

USE OF NON-RIPARIAN HABITATS BY LEAST BELL'S VIREOS¹

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Abstract: The least Bell's vireo (*Vireo bellii pusillus*) is an endangered songbird inhabiting riparian woodlands in southern California. Although the species requires riparian habitats for nesting, vireos also occur in upland habitats adjacent to breeding areas. Vireos breeding at the Sweetwater River in San Diego County during 1986 and 1987 were observed using non-riparian areas for foraging and nesting. The use of non-riparian habitats, primarily areas of coastal sage scrub and chaparral vegetation, varied over the nesting cycle, and was related to territory location and habitat composition. These observations suggest that planning boundaries intended to protect resources essential for breeding vireos should include upland areas bordering riparian habitats.

The least Bell's vireo (*Vireo bellii pusillus*), a southwestern subspecies of Bell's vireo, is a migratory songbird inhabiting riparian woodlands in southern California and northern Baja California. Once widespread and abundant (Cooper 1861; Anthony 1893, 1895; Fisher 1893; Grinnell and Swarth 1913; Grinnell and Storer 1924; Grinnell and Miller 1944), the species has undergone a dramatic decline during the last 4 decades according to the U.S. Fish and Wildlife Service (USFWS 1988, leading to its designation by the Secretary of the Interior as endangered in 1986. The vireo's decline in numbers has been attributed to the loss and degradation of riparian habitat through out the species' range, as well as to the expansion in range of the brown-headed cowbird (*Molothrus ater*), a nest parasite (USFWS 1988).

Although characterized as a riparian breeding species, least Bell's vireos use non-riparian habitats within and adjacent to floodplains for foraging and other activities. Gray and Greaves (1984) were among the first to document the use of non-riparian foraging sites by vireos, reporting observations of birds foraging in chaparral areas near the Santa Ynez River in Santa Barbara County. Recent observations of vireos using non-riparian habitats at other sites suggest that this behavior may be widespread and that the availability of such areas may be important to nesting vireos. This paper reports on the nature and extent of use of non-riparian habitats by least Bell's vireos breeding at the Sweetwater River in San Diego County.

Study Site and Methods

Study Site

We studied least Bell's vireos at the Sweetwater River in southern San Diego County, California. The study site includes a 5-kilometer stretch of the river bounded to the east by the Cottonwood Golfcourse and to the west by the Sweetwater Reservoir. Approximately 566 hectares of riparian wood land occur within this reach, which is bordered primarily by upland areas of coastal sage scrub and chaparral habitats. The width of the riparian stand ranges from approximately 10 meters just east of the reservoir to over 250 meters to the west and east of this point (fig. 1).

Methods

Vireos were observed from mid-March through mid-August during 2 breeding seasons in 1986 and 1987. Surveys were conducted early in the spring to determine the number and location of all vireo pairs within the study area. Pairs were then visited weekly throughout the season, and their breeding activities monitored. Visits to individual territories lasted for periods of from 0.5 to 2.0 hours, during which observers recorded behavioral data about the birds, including the occurrence and location of territorial advertisement (singing), border disputes, foraging, and behaviors related to nest attendance. Any activities occurring in non-riparian habitats were described, noting the identity and behavior of the individual(s) involved, their distance from the riparian edge, and the habitat type and plant species in which they were observed. Four non-riparian habitat types were assigned by the presence of at least one of the following indicator species: coastal sage scrub: *Artemisia californica*, *Eriogonum fasciculatum*; chaparral: *Malosma laurina*, *Prunus ilicifolia*, *Adenostoma fasciculatum*; grassland: grass species; degraded riparian: sparse vegetation of *Salix* spp., *Sambucus mexicana*, and exotic trees and shrubs.

Vireo territories were mapped by plotting the locations of perches used by singing males on aerial photographs of the site, and connecting the outermost perch

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locations for each male. Home range boundaries were determined for some pairs by incorporating known territories with adjacent areas used by the pair, but not observed to have been defended by them. The sizes of territories and home ranges were calculated by tracing these areas with a planimeter. Territories were classified as "edge" territories if their boundaries coincided with of the edge the riparian woodland, or if the birds could reach adjacent non-riparian habitats without traveling through another vireo's territory. All other territories were classified as "central" territories.

The vegetation structure and composition of vireo territories were described by estimating the following variables:

RIPWIDTH: Width-class of riparian vegetation perpendicular to the drainage channel (<10, 11-50, 51-250, 251-1000 , >1000 meters).

AQUATIC: Percent cover of aquatic and/or emergent plant species.

OPENHERB: Percent cover of bare ground and herbaceous plant species.

SHRUB: Percent cover of shrubs (<3 meters high).

TREE: Percent cover of trees (>3 meters high).

UNDRSTOR: Proportion of TREE with shrub understory.

These habitat variables were visually estimated at the location of each territory by sampling a 10-meter-wide belt transect running perpendicular to the river channel, bounded by the riparian-upland edge. Cover estimates were made according to a modification of the Daubenmire Cover Scale (Daubenmire 1959, 1968) in which the intervals of the upper and lower cover classes were expanded to account for the relative inaccuracy of the estimation method used.

Results and Discussion

Distribution and Abundance of Least Bell's Vireos

A total of 46 breeding pairs were observed at the study site in 1986; this population increased to include 56 pairs in 1987. The densest concentrations of vireos occurred at the upper end of the Sweetwater Reservoir, and in the upper segment of the study area adjacent to the Cottonwood Golfcourse, although birds were distributed along the entire length of the drainage, including narrow stretches of riparian habitat bordered by steep canyon walls (fig. 1). Most of the territories occupied in 1986 were also occupied in 1987, possibly by the same individuals.

Use of Non-riparian Areas

Foraging

In 1986, one or both members of 15 vireo pairs (31 percent of all pairs) were observed foraging outside of their territories in non-riparian habitats at least once during the study period. Typically, individuals seen feeding outside of the riparian zone were males; however, females of at least six pairs also fed in non-riparian vegetation. Only one instance of a fledgling feeding outside of the riparian zone was observed.

Vireos tended to forage in areas adjacent to the riparian stands wherein their territories were located, traveling from 3 to as far as 61 meters to reach these sites:

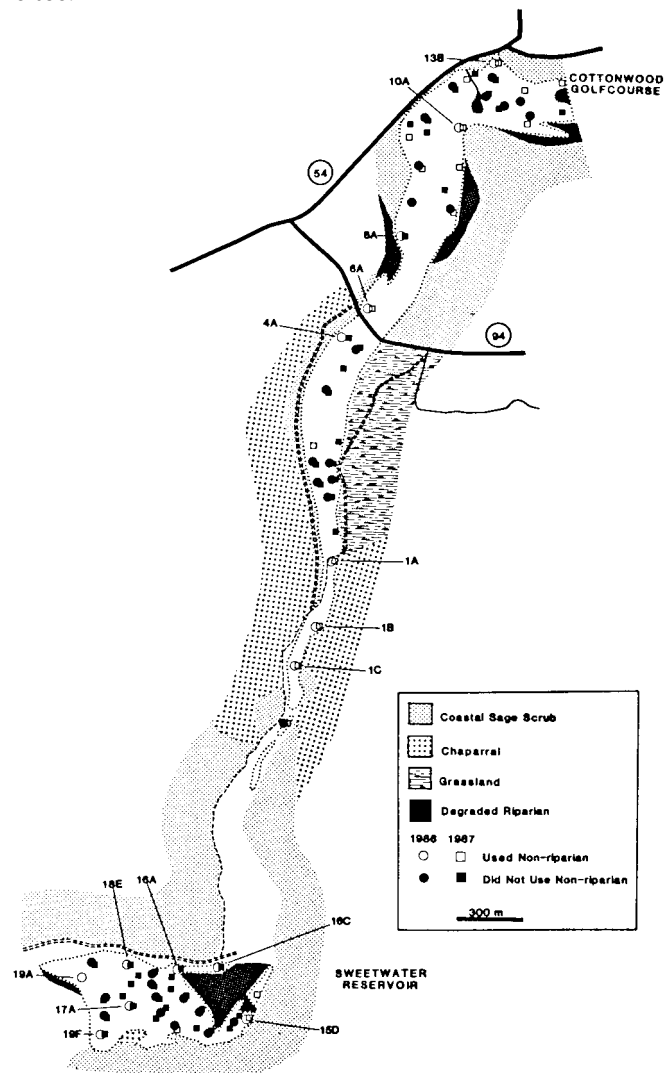


Figure 1- Territory locations of breeding least Bell's vireos at the Sweetwater River, San Diego County, California, in 1986 and 1987.

Pair	Type of Habitat ^s	Mean Distance from Territory (m)
1A	DR	6
	CHP	12
1B	CHP	25
1C	CSS	15
	CHP	16
4A	CSS	3
6A	DR	15
8A	DR	14
10A	DR	30
13B	DR	6
15D	CSS	--
16A	CSS	8
16C	DR	30
17A	CHP	27
18E	CSS	6
19A	DR	61
19F	CSS	19

¹ DR: degraded riparian, CSS: coastal sage scrub, CHP: chaparral.

While foraging in non-riparian habitats, vireos fed in species of plants not typically found within their territories. The most frequently visited species was *Malosma laurina*, which occurs in chaparral and coastal sage scrub habitats, followed by *Artemisia californica*, present primarily in coastal sage scrub areas, and *Sambucus mexicana*, which occurs in both coastal sage scrub and degraded riparian areas. Vireos were also observed foraging in an additional 12 species:

Species	Number of Visits
<i>Malosma laurina</i>	13
<i>Sambucus mexicana</i>	7
<i>Artemisia californica</i>	7
<i>Baccharis sarathroides</i>	3
<i>Baccharis glutinosa</i>	2
<i>Brassica nigra</i>	3
<i>Salix</i> spp.	2
<i>Prunus ilicifolia</i>	2
<i>Nicotiana glauca</i>	1
<i>Salvia mellifera</i>	1
<i>Heteromeles arbutifolia</i>	1
<i>Silybum</i> sp.	1
<i>Platanus racemosa</i>	1
<i>Schinus molle</i>	1

The use of adjacent areas by foraging vireos varied according to the stage of the nesting cycle (fig. 2). The largest number of non-riparian foraging bouts occurred when pairs had fledglings, although substantial numbers also occurred prior to egg-laying and during incubation. Birds rarely fed outside of their territories when raising nestlings.

When territory characteristics were compared among vireo pairs that foraged in adjacent non-riparian areas and those that did not, two overall differences emerged. First, birds using adjacent foraging sites tended to occur along the narrowest stretches of the river (fig. 3; Kruskal-Wallace statistic = 4.78, 1 d.f., $P=0.028$), and second,

these birds had territories positioned on the edge of riparian stands (Kruskal-Wallace statistic = 6.40, 1 d.f., $P=0.011$). These two factors are linked in their effect in that most centrally located territories occur in wide stands of riparian vegetation, while edge territories tend to be located along narrow stretches of the river. By far, the largest proportion of birds feeding outside the riparian zone were those possessing edge territories; only one of these 15 pairs occupied a central territory. Forty-five percent (14/31) of pairs with edge territories fed in non-riparian areas, while only 6 percent (1/17) of pairs with central territories did so, a difference which is significant ($\chi^2 = 16.4$, 1 d.f., $P<0.005$).

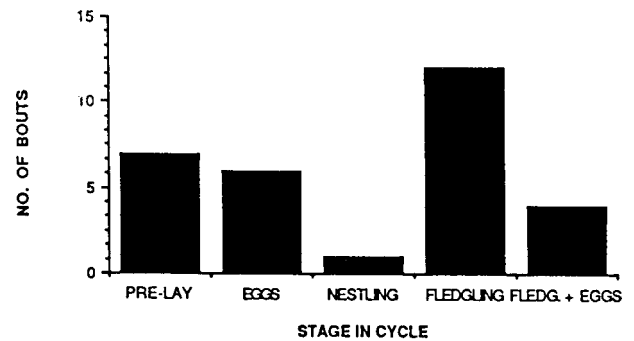


Figure 2— Frequency of non-riparian foraging bouts by least Bell's vireos during different phases of the nesting cycle.

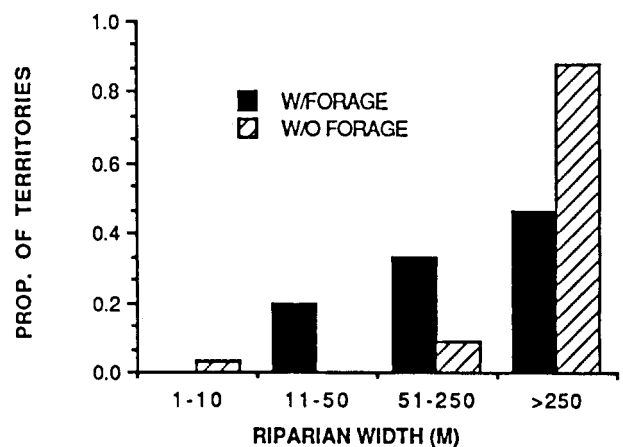


Figure 3— Proportion of territories of least Bell's vireos that used, and did not use non-riparian foraging areas, in riparian stands of different width.

Because the use of adjacent foraging areas was largely confined to pairs with edge territories, we compared the habitat characteristics of central and edge territories in an attempt to discern differences which might affect vireo foraging behavior. Territories differed in several regards with respect to their location in the riparian zone. Edge territories had significantly less tree (Kruskal-Wallis statistic = 8.87, 1 d.f., $P=0.003$; fig. 4a), and shrub cover (Kruskal-Wallis statistic = 7.70, 1 d.f., $P=0.006$; fig. 4b), and significantly more bare ground and herbaceous cover (Kruskal-Wallis statistic = 10.66, 1 d.f., $P=0.001$; fig. 4c), than did central territories. Since vireos feed primarily in trees and shrubs, the amount of this vegetation within a territory may be correlated with the amount of food available; thus, edge territories may have lower food resource densities than central territories. Edge territories also tended to be smaller in area than central territories (Kruskal-Wallis statistic = 2.88, 1 $P=0.089$); although this difference is not statistically significant, it supports the hypothesis that birds nesting in edge territories may have fewer overall resources than birds in centrally located territories, and that they may rely upon access to non-riparian foraging sites to supplement their resources.

Other Uses of Non-riparian Habitats

A closer examination in 1987 of the use of non-riparian areas by vireos revealed that these areas are not strictly used as extra-territorial foraging sites. Twenty-three pairs (43 percent of all pairs) were observed using non-riparian sites in 1987, and all 23 incorporated these areas into their home ranges. One additional unpaired male was observed occasionally visiting non-riparian sites; this male is excluded from the analyses that follow.

Of the 23 pairs whose home ranges included non-riparian areas, 8 pairs (35 percent) placed at least 1 nest within the non-riparian area, 10 pairs (44 percent) foraged with their fledglings in non-riparian sites, and 4 pairs (17 percent) both nested and fed with fledglings in non-riparian areas (table 1). As in 1986, most of the non-riparian activity occurred in coastal sage scrub habitats; birds also used degraded riparian and chaparral habitats (table 1).

Table 1 — Nature of Use and Type of Non-riparian Habitats Used by Least Bell's Vireos at the Sweetwater River, 1987

Type of Use ¹	# Pairs	Habitat Type		
		Coastal Sage Scrub	Degraded Riparian	Chaparral
HR	23	21	8	3
HR + N	8	7	4	0
HR + F	10	10	3	1
HR + N + F	4	4	2	0

¹HR = home range, N = nesting, F = feeding with fledglings

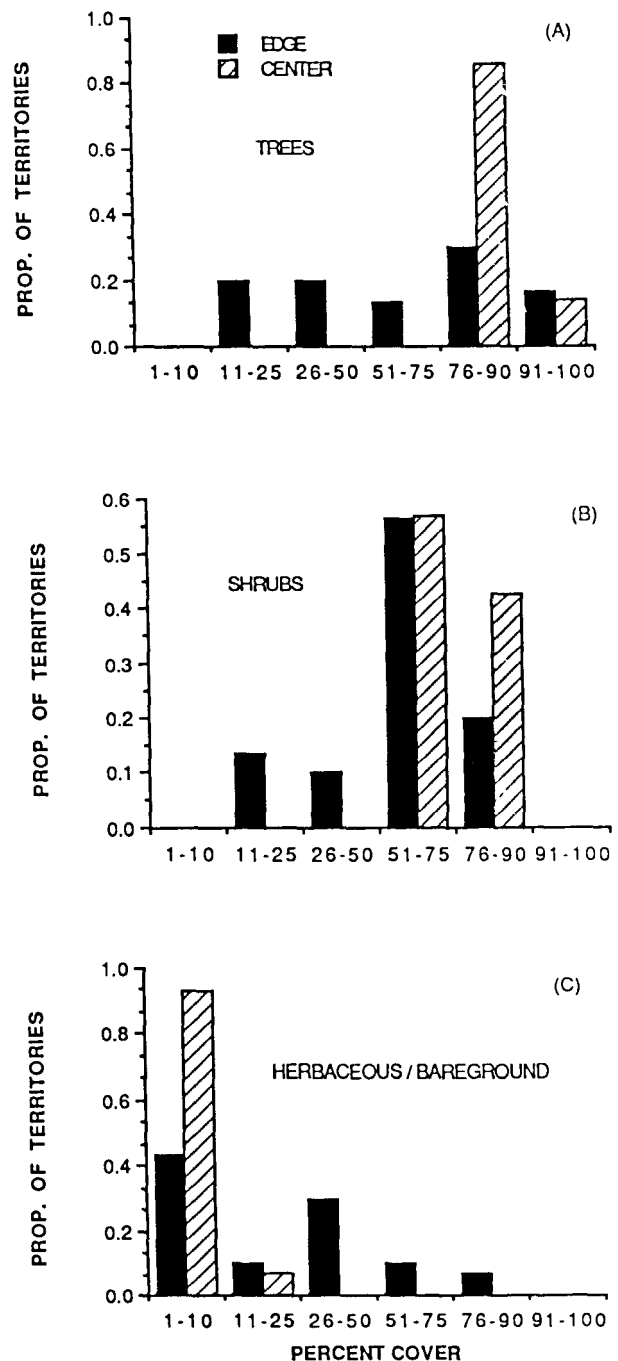


Figure 4— Percent cover of (a) trees, (b) shrubs, and (c) bare ground and herbaceous vegetation in central and edge territories of least Bell's vireos.

Pairs with edge territories were significantly more likely to use adjacent non-riparian sites than those whose territories were centrally located, as observed in 1986. Forty-eight percent (22/46) of pairs with edge territories used non-riparian areas, in contrast with 4 percent (1/23) of pairs with central territories ($\chi^2 = 18.9$, 1 d.f., $P < 0.005$). Of the 23 pairs using non-riparian areas, 22 (96 percent) possessed edge territories.

Pairs using non-riparian areas tended to occur in narrower reaches of the river than did those not using non-riparian areas (Kruskal-Wallis statistic = 12.95, 1 d.f., $P < 0.003$), although pairs using non-riparian areas also occurred in wider reaches. All of the pairs (8/8) occurring in riparian stands less than 50 meters in width used non-riparian sites, while 36 percent (8/22) of those in stands 51-250 meters wide, and only 18 percent (7/38) of those in the widest riparian stands, used adjacent non-riparian areas.

The distance between the riparian edge and the outermost border of the non-riparian component of vireo home ranges averaged 19.9 ± 15.3 meters, and ranged from 7.6 meters to 61.0 meters. Ninety-six percent (22/23) of home range boundaries were less than 46 meters from the riparian edge, and 87 percent (20/23) were less than 40 meters from the riparian edge. The distance between non-riparian home range borders and the riparian edge differed as a function of the width of the riparian stand in which pairs were located. In stands less than 50 meters in width, home range boundaries occurred on average 13.1 ± 8.7 (range: 7.6 - 33.5) meters from the riparian edge. This distance averaged 29.9 ± 19.4 (range: 3.1 - 61.0) meters, and 16.3 ± 8.8 (range: 4.6 - 45.7) meters, for stands 51-250, and greater than 250 meters in width, respectively.

Conclusions

Recent efforts to protect least Bell's vireos and achieve the recovery goals established by the USFWS (USFWS 1988) have focused on an assessment of the species' habitat requirements and use patterns, with considerable attention being devoted to identification of the habitat characteristics of riparian nesting sites (RECON 1988). Observations of vireos using non-riparian areas at the Sweetwater River and other sites suggest that the habitat requirements of some birds may include the availability of areas beyond the riparian woodlands themselves. These findings have prompted more detailed examinations of the relationship between territory composition and reproductive success, and the extent to which vireos occupying marginal habitats are dependent

upon non-riparian resources for successful nesting. Ideally, planning decisions affecting the vireo should await the results of these analyses; in reality, this is unlikely to occur. We contend that even in the absence of additional data, the findings reported here provide sufficient justification for the inclusion of access to non-riparian resources as part of the habitat requirements of nesting vireos, and recommend that protective boundaries encompassing essential resources should include upland areas as well as riparian woodlands.

Acknowledgments

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