Pilgrim Creek Restoration Project:
Bird Community and Vegetation Structure

1998 Annual Report

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I. INTRODUCTION

This report summarizes the results of bird and vegetation monitoring conducted between 1995 and 1998 at 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 second 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).

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 during each year of the study. 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-BRD 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 Measurement

a. *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. Twenty-four transects were established in 1997 in habitat to the west of the river, and measured in both 1997 and 1998. An additional four transects were established in the restored habitat east of the creek in 1998 and measured that year. 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. 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.

b. *Sedimentation Patterns*

The pattern of sediment deposition within the restoration site was investigated with the goal of evaluating the relationship between flood-associated sedimentation and plant growth. Sedimentation was quantified by measuring the depth of surface sediment, principally sand, in samples extracted with a soil coring device from the center of each vegetation quadrat. Because of uncontrolled variables influencing the extraction of soil samples, such as soil moisture, the degree to which each quadrat had experienced flooding and deposition based upon inspection of the soil surface was also scored subjectively as none, trace (slight layer), light (trace-15cm), moderate (15-45cm), or high (> 45cm).

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 1998 served as reference data with which to evaluate bird use of the restored habitat.

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 grouped for analysis by 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. Within each category, relative abundance codes were assigned by comparing the mean abundance of individual species to the mean abundance of all birds in the category, drawing from the 3-month seasonal period (December-February, March-May, June-August, September-November) with the highest abundance for that species. For example, a resident species that reached peak abundance in June-August was ranked according to the average abundance of all residents during that period. Species were classified as abundant if their peak seasonal abundance exceeded two standard deviations above the mean for the category, common if it was up to two standard deviations above the mean, uncommon if it was between the mean and half of the mean ($\overline{X}$/2), and rare if it was less than $\overline{X}$/2. Relative abundance codes apply only to birds within the same residency category and site; e.g. they do represent comparisons of abundance between restored and reference habitat. Future analyses of actual bird densities will allow for the latter comparison, as well as comparisons across residency categories.

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 ranged from 20 territorial males in 1996 to 31 territorial males in 1998 (Table 1, Figures 1-3). While vireo numbers varied little between 1996 and 1997, increasing by just 10 percent, the population expanded dramatically in 1998, increasing by 41 percent in one year. Not only did the number of territorial males grow, so also did the number of pairs, increasing from 20 in 1996 and 1997 to 28 in 1998 (40 percent). Virtually all of this growth was accounted for by the use in 1998 of non-riparian upland habitats,

Figure 1. Least Bell's Vireo Territory Locations at Pilgrim Creek, 1996

Figure 2. Least Bell's Vireo Territory Locations at Pilgrim Creek, 1997.

Figure 3. Least Bell's Vireo Territory Locations at Pilgrim Creek, 1998.

when eight territories were established along the base of the slopes at the west edge of the property (Figure 3). In addition to birds within the actual study site, vireos were located each year outside of the study area boundaries, both upstream and downstream (Figures 1-3), bringing the total counts of males in the project vicinity to 21, 24, and 33 for 1996-1998, respectively. Unless otherwise noted, these territories were not monitored, and are not included in subsequent analyses.

Two of the 20 males breeding at Pilgrim Creek in 1996 were birds banded in previous years (Tables 1, 2). One of these was originally banded as a nestling in Guajome Regional Park on the San Luis Rey River in 1992, and was rebanded at Pilgrim Creek in 1994 (Kus, unpubl. data). The other was banded as an adult in 1994 at Pilgrim Creek while trying to capture the aforementioned bird. While this latter bird was not seen again after 1996, the bird from the San Luis Rey River returned each year of the study, and was six years old by 1998. Two additional males were banded for the first time as adults in 1996.

Banding effort was intensified in 1997, and 11 new males were banded. In addition, a two-year-old male from the lower San Luis Rey River moved into the site, a male banded as a nestling at Pilgrim Creek the previous year returned to breed at the site, and three of the four banded birds from 1996 returned, bring the total number of banded males to 16, or 73 percent of the population.

Eleven of the 16 banded birds present in 1997 returned in 1998 (69 percent), and an additional nine new males and one female were captured and marked.

The presence of banded birds in 1998 allowed for detection of movement by territorial males (Figure 3). For example, male 25 moved from a territory near the creek, which he had occupied in 1997, to a new site in the uplands, where he paired and nested successfully. Meanwhile, single male 15 occupied the territory abandoned by male 25 for approximately three weeks, then moved to a site in irrigation cell 16 that had been abandoned by single male 4, who left the study area. Male 28 moved from a territory in the uplands following successful nesting to a location closer to the main creek, although he did not nest there.

2. Nesting Activity

a. *Type and Number of Nests*

A total of 100 nests were followed over the three years of the study (Table 3). All

Table 1.
Status and Territory ID of Least Bell's Vireos, Pilgrim Creek, 1996-1998

1996			1997			1998		
Map Code	**Status**	**Comments**	**Map Code**	**Status**	**Comments**	**Map Code**	**Status**	**Comments**
1[a]	U[b]	M=1890-35259[c]	1	P	M=2070-14818	1[a]	P	
2	P		2	P	M=1890-35259	2	P	M=2070-14818
3	P	M=1650-30078	3	P	M=2070-14821	3	P	M=1890-35259
4	P		4	P	M=2070-14820	4	S	M=2070-14836
5	P		5	P	M=2070-14817	5	P	M=2070-14837
6	P		6	P	M=2070-14815	6	P	
7	P		7	S	M=2070-14816	7	P	M=2070-14820
8	P		8	P	M=2070-14814	8	P	M=2070-14869
9	P	M=2080-53440	9	P	M=2080-53440	9	P	M=2070-14817
10	P	M=2080-53444	10	P	M=2080-53444	10	P	M=2070-14815
11	P		11	P	M=2080-53428	11	P	M=2070-14814
12	P		12	P		12	P	M=2070-53444
13	P		13	P	M=2070-14819	13	P	M=2080-53428
14	P		14	P	M=1650-60041	14	P	M=2070-14838 F=2070-14840
15	P		15	P	M=2070-14813	15	S	M=2070-14812
16	P		16	P		16	P	
17	P		17	U		17	P	
18	P		18	P		18	P	M=2070-14868
19	P		19	P		19[a]	U	
20	P		20	P		20	P	
21	P		21	P		21	P	
			22	P	M=1960-42415	22	P	
			23[a]	U		23	P	M=1960-42415
			24[a]	U		24	P	
						25	P	M=2070-14813
						26	P	M=2070-14825
						27	P	M=2070-14826
						28	P	M=2070-14824
						29	P	M=2070-14823
						30	P	
						31	P	
						32	P	
						33	S	

[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-BRD band number.

Table 2.
Histories of Banded Least Bell's Vireo Males at Pilgrim Creek, 1996-1998

1996			1997			1998		
Band Number	**Age (yrs)**	**Natal Site**	**Band Number**	**Age (yrs)**	**Natal Site**	**Band Number**	**Age (yrs)**	**Natal Site**
1890-35259	4	SLR[c]	—>	5		—>	6	
1650-30078	2	?						
2080-53440[a]	AHY[b]	?	—>	AHY+1				
2080-53444	AHY	?	—>	AHY+1		—>	AHY+2	
			1960-42415	2	SLR	—>	3	
			2080-53428	1	Pilgrim	—>	2	
			2070-14812	AHY	?	—>	AHY+1	
			2070-14813	AHY	?	—>	AHY+1	
			2070-14814	AHY	?	—>	AHY+1	
			2070-14815	AHY	?	—>	AHY+1	
			2070-14816	AHY	?			
			2070-14817	AHY	?	—>	AHY+1	
			2070-14818	AHY	?	—>	AHY+1	
			2070-14819	AHY	?			
			2070-14820	AHY	?	—>	AHY+1	
			2070-14821	AHY	?			
			1650-60041	AHY	?			
						2070-14823	AHY	?
						2070-14824	AHY	?
						2070-14825	AHY	?
						2070-14826	AHY	?
						2070-14836	AHY	?
						2070-14837	AHY	?
						2070-14838	AHY	?
						2070-14840[d]	AHY	?
						2070-14868	AHY	?
						2070-14869	AHY	?

[a] *Band numbers in italics indicate adults banded that year at Pilgrim Creek.*
[b] *AHY=adult of unknown age.*
[c] *SLR=San Luis Rey River.*
[d] *Sex=female.*

but two of these nests were completed, and capable of receiving eggs. The number of nests produced in 1998 was nearly double that in each of the previous years, and was reflected in the number of completed nests per pair, which increased from 1.3 in 1996 to 1.8 in 1998. Between 78 and 100 percent of the completed nests located each year were monitored throughout the

period they were active; of the seven nests not monitored, two were inaccessible and could not be safely approached, and five were not located but known to exist by the behavior of the pairs and subsequent appearance of fledglings. One of the nests monitored in 1998 was produced by a pair outside the study area boundaries; this nest is included in analyses of nest success, but not pair success, because not all of the nesting activity of this pair was monitored.

Table 3.
Type and Number of Nests Built by Least Bell's Vireos,
Pilgrim Creek, 1996-1998

	Number of Nests		
Type of Nest	**1996**	**1997**	**1998**
False	0	0	0
Incomplete	1	0	1
Complete	26	23	49[a]
TOTAL	27	23	50
Completed Nests per Pair	1.3	1.2	1.8

[a]*Includes one nest of a pair (Map code 1) outside study area.*

b. *Nest Initiation*

Nesting commenced in April during all three years, but the first peak in nest initiations occurred two weeks earlier in 1997 than in 1996 and 1998. While only 10 percent of pairs in 1996, and 4 percent in 1998, had initiated nesting by 15 April, 30 percent of pairs in 1997 had done so. Roughly half to two-thirds of pairs in all years had initiated nesting by 30 April. Nest initiations extended through June in all years, with most nests produced after mid-May representing second or third attempts.

c. *Nesting Effort by Pairs*

The majority of nests observed in 1996 and 1997 represented first nesting attempts (Table 4), and less than one-third of the population attempted more than one nest in those years. However, in 1998, the opposite was observed, with two-thirds of pairs completing two or more nests. Of these pairs, four (21 percent) successfully double-brooded.

Table 4.
Number of Completed Nests Produced by Least Bell's Vireo Pairs, Pilgrim Creek, 1996-1998

	Number of Pairs		
Number of Completed Nests	**1996**	**1997**	**1998**
0	0 (0.00)[a]	1 (0.05)	1 (0.04)
1	14 (0.70)	15 (0.75)	8 (0.29)
2	6 (0.30)	4 (0.20)	17 (0.61)
3	0 (0.00)	0 (0.00)	2 (0.07)
TOTAL	20	20	28[b]

[a]*Numbers in parentheses are proportions of total pairs each year.*
[b]*Excludes pairs outside study area.*

d. *Nesting Success*

Nest success was consistently high in the study area, with 58, 61, and 55 percent of nests in 1996-1998, respectively, successfully fledging vireo young. Of the unsuccessful nests, the majority of failures were attributed to predation (Table 5). In five cases, when nest failure occurred early in the cycle before egg-laying had been confirmed, the cause was recorded as unknown, but may have been predation as well. One nest in 1998 was found abandoned with two eggs for unknown reasons. Three nests in 1996, or 12 percent of completed nests, failed as a result of abandonment subsequent to cowbird parasitism (see below).

Table 5.
Cause of Failure of Unsuccessful Least Bell's Vireo Nests, Pilgrim Creek, 1996-1998

	Number of Nests		
Cause of Failure	**1996**	**1997**	**1998**
Predation	8	6	19
Parasitism	3	0	0
Other[a]	0	3	3
Total Failed Nests	11	9	22
Total Completed Nests	26	23	49

[a]*See text for explanation.*

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 in 1996 occurred in roughly equal proportions over the egg and nestling stages; to a lesser extent, this was also the case in 1997, although the preponderance of nest failures around the time of hatching makes interpretation of the data difficult. In contrast, over 90 percent of the nest failures in 1998 occurred prior to hatching, suggesting differences in the predator regimes between years.

Table 6.
Stage of Failure of Unsuccessful Least Bell's Vireo Nests,
Pilgrim Creek, 1996-1998

	Number of Nests		
Stage of Failure	**1996**	**1997**	**1998**
Pre-laying/Eggs[a]	0 (0.00)[b]	2 (0.22)	6 (0.27)
Eggs	5 (0.45)	1 (0.11)	14 (0.64)
Eggs/nestlings[a]	1 (0.09)	4 (0.44)	0 (0.00)
Nestlings	5 (0.45)	2 (0.22)	2 (0.09)
Total Failed Nests	11	9	22

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

e. *Parasitism by Brown-headed Cowbirds*

Parasitism of vireo nests occurred in 1996, but was not observed in the following two years (Table 7). In 1996, four nests, or 15 percent of the completed nests, were parasitized. Three of these nests were abandoned: two by the time the parasitism was discovered, and one following removal of a cowbird egg where the nest was evidently re-visited by a cowbird and the vireo eggs punctured. One of the parasitized nests remained active following removal of the cowbird egg, and eventually fledged three vireo young.

f. *Reproductive Success and Productivity*

Average clutch size (based on non-parasitized nests observed with full clutches) ranged from 3.3 $\pm$ 0.6 eggs per nest (N=19) in 1996 to 3.5 in 1997 and 1998 (N=13 and 37, respectively) (Table 8). Hatch rates were dramatically lower in 1998 than in the preceding two

Table 7.
Number and Fate of Parasitized Least Bell's Vireo Nests,
Pilgrim Creek, 1996-1998

	Number of Nests		
	1996	**1997**	**1998**
Nests Parasitized	4	0	0
Pairs Parasitized	4	0	0
Total Cowbird Eggs Laid	3[a]	0	0
Fate of Nests:			
Abandoned	3		
Not abandoned:			
Successful	1		
Unsuccessful			

[a]*One nest found with pecked vireo eggs in nest and on ground.*

years, reflecting the high rate of egg predation in that year. In contrast, fledging rates in 1998, when 94 percent of nestlings fledged, were considerably higher than in previous years, when from 71 to 83 percent of nestlings fledged, reflecting the comparatively higher rates of nestling predation in 1996 and 1997. Overall, pairs produced between 0.53 (1996) and 0.62 (1997) fledglings per egg.

Although productivity with regard to the number of young fledged per nest (1.78) and per egg (0.62) were highest in 1997, overall pair productivity, defined as the number of young produced over the entire season, was highest in 1998, at 2.68 fledglings per pair (Table 9). This high rate of productivity relative to previous years was attributable to the tendency of pairs to attempt multiple nests, successful double-brooding on the part of several pairs, and the relatively low rate of nestling predation in 1998. Not only was per-pair production of young higher in 1998 than in other years, a greater proportion of the population (82 percent of pairs) contributed to the production of young.

3. Banding

Fifteen nestlings in seven nests, six nestlings in two nests, and 38 nestlings in 14 nests, were banded in 1996-1998, respectively. Only one of these birds, banded in 1996, was subsequently seen at the study site (see above); however, sightings along Pilgrim Creek within Camp Pendleton (P. Ashfield, pers. comm.) indicate that birds are dispersing throughout this and probably other nearby drainages.

Table 8.
Reproductive Success and Productivity of Least Bell's Vireos,
Pilgrim Creek, 1996-1998

	Total Number		
Parameter	**1996**	**1997**	**1998**
Nests with eggs	23	16	43
Eggs laid	75	53	142
Average clutch size[a]	3.3 ± 0.6	3.5 ± 0.7	3.5 ± 0.6
Hatchlings	56	40	84
Nests with hatchlings	18	12	29
Hatching success:			
Eggs[b]	75%	76%	59%
Nests[c]	78%	75%	67%
Fledglings	40	33	79
Nests with fledglings	13	10	27
Fledging success:			
Hatchlings[d]	71%	83%	94%
Nests[e]	72%	83%	93%
Fledglings per egg	0.53	0.62	0.56
Fledglings per nest[f]	1.69	1.78	1.61
Fledglings per pair	2.20	2.05	2.68[g]
Fledglings per nesting pair	2.20	2.16	2.78[g]
Pairs fledging ≥ one young	15	14	23

[a]Based upon 19, 13, and 37 non-parasitized nests seen with full clutches in 1996-1998, respectively.
[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 4 fledglings from two nests not seen in 1996; 8 fledglings from 7 nests not seen in 1997, and 6 nests not seen with eggs in 1998.
[g]Does not include pair outside study area.

4. Nest Site Characteristics

The average height of vireo nests in the study area ranged from 0.8 ± 0.3 m in 1998 (N=31) to 1.0 ± 0.3 in 1997 (N=15). Vireos placed nests in a total of 13 different species over the years, with the majority of nests in all years placed in *Salix lasiolepis* (Arroyo Willow). Other common host species were *Baccharis glutinosa* (Mule Fat), *Salix hindsiana* (Sandbar Willow), and *Sambucus mexicana* (Elderberry). Eleven percent of nests in 1998 were placed in *Brassica* sp. (Mustard), reflecting the extensive use of upland habitats for nesting that year.

Table 9.
Plant Species Used as Nest Support by Least Bell's Vireos,
Pilgrim Creek, 1996-1998

	Number of Nests		
Species	**1996**	**1997**	**1998**
Salix lasiolepis	14	9	21
Salix gooddingii	1	0	0
Salix hindsiana	2	2	4
Baccharis glutinosa	2	2	6
Sambucus mexicana	2	2	6
Rosa californica	2	1	0
Toxicodendron diversilobum	0	1	0
Brassica sp.	0	0	5
Nicotiana glauca	1	0	0
Foeniculum vulgare	1	0	0
Artemesia douglasiana	0	1	0
Baccharis pilularis	0	0	2
Platanus racemosa	0	0	1
Total	25	18	45

B. Vegetation Measurement

1. Vegetation Structure

High rainfall and associated flooding during the 1997-98 winter season produced scouring flows through Pilgrim Creek, washing out a road crossing near the northern boundary of the property, and reducing vegetation cover in the lower reaches of the canopy (Figure 5). These same conditions promoted vegetation growth of the restored habitat, however, which received abundant rainfall without scouring floods (Figure 6). Vegetation cover more than doubled at all heights relative to 1997, and canopy height increased, reaching 5 m in same places. Although plant growth in a single year was substantial, overall, the habitat at the site does not yet fall within the range of suitable habitat as defined by the model.

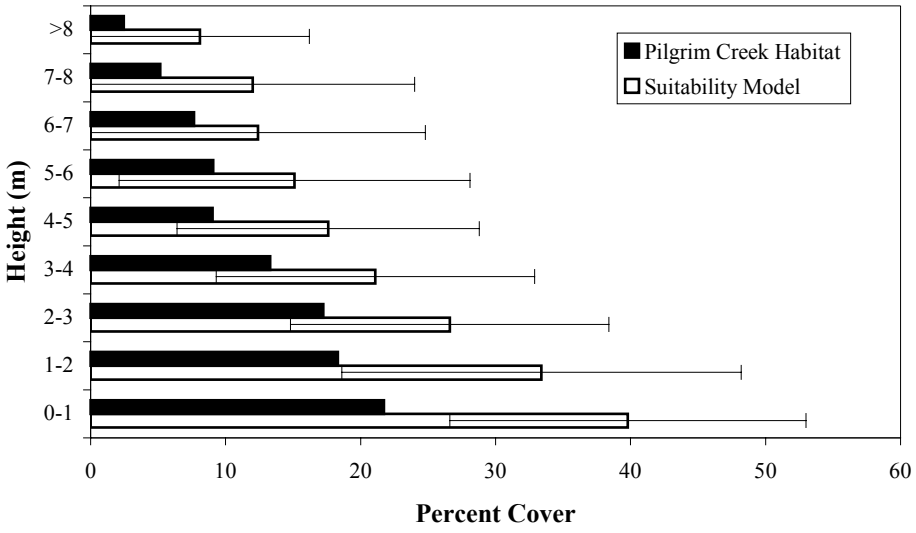


Figure 5. Average percent cover by height: Pilgrim Creek, 1998

Figure 4. Vegetation transects and irrigation cells, Pilgrim Creek restoration site.

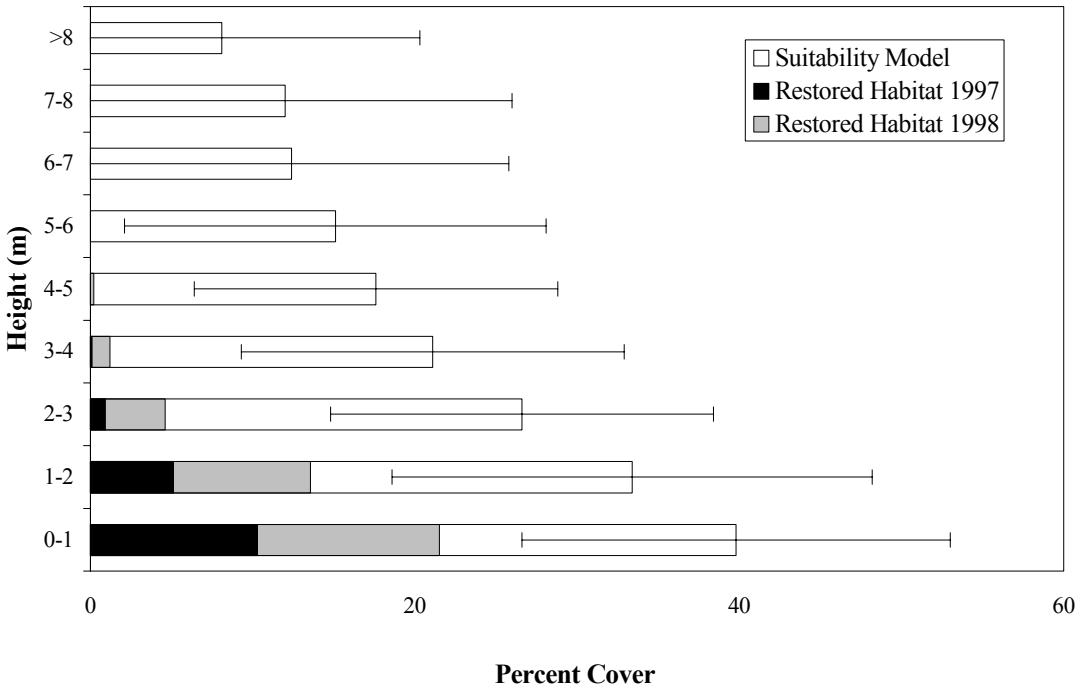


Figure 6. Average percent cover by height: restored habitat, 1997-1998

Vegetation development was not homogeneous over the restoration site, and was generally greater in the northern cells, 1-9, than in cells 10-15 (Figure 7). In fact, several of the northern cells met or nearly met the suitability criteria at the lowest canopy heights (up to 2 m), and cell 1 developed suitably dense vegetation up to 4 m. In contrast, vegetation in the rest of the site, although growing, remained sparse and relatively short. Vegetation growth in cell 16, on the northeast side of Pilgrim Creek, was comparable to that in cells 1-9.

Figure 7
Average Percent Cover by Height of Restored Habitat: Cell-by-cell Assessment

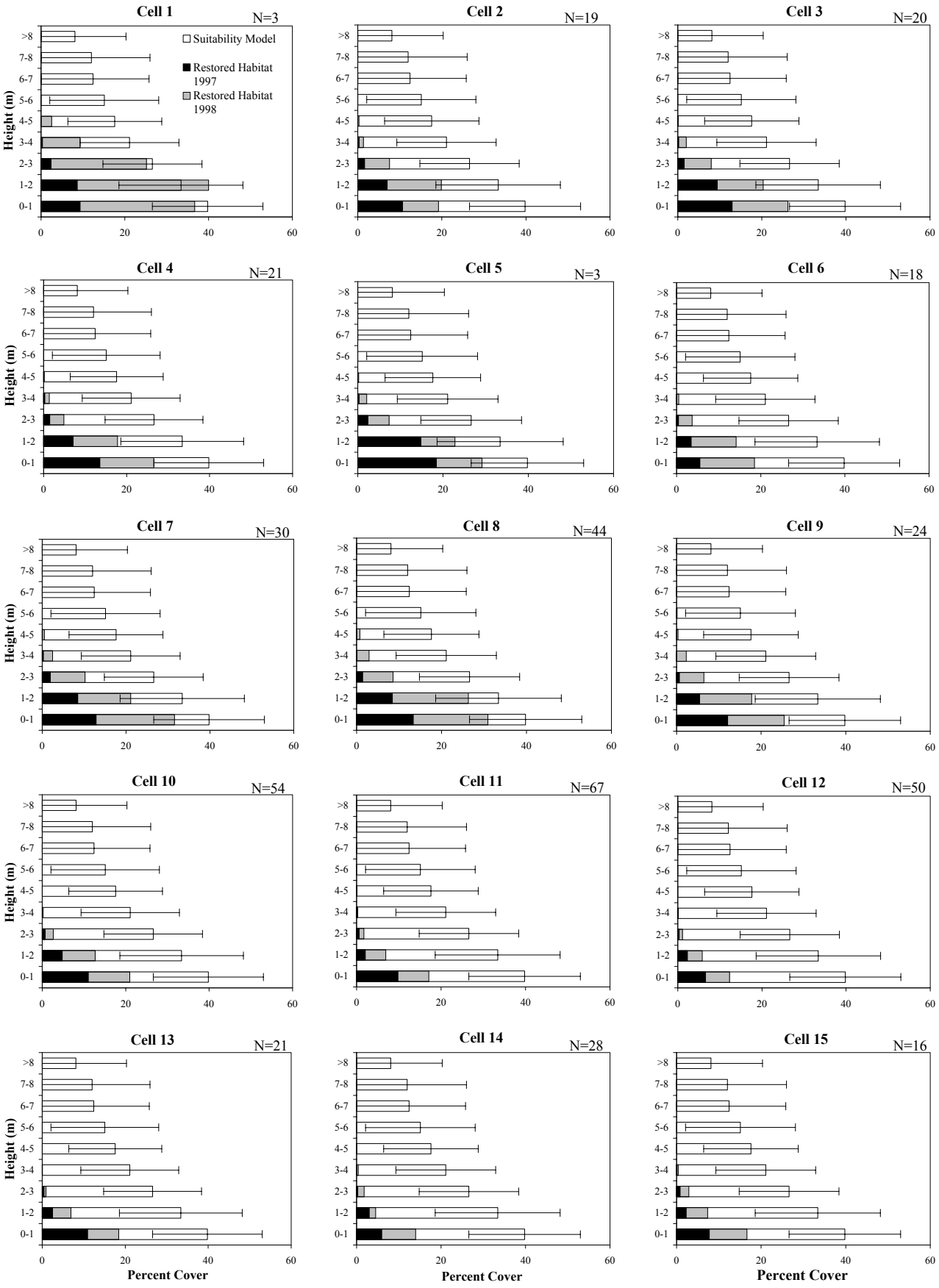
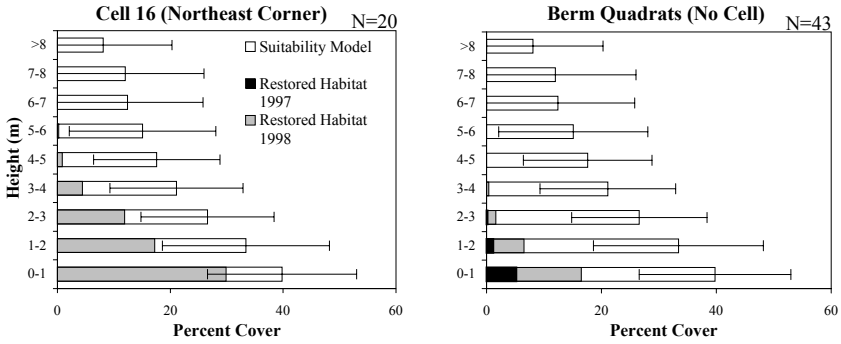


Figure 7 (Continued)
Average Percent Cover by Height of Restored Habitat: Cell-by-cell Assessment



2. Sedimentation Patterns

Sedimentation occurred unevenly across the restoration site, depending upon proximity to the main creek, dirt roads, and adjacent sources of runoff. The sites receiving the highest sedimentation included portions of cells 1, 2, 3 and 8 close to Pilgrim Creek, the eastern portion of cell 10 adjacent to a dirt road, and the eastern portion of cell 5, situated at the base of a canyon transferring runoff from Camp Pendleton. Sedimentation in these and other areas was evident in the form of sandy surface deposits.

Sediment depth, as measured by our soil core technique, proved to be a poor predictor of total vegetation in sampling quads ($r^2 = 0.03$, N = 403). Degree of siltation, our subjective measure, explained more of the variability in vegetation cover across quads ($r^2 = 0.05$, N = 403), but still had little value as a predictor. When individual species were considered separately in the analysis, siltation was generally unrelated to cover with the exception of arroyo willow, for which 11 percent of the variability among quads was explained by this variable ($r^2 = 0.11$, N = 403). While still weak, this correlation suggests that arroyo willow, of all the species growing at the restoration site, may be responding to sediment and/or nutrient influx associated with runoff and creek overbanking.

Although siltation was largely unrelated to existing vegetative cover within quads, it did appear to influence *growth*, as measured by the change in percent cover between 1997 and 1998. Total vegetation growth was 1.5 times greater in quads with high siltation ($\overline{X}$ = 35.4 ± 28.0) than with low ($\overline{X}$ = 22.4 ± 22.5; t = -4.2, 401 df, P < 0.0001). Arroyo willow and black willow, the two dominant species at the restoration site, exhibited growth rates 2-3 times greater in quads with high siltation as in quads with low siltation (arroyo willow: $\overline{X}$ = 16.1 ± 21.5 (high), $\overline{X}$ = 4.6 ± 11.3 (low), t = -6.4, 401 df, P < 0.0001; black willow: $\overline{X}$ = 9.9 ± 18.0 (high), $\overline{X}$ = 5.7 ± 13.8 (low), t = -2.2, 401 df, P < 0.03). In contrast, herbaceous cover increased less in quads with high siltation ($\overline{X}$ = 5.0 ± 7.3) than with low ($\overline{X}$ = 8.3 ± 8.7, t = 2.9, 401 df, P < 0.003), possibly a response to shading by the higher canopy.

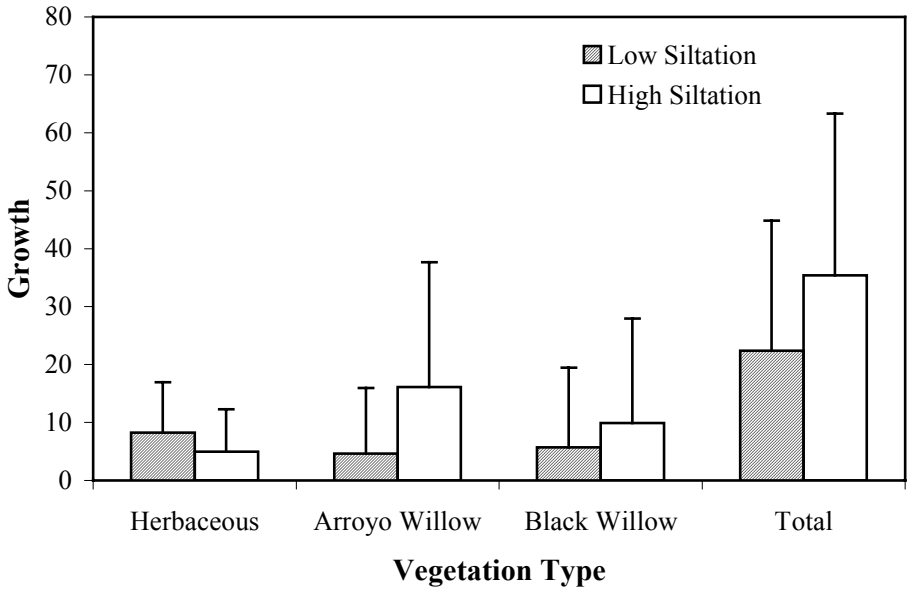


Figure 8. Change in percent cover between 1997 and 1998 (growth) of vegetation as a function of siltation, Pilgrim Creek restoration site.

C. Bird Surveys

The Pilgrim Creek study area was used by a large and diverse group of birds, including landbirds, shorebirds, waterfowl, and raptors. Sixty-one species were detected along the upland transect over the three years, primarily sedentary species, but also several summer and winter season residents (Table 10). Among the most abundant species were bushtit *(Psaltriparus minimus*), California towhee (*Pipilo crissalis*), common yellowthroat (*Geothlypis trichas*), house finch (*Carpodacus mexicanus*), song sparrow (*Melospiza melodia*), western meadowlark (*Sturnella neglecta*), and white-crowned sparrow (*Zonotrichia leucophrys*). The number of species using the uplands increased in 1998 when several typically riparian species, including least Bell's vireo, expanded their distribution to include the lush and green coastal sage scrub areas.

Thirty-five species of waterbirds, including sandpipers, herons and egrets, and waterfowl, were observed using the restoration site (Table 11). The majority of these species are winter visitors to San Diego County that used the Pilgrim Creek site in a transient manner when water conditions were favorable. In particular, birds were attracted to the pond adjacent to cells 12 and 13, and to standing water in the southern cells.

Six species: cliff swallow (*Petrochelidon pyrrhonota*), northern rough-winged swallow (*Stelgidopteryx serripennis*), tree swallow (*Tachycineta bicolor*), barn swallow (*Hirundo rustica*), white-throated swift (*Aeronautes saxatalis*), and turkey vulture (*Cathartes aura*), were detected only as flyovers (Table 11).

A total of 73 species were observed in riparian habitat along Pilgrim Creek over the three years (Table 12), although not all species were present in all years. The majority of species were year-round residents (48 percent), with the remainder evenly divided between migratory breeding species (16 percent), wintering species (19 percent), and transients (16 percent).

Of the species present in 1998, species richness was higher along the creek (= the reference habitat; 63 species) than in the restored habitat (43 species), although many species occurred in both areas. The restoration site was most similar to the reference habitat with regard to wintering species, with 83 percent (10/12) of the species in the reference habitat also present in the restored habitat, and least similar with regard to transients and migrants in passage, of which none were seen in the restored site (0/8). Seventy-four percent (23/31) of resident birds using the reference habitat in 1998 also occurred in the restoration site, and 58 percent (7/12) of breeding migrants used both habitats. Only three species occurred exclusively in the restoration site, including two wintering species (western meadowlark and common ground-dove (*Columbina passerina*)) and one transient (vesper sparrow (*Pooecetes gramineus*)).

Among the most common breeding species in the restored habitat were those favoring low shrubby vegetation for foraging or nesting, such as common yellowthroats, song sparrows, bushtits, goldfinches (*Carduelis* spp.), and least Bell's vireos. With the exception of song sparrows and yellowthroats, which were widely distributed over the site, these species tended to restrict their use of the restored habitat to the edges adjacent to mature vegetation along Pilgrim Creek, where they had access to taller vegetation preferred for foraging (vireos) or nesting (goldfinches, bushtits). Least Bell's vireos appeared to be the species most limited in their use of the restored site by availability of suitable habitat, and were the only common species for which nesting was not documented (Table 12), although two territories were established in planted vegetation (15b, 28b, Figure 3). Vireos did, however, use the restored vegetation extensively when foraging with young fledged from nests in adjacent mature habitat.

Table 10. Relative Abundance of Terrestrial Birds in Uplands at Pilgrim Creek, 1996-1998

Species[a]	Seasonal Occurrence	Relative Abundance[b]		
		1996	1997	1998
American crow	Resident	C	-	R
American kestrel	Resident	R	C	R
Anna's hummingbird	Resident	A	A	C
Bewick's wren	Resident	U	R	C
Black phoebe	Resident	C	C	R
Bushtit	Resident	C	A	A
California gnatcatcher	Resident	C	C	C
California quail	Resident	C	C	C
California thrasher	Resident	C	C	C
California towhee	Resident	C	C	A
Cassin's kingbird	Resident	C	C	U
Common raven	Resident	C	U	U
Common yellowthroat	Resident	C	C	A
Cooper's hawk	Resident	-	-	R
European starling	Resident	R	-	-
Greater roadrunner	Resident	R	R	U
House finch	Resident	A	A	A
House wren	Resident	C	C	C
Killdeer	Resident	C	C	C
Lesser goldfinch	Resident	C	C	C
Mourning dove	Resident	C	A	C
Northern flicker	Resident	-	U	R
Northern harrier	Resident	R	-	R
Northern mockingbird	Resident	-	U	R
Nuttall's woodpecker	Resident	R	-	U
Orange-crowned warbler	Resident	R	-	R
Red-tailed hawk	Resident	R	U	-
Red-winged blackbird	Resident	-	-	R
Rufous-crowned sparrow	Resident	-	-	R
Song sparrow	Resident	A	A	A
Spotted towhee	Resident	C	U	C
White-tailed kite	Resident	R	-	R
Wrentit	Resident	U	U	C
American goldfinch	Breeding	-	-	U
Ash-throated flycatcher	Breeding	-	U	R
Black-headed grosbeak	Breeding	-	R	R
Blue grosbeak	Breeding	C	U	C
Bullock's oriole	Breeding	R	U	U
Hooded oriole	Breeding	-	-	C
Lazuli bunting	Breeding	-	U	U
Least Bell's vireo	Breeding	C	-	A

Table 10. Relative Abundance of Terrestrial Birds in Uplands at Pilgrim Creek, 1996-1998 *(continued)*

Species	Seasonal Occurrence	Relative Abundance		
		1996	1997	1998
Western kingbird	Breeding	-	-	R
Yellow warbler	Breeding	-	-	R
Yellow-breasted chat	Breeding	-	-	C
American Pipit	Winter	C	U	R
Blue-gray gnatcatcher	Winter	U	-	R
Hermit thrush	Winter	-	-	R
Lincoln's sparrow	Winter	-	-	U
Ruby-crowned kinglet	Winter	U	U	U
Savannah sparrow	Winter	-	R	R
Say's phoebe	Winter	U	C	R
Sharp-shinned hawk	Winter	-	-	R
Western meadowlark	Winter	R	C	A
White-crowned sparrow	Winter	A	A	A
Yellow-rumped warbler	Winter	A	C	C
Allen's hummingbird	Migrant/Transient	R	-	-
Chipping sparrow	Migrant/Transient	-	-	R
Grasshopper sparrow	Migrant/Transient	R	-	-
Nashville warbler	Migrant/Transient	-	-	R
Western tanager	Migrant/Transient	-	-	R
Wilson's warbler	Migrant/Transient	-	-	R

[a] *See Appendix 1 for scientific names.*

[b] *A=abundant, C=common, U=uncommon, R=rare. See text for definitions.*

Table 11. Aerial and Wetland Bird Species Observed at Pilgrim Creek, 1996-1998

Species*	Seasonal Occurrence	Foraging Habitat	Presence / Absence		
			1996	1997	1998
Cliff swallow	Breeding	Aerial	x	x	x
Northern rough-winged swallow	Breeding	Aerial	x	x	x
Tree swallow	Breeding	Aerial		x	x
Barn swallow	Migrant/Transient	Aerial			x
Turkey vulture	Migrant/Transient	Aerial		x	x
White-throated swift	Migrant/Transient	Aerial			x
Killdeer	Resident	Wetland	x	x	x
Great blue heron	Resident	Wetland	x	x	x
Great egret	Resident	Wetland	x	x	x
Green Heron	Resident	Wetland		x	x
Mallard	Resident	Wetland	x	x	x
Snowy egret	Resident	Wetland	x	x	x
American coot	Winter	Wetland	x	x	x
Common snipe	Winter	Wetland	x	x	x
Sora	Winter	Wetland		x	x
Virginia rail	Breeding	Wetland			x
Green-winged teal	Migrant/Transient	Wetland			x
American avocet	Migrant/Transient	Wetland		x	x
American bittern	Migrant/Transient	Wetland	x		x
American wigeon	Migrant/Transient	Wetland		x	
Black-crowned night heron	Migrant/Transient	Wetland			x
Black-necked stilt	Migrant/Transient	Wetland	x	x	x
Bufflehead	Migrant/Transient	Wetland		x	
Blue-winged teal	Migrant/Transient	Wetland			x
Cattle egret	Migrant/Transient	Wetland			x
Cinnamon teal	Migrant/Transient	Wetland	x	x	x
Common moorhen	Migrant/Transient	Wetland			x
Eared grebe	Migrant/Transient	Wetland			x
Gadwall	Migrant/Transient	Wetland		x	x
Greater yellowlegs	Migrant/Transient	Wetland	x		x
Log-billed dowitcher	Migrant/Transient	Wetland		x	
Least sandpiper	Migrant/Transient	Wetland	x	x	x
Least tern	Migrant/Transient	Wetland		x	
Lesser yellowlegs	Migrant/Transient	Wetland		x	
Northern pintail	Migrant/Transient	Wetland			x
Northern shoveler	Migrant/Transient	Wetland		x	x
Ruddy duck	Migrant/Transient	Wetland	x	x	x
Spotted sandpiper	Migrant/Transient	Wetland		x	x
Western sandpiper	Migrant/Transient	Wetland		x	x
White-faced ibis	Migrant/Transient	Wetland	x		x
Willet	Migrant/Transient	Wetland		x	

Table 12. Relative Abundance of Terrestrial Riparian Birds at Pilgrim Creek, 1996-1998

Species*	Seasonal Occurrence	Relative Abundance				Restoration Site Confirmed Breeding, 1998
		Reference Habitat			Restoration	
		1996	1997	1998	1998	
Bushtit	Resident	A	A	A	A	Yes
Common yellowthroat	Resident	A	A	A	A	Yes
Red-winged blackbird	Resident	U	C	U	A	No
Song sparrow	Resident	A	A	A	A	Yes
Anna's hummingbird	Resident	A	A	C	C	Yes
Black phoebe	Resident	C	C	C	C	No
House wren	Resident	C	C	C	C	No
Lesser goldfinch	Resident	A	A	C	C	Yes
Mourning dove	Resident	C	C	C	C	No
Bewick's wren	Resident	U	U	C	U	No
California towhee	Resident	U	C	U	U	No
Marsh wren	Resident	-	-	U	U	No
Nuttall's woodpecker	Resident	C	C	C	U	No
Spotted towhee	Resident	C	C	C	U	No
American kestrel	Resident	R	R	R	R	No
California quail	Resident	R	-	R	R	No
Cassin's kingbird	Resident	R	C	R	R	No
Common raven	Resident	R	R	R	R	No
Downy woodpecker	Resident	U	R	U	R	No
Greater roadrunner	Resident	R	-	-	R	No
House finch	Resident	A	A	A	R	No
Northern flicker	Resident	-	R	R	R	No
Orange-crowned warbler	Resident	U	C	U	R	No
American crow	Resident	U	U	R	-	No
Barn owl	Resident	-	-	R	-	No
California gnatcatcher	Resident	R	R	-	-	No
California thrasher	Resident	R	-	-	-	No
Cooper's hawk	Resident	U	R	R	-	No
European starling	Resident	-	R	R	-	No
Hutton's vireo	Resident	U	U	U	-	No
Northern harrier	Resident	R	R	-	-	No
Red-shouldered hawk	Resident	U	U	R	-	No
Red-tailed hawk	Resident	R	R	R	-	No
White-tailed kite	Resident	C	U	R	-	No
Wrentit	Resident	U	U	U	-	No
American goldfinch	Breeding	C	U	C	C	No
Least Bell's vireo	Breeding	A	A	A	C	No
Blue grosbeak	Breeding	R	U	U	U	No
Yellow warbler	Breeding	C	C	C	U	No

Table 12. Relative Abundance of Terrestrial Riparian Birds at Pilgrim Creek, 1996-1998 *(continued)*

Species[a]	Seasonal Occurrence	Relative Abundance				Restoration Site Confirmed Breeding, 1998
		Reference Habitat			Restoration	
		1996	1997	1998	1998	
Yellow-breasted chat	Breeding	C	C	C	U	No
Ash-throated flycatcher	Breeding	R	R	R	R	No
Hooded oriole	Breeding	R	-	R	R	No
Black-chinned hummingbird	Breeding	-	-	R	-	No
Black-headed grosbeak	Breeding	U	C	C	-	No
Bullock's oriole	Breeding	R	R	R	-	No
Lazuli bunting	Breeding	-	-	R	-	No
Pacific slope flycatcher	Breeding	R	U	C	-	No
Western meadowlark	Winter	-	-	-	A	-
White-crowned sparrow	Winter	C	A	C	A	-
Yellow-rumped warbler	Winter	C	A	C	A	-
American Pipit	Winter	U	C	C	C	-
Hermit thrush	Winter	R	-	U	C	-
Lincoln's sparrow	Winter	R	-	C	C	-
Ruby-crowned kinglet	Winter	C	C	C	C	-
Savannah sparrow	Winter	-	C	C	C	-
Common ground-dove	Winter	-	R	-	U	-
Say's phoebe	Winter	R	R	R	U	-
Belted kingfisher	Winter	-	-	R	R	-
Blue-gray gnatcatcher	Winter	R	-	U	R	-
Golden-crowned sparrow	Winter	-	-	R	-	-
Sharp-shinned hawk	Winter	-	R	R	-	-
Vesper sparrow	Migrant/Transient	-	-	-	R	-
Black-throated gray warbler	Migrant/Transient	R	R	U	-	-
Dark-eyed junco	Migrant/Transient	-	R	-	-	-
Lawrence's goldfinch	Migrant/Transient	R	-	R	-	-
Loggerhead shrike	Migrant/Transient	R	-	-	-	-
Nashville warbler	Migrant/Transient	-	-	R	-	-
Swainson's thrush	Migrant/Transient	R	-	-	-	-
Townsend's warbler	Migrant/Transient	R	R	R	-	-
Warbling vireo	Migrant/Transient	R	-	R	-	-
Western tanager	Migrant/Transient	-	-	R	-	-
Willow flycatcher	Migrant/Transient	-	-	R	-	-
Wilson's warbler	Migrant/Transient	U	U	U	-	-

[a] *See Appendix 1 for scientific names.*

[b] *A=abundant, C=common, U=uncommon, R=rare. See text for definitions.*

IV. CONCLUSIONS

The Pilgrim Creek study area supports 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 abundant and exhibiting high productivity. Although the habitat along Pilgrim Creek appears to be saturated and unlikely to support many additional territories, vireos displayed the potential for further population growth at the site through the use of suitable upland areas in 1998. The use of upland habitats, particularly coastal sage scrub, has been documented in other populations (Kus and Miner 1989; P. Famalaro, pers. comm.), and is linked in part to high winter rainfall and the associated development of vegetation, particularly *Brassica* sp. and other herbaceous species that provide dense cover where the perennial vegetation is otherwise generally sparse and low. In addition, high surface flows and overbank flooding may limit the availability of suitable habitat within riparian corridors for birds arriving in early Spring, forcing them to settle in suitable upland areas nearby where the substrate is dry. Support for this hypothesis is provided by the observation that at Pilgrim Creek in 1998, the upland territories were among the first to be established by vireos selecting new territories at the outset of the season. Because the use of upland habitat is weather-dependent, it does not occur every year, and thus is unlikely to result in sustained growth of the Pilgrim Creek study area population. However, it demonstrates the importance of such habitat in certain years, and results in the production of young that contribute to maintenance of the main creek sub-population, as well as other populations through dispersal. Continued study of this phenomenon through long-term monitoring of banded birds would be useful in understanding the factors promoting use of upland areas, and the alternative strategies adopted by nesting vireos.

Despite high productivity of vireos in each year of the study, only one instance of recruitment of locally fledged young into the breeding population was observed. This finding, coupled with the high return rates of banded adults to the site, suggests that most young are dispersing to other drainages for breeding. However, an intensified banding effort targeting nestlings will be required to fully assess the extent of local recruitment in this population, and the degree to which young are emigrating. Development of the restored vegetation into suitable nesting habitat will provide an additional opportunity to examine the dispersal behavior of young birds as previously unoccupied habitat becomes available to them.

The primary difference in nesting activity across the three years was the number of nesting attempts per pair each season, which increased substantially in 1998, when over two-thirds of pairs initiated multiple nests. This tendency to re-nest was associated with the high rate (45 percent) of nest predation relative to previous years, when fewer than 30 percent of nests were lost to predators. Although productivity of nesting pairs in 1998 was ultimately high, the time, energy and resources required to produce young were greater than under conditions when similar productivity was achieved through fewer nesting attempts. The possibility that predation

might be increasing at the site is of concern in that it might be associated with nearby urbanization, and may or may not be subject to potential management. Further monitoring is warranted to determine whether the annual differences in predation rates observed thus far are within the range of natural variability, or are the result of other factors.

Growth of the planted vegetation in the restoration site is progressing rapidly, most likely in response to high rainfall and favorable growing conditions since the site was established (Kus 1998). Foliage cover more than doubled in one year in parts of the site, suggesting that with continued favorable conditions, development of the structural characteristics required by nesting vireos could be achieved rapidly. However, because rainfall is variable and fluctuates widely from year to year, it is not possible to predict with any rigor how long it will take for the restoration site to provide suitable vireo habitat. Nevertheless, it is encouraging that the site is already being used by a few nesting species, and that vireos are using the site for foraging.

As observed at other restoration sites (Kus 1998), development of vegetation has not been homogenous over the entire site. Growth was greatest in the northern portions of the site, where we suspect the irrigation regime and exposure to winter flooding created more favorable conditions than in the southern cells, where standing water and relative isolation from flood flows appear to have stunted growth. Our preliminary data on sediment patterns across the site suggest that sedimentation may be an important variable influencing growth rates of willows, although they do not allow us to distinguish the source of the sedimentation (e.g. flooding, erosion, present at time of planting), nor the mechanism by which growth is enhanced (e.g. nutrient inflow, soil texture, moisture holding capacity, etc.). A carefully designed analysis using less crude and subjective measures of sedimentation and its relationship to vegetation growth would be extremely useful in identifying the hydrologic conditions most favorable to development of restored habitat.

Initial observations of bird use of the restoration site indicate a high degree of overlap with the mature habitat in the use by resident and wintering species, but a lower degree of similarity in use by migratory breeders. Of birds in the latter category, those species most abundant in the restoration site were foliage gleaners, for which ample foraging opportunity was provided. Species occurring in low numbers or absent from the restored habitat included raptors, flycatchers, and others for which suitable foraging habitat was largely lacking. Future analyses will include a comparison of bird densities in the two habitats, as well as further examination of the guild structure in both sites.

V. LITERATURE CITED

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Appendix 1. Common and Scientific Names of Birds Observed at Pilgrim Creek Study Area, 1995-1998

Common Name	Scientific Name
Allen's hummingbird	*Selasphorus sasin*
American avocet	*Recurvirostra americana*
American bittern	*Botaurus lentiginosus*
American coot	*Fulica americana*
American crow	*Corvus brachyrhynchos*
American goldfinch	*Carduelis tristis*
American kestrel	*Falco sparverius*
American Pipit	*Anthus rubescens*
American wigeon	*Anas americana*
Anna's hummingbird	*Calypte anna*
Ash-throated flycatcher	*Myiarchus cinerascens*
Barn owl	*Tyto alba*
Barn swallow	*Hirundo rustica*
Belted kingfisher	*Ceryle alcyon*
Bewick's wren	*Thyromanes bewickii*
Black phoebe	*Sayornis nigricans*
Black-chinned hummingbird	*Archilochus alexandri*
Black-crowned night heron	*Nycticorax nycticorax*
Black-headed grosbeak	*Pheucticus melanocephalus*
Black-necked stilt	*Himantopus mexicanus*
Black-throated gray warbler	*Dendroica nigrescens*
Blue grosbeak	*Guiraca caerulea*
Blue-gray gnatcatcher	*Peioptila caerulea*
Blue-winged teal	*Anas discors*
Bufflehead	*Bucephala albeola*
Bullock's oriole	*Icterus bullockii*
Bushtit	*Psaltriparus minimus*
California gnatcatcher	*Polioptila californica*
California quail	*Callipepla californica*
California thrasher	*Toxostoma redivivum*
California towhee	*Pipilo crissalis*
Cassin's kingbird	*Tyrannus vociferans*
Cattle egret	*Bubulcus ibis*
Chipping sparrow	*Spizella passerina*
Cinnamon teal	*Anas cyanoptera*
Cliff swallow	*Petrochelidon pyrrhonota*
Common ground-dove	*Columbina passerina*
Common moorhen	*Gallinula chloropus*
Common raven	*Corvus corax*
Common snipe	*Gallinago gallinago*
Common yellowthroat	*Geothlypis trichas*
Cooper's hawk	*Accipiter cooperii*
Dark-eyed junco	*Junco hyemalis*
Downy woodpecker	*Picoides pubescens*
Eared grebe	*Podiceps nigricollis*
European starling	*Sturnus vulgaris*
Gadwall	*Anas strepera*
Golden-crowned sparrow	*Zonotrichia atricapilla*
Grasshopper sparrow	*Ammodramus savannarum*
Great blue heron	*Ardea herodias*
Great egret	*Egretta alba*
Greater roadrunner	*Geococcyx californianus*
Greater yellowlegs	*Tringa melanoleuca*
Green Heron	*Butorides virescens*
Green-winged teal	*Anas crecca*
Hermit thrush	*Catharus guttatus*
Hooded oriole	*Icterus cucullatus*
House finch	*Carpodacus mexicanus*
House wren	*Troglodytes aedon*
Hutton's vireo	*Vireo huttoni*
Killdeer	*Charadrius vociferus*
Lawrence's goldfinch	*Carduelis lawrencei*
Lazuli bunting	*Passerina amoena*
Least Bell's vireo	*Vireo bellii pusillus*
Least sandpiper	*Calidris minutilla*
Least tern	*Sterna antillarum*
Lesser goldfinch	*Carduelis psaltria*
Lesser yellowlegs	*Tringa flavipes*
Lincoln's sparrow	*Melospiza lincolnii*
Log-billed dowitcher	*Limnodromus scolopaceus*
Loggerhead shrike	*Lanius ludovicianus*
Mallard	*Anas platyrhynchos*
Marsh wren	*Cistothorus palustris*
Mourning dove	*Zenaida macroura*
Nashville warbler	*Vermivora ruficapilla*
Northern flicker	*Colaptes auratus*
Northern harrier	*Circus cyaneus*
Northern mockingbird	*Mimus polyglottos*
Northern pintail	*Anas acuta*
Northern rough-winged swallow	*Stelgidopteryx serripennis*
Northern shoveler	*Anas clypeata*
Nuttall's woodpecker	*Picoides nuttallii*
Orange-crowned warbler	*Vermivora celata*
Pacific slope flycatcher	*Empidonax difficilis*
Red-shouldered hawk	*Buteo lineatus*
Red-tailed hawk	*Buteo jamaicensis*
Red-winged blackbird	*Agelaius phoeniceus*
Ruby-crowned kinglet	*Regulus calendula*
Ruddy duck	*Oxyura jamaicensis*
Rufous-crowned sparrow	*Aimophila ruficeps*
Savannah sparrow	*Passerculus sandwichensis*
Say's phoebe	*Sayornis saya*

Appendix 1. Common and Scientific Names of Birds Observed at Pilgrim Creek Study Area, 1995-1998
(continued)

Common Name	Scientific Name
Sharp-shinned hawk	*Accipiter striatus*
Snowy egret	*Egretta thula*
Song sparrow	*Melospiza melodia*
Sora	*Porzana carolina*
Spotted sandpiper	*Actitis macularia*
Spotted towhee	*Pipilo maculatus*
Swainson's thrush	*Catharus ustulata*
Townsend's warbler	*Dendroica townsendi*
Tree swallow	*Tachycineta bicolor*
Turkey vulture	*Cathartes aura*
Vesper sparrow	*Pooecetes gramineus*
Virginia rail	*Rallus limicola*
Warbling vireo	*Vireo gilvus*
Western kingbird	*Tyrannus verticalis*
Western meadowlark	*Sturnella neglecta*
Western sandpiper	*Calidris mauri*
Western tanager	*Piranga ludoviciana*
White-crowned sparrow	*Zonotrichia leucophrys*
White-faced ibis	*Plegadis chihi*
White-tailed kite	*Elanus leucurus*
White-throated swift	*Aeronautes saxatalis*
Willet	*Catoptrophorus semipalmatus*
Willow flycatcher	*Empidonax traillii*
Wilson's warbler	*Wilsonia pusilla*
Wrentit	*Chamaea fasciata*
Yellow warbler	*Dendroica petechia*
Yellow-breasted chat	*Icteria virens*
Yellow-rumped warbler	*Dendroica coronata*