



Distribution, Abundance, and Breeding Activities of the Least Bell's Vireo at Marine Corps Base Camp Pendleton, California

2007 Annual Data Summary



Prepared for:

**Assistant Chief of Staff, Environmental Security
U.S. Marine Corps Base Camp Pendleton**

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY
WESTERN ECOLOGICAL RESEARCH CENTER

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By James W. Rourke and Barbara E. Kus

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Assistant Chief of Staff, Environmental Security
U.S. Marine Corps Base, Camp Pendleton
Camp Pendleton, California 92055

San Diego Field Station
USGS Western Ecological Research Center
4165 Spruance Road, Suite 200
San Diego, CA 92101

Sacramento, California
2008

U.S. DEPARTMENT OF THE INTERIOR
DIRK KEMPTHORNE, SECRETARY

U.S. GEOLOGICAL SURVEY
Mark D. Myers, Director

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Cover photographs by Michelle Rogne

Recommended citation:

Rourke, J. W. and B. E. Kus. 2008. Distribution, abundance and breeding activities of the least Bell's vireo at Marine Corps Base Camp Pendleton, California. 2007 Annual Data Summary. Prepared for Assistant Chief of Staff, Environmental Security, Marine Corps Base Camp Pendleton.

TABLE OF CONTENTS

<i>LIST OF TABLES</i>	<u>Page</u> i
<i>LIST OF FIGURES</i>	ii
<i>LIST OF APPENDICES</i>	iv
EXECUTIVE SUMMARY	v
INTRODUCTION	1
STUDY AREAS AND METHODS	2
Field Surveys	2
Nest Monitoring	6
Banding	8
Data Analyses	8
RESULTS	9
Population Size and Distribution	9
Habitat Characteristics	12
Banded Birds.....	13
Survivorship, Fidelity, and Movement	14
Nest Monitoring.....	17
Nest Success.....	22
Cowbird Parasitism.....	23
Productivity.....	23
Nest Characteristics	26
DISCUSSION	27
LITERATURE CITED	31

LIST OF TABLES

1. Number and distribution of least Bell's vireos at Camp Pendleton, 2007	10
2. Number of territorial males at Marine Corps Base Camp Pendleton, by drainage, in 2004-2007	12
3. Habitat types used by least Bell's vireos at Marine Corps Base Camp Pendleton, 2007.....	13
4. Proportion of least Bell's vireo territories dominated or co-dominated by exotic vegetation in 2007 through 2005, by drainage.....	13
5. Between-year movement of least Bell's vireos at Marine Corps Base Camp Pendleton in 2007	15
6. Number of least Bell's vireo territories and nests monitored at Marine Corps Base Camp Pendleton, 2007	17

TABLE OF CONTENTS

(continued)

LIST OF TABLES

(continued)

7. Fate of least Bell's vireo nests in fully and partially monitored territories, Camp Pendleton, 2007.....	22
8. Reproductive success and productivity of nesting least Bell's vireos at Reference and <i>A. donax</i> Removal sites, Camp Pendleton, 2007	23
9. Results from two-way ANOVA testing for differences in average clutch size of least Bell's vireos nesting at <i>Arundo donax</i> Removal and Reference plots/treatments at Marine Corps Base Camp Pendleton, 2005-2007	25
10. Results from two-way ANOVA testing for differences in the average number of young fledged per pair of least Bell's vireos nesting at <i>Arundo donax</i> Removal and Reference plots/treatments at Marine Corps Base Camp Pendleton, 2005-2007	26
11. Least Bell's vireo nest characteristics and results of two-sample <i>t</i> -tests of successful vs. unsuccessful nesting attempts at Reference and <i>A. donax</i> Removal sites, Marine Corps Base Camp Pendleton, 2007	26
12. Host plant species used by least Bell's vireos at Reference and <i>A. donax</i> Removal sites, Marine Corps Base Camp Pendleton, 2007	27

LIST OF FIGURES

1. Least Bell's vireo survey areas at Marine Corps Base Camp Pendleton, 2007.	3
2. Location of least Bell's vireo nest monitoring areas at Marine Corps Base Camp Pendleton, 2007.....	7
3. Territory establishment of least Bell's vireos at Marine Corps Base Camp Pendleton in 2005 through 2007	11
4. Number of least Bell's vireo territories at Marine Corps Base Camp Pendleton, 1978 – 2007	11
5. Locations of monitored least Bell's vireo territories at the Above Hospital Reference site, Marine Corps Base Camp Pendleton, 2007	18
6. Locations of monitored least Bell's vireo territories at the Below Hospital Reference site, Marine Corps Base Camp Pendleton, 2007	19
7. Locations of monitored least Bell's vireo territories at the Air Station <i>A. donax</i> Removal site, Marine Corps Base Camp Pendleton, 2007	20
8. Locations of monitored least Bell's vireo territories at the Seep <i>A. donax</i> Removal site, Marine Corps Base Camp Pendleton, 2007.....	21
9. Annual average least Bell's vireo clutch size of nests at <i>Arundo donax</i> Removal and Reference sites/treatments (A), and summarized by year across treatments (B) at Marine Corps Base Camp Pendleton from 2005-2007.....	24
10. Average number of least Bell's vireo young fledged per pair at <i>Arundo donax</i> Removal and Reference sites/treatments per year (A), and summarized by treatment across years (B) at Marine Corps Base Camp Pendleton from 2005-2007	25

11. Least Bell's vireo survey areas at Marine Corps Base Camp Pendleton, 2007: Upper Santa Margarita River, Lake O'Neill, Fallbrook Creek, De Luz Creek, Roblar Creek, and Basilone and Roblar Roads	34
12. Least Bell's vireo survey areas at Marine Corps Base Camp Pendleton, 2007: Lower Santa Margarita River, 22 Area, Pueblitos Canyon, Tuley Canyon, Newton Canyon, Cocklebur Canyon, French Creek, and Aliso Creek	35
13. Least Bell's vireo survey areas at Marine Corps Base Camp Pendleton, 2007: San Onofre Creek South Fork, Horno Canyon, Piedra de Lumbre Canyon, Las Flores Creek, and Hidden Canyon	36
14. Least Bell's vireo survey areas at Marine Corps Base Camp Pendleton, 2007: Talega Canyon, Cristianitos Creek, San Mateo Creek, and San Onofre Creek.....	37
15. Least Bell's vireo survey areas at Marine Corps Base Camp Pendleton, 2007: Upper San Mateo Creek.....	38
16. Least Bell's vireo survey areas at Marine Corps Base Camp Pendleton, 2007: Windmill Canyon, Ysidora Basin to Windmill Canyon, Pilgrim Creek, and De Luz Homes Habitat	39
17. Locations of least Bell's vireos at Marine Corps Base Camp Pendleton, 2007: Upper Santa Margarita River	41
18. Locations of least Bell's vireos at Marine Corps Base Camp Pendleton, 2007: Upper Santa Margarita River, De Luz Creek, and Roblar Creek	42
19. Locations of least Bell's vireos at Marine Corps Base Camp Pendleton, 2007: Santa Margarita River, Lake O'Neill, and Fallbrook Creek.....	43
20. Locations of least Bell's vireos at Marine Corps Base Camp Pendleton, 2007: Santa Margarita River and 22 Area	44
21. Locations of least Bell's vireos at Marine Corps Base Camp Pendleton, 2007: Santa Margarita River and Pueblitos Canyon.....	45
22. Locations of least Bell's vireos at Marine Corps Base Camp Pendleton, 2007: Santa Margarita River, Ysidora Basin, and Ysidora Basin to Windmill Canyon.....	46
23. Locations of least Bell's vireos at Marine Corps Base Camp Pendleton, 2007: Lower Santa Margarita River, Newton Canyon, and Cocklebur Canyon.....	47
24. Locations of least Bell's vireos at Marine Corps Base Camp Pendleton, 2007: Upper Pilgrim Creek, De Luz Homes Habitat, and Lake O'Neill.....	48
25. Locations of least Bell's vireos at Marine Corps Base Camp Pendleton, 2007: Upper and Lower Pilgrim Creek.....	49
26. Locations of least Bell's vireos at Marine Corps Base Camp Pendleton, 2007: Windmill Canyon, and Ysidora Basin to Windmill Canyon.....	50
27. Locations of least Bell's vireos at Marine Corps Base Camp Pendleton, 2007: French Creek, Aliso Creek, and Hidden Canyon	51
28. Locations of least Bell's vireos at Marine Corps Base Camp Pendleton, 2007: Lower Las Flores Creek	52
29. Locations of least Bell's vireos at Marine Corps Base Camp Pendleton, 2007: Piedra de Lumbre Canyon, and Upper Las Flores Creek	53
30. Locations of least Bell's vireos at Marine Corps Base Camp Pendleton, 2007: Lower San Onofre Creek and Lower San Mateo Creek.....	54
31. Locations of least Bell's vireos at Marine Corps Base Camp Pendleton, 2007: San Onofre Creek and San Mateo Creek	55

32. Locations of least Bell's vireos at Marine Corps Base Camp Pendleton, 2007: San Onofre Creek	56
33. Locations of least Bell's vireos at Marine Corps Base Camp Pendleton, 2007: Upper San Onofre Creek	57
34. Locations of least Bell's vireos at Marine Corps Base Camp Pendleton, 2007: San Mateo Creek and Cristianitos Creek	58
35. Locations of least Bell's vireos at Marine Corps Base Camp Pendleton, 2007: Upper San Mateo Creek	59

LIST OF APPENDICES

A. Least Bell's Vireo Survey Areas at Marine Corps Base Camp Pendleton, 2007	33
B. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2007	40
C. Banded Least Bell's Vireos at Camp Pendleton, 2007	60
D. Status and Nesting Activities of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2007	65

EXECUTIVE SUMMARY

Surveys for the endangered least Bell's vireo (*Vireo bellii pusillus*) were conducted at Marine Corps Base Camp Pendleton, California, between 2 April and 11 July 2007. Drainages containing riparian habitat suitable for vireos were surveyed three to seven times. Because of difficulties in maintaining radio contact with Range Control the upper Santa Margarita River was surveyed once for vireos. Seven hundred and seven territorial male vireos were detected on 19 out of the 23 drainages/sites surveyed. Ninety-one percent of all vireo territories occurred on the seven most populated drainages, with the Santa Margarita River containing 58% of all territories on Base. Eighty percent of male vireos were confirmed as paired.

In 2007, the overall size of the vireo population was similar to the 2006 population, differing by only 11 territories, and was within the range of approximately 700-1000 territories observed on Marine Corps Base Camp Pendleton for the past 13 years. The number of territories on 87% (20/23) of drainages surveyed differed by fewer than four territories compared to 2006, while 65% (15/23) of drainages differed by one or fewer territories. Six drainages increased in vireo numbers, 10 decreased, and 7 showed no change. Overall, the vireo population on Base decreased by 2% in 2007 compared to 2006.

The majority of vireo territories occurred in habitat characterized as Willow Riparian, with 74% of males in the study area found in this habitat. An additional 6% of birds occupied willow habitat co-dominated by cottonwoods or sycamores. Thirteen percent of territories were found in Riparian Scrub, dominated by *Baccharis salicifolia* and/or *Salix exigua*. Six percent of the vireos used drier habitats including areas dominated by a mix of sycamores and oaks (1% of total) or upland vegetation (5%). Fewer than 1% of vireo territories were placed in habitat dominated by solely non-native vegetation.

Nesting activity was monitored in 48 territories within the *A. donax* Removal and Reference monitoring areas. A total of 108 nests were monitored during the breeding season; however, 10 of these were not completed and were excluded from calculations of nest success and productivity. Nest success of pairs breeding in Reference and Removal sites did not differ significantly. Forty-seven percent (25/53) of Reference nests and 49% (22/45) of Removal nests successfully fledged young. Predation was believed to be the primary source of nest failure at both sites. Predation accounted for 75% (21/28) and 91% (21/23) of nest failures at Reference and Removal sites, respectively. Two nests contained infertile eggs and were abandoned after 22 days of incubation. The probable cause of failure of one nest was Argentine ant (*Linepithema humile*) predation. No nest parasitism of least Bell's vireos by brown-headed cowbirds (*Molothrus ater*) was documented. Overall, productivity measures of least Bell's vireos nesting at Reference and Removal sites were very similar. In 2007, average clutch size, average brood size, and the average number of young fledged per pair were not statistically different between Reference and Removal sites. However, when data from 2005-2007 were combined and analyzed, a marginally significant difference ($F_{0.10, 1, 115} = 2.8$, $P = 0.10$) in the average number of young fledged per pair between treatments was found, with pairs at Reference plots fledging more young (2.8 young per pair \pm 0.2 SE) from 2005 to 2007 than pairs at Removal sites (2.4 young per pair \pm 0.2 SE).

In 2007, successful and unsuccessful nests within Reference and Removal sites did not differ statistically in average nest height, height of the host plant, or the distance the nest was placed from the edge of the host. Overall, vireo nests at Removal sites were placed significantly higher above ground and built further from the edge of the plant in which they were placed than nests at Reference sites. A total of 15 plant species were used as hosts for vireo nests in 2007. Seventy-one percent of nests were placed in *S. lasiolepis*, *S. exigua* and *B. salicifolia*.

A total of 202 least Bell's vireos were banded during the 2007 season. These included 45 adult vireos, 1 vireo of indeterminable age, and 156 hatch-year birds. The 45 adult vireos, 1 vireo of indeterminable age, and 5 hatch-year birds were banded with unique color combinations. The remaining 151 birds were nestlings, banded with a single gold numbered federal band on the right leg. Fifty-three least Bell's vireos banded prior to the 2007 breeding season were resighted on Base in 2007. Nine of the 53 vireos were originally banded off Base; one on Pilgrim Creek and eight on the San Luis Rey River. Adult birds of known age ranged from 1-9 years old. Adult survivorship, or the proportion of individuals known to survive from one year to the next, was 63% (31/49). The majority of returning adult vireos showed strong between-year site fidelity. Overall vireo territory fidelity between 2006 and 2007 was 90% (28/31). The average distance dispersed by returning adult vireos was 0.2 ± 0.5 km (std). Survivorship of first year birds fledged from Camp Pendleton in 2006 and documented on Base in 2007 was 10% (8/81). Five of the eight first year birds detected were male. Dispersal distance of first year vireos fledged from Camp Pendleton nests ranged from 0.4-2.0 km. Two first year vireos that fledged from nests on the San Luis Rey River were documented on Base. Both were females. Overall, the average distance first year vireos dispersed was 6.2 ± 6.8 km (std).

INTRODUCTION

The least Bell's vireo (*Vireo bellii pusillus*; hereafter "vireo") is a small, migratory songbird that breeds in southern California and northwestern Baja California, Mexico from April through July. Historically abundant within lowland riparian ecosystems, vireo populations began declining in the late 1900's as a result of habitat loss and alteration associated with urbanization and conversion of land adjacent to rivers to agriculture (Franzreb 1989, USFWS 1998, RHJV 2004). Additional factors contributing to the vireo's decline have been the expansion in range of the brown-headed cowbird (*Molothrus ater*), a brood parasite, to include the Pacific coast (USFWS 1986; Franzreb 1989; Brown 1993; Kus 1998, 1999), and the introduction of invasive exotic plant species, such as giant reed (*Arundo donax*), into riparian systems. By 1986, the vireo population in California numbered just 300 territorial males (USFWS 1986).

In response to the dramatic reduction in numbers of least Bell's vireos in California, the California Fish and Game Commission listed the species as endangered in 1980, with the U.S. Fish and Wildlife Service following suit in 1986. Since listing, the vireo population in southern California has rebounded, largely in response to cowbird control, and habitat restoration and preservation (Kus and Whitfield 2005). As of 2006, the statewide vireo population was estimated to be approximately 2,500 territories (USGS, unpublished data), roughly a third of which occurred on Marine Corps Base Camp Pendleton.

Male least Bell's vireos arrive on breeding grounds in southern California in mid-March. Male vireos are conspicuous, and frequently sing their diagnostic primary song throughout the breeding season from exposed perches. Females arrive approximately 1-2 weeks after males and are more secretive, but are often seen early in the season traveling through habitat with the male. The female, with the male's help, builds an open cup nest in dense vegetation approximately 1 m above the ground. Typical clutch size for least Bell's vireos average 3-4 eggs. Typically, the female and male incubate the eggs for 14 days, with young fledging from the nest at 11-12 days of age. It is not unusual for vireos to re-nest after a failed attempt provided ample time remains within the breeding season. Vireos rarely fledge more than one brood in a season. Nesting lasts from early April through July, but adults and juvenile birds remain on the breeding grounds into late September/early October before migrating to their wintering grounds in southern Baja California, Mexico.

The purpose of this study was to document the status of least Bell's vireo at Marine Corps Base Camp Pendleton in San Diego County, California. Specifically, our goals were to (1) determine the size and composition of the Bell's vireo population at the Base, (2) characterize habitat used by vireos, (3) band a subset of vireos to facilitate the estimation of vireo survivorship and movement, and (4) assess the short-term effects of *A. donax* removal on vireo fecundity, nest success, and productivity by intensively monitoring vireos within established nest monitoring plots that had recently undergone *A. donax* removal and at reference sites in which *A. donax* had been removed 7-10 years earlier, between 1997 and 2000. These data, when combined with data from other years, will inform natural resource managers about the status of this endangered species at Camp Pendleton, and guide modification of land use and management practices as appropriate to ensure the species' continued existence.

This work was funded by the Assistant Chief of Staff, Environmental Security, Resources Management Division, Marine Corps Base Camp Pendleton, California.

STUDY AREAS AND METHODS

Field Surveys

All of Camp Pendleton's major drainages, and several minor ones supporting riparian habitat, were surveyed for vireos between 2 April and 11 July 2007 (Figure 1). Field work was conducted by Lisa Allen, Ursula Carliss, Matt Dresser, Kimberly Ferree, Scarlett Howell, Barbara Kus, Tate Mason, Ron Melcer, Eric Nolte, Michelle Rogne, James Rourke, Jennifer Scott, and Michael Wellik. The specific areas surveyed are as follows:

- 1. *Santa Margarita River:***
 - a. Between Interstate 5 upstream to the confluence with De Luz Creek, including all riparian habitat within Stagecoach Canyon and Ysidora Basin east of Vandegrift Road (Appendix A, Figures 11, 12).
 - b. From the confluence with De Luz Creek upstream to the Base boundary (Appendix A, Figure 11).
- 2. *De Luz Creek,*** between the confluence with the Santa Margarita River and the Base boundary (Appendix A, Figure 11).
- 3. *Roblar Creek,*** between the confluence with De Luz Creek and a point approximately 1 km upstream (Appendix A, Figure 11).
- 4. *Lake O'Neill/Fallbrook Creek:***
 - a. All riparian habitat around Lake O'Neill (Appendix A, Figure 11).
 - b. Between Lake O'Neill and the Base boundary with the Fallbrook Naval Weapons Station (Appendix A, Figure 11).
- 5. *Basilone and Roblar Roads,*** a small patch of habitat straddling Basilone Road at the intersection of Basilone and Roblar Roads (Appendix A, Figure 11).
- 6. *22 Area,*** all riparian habitat within the 22 Area, east of Vandegrift Road and the Supply Depot (Appendix A, Figure 12).
- 7. *Pueblitos Canyon,*** between Vandegrift Road and a point approximately 2.5 km upstream (Appendix A, Figure 12).
- 8. *Tuley Canyon,*** between the Base boundary and a point approximately 1.1 km upstream (Appendix A, Figure 12).
- 9. *Newton Canyon,*** between the confluence with the Santa Margarita River and the upstream limit of riparian habitat (Appendix A, Figure 12).

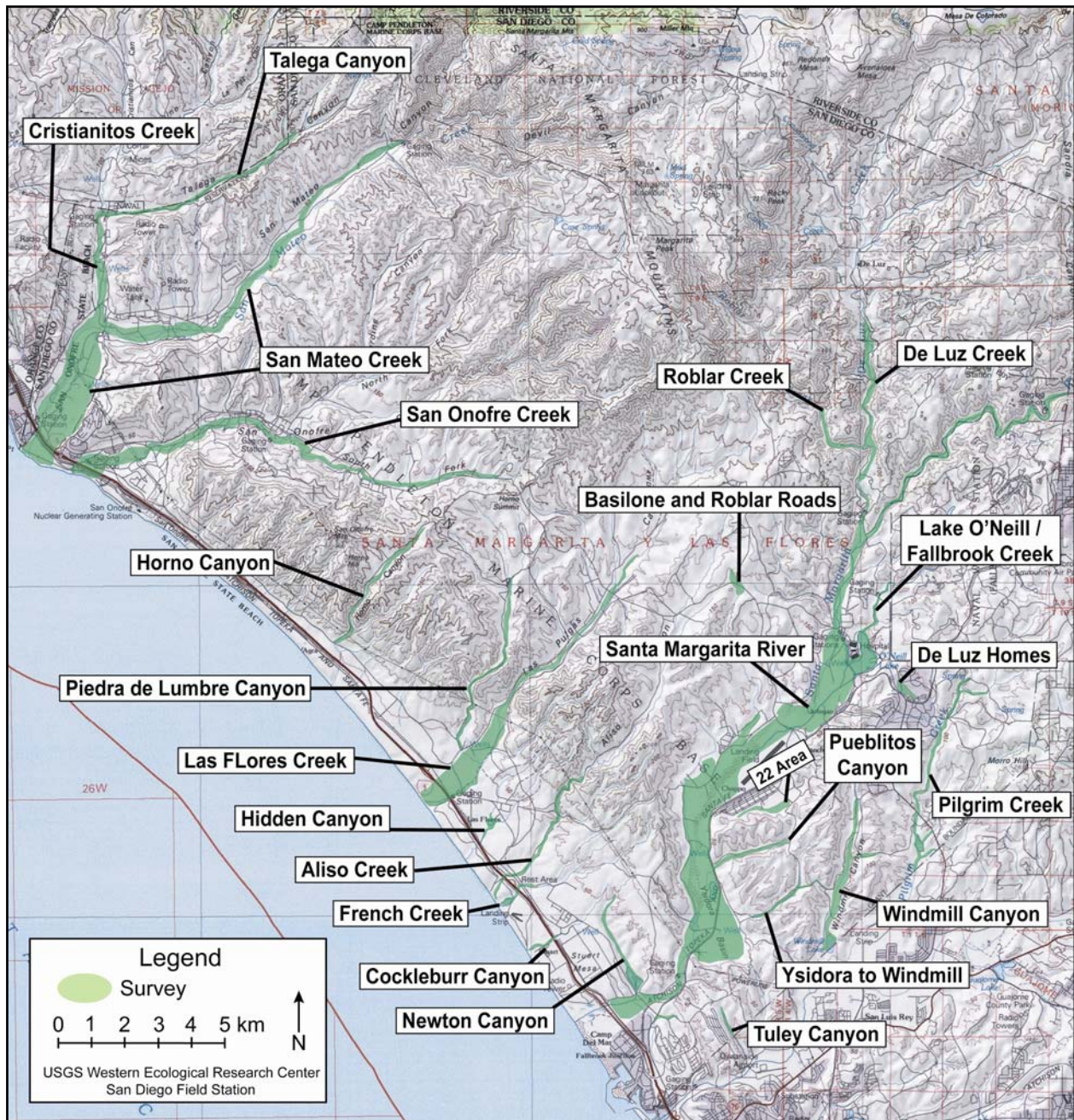


Figure 1. Least Bell's vireo survey areas at Marine Corps Base Camp Pendleton, 2007.

- 10. Cocklebur Canyon**, between the Pacific Ocean and a point 0.25 km east of Interstate 5 (Appendix A, Figure 12).
- 11. French Creek**, between the Pacific Ocean and the Edson Range Impact Area (Appendix A, Figure 12).
- 12. Aliso Creek**, between the Pacific Ocean and 0.5 km upstream of the electrical transmission lines (Appendix A, Figure 12).
- 13. Hidden Canyon**, between Interstate 5 and Stuart Mesa Road (Appendix A, Figure 13).
- 14. Las Flores Creek (within Las Pulgas Canyon):**
- Between Stuart Mesa Road and the high voltage electrical transmission lines (Appendix A, Figure 13).
 - Between the Pacific Ocean and Stuart Mesa Road (Appendix A, Figure 13).
 - From the high voltage electrical transmission lines upstream to the Zulu Impact Area, approximately 0.75 km upstream of Basilone Road (Appendix A, Figure 13).
- 15. Piedra de Lumbre Canyon**, between the confluence with Las Flores Creek and the upstream limit of riparian habitat (Appendix A, Figure 13).
- 16. Horno Canyon**, between Old Highway 101 and the upstream limit of riparian habitat (Appendix A, Figure 13).
- 17. San Onofre Creek:**
- From the Pacific Ocean to the south fork/north fork confluence, and upstream on the south fork to Basilone Road (Appendix A, Figures 13, 14).
 - From Basilone Road upstream to the access road to Range 219 (Appendix A, Figure 13).
- 18. San Mateo Creek:**
- From the Pacific Ocean upstream to San Mateo Road, including habitat south of the creek and south and east of the agricultural fields (Appendix A, Figures 14).
 - From San Mateo Road upstream to the Base boundary (Appendix A, Figure 14, 15).
- 19. Cristianitos Creek**, between the confluence with San Mateo Creek and the Base boundary (Appendix A, Figure 14).
- 20. Talega Canyon**, between the confluence with Cristianitos Creek and a point approximately 6.5 km upstream (Appendix A, Figure 14).
- 21. Pilgrim Creek:**
- Between the southern Base boundary and Vandegrift Boulevard, including the two side drainages east of Pilgrim Creek (Appendix A, Figure 16).
 - From Vandegrift Boulevard upstream to the limit of riparian habitat (Appendix A, Figure 16).

- 22. Windmill Canyon**, from the Base boundary past the golf course to the upstream extent of habitat (includes both of the 2004 Windmill Canyon and Horse Pasture sites) (Appendix A, Figure 16).
- 23. Ysidora Basin to Windmill Canyon**, between Upper Ysidora Basin and Windmill Canyon/ Pueblitos Canyon (Appendix A, Figure 16).
- 24. De Luz Homes Habitat**, patches of habitat adjacent to the De Luz Homes development (Appendix A, Figure 16).

The majority of drainages were surveyed from 3-7 times at least 10 days apart. Sites surveyed seven times throughout the breeding season were: Santa Margarita River (1a), Lake O'Neill/Fallbrook Creek (4a), Las Flores Creek (14a), and Pilgrim Creek (21a). Sites surveyed six times included: De Luz Creek, Aliso Creek, Las Flores Creek (14b), San Onofre Creek (17a), San Mateo Creek (18a), and Cristianitos Creek. Sites surveyed three times were: Lake O'Neill/Fallbrook Creek (4b), Basilone and Roblar Roads, 22 Area, Pueblitos Canyon, Newton Canyon, French Creek, Hidden Canyon, Piedra de Lumbre Canyon, San Onofre Creek (17b), San Mateo Creek (18b), Pilgrim Creek (21b), Windmill Canyon, Ysidora Basin to Windmill Canyon, and De Luz Homes Habitat. Because of difficulties in maintaining radio contact with Range Control within the steep walled canyons within site (1b) the upper portion of the Santa Margarita River was only surveyed once for vireos. The habitat within Tuley Canyon was considered poor quality for nesting vireos and was only surveyed once.

Biologists followed standard survey techniques described in the USFWS least Bell's vireo survey guidelines (USFWS 2001). Observers moved slowly (1-2 km per hour) through the riparian habitat while searching and listening for vireos. Observers walked along the edge(s) of the riparian corridor on the upland and/or river side where habitat was narrow enough to detect a bird on the opposite edge. In wider stands, observers traversed the habitat to detect all birds throughout its extent. Surveys were conducted between dawn and early afternoon, depending on wind and weather conditions.

All male least Bell's vireos were detected and confirmed audibly by hearing their diagnostic song. Attempts were made to observe males visually to note banding status but were not required to confirm the identity of the species as the song was considered the most diagnostic field characteristic. The presence of a female vireo within a territory was confirmed either audibly through the detection of the "pair call" elicited between mated birds, or visually when observed traveling quietly with the male. For each bird encountered, investigators recorded age (adult or juvenile), sex, breeding status (paired, unpaired, undetermined, or transient), and whether the bird was banded. Birds were considered transients if they were not detected on two or more consecutive surveys after an initial detection. Vireo locations were mapped on 1:12,000 aerial photographs as well as 1:24,000 USGS topographic maps, using a Garmin 12 Global Positioning System (GPS) unit with 1-15 m positioning accuracy to determine geographic coordinates (WGS84). Dominant native and exotic plants were recorded, and percent cover of exotic vegetation estimated using cover categories of <5, 5-50, 51-95 and >95%. The overall habitat type within the territory was specified according to the following categories:

Mixed willow riparian: Habitat dominated by one or more willow species including *Salix gooddingii*, *S. lasiolepis*, and *S. laevigata*, with *Baccharis salicifolia* as a frequent co-dominant.

Willow-cottonwood: Willow riparian habitat in which *Populus fremontii* is a co-dominant.

Willow-sycamore: Willow riparian habitat in which *Platanus racemosa* is a co-dominant.

Sycamore-oak: Woodlands in which *P. racemosa* and *Quercus agrifolia* occur as co-dominants.

Riparian scrub: Dry and/or sandy habitat dominated by *S. exigua* or *B. salicifolia*, with few other woody species.

Upland scrub: Coastal sage scrub adjacent to riparian habitat.

Non-native: Sites vegetated exclusively with non-native species such as *A. donax* and *Tamarix ramosissima*.

Nest Monitoring

We monitored least Bell's vireo nests to evaluate the effects of *A. donax* removal on nest success and productivity. *A. donax* is a highly invasive, non-native plant within riparian systems in southern California. Originally introduced for bank stabilization in the 1800's, *A. donax* has become a major component of many riparian systems, becoming the dominant vegetation within streams and rivers. As part of a riparian restoration effort, Marine Corps Base Camp Pendleton has been removing large quantities of *A. donax* on the Santa Margarita River. Areas that have recently undergone *A. donax* removal tend to consist of patches of native woody plants surrounded by areas of bare earth. These open areas are typically populated by native and non-native herbaceous plants until the appropriate conditions arise that allow for the establishment of native woody species, such as *B. salicifolia*, *S. exigua*, *S. gooddingii*, *S. lasiolepis*, and *S. laevigata*. We monitored vireos within four established monitoring areas: two sites within locations in which *A. donax* was removed historically and the native vegetation recovered (hereafter referred to as "Reference" sites), and two sites in areas where *A. donax* had been removed within the previous 4-5 years (hereafter "Removal" sites) (Figure 2).

Nesting activity was documented for 24 pairs in Reference sites and 24 pairs in Removal sites throughout the breeding season. Pairs were chosen based on their location within areas that were monitored in previous years and in order of their detection on-site during the first vireo survey to ensure a complete record of activity within the territory. Pairs were observed for evidence of nesting, and their nests were located. Nests were visited as infrequently as possible to minimize the chances of leading predators or brown-headed cowbirds to nest sites; typically, there were 3-5 visits per nest. The first visit was timed to determine the number of eggs laid, the next few visits to determine hatching and age of young, and the last to band nestlings. Fledging was confirmed through detection of young outside the nest, or, rarely, the presence of feather dust in the nest (SUC). Unsuccessful nests were placed into one of four nest fate categories. Nests found empty or destroyed prior to the estimated fledge date and where the adult vireos

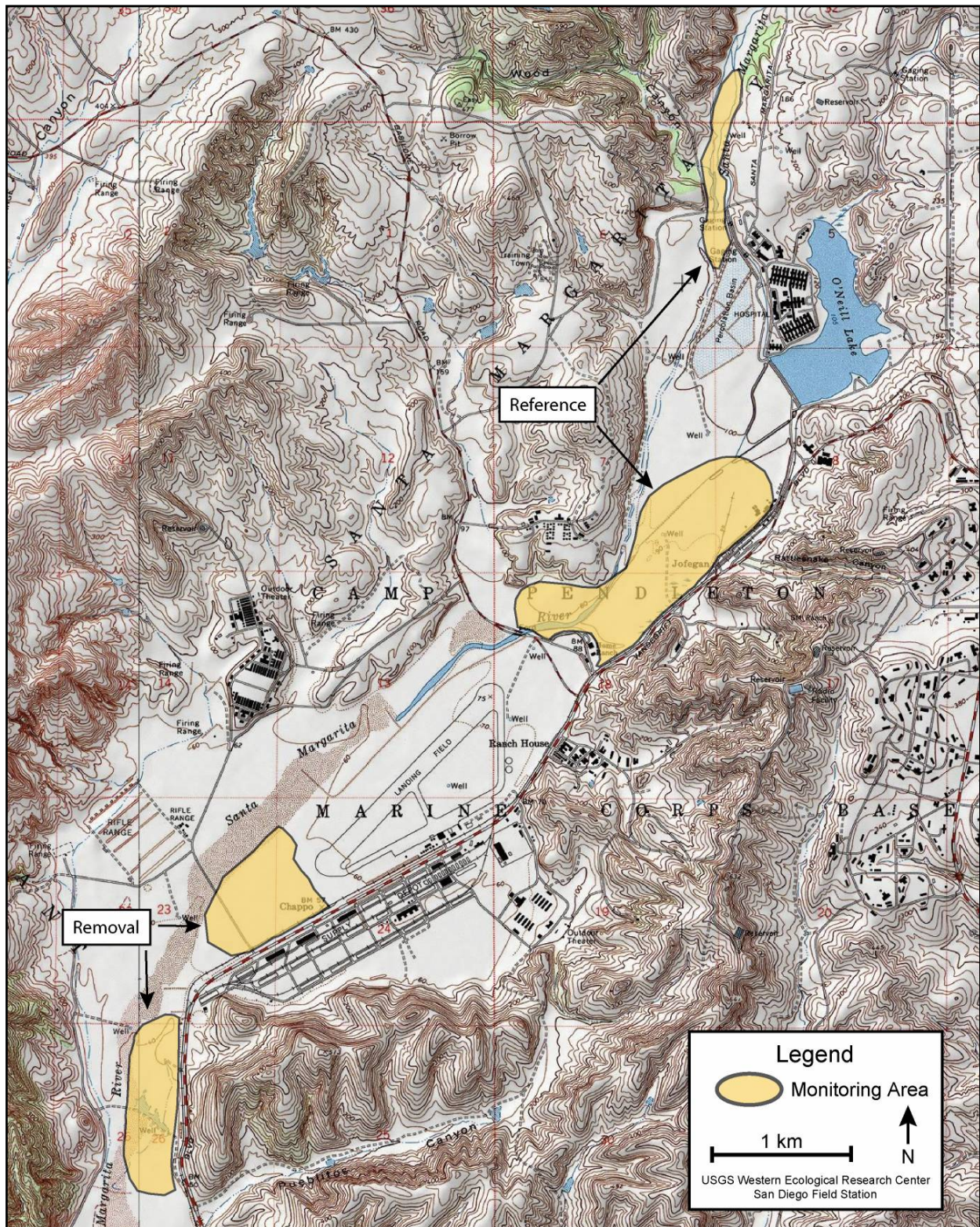


Figure 2. Location of least Bell's vireo nest monitoring areas at Marine Corps Base Camp Pendleton, 2007.

were not found tending fledgling(s) were considered depredated (PRE). Previously active nests that were subsequently abandoned by adult vireos after one or more brown-headed cowbird eggs were laid in the nest were considered to have failed because of nest parasitism (PAR). Any nests that fledged cowbird young without fledging vireo young were also considered to have failed because of nest parasitism (PAR). Nests failing for reasons such as poor nest construction or the collapse of a host plant that caused a nest's contents to be dumped onto the ground, or the presence of a clutch of infertile eggs, were classified as failing because of other causes that were known (OTH). Nests that appeared intact and undisturbed, but were abandoned with vireo eggs and/or nestlings were classified as having failed because of unknown causes (UNK). Characteristics of nests, including height, host species, host height, and the distance nests were placed from the edge of the host plant, and to the edge of the vegetation clump in which they were placed were recorded following abandonment or fledging of young from nests.

Camp Pendleton implements an intensive annual cowbird control program on Base, and parasitism of least Bell's vireo nests is extremely rare. Nevertheless, we were prepared to follow our standard protocol for manipulating nest contents in the event cowbird eggs or nestlings were detected in vireo nests. In nests with fewer than three vireo eggs, cowbird eggs are removed no sooner than the seventh day of incubation to minimize the possibility of nest abandonment in response to the removal. Cowbird eggs are removed from nests containing three or more vireo eggs as they are found. Cowbird nestlings are removed immediately from nests.

Banding

The primary goals of banding least Bell's vireos on Camp Pendleton were: 1) to better understand adult vireo site fidelity within a potential source population, 2) to investigate natal dispersal on Base, and the role Camp Pendleton young play in potentially supporting vireo populations off Base, and 3) to understand how *A. donax* removal affects vireo demography. Nestlings from monitored nests were banded at 6-7 days of age with a single anodized gold numbered federal band on the right leg. A subset of adult vireos within monitoring and prospective *A. donax* removal sites were captured in mist nets and banded with a unique combination of colored plastic and anodized metal bands. Adults previously banded with a single numbered federal band were target netted to determine their identity, and their original band was supplemented with other bands to generate a unique color combination. If the adult was originally banded on Base, either an anodized gold or orange plastic band was incorporated into the combination to designate Camp Pendleton as the bird's site of origin.

Data Analyses

We conducted statistical tests to determine whether there were differences in nest success, productivity, or vegetation characteristics between pairs nesting at Reference and *A. donax* Removal sites. Chi-square analysis was used to test for differences in nest success between sites. Depending on the dispersion of the data, either equal or unequal variance two-sample t-tests were used to test for differences in average clutch size, average brood size, and the number of young fledged per pair. Two-sample t-tests were also used to test for differences in nest vegetation characteristics between successful and unsuccessful nests within and between Reference and Removal sites. Two-way Analysis of Variance (ANOVA) was used to test for differences in reproductive success of vireos from 2005 to 2007 within and across treatment

types. Tukey's test was used to correct for inflation of significance due to multiple comparison testing. If nests were parasitized by brown-headed cowbirds, rescued by removing the cowbird egg(s) and/or nestling(s), and subsequently fledged vireo young, all success and productivity calculations were rerun treating successful rescued nests as failed nests to estimate the potential impact(s) of cowbird parasitism on the Pendleton vireo population. Data were analyzed using SYSTAT statistical software (SYSTAT Software, Inc. 2005).

RESULTS

Population Size and Distribution

Seven hundred and forty-two least Bell's vireo sites were identified during Base-wide surveys (Table 1, Appendix B, Figures 17-35). This included 707 territorial male vireos, 80% of which were confirmed as paired, and 35 transients. Transient vireos were observed on 11 of the 24 (46%) drainages/sites surveyed. Ninety-one percent of all vireo territories occurred on the seven most populated drainages/sites (i.e., Santa Margarita River, Las Flores Creek, San Mateo Creek, San Onofre Creek, De Luz Creek, Pilgrim Creek, and the 22 Area), with the majority of vireo territories (58%) occurring along the Santa Margarita River, the largest expanse of riparian vegetation on Base (Tables 1, 2). The remaining 17 drainages/sites each contained 10 or fewer territories.

Least Bell's vireos began arriving on Base during the first week of April (Figure 3). The approximate two week delay in arrival of the majority of vireos documented in 2006 was not observed in 2007. Even though vireos began establishing territories in early April, similar to 2005, the final population estimate in 2007 (707) was more similar to that of 2006 (718), differing by only 11 territories, compared to 2005 (827).

Table 1. Number and distribution of least Bell's vireos at Camp Pendleton, 2007.

Drainage/Survey Site	Known Pairs	Single/ Status Undetermined	Transient	Total Territories
Santa Margarita River:				
I-5 to De Luz Creek	325	46	12	371
De Luz Creek to Base Boundary	20	20	0	40
De Luz Creek	23	1	0	24
Roblar Creek	0	0	0	0
Lake O'Neill/Fallbrook Creek	6	3	0	9
Basilone-Roblar Roads	0	0	0	0
22 Area	7	5	2	12
Pueblitos Canyon	0	2	0	2
Newton Canyon	4	1	0	5
Cocklebur Creek	0	2	0	2
French Canyon	2	0	1	2
Aliso Creek	6	3	2	9
Hidden Canyon	4	0	1	4
Las Flores Creek:				
Pacific Ocean to Stuart Mesa Road	9	3	0	12
Stuart Mesa Road to Power Lines	27	4	0	31
Power Lines to Zulu Impact Area	28	10	2	38
Piedra de Lumbre Canyon	6	0	0	6
Horno Canyon	0	0	0	0
San Onofre Creek:				
Pacific Ocean to Basilone Road	22	16	5	38
Basilone Road to Access Road to Range 219	4	2	1	6
San Mateo Creek				
Pacific Ocean to San Mateo Road	33	9	0	42
San Mateo Road to Yankee Training Area	2	2	2	4
Cristianitos Creek	7	1	5	8
Talega Canyon	0	0	0	0
Tuley Canyon	0	0	0	0
Pilgrim Creek:				
Base Boundary upstream to Vandegrift Boulevard	16	1	1	17
Vandegrift Boulevard to upstream riparian limit	7	2	0	9
Windmill Canyon	7	1	1	8
Ysidora Basin to Windmill Canyon	2	3	0	5
De Luz Homes	0	3	0	3
Total	567	140	35	707

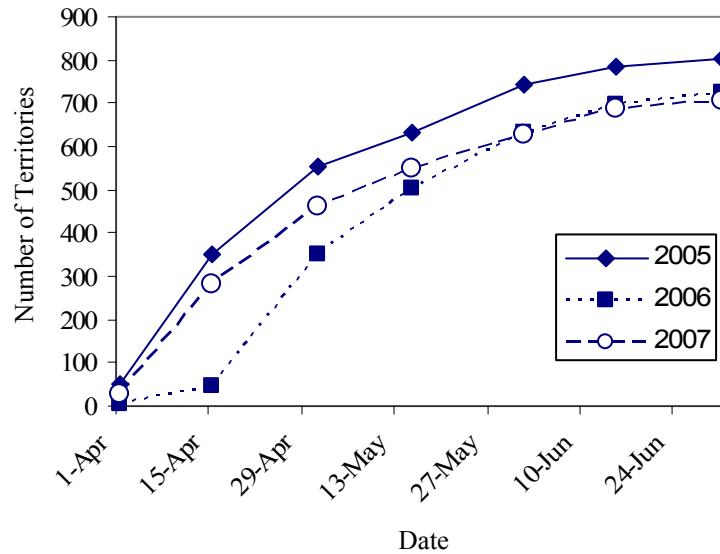


Figure 3. Territory establishment of least Bell's vireos at Marine Corps Base Camp Pendleton in 2005 through 2007.

The number and distribution of least Bell's vireo territories documented on Base in 2007 was remarkably similar to that in 2006 (Figure 4, Table 2). In 2007, the number of territories on 87% (20/23) of drainages surveyed differed by fewer than four territories compared to 2006, while 65% (15/23) of drainages differed by one or fewer territories. Six drainages increased in vireo numbers, 10 decreased, and 7 showed no change. The site with the largest numeric loss in

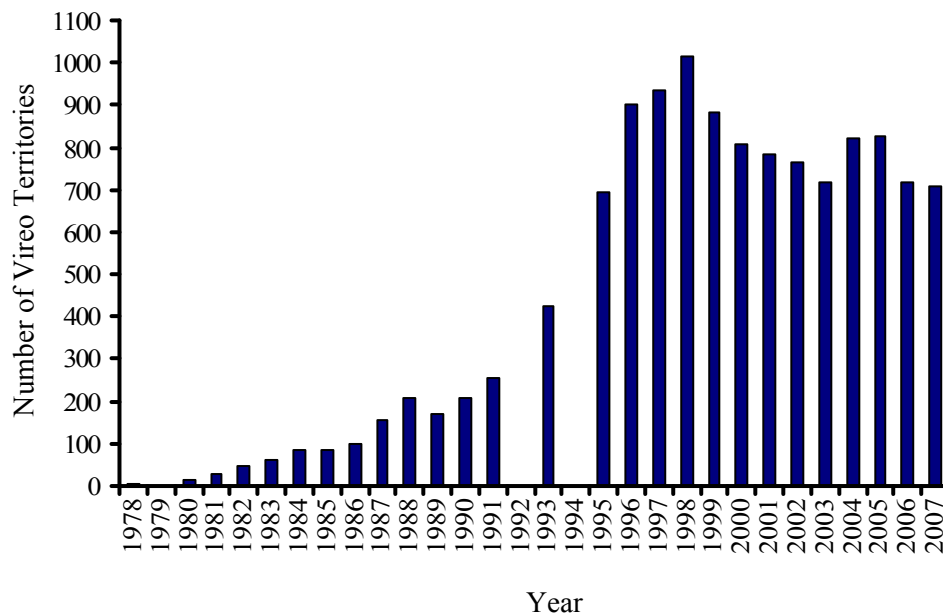


Figure 4. Number of least Bell's vireo territories at Marine Corps Base Camp Pendleton, 1978 – 2007. (Source: Griffith Wildlife Biology 2004, Rourke and Kus 2006, 2007).

Table 2. Number of territorial males at Marine Corps Base Camp Pendleton, by drainage, in 2004-2007. Numeric change is the positive or negative change in the number of vireo territories between 2007 and 2006.

Drainage	Number of Territorial Males				Numeric
	2004 ^a	2005	2006	2007	Change
Santa Margarita River ^b	440	472	417	423	6
De Luz Creek	26	18	25	24	-1
Roblar Creek	1	0	0	0	0
Lake O'Neill/Fallbrook Creek	16	20	10	9	-1
Pueblitos Canyon	3	5	3	2	-1
Newton Canyon	9	8	8	5	-3
Cocklebur Creek	0	2	2	2	0
French Canyon	5	6	4	2	-2
Aliso Creek	21	21	11	9	-2
Hidden Canyon	5	8	5	4	-1
Las Flores Creek	84	85	76	81	5
Piedra de Lumbre Canyon	5	8	9	6	-3
Horno Canyon	0	1	0	0	0
San Onofre Creek	56	52	43	44	1
San Mateo Creek	68	56	59	46	-13
Cristianitos Creek	8	6	8	8	0
Talega Canyon	0	1	0	0	0
Pilgrim Creek	37	36	23	26	3
Windmill Canyon	20	12	7	8	1
Ysidora Basin to Windmill Canyon	8	4	6	5	-1
De Luz Homes	5	4	2	3	1
Basilone-Roblar Roads	-	2	0	0	0
Tuley Canyon	2	-	0	0	0
Total	819	827	718	707	-11

^a 2004 sites not listed: Vandegrift Hills (1), Kilo 1/ Kilo 2 Hills (2); 2004 total = 822 territories

^b Includes vireo territories detected within the 22 Area.

vireo numbers was San Mateo Creek, losing 13 territories (22%). The drainage with the largest numeric increase in vireo numbers was the Santa Margarita River, increasing by six territories (1%). Overall, the vireo population on Base decreased by 2% in 2007 compared to 2006.

Habitat Characteristics

Vireos used a number of different habitat types ranging from willow-dominated thickets along stream courses to upland vegetation along roads and channel margins (Table 3). The majority of vireo territories occurred in habitat characterized as Willow Riparian, with 74% of males in the study area found in this habitat. An additional 6% of birds occupied willow habitat co-dominated by cottonwoods or sycamores. Thirteen percent of territories were found in Riparian Scrub, dominated by *B. salicifolia* and/or *S. exigua*. Six percent of the vireos used drier habitats including areas dominated by a mix of sycamores and oaks (1% of total) or upland vegetation (5%). Fewer than 1% of vireo territories were placed in habitat consisting exclusively of non-native vegetation.

Table 3. Habitat types used by least Bell's vireos at Marine Corps Base Camp Pendleton, 2007.

Habitat Type	Number of Territories			Percent of Total
	>50% Native	>50% Exotic	Total	
Mixed Willow	515	10	525	74%
Willow/Cottonwood	4	0	4	1%
Willow/Sycamore	37	1	38	5%
Riparian Scrub	91	4	95	13%
Sycamore/Oak	8	0	8	1%
Upland Scrub	32	4	36	5%
Non-native	0	1	1	< 1%
Total	687	20	707	100%

Fewer vireo territories were documented in exotic vegetation in 2007 compared to 2006 (Table 4). Three percent of vireo territories (20/707) in 2007 were in areas where exotic species such as *A. donax*, *Conium maculatum*, *Brassica nigra*, and *T. ramosissima* made up 50% or more of the habitat versus 6% (45/718) the previous year. Moreover, in 2007 fewer drainages contained territories dominated by non-native vegetation compared to 2006. Exotic vegetation dominated at least one territory on five drainages in 2007 compared to eight drainages in 2006.

Table 4. Proportion of least Bell's vireo territories dominated or co-dominated by exotic vegetation in 2005 through 2007, by drainage. Numbers in parentheses are the number of territories on the drainage.

Drainage	Proportion of territories					
	2007		2006		2005	
Cristianitos Creek	0.25	(8)	0.13	(8)	0.50	(6)
Windmill Creek	0.13	(8)	0.14	(7)	0.67	(12)
Aliso Creek	0.11	(9)	0.00	(11)	0.05	(21)
Lake O'Neill/Fallbrook Creek	0.11	(9)	0.00	(10)	0.15	(20)
Santa Margarita River ¹	0.04	(423)	0.05	(417)	0.17	(472)
De Luz Creek	0.00	(24)	0.04	(25)	0.06	(18)
Horno Canyon	0.00	(0)	0.00	(0)	1.00	(1)
Las Flores Creek	0.00	(81)	0.14	(76)	0.02	(85)
Newton Canyon	0.00	(5)	0.13	(8)	0.63	(8)
Piedra de Lumbre Canyon	0.00	(6)	0.00	(9)	1.00	(8)
San Mateo Creek	0.00	(46)	0.12	(59)	0.66	(56)
San Onofre Creek	0.00	(44)	0.00	(43)	0.23	(52)
Ysidora Basin to Windmill Canyon	0.00	(5)	0.50	(6)	0.25	(4)
Total	0.03	(707)	0.06	(718)	0.19	(827)

¹ Includes vireo territories detected within the 22 Area.

Banded Birds

Fifty-three least Bell's vireos banded prior to the 2007 breeding season were resighted on Base in 2007 (Appendix C). Twenty vireos banded on Base in 2005 and 20 banded on Base in 2006 returned to established territories in 2007. Of the returning birds originally banded in 2006, 13 were returning adults, and 7 were banded as nestlings. Nine additional vireos originally

banded off Base, one on Pilgrim Creek (Kus *et al.* 2004) and eight on the San Luis Rey River (Ferree and Kus 2007, Kus unpubl. data), were resighted in established territories. One vireo originally banded at the Santa Margarita River Monitoring Avian Productivity and Survivorship (MAPS) Station (Kus and Beck 1998), and three others that were not recaptured, but were most likely banded at the same MAPS station because of their proximity to the MAPS area, were also resighted. Adult birds of known age ranged from 1-9 years old.

A total of 202 least Bell's vireos were banded during the 2007 season. These included 45 adult vireos and 1 vireo of indeterminable age that were target netted and banded with a unique color combination, and 156 hatch-year birds, 151 of which were banded as nestlings with a single gold numbered federal band and 5 of which were incidentally caught either while attempting to target net an adult vireo or at one of the Base's two MAPS stations.

Survivorship, Fidelity, and Movement

The recapture and resighting of banded birds allowed us to determine the rate at which vireos previously documented on Base returned to hold territories in 2007. Although this is the minimum number of vireos known to survive, and does not include birds that dispersed off Base or that we may have failed to detect/resight, it can be used as an inference to calculate minimum annual survivorship for the vireo population on Base. Of 45 uniquely color banded adult vireos present during the 2006 breeding season, 60% (27/45) returned to Camp Pendleton in 2007. An additional four vireos banded in 2005, but not resighted in 2006, were documented in 2007. When these are incorporated into the known returning adults in 2007, the total adult annual vireo survival was 63% (31/49).

A vireo's sex did not affect the likelihood that it returned. In 2006, 94% (46/49) of vireos banded with a unique color combination were male and 6% (3/49) were female. In 2007, the same gender proportions were documented in returning birds (i.e. 94% (29/31) male and 6% (2/31) female). Overall, the percentage of males and females returning was roughly the equal, as 63% (29/46) of males and 67% (2/3) of females returned to Camp Pendleton between 2006 and 2007.

Resighting banded birds allowed us to identify individuals that either returned to the same area they used in a previous year or moved to a different location (Table 5). The majority of returning adult vireos showed strong between-year site fidelity. Twenty-five of the 31 returning birds (81%) occupied a breeding area they had defended previously (within 100 m). Three additional vireos returned to areas adjacent to their previous territories (within 300 m). If these birds are included in calculations, overall vireo territory fidelity between 2006 and 2007 was 90% (28/31). One returning female dispersed approximately 900 m from her 2006 location on the Santa Margarita River, remaining within the same drainage, and two vireos not detected since 2005 were documented dispersing longer distances. The first bird was an adult when originally banded and dispersed 2.6 km within the Santa Margarita River drainage. The second vireo was judged to be a probable hatch-year bird when banded on the Santa Margarita River in 2005. In 2007, it was resighted defending a territory on Las Flores Creek, 6.7 km from its original banding location. It is unknown whether this bird dispersed to Las Flores Creek as a

first year adult in 2006 or as a returning adult in 2007. Excluding this bird, the average distance dispersed by returning adult vireos was 0.2 ± 0.5 km (std).

Fidelity to treatment type was also very high, as 100% (6/6) of adult vireos from territories at Reference sites and 93% (14/15) of vireos from Removal sites returned to the same treatment type they had defended previously. The single bird (-: PUPU/Mgo, Table 5) that did not return to the *A. donax* Reed Removal site in which it previously nested was documented defending a territory approximately 2.6 km upstream on the Santa Margarita River in 2007. Overall, 95% (20/21) of adult vireos that previously defended a territory within a monitoring site/treatment type returned to the same site/treatment type in 2007.

Table 5. Between-year movement of least Bell's vireos at Marine Corps Base Camp Pendleton in 2007.

Year Last Detected	Drainage ^a / Territory	Drainage / Territory in 2007	Dispersal Distance (km)	Band Combination ^b		Age in 2007 ^c	Sex ^d
				Left Leg	Right Leg		
2006	SLR / Outkast	SMR / QIN	12.6	WHPU/Mdb	-	1 yr	F
2006	SLR / FO12	SMR / ARI	14.6	Mdb	WHPU/pupu	1 yr	F
2006	SMR / ALI	SMR / ARS	0.4	WHPU/Mgo	pupu	1 yr	F
2006	SMR / FAU	SMR / UM30	2.0	BKLP/Mgo	pupu	1 yr	M
2006	SMR / CAG	SMR / AER	1.4	PUOR/Mgo	pupu	1 yr	M
2006	SMR / ES25	SMR / ES01	0.0	gogo	WHWH/Msi	2 yr	M
2006	SMR / AE102	SMR / AE17	0.2	-	DPDP/Mgo	2 yr	M
2006	SMR / AER	SMR / AST	0.1	BYST	Mgo	2 yr	M
2006	SMR / AW22	SMR / AW09	0.0	BYST/pupu	Mgo	2 yr	M
2006	SMR / SNP	SMR / SNP	0.0	OROR/pupu	Mgo	2 yr	M
2006	SMR / VEG	SMR / CHE	0.2	DPWH/Mgo	-	≥ 2 yr	F
2005	SMR / PR09	LF / LL29	6.7	LPBK/Mgo	pupu	≥ 2 yr	M
2006	SMR / DAT	SMR / DAT	0.0	pupu	LPBK/Mgo	≥ 2 yr	M
2006	SMR / APO	SMR / APO	0.0	pupu	BYST/Mgo	≥ 2 yr	M
2006	SMR / BIL	SMR / BIL	0.0	DGOR	Mgo	≥ 2 yr	M
2006	SMR / LIA	SMR / BEN	0.3	pupu	PUWH/Mgo	≥ 2 yr	M
2006	SMR / ARS	SMR / ARS	0.0	-	YEPU/Mgo	≥ 2 yr	M
2006	SMR / ALC	SMR / ALC	0.0	-	BYST/Mgo	≥ 2 yr	M
2006	SMR / ALA	SMR / AE05	0.1	Mgo	PUPU/pupu	≥ 2 yr	M
2006	SMR / SG01	SMR / SG07	0.1	pupu	WHWH/Mgo	≥ 2 yr	M
2006	SMR / HTI	SMR / HTI	0.0	-	BWST/Mgo	≥ 2 yr	M
2006	SMR / ORN	SMR / ORN	0.1	-	OROR/Mgo	≥ 2 yr	M
2006	SMR / VEG	SMR / VEG	0.0	PUPU/pupu	Mgo	≥ 2 yr	M
2006	DL / MAPS	DL / DS11	0.1	LPBK/Msi	gogo	≥ 2 yr	M
2006	SMR / HLD	SMR / HLD	0.0	PUWH/Mgo	pupu	≥ 3 yr	M
2006	SMR / LAP	SMR / LAP	0.0	Mgo	DPWH/pupu	≥ 3 yr	M
2005	SMR / AE19	SMR / AER	0.1	Mgo	LPBK/pupu	≥ 3 yr	M
2005	SMR / AE17	SMR / AE23	2.6	-	PUPU/Mgo	≥ 3 yr	M
2005	SMR / AE05	SMR / ALI	0.0	Mgo	PUWH/pupu	≥ 3 yr	M
2006	SMR / DRK	SMR / DRK	0.0	DGOR/Mgo	pupu	≥ 3 yr	M
2006	SMR / PO14	SMR / PO04	0.1	YEPU/Mgo	-	≥ 3 yr	M
2006	SMR / ATK	SMR / ATK	0.0	OROR/Msi	pupu	≥ 3 yr	M
2006	SMR / ALI	SMR / ALI	0.0	ORPU/Msi	pupu	≥ 3 yr	M

Table 5 (*continued*). Between-year movement of least Bell's vireos at Marine Corps Base Camp Pendleton in 2007.

Year Last Detected	Drainage ^a / Territory	Drainage / Territory in 2007	Dispersal Distance (km)	Band Combination ^b		Age in 2007 ^c	Sex ^d
2006	PC / PS17	PC / PS02	0.1	Mbk	YEYE	4 yr	M
2006	SMR / HW09	SMR / HW23	0.9	BKYE	Mdb	≥ 4 yr	F
2006	SMR / BN03	SMR / BN04	0.1	-	DGOR/Mgo	≥ 9 yr	M
≤ 2005	SLR	SMR/BIL	8.1 ^e	-	Mdb	AHY	F
≤ 2006	SLR	WC/WC05	3.4 ^e	Mdb	-	AHY	F
≤ 2006	SLR	SMR/HE34	8.7 ^e	Mdb	-	AHY	F
≤ 2006	SLR	SMR/HE31	8.7 ^e	Mdb	-	AHY	M
≤ 2006	SLR	SMR/AE16	7.5 ^e	Mdb	-	AHY	M

^a Drainage Codes: DL = De Luz Creek; LF = Las Flores Creek; PC = Pilgrim Creek; SLR = San Luis Rey River; SMR = Santa Margarita River; WC = Windmill Canyon.

^b Band colors: Mdb = dark blue numbered federal band; MbK = black numbered federal band; Mgo = gold numbered federal band; Msi = silver numbered federal band; gogo = metal gold; BKLP = plastic black-light pink split; BKYE = plastic black-yellow split; BWST = plastic blue-white striped; BYST = plastic black-yellow striped; DGOR = plastic dark green-orange split; DPDP = plastic dark pink; DPWH = plastic dark pink-white split; LPBK = plastic light pink-black split; OROR = plastic orange; ORPU = plastic orange-purple split; PUOR = plastic purple-orange split; PUPU = plastic purple; pupu = metal purple; PUWH = plastic purple-white split; WHPU = plastic white-purple split; WHWH = plastic white; YEPu = plastic yellow-purple split; YEYE = plastic yellow.

^c Age: AHY = after hatch-year.

^d Sex: F = female; M = male.

^e Distance measured from 2007 territory to the closest location on the San Luis Rey River where banding has been conducted (i.e., approximately 400m northeast of College Road) (USGS, unpublished data).

Eight of the 81 hatch-year vireos banded in 2006 that survived to fledge were resighted at Camp Pendleton in 2007, yielding an estimated first year survivorship of 10%. Since female vireos are elusive and difficult to resight, this estimate is most likely conservative. Five of the eight first year birds detected were male. Assuming an even sex ratio of nestlings, a more accurate estimate of first year survivorship of male vireos, and possibly first year vireos in general, is 12% (5/40.5). Three of the eight returning first year birds were recaptured and banded with a unique color combination. Two were male and one was female, and all originally fledged from, and dispersed to, territories located within the Santa Margarita River. The female and one of the male vireos fledged from, and returned to, *A. donax* Reed Removal sites. The female returned to nest within the same site from which she fledged, while the male dispersed 1.4 km upstream to another Removal monitoring site. The second male fledged from a Reference monitoring site and dispersed 2 km upstream on the Santa Margarita River. Dispersal distance of first year vireos fledged from Camp Pendleton nests ranged from 0.4-2.0 km. Two additional first year vireos that fledged from nests on the San Luis Rey River were recaptured and banded with unique color combinations. Both were female, and both dispersed into Reference monitoring sites. The distance between the first bird's natal site and 2007 location was over 12 km, while the second's was more than 14 km. Overall, the average distance first year vireos dispersed was 6.2 ± 6.8 km (std) (N=5).

Five other vireos that had been banded off Base were resighted in 2007. All carried a single blue numbered federal band (Mdb) indicating that they were originally banded as nestlings on the San Luis Rey River. Three were females and two were males. Both males and two of the

females dispersed to Reference monitoring sites. Minimum dispersal distances were determined for each bird by measuring the distance between its 2007 location and the closest monitored vireo population where banding has been conducted. The age of the birds are unknown as banding has been conducted annually on the San Luis Rey River since 1989. Minimum dispersal distances ranged from 3.4 to 8.7 km (Table 5).

Nest Monitoring

Nesting activity was monitored in a total of 48 territories within the *A. donax* Removal and Reference monitoring areas (Table 6, Figures 5-8, Appendix D). Of these, 46 territories were "fully" monitored, meaning that all nests within the territory were found and documented during the breeding season. Pairs within the remaining two territories were documented nesting; however, only a subset of nests by a pair were found and monitored ("partially monitored"). A total of 108 nests were monitored during the breeding season; however, 10 of these were not completed (coded as "INC" in Appendix D) and have been excluded from calculations of nest success and productivity. Of the remaining 98 nests, 96 were in fully monitored territories.

Table 6. Number of least Bell's vireo territories and nests monitored at Marine Corps Base Camp Pendleton, 2007.

	<u>Nest Monitoring Area Type</u>	
	Reference	Removal
Territories fully monitored	23	23
Nests in fully monitored territories	52	44
Completed nests per pair (fully monitored territories)	2.3 ± 0.8 (std)	1.9 ± 0.5 (std)
Territories partially monitored	1	1
Nests in partially monitored territories	1	1
Total # of nests monitored	53	45

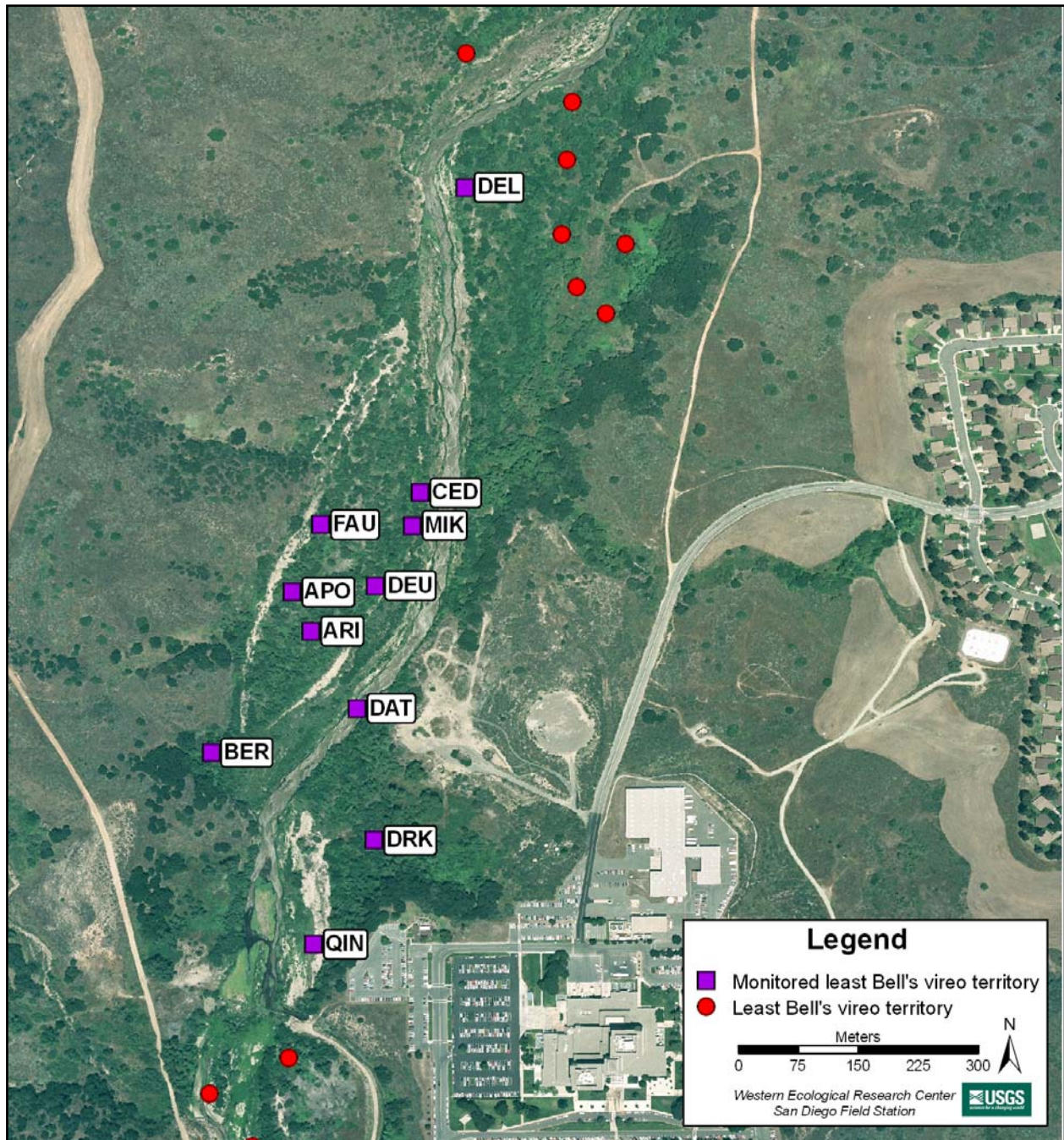


Figure 5. Locations of monitored least Bell's vireo territories at the Above Hospital Reference site, Marine Corps Base Camp Pendleton, 2007.

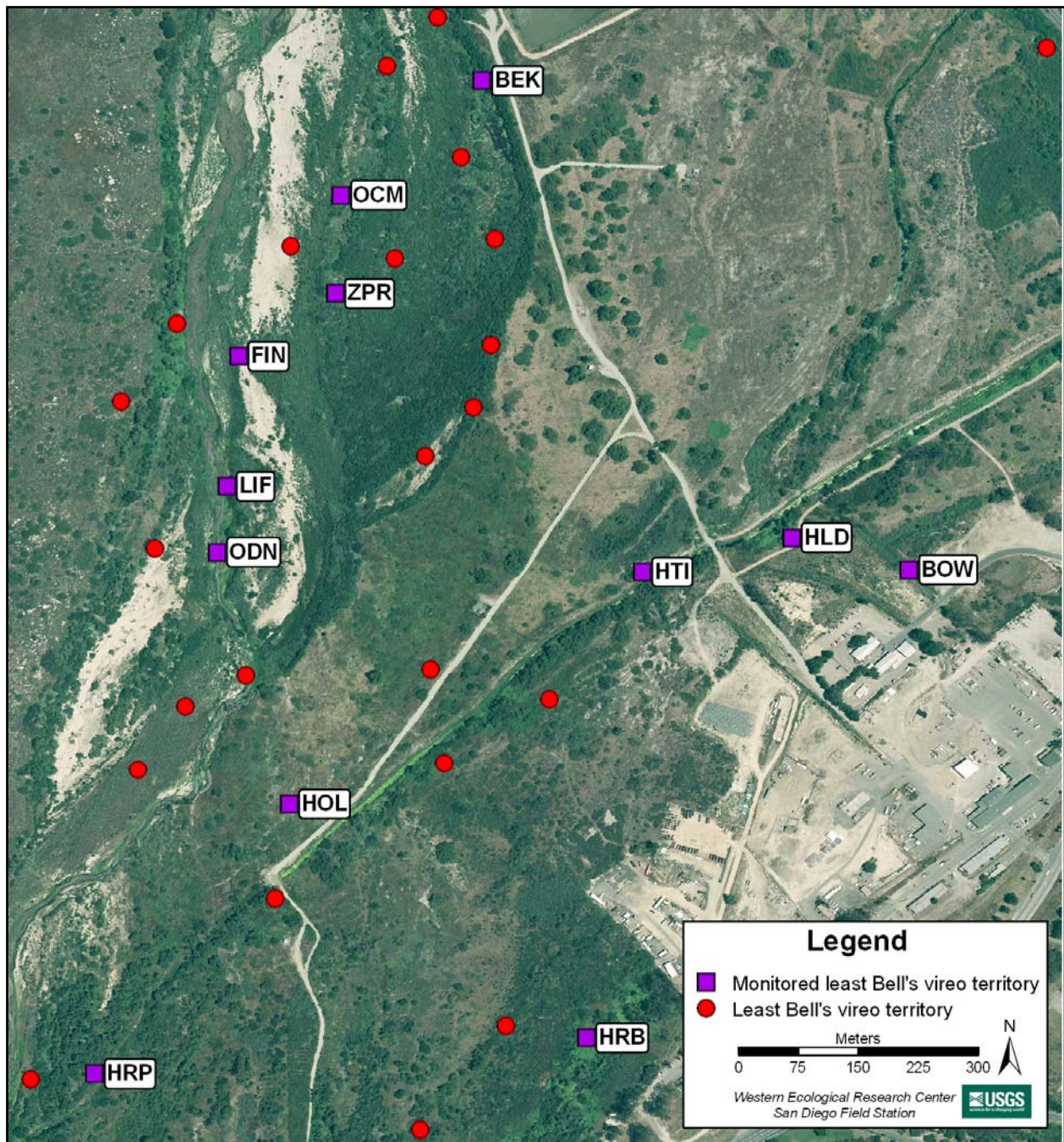


Figure 6. Locations of monitored least Bell's vireo territories at the Below Hospital Reference site, Marine Corps Base Camp Pendleton, 2007.

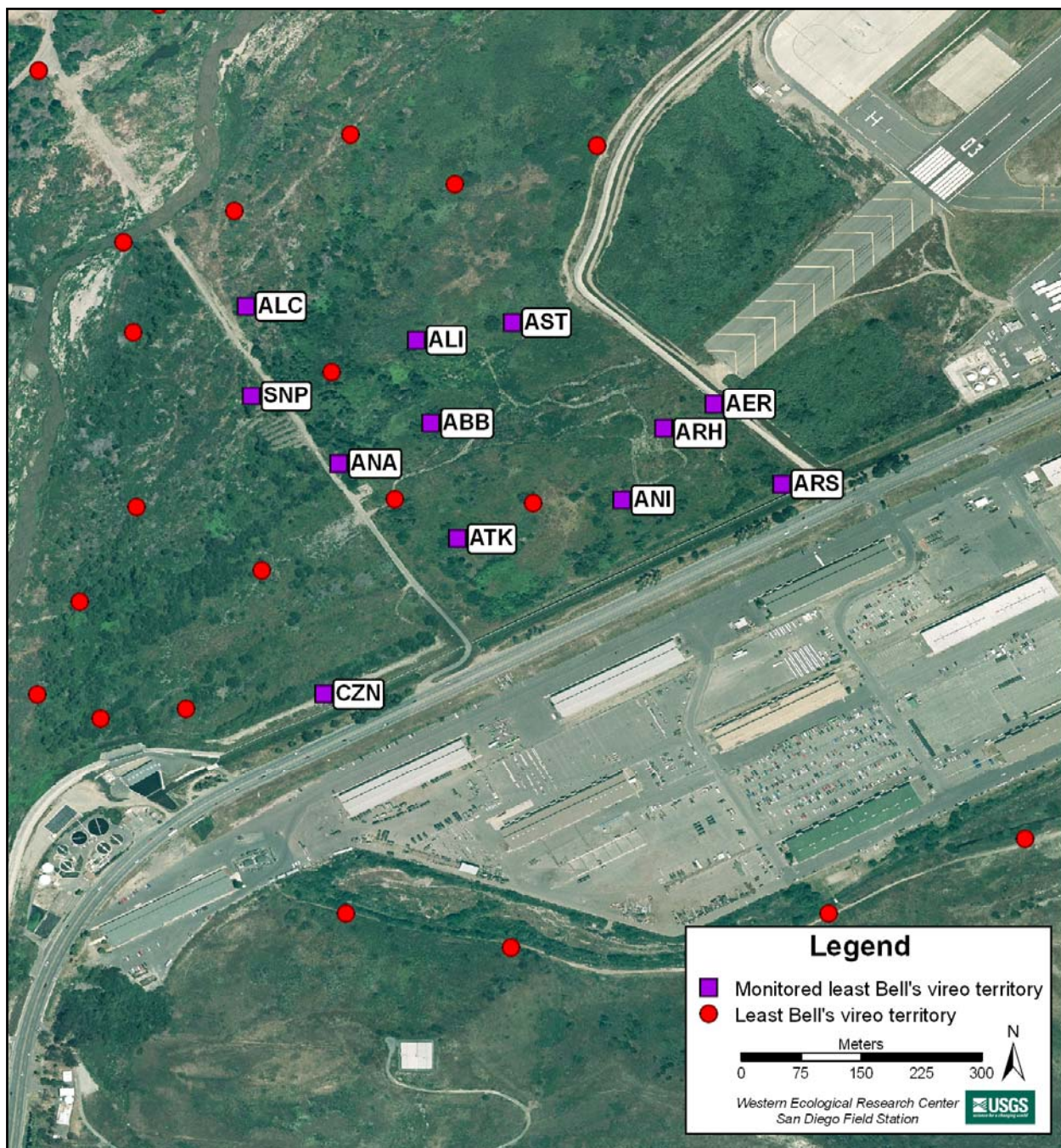


Figure 7. Locations of monitored least Bell's vireo territories at the Air Station A. *donax* Removal site, Marine Corps Base Camp Pendleton, 2007.

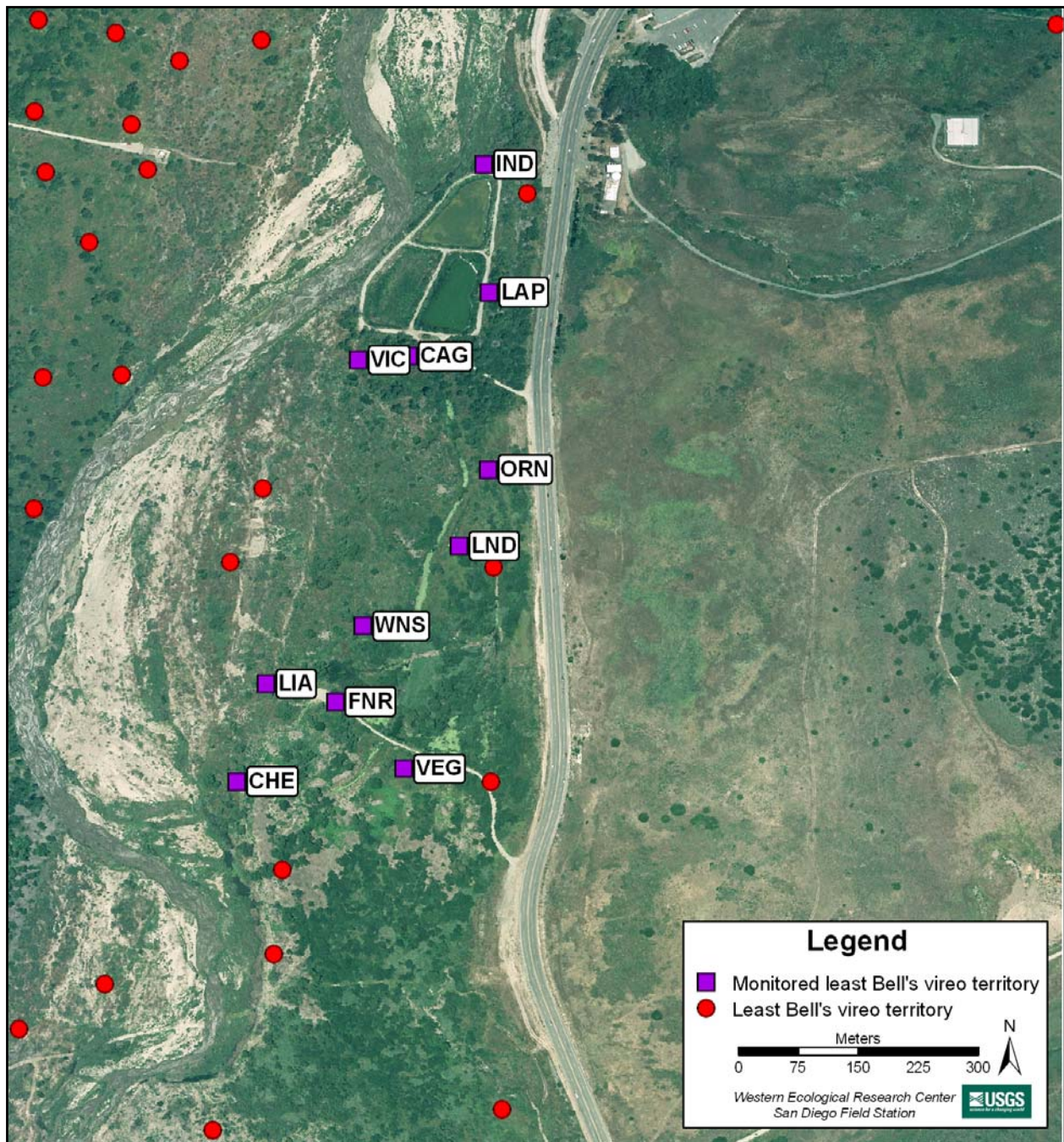


Figure 8. Locations of monitored least Bell's vireo territories at the Seep A. *donax* Removal site, Marine Corps Base Camp Pendleton, 2007.

Within fully monitored territories, pairs in the Reference sites averaged more nesting attempts (2.3 nests per pair) than pairs at Removal sites (1.9 nests per pair) ($t_{0.05, 44} = 1.74$, $P = 0.09$) over the course of the 2007 breeding season. Fully monitored pairs at Reference sites were as likely to re-nest after their initial attempt as were pairs at Removal sites ($\chi^2_{0.05, 1} = 0.01$, $P = 0.91$), as 87% of Reference pairs initiated a second attempt compared to 83% of Removal pairs. Nest fate influenced the likelihood that pairs would re-nest. One hundred percent of Reference and 94% of Removal pairs whose initial nests failed attempted second nests, compared to only 57% of Reference and 40% of Removal pairs re-nesting after a successful first attempt. Seven Reference and two Removal pairs initiated three nesting attempts, and two Reference pairs initiated four nesting attempts in 2007. Three Reference and one Removal pair successfully double brooded, fledging young from two nests within the 2007 breeding season.

Nest Success

Nest success of pairs breeding in Reference and Removal sites did not differ significantly ($\chi^2_{0.05, 1} = 0.03$, $P = 0.87$), as 47% (25/53) of Reference nests and 49% (22/45) of Removal nests successfully fledged young. Causes of nest failure were similar between Reference and Removal sites. Predation was believed to be the primary source of nest failure at both sites, although no predation events were witnessed (Table 7). Predation accounted for 75% (21/28) and 91% (21/23) of nest failures at Reference and Removal sites, respectively. Overall, 40 and 47%, respectively, of completed vireo nests were lost to predation. Two nests, from different pairs, contained infertile eggs and were abandoned after 22 days of incubation. One nest was poorly constructed and failed when it detached from the host plant, dumping its contents of three eggs on the ground. Although the cause of failure of an additional nest is unknown, it is probable that it failed because of Argentine ant (*Linepithema humile*) predation. When visited on 9 May, the nest contained three healthy nestlings. On 13 May, when the nest was visited again, the nest contained the skeletons of two dead nestlings and ants were present on and around the nest. Finally, the cause of failure of five nests was unknown. It is possible that they were depredated in the egg stage or abandoned prior to egg laying, as they failed during the time eggs should have been laid, but no eggs were observed in the nest.

Table 7. Fate of least Bell's vireo nests in fully and partially monitored territories, Camp Pendleton, 2007. Numbers in parentheses are proportions of total nests.

Cause of Nest Failure	Number of Nests		
	Reference	Removal	Total
Successful	25	22	47 (0.48)
Failed			
Predation	21	21	42 (0.43)
Parasitism	0	0	0 (0.00)
Other/Unknown	7	2	9 (0.09)
Total Completed Nests	53	45	98 (1.00)

Cowbird Parasitism

No nest parasitism of Bell's vireos by brown-headed cowbirds was documented in 2007.

Productivity

Reproductive success of least Bell's vireos nesting at *A. donax* Reference and Removal sites differed in some aspects (Table 8), but overall productivity measures were very similar. Measures of productivity did not differ at the egg or nestling stage as average clutch size and average brood size were not statistically different between Reference and Removal sites.

Table 8. Reproductive success and productivity of nesting least Bell's vireos at Reference and *A. donax* Removal sites, Camp Pendleton, 2007.

Parameter	Total Number	
	Reference	Removal
Nests with eggs	48	43
Eggs laid	157	139
Average clutch size ^a	3.4 ± 0.5 (std)	3.3 ± 0.5 (std)
Nests with hatchlings	30	35
Hatchlings	88	105
Average brood size ^b	3.1 ± 0.6 (std)	3.0 ± 0.7 (std)
Hatching success:		
Eggs ^c	56%	76%
Nests ^d	63%	81%
Nests with fledglings	25	22
Fledglings	69	61
Fledging success:		
Hatchlings ^e	78%	58%
Nests ^f	83%	63%
Fledglings per egg	0.5	0.4
Fledglings per nest	1.3	1.4
Average number of young fledged per pair ^g	2.9 ± 1.6 (std)	2.5 ± 1.8 (std)
Pairs fledging ≥ one young ^h	21 (91%)	20 (87%)

^a Based on 39 Reference and 39 Removal non-parasitized nests with a full clutch. (Two-sample t-test: $t_{0.05, 76} = 1.51$, $P = 0.14$).

^b Based on 19 Reference and 24 Removal non-parasitized nests known to have a full brood. (Two-sample t-test: $t_{0.05, 41} = 0.25$, $P = 0.80$).

^c Percent of all eggs that hatched.

^d Percent of all nests with eggs in which at least one egg hatched.

^e Percent of all nestlings that fledged.

^f Percent of all nests with nestlings in which at least one young fledged.

^g Based on 23 Reference and 23 Removal pairs who were fully monitored. (two-sample t-test: $t_{0.05, 44} = 0.81$, $P = 0.42$).

^h Based on fully monitored pairs.

Measures of hatching success were greater at Removal sites. A higher percentage of nests at Removal sites reached the nestling stage (81% vs. 63%), translating into a greater percentage of eggs hatching at Removal sites (76%) compared to Reference sites (56%). Conversely, measures of fledging success were better at Reference sites. Of the nests containing nestlings, a higher percentage of Reference nests (83%) successfully fledged young compared to Removal nests (63%). As a result, overall productivity per pair between the treatments did not differ significantly, with pairs at Reference sites fledging 2.9 young per pair and pairs at Removal sites fledging 2.5 young per pair. Overall, 91% (21/23) of pairs at Reference sites and 87% (20/23) of pairs at Removal sites were ultimately successful in fledging young from at least one nest.

From 2005-2007, there have been no statistical differences documented in average clutch size, average brood size, or the number of young fledged per pair between Reference and Removal plots when analyzed on an annual basis (Rourke and Kus 2006, 2007). When data from 2005-2007 were combined and analyzed using a two-way ANOVA, however, significant differences in average clutch size between years and in the total number of young fledged per pair between treatments became apparent. From 2005-2007, average clutch size was consistently lower, although not at a statistically significant level, in nests at *A. donax* Removal sites compared to Reference sites (Figure 9A). When data from all three years were combined and analyzed, a significant year effect was found (Table 9, Figure 9B), with the average number of eggs per nest produced in 2007 significantly lower than the mean 2005 clutch size ($F_{0.05, 2, 191} = 3.7$, $P = 0.03$). No difference in clutch size was found between 2005 and 2006, or 2006 and 2007. Mean clutch size was 3.6 eggs per nest in 2005, 3.5 eggs per nest in 2006, and 3.3 eggs per nest in 2007.

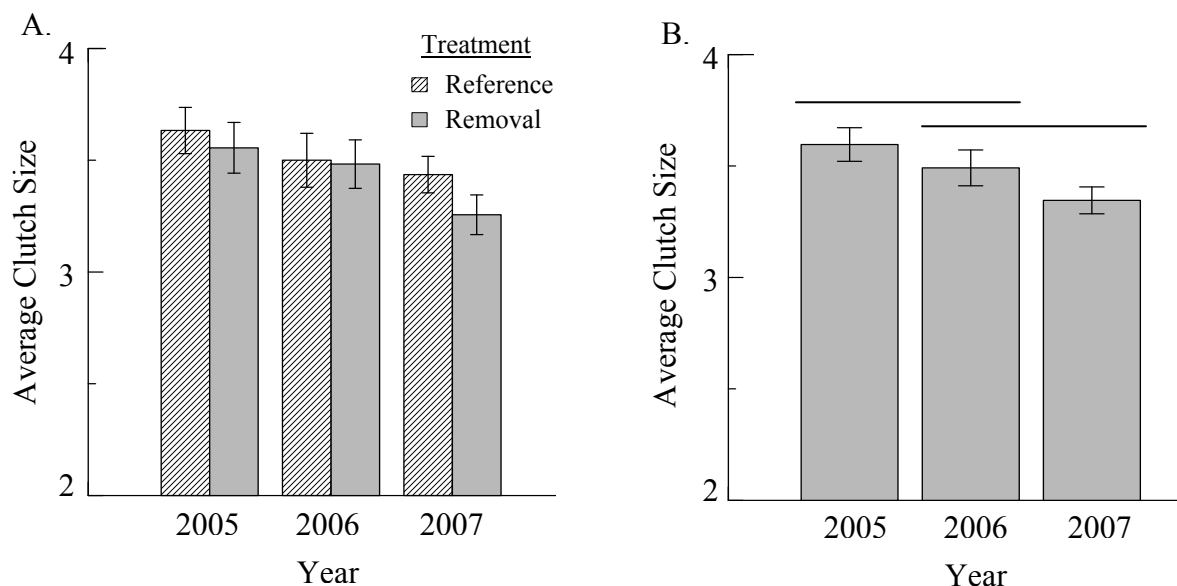


Figure 9. Annual average least Bell's vireo clutch size (± SE) of nests at *Arundo donax* Removal and Reference sites/treatments (A), and summarized by year across treatments (bars under the same line were not statistically different) (B) at Marine Corps Base Camp Pendleton from 2005-2007.

Table 9. Results from two-way ANOVA testing for differences in average clutch size of least Bell's vireos nesting at *Arundo donax* Removal and Reference sites/treatments at Marine Corps Base Camp Pendleton, 2005-2007.

Source	SS	df	MS	F	P
Treatment	0.55	1	0.55	1.63	0.20
Year	2.46	2	1.23	3.69	0.03
Treatment * Year	0.23	2	0.11	0.34	0.71
Error	63.71	191	0.33		

A similar trend to what was documented with average clutch size for nests at Reference and Removal sites was documented for overall productivity of pairs nesting at those sites. From 2005-2007, pairs at Removal sites, on average, fledged fewer young each year compared to pairs at Reference sites (Figure 10A). Although none of these differences were statistically significant within a single year (Rourke and Kus 2006, 2007), when data were combined results from a two-way ANOVA indicated a marginally significant difference ($F_{0.10, 1, 115} = 2.8$, $P = 0.10$) between the average number of young fledged by pairs at Reference sites (2.8 young per pair \pm 0.2 SE) compared to young fledged from Removal sites (2.4 young per pair \pm 0.2 SE) (Figure 10B, Table 10) from 2005-2007.

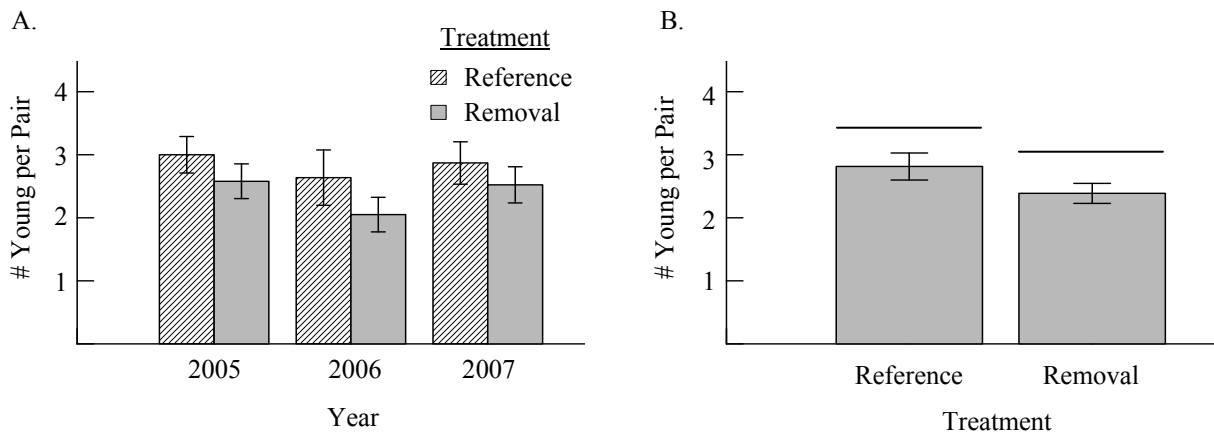


Figure 10. Average number of least Bell's vireo young fledged per pair (\pm SE) at *Arundo donax* Removal and Reference sites/treatments per year (A), and summarized by treatment across years (bars under different lines are statistically different) (B) at Marine Corps Base Camp Pendleton from 2005-2007.

Table 10. Results from two-way ANOVA testing for differences in the average number of young fledged per pair of least Bell's vireos nesting at *Arundo donax* Removal and Reference plots/treatments at Marine Corps Base Camp Pendleton, 2005-2007.

Source	SS	df	MS	F	P
Year	4.34	2	2.17	1.02	0.36
Treatment	5.99	1	5.99	2.81	0.10
Year * Treatment	0.32	2	0.16	0.08	0.93
Error	245.02	115	2.13		

Nest Characteristics

In 2007, successful and unsuccessful nests within Reference and Removal sites did not differ statistically in average nest height, height of the host plant, or the distance the nest was placed from the edge of the host (Table 11). However, overall differences in nest placement were observed between nests built within Reference and *A. donax* Removal sites. Vireo nests at Removal sites were placed significantly higher above ground and built further from the edge of the plant in which they were placed than nests at Reference sites (Table 11). There was no difference in the height of a nest's host plant between Reference and Removal sites.

Table 11. Least Bell's vireo nest characteristics and results of two-sample *t*-tests of successful vs. unsuccessful nesting attempts at Reference and *A. donax* Removal sites, Marine Corps Base Camp Pendleton, 2007. Two-sample equal variance tests were conducted unless otherwise noted.

Nest Characteristic	Nest Fate		df ^a	<i>t</i> ^b	<i>P</i> ^c
	Successful	Unsuccessful			
Reference Site					
Average nest height (m)	0.72	0.71	47	0.01	0.99
Average host height (m)	3.30	3.24	45	0.07	0.94
Average distance to edge of host (m)	0.36	0.31	46	0.47	0.64
Removal Site					
Average nest height (m)	0.96	0.96	33	0.04	0.97
Average host height (m)	4.56	3.66	36	0.95	0.35
Average distance to edge of host (m)	0.54	0.52	36	0.09	0.93
Overall	Reference	Removal			
Average nest height (m)	0.71	0.96	82	-4.83	< 0.001
Average host height (m)	3.27	4.09	83	-1.35	0.18
Average distance to edge of host (m) ^d	0.33	0.53	55	-1.70	0.10

^a df = degrees of freedom

^b *t* = two-sample *t*-test test statistic

^c *P* = P-value

^d Two-sample unequal variance *t*-test was conducted

A total of 15 plant species were used as hosts for vireo nests at Reference and *A. donax* Removal sites in 2007, although not all were used within each treatment (Table 12). Vireos used 12 of the 15 species at Reference sites and 9 of the 15 at Removal sites. Despite this difference

vireos at Reference and Removal sites were comparable in their selection of host species, as 69-72% of nests were placed in *S. lasiolepis*, *S. exigua* and *B. salicifolia* (Table 12). Vireos at Removal sites placed an additional 11% of nests in *S. gooddingii*, which although present at Reference sites was not used as a host plant. Only a single nest, within one of the *A. donax* Removal sites, was built in an exotic plant species (*C. maculatum*) in 2007. The remaining 23% of nests were placed in 10 plant species. Nine of these plant species were used as host plants at Reference sites while only 4 of the 10 species were used as hosts at Removal sites.

Table 12. Host plant species used by least Bell's vireos at Reference and *A. donax* Removal sites, Marine Corps Base Camp Pendleton, 2007. Numbers in parentheses are proportions of total nests.

Host Species	Number of Nests	
	Reference	Removal
<i>Salix lasiolepis</i>	19 (0.37)	18 (0.41)
<i>Baccharis salicifolia</i>	11 (0.22)	5 (0.11)
<i>S. exigua</i>	5 (0.10)	9 (0.20)
<i>Toxicodendron diversilobum</i>	3 (0.06)	1 (0.02)
<i>Vitis californica</i>	3 (0.06)	0 (0.00)
<i>Rubus ursinus</i>	2 (0.04)	2 (0.05)
<i>Artemisia douglasiana</i>	2 (0.04)	1 (0.02)
<i>Baccharis pilularis</i>	2 (0.04)	0 (0.00)
<i>Platanus racemosa</i>	1 (0.02)	0 (0.00)
<i>Populus fremontii</i>	1 (0.02)	0 (0.00)
<i>Quercus agrifolia</i>	1 (0.02)	0 (0.00)
<i>Urtica dioica</i>	1 (0.02)	0 (0.00)
<i>S. gooddingii</i>	0 (0.00)	5 (0.11)
<i>Rosa californica</i>	0 (0.00)	2 (0.05)
<i>Conium maculatum</i>	0 (0.00)	1 (0.02)

DISCUSSION

In 2007, the number of documented least Bell's vireo territories was within the range of approximately 700-1000 territories observed on Marine Corps Base Camp Pendleton for the past 13 years. The vireo population has fluctuated between a low of 696 territories in 1995 and a high of 1,011 territories in 1998 (Griffith Wildlife Biology 2004) (Figure 4). From 1998 to 2003, the vireo population steadily declined to 718 territories. In 2004 and 2005, the vireo population increased to 823 and 827 territories, respectively. In 2006, the population was identical to the 2003 estimate of 718 territories, and in 2007 it lost 11 territories, declining to 707. The most striking feature of the 2007 population estimate is how little it changed from 2006. Not only was the total estimate similar, but the distribution of birds across the Base changed little. With the exception of San Mateo Creek, which lost 13 territories, declining by 22%, the total change in territory numbers within the remaining 22 drainages/sites ranged from 0 to 6 territories and averaged 1.5 ± 1.7 (std) territories per drainage/site. The stability in vireo numbers across drainages/sites is further evident as 68% (15/22) of those drainages differed by zero to one territory compared to their 2006 total.

Despite the stability in the Camp Pendleton vireo population between 2006 and 2007, four drainages/sites have consistently declined in vireo number since 2005 (Hidden Canyon by 50%, Aliso Creek by 57%, Pueblitos Canyon by 60%, and French Creek by 67%) (Table 2). One possible explanation for the decline, and possibly the 2007 decline documented on San Mateo Creek, is the increasing aridity of conditions on Base since 2005. The winter of 2004-2005 was extremely wet, promoting dense growth of many herbaceous plants that were subsequently used by vireos during the 2005 breeding season. In 2005, vireo numbers on French Creek, Hidden Canyon, and Pueblitos Creek increased slightly compared to 2004 totals. The following winter (2005-2006) was drier and the winter of 2006-2007 was so dry that the vigor of many herbaceous plants was noticeably reduced. Many biologists noted that areas that in previous years contained herbaceous plants that reached at least waist- or chest-height grew to only knee-height in 2007. It is possible that the reduced volume of herbaceous plants in drier years leads to a reduction in availability of suitable habitat for territorial vireos, and results in a correspondingly lower population size on select drainages.

There are a number of similarities in measures of least Bell's vireo reproductive success between 2005, 2006, and 2007 at Reference and *A. donax* Removal sites. Within years, there have been no statistical differences in average clutch size, average brood size, or the number of young fledged per pair between Reference and Removal plots (Rourke and Kus 2006, 2007). In addition, the percentage of pairs fledging young has been relatively high in all years ranging from a low of 73% to a high of 93%, regardless of treatment type. However, when data from all years were analyzed together using a two-way ANOVA, a marginally significant difference in the total number of young fledged per pair between treatments became apparent, with pairs at Reference plots fledging statistically more young (2.8 ± 0.2 SE) from 2005 to 2007 than pairs at Removal sites (2.4 ± 0.2 SE) (Figure 10, Table 10). One possible explanation for this difference is that in two out of the last three years, pairs at Reference sites have been more likely to renest after a failed first attempt, and in all years have been more likely to renest after a successful first nesting attempt, than pairs at Removal sites. This has translated into more pairs at Reference sites successfully fledging young from two nests within a season compared to pairs from Removal sites. The cause of this difference in renesting is unknown. It is possible that it is related to a difference in habitat between the sites that fosters renesting after a successful attempt, and/or could be related to a difference in age-specific parameter(s) in vireo biology of birds within treatments, where birds nesting at Reference sites are potentially older and more experienced than vireos at Removal sites. As stated, the significance level ($P = 0.10$) of this effect was marginal. However, given the endangered status of the species, low annual sample sizes, and therefore reduced power to detect effects within a single year, and that a primary objective of this research is to determine whether *A. donax* removal has an effect(s) on vireo productivity, we believe further research is warranted.

When data from the last three years of monitoring were combined and analyzed an overall reduction in clutch size was documented (Figure 9, Table 9). From 2005 to 2007, total average clutch size decreased from 3.6 to 3.3 eggs per nest. The significance of this decline, if any, is uncertain as the mean number of young fledged per pair between 2005 and 2007 did not differ statistically (Table 10, $F_{0.05, 2, 115} = 1.0$, $P = 0.36$). It is possible that the decline in clutch size in 2007 was related to the extreme arid conditions experienced during the 2007 breeding

season discussed earlier and that it will return to 2005/2006 levels in years of greater precipitation.

Since 2005, the banding of least Bell's vireos with unique color combinations has allowed us to estimate both adult and juvenile survival rates as well as investigate annual dispersal of adult and first year adult vireos. In 2007, four vireos that were originally banded in 2005 as adults, and not documented in 2006, were resighted. The 2006 survivorship estimate that was reported in Rourke and Kus (2007) was 30% (11/37) for adult vireos. With the detection of these four birds in 2007, the survivorship estimate for adult vireos in 2006 should be revised to 41% (15/37). In 2006 and 2007, 10% of vireos fledged the previous year survived and were detected holding territories on Base. It should be noted that because of the cryptic nature of female vireos these estimates are largely derived from detections of male vireos and are potentially underestimates of total vireo survival.

Annual survivorship estimates for adult and/or second-year least Bell's vireos may be further underestimated because of their potential dispersal/emigration off Base. One of the largest off Base drainages containing suitable vireo habitat and thus a potential destination for migrating vireos is the San Luis Rey River running along the southern border of Camp Pendleton. However, none of the 205 unaccounted-for adult and juvenile least Bell's vireos banded in 2005 and 2006 were resighted along 17.5 km of the San Luis Rey River in 2007 (Ferree and Kus 2008, USGS, unpublished data). During the 2006 and 2007 breeding seasons, 11 vireos originally banded on the San Luis Rey River were resighted on Base, demonstrating that dispersal between the drainages is occurring. To date, the longest dispersal event documented for a vireo originally banded on Camp Pendleton is 6.7 km, from the Santa Margarita River northwest to Las Flores Creek, a distance long enough to reach the San Luis Rey River or Pilgrim Creek to the south. Further banding and resighting of vireos within southern California will allow a better determination of the extent of movement between populations and the role such movements play in maintaining genetic diversity and persistence in these populations. Continued monitoring of cohorts banded as nestlings provides the opportunity to collect life-time reproductive data for a segment of the population, facilitating identification of age-and possibly sex-related patterns in life history characteristics that influence population size, productivity, and genetic structure.

In summary, it is evident that the vireo population on Camp Pendleton responded positively to management actions between the early 1980's and 1990's, including control of brown-headed cowbirds, removal of invasive exotic riparian plant species, and protection of vireo habitat. Vireo populations across southern California showed a similar increase during this time period (USFWS 2006). Since 1998, when the base population reached its peak numbers, the vireo population has slowly declined to stabilize between 700 and 800 territories. The current (3-year) downward trend in the vireo population seems to be driven by climate-related factors, notably several years of below-average rainfall, and was also demonstrated in the lower San Luis Rey River population (Ferree and Kus 2008), although the San Luis Rey population has not reflected the downward trend in the Camp Pendleton population since 1998. It is evident that vireo populations in southern California are not isolated by drainage as we have seen banded birds crossing into nearby drainages. The dispersal of vireos across drainages, and the consequent fluctuations in numbers of vireo territories in each drainage, indicate the ability of

vireos, especially dispersing juveniles (and rarely, adults), to move to habitat that may be more suitable. Therefore, a close look at impacts to vireo habitat and productivity in drainages on Camp Pendleton that have shown a downward trend in vireo territories since 1998 would be required to determine if management actions in these areas (protection/restoration of habitat) may be warranted.

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APPENDIX A

**LEAST BELL'S VIREO SURVEY AREAS AT MARINE CORPS BASE CAMP
PENDLETON, 2007**

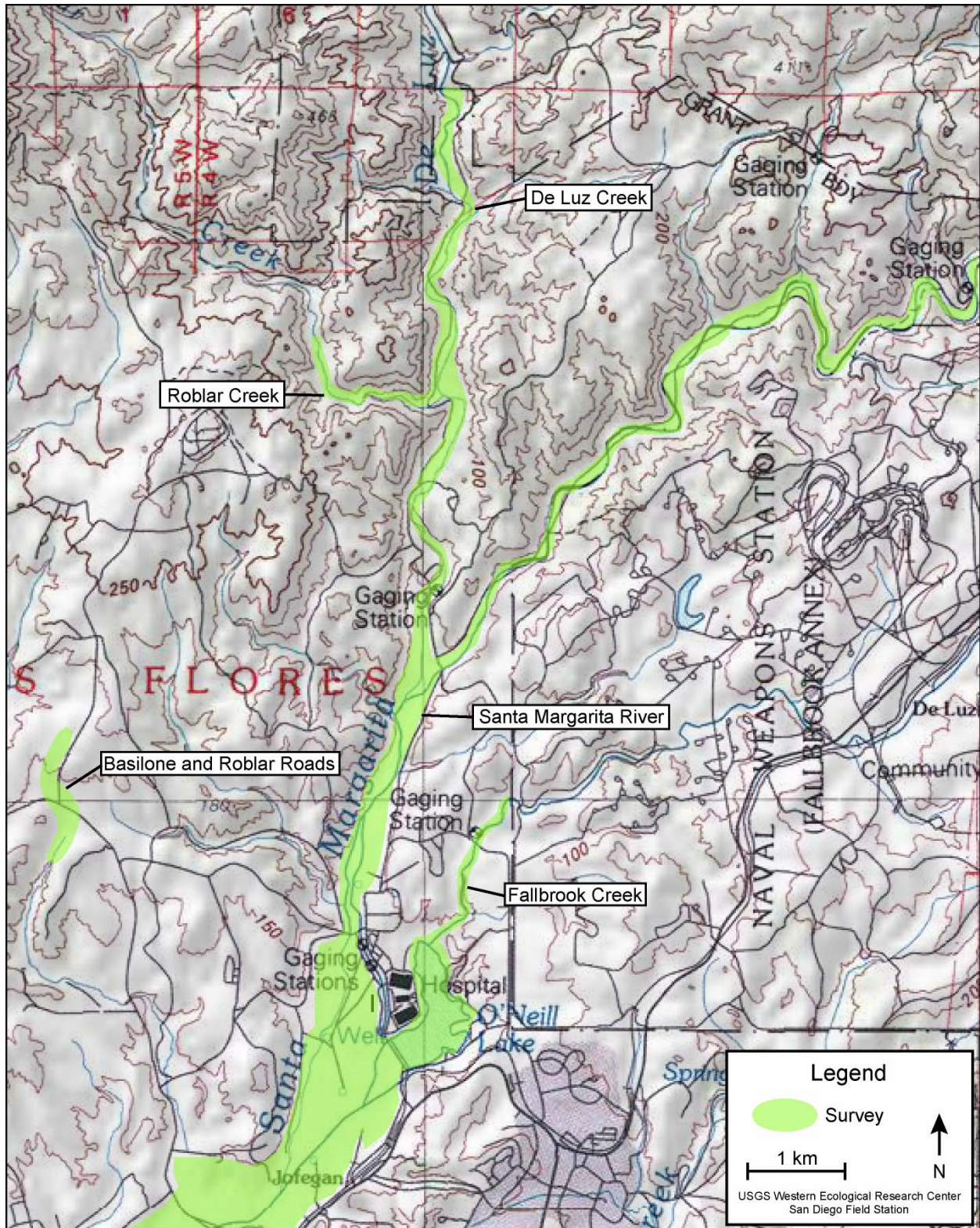


Figure 11. Least Bell's vireo survey areas at Marine Corps Base Camp Pendleton, 2007: Upper Santa Margarita River, Lake O'Neill, Fallbrook Creek, De Luz Creek, Roblar Creek, and Basilone and Roblar Roads.

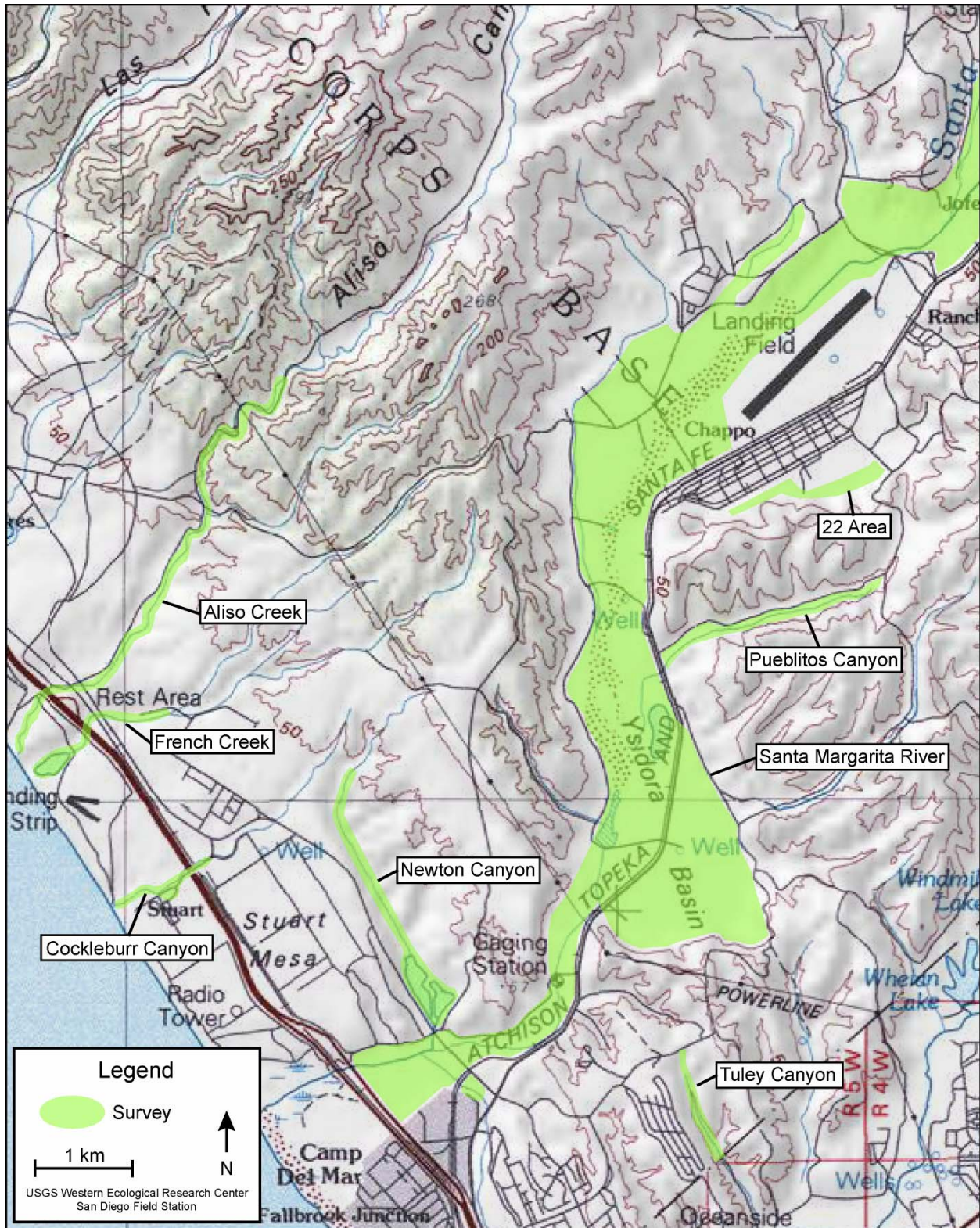


Figure 12. Least Bell's vireo survey areas at Marine Corps Base Camp Pendleton, 2007: Lower Santa Margarita River, 22 Area, Pueblitos Canyon, Tuley Canyon, Newton Canyon, Cocklebur Canyon, French Creek, and Aliso Creek.

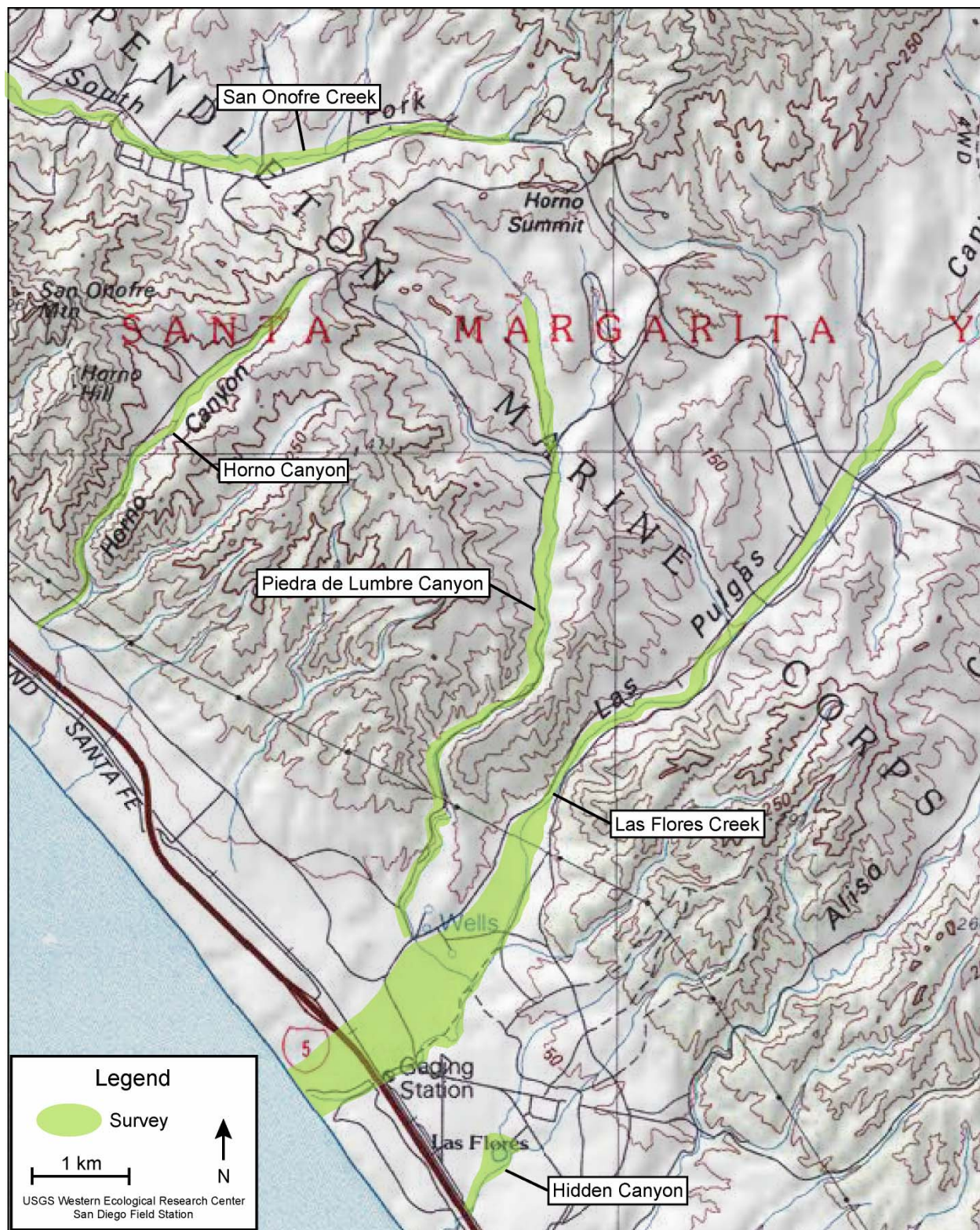


Figure 13. Least Bell's vireo survey areas at Marine Corps Base Camp Pendleton, 2007: San Onofre Creek South Fork, Horno Canyon, Piedra de Lumbre Canyon, Las Flores Creek, and Hidden Canyon.

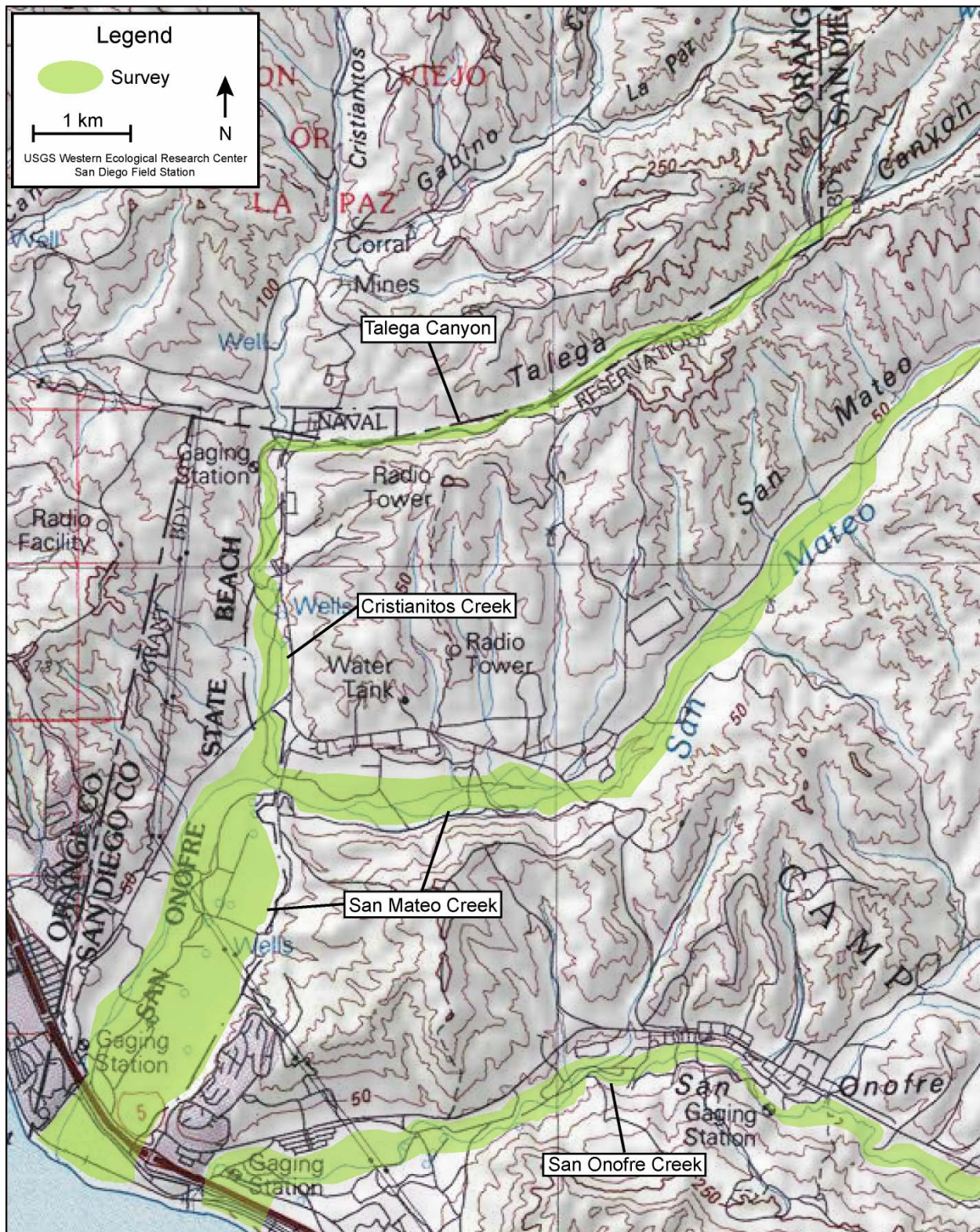


Figure 14. Least Bell's vireo survey areas at Marine Corps Base Camp Pendleton, 2007: Talega Canyon, Cristianitos Creek, San Mateo Creek, and San Onofre Creek.

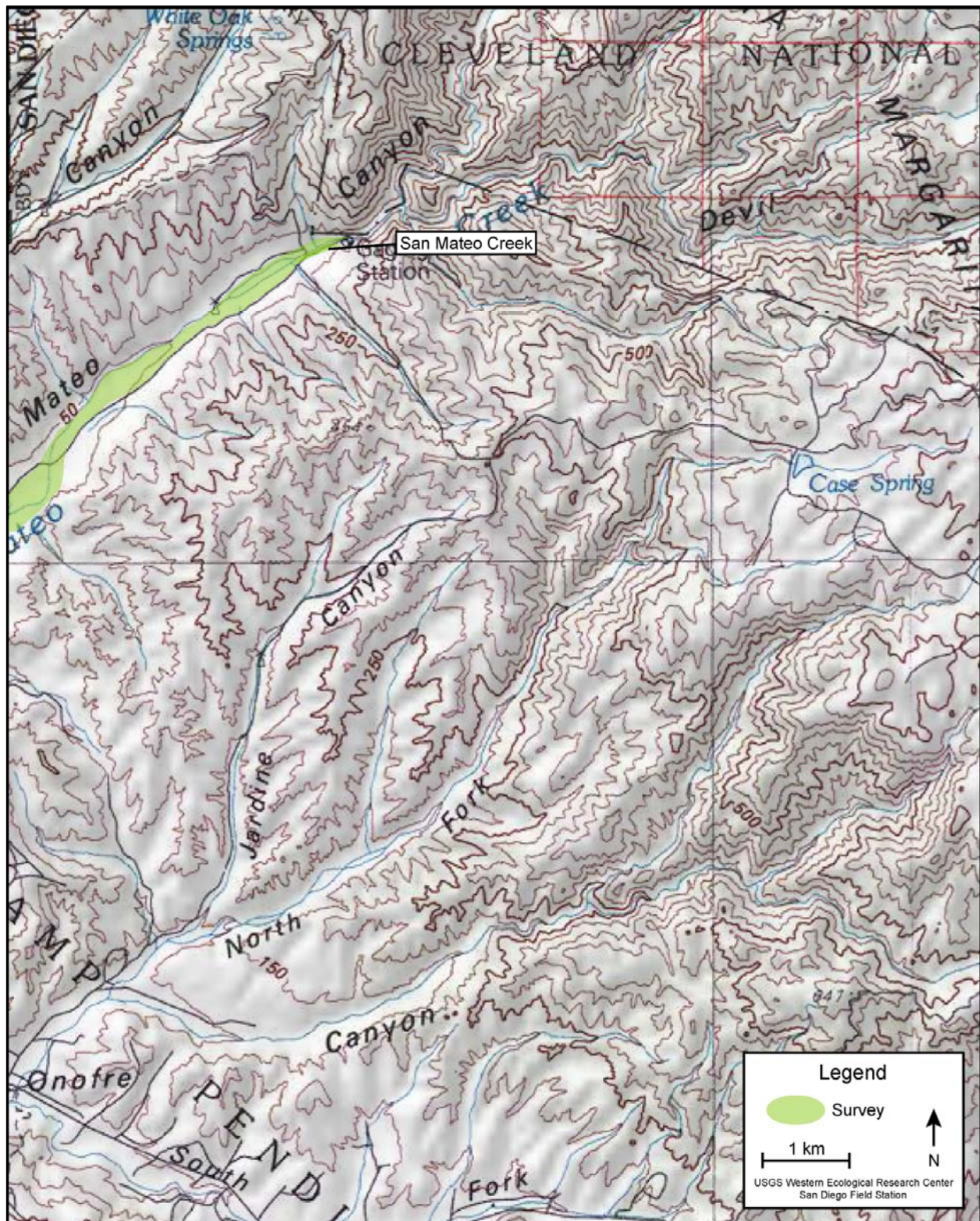


Figure 15. Least Bell's vireo survey areas at Marine Corps Base Camp Pendleton, 2007: Upper San Mateo Creek.

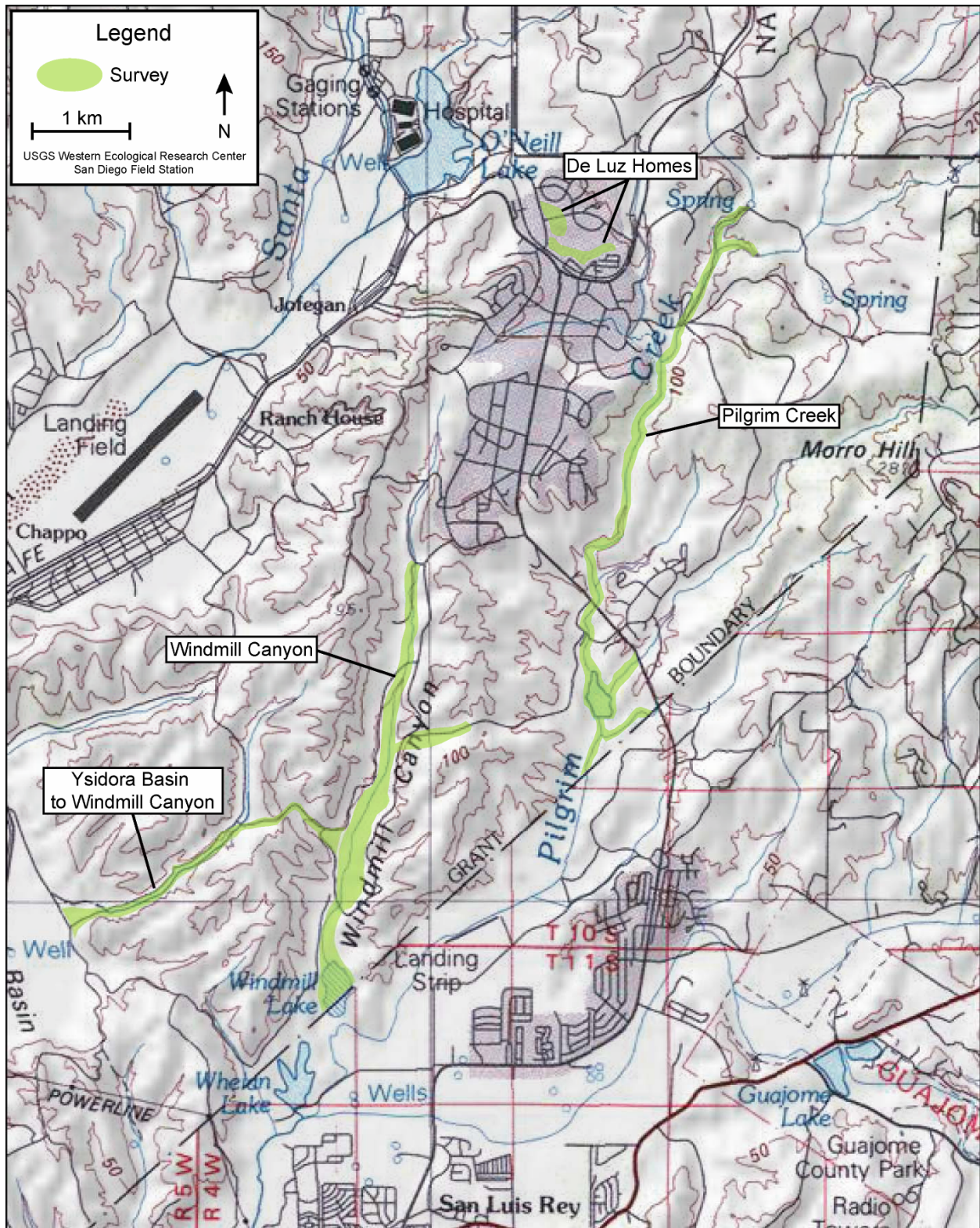


Figure 16. Least Bell's vireo survey areas at Marine Corps Base Camp Pendleton, 2007: Windmill Canyon, Ysidora Basin to Windmill Canyon, Pilgrim Creek, and De Luz Homes Habitat.

APPENDIX B

LOCATIONS OF LEAST BELL'S VIREOS AT MARINE CORPS BASE CAMP PENDLETON, 2007

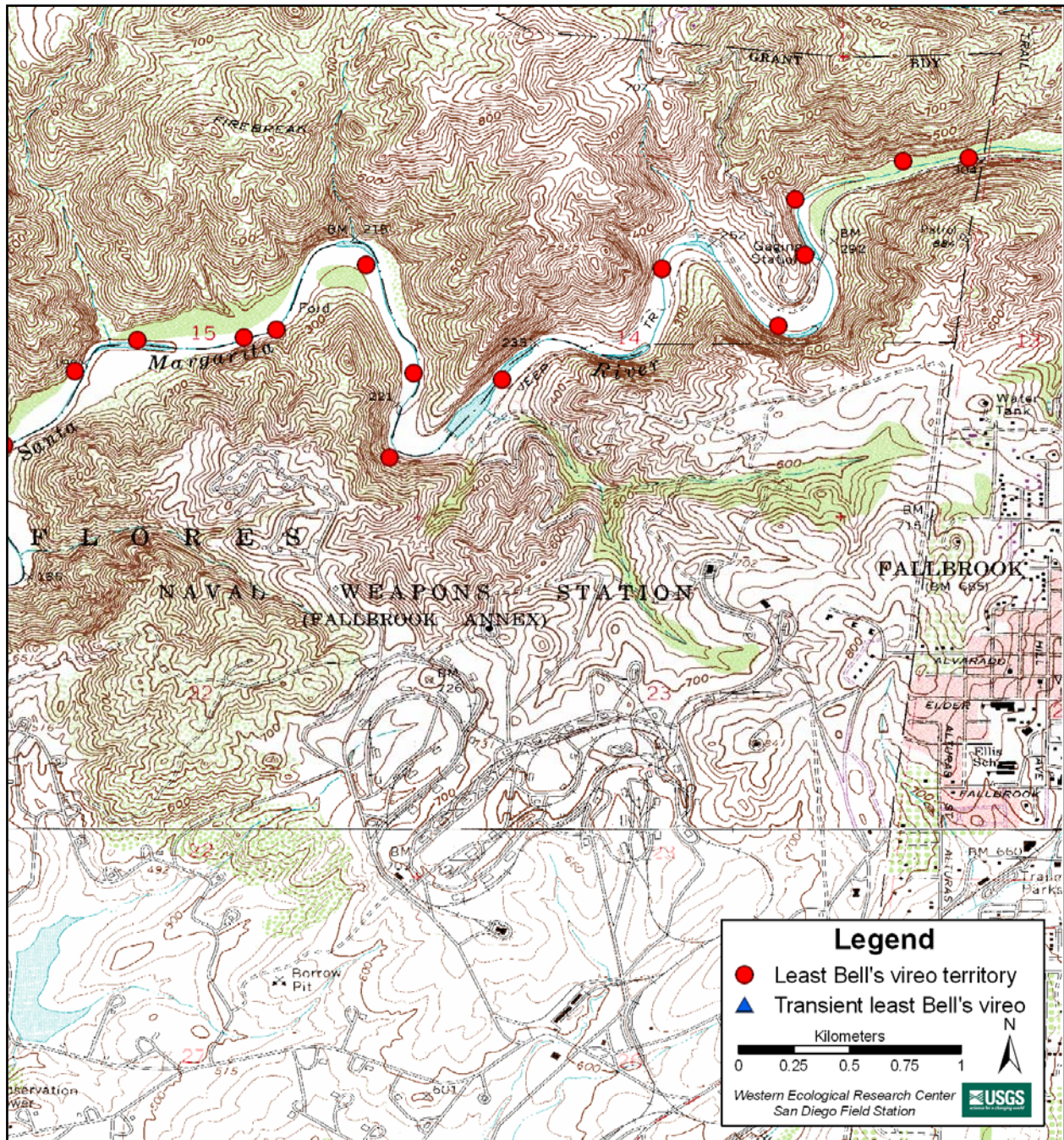


Figure 17. Locations of least Bell's vireos at Marine Corps Base Camp Pendleton, 2007: Upper Santa Margarita River.

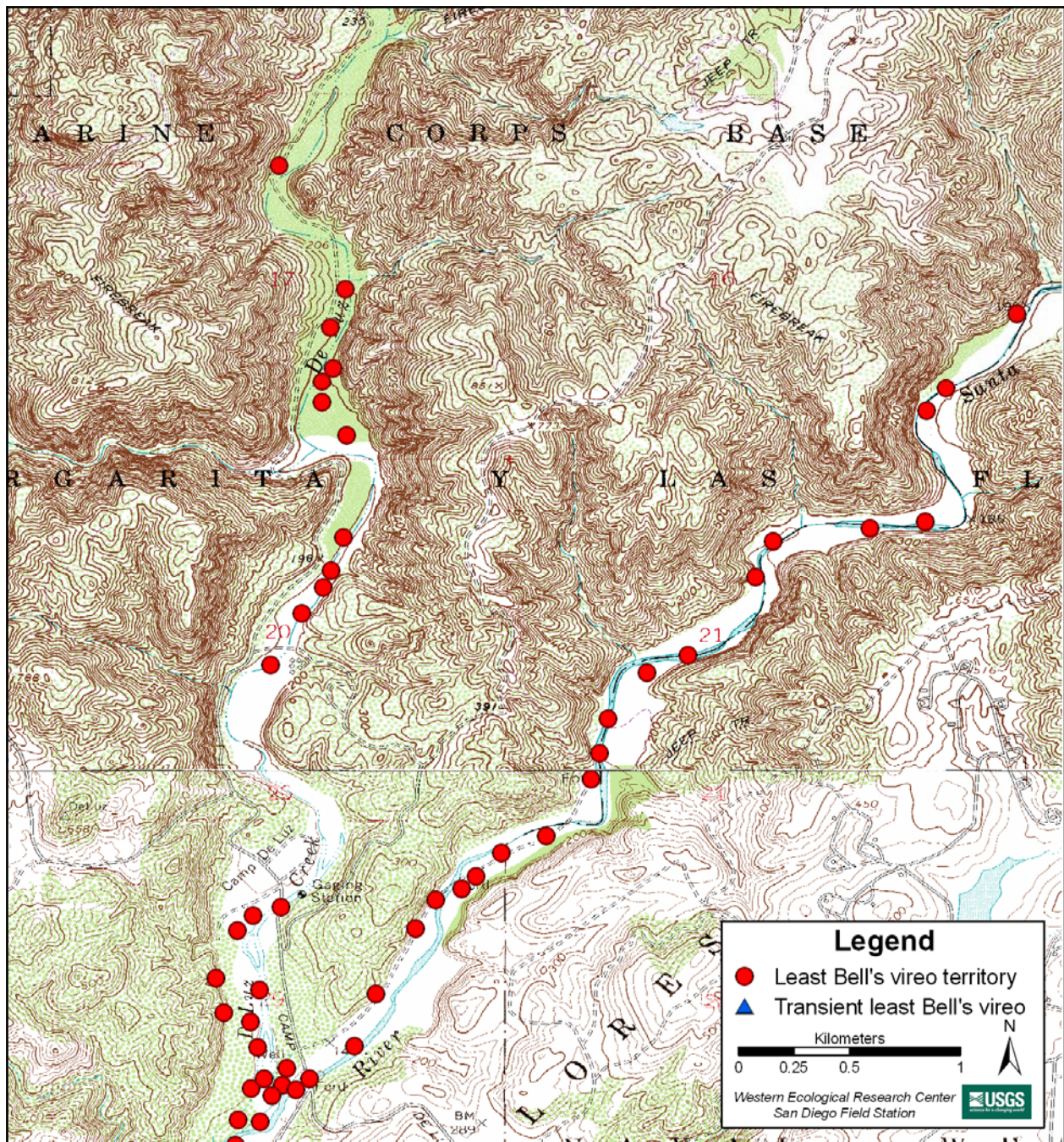


Figure 18. Locations of least Bell's vireos at Marine Corps Base Camp Pendleton, 2007: Upper Santa Margarita River, De Luz Creek, and Roblar Creek.

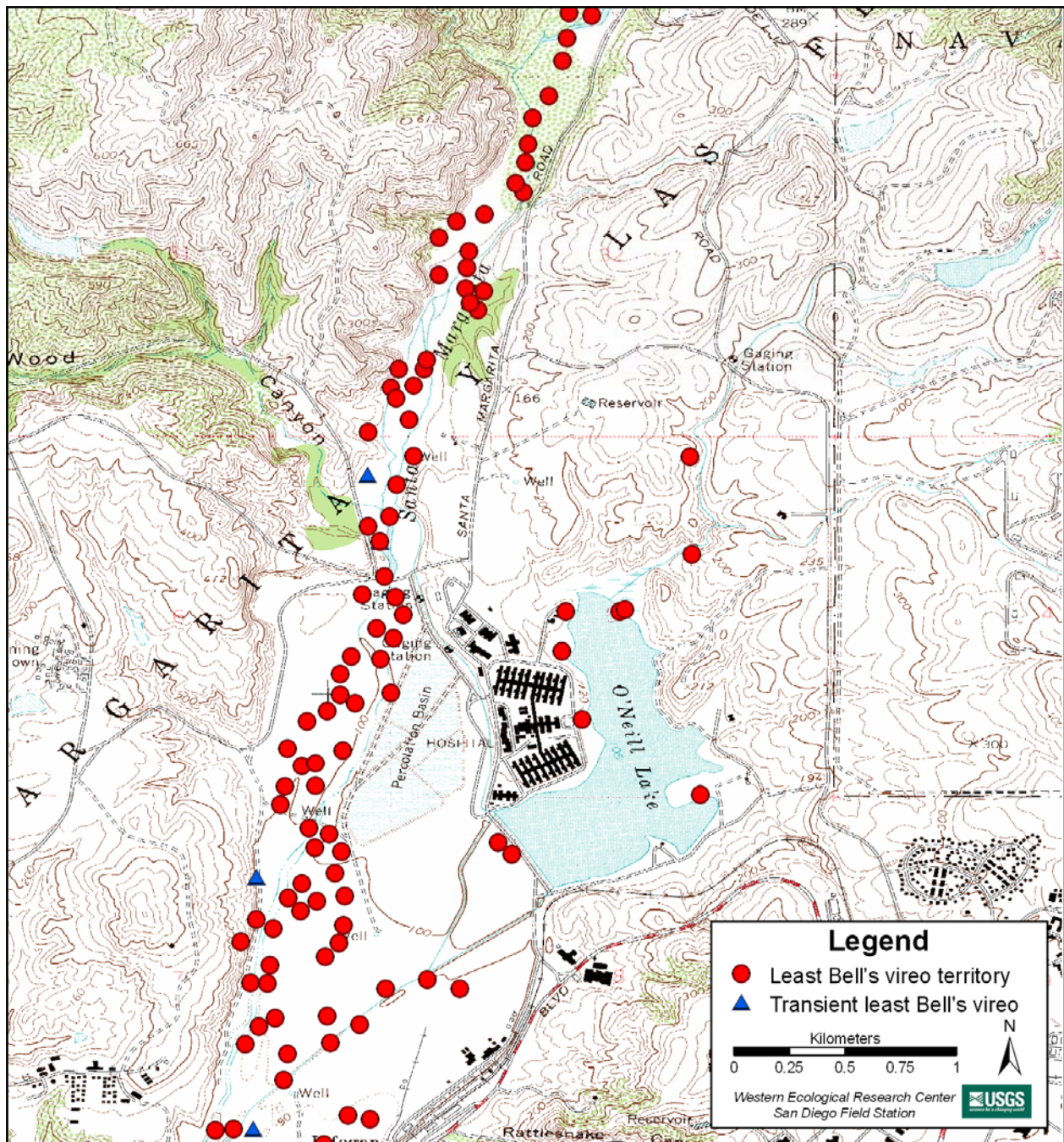


Figure 19. Locations of least Bell's vireos at Marine Corps Base Camp Pendleton, 2007: Santa Margarita River, Lake O'Neill, and Fallbrook Creek. .

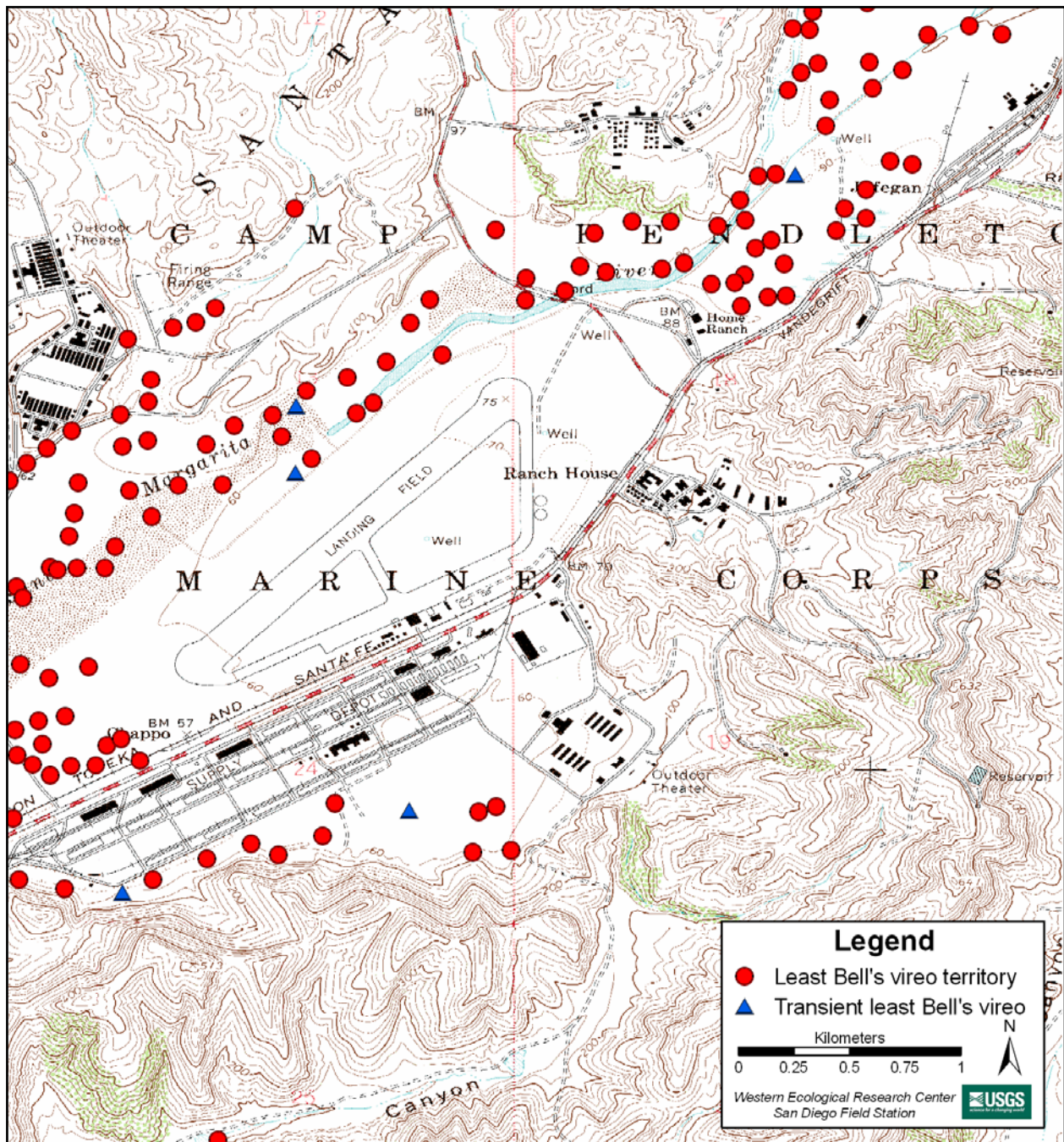


Figure 20. Locations of least Bell's vireos at Marine Corps Base Camp Pendleton, 2007: Santa Margarita River and 22 Area.

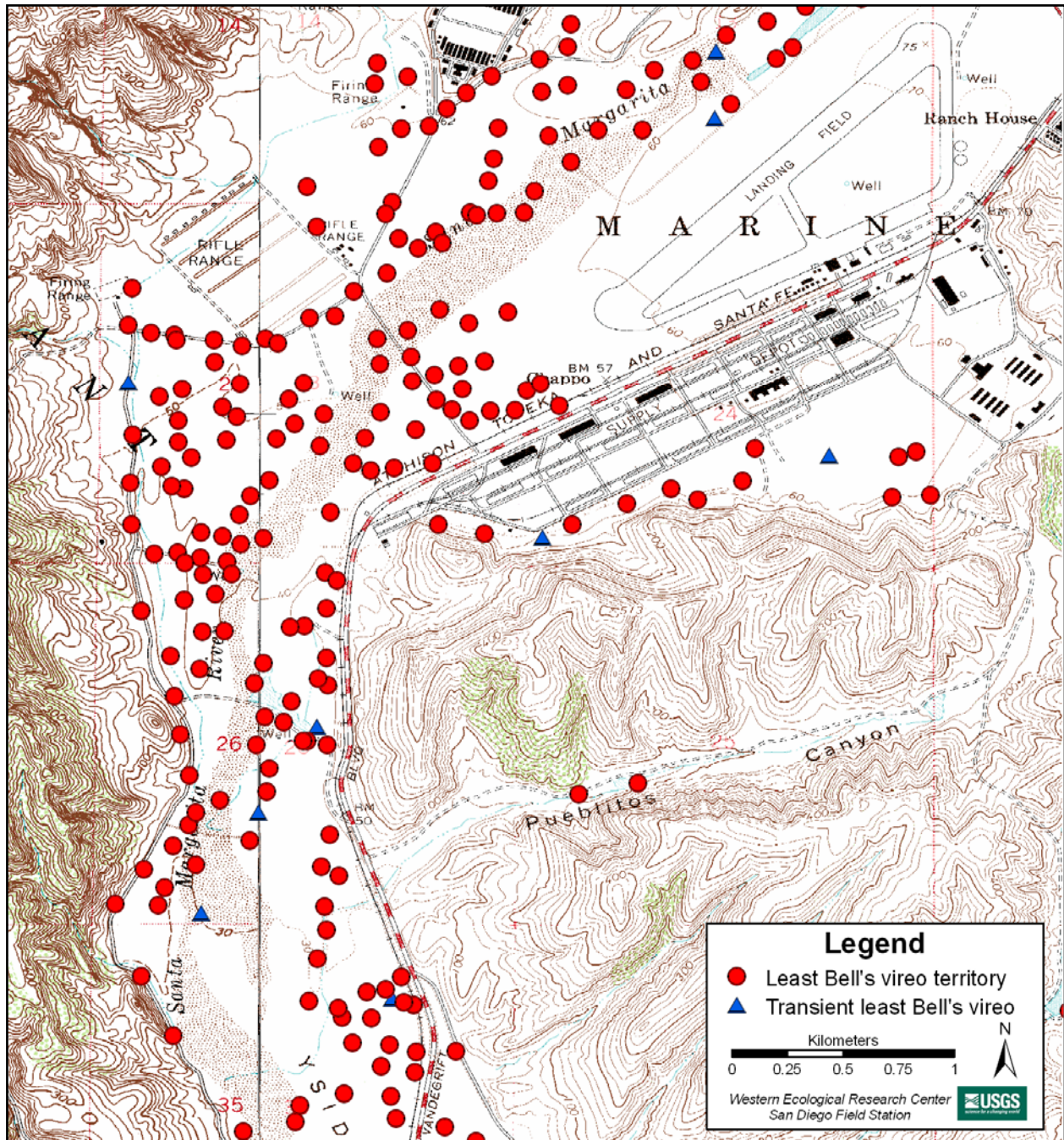


Figure 21. Locations of least Bell's vireos at Marine Corps Base Camp Pendleton, 2007: Santa Margarita River and Pueblitos Canyon.

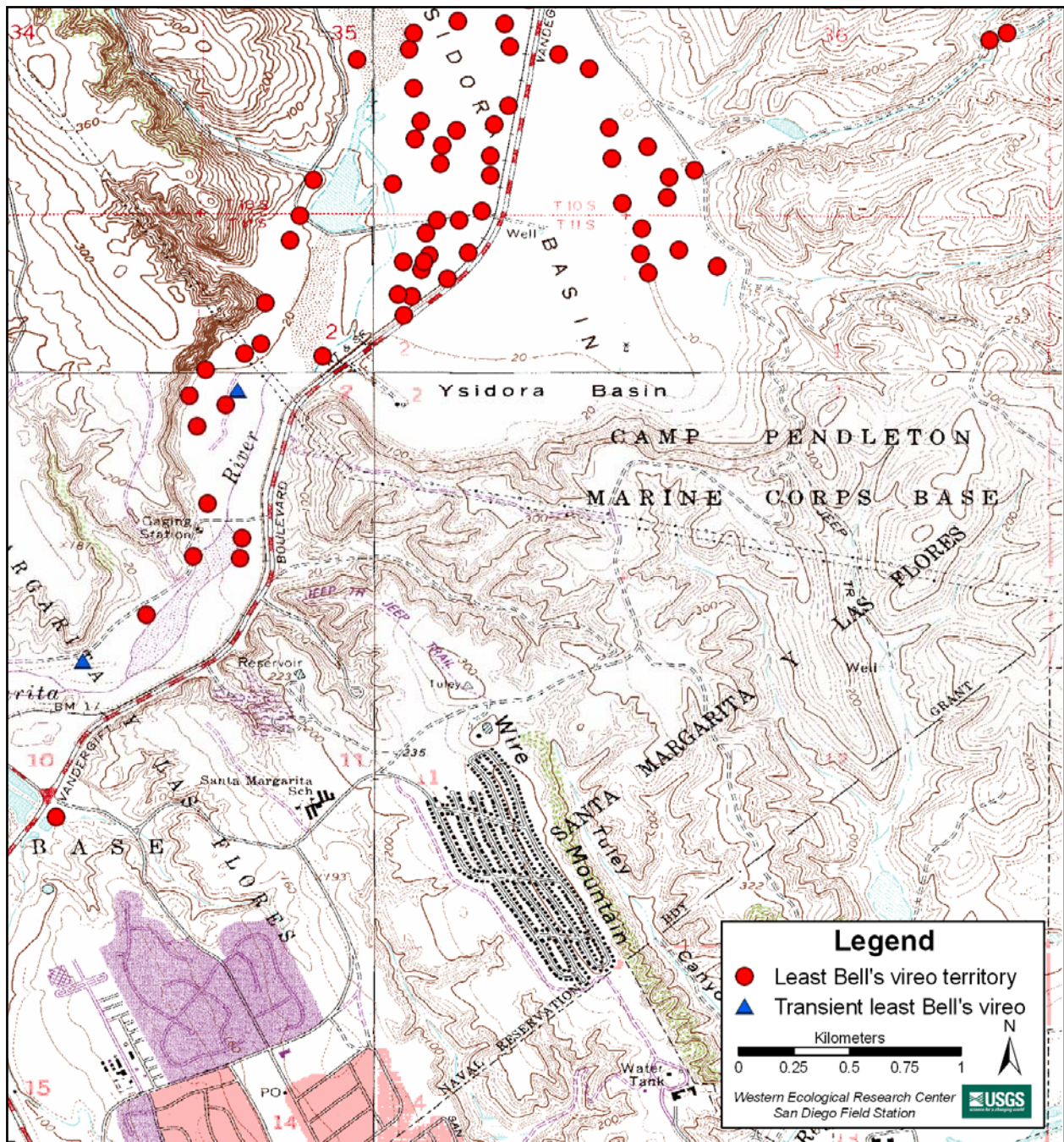


Figure 22. Locations of least Bell's vireos at Marine Corps Base Camp Pendleton, 2007: Santa Margarita River, Ysidora Basin, and Ysidora Basin to Windmill Canyon.

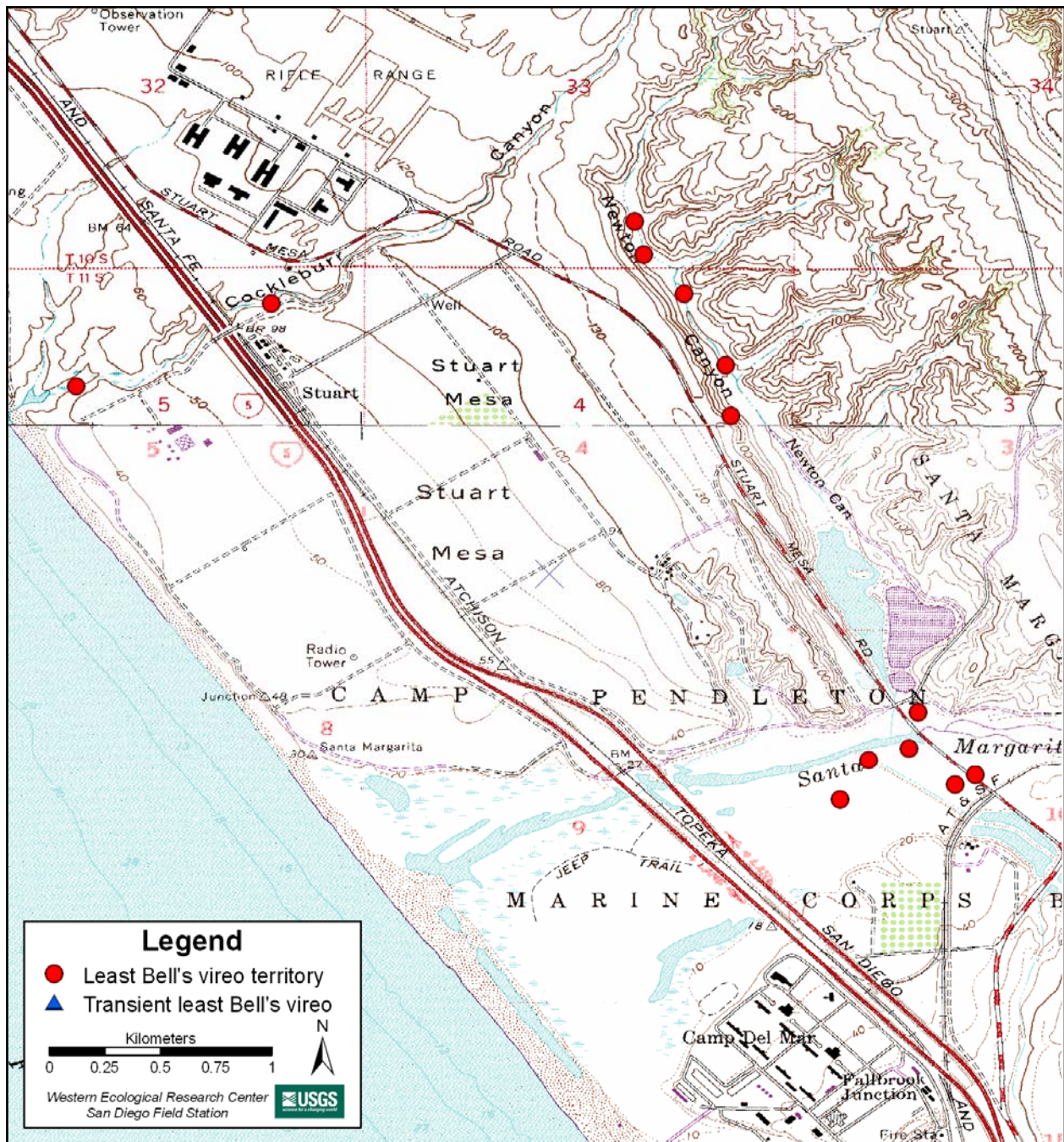


Figure 23. Locations of least Bell's vireos at Marine Corps Base Camp Pendleton, 2007: Lower Santa Margarita River, Newton Canyon, and Cocklebur Canyon..

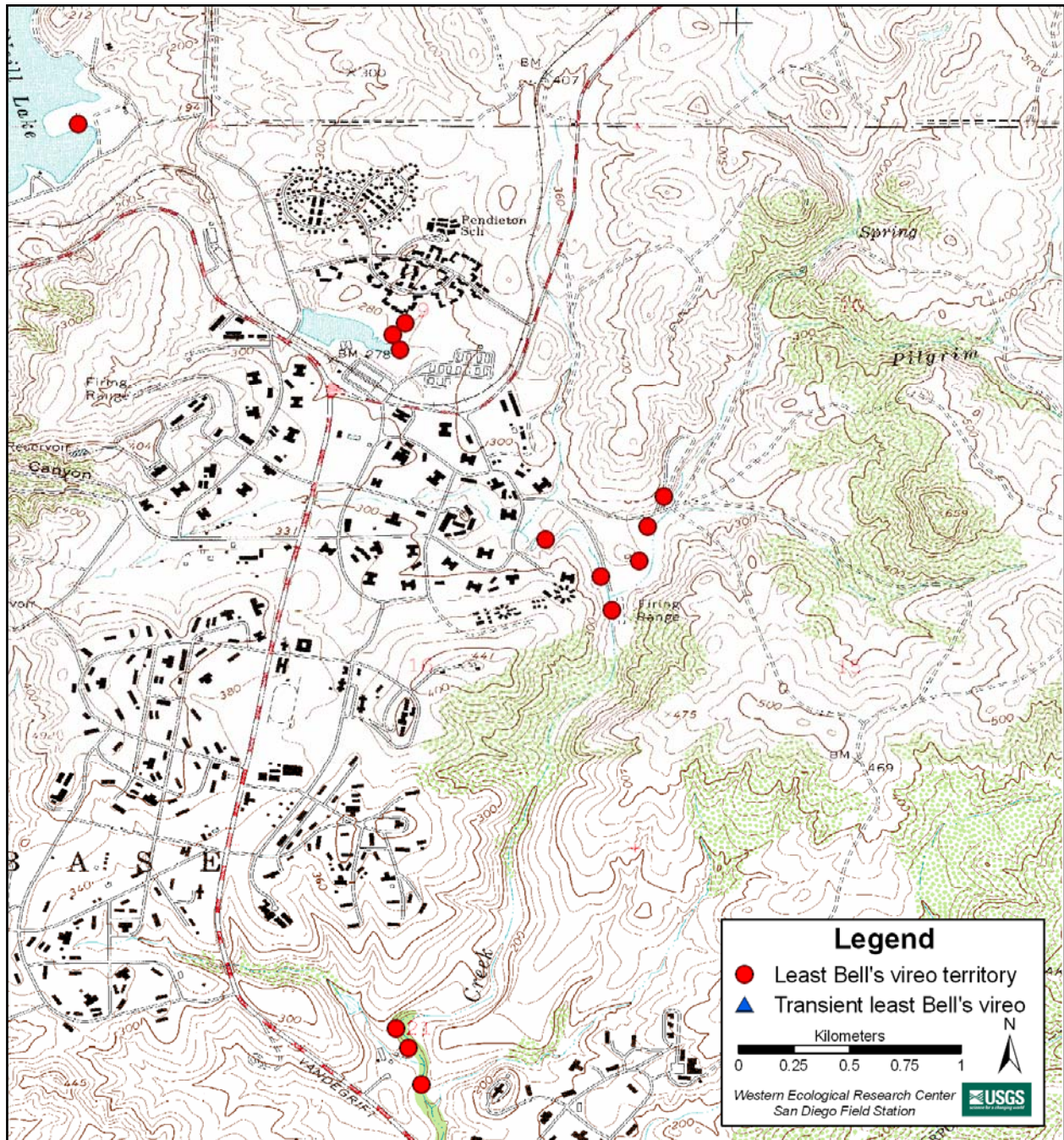


Figure 24. Locations of least Bell's vireos at Marine Corps Base Camp Pendleton, 2007: Upper Pilgrim Creek, De Luz Homes Habitat, and Lake O'Neill.

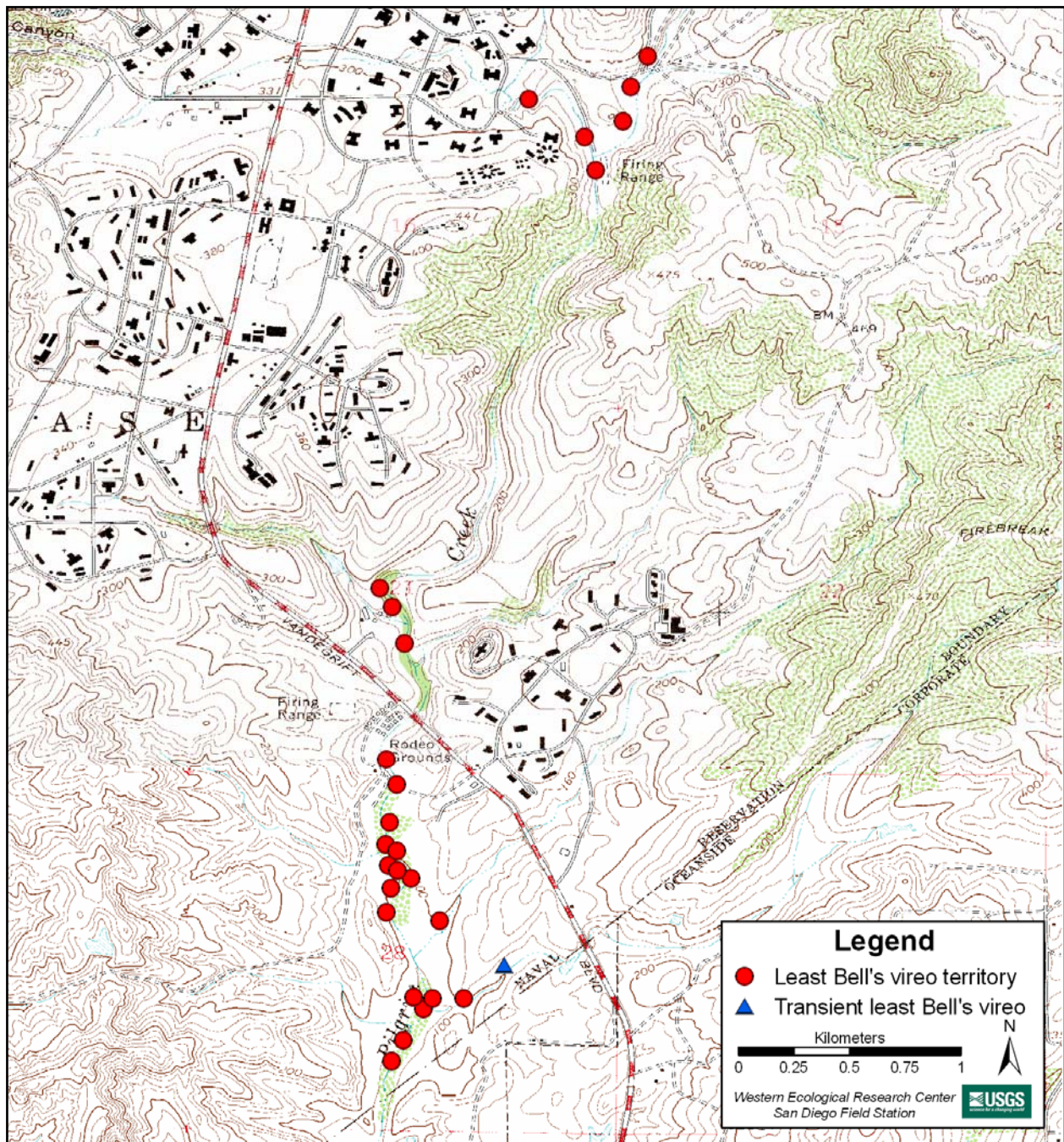


Figure 25. Locations of least Bell's vireos at Marine Corps Base Camp Pendleton, 2007: Upper and Lower Pilgrim Creek.

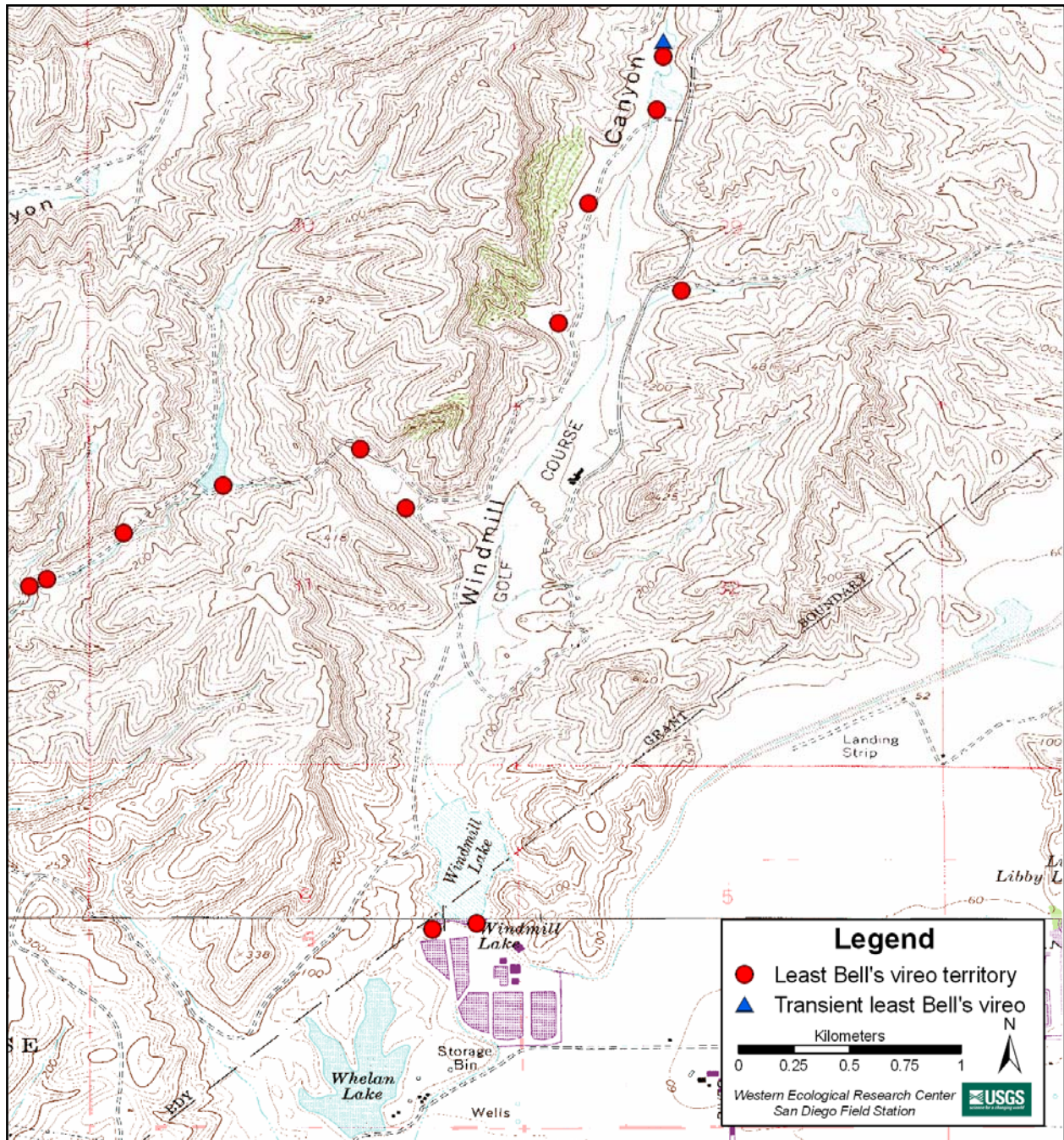


Figure 26. Locations of least Bell's vireos at Marine Corps Base Camp Pendleton, 2007: Windmill Canyon, and Ysidora Basin to Windmill Canyon.

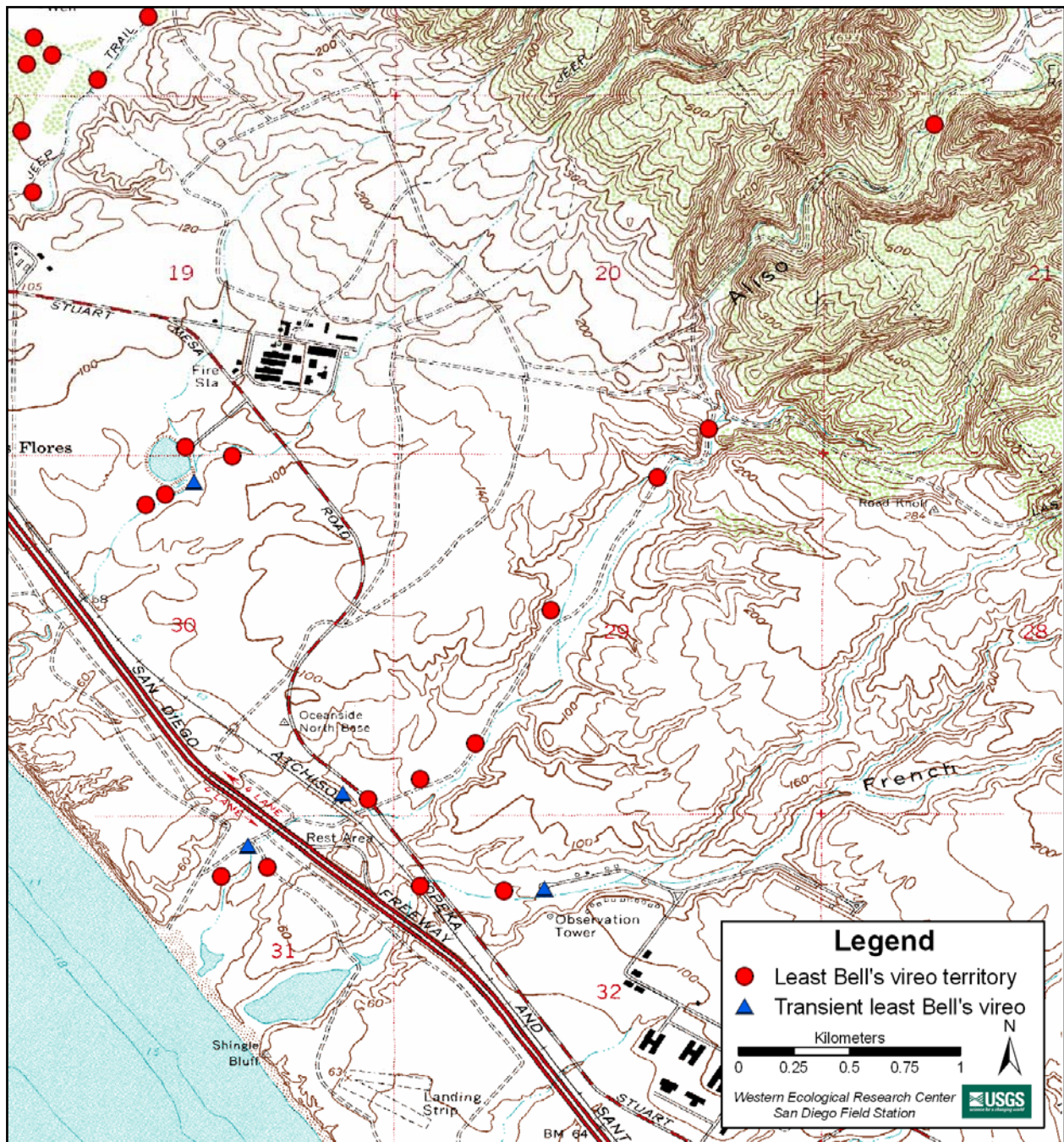


Figure 27. Locations of least Bell's vireos at Marine Corps Base Camp Pendleton, 2007: French Creek, Aliso Creek, and Hidden Canyon.

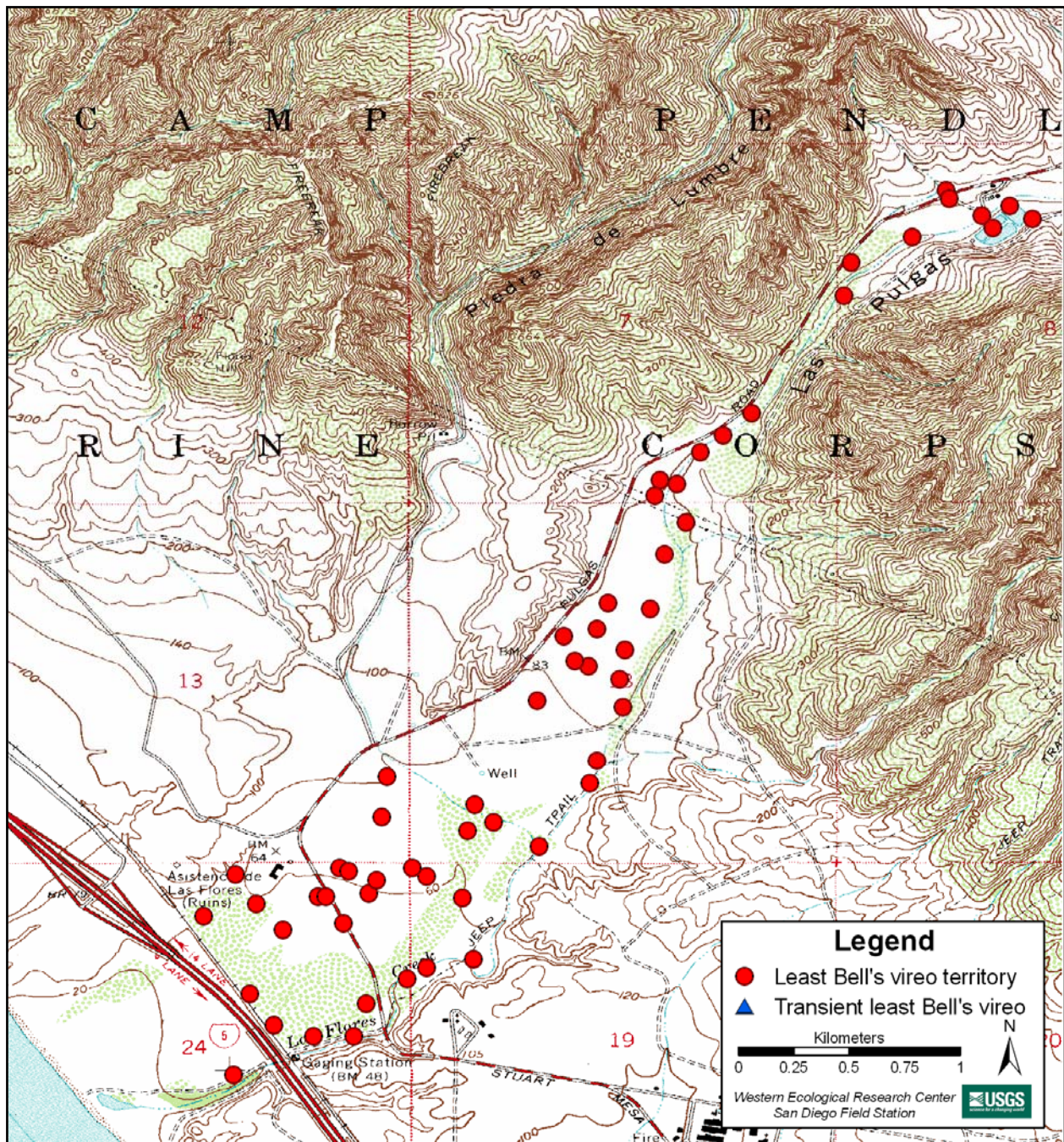


Figure 28. Locations of least Bell's vireos at Marine Corps Base Camp Pendleton, 2007: Lower Las Flores Creek.

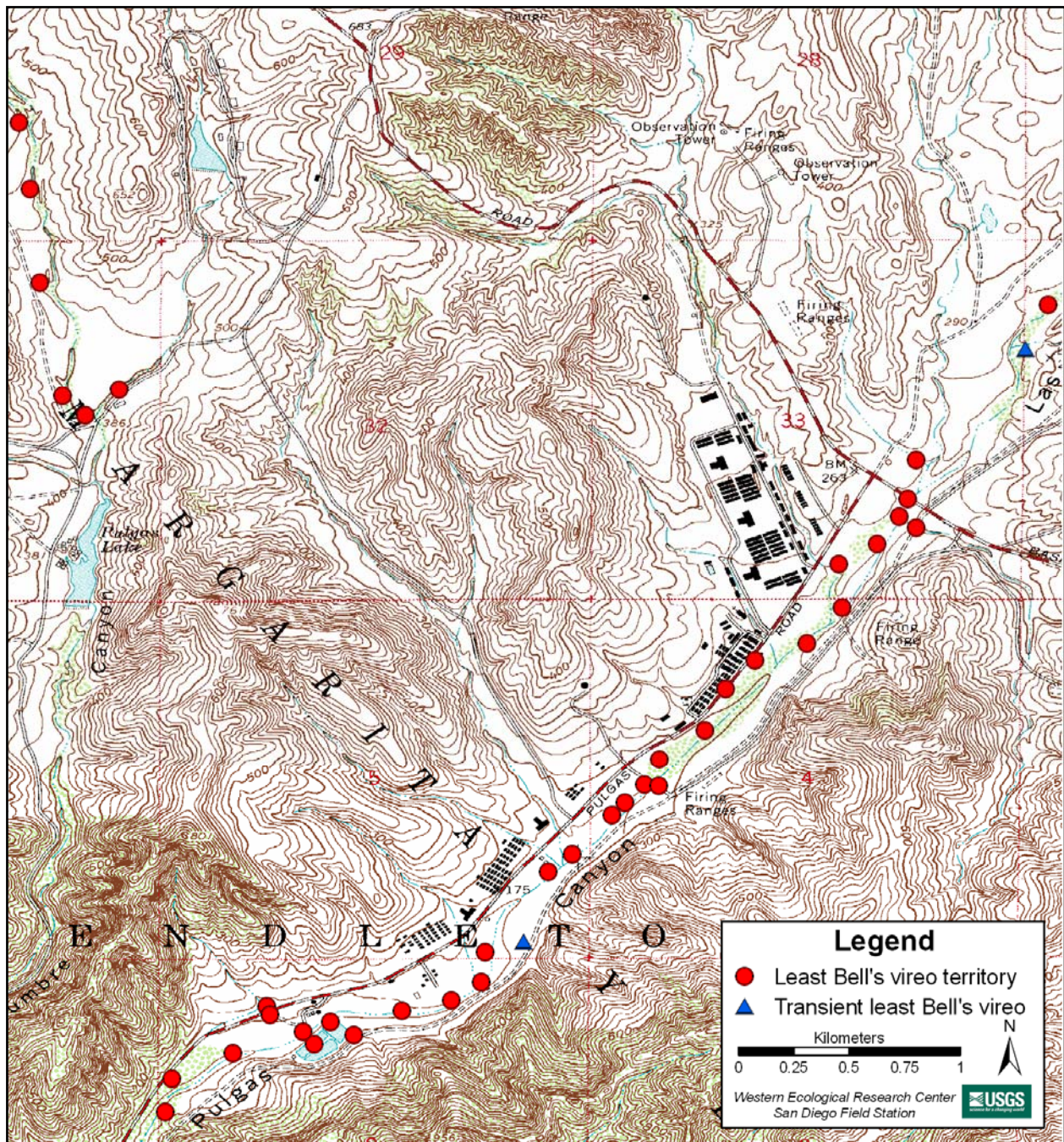


Figure 29. Locations of least Bell's vireos at Marine Corps Base Camp Pendleton, 2007: Piedra de Lumbre Canyon, and Upper Las Flores Creek.

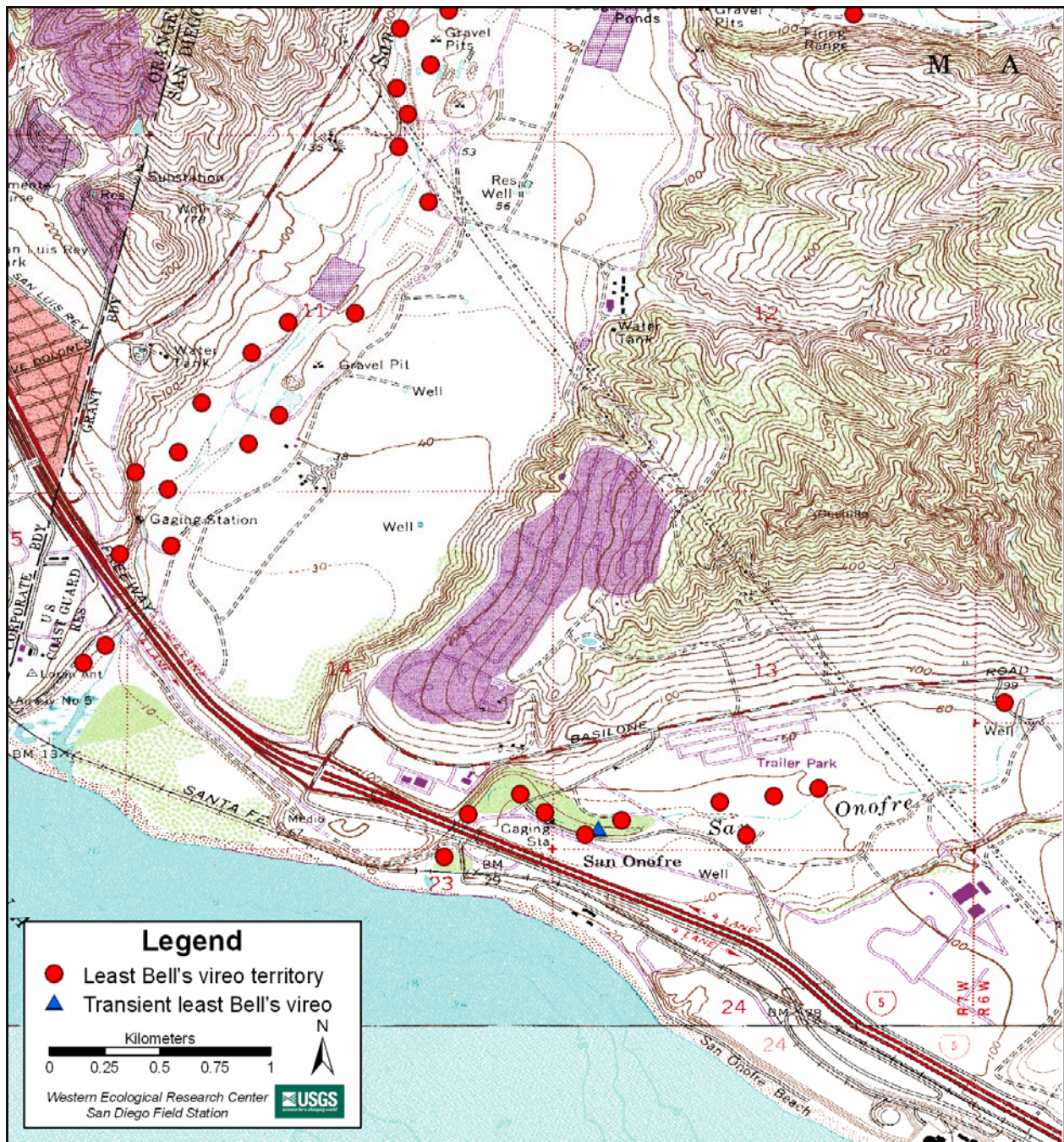


Figure 30. Locations of least Bell's vireos at Marine Corps Base Camp Pendleton, 2007: Lower San Onofre Creek and Lower San Mateo Creek.

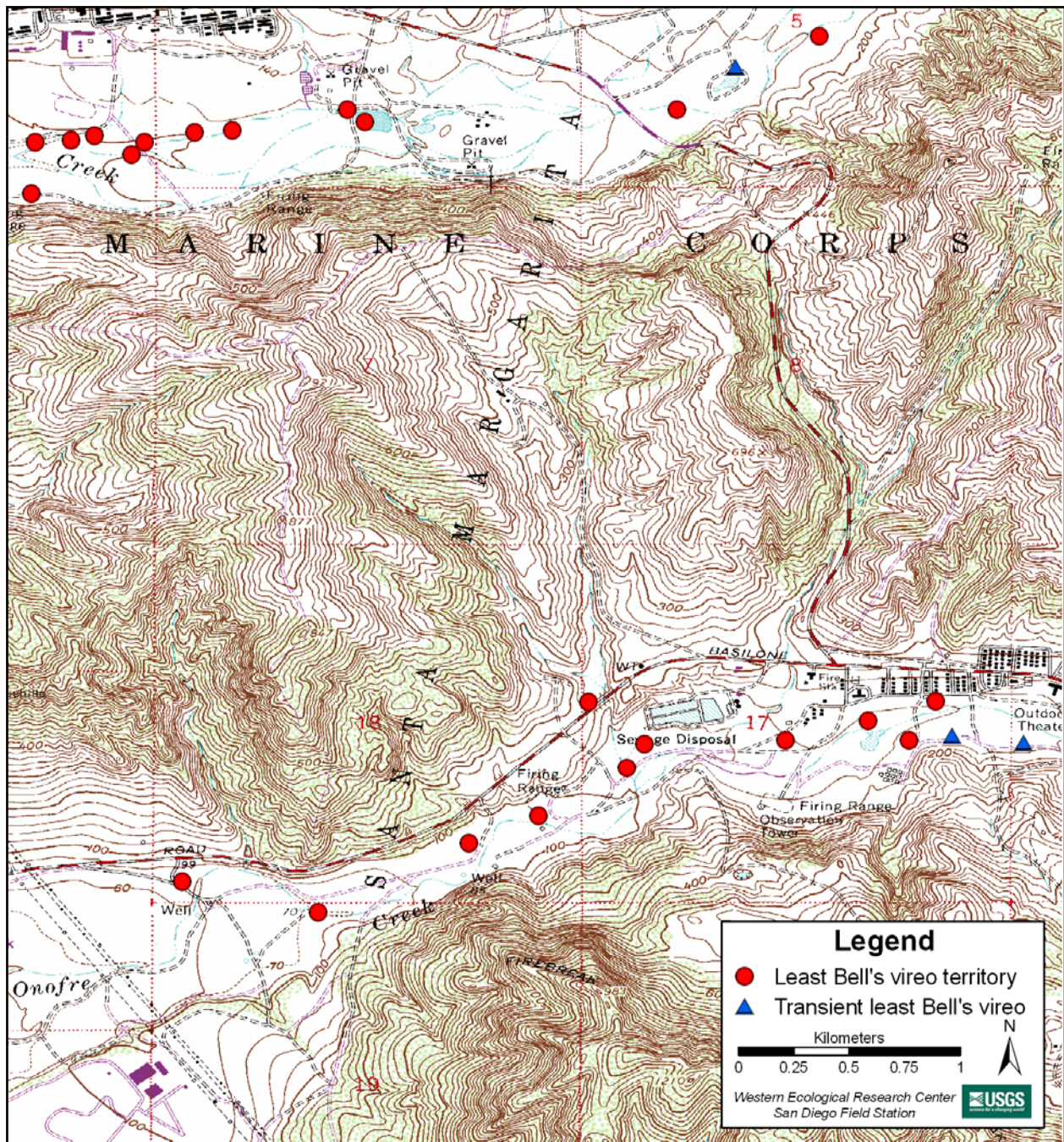


Figure 31. Locations of least Bell's vireos at Marine Corps Base Camp Pendleton, 2007: San Onofre Creek and San Mateo Creek.

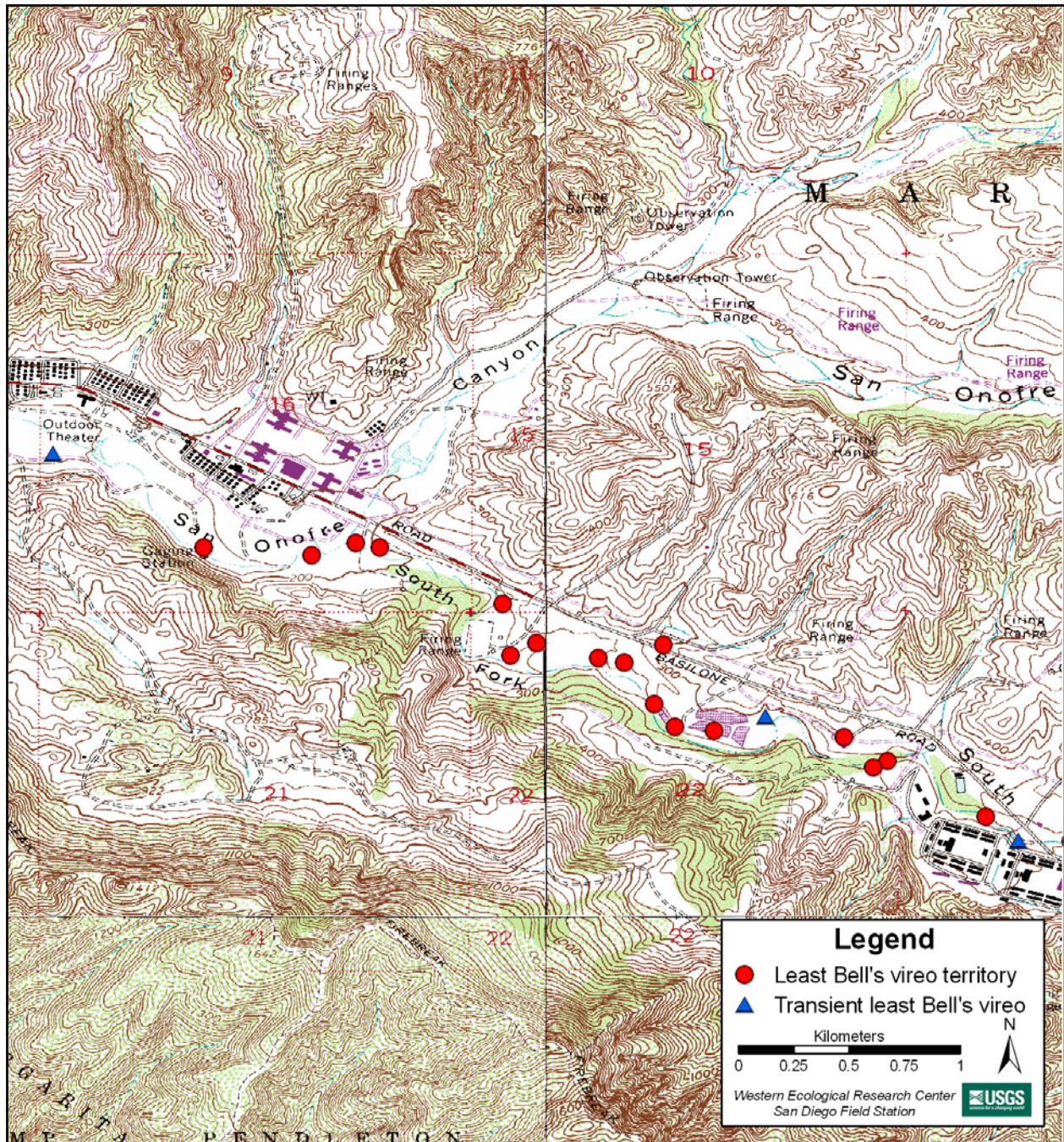


Figure 32. Locations of least Bell's vireos at Marine Corps Base Camp Pendleton, 2007: San Onofre Creek.

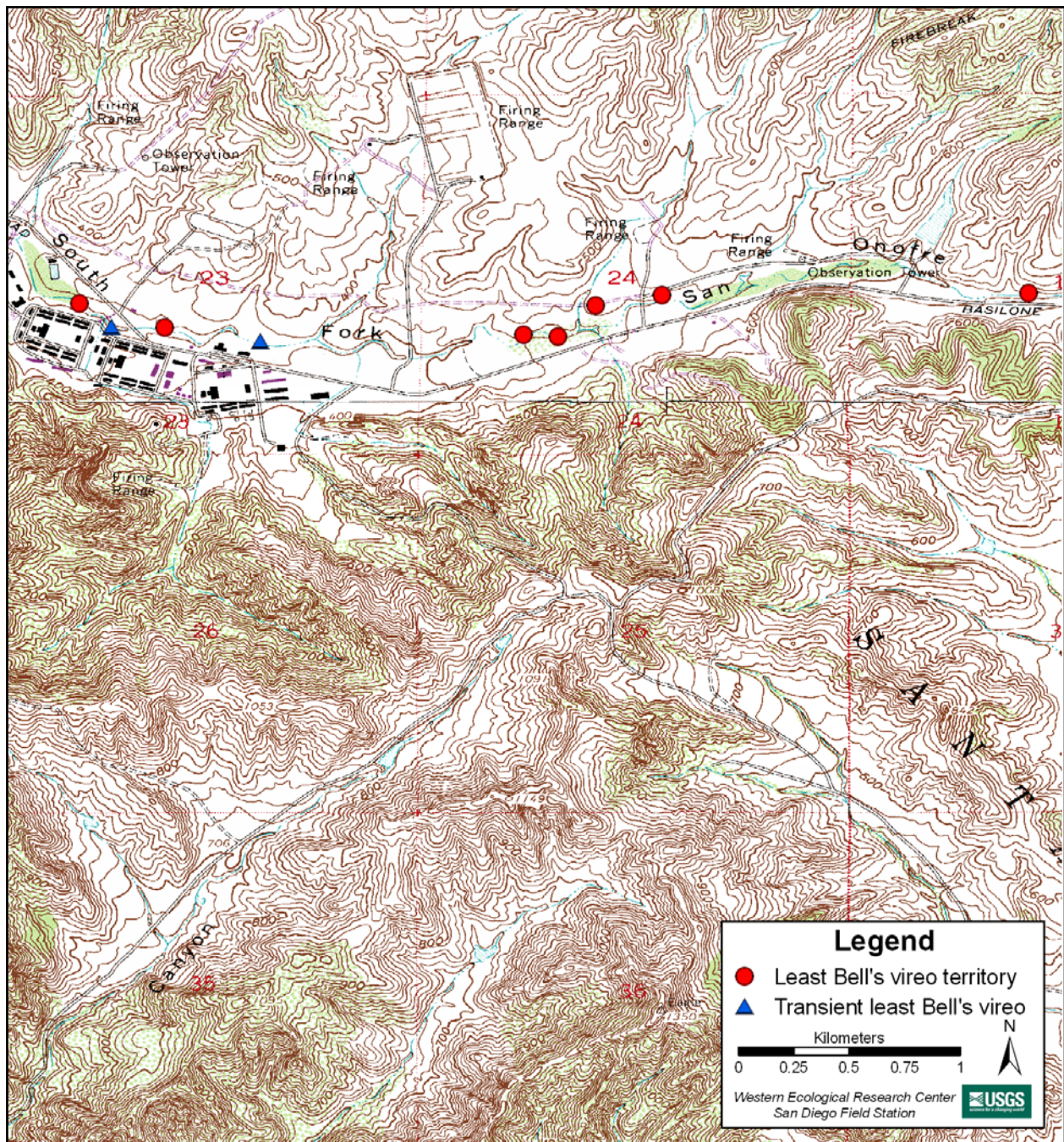


Figure 33. Locations of least Bell's vireos at Marine Corps Base Camp Pendleton, 2007: Upper San Onofre Creek.

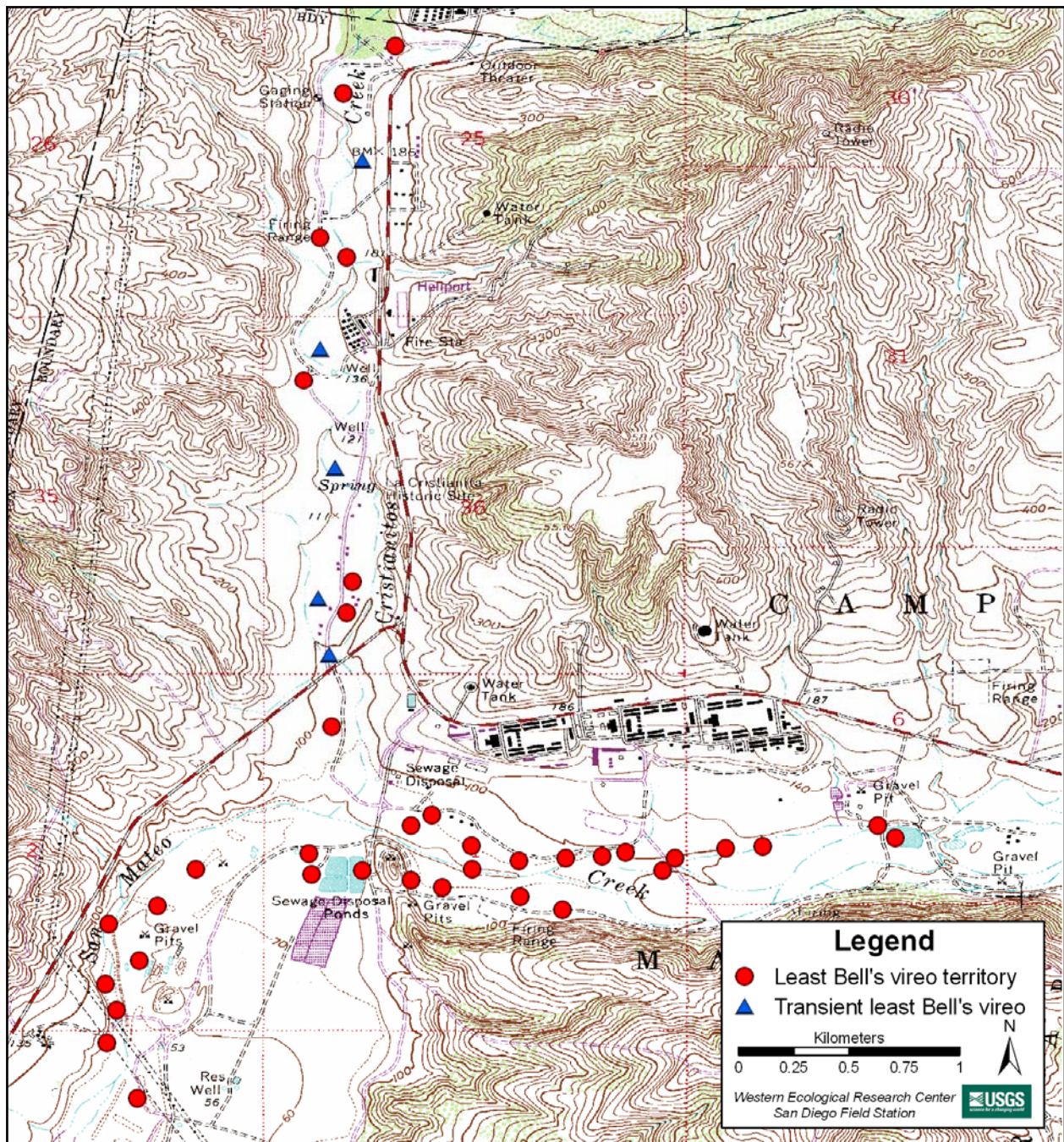


Figure 34. Locations of least Bell's vireos at Marine Corps Base Camp Pendleton, 2007: San Mateo Creek and Cristianitos Creek.

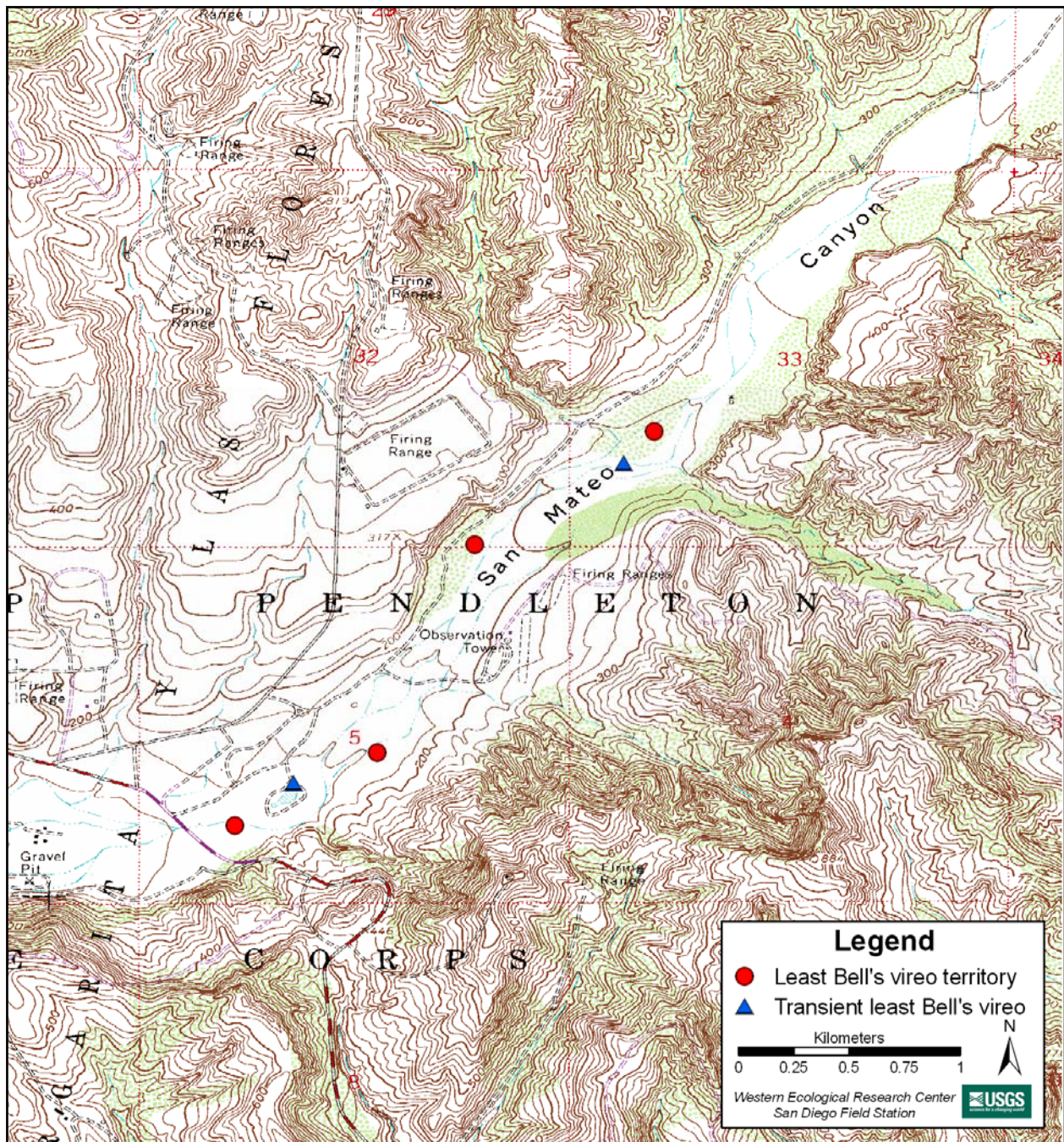


Figure 35. Locations of least Bell's vireos at Marine Corps Base Camp Pendleton, 2007: Upper San Mateo Creek.

APPENDIX C

BANDED LEAST BELL'S VIREOS AT CAMP PENDLETON, 2007

<u>Drainage</u>	<u>Band Combination^a</u>		<u>Age^b</u>	<u>Comments</u>
<u>Sex</u>	<u>Left Leg</u>	<u>Right Leg</u>		
<u>De Luz Creek</u>				
F	gogo	WHPU/Msi	AHY	Banded at the De Luz Creek MAPS Station in 2007 as an adult.
M	LPBK/Msi	gogo	≥ 2 yr	Banded at the De Luz Creek MAPS Station in 2006 as an adult.
M	-	Msi	AHY	Resighted close to De Luz MAPS Station.
U	gogo	OROR/Msi	AHY	Banded at the De Luz Creek MAPS Station in 2007 as an adult.
U	gogo	PUPU/Msi	AHY	Banded at the De Luz Creek MAPS Station in 2007 as an adult.
U	Msi	DPWH/gogo	AHY	Banded at the De Luz Creek MAPS Station in 2007 as an adult.
<u>Las Flores Creek</u>				
M	LPBK/Mgo	pupu	≥ 2 yr	Probable HY when banded in 2005 on the Santa Margarita River.
<u>Pilgrim Creek</u>				
M	Mbk	YEYE	4 yr	Banded off Base on Pilgrim Creek as a nestling in 2003.
M	pupu	OROR/Mgo	AHY	Banded as an adult in 2007 - PS01 territory.
<u>Santa Margarita River</u>				
F	Mdb	WHPU/pupu	1 yr	Banded off Base on the San Luis Rey River as a nestling in 2006.
F	WHPU/Mdb	-	1 yr	Banded off Base on the San Luis Rey River as a nestling in 2006.
F	WHPU/Mgo	pupu	1 yr	Banded as a nestling in 2006 at the Santa Margarita River.
F	DPWH/Mgo	-	≥ 2 yr	Banded as an adult in 2006 at the Santa Margarita River.
F	BKYE	Mdb	≥ 4 yr	Banded off Base on the San Luis Rey River in 2004 as an adult.
F	-	Mdb	AHY	Banded off Base on the San Luis Rey River as a nestling in or before 2005.
F	-	Mgo	AHY	Banded as a nestling in 2005 at Camp Pendleton.
F	-	Mgo	AHY	Banded as a nestling in 2005 at Camp Pendleton.
F	-	Msi	AHY	Resighted just north of De Luz Road on the Santa Margarita River.
F	BKKB/gogo	Msi	AHY	Banded as an adult in 2007 - CAG territory.
F	gogo	PUOR/Msi	AHY	Banded at the Santa Margarita MAPS Station in 2007 as an adult.
F	LPLP/Msi	gogo	AHY	Banded at the Santa Margarita MAPS Station in 2007 as an adult.
F	LPLP/pupu	Mgo	AHY	Banded as an adult in 2007 - HOL territory.
F	Mdb	-	AHY	Banded off Base on the San Luis Rey River as a nestling in or before 2006.
F	Mgo	-	AHY	Banded as a nestling in 2006 at Camp Pendleton.
F	Mgo	-	AHY	Banded as a nestling in 2006 at Camp Pendleton.
F	Mgo	LPLP/pupu	AHY	Banded as an adult in 2007 - ODN territory.
F	ORDG/Mgo	pupu	AHY	Banded as an adult in 2007 - VIC territory.
F	pupu	WHDP/Mgo	AHY	Banded as an adult in 2007 - AER territory.

<u>Drainage</u>	<u>Band Combination^a</u>		<u>Age^b</u>	<u>Comments</u>
<u>Sex</u>	<u>Left Leg</u>	<u>Right Leg</u>		
<u>Santa Margarita River (continued)</u>				
F	PUWH/pupu	Mgo	AHY	Banded at the Santa Margarita MAPS Station in 2007 as an adult.
F	YEYE/gogo	Msi	AHY	Banded at the Santa Margarita MAPS Station in 2007 as an adult.
M	BKLP/Mgo	pupu	1 yr	Banded as a nestling in 2006 at the Santa Margarita River.
M	PUOR/Mgo	pupu	1 yr	Banded as a nestling in 2005 at Santa Margarita River.
M	-	DPDP/Mgo	2 yr	Banded as a nestling in 2005 at the Santa Margarita River.
M	BYST	Mgo	2 yr	Banded as a nestling in 2005 at the Santa Margarita River.
M	BYST/pupu	Mgo	2 yr	Banded as a nestling in 2005 at the Santa Margarita River.
M	gogo	WHWH/Msi	2 yr	Banded as a nestling in 2005 at the Santa Margarita River.
M	OROR/pupu	Mgo	2 yr	Banded as a nestling in 2005 at Santa Margarita River.
M	-	BWST/Mgo	≥ 2 yr	Banded as an adult in 2006 at the Santa Margarita River.
M	-	BYST/Mgo	≥ 2 yr	Banded as an adult in 2006 at the Santa Margarita River.
M	-	OROR/Mgo	≥ 2 yr	Banded as an adult in 2006 at the Santa Margarita River.
M	-	YEPU/Mgo	≥ 2 yr	Banded as an adult in 2006 at the Santa Margarita River.
M	DGOR	Mgo	≥ 2 yr	Banded as an adult in 2006 at the Santa Margarita River.
M	Mgo	PUPU/pupu	≥ 2 yr	Banded as an adult in 2006 at the Santa Margarita River.
M	pupu	BYST/Mgo	≥ 2 yr	Banded as an adult in 2006 at the Santa Margarita River.
M	pupu	LPBK/Mgo	≥ 2 yr	Banded as an adult in 2006 at the Santa Margarita River.
M	pupu	PUWH/Mgo	≥ 2 yr	Banded as an adult in 2006 at the Santa Margarita River.
M	pupu	WHWH/Mgo	≥ 2 yr	Banded as an adult in 2006 at the Santa Margarita River.
M	PUPU/pupu	Mgo	≥ 2 yr	Banded as an adult in 2006 at the Santa Margarita River.
M	-	PUPU/Mgo	≥ 3 yr	Banded as an adult in 2005 at the Santa Margarita River.
M	DGOR/Mgo	pupu	≥ 3 yr	Banded as an adult in 2005 at the Santa Margarita River.
M	Mgo	DPWH/pupu	≥ 3 yr	Banded as an adult in 2005 at the Santa Margarita River.
M	Mgo	LPBK/pupu	≥ 3 yr	Banded as an adult in 2005 at the Santa Margarita River.
M	Mgo	PUWH/pupu	≥ 3 yr	Banded as an adult in 2005 at the Santa Margarita River.
M	OROR/Msi	pupu	≥ 3 yr	Banded as an adult in 2005 at the Santa Margarita River.
M	ORPU/Msi	pupu	≥ 3 yr	Banded as an adult in 2005 at the Santa Margarita River.
M	PUWH/Mgo	pupu	≥ 3 yr	Banded as an adult in 2005 at the Santa Margarita River.
M	YEPU/Mgo	-	≥ 3 yr	Banded as an adult in 2005 at the Santa Margarita River.
M	-	DGOR/Mgo	≥ 9 yr	Banded at the Santa Margarita MAPS Station in 1998 as an adult.
M	-	Mgo	AHY	Banded as a nestling in 2005 at Camp Pendleton.
M	-	Mgo	AHY	Banded as a nestling in 2005 at Camp Pendleton.
M	-	Msi	AHY	Resighted close to Santa Margarita MAPS Station.
M	-	PUOR/Msi	AHY	Banded as an adult in 2007 - MIK territory.
M	PUWH/Mgo	-	AHY	Banded in 2007 by Fallbrook Naval Weapons Station personnel
M	WHWH/Mgo	-	AHY	Banded in 2007 by Fallbrook Naval Weapons Station personnel

Drainage	Band Combination^a		Age^b	Comments
Sex	Left Leg	Right Leg		
<u>Santa Margarita River</u> (<i>continued</i>)				
M	DPDP/pupu	Mgo	AHY	Banded at the Santa Margarita MAPS Station in 2007 as an adult.
M	gogo	LPBK/Msi	AHY	Banded as an adult in 2007 - HE17 territory.
M	LPBK/pupu	Mgo	AHY	Banded at the Santa Margarita MAPS Station in 2007 as an adult.
M	Mdb	-	AHY	Banded off Base on the San Luis Rey River as a nestling in or before 2006.
M	Mdb	-	AHY	Banded off Base on the San Luis Rey River as a nestling in or before 2006.
M	Mgo	-	AHY	Banded as a nestling in 2006 at Camp Pendleton.
M	Mgo	-	AHY	Banded as a nestling in 2006 at Camp Pendleton.
M	Mgo	-	AHY	Banded as a nestling in 2006 at Camp Pendleton.
M	Mgo	BYST/pupu	AHY	Banded as an adult in 2007 - HRP territory.
M	Mgo	OROR/pupu	AHY	Banded as an adult in 2007 - ARH territory.
M	Mgo	WHWH	AHY	Banded in 2007 by Fallbrook Naval Weapons Station personnel
M	Mgo	WHWH/pupu	AHY	Banded as an adult in 2007 - QIN territory.
M	Msi	DPDP/gogo	AHY	Banded as an adult in 2007 - ATT territory.
M	PUOR/Msi	gogo	AHY	Banded as an adult in 2007 - LAP territory.
M	pupu	BKBK/Mgo	AHY	Banded as an adult in 2007 - IND territory.
M	pupu	BKLP/Mgo	AHY	Banded as an adult in 2007 - ANA territory.
M	pupu	PUPU/Mgo	AHY	Banded as an adult in 2007 - VIC territory.
M	pupu	PUYE/Mgo	AHY	Banded as an adult in 2007 - HE26 territory.
M	WHDP/Mgo	pupu	AHY	Banded as an adult in 2007 - BOW territory.
M	WHPU/Mgo	-	AHY	Banded as an adult in 2007 - ANI territory.
M	WHWH/Msi	gogo	AHY	Banded as an adult in 2007 - HOL territory.
M	YEYE/Mgo	-	AHY	Banded in 2007 by Fallbrook Naval Weapons Station personnel
M	YEYE/Msi	gogo	AHY	Banded as an adult in 2007 - LIF territory.
U	Msi	YEYE/gogo	HY	Banded at the Santa Margarita MAPS Station in 2007.
U	OROR/Msi	-	HY	2007 juvenile, caught while target netting adult in HE24 territory.
U	pupu	ORPU/Mgo	HY	2007 juvenile, caught while target netting adult in ODN territory.
U	pupu	WHPU/Mgo	HY	2007 juvenile, caught while target netting adult in LIF territory.
U	PUPU/gogo	Mgo	HY	2007 juvenile from CHE territory, recaptured at Santa Margarita MAPS and color banded.
U	DPWH/Msi	gogo	AHY	Banded at the Santa Margarita MAPS Station in 2007 as an adult.
U	gogo	PUWH/Msi	AHY	Banded at the Santa Margarita MAPS Station in 2007 as an adult.
U	gogo	PUYE/Msi	AHY	Banded at the Santa Margarita MAPS Station in 2007 as an adult.
U	Mgo	ORPU/pupu	AHY	Banded at the Santa Margarita MAPS Station in 2007 as an adult.

<u>Drainage</u>	<u>Band Combination^a</u>		<u>Age^b</u>	<u>Comments</u>
<u>Sex</u>	<u>Left Leg</u>	<u>Right Leg</u>		
<u>Santa Margarita River</u> (<i>continued</i>)				
U	WHDP/Msi	gogo	AHY	Banded as an adult in 2007 - ANI territory.
U	WHWH/gogo	Msi	AHY	Banded at the Santa Margarita MAPS Station in 2007 as an adult.
<u>Windmill Canyon</u>				
F	Mdb	-	AHY	Banded off Base on the San Luis Rey River as a nestling in or before 2006.

^a Band colors: Mdb = dark blue numbered federal band; MbK = black numbered federal band; Mgo = gold numbered federal band; Msi = silver numbered federal band; gogo = metal gold; BKBK = plastic black; BKLP = plastic black-light pink split; BKYE = plastic black-yellow split; BWST = plastic blue-white striped; BYST = plastic black-yellow striped; DGOR = plastic dark green-orange split; DPDP = plastic dark pink; DPWH = plastic dark pink-white split; LPBK = plastic light pink-black split; LPLP = plastic light pink; ORDG = plastic orange-dark green split; OROR = plastic orange; ORPU = plastic orange-purple split; PUOR = plastic purple-orange split; PUPU = plastic purple; pupu = metal purple; PUWH = plastic purple-white split; PUYE = plastic purple-yellow split; WHDP = plastic white-dark pink split; WHPU = plastic white-purple split; WHWH = plastic white; YEPU = plastic yellow-purple split; YEYE = plastic yellow.

^b Age: AHY = after hatch-year, HY = hatch-year.

APPENDIX D

STATUS AND NESTING ACTIVITIES OF LEAST BELL'S VIREOS AT MARINE CORPS BASE CAMP PENDLETON, 2007

Reference Site Territories					
Territory	Nest	Monitoring ^a	Nest Fate ^b	#Fledged	Comments
APO	1	F	SUC	2	
ARI	1	F	PRE	0	
	2		SUC	2	
BEK	1	F	PRE	0	
	2		PRE	0	
	3		SUC	3	
BER	1	F	INC	0	Nest building was initiated, but the nest was never completed.
	2		SUC	2	
BOW	1	F	INC	0	Nest building was initiated, but the nest was never completed.
	2		PRE	0	
	3		SUC	3	
CED	1	F	SUC	3	
	2		SUC	3	
DAT	1	F	PRE	0	Nest building was initiated, but the nest was never completed.
	2		INC	0	
	3		PRE	0	
DEL	1	F	INC	0	Nest building was initiated, but the nest was never completed.
	2		PRE	0	
	3		UNK	0	
	4		PRE	0	
DEU	1	F	UNK	0	Cause of failure unknown.
	2		SUC	4	
	3		UNK	0	
DRK	1	F	PRE	0	
	2		SUC	3	
FAU	1	F	SUC	3	
	2		PRE	0	
FIN	1	F	INC	0	Nest building was initiated, but the nest was never completed.
	2		PRE	0	
	3		SUC	1	
HRP	1	F	SUC	1	
	2		SUC	2	
HE37	1	P	SUC	3	
HRB	1	F	SUC	2	
HLD	1	F	PRE	0	
	2		SUC	3	
HOL	1	F	PRE	0	
	2		PRE	0	
	3		PRE	0	
	4		SUC	3	
HTI	1	F	OTH	0	Probable cause of nest failure: infertile eggs.
	2		SUC	2	

Reference Site Territories (<i>continued</i>)					
Territory	Nest	Monitoring ^a	Nest Fate ^b	#Fledged	Comments
LIF	1	F	UNK	0	Cause of failure unknown.
	2		SUC	4	
MIK	1	F	PRE	0	
	2		SUC	4	
OCM	1	F	PRE	0	Cause of failure unknown.
	2		PRE	0	
	3		UNK	0	
	4		SUC	3	
ODN	1	F	PRE	0	Nest was poorly constructed and detached from host plant dumping eggs onto the ground.
	2		SUC	3	
	3		OTH	0	
QIN	1	F	PRE	0	
	2		PRE	0	
	3		SUC	3	
ZPR	1	F	SUC	4	
	2		SUC	3	
<i>Arundo donax</i> Removal Site Territories					
ABB	1	F	SUC	2	
	2		SUC	3	
AER	1	F	OTH	0	Probable cause of nest failure: infertile eggs. Nest building was initiated, but the nest was never completed.
	2		INC	0	
	3		SUC	3	
ARS	1	F	SUC	3	
	2		PRE	0	
ALI	1	F	PRE	0	
	2		SUC	3	
ALC	1	F	OTH	0	Possible ant predation. The skeletons of two nestlings were found in the nest, which had been alive and healthy four days prior. Nest building was initiated, but the nest was never completed.
	2		INC	0	
	3		INC	0	
	4		SUC	2	
ANA	1	F	INC	0	Nest building was initiated, but the nest was never completed.
	2		PRE	0	
	3		SUC	2	
ANI	1	F	PRE	0	
	2		SUC	4	
ARH	1	F	PRE	0	
	2		SUC	4	
AST	1	F	PRE	0	
	2		SUC	3	
ATK	1	F	SUC	1	

<i>Arundo donax</i> Removal Territories (continued)					
Territory	Nest	Monitoring ^a	Nest Fate ^b	#Fledged	Comments
ATT	1	P	SUC	3	
CAG	1	F	SUC	3	
CHE	1	F	PRE	0	
	2		SUC	3	
CZN	1	F	PRE	0	
	2		SUC	4	
FNR	1	F	PRE	0	
	2		PRE	0	
	3		PRE	0	
IND	1	F	PRE	0	
	2		SUC	3	
LAP	1	F	PRE	0	
	2		PRE	0	
LIA	1	F	SUC	3	
LND	1	F	PRE	0	
ORN	1	F	PRE	0	
	2		SUC	1	
SNP	1	F	PRE	0	
	2		SUC	2	
VEG	1	F	PRE	0	
	2		PRE	0	
	3		SUC	3	
VIC	1	F	PRE	0	
	2		INC	0	Nest building was initiated, but the nest was never completed.
	3		SUC	3	
WNS	1	F	PRE	0	
	2		SUC	3	

^a Monitoring: F = fully monitored territory; P = partially monitored territory.

^b Nest Fate: Nest fate: INC = nest never completed; SUC = fledged at least one least Bell's vireo young; PRE = nest failure caused by predation; PAR = failure/abandonment caused by brown-headed cowbird parasitism; OTH = reason for nest failure known, such as substrate failure; UNK = reason for nest failure/abandonment unknown.