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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