

# DESCRIPTION OF NESTING HABITAT FOR THE LEAST BELL'S VIREO IN SAN DIEGO COUNTY<sup>1</sup>

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**Abstract:** *Least Bell's Vireo* (*Vireo bellii pusillus*) nesting sites on three rivers in coastal southern California were characterized to provide data for a habitat restoration plan for this endangered species. In addition, riparian areas outside vireo territories were sampled to compare with nesting habitat. The parameters measured were percent cover, percent open ground, plant heights, plant density, height class frequency, species frequency, and species diversity. The vireo nest sites showed no significant differences from the non-nest riparian sites for any of the variables studied. The nest sites on the San Diego River had lower native plant density and diversity than nest sites on the Sweetwater and San Luis Rey rivers. There were no significant differences in nesting habitat between the Sweetwater and San Luis Rey. We suggest using the data from all three rivers in designing revegetation sites for the Least Bell's Vireo in coastal San Diego County if data on the specific watershed being revegetated can not be obtained.

The Least Bell's Vireo (*Vireo bellii pusillus*) is an endangered riparian bird which occurs primarily in coastal southern California. Habitat loss and cowbird parasitism are the primary causes for its rapid population and distribution decline (USFWS, 1985).

Riparian habitat restoration is part of the active management plan for the recovery of the Least Bell's Vireo. As development pressures continue in the current vireo range, restoration is being required almost on a routine basis for project impact mitigation. Effective restoration of vireo habitat requires a more thorough knowledge of the habitat than presently exists. In the only published paper on Least Bell's Vireo habitat, Gray and Greaves (1984) described the habitat in Santa Barbara County with data on plant species frequency, frequency of vegetative height classes, and stems per hectare. We wanted to broaden the vegetative description of the habitat and include several rivers from San Diego County. In addition, our study was designed to yield data that could be more easily adapted for use in a revegetation plan.

Our primary goal, to characterize the nesting habitat of the Least Bell's Vireo in San Diego County for the design of restoration projects, prompted us to ask the following two questions: (1) are there differences in vireo nesting habitat among three of the major rivers

in San Diego County, the Sweetwater, San Diego, and San Luis Rey? (2) are there differences in vegetation between vireo nesting areas and riparian areas outside vireo territories?

## Methods

### Selection of study plots

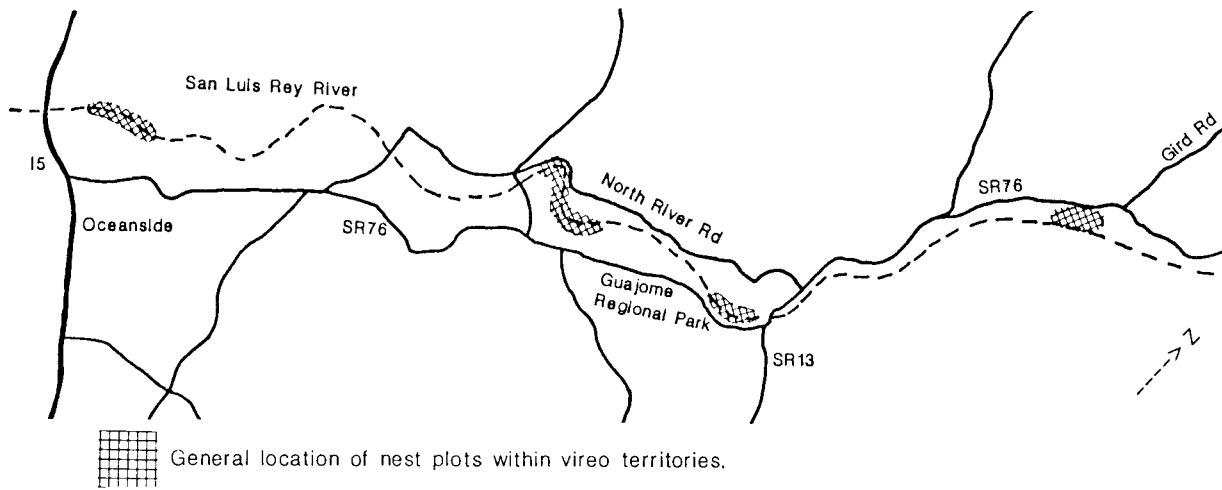
All Least Bell's Vireo nests monitored in 1986 on the Sweetwater, San Diego, and San Luis Rey rivers were assigned numbers, and a sample of ten were randomly chosen from each river (figs. 1, 2, 3, and 4). A 10 meter diameter circular plot was centered on each nest.



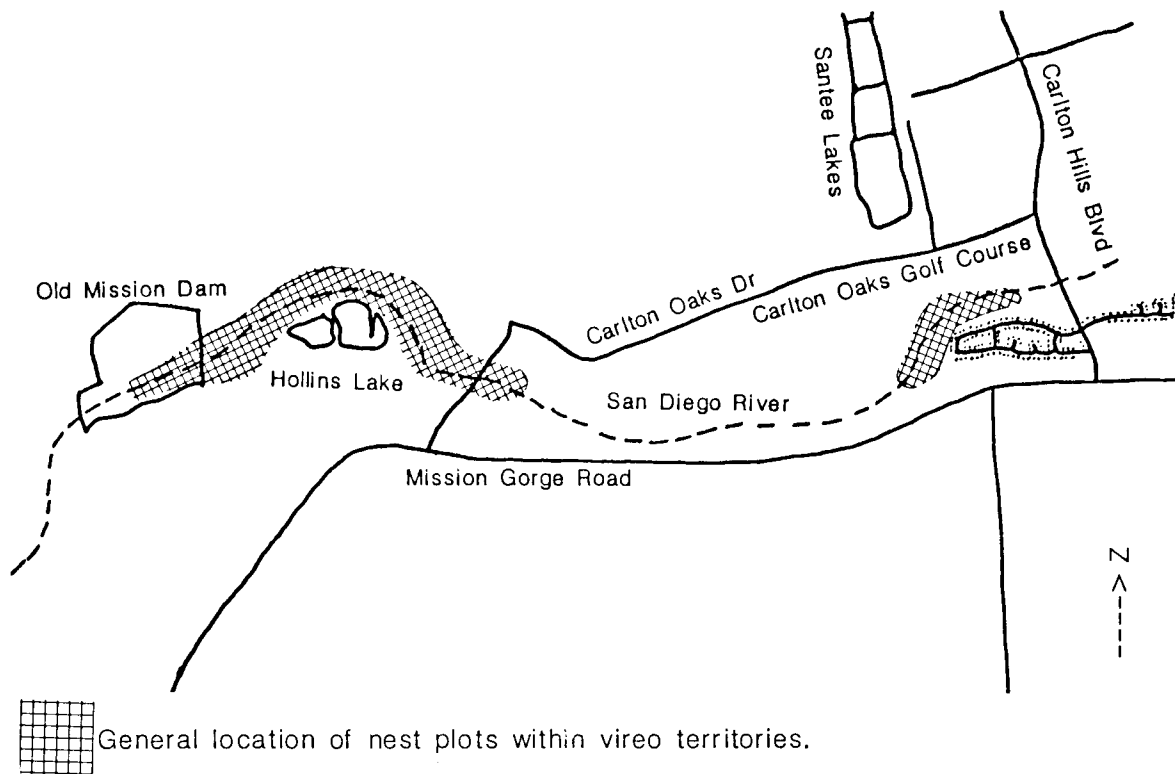
**Figure 1**— Coastal San Diego County, Calif. showing the location of the three river drainages studied.

<sup>1</sup> Presented at the California Riparian Systems Conference; September 22-24, 1988; Davis, California.

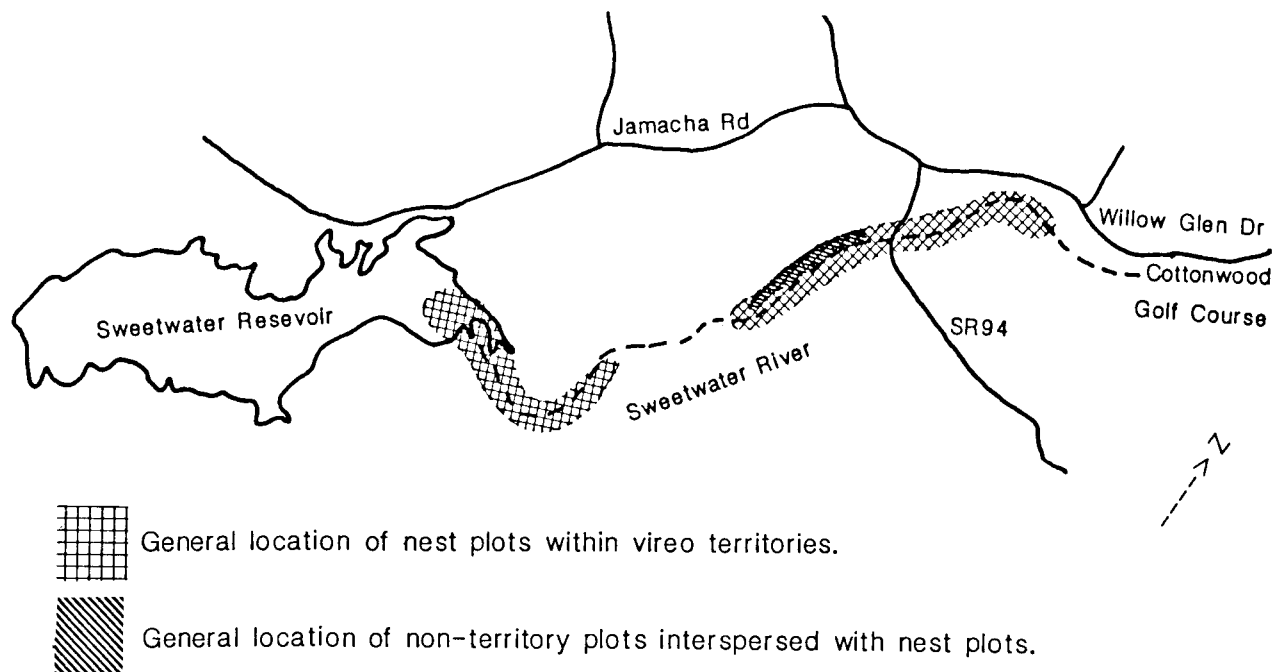
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**Figure 2-** Location of study sites on the San Luis Rey River, San Diego County, Calif., 1986.



**Figure 3-** Location of study sites on the San Diego River, San Diego County, Calif., 1986.



**Figure 4**— Location of study sites for nest and non-nest plots on the Sweetwater River, San Diego County, Calif., 1986.

Ten non-nesting areas with riparian vegetation and in close proximity to, but outside, vireo territories were identified on the Sweetwater River. Random numbers were used to locate one 10 meter diameter circular plot within each of the ten areas. The non-nest plots were interspersed with vireo nest plots (fig. 2).

The parameters measured were percent vegetative cover, percent open ground, height of plant stands, frequency of height classes, plant density, plant species frequency, and plant species diversity. Vertical structure of the vegetation is believed to be more important than species composition for nest site selection in the Least Bell's Vireo (Gray and Greaves 1984). Therefore, instead of making comparisons separately for each plant species, the species were grouped according to their growth form and whether they are native or exotic.

#### Percent cover

Each plot was mapped to scale, delineating the major vegetation stands found within it including open areas and watercourses. Stands often consisted of more than one plant species. Percent cover of native trees, shrubs, herbs, and exotic plants was calculated from the scale maps with a planimeter.

#### Plant heights

An average level of the plant tops within each relatively distinct plant stand was estimated and measured.

Heights above 3.5 meters were estimated to the nearest 0.5 meter. Since exotic plants included different growth forms, to simplify the analysis of heights, native and exotic plants were combined and all species were grouped as trees, shrubs, or herbs.

The frequency of specific height classes was determined in addition to heights of tree, shrub, and herb stands. The height classes included: open ground, ground cover (< 0.6 meter), low canopy (3.1 — 6.0 meters), and high canopy (> 6.0 meters).

#### Plant density

All plants occurring within the plots were identified and counted. This enabled calculation of plant density by species and by plant growth form. However only density by growth form is reported here and includes native trees, shrubs, herbs, and exotics.

#### Plant species frequency and diversity

Percent frequency of plant species was calculated as the number of plots in which a species occurred divided by the total number of plots. Diversity represents the number of species per 10 meter diameter plot and was divided into natives and exotics.

## Statistical methods

A randomized complete block analysis of variance was used for each of the vegetation parameters except species frequency and height class frequency. Plant growth form was the blocking factor for all analyses. The treatments in one set of analyses were the three San Diego county rivers (all plots centered on vireo nests). Vireo nest sites and riparian sites outside vireo territories (i.e. non-nest plots), both on the Sweetwater River, were compared in the second set of analyses.

All samples were tested for normal distributions with the Kolmogorov-Smirnov goodness of fit test, and homogeneity of variances with Hartely's F-max test. In some cases the data were logarithmically transformed to meet these criteria. When the logarithmic and square root transformations failed to normalize the distributions or render variances homogeneous, the data were ranked and the usual analysis of variance was performed on the ranks (Montgomery 1984). When this ranking test was used, the data were presented as medians instead of means and 25th and 75th percentiles instead of standard errors. Fisher's least significant difference test (Fisher's LSD) was used to make pairwise comparisons following the analysis of variance when treatment effects were significant. Alpha was set to 0.05 for all tests.

## Results

### Species frequency

The percent frequency of black willow (*Salix gooddingii*) and arroyo willow (*Salix lasiolepis*) was high on all three San Diego County rivers (table 1). Mulefat (*Baccharis glutinosa*) was overall the most frequently occurring plant in the study. There were no clear cut trends in percent frequency of species in nest plots versus non-nest plots or among rivers with one exception. Native herb frequency was low on the San Diego River relative to the other rivers.

### Percent cover

Percent cover of trees, shrubs, herbs, and exotics was not significantly different among the Sweetwater, San Diego, and San Luis Rey rivers (3 x 4 ANOVA using ranks, df = 2 and 108, F = 0.64, p = 0.86) (fig. 5). High variability in percent cover resulted in no significant differences on the Sweetwater River between non-nest plots and nest plots (2 x 4 ANOVA using ranks, df = 1 and 72, F = 1.07, p = 0.31) (fig. 5).

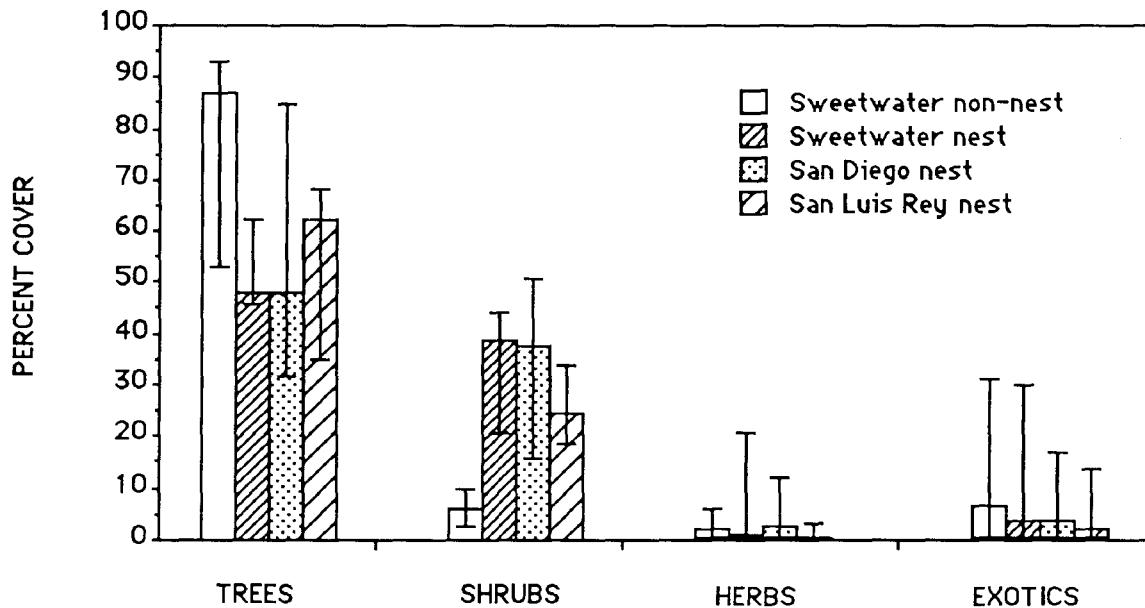
Percent open ground in nest plots was not significantly different among the three rivers (one-way ANOVA, df = 2 and 27, F = 0.70, p = 0.50) (fig. 6). Although the percent open ground was about twice as high in the nest plots as the non-nest plots, they were not significantly different (student's t-test, df = 18, t = -1.45, p = 0.16) (fig. 6).

### Plant heights

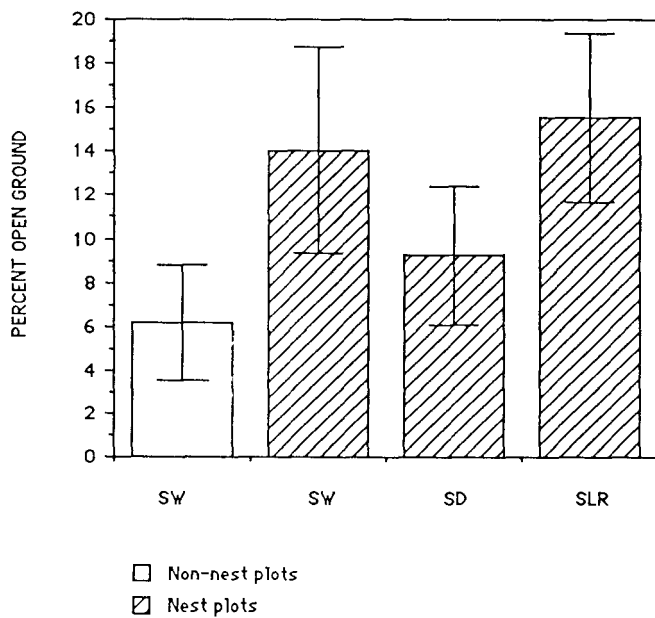
Heights of tree, shrub, and herb stands were not significantly different among rivers (3 x 3 ANOVA, log transformation used, df = 2 and 81, F = 0.31, p = 0.74) nor between vireo nest plots and non-nest plots (2 x 3 ANOVA log transformation used, df = 1 and 54, F = 0.45, p = 0.50) (fig. 7).

**Table 1** - Percent frequency of plant species occurring in 10 m diameter plots on the Sweetwater (SW), San Diego (SD), and San Luis Rey (SLR) Rivers, San Diego County, Calif., 1986. Only species that occur in at least four out of the total 40 plots are shown.

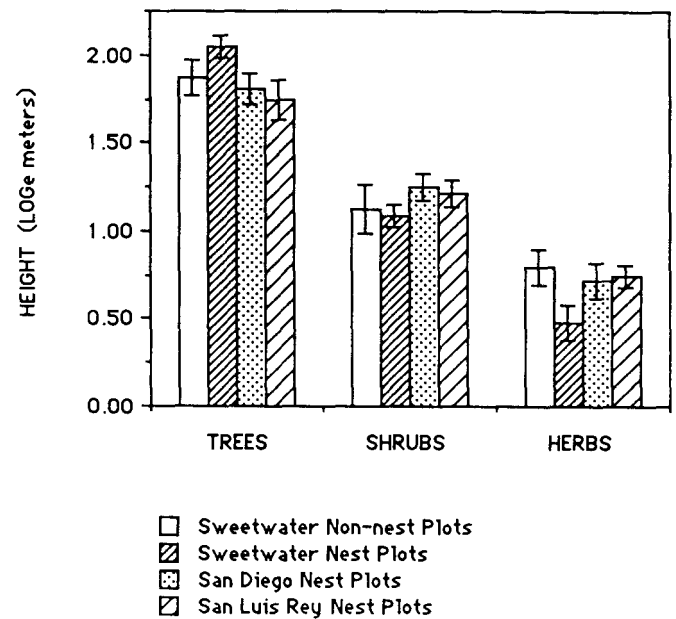
| Species                          | Non-nest<br>SW | Nest<br>SW | Nest<br>SD | Nest<br>SLR |
|----------------------------------|----------------|------------|------------|-------------|
| <b>NATIVES</b>                   |                |            |            |             |
| <b>Trees</b>                     |                |            |            |             |
| <i>Salix gooddingii</i>          | 40             | 100        | 80         | 50          |
| <i>Salix lasiolepis</i>          | 60             | 60         | 50         | 80          |
| <i>Populus fremontii</i>         | 0              | 20         | 20         | 30          |
| <i>Salix hindsiana</i>           | 0              | 0          | 10         | 40          |
| <i>Sambucus mexicana</i>         | 30             | 10         | 0          | 10          |
| <b>Shrubs</b>                    |                |            |            |             |
| <i>Baccharis glutinosa</i>       | 80             | 80         | 100        | 80          |
| <i>Artemisia palmeri</i>         | 10             | 40         | 0          | 70          |
| <i>Baccharis sarothroides</i>    | 20             | 10         | 20         | 0           |
| <b>Herbs</b>                     |                |            |            |             |
| <i>Artemisia douglasiana</i>     | 20             | 30         | 0          | 90          |
| <i>Ambrosia psilostachya</i>     | 10             | 40         | 20         | 40          |
| <i>Urtica holosericea</i>        | 40             | 20         | 0          | 20          |
| <i>Iletherotheca grandiflora</i> | 0              | 20         | 0          | 30          |
| <i>Phacelia</i> sp.              | 10             | 0          | 0          | 30          |
| <b>EXOTICS</b>                   |                |            |            |             |
| <b>Trees or Shrubs</b>           |                |            |            |             |
| <i>Tamarix</i> sp.               | 10             | 50         | 0          | 10          |
| <i>Nicotiana glauca</i>          | 0              | 40         | 10         | 10          |
| <i>Arundo donax</i>              | 10             | 0          | 10         | 20          |
| <b>Herbs</b>                     |                |            |            |             |
| <i>Brassica nigra</i>            | 20             | 30         | 50         | 70          |
| <i>Rumex</i> sp.                 | 40             | 10         | 60         | 30          |
| <i>Solanum</i> sp.               | 40             | 20         | 40         | 10          |
| <i>Centaurea melitensis</i>      | 40             | 30         | 30         | 0           |
| <i>Bromus</i> sp.                | 10             | 10         | 30         | 50          |
| <i>Cyperus</i> sp.               | 0              | 20         | 10         | 30          |
| <i>Apium graveolens</i>          | 30             | 20         | 0          | 0           |
| <i>Foeniculum vulgare</i>        | 10             | 10         | 30         | 0           |



**Figure 5**— Median percent vegetative cover in vireo nest plots and non-nest plots on the Sweetwater River and in nest plots on the San Diego and San Luis Rey Rivers, San Diego County, Calif., 1986. Error bars are 25th and 75th percentiles.



**Figure 6**— Mean percent open ground in vireo nest plots and non-nest plots on the Sweetwater River and in nest plots on the San Diego and San Luis Rey Rivers, San Diego County, Calif., 1986. Error bars are plus or minus 1 standard error.



**Figure 7**— Mean log height of vegetation by growth form in vireo nest plots and non-nest plots on the Sweetwater River and in nest plots on the San Diego and San Luis Rey Rivers, San Diego County, Calif., 1986. Error bars are plus and minus 1 standard error.

The percent frequency of vegetative cover by height class is presented in Table 2. Ground cover was present more frequently in the San Luis Rey and Sweetwater nest plots than in the San Diego nest plots. Low shrub, high shrub, and low canopy layers were present in 80 to 100 percent of the plots on each of the three rivers, including non-nest sites. The frequency of a high canopy was variable among rivers.

### Plant densities

Plant densities in the nest plots were significantly different among the three rivers (3 x 4 ANOVA using ranks,  $df = 2$  and  $108$ ,  $F = 10.65$ ,  $p < 0.001$ ) (fig. 8). Pair-wise comparisons using Fisher's LSD method revealed the following: (1) both native tree and shrub densities in nest plots were lower on the San Diego than on the San Luis Rey but were not different between the Sweetwater and either of the other two rivers, (2) plant density of native herbs was significantly lower on the San Diego than on the Sweetwater or San Luis Rey Rivers, (3) the densities of introduced plants did not differ significantly among the three rivers.

There were no significant differences in plant density between non-nest plots and nest plots for all growth forms (2 x 4 ANOVA, log transformation used,  $df = 1$  and  $72$ ,  $F = 2.58$ ,  $p = 0.09$ ) (fig. 9).

### Species diversity

Native plant species diversity in nest plots was significantly lower on the San Diego River than on both the Sweetwater and the San Luis Rey (3 x 2 ANOVA,  $df = 2$  and  $54$ ,  $F = 4.26$ ,  $p = 0.02$ ) (Fisher's LSD test) (fig. 10). In contrast, there were no significant differences in the diversity of exotic plant species among rivers (Fisher's LSD test).

There was no significant difference in the number of native or exotic species per non-nest plot compared with nest plots (2 x 2 ANOVA,  $df = 1$  and  $36$ ,  $F = 3.31$ ,  $p = 0.09$ ) (fig. 10). High variability among plots overshadowed the apparent difference between non-nest and nest plots in mean diversity of natives.

**Table 2** — Percent frequency of height classes in 10 m diameter plots on the Sweetwater (SW), San Diego (SD), and San Luis Rey (SLR) Rivers, San Diego County, Calif., 1986.

| Height Classes           | NON-<br>NEST<br>SW | NEST<br>SW | NEST<br>SD | NEST<br>SLR |
|--------------------------|--------------------|------------|------------|-------------|
| Open                     | 50                 | 80         | 70         | 80          |
| Ground Cover (< 0.6 m)   | 60                 | 90         | 40         | 100         |
| Low Shrub (0.6 — 1.5 m)  | 90                 | 80         | 90         | 100         |
| High Shrub (1.6 — 3.0 m) | 80                 | 90         | 90         | 100         |
| Low Canopy (3.1 — 6.0 m) | 90                 | 80         | 100        | 90          |
| High Canopy (> 6.0 m)    | 50                 | 90         | 30         | 60          |

## Discussion

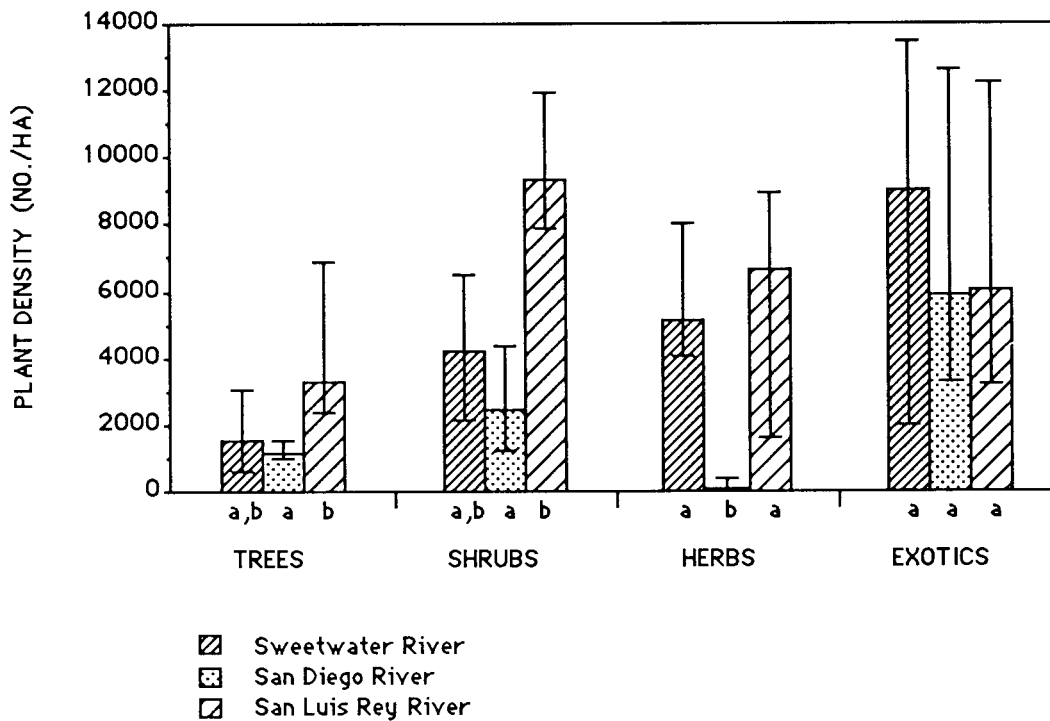
Nest sites on the San Diego River had lower native plant density, native species diversity, and frequency of native herbs than nest sites on the Sweetwater and San Luis Rey. There were no significant differences in any of the vegetation parameters between the Sweetwater and the San Luis Rey. We believe that greater human presence is responsible for the lower native plant density and diversity on the San Diego River. There is generally more human disturbance in the riparian vegetation within the vireo's breeding range on the San Diego River because of a golf course, scattered camping sites, and partial channelization of the river. Even though the San Diego River is more disturbed, a relatively high population density of vireos occurs there (Jeff Newman, pers. comm.). Therefore it is appropriate to use data from all three rivers in a restoration model for vireo habitat in coastal San Diego County (table 3). However, whenever possible, it is best to use data on vireo habitat within the particular watershed being restored.

We found no significant differences between vireo nest sites and non-nest sites in all the vegetation parameters studied. Gray and Greaves (1984) also found no differences between nest and non-nest sites in stem densities, species frequencies, and height class frequencies. Also in agreement with their data was the wide variability among nest plots in vegetation structure. This high variability, and the similarity between areas occupied and not occupied by vireos, indicates that the vireo is a generalist nester, at least within willow-cottonwood woodland, with respect to: species frequency, cover, and plant density.

**Table 3** — Means and standard errors of 30 Least Bell's Vireo nest plots on the Sweetwater, San Diego, and San Luis Rey rivers, San Diego County, Calif., 1986.

|                      | Percent Cover | Plant Density<br>(no/ha) | Plant Height<br>(meters) |
|----------------------|---------------|--------------------------|--------------------------|
| Natives <sup>1</sup> |               |                          |                          |
| Trees                | 55.37 ± 21.73 | 2,750 ± 3,084            | 5.76 ± 1.84              |
| Shrubs               | 34.95 ± 25.70 | 7,279 ± 9,580            | 2.36 ± 0.84              |
| Herbs                | 9.54 ± 18.24  | 5,577 ± 7,053            | 0.99 ± 0.56              |
| Exotics              | 11.21 ± 16.72 | 10,016 ± 13,012          | —                        |
| Open Ground          | 12.93 ± 12.36 | —                        | —                        |

<sup>1</sup>Natives and exotics are combined for mean plant heights.



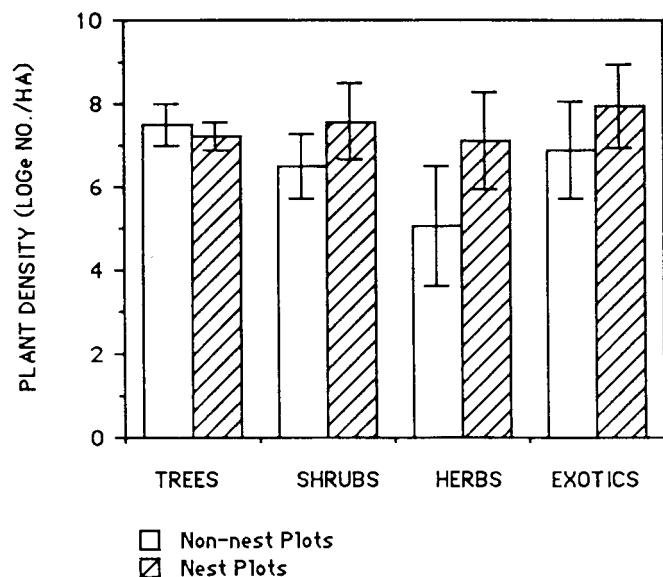
**Figure 8**– Median plant densities in vireo nest plots on the Sweetwater, San Diego, and San Luis Rey Rivers, San Diego County, Calif., 1986. Error bars are 25th and 75th percentiles. Medians with the same letter in the same group (i.e. trees) are not significantly different.

Although the vireo is a generalist nester in several ways, this does not lessen the importance of approximating natural riparian woodland as closely as possible when restoring vireo habitat. Our data can be used directly in designing a riparian revegetation area (Baird and Rieger, these proceedings). The height class frequencies in nest plots show that a restoration plan should include persistent low and high shrub layers and a tree canopy. Percent cover of growth forms, species frequencies, and plant densities should be used as a basis for (1) the percent areas to plant with native trees, shrubs, and herbs, (2) species composition, and (3) overall plant densities. A revegetation design based on plant density as opposed to stem density is more functional because the number of stems per plant is difficult to predict given the variability of branching patterns.

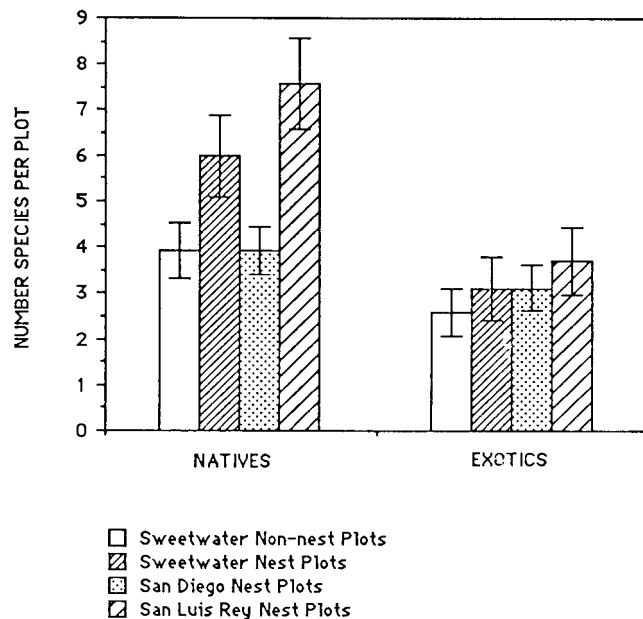
Characterization of the vireo's foraging habitat and other areas within their territories is the next step toward developing a holistic habitat restoration plan for this species. We strongly encourage the use of quantitative data from natural communities for designing the restoration of habitat for other endangered species.

## Acknowledgments

We thank Jane Griffith and John Griffith for collection of the field data; John Beezley, Matt Colbert, and Kate Baird for reviewing the manuscript; Yvonne Potter for preparing the maps; Boyd Collier, San Diego State University for statistical analysis advice.



**Figure 9**— Mean log plant density in vireo nest plots and non-nest plots on Sweetwater River, San Diego County, Calif., 1986. Error bars are plus and minus 1 standard error.



**Figure 10**— Mean number of species per plot in vireo nest sites and non-nest sites on the Sweetwater River and in nest sites on the San Diego and San Luis Rey Rivers, San Diego County, Calif., 1986. Error bars are plus and minus 1 standard error. Means with the same letter in the same group (i.e. natives) were not significantly different. Sweetwater nest plots were not significantly different from non-nest plots.

## References

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