Pilgrim Creek Restoration Project: Bird Community and Vegetation Structure

1999 Annual Report

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TABLE OF CONTENTS

TABLE OF CONTENTS
(*continued*)

FIGURES

TABLES

APPENDICES

I. INTRODUCTION

This report summarizes the results of bird and vegetation monitoring conducted in 1999 as part of a continuing project assessing the Pilgrim Creek Habitat Mitigation Site in San Diego County, California. The Mitigation Site supports natural stands of riparian and coastal sage scrub habitat, as well as planted vegetation intended to restore former expanses of these two habitat types in areas converted by agriculture. Protection of the existing habitats through acquisition, and the restoration of natural communities at the site, were undertaken as mitigation for impacts to riparian and coastal sage scrub habitat produced by a nearby highway expansion project (CalTrans 1995). The objective of the current monitoring is threefold: (1) monitor the status and productivity of least Bell's vireo (*Vireo bellii pusillus*), a State and Federally endangered riparian obligate, (2) evaluate the structural development of planted vegetation in the riparian restoration site with regard to its suitability for nesting vireos and other birds, and (3) quantitatively compare bird use of the restoration site to that of natural reference habitat along Pilgrim Creek with regard to species composition and abundance. This report represents the third of five annual evaluations planned by CalTrans to track progress towards the goal of creating habitat with the structural and functional attributes of natural riparian habitat (Kus 1997, Kus *et al.* 1999).

II. STUDY SITE AND METHODS

A. STUDY SITE

The study site is located along Pilgrim Creek, a tributary to the San Luis Rey River in northern San Diego County. The site is bordered to the west by Marine Corps Base Camp Pendleton, to the south by a golf course, and on the remaining sides by Douglas Drive and residential developments. The stretch of Pilgrim Creek on the site supports approximately 4 ha of willow-dominated riparian habitat along a narrow channel. Coastal sage scrub, including 14 ha of restored habitat, covers the slopes bordering the site to the west, and the center of the site supports riparian vegetation planted in 1996 within an 11-ha restoration area, as well as a 0.6-ha freshwater marsh. An additional small cell of planted riparian vegetation lies between Pilgrim Creek and Douglas Drive on the east side of the river.

B. METHODS

1. Least Bell's Vireo Monitoring

Least Bell's vireos were monitored between 15 March and 31 August 1999. Surveys were initiated early in the spring to determine the number, location and breeding status (paired or unpaired) of all singing males within the study area. Once pairs were located, they were

observed for evidence of nesting. Nest locations were determined, and nests monitored throughout the period that they were active. Nests were checked during afternoon hours, and their contents observed using mirrors suspended over the nest from distances of 1-2 m. Any cowbird eggs or young discovered in vireo nests were removed. Nests were visited as infrequently as possible to minimize disturbance to the vireos, and the potential for attracting predators or cowbirds to nest sites. Typically, the first visit to a nest was timed to determine the number of eggs laid, the second visit to determine the number and ages of nestlings present, and the third visit to band nestlings. Territories were visited throughout the season, and an attempt made to determine the number and fate of all nests produced.

Characteristics of nest sites were measured following abandonment of nests. Nest height to the nearest cm was recorded as the distance between the ground and the nest rim. The species of plant supporting the nest was also recorded.

Nestlings were banded when they were between six and eight days of age. Each bird received a metal USGS numbered band on one leg, and a black plastic band specifying Pilgrim Creek as the natal drainage on the other. Selected adults, mostly males, were captured in mist nets placed in the bird's territory, using song playbacks to draw the bird into the net. Any birds banded previously as nestlings at Pilgrim Creek or elsewhere were captured to determine identity, age, and natal history, and to re-band with a unique combination. In addition, as many as possible of the unbanded males at the study site were captured and banded with identifying combinations to monitor site fidelity, population turnover, and use of the restoration site.

2. Vegetation Structure

Vegetation data were collected at points along permanently marked transects running perpendicular to Pilgrim Creek and arrayed to provide uniform coverage of the restoration site (Figure 1). Twenty-four transects were established in 1997 in habitat to the west of the river, and measured in 1997, 1998, and 1999. An additional four transects were established in the restored habitat east of the creek in 1998 and measured that year as well as in 1999. A total of 506 quads spaced at 10-m intervals along the transects were measured, yielding a sampling density of 46 quads per hectare (18 per acre). Foliage volume at 1-m height intervals was estimated using the "stacked cube" method, developed specifically to characterize canopy architecture in structurally diverse riparian habitat (Kus 1998). By this method, field workers record percent cover of vegetation, by species, within 2- by 2- by 1-m high sampling volumes "stacked" vertically between the ground and the top of the canopy above the point. Four 2-m lengths of PVC pipe are placed on the ground to define the quadrat boundaries, and connectible lengths of PVC, marked at 1-m intervals, are used to determine height within the canopy. Percent cover is scored in the field using a modified Daubenmire (1959) scale with cover classes < 1, 1-10, 11-25, 26-50, 51-75, 76-90, and >90 percent. For analysis, cover codes were converted to class midpoints, which were then used to quantify vegetation structure at each

sampling point, within each planting cell, and for the site as a whole.

In addition, vegetation structure data were collected at 54 points along 16 transects within the mature riparian habitat along Pilgrim Creek to provide a reference for the restored habitat, and to facilitate analyses examining relationships between habitat structure and bird densities in both sites.

Because the least Bell's vireo is the primary target of the mitigation project, habitat within the restoration site was assessed with regard to its suitability as vireo nesting habitat by comparing it to a model quantifying vireo habitat at major breeding populations in San Diego County (Kus 1998). The model was developed as a tool for evaluating whether sites unoccupied by vireos supported habitat suitable for nesting; that is, does the site fall within the range of habitat structure found within vireo nesting territories? The criteria established for making this determination requires that average cover at each height in the site under consideration fall within two standard deviations of the corresponding averages for known vireo nesting habitat, a range representing the 95 percent confidence interval of each mean (Snedecor and Cochran 1976). Sites failing to meet these criteria are considered unsuitable as nest sites for vireos.

3. Bird Surveys

Bi-weekly bird surveys of Pilgrim Creek were initiated in 1995 to provide baseline data on the riparian bird community at the site. Beginning in 1998, data collection was expanded to include the restored habitat, which by then was in its second growing season. Data collected along the creek in 1999 served as reference data with which to evaluate bird use of the restored habitat in the current year.

Birds were surveyed by observers following established routes designed to provide coverage of the entire sites. Species, age, sex, and behavior were recorded for every bird encountered, as were plant species and bird height for birds perched in vegetation. Any nests or nesting behavior observed during surveys were noted. Surveys were conducted during early morning hours, and typically lasted 2-3 hours in each habitat, which were surveyed on sequential days.

In addition to surveys of mature habitat along Pilgrim Creek and the restored riparian habitat, surveys of the coastal sage scrub uplands were conducted in the same manner and according to the same schedule. Although not systematically surveyed, birds using the freshwater marsh/pond were noted as well.

Riparian birds were categorized relative to seasonal occurrence (year-round resident, migratory breeding species, migratory wintering species, and migrants/transients) based upon the species' use of the Pilgrim Creek site, not necessarily their occurrence in the County as a whole.

Birds were grouped for analysis into four habitat affinity guilds: wetland, open habitat, scrub or habitat generalist, and woodland species. Species densities were calculated and expressed as the average number of individuals per survey per hectare, using areas derived from aerial photos and maps of the study area. Densities were calculated separately for each of four seasons (Spring: April-June, Summer: July-September, Fall: October-December, Winter: January-March). In the current report, comparisons across habitats of the four habitat affinity guilds include only breeding season data (combined Spring and Summer densities).

III. RESULTS AND DISCUSSION

A. Least Bell's Vireo Monitoring

1. Population Size and Composition

The least Bell's vireo population within the study site numbered 25 territorial males in 1999, including 22 pairs and three unpaired males (Figure 2, Table 1). The population declined by 19 percent from 1998 when 31 territories were present, but is slightly larger than the population size (22 territorial males) in 1997. The relatively large number of territories within the study site in 1998 was accounted for by the extensive use (eight territories) of mustard (*Brassica* sp.) stands along the base of the slopes at the western edge of the property. Mustard was cleared from the slopes prior to the 1999 nesting season, and vireos did not establish territories in these areas in 1999.

An additional territorial male of unknown status was detected outside of the study area boundary upstream of the restoration site (Figure 2) in an area occupied by vireos in past years. This male was not monitored for nesting activity, but was detected often enough in passing to determine the downstream limits of his territory.

Four territories were established within the restored habitat (Figure 2), including two placed entirely within the site and two extending into the site from adjacent habitat. Three of the territories were occupied by pairs, all of which nested (Table 1).

Eleven of the 25 males breeding at Pilgrim Creek in 1999 were birds banded in previous years (Tables 1 and 2). The majority of these males were banded at the site as adults of unknown age; however, three were banded as nestlings in territories along Pilgrim Creek (one) and the San Luis Rey River (two), and their precise ages thus known. The eldest of these males was seven years old and is one of four banded males present at Pilgrim Creek at the onset of the

Table 1.
Status and Territory ID of Least Bell's Vireos, Pilgrim Creek, 1999

Map Code	Status	Comments	Map Code	Status	Comments
1	P	M=2070-14900	14	P	
2	P	M=2070-14818	15	P	M=2070-14885
3	P	M=1890-35259	16	S	M=2080-53428
4	P		17	P	
5	P	M=2070-14837	18	P	M=2070-14823
6	P		19	P	M=2070-14812
7	P	F=2140-39231	20	P	
8	P	M=2070-14869	21	P	M=2070-14868
9	P		22	P	
10	P		23	P	M=1960-42415
11	S	M=2070-14815	24	P	
12	S		25	P	
13	P	M=2070-14814	26[a]	U	

[a]*Territory not in study area.*
[b]*P=pair, S=single male, U=male of unknown status.*
[c]*M=male, F=female. Number is USGS band number.*

study in 1996. The other two males were three and four years of age, and included the only nestling banded at Pilgrim Creek ever observed to return to the study site as a breeding adult. Two additional males and one female were banded for the first time as adults in 1999.

2. Nesting Activity

a. *Type and Number of Nests*

A total of 35 nests were documented, including 34 that were monitored, and one that was not located but known to have existed by the appearance of fledglings with a pair suspected of nesting. Thirty-two of the 35 nests represented completed attempts, while three nests were abandoned during construction. Pairs averaged 1.5 completed nests per season, slightly lower than the average of 1.8 recorded for pairs in 1998.

b. *Nest Initiation*

Nesting commenced considerably later in 1999 than in previous years. No nests were initiated prior to 16 April, and whereas half to two-thirds of pairs in 1996-1998 had initiated nests by 30 April, only nine percent had done so in 1999. By mid-May, 55 percent of pairs in 1999 had attempted nests, in contrast to 100 percent of pairs in previous years.

Twenty-three percent (5/22) of pairs in 1999 initiated first nests as late as June, although most nests in June were re-nesting attempts by pairs unsuccessful in their first attempts.

c. *Nesting Effort by Pairs*

The majority of nests observed in 1999 represented first nesting attempts, and only 41 percent of the population attempting more than one nest (Table 3). Nesting effort of pairs was consistent with the pattern observed during 1996 and 1997, but departed from the effort observed in 1998, when nearly 70 percent of pairs completed two or more nests. No pairs in 1999 double-brooded (fledged young from more than one nest) in contrast to 1998, when four pairs did so.

Table 3.
Number of Completed Nests Produced by Least Bell's Vireo Pairs,
Pilgrim Creek, 1999

Number of Completed Nests	Number of Pairs
0	0 (0.00)[a]
1	13 (0.59)
2	8 (0.36)
3	1 (0.05)
TOTAL	22

[a]*Numbers in parentheses are proportions of total pairs.*

d. *Nesting Success*

Nest success was considerably lower in 1999 than in previous years, with 38 percent (12/32) of nests fledging young in contrast to the 50-61 percent documented since 1996. As in the past, the majority of nest failures were attributed to predation (Table 4). Two nests failed for reasons other than predation: one was poorly constructed and fell when its supporting branch broke, and the other was found with dead 4-5-day-old nestlings.

Abandonment of nests was observed during all stages of the nesting cycle (Table 6), although the infrequency of nest visitation by field observers precluded the determination of the exact time of nest abandonment in some cases. Nest failures occurred in roughly equal proportions over the egg and nestling stages, similar to the pattern observed in 1996 and 1997. Predation on nestlings was considerably higher than in 1998, however, when only nine percent of predation events occurred during the nestling stage, suggesting differences in the predator regimes among years.

Table 4.
Cause of Failure of Unsuccessful Least Bell's Vireo Nests,
Pilgrim Creek, 1999

Cause of Failure	Number of Nests
Predation	18
Parasitism	0
Other[a]	2
Total Failed Nests	20
Total Completed Nests	32

[a]*See text for explanation.*

Table 5.
Stage of Failure of Unsuccessful Least Bell's Vireo Nests,
Pilgrim Creek, 1999

Stage of Failure	Number of Nests
Pre-laying/Eggs[a]	1 (0.05)[b]
Eggs	10 (0.50)
Eggs/nestlings[a]	1 (0.05)
Nestlings	8 (0.40)
Total Failed Nests	11

[a]*Exact stage of failure not determined.*
[b]*Numbers in parentheses are proportions of total number of failed nests.*

e. *Parasitism by Brown-headed Cowbirds*

No instances of cowbird parasitism were observed, although brown-headed cowbirds were documented at the site for the first time since the study began in 1996.

f. *Reproductive Success and Productivity*

Clutch size (based on 25 nests observed with full clutches) averaged 3.4 $\pm$ 0.7 eggs per nest (Table 6), comparable to previous years. Hatch rates were similar to those documented in 1998, when egg predation was high, but lower than in 1996 and 1997, when overall predation

rates were lower. Fledging rates were also lower than in the past, when between 71 and 94 percent of nestlings, and nests containing nestlings, fledged. Overall, pairs produced 0.35 fledglings per egg, in contrast to the 0.53-0.62 fledglings per egg produced in past years.

Seasonal productivity of vireos averaged 1.6 fledglings per pair, also lower than in previous years when pairs produced from 2.1 to 2.9 young per season. Only 55 percent of pairs (12/22) fledged one or more vireo young, the lowest proportion ever observed at this site where typically more than 70 percent of pairs contribute to the production of young.

Table 6.
Reproductive Success and Productivity of Least Bell's Vireos, Pilgrim Creek, 1999

Parameter	Total Number
Nests with eggs	29
Eggs laid	95
Average clutch size[a]	3.4 ± 0.7
Hatchlings	60
Nests with hatchlings	19
Hatching success:	
Eggs[b]	63%
Nests[c]	66%
Fledglings	34
Nests with fledglings	11
Fledging success:	
Hatchlings[d]	57%
Nests[e]	58%
Fledglings per egg	0.35
Fledglings per nest[f]	1.09
Fledglings per pair	1.59
Pairs fledging ≥ one young	12

[a]Based upon 25 non-parasitized nests seen with full clutches.
[b]Percentage of all eggs that hatched.
[c]Percentage of all nests in which at least one egg hatched.
[d]Percentage of all hatchlings that fledged.
[e]Percentage of all nests with hatchlings in which at least one young fledged.
[f]Includes 1 fledgling from a nest not seen.

3. Banding

Forty-six nestlings in 15 nests were banded, representing 92 percent of the nestlings in monitored nests. Of these nestlings, 36 are believed to have fledged, while the other ten were in nests depredated before fledging.

4. Nest Site Characteristics

The average height of vireo nests in the study area in 1999 was 1.0 $\pm$ 0.6 m, comparable to previous years. Vireos placed nests in a total of seven different species, with the majority of nests placed in *Salix lasiolepis* (Arroyo Willow) and *Baccharis glutinosa* (Mule Fat) (Table 7).

Table 7.
Plant Species Used as Nest Support by Least Bell's Vireos, Pilgrim Creek, 1999

Species	Number of Nests
Salix lasiolepis	18
Salix hindsiana	1
Baccharis glutinosa	7
Sambucus mexicana	1
Rosa californica	1
Populus fremontii	2
Unspecified herbaceous	1
Total	31

B. Vegetation Structure

Canopy cover in the habitat along Pilgrim Creek increased at nearly all heights by up to five percent relative to 1998, with the exception of vegetation within 1 m of the ground, which declined slightly (Figure 3). A similar pattern of change was observed in the restored habitat (Figure 4), where vegetation cover remained unchanged or was slightly reduced below heights of

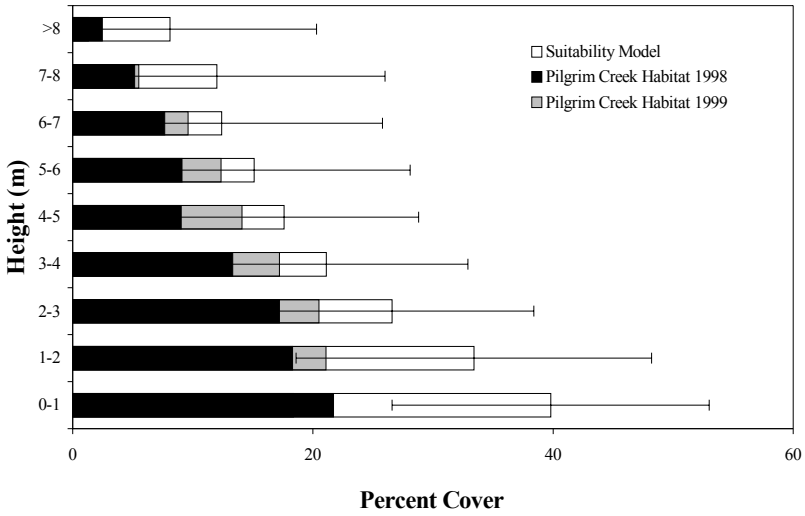

Figure 3. Average percent cover by height: Pilgrim Creek, 1998-99

2 m, and increased in density and height above 2 m. Vegetation development continues to be non-uniform across irrigation cells. Cover in the northern cells exceeds that in the southern cells, and in a number of cells (1,3,4,5,7,8,9 and 16) has achieved or nearly achieved the suitability criteria for heights up to 2 m (Figures 5 and 6). Much of the increase in cover and height above 2 m documented for the restoration site as a whole occurred in these northern cells, while the vegetation in cells 10-15 remained largely unchanged.

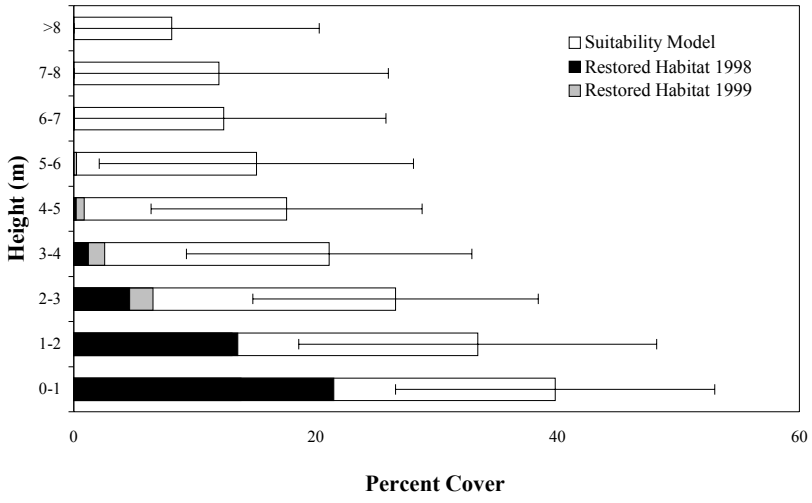

Figure 4. Average percent cover by height: restored habitat, 1998-99

C. Bird Surveys

The Pilgrim Creek study area is used by a large and diverse group of birds, including landbirds, shorebirds, waterfowl, and raptors. One hundred and fifteen species were detected at the site in 1999 (Table 8), bringing the total number documented since 1995 to 132 (Appendix 1). Of these 115 species, 69 (excluding flyovers) occurred in the riparian habitat along Pilgrim Creek, providing the reference community for evaluations of bird use of the restored habitat. This community includes a mix of year-round residents, migratory breeding species, wintering species, and transients.

Bird densities (average number of individuals per survey per hectare) varied across species, season, habitat (reference or restored), and, within the restoration site, cells. Wetland species (Table 9A) showed little overlap in their use of the reference and restored habitats, and occurred primarily in the restoration site where the pond in cells 12 and 13 attracted waterfowl and shorebirds, species present in very low densities, if at all, in the reference habitat. In contrast, the reference habitat was used by herons and egrets, species not seen in the restoration site. The reference and restored sites also differed in their use by open habitat species (Table 9B), although this group was the least abundant of all habitat affinity groups in the study area. With the exception of Cassin's kingbird (*Tyrannus vociferans*), no species in this guild were observed in the reference habitat, while species such as Say's phoebe (*Sayornis saya*), Savannah sparrow (*Passerculus sandwichensis*), and killdeer (*Charadrius vociferus*) were regularly seen in the restoration site, particularly in cells 8 and 11-14 where vegetation was sparse.

The reference and restored sites were more similar with regard to species richness, although not densities, of habitat structure generalists and woodland habitat species. Habitat structure generalists (Table 9C), although over three times as abundant in the reference habitat, occurred throughout the restoration site as well, with a more equitable distribution across cells than was documented for wetland species and open habitat species. Within the restoration site, the highest densities of birds in this guild occurred in cells 15 and 16, and reflected the presence of large numbers of song sparrows (*Melospiza melodia*) and common yellowthroats (*Geothlypis trichas*). These two species were abundant in the reference habitat as well, but more species contributed to overall density of this guild in the latter habitat than was the case in the restoration site, particularly when cells are considered individually.

Not surprisingly, differences in bird densities between the reference and restored habitats were most pronounced with regard to the woodland habitat species (Table9D), which were an order of magnitude more abundant in the former habitat than in the latter. Although they occurred throughout the restoration site, woodland birds achieved their highest densities in cells 1,2,5,7,8 and 16, cells with well-developed vegetation, and were least abundant in cells 12 and 13, where vegetation was sparse (Figures 5 and 6). Species richness was also greater in the reference habitat than in the restoration site, which did not support several of the flycatchers and warblers found along Pilgrim Creek. Among the most abundant species in the reference habitat

were American goldfinch (*Carduelis tristis*), least Bell's vireo, yellow warbler (*Dendroica petechia*), and yellow-breasted chat (*Icteria virens*); two of these (American goldfinch and least Bell's vireo) were also the most abundant in the restored habitat.

IV. CONCLUSIONS

The Pilgrim Creek study area continues to support a diverse community of riparian and upland birds, including several endangered and sensitive species. Least Bell's vireos, the primary focus of management of the site, are among the most abundant of the riparian obligates along Pilgrim Creek and, encouragingly, in the restored riparian habitat as well. While vireo numbers along the creek appear to have reached their maximum, vireos are expanding their distribution to include the restored habitat, which, with continued structural development, should provide additional suitable habitat facilitating vireo population growth.

Although habitat along Pilgrim Creek continues to support high densities of breeding vireos, nest success was lower in 1999 than in previous years as a result of heavy predation, continuing a downward trend documented in 1998. While many factors, including the late return of vireos to the breeding grounds, may have contributed to this low nesting success, a possible factor is the role that recent residential development of surrounding areas might have played in altering the composition and/or abundance of nest predators at the site. Identification of the effects of urbanization on predator communities, and associated impacts on avian nesting success, is an important research need. Meanwhile, further monitoring of predation rates at this site and other sites is warranted to determine the extent to which annual differences in predation rates observed thus far are within the range of natural variability as opposed to the result of other factors.

Vegetation within the restoration site changed little between 1998 and 1999, and essentially mimicked the pattern observed in the reference habitat, increasing in height and cover above 2 m, and declining in cover below that height. The reduction in cover in the lower regions of the canopy is most likely the result of differences between years in the establishment and growth of herbaceous annuals, as well as differences in the weeding and watering activities associated with site maintenance. Vegetation growth continues to be heterogeneous across cells, with plantings in the northern cells achieving greater cover and height than those in the southern cells. Differences across cells with regard to vegetation structure are reflected in the patterns of bird use we observed, with the northern cells attracting species dependent on woodlands with a high degree of canopy stratification, and the southern cells supporting more open habitat species. The location of vireo territories within the restoration site coincides with patches of well developed vegetation, consistent with observations at other sites (Kus 1998). Future monitoring and analysis will allow us to further describe changes in the bird community as vegetation development progresses, and to refine a model for using bird community composition as a tool for tracking habitat development in restoration projects.

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