouldered Hawk, Nuttall's Woodpecker, Black Phoebe, Western Scrub-Jay Cliff Swallow, and American Robin. In the Lower Arroyo in 2008 breeding was probable (birds seen copulating or carrying nesting material) for Allen's Hummingbird and Nutmeg Mannikin. Breeding was confirmed (adults carrying food or juveniles seen) for: Mallard, Red-tailed Hawk, Black Phoebe, Western Scrub-Jay, Northern Rough-winged Swallow, Oak Titmouse, House Wren, Northern Mockingbird, Spotted Towhee, California Towhee, and Bullock's Oriole. In 2009 probable breeders were: Red-tailed Hawk, Nuttall's Woodpecker, Oak Titmouse, and Bushtit. And, confirmed breeders were: Anna's Hummigbird, American Crow, Common Raven, Cliff Swallow, California Thrasher, and House Sparrow.

Table II is also the cumulative bird species lists for all surveys at both parks. In three years of surveying 114 species have been recorded at Hahamongna and 96 at Lower Arroyo Park, including introduced birds and exotics. If one were to rely solely on written descriptions of the parks it may seem strange that the two parks, of such similar size and composition, and so close could be so different in the bird species compositions. However, even a cursory glance in the field reveals that the Lower Arroyo has smaller and poorer quality habitat areas (particularly wetland and weedy open space) than Hahamonga. Absences on the Lower Arroyo bird list (see Table II) are of species which prefer those habitats: waterfowl, some raptors, shorebirds, and blackbirds. Furthermore, the Lower Arroyo has greater recreational infrastructure and consequently more people there utilizing those facilities. Well worn trails fragment every part of the park – many used by walkers with dogs illegally off leash. Archery ranges line the west side of the canyon. As noted above, the heavy traffic, plus fragmentation of the park and the lack of connectivity with the more natural areas present upstream (like Hahamongna and the San Gabriel Mountains) are likely the major contributors to the absence of California Quail from the Lower Arroyo. Hahamongna, possessing more native and less disturbed habitat, has absences (or lower numbers) of species that either are obligate to residential/decorative woodland or have adapted well and thrive in such environs. The clearest examples of such species are exotics like Yellow-chevroned Parakeet and Red-whiskered Bulbul, both of which were recorded multiple times in the Lower Arroyo but only once (Yellow-chevroned Parrakeet only) at Hahamongna. Cedar Waxwings, a flocking bird that feeds on fruit, were seen more times and in much greater numbers in the Lower Arroyo. More could be added to those lists with the addition of a peak spring migration survey in late April – a likely addition in future years.

The status of chosen habitat indicator species has been correlated to the physical attributes of each park and remained robust through three years of surveys. As those physical attributes change due to human usage, natural phenomena, and the short-term and long-term variations in climate so will the ecology of the parks. The data in greater temporal context will tell us more – trends in overall species diversity, population, and status. It is hoped that as this study matures interesting facts will continue to arise from this work.

Table I. Dates of surveys conducted in Hahamongna and Lower Arroyo Parks.
Both a point count and a general bird survey were conducted on each date.

Hahamongna			Lower Arroyo		
2007	2008	2009	2007	2008	2009
2/21/2007	2/25/2008	2/10/2009	2/22/2007	2/26/2008	2/19/2009
3/12/2007	3/18/2008	3/13/2009	3/13/2007	3/17/2008	3/10/2009
3/22/2007	3/25/2008	3/18/2009	3/23/2007	3/24/2008	3/17/2009
3/30/2007	4/1/2008	3/27/2009	3/30/2007	3/31/2008	3/24/2009
6/12/2007	6/13/2008	5/15/2009	6/13/2007	6/15/2008	6/19/2009
6/23/2007	6/27/2008	6/12/2009	9/26/2007	6/27/2008	6/27/2009
6/30/2007	6/27/2008	6/19/2009	12/13/2007	7/3/2008	9/17/2009
9/21/2007	12/19/2008	10/11/2009		9/12/2008	12/15/2009
12/14/2007		12/5/2009		12/12/2008	

Table II. Summary data from surveys conducted at Hahamongna and Lower Arroyo Parks. The data displayed for each year indicates the number of surveys on which a species was observed and the average count over those surveys.

	Hahamongna						Lower Arroyo					
	2007		2008		2009		2007		2008		2009	
Total number of surveys per year:	9		8		9		7		9		8	
Species	Num. surveys seen	Avg. count	Num. surveys seen	Avg. count	Num. surveys seen	Avg. count	Num. surveys seen	Avg. count	Num. surveys seen	Avg. count	Num. surveys seen	Avg. count
Canada Goose	3	3			2	7	2	4	2	2	2	27
Gadwall	1	1										
American Wigeon	1	7	4	5								
Mallard	8	5	8	11	7	9	6	7	9	7	8	7
Cinnamon Teal			1	3								
Ring-necked Duck	1	1	3	4								
Hooded Merganser					1	2	1	1	2	3	2	2
Common Peafowl											1	1
California Quail	5	8			8	3						
Pied-billed Grebe	2	1										
Double-crested Cormorant			1	4	2	6	1	1				
Great Blue Heron	7	1	4	1	1	1	1	3			2	1
Great Egret	5	2	1	1	2	1						
Snowy Egret							1	1				
Green Heron	1	1							1	1		
Black-crowned Night-Heron	3	1			2	2						
Turkey Vulture			1	2			1	6	1	2	1	6
White-tailed Kite	3	1										
Sharp-shinned Hawk	4	1	1	1	2	1	2	1			3	1
Cooper's Hawk	5	2	6	2	5	1	2	1	4	2	6	2
Red-shouldered Hawk	5	1	7	1	6	2	5	1	5	1	5	1
Swainson's Hawk	1	1										
Red-tailed Hawk	8	3			6	11	6	2	7	2	6	3
American Kestrel	7	2	1	1								
Merlin	1	1			1	1						
Peregrine Falcon											1	1
American Coot	3	3	4	3	3	2						
Killdeer	3	2	4	2	5	5						
Spotted Sandpiper	1	1										
Ring-billed Gull			1	1								
California Gull					2	16			1	3	2	10
Rock Pigeon	7	8	6	9	5	6	6	4	5	5	5	4
Band-tailed Pigeon	4	2	4	2	6	3	7	14	9	17	8	28
Mourning Dove	9	21	8	25	9	23	7	16	9	17	8	14
Mitred Parakeet											1	15
Yellow-chevroned Parakeet			1	1			4	2	3	3	6	4
Red-crowned Parrot	7	5	4	11	9	7	7	7	8	6	8	8
Lilac-crowned Parrot	2	2	1	2			1	1	1	1	1	5

Table II. Continued

	Hahamongna						Lower Arroyo					
	2007		2008		2009		2007		2008		2009	
Total number of surveys per year:	9		8		9		7		9		8	
Species	Num. surveys seen	Avg. count	Num. surveys seen	Avg. count	Num. surveys seen	Avg. count	Num. surveys seen	Avg. count	Num. surveys seen	Avg. count	Num. surveys seen	Avg. count
Amazona Parrot sp.	3	5	3	11								
Yellow-headed Parrot											1	2
Great Horned Owl							1	2				
Vaux's Swift							1	13	1	2		
White-throated Swift	5	11	6	7	7	17	5	15	7	5	7	19
Black-chinned Hummingbird					1	1			1	3	2	5
Anna's Hummingbird	9	15	8	14	9	14	7	13	9	13	8	13
Rufous Hummingbird									1	1	3	2
Allen's Hummingbird			2	2			7	13	5	4	7	4
Selasphorus Hummingbird sp.	8	3	3	1	4	2	7	5	7	10	7	4
Belted Kingfisher	1	1			1	1						
Acorn Woodpecker	9	8	8	10	9	8	7	3	7	3	7	3
Red-naped Sapsucker					1	1						
Red-breasted Sapsucker	1	1			2	1						
Nuttall's Woodpecker	9	6	8	6	9	5	7	5	9	7	8	6
Downy Woodpecker	7	2	6	1	8	2	3	1	7	2	8	2
Northern Flicker	7	3	6	3	6	2	5	7	5	4	6	6
Western Wood-Pewee	2	7	2	1	2	1	1	1			1	1
Willow Flycatcher	1	2					1	1				
Pacific-slope Flycatcher	2	2					1	2	4	1	4	4
Black Phoebe	9	8	8	7	9	10	7	14	9	14	8	14
Say's Phoebe	4	2	1	2	2	2			1	1		
Ash-throated Flycatcher	2	1	2	2	3	3			1	2	2	2
Cassin's Kingbird					2	2					1	1
Western Kingbird	2	1	1	1					1	1	1	1
Plumbeous Vireo									1	1	1	1
Cassin's Vireo									2	1		
Hutton's Vireo	7	2	1	1	2	1	1	1	1	1	3	1
Warbling Vireo							3	1			1	1
Steller's Jay					1	1						
Western Scrub-Jay	8	32	8	21	9	21	7	23	9	20	8	21
American Crow	9	11	8	6	9	5	7	5	9	6	7	3
Common Raven	9	5	7	5	9	11	7	3	7	4	8	6
Tree Swallow			1	10							1	4
Violet-green Swallow	1	8	1	2	1	6						
Northern Rough-winged Swallow	7	12	7	22	6	18	4	9	6	11	7	15
Cliff Swallow	3	9	3	4			2	14	5	12	5	36
Barn Swallow									1	1	1	1
Mountain Chickadee	2	3					4	2			1	2
Oak Titmouse	9	10	8	8	9	8	7	5	9	5	8	7

Table II. Continued

	Hahamongna						Lower Arroyo					
	2007		2008		2009		2007		2008		2009	
Total number of surveys per year:	9		8		9		7		9		8	
Species	Num. surveys seen	Avg. count	Num. surveys seen	Avg. count	Num. surveys seen	Avg. count	Num. surveys seen	Avg. count	Num. surveys seen	Avg. count	Num. surveys seen	Avg. count
Bushtit	9	67	8	31	9	38	7	45	9	42	8	73
White-breasted Nuthatch	7	2										
Bewick's Wren	9	18	8	14	9	19	7	14	9	10	8	13
House Wren	8	2	6	5	7	5	7	6	7	7	8	8
Red-whiskered Bulbul							2	4	4	2	7	3
Ruby-crowned Kinglet	5	20	5	17	6	24	5	14	5	15	5	15
Blue-gray Gnatcatcher	6	2	3	1	2	2	1	1				
Western Bluebird	6	7	5	3	4	6					1	2
Hermit Thrush	4	4	5	2	5	4	5	3	5	3	4	2
American Robin	7	3	6	2	4	3	6	3	7	14	8	6
Wrentit	9	8	8	8	8	6	6	4	8	4	7	4
Northern Mockingbird	9	10	8	5	8	10	7	11	9	14	8	16
California Thrasher	9	4	4	1	9	4	6	3	8	4	8	4
European Starling	9	20	8	14	9	10	7	9	5	3	6	2
Cedar Waxwing	1	7	3	9	3	13	5	44	4	34	5	31
Phainopepla	2	4	3	2	3	3	2	7	3	2	8	3
Orange-crowned Warbler	6	4	3	3	6	4	7	5	7	5	7	4
Nashville Warbler			1	1			1	1	1	1		
Yellow Warbler	4	6	3	9	3	17	2	8	4	3	3	6
Yellow-rumped Warbler	5	58	5	59	6	61	6	34	5	49	5	50
Black-throated Gray Warbler	1	1	1	2	3	1	2	2	2	1	2	1
Townsend's Warbler	1	1	1	1	3	3	1	1	1	1	3	1
Hermit Warbler	1	1										
Common Yellowthroat	8	7	7	6	9	7	7	5	9	4	8	5
Wilson's Warbler	3	4	1	3	4	2	2	2	3	3	2	1
Yellow-breasted Chat	1	1	3	3	3	1						
Western Tanager	1	2					2	2			1	1
Spotted Towhee	9	15	8	17	9	22	7	9	9	9	8	10
California Towhee	9	23	8	15	9	22	7	15	9	12		
Chipping Sparrow	3	14	1	3							1	1
Lark Sparrow					1	1						
Savannah Sparrow									1	1		
Fox Sparrow	3	1							1	2	1	2
Song Sparrow	9	16	8	21	9	18	6	10	9	11	8	13
Lincoln's Sparrow	3	4	4	3	3	1	2	2	4	2	1	1
White-crowned Sparrow	6	21	5	19	6	13	6	13	5	20	4	6
Golden-crowned Sparrow	1	1	3	1			2	3	1	3		
Dark-eyed Junco	4	11	3	4	4	7	1	4			3	3
Black-headed Grosbeak	4	11	4	6	3	7	1	7	3	3	3	6
Blue Grosbeak			1	2								

Table II. Continued

	Hahamongna						Lower Arroyo					
	2007		2008		2009		2007		2008		2009	
Total number of surveys per year:	9		8		9		7		9		8	
Species	Num. surveys seen	Avg. count	Num. surveys seen	Avg. count	Num. surveys seen	Avg. count	Num. surveys seen	Avg. count	Num. surveys seen	Avg. count	Num. surveys seen	Avg. count
Lazuli Bunting	1	1										
Red-winged Blackbird	5	7	1	5	3	3					2	2
Western Meadowlark	2	4										
Brewer's Blackbird	5	5	2	1	4	5						
Brown-headed Cowbird	4	6	4	7	3	4	2	3	3	4	2	7
Hooded Oriole	1	2					1	1	6	1	5	2
Bullock's Oriole	3	3	2	2	1	1	3	2	7	7	5	9
Purple Finch	6	2	5	3	4	3	4	2	4	3	3	2
House Finch	9	83	8	58	9	46	7	35	9	49	8	49
Lesser Goldfinch	9	46	8	23	9	28	7	12	9	16	8	23
American Goldfinch	6	11	4	8	4	5	5	13	5	19	5	56
House Sparrow	6	4	1	1	2	3	5	6	7	4	8	7
Nutmeg Mannikin	4	3	3	3	2	3	1	5	2	2	6	4

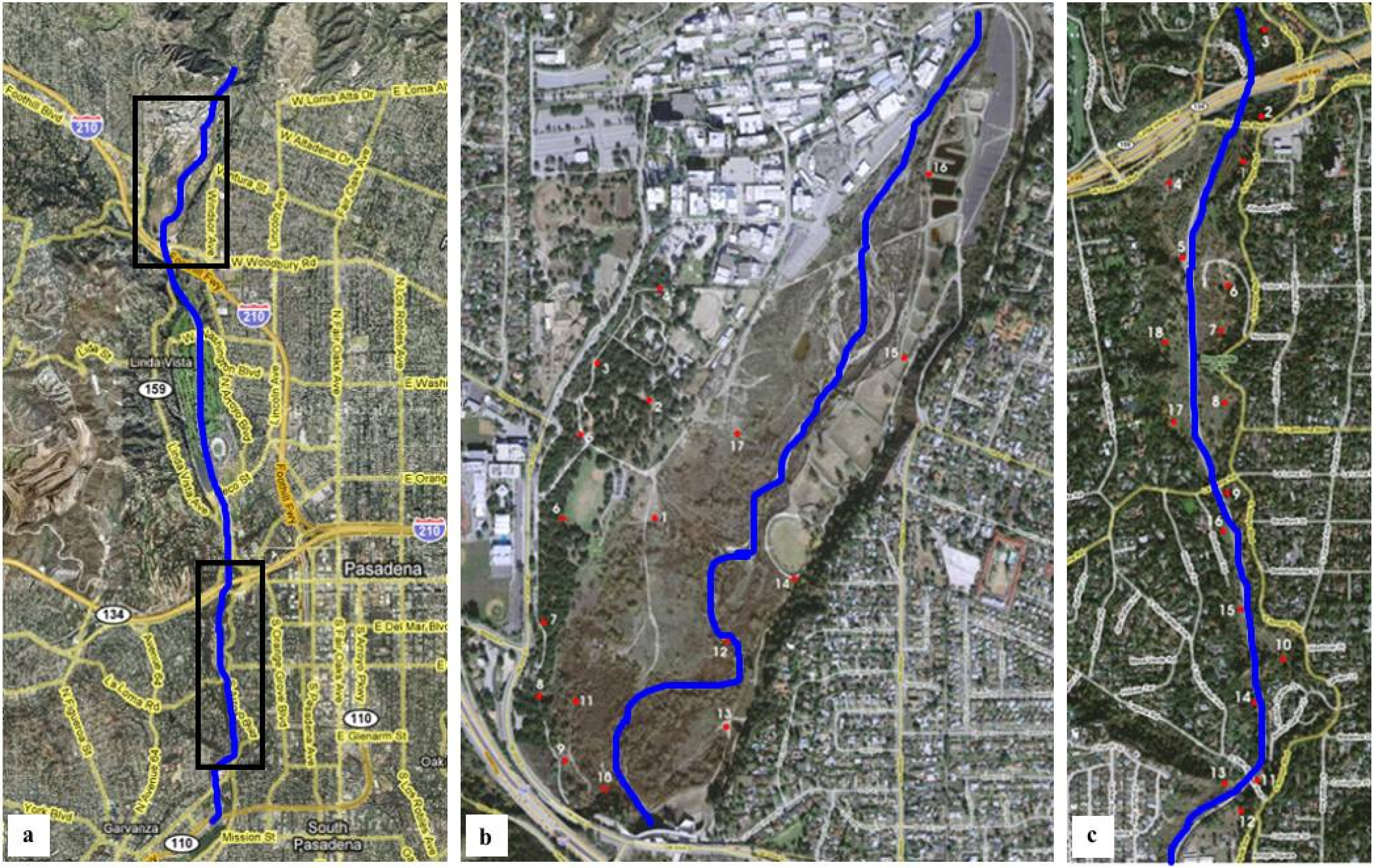
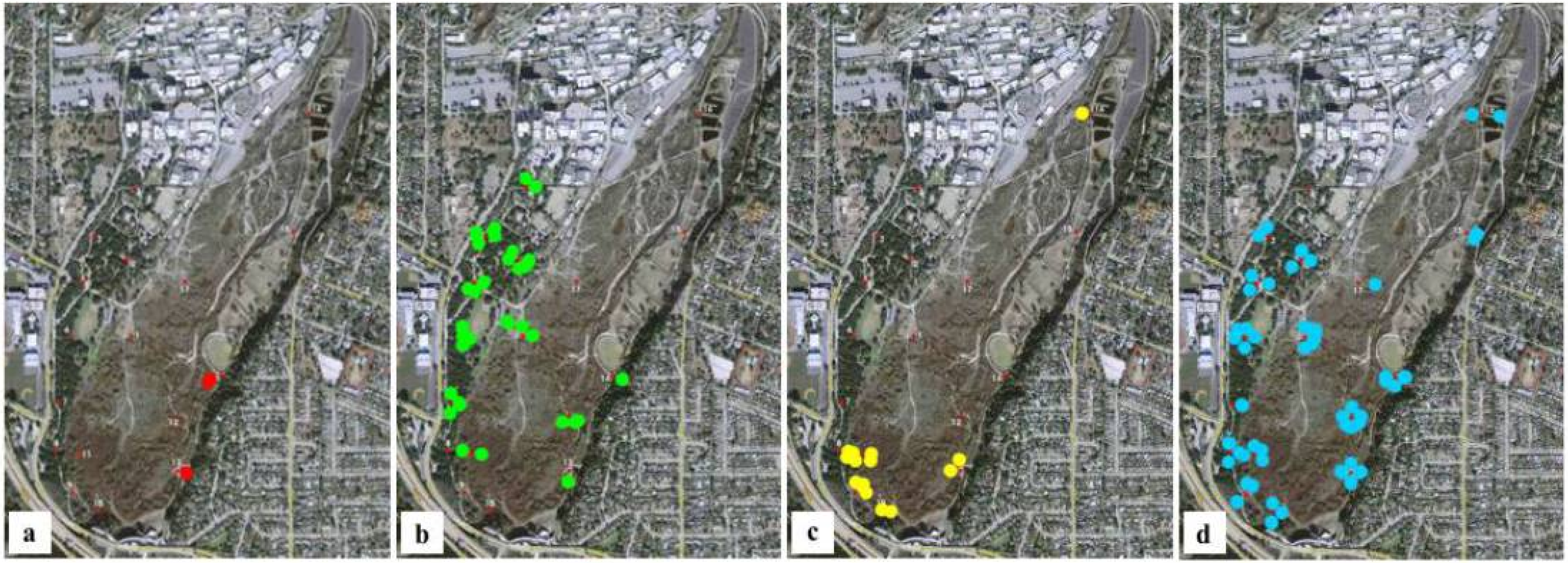


Figure 1. Maps of the survey areas showing (a) the path of the Arroyo Seco in blue from where it leaves the San Gabriel Mountains and runs through Pasadena toward the Los Angeles River. The black outlined regions are the survey areas. The northern survey site is Hahamongna shown in detail in (b) and the southern site is the Lower Arroyo Park shown in detail in (c). The detail maps also show the point count locations identified by the red dots and corresponding point identification number.



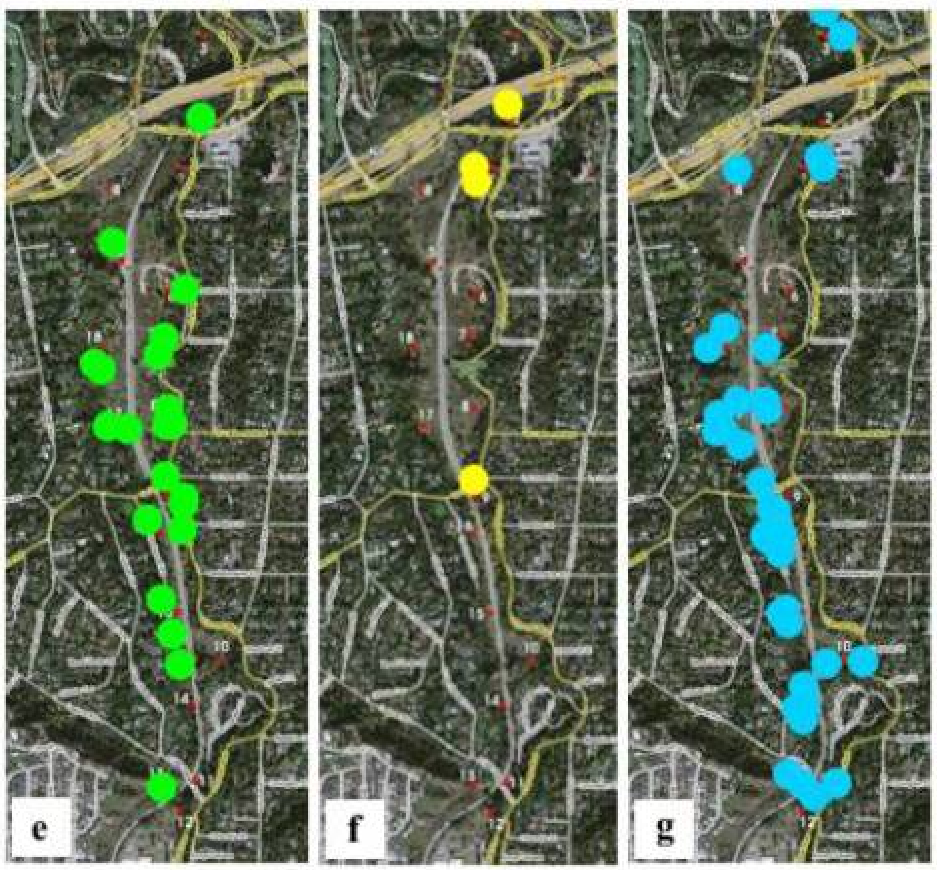


Figure 2 . Cumulative point count species detections for Hahamonga (a - d) and the Lower Arroyo (e - g). (a) California Quail. (b, e) Oak Titmouse. (c, f) Yellow Warbler. (d, g) Spotted Towhee.

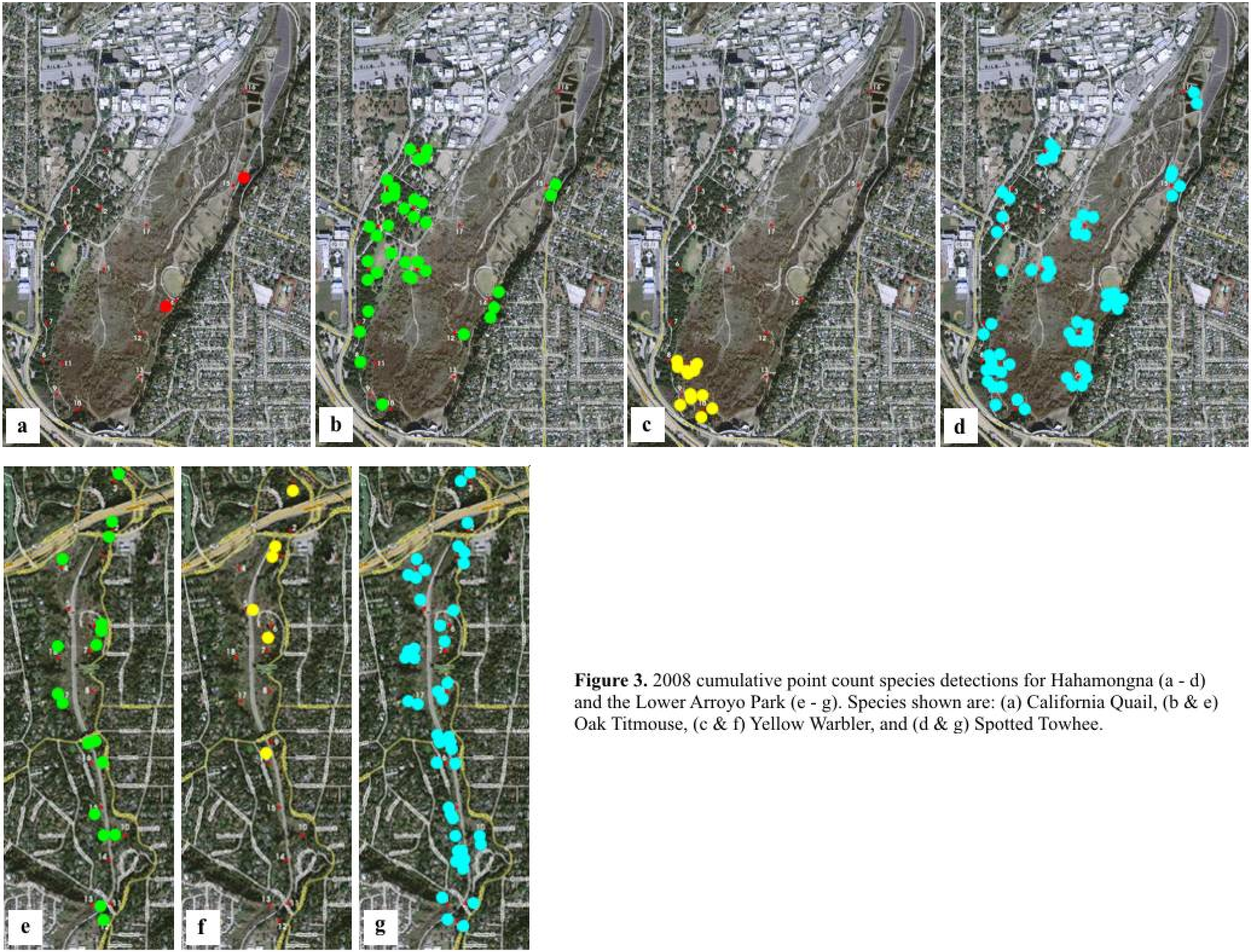


Figure 3. 2008 cumulative point count species detections for Hahamongna (a - d) and the Lower Arroyo Park (e - g). Species shown are: (a) California Quail, (b & e) Oak Titmouse, (c & f) Yellow Warbler, and (d & g) Spotted Towhee.

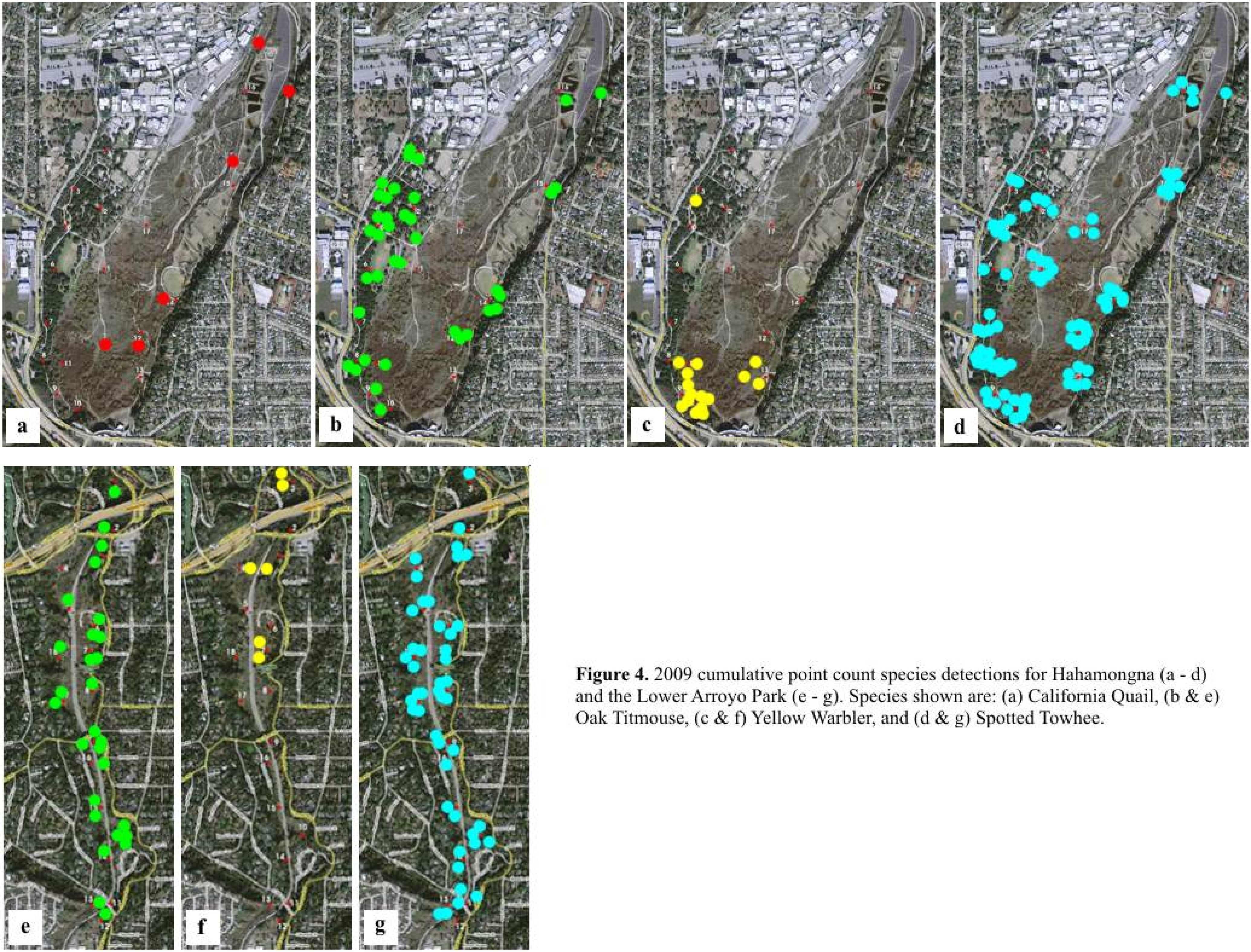


Figure 4. 2009 cumulative point count species detections for Hahamongna (a - d) and the Lower Arroyo Park (e - g). Species shown are: (a) California Quail, (b & e) Oak Titmouse, (c & f) Yellow Warbler, and (d & g) Spotted Towhee.

EXHIBIT F

Checklist S11322580

Location

Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US (Map)

Date and Effort

Fri Aug 10, 2012 6:35 AM

Protocol: Area

Party Size: 1

Duration: 22 minute(s)

Area: 3.0 ac

Observers: **Darren Dowell**

Species

21 species total

2 **Mourning Dove**

2 **Anna's Hummingbird**

1 **Allen's Hummingbird**

1 **Acorn Woodpecker**

1 **Nuttall's Woodpecker**

2 **Red-crowned Parrot**
not using the survey area

1 **Bell's Vireo**
near 34.191921,-118.174898; silent; not sure if the same as seen later further north; photographed

2 **Western Scrub-Jay**

5 **Bushtit**

2 **White-breasted Nuthatch**
in oaks and willow between dirt lot and paved lot

1 **Bewick's Wren**

2 **California Thrasher**

2 California Thrasher

2 **European Starling**

1 **Phainopepla**
not using survey area; high flight to west

1 **Spotted Towhee**

2 **California Towhee**

1 **Black-headed Grosbeak**

1 **Lazuli Bunting**

11 **House Finch**
one begging juvenile

2 **Lesser Goldfinch**

1 **Scaly-breasted Munia**

Are you submitting a **complete checklist** of the birds you were able to identify?

Yes

Checklist S11322426

Location

Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US (Map)

Date and Effort

Fri Aug 10, 2012 5:52 AM

Protocol:	Traveling
Party Size:	1
Duration:	4 hour(s), 18 minute(s)
Distance:	3.0 mile(s)
Observers:	**Darren Dowell**

Species

53 species total

4	**Mallard**
20	**California Quail**
1	**Cooper's Hawk** immature
1	**Red-shouldered Hawk**
6	**Killdeer**
6	**Rock Pigeon (Feral Pigeon)**
3	**Band-tailed Pigeon**
30	**Mourning Dove**
1	**White-throated Swift**
3	**Black-chinned Hummingbird**
21	**Anna's Hummingbird**
7	**Allen's Hummingbird**

7	**Acorn Woodpecker**
6	**Nuttall's Woodpecker**
1	**Downy Woodpecker**
20	**Red-crowned Parrot**
1	**Western Wood-Pewee**
14	**Black Phoebe**
1	**Bell's Vireo** near 34.193026,-118.174696; not sure if this is the same one during Pt. 1 count; loud scold calls, but not really singing; photos
1	**Hutton's Vireo**
15	**Western Scrub-Jay**
3	**American Crow**
6	**Common Raven**
1	**Northern Rough-winged Swallow**
6	**Barn Swallow**
8	**Oak Titmouse**
90	**Bushtit**
2	**White-breasted Nuthatch**
2	**House Wren**
30	**Bewick's Wren**
5	**Wrentit**
3	**Western Bluebird**
3	**American Robin** one juvenile (poor photographs)
2	**California Thrasher**

3 **Northern Mockingbird**

14 **European Starling**

5 **Orange-crowned Warbler**

12 **Common Yellowthroat**
one juvenile being fed

8 **Yellow Warbler**

13 **Spotted Towhee**
three juveniles (one photographed)

1 **Rufous-crowned Sparrow**
far northeast area; singing and calling

30 **California Towhee**
at least one begging juvenile

14 **Song Sparrow**

10 **Black-headed Grosbeak**

8 **Lazuli Bunting**

8 **Hooded Oriole**
one begging juvenile

1 **Bullock's Oriole**

55 **House Finch**
a few juveniles

65 **Lesser Goldfinch**
some begging juveniles

1 **Lawrence's Goldfinch**

at dried up pond

2 **American Goldfinch**

3 **House Sparrow**

20 **Scaly-breasted Munia**
several immature

Are you submitting a **complete checklist** of the birds you were able to identify?

Yes

Checklist S19544370

Location Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US (Map)

Date and Effort Fri Aug 22, 2014 6:03 AM

Protocol:	Traveling
Party Size:	1
Duration:	5 hour(s), 27 minute(s)
Distance:	4.0 mile(s)
Observers:	**Darren Dowell**

Species 61 species (+1 other taxa) total

Hide Media

5 **California Quail**
rough guess; one flock in two groups

1 **Great Egret**
flyover

1 **Turkey Vulture**

1 **Cooper's Hawk**

1 **Red-tailed Hawk**

24 **Rock Pigeon (Feral Pigeon)**

3 **Band-tailed Pigeon**

1 **Eurasian Collared-Dove**
seen very well, above main (sports field) parking lot

20 **Mourning Dove**

1 **White-throated Swift**

11 **Anna's Hummingbird**

11 **Allen's Hummingbird**

1	**hummingbird sp.** female-type Costa's candidate at the NE pond pre-sunrise; unfortunately did not get observations in good light
6	**Acorn Woodpecker**
7	**Nuttall's Woodpecker**
1	**Downy Woodpecker**
1	**American Kestrel**
30	**Red-crowned Parrot**
15	**Mitred Parakeet**
12	**Black Phoebe**
1	**Bell's Vireo** binocular observation only; moving quickly through mule fat, and did not get camera out in time. Several identifying features seen, including general vireo shape with fairly long tail cocked up, fairly thick vireo-like bill, pale lore but lack of supercilium like WAVI. This individual was pale overall, no shades of yellow or green like in some (young?) birds. No clear vocalizations noted. Location collected with iPhone: 34.195158,-118.171390
1	**Hutton's Vireo**
20	**Western Scrub-Jay**
6	**American Crow**
5	**Common Raven**
2	**Northern Rough-winged Swallow**
5	**Barn Swallow**
8	**Oak Titmouse**
75	**Bushtit**
3	**White-breasted Nuthatch**
2	**House Wren**
11	**Bewick's Wren**
2	**Blue-gray Gnatcatcher**

2 **Wrentit**

6 **California Thrasher**

4 **Northern Mockingbird**

10 **European Starling**

1 **Cedar Waxwing**
heard only; also accidentally recorded while hoping for something else to vocalize, and it sounds good for this species (very high trailing off whine, very little trill for this one)

1 **Tennessee Warbler**
Location: in eucalyptus in southEAST part of basin near drainage pond, coordinates 34.186787, -118.173329 . Seen briefly, photographed, lost when repositioning for better sun angle, then not found again in a couple of minutes of looking.

Photo description to follow. First impression is that this is *not* the adult male present in mid July through mid August, but a different bird.

13 **Orange-crowned Warbler**

1 **Nashville Warbler**

1 **Virginia's Warbler**
Location: about 1/3 of the way up the lerp-infested tree in southwest part of basin that has been occasionally visited by the July-August male Tennessee warbler, coordinates 34.187395, -118.177267 . Seen only briefly around 8:30 AM -- first seen through binoculars as a Virginia's candidate or very dull Nashville, with no green noted on the back or wings, then got one photo before it flew to east. Not seen in following half hour. Despite the brief sighting, it didn't exhibit the frantic foraging pace typical of many Nashvilles.

Photo description to follow.

7 **Common Yellowthroat**

11 **Yellow Warbler**

1 **Black-throated Gray Warbler**
adult male; my first-of fall

7 **Wilson's Warbler**

9 **Spotted Towhee**

24 **California Towhee**

2 **Savannah Sparrow (Western)**
my first-of-fall (finally); on sports field

11 **Song Sparrow**

1 **Western Tanager**

6 **Black-headed Grosbeak**

7 **Lazuli Bunting**

7 **Brewer's Blackbird**

8	**Hooded Oriole**
1	**Bullock's Oriole**
95	**House Finch**
1	**Purple Finch** heard only, singing
7	**Lesser Goldfinch**
1	**American Goldfinch**
2	**House Sparrow**
25	**Scaly-breasted Munia** adults, juvs., and in-between

Are you submitting a **complete checklist** of the birds you were able to identify?

Yes

Checklist S14376997

Location

Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US (Map)

Date and Effort

Fri Jun 07, 2013 6:35 AM

Protocol:	Traveling
Party Size:	1
Duration:	1 hour(s), 30 minute(s)
Distance:	1.0 mile(s)
Observers:	**Darren Dowell** , Darren Dowell (PAS CBC circle) List

Species

38 species total

2	**California Quail**
7	**Rock Pigeon (Feral Pigeon)**
15	**Mourning Dove**
2	**White-throated Swift**
1	**Anna's Hummingbird**
3	**Acorn Woodpecker**
3	**Nuttall's Woodpecker**
6	**Red-crowned Parrot**
5	**Black Phoebe**
1	**Bell's Vireo** Continuing (singing) in same location. Recorded with LB's Olympus; marginal photos. Possibly 2 birds seen.
7	**Western Scrub-Jay**
3	**American Crow**

4	**Northern Rough-winged Swallow**
5	**Oak Titmouse**
15	**Bushtit**
2	**House Wren**
15	**Bewick's Wren**
2	**Blue-gray Gnatcatcher** Continuing in oak woodland, but not together today
2	**Wrentit**
2	**Western Bluebird**
3	**American Robin**
3	**California Thrasher**
1	**Northern Mockingbird**
15	**European Starling**
5	**Common Yellowthroat**
9	**Yellow Warbler**
1	**Yellow-rumped Warbler (Audubon's)** Alternate plumage; singing (recorded); photographed
10	**Spotted Towhee**
15	**California Towhee** Adult carrying food to unseen but begging juv.
4	**Song Sparrow**
1	**Black-headed Grosbeak**
1	**Blue Grosbeak** Singing male
4	**Brown-headed Cowbird**
1	**Hooded Oriole**

1	Bullock's Oriole
50	House Finch
50	Lesser Goldfinch
1	House Sparrow

Are you submitting a **complete checklist** of the birds you were able to identify?

Yes

Checklist S14226285

Location

Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US (Map)

Date and Effort

Fri May 24, 2013 6:30 AM

Protocol:	Traveling
Party Size:	1
Duration:	1 hour(s), 45 minute(s)
Distance:	1.5 mile(s)
Observers:	**Darren Dowell** , Darren Dowell (PAS CBC circle) List

Species

5 species total

1 **Willow Flycatcher**
finally! east of stables in mule fat, willow, and oak; no "fitz-bew", but occasional upslurred "hwit" like a GRFL; short primary projection; barest hint of an eye ring; relatively long bill with yellow lower mandible; one prominent pale wing bar with a subdued buffy second wing bar; prominent crest on top of head

1 **Bell's Vireo**
singing from same location; unseen, and no recordings made today

1 **Swainson's Thrush**

1 **Townsend's Warbler**
female, seen well (not BTNW)

2 **Wilson's Warbler**

Are you submitting a **complete checklist** of the birds you were able to identify?

No

Checklist S14231946

Location

Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US (Map)

Edit Location

Date and Effort

Fri May 24, 2013 9:15 AM

Edit Date and Effort

Protocol:	Traveling
Party Size:	1
Duration:	1 hour(s), 20 minute(s)
Distance:	1.0 mile(s)
Observers:	**Lance Benner**
Comments:	I covered the southwestern part of the park: south of the main parking lot down to Flint Creek

Species

28 species total

Hide Media | Edit Species List

2	**California Quail**	Delete
1	**Cooper's Hawk**	Delete
1	**Red-tailed Hawk**	Delete
1	**Mourning Dove**	Delete
2	**White-throated Swift**	Delete
2	**Nuttall's Woodpecker**	Delete
2	**Downy Woodpecker**	Delete
4	**Red-crowned Parrot**	Delete
1	**Black Phoebe**	Delete
1	**Bell's Vireo**	Delete

Seen, heard singing, song recorded, and photographed. It was in thick vegetation in the basin east of Berkshire creek.

An audio file is available on Xeno-Canto at:
http://www.xeno-canto.org/124888

Print

Download

Email Yourself

Delete

Share w/ Others in Your Party

Send link via:

Submit another for...

Same location and date
Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US on Fri May 24, 2013

Same location
Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US

Same area and date
Another location near Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US on Fri May 24, 2013

Same area
Another location near Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US

Same date
Fri May 24, 2013

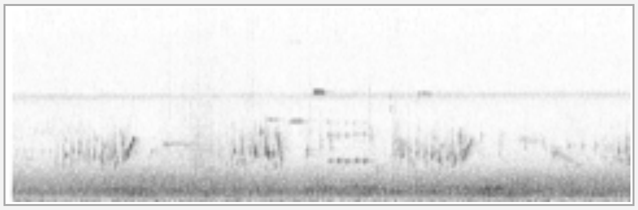
Different location and date

Hide from eBird Output ?

Change Portal

http://www.xeno-canto.org/134888

xeno-canto XC134888



0:00 0:43

Bell's Vireo (Vireo bellii pusillus) · song
Lance A. M. Benner
Hahamongna Park, Pasadena, Los Angeles County, California, United…

2 Hutton's Vireo Delete

3 Western Scrub-Jay (Coastal) Delete

2 American Crow Delete

3 Common Raven Delete
One was that bird missing a couple of primary feathers in its right wing. It's been in the area since at least the summer of 2012.

8 Northern Rough-winged Swallow Delete

2 Oak Titmouse Delete

30 Bushtit Delete

6 Bewick's Wren Delete

1 Wrentit Delete

2 California Thrasher Delete

4 Common Yellowthroat Delete

12 Yellow Warbler Delete

7 California Towhee Delete

20 Song Sparrow Delete

2 Black-headed Grosbeak Delete

2 Brown-headed Cowbird Delete

30 House Finch Delete

20 Lesser Goldfinch Delete

Edit Species List

Are you submitting a **complete checklist** of the birds you were able to identify?

Edit Answer

Yes

Checklist S14376987

Location

Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US (Map)

Date and Effort

Mon Jun 03, 2013 6:25 AM

Protocol:	Traveling
Party Size:	1
Duration:	1 hour(s), 20 minute(s)
Distance:	1.0 mile(s)
Observers:	**Darren Dowell** , Darren Dowell (PAS CBC circle) List

Species

39 species total

X	**California Quail**
1	**Cooper's Hawk**
1	**Red-tailed Hawk**
3	**Rock Pigeon (Feral Pigeon)**
5	**Mourning Dove**
1	**Anna's Hummingbird**
6	**Acorn Woodpecker**
2	**Nuttall's Woodpecker**
2	**Red-crowned Parrot**
3	**Black Phoebe**
1	**Bell's Vireo** continuing (singing) in same location; recorded with L.B.'s recorder

7	**Western Scrub-Jay**
2	**American Crow**
1	**Common Raven**
10	**Northern Rough-winged Swallow**
6	**Oak Titmouse**
15	**Bushtit**
2	**House Wren**
10	**Bewick's Wren**
2	**Blue-gray Gnatcatcher** foraging together in oaks south of Rose Bowl Riders area; vocal, and recorded with L.B.'s recorder
1	**Wrentit**
1	**Western Bluebird**
4	**American Robin**
3	**California Thrasher**
2	**Northern Mockingbird**
25	**European Starling**
1	**Orange-crowned Warbler** heard only; interesting song (trill on one pitch, trill on a lower pitch, then two syllable conclusion; tried to record it)
5	**Common Yellowthroat**
5	**Yellow Warbler**
5	**Spotted Towhee**
10	**California Towhee**
2	**Song Sparrow**
1	**Black-headed Grosbeak**

2 **Blue Grosbeak**
singing male and female type near (former) new winter pond NE of parking lot

3 **Brown-headed Cowbird**

20 **House Finch**

20 **Lesser Goldfinch**

2 **House Sparrow**

1 **Scaly-breasted Munia**

Are you submitting a **complete checklist** of the birds you were able to identify?

Yes

Checklist S14449191

Location

Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US (Map)

Date and Effort

Mon Jun 17, 2013 3:40 PM

Protocol:	Traveling
Party Size:	1
Duration:	1 hour(s), 33 minute(s)
Distance:	1.5 mile(s)
Observers:	**Darren Dowell** , Darren Dowell (PAS CBC circle) List

Species

43 species total

2	Mallard
2	California Quail
1	Red-shouldered Hawk
1	Red-tailed Hawk
1	Killdeer
1	Rock Pigeon (Feral Pigeon)
25	Mourning Dove
5	White-throated Swift
1	Anna's Hummingbird
2	Allen's Hummingbird
1	Acorn Woodpecker
2	Nuttall's Woodpecker

1 **Black Phoebe**

2 **Cassin's Kingbird**

1 **Bell's Vireo**
continuing (singing) in same location

2 **Western Scrub-Jay**

2 **American Crow**

2 **Common Raven**

30 **Northern Rough-winged Swallow**
at least 2 juv.

1 **Violet-green Swallow**
around northeastern pond

3 **Barn Swallow**

2 **Cliff Swallow**

2 **Oak Titmouse**

10 **Bushtit**

2 **Bewick's Wren**

2 **Wrentit**

8 **Northern Mockingbird**

5 **European Starling**

2 **Phainopepla**

7 **Common Yellowthroat**

11 **Yellow Warbler**

7 **Spotted Towhee**

5 **California Towhee**

4 **Song Sparrow**

3 **Black-headed Grosbeak**

3	**Red-winged Blackbird**
6	**Brown-headed Cowbird**
1	**Hooded Oriole**
1	**Bullock's Oriole**
40	**House Finch**
75	**Lesser Goldfinch**
2	**House Sparrow**
4	**Scaly-breasted Munia**

Are you submitting a **complete checklist** of the birds you were able to identify?

Yes

Checklist S2912584

Older All Checklists Newer

Location

Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US (Map)

Date and Effort

Sat Apr 28, 2007

Protocol: Incidental

Party Size: 1

Observers: **Jeffrey Fenwick**

Species

28 species total

1	Mallard
2	White-tailed Kite
1	Red-tailed Hawk
2	Killdeer
2	Mourning Dove
3	Anna's Hummingbird
1	Nuttall's Woodpecker
1	American Kestrel
1	Black Phoebe
1	Ash-throated Flycatcher
1	Bell's Vireo
4	Western Scrub-Jay
2	American Crow
1	Common Raven

10	**Northern Rough-winged Swallow**
10	**Bushtit**
1	**House Wren**
1	**Bewick's Wren**
1	**Wrentit**
4	**Northern Mockingbird**
2	**European Starling**
5	**Cedar Waxwing**
1	**Spotted Towhee**
3	**California Towhee**
1	**Chipping Sparrow**
2	**Black-headed Grosbeak**
2	**House Finch**
2	**Lesser Goldfinch**

Are you submitting a **complete checklist**
of the birds you were able to identify?

Yes

Checklist S14370133

Location

Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US (Map)

Date and Effort

Sat Jun 08, 2013 12:00 PM

Protocol:	Traveling
Party Size:	1
Duration:	1 hour(s), 13 minute(s)
Distance:	1.0 mile(s)
Observers:	**David Bell**

Species

27 species total

10	White-throated Swift
2	Black-chinned Hummingbird
2	Anna's Hummingbird
5	Allen's Hummingbird
2	Nuttall's Woodpecker
1	Black Phoebe
1	Bell's Vireo
2	Hutton's Vireo
8	Western Scrub-Jay (Coastal)
1	Common Raven
20	Northern Rough-winged Swallow
10	Cliff Swallow
4	Oak Titmouse

25 **Bushtit**

4 **Bewick's Wren**

2 **Wrentit**

1 **American Robin**

3 **California Thrasher**

1 **Orange-crowned Warbler**

20 **Common Yellowthroat**

5 **Yellow Warbler**

6 **Spotted Towhee**

10 **California Towhee**

15 **Song Sparrow**

2 **Brown-headed Cowbird**

40 **House Finch**

10 **Lesser Goldfinch**

Are you submitting a **complete checklist** of the birds you were able to identify?

Yes

Checklist S14486565

Location

Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US (Map)

Date and Effort

Sat Jun 22, 2013 4:37 AM Nocturnal

Protocol: Traveling

Party Size: 1

Duration: 3 hour(s), 30 minute(s)

Distance: 1.5 mile(s)

Observers: **Darren Dowell** , Darren Dowell (PAS CBC circle)

List

Species

44 species total

4 Mallard

1 Cooper's Hawk

1 Red-shouldered Hawk
heard calling from northwestern area

2 Killdeer

2 Rock Pigeon (Feral Pigeon)

2 Mourning Dove

2 White-throated Swift

5 Anna's Hummingbird

4 Allen's Hummingbird

5 Nuttall's Woodpecker

1 Downy Woodpecker

12 Red-crowned Parrot

1 **Black Phoebe**

1 **Bell's Vireo**
continuing (singing) in same area but also a lot of time further to south,where lower trail now dead ends by sycamore and eucalyptus

2 **Hutton's Vireo**

7 **Western Scrub-Jay**

15 **American Crow**

2 **Common Raven**

30 **Northern Rough-winged Swallow**
at least one juv.

3 **Barn Swallow**

7 **Cliff Swallow**
at least one juv. at dam

3 **Oak Titmouse**

20 **Bushtit**

3 **House Wren**
one juv.

10 **Bewick's Wren**

3 **Wrentit**

2 **California Thrasher**

7 **Northern Mockingbird**
first passerine, starting 4:43

5 **European Starling**

2 **Orange-crowned Warbler**

15 **Common Yellowthroat**

8 **Yellow Warbler**

10 **Spotted Towhee**

5	**California Towhee**
10	**Song Sparrow**
5	**Black-headed Grosbeak**
1	**Lazuli Bunting** male
10	**Brown-headed Cowbird**
3	**Hooded Oriole**
1	**Bullock's Oriole**
50	**House Finch**
10	**Lesser Goldfinch**
1	**House Sparrow**
3	**Scaly-breasted Munia**

Are you submitting a **complete checklist** of the birds you were able to identify?

Yes

Checklist S13987677

Older | All Checklists | Newer

Location

Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US (Map)

Date and Effort

Sat May 04, 2013 12:05 PM

Protocol:	Traveling
Party Size:	1
Duration:	1 hour(s)
Distance:	1.1 mile(s)
Observers:	**David Bell**

Species

30 species total

3	California Quail
1	Red-tailed Hawk
7	Mourning Dove
10	White-throated Swift
1	Black-chinned Hummingbird
2	Acorn Woodpecker
1	Bell's Vireo
2	Hutton's Vireo
10	Western Scrub-Jay (Coastal)
2	Common Raven
40	Northern Rough-winged Swallow
2	Violet-green Swallow
15	Cliff Swallow

65	Bushtit
1	House Wren
5	Bewick's Wren
2	California Thrasher
3	Orange-crowned Warbler
10	Common Yellowthroat
15	Yellow Warbler
2	Wilson's Warbler
1	Yellow-breasted Chat
10	Spotted Towhee
25	California Towhee
20	Song Sparrow
13	Western Tanager
18	Black-headed Grosbeak
40	House Finch
25	Lesser Goldfinch
10	American Goldfinch

Are you submitting a **complete checklist** of the birds you were able to identify?

Yes

Checklist S13986803

Location

Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US (Map)

Date and Effort

Sat May 04, 2013 7:28 AM

Protocol:	Traveling
Party Size:	14
Duration:	4 hour(s), 16 minute(s)
Distance:	3.0 mile(s)
Observers:	E.J. Remson List , Marilynn Hildebrandt List , Mei Kwan List , **Ron Cyger**
Comments:	Pasadena Audubon Society bird walk Submitted from BirdLog NA for iOS, version 1.5.2

Species

45 species total

2 Canada Goose

2 Mallard

1 California Quail

1 Turkey Vulture

1 Cooper's Hawk

1 Red-tailed Hawk

8 Rock Pigeon (Feral Pigeon)

2 Band-tailed Pigeon

4 Mourning Dove

1 Vaux's Swift

Flying with WTSW, smaller size, different shaped swift with no white showing.

8	**White-throated Swift**
3	**Anna's Hummingbird**
1	**Allen's Hummingbird**
6	**Acorn Woodpecker**
2	**Nuttall's Woodpecker**
2	**Red-crowned Parrot**
1	**Pacific-slope Flycatcher** Heard.
3	**Black Phoebe**
1	**Bell's Vireo** Heard and briefly seen. On the east side of park by willows half way down from parking lot to dam.
2	**Hutton's Vireo**
2	**Warbling Vireo**
3	**Western Scrub-Jay**
1	**American Crow**
4	**Common Raven**
12	**Northern Rough-winged Swallow**
4	**Cliff Swallow**
2	**Oak Titmouse**
32	**Bushtit**
1	**House Wren**
4	**Bewick's Wren**
1	**California Thrasher**
12	**European Starling**
1	**Orange-crowned Warbler**

3	**Common Yellowthroat**
1	**Yellow Warbler**
6	**Wilson's Warbler**
6	**Spotted Towhee**
4	**California Towhee**
2	**Song Sparrow**
4	**Western Tanager**
3	**Black-headed Grosbeak**
1	**Brown-headed Cowbird**
24	**House Finch**
1	**Purple Finch**
12	**Lesser Goldfinch**

Are you submitting a **complete checklist**
of the birds you were able to identify?

Yes

Checklist S13993938

Older All Checklists Newer

Location

Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US (Map)

Date and Effort

Sat May 04, 2013 8:20 AM

Protocol:	Traveling
Party Size:	1
Duration:	1 hour(s), 30 minute(s)
Distance:	1.5 mile(s)
Observers:	**Nancy Strang**

Species

48 species (+1 other taxa) total

X	Canada Goose
X	Mallard
X	Turkey Vulture
X	Red-shouldered Hawk
X	Killdeer
X	Rock Pigeon (Feral Pigeon)
X	Mourning Dove
1	Vaux's Swift
10	White-throated Swift
1	Black-chinned Hummingbird
X	Anna's Hummingbird
X	Allen's Hummingbird
4	Acorn Woodpecker

2	Nuttall's Woodpecker
X	Red-crowned Parrot
1	Pacific-slope Flycatcher
3	Black Phoebe
1	Say's Phoebe
1	Ash-throated Flycatcher
1	Bell's Vireo
2	Warbling Vireo
X	Western Scrub-Jay
X	American Crow
X	Common Raven
X	Northern Rough-winged Swallow
X	Cliff Swallow
X	swallow sp.
X	Bushtit
X	House Wren
X	Bewick's Wren
X	Blue-gray Gnatcatcher
1	California Thrasher
4	Northern Mockingbird
X	European Starling
1	Orange-crowned Warbler
X	Common Yellowthroat
1	Yellow Warbler

1	**Hermit Warbler**
2	**Wilson's Warbler**
X	**Spotted Towhee**
X	**California Towhee**
1	**Western Tanager**
X	**Black-headed Grosbeak**
1	**Lazuli Bunting**
X	**Bullock's Oriole**
X	**House Finch**
1	**Purple Finch**
X	**Lesser Goldfinch**
X	**House Sparrow**

Are you submitting a **complete checklist** of the birds you were able to identify?

Yes

Checklist S14641961

Location

Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US (Map)

Date and Effort

Sun Jul 14, 2013 6:38 AM

Protocol:	Traveling
Party Size:	1
Duration:	3 hour(s), 39 minute(s)
Distance:	4.45 mile(s)
Observers:	**Daniel Sloan**
Comments:	All on foot. Low 60s to high 70s, sunny, light breeze. From parking lot, right along path, down trail to beneath bridges and dam.

Species

37 species (+1 other taxa) total

2 **California Quail**
Heard only

1 **Cooper's Hawk**
Sitting in tree just off trail, approx. 10 feet from the ground, eating something or other. Pictures obtained, but unsure of the meal.

2 **Red-tailed Hawk (Western)**

X **Rock Pigeon (Feral Pigeon)**

5 **Mourning Dove**

5 **White-throated Swift**

2 **Anna's Hummingbird**

5 **Allen's Hummingbird**

5 **Acorn Woodpecker**

2 **Nuttall's Woodpecker**

1 **Downy Woodpecker**

1 **Northern Flicker**
Heard only

2 **Yellow-headed Parrot**
Heard, and then seen

3 **Amazona sp.**

2 **Black Phoebe**

1 **Bell's Vireo**

7 **Western Scrub-Jay (Coastal)**

1 **Common Raven**

2 **Northern Rough-winged Swallow**

1 **Cliff Swallow**

3 **Oak Titmouse**

6 **Bushtit**

2 **House Wren**

2 **Wrentit**

1 **Northern Mockingbird**

2 **Common Yellowthroat**

1 **Yellow Warbler**

3 **Spotted Towhee**

16 **California Towhee**

5 **Song Sparrow**

4 **Black-headed Grosbeak**

Age & Sex

	Juvenile	Immature	Adult	Age Unknown
Male			2	
Female				

	Juvenile	Immature	Adult	Age Unknown
Female				
Sex Unknown		1		1

1 **Blue Grosbeak**

Age & Sex

	Juvenile	Immature	Adult	Age Unknown
Male			1	
Female				
Sex Unknown				

3 **Lazuli Bunting**

Age & Sex

	Juvenile	Immature	Adult	Age Unknown
Male			2	
Female			1	
Sex Unknown				

24 **House Finch**

18 **Lesser Goldfinch**

1 **American Goldfinch**

2 **Northern Red Bishop**

Age & Sex

	Juvenile	Immature	Adult	Age Unknown
Male				
Female				2
Sex Unknown				

12 **Scaly-breasted Munia**

Are you submitting a **complete checklist** of the birds you were able to identify?

Yes

Checklist S11159008

Location

Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US (Map)

Date and Effort

Sun Jul 15, 2012 2:14 PM

Protocol:	Traveling
Party Size:	1
Duration:	54 minute(s)
Distance:	0.3 mile(s)
Observers:	**David Bell**

Species

12 species total

Hide Media

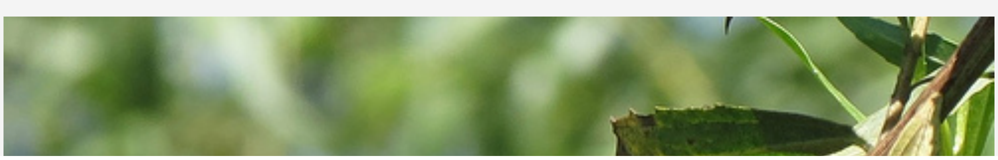
1 **Red-tailed Hawk**

2 **Mourning Dove**

3 **Acorn Woodpecker**

1 **Bell's Vireo**

I returned in the afternoon to see if I could refind and photograph Bell's Vireo. I was able to find and photograph one bird. Photo below. Darren Dowell and John Garrett also got photos. It appears to me from the details of the edgings on the tertials and scapulars that the birds photographed may be different, with the bird below and adult and Darren's an immature.



10	**Northern Rough-winged Swallow**
15	**Bewick's Wren**
2	**California Thrasher**
5	**Common Yellowthroat**
3	**Spotted Towhee**
5	**California Towhee**
5	**Song Sparrow**
2	**Hooded Oriole**

Are you submitting a **complete checklist** of the birds you were able to identify?

No

Checklist S11156821

Older All Checklists Newer

Location Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US (Map)

Date and Effort Sun Jul 15, 2012 8:44 AM

Protocol:	Traveling
Party Size:	1
Duration:	50 minute(s)
Distance:	0.6 mile(s)
Observers:	**David Bell**

Species 27 species total

4	Mourning Dove
15	White-throated Swift
4	Anna's Hummingbird
12	Allen's Hummingbird
1	Acorn Woodpecker
1	Nuttall's Woodpecker
2	Black Phoebe
1	Cassin's Kingbird
1	Western Kingbird
2	Bell's Vireo Apparently one adult and one juvenile together
3	Western Scrub-Jay (Coastal)
5	American Crow

2	**Northern Rough-winged Swallow**
4	**Oak Titmouse**
60	**Bushtit**
5	**Bewick's Wren**
4	**Wrentit**
2	**Orange-crowned Warbler**
10	**Common Yellowthroat**
7	**Yellow Warbler**
7	**Spotted Towhee**
7	**California Towhee**
1	**Western Tanager** Adult male
9	**Black-headed Grosbeak**
2	**Brown-headed Cowbird**
5	**House Finch**
5	**Lesser Goldfinch**

Are you submitting a **complete checklist**
of the birds you were able to identify?

Yes

Checklist S11159333

Location

Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US (Map)

Date and Effort

Sun Jul 15, 2012 1:50 PM

Protocol: Traveling

Party Size: 4

Duration: 1 hour(s), 20 minute(s)

Distance: 0.5 mile(s)

Observers: Darren Dowell List , **John Garrett** , Laura Garrett List

Species

28 species total

Hide Media

1 **Red-tailed Hawk (Western)**

2 **Mourning Dove**

1 **White-throated Swift**

2 **Black-chinned Hummingbird**

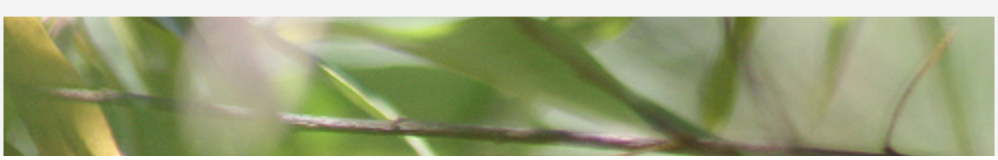
1 **Anna's Hummingbird**

2 **Acorn Woodpecker**

1 **Nuttall's Woodpecker**

2 **Bell's Vireo**

continuing birds (although only one seen well and photographed) found this morning by David Bell; in willows and mulefat where the city of Pasadena intends to build soccer fields. Voice recorded by Darren Dowell. Photographed:



2	Western Scrub-Jay (Coastal)
10	Northern Rough-winged Swallow
1	Barn Swallow
4	Cliff Swallow
2	Oak Titmouse
6	Bushtit
8	Bewick's Wren
4	Wrentit
2	California Thrasher

2 **Northern Mockingbird**

4 **Common Yellowthroat**

2 **Yellow Warbler**

5 **Spotted Towhee**

6 **California Towhee**

5 **Song Sparrow**

2 **Black-headed Grosbeak**

2 **Brown-headed Cowbird**

1 **Hooded Oriole**

Age & Sex

	Juvenile	Immature	Adult	Age Unknown
Male			1	
Female				
Sex Unknown				

3 **House Finch**

4 **Lesser Goldfinch**

Are you submitting a **complete checklist** of the birds you were able to identify?

Yes

Checklist S11231446

Print
Download
Email Yourself
Delete

Share w/ Others in Your Party
Send link via:

Submit another for...

Same location and date
Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US on Sun Jul 29, 2012

Same location
Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US

Same area and date
Another location near Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US on Sun Jul 29, 2012

Same area
Another location near Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US

Same date
Sun Jul 29, 2012

Different location and date

Hide from eBird Output ?

Change Portal

Location Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US (Map) Edit Location

Date and Sun Jul 29, 2012 6:15 AM

Date and Effort

Sun Jul 29, 2012 6:15 AM

Edit Date and Effort

Protocol:	Traveling
Party Size:	3
Duration:	3 hour(s), 32 minute(s)
Distance:	1.0 mile(s)
Observers:	Darren Dowell List , John Garrett List , **Lance Benner**
Comments:	N/A

Species

55 species (+2 other taxa) total

Hide Media Edit Species List

1	**Mallard**	Delete
13	**California Quail**	Delete
1	**Red-shouldered Hawk (California)**	Delete
1	**Red-tailed Hawk (Western)**	Delete
8	**Rock Pigeon (Feral Pigeon)**	Delete
35	**Band-tailed Pigeon**	Delete
13	**Mourning Dove**	Delete
15	**White-throated Swift**	Delete
6	**Black-chinned Hummingbird**	Delete
4	**Anna's Hummingbird**	Delete
2	**Allen's Hummingbird**	Delete
10	**Rufous/Allen's Hummingbird**	Delete
6	**Acorn Woodpecker**	Delete
7	**Nuttall's Woodpecker**	Delete
2	**Downy Woodpecker**	Delete
45	**Red-crowned Parrot**	Delete
1	**Pacific-slope Flycatcher**	Delete

5 Black Phoebe Delete

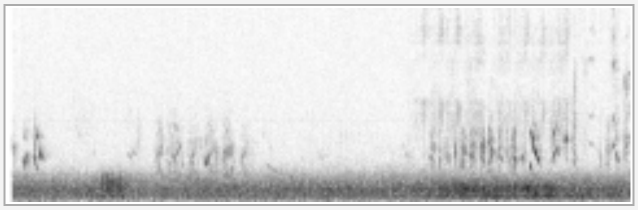
2 Bell's Vireo Delete

continuing birds found by David Bell on 7/15. One was whisper-singing and perhaps even singing regularly (recorded extensively by LB); it seemed to be this fresh bird:

There was also a worn bird that we never saw calling.

Recordings are available on the Xeno-Canto website at:
http://www.xeno-canto.org/106457
http://www.xeno-canto.org/106459
http://www.xeno-canto.org/106462

xeno-canto XC106459



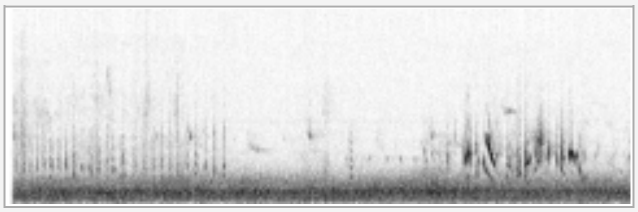
0:00 0:20

Bell's Vireo (Vireo bellii pusillus) · song

Lance A. M. Benner

Hahamongna Park, Pasadena, Los Angeles County, California, United…

xeno-canto XC106462



0:00 0:59

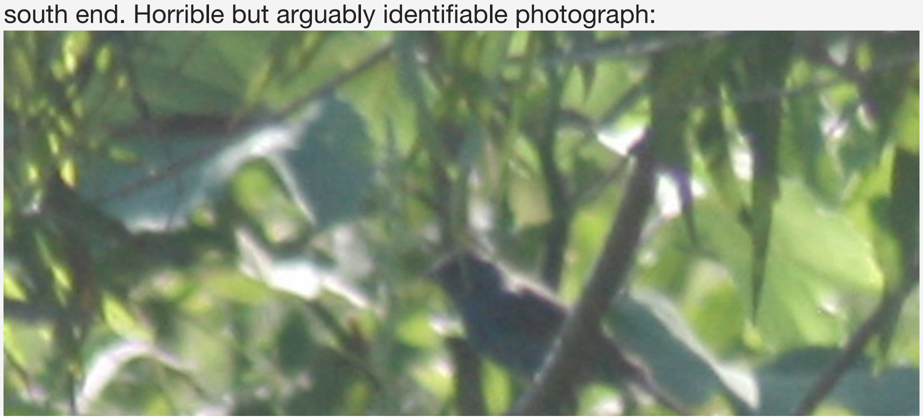
Bell's Vireo (Vireo bellii pusillus) · song

Lance A. M. Benner

Hahamongna Park, Pasadena, Los Angeles County, California, United…

2	**Hutton's Vireo**	Delete
8	**Western Scrub-Jay (Coastal)**	Delete
2	**American Crow**	Delete
4	**Common Raven**	Delete
6	**Northern Rough-winged Swallow**	Delete
2	**Barn Swallow**	Delete
6	**Oak Titmouse**	Delete
40	**Bushtit**	Delete
1	**White-breasted Nuthatch**	Delete
3	**House Wren**	Delete
9	**Bewick's Wren**	Delete

8	**Wrentit**	Delete
2	**Western Bluebird**	Delete
2	**American Robin**	Delete
5	**California Thrasher**	Delete
2	**Northern Mockingbird**	Delete
6	**European Starling**	Delete
6	**Orange-crowned Warbler**	Delete
10	**Common Yellowthroat**	Delete
8	**Yellow Warbler** photographs of young being fed	Delete
11	**Spotted Towhee**	Delete
22	**California Towhee**	Delete
10	**Song Sparrow**	Delete
3	**Western Tanager**	Delete
14	**Black-headed Grosbeak**	Delete
1	**Blue Grosbeak** calling; seen at a distance--definitely a male, but couldn't tell SY or ASY	Delete
1	**Lazuli Bunting**	Delete
1	**Indigo Bunting** All blue male in weedy/willowy area with some other buntings (and mannikins, finches, etc) toward south end. Horrible but arguably identifiable photograph:	Delete



4 **Lazuli/Indigo Bunting** Delete

10 **Brewer's Blackbird** Delete

1 **Brown-headed Cowbird** Delete
juvenile being fed by a COYE

14 **Hooded Oriole** Delete

5 **Bullock's Oriole** Delete

70 **House Finch** Delete

15 **Lesser Goldfinch** Delete

2 **Lawrence's Goldfinch** Delete
conservatively two

1 **American Goldfinch** Delete
calling flyover

12 **Scaly-breasted Munia** Delete

Additional species seen by Darren Dowell:

1 **Green Heron**
Add to my list

1 **Cooper's Hawk**
Add to my list

3 **Killdeer**
Add to my list

2 **Cliff Swallow**
Add to my list

Edit Species List

Are you submitting a **complete checklist** of the birds you were able to identify? Edit Answer

Yes

Checklist S14433956

Location

Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US (Map)

Date and Effort

Sun Jun 16, 2013 6:01 AM

Protocol:	Traveling
Party Size:	2
Duration:	2 hour(s), 24 minute(s)
Distance:	0.75 mile(s)
Observers:	**Janet Scheel** , Mark Scheel List

Species

37 species total

1	Cooper's Hawk
2	Red-shouldered Hawk
1	Red-tailed Hawk
2	Rock Pigeon (Feral Pigeon)
10	Mourning Dove
1	White-throated Swift
2	Black-chinned Hummingbird
5	Anna's Hummingbird
2	Allen's Hummingbird
5	Acorn Woodpecker
2	Nuttall's Woodpecker
3	Red-crowned Parrot
2	Black Phoebe

1	**Ash-throated Flycatcher**
1	**Bell's Vireo** Continuing bird, heard only. Appx. location 34.18773913,-118.17728669
4	**Western Scrub-Jay**
2	**American Crow**
20	**Northern Rough-winged Swallow**
4	**Oak Titmouse**
10	**Bushtit**
9	**Bewick's Wren**
1	**Blue-gray Gnatcatcher**
2	**Wrentit**
1	**Western Bluebird**
3	**California Thrasher**
1	**Northern Mockingbird**
3	**European Starling**
8	**Common Yellowthroat**
10	**Yellow Warbler**
14	**Spotted Towhee**
20	**California Towhee**
8	**Song Sparrow**
5	**Black-headed Grosbeak**
4	**Brown-headed Cowbird**
1	**Bullock's Oriole**
25	**House Finch**

8 **Lesser Goldfinch**

Are you submitting a **complete checklist** of the birds you were able to identify?

Yes

Checklist S14537158

Location

Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US (Map)

Date and Effort

Sun Jun 30, 2013 8:08 AM

Protocol:	Traveling
Party Size:	1
Duration:	47 minute(s)
Distance:	1.0 mile(s)
Observers:	**David Bell**

Species

33 species total

2	Mourning Dove
4	White-throated Swift
1	Black-chinned Hummingbird
2	Anna's Hummingbird
2	Acorn Woodpecker
2	Nuttall's Woodpecker
2	Red-crowned Parrot
3	Black Phoebe
1	Bell's Vireo
5	Western Scrub-Jay (Coastal)
2	American Crow
30	Northern Rough-winged Swallow
9	Oak Titmouse

10	**Bushtit**
15	**Bewick's Wren**
3	**Blue-gray Gnatcatcher** Adults with juv. In Tom Sawyer camp fenced area
1	**Western Bluebird**
10	**European Starling**
10	**Common Yellowthroat**
5	**Yellow Warbler**
5	**Spotted Towhee**
15	**California Towhee**
5	**Song Sparrow**
2	**Black-headed Grosbeak**
1	**Blue Grosbeak** Adult male singing. East of open area near red dumpster.
1	**Brewer's Blackbird**
4	**Brown-headed Cowbird**
4	**Hooded Oriole** Adults feeding barely fledged juvs.
3	**Bullock's Oriole**
10	**House Finch**
10	**American Goldfinch**
25	**House Sparrow**
2	**Scaly-breasted Munia**

Are you submitting a **complete checklist**
of the birds you were able to identify?

Yes

Yes

Checklist S11256799

Location

Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US (Map)

Date and Effort

Thu Aug 02, 2012 6:05 AM

Protocol: Area

Party Size: 1

Duration: 12 minute(s)

Area: 3.0 ac

Observers: **Darren Dowell**

Species

27 species total

5 California Quail

1 Red-shouldered Hawk

9 Mourning Dove

2 Anna's Hummingbird

1 Allen's Hummingbird

3 Acorn Woodpecker

1 Nuttall's Woodpecker

2 Red-crowned Parrot
flyover, not using location

2 Black Phoebe

1 Bell's Vireo
sang from the mulefat to the northeast

Western Scrub-Jay
4

1 American Crow
flyover, not using location

flyover, not using location

2 Oak Titmouse

3 Wrentit

1 California Thrasher

1 Northern Mockingbird

2 European Starling

1 Orange-crowned Warbler

2 Common Yellowthroat

2 Spotted Towhee

3 California Towhee

2 Song Sparrow

1 Black-headed Grosbeak

1 Hooded Oriole

2 House Finch

2 Lesser Goldfinch

2 Scaly-breasted Munia

Are you submitting a **complete checklist** of the birds you were able to identify?

Yes

Checklist S11290082

Location

Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US (Map)

Date and Effort

Thu Aug 02, 2012 11:20 AM

Protocol:	Traveling
Party Size:	2
Duration:	2 hour(s), 20 minute(s)
Distance:	2.0 mile(s)
Observers:	**Alex Burdo**

Species

29 species total

1	**Cooper's Hawk**
1	**Red-shouldered Hawk**
1	**Red-tailed Hawk**
8	**Rock Pigeon (Feral Pigeon)** Breeding Code: F Flyover
2	**Mourning Dove**
6	**Anna's Hummingbird**
2	**Acorn Woodpecker**
1	**Nuttall's Woodpecker**
4	**Black Phoebe**
1	**Bell's Vireo**
9	**Western Scrub-Jay**
1	**American Crow**

1	Common Raven
8	Oak Titmouse
28	Bushtit
1	House Wren
4	Bewick's Wren
1	Cactus Wren
2	Wrentit
3	Northern Mockingbird
1	Yellow Warbler
1	Spotted Towhee
3	California Towhee
1	Song Sparrow
1	Black-headed Grosbeak
1	Lazuli Bunting
22	House Finch
13	Lesser Goldfinch
15	Scaly-breasted Munia

Are you submitting a **complete checklist** of the birds you were able to identify?

Yes

Checklist S11256886

Location

Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US (Map)

Date and Effort

Thu Aug 02, 2012 6:17 AM

Protocol:	Traveling
Party Size:	1
Duration:	3 hour(s), 28 minute(s)
Distance:	1.0 mile(s)
Observers:	**Darren Dowell**

Species

43 species total

3	**Mallard**
5	**California Quail**
1	**Red-shouldered Hawk**
3	**Rock Pigeon (Feral Pigeon)**
2	**Mourning Dove**
4	**White-throated Swift**
1	**Black-chinned Hummingbird**
4	**Anna's Hummingbird**
10	**Allen's Hummingbird**
3	**Nuttall's Woodpecker**
1	**American Kestrel** well seen; first I've seen here for a while
4	**Black Phoebe**
1	**Ash-throated Flycatcher**

1 **Cassin's Kingbird**
photos

2 **Bell's Vireo**
6:30 - 7:00: two individuals seen at one time near 34.192494,-118.174310 -- chasing/scolding behavior, did not notice one feeding another. Photos and recordings. 9:15: recorded singing individual much further to south, near 34.188163,-118.176928 .

1 **Hutton's Vireo**

7 **Western Scrub-Jay**

3 **Common Raven**

4 **Oak Titmouse**

40 **Bushtit**

1 **White-breasted Nuthatch**

1 **House Wren**

10 **Bewick's Wren**

4 **Wrentit**

2 **California Thrasher**

2 **Northern Mockingbird**

5 **Orange-crowned Warbler**

6 **Common Yellowthroat**
two juveniles in family group

9 **Yellow Warbler**

4 **Spotted Towhee**

10 **California Towhee**

7 **Song Sparrow**

2 **Western Tanager**

10 **Black-headed Grosbeak**

one juvenile being fed (photos)

5 Lazuli Bunting

10 Brewer's Blackbird

6 Hooded Oriole

2 Bullock's Oriole

40 House Finch
at least one juvenile

20 Lesser Goldfinch
at least one juvenile

1 American Goldfinch
basic plumage

1 House Sparrow

10 Scaly-breasted Munia

Are you submitting a **complete checklist** of the birds you were able to identify?

Yes

Checklist S14577245

Location

Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US (Map)

Date and Effort

Thu Jul 04, 2013 11:27 AM

Protocol: Traveling

Party Size: 2

Duration: 1 hour(s), 12 minute(s)

Distance: 0.5 mile(s)

Observers: **BJ Stacey** , Michaeleen Stacey List

Comments: Birded with Michaeleen

Species

17 species total

1	Turkey Vulture
1	Red-tailed Hawk (Western)
3	White-throated Swift
1	Anna's Hummingbird
3	Acorn Woodpecker
1	Nuttall's Woodpecker
1	Peregrine Falcon
1	Black Phoebe
1	Bell's Vireo
4	Oak Titmouse
1	Bewick's Wren
4	Western Bluebird

5	**Northern Mockingbird**
1	**Phainopepla**
5	**California Towhee**
1	**Lazuli Bunting**
15	**Lesser Goldfinch**

Are you submitting a **complete checklist**
of the birds you were able to identify?

Yes

Checklist S19206580

Location Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US (Map)

Date and Effort Thu Jul 24, 2014 6:49 AM

Protocol: Traveling
Party Size: 2
Duration: 1 hour(s), 56 minute(s)
Distance: 0.75 mile(s)
Observers: **Darren Dowell** , Lance Benner List

Species 44 species (+1 other taxa) total

Hide Media

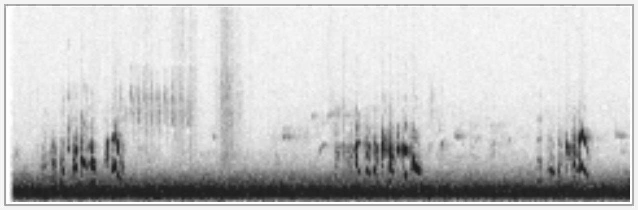
1	California Quail
7	Rock Pigeon (Feral Pigeon)
25	Mourning Dove
1	White-throated Swift
1	Black-chinned Hummingbird
3	Anna's Hummingbird
2	Rufous/Allen's Hummingbird
2	Acorn Woodpecker
2	Nuttall's Woodpecker
1	Downy Woodpecker
4	Red-crowned Parrot
2	Black Phoebe
1	Bell's Vireo

singing bird observed, recorded, and photographed as it ranged widely around where one was singing bird observed, recorded, and photographed as it ranged widely around where one was seen yesterday. At one point, there was a suggestion of interaction with a possible second BEVI, but it was not seen or heard well enough to confirm.

Detailed description from photos by LB: "The bird has worn tail feathers, some pale yellow in the wings, and prominent white above the eye. A couple of shots show the hooked beak clearly."

Recordings by LB:

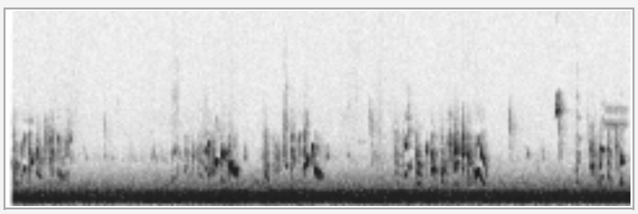
xeno-canto XC188496



0:00 0:44

Bell's Vireo (Vireo bellii pusillus) · song
Lance A. M. Benner
Hahamongna Park, Pasadena, Los Angeles County, California, United…

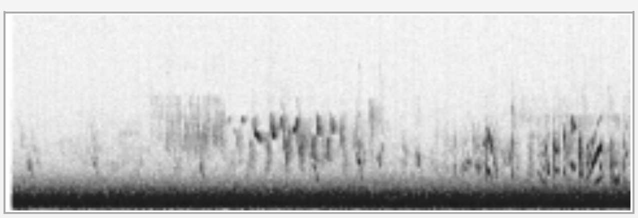
xeno-canto XC188497



0:00 0:16

Bell's Vireo (Vireo bellii pusillus) · song
Lance A. M. Benner
Hahamongna Park, Pasadena, Los Angeles County, California, United…

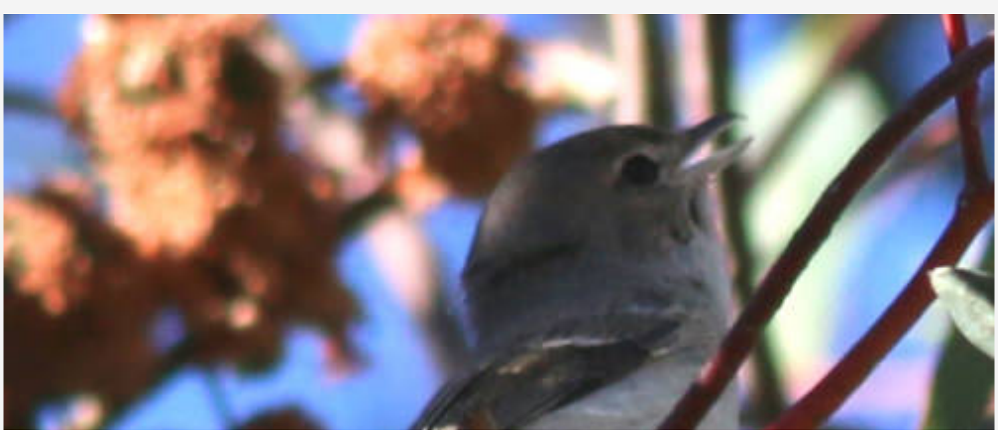
xeno-canto XC188498



0:00 0:29

Bell's Vireo (Vireo bellii Pusillus) · song
Lance A. M. Benner
Hahamongna Park, Pasadena, Los Angeles County, California, United…

Photos by CDD & LB:



1	**Hutton's Vireo**
4	**Western Scrub-Jay**
1	**American Crow**
2	**Common Raven**
3	**Northern Rough-winged Swallow**
2	**Violet-green Swallow**
1	**Barn Swallow**
3	**Cliff Swallow**
2	**Oak Titmouse**
10	**Bushtit**
1	**White-breasted Nuthatch** northwest part
4	**Bewick's Wren**
2	**Blue-gray Gnatcatcher** continuing near north restroom
2	**Wrentit**
1	**Western Bluebird**
2	**California Thrasher**
10	**European Starling**

5 **Phainopepla**
single flock in flight to west out of basin

2 **Orange-crowned Warbler**

3 **Common Yellowthroat**

3 **Yellow Warbler**

1 **Yellow-breasted Chat**
heard only, from continuing location

3 **Spotted Towhee**

7 **California Towhee**

3 **Black-headed Grosbeak**

1 **Brown-headed Cowbird**
begging juv. being fed by COYE

Breeding Code FL Confirmed--Recently Fledged Young

1 **Bullock's Oriole**

25 **House Finch**

5 **Lesser Goldfinch**

2 **American Goldfinch**

2 **House Sparrow**

1 **Scaly-breasted Munia**

Are you submitting a **complete checklist** of the birds you were able to identify?

Yes

Checklist S11218574

Location

Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US (Map)

Date and Effort

Thu Jul 26, 2012 6:10 PM

Protocol:	Traveling
Party Size:	1
Duration:	2 hour(s)
Distance:	0.5 mile(s)
Observers:	**John Oliver**
Comments:	Several Desert Cottontails, California Ground Squirrels, and Western Fence Lizards were also seen.

Species

30 species total

4 Mallard

Age & Sex

	Juvenile	Immature	Adult	Age Unknown
Male			1	
Female				
Sex Unknown		3		

5 Band-tailed Pigeon

25 Mourning Dove

2 White-throated Swift

3 Anna's Hummingbird

2 Allen's Hummingbird

3 Acorn Woodpecker

3 Nuttall's Woodpecker

Heard only

Heard only.

4 Black Phoebe

1 Bell's Vireo
One bird, likely a juvenile, seen in the willow patch just south of the sewer ponds and west of the JPL parking lot. Identified by overall grayish plumage with two fairly faint wing bars and a noticeable white eye line.

3 Western Scrub-Jay (Coastal)

25 American Crow

4 Northern Rough-winged Swallow

2 Violet-green Swallow

2 Barn Swallow

1 Cliff Swallow

20 Bushtit
Heard only.

1 House Wren

6 Bewick's Wren

2 Western Bluebird

Age & Sex

	Juvenile	Immature	Adult	Age Unknown
Male			1	
Female			1	
Sex Unknown				

1 California Thrasher

3 Northern Mockingbird

15 European Starling

4 California Towhee

2 Song Sparrow

4 Brown-headed Cowbird

Age & Sex

	Juvenile	Immature	Adult	Age Unknown
Male			**2**	
Female			**2**	
Sex Unknown				

1 Hooded Oriole

Age & Sex

	Juvenile	Immature	Adult	Age Unknown
Male				
Female			**1**	
Sex Unknown				

1 Bullock's Oriole

8 House Finch

30 Lesser Goldfinch

Are you submitting a **complete checklist** of the birds you were able to identify?

Yes

Checklist S14305416

Location

Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US (Map)

Date and Effort

Thu May 02, 2013 6:33 AM

Protocol:	Traveling
Party Size:	1
Duration:	1 hour(s), 37 minute(s)
Distance:	1.0 mile(s)
Observers:	**Darren Dowell** , Darren Dowell (PAS CBC circle) List

Species

42 species total

3	California Quail
2	Red-shouldered Hawk
1	Red-tailed Hawk
3	Rock Pigeon (Feral Pigeon)
1	Band-tailed Pigeon
X	Mourning Dove
1	White-throated Swift
3	Anna's Hummingbird
4	Acorn Woodpecker
X	Red-crowned Parrot
3	Black Phoebe one juv.
5	Ash-throated Flycatcher

5	Ash-throated Flycatcher
1	**Bell's Vireo** near 34.189401,-118.175382
1	**Warbling Vireo**
X	**Western Scrub-Jay**
1	**American Crow**
3	**Northern Rough-winged Swallow**
1	**Oak Titmouse**
X	**Bushtit**
2	**House Wren**
5	**Bewick's Wren**
2	**American Robin**
2	**California Thrasher**
15	**European Starling** at least one juv.
25	**Cedar Waxwing**
1	**Orange-crowned Warbler**
2	**Common Yellowthroat**
5	**Yellow Warbler**
1	**Black-throated Gray Warbler** female
1	**Townsend's Warbler** male
2	**Wilson's Warbler**
5	**Spotted Towhee**
15	**California Towhee**
2	**Lark Sparrow**

one carrying nesting material

3 **Song Sparrow**

5 **Western Tanager**

5 **Black-headed Grosbeak**

1 **Blue Grosbeak**

2 **Brown-headed Cowbird**

30 **House Finch**

40 **Lesser Goldfinch**
at least one juv.

2 **House Sparrow**

Are you submitting a **complete checklist** of the birds you were able to identify?

Yes

Checklist S14216249

Location

Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US (Map)

Date and Effort

Thu May 23, 2013 6:30 AM

Protocol: Traveling

Party Size: 1

Duration: 1 hour(s), 35 minute(s)

Distance: 1.5 mile(s)

Observers: **Darren Dowell** , Darren Dowell (PAS CBC circle)

List

Species

5 species total

1 **Red-tailed Hawk**

2 **Acorn Woodpecker**

2 **Western Wood-Pewee**

1 **Bell's Vireo**
heard only, singing often (and recorded with iPhone, much better quality today); south of 34.188645,-118.176953

2 **Hooded Oriole**

Are you submitting a **complete checklist** of the birds you were able to identify?

No

Checklist S14304984

Location

Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US (Map)

Date and Effort

Thu May 30, 2013 6:30 AM

Protocol:	Traveling
Party Size:	1
Duration:	1 hour(s)
Distance:	1.0 mile(s)
Observers:	**Darren Dowell** , Darren Dowell (PAS CBC circle) List

Species

2 species total

1 **Downy Woodpecker**

1 **Bell's Vireo**
continuing (singing) in same location

Are you submitting a **complete checklist** of the birds you were able to identify?

No

Checklist S13958536

Location

Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US (Map)

Date and Effort

Tue Apr 30, 2013 3:22 PM

Protocol:	Traveling
Party Size:	1
Duration:	1 hour(s), 24 minute(s)
Distance:	1.5 mile(s)
Observers:	**Darren Dowell** , Darren Dowell (PAS CBC circle)

List

Species

45 species total

10 Mallard

Age & Sex

	Juvenile	Immature	Adult	Age Unknown
Male				
Female				
Sex Unknown	4		6	

2 California Quail

1 Green Heron
adult alongside spreading basin in northeast

1 Turkey Vulture

2 Red-tailed Hawk

3 Killdeer

3 Spotted Sandpiper
along northeast spreading basins (which contain water)

1 Band-tailed Pigeon

1 Mourning Dove

5	**White-throated Swift**
1	**Black-chinned Hummingbird**
3	**Anna's Hummingbird**
1	**Allen's Hummingbird**
1	**Acorn Woodpecker**
1	**Bell's Vireo** south of Johnson Field; not seen, but heard well (singing); recorded with iPhone
1	**Warbling Vireo**
4	**Western Scrub-Jay**
2	**American Crow**
4	**Common Raven**
30	**Northern Rough-winged Swallow**
2	**Barn Swallow**
5	**Cliff Swallow**
15	**Bushtit**
3	**House Wren**
7	**Bewick's Wren**
2	**Wrentit**
1	**American Robin**
1	**California Thrasher**
4	**Northern Mockingbird**
6	**European Starling**
1	**Common Yellowthroat**
6	**Yellow Warbler**

1	Yellow-rumped Warbler (Audubon's)
3	Spotted Towhee
15	California Towhee
5	Song Sparrow
5	Western Tanager
4	Black-headed Grosbeak
2	Red-winged Blackbird
2	Brown-headed Cowbird
1	Hooded Oriole
2	Bullock's Oriole
50	House Finch
10	Lesser Goldfinch
2	House Sparrow

Are you submitting a **complete checklist** of the birds you were able to identify?

Yes

Checklist S11168018

Location

Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US (Map)

Date and Effort

Tue Jul 17, 2012 6:30 AM

Protocol: Traveling

Party Size: 1

Duration: 1 hour(s)

Distance: 0.2 mile(s)

Observers: **Darren Dowell**

Species

2 species total

1 **Bell's Vireo**
Twice (in two locations) had attention drawn to bird calling in similar way to one recorded on Sunday. Bird seen on both occasions consistent with adult, but I can't confirm the calling bird was the same as the one seen. Gray bird, roughly gnatcatcher shape, pale wing bar, foraging in mule fat. Locations photographed and marked with GPS, but bird photos did not turn out.

X **Common Yellowthroat**
juvenile photographed (poorly)

Are you submitting a **complete checklist** of the birds you were able to identify?

No

Checklist S22501990

Location

Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US (Map)

Date and Effort

Tue Mar 24, 2015 6:52 AM

Protocol: Traveling

Party Size: 1

Duration: 2 hour(s), 30 minute(s)

Distance: 1.5 mile(s)

Observers: **Darren Dowell**

Species

57 species total

Hide Media

9 Canada Goose
flyover

8 Mallard

1 Cinnamon Teal
male at dam

1 **Green-winged Teal (American)**
male at dam

2 **California Quail**

1 **Turkey Vulture**

1 **Cooper's Hawk**

1 **Red-shouldered Hawk**
in sycamore in northwest area

1 **American Coot**

5 **Rock Pigeon (Feral Pigeon)**

7 **Band-tailed Pigeon**

6 **Mourning Dove**

5 **White-throated Swift**

3 **Anna's Hummingbird**

5 **Acorn Woodpecker**

2 **Nuttall's Woodpecker**

1 **Downy Woodpecker**

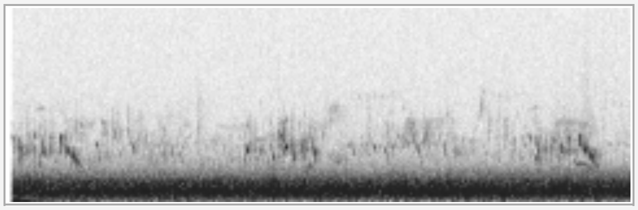
1 **Northern Flicker**

2 **Red-crowned Parrot**

1 **Black Phoebe**

1 **Bell's Vireo**
singing spontaneously, recorded with LS-10; no visual sighting

xeno-canto XC233134



0:00 0:31

Bell's Vireo (Vireo bellii) · song
Darren Dowell
Hahamongna Park, Pasadena, Los Angeles County, California, United...

2 **Hutton's Vireo**

1 **Warbling Vireo**

7 **Western Scrub-Jay**

4 **American Crow**

10 **Common Raven**

10 **Northern Rough-winged Swallow**

4 **Oak Titmouse**

15 **Bushtit**

5 **House Wren**

10 **Bewick's Wren**

3 **Blue-gray Gnatcatcher**
including one continuing near northern restroom

3 **Ruby-crowned Kinglet**

2 **Wrentit**

2 **Western Bluebird**

7 **Hermit Thrush**

5 **American Robin**

2 **California Thrasher**

1 **Northern Mockingbird**

12 **European Starling**

4 **Orange-crowned Warbler**

6 **Common Yellowthroat**

40 **Yellow-rumped Warbler (Audubon's)**
abundant singing now

1 **Townsend's Warbler**

12 **Spotted Towhee**

15 **California Towhee**

5 **Song Sparrow**

2 **Lincoln's Sparrow**

1 **White-throated Sparrow**

continuing tan-striped individual, seen well & photographed, near southeast corner of Rose Bowl Riders stable area

15 **White-crowned Sparrow (Gambel's)**

1 **Black-headed Grosbeak**
seen in flight (medium-sized bird with bright flashes of white on wings) and heard (two "sneakers on gym floor" squeaks) only; no long tail like a mockingbird, etc.; presumably only slightly early

3 **Brown-headed Cowbird**

1 **Bullock's Oriole**
unseen; singing and chattering

unseen, singing and chattering

15 **House Finch**

3 **Purple Finch**

7 **Lesser Goldfinch**

1 **American Goldfinch**

Are you submitting a **complete checklist** of the birds you were able to identify?

Yes

Checklist S14271657

Location

Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US (Map)

Date and Effort

Tue May 28, 2013 6:35 AM

Protocol: Traveling

Party Size: 1

Duration: 1 hour(s), 23 minute(s)

Distance: 1.0 mile(s)

Observers: Darren Dowell List , **Darren Dowell (PAS CBC circle)**

Species

43 species total

2	**California Quail**
2	**Red-shouldered Hawk** adults in same tree
1	**Red-tailed Hawk**
1	**Rock Pigeon (Feral Pigeon)**
7	**Mourning Dove**
X	**White-throated Swift**
2	**Anna's Hummingbird**
1	**Allen's Hummingbird**
4	**Acorn Woodpecker**
4	**Nuttall's Woodpecker** including (at least) one nestling
6	**Red-crowned Parrot**
6	**Black Phoebe**

1	**Bell's Vireo** continuing in same location (singing frequently)
1	**Hutton's Vireo**
1	**Warbling Vireo**
7	**Western Scrub-Jay**
1	**American Crow**
15	**Northern Rough-winged Swallow**
2	**Cliff Swallow**
2	**Oak Titmouse**
15	**Bushtit**
5	**House Wren**
10	**Bewick's Wren**
1	**Wrentit**
1	**Western Bluebird**
2	**American Robin**
1	**Northern Mockingbird**
10	**European Starling**
4	**Orange-crowned Warbler**
3	**Common Yellowthroat**
7	**Yellow Warbler**
4	**Spotted Towhee**
10	**California Towhee** 2 juveniles
4	**Song Sparrow**

2 **Western Tanager**

3 **Black-headed Grosbeak**

3 **Great-tailed Grackle**
flyover east to west, all together

4 **Brown-headed Cowbird**

1 **Hooded Oriole**

40 **House Finch**

1 **Purple Finch**
continuing (late?) bird(s); song from two locations, but could have been the same one moving

50 **Lesser Goldfinch**

3 **House Sparrow**

Are you submitting a **complete checklist** of the birds you were able to identify?

Yes

Checklist S14562718

Location

Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US (Map)

Date and Effort

Wed Jul 03, 2013 6:37 AM

Protocol:	Traveling
Party Size:	1
Duration:	1 hour(s), 39 minute(s)
Distance:	1.0 mile(s)
Observers:	**Darren Dowell** , Darren Dowell (PAS CBC circle) List

Species

39 species total Hide Media

1	**Double-crested Cormorant** flyby far to south
2	**Great Blue Heron** flyover, together
2	**Cooper's Hawk** immatures, seemed young, together
3	**Rock Pigeon (Feral Pigeon)**
1	**Band-tailed Pigeon**
3	**Mourning Dove**
5	**White-throated Swift**
2	**Black-chinned Hummingbird**
3	**Anna's Hummingbird**
15	**Allen's Hummingbird**

2	**Nuttall's Woodpecker**
6	**Red-crowned Parrot**
1	**Black Phoebe**
1	**Bell's Vireo** singing bird continuing in new more southern location, near intersection of Berkshire Creek and Flint Wash. Recorded with iPhone.
1	**Hutton's Vireo**
5	**Western Scrub-Jay**
3	**American Crow**
3	**Common Raven**
15	**Northern Rough-winged Swallow**
1	**Oak Titmouse**
40	**Bushtit**
15	**Bewick's Wren**
2	**Wrentit**
2	**Orange-crowned Warbler**
6	**Common Yellowthroat**
8	**Yellow Warbler**
1	**Yellow-breasted Chat** unseen, but singing clearly (recorded with iPhone); near intersection of Berkshire Creek and Flint Wash.
7	**Spotted Towhee**
5	**California Towhee**
10	**Song Sparrow**
1	**Black-headed Grosbeak**
1	**Blue Grosbeak**

adult male, singing

1 **Indigo Bunting**
adult male, near intersection of Berkshire Creek and Flint Wash (approx. 34.186285,-118.176249; best accessed by walking up channel from base of dam to the east of the location). Almost entirely blue, darker on wings and lores, relatively small bill, no brown wing bars. One photo.

4 **Brown-headed Cowbird**
one juv. being fed by YEWA

1 **Hooded Oriole**

40 **House Finch**

25 **Lesser Goldfinch**

1 **House Sparrow**

6 **Scaly-breasted Munia**

Are you submitting a **complete checklist** of the birds you were able to identify?

Yes

Checklist S19197633

Location

Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US (Map)

Date and Effort

Wed Jul 23, 2014 6:42 AM

Protocol: Traveling

Party Size: 1

Duration: 2 hour(s), 33 minute(s)

Distance: 1.5 mile(s)

Observers: **Darren Dowell**

Species

45 species (+1 other taxa) total

1 **California Quail**

1 **Red-shouldered Hawk**
adult

8 **Rock Pigeon (Feral Pigeon)**

17 **Mourning Dove**

3 **White-throated Swift**

2 **Black-chinned Hummingbird**

7 **Anna's Hummingbird**

7 **Allen's Hummingbird**

7 **Acorn Woodpecker**
one begging juv. being fed

Breeding Code FY Confirmed--Feeding Young

4 **Nuttall's Woodpecker**

2 **Downy Woodpecker**

10	**Red-crowned Parrot**
3	**Black Phoebe**
1	**Bell's Vireo** first noticed by distinctive song, which was then recorded with iPhone. Later, got a glimpse of one -- gray bird, pale wing bar, long vireo-like bill. Seemed to be in the company of HUVI, possibly interacting. Location was recorded with iPhone and is documented in above checklist comment field.
4	**Hutton's Vireo**
8	**Western Scrub-Jay**
3	**American Crow**
5	**Northern Rough-winged Swallow**
5	**Violet-green Swallow**
5	**Cliff Swallow**
6	**Oak Titmouse**
35	**Bushtit**
9	**Bewick's Wren**
1	**Blue-gray Gnatcatcher**
3	**Wrentit**
5	**California Thrasher**
1	**Northern Mockingbird**
10	**European Starling**
3	**Orange-crowned Warbler**
4	**Common Yellowthroat**
11	**Yellow Warbler**
1	**Yellow-breasted Chat** singing, unseen in continuing area

14 **Spotted Towhee**

15 **California Towhee**

4 **Song Sparrow**

2 **Western Tanager**

6 **Black-headed Grosbeak**

2 **Lazuli Bunting**

Age & Sex

	Juvenile	Immature	Adult	Age Unknown
Male			2	
Female				
Sex Unknown				

2 **Lazuli/Indigo Bunting**
one heard only, other a distant female type

1 **Brown-headed Cowbird**

3 **Hooded Oriole**

1 **Bullock's Oriole**

80 **House Finch**

10 **Lesser Goldfinch**

3 **House Sparrow**

5 **Scaly-breasted Munia**
adults

Are you submitting a **complete checklist** of the birds you were able to identify?

Yes

Checklist S14408421

Older | All Checklists | Newer

Location

Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US (Map)

Date and Effort

Wed Jun 12, 2013 4:50 PM

Protocol:	Traveling
Party Size:	1
Duration:	3 hour(s), 15 minute(s)
Distance:	1.5 mile(s)
Observers:	**John Oliver**
Comments:	One Desert Cottontail and many Western Fence Lizards and California Ground Squirrels were also seen.

Species

42 species (+1 other taxa) total

3	**Mallard**
1	**Cooper's Hawk**
1	**Red-tailed Hawk (Western)**
1	**Killdeer**
1	**Rock Pigeon (Feral Pigeon)**
2	**Band-tailed Pigeon**
25	**Mourning Dove**
10	**White-throated Swift**
6	**Anna's Hummingbird**
4	**Rufous/Allen's Hummingbird**
5	**Acorn Woodpecker**

2 **Nuttall's Woodpecker**

8 **Red-crowned Parrot**

4 **Black Phoebe**

1 **Bell's Vireo**
Singing male seen on the trail nearest the bridge at the south edge of the park.

Breeding Code S Possible--Singing male

2 **Hutton's Vireo**

10 **Western Scrub-Jay (Coastal)**

3 **American Crow**

30 **Northern Rough-winged Swallow**

1 **Violet-green Swallow**

10 **Cliff Swallow**

2 **Oak Titmouse**

30 **Bushtit**

1 **White-breasted Nuthatch**

6 **Bewick's Wren**

6 **Wrentit**

3 **Western Bluebird**

2 **California Thrasher**

4 **Northern Mockingbird**

10 **European Starling**

1 **Phainopepla**

Age & Sex

	Juvenile	Immature	Adult	Age Unknown
Male				
Female			1	

Female			1	
Sex Unknown				

4 Common Yellowthroat

6 Yellow Warbler

5 Spotted Towhee

10 California Towhee

8 Song Sparrow

8 Black-headed Grosbeak

2 Red-winged Blackbird

8 Brown-headed Cowbird

4 Bullock's Oriole

25 House Finch

25 Lesser Goldfinch

5 House Sparrow

Are you submitting a **complete checklist** of the birds you were able to identify?

Yes

Checklist S13954534

Location

Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US (Map)

Edit Location

Date and Effort

Wed May 01, 2013 8:15 AM

Edit Date and Effort

Protocol:	Traveling
Party Size:	1
Duration:	1 hour(s), 20 minute(s)
Distance:	1.0 mile(s)
Observers:	**Lance Benner**
Comments:	I walked east from the main parking lot to the Johnson Field, then south for a few hundred yards, then back to the parking lot, north a few hundred yards, then east another 200-300 yards, and then back to my car.

Species

40 species total

Hide Media | Edit Species List

3	**Mallard**	Delete
10	**California Quail**	Delete
1	**Killdeer**	Delete
4	**Rock Pigeon (Feral Pigeon)**	Delete
8	**Band-tailed Pigeon**	Delete
4	**Mourning Dove**	Delete
5	**White-throated Swift**	Delete
3	**Anna's Hummingbird**	Delete
5	**Acorn Woodpecker**	Delete
1	**Nuttall's Woodpecker**	Delete

Print

Download

Email Yourself

Delete

Share w/ Others in Your Party

Send link via:

Submit another for...

Same location and date
Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US on Wed May 01, 2013

Same location
Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US

Same area and date
Another location near Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US on Wed May 01, 2013

Same area
Another location near Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US

Same date
Wed May 01, 2013

Different location and date

Hide from eBird Output ?

Change Portal

10 Red-crowned Parrot Delete

1 Ash-throated Flycatcher Delete

1 Cassin's Kingbird Delete

1 Bell's Vireo Delete

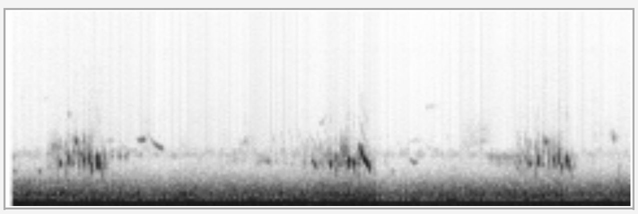
Identified by voice but not seen. Vocalizations recorded with a Marantz PMD670 digital recorder equipped with a Sennheiser ME67 shotgun microphone. The bird was a few tens of meters north of disc golf hole 13 (200-300 meters east of the stables).

A recording and sonogram are available on the Xeno-Canto website at:

http://www.xeno-canto.org/132023

Direct link to the audio file

xeno-canto XC132023



0:00 0:28

Bell's Vireo (Vireo bellii) · song

Lance A. M. Benner

Hahamongna Park, Pasadena, Los Angeles County, California, United…

8 Western Scrub-Jay (Coastal) Delete

4 American Crow Delete

6 Common Raven Delete

4 Northern Rough-winged Swallow Delete

30 Violet-green Swallow Delete

20 Bushtit Delete

4 House Wren Delete

6 Bewick's Wren Delete

4 Wrentit Delete

2	**American Robin**	Delete
3	**California Thrasher**	Delete
2	**Northern Mockingbird**	Delete
6	**European Starling**	Delete
10	**Cedar Waxwing**	Delete
2	**Common Yellowthroat**	Delete
3	**Yellow Warbler**	Delete
6	**Spotted Towhee**	Delete
4	**California Towhee**	Delete
8	**Song Sparrow**	Delete
1	**Dark-eyed Junco**	Delete
1	**Western Tanager**	Delete
3	**Black-headed Grosbeak**	Delete
1	**Hooded Oriole**	Delete
1	**Bullock's Oriole**	Delete
20	**House Finch**	Delete
30	**Lesser Goldfinch**	Delete

Edit Species List

Are you submitting a **complete checklist** of the birds you were able to identify?

Edit Answer

Yes

Checklist S14208401

Location

Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US (Map)

Date and Effort

Wed May 22, 2013 6:25 AM

Protocol:	Traveling
Party Size:	1
Duration:	2 hour(s), 7 minute(s)
Distance:	3.0 mile(s)
Observers:	**Darren Dowell** , Darren Dowell (PAS CBC circle) List

Species

49 species total

1	**Mallard**
1	**Cooper's Hawk**
1	**Red-shouldered Hawk**
5	**Killdeer**
6	**Rock Pigeon (Feral Pigeon)**
4	**Band-tailed Pigeon**
20	**Mourning Dove**
10	**White-throated Swift**
1	**Anna's Hummingbird**
3	**Allen's Hummingbird**
3	**Nuttall's Woodpecker**
X	**Red-crowned Parrot**

7 **Black Phoebe**
at least one juvenile

1 **Say's Phoebe**
in main wash in northern part; calling; photographed; late-ish; same one as last week?

1 **Ash-throated Flycatcher**

1 **Cassin's Kingbird**

1 **Bell's Vireo**
heard only, short sections of song, recorded with iPhone; a little to the east of listening location 34.188442,-118.177423 (Berkshire Creek)

10 **Western Scrub-Jay**

7 **American Crow**

9 **Common Raven**
5 juveniles on wire at dam; photos

10 **Northern Rough-winged Swallow**

1 **Violet-green Swallow**
near NE pond (filled)

6 **Barn Swallow**
some juveniles

2 **Cliff Swallow**

2 **Oak Titmouse**

25 **Bushtit**

4 **House Wren**

10 **Bewick's Wren**

4 **Wrentit**

2 **American Robin**

3 **California Thrasher**

3 **Northern Mockingbird**

10 **European Starling**

7 **Phainopepla**
direct count

2 **Orange-crowned Warbler**

5 **Common Yellowthroat**

8 **Yellow Warbler**
direct count

10 **Spotted Towhee**

15 **California Towhee**

5 **Song Sparrow**
one juvenile

1 **Western Tanager**

7 **Black-headed Grosbeak**

1 **Blue Grosbeak**
singing male, almost into full blue plumage, on east side SW of JPL parking lot

2 **Red-winged Blackbird**

2 **Brown-headed Cowbird**

3 **Bullock's Oriole**
pair visiting a nest, plus a third adult elsewhere

30 **House Finch**

40 **Lesser Goldfinch**

1 **House Sparrow**

Are you submitting a **complete checklist** of the birds you were able to identify?

Yes

Checklist S14304813

Older All Checklists Newer

Location

Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US (Map)

Date and Effort

Wed May 29, 2013 3:58 PM

Protocol: Traveling

Party Size: 1

Duration: 51 minute(s)

Distance: 1.0 mile(s)

Observers: **Darren Dowell** , Darren Dowell (PAS CBC circle)

List

Species

32 species total

2 Mallard

1 California Quail

2 Cooper's Hawk

2 Rock Pigeon (Feral Pigeon)

2 White-throated Swift

1 Black-chinned Hummingbird
male

2 Anna's Hummingbird

1 Nuttall's Woodpecker

2 Black Phoebe

1 Ash-throated Flycatcher

1 Bell's Vireo
continuing (singing) in same location

1 Hutton's Vireo

1	Hutton's Vireo
3	Western Scrub-Jay
2	American Crow
1	Common Raven
5	Northern Rough-winged Swallow
2	Cliff Swallow
1	Oak Titmouse
10	Bushtit
2	House Wren
6	Bewick's Wren
2	Wrentit
1	Northern Mockingbird
1	Phainopepla
1	Orange-crowned Warbler
5	Common Yellowthroat
6	Yellow Warbler
10	Spotted Towhee
4	Song Sparrow
2	Black-headed Grosbeak
7	House Finch
20	Lesser Goldfinch

Are you submitting a **complete checklist** of the birds you were able to identify?

Yes

Checklist S2902089

Older All Checklists Newer

Location

Hahamongna Watershed Park (formerly Oak Grove Park), Los Angeles County, California, US (Map)

Date and Effort

Sat Apr 21, 2007

Protocol: Incidental

Party Size: 1

Observers: **Jeffrey Fenwick**

Species

35 species total

11	Mallard
4	California Quail
1	Green Heron
2	Red-tailed Hawk
4	Killdeer
2	Rock Pigeon (Feral Pigeon)
1	Band-tailed Pigeon
2	Mourning Dove
1	Anna's Hummingbird
1	Acorn Woodpecker
1	Nuttall's Woodpecker
2	American Kestrel
1	Dusky Flycatcher
3	Black Phoebe

3	Ash-throated Flycatcher
2	Bell's Vireo
4	Western Scrub-Jay
2	American Crow
1	Common Raven
10	Northern Rough-winged Swallow
5	Bushtit
1	Bewick's Wren
2	Wrentit
10	Western Bluebird
1	California Thrasher
3	Northern Mockingbird
10	European Starling
30	Cedar Waxwing
2	Yellow-rumped Warbler
2	Spotted Towhee
2	California Towhee
15	Chipping Sparrow
1	Song Sparrow
10	Lazuli Bunting
20	House Finch

Are you submitting a **complete checklist** of the birds you were able to identify?

Yes

Yes

EXHIBIT G

C. Darren Dowell

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Pasadena, CA 91109
(818) 393-5032

754 N. Mar Vista Ave.
Pasadena, CA 91104
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EDUCATION/PROFESSIONAL APPOINTMENTS

Research Scientist, Jet Propulsion Laboratory, 2005-present
Visiting Associate and **Lecturer**, California Institute of Technology, 2003-present
Scientist, Jet Propulsion Laboratory, 2003-2005
Sr. Postdoctoral Scholar, Department of Physics, California Institute of Technology, 2000-2003
Postdoctoral Scholar, Department of Physics, California Institute of Technology, 1997-2000
Ph.D. Astronomy and Astrophysics, University of Chicago, 1997. Dissertation: "Far-Infrared Polarization by Absorption in the Molecular Cloud Sagittarius B2"
M.S. Astronomy and Astrophysics, University of Chicago, 1992
B.A. Physics (Space Physics and Astronomy), cum laude, Rice University, 1991. Senior Thesis: calibration of an optical spectrograph and observations of Orion Nebula

RESEARCH INTERESTS

Experimental Astrophysics and Cosmology
Infrared and Submillimeter Astrophysics
Polarimetry, Dust Grains, and Magnetic Fields
Star Formation
High-Redshift Submillimeter Studies
Cosmic Microwave Background

TEACHING EXPERIENCE

Teaching Assistant, undergraduate physics, California Institute of Technology, 2007, 2008, 2010, 2011
Teaching Assistant, radio astronomy lab course, U. Chicago, 1993
Teaching Assistant, undergraduate astronomy courses for non-science majors, U. Chicago, 1991-1992

PROFESSIONAL HONORS AND MEMBERSHIPS

NASA Group Achievement Award to BICEP Experiment Team (2010)
JPL Team Award for contribution to Herschel/SPIRE Test & Analysis (2009)
NASA Graduate Student Researchers Program Fellowship, 1995-1997
American Astronomical Society, 1996-present

OTHER INTERESTS

hiking
nature study, especially birds of southern California and of Hawai'i
gardening and native plants

ORNITHOLOGICAL AND CONSERVATION EXPERIENCE

regular contributor to eBird: 3275 checklists (2009 – present)
bird surveyor for Pasadena Audubon Society: Hahamongna Watershed Park (2009 – present)
bird surveyor for Breeding Bird Survey: Harbor Lake 2 CA route 14-345 (2014)
bird surveyor for Pacific Flyway Shorebird Survey: Los Angeles County/Ballona (2014)
bird surveyor for Christmas Bird Counts: Pasadena/San Gabriel Valley (2009 – 2014), Los Angeles (2014)
field trip leader, Pasadena Audubon Society (2012 – present): Hahamongna Watershed Park, spring migration in Antelope Valley, Legg Lake, Ken Malloy Harbor Park, Huntington Central Park
board member, Pasadena Audubon Society: vice president (2012 – 2013), program chair (2013 – present)
occasional volunteer for invasive plant species removal and trash pickup in Hawai'i and Pasadena area
member, The Nature Conservancy (2008 – present)
member, Conservation Council for Hawai'i (2008 – present)

SELECTED REFEREED PUBLICATIONS IN ASTROPHYSICS, COSMOLOGY, AND ASTRONOMICAL INSTRUMENTS

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D. Barkats, …, **C. D. Dowell**, et al., *Astrophysical Journal*, 783, 67 (2014) – "Degree-scale Cosmic Microwave Background Polarization Measurements from Three Years of BICEP1 Data"

C. D. Dowell, A. Conley, J. Glenn, et al., *Astrophysical Journal*, 780, 75 (2014) – "HerMES: Candidate High-redshift Galaxies Discovered with Herschel/SPIRE"

M. J. Griffin, C. E. North, B. Schulz, A. Amaral-Rogers, G. Bendo, J. Bock, L. Conversi, A. Conley, **C. D. Dowell**, M. Ferlet, J. Glenn, T. Lim, C. Pearson, M. Pohlen, B. Sibthorpe, L. Spencer, B. Swinyard, & I. Valtchanov, *Monthly Notices of the Royal Astronomical Society*, 434, 992 (2013) – "Flux calibration of broad-band far-infrared and submillimetre photometric instruments: theory and application to Herschel-SPIRE"

G. J. Bendo, M. J. Griffin, J. J. Bock, L. Conversi, **C. D. Dowell**, T. Lim, N. Lu, C. E. North, A. Papageorgiou, C. P. Pearson, M. Pohlen, E. T. Polehampton, B. Schulz, D. L. Shupe, B. Sibthorpe, L. D. Spencer, B. M. Swinyard, I. Valtchanov, & C. K. Xu, *Monthly Notices of the Royal Astronomical Society*, 433, 3062 (2013) – "Flux calibration of the Herschel-SPIRE photometer"

J. Bulger, T. Hufford, A. Schneider, J. Patience, I. Song, R. J. DeRosa, A. Rajan, **C. D. Dowell**, D. McCarthy, & C. Kulesa, *Astronomy & Astrophysics*, 556, 119 (2013) – "Submillimeter observations of IRAS and WISE debris disk candidates"

M. Zemcov, …, **C. D. Dowell**, et al., *Astrophysical Journal Letters*, 769, L31 – "HerMES: A Deficit in the Surface Brightness of the Cosmic Infrared Background due to Galaxy Cluster Gravitational Lensing"

D. A. Riechers, C. M. Bradford, D. L. Clements, **C. D. Dowell**, I. Pérez-Fournon, R. J. Ivison, C. Bridge, A. Conley, H. Fu, J. D. Vieira, J. Wardlow, J. Calanog, A. Cooray, P. Hurley, R. Neri, J. Kamenetzky, et al., *Nature*, 496, 329 (2013) – "A dust-obscured massive maximum-starburst galaxy at a redshift of 6.34"

E. M. Bierman, T. Matsumura, **C. D. Dowell**, B. G. Keating, et al., Astrophysical Journal, 741, 81 (2011) – "A Millimeter-wave Galactic Plane Survey with the BICEP Polarimeter"

S. Dehaes, E. Bauwens, L. Decin, K. Eriksson, G. Raskin, B. Butler, **C. D. Dowell**, B. Ali, & J. A. D. L. Blommaert, Astronomy & Astrophysics, 533, A107 (2011) – "Structure of the outer layers of cool standard stars"

J. Patience, J. Bulger, R. R. King, B. Ayliffe, M. R. Bate, I. Song, C. Pinte, J. Koda, **C. D. Dowell**, & A. Kovács, Astronomy & Astrophysics, 531, L17 – "Spatially resolved submillimeter imaging of the HR 8799 debris disk"

I. W. Stephens, L. W. Looney, **C. D. Dowell**, J. E. Vaillancourt, & K. Tassis, Astrophysical Journal, 728, 99 (2011) – "The Galactic Magnetic Field's Effect in Star-forming Regions"

…

A. Kovács, S. C. Chapman, **C. D. Dowell**, A. W. Blain, & T. G. Phillips, *Astrophysical Journal*, 650, 592 (2006) – "SHARC-2 350 Micron Observations of Distant Submillimeter Selected Galaxies"

K. A. Marsh, **C. D. Dowell**, T. Velusamy, K. Grogan, & C. A. Beichman, *Astrophysical Journal*, 646, L77 (2006) – "Images of Vega Dust Ring at 350 and 450 μm: New Clues to the Trapping of Multiple-Sized Dust Particles in Planetary Resonance"

F. Yusef-Zadeh, H. Bushouse, **C. D. Dowell**, M. Wardle, D. Roberts, C. Heinke, G. C. Bower, B. Vila Vilaro, S. Shapiro, A. Goldwurm, & G. Belanger, *Astrophysical Journal*, 644, 198 (2006) – "A Multi-Wavelength Study of Sgr A*: The Role of Near-IR Flares in the Production of X-ray, Soft Gamma-Ray and Submillimeter Emission"

A. Beelen, P. Cox, D. J. Benford, **C. D. Dowell**, A. Kovacs, F. Bertoldi, A. Omont, & C. L. Carilli, *Astrophysical Journal*, 642, 694 (2006) – "350 Micron Dust Emission from High Redshift Quasars"

C. Borys, **et al.**, *Astrophysical Journal*, 636, 134 (2006) – "MIPS J142824.0+352619: A Hyperluminous Starburst Galaxy at z = 1.325"

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L. Kirby, J. A. Davidson, J. L. Dotson, **C. D. Dowell**, & R. H. Hildebrand, *Publications of the Astronomical Society of the Pacific*, 117, 991 (2005) – "Improved Data Reduction for Far-Infrared/Submillimeter Polarimetry"

K. A. Marsh, T. Velusamy, **C. D. Dowell**, K. Grogan, & C. A. Beichman, *Astrophysical Journal*, 620, L47 (2005) – "Image of Fomalhaut Dust Ring at 350 Microns: The Relative Column Density Map Shows Pericenter-Apocenter Asymmetry"

M. Houde, **C. D. Dowell**, R. H. Hildebrand, J. L. Dotson, J. E. Vaillancourt, T. G. Phillips, R. Peng, & P. Bastien, *Astrophysical Journal*, 604, 717 (2004) – "Tracing the Magnetic Field in Orion A"

D. T. Chuss, J. A. Davidson, J. L. Dotson, **C. D. Dowell**, R. H. Hildebrand, G. Novak, & J. E. Vaillancourt, *Astrophysical Journal*, 599, 1116 (2003) – "Magnetic Fields in Cool Clouds within the Central 50 Parsecs of the Galaxy"

M. Jhabvala, S. Babu, C. Monroy, M. M. Freund, & **C. D. Dowell**, *Cryogenic*s, 42, 517 (2002) – "Development of low-noise high value chromium silicide resistors for cryogenic detector applications"

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J. L. Dotson, J. Davidson, **C. D. Dowell**, D. A. Schleuning, & R. H. Hildebrand, Astrophysical Journal Supplement Series, 128, 335 (2000) – "Far-Infrared Polarimetry of Galactic Clouds from the Kuiper Airborne Observatory"

G. Novak, J. L. Dotson, **C. D. Dowell**, R. H. Hildebrand, T. Renbarger, & D. A. Schleuning, *Astrophysical Journal*, 529, 241 (2000) – "Submillimeter Polarimetric Observations of the Galactic Center"

R. H. Hildebrand, J. L. Dotson, **C. D. Dowell**, D. A. Schleuning, & J. E. Vaillancourt, *Astrophysical Journal*, 516, 834 (1999) – "The Far-Infrared Polarization Spectrum: First Results and Analysis"

D. C. Lis, E. Serabyn, J. Keene, **C. D. Dowell**, D. J. Benford, T. G. Phillips, T. R. Hunter, & N. Wang, *Astrophysical Journal*, 509, 299 (1998) – "350 Micron Continuum Imaging of the Orion A Molecular Cloud with the Submillimeter High Angular Resolution Camera"

C. D. Dowell, R. H. Hildebrand, D. A. Schleuning, J. E. Vaillancourt, J. L. Dotson, G. Novak, T. Renbarger, & M. Houde, *Astrophysical Journal*, 504, 588 (1998) – "Submillimeter Array Polarimetry with Hertz"

G. Novak, J. L. Dotson, **C. D. Dowell**, P. F. Goldsmith, R. H. Hildebrand, S. R. Platt, & D. A. Schleuning, *Astrophysical Journal*, 487, 320 (1997) – "Polarized Far-Infrared Emission from the Core and Envelope of the Sagittarius B2 Molecular Cloud"

C. D. Dowell, *Astrophysical Journal*, 487, 237 (1997) – “Far-Infrared Polarization by Absorption in the Molecular Cloud Sagittarius B2”

D. A. Schleuning, **C. D. Dowell**, R. H. Hildebrand, S. R. Platt, & G. Novak, *Publications of the Astronomical Society of the Pacific*, 109, 307 (1997) – “Hertz, a Submillimeter Polarimeter”

J. A. Agostinelli, J. M. Chwalek, C. J. Baron, G. Lubberts, & **C. D. Dowell**, *Physica C*, 207, 203 (1993) – “YBCO-based ramp-edge Josephson junctions and DC SQUIDs with a cubic-YBCO barrier layer”

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E. C. Smith, …, **C. D. Dowell**, et al., in *Proc. SPIE*, 9147, 914706 (2014) – “SOFIA science instruments: commissioning, upgrades and future opportunities”

S. J. Benton, …, **C. D. Dowell**, et al., in *Proc. SPIE*, 9145, 91450V (2014) – “BLASTbus electronics: general-purpose readout and control for balloon-borne experiments”

M. W. Werner, **C. D. Dowell**, D. T. Chuss, M. R. Morris, G. Novak, & HAWC+ Team, in *Proc. IAU*, 303, 121 (2014) – “SOFIA/HAWC+: Mapping the Galactic center magnetic field”

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C. D. Dowell et al., Proc. SPIE, 7735, 213 (2010) – “HAWCPol: a first-generation far-infrared polarimeter for SOFIA”

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P. K. Day, H. G. LeDuc, R. A. M. Lee, **C. D. Dowell**, & J. Zmuidzinas, in *Proc. SPIE*, 6275, #57 (2006) – “Distributed antenna-coupled transition edge sensors”

K. W. Yoon, **et al.**, in *Proc. SPIE*, 6275, #51 (2006) – “The Robinson Gravitational Wave Background Telescope (BICEP): a bolometric large angular scale CMB polarimeter”

H. Li, M. Attard, C. D. Dowell, R. H. Hildebrand, M. Houde, L. Kirby, G. Novak, & J. E. Vaillancourt, in *Proc. SPIE*, 6275, #48 (2006) – “SHARP: the SHARC-II polarimeter for CSO”

G. J. Stacey, **et al.**, in *Proc. SPIE*, 6275, #47 (2006) – “Instrumentation for the CCAT Telescope”

C. D. Dowell, L. Kirby, G. Novak, & F. Yusef-Zadeh, *Bull. Amer. Astron. Soc.*, #32.05 (2005) – “Submillimeter Monitoring of Sgr A* with SHARC II/CSO” (abstract)

P. K. Day, H. LeDuc, A. Goldin, **C. D. Dowell**, & J. Zmuidzinas, in *Proc. SPIE*, 5498, 857 (2004) – “Far Infrared/Submillimeter Imager-Polarimeter Using Distributed Antenna-Coupled Transition Edge Sensors”

G. Novak, D. T. Chuss, J. A. Davidson, J. L. Dotson, **C. D. Dowell**, R. H. Hildebrand, M. Houde, L. Kirby, M. Krejny, A. Lazarian, H. Li, S. H. Moseley, J. E. Vaillancourt, & F. Yusef-Zadeh, in *Proc. SPIE*, 5498, 278 (2004) – “A Polarimetry Module for CSO/SHARC-II”

R. Shafer, **D. Dowell**, A. Kovacs, C. Borys, J. Bird, D. Lis, T. Phillips, R. Arendt, D. Benford, D. Chuss, S. Khan, H. Moseley, R. Silverberg, & J. Staguhn, in *Proc.*

SPIE (2004) – "Observing with the SHARC II Instrument: Performance, Analysis, and Optimization"
R. F. Silverberg, C. A. Allen, S. R. Babu, D. J. Benford, D. T. Chuss, J. L. Dotson, **C. D. Dowell**, M. Jhabvala, D. A. Harper, R. F. Loewenstein, S. H. Moseley, J. G. Staguhn, G. Voellmer, & E. J. Wollack, in *Proc. SPIE*, 5498, 187 (2004) – "Two Bolometer Arrays for Far-Infrared and Submillimeter Astronomy"
G. M. Voellmer, C. A. Allen, S. R. Babu, A. E. Bartels, **C. D. Dowell**, J. Dotson, D. A. Harper, S. H. Moseley, T. Rennick, P. Shirron, W. W. Smith, & E. J. Wollack, in *Proc. SPIE*, 5498, 428 (2004) – "A Two-Dimensional, Semiconducting Bolometer Array for HAWC"
C. D. Dowell, C. A. Allen, S. Babu, M. M. Freund, M. B. Gardner, J. Groseth, M. Jhabvala, A. Kovacs, D. C. Lis, S. H. Moseley, T. G. Phillips, R. Silverberg, G. Voellmer, & H. Yoshida, in "Millimeter and Submillimeter Detectors for Astronomy", ed. T. G. Phillips & J. Zmuidzinas, *Proc. SPIE*, 4855, 73 (2003) – "SHARC II: a Caltech Submillimeter Observatory facility camera with 384 pixels"
C. D. Dowell, J. A. Davidson, J. L. Dotson, R. H. Hildebrand, G. Novak, T. S. Rennick, & J. E. Vaillancourt, in "Polarimetry in Astronomy", ed. S. Fineschi, *Proc. SPIE*, 4843, 250 (2003) – "Hale, a multi-wavelength, far-infrared polarimeter for SOFIA"
C. D. Dowell, S. H. Moseley, Jr., & T. G. Phillips, in "Imaging at Radio Through Submillimeter Wavelengths", ed. J. Mangum & S. Radford*, ASP Conference Series*, 217 (2000) – "Plans for a Second Generation 350 Micron Camera for the Caltech Submillimeter Observatory"
S. H. Moseley, Jr., **C. D. Dowell**, C. Allen, & T. G. Phillips, in "Imaging at Radio Through Submillimeter Wavelengths", ed. J. Mangum & S. Radford*, ASP Conference Series*, 217 (2000) – "Semiconducting Pop-Up Bolometers for Far-Infrared and Submillimeter Astronomy"
D. C. Lis, Y. Li, **C. D. Dowell**, & K. M. Menten, in "The Universe as Seen by ISO", ed. P. Cox & M. F. Kessler, *ESA-SP*, 427, 627 (1999) – "Cold GMC Cores in the Galactic Centre"
C. D. Dowell, D. C. Lis, E. Serabyn, M. Gardner, A. Kovacs, & S. Yamashita, in "The Central Parsecs of the Galaxy", ed. H. Falcke, A. Cotera, W. J. Duschl, F. Melia, & M. J. Rieke, *ASP Conference Series*, 186 (1998) – "SHARC 350 Micron Mapping of the Galactic Center from the Caltech Submillimeter Observatory"
R. H. Hildebrand, J. L. Dotson, **C. D. Dowell**, G. Novak, D. A. Schleuning, & J. Vaillancourt, *Proc. SPIE*, 3357, 289 (1998) – "Hertz: an imaging polarimeter"
D. A. Schleuning, **C. D. Dowell**, & S. R. Platt, in "Polarimetry of the Interstellar Medium", ed. W. G. Roberge & D. C. B. Whittet, *ASP Conference Series*, 97, 285 (1996) – "Array Polarimetry of the Orion Nebula from the Caltech Submillimeter Observatory"
R. H. Hildebrand, J. L. Dotson, **C. D. Dowell**, S. R. Platt, D. Schleuning, J. A. Davidson, & G. Novak, in "Airborne Astronomy Symposium on the Galactic Ecosystem: From Gas to Stars to Dust", ed. M. R. Haas, J. A. Davidson, & E. F. Erickson, *ASP Conference Series*, 73, 97 – "Far-Infrared Polarimetry"
J. A. Davidson, D. Schleuning, J. L. Dotson, **C. D. Dowell**, & R. H. Hildebrand in "Airborne Astronomy Symposium on the Galactic Ecosystem: From Gas to Stars to Dust", ed. M. R. Haas, J. A. Davidson, & E. F. Erickson, *ASP Conference*

Series, 73, 225 – "The Magnetic Field Structure in High-Mass Star Formation Regions"

D. A. Harper, D. M. Cole, **C. D. Dowell**, J. F. Lees, & R. F. Loewenstein in "Airborne Astronomy Symposium on the Galactic Ecosystem: From Gas to Stars to Dust", ed. M. R. Haas, J. A. Davidson, & E. F. Erickson, *ASP Conference Series*, 73, 257 – "New Far Infrared Images of Bright, Nearby, Star-Forming Regions" (abstract)

S. R. Platt, J. L. Dotson, **C. D. Dowell**, R. H. Hildebrand, D. Schleuning, & G. Novak, in "Airborne Astronomy Symposium on the Galactic Ecosystem: From Gas to Stars to Dust", ed. M. R. Haas, J. A. Davidson, & E. F. Erickson, *ASP Conference Series*, 73, 543 – "Stokes, the Chicago Far-Infrared Polarimeter"

<u>EXHIBIT H</u>

LANCE A. M. BENNER
CURRICULUM VITAE

Last update: 2015 April 14

Relevant Experience
Over 19 years of experience with Goldstone and Arecibo radar imaging of near-Earth and main-belt asteroids, comets, data reduction, analysis, and 3D shape modeling. Author on more than 60 peer-reviewed papers. Contributor of hundreds of radar astrometry measurements to improve asteroid and comet orbits.

Personal Information

Date of birth:	October 23, 1964
Place of birth:	Cleveland, OH
Citizenship:	United States

Education

August, 1994	Ph. D. in Earth and Planetary Sciences, Washington University in St. Louis Thesis title: Satellite Capture in the Outer Solar System: Application to Triton and P/Shoemaker-Levy 9 Thesis advisor: Dr. William B. McKinnon
May, 1987	A. B. in Physics, Cornell University

Positions Held

2003-present	Research Scientist, NASA-Jet Propulsion Laboratory
1998-2003	Scientist, NASA-Jet Propulsion Laboratory
1995-1998	National Research Council Fellow, NASA-Jet Propulsion Laboratory Advisor: Dr. Steven J. Ostro
1994-1995	Postdoctoral Research Associate in Earth and Planetary Sciences, Washington University in St. Louis
1993-1994	Graduate Research Assistant
1990-1993	NASA Graduate Student Researchers Fellow
1987-1990	Graduate Teaching Assistant

ORNITHOLOGY

Contributor to the eBird online database of worldwide bird observations: more than 4500 checklists entered (from 12 countries) since 2003 including over 3400 checklists from Los Angeles County. http://ebird.org/content/ebird/

Contributor to the Xeno-Canto online database of worldwide bird vocalizations:
More than 400 recordings entered since 2012. http://www.xeno-canto.org

Benner contributions: http://www.xeno-canto.org/contributor/MDZVOPUOXU

USGS Breeding Bird Survey: 2012-present. Route #14111 in the San Gabriel Mountains. An annual survey consisting of 50 point counts at 0.5 mile intervals between Table Mountain Campground and Cloud Burst Summit. https://www.pwrc.usgs.gov/bbs/

Nightjar Survey (three routes): 2008, 2009, 2010 http://www.nightjars.org

Imperial Valley Mountain Plover and Long-Billed Curlew Surveys: 2007-2011
Survey Leaders: Kathy Molina and Kimball Garrett

Los Angeles County Cactus Wren Survey: 2009
Survey Leaders: Daniel Cooper and Robert Hamilton

Millard Canyon Survey: 2012 Survey Leader: Michael Long

Hahamongna Watershed Park Survey: 2006, 2007 Survey leader: Jon Feenstra

Kern River Valley Preserve Survey: 2001, 2002 Survey leader: Bob Barnes

Los Angeles County Breeding Bird Survey: 2000 (owls and nightjars)

Christmas Bird Counts

Pasadena, CA		
	Hahamongna	2004-2013
	Mt. Wilson	2014-present
	Owls	2004-present
Malibu, CA		2003-present
Waterville, ME		2013
Blythe, CA		2003
Lancaster, CA		1999

Original Ornithology Research (undertaken on my own):

1. Owl Monitoring Program: San Gabriel Mountains, 2000-present. Surveys for owls and nightjars to investigate status and distribution.

2. Flight call types of red crossbills and evening grosbeaks in southern California: Surveys consisting of recording vocalizations and analysis of audio spectrograms: 2011-present. This work provided the first identifications of flight call types for these species in southern California. The red crossbill results were reported in a peer-reviewed publication:
Szeliga, W., L. Benner, J. Garrett, and K. Ellsworth (2014). Call types of the red crossbill in the San Gabriel, San Bernardino, and San Jacinto Mountains, Southern California. *Western Birds* 45, 213-223.

Pasadena Audubon Society Service:

Field trip leader:	2005-present	See below for a list of trips
Board of Directors:	2008-present	Member at large, grants committee

Columnist for the *Wrentit* newsletter: bi-monthly articles on individual species
Speaker at monthly programs (five times; see below)
Trips led for the Pasadena Audubon Society:

- Owls in the San Gabriel Mountains
- Throop Peak, San Gabriel Mountains
- Early spring, San Gabriel Mountains
- Hahamongna Watershed Park
- Big Santa Anita Canyon, San Gabriel Mountains
- Eaton Canyon
- Encanto Park/San Gabriel River Nighthawks
- Pelagic Birding from King Harbor (Redondo Beach) and Long Beach Harbor
- West Fork, San Gabriel River, San Gabriel Mountains
- Big Morongo Canyon Preserve (San Bernardino County)
- Mojave National Preserve (San Bernardino County)
- San Jacinto Wildlife Area (Riverside County)

Trip leader for bird festivals: Pasadena Bird Festival, Kern River Valley Nature Festival

Ornithology Presentations: 2004-present
Programs at monthly Audubon Society chapter meetings and for other organizations:
Pomona Valley Audubon, Pasadena Audubon, Whittier Audubon, El Dorado Audubon (Long Beach), Santa Monica Bay Audubon, San Bernardino Audubon, Sea and Sage Audubon (Irvine), San Fernando Valley Audubon, San Diego Field Ornithologists, Arecibo Observatory (Puerto Rico), JPL Hiking Club, Angeles National Forest-Chilao Visitors Center, Pasadena Bird Festival.
Topics: Owls of Los Angeles County
Owls of Southern California
Birds of Puerto Rico
Birds of Guatemala
Red Crossbills
Birds of Tanzania (in collaboration with Mark Scheel and Susan Gilliland)

Compiler for "America's Birdiest County" in Los Angeles: 2007, 2008, 2010-present.
An annual event to find as many birds in one weekend in Los Angeles County as possible. Originally a national event, but now restricted to a few counties in southern California. Los Angeles was national champion for six years before the nationwide competition ended in 2012. Typical participation is 70-100 people.

Memberships:
Cornell Laboratory of Ornithology
Point Reyes Bird Observatory
Western Field Ornithologists: Contributor of bird photos and one peer-reviewed paper.
Pasadena Audubon Society

Los Angeles Audubon Society
Maine Audubon Society
Owl Research Institute
Small Bird Club: A semi-scholarly group of prominent Los Angeles County birders who meet monthly, discuss recent ornithology research, and give presentations. Named in honor of Arnold Small, the founder of the group and a distinguished California ornithologist.

Ornithology-related equipment:
Swarovski EL 8x32 binoculars
Swarovski SLC 7x42 binoculars

Nikon ED50 spotting scope and Gitzo traveler series tripod
Kowa TSN-821 spotting scope and Bogen tripod

Canon 70D digital SLR camera
Canon 400 mm f/5.6 telephoto lens
Canon 300 mm f/4 telephoto lens

Marantz PMD-670 digital sound recorder
Olympus LS-10 and LS-10S digital sound recorders
Telinga 22 inch paraboloid dish equipped with a Sennheiser ME62 omni-directional microphone
Sennheiser ME-67 shotgun microphone
Sennheiser MKE-400 short shotgun microphone

Sound processing software: “Raven Lite” and “Audacity”

PLANETARY SCIENCE

Fellowships and Honors

2012	NASA Group Achievement Award: 2005 YU55 observation team
2011	NASA Group Achievement Award: Near-Earth Objects Surveys
2001	Asteroid 9012 Benner named in recognition of contributions to asteroid science
1999, 2006	JPL Outstanding Accomplishment Awards
1999	NASA group achievement award: SOHO recovery team
1995-1998	National Research Council Associateship

Previously Funded Research

PI: "Radar reconnaissance of near-Earth asteroids." NASA Solar System Observations Program (2014)

PI: "4-Meter-Resolution Goldstone Radar Imaging of Near-Earth Objects." NASA Advanced Exploration Systems Program (2011). Program Manager.

PI: "Radar reconnaissance of Near-Earth asteroids." NASA Near-Earth Objects Observations program (2011).

PI: "Radar investigation of Main-Belt Asteroids." NASA Near-Earth Objects Observations Program (2011).

PI: "Asteroid Lightcurve Inversion" NASA Planetary Geology and Geophysics Program (2009)

Co-I: "Estimating tidal dissipation in Jupiter from Goldstone and Arecibo ranging data" JPL Research and Technology Development Fund (2015). PI: Dr. Marina Brozovic.

Co-I: *Near-Earth Asteroid Scout* mission team. PI: Dr. Julie Castillo-Rogez. NASA Advanced Exploration Systems Program. (2014-present)

Co-I: "Radar Investigation of Main-Belt Asteroids." NASA Planetary Astronomy Program (2007). PI: Dr. Steven J. Ostro

Co-I: "Radar Reconnaissance of Near-Earth Asteroids." NASA Near-Earth Objects Observations (2004). PI: Dr. Steven J. Ostro

Co-I: "Radar Investigation of Asteroids and Planetary Satellites." NASA Planetary Astronomy Program (2004). PI: Dr. Steven J. Ostro

Co-I: "Asteroid Lightcurve Inversion." NASA Planetary Geology and Geophysics Program (2003). PI: Dr. Steven J. Ostro.

Co-I: "Radar Investigation of Asteroids and Planetary Satellites." NASA Planetary Astronomy Program (2001). PI: Dr. Steven J. Ostro

Professional Societies

American Association for the Advancement of Science
American Astronomical Society, Division for Planetary Sciences
American Geophysical Union
International Meteor Organization
International Occultation and Timing Association
Meteoritical Society
Planetary Society

Invited Conference Talks
2009 Planetary Defense Conference, Granada, Spain
2009 Ostro Symposium, JPL
2009 Division for Planetary Sciences meeting, Ostro Memorial Session, San Juan, PR
2010 Lunar and Planetary Science Conference, Houston, TX
2010 Glofest (in honor of Eleanor Helin), Caltech
2011 Planetary Defense Conference, Bucharest, Romania
2011 Target NEO Workshop, Washington, DC
2011 International Primitive Body Exploration Working Group workshop, Caltech
2012 Asteroids, Comets, and Meteors meeting, Niigata, Japan
2013 American Astronomical Society meeting, Long Beach, CA
2013 Planetary Defense Conference, Flagstaff, AZ
2013 International Primitive Body Exploration Working Group workshop, Nice, France
2013 8th Catastrophic Disruption in the Solar System Workshop, Kona, HI
2013 Target NEO II Workshop, Washington, DC
2013 Arecibo Observatory 50th Anniversary Symposium, Arecibo, PR
2014 International Asteroid Warning Network Steering Committee Meeting, Boston, MA
2014 NASA Exploration Science Forum, NASA-Ames Research Center, Mountain View, CA

Plus numerous invited talks at the annual pro-am Society for Astronomical Sciences Symposium in Big Bear Lake, CA since 2003.

Other Service
National Research Council Committee to Review Near-Earth Object Surveys and Hazard Mitigation Strategies (2009-2010). Co-author of the NRC report.
DPS Meeting Scientific Organizing Committee (2010)
DPS Meeting Local Organizing Committee (2006, 2010)
NASA Planetary Geology and Geophysics Program Review Panels
NASA Planetary Astronomy Program Review Panels
NASA Near-Earth Objects Observations Program Review Panels
External reviewer for NASA's Planetary Geology and Geophysics, Near-Earth Objects Observations, Outer Planets Research, Planetary Astronomy, and Space Technology Research Opportunities-Early Stage Innovations Programs.
Canadian Natural Sciences and Engineering Research Council (NSERC) reviewer
U. S. Civilian Research and Development Foundation reviewer
Reviewer for the journals *Icarus*, *Meteoritics and Planetary Science*, *Nature*, *Science,* and *Eos.*

LANCE A. M. BENNER
PEER-REVIEWED PLANETARY SCIENCE PUBLICATIONS

Benner, L. A. M., M. C. Nolan, M. W. Busch, J. D. Giorgini, P. A. Taylor, and J. L. Margot. Radar observations of near-Earth and main-belt asteroids. In *Asteroids IV* (P. Michel, and F. De Meo, Eds.), Univ. of Arizona Press, Tucson, in press (2015).

Lawrence, K. J., **L. A. M. Benner**, M. Brozovic, S. J. Ostro, J. S. Jao, J. D. Giorgini, M. A. Slade, and R. F. Jurgens. Goldstone radar imaging of near-Earth asteroid 2003 MS2. Submitted to *Icarus* (2015).

Naidu, S. P., J. L. Margot, P. A. Taylor, M. C. Nolan, M. W. Busch, **L. A. M. Benner**, M. Brozovic, J. D. Giorgini, J. S. Jao, and C. Magri. Radar imaging and characterization of binary near-Earth asteroid (185851) 2000 DP107. Submitted to the *Astronomical Journal*, (2015).

Brozovic, M., **L. A. M. Benner**, C. Magri, D. J. Scheeres, M. W. Busch, J. D. Giorgini, V. Reddy, L. Le Corre, M. D. Hicks, J. S. Jao, C. G. Lee, L. G. Snedeker, M. A. Silva, M. A. Slade, and K. J. Lawrence. Goldstone radar evidence for short-axis mode non-principal axis rotation of near-Earth asteroid (214869) 2007 PA8. *Icarus*, in preparation.

Shepard, M. K., P. A. Taylor, M. C. Nolan, E. S. Howell, A. Springmann, J. D. Giorgini, B. D. Warner, A. W. Harris, R. Stephens, W. J. Merline, A. Rivkin, **L. A. M. Benner**, D. Coley, B. E. Clark, M. Ockert-Bell, and C. Magri. A radar survey of M- and X-class asteroids. III. Insights into their compositions, hydration state, and structure. Radar observations of asteroids 64 Angelina and 69 Hesperia. *Icarus* **245**, 38-55 (2015).

Chesley, S. R., D. Farnocchia, M. C. Nolan, D. Vokrouhlicky, P. W. Chodas, A. Milani, F. Spoto, B. Rozitis, **L. A. M. Benner**, W. F. Bottke, M. W. Busch, J. P. Emery, E. S. Howell, D. S. Lauretta, J. L. Margot, and P. A. Taylor (2014). Orbit and bulk density of the OSIRIS-REx target Asteroid (101955) Bennu. *Icarus* **235**, 5-22 (2014).

Nolan, M. C., C. Magri, E. S. Howell, **L. A. M. Benner**, J. D. Giorgini, C. W. Hergenrother, R. S. Hudson, D. S. Lauretta, J. L. Margot, S. J. Ostro, and D. J. Scheeres. Shape model and surface properties of the OSIRIS-REx target asteroid (101955) 1999 RQ36 from radar and lightcurve observations. *Icarus* **226**, 629-640 (2013).

Naidu, S. P., J. L. Margot, M. W. Busch, P. A. Taylor, M. C. Nolan, E. S. Howell, M. Brozovic, **L. A. M. Benner**, J. D. Giorgini, and C. Magri. Radar imaging and physical characterization of near-Earth asteroid (162421) 2000 ET70. *Icarus* **226**, 323-335 (2013).

Busch, M. W., W. F. Brisken, **L. A. M. Benner**, M. Brozovic, J. D. Giorgini, J. L. Margot, M. C. Nolan, P. A. Taylor, E. S. Howell, and C. Magri. Arecibo/VLBA radar observations of contact binary near-Earth asteroid 2003 UV11. *Icarus*, submitted.

Brozovic, M., **L. A. M. Benner**, M. C. Nolan, E. S. Howell, P. A. Taylor, C. Magri,, D. J. Scheeres, J. D. Giorgini, J. T. Pollock, P. Pravec, A. Galad, M. W. Busch, J. L. Margot, M. K.

Shepard, D. E. Reichart, K. M. Ivarsen, J. B. Haislip, A. P. LaCluyze, J. Jao, M. A. Slade, K. J. Lawrence, and M. D. Hicks. Radar observations and physical modeling of triple near-Earth asteroid (136617) 1994 CC. *Icarus* **216**, 241-256 (2011).

Magri, C., E. S. Howell, M. C. Nolan, P. A. Taylor, Y. R. Fernandez, M. Mueller, R. J. Vervack, **L. A. M . Benner**, and 18 colleagues. Radar and photometric observations and shape modeling of contact binary near-Earth asteroid (8567) 1996 HW1. *Icarus* **214,** 210-227 (2011).

Shepard, M. K., A. W. Harris, P. A. Taylor, B. E. Clark, M. Ockert-Bell, M. C. Nolan, E. S. Howell, C. Magri, J. D. Giorgini, and **L. A. M. Benner**. Radar observations of asteroids 64 Angelina and 69 Hesperia. *Icarus* **215**, 547-551 (2011).

Busch, M. W., S. J. Ostro, **L. A. M. Benner**, M. Brozovic, J. D. Giorgini, J. S. Jao, D. J. Scheeres, C. Magri, M. C. Nolan, E. S. Howell, P. A. Taylor, J. L. Margot, and W. Brisken. Radar observations and the shape of near-Earth asteroid 2008 EV5. *Icarus* **212**, 649-660 (2011).

Fang, J., J. L. Margot, M. Brozovic, M. C. Nolan, **L. A. M. Benner**, and P. A. Taylor. Orbits of near-Earth asteroid triples 2001 SN263 and 1994 CC: Properties, origin, and evolution. *Astronomical Journal* **141**, 154 (2011).

Slade, M. A., **L. A. M. Benner**, and A. Silva. Goldstone Solar System Radar Observatory: Earth-based planetary mission support and unique science results. *Proceedings IEEE* **99**, 757-769 (2011).

Behrend, R., F. Manzini, A. Klotz, F. Colas, Y. Damerdji, S. J. Ostro, P. Antonini, E. Barbotin, **L. A. M. Benner**, L. Bernasconi, C. Cavadore, S. Charbonnel, J. Coloma, R. Crippa, G. Farroni, R. Koff, F. Kugel, J. D. Giorgini, A. A. Hine, A. Leroy, J. M. Llapasset, C. Magri, J. L. Margot, M. C. Nolan, A. Oksanen, P. Paakkonen, R. Poncy, R. Roy, D. Starkey, H. Correia, and D. Paletti. Discovery of the binary nature of the Mars-crosser 1139 Atami. *Astronomy and Astrophysics*, in press.

Committee to Review Near-Earth Object Surveys and Hazard Mitigation Strategies (including **L. A. M. Benner**). *Defending Planet Earth: Near-Earth Object Surveys and Hazard Mitigation Strategies.* National Research Council of the National Academies. National Academies Press, Washington, DC (2010).

Busch, M. W., S. R. Kulkarni, W. Brisken, S. J. Ostro, **L. A. M. Benner**, J. D. Giorgini, and M. C. Nolan. Determining asteroid spin states using radar speckles. *Icarus* **209**, 535-541 (2010).

Shepard, M. K., B. E. Clark, M. Ockert-Bell, M. C. Nolan, E. S. Howell, C. Magri, J. D. Giorgini, **L. A. M. Benner**, S. J. Ostro, A. W. Harris, B. D. Warner, R. D. Stephens, and M. Mueller. A radar survey of M- and X-class asteroids. II. Summary and synthesis. *Icarus* **208**, 221-237 (2010).

Brozovic, M., **L. A. M. Benner**, C. Magri, S. J. Ostro, D. J. Scheeres, J. D. Giorgini, M. C. Nolan, J. L. Margot, R. F. Jurgens, and R. Rose. Radar observations and a physical model of contact binary asteroid 4486 Mithra. *Icarus* **208**, 207-220 (2010).

Ostro, S. J., C. Magri, **L. A. M. Benner**, J. D. Giorgini, M. C. Nolan, A. A. Hine, M. W. Busch, and J. L. Margot. Radar imaging of asteroid 7 Iris. *Icarus* **207**, 285-294 (2010).

Brozovic, M., S. J. Ostro, **L. A. M. Benner**, J. D.Giorgini, R. F. Jurgens, R. Rose, M. C. Nolan, A. A. Hine, C. Magri, D. J. Scheeres, and J. L. Margot. Radar observations and a physical model of asteroid 4660 Nereus, a prime space mission target. *Icarus* **201**, 153-166 (2009).

Benner, L. A. M., S. J. Ostro, C. Magri, M. C. Nolan, E. S. Howell, J. D. Giorgini, J. L. Margot, M. W. Busch, M. K. Shepard, P. A. Taylor, and R. F. Jurgens. Near-Earth asteroid surface roughness depends on compositional class. *Icarus* **198**, 294-304 (2008).

Busch, M. W., **L. A. M. Benner**, S. J. Ostro, J. D. Giorgini, R. F. Jurgens, R. Rose, D. J. Scheeres, C. Magri, M. C. Nolan, and A. A. Hine. Physical properties of near-Earth asteroid (33342) 1998 WT24. *Icarus* **195**, 614-621 (2008).

Shepard, M. K., K. M. Kressler, B. Ellen Clark, M. E. Ockert-Bell, M. C. Nolan, E. S. Howell, C. Magri, J. D. Giorgini, **L. A.M. Benner**, S. J. Ostro. Radar observations E-class asteroids 44 Nysa and 434 Hungaria. *Icarus* **195**, 220-225 (2008).

Shepard, M. K., B. E. Clark, M. C. Nolan, E. Howell, C. Magri, J. D. Giorgini, **L. A. M. Benner**, S. J. Ostro, A. W. Harris, B. Warner, P. Pravec, M. Fauerbach, T. Bennett, A. Klotz, R. Behrend, H. Correia, J. Coloma, S. Casulli, and A. Rivkin. A radar survey of X- and M-class asteroids. *Icarus* **195**, 184-205 (2008).

Shepard, M. K., B. E. Clark, M. C. Nolan, **L. A. M. Benner**, S. J. Ostro, J. D. Giorgini, F. Vilas, K. Jarvis, S. Lederer, L. Lim, T. McConnochie, J. F. Bell, J. L. Margot, A. S. Rivkin, and P. Pravec. Multi-wavelength observations of asteroid 2100 Ra-Shalom. *Icarus* **193**, 20-38 (2008).

Giorgini, J. D., **L. A. M. Benner**, S. J. Ostro, M. C. Nolan, and M. W. Busch. Predicting the Earth encounters of (99942) Apophis. *Icarus* **193**, 1-19 (2008).

Ostro, S. J., J. D. Giorgini, and **L. A. M. Benner**. Radar reconnaissance of near-Earth asteroids. In *Near-Earth Objects, Our Celestial Neighbors: Opportunity and Risk*, pp. 143-150. A. Milani, G. B. Valsecchi, and D. Vokrouhlicky, Eds. Cambridge, UK: Cambridge University Press (2007).

Busch, M. W., J. D. Giorgini, S. J. Ostro, **L. A. M. Benner**, R. F. Jurgens, R. Rose, M. D. Hicks, P. Pravec, P. Kusnirak, M. J. Ireland, D. J. Scheeres, S. B. Broschart, C. Magri, M. C. Nolan, and A. A. Hine. Physical modeling of near-Earth asteroid (29075) 1950 DA. *Icarus* **190**, 608-621 (2007).

Taylor, P. A., J. L. Margot, D. Vokrouhlicky, D. J. Scheeres, P. Pravec, S. C. Lowry, A.

Fitzsimmons, M. C. Nolan, S. J. Ostro, **L. A. M. Benner**, J. D. Giorgini, and C. Magri. Increasing spin rate of asteroid 54509 (2000 PH5): A result of the YORP effect. *Science* **316**, 274-277 (2007).

Busch, M. W., S. J. Ostro, **L. A. M. Benner**, J. D. Giorgini, C. Magri, E. S. Howell, M. C. Nolan, A. A. Hine, D. B. Campbell, I. I. Shapiro, and J. F. Chandler. Arecibo radar observations of Phobos and Deimos. *Icarus* **186**, 581-584 (2007).

Magri, C., S. J. Ostro, D. J. Scheeres, M. C. Nolan, J. D. Giorgini, **L. A. M. Benner**, and J. L. Margot. Radar observations and a physical model of asteroid 1580 Betulia. *Icarus* **186**, 152-177 (2007).

Scheeres, D. J., E. G. Fahnestock, S. J. Ostro, J. L. Margot, **L. A. M. Benner**, S. B. Broschart, J. Bellerose, J. D. Giorgini, M. C. Nolan, C. Magri, P. Pravec, P. Scheirich, R. Rose, R. F. Jurgens, E. M. De Jong, and S. Suzuki. Dynamical configuration of binary near-Earth asteroid (66391) 1999 KW4. *Science* **314**, 1280-1283 (2006).

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M. A. Slade, M. L. Thomas, R. Winkler, and D. K. Yeomans. Radar observations of asteroid 7822 (1991 CS). *Icarus* **137**, 247-259 (1999).

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EXHIBIT I

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RESUME
of
MICHAEL C. LONG

EXPERIENCE:

1971 to 2010 LOS ANGELES COUNTY NATURAL AREAS AND NATURE CENTERS
DEPARTMENT OF PARKS AND RECREATION
Eaton Canyon Natural Area Park
Pasadena, California

REGIONAL PARK SUPERINTENDENT III (NATURAL AREAS ADMINISTRATOR - RETIRED)

From 1971-2010, experience as a County Naturalist, Biologist and Superintendent in environmental education and interpretation, wildlife management, floral and faunal surveys. Natural Areas Division operates and maintains the nineteen wildlife sanctuaries and nature centers throughout Los Angeles County for the Department of Parks and Recreation. Responsibilities involved supervision and operation of all nineteen Natural Area Parks, Nature Centers and Wildlife Sanctuaries (total over 6000 acres) with staff of 30 full-time, 28 part-time employees and over 200 active volunteers.

Responsible for:

supervising personnel and operation of all County natural area parks. Monitoring and managing resources, wildlife, and plants on County wildlife sanctuaries and natural areas; enforcing County and State wildlife regulations as authorized County Fish and Game Warden.

preparing budgets, tracking expenditures and staff schedules and part-time hours use.

providing environmental interpretation for the general public, school groups, other organized groups including conducting interpretive lectures, walks, writing brochures and developing natural history displays. Training of volunteer naturalists to conduct programs.

advising in land-use planning for Department of Parks and Recreation and development of new nature centers, including architecture, interpretive display design and programming.

performing field work, assessing biological impact, writing, and reviewing floral and faunal surveys for Environmental Impact Reports throughout Los Angeles County for county departments, state and federal agencies.

Accomplishments:

conducted, participated in over 70 floral and faunal surveys for E.I.R.'s. Included field survey, lab work, writing and typing of final reports. Surveys ranged from one-day to six months duration. Work substantially increased accuracy and credibility of County E.I.R.'s.

directly participated in negotiations, planning, implementation and management phases of the creation of 150 acres of riparian wildlife habitat with lakes; result of out-of-court settlement of lawsuit against County; involved negotiations with environmental groups, Army Corps of Engineers, County planners and led to Outstanding Achievement Award for nature center.

brought to Natural Areas and refined comprehensive knowledge of biological sciences and acted as principal botanist, herpetologist and ornithologist for the Nature Centers. Promoted from Recreation Specialist Aid to full-time Natural Areas Supervisor, and Natural Areas Administrator.

conducted many thousands of elementary through college level students on environmental education program, instilling knowledge and understanding of ecological and biological principles.

recruited and trained hundreds of volunteer naturalists at all County Nature Centers from 1975 to present. Continue as a volunteer trainer.

Federal and State licensed bird bander, conducting marking and recapture studies, and educational programs on birds at all County Natural Areas and other sites 1985-1995.

coordinated and compiled the annual Audubon Christmas Bird Count, Pasadena-San Gabriel Valley, 1985-1991. Currently participating annually.

attached eight months to U. S. Forest Service, Supervisor's Office, Angeles National Forest to develop plan for first Information/Visitor Center for forest and to evaluate forest interpretive plan. Coordinated with forest engineers, field personnel, landscape architect, outside agencies and resulted in construction, operation of first forest Information/Visitor Center.

taught classes in bird identification and biology, including 6-week and 8-week sessions, 1980 to present.

received the County Department of Parks and Recreation Use of Volunteers Award, 1990, the Valor Award, 1993, the Director's Award, 1995 and Volunteer Involvment Award, 1998. Received Whittier Audubon Society Conservation Award 1997. Received the Angeles Chapter Sierra Club Elna Bakker Nature Interpretation Award 2010.

Since an October 1993 fire destroyed the Eaton Canyon Nature Center, coordinated the public awareness, fund-raising campaign and design and build project for the new 7600 sq. ft. Center, completed and opened in November 1998.

CONSULTING AND CONTRACT WORK

- Numerous Biological Assessments, Biota Reports for Significant Ecological Areas, Wetlands Delineations, Projects involving Fish and Game Section 1601-1603 and Army Corps 404 Permits, as subcontractor to FHA (Frank Hovore and Associates, Environmental Consulting) and other Consultants.

Least Bell's Vireo and Southwestern Willow Flycatcher

- Least Bell's Vireo Surveys for lower Arroyo Seco, for City of Pasadena, Gavilan Rd/Harford Spgs. Park, Riverside Co. Public Works.
- Sensitive bird survey (Least Bell's Vireo, Southwestern Willow Flycatcher, Yellow Warbler, Yellow-breasted Chat) Hidden Valley Wildlife Area, City of Riverside.
- Least Bell's Vireo and Southwestern Willow Flycatcher survey and monitoring, Prado Basin, City of Corona.
- Las Virgenes Creek sensitive bird survey (esp. Least Bell's Vireo, Southwestern Willow Flycatcher, Yellow Warbler) for Topanga-Las Virgenes Resource Cons. Dist.
- Habitat Survey for Least Bell's Vireo, Tributary Santa Clara River, City of Santa Clarita
- Wildlife Report, Vegetation and Sensitive Species Reports for U.S. Forest Service, Tujunga Canyon for EA Engineering, Science and Technology.
- Observations on Least Bell's Vireo breeding pair, Whittier Narrows Wildlife Area, So. El Monte (summarized in "Birds of Whittier Narrows" and "Supplement")

California Gnatcatcher

- Federal (U.S. Fish and Wildlife) Permit for California Gnatcatcher protocol surveys.
- California Gnatcatcher surveys and monitoring, City of Moorpark, Bonelli Park, Chevron, and Forest Lawn properties.
- Implementing habitat restoration for California Gnatcatcher with Sapphos Environmental, County of Los Angeles, U.S. Fish and Wildlife biologists.
- Conducted California Gnatcatcher biology and habitat sensitivity workshop for Bonelli Regional Park staff, County of Los Angeles.
- Field Studies and rediscovery of California Gnatcatchers at historic locality, Tujunga Wash, Sunland. Field Report form and field observations to CNDDB and Dr. Jon Atwood, Kimball Garrett.

Amphibians

- Red-legged Frog population studies, Santa Rosa Plateau, Riverside Co. with Drs. Mark Jennings and Marc Hayes.
- Arroyo Toad Surveying and Monitoring, Castaic Creek, Los Angeles Dept. of Water and Power.
- Researched and prepared petition for listing Mountain Yellow-legged Frog submitted to U.S. Fish and Wildlife Service.
- Ongoing studies of declining amphibians with emphasis on salamanders *(Ensatina, Aneides, Batrachoseps, Taricha*).

Additional Work

- Presenter: "Reinvisioning the San Gabriel River Conference", Baldwin Park, CA Dec. 1999
- Presenter: "Biota of the San Gabriel River Watershed" symposium May 2012.
- Rare Plant Survey and Sensitive Species Report for Sawpit Canyon Trail development, for City of Monrovia.
- Plant Community survey and mapping, San Gabriel Canyon pipeline. J.M. Montgomery, Consulting Engineers, (for City of Pasadena Water and Power Dept.).
- Monitoring construction in riparian zone under DFG Sec. 1600 Permit; Casitas Dam/Coyote Creek outflow

- Participant: Bird Census Workshop (Point Counts, Spot Mapping, Banding and Area Survey techniques), Big Sur Bird Observatory, with Dr. Stephen Laymon, et al.
- Independent studies and conducted surveys of Coastal Cactus Wrens, Tujunga Wash & Santa Fe Dam, L. A. Co.
- Served on Arroyo Seco Habitat Advisory Committee for City of Pasadena, Environ. Affairs Office.
- Served 14 yrs. on Los Angeles County Dept. of Regional Planning, Significant Ecological Areas Tech. Advisory Committee and served on Rivers and Mountains Conservancy Habitat Science Advisory Committee.
- Currently a volunteer Advisor to the Arroyos & Foothills Conservancy, for land assessments, flora, fauna and land use.

1981 - 1984 ACADEMICS DEPARTMENT
ART CENTER COLLEGE OF DESIGN
Pasadena, California

INSTRUCTOR OF ENVIRONMENTAL BIOLOGY AND HUMAN ECOLOGY

Taught courses in Environmental Biology, Human Ecology and Beginning Ornithology for four years.

1970 - 1972 CALIFORNIA STATE UNIVERSITY LOS ANGELES
DEPARTMENT OF ZOOLOGY
Los Angeles, California

MUSEUM CURATOR - STUDENT ASSISTANT

Worked for two years while obtaining B.S. degree in Department of Zoology with approximately twenty-five instructors; reported to Instructor in Zoology. Responsible for:

Curating University Zoology Museum housing skins and specimens of birds, mammals, reptiles, amphibians, fish and invertebrates.
Performing identification, preparation, cataloging of vertebrate and invertebrate specimens.

1968 - 1970 **LAB ASSISTANT - LIFE SCIENCE**, EAST LOS ANGELES COLLEGE
LIFE SCIENCE DEPARTMENT
Los Angeles, California

EDUCATION

A.A., Biology, 1969, East Los Angeles College
B.S., Zoology, 1972, California State University Los Angeles

PROFESSIONAL ORGANIZATIONS:

- California Native Plant Society (Rare Plant Chairman, V. Pres., founding member, San Gabriel Mtns. Chapter)
- Southern California Botanists
- California Botanical Society
- Western Field Ornithologists
- Pt. Blue Conservation Science
- Declining Amphibian Populations Task Force
- National Audubon Society (Current V. President, former Conservation Chair, Director, Pasadena Audubon)
- Nature Conservancy
- Arroyos & Foothills Conservancy
- Sierra Club, Natural Science Section

PROFESSIONAL PAPERS:

Food Habits of *Rana muscosa* (Anura: Ranidae), Herpeton, 1970, 5 (1): 8 pp.

Defensive Display of the Desert Slender Salamander, *Batrachoseps aridus* (with A.H.Brame and A.A.Chiri), Herpeton, 1973, 8 (1): 3 pp.

Natural History Notes on the Arboreal Salamander (*Aneides lugubris*) Herpetology, Mar. 1973 (S.W. Herpetologist's Soc) 7:1 pp. 6-11

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Wildflower Sanctuaries of Los Angeles County, (with R. McKernan), Audubon Imprint, May 1977, 1(10): 3 pp

Birds of the Whittier Narrows Recreation Area, Los Angeles County, California 79 pp. 1993.
Revision in preparation 100 pp.

Supplement to The Birds of the Whittier Narrows Recreation Area, Los Angeles County, California 56 pp. June 2011.

Avian Resources and Land Use in the Whittier Narrows Basin and San Gabriel River Riparian Area, manuscript, symposium proceedings, Natural Resources of the Puente Hills-Chino Hills Corridor: Implications for Land Use and Planning, Whittier College, Whittier, CA 1996

Anna's Hummingbirds with Hymenoptera Impaled on Bills, Western Birds, 1993, 24: 267-269

Desert Night Lizard (*Xantusia vigilis*) in Coastal Los Angeles County, California (in preparation).

Edited and published, Herpetofauna of the San Gabriel Mountains, by Allan Schoenherr, 1976, 95 pp.

Two new hummingbird guides (Review) *Western Tanager* 68(6): 8-9 July/August 2002

Herptofauna And Habitats: A Survey Of The San Gabriel River, Biota of the San Gabriel River Watershed, So. Calif. Acad. of Sciences Symposium May 4, 2012. Published article in Watershed Wise 14 (3).

EXTRA-CURRICULAR ACTIVITIES:

Worked while attending college; worked as Leader and Naturalist annually 1974-89 at week-long natural history workshop southern Sierra Nevada; present illustrated talks on natural history subjects to the public and conservation organizations.

HOBBIES:

Reading, writing, hiking, camping, birding and nature study, guitar.

PERSONAL DATA:

D.O.B.: 7-4-48; married; two children; excellent health

Reference:

E. J. Remson, Senior Project Manager, The Nature Conservancy
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ADDITIONAL REFERENCES AND FURTHER DATA ON REQUEST

rev. 7/14

<u>EXHIBIT J</u>

California Partners in Flight Riparian Bird Conservation Plan

Least Bell's Vireo (*Vireo bellii pusillus*)


Photo by James Gallagher, Sea and Sage Audubon

Prepared by: **Barbara Kus** (barbara_kus@usgs.gov)

USGS Western Ecological Research Center
San Diego Field Station, 5745 Kearny Villa Road, Suite M
San Diego, CA 92123

RECOMMENDED CITATION

Kus, B. 2002. Least Bell's Vireo (*Vireo bellii pusillus*). *In* The Riparian Bird Conservation Plan: a strategy for reversing the decline of riparian-associated birds in California. California Partners in Flight. http://www.prbo.org/calpif/htmldocs/riparian_v-2.html

SHORTCUTS

range map

references

SUBSPECIES STATUS:

The Least Bell's Vireo, *Vireo bellii pusillus*, is one of four subspecies of Bell's Vireo recognized by the American Ornithologist's Union (AOU 1957). It is the western-most subspecies, breeding entirely within California and northern Baja California. A second subspecies, *V. bellii arizonae*, has a limited distribution in California along the lower Colorado River, but occurs primarily throughout Arizona, Utah, Nevada, and Sonora, Mexico. The subspecies are believed to be isolated from one another during both the breeding and wintering seasons (Hamilton 1962).

MANAGEMENT STATUS: The Least Bell's Vireo was listed as a state endangered species by the California Fish and Game Commission in 1980, and as a federally endangered species in 1986. Critical habitat for the species was designated in 1994.

DISTRIBUTION

HISTORICAL DISTRIBUTION

Historically, the Least Bell's Vireo was a common to locally abundant species in lowland riparian habitat, ranging from coastal southern California through the Sacramento and San Joaquin Valleys as far north as Red Bluff (Tehama County). Populations also occurred in the foothill streams of the Sierra Nevada and Coast Ranges, and in Owens Valley, Death Valley, and scattered locations in the Mojave Desert (Cooper 1861; Baird et al. 1874; Belding 1878; Fisher 1893, Anthony 1893, 1895; Grinnell and Swarth 1913; Grinnell and Storer 1924; Grinnell et al. 1930, Grinnell and Miller 1944). Grinnell and Miller (1944) reported elevational extremes of -54 m (-175 ft.) in Death Valley to 1,260 m (4,100 ft.) at Bishop, Inyo County.

CURRENT BREEDING DISTRIBUTION

By the time the species was listed by the U.S. Fish and Wildlife Service in 1986, it had been extirpated from most of its historic range, and numbered just 300 pairs statewide. Populations were confined to eight counties south of Santa Barbara, with the majority of birds occurring in San Diego County. In the decade since listing, Least Bell's Vireo numbers have increased 6-fold, and the species is expanding into its historic range. In 1998, the population size was estimated at 2,000 pairs (L. Hays, USFWS, pers. comm.). Nesting vireos have recolonized the Santa Clara River (Ventura County) to the north, where 67 pairs nested in 1998 (J. Greaves, pers. comm.), and the Mojave River (San Bernardino County) to the northeast (Kus and Beck 1998). The northernmost reported sighting in recent years is of a nesting pair of vireos near Gilroy (Santa Clara County) in 1997 (Roberson et al. 1997). Roughly half of the current vireo population occurs on drainages within Marine Corps Base Camp Pendleton in San Diego County (Fish and Wildlife Service, 1998).

WINTER DISTRIBUTION

Least Bell's Vireos winter in southern Baja California, Mexico. Unlike during the breeding season, they are not limited in winter to willow-dominated riparian areas, but occupy a variety of habitats including mesquite scrub within arroyos, palm groves, and hedgerows bordering agricultural and residential areas (Kus, unpubl. data).

ECOLOGY

AVERAGE TERRITORY SIZE

Males establish and defend territories through counter-singing, chase and sometimes physical combat with neighboring males. Territory size ranges from 0.5 to 7.5 acres; some averages are: Tijuana River, 1991: 2.5 ± 1.2 acres, Kus 1991e; 1992: 2.7 ± 1.4 acres, Kus1992c; 1993: 1.8 ± 0.8 acres, Kus 1993d; Sweetwater River, 1996: 1.9 ± 0.8 acres, RECON 1989; Prado Basin (Santa Ana River): 1987: 1.9 ± 0.9 acres, Hays 1987; 1988: 1.6 ± 0.9 acres, Hays 1988; San Diego River: 1987: 2.1 ± 1.0

acres, Kus 1989a; 1988: 1.7 ± 0.9 acres, Kus 1989a. Newman (1992) investigated the relationship between territory size, vegetation characteristics, and reproductive success for populations of vireos at the San Diego and Sweetwater Rivers, but found no significant factors which could account for the variability in territory size observed at his sites.

TIME OF OCCURRENCE AND SEASONAL MOVEMENTS

Arrival dates on breeding grounds: Birds begin returning to southern California breeding sites in mid- to late-March; Grinnell and Miller (1944) reported later arrival (early April) for historic northern California populations. Males arrive in advance of females by several days, and observations of banded birds suggest that returning adult breeders may arrive earlier than first-year birds by several weeks (Kus, unpubl. data).

Departure dates from breeding grounds:Vireos are generally present on the breeding grounds until late September, although they may begin departing by late July. Stragglers have been noted in October and November (McCaskie and Pugh 1965; McCaskie 1969; K. Miner, pers. comm.; J. Newman, pers. comm.).

Spring migration period: Vireos usually arrive in California during mid- to late-March. Two least Bell's vireo were seen as early as March 17, 1972 at Old Mission Damn in San Diego (McCaskie 1972).

Fall Migration Period: Vireos usually leave their breeding grounds by September. Some extreme dates are September 23 (1977, B. Cord) at Old Mission Dam and October 5, 1884 in Poway (F. E. Blaisdell in Belding 1890).

Extent of wintering in CA: Vireos occasionally occur in California during the winter. Some records include: one individual on the San Diego River (San Diego County) on 1 January 1963 (McCaskie and Banks 1964), one at Bonita (San Diego County) between 18 December 1969 and 17 January 1970 (McCaskie 1970), two on the Otay River (San Diego County): one on 27 December 1970 (McCaskie 1971) and the other on 6 January 1979 (McCaskie 1979), and one at Coronado (San Diego County) on 15 December 1980 (McCaskie 1980).

MIGRATION STOPOVER CHARACTERISTICS

Little information on habitat use; species as a whole described as using coastal scrub, riparian, and other woodland habitats during migration (Brown 1993).

FOOD HABITS

FORAGING STRATEGY

Least Bell's Vireos obtain prey primarily by foliage gleaning (picking prey from leaf or bark substrates), and hovering (removing prey from vegetation surfaces while fluttering in the air). Salata (1983) noted foliage gleaning during 93 percent of his observations of foraging vireos (N=131), and hovering during 30 percent. Miner (1989), in a study of vireo foraging ecology at the Sweetwater River (San Diego County), observed that 50.4 percent of prey attacks (N=413) consisted of foliage gleaning, and 38.7 percent hovers. Both Salata (1983) and Miner (1989) observed vireos occasionally capturing prey by hawking (pursuit and capture of flying prey), and Miner (1989) noted a behavior she called "clinging," which she described as hovering, but with the feet in contact with the vegetation.

Foraging occurs at all levels of the canopy, but appears to be concentrated in the lower to mid-strata, particularly when pairs have active nests (Grinnell and Miller, 1944; Goldwasser 1981; Gray and Greaves 1984; Salata (1983), Miner (1989). Salata (1983) found that 69 percent of 131 foraging observations were within 4 meters (12 feet) of the ground. Miner (1989) found a similar peak in foraging activity in vegetation between 3-6 meters (9-18 feet) in height. Moreover, she determined that the distribution of vireo foraging time across all heights was not simply a function of the availability of vegetation at those heights, but rather represented an actual preference for the 3-6 meter zone.

DIET

Least Bell's Vireos are insectivores, preying on a wide variety of insect types including bugs, beetles, grasshoppers, moths, and particularly caterpillars (Chapin 1925; Bent 1950).

DRINKING

Vireos probably do not require water for drinking.

BREEDING HABITAT

SITE FIDELITY

Data collected for color-banded birds indicate that site fidelity is high among adults, with many birds not only returning to the same territory, but placing nests in the same shrub used the previous year (Salata 1983b, Kus unpubl. data). Return rates of first-year breeders to their natal drainages ranged from 15-18% over the course of nine years of study on the Santa Ynez River in Santa Barbara County (Greaves 1987; Greaves and Gray 1991). Kus (unpubl. data), drawing from 10 years of study at several San Diego County sites, found that on average, 20% of first-time breeders dispersed away from their natal drainages, with a higher proportion of males (22%) than females (13%) dispersing.

NEST SUBSTRATE

Least Bell's Vireos place their nests in a variety of plants that provide concealment in the form of dense foliage. The most frequently used species include willows (*Salix* sp.), mulefat (*Baccharis glutinosa*), California wild rose (*Rosa californica*),poison oak (*Toxicodendron diversilobum*), mugwort (*Artemisia douglasiana*), and cottonwood (*Populus fremontii*) (Olson & Gray 1989, RECON 1989).

HEIGHT OF NEST

Nests are typically placed within one meter of the ground. Average height of 25 nests at the Sweetwater River (San Diego County) was 0.9 ± 0.4 meters; for 24 nests at the San Diego River (San Diego County); 1.3 ± 0.6 meters, and for 16 nests at the San Luis Rey River; 1.1 ± 0.3 meters (RECON 1989). Nest height of 226 nests at the Santa Margarita River (San Diego County) ranged from 0.3 - 2.4 meters, averaging 1.0 meters (Salata 1984). The average height for 32 nests at Santa Ynez River (Santa Barbara County) was 0.7 ± 0.35 meters, with a range of 0.4 - 1.2 meters (Olson & Gray 1989).

HEIGHT OF PLANT

Average host heights range from 2.8-5 meters; some examples are: 3.2 ± 1.8 meters for 29 nests at the Sweetwater River (San Diego County); 4.1 ± 2.4 meters for 23 nests at the San Luis Rey River (San Diego County); 5.0 ± 2.5 meters for 21 nests at the San Diego River (San Diego County) (RECON 1989), 2.8 ± 0.4 for 32 nests on Santa Ynez River (Santa Barbara County) (Olson & Gray 1989).

VEGETATION SURROUNDING THE NEST

Early to mid-successional riparian habitat is typically used for nesting by the Least Bell's Vireo because it supports the dense shrub cover required for nest concealment as well as a structurally diverse canopy for foraging. Vegetation characteristics of riparian stands between five to ten years of age are most suitable for nesting Least Bell's Vireo (Goldwasser 1981, Kus 1998, RECON 1989, Fish & Wildlife Service 1998). Restored riparian in the coastal lowlands of southern California has the habitat structure to support breeding vireos within 3-5 years particularly if they are adjacent to established riparian areas (Kus 1998).

PLANT SPECIES CONCEALING THE NEST

Least Bell's Vireo nests are normally found in areas with dense understory (RECON 1989, Salata 1981 and 1983, Goldwasser 1981). At the Santa Ynez River (Santa Barbara County), below 1.0m, mugwort (Artimisia douglasiana) and summer mustard (Brasica nigra) contribute most to foliage density (Olson & Gray 1989).

PERCENT NEST COVER

Open space within a one meter radius surrounding a nest was calculated at three river drainages in San Diego County: Sweetwater River, San Diego River and San Luis Rey River (RECON 1989). Open space represents sections in which there was less than 50 percent vegetation coverage in six sections including above and below the nest. Results represent the average number of openings within one meter of the nest: Sweetwater River = 0.7 ± 0.8 (N=29), San Diego River = 2.3 ± 1.7 (N=24), and San Luis Rey River = 1.6 ± 1.5 (N=23).

CANOPY COVER

The canopy of riparian habitat is mainly dominated by willows. On the Santa Margarita River, at Camp Pendleton, 97% of the canopy around the nest is willow spp. (N=38) and the average percent canopy cover within 0.4ha of a nest = 25% (Salata 1983).

AVERAGE TOP CANOPY HEIGHT

Santa Ynez River (Santa Barbara County): average = 8.3 m, range = 1.8-18.3m (Olson & Gray 1989). Santa Margarita River (Camp Pendleton, San Diego County) average = 7 m, range 3-15m (Salata 1983).

DOMINANT PLANT SPECIES IN CANOPY

On Santa Ynez River in Santa Barbara mainly Fremont cottonwood (*Populus fremontii*), arroyo willow (*Salix lasiolepis*) and red willow (*Salix laevigata*) (Olson and Gray 1989). San Diego County most dominant trees are black willow (*Salix goodingii*) and arroyo willow (*Salix lasiolepes*) (RECON 1989).

AVERAGE SHRUB COVER

Vireos tend to occupy areas which support dense shrub cover (Salata 1981, Salata 1983, Goldwasser 1981). The proportion of tress with shrub understory was significantly higher at sites occupied by vireos than at those in which vireo did not occupy (RECON 1989 p 27).

DOMINANT SHRUB SPECIES

On Santa Ynez River in Santa Barbara County mainly mugwort (*Artimisia douglasiana*), mulefat (*Baccharis salicifolia*), and willow shrubs (*Salix* spp.) (Olson and Gray 1989). On Sweetwater River, San Diego River, and San Luis Rey River in San Diego County the most common shrub species (92 % of territories) is mulefat (Baccharis glutinosa) (RECON 1989).

CO-DOMINANT SHRUB SPECIES

On Sweetwater River, San Diego River, and San Luis Rey River (San Diego County), mulefat (*Baccharis glutinosa*) is the most dominant followed in high number by the willow shrubs (*Salix* spp.), and tamarisk (*Tamarix* sp.) (RECON 1989).

DOMINANT FORB SPECIES

The greatest foliage density around nests occurs between 0.2 and 1.0m and consists mostly of mugwort (*Artemisia douglasiana*) and summer mustard (*Brassica nigra*) (Olson & Gray 1989, RECON

1989).

CO-DOMINANT FORB SPECIES

Curly dock (*Rumex crispus*) and western ragweed (*Ambrosia psilostachya*) (RECON 1989).

GROUND COVER

The proportion of nests, at several sites in San Diego County, that were concealed by ground cover are: Sweetwater River 62 percent (18/29), San Luis Rey River 65 percent (15/23) and San Diego River 29 percent (6/21) (RECON 1989).

GRASS/SEDGE/FORBS

Least Bell's Vireo prefer to nest in areas with low aquatic and herbaceous cover (RECON 1989).

TREE DBH

In a study along the Santa Ynez River (Santa Barbara County), trees at successful nest sites were significantly greater in mean DBH than unsuccessful nests (Olson & Gray 1989). The average DBH for trees surrounding nests was 15.5cm with a range of 1.8-50.0cm) (Olson & Gray 1989).

DISTANCE TO WATER

There is no data on nests and distance to water, however, nests are found within the active floodplain of a waterway and are, therefore, within about 300m of surface water.

NEST TYPE

Open-cup nest placed in the horizontal fork of a tree or shrub branch and bound at the rim. Nests are typically constructed of soft plant strips and shreds, leaf fragments, small pieces of bark, spider webs, and other materials, and are usually lined with soft substances such as plant down or hair (Bent 1950).

TYPICAL BREEDING DENSITIES

The density of breeding Least Bell's Vireo is difficult to calculate due to the clumped nature of their territories. In many areas along the river a group of territories will be found interspersed with areas containing no territories. In 1994, along the San Diego River (San Diego County), Least Bell's Vireo territories were averaged at 0.41 territories per ha (Kus 1994). In 1988, along the San Luis Rey River (San Diego County) territories were averaged at 0.22 territories per ha (Kus 1988). This same river, however, had areas where densities were as high as 2.8 territories per ha (Kus 1988).

BREEDING BIOLOGY

MATING SYSTEM

Monogamous. Birds may switch mates between successive nesting attempts within the same season and between years (serial monogamy). Spiegelberg (1997), using microsatellite techniques to study the genetic structure of family groups, failed to detect any evidence of extra-pair copulatory activity in the three vireo populations he studied.

INITIATION OF NESTING

Nest-building can begin soon after arrival of the pair, typically in late March, although prolonged inclement weather can delay nest-building for several weeks (pers. obs.). Nest initiations peak during April, but can continue through the first week of July.

DISPLAYS

Males use high, often exposed, perches in the canopy as singing perches during territorial defense and advertisement. Courtship includes displays in which birds flick their wings and alternately fan and depress their tails, often accompanied by rapid calls (Bent 1950, Brown 1993).

CLUTCH SIZE

Typically 3-4, occasionally 2, rarely 5 (Bent 1950).

INCUBATION

Both male and female share in incubation, although females incubate more than males during the day (Hensley 1950, Nolan 1960). Nighttime incubation appears to done exclusively by females (Barlow 1962).

INCUBATION PERIOD

Incubation in this subspecies typically commences with the penultimate egg (Kus, unpubl. data), although reports for other subspecies indicate that it can begin as early as laying of the first egg (Pitelka and Koestner 1942). Incubation lasts about 14 days (Bent 1950).

DEVELOPMENT AT HATCHING

Altricial.

NESTLING PERIOD

Nestlings fledge 10-12 days after hatching.

FLEDGLING PERIOD

PARENTAL CARE

Both sexes feed and brood nestlings. Fledged young may be cared for by both parents, or, if the pair re-nests, primarily by the male.

POST FLEDGING BIOLOGY OF OFFSPRING

Fledglings are cared for by their parents for at least two weeks after fledging, during which time territorial boundaries are relaxed as family groups range over larger areas. Studies of banded birds reveal that fledglings generally remain in the territory or its vicinity for most of the season; however, the behavior of older fledglings produced early in the year has not been well studied (Kus, unpubl. data).

POST BREEDING SOCIAL BEHAVIOR

Little information. Territorial boundaries are relaxed at the end of the breeding season, and male singing frequency declines substantially during the post-breeding molt, making it difficult to detect and locate birds.

DELAYED BREEDING

Birds typically begin breeding as first-year adults.

NUMBER OF BROODS

Least Bell's Vireos can initiate as many as five nests during a season, but typically do not raise more than two broods, with most pairs raising no more than one brood per season.

BROOD PARASITISM

Least Bell's Vireos are extremely vulnerable to cowbird parasitism, which, in concert with habitat loss and degradation, is considered a primary factor responsible for the species decline (Linton 1908; Dawson 1923; Hanna 1928; Rowley 1930; Bent 1950; Grinnell 1950). In heavily parasitized areas, up to four cowbird eggs may be found in vireo nests (Salata 1983; B. Jones, unpubl. data), particularly during the second half of the nesting season when fewer hosts are available. Reports prior to the implementation of cowbird management programs indicate that cowbirds parasitized 33-100% of vireo nests (Goldwasser et al. 1980; L. Salata, unpubl. data; B. Jones, unpubl. data; Gray and Greaves 1984; L. Hays, unpubl. data). Even with cowbird management, in some areas, up to 43% of nests are parasitized, of which, on average, 29% are abandoned (Kus 1999).

LANDSCAPE FACTORS

ELEVATION

Grinnell and Miller (1944) reported elevational extremes of -54 m (-175 ft.) in Death Valley to 1,260 m (4,100 ft.) at Bishop, Inyo County.

FRAGMENTATION

Much of the riparian habitat throughout the range of the Least Bell's Vireo has been destroyed leaving fragmented remnants. The riparian system in southern California has decreased by about 90% of what was present in 1850 (Smith 1977). In San Diego County the loss is reported at 61% (Oberbauer 1990).

PATCH SIZE

Vireos occur in disproportionately high frequencies in the wider sections (greater than 250m) of the riparian relative to site availability (RECON 1989).

DISTURBANCE

The riparian system is adapted to periodic flooding. The dynamic aspect of the riparian vegetation allows for fast recovery to disturbance as long as the natural water flow and sedimentation regimes are intact (Fish & Wildlife 1998). Flooding is currently restricted in almost all habitat occupied by the Least Bell's Vireo due to upstream dams. Potential disturbance to riparian habitat and nesting Least Bell's Vireo are associated with urbanization and agriculture and include: runoff from both agricultural fields and roadways, traffic noise, feral pets, recreational use of habitat, and increased foraging habitat for brown-headed cowbird (Molthrus ater).

Least Bell's Vireo often nest near open spaces or trails. Nest failure and abandonment can be caused by human disturbance such as trampling of nests or nest sites or clearing of vegetation (Fish & Wildlife 1998). Brood parasitism and habitat fragmentation are the primary factors causing the species decline and are both results of human-induced disturbance.

ADJACENT LAND USE

Due to increased urbanization and agriculture in southern California, much of the riparian habitat is now surrounded by agricultural areas such as farming, cattle grazing and horse ranching as well as urban development such as roads, golf courses, residential development, and commercial development. Vireo territories (n=35) bordering on agricultural and urban areas were significantly less successful in producing young than territories bordering on coastal sage scrub, grassland and chaparral (RECON 1989).

PESTICIDE USE

No specific data but it is possible that pesticides could be incorporated into the riparian system due to runoff by neighboring agricultural fields.

PREDATORS

Predators may include Western Scrub-jays (*Aphelocoma californica*), Cooper's Hawk (*Accipiter cooperii*), raccoon (*Procyon lotor*), Virginia opossum (*Didelphis virginiana*), coyote (*Canis latrans*), long-tailed weasel (*Mustela frenata*), dusky-footed woodrat (*Neotoma fuscipes*), deer mouse (*Peromyscus maniculatus*), house mouse (*Mus musculus*), rat (*Rattus rattus*), domestic cat (*Felis domesticus*), gopher snakes (*Pituophis melanoleucus*) (Franzreb 1989).

DEMOGRAPHY AND POPULATION TRENDS

DEMOGRAPHICS

Survivorship. It is estimated that 5 to 29 percent of Least Bell's Vireos survive to their first breeding season. This is based on studies of color-banded birds returning to their natal breeding grounds and may not include birds that have dispersed to unstudied areas (Fish & Wildlife 1998).

No sex specific differences in survival have been reported. No estimates of survival are available for period from fledging to sexual maturity.

Reproductive success. The annual percentage of fledglings per nest range from 33 percent to 89 percent with long term averages ranging between 41 percent and 74 percent. Annual average numbers of fledglings per nest range between 0.7 and 3.3 with averages falling between 1.1 and 2.4. The Least Bell's Vireo can attempt as many as 5 nests per season, therefore, it is appropriate to relate the number of fledglings per pair to emphasis an individual's reproductive success. The annual average number of fledglings per pair ranges from 0.9 and 4.5, with long term averages ranging between 1.8 and 3.2. (Fish & Wildlife 1998).

POPULATION TREND

Historical accounts of Least Bell's Vireo described them as common to abundant in the late 1800's and early 1900's (Cooper 1861, 1874, Anthony 1893 and 1895, Baird et al. 1874, Belding 1878, Fisher 1893, Grinnell and Swarth 1913, Grinnell and Storer 1924, Grinnel et al. 1930, Grinnell and Miller 1944). By 1986, the population had declined to an estimated 300 pairs, with the majority occurring in San Diego County. Restoration efforts and Brown-headed Cowbird control have allowed populations to increase in recent years. In 1998, the population size was estimated at 2,000 (L. Hays, USFWS, pers. comm.). A population viability analysis, using computer simulations, indicates that the Least Bell's Vireo populations currently exceed minimum viable population size (Fish & Wildlife 1998). This was based on eight populations in San Diego County, Riverside County and Santa Barbara County. This means that the population has less than a five percent probability of going extinct in the next 100 years (Soule 1987) as long as habitat size and quality remains the same or increases and brown-headed cowbird control continues.

MANAGEMENT ISSUES AND OPTIONS

EXOTIC SPECIES INVASION/ENCROACHMENT

The invasion of exotic plant species into the riparian system increases habitat fragmentation and can decrease suitable nesting habitat in some cases. Invasive non-natives found in current Least Bell's

Vireo habitat include castor bean (*Ricinus communis*), cocklebur (*Xanthium strumarium*), tamarisk (*Tamarix* sp.) and giant reed (*Arundo donax*) (Fish & Wildlife 1998). *Arundo donax* is of prime concern due to it's ability to disperse throughout the drainage and it's rapid growth that allows it to outcompete and restrict growth of native riparian habitat.

MANAGEMENT NEEDS

1. Preserve and enhance existing riparian habitat within the vireo historic range.
2. Control exotic vegetation.
3. Continue cowbird removal and/or develop alternative means of controlling cowbird parasitism.
4. Management on a community level in order to reduce predation levels.

ASSOCIATED BIRD SPECIES

Southwestern Willow Flycatcher (*Empidonax trailii extimus*), Yellow Warbler (*Dedroica petechis brewsteri*), Yellow-breasted Chat (*Icteria virens*), Song Sparrow, Common Yellowthroat, Black-headed Grosbeak, Tree Swallows, Downy Woodpeckers, House Wren, Pacific-slope Flycatcher, Ashthroated Flycatcher, Spotted Towhee, Orange-crowned Warbler, Hutton's Vireo, Nuttall's Woodpecker, Black Pheobe, Bushtit, Swainson's Thrush, American Goldfinch, Lesser Goldfinch, Wrentit, Bewick's Wren, Cooper's Hawk, Red-shouldered Hawk, White-tailed Kite, Ruby-crowned Kinglet, Sharp-shinned Hawk, Hermit Thrush

MONITORING METHODS AND RESEARCH NEEDS

MONITORING NEEDS

1. Conduct regular monitoring of vireo populations.
2. Conduct thorough rangewide surveys.
3. Conduct a statewide inventory of riparian habitat.
4. Color banding to collect data for demographic and dispersal analysis.

RESEARCH NEEDS

1. Determine whether any reproductive parameters are density-dependent.
2. Determine whether dispersal is density-dependent.
3. Examine the effect of different cowbird control regimes on vireo parasitism rates and reproductive success.
4. Evaluate the use of restored habitat by vireos.
5. Investigate the status of wintering habitat and identify current or potential threats.
6. Identify predators and establish means of control.
7. Identify additional and potential Least Bell's Vireo breeding habitat within its historical range.

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<u>EXHIBIT K</u>

Least Bell's Vireo
(Vireo bellii pusillus)

5-Year Review
Summary and Evaluation

Photo by B. Moose Peterson

U. S. Fish and Wildlife Service
Carlsbad Fish and Wildlife Office
Carlsbad, California

September 2006

5-YEAR REVIEW

Species reviewed: Least Bell's vireo (*Vireo bellii pusillus*)

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5-YEAR REVIEW
Least Bell's vireo/*Vireo bellii pusillus*

I. GENERAL INFORMATION

I.A. Methodology used to complete the review:

Dr. Donald McGraw was contracted by the U. S. Fish and Wildlife Service (Service) to gather and synthesize information regarding the status of the least Bell's vireo (*Vireo bellii pusillus*, "vireo"). This review was subsequently compiled by Peter Beck of the Carlsbad Fish and Wildlife Office (CFWO) and considered Dr. McGraw's final report (McGraw 2006), office files, available literature, new survey information, and interviews of individuals involved with surveying, research and management of this species. Vireo survey reports submitted to the Ventura Fish and Wildlife Office (VFWO) were supplied to CFWO by Chris Dellith of the VFWO.

I.B. Reviewers

Lead Region: Diane Elam and Mary Grim, California-Nevada Operations Office, 916-414-6453.

Lead Field Office: Karen Goebel, Gjon Hazard, and Peter Beck, Carlsbad Fish and Wildlife Office, 760-431-9440.

I.C. Background

I.C.1. FR Notice citation announcing initiation of this review:

The notice announcing the initiation of this 5-year review and opening of the first comment period for 60 days was published on July 7, 2005 (70 FR 39327). A notice reopening the comment period for 60 days was published on November 3, 2005 (70 FR 66842). No comments were received during the comment period.

I.C.3. Listing history:

Original Listing:
FR notice: Federal Register 51(85):16474-16481.
Date listed: May 2, 1986.
Entity listed: Least Bell's vireo (*Vireo bellii pusillus*); subspecies.
Classification: Endangered.

I.C.5. Associated rulemakings:

Critical Habitat: Federal Register 59(22):4845-4867.

I.C.6. Review History:

No formal status review (per the criteria set in the March 27, 2006, draft 5-Year Review Guidelines) has been conducted since the original listing of the species. Informal status reviews have been conducted on a regular basis and incorporated into multiple biological opinions, habitat conservation plans, and the 1998 draft recovery plan developed for this subspecies.

I.C.7. Species' Recovery Priority Number at start of review:

3C. This priority number, as identified in the 2005 Recovery Data Call, indicates a high degree of threat but a high potential for recovery for a listed subspecies.

I.C.8. Recovery Plan or Outline:

A draft recovery plan for the least Bell's vireo was printed and distributed within and outside of the Service in 1998 (Service 1998). This plan was never finalized and remains in draft form.

Name of plan: Draft Recovery Plan for the Least Bell's Vireo (*Vireo bellii pusillus*).
Date issued: 1998.

II. REVIEW ANALYSIS

II.A. Application of the 1996 Distinct Population Segment (DPS) policy

II.A.1. Is the species under review listed as a DPS?

____ ***Yes**, go to section II.A.2.*
_X_ ***No**, go to section II.A.4.*

II.A.4. Is there relevant new information that would lead you to consider listing this species as a DPS in accordance with the 1996 policy?

____ ***Yes**.*
_X_ ***No**, go to Section II.B., Recovery Criteria.*

II.B. Recovery Criteria

II.B.1. Does the species have a final, approved recovery plan containing objective, measurable criteria?

____ ***Yes***
_X_ ***No***

Although a draft recovery plan was distributed to the public in 1998 (Service 1998), it was not finalized due to other higher priority listing and recovery actions. The draft recovery plan constituted a thorough summary of the status of the species at the time it was distributed and provided broadly measurable recovery goals aimed at reducing threats and increasing the number of breeding pairs within the species' present and historic range.

II.B.2. Adequacy of recovery criteria.

II.B.2.a. Do the recovery criteria reflect the best available and most up-to-date information on the biology of the species and its habitat?

____ ***Yes;*** *go to section II.B.2.b.*
_X_ ***No;*** *Explain and continue to section II.B.2.b.*

The draft recovery plan provides broadly measurable vireo population goals (occurrence for 5 consecutive years of "several hundred" breeding pairs of vireos at 14 distinct current or historical sites), but the draft recovery plan did not include a habitat-based assessment to evaluate whether the identified current and historical sites, even with restoration, could support these population goals. Due to new information regarding the species and an improved understanding of ongoing recovery actions to reduce threats, the recovery goals and strategies should be modified and refined.

II.B.2.b. Are all of the five listing factors* that are relevant to the species addressed in the recovery criteria (and is there no new information to consider regarding existing or new threats)?

____ ***Yes,*** *go to section II.B.3.*
_X_ ***No,*** *Explain and continue to section II.B.3.*

Two of the five listing factors, habitat loss (listing factor 1) and brown-headed cowbird (*Molothrus ater*, "cowbird") nest parasitism (listing factor 5), are partially addressed in the recovery criteria. Listing factor 2 is not relevant for this subspecies. Listing factors 3 and 4 do not appear to be addressed explicitly. Although not discussed in detail in the original listing, one recovery criterion within the draft recovery plan recognizes and addresses habitat degradation and loss resulting from invasion of riparian habitat by introduced exotic plant species (primarily *Arundo donax*, "giant reed"; listing factor 1). The plan could be improved by more directly addressing a solution to the underlying threats that led to the initial decline and listing.

II.B.3. List the recovery criteria as they appear in the recovery plan and discuss how each criterion has or has not been met, citing information. For threats-related recovery criteria, please note which of the 5 listing factors* are addressed by that criterion. If any of the five listing factors are not relevant to this species, please note that here.

Downlisting Criterion 1:

"For a period of 5 consecutive years...Stable or increasing least Bell's vireo populations/metapopulations, each consisting of several hundred or more breeding pairs, are protected and managed at the following sites: Tijuana River, Dulzura Creek/Jamul Creek/Otay River, Sweetwater River, San Diego River, San Luis Rey River, Camp Pendleton/Santa Margarita River, Santa Ana River, an Orange County/Los Angeles County metapopulation, Santa Clara River, Santa Ynez River, and an Anza Borrego metapopulation."

Although the draft recovery plan does not define when an area is "protected and managed," the required population increase is most likely to occur when overall habitat loss and degradation is substantially reduced or reversed through enhancement and restoration actions at the 11 specific locations listed in Criterion 1; therefore, this criterion appears to primarily address listing factor 1. It is possible that this criterion was also intended to address cowbird control (listing factor 5), although this is not explicit.

Since listing of the species in 1986, there has been tremendous growth of the vireo populations in specific areas in San Diego and Riverside. However, only the Camp Pendleton/Santa Margarita River and the Santa Ana River populations have clearly met and exceeded the target of "several hundred or more breeding pairs" of vireos at the designated site (Table 1). Population increases at both of these locations have likely been driven by habitat protection, habitat quality improvement by the removal of invasive exotic plants, and thorough, consistent cowbird control (Griffith and Griffith 2000; Zembal *et al.* 2003) achieved as a result of ESA section 7 consultations.

While other vireo populations have not reached target levels set by Downlisting Criterion 1, the general population trend has been positive (Table 1). It should be noted that while these 11 populations only represent a portion of the known vireo populations, they contain approximately 90 percent of the known vireo territories (refer to Section II.2.C. Biology and Habitat for a full discussion of vireo abundance). New information about vireo population dynamics and the observed patterns in the vireo population growth since the listing suggests this downlisting criterion may need to be revised.

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1)Present or threatened destruction, modification or curtailment of its habitat or range;
2) Overutilization for commercial, recreational, scientific, or educational purposes;
3) Disease or predation;
4) Inadqequacy of existing regulatory mechanisms;
5) Other natural or manmade factors affecting its continued existence.

Table 1: Most Recent Comprehensive Estimates of Vireos at 11 Population Units.[1]

Location	**County**	**Year**[2]	**Vireo Territories**[3]	**Population Trend**[4]
Tijuana River	San Diego	2004-2005	150	+ / -
Dulzura Creek/Jamul Creek/Otay River[5]	San Diego	2001-2005	36	+ / I
Sweetwater River	San Diego	2001	103	+ / +
San Diego River	San Diego	1997	66	+ / I
San Luis Rey River[6]	San Diego	2000	233	+ / I
Camp Pendleton/Santa Margarita River[7]	San Diego	2005	827	+ / -
Santa Ana River[8]	Orange Riverside, San Bernardino	2005	813	+ / +
Orange and Los Angeles Counties[9]	Orange Los Angeles	2001-2005	180	+ / +
Santa Clara River	Los Angeles Ventura	2001	119	+ / +
Santa Ynez River	Santa Barbara	2001	11	- / -
Anza Borrego Desert State Park	San Diego	2002	117	+ / +

1 As designated in the 1998 draft recovery plan.
2 Year(s) of most recent extensive surveys. Composite of surveys across multiple years used where within-year surveys not considered adequately comprehensive.
3 Minimum estimate; generally a composite of multiple survey efforts covering different reaches; may exclude large stretches of non-surveyed habitat. All estimates based on survey reports submitted to the Carlsbad Field Office or values obtained from the U.S. Geological Survey (USGS) database (USGS 2006).
4 Overall trend since original listing / Trend comparing 1996-2000 to 2001-2005. "+"=Increasing, "-" =Declining, "I"=Inadequate data to evaluate.
5 Primarily derived from Otay River surveys. No comprehensive surveys of Dulzura and Jamul Creeks since 1996.
6 Mainstem only; excludes Pilgrim Creek.
7 Includes all willow riparian habitat on MCB Camp Pendleton; excludes portions of Santa Margarita River off of MCB Camp Pendleton.
8 Mainstem and Prado Basin study area only: excludes San Timoteo Creek, Temescal Wash, and other tributaries.
9 Excluding Santa Ana River and Santa Clara River mainstems.

Delisting Criterion 2:

"Stable or increasing least Bell's vireo populations/metapopulations, each consisting of several hundred or more breeding pairs, having become established and are protected and managed at the following sites: Salinas River, a San Joaquin metapopulation, and a Sacramento Valley metapopulation."

Like Downlisting Criterion 1, Delisting Criterion 2 appears to primarily address listing factor 1, and possibly listing factor 5 (cowbird parasitism). No breeding vireos have been recorded in Salinas Valley since 1986, and none have been recorded in the Sacramento Valley since prior to the listing of the vireo. In 2005, the first breeding pair of vireos detected in the San Joaquin Valley since the listing of the vireo successfully bred at the San Joaquin National Wildlife Refuge in Stanislaus County. Again in 2006, a single pair of vireos (including the same male banded at the site in 2005) bred successfully at this site. This pair may represent the nascent re-colonization of the San Joaquin Valley.

A few incidental sightings of vireos after the breeding season have occurred within the last five years in the Salinas Valley, but territorial and reproductive status for these birds has not been established. It is possible that a few more vireo territories are dispersed across the San Joaquin and Salinas Valleys and have not been detected due to extremely low population densities and minimal or no formal vireo surveys. There have been no sightings of vireos in the Sacramento Valley since prior to the listing, and there are no known source populations nearby; therefore, it is unlikely that any breeding vireos have occurred within recent years in the Sacramento Valley. Although a few vireos and at least one breeding territory have been detected in the combined area of the Salinas, San Joaquin, and Sacramento Valleys within recent years, Delisting Criterion 2 has not been met. With the current knowledge of vireo population increases within its present range and in consideration of a population viability analysis (PVA), this Delisting Criterion may need to be revised.

<u>Delisting Criterion 3:</u>

"Threats are reduced or eliminated so that least Bell's vireo populations/metapopulations listed above are capable of persisting without significant human intervention, or perpetual endowments are secured for cowbird trapping and exotic plant (<u>Arundo</u>) control in riparian habitat occupied by least Bell's vireos."

This criterion implicitly addresses all listing factors ("threats"), but most explicitly addresses listing factors 1 (habitat degradation caused by exotic plant invasion) and 5 (cowbird parasitism). Since the listing of the vireo there has been substantial progress made in controlling cowbird populations and giant reed invasion in specific areas in southern California, but these threats have not been adequately reduced even across most of the vireo's current range. It is unlikely that these threats can be completely eliminated, but they may be controlled with coordinated, consistent, widespread management efforts. Thus, while substantial progress has been made, Delisting Criterion 3 has not been fully met (refer to section II.C.2 Five Factor Analysis for a full discussion of current threats).

II.C. Updated Information and Current Species Status

II.C.1. Biology and Habitat:

Abundance

The vireo population in the U. S. has increased 10-fold since its listing in 1986, from 291 to 2,968 known territories (Table 2). The population has grown during each five-year period since the original listing, although the rate of increase has slowed over the last 10 years. Population growth has been greatest in San Diego County (621 percent increase) and Riverside County (2,997 percent increase), with lesser but significant increases in Orange County, Ventura County, San Bernardino County, and Los Angeles County. The population in Santa Barbara County has declined by 54 percent since the original listing and 79 percent since its post-listing peak in 1986, although it is uncertain whether this population was historically significant. Kern, Monterey, San Benito, and Stanislaus Counties have had a few isolated individuals and/or breeding pairs since the original listing, but these counties have not supported any sustained populations. Although the number of individuals in Inyo County has increased to up to 11 territorial locations, these birds occur over widely dispersed locations, and there is some uncertainty whether these individuals are *V. b. pusillus* or *V. b. arizonae* (Arizona Bell's vireo; Patten *et al.* 2003).

Table 2: Estimate of Least Bell's Vireo Territories by County

	Estimate of Vireo Territories (and Percentage of the Total Population) for a given Range of Years[1]				
County	1977-1985[2]	1986-1990	1991-1995	1996-2000	2001-2005
San Diego[3]	223 (77%)	401 (76%)	1118 (78%)	1899 (76%)	1609 (54%)
Riverside[4]	29 (10%)	50 (9%)	223 (16%)	395 (16%)	898 (30%)
Orange	1 (<1%)	3 (1%)	16 (1%)	68 (3%)	177 (6%)
San Bernardino	0 (0%)	2 (<1%)	5 (<1%)	20 (1%)	87 (3%)
Los Angeles	6 (2%)	1 (<1%)	4 (<1%)	13 (1%)	56 (2%)
Ventura[5]	5 (2%)	8 (2%)	35 (2%)	86 (3%)	117 (4%)
Santa Barbara[6]	26 (9%)	57 (11%)	32 (2%)	12 (<1%)	12 (<1%)
Inyo	0 (0%)	4 (1%)	5 (<1%)	0 (0%)	11 (<1%)
Kern	0 (0%)	0 (0%)	1 (<1%)	0 (0%)	0 (0%)
Monterey	0 (0%)	3 (1%)	0 (0%)	0 (0%)	0 (0%)
San Benito	1 (<1%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Stanislaus	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (<1%)
Total	**291**	**529**	**1439**	**2493**	**2968**
Percent Increase from Previous Period	-	82%	172%	73%	20%
Percent Increase since Listing	-	82%	394%	753%	920%

[1] Estimates based on a composite of surveys across the specified range of years.
[2] From the original listing (51 FR 16474).
[3] Approximately 50% or greater from Camp Pendleton.
[4] Approximately 90% or greater from the Santa Ana River and its tributaries.
[5] Approximately 90% or greater from the Santa Clara River.
[6] Approximately 90% or greater from the Santa Ynez River.

Preliminary reports from vireo surveys conducted in 2006 indicate that the vireo population at two key locations, Camp Pendleton and the Prado Basin on the Santa Ana River, may have declined by up to 15 percent. Possible causes for these reported declines are uncertain. Although single year declines should be viewed with caution when evaluating population trends, they indicate population volatility associated with a higher risk of extinction (Fagan *et al.* 1999).

As discussed in section II.B.3., vireos have recently been discovered in the San Joaquin Valley. Although incidental vireo sightings have been reported for the Salinas Valley, no territories have been recently identified for the Salinas or Sacramento Valleys.

No systematic surveys of the vireo population in Mexico have been conducted since the listing of this species. Vireos appear to be dispersed from the international border down through at least Cataviña (approximate latitude North 29° 45') in Baja California Norte, but these populations are subject to ongoing habitat loss and uncontrolled cowbird parasitism (Service 1998). It is uncertain whether the vireo populations in Mexico are self-sustaining or are being augmented by dispersal of vireos from populations in the U. S.

The draft recovery plan includes a PVA for 8 vireo populations, including 7 of the 11 target recovery populations (*i.e.*, the Tijuana River, Sweetwater River, San Diego River, San Luis Rey River, Santa Margarita River, the Santa Ana River, and the Santa Ynez River; Service 1998). Based on historical data collected from the selected sites and reasoned assumptions about other demographic parameters for the vireo, the PVA concluded that vireo populations at seven of these eight sites had a zero probability of going extinct within the next 100 years. Only the Santa Ynez River population was determined to be at risk of extinction.

A fundamental assumption of this PVA was that intensive cowbird control (*i.e.*, cowbird trapping) would be continued at each of these locations into the future. The PVA was based on an average annual reproductive rate of 2.6 offspring produced per pair. Although this annual reproductive rate was based on empirical data, these rates are from populations that had high levels of cowbird control and low to moderate parasitism rates. Without cowbird control, the average annual reproductive rate is likely to decline substantially (Kus and Whitfield 2005). The draft recovery plan indicates that without intensive cowbird control, or some other solution to the continuing threat that cowbird parasitism poses to vireos (*i.e.*, development of sufficient anti-parasitism defenses by the vireo), that vireo populations at each of these sites are likely to return to the low levels that occurred at the time of the listing.

In summary, the U. S. population from Ventura County southward has increased significantly, while the population from Santa Barbara County northward has actually declined. At the time the draft recovery plan was distributed in 1998, there were no demographic features or trends identified that would indicate limitations on recovery. No limiting demographic features or trends have been identified since the development of the draft recovery plan.

Distribution

Greater than 99 percent of the remaining vireos were concentrated in southern California (Santa Barbara County and southward) at the time of the listing in 1986 (51 FR 16474), with San Diego County containing 77 percent of the population. Although the population has grown 10-fold since the listing, greater than 99 percent still remain in southern California (Table 2). The populations are now more evenly distributed in southern California with 54 percent of the total population occurring in San Diego County and 30 percent of the population occurring in Riverside County; however, there has been only a slight shift northward in the species' overall distribution. Historically, the San Joaquin and Sacramento Valleys were considered to be the center of the vireo's breeding range

(60 to 80 percent of the historic population; 51 FR 16474), but the vireo has not yet meaningfully re-colonized those areas. Thus, despite the significant increase in overall population numbers, the population remains constricted to the southern portion of its historic range.

Habitat Conditions
Riparian habitat suitable for vireos had declined by an estimated 95 percent at the time of the listing, primarily driven by anthropogenic modification (*e.g.*, flood control, water impoundment and diversion, urban development, agricultural conversion, and livestock grazing; Service 1998). An objective, systematic estimate of the amount of available riparian habitat in California does not currently exist, although estimates for smaller regions indicate stable to increasing riparian habitat (Faber 2003). The Riparian Habitat Joint Venture ("RHJV"; a cooperative association of Federal, State and private organizations) plans to systematically map existing riparian habitat in California starting in 2007 (RHJV 2006).

Though some unauthorized and not quantified loss of riparian habitat continues to occur (Hays 2006), and no systematic estimate of the State's available riparian habitat exists, riparian habitat in San Diego County appears to have stabilized since the listing of the vireo and has improved locally where afforded protection by the ESA and other Federal and State legislation (*i.e.*, Clean Water Act; California Fish and Game Code Sections 1600-1616 addressing lake or streambed alterations). It appears that riparian habitat connectivity may also be improving along the mainstems of some major rivers in southern California (*e.g.*, on the Santa Margarita, Santa Ana Rivers, and to a lesser extent the San Luis Rey River) due to giant reed removal, restoration, and the reduction of high impact activities like sand mining operations (Service 1998), but fragmentation may still be occurring on lower order tributary streams due to increasing urban development and associated flood control (Kus 2006).

In many situations where riparian habitat is impacted by authorized Federal and State actions, an equal or greater amount of riparian habitat is restored (*i.e.*, through active planting and maintenance of riparian habitat) or enhanced (*i.e.*, through giant reed and other exotic plant removal) to offset the impacts. Restoring or enhancing riparian habitat through giant reed removal has met with some success on the Santa Ana River in southern California (Hays 2006) and the Russian River (outside of the vireo's range) in northern California (Gaffney and Gledhill 2003).

Despite the localized and likely improved condition overall of Southern California's riparian habitats, associated native upland plant communities (*i.e.*, coastal sage scrub, chaparral, oak woodlands) adjacent to riparian habitat are not afforded the regulatory protections of wetlands because they are often outside of the jurisdiction of the regulatory agencies and thus do not receive the same degree of consideration when impacted by State and Federal actions. Although no baseline assessment is available, it appears that riparian areas are increasingly bordered by urbanization where they would have historically been bordered by native upland plant communities (Kus 2002). Vireo territories bordering on agricultural and urban areas are less successful in producing young than territories bordering on native upland plant communities (RECON 1989 *in* Kus 2002).

A thorough evaluation of the change in riparian habitat in the northern portion of the vireo's historic range (*i.e.*, the Salinas Valley, San Joaquin Valley, and Sacramento Valley) has not been conducted, but it appears that there has been substantially increased protection and restoration of riparian habitats in northern California (Faber 2003). Restoration of riparian habitat has occurred on the Cosumnes, Kern, Merced, Sacramento, and San Joaquin Rivers since the listing of the species (Faber 2003).

In summary, historic loss of riparian habitat contributed to the decline of the species and factored in the decision to list the vireo as endangered in 1986. Since then, the amount of riparian habitat loss has been reduced and to some extent restoration efforts have increased vireo habitat. Most of this improvement has occurred in southern California, although it appears that protection and restoration efforts in the northern portion of the vireo's historic range have been successful also.

Genetics and taxonomy
No in-depth studies of genetic variation in the least Bell's vireo have been published since the listing of the species. One study (Spiegelberg 1997) used genetic analyses to evaluate the incidence of extra-pair paternity in this species within a limited sample of vireo families (n = 12 families; "families" consist of both adults in a pair and at least one offspring) in San Diego County, but this study did not evaluate broader genetic variation within the subspecies or across subspecies. Spiegelberg (1997) found no evidence of extra-pair paternity among sampled vireos and considered this to be atypical among bird species.

No changes to the vireo taxonomic classification or the accepted nomenclature have been published or otherwise proposed since the listing.

II.C.2. Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms):

II.C.2.a. Present or threatened destruction, modification or curtailment of its habitat or range:

At the time of listing, loss of habitat due to agricultural practices, urbanization, and exotic plant invasion was identified as a major threat to vireo populations. Since the listing of the vireo, destruction and modification of riparian habitat within its current range has been curtailed significantly, primarily as a consequence of protections provided by the original listing in 1986 (51 FR 16474), the subsequent designation of critical habitat in 1994 (59 FR 4845), and other Federal and State regulatory processes.

Urbanization
Urbanization appears to have displaced former agriculture and grazing operations in

many areas within southern California, thereby indirectly reducing riparian habitat degradation caused by these activities. Agriculture and grazing continue to threaten riparian habitat within the larger historic range, particularly the Salinas, San Joaquin, and Sacramento valleys (Service 1998). Where the impacts of grazing and agriculture are reduced as a consequence of being displaced by urbanization, improved habitat quality may come at the cost of increased habitat fragmentation and decreased riparian/urban buffering.

Invasive Plants

Within the past decade, control of giant reed and other exotic plants has been and continues to be systematically conducted on both the Santa Ana River and at Camp Pendleton. This effort has been effective at removing giant reed over large portions of these specific population areas. Recovery of riparian habitat after giant reed removal has been limited at some locations, but recovery has been more noticeable on the Santa Ana River near Prado Basin (Hays 2006). In general, giant reed removal has been effective but will require continued annual efforts to achieve local eradications and address new invasions.

Giant reed removal on Camp Pendleton is currently a funding priority due to, in part, the endangered status of the vireo. Control of giant reed within the Santa Ana River Watershed is organized through a multi-agency partnership (Santa Ana Watershed Association, "SAWA") and is funded by the proceeds from an endowment and through competitive grants (Zembal *et al.* 2003). Giant reed removal has also been initiated within several other watersheds within southern California and has been organized through cooperative partnerships with funds provided from competitive grants (Natural Resources Conservation Service 2006). Giant reed is also found and has been recognized as a problem within northern California watersheds, and associated eradication efforts have been initiated at several locations (Sacramento and Russian Rivers; Faber 2003).

Although control of giant reed has made great progress since the original listing of the vireo, invasions by other exotic plants (*e.g.*, *Tamarix* species, perennial pepperweed [*Lepidium latifolium*]) continue to degrade existing riparian habitat and impede recovery efforts (Kus and Beck 1998; Hoffman and Zembal 2006).

Protection and Restoration

A primary factor to consider in addressing the current threat of vireo habitat destruction and modification is today's greater public awareness of the value of riparian habitat to conserving California's overall biodiversity. The importance of conserving California's riparian habitats is widely recognized by Federal, State, and private partnerships such as the California Riparian Habitat Conservation Program formed by State law in 1991, the California Chapter of Partners in Flight (CalPIF) established in 1992, and the California Riparian Habitat Joint Venture initiated (RHJV) by CalPIF in 1994. These programs share the common mission of coordinating and implementing conservation efforts aimed at protecting and restoring California's riparian ecosystems.

Rehabilitation of riparian habitats and processes has been identified as a major conservation priority in California (RHJV 2006), leading to many riparian restoration and conservation actions that are not driven by Federal or State regulatory processes (Faber 2003). Compliance driven and voluntary riparian restoration activities throughout the historic range may have contributed to an increase in riparian habitat since the listing of the vireo, although this cannot be established without a thorough evaluation of riparian habitat within California.

In summary, the trend of riparian habitat loss and degradation appears to have been substantially abated, and possibly reversed on a local level. While there are currently no quantified, range-wide estimates of the change in riparian habitat since the listing (see section II.C.1.e), there is recognition that the degree of threat to the vireo caused by habitat loss has been significantly reduced, albeit not entirely eliminated.

II.C.2.b. Overutilization for commercial, recreational, scientific, or educational purposes:

Overutilization has not been identified as a threat to the vireo.

II.C.2.c. Disease or predation:

Nest predation (*i.e.*, by native and introduced nest predators; see Service 1998) rates between 25 to 40 percent were reported in the listing rule, which was considered abnormally high by the Service at the time of the listing in 1986. Although nest predation rates on vireos can exceed 60 percent of the vireo nests in a given area within a year (Kus 1999), typical nest predation rates average around 30 percent (Franzreb 1989). Although nest predation rates for this species appear to be high, they are comparable to nest predation rates for other North American passerines (Martin and Clobert 1996).

In highly urbanized areas, where habitat is fragmented and upland plant community buffers are minimal or non-existent, there is a potential for an increase in nest and adult predation due to mesopredator release and/or the addition of non-native predators (*i.e.*, domestic cats, *Felis catus*) (Crooks and Soule 1999). This process may lead to local extirpation of small, isolated bird populations. The only empirical study (Peterson 2002; Peterson *et al.* 2004) that has directly investigated vireo nest predation relative to habitat fragmentation found that most local landscape features (including urbanization) did not appear to elevate vireo nest predation rates; from a larger spatial perspective, nest predation appeared to be a somewhat random process. There have been no studies published that directly investigate the impact of domestic cats on adult or nestling vireos, although Peterson *et al.* (2004) did not observe vireo depredation by domestic cats or detect them in the vicinity of vireo nests.

Argentine ants (*Linepithema humile*), a non-native ant species whose spread is generally believed to be augmented by urbanization (Suarez *et al.* 1998), has been observed to be a predator of vireo nests where they co-occur (Peterson *et al.* 2004). Although not identified as a threat at the time of the listing, Argentine ants may pose a problem to vireos if the riparian-urban interface of occupied vireo habitat increases without adequate buffers.

Although background nest predation rates on vireos reported at the time of listing appeared high, they are comparable to that of other species (Martin and Clobert 1996) and do not appear to have impeded vireo population expansion where cowbird control and riparian habitat conservation has been effective (*e.g.*, at Camp Pendleton and at the Prado Basin on the Santa Ana River; Griffith and Griffith 2000; Zembal *et al.* 2003). With a continued increase in riparian habitat conservation and restoration (as described in sections II.C.1.e and II.C.2.a), the potential risk of increased predation due to habitat fragmentation (as listed in 51 FR 16474) has and should continue to decline. Predation does not currently appear to constitute an imminent threat to the survival of the vireo. Expansion of the Argentine ant population in association with ongoing urban development may constitute a previously unrecognized predation threat to the vireo, but this threat needs further study.

West Nile virus is a potential disease threat not known at the time of the listing. The vireo has likely been exposed to West Nile virus, as displayed by *Corvus sp.* mortalities in Los Angeles and Orange Counties (Turell *et al.* 2002, 2005; Reisen *et al.* 2006); however, direct mortalities of vireos from this disease have not been reported.

II.C.2.d. Inadequacy of existing regulatory mechanisms:

State Protections

Least Bell's vireo is listed as an endangered species under the California Endangered Species Act of 1984 (CESA). This legislation requires State agencies to consult with the California Department of Fish and Game (CDFG) on activities that may affect a State-listed species and mitigate for any adverse impacts to the species or its habitat.

The California Environmental Quality Act (CEQA) requires review of any project that is undertaken, funded, or permitted by the State or a local governmental agency. If significant effects are identified, the lead agency has the option of requiring mitigation through changes in the project or to decide that overriding considerations make mitigation infeasible (CEQA Sec. 21002). In the latter case, projects may be approved that cause significant environmental damage, such as destruction of listed endangered species or their habitat. Protection of listed species through CEQA is, therefore, dependent upon the discretion of the lead agency involved.

The Natural Communities Conservation Planning Act (NCCP) program purpose is to conserve natural communities at the ecosystem scale while accommodating compatible land use, including urban development. NCCPs identify and provide for the regional or area-wide protection of plants, animals, and their habitats, while allowing compatible and appropriate economic activity.

Another state regulatory program promoting the recovery of the vireo is the California Lake and Streambed Alteration Program (California Fish and Game Code Sections 1600-

1616). This program provides a permitting process to reduce impacts to fish and wildlife from projects affecting important water resources of the State, including lakes, streams, and rivers. Because riparian habitats are closely associated with lakes, streams, and rivers, this program provides recognition of the importance of riparian habitats to sustaining California's fish and wildlife species and helps prevent the loss and degradation of riparian habitats important to the vireo.

Federal Protections

The National Environmental Policy Act (NEPA) provides some protection for least Bell's vireo. For activities undertaken, authorized, or funded by Federal agencies, NEPA requires the project be analyzed for potential impacts to the human environment prior to implementation (42 U.S.C. 4371 et seq.). For instances where that analysis reveals significant environmental effects, the Federal agency must propose mitigations that could offset those effects (40 CFR 1502.16). These mitigations are usually developed in coordination with the Service during section 7 consultation and should provide some protection for listed species. However, NEPA does not require that adverse impacts be fully mitigated, and so some impacts could still occur. Additionally, NEPA is only required for projects with a Federal nexus, and therefore, actions taken by private landowners are not required to comply with this law.

Under section 404 of the Clean Water Act, the USACE regulates the discharge of fill material into waters of the United States, which include navigable and isolated waters, headwaters, and adjacent wetlands (33 U.S.C. 1344). In general, the term "wetland" refers to areas meeting the USACE criteria of having hydric soils, hydrology (either sufficient flooding or water on the soil surface), and hydrophytic vegetation (plants specifically adapted for growing in wetlands). Any actions within the vireo's habitat that has the potential to impact waters of the United States would be reviewed under the Clean Water Act as well as NEPA and the Endangered Species Act. These reviews would require consideration of impacts to the vireo and its habitat, and when significant impacts could occur, mitigations would be recommended.

The Endangered Species Act (Act) is the primary Federal law providing protection for the vireo. Since its listing, the Service has analyzed the potential effects of many projects under section 7(a)(2) of the Act, which requires Federal agencies to consult with the Service prior to authorizing, funding, or carrying out activities that may affect listed species. A jeopardy determination is made for a project that is reasonably expected, either directly or indirectly, to appreciably reduce the likelihood of both the survival and recovery of a listed species in the wild or reducing its reproduction, numbers or distribution (50 CFR § 402.02). A non-jeopardy opinion may include reasonable and prudent measures that minimize the amount or extent of incidental take of vireo from a project. Incidental take refers to taking that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by a Federal agency or applicant (50 CFR § 402.02). While projects that are likely to result in adverse effects often include minimization measures, the Service is limited to requesting minor modifications in the project description. In instances where some incidental take is unavoidable, the Service requires that additional measures be performed by the project proponents to compensate for negative impacts.

A prime example of the protection provided by the Act is the conservation benefit that resulted at two main population centers at Camp Pendleton and within the Prado Basin of the Santa Ana River. Interagency section 7 consultations made necessary by the listing of the vireo were the basis of existing Federal partnerships between the Service and the U. S. Marine Corps and the USACE aimed at promoting the recovery of the vireo. Coordination of Federal agency actions at these two essential locations has resulted in significant habitat management, habitat restoration, and research activities. Today, these two populations support the largest concentrations of vireo and likely represent the major source populations providing for expansion of the vireo in southern California (Griffith and Griffith 2000; Zembal *et al.* 2003).

Incidental take permits, pursuant to Section 10(a)(1)(B) of the Act, may be issued for projects without a Federal nexus. This section provides protection for vireo through the approval of habitat conservation plans (HCPs) that detail measures to minimize and mitigate the potential impacts of the project to the maximum extent practicable. Regional HCPs in San Diego, Orange, and Riverside counties now provide an additional layer of regulatory protection for the vireo over much of its current range, and these HCPs are coordinated with the related NCCP-State program identified above. This regulatory protection was not wholly realized prior to the listing of the vireo. The vireo is now a "covered species" under most existing and planned regional NCCP/HCPs in southern California. Under any permitted NCCP/HCP, covered species conservation is provided regardless of the Federal or State-listed status of a species. Thus, even if the status of the vireo was changed under the Act, the requirements for vireo conservation under the existing regional NCCP/HCPs would remain in effect for the life of the permit (generally 50 to 75 years), and most of the habitat protection and management benefits would continue in perpetuity.

Protection on Department of Defense Lands

The Sikes Act (16 U.S.C. 670) authorizes the Secretary of Defense to develop cooperative plans for conservation and rehabilitation programs on military reservations and to establish outdoor recreation facilities. The Sikes Act also provides for the Secretaries of Agriculture and the Interior to develop cooperative plans for conservation and rehabilitation programs on public lands under their jurisdiction. While the Sikes Act of 1960 was in effect at the time of the vireo's listing, it was not until the amendment of 1997 (Sikes Act Improvement Act) that Department of Defense (DOD) installations were required to prepare Integrated Natural Resource Management Plans (INRMP). Consistent with the use of military installations to ensure the readiness of the Armed Forces, INRMPs provide for the conservation and rehabilitation of natural resources on military lands. They incorporate, to the maximum extent practicable, ecosystem management principles and provide the landscape necessary to sustain military land uses. While INRMPs are not technically a regulatory mechanism because their implementation is subject to funding availability, they address the conservation of natural resources on military lands and can be an added conservation tool in promoting the recovery of endangered and threatened species.

In 2001, the Marine Corps adopted an INRMP for Camp Pendleton (U.S. Marine Corps 2001). Like other INRMPs, it is largely ecosystem-based except where biological opinions direct species-specific actions. Camp Pendleton's INRMP incorporated the Service's *1995 Biological Opinion on Programmatic Activities and Conservation Plans in Riparian and Estuarine/Beach Ecosystems on Marine Corps Base, Camp Pendleton* (1-6-95-F-02) (the "Riparian BO"), which addresses the majority of vireo breeding habitat at Camp Pendleton. Because it incorporates the provisions of this consultation, Camp Pendleton's INRMP provides specific direction regarding vireo management and conservation. It is possible, therefore, that management actions specific to maintaining vireo populations at Camp Pendleton (such as cowbird trapping) may receive lower priority under the current INRMP if the vireo was no longer listed under the ESA. The INRMP would likely continue to provide benefit to the vireo through the protection and management of its habitat; however, these benefits would be subject to military funding allocations that generally give higher priority to endangered species management issues.

Prior to its listing in 1986, the vireo was also afforded the regulatory protections of the Migratory Bird Treaty Act, which prohibits generally the take, capture, killing, or possession of migratory birds, their eggs, parts, and nests but does not protect habitat except where habitat alterations would directly kill or injure birds (*e.g.*, felling a tree with an active nest). On January 10, 2001, Executive Order 13186 was issued to address the responsibilities of Federal Agencies to Protect Migratory Birds. The Executive Order directed Federal agencies whose actions have a measurable negative impact on migratory bird populations to develop Memoranda of Understanding (MOU) with the Service to promote the conservation of migratory birds. Under a July 31, 2006, Memorandum of Understanding (MOU) between the Service and the Department of Defense (DoD), the vireo, as a migratory bird species, will receive certain benefits on DoD lands.

The MOU addresses certain DoD activities including natural resources management, installation support functions, industrial activities, routine construction or demolition activities, and hazardous waste cleanup. Through the MOU, the parties will strive to protect migratory birds, work to protect habitat adjacent to DoD lands, and promote collaborative projects. Additionally, the DoD will follow migratory bird permitting requirements, incorporate or encourage incorporation of migratory bird conservation into INRMPs and other environmental documents, manage military lands and non-military readiness activities in a manner that supports migratory bird conservation, and develop and/or implement monitoring programs. The MOU provides that the management of DoD installations should be done in consideration to habitat protection (with specific attention to riparian habitats), fire and fuels management, and invasive species management.

Like INRMPs, this MOU is subject to budgetary limits; however, it provides an added level of recognition to the importance of conserving migratory birds and their habitats that was not in existence at the time the vireo was listed. We anticipate that this MOU will further emphasize the importance of riparian vegetation communities (vireo habitat) to decision makers on DoD installations, such as Camp Pendleton, and otherwise promote migratory bird conservation, which could directly or indirectly benefit vireo recovery.

Summary of Factor D

In summary, at the time of the vireo listing in 1986, Federal and State laws, while in place, were not effective in reducing impacts to riparian habitats suitable for vireo, which had declined by an estimated 95 percent (51 FR 16474). Listing of the vireo provided greater incentives for Federal agencies to conserve and manage vireo habitat. At the same time, planning and development of regional NCCP/HCPs in Southern California provided additional conservation benefits to the vireo on private lands. In recent years, greater emphasis has been placed on conserving natural resources and, in particular, migratory birds, on military lands. With these overall improvements, it is unlikely that the increasing trend for riparian habitat conservation would be negatively affected by a change in the legal status of the vireo under the ESA. Thus, the inadequacy of existing regulatory mechanisms is no longer a primary threat to the recovery of the vireo.

II.C.2.e. Other natural or manmade factors affecting its continued existence:

The 1986 listing rule identifies brood parasitism by cowbirds as a substantial threat to the vireo. As noted in the rule, cowbirds were historically rare within the range of the vireo. Laymon (1987) detailed the rapid spread of cowbirds across California: the invasion started in the southeast in about 1900, expanded throughout southern California by 1920, and spread through the northern portion of the vireo's historical range by the 1940s. Cowbirds are now common throughout most of the current range of the vireo (Garrett and Dunn 1981). It is thought that the meteoric rise and expansion of cowbirds is largely due to anthropogenic changes in the landscape (Rothstein 1994).

Brood parasitism represents a novel threat to the vireo, in evolutionary terms. The first documentation of brood parasitism in this subspecies was in 1907 (Linton 1908; Franzreb 1987). Grinnell and Miller (1944) noted that cowbirds heavily parasitize the vireo. They also indicated a "noticeable decline" in the vireo, "apparently coincident with [the] increase of cowbirds." Brown (1993) summarized nest parasitism rates for the vireo to be between 30 and 50 percent. Nest parasitism rates in some populations of vireos have been as high as 80 percent (Jones 1985 *in* Franzreb 1987). As modeled by Laymon (1987), nest parasitism rates of 30 to 48 percent would allow vireo populations to be unstable, potentially suffering extinction from stochastic events, while rates higher than 48 percent would lead to extinction in a short time. More recently, Kus and Whitfield (2005) found that annual productivity of vireos increased by one young for each drop of 30 percent in parasitism frequency.

To promote recovery of the vireo, cowbird management has been implemented in many areas. This management has primarily been implemented through cowbird trapping programs initiated as a result of the ESA section 7 interagency consultation process. Cowbird trapping has been especially effective at the local level. For example, on Camp Pendleton (Griffith and Griffith 2000; Griffith Wildlife Biology 2001) and at the

Sweetwater Reservoir (Famolaro 2006) active cowbird control has, at least over the short term, reduced the rate of cowbird nest parasitism in least Bell's vireos to nearly 0 percent. Cowbird trapping, in general, has been attributed in promoting an increase in the overall vireo population rangewide (Kus 1999; Kus and Whitfield 2005). Despite the intensive trapping that has occurred at some locations over a number of years, it does not appear that cowbird numbers have been affected (Griffith Wildlife Biology 2004).

Although cowbird trapping has been lauded as a short-term management technique, it has been criticized for not promoting the long-term recovery of the vireo. Both Kus and Whitfield (2005) and Peer *et al.* (2005) have suggested that removing cowbirds from the vireo's environment limits or prevents selective pressures that may allow the vireo to evolve nest parasitism defenses. If the vireo had natural defenses to brood parasitism, they argue, cowbird trapping would not be necessary (Kus and Whitfield 2005; Peer *et al.* 2005). Such defenses have been observed in the nominate subspecies of the Bell's vireo (*V. b. bellii*), which has been in contact with cowbirds over a longer period of evolutionary time (Parker 1999).

Further, Sharp and Kus (2006) found that high microhabitat cover around vireo nests reduces the rate of cowbird parasitism. They suggest that the effect of cowbirds on vireos can be managed through management of vireo habitat. Also, Rothstein (2004 *in* Peer *et al.* 2005) suggests that small host populations may be parasitized more heavily than larger host populations.

In summary, cowbird nest parasitism continues to be a significant threat to the vireo. Cowbird trapping has proven a successful tool to halt vireo population declines over the short term, but trapping may not be the best method for long-term recovery of the vireo. It remains unclear as to the best way to manage this threat and additional research is needed to resolve this issue.

II.D. Synthesis:

The vireo population has grown robustly since the listing in 1986, primarily in response to improvements in habitat abundance and quality and effective cowbird control. The rapid loss and degradation of riparian habitat occurring across the vireo's range prior to the listing appears to have been halted and possibly reversed to some degree. Listing of the vireo under the ESA helped bring about a greater awareness of the importance of conserving riparian habitats for the benefit of many wildlife species.

Several regional NCCP/HCPs have been developed that include long-term conservation goals for vireo. Additional protections have been added for migratory bird conservation on military lands through the Sikes Act Improvement Act and the 2006 MOU between the Service and DoD. More effective implementation of Federal and State regulatory programs addressing water resource issues directly and indirectly provide conservation benefits to riparian habitats and the vireo, and public/private partnerships are now in existence with the specific mission of conserving riparian habitats and migratory birds, including the vireo.

Although nest parasitism by cowbirds has been reduced on a local level in southern California, it remains the primary threat limiting the vireo's overall recovery. A PVA conducted in 1998 determined that vireo populations at seven significant sites would not likely go extinct within the next 100 years, as long as habitat size and quality remains the same or increases and cowbird control continues. Thus, to sustain the vireo, continued cowbird control and exotic plant removal in riparian areas are likely to be necessary for the foreseeable future. Confounding the issue of nest parasitism by cowbirds, new studies have questioned the use of cowbird trapping as the only management tool in recovering the vireo over the long-term, and additional research is needed to resolve this issue.

Although the vireo has not met the downlisting goals of the draft recovery plan for several hundred or more breeding pairs of vireo at all 11 identified sites, these goals were not habitat-based, and the overall population trend since the time of the listing for 10 of the 11 sites has been positive. Despite the ongoing threat of nest parasitism by cowbirds, the vireo population has increased by 10-fold since the time of its listing to an estimated 2,968 territories. Cowbird trapping is well established at Camp Pendleton and within the Prado Basin of the Santa Ana River, which support the two largest concentrations of vireo. Wholesale loss and degradation of riparian habitats has halted, and riparian habitat restoration efforts are ongoing. This suggests that the species is no longer in danger of extinction throughout all or a significant portion of its range and warrants reclassification to threatened status.

We are not recommending delisting of the vireo at this time because: 1) further research is needed to address the primary threat of cowbird parasitism on the long-term recovery of the vireo; 2) without intensive cowbird control at the main population sites, which is linked to section 7 consultations under the Act, or new evidence to suggest that vireo can persist without management intervention, vireo populations are likely to return to the low levels that necessitated its listing; 3) the PVA determined that there was no imminent threat of extinction to the vireo, but this was based on maintaining reproductive rates correlated with cowbird control; and 4) draft recovery goals established for delisting need further assessment based on current knowledge of population trends and species distribution throughout the State.

III. RESULTS

III.A. Recommended Classification: Downlist to threatened status.

III.B. New Recovery Priority Number:

9. Per our listing and recovery priority guidance for threatened or endangered species (48 FR 43098), the least Bell's vireo, as a subspecies with moderate degree of threat and a high recovery potential, has a recovery priority number of 9. Much of the past economic conflict has been alleviated within the vireo's current range through ESA section 7 consultations and regional HCPs.

III.C. If a reclassification is recommended, indicate the Listing and Reclassification

Priority Number (FWS only):

This species should be given a reclassification priority of "4," which indicates an unpetitioned action with a moderate management impact.

IV. RECOMMENDATIONS FOR FUTURE ACTIONS

1. Complete a functional recovery plan for the vireo with realistic, objectively based recovery goals.

2. Provide funding and technical support for further studies investigating continuing threats to the vireo from cowbird parasitism, exotic plant invasion of riparian habitats, and potentially elevated predation pressures due to habitat fragmentation or presence of exotic predators (*i.e.*, domestic cats and Argentine ants).

3. Complete an assessment or support other efforts (such as the RHJV effort) to assess the amount and distribution of riparian habitat in California including:

    a. Establishment of baseline values for comparison to past and future estimates, including an assessment of various riparian habitat subtypes.

    b. An evaluation of changes in distribution and connectivity of riparian habitat at different stream-order levels (*i.e.*, primary, secondary, tertiary, *etc.*).

    c. An evaluation of the amount of riparian habitat restoration attempted and successfully completed since the listing, including restoration not driven by regulatory compliance.

4. Develop and implement:

    a. A systematic survey program to locate vireo re-colonizations of the Salinas, San Joaquin, and Sacramento Valleys so that appropriate management can be developed and implemented.

    b. Systematic survey programs for watersheds in southern California that are no longer regularly surveyed within a given 5-year period (*e.g.,* Dulzura Creek/Jamul Creek/Otay River, San Diego River, San Dieguito River/Santa Ysabel Creek, San Gabriel River, *etc.*). It is possible that these systematic surveys may need to rely on volunteer efforts organized and supported by the Service.

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U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of Least Bell's Vireo (*Vireo bellii pusillus*)

Current Classification: endangered

Recommendation resulting from the 5-Year Review:

_X_ Downlist to Threatened

____ Uplist to Endangered

____ Delist

____ No change needed

Appropriate Listing/Reclassification Priority Number, if applicable: 4

Review Conducted By: Karen Geobel, Gjon Hazard and Peter Beck

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve ______________________ Date 9-21-06

REGIONAL OFFICE APPROVAL:

Lead Regional Director, Fish and Wildlife Service

Approve ______________________ Date 9/20/2006

EXHIBIT L

Least Bell's Vireo

As part of a 1993 agreement with the U.S. Army Corps of Engineers (Corps), OCWD agreed to manage more than 124 acres behind Prado Dam as protective habitat for the least Bell's vireo and to provide $1 million for a vireo monitoring program. The program included restoration of habitat and the trapping of cowbirds that parasitize vireo nests. Subsequent agreements increased the acreage of habitat under OCWD's management.

A crucial factor in determining allowable water storage elevations behind Prado Dam was the protection of the least Bell's vireo, a small endangered songbird that nests in the willows of Prado Basin. The U.S. Fish and Wildlife Service (USFWS) required that habitat areas be reserved for the vireo as mitigation for higher levels of water conservation.

OCWD's vireo mitigation program has been one of California's great environmental success stories. To date, OCWD has created more than 800 acres of habitat for the least Bell's vireo as well as another endangered species, the southwestern willow flycatcher, and has funded more than $3 million in mitigation and monitoring measures for the vireo program. Through these restoration activities, OCWD has made significant contributions towards the recovery of vireo. In the mid-1980s, the vireo population had dropped to less than 20 breeding pairs. A 2010 survey identified 569 territorial males in the Prado Basin with 1,200 territories in the Santa Ana River watershed. Plans are underway to create additional river edge habitat, the preferred habitat of the flycatcher, in order to increase the population of this endangered bird.

About least Bell's vireo:

The least Bell's vireo is a small migratory songbird that nests in Southern California. The vireo was listed as endangered by the California Department of Fish and Game in 1980, and by the U.S. Fish and Wildlife Service in 1986 because of loss and degradation of its riparian habitat and the alarming reduction in its numbers in California. By the time this once common migratory songbird was listed, only 300 pairs were left breeding in the entire state of California, including all of its former range other than a small part of northern Baja California, Mexico. At that time only 19 pairs were identified in Prado Basin.

The plight of the vireo and many other nesting songbirds became a focus for management efforts in the basin. Multiple partnerships were formed; agreements were signed; and management and restoration efforts were launched to restore and protect riparian forests and their avian inhabitants. The U.S. Army Corps of Engineers sponsored the work by a Fish and Wildlife Service staff member that led to the discovery of the vireos in Prado Basin and instituted their monitoring and management. The California Department of Transportation and the Nature Conservancy were two additional early partners. OCWD stepped in and started funding the program that is now more than 19 years old.

Management of the vireo in Prado Basin includes removal and management of exotic non-native vegetation, restoring its riparian habitat, monitoring the vireo population and interceding on the vireo's behalf when warranted, trapping and removing brown-headed cowbirds from the habitat, and since 1997, duplicating these efforts throughout the entire Santa Ana River watershed.

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<u>EXHIBIT M</u>

CHARACTERISTICS OF LEAST BELL'S VIREO NEST SITES ALONG THE SANTA YNEZ RIVER[1]

Thomas E. Olson and M. Violet Gray [2]

Abstract: Due primarily to alteration of riparian vegetation and nest parasitism by brown-headed cowbirds (Molothrus ater), *the least Bell's vireo* (Vireo bellii pusillus) *has undergone a tremendous decline in range and numbers since the 1920's. In 1987, we sampled vegetation at 32 nest sites to characterize nesting habitat of least Bell's vireos in the Santa Ynez River drainage. Most next (59.4%) were located in willows* (Salix spp.) *or mugwort* (Artemisia douglasiana) *at heights of less than 1 m. Vireos selected sites with relatively dense vegetative cover in the vicinity of the nests. Herbaceous species and dead plant material comprised much of the nesting cover.*

The least Bell's vireo nests in California and northwestern Baja California, and winters in southern Baja California. It is one of four recognized subspecies of Bell's vireo (*Vireo bellii*) (American Ornithologists' Union 1983). Nests are usually constructed in dense, willow-dominated riparian vegetation within 3 m of the ground.

Although formerly a common to abundant breeding species in the Central Valley and other low-elevation riparian zones in California, the least Bell's vireo has undergone a dramatic decline in abundance and distribution. Despite a substantial decrease in numbers that began as early as the 1920s, this species was still widely distributed within California in the 1940s, extending northward to Red Bluff, Tehama County (Grinnell and Miller 1944). Since that time, the number and breeding range of least Bell's vireos have steadily decreased, with all northern California populations believed to be extirpated by 1970 (Goldwasser and others 1980). The decline has been attributed primarily to: (1) alteration and destruction of riparian vegetation that comprises suitable breeding habitat; and (2) nest parasitism by brown-headed cowbirds. Because of this decline, the least Bell's vireo is a state-and federal-listed endangered species.

The population in California in 1985 was estimated at approximately 300 pairs, based primarily on surveys conducted during the previous 12 years by Gaines (1974, 1977), Goldwasser (1978, 1981), Goldwasser and others (1980), and Gray and Greaves (1984). Nearly 20 percent of that total occurred along the Santa Ynez River in Santa Barbara County.

Continued residential and industrial development in southern and central California has increased the demand for water projects that could result in further alteration of least Bell's vireo nesting habitat. Information about this endangered species must be developed to resolve current and future conflicts between the demands of an increasing human population and habitat requirements of the least Bell's vireo. Such information will be necessary to mitigate adverse effects to vireos. The objective of this study was to characterize nest sites of least Bell's vireos and to describe trends in use of nesting habitat within the Santa Ynez River drainage.

Study Area and Methods

We sampled vegetation at 32 least Bell's vireo nest sites in 1987 along the Santa Ynez River in Santa Barbara County (fig. 1). The study area was located approximately 10 km north of Santa Barbara and included the eastern end of Gibraltar Reservoir, a 3-km portion of the Santa Ynez River upstream from the reservoir, and Mono Creek from its confluence with the Santa Ynez River to the Mono Debris Basin.

Approximately 240 ha of suitable vireo breeding habitat occurred in the study area. Riparian vegetation types included cottonwood forest, willow woodland, riparian scrub, and dry wash. Dominant overstory species were Fremont cottonwood (*Populus fremontii*), arroyo willow (*Salix lasiolepis*), and red willow (*S. laevigata*). Common species in a diverse understory included mugwort (*Artemisia douglasiana*), mule fat (*Baccharis salicifolia*), and willow (*Salix* spp.) shrubs. Adjacent vegetation types were primarily chaparral, with smaller areas of oak woodland. Unlike most areas where least Bell's vireos nest in California, this study area was completely publicly owned and administered (United States Forest Service and the City of Santa Barbara). As such, little disturbance occurred in the study area and surrounding buffer areas.

[1] Presented at the California Riparian Systems Conference; September 22-24, 1988; Davis, California.

[2] Terrestrial Biologist, Dames & Moore, Goleta, California; Independent Consultant, Santa Barbara, California.

Figure 1— The study area was located along Gibraltar Reservoir, the Santa Ynez River, and Mono Creek in Santa Barbara County, California.

Vegetation was sampled at 18 successful and 14 unsuccessful least Bell's vireo nest sites using methodology modified from James (1971). Similar methodology has been used in other studies of least Bell's vireos. Successful nests were defined as those from which at least one young vireo fledged. At each nest site, a 0.04-ha circle was established, centered on the nest. In addition, two 20-m by 2-m transects were established across the circle. These transects were oriented parallel and perpendicular to the main stream channel and were divided into 10 cells, each 2 m by 2 m. All vegetation sampling was done after nesting activity had ceased.

Data collection was completed in three parts: At the nest, within the 0.04-ha circle, and along the 20-m by 2-m transects. The species and height of the nest substrate plants were recorded, as well as the height of the nest above the ground.

Within the 0.04-ha circle, the species, height, and diameter at breast height (DBH) of all trees (DBH ≥ 7.5 cm) were noted. The physical and vegetative characteristics of the habitat were diagramatically sketched and qualitatively described.

Along the two transects, we determined stem density by counting the number of stems of forbs, shrubs, and young trees (DBH < 7.5 cm) within each cell. Vertical foliage density was measured along the transects by placing a 4-m sampling rod at the edge of each cell farthest from the nest. Plant species (leaves or stems) impinging upon the sampling rod were recorded as "foliage hits" in five height intervals: 0-0.2 m, 0.2-1.0 m, 1.0-2.0 m, 2.0-4.0 m, and >4.0 m. Hits in the latter interval were visually estimated. Foliage density in each height interval at a given nest site was represented by the total number of hits at 20 stops (sampling points).

Results

In 1987, least Bell's vireo nests in the study area were generally located in vegetation characterized by riparian species. Nineteen (59 percent) nest sites, however, occurred on flood plain terraces 2-5 m above the level of the main river channel. Those nests were located 10-200 m laterally from the nearest edge of the channel and were situated in vegetation cover that also included upland species, such as summer mustard (*Brassica geniculata*), coast live oak *(Quercus agrifolia),* star thistle (*Centaurea soltitialis*), and annual grasses. In contrast, only 10 (31 percent) nests were located within 3 m of the main river channel.

Eleven different plant species were used as nest substrate (table 1). Nineteen of 32 nests (59.4 percent) occurred in 4 species: arroyo willow, red willow, narrowleaf willow (*Salix exigua*), and mugwort. The remaining 13 (40.6 percent) nests were located in 7 different species. The species of substrate plant used did not influence nesting success (x^2, P > 0.50).

Most nests were situated at relatively low heights. Mean nest height was 70.6 ± 3.5 cm (table 2). There was no difference between mean nest height of successful (66.3 cm) and unsuccessful (72.8 cm) nests (*t*, 0.20 < *P* < 0.40). Although nearly half of all nests were located in willow species which are capable of developing into large canopy trees, mean total height of all nest substrate plants was only 2.8 ± 0.4m. Vireos used a variety of growth forms as nest substrate, including shrubs, upright trees, and trees previously downed in floods that continued to grow horizontally. Mean height of substrate plants did not differ between successful (2.6 m) and unsuccessful (2.9 m) nests (*t, P* > 0.50). Nest height expressed as percent of total height of the nest substrate plant varied considerably. The mean was 32.5 ± 3.0 percent, with a range of 4-78 percent. Mean values for successful (32.4 percent) and unsuccessful (32.6 percent) nests were similar (*t, P* > 0.50).

Table 1 – Plant species used by least Bell's vireos as nest substrate, Santa Ynez River, 1987.

Species	Number of nests			Percent of total
	Successful	Unsuccessful	All nests	
Arroyo willow *Salix lasiolepis*	4	2	6	18.9
Red willow *S. laevigata*	3	2	5	15.6
Narrowleaf willow *S. exigua*	3	1	4	12.5
Mugwort *Artemisia douglasiana*	1	3	4	12.5
Mule fat *Baccharis salicifolia*	2	1	3	9.4
Fremont cottonwood *Populus fremontii*	0	3	3	9.4
California blackberry *Rubus ursinus*	2	0	2	6.2
Summer mustard *Brassica geniculata*	1	0	1	3.1
Star thistle *Centaurea solstitialis*	1	0	1	3.1
Coast live oak *Quercus agrifolia*	0	1	1	3.1
California wild rose *Rosa californica*	0	1	1	3.1
California blackberry *Rubus ursinus*-mugwort *Artemisia douglasiana*	1	0	1	3.1
Total	18	14	32	100.0

Table 2— Height of nests and substrate plants, Santa Ynez River, 1987.

Nest Characteristic	Mean Sue-cessful (n=18)	Mean Unsuc-cessful (n=14)	Mean All nests (n=32)	Range for all nests
Height of nest above ground (cm)	66.3	72.8	70.6	37-118
Total height of substrate plant (m)	2.6	2.9	2.8	0.8-12.2
Nest height as pct of substrate plant height	32.4	32.6	32.5	4-78

Although the density of foliage within different height intervals at the nest sites was relatively constant, greatest density at successful and unsuccessful nests occurred from 0.2 to 1.0 m (fig. 2) Below 1.0 m, mugwort and summer mustard contributed most to foliage density. Above 1.0 m, foliage density was comprised mostly of mule fat, Fremont cottonwood, and willows. Similar to foliage density, plant species richness was somewhat greater in the 0.2-1.0 m interval than in other intervals. Overall number of species encountered within various height intervals at all nest sites included 20 at 0-0.2 m, 22 at 0.2-1.0 m, 18 at 1.0-2.0 m, 14 at 2.0-4.0 m, and 7 over 4.0 m.

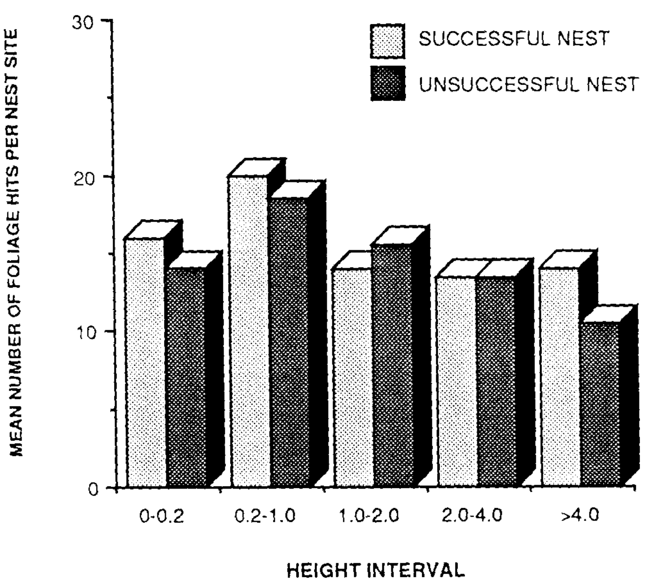


Figure 2– Vertical foliage density at successful and unsuccessful nest sites as expressed by the mean of foliage hits per nest site, Santa Ynez River, 1987.

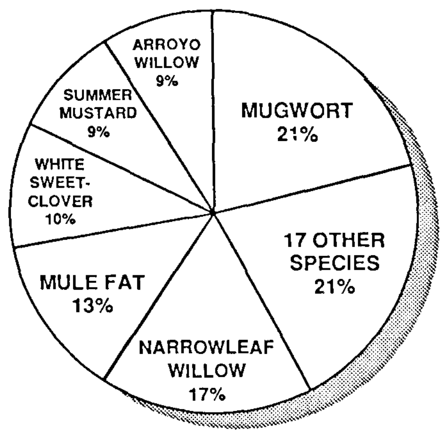
Density and species richness of foliage at various height intervals were similar between successful and unsuccessful nests. However, mean species richness in the 0.2-1.0 m interval was greater at successful nest sites (5.2) than at unsuccessful nest sites (4.1) (*t*, $0.02 < P < 0.05$), perhaps indicating better nesting cover at the former sites. An apparent difference noted in the >4.0 m interval (13.5 foliage hits per successful site, compared to 10.5 foliage hits per unsuccessful site) was not significant (*t*, $0.20 < P < 0.30$).

The mean stem density of herbs, shrubs, and saplings (< 7.5 cm diameter) at breast height for the 32 nest sites was 45,668 ± 619 per ha. The range of stem densities was considerable: 6,875-190,000 stems per ha. Mean stem densities at successful (42, 305 ± 4317 stems per ha) and unsuccessful (49, 991 ± 13,239 stems per ha) nests were not different (*t*, $P > 0.50$). Of 23 plant species recorded at breast height, 6 accounted for 79 (successful nests) to 89 (unsuccessful nests) percent of all sterns: mugwort, narrowleaf willow, mule fat, arroyo willow, white sweetclover *(Melilotus albus)*, and summer mustard (fig. 3). Thirty-four percent of the stems recorded at all nest sites were dead, primarily mugwort, with lesser amounts of mule fat, summer mustard, willows, and star thistle. The proportion of sterns that were dead did not differ between successful (33 percent) and unsuccessful (36 percent) nests (t, $P > 0.50$).

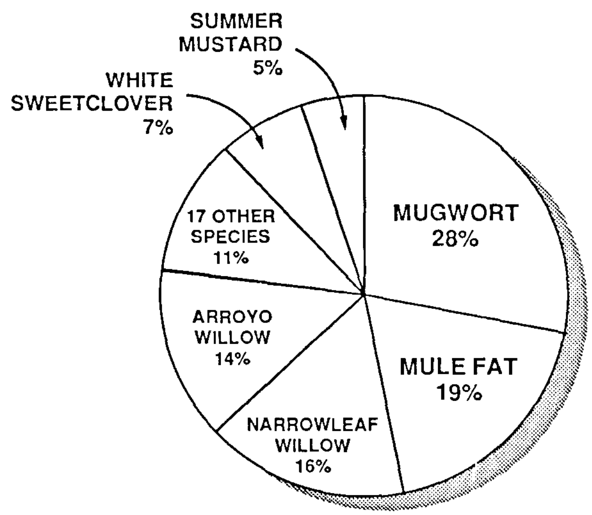
The density of trees (DBH > 7.5 cm) at nest sites averaged 376.5 ± 53.2 per ha, of which 309 (82 percent) were live. Densities of trees at successful (393.1/ha) and unsuccessful (355.4/ha) nest sites were not different (table 3; *t*, $P > 0.50$). Size of trees varied, with an average height of 8.3 m (range = 1.8-18.3 m) and a mean DBH of 15.5 cm (range = 8.0-50.0 cm). Although trees at successful and unsuccessful nest sites were similar in mean height, mean DBH differed. Trees at successful nest sites were significantly greater in mean DBH than at unsuccessful nest sites (*t*, $P < 0.01$). Dominant trees at all nest sites were red willow, arroyo willow, and Fremont cottonwood. Cottonwoods and sycamores were the tallest canopy species, and coast live oaks had the greatest mean DBH. Most nests were located under extensive overhead tree density; at 19 of 32 nest sites, more than 10 trees were present within the 0.04-ha sampling circle.

Discussion

Vegetative cover at least Bell's vireo nest sites in 1987 was comprised not only of riparian plants, but also of several upland species. Despite the use of varied sites, most nests were constructed near open water in washes and the main stream channel. Proximity to open water may be an important factor in food (insect) availability.



SUCCESSFUL NEST SITES



UNSUCCESSFUL NEST SITES

Figure 3– Stems encountered at breast height along 20-m by 2-m transects at successful and unsuccessful nest sites by species, Santa Ynez River, 1987.

We found that the use of plant species as nest substrate was not proportionate to their availability. Vireos selected 3 species of willows (arroyo, red, narrowleaf) as nest substrate over more dominant plants, particularly mugwort and summer mustard. Within the 0.2-1.0 m height interval (in which 30 of 32 nests were constructed), mugwort and summer mustard accounted for 54.4 percent of all foliage hits at nest sites, compared to percentages of 21.2 for the 3 species of willows and 24.4 for all other species. However, nearly half (47.0 percent) of all vireo nests were situated in willows. Nests constructed in mugwort and summer mustard accounted for only 18.7 percent of all 1987 nests. The remaining nests (34.3 percent) were in 6 other plant species. Using a statistical technique suggested by Neu and others (1974), we determined that the disproportionate use of plant species as nest substrate was significant (x^2, $P < 0.01$) and that vireos preferred willows while avoiding mugwort and summer mustard (Bonferroni Z statistic, 90 percent family confidence coefficient). The selection of willows as nest substrate suggests a preference for rigid structural support for construction of nests.

Vireos in the study area appeared to construct nests and were more successful in a height interval that provided a high degree of vegetative cover. Thirty of 32 nests (94 percent) were located at heights between 0.2 and 1.0 m where foliage density and plant species richness were greatest. Height of nests, size of substrate plants and foliage density within the 0.2-1.0 m interval did not affect nesting success. We did, however, observe higher plant species richness in that interval at successful nest sites (average number of species = 5.2) than at unsuccessful nest sites (4.1) (t, $0.02 < P < 0.05$).

Mean height of nests in this study area during 1981 (the only other year in which comparable data were collected) (Gray and Greaves 1984) was 64 cm, similar to our findings. In contrast, mean nest heights elsewhere have been substantially higher, including 1.0 m at several northern San Diego County sites (Goldwasser 1981); 1.0 m at Camp Pendleton, also in San Diego County (Salata 1983); and 1.2-1.3 m at Prado Basin, Orange County (Zembal 1985, Collins and others 1986).

The variation in mean nest height among southern California populations of least Bell's vireos may support our finding of a preference for dense cover in the vicinity of the nest. Vegetation structure at some other study areas in California is different, possibly lacking a dense understory below 1.0 m (J. Greaves, pers. comm., 1988; Gray, pers. obs.). Overmire (1963) found that the midwestern subspecies of Bell's vireo (*Vireo bellii bellii*) nested in Oklahoma at greater heights in grazed areas where understory vegetation had been reduced. Mean number of stems per ha at breast height at Camp Pendleton (134,541) was nearly three times as great as that recorded in this study area (45,668), perhaps reflecting denser, more complex vegetation at a higher interval within the understory at the former study area. Other investigators have reported much lower mean stem densities, including 5500 stems per ha in San Diego County (Goldwasser 1981) and 9914 stems per ha at Prado Basin (Zembal 1986).

Table 3 - Density and size of trees at least Bell's vireo nest sites, Santa Ynez River, 1987[1].

	Successful nests (n=18)			Unsuccessful nests (n=14)		
	Number per ha	Mean height (m)	Mean DBH[2] (cm)	Number per ha	Mean height (m	Mean DBH[2] (cm)
Western sycamore	2.8	9.9	14.0			
Fremont cottonwood	123.6	10.2	19.0	128.6	10.2	16.7
Coast live oak	16.7	8.0	35.9	14.3	6.2	21.0
Narrowleaf willow	1.4	4.6	9.0			
Red willow	220.8	7.4	15.4	150.0	7.1	13.2
Arroyo willow	22.2	7.0	10.6	150.0	6.4	10.5
Other	5.6	9.1	24.0			
Total	393.1	8.4	17.2	355.4	8.1	14.3

[1]Based on occurrence of trees (DBH ≥ 7.5 cm) within a 0.04-ha circle, centered on the nest site.

[2]DBH = diameter at breast height.

Interestingly, overhead cover at most nest sites, especially in the 1.0-2.0 m interval, was not comprised entirely of live, woody plant material. Counts of stems/ha at breast height indicated that herbaceous species, particularly mugwort and white sweetclover, accounted for a substantial proportion of overhead cover (fig. 3). In addition, approximately 34 percent of all stems (herbaceous and woody) recorded at breast height were dead, as were 21 percent of the foliage hits in the 0.2-1.0 m height interval.

Overstory tree density which provides overhead cover also appears to be an important component of nesting cover. Nearly all nest sites were under some degree of overhead cover from trees of different size classes, especially red willow and Fremont cottonwood. Of 32 nest sites, 19 (59 percent) were under a dense canopy where ≥10 trees occurred within the 0.04-ha circle. Two other findings also suggest a need for overhead cover. First, within the nest substrate plant, nests were usually located in the bottom half (nest height averaged 32 percent of total height of plant). In addition, trees at successful nest sites were significantly greater in DBH than those at unsuccessful nest sites; trees in older age classes may provide more cover. A combination of cover in the vicinity of the nest and overhead cover may be important for protection from terrestrial and avian predators. Although foliage densities in the 0.2-1.0 m (vicinity of nest) height interval were similar for successful and unsuccessful nest sites, plant species richness differed. Successful nest sites contained a higher species richness between 0.2 and 1.0 m, perhaps indicating a higher degree of cryptic cover.

Conclusions

We conclude that several components of the Santa Ynez River riparian zone appear to be important for least Bell's vireo nesting habitat. These components include:

1. Minimally disturbed vegetation types adjacent to the riparian zone. Many nests were located at edges between riparian and upland vegetation types. These adjacent areas are often sites of foraging by adult and fledgling least Bell's vireos (Gray and Greaves 1984) and can act as a buffer zone between vireo breeding habitat and disturbed areas.
2. Complex vegetation, including high plant species richness and stem density below 2.0 m for actual and cryptic cover at the nest site. A substantial proportion of the vegetation in this height interval may be comprised of herbaceous species or dead material of woody and herbaceous species.
3. Shrubby willows in the understory to provide rigid structural support for nests.
4. A relatively high overstory tree density comprised mostly of Fremont cottonwoods and willows which provides a dense overstory canopy. A relatively higher proportion of the trees should be from older age classes.

Our results generally agree with those of other studies of least Bell's vireos. Goldwasser (1981) and Salata (1983) believed that structure and composition of vegetation below 3 and 4 m, respectively, were critical. Salata (1983) also reported the importance of a mix of tree size classes, with a mean height of 8 m. Gray and Greaves (1984) recommended protection of ground cover and low shrub layers. Additional research is needed to identify specific habitat requirements necessary for mitigation and revegetation plans.

Acknowledgments

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