RIPARIAN FOREST AS HABITAT FOR THE LEAST BELL'S VIREO[1]

M. Violet Gray and James M. Greaves [2]

Abstract.--Data are presented on vegetation structure in Least Bell's Vireo (Vireo bellii pusillus) breeding habitats. A discussion of vegetation and several other factors relevant to breeding success of this endangered species is presented. Recommendations are made for actions to ensure the future of the subspecies as a breeding inhabitant of riparian forests.

INTRODUCTION

The purposes of this paper are to present data and a discussion of the use of riparian forest by the Least Bell's Vireo (Vireo bellii pusillus), its breeding success over two seasons, and an assessment of the features in the habitat which are important to breeding success. The data are the results of a study initiated in 1979 and continued through the 1980 and 1981 breeding seasons in Gibraltar Reservoir watershed in Santa Barbara County, California.

The Least Bell's Vireo (referred to here as vireo) has undergone a rapid decline in California in both numbers and breeding range over the last several decades. Once present as far north as Chico, California (Cogswell 1958), and numerous enough to be considered a common summer resident (Grinnell 1928), the species' present known northern breeding range limit is Santa Barbara County. Only about 200 pairs are thought to still breed in the state (Wertz 1981). The species is considered to be heavily parasitized by the Brown-headed Cowbird (Molothrus ater) (McCaskie 1975), with a rate as high as 58% (Goldwasser 1978). The cowbird has been blamed for the vireo's decline in California (Tate 1981). However, we believe that the cowbird problem is merely a symptom of a more crucial problem--the loss or degradation of habitat suitable to sustain healthy breeding riparian bird communities.

Over the past 100 years, the riparian zones of many rivers have been heavily grazed; major cities have diverted water supplies from watercourses supplying riparian areas; flood control districts have channelized, denuded of vegetation, and often concrete-lined, streambeds; and overuse of water for irrigation has depleted the water tables in many of the state's richest river valleys. As the many prime riparian forests have disappeared, the vireos have disappeared as well, and now survive mostly in remote areas where riparian systems are relatively unaltered; or they attempt to breed (often with no success) in areas where the vegetation has been highly degraded. In these latter areas, cowbirds are often abundant and thus have significant negative effects on the reproductive capacities of most breeding song birds, including the vireo. As the most obvious agent of breeding failure, cowbirds receive an undue portion of the blame.

The riparian vegetation of the Gibraltar Reservoir study area was relatively undisturbed and supported the largest known population of the California subspecies of the vireo--about 60 pairs. By providing data on the use of this unaltered vegetation by the vireo, we hope to aid in establishing guidelines for habitat rehabilitation throughout the bird's breeding range in the state.

DESCRIPTION OF STUDY AREA

The study area comprises 243 ha. (600 ac.) and consists of four sections, each approximately 1.6 km. (1 mi.) in length, containing similar degrees of forestation. The Santa Ynez River, for 1.6 km. (1 mi.) to the southeast and 1.6 km. (1 mi.) west of its confluence with Mono Creek, makes up half the study area. Southeast of the Mono Creek confluence, the river extends for about 11.3 km. (7 mi.) upstream to Juncal Dam (Jameson Lake). Only the lower 1.6 km. of this reach of river is used regularly by the vireo, although a few have been found nesting in thickets above the study area. West of the confluence is the silted-in eastern third of Gibraltar Reservoir (on the Santa Ynez River) which, over the

[1] Paper presented at the California Riparian Systems Conference. [University of California, Davis, September 17-19, 1981].

[2] M. Violet Gray is a field biologist presently contracted to the USDA Forest Service, Santa Barbara District, Calif. James M. Greaves is a biologist presently contracted to the USDA Forest Service, Santa Barbara District, Calif., and Curatorial Assistant, Museum of Natural History, Santa Barbara, Calif.

past 40 years, has developed into a broad silt floodplain with a narrow creek channel bordered by lush riparian forest. This area contains the habitat for approximately one-third to one-half of the vireo population (hereafter Gibraltar Reservoir population).

Mono Creek joins the Santa Ynez River at the east end of the reservoir and has approximately the same flow as the river. The creek is obstructed about 1.6 km. (1 mi.) above the confluence by a debris dam built in the 1930s. Above this dam is the broad bowl of Mono Debris Basin, fed by Mono Creek, Indian Creek, and Little Caliente Creek. One-quarter of the vireo population breeds in the 1.3-sq. km. (0.5-sq. mi.) basin.

The study area is surrounded by rugged mountains with slopes often exceeding 40°. The slopes are very dry; many have open rocky patches that support little or no vegetation. Chaparral communities dominate the majority of the slopes, except where intense fires have recently burned, promoting the growth of grasslands.

There are several plant communities that can be classified as riparian vegetation which are not necessarily dominated by willow/cottonwood forest, and which are associated with vireo breeding. The Gibraltar/Mono study area contains at least four of these communities: oak woodland; willow/cottonwood forest; shrubby thicket; and dry wash. Each of these communities is dependent upon the regular flow of water through canyons, and its stability is determined by the river's flow and flood levels.

Oak Woodland

This is the most permanent of the four communities. It occupies the drier sites in the study area and is transitional between the mesic willow/cottonwood forest and the xeric chaparral-scrub communities. Coast live oak (Quercus agrifolia), squaw bush (Rhus trilobata), poison oak (R. diversiloba), elderberry (Sambucus mexicana), and snowberry (Symphoricarpos mollis) are common elements of this community. There is a great deal of intrusion by species more typical of chaparral communities, such as Ceanothus spp., chaparral honeysuckle (Lonicera johnstonii), and basin sagebrush (Artemisia tridentata).

This community is the only one of the four in which grasses predominate as the primary herbaceous groundcover. Introduced species of brome grass (Bromus spp.) and wild oats (Avena fatua), as well as native mugwort (Artemisia douglasiana) form the major groundcover species. In openings between the oaks or in less shaded areas beneath oaks, thickets of shrubby species have developed. These thickets seldom reach 1.8 m. (6 ft.) in height and are usually limited to about 1.2 m. (4 ft). Wild blackberry (Rubus ursinus) and California wild rose (Rosa californica) are occasional components of these areas and seem to occupy the ecotone between oak woodland and willow/cottonwood forest as well as being regular associates of the latter community. Tall shrubs and young trees do not generally form a continuous layer here. Young oaks, buck brush (Ceanothus cuneatus), red heart (C. spinosus), elderberrry, and coyote bush (Baccharis pilularis) appear as salients from the more continuous lower layer of shrubs. Thus, there is an open aspect to this community which is accentuated by the sparsely foliated habit of many of the dominant taxa. Mature oaks in this area are commonly 15.2 m. (50 ft.) high, with particularly large individuals exceeding 21.3 m. (70 ft.).

Willow/Cottonwood Forest

This community occurs in two basic forms. The first is that of a dense-canopied forest with little or no vegetation below the canopy level. The second form has the same canopy structure, but is also rich in shrubby and/or herbaceous undergrowth. The canopy generally consists of a mixture of Fremont cottonwood (Populus fremontii) and red willow (Salix laevigata), often growing to heights of 9.1-18.3 m. (30-60 ft.). The majority of the willows are not much greater than 229 mm. (9 in.) diameter-at-breast-height (DBH), many having little girth despite their great heights. In a few areas, most notably in the Mono Debris Basin, both willow and cottonwood are found with trunk diameters approaching 1.2 m. (4 ft.). The cottonwood grows in smaller numbers, but to slightly greater size, scattered among the willow. Where cottonwood exist to the exclusion of willow, it takes the form of either evenly distributed gallery forest or large trees growing in grove-like clusters of six to 12 trees, in an open woodland arrangement.

Another common species, arroyo willow (S. lasiolepis), does not generally grow to sufficient size to become a part of the forest canopy layer, but some rather slender trees mixed in with red willow have been found with heights up to 13.7 m. (45 ft.). Other taxa found in this lower canopy, but to a lesser degree, are: western sycamore (Platanus racemosa), black cottonwood (Populus trichocarpa), black willow (S. gooddingii), yellow willow (S. lasiandra), and white alder (Alnus rhombifolia).

The low shrub layer consists partially of taxa which are herbaceous, such as mugwort, but which have the habit of growing in shrub-like clumps and which function (with respect to several nesting bird species) as low shrubs. This layer also contains shrubs which do not attain heights greater than 1.2 m. (4 ft.) or which are at a stage of intermediate growth. Nearly all the plants from the other layers, except those forbs and grasses which usually do not attain heights of 0.6 m. (2 ft.), can be found in the low shrub layer.

The structure of the high shrub layer differs from that of the low shrub layer in that the lower 0.6-1.2 m. (2-4 ft.) of the plants in the

high shrub layer are generally devoid of dense foliage. Unless it occurs in conjunction with the low shrub layer or groundcover, the absence of foliage at the lower level in the high shrub layer makes high shrubs of little use to nesting vireos in the study population. All of the willow species contribute to the high shrub layer, either as young or adult trees or in the form of shoots from downed larger trees. Narrowleaf willow (Salix exigua) is a major element of this layer, along with wild blackberry, California wild rose, snowberry, and seep-willow (Baccharis glutinosa). Immature trees of all the above-mentioned species are occasional components of the high shrub layer.

The groundcover in these forested areas is generally composed of only one or two species, with white sweet-clover (Melilotus albus) and mugwort predominating. Many moisture-requiring forbs, such as peony (Paeonia californica), speedwell (Veronica anagallis-aquatica), and hedge-nettle (Stachys albens), were present at several survey sites.

Shrubby Thicket

The thicket is the simplest vegetative community in the study area. It generally possesses neither a canopy nor much groundcover and often is composed solely of one plant species, the most common of which are narrowleaf willow and black willow. The thicket presents an outer aspect which appears to be a solid wall from the ground to the top of the stand, often reaching 6.1 m. (20 ft.) when mature. The wall of vegetation is formed by a combination of low and high shrub layers growing at the edge of the thicket. The interior, which is usually the most mature section, is seldom as dense as the exterior. This community usually occupies loose sandy or rocky ground which is not stable enough to support the larger forest types.

Dry Wash

These areas are generally useless to vireos for breeding, except when thickets establish themselves and are sufficiently large to provide foraging habitat or nest sites. On occasion a tree or small thicket has grown in such a way in a dry wash to withstand the heavy flooding of winter runoff, and vireo nests have been found in such sites. These areas produce cover very slowly because they are heavily washed and scoured every year. There is some encroachment at the edges by thickets of narrowleaf or arroyo willow, which seem to combine rapid maturing rates with strong tolerance for unstable sandy or gravelly soils.

There is some groundcover in the dry washes each year, depending on how heavily scoured they have been and how high the previous winter runoff was. Wild mustard (Brassica campestris), white sweet-clover, and cocklebur (Xanthium strumarium) usually dominate, with some chaparral and oak woodland plants interspersed throughout.

Large piles of debris have created other major open spaces in the study area. These are found scattered within riparian woodlands and consist of matter ranging from large cottonwood and willow trunks to mats of dry foliage mixed with silt. They seldom support much vegetation other than introduced weeds such as curly dock (Rumex crispus) or heliotrope (Heliotropium curassavicum).

METHODS

Before 1979, no in-depth breeding data existed for the Least Bell's Vireo, and there was little information about its habitat requirements. In 1979, the authors began a study of the Gibraltar Reservoir population, banding and color-banding young birds as groundwork for a long-term population study. In 1980 and 1981, we continued these studies and began gathering data on vegetation at individual nest sites and along transect lines established in 243 ha. (600 ac.) of forest comprising the study area.

Because the vireo was the focus of this study, intense field work was required to locate nest sites, determine the number of pairs, and conduct the banding studies. We developed methods in the field for the search-and-find part of the project, walking throughout the habitat, following natural courses as much as possible, listening and looking for vireos. Whenever a male or a pair was encountered, we searched its territory until a nest was located or it was determined that it was not nesting. Adults were mist-netted when practicable, preferably prior to incubation of eggs, and young were banded between the ages of 6 and 10 days (10 to 12 days nestling life). We monitored each nest for success or failure and cause of failure; measured parameters for possible reasons for success; and recorded numbers of eggs, hatchings, and fledgings.

The vegetation study consisted of two parts: a habitat description taken from observation in the field (see DESCRIPTION OF STUDY AREA), and a quantitative analysis of transect data and nest-site surveys. To determine in detail what features of the vegetation are important to vireos in the study area, we surveyed sample plots at 0.04-ha. (0.1-ac.) circles around nest sites (James 1971, modified), and at 161 sites along 11 transect lines arranged across streamcourses. Transect plots were spaced 10 m. apart, each plot alternating to the right or left of the line and having an area of 3 m. square. All data were gathered over each square meter within each transect plot. These transects covered a total length of 2,093 m. Data collected at all sites included: frequency or absence of cover by class; frequency of plant species; and density of shrubs. Four cover-classes were used: groundcover (less than 60 cm. height), low shrub (60-120 cm.), high shrub (greater than 120 cm.), and canopy (greater than 6 m. and stems greater than 7.6 cm. [3 in.] DBH).

RESULTS AND DISCUSSION

Vireo Breeding

Arrival and Territory

Most males and some females arrived in the study area in mid-April. Males initiated nest building immediately upon their arrival, with the females apparently deciding whether to use the nest as is, complete it, or build elsewhere. The remainder of the population drifted in over the following two to four weeks. Territories ranged in size from 0.2 ha. to 1.6 ha. (0.5 ac. to 4.0 ac.), the size usually dependent on availability of food and water, and sufficient vegetation for at least several nest sites.

Nest Location

Nest heights averaged 64 cm. (range 33-133 cm.) aboveground, with successful nests about 8 cm. lower than failed nests. Most nests were placed near or at the edges of thickets, or at the edges of woods and open fields or washes, in low shrub or upper groundcover levels. A few nests were placed in full sun adjacent to, but not protected by, abundant cover. Some nests were built in galleried forests and were usually placed in tangles of groundcover or low shrubs at the bases of large trees. Most nests were hidden well behind a screen of leaves, limbs, or dead material, or combinations of live and dead material. However, high contrast (light and shadow moving across the nest during the day) seems to have contributed more to nesting success than either frequency of occurrence or density of vegetation around the nests. With only a few exceptions, nests were suspended: a) from forks or parallel stems or twigs of live woody material under 5 mm. in diameter; b) from dead twigs of willow or cottonwood; or c) from dead stems of mugwort or white sweet-clover under a cover of live material, usually mugwort.

Nesting and Production

Every known vireo pair nested at least once, usually exploring several sites before settling on a suitable one. Most pairs built a least two nests; as many as six nests were located in one territory. Several pairs built only two nests, successfully rearing young in both, and one pair built a third nest after its second fledging (table 1).

Several successful pairs were able to raise only one nestling in 1981 from each of two successful nests in their territories, in contrast to the normal three or four young raised per nest by most of the population. In 1979 and 1980, the only one-chick nests were the result of cowbird activity, or were begun late in the season when food and water stress would be expected to be higher. Thus, the lower fledgling number per pair, in spite of a higher nesting success rate, may have been the result of a higher-than-normal amount of nonpredation nestling mortality.

Table 1.--Breeding data of Gibraltar Reservoir Least Bell's Vireo population.

	1980	1981
Males present (estimated)	50	61
Nesting pairs (study population)	43	48
Successful pairs	26	32
Percent pairs successful	60%	67%
Vireo eggs produced (minimum)	238	262
Vireo eggs hatched (minimum)	147	147
Vireo young fledged (minimum)	85	91
Average young/successful pair	3.27	2.84
Nesting attempts (nests built)	95	103
Nests used (known minimum)	77	86
Nests successful (minimum)	29	36
Percent nests successful	38%	42%
Average young/successful nest	2.93	2.53
Nests parasitized (known)	14	11
Cowbird eggs produced	14	11
Cowbird eggs hatched[1]	3	2
Nests destroyed by cowbirds[2]	11	10
Nests deserted after parasitism	3	3
Percent parasitized and destroyed	32%	23%

[1] In 1980, cowbird eggs were left in nests until vireo response was ascertained; thereafter, eggs were removed. One cowbird was successfully raised before it could be found and removed. Two nests successfully raised three vireos after a cowbird egg and a chick were removed. In 1981, all cowbird eggs and chicks were removed as they were found. Three nests raised seven vireos after cowbird eggs were removed. One cowbird was successfully raised before its nest was found.

[2] Eggs pierced or dumped, chicks killed in the nest or dumped out, nest cup broken from limb after eggs dumped. Nests deserted after being visited by cowbirds but prior to vireo egg-laying were not included as cowbird-destroyed nests, but rather as straight failures.

Feeding Patterns

As the 1981 season progressed, vireos were seen foraging farther into the chaparral, often traveling several hundred yards to obtain food for their nestlings. This pattern of activity was apparent to a greater extent in 1979 and 1981, indicating the possibility of cyclic food shortages. We and others observed that the vireo does not leave its brood exposed during the 14- to 16-day incubation period (Hensley 1950). During the 1981 season, however, many nests were left unattended for long periods of time with neither adult present nearby. We suspect the reason for this was a combination of extremely high temperatures and low food availability which necessitated the absence from the nest for long periods by both adults because neither was able to obtain enough food for its own sustenance during its turn away from the nest. High daytime temperatures aided in incubation, but humidity

was insufficiently maintained around the eggs, and, as a result, many freshly hatched young were weakened and unable to survive the rigors of life outside the egg.

Departure from the Study Area

Adult birds departed the study area as early as mid-July, and all were gone by the beginning of September. Most young birds left or were not seen in their natal territories after the fourth week from fledging. However, in 1981 many first-clutch young were present during second breeding attempts and disappeared from their territories at the time the second brood was ready to fledge, often found over 1.6 km. (1 mi.) away in another vireo's territory. Generally, females and young left the study area before males.

Use of Habitat

The vireo behaves both as a specialist and a generalist within separate and particular elements of the habitat. One major constraint is that the species nests solely in California's southern riparian zones. Since these vireos often raise two clutches of four young each and food is therefore a primary consideration during the breeding season, they would be expected to breed in areas of high humidity and insect productivity such as the riparian zones.

The Vireo as Specialist

As mentioned, nests are placed in a narrow range of heights, rarely higher than 1.8 m. (6 ft.). Since such higher placements are generally reactions to radical environmental disturbances (e.g., sudden removal of lower vegetation layers),[4] they do not appear to reflect a trend toward use of diverse nesting levels.

Nests are usually near the edge of a thicket, or, if in a small shrub or thicket, they may be in the middle. Usually all nests are within 1 m. (3 ft.) of an opening. This arrangement allows at least one unobstructed flight path to the nest, easy visibility of predators, and good foliage cover for nest safety. For small birds incapable of much actual defense at the nest (Best and Stauffer 1980), all of these factors contribute to successful nesting attempts. The branching arrangement of the immediately supporting nest substrate is usually a horizontal or down-sloping fork, or horizontally parallel stems.

The Vireo as Generalist

Within the constraints of the above-stated requisite elements, the vireo is a generalist. Nest substrate, in terms of plant species, seems to correlate fairly closely to those plant taxa available and abundant, with a few notable exceptions. California wild rose and coast live oak were both used more often than they were encountered in the study area transect lines. This may be because they associate closely with other species (willows and mugwort, respectively) which are abundant and widespread (table 2). The vireo is also a generalist in its selection of plant life forms, using forbs, shrubs, and trees for both nest support and cover. It generalizes more broadly in nest cover, often preferring large-leaved plants, or mixtures of leaf size-classes.

Table 2.--Percent frequency of occurrence and percent use by vireos for nest cover substrate, of plant species available and liable to be used. B--percent frequency of occurrence data from transect plots, n = 161. C1--percent total nests per species, species used for cover, n = 227. C2--percent total nests per species, species used for nest support, n = 216. Dashes are used where combinations did not occur but were possible within the study area.

Plant species	B	C1	C2
Trees			
Salix laevigata	9.4	23.3	15.3
Populus fremontii	5.6	7.0	5.1
Salix gooddingii	0.6	0.9	1.4
S. lasiandra	0.5	-	-
Quercus agrifolia	0.5	4.4	3.2
Platanus racemosa	0.4	-	-
Tamarix sp.	0.1	-	-
Populus trichocarpa[1]	-	0.9	0.9
Alnus rhombifolia	-	-	-
Shrubs			
Salix exigua	18.0	22.5	20.8
S. lasiolepis	11.5	7.9	9.3
Rubus ursinus	3.7	12.8	11.1
Rhus trilobata	1.0	2.6	2.3
Rhus diversiloba	1.0	0.4	0.5
Baccharis glutinosa	-	4.4	1.4
B. pilularis	0.8	0.9	0.5
Rosa californica	0.8	7.0	7.4
Symphoricarpos mollis	0.6	3.5	3.2
Sambucus mexicana	0.1	0.4	0.5
Prunus ilicifolia	0.1	-	-
Eriodictyon sp.	-	0.9	0.5
Salvia apiana	-	-	-
S. leucophylla	-	0.4	0.5
S. mellifera	-	-	-
Potentilla glandulosa	-	-	-
Artemisia californica	-	-	-
A. tridentata	-	-	-

[1] Some species were recorded in the study area but not on transect plots; these are included as possible nest cover and substrate, but no data were gathered on frequency in the study area.

[4] Goldwasser, Sharon. Personal communication.

Table 2.--Continued.

Plant species	B	C1	C2
Forbs			
Melilotus albus	16.4	17.6	3.2
Artemisia douglasiana	15.0	26.9	10.2
Baccharis douglasii	1.2	0.4	0.5
Conyza canadensis	0.6	1.4	0.9
Ambrosia psilostachya	0.5	-	-
Helenium puberulum	0.5	0.9	0.5
Xanthium strumarium	0.3	-	-
Brassica campestris	0.3	1.8	-
Penstemon heterophyllum	0.3	-	-
Urtica holosericea	0.1	1.3	-
Verbena lasiostachys	0.1	1.8	-
Stachys albens	0.1	0.4	0.5
Elymus condensatus	-	0.4	-
Marah fabaceus	-	-	-
Centaurea solstitialis	-	0.9	0.5

Shrub density at nest sites seems to correspond to density throughout the forest, indicating that the vireos do not seek out any unusually dense stand of vegetation for nesting. There is an extremely broad range of densities both at nest sites and at transect plots, so density is apparently not of importance to the bird in nest-site selection (table 3).

Table 3.--Mean shrub density compared at 0.04 ha. (0.1 ac.) nest circles and line transect plots. Range from raw data figures.

Sampling	Density (stems/ha.)	Range (stems/ha.)
Nest circles	17,070	620-72,200
Transect plots		
All plots	10,280	0-90,000
Excluding open ground	21,100	1,110-90,000

Cover-type frequencies were generally similar in both samplings (nest site and transect plots) (table 4), so presence of a particular cover-type such as canopy does not appear to be a consideration in nest site selection.

Table 4.--Cover-type frequencies compared for nest sites and the general study area, as interpreted from nest-circle and transect-plot data respectively.

Cover-type	Nest sites (%)	Study area (%)
Canopy	40.1	47.8
High shrub	41.8	40.4
Low shrub	29.4	36.2
Groundcover	35.6	32.2
Open ground	25.5	3.7

Although no data were recorded indicating time allotments in any one level or community, the vireos were observed foraging in all levels and communities in and adjacent to the study area during all parts of the breeding season. However, they seemed to spend a major portion of their time gleaning insects from leaves in the willow and cottonwood forests at and below the middle levels of the canopies. Early to mid-season feeding activity was limited generally to areas near nest sites, while later season feeding encompassed all communities, including a good portion of time in adjacent chaparral.

RECOMMENDATIONS

These recommendations are made for general management of Least Bell's Vireo breeding habitat and for rehabilitation of historical or degraded sites.

1. Prohibit removal of groundcover and low shrubs.

2. If non-native plant species are removed, they should be replaced immediately (within one season) with a suitable native of comparable form.

3. Limit or eliminate recreation and grazing or other agricultural uses in sensitive riparian systems or critical habitat.

4. Replanting of denuded areas should include a diversity of species and should include species which provide all cover-type layers.

ACKNOWLEDGMENTS

This research was sponsored by USDA Forest Service, Santa Barbara District, Calif.; California Department of Fish and Game, Non-game Management Branch; Santa Barbara Audubon Society; USDI Fish and Wildlife Service, Office of Endangered Species. We thank Alan Craig, Maeton Freel, and Sanford Wilbur for their personal aid in obtaining funding. We also thank contributing Audubon Society chapters: Altical, Los Angeles, Morro Coast, and Santa Barbara.

LITERATURE CITED

Best, Louis B., and Dean F. Stauffer. 1980. Factors affecting nesting success in riparian bird communities. Condor 82:149-158.

Cogswell, H.L. 1958. Middle Pacific Region. Audubon Field Notes 12:379-384.

Goldwasser, Sharon. 1978. Distribution, reproductive success and impact of nest parasitism by Brown-headed Cowbirds on Least Bell's Vireos. 27 p. California Department of Fish and Game, Sacramento.

Goldwasser, Sharon, David Gaines and Sanford R. Wilbur. 1980. The Least Bell's Vireo in California: a de facto endangered species. Am. Birds 34:742-745.

Grinnell, J. 1928. A distributional summation of the ornithology of Lower California. Univ. California Publ. Zool. 32(1):1-300.

Hensley, M.M. 1950. Notes on the breeding behavior of the Bell's Vireo. Auk 67:243-244.

James, F.C. 1971. Ordinations of habitat relationships among breeding birds. Wilson Bull. 83:215-236.

McCaskie, G. 1975. Southern Pacific Coast Region. Am. Birds 29:1029-1036.

Tate, James, Jr. 1981. The blue list for 1981. Am. Birds 35:3-10.

Wertz, Paul. 1981. Update on endangered species. Outdoor California 42:1-6.