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

2009 Annual Report

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 Suellen Lynn and Barbara E. Kus

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## EXECUTIVE SUMMARY

Surveys for the endangered Least Bell's Vireo (*Vireo bellii pusillus*) were conducted at Marine Corps Base Camp Pendleton, California, between 30 March and 6 July 2009. Drainages containing riparian habitat suitable for vireos were surveyed two to seven times. One thousand and thirteen territorial male vireos and 74 transient vireos were detected on 22 out of the 23 drainages/sites surveyed. Ninety-six percent of all vireo territories occurred on the ten most populated drainages, with the Santa Margarita River containing 58% of all territories on Base. Seventy percent of male vireos were confirmed as paired.

In 2009, the number of documented Least Bell's Vireo territories (1,013) exceeded the greatest recorded number of vireo territories on Marine Corps Base Camp Pendleton over the past 14 years. The number of territories on 78% (18/23) of drainages surveyed increased from 2008 and the remaining five drainages showed no change or decreased by two or fewer territories. Overall, the vireo population on Base increased by 37% from 2008 to 2009.

The majority of vireo territories occurred in habitat characterized as Willow Riparian, with 55% of males in the study area found in this habitat. An additional 8% of birds occupied willow (*Salix* spp.) habitat co-dominated by cottonwoods (*Populus fremontii*) or sycamores (*Platanus racemosa*). Twenty-nine percent of territories were found in Riparian Scrub, dominated by mule fat (*Baccharis salicifolia*) and/or sandbar willow (*S. exigua*). Seven percent of the vireos used drier habitats including areas dominated by a mix of sycamores and oaks (*Quercus agrifolia*; 2% of total) or upland vegetation (5%). Approximately 1% of vireo territories were placed in habitat dominated by non-native vegetation.

Three hundred and thirty-six Least Bell's Vireos were banded during the 2009 season. These included 117 adult vireos, 218 hatch-year vireos, and 1 vireo of unknown age. The 117 adult vireos, 1 vireo of unknown age, and 18 hatch-year birds were banded with unique color combinations. The remaining 200 birds were nestlings, banded with a single gold numbered federal band on the right leg. One hundred and fifty-six Least Bell's Vireos banded prior to the 2009 breeding season were resighted on Base in 2009. Eighteen of these were originally banded off Base, 17 on the San Luis Rey River and 1 on the San Diego River. Adult birds of known age ranged from 1-5 years old. Adult survivorship, or the proportion of individuals known to survive from 2008 to 2009, was 53% (81/152). Survivorship of first-year birds fledged from Marine Corps Base Camp Pendleton in 2008 and documented on Base or elsewhere in 2009 was 10% (22/229), based on the number of uniquely banded individuals. First-year survivorship may be as high as 14% (31/229) if we include birds with single gold federal bands that may have fledged in 2008 but were not recaptured to confirm fledge year. Of the 22 uniquely color banded first-year birds detected, 20 were male.

The majority of returning adult vireos showed strong between-year site fidelity. Overall vireo territory fidelity between 2008 and 2009 was 85% (45/53). The average between-year movement for returning adult vireos was 0.1 ± 0.2 km (SD). Dispersal distance of first-year vireos fledged from Marine Corps Base Camp Pendleton nests ranged from 0.7-5.3 km. Five first-year vireos that fledged from nests on the San Luis Rey River (one female and four males) and one male that fledged from a nest on the San Diego River in 2008 were documented on Base. Overall, the average distance first-year vireos dispersed was 5.4 ± 11.4 km (SD).

Adult survivorship of vireos on giant reed (*Arundo donax*) Removal sites and Reference sites was 52% and 51%, respectively. First-year survivorship was 6% and 13%, respectively. One hundred percent of adults at Removal sites and 95% at Reference sites returned in 2009 to the same territory occupied in 2008. One 2008 male nestling from a Removal site returned to a Removal site in 2009, and seven nestlings (six males and one female) from Removal sites dispersed outside of monitoring sites. Four 2008 male nestlings from Reference sites returned to Reference sites in 2009, and nine nestling (eight males and one female) from Reference sites dispersed outside of monitoring sites in 2009.

Several vireos moved between drainages to their 2009 sites. In addition to the 18 vireos that moved from other areas to Marine Corps Base Camp Pendleton (17 vireos were originally banded on the San Luis Rey River and 1 vireo originally banded on the San Diego River), 4 adults and 1 juvenile moved from Marine Corps Base Camp Pendleton and were detected elsewhere. Two females that were detected breeding on the San Luis Rey River, one male detected breeding at Sweetwater Reservoir, and one male was detected breeding on the San Gabriel River in Los Angeles County. The juvenile was detected in September, 2009, in Los Osos, California, near Morro Bay.

Nesting activity was monitored in 51 territories within four giant reed Removal and Reference monitoring areas. A total of 120 nests were monitored during the breeding season; however, 11 of these were not completed and were excluded from calculations of nest success and productivity.

The majority of pairs attempted to re-nest after their first nesting attempt in 2009, regardless of the outcome of their first nesting attempt. Fifty percent of pairs at Removal sites and 9% of pairs at Reference sites fledged young from two nests in 2009. There was no difference in timing of first nesting attempts at Removal and Reference sites, although the first nests overall in 2009 were initiated earlier than in all previous years except 2008.

Nest success was higher for pairs breeding in Removal sites compared to Reference sites. Seventy-three percent (37/51) of Removal nests and 38% (22/58) of Reference nests successfully fledged young. First nesting attempts were more likely to be successful at Removal sites (71%) than at Reference sites (30%), and the 51% of successful nest attempts in 2009 was higher than in all previous years except 2008. Predation was believed to be the primary source of nest failure at both sites. Predation accounted for 43% (6/14) and 97% (35/36) of nest failures at Removal and Reference sites, respectively. Potential causes of nest failure at other nests included failure of support branches, infertile eggs, and disturbance-related abandonment. No nest parasitism of Least Bell's Vireos by Brown-Headed Cowbirds (*Molothrus ater*) was documented. Overall, most productivity measures of Least Bell's Vireos nesting at Removal and Reference sites were similar. In 2009, average clutch size and the number of young fledged per pair were not statistically different between Removal and Reference sites. However, hatching success was significantly higher at Removal sites than at Reference sites in 2009. When data from 2005-2009 were analyzed, a significant year effect was found, with the average clutch size significantly higher in 2005 and 2008 than in 2007, and average number of young fledged per pair significantly higher in 2008 than in all other years, and significantly higher in 2009 than in 2006. Additionally, treatment and year interacted significantly so that the average number of

young fledged per pair at Removal sites was significantly higher in 2008 and 2009 but not in other years. Daily nest survival was consistently higher at Removal sites, except for in 2007. From these analyses, it is evident that the removal of giant reed did not negatively affect vireo breeding productivity.

Density of vireo territories increased at both Removal and Reference sites in 2009. Density at Removal sites was lowest in 2002, during and immediately following giant reed removal, and has increased since then to peak in 2009.

Primary productivity and the types of prey consumed by vireos have been shown to vary with annual precipitation (Cody 1981, Grant and Grant 1987). However, we found that annual precipitation, and by association primary productivity and prey abundance, did not affect vireo productivity between 2005 and 2009, and thus did not explain the annual differences we observed. In 2008, we found that annual precipitation was positively associated with the total number of vireo territories on Marine Corps Base Camp Pendleton during the subsequent breeding season. However, in 2009, this relationship was no longer significant.

In 2009, successful and unsuccessful nests within Removal and Reference sites did not differ statistically in average nest height or distance to the edge of the nest clump. Unlike at Reference sites, successful nests at Removal sites were placed in shorter trees and were closer to the edge of the nest host and the edge of the riparian than unsuccessful nests. Overall, vireo nests at Removal sites were placed significantly higher above ground, in taller host plants, and built further from the edge of the host plant, further from the edge of the nest clump, and further from the edge of the riparian vegetation than nests at Reference sites, possibly reflecting the available host species at these sites. Sixteen plant species were used as hosts for vireo nests in 2009. Seventy-four percent of nests were placed in arroyo willow (*S. lasiolepis*), sandbar willow, and mule fat.

Recent stability and the substantial increase in the vireo population over the past year on Marine Corps Base Camp Pendleton generally reflect similar population trends on the nearby San Luis Rey River. The general increase in the Marine Corps Base Camp Pendleton vireo population from 2008 to 2009 is reflected in increases throughout most of the drainages on Marine Corps Base Camp Pendleton, including re-occupation of drainages that had not been occupied recently. This general increase swamped the effect of previously suggested redistribution of the vireo population reflecting changing conditions at different sites. Re-occupation of drainages after years when they were vacant likely is driven by dispersal of young vireos. Vireos moved between Marine Corps Base Camp Pendleton and surrounding drainages, most frequently detected moving from the San Luis Rey River to Marine Corps Base Camp Pendleton. Vireos from Marine Corps Base Camp Pendleton were detected on the San Luis Rey River, the San Diego River, and the Sweetwater Reservoir.

Productivity in general was high in 2009, although not as high as in 2008. This high productivity was possibly associated with an early commencement of the breeding season coupled with high success rate of first nests. This increase in productivity was also evident in the lower San Luis Rey vireo population. Assuming that Removal and Reference sites were equal in all characteristics except for our test variable (the timing of giant reed removal), it may be

concluded that Removal sites were at least comparable in quality to Reference sites with respect to vireo breeding habitat.

Vireo density decreased at Removal sites immediately following intensive giant reed removal, most likely in response to decreased understory structure caused by the removal of giant reed. We saw an increase in vireo breeding productivity (clutch size and number of young fledged per pair) in the past two years, indicating that vireo habitat is in the process of or had recovered to pre-giant reed removal quality.

Nest site characteristics did not differ greatly between successful and unsuccessful nests, either at Removal sites or at Reference sites. We did not measure available habitat characteristics, but it is possible that the selection of host plants reflects the presence of more large trees at Removal sites.

## 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 1900s 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, and the U.S. Fish and Wildlife Service followed 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 from exposed perches throughout the breeding season. 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. Clutch size for Least Bell's Vireos averages 3-4 eggs. Typically, the female and male incubate the eggs for 14 days, and young fledge 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 Least 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 giant reed removal on vireo fecundity, nest success, and productivity by intensively monitoring vireos within established nest monitoring sites that had recently undergone giant reed removal and at reference sites in which giant reed had been removed 10-12 years earlier, between 1997 and 1999.

In October and November 2007, wildfires burned a substantial portion of several drainages on Marine Corps Base Camp Pendleton, including Aliso Canyon, Las Flores Creek,

Horno Canyon, Piedra de Lumbre Canyon, San Onofre Creek, and sections of the Santa Margarita River, and in October 2008, a wildfire burned a section of the Pilgrim Creek drainage (Fig. 1). While this project did not include a specific study design to determine the effects of fire on vireos, these data may be used to track vireo response to the fire and post-fire habitat recovery. When combined with data from other years, these data will inform natural resource managers about the status of this endangered species at Marine Corps Base 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 Marine Corps Base Camp Pendleton's major drainages, and several minor ones supporting riparian habitat, were surveyed for vireos between 30 March and 6 July 2009 (Fig. 1). Field work was conducted by Katie Allen, Arlene Arnold, Melissa Blundell, Travis Cooper, Aaron Gallagher, Scarlett Howell, Barbara Kus, Suellen Lynn, Melanie Madden-Smith, Eric Nolte, Ryan Pottinger, Jeff Ritterson, Michelle Rogne, Michael Wellik, and David Wilamowski. 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, Figs. 18 and 19).
   b. From the confluence with De Luz Creek upstream 1.3 km to the Fallbrook Naval Weapons Station (FNWS) boundary, a 7 km section of shared boundary with FNWS, and then upstream 2.3 km to the Base boundary (Appendix A, Fig. 18).

2. ***De Luz Creek,*** between the confluence with the Santa Margarita River and the Base boundary (Appendix A, Fig. 18).

3. ***Roblar Creek,*** approximately 1.6 km of stream beginning approximately 1 km upstream of the confluence with De Luz Creek and ending at the gate to 409 Impact Area (Appendix A, Fig. 18).

4. ***Lake O'Neill/Fallbrook Creek:***
   a. All riparian habitat around Lake O'Neill (Appendix A, Fig. 18).
   b. Between Lake O'Neill and the Base boundary with FNWS (Appendix A, Fig. 18).

5. ***Basilone and Roblar Roads,*** a small patch of habitat straddling Basilone Road at the intersection of Basilone and Roblar Roads (Appendix A, Fig. 18).

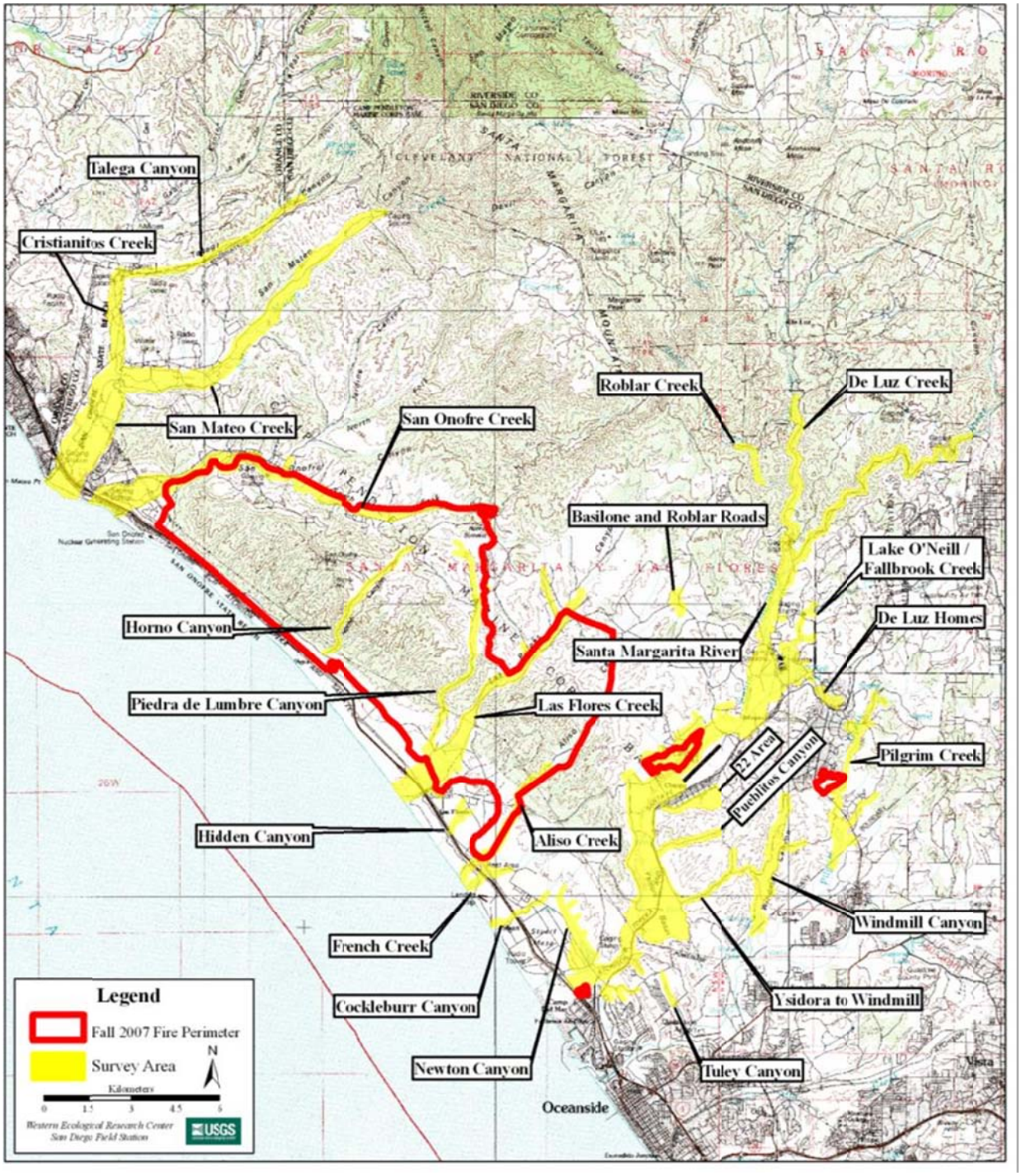


Fig. 1. Least Bell's Vireo survey areas and the Fall 2007 fire perimeter at Marine Corps Base Camp Pendleton, 2009.

6. ***22 Area,*** all riparian habitat within the 22 Area, east of Vandegrift Road and the Supply Depot (Appendix A, Fig. 19).

7. ***Pueblitos Canyon,*** between Vandegrift Road and a point approximately 2.5 km upstream (Appendix A, Fig. 19).

8. ***Tuley Canyon,*** between the Base boundary and a point approximately 1.1 km upstream (Appendix A, Fig. 19).

9. ***Newton Canyon,*** between the confluence with the Santa Margarita River and the upstream limit of riparian habitat (Appendix A, Fig. 19).

10. ***Cockleburr Canyon,*** between the Pacific Ocean and a point 0.25 km east of Interstate 5 (Appendix A, Fig. 19).

11. ***French Creek,*** between the Pacific Ocean and the Edson Range Impact Area (Appendix A, Fig. 19).

12. ***Aliso Creek,*** between the Pacific Ocean and 0.5 km upstream of the electrical transmission lines (Appendix A, Fig. 19).

13. ***Hidden Canyon,*** between Interstate 5 and Stuart Mesa Road (Appendix A, Fig. 20).

14. ***Las Flores Creek (within Las Pulgas Canyon):***
    a. Between Stuart Mesa Road and the high voltage electrical transmission lines (Appendix A, Fig. 20).
    b. Between the Pacific Ocean and Stuart Mesa Road (Appendix A, Fig. 20).
    c. From the high voltage electrical transmission lines upstream to the Zulu Impact Area, approximately 0.75 km upstream of Basilone Road (Appendix A, Fig. 20).

15. ***Piedra de Lumbre Canyon,*** between the confluence with Las Flores Creek and the upstream limit of riparian habitat, approximately 2.7 km upstream of Las Pulgas Lake (Appendix A, Fig. 20).

16. ***Horno Canyon,*** between Old Highway 101 and the upstream limit of riparian habitat (Appendix A, Fig. 20).

17. ***San Onofre Creek:***
    a. From the Pacific Ocean to the south fork/north fork confluence, and upstream on the south fork to Basilone Road (Appendix A, Figs. 20 and 21).
    b. From Basilone Road upstream to the access road to Range 219 (Appendix A, Fig. 20).

18. ***San Mateo Creek:***
    a. 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, Fig. 21).
    b. From San Mateo Road upstream to the Base boundary (Appendix A, Figs. 21 and 22).

***19. Cristianitos Creek,*** between the confluence with San Mateo Creek and the Base boundary (Appendix A, Fig. 21).

***20. Talega Canyon,*** between the confluence with Cristianitos Creek and a point approximately 6.5 km upstream (Appendix A, Fig. 21).

***21. Pilgrim Creek:***

a. Between the southern Base boundary and Vandegrift Boulevard, including the two side drainages east of Pilgrim Creek (Appendix A, Fig. 23).
b. From Vandegrift Boulevard upstream to the limit of riparian habitat (Appendix A, Fig. 23).

***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, Fig. 23).

***23. Ysidora Basin to Windmill Canyon,*** between Upper Ysidora Basin and Windmill Canyon/ Pueblitos Canyon (Appendix A, Fig. 23).

***24. De Luz Homes Habitat,*** patches of habitat adjacent to the De Luz Homes development (Appendix A, Fig. 23).

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 and 4b), Las Flores Creek (14a and 14c), and Pilgrim Creek (21a). Sites surveyed six times included: De Luz Creek, Roblar Creek, Aliso Creek, Las Flores Creek (14b), San Onofre Creek (17a), San Mateo Creek (18a), Cristianitos Creek, and Cockleburr Canyon. Sites surveyed three times were: Basilone and Roblar Roads, 22 Area, Pueblitos Canyon, Newton Canyon, French Creek, Hidden Canyon, Horno 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. The upper portion of the Santa Margarita River (1b), Tuley Canyon, and Talega Canyon were surveyed twice for vireos.

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 black willow (*Salix gooddingii*), arroyo willow (*S. lasiolepis*), and red willow (*S. laevigata*), with mule fat (*Baccharis salicifolia*) as a frequent co-dominant.

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

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

***Sycamore-oak***: Woodlands in which sycamore and oak (*Quercus agrifolia*) occur as co-dominants.

***Riparian scrub***: Dry and/or sandy habitat dominated by sandbar willow (*S. exigua*) or mule fat, 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 giant reed and salt-cedar (*Tamarix ramosissima*).

**Nest Monitoring**

We monitored Least Bell's Vireo nests to evaluate the effects of giant reed removal on nest success and productivity. Giant reed is a highly invasive, non-native plant within riparian systems in southern California. Originally introduced for bank stabilization in the 1800s, giant reed 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 giant reed on the Santa Margarita River. Areas that have recently undergone giant reed 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 mule fat, sandbar willow, black willow, arroyo willow, and red willow. We monitored vireos within four established monitoring areas: two sites

in areas where extensive giant reed removal occurred between 2000 and 2002, with limited, on-going maintenance (hereafter "Removal" sites) and two sites in areas where some peripheral giant reed removal occurred mainly between 1997 and 1999 and the native vegetation has recovered (hereafter "Reference" sites; Fig. 2).

We compared vireo breeding productivity and factors that potentially influence productivity between Removal and Reference sites and across years (2005-2009) to determine whether giant reed removal influenced vireo productivity and how productivity responded to recovery of native habitat where giant reed had been removed. The following parameters were examined: clutch size, hatching rate, fledging rate, nest success, re-nesting rate, total number of fledglings per pair, nest placement, predation rate, and cowbird parasitism rate.

We also attempted to determine the effects of giant reed removal on adult and juvenile survivorship, site fidelity, and movements of adults and juveniles between years to determine patterns of attraction or avoidance of Removal and Reference sites. To this end, we attempted to band all adult and juvenile vireos at monitored nest sites and recapture or resight all banded vireos within Removal and Reference sites and the surrounding areas to identify individuals and compile a history of their territory occupation across years and their movements into and out of Removal and Reference sites.

Finally, we compiled annual density within Removal and Reference sites by delineating the boundary surrounding all monitored nests at each Removal and Reference site (Fig. 2), then counting the number of vireo territories that occurred within those boundaries each year from 1997 through 2009. We examined these data to look for trends in local population size and density, particularly in response to the recovery of native habitat following giant reed removal.

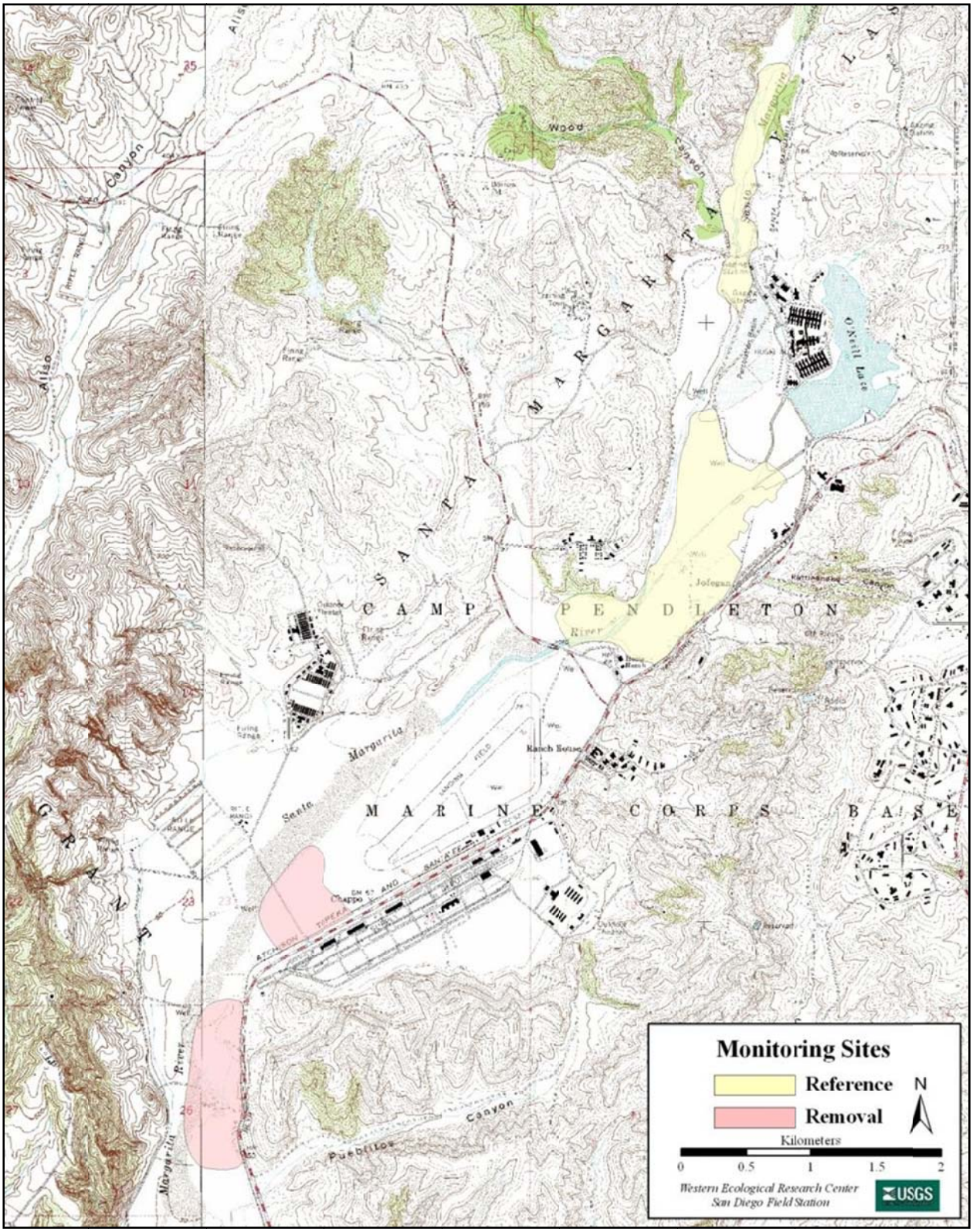


Fig. 2. Location of Least Bell's Vireo nest monitoring areas at Marine Corps Base Camp Pendleton, 2009.

Nesting activity was documented for 24 pairs in Removal sites and 23 pairs in Reference sites throughout the breeding season. A subset of nests was monitored for four additional pairs where nests were found and monitored opportunistically. 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 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.

Marine Corps Base 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.

**Precipitation Data**

Precipitation has been associated with bird population dynamics, especially in arid environments (Boag and Grant 1984; Rotenberry and Wiens 1989, 1991; Chase et al. 2005), primarily through its influence on primary productivity (Cody 1981, Grant and Grant 1987). We examined precipitation data from three weather stations on Marine Corps Base Camp Pendleton: Las Flores, Target Range, and Ammo Dump (WRCC 2009), which surround the Removal and Reference monitoring sites. We chose to use precipitation data from the Target Range weather station because (1) the Target Range weather station presented the most complete set of precipitation data and (2) data from the other two weather stations correlated well with the Target Range data set (Las Flores x Target Range $R^2 = 0.76$, $P = 0.001$, $n = 11$; Ammo Dump x

Target Range $R^2 = 0.77$, $P = 0.02$, $n = 6$). Annual precipitation was compiled for each bioyear (July through June), which measures precipitation during the winter prior to the year of associated vireo demographic data (e.g., precipitation from July 2004 through June 2005 is associated with vireo data from 2005). We analyzed the relationships between annual precipitation and total number of territories, average clutch size, and number of young fledged per pair.

**Banding**

The primary goals of banding Least Bell's Vireos on Marine Corps Base 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 Marine Corps Base Camp Pendleton young play in potentially supporting vireo populations off Base, and (3) to understand how giant reed 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 Removal and Reference sites were captured in mist nets and banded with a unique combination of colored plastic and anodized metal bands, including either an anodized gold or orange plastic band to designate Marine Corps Base Camp Pendleton as the bird's site of origin. 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.

**Data Analyses**

We conducted statistical tests to determine whether there were differences in vireo territory density, nest success, productivity, or nest site characteristics between pairs nesting at Removal and Reference sites. We used Chi-square and Fisher's Exact tests to determine if there were differences in overwinter survivorship, re-nesting rate, re-nesting after successful or unsuccessful nests, overall nest success, success of first nesting attempt, nests reaching nestling stage, egg hatching rate, and vireo population density between Removal and Reference sites, and to determine if there were differences in first and second nesting success rates by year. Chi-square tests were used when sample sizes were sufficient; Fisher's Exact tests were used when one or more category contained fewer than five samples. We used *t*-tests and Mann-Whitney *U*-tests to determine if there were differences in the number of nesting attempts, the initiation of first nesting attempts, average clutch size, average number of young/pair, nest height, host plant height, distance to the edge of the host plant, distance to the edge of the vegetation clump, and distance to the edge of the riparian vegetation in which the nest was located between Removal and Reference sites, and to determine if there were difference in nest placement characteristics between successful and failed nests within Removal and Reference sites. *T*-tests were used when distributions were normal and variances were similar; Mann-Whitney *U*-tests were used when the data violated these assumptions. We used Analysis of Variance (ANOVA) and Tukey's post-hoc pairwise comparisons to determine if there were differences in the timing of the first nesting attempt by year, clutch size by year between Removal and Reference sites, and young fledged per pair by year between Removal and Reference sites. We used simple Pearson's correlations to determine if annual precipitation correlated with clutch size, number of young per pair, and total number of vireo territories on Marine Corps Base Camp Pendleton. 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). Two-tailed tests were considered significant if $P < 0.10$. All data from Marine Corps Base Camp Pendleton from 2005, 2006, 2007, and 2008 used in comparisons with current data can be found in Rourke and Kus 2006a, Rourke and Kus 2007a, Rourke and Kus 2008, and Lynn and Kus 2009.

We used MARK (White and Burnham 1999) to model the effects of giant reed removal on daily survival rate (DSR) of vireo nests (Dinsmore *et al.* 2002). Nest survival was calculated across a 30-day cycle length (4 days laying, 14 days incubation, 12 days nestling period) in which incubation begins with the penultimate egg. Age of nests at the time they were discovered was calculated by forward- or backward-dating of nests in relation to known dates of nest building, laying, or hatching. We used an information-theoretic approach (Burnham and Anderson 2002) to evaluate support for models reflecting *a priori* hypotheses regarding the effect of treatment and habitat variables on DSR. We hypothesized that DSR would be lower in Removal than in Reference sites. We used logistic regression with a logit link to build models. First, we generated a constant survival model to serve as a reference for the effect of treatment and habitat variables on DSR. We then modeled the treatment covariate and evaluated support for the model in relation to the constant survival model. We also modeled the effect of year on DSR to search for any temporal differences across our study.

## RESULTS

### Population Size and Distribution

A total of 1,087 Least Bell's Vireo sites were identified during Base-wide surveys (Table 1, Appendix B, Figs. 24-43). This included 1,013 territorial male vireos, 70% of which were confirmed as paired, and 74 transients. Transient vireos were observed on 12 of the 24 (50%) drainages/sites surveyed. Ninety-six percent of all vireo territories occurred on the ten most populated drainages/sites (i.e., Santa Margarita River, Las Flores Creek, San Mateo Creek, San Onofre Creek, De Luz Creek, Pilgrim Creek, Aliso Creek, Windmill Creek, Cristianitos Creek, and Lake O'Neill/Fallbrook Creek), and the majority of vireo territories (58%) occurred along the Santa Margarita River, the largest expanse of riparian vegetation on Base (Tables 1, 2). The remaining 14 drainages/sites each contained ten or fewer territories.

The distribution of Least Bell's Vireo territories documented on Base in 2009 was similar to that in 2008, although numbers increased in almost all survey areas (Fig. 3, Table 2), and increased more in areas that had been burned in 2007. In 2009, the vireo population increased in 78% of drainages surveyed (18/23). The remaining five drainages showed no change or decreased by two or fewer territories between 2008 and 2009. The drainage with the largest numeric increase in vireo territories continued to be the Santa Margarita River, increasing by 136 territories (29%). The site with the largest numeric loss in vireo numbers was Hidden Canyon, losing two territories (50%). Overall, the vireo population on Base increased by 37% from 2008 to 2009.

Table 1. Number and distribution of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2009.

| Drainage/Survey Site | Known Pairs | Single/ Status Undetermined | Transient | Total Territories |
|---|---|---|---|---|
| Santa Margarita River: | | | | |
| I-5 to De Luz Creek | 428 | 131 | 39 | 559 |
| De Luz Creek to Base Boundary | 16 | 17 | 0 | 33 |
| De Luz Creek | 25 | 14 | 1 | 39 |
| Roblar Creek | 0 | 2 | 0 | 2 |
| Lake O'Neill/Fallbrook Creek | 6 | 5 | 2 | 11 |
| Basilone-Roblar Roads | 0 | 5 | 0 | 5 |
| 22 Area | 5 | 2 | 0 | 7 |
| Pueblitos Canyon | 0 | 1 | 0 | 1 |
| Newton Canyon | 5 | 1 | 0 | 6 |
| Cockleburr Creek | 0 | 2 | 0 | 2 |
| French Canyon | 1 | 1 | 0 | 2 |
| Aliso Creek | 14 | 7 | 2 | 21 |
| Hidden Canyon | 1 | 1 | 0 | 2 |
| Las Flores Creek: | | | | |
| Pacific Ocean to Stuart Mesa Road | 6 | 4 | 1 | 10 |
| Stuart Mesa Road to Power Lines | 39 | 10 | 2 | 49 |
| Power Lines to Zulu Impact Area | 36 | 12 | 1 | 48 |
| Piedra de Lumbre Canyon | 3 | 2 | 2 | 5 |
| Horno Canyon | 1 | 0 | 0 | 1 |
| San Onofre Creek: | | | | |
| Pacific Ocean to Basilone Road | 29 | 24 | 5 | 53 |
| Basilone Road to Access Road to Range 219 | 9 | 0 | 0 | 9 |
| San Mateo Creek | | | | |
| Pacific Ocean to San Mateo Road | 51 | 29 | 7 | 80 |
| San Mateo Road to Yankee Training Area | 2 | 1 | 0 | 3 |
| Cristianitos Creek | 8 | 5 | 3 | 13 |
| Talega Canyon | 1 | 0 | 0 | 1 |
| Tuley Canyon | 0 | 0 | 0 | 0 |
| Pilgrim Creek: | | | | |
| Base Boundary upstream to Vandegrift Boulevard | 9 | 6 | 5 | 15 |
| Vandegrift Boulevard to upstream riparian limit | 4 | 8 | 0 | 12 |
| Windmill Canyon | 9 | 4 | 2 | 13 |
| Ysidora Basin to Windmill Canyon | 1 | 4 | 2 | 5 |
| De Luz Homes | 1 | 5 | 0 | 6 |
| Total | 710 | 303 | 74 | 1,013 |

Table 2. Number of territorial males at Marine Corps Base Camp Pendleton, by drainage, 2004-2009. Numeric change is the positive or negative change in the number of vireo territories between 2008 and 2009.

| | Number of Territorial Males | | | | | | Numeric |
|---|---|---|---|---|---|---|---|
| **Drainage** | **2004[a]** | **2005** | **2006** | **2007** | **2008** | **2009** | **Change** |
| Santa Margarita River[b] | 440 | 472 | 417 | 423 | 463 | 599 | +136 |
| De Luz Creek | 26 | 18 | 25 | 24 | 25 | 39 | +14 |
| Roblar Creek | 1 | 0 | 0 | 0 | 0 | 2 | +2 |
| Lake O'Neill/Fallbrook Creek | 16 | 20 | 10 | 9 | 11 | 11 | 0 |
| Pueblitos Canyon | 3 | 5 | 3 | 2 | 2 | 1 | -1 |
| Newton Canyon | 9 | 8 | 8 | 5 | 4 | 6 | +2 |
| Cockleburr Creek | 0 | 2 | 2 | 2 | 1 | 2 | +1 |
| French Canyon | 5 | 6 | 4 | 2 | 2 | 2 | 0 |
| Aliso Creek | 21 | 21 | 11 | 9 | 11 | 21 | +10 |
| Hidden Canyon | 5 | 8 | 5 | 4 | 4 | 2 | -2 |
| Las Flores Creek | 84 | 85 | 76 | 81 | 70 | 107 | +37 |
| Piedra de Lumbre Canyon | 5 | 8 | 9 | 6 | 3 | 5 | +2 |
| Horno Canyon | 0 | 1 | 0 | 0 | 0 | 1 | +1 |
| San Onofre Creek | 56 | 52 | 43 | 44 | 41 | 62 | +21 |
| San Mateo Creek | 68 | 56 | 59 | 46 | 53 | 83 | +30 |
| Cristianitos Creek | 8 | 6 | 8 | 8 | 4 | 13 | +9 |
| Talega Canyon | 0 | 1 | 0 | 0 | 0 | 1 | +1 |
| Pilgrim Creek | 37 | 36 | 23 | 26 | 26 | 27 | +1 |
| Windmill Canyon | 20 | 12 | 7 | 8 | 12 | 13 | +1 |
| Ysidora Basin to Windmill Canyon | 8 | 4 | 6 | 5 | 4 | 5 | +1 |
| De Luz Homes | 5 | 4 | 2 | 3 | 2 | 6 | +4 |
| Basilone-Roblar Roads | - | 2 | 0 | 0 | 0 | 5 | +5 |
| Tuley Canyon | 2 | - | 0 | 0 | 0 | 0 | 0 |
| Total | 819 | 827 | 718 | 707 | 738 | 1013 | +275 |

[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.

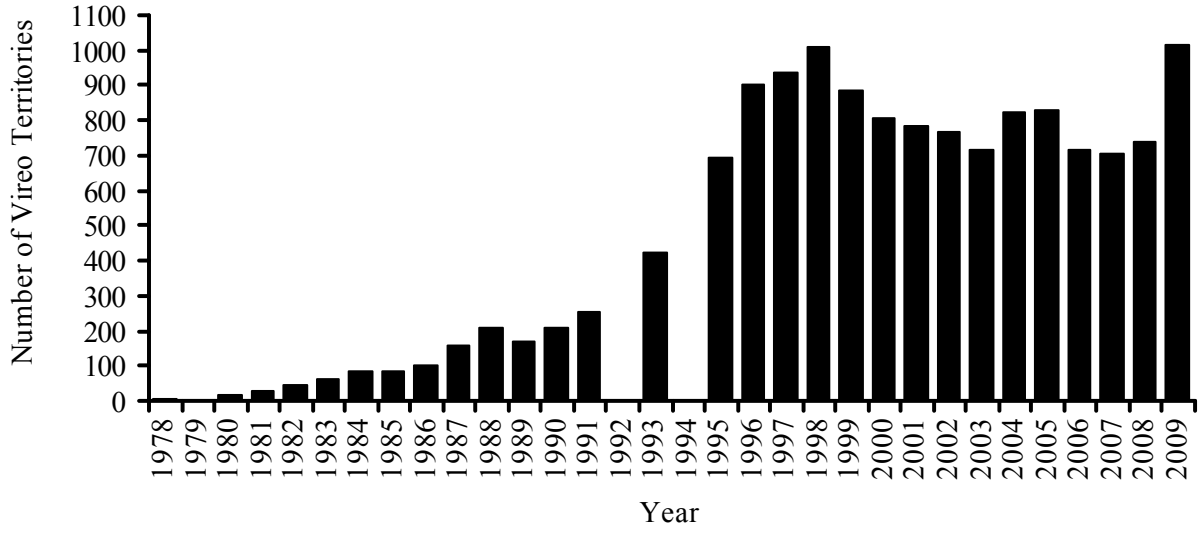


Fig. 3. Number of Least Bell's Vireo territories at Marine Corps Base Camp Pendleton, 1978–2009. (Source: Griffith Wildlife Biology 2004, Rourke and Kus 2006a, 2007a, 2008, Lynn and Kus 2009).

Areas that burned in 2007 showed an increase in vireo numbers in 2009 after an initial decrease in 2008 (Fig. 4). Five of the six drainages that burned in 2007 had a greater number of vireos inside the burned areas than before the fire. Base-wide, the number of vireo territories in areas that burned in 2007 decreased by 29% in 2008, then increased by 101% in 2009, for an overall increase of 42% from before the fire to 2009.

Least Bell's Vireos began arriving on Base during the last week of March (Fig. 5), with 88 territories established by 31 March. By 1 April 2009, 9% of males had established territories. By 15 April 42% of males were present, and by the end of April, 66% of males were detected at their territories. This generally follows the pattern of territory establishment on Marine Corps Base Camp Pendleton over the past five years.

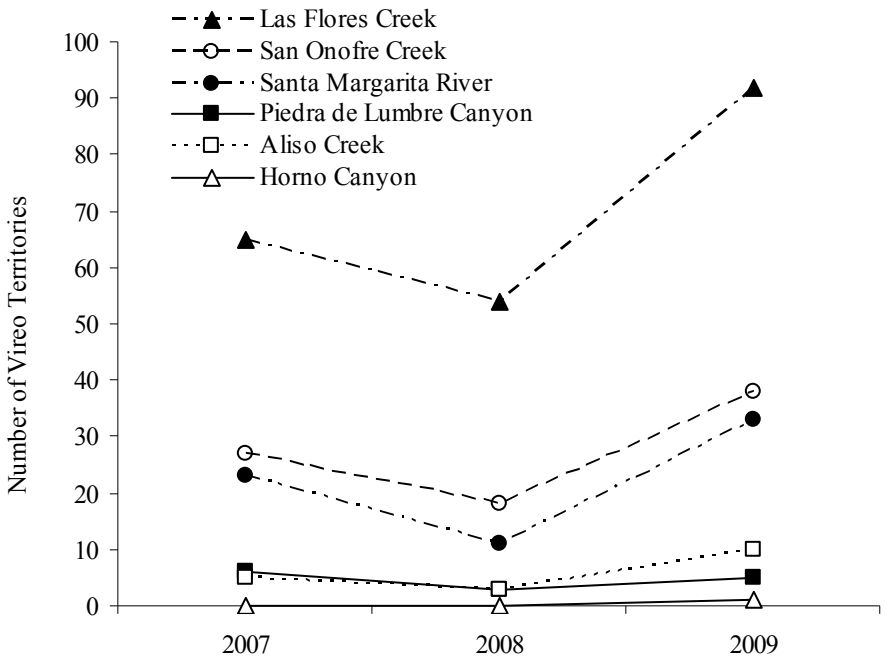


Fig. 4. Change in the number of Least Bell's Vireo territories in areas that burned in 2007 at Marine Corps Base Camp Pendleton, 2007–2009.

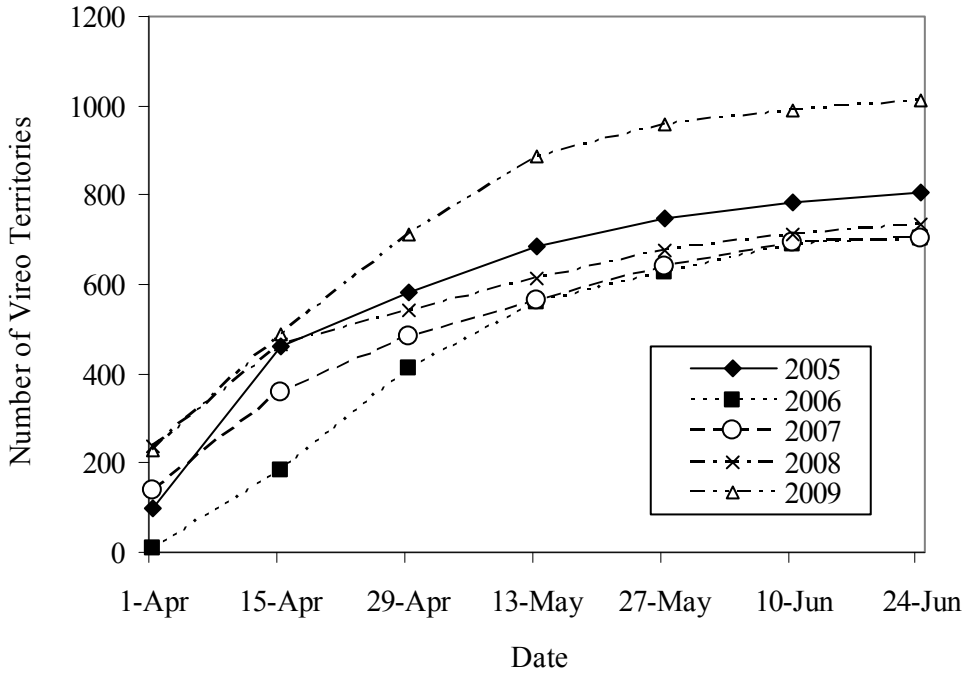


Fig. 5. Territory establishment of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2005-2009.

## 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 mixed willow riparian, with 54% of males in the study area found in this habitat. An additional 8% of birds occupied willow habitat co-dominated by cottonwoods or sycamores. Thirty percent of territories were found in riparian scrub, dominated by mule fat and/or sandbar willow. Eight percent of the vireos used drier habitats including areas dominated by a mix of sycamore and oaks (2%) or upland vegetation (6%). Approximately 1% of vireo territories occupied habitat consisting exclusively of non-native vegetation.

Table 3. Habitat types used by Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2009.

| | Number of Territories | | | |
|---|---|---|---|---|
| **Habitat Type** | **>50% Native** | **>50% Exotic** | **Total** | **Percent of Total** |
| Mixed Willow | 525 | 28 | 543 | 54% |
| Willow/Sycamore | 59 | 10 | 69 | 7% |
| Willow/Cottonwood | 5 | 0 | 5 | <1% |
| Sycamore/Willow | 2 | 0 | 2 | <1% |
| Riparian Scrub | 271 | 32 | 303 | 30% |
| Upland Scrub | 41 | 16 | 57 | 6% |
| Oak/Sycamore | 18 | 3 | 21 | 2% |
| Non-native | 0 | 9 | 9 | 1% |
| Total | 911 | 98 | 1,009[a] | 100% |

[a] Data not recorded in all territories.

A similar proportion of vireo territories were documented in exotic vegetation in 2009 as in 2008 (Table 4). Ten percent (98/1,009) of vireo territories in 2009 and 9% in 2008 were in areas where exotic species such as giant reed, poison hemlock (*Conium maculatum*), black mustard (*Brassica nigra*), and salt-cedar comprised at least 50% of the habitat. However, in 2009, more drainages contained territories dominated by non-native vegetation than in 2006, 2007, and 2008. Exotic vegetation dominated at least one territory on 11 drainages in 2009 compared to 8 drainages in 2006, 5 drainages in 2007, and 9 drainages in 2008. 2005 remained the year with the highest number of drainages (13) containing at least one vireo territory dominated by exotic vegetation.

Table 4. Proportion of Least Bell's Vireo territories dominated or co-dominated by exotic vegetation, by drainage, 2005-2009. Numbers in parentheses are the number of territories on the drainage.

| | Proportion of Territories | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Drainage** | **2005** | | **2006** | | **2007** | | **2008** | | **2009** | |
| Windmill Creek | 0.67 | (12) | 0.14 | (7) | 0.13 | (8) | 0.67 | (12) | 0.92 | (13) |
| Hidden Canyon | 0.00 | (8) | 0.00 | (5) | 0.00 | (4) | 0.00 | (4) | 0.50 | (2) |
| Las Flores Creek | 0.02 | (85) | 0.14 | (76) | 0.00 | (81) | 0.29 | (70) | 0.22 | (107) |
| San Onofre Creek | 0.23 | (52) | 0.00 | (43) | 0.00 | (44) | 0.13 | (41) | 0.21 | (62) |
| Newton Canyon | 0.63 | (8) | 0.13 | (8) | 0.00 | (5) | 0.50 | (4) | 0.20 | (6) |
| Piedra de Lumbre Canyon | 1.00 | (8) | 0.00 | (9) | 0.00 | (6) | 0.67 | (3) | 0.20 | (5) |
| Ysidora Basin to Windmill Canyon | 0.25 | (4) | 0.50 | (6) | 0.00 | (5) | 0.25 | (4) | 0.20 | (5) |
| Pilgrim Creek | 0.00 | (36) | 0.00 | (23) | 0.00 | (26) | 0.00 | (26) | 0.15 | (27) |
| San Mateo Creek | 0.66 | (56) | 0.12 | (59) | 0.00 | (46) | 0.14 | (53) | 0.10 | (83) |
| Cristianitos Creek | 0.50 | (6) | 0.13 | (8) | 0.25 | (8) | 0.00 | (4) | 0.08 | (13) |
| Santa Margarita River[a] | 0.17 | (472) | 0.05 | (417) | 0.04 | (423) | 0.03 | (463) | 0.06 | (599) |
| Aliso Creek | 0.05 | (21) | 0.00 | (11) | 0.11 | (9) | 0.00 | (11) | 0.00 | (21) |
| Basilone-Roblar Roads | 0.00 | (2) | - | - | - | - | - | - | 0.00 | (5) |
| Cockleburr Canyon | 0.00 | (2) | 0.00 | (2) | 0.00 | (2) | 0.00 | (1) | 0.00 | (2) |
| De Luz Creek | 0.06 | (18) | 0.04 | (25) | 0.00 | (24) | 0.00 | (25) | 0.00 | (39) |
| De Luz Homes | 0.00 | (4) | 0.00 | (2) | 0.00 | (3) | 0.00 | (2) | 0.00 | (6) |
| French Canyon | 0.00 | (6) | 0.00 | (4) | 0.00 | (2) | 0.00 | (2) | 0.00 | (2) |
| Horno Canyon | 1.00 | (1) | - | - | - | - | - | - | 0.00 | (1) |
| Lake O'Neill/Fallbrook Creek | 0.15 | (20) | 0.00 | (10) | 0.11 | (9) | 0.00 | (11) | 0.00 | (11) |
| Pueblitos Canyon | 0.00 | (5) | 0.00 | (3) | 0.00 | (2) | 0.50 | (2) | 0.00 | (1) |
| Roblar Creek | - | - | - | - | - | - | - | - | 0.00 | (2) |
| Talega Canyon | 0.00 | (1) | - | - | - | - | - | - | 0.00 | (1) |
| Total | 0.19 | (827) | 0.06 | (718) | 0.03 | (707) | 0.09 | (703[b]) | 0.10 | (1,009[b]) |

[a] Includes vireo territories detected within the 22 Area.
[b] Data not recorded in all territories.

## Banded Birds

We were able to observe 1,291 adult Least Bell's Vireos (956 males, 88% of all males, and 335 females, 46% of all females) on Base well enough to determine banding status in 2009, although not all banded vireos were observed well enough to conclusively identify the individual. One hundred and fifty-six of these had been banded prior to the 2009 breeding season (Appendix C). We were able to identify 108 vireos that were banded with unique color band combinations in 2009. Of these, 90 vireos had been banded on Base or at FNWS: 5 vireos banded in 2005, 12 banded in 2006, 31 banded in 2007 (4 of these at FNWS), and 42 banded in 2008 (Table 5), and 18 vireos were originally banded off Base (17 on the San Luis Rey River; Ferree and Kus 2007, 2008, USGS unpublished data, and 1 on the San Diego River; Wellik et al. 2009). Of the returning birds originally banded on Base in 2008, 24 were returning adults and 18 were banded as nestlings (captured in 2009 and given color bands) or fledglings. Adult birds of known age ranged from 1-5 years old.

Twenty-one vireos (13 males and 8 females) with a single numbered metal band were resighted in 2009 (Table 6). Eight of these individuals were banded as nestlings off Base on the San Luis Rey River and 12 were banded as nestlings on Base. One resighted vireo had a single silver metal band and may have been banded at one of the two Monitoring Avian Productivity and Survivorship (MAPS) Stations on Base or may have originated from another banding project off Base. Efforts to recapture and identify these vireos were unsuccessful. It is likely that many of these birds were first-year adults banded as nestlings in 2008, but because we did not recapture them this could not be confirmed.

Table 5. Number of Least Bell's Vireos individually identified by bands at Marine Corps Base Camp Pendleton in 2009, by original year banded, age, original banding location, and sex.

| | | Number of Vireos Observed by Origin | | | | |
|---|---|---|---|---|---|---|
| | | Marine Corps Base Camp Pendleton | | San Luis Rey River | | San Diego River |
| Year Banded | Age in 2009 | Male | Female | Male | Female | Male |
| 2005 | ≥ 5 yrs. | 2 | 0 | 0 | 0 | 0 |
| | ≥ 4 yrs. | 1 | 0 | 0 | 0 | 0 |
| | 4 yrs. | 0 | 2 | 0 | 1 | 0 |
| 2006 | ≥ 4 yrs. | 10 | 0 | 1 | 0 | 0 |
| | 3 yrs. | 2 | 0 | 2 | 1 | 0 |
| 2007 | ≥ 3 yr. | 13[a] | 2 | 0 | 0 | 0 |
| | 3 yr. | 1 | 0 | 0 | 0 | 0 |
| | ≥ 2 yr. | 1 | 0 | 0 | 0 | 0 |
| | 2 yr. | 8 | 6 | 6 | 0 | 0 |
| 2008 | ≥ 2 yr. | 15 | 7 | 0 | 0 | 0 |
| | 2 yr. | 2 | 0 | 0 | 0 | 0 |
| | 1 yr. | 18 | 0 | 5 | 1 | 1 |
| Total | | 73 | 17 | 14 | 3 | 1 |

[a] Four vireos were originally banded at FNWS.

Table 6. Banding location and sex of Least Bell's Vireos with single metal numbered federal bands observed on Marine Corps Base Camp Pendleton in 2009.

| Original Banding Location | Males | Females |
|---|---|---|
| Marine Corps Base Camp Pendleton | 9 | 3 |
| San Luis Rey River | 4 | 4 |
| MAPS/Other[a] | 0 | 1 |
| Total | 13 | 8 |

[a] Vireos with metal silver numbered federal bands may have been banded off Base at unassociated banding stations.

A total of 336 Least Bell's Vireos were captured during 2009 (Table 7). These included 117 adult vireos that were banded with a unique color combination (48 recaptures and 69 new captures), 218 hatch-year birds (202 of which were banded as nestlings with a single gold numbered federal band and 16 of which were incidentally caught either while attempting to

target net an adult vireo or at one of the Base's two MAPS stations), and 1 vireo of unknown age. One of the nestlings banded in 2009 was detected near at the south end of Morro Bay, Los Osos, California (J. Royer, pers. comm.) in September, 2009. This juvenile was identified as a 2009 nestling by reading a partial band number from a photograph taken by A. Schmierer. Of the juveniles that were incidentally caught and given unique color combinations, two had been initially banded as nestlings on Base and one had been initially banded as a nestling on the San Luis Rey River in 2009.

Table 7. Summary of new Least Bell's Vireos captured and banded on Marine Corps Base Camp Pendleton in 2009. Numbers in parentheses are recaptures/new captures.

| Age Banded | Males | Females | Unknown Sex |
|---|---|---|---|
| Adult | 59 (32/27) | 25 (13/12) | 33 (3/30) |
| Juvenile[a] | . | . | 16 (1/15) |
| Unknown | . | . | 1 (0/1) |
| Nestling[b] | . | . | 202 (0/202) |
| Total | 59 (32/27) | 25 (13/12) | 252 (3/249) |

[a] Incidentally captured post-fledging, given unique color band combinations. Includes one juvenile that was originally banded as a nestling on the San Luis Rey River in 2009.

[b] Includes two vireos that were originally banded as nestlings on Base in 2009, then were incidentally recaptured and given unique color band combinations later in 2009.

## Survivorship, Fidelity, and Movement

### *Base-wide Survivorship*

The recapture and resighting of banded birds allowed us to determine the rate at which vireos previously documented on Base returned to hold territories or were resighted in 2009. Although this is the minimum number of vireos known to survive and does not include all 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 129 uniquely color banded adult vireos present on Base during the 2008 breeding season, 45% (58/129) returned to Marine Corps Base Camp Pendleton in 2009 (Table 8). Twenty-three additional vireos that were not detected in 2008 were observed in 2009, increasing vireo survivorship to 53% (81/152). Sixty-two of the 102 adult male vireos known to be alive in 2008 were resighted in 2009, an over-winter survivorship rate of 61%. Nineteen of the 36 adult female vireos known to be alive in 2008 were resighted in 2009, an over-winter survivorship rate of 53%. The remaining 59 males and females, and 14 vireos of unknown sex, were not resighted in 2009. The discrepancy in sex-related over-winter survivorship may be attributed to difficulty in resighting females. In any given year, the proportion of females that are resighted is lower than for males. Therefore, the chances of resighting a particular female are correspondingly smaller.

Table 8. Number of banded adult Least Bell's Vireos detected in 2008 at giant reed (*Arundo donax*) Removal sites, Reference sites, and other areas on Marine Corps Base Camp Pendleton, and those that returned in 2009. Numbers in parentheses include vireos that were identified in 2009 but not in 2008.

| Year/Sex | Removal Sites | Reference Sites | Other Areas | Total |
|---|---|---|---|---|
| 2008 | | | | |
| Male | 26 | 26 | 37 | 89 (102) |
| Female | 4 | 10 | 12 | 26 (36) |
| Unknown | 0 | 3 | 11 | 14 |
| 2009 | | | | |
| Male | 14 (16) | 15 (17) | 20 (29) | 49 (62) |
| Female | 2 (3) | 4 (10) | 3 (6) | 9 (19) |

Twenty-three individually banded vireos that were detected in 2009 were not observed in 2008. These include 11 vireos (6 males and 5 females) banded as nestlings and 4 vireos (2 males and 2 females) banded as adults in 2007, 2 vireos (1 male and 1 female) banded as nestlings and 4 vireos (3 males and 1 female) banded as adults in 2006, and 1 female vireo banded as a nestling and 1 vireo of unknown age banded in 2005. These detections increased the first-year survivorship estimate for 2006 from 15% to 16% (Rourke and Kus 2007a), for 2007 from 22% to 25% (Rourke and Kus 2008), and for 2008 from 11% to 21% (Lynn and Kus 2009), and increased the adult survivorship for 2007 from 66% to 70% (Rourke and Kus 2008) and for 2008 from 49% to 59%. Three other vireos with metal gold numbered federal bands that were originally banded on Base or at FNWS as nestlings were resighted in 2009, two on the San Luis Rey River (Ferree and Kus in prep.; USGS unpublished data) and one on the Sweetwater River (Rogne and Kus, in prep.), although we were not able to recapture these birds to determine their natal year and specific origin.

Of the 229 hatch-year vireos banded in 2008 that survived to fledge, 19 (all males) were resighted with or captured and given unique color band combinations on Base in 2009 (Table 9). Two hatch-year female vireos were banded on Base in 2008 and were recaptured and given a unique color band combination at the Marine Corps Air Station (MCAS) and at FNWS in 2009 (Lynn and Kus, in prep., USGS unpublished data). One other first-year vireo, a male with a full color combination, was observed on the San Gabriel River in Los Angeles County (B. Daniels, pers. comm.). This male was apparently paired and exhibited nesting behavior. The addition of these three vireos increases the conservative first-year survivorship to 10%. Assuming an equal sex ratio of banded nestlings, first-year survivorship of males was 17% (20/114.5) and females was 2% (2/114.5). Another nine vireos that were resighted in 2009 on Base with gold numbered federal bands on their left legs (seven males and two females) may have been banded as nestlings in 2008 or in 2006. Assuming that these nine vireos were banded as nestlings in 2008, the first-year survivorship estimate increases to 14% (24% for males and 3% for females). Because female vireos are elusive and difficult to recapture, the first-year survivorship estimate may be conservative.

Table 9. Number of Least Bell's Vireos banded as nestlings at giant reed (*Arundo donax*) Removal sites, Reference sites, and other areas on Marine Corps Base Camp Pendleton in 2008, and those that returned in 2009.

| Year/Sex | Removal Sites | Reference Sites | Other Areas | Total |
|---|---|---|---|---|
| 2008 | | | | |
| Unknown | 127 | 94 | 8 | 229 |
| 2009 | | | | |
| Male | 8[a] | 11 | 1 | 20 |
| Female | 1[b] | 1[c] | 0 | 2 |

[a] One vireo was resighted on the San Gabriel River, Los Angeles County.
[b] One vireo was recaptured at MCAS.
[c] One vireo recaptured on FNWS.

*Survivorship at Removal and References Sites*

Of the 30 banded adult vireos (26 males and 4 females) that were detected within Removal sites in 2008, 16 (14 males and 2 females) were resighted in 2009 for a 52% survival rate (52% for males, 50% for females; Table 8). Of the 39 banded adult vireos (26 males, 10 females, and 3 unknown sex) that were detected within Reference sites in 2008, 19 (15 males and 4 females) were resighted in 2009 for a 51% survival rate (62% for males and 40% for females). No vireos moved between Removal and Reference sites between 2008 and 2009, although one banded female moved from a Reference site to another area of the Base, and one banded male vireo moved from a different area of the Base to a Removal site. Over-winter survival rate did not differ between Removal and Reference sites ($\chi^2 = 0.03$, $P = 0.87$).

All but 8 of the 229 banded nestlings that were known to fledge in 2008 were banded on a Removal or Reference site. Of these 229, 20 were recaptured and given unique color band combinations in 2009 (18 on Marine Corps Base Camp Pendleton, 1 at MCAS, and 1 at FNWS) for an overall first-year survival rate of 9% for fledglings from Removal and Reference sites (Table 9). First-year survivorship at Removal sites did not differ between Removal and Reference sites (Fisher's Exact $P = 0.21$).

*Base-wide Site Fidelity and Movement*

Resighting banded birds allowed us to identify individuals that either returned to the same site they used in a previous year (within 100 m) or moved to a different location (Table 10). Fifty-eight adult vireos that were identified in 2008 were resighted in 2009, fifty-three of which occupied known territories both years. Five vireos were excluded from analysis because they were recaptured at either the De Luz or Santa Margarita MAPS stations in 2008 or 2009 but their territories were not known for the year in which they were captured. The majority of returning adult vireos showed strong between-year site fidelity. Of the 53 returning adults, 45 (85%) occupied a breeding site in 2009 that they had defended in 2008 (within 100 m). Three additional vireos (6%) returned to sites adjacent to their previous territories (within 300 m). Five vireos (two males and three females) moved between 0.4 and 1.1 km from their 2008 breeding territories to their 2009 breeding territories, but remained within the same drainage. The average distance moved by returning adult vireos was 0.1 ± 0.2 km (SD).

Table 10. Between-year movement of adult Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2009.

| Year Last | Drainage[a] / Territory / Treatment | | Distance Moved | Band Combination[b] | | Age in | |
|---|---|---|---|---|---|---|---|
| Detected | Last Seen | 2009 | (km) | Left Leg | Right Leg | 2009 | Sex[c] |
| 2008 | SMR / HLD / REF | SMR / HLD / REF | 0.0 | PUWH/Mgo | pupu | ≥ 5 yr. | M |
| 2008 | SMR / ATK / REM | SMR / ATK / REM | 0.0 | ORORMsi | pupu | ≥ 5 yr. | M |
| 2008 | SMR / DRK / REF | SMR / DRK / REF | 0.0 | pupu | LPBK/Mgo | ≥ 4 yr. | M |
| 2008 | SMR / HW40 | SMR / HW23 | 0.0 | DGOR | Mgo | ≥ 4 yr. | M |
| 2008 | SMR / ARS / REM | SMR / ARS / REM | 0.0 | - | YEPU/Mgo | ≥ 4 yr. | M |
| 2008 | SMR / AE16 | SMR / AE10 | 0.0 | Mgo | PUPU/pupu | ≥ 4 yr. | M |
| 2008 | SMR / SG06 | SMR / SG09 | 0.6 | pupu | WHWH/Mgo | ≥ 4 yr. | M |
| 2008 | SMR / HTI / REF | SMR / HTI / REF | 0.1 | - | BWST/Mgo | ≥ 4 yr. | M |
| 2008 | SMR / ORN / REM | SMR / ORN / REM | 0.0 | - | ORORMgo | ≥ 4 yr. | M |
| 2008 | SMR / JSP / REF | SMR / JSP / REF | 0.1 | - | WHDP/Mdb | 4 yr. | F |
| 2008 | SMR / ATT / REM | SMR / ATT / REM | 0.0 | ORPU/pupu | Mgo | 4 yr. | F |
| 2008 | SMR / CED / REF | SMR / DEU / REF | 0.1 | - | PUORMsi | ≥ 3 yr. | M |
| 2008 | SMR / ANI / REM | SMR / ANI / REM | 0.0 | WHDP/Msi | gogo | ≥ 3 yr. | M |
| 2008 | SMR / HE22 / REF | SMR / HE20 / REF | 0.0 | gogo | LPBK/Msi | ≥ 3 yr. | M |
| 2008 | SMR / ANA / REM | SMR / ANA / REM | 0.1 | pupu | BKLP/Mgo | ≥ 3 yr. | M |
| 2008 | SMR / BOW / REF | SMR / BOW / REF | 0.1 | WHDP/Mgo | pupu | ≥ 3 yr. | M |
| 2008 | SMR / HRP / REF | SMR / HRP / REF | 0.1 | Mgo | BYST/pupu | ≥ 3 yr. | M |
| 2008 | PL / PS03 | PL / PN03 | 1.1 | pupu | ORORMgo | ≥ 3 yr. | M |
| 2008 | SMR / ATT / REM | SMR / ATT / REM | 0.0 | Msi | DPDP/gogo | ≥ 3 yr. | M |
| 2008 | SMR / HOL / REF | SMR / HOL / REF | 0.0 | WHWH/Msi | gogo | ≥ 3 yr. | M |
| 2008 | SMR / AH13 | SMR / AH28 | 0.1 | - | DBDB/Mgo | ≥ 3 yr. | M |
| 2008 | SMR / RR18 | SMR / RR20 | 0.1 | - | Mgo/WHWH | ≥ 3 yr. | M |
| 2008 | SMR / PON / REM | SMR / IND / REM | 0.0 | Mdb | DPDP/sisi | 3 yr. | M |
| 2008 | SMR / UM41 | SMR / UM01 | 0.0 | BKLP/Mgo | pupu | 3 yr. | M |
| 2008 | SMR / HW36 / REF | SMR / HW07 / REF | 0.1 | WHDP/Mdb | - | 3 yr. | M |
| 2008 | DL / DS17 | DL / DLMAPS | 0.3 | gogo | DGOR/Msi | 3 yr. | M |
| 2008 | SMR / ARH / REM | SMR / AER / REM | 0.1 | YEPU/pupu | Mgo | ≥ 2 yr. | M |
| 2008 | SMR / JSP / REF | SMR / JSP / REF | 0.1 | PUYE/Mgo | pupu | ≥ 2 yr. | M |
| 2008 | SMR / CAG / REM | SMR / CAG / REM | 0.0 | BYST/gogo | Mgo | ≥ 2 yr. | M |
| 2008 | SMR / RR26 | SMR / RR15 | 0.0 | DPWH/sisi | Mgo | ≥ 2 yr. | M |
| 2008 | SMR / MOU / REF | SMR / AH01 / REF | 0.0 | Mgo | BYST/gogo | ≥ 2 yr. | M |
| 2008 | SMR / MT27 | SMR / MT04 | 0.2 | Mgo | PUORsisi | ≥ 2 yr. | M |
| 2008 | SMR / BER / REF | SMR / BER / REF | 0.0 | Mgo | WHWH/sisi | ≥ 2 yr. | M |
| 2008 | DL / DS11 | DL / DS18 | 0.0 | gogo | ORORMsi | ≥ 2 yr. | M |
| 2008 | SMR / AST / REM | SMR / AST / REM | 0.0 | DPDP/Msi | gogo | ≥ 2 yr. | M |
| 2008 | SMR / HW28 | SMR / HW22 | 0.0 | PUYE/Msi | gogo | ≥ 2 yr. | M |
| 2008 | SMR / HW45 | SMR / HW32 | 0.1 | ORPU/gogo | Msi | ≥ 2 yr. | M |
| 2008 | SMR / HW45 | SMR / HW33 | 0.1 | WHDP/gogo | Msi | ≥ 2 yr. | M |
| 2008 | SMR / AE10 | SMR / AE04 | 0.0 | WHPU/gogo | Msi | ≥ 2 yr. | M |
| 2008 | SMR / FIN / REF | SMR / FIN / REF | 0.0 | - | DGOR/Msi | ≥ 2 yr. | M |
| 2008 | SMR / ABB / REM | SMR / ABB / REM | 0.0 | Mgo | PUPU/sisi | ≥ 2 yr. | M |
| 2008 | SMR / SMMAPS | SMR / ES23 | 0.1 | gogo | ORPU/Msi | ≥ 2 yr. | M |

Table 10. Continued.

| Year Last Detected | Drainage[a] / Territory / Treatment | | Distance Moved (km) | Band Combination[b] | | Age in 2009 | Sex[c] |
|---|---|---|---|---|---|---|---|
| | Last Seen | 2009 | | Left Leg | Right Leg | | |
| 2008 | SMR / SMMAPS | SMR / SMMAPS | 0.0 | PUOR/pupu | Msi | ≥ 2 yr. | M |
| 2008 | SMR / AST / REM | SMR / AST / REM | 0.0 | Mgo | DPWH/gogo | ≥ 2 yr. | F |
| 2008 | SMR / HE23 / REF | SMR / HE10 / REF | 0.5 | DGOR/Msi | - | ≥ 2 yr. | F |
| 2008 | SMR / FIN / REF | SMR / HE02 / REF | 0.2 | Msi | PUYE/gogo | ≥ 2 yr. | F |
| 2008 | SMR / AH14 / REF | SMR / AH23 | 0.4 | pupu | ORDG/Mgo | ≥ 2 yr. | F |
| 2008 | SMR / SMMAPS | SMR / BN12 | 0.2 | Msi | PUWH/gogo | ≥ 2 yr. | F |
| 2008 | SMR / SMMAPS | SMR / SMMAPS | 0.2 | pupu | PUOR/Msi | ≥ 2 yr. | F |
| 2008 | SMR / PEP / REF | SMR / QIN / REF | 0.0 | DPWH/gogo | Mgo | 2 yr. | M |
| 2008 | LF / LL18 | LF / LL12 | 0.0 | PUWH/pupu | Mdb | 2 yr. | M |
| 2008 | SMR / BGL / REM | SMR / ES17 / REM | 0.0 | pupu | OROR/Mdb | 2 yr. | M |
| 2008 | SMR / ES01 | SMR / ES26 | 0.0 | pupu | OROR/Msi | 2 yr. | M |
| 2008 | SMR / DON / REM | SMR / ES14 / REM | 0.0 | PUWH/sisi | Mgo | 2 yr. | M |
| 2008 | SMR / HE05 / REF | SMR / HE12 / REF | 0.1 | WHWH/sisi | Mgo | 2 yr. | M |
| 2008 | SMR / ES20 | SMR / ES60 / REM | 0.1 | YEPU/gogo | Mgo | 2 yr. | M |
| 2008 | SMR / SG18 | SMR / SG02 | 0.0 | - | ORDG/Mgo | 2 yr. | M |
| 2008 | SMR / HE24 / REF | SMR / HE12 / REF | 0.4 | WHDP/pupu | Mgo | 2 yr. | F |
| 2007 | LF / LL29 | LF / LL45 | 0.8 | LPBK/Mgo | pupu | ≥ 4 yr. | M |
| 2007 | SMR / APO / REF | SMR / AH03 / REF | 0.6 | pupu | BYST/Mgo | ≥ 4 yr. | M |
| 2007 | SMR / ES06 / REM | SMR / VEG / REM | 0.1 | DPDP/pupu | Mgo | ≥ 4 yr. | M |
| 2007 | SMR / FALL | SMR / UM12 | - | - | Mgo/LGLG | ≥ 3 yr. | M |
| 2007 | SMR / FALL | SMR / UM10 | - | Mgo | DBDB | ≥ 3 yr. | M |
| 2007 | SMR / CAG / REM | SMR / CAG / REM | 0.0 | BKBK/gogo | Msi | ≥ 3 yr. | F |
| 2007 | SMR / SMMAPS | SMR / HE46 / REF | 6.9 | PUWH/pupu | Mgo | ≥ 3 yr. | F |
| 2007 | SLR / WRF | SOF / OW09 | 34.9 | LPBK | DBWH/Mdb | 2 yr. | M |
| 2007 | SLR / WGIL | PC / PS05 | 5.9 | pupu | LPBK/Mdb | 2 yr. | M |
| 2007 | SMR / VIC / REM | SMR / YB16 | 3.7 | DGOR/gogo | Mgo | 2 yr. | M |
| 2007 | SLR / WALY | AL / AL02 | 9.4 | YEPU/gogo | Mdb | 2 yr. | M |
| 2007 | SLR / FO 6 | WC / WC12 | 3.4 | LPBK | BYST/Mdb | 2 yr. | M |
| 2007 | SMR / HTI / REF | SMR / AE14 | 1.9 | LPBK | Mgo | 2 yr. | M |
| 2007 | SMR / DRK / REF | LF / LN01 | 10.8 | LPLP/gogo | Mgo | 2 yr. | F |
| 2007 | SMR / DRK / REF | SMR / AH01 / REF | 0.8 | PUPU | YEYE/Mgo | 2 yr. | F |
| 2007 | SMR / ES05 / REM | SMR / ARI / REF | 8.3 | DPWH | Mgo | 2 yr. | F |
| 2007 | SMR / LIF / REF | SMR / PR16 | 6.6 | WHPU | BKBK/Mgo | 2 yr. | F |
| 2007 | SMR / BOW / REF | SMR / QIN / REF | 2.3 | LPLP | Mgo | 2 yr. | F |
| 2006 | SMR / HNK / REF | SMR / HE54 / REF | 0.1 | pupu | DPWH/Mgo | ≥ 4 yr. | M |
| 2006 | SLR / WKEL | SMR / BER / REF | 11.8 | Mdb | YEYE/pupu | ≥ 4 yr. | F |
| 2006 | SMR / LAP / REM | SMR / LIA / REM | 0.6 | Mgo | YEYE/gogo | 3 yr. | M |
| 2006 | SLR / FO 6 | SMR / BS04 | 4.5 | PUWH/Mdb | BKBK | 3 yr. | F |
| 2005 | SMR / AE24 / REM | SMR / LIF / REF | 4.5 | PUYE | Mgo | 4 yr. | F |
| ≤ 2008 | SLR | SMR / YB03 | 2.8 | Mdb | - | ≥ 1 yr. | M |
| ≤ 2008 | SLR | PC / PS09 | 2.5 | Mdb | - | ≥ 1 yr. | M |
| ≤ 2008 | SLR | SMR / HE39 | 8.7 | Mdb | - | ≥ 1 yr. | F |

Table 10. Continued.

| Year Last Detected | Drainage[a] / Territory / Treatment | | Distance Moved (km) | Band Combination[b] | | Age in 2009 | Sex[c] |
|---|---|---|---|---|---|---|---|
| | Last Seen | 2009 | | Left Leg | Right Leg | | |
| ≤ 2008 | SLR | SMR / SG14 | 7.5 | Mdb | - | ≥ 1 yr. | F |
| ≤ 2008 | SLR | SMR / PO15 | 3.8 | Mdb | - | ≥ 1 yr. | F |
| ≤ 2008 | SLR | SMR / BS02 | 3.5 | Mdb | - | ≥ 1 yr. | F |
| ≤ 2007 | SLR | SMO / MT05 | 28.9 | - | Mdb | ≥ 2 yr. | M |
| ≤ 2007 | SLR | SMR / PR43 | 5.4 | - | Mdb | ≥ 2 yr. | M |

[a] Drainage Codes: AL = Aliso Creek; DL = De Luz Creek; LF = Las Flores Creek; PC = Pilgrim Creek; SLR = San Luis Rey River; SMO = San Mateo Creek; SMR = Santa Margarita River; SOF = San Onofre Creek; WC = Windmill Canyon. Treatment Codes: REM = Removal; REF = Reference.

[b] Band colors: Mdb = dark blue numbered federal band; Mgo = gold numbered federal band; Msi = silver numbered federal band; gogo = metal gold; pupu = metal purple; sisi = metal silver; BKBK = plastic black; BKLP = plastic black-light pink split; BWST = plastic blue-white striped; BYST = plastic black-yellow striped; DBDB = plastic dark blue; DBWH = plastic dark blue-white split; DGOR = plastic dark green-orange split; DPDP = plastic dark pink; DPWH = plastic dark pink-white split; LGLG = plastic light green; LPLP = plastic light pink; LPBK = plastic light pink-black split; ORDG = plastic orange-dark green split; OROR = plastic orange; ORPU = plastic orange-purple split; PUOR = plastic purple-orange split; PUPU = plastic 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.

[c] Sex: M = male; F = female

[d] No distance measured because exact origin not known.

[e] Distance derived from nearest potential original territory on the San Luis Rey River.

The 22 first-year vireos from Marine Corps Base Camp Pendleton that were resighted in 2009 dispersed an average of 7.1 ± 21.9 km from their 2008 natal sites (range 0.7-105.0 km for males and 1.2-5.3 km for females; Table 11). Six first-year vireos that fledged from nests outside of Marine Corps Base Camp Pendleton in 2008 (five on the San Luis Rey River and one on the San Diego River) were recaptured and banded with unique color combinations on Base. One female dispersed 5.1 km from the San Luis Rey River to the Santa Margarita River drainage. Two males dispersed 9.1 km and 10.9 km from the San Luis Rey River to Reference sites on Base in 2009. Two other males dispersed 3.0 km and 4.6 km from the San Luis Rey River to the Santa Margarita River and Pilgrim Creek drainages, respectively. One male dispersed 61.3 km from the San Diego River to the Santa Margarita River drainage. Overall, the average distance first-year vireos dispersed from all sites to Marine Corps Base Camp Pendleton was 5.4 ± 11.4 km (SD) ($n$ = 27).

Table 11. Between-year dispersal of Least Bell's Vireos banded as juveniles in 2008, at Marine Corps Base Camp Pendleton in 2009.

| Year Last Detected | Drainage[a] / Territory / Treatment | | Dispersal Distance (km) | Band Combination[b] | | Sex[c] |
|---|---|---|---|---|---|---|
| | 2008 | 2009 | | Left Leg | Right Leg | |
| 2008 | SMR / PEP / REF | SMR / MC17 | 5.0 | PUWH/Mgo | WHPU | M |
| 2008 | SMR / CED / REF | DL / DS22 | 3.9 | BKBK/Mgo | BKBK | M |
| 2008 | SMR / AE23 | SMR / SG25 | 3.8 | DPWH/Mgo | DPDP | M |
| 2008 | SMR / DON / REM | SMR / PO03 | 3.7 | Mgo | WHPU | M |
| 2008 | SMR / CZN / REM | SMR / SG17 | 3.6 | Mgo | WHPU/gogo | M |
| 2008 | SMR / DAQ / REF | SMR / AW35 | 3.6 | Mgo | WHDP/sisi | M |
| 2008 | SMR / ARS / REM | SMR / BN21 | 3.2 | Mgo | BYST/sisi | M |
| 2008 | SMR / HLD / REF | SMR / DEU / REF | 2.7 | Mgo | DPDP/sisi | M |
| 2008 | SMR / HLD / REF | SMR / AE33 | 2.3 | Mgo | ORDG/pupu | M |
| 2008 | SMR / DEU / REF | SMR / HW27 | 2.0 | Mgo | LPBK/sisi | M |
| 2008 | SMR / ATK / REM | SMR / AW24 | 1.6 | YEYE/Mgo | PUPU | M |
| 2008 | SMR / ARH / REM | SMR / ES79 / REM | 1.4 | Mgo | PUOR | M |
| 2008 | SMR / HTI / REF | SMR / HE35 / REF | 1.4 | Mgo | YEPU/sisi | M |
| 2008 | SMR / VEG / REM | SMR / BN40 | 1.4 | Mgo | WHPU/sisi | M |
| 2008 | SMR / TUL / REM | SMR / RR50 | 1.3 | DGOR/Mgo | DGOR | M |
| 2008 | SMR / DEU / REF | SMR / AH32 | 1.3 | Mgo | YEPU | M |
| 2008 | SMR / ZPR / REF | SMR / HE18 / REF | 1.0 | WHWH/Mgo | OROR | M |
| 2008 | SMR / HLD / REF | SMR / HW58 | 0.9 | Mgo | ORPU/sisi | M |
| 2008 | SMR / FIN / REF | SMR / WSP / REF | 0.7 | Mgo | BYST | M |
| 2008 | SMR / HTI / REF | FC / IND | 5.3 | Mgo | PUOR/pupu | F |
| 2008 | SMR / ATT / REM | SMR / MC06 | 1.2 | YEPU/Mgo | WHPU | F |
| 2008 | SMR / QIN / REF | SZ / DUARTE | 105.0 | Mgo | WHWH/gogo | M |
| 2008 | SLR / CSCH | SMR / HW51 / REF | 10.9 | Mdb | WHDB/sisi | M |
| 2008 | SLR / CJET | SMR / DAQ / REF | 9.1 | WHDB/Mdb | DPWH | M |
| 2008 | SLR / DWIL | PC / PS19 | 4.6 | DBWH/Mdb | LPBK | M |
| 2008 | SLR / BLAS | SMR / SE16 | 3.0 | BKLP/Mdb | DPWH | M |
| 2008 | SLR / WRAD | SMR / SE02 | 5.1 | DBWH/sisi | Mdb | F |
| 2008 | SDO / HTS | SMR / HW26 | 61.3 | Mlb | WHWH/gogo | M |

[a] Drainage Codes: DL = De Luz Creek; FC = Fallbrook Creek; PC = Pilgrim Creek; SDO = San Diego River; SLR = San Luis Rey River; SMR = Santa Margarita River, SZ = San Gabriel River. Treatment Codes: REF = Reference; REM = Removal.

[b] Band colors: Mdb = dark blue numbered federal band; Mgo = gold numbered federal band; Mlb = light blue numbered federal band; gogo = metal gold; pupu = metal purple; sisi = metal silver; BKBK = plastic black; BKLP = plastic black-light pink split; BYST = plastic black-yellow striped; DBWH = plastic dark blue-white split; DGOR = plastic dark green-orange split; DPDP = plastic dark pink; DPWH = plastic dark pink-white split; LPBK = plastic light pink-black split; ORDG = plastic orange-dark green split; OROR = plastic orange; ORPU = plastic orange-purple split; PUOR = plastic purple-orange split; PUPU = plastic purple; PUWH = plastic purple-white split; WHDB = plastic white-dark blue split; WHDP = plastic white-dark pink split; WHPU = plastic white-purple split; WHWH = plastic white; YEPU = plastic yellow-purple split; YEYE = plastic yellow.

[c] Sex: M = male; F = female.

Eight other vireos that had been banded off Base were resighted at Marine Corps Base Camp Pendleton in 2009. All carried a single blue numbered federal band indicating that they were originally banded as nestlings on the San Luis Rey River. Four were male and four were

female. We estimated minimum dispersal distances for each bird by measuring the distance between its 2009 location and the closest monitored vireo population where banding has been conducted on the San Luis Rey River. The ages of the birds are unknown as banding has been conducted annually on the San Luis Rey River since 1989. Minimum dispersal distances ranged from 2.5-28.9 km (Table 10).

*Site Fidelity and Movement – Removal and Reference Sites*

Fidelity to treatment type was also very high and did not differ between treatments, as 100% (15/15) of vireos from Removal sites and 95% (19/20) of adult vireos from territories at Reference sites returned to the same treatment type they had defended in 2008 (Table 10). The one vireo that did not return to a Reference site was a female that was documented using a territory 0.4 km away within the same drainage in 2009. Overall, 97% (34/35) of adult vireos that occupied a territory within a monitoring site/treatment type in 2008 returned to the same site/treatment type in 2009.

Twenty-one of the 22 first-year vireos detected in 2009 fledged from either a Removal site or a Reference site and 18 dispersed to territories located within the Santa Margarita River drainage. One male from a Reference site dispersed 3.9 km from his natal site to the De Luz Creek drainage, one female from a Reference site dispersed 5.3 km from her natal site to Fallbrook Creek on FNWS, and one male from a Reference site dispersed 105.0 km from his natal site to the San Gabriel River in the City of Duarte, Los Angeles County. The only other first-year female recaptured in 2009 had dispersed 1.2 km from her natal Removal site to MCAS, also along the Santa Margarita River drainage. Seven males fledged from Removal sites and one returned to a different Removal site (1.4 km from his natal site). The other six dispersed to areas outside of the monitoring sites. Eleven males fledged from Reference sites and three returned to the same Reference site (0.7-1.4 km from their natal sites), one dispersed to a different Reference site (2.7 km), and seven dispersed to areas outside of the monitoring sites. Males from Removal and Reference sites dispersed 0.7-105.0 km from their natal sites.

**Nest Monitoring**

Nesting activity was monitored in a total of 51 territories within the Removal and Reference monitoring areas (Table 12, Figs. 6-9, Appendix D). Of these, 47 territories were "fully" monitored, meaning that all nests within the territory were found and documented during the breeding season. Pairs within the remaining four territories were documented nesting; however, only a subset of nests by a pair was found and monitored ("partially monitored"). A total of 120 nests were monitored during the breeding season; 11 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 109 nests, 105 were in fully monitored territories.

Table 12. Number of Least Bell's Vireo territories and nests monitored at giant reed (*Arundo donax*) Removal and Reference sites on Marine Corps Base Camp Pendleton, 2009.

| | Nest Monitoring Area Type | |
|---|---|---|
| | **Removal** | **Reference** |
| Territories fully monitored | 24 | 23 |
| Nests in fully monitored territories[a] | 53 | 62 |
| Completed nests per pair (fully monitored territories) | 2.04 ± 0.86 (SD) | 2.43 ± 1.04 (SD) |
| Territories partially monitored | 2 | 2 |
| Nests in partially monitored territories[a] | 3 | 2 |
| Total # of nests monitored | 56 | 64 |

[a] Includes incomplete nests.

*Nesting Attempts*

Within fully monitored territories, there was no difference in number of nesting attempts per pair at Removal sites (2.0 nests per pair) and at the Reference sites (2.4 nests per pair; $t$ = 1.42, $P$ = 0.16) over the course of the 2009 breeding season. Fully monitored pairs at Removal sites were as likely to re-nest after their initial attempt as were pairs at Reference sites (Fisher's Exact $P > 0.99$), as 92% of Removal pairs and 87% of Reference pairs initiated a second attempt. Nest fate did not influence the likelihood that pairs would re-nest. At both Removal and Reference sites, all pairs attempted a second nest after a failed first nesting attempt. At Removal sites, 88% attempted to re-nest after a successful nesting attempt (Fisher's Exact $P > 0.99$) and at Reference sites, 57% of pairs attempted second nests after a successful first nesting attempt (Fisher's Exact $P = 0.50$). Overall, 100% (23/23) of vireo pairs attempted to re-nest after a failed first nesting attempt in 2009, similar to the proportion that attempted to re-nest after a failed first nesting attempt in previous years (Fig. 10). The rate of re-nesting attempts following a successful nesting attempt in 2009 (79%; 19/24) was similar to 2008, and higher than in previous years (Fig. 10). Three pairs at Removal sites and nine pairs at Reference sites initiated three nesting attempts, two pairs at Reference sites initiated four nesting attempts, two pairs at Reference sites initiated five nesting attempts, and one pair at Removal sites initiated six nesting attempts in 2009.

The majority of first nesting attempts in 2009 at Removal and Reference sites were initiated during the same week (5–12 April), although one nest at a Removal site was initiated the week before (29 March–4 April). The median date of first nest initiation did not differ between treatment types (median at Removal sites = 16 April, median at Reference sites = 18 April; $t$ = 1.09, $P$ = 0.28). First nesting attempts were initiated early in 2009, similar to 2008, and latest in 2006 (median for 2009 = 17 April; 2008 = 15 April; 2005 = 23 April; 2006 = 10 May; 2007 = 28 April; $F$ = 7.034; $P < 0.001$; Fig. 11).

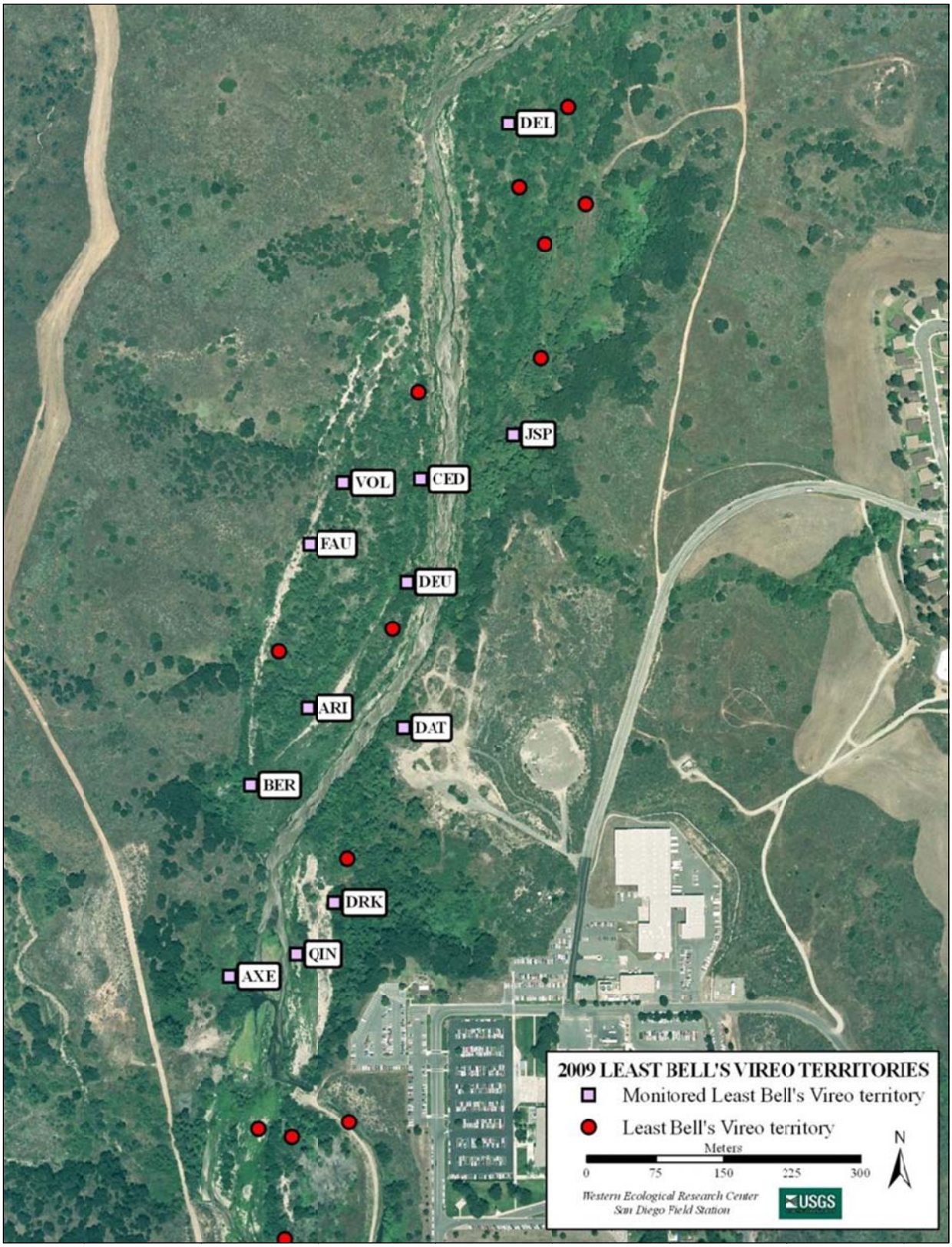


Fig. 6. Locations of monitored Least Bell's Vireo territories at the Above Hospital Reference site, Marine Corps Base Camp Pendleton, 2009.

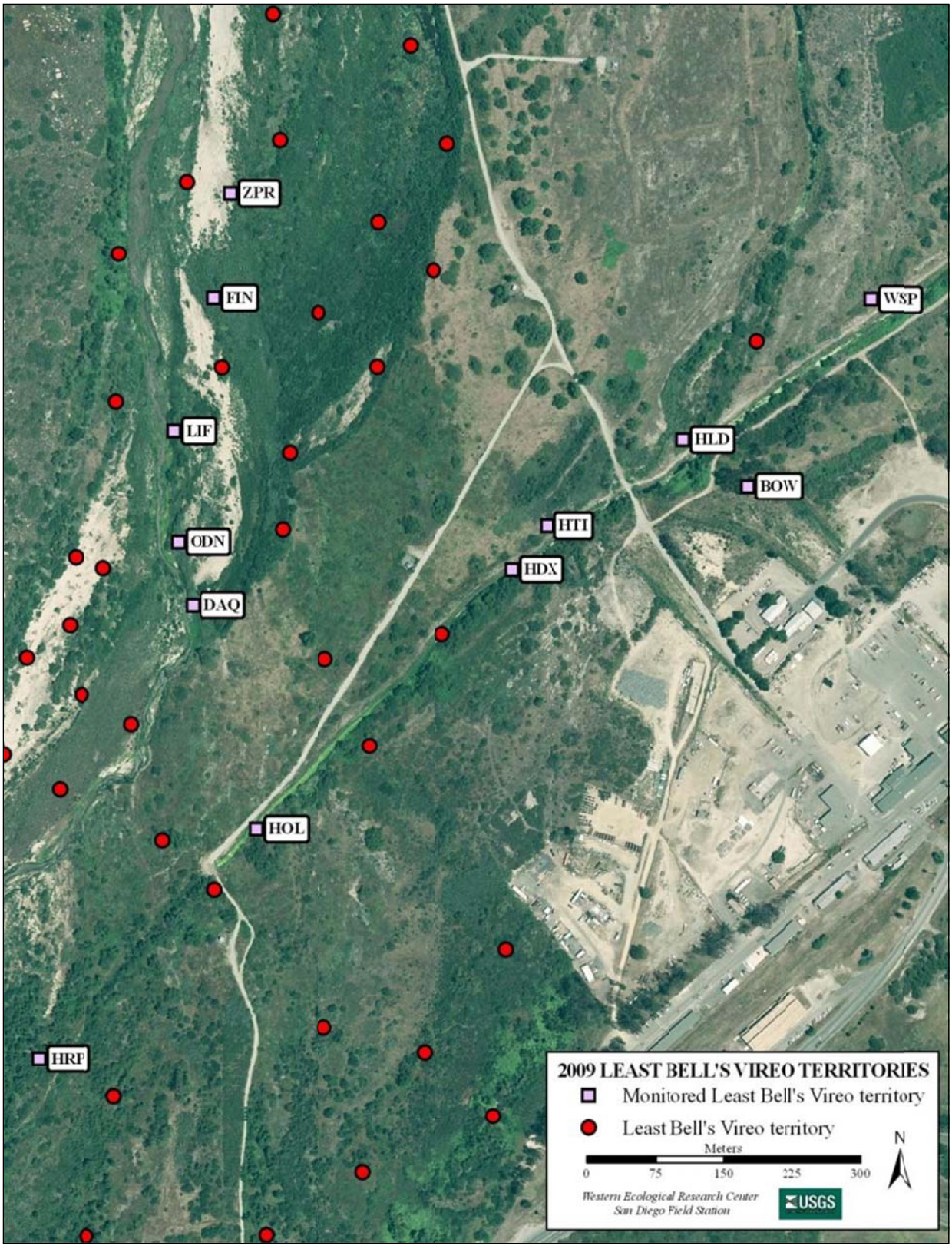


Fig. 7. Locations of monitored Least Bell's Vireo territories at the Below Hospital Reference site, Marine Corps Base Camp Pendleton, 2009.

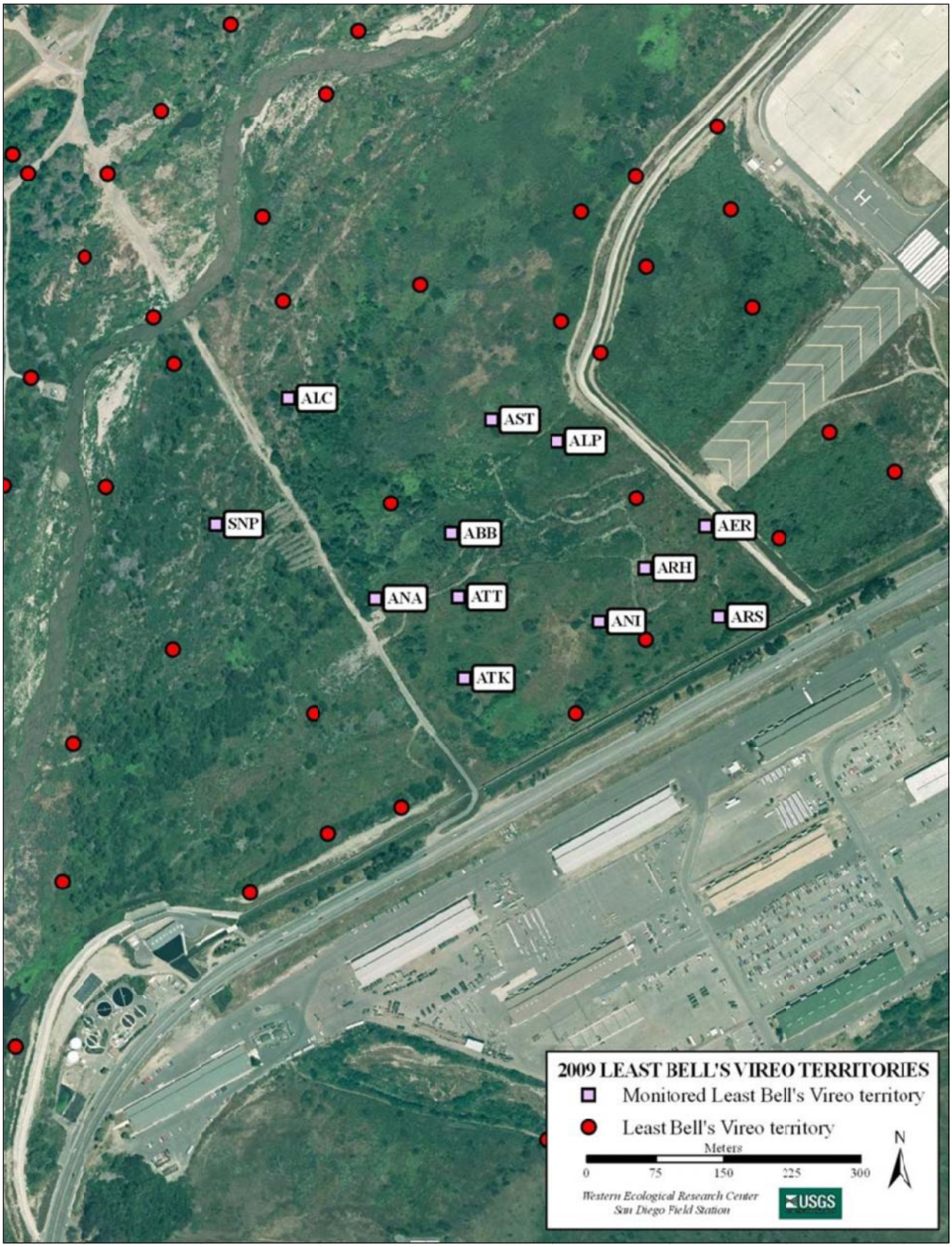


Fig. 8. Locations of monitored Least Bell's Vireo territories at the Air Station giant reed (*Arundo donax*) Removal site, Marine Corps Base Camp Pendleton, 2009.

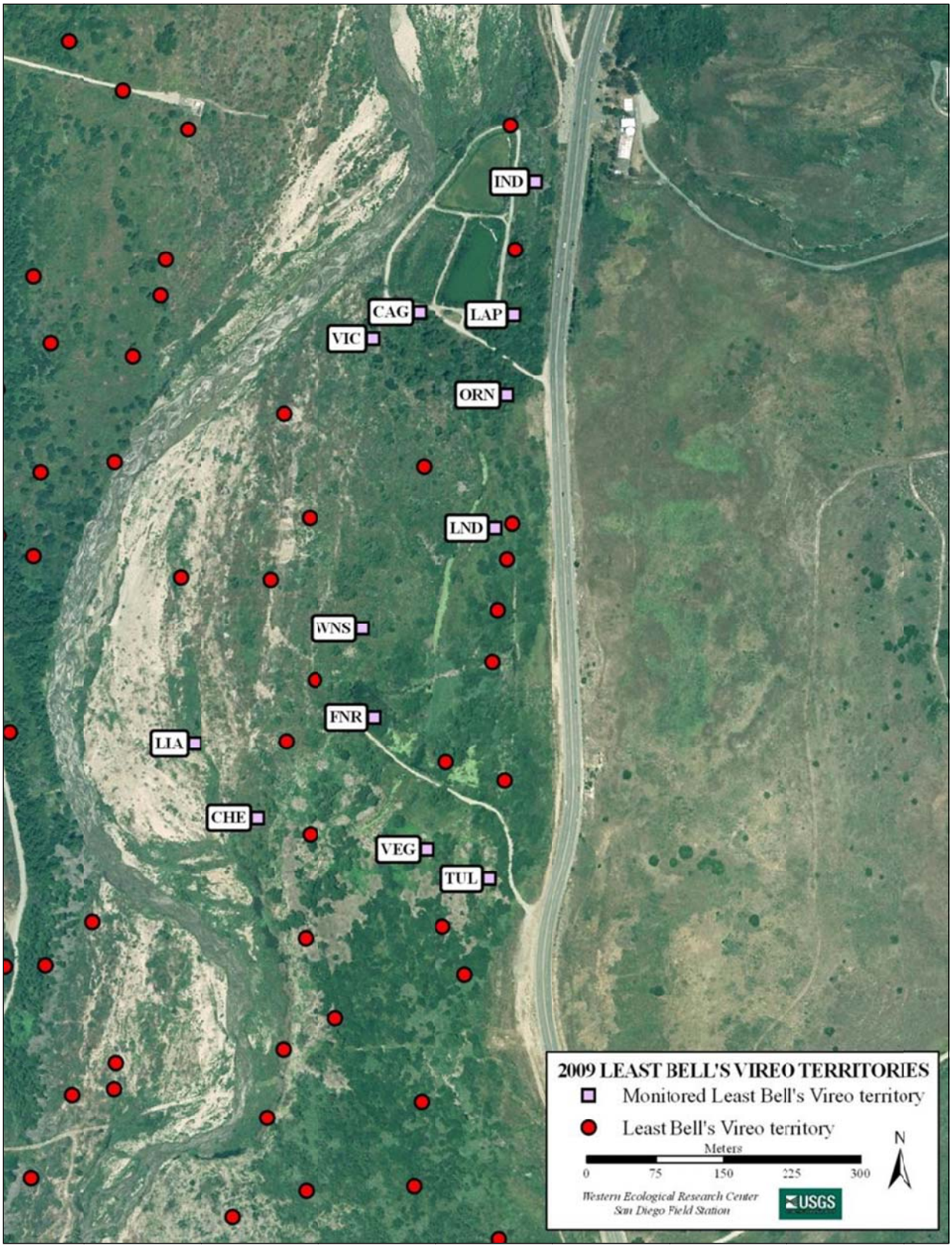


Fig. 9. Locations of monitored Least Bell's Vireo territories at the Seep giant reed (*Arundo donax*) Removal site, Marine Corps Base Camp Pendleton, 2009.

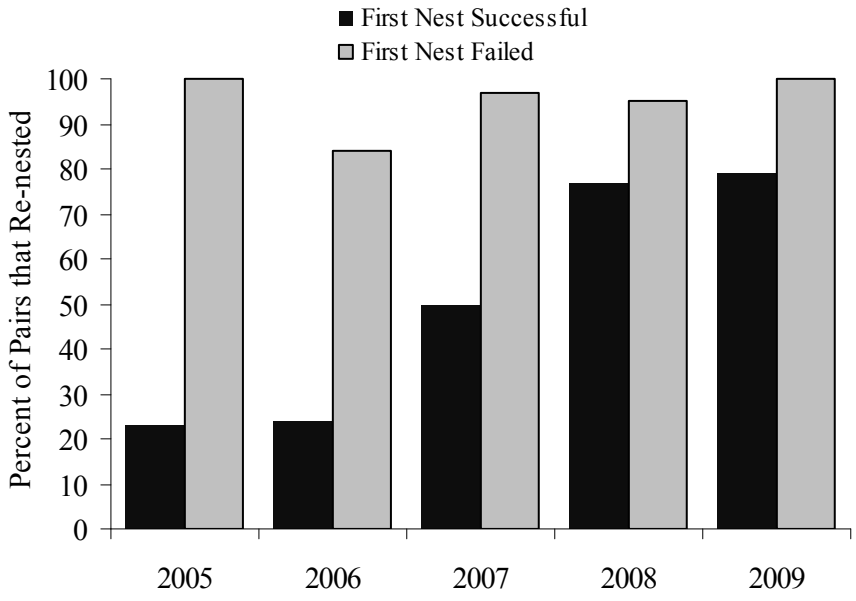


Fig. 10. Percent of vireo pairs that re-nested after a successful or failed first nesting attempt on Marine Corps Base Camp Pendleton, 2005-2009.

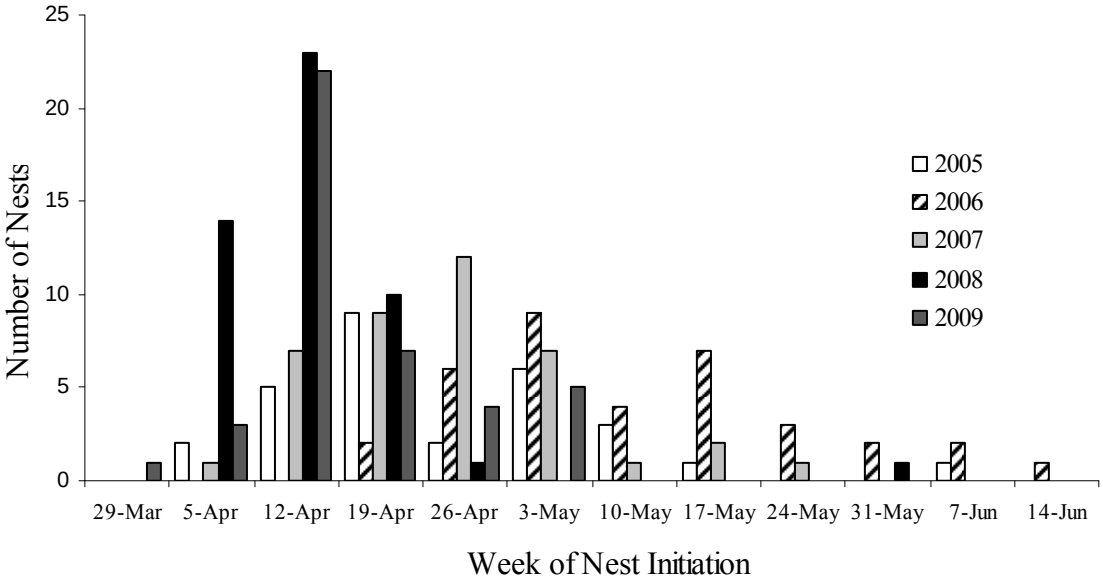


Fig. 11. Number of first Least Bell's Vireo nests initiated by week at Marine Corps Base Camp Pendleton, 2005-2009.

*Nest Success*

Nests in Removal sites were more likely to be successful than nests in Reference sites ($\chi^2$ = 11.74, $P$ = 0.001), as 73% (37/51) of Removal nests successfully fledged young while 38% (22/58) of Reference nests successfully fledged young (Table 13). First nesting attempts were significantly more likely to be successful at Removal sites (71%) than at Reference sites (30%; $\chi^2$ = 6.1; $P$ = 0.01) in 2009 (Fig. 12A). Overall, 51% of first nesting attempts were successful in 2009, which was a higher percentage of successful first nests than all previous years except 2008 (2005 = 39%, 2006 = 40%, 2007 = 26%, 2008 = 61%; $\chi^2$ = 13.2, $P$ = 0.01; Fig. 12B).

Table 13. Fate of Least Bell's Vireo nests in fully and partially monitored territories, Marine Corps Base Camp Pendleton, 2009. Numbers in parentheses are proportions of total nests.

| | Number of Nests | | |
|---|---|---|---|
| **Nest Fate** | **Removal** | **Reference** | **Total** |
| Successful | 37 | 22 | 59 (0.54) |
| Failed | | | |
| Predation | 6 | 35 | 41 (0.38) |
| Parasitism | 0 | 0 | 0 (0.00) |
| Other/Unknown | 8 | 1 | 9 (0.08) |
| Total Completed Nests | 51 | 58 | 109 (1.00) |

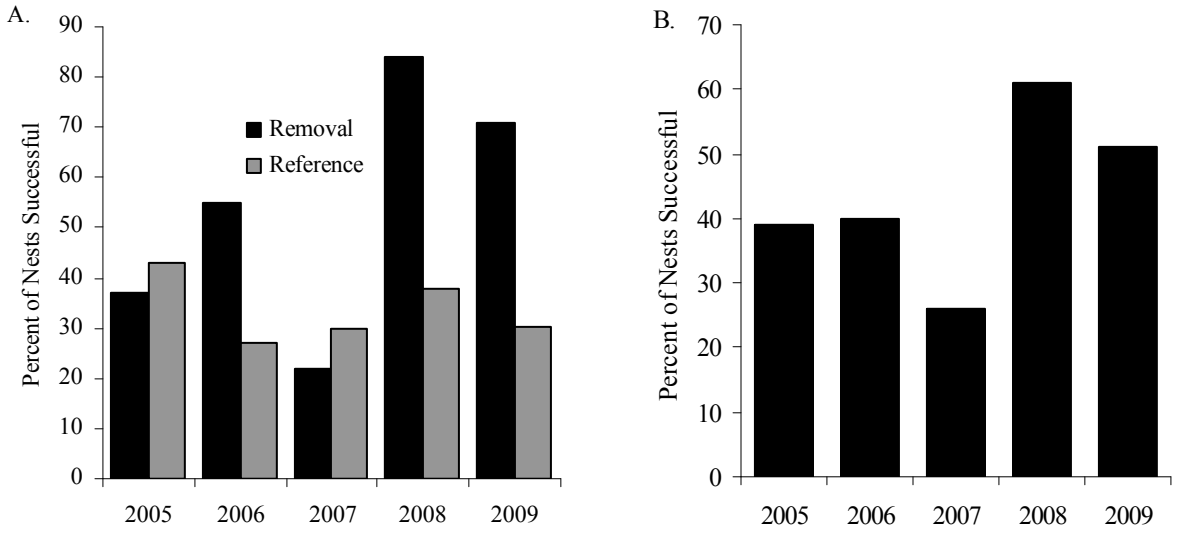


Fig. 12. Percent of successful Least Bell's Vireo nesting attempts (A) for first nests at Removal and Reference sites, and (B) for first overall, on Marine Corps Base Camp Pendleton, 2005-2009.

Causes of nest failure differed between Removal and Reference sites. Predation was believed to be the primary source of nest failure at Reference sites, although no predation events were witnessed (Table 13). Predation accounted for 97% (35/36) of nest failures at Reference

sites and only 43% (6/14) of nest failures at Removal sites. Overall, 60% and 12% of completed vireo nests, respectively, were lost to predation. We also documented nests that failed for other known (not predation) and unknown reasons at our study sites. Two nests at a Removal site failed because the branches supporting the nests broke or caused the nest to move excessively. Two nests at Removal sites failed between nest-building and egg-laying from unknown causes. Three nests at Removal sites were abandoned with eggs (one that failed early may have been disturbed during egg-laying, one was discovered with undamaged and cracked eggs on the ground below the nest, and one failed near hatching and may have contained infertile eggs). One nest at a Removal site failed with nestlings from unknown causes, although one nestling was missing. One nest at a Reference site failed between nest-building and egg-laying from unknown causes.

*Cowbird Parasitism*

No nest parasitism of Least Bell's Vireos by Brown-headed Cowbirds was documented in 2009.

*Productivity*

Clutch size and number of young fledged per pair did not differ between Removal and Reference sites (Table 14). Measures of hatching success were greater at Removal sites. A higher percentage of nests at Removal sites reached the nestling stage (90% vs. 50%; $\chi^2 = 16.7$; $P < 0.01$), translating into a greater percentage of eggs hatching at Removal sites than at Reference sites (81% vs. 52%; $\chi^2 = 29.5$; $P < 0.01$). Measures of fledging success were similar between Removal and Reference sites. Of the nests containing nestlings, a slightly higher percentage of Removal nests (86%) successfully fledged young than Reference nests (81%). Overall productivity per pair was not significantly different at Removal sites (4.1 young per pair) than at Reference sites (3.4 young per pair; Table 14). All (24/24) pairs at Removal sites and 78% (18/23) of pairs at Reference sites were ultimately successful in fledging young from at least one nest. Twelve pairs at Removal (50%) and two pairs at Reference (9%) sites successfully double brooded, fledging young from two nests during the 2009 breeding season. Overall, vireo pairs at monitored sites on Marine Corps Base Camp Pendleton fledged 3.8 vireo young per pair, and 89% (42/47) of all monitored pairs were successful in fledging at least one young in 2009.

Table 14. Reproductive success and productivity of nesting Least Bell's Vireos at giant reed (*Arundo donax*) Removal and Reference sites, Marine Corps Base Camp Pendleton, 2009.

| Parameter | Removal Sites | Reference Sites | Total |
|---|---|---|---|
| Nests with eggs | 48 | 54 | 102 |
| Eggs laid | 162 | 162 | 324 |
| Average clutch size[a] | 3.5 ± 0.6 (SD) | 3.5 ± 0.6 (SD) | 3.5 ± 0.6 (SD) |
| Nests with hatchlings | 43 | 27 | 70 |
| Hatchlings | 132 | 85 | 217 |
| Hatching success: | | | |
| Eggs[b] | 81% | 52% | 67% |
| Nests[c] | 90% | 50% | 69% |
| Nests with fledglings | 37 | 22 | 59 |
| Fledglings | 104 | 68 | 172 |
| Fledging success: | | | |
| Hatchlings[d] | 79% | 80% | 79% |
| Nests[e] | 86% | 81% | 84% |
| Fledglings per egg | 0.6 | 0.4 | 0.5 |
| Fledglings per nest | 2.2 | 1.3 | 1.7 |
| Average number of young fledged per pair[f] | 4.1 ± 2.1 (SD) | 3.4 ± 1.2 (SD) | 3.8 ± 1.8 (SD) |
| Pairs fledging ≥ one young[g] | 24 (100%) | 18 (78%) | 42 (89%) |

[a] Based on 37 Removal and 34 Reference non-parasitized nests with a full clutch ($t$ = -0.10; $P$ = 0.92).
[b] Percent of all eggs that hatched.
[c] Percent of all nests with eggs in which at least one egg hatched.
[d] Percent of all nestlings that fledged.
[e] Percent of all nests with nestlings in which at least one young fledged.
[f] Based on 24 Removal and 23 Reference pairs who were fully monitored (two-sample Mann-Whitney $U$-test; $U$ = 243, $P$ = 0.50).
[g] Based on fully monitored pairs.

*Five-Year Productivity Comparisons*

From 2005-2009, there were no statistical differences documented in average clutch size per pair between Removal and Reference sites when analyzed on an annual basis (Rourke and Kus 2006a, 2007a, 2008, Lynn and Kus 2009, this study; Fig. 13A). When data from 2005-2009 were combined and analyzed using a two-way ANOVA, however, significant differences in average clutch size between years became apparent (Table 15, Fig. 13B), with the average clutch size in 2007 significantly lower than the average clutch size in 2005 and 2008. No difference in clutch size was found between any other pairs of years. Mean clutch size ranged from 3.3 (in 2007) to 3.7 (in 2008).

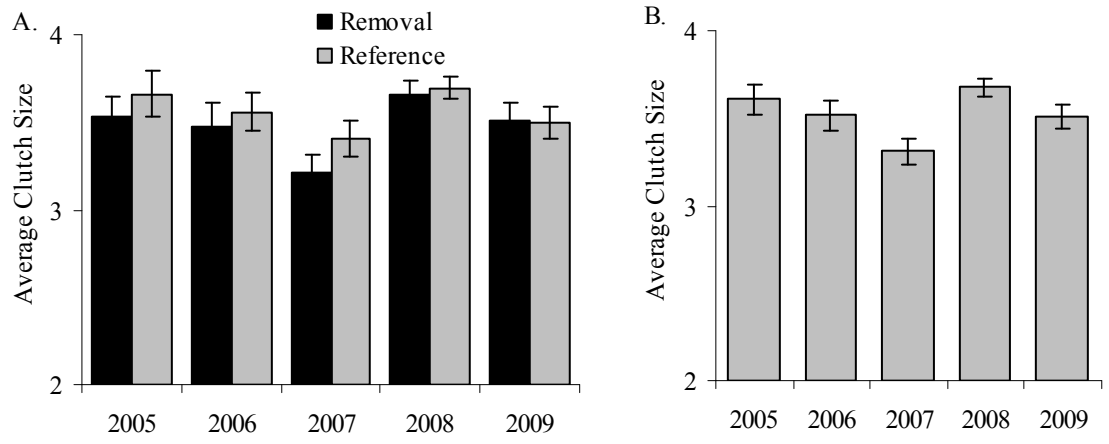


Fig. 13. Average annual Least Bell's Vireo clutch size (± SE) of nests (A) at giant reed (*Arundo donax*) Removal and Reference sites and (B) summarized by year across treatments at Marine Corps Base Camp Pendleton, 2005-2009.

Table 15. Results from two-way ANOVA testing for differences in average clutch size of Least Bell's Vireos nesting at giant reed (*Arundo donax*) Removal and Reference sites at Marine Corps Base Camp Pendleton, 2005-2009.

| Source | SS | df | MS | *F* | *P* |
|---|---|---|---|---|---|
| Treatment | 0.55 | 1 | 0.55 | 1.78 | 0.18 |
| Year | 4.96 | 4 | 1.20 | 4.05 | < 0.01 |
| Treatment * Year | 0.44 | 4 | 0.11 | 0.35 | 0.84 |
| Error | 109.15 | 356 | 0.31 | | |

A similar trend was documented for overall productivity of pairs nesting at Removal and Reference sites from 2005-2007, but not in 2008 and 2009. From 2005-2007, pairs at Removal sites and Reference sites did not fledge different numbers of young per pair (Fig. 14A), however, pairs at Removal sites fledged significantly more young per year than at Reference sites in both 2008 and 2009 (Lynn and Kus 2009, this study; Table 16, Fig. 14A). When data were combined, results from a two-way ANOVA indicated a significant difference in the average

number of young fledged per pair between years, with average number of young per pair significantly higher in 2008 than in all other years and significantly higher in 2009 than in 2006. There was also a significant interaction between year and treatment, with treatment influencing productivity in 2008 and 2009 but not in other years. Mean number of young fledged per pair ranged from 2.4 (in 2006) to 4.4 (in 2008).

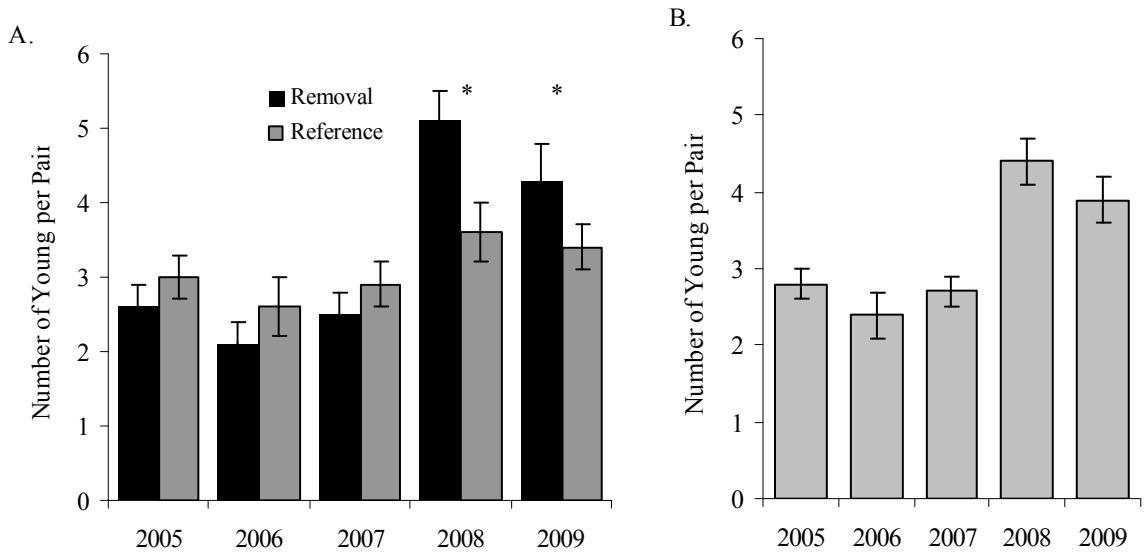


Fig. 14. Average number of Least Bell's Vireo young fledged per pair (± SE) at (A) giant reed (*Arundo donax*) Removal and Reference sites per year (* indicates $P < 0.10$), and (B) summarized by year across treatments at Marine Corps Base Camp Pendleton, 2005-2009.

Table 16. Results from two-way ANOVA testing for differences in the average number of young fledged per pair of Least Bell's Vireos nesting at giant reed (*Arundo donax*) Removal and Reference sites at Marine Corps Base Camp Pendleton, 2005-2009.

| Source | SS | df | MS | *F* | *P* |
|---|---|---|---|---|---|
| Year | 126.85 | 4 | 31.71 | 10.78 | < 0.01 |
| Treatment | 6.41 | 1 | 6.41 | 2.18 | 0.14 |
| Year * Treatment | 48.50 | 4 | 12.13 | 4.12 | < 0.01 |
| Error | 609.03 | 207 | 2.94 | | |

*Nest Survival*

Analysis of DSR across all five years showed that year and type of monitoring site (Removal or Reference) alone were not good predictors of vireo nest survival (Table 17). Although both of these terms appeared in the best supported model, along with the interaction of the two terms, analysis of odds ratios showed that the confidence interval for both terms alone included 1, which indicates that neither year nor type of monitoring site affected vireo nest survival (Table 18). The interaction of year and treatment, however, was a significant predictor

of vireo nest survival, echoing results presented above relating these variables to annual production of fledglings. Vireo nest survival was higher at Removal sites for most years, except in 2007 when there was no difference between DSR at Removal and Reference sites (Fig. 15).

Table 17. Logistic regression models for the effects of year and treatment on nest survival of least Bell's vireos in Reference and Removal sites on Marine Corps Base Camp Pendleton, 2005-2009. Models are ranked from best to worst based on Akaike's Information Criteria for small samples ($AIC_C$), $\Delta AIC_C$, and Akaike weights (w). $AIC_C$ is based on -2 x loge likelihood (L) and the number of parameters (K) in the model..

| Model | Deviance | # Parameters | $AIC_C$ | $\Delta AIC_C$ | $AIC_C$ Weight |
|---|---|---|---|---|---|
| Year + Treatment + Year * Treatment | 1343.33 | 4 | 1351.34 | 0.00 | 0.65 |
| Year + Treatment | 1347.48 | 3 | 1353.48 | 2.15 | 0.22 |
| Treatment | 1350.60 | 2 | 1354.60 | 3.26 | 0.13 |
| Year | 1367.08 | 2 | 1371.08 | 19.74 | 0.00 |
| Constant | 1371.08 | 1 | 1373.08 | 21.74 | 0.00 |

Table 18. Parameter estimates (β), standard error (SE), odds ratios and 95% confidence intervals (CI) for the best supported model explaining daily survival rate of least Bell's vireos at Reference and Removal sites on Marine Corps Base Camp Pendleton, 2005-2009.

| Effect | β | SE | Odds Ratio | 95% CI |
|---|---|---|---|---|
| Year | 0.0104 | 0.0662 | 1.011 | 0.888 – 1.150 |
| Treatment | 0.2005 | 0.2583 | 1.222 | 0.736 – 2.027 |
| Year * Treatment | 0.2202 | 0.1082 | 1.246 | 1.008 – 1.541 |

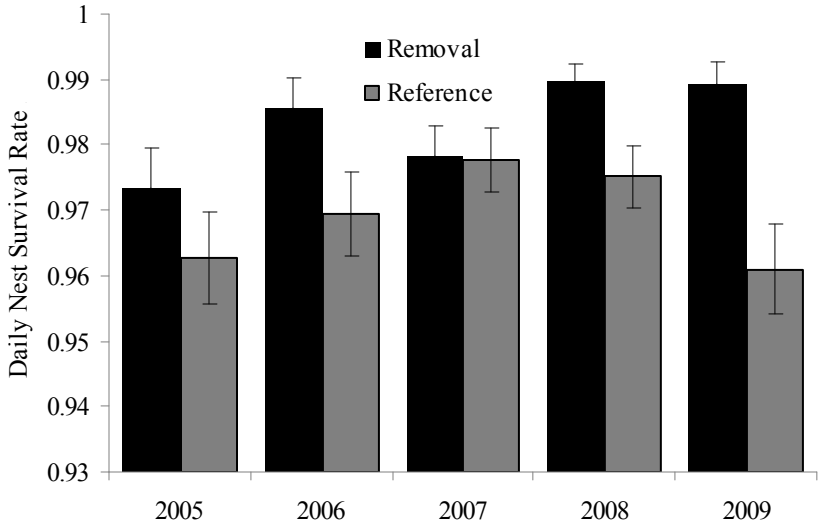


Fig. 15. Daily vireo nest survival rate at Removal and Reference sites on Marine Corps Base Camp Pendleton, 2005-2009.

*Population Density*

The density of the vireo population increased in 2009 at both Removal and Reference sites, and was the highest observed in both sites since 1997 (Fig. 16). Vireo density at Removal and Reference sites was similar in 2009 ($\chi^2$= 0.89, $P$ = 0.34, df = 1). Vireo density at Removal sites was consistently higher than or comparable to that at Reference sites prior to 2001 (when giant reed removal began at our treatment sites). Vireo density at Removal sites was reduced during the two years following treatment, but increased to match that of Reference sites by the third post-treatment year (Griffith Wildlife Biology 2004; Rourke and Kus 2006a, 2007a, 2008, Lynn and Kus 2009).

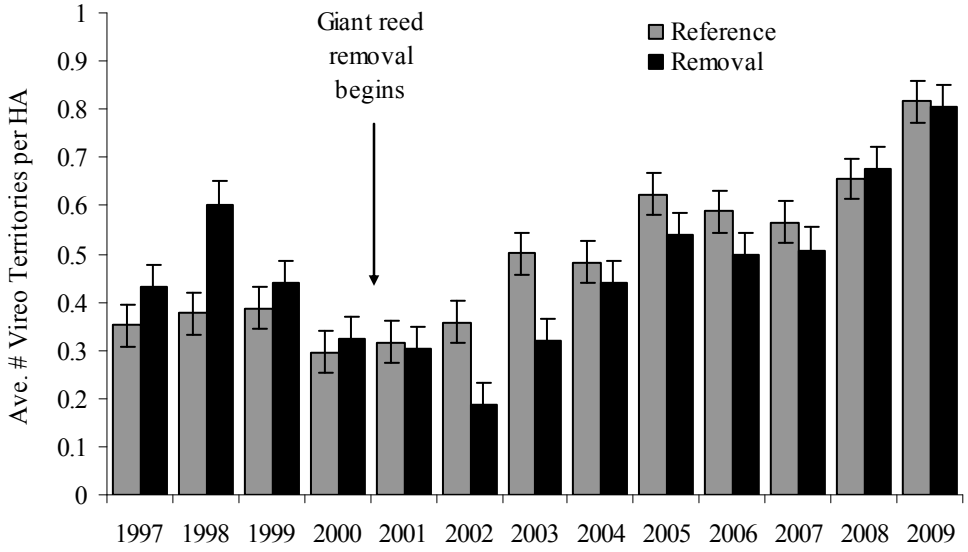


Fig. 16. Annual density of Least Bell's Vireo territories (± SE) at Reference and giant reed (*Arundo donax*) Removal sites by year, averaged across sites. (Source: Griffith Wildlife Biology 2004, Rourke and Kus 2006a, 2007a, 2008, Lynn and Kus 2009).

*Annual Precipitation Effects on Vireo Productivity and Population Size*

Although there were some indications that annual precipitation may be related to vireo productivity (Fig. 17), especially during years with low annual precipitation, we did not find any significant relationships between vireo clutch size ($r$ = 0.69, $P$ = 0.20) or young/pair ($r$ = -0.11, $P$ = 0.86) and annual precipitation. Unlike in 2008, we found that the total number of vireo territories on Marine Corps Base Camp Pendleton, going back to 1997, was not correlated with annual precipitation ($r$ = 0.38; $P$ = 0.21; Fig. 18).

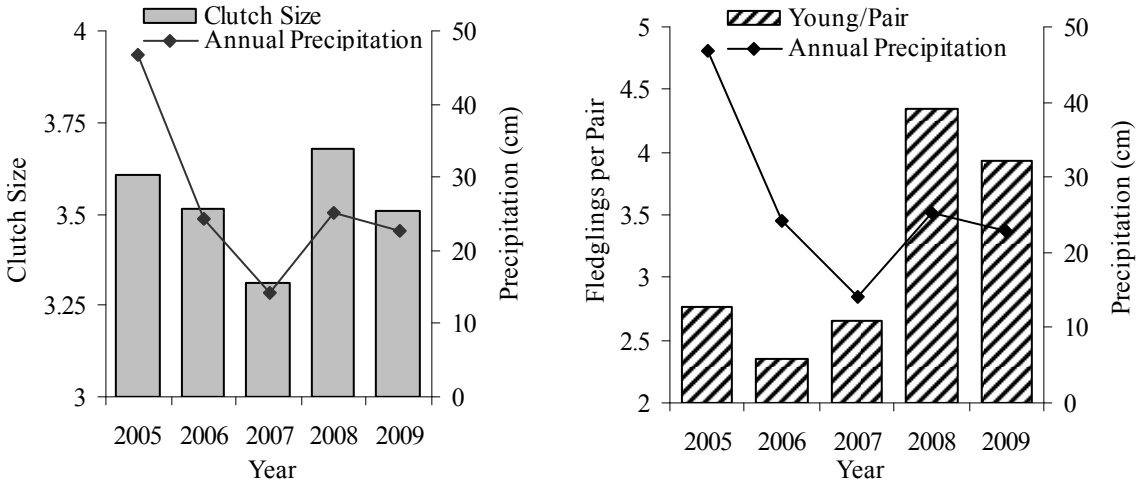


Fig. 17. Average Least Bell's Vireo clutch size and number of young fledged per pair in relation to total precipitation in the preceding bioyear (July – June), 2005-2009.

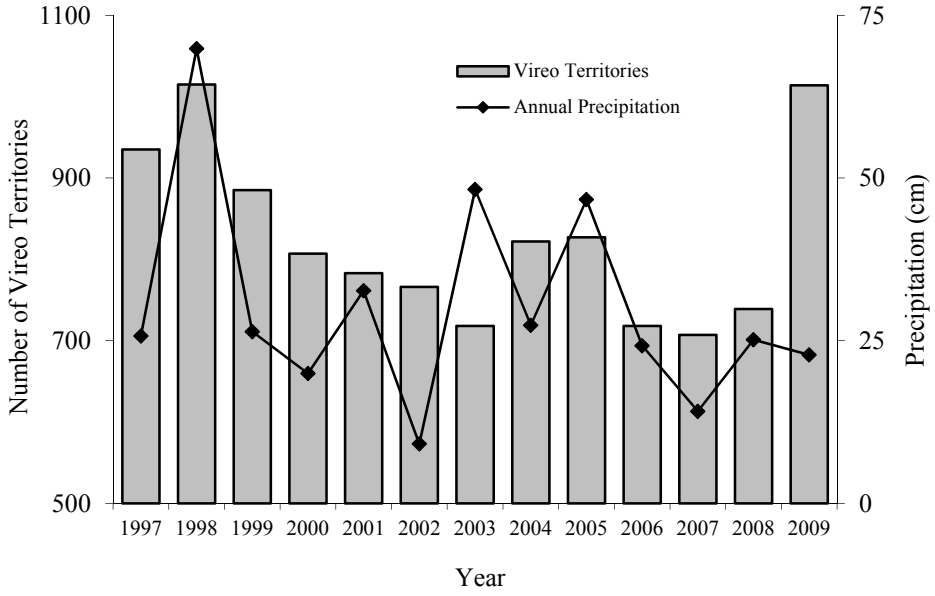


Fig. 18. Relationship between number of Least Bell's Vireo territories on Marine Corps Base Camp Pendleton and total precipitation in the preceding bioyear (July – June), 1997-2009 ($r = 0.38$, $P = 0.21$).

*Nest Characteristics*

Sixteen plant species were used as hosts for vireo nests at Removal and Reference sites in 2009, although not all were used within each treatment (Table 19). Vireos used 9 of the 16 species at Removal sites and 15 of the 16 species at Reference sites. Despite this difference,

vireos at Removal and Reference sites were comparable in their selection of host species, as 63-87% of nests were placed in arroyo willow, sandbar willow, and mule fat (Table 19). Four vireo nests were built in exotic plant species, two in poison hemlock (one at a Removal and one at a Reference site) and two in black mustard (at Reference sites). The remaining 26% of nests were placed in 11 plant species. Of the remaining 11 plant species, 10 were used as host plants at Reference sites and 5 were used as hosts at Removal sites.

Table 19. Host plant species used by Least Bell's Vireos at giant reed (*Arundo donax*) Removal and Reference sites, Marine Corps Base Camp Pendleton, 2009. Numbers in parentheses are proportions of total nests.

| | Number of Nests | |
|---|---|---|
| **Host Species** | **Removal** | **Reference** |
| Arroyo willow | 30 (0.57) | 21 (0.33) |
| Mule fat | 11 (0.21) | 10 (0.16) |
| Sandbar willow | 5 (0.09) | 9 (0.14) |
| Mexican elderberry (*Sambucus nigra*) | 2 (0.04) | 1 (0.02) |
| Poison oak (*Toxicodendron diversilobum*) | 1 (0.02) | 4 (0.06) |
| California blackberry (*Rubus ursinus*) | 1 (0.02) | 3 (0.05) |
| California wild grape (*Vitis californica*) | 0 (0.00) | 3 (0.05) |
| Poison hemlock | 1 (0.02) | 1 (0.02) |
| Black willow | 1 (0.02) | 0 (0.00) |
| California sycamore | 0 (0.00) | 3 (0.05) |
| Mugwort (*Artemisia douglasiana*) | 0 (0.00) | 3 (0.05) |
| Black mustard | 0 (0.00) | 2 (0.03) |
| California wild rose (*Rosa californica*) | 0 (0.00) | 1 (0.02) |
| Coyote brush (*Baccharis pilularis*) | 0 (0.00) | 1 (0.02) |
| San Diego sagewort (*Artemisia palmeri*) | 0 (0.00) | 1 (0.02) |
| Wreath-plant (*Stephanomeria sp.*) | 0 (0.00) | 1 (0.02) |

In 2009, successful and unsuccessful nests within Removal and Reference sites were generally similar in placement. However, at Removal sites, successful nests were placed in significantly shorter hosts than unsuccessful nests and significantly closer to the edge of the host plant and the edge of the riparian vegetation than unsuccessful nests (Table 20). This placement may be explained by higher proportion of larger trees (arroyo willows typically are larger than mule fat and sandbar willows) at Removal sites than at Reference sites. It is possible that vireos may be using host species in proportion to their availability at each site, although we did not collect host plant availability data to verify this. The tendency to use larger trees at Removal sites was confirmed by examining the nest placement characteristics of all nests at Removal sites compared to all nests at Reference sites (Table 20). Vireo nests at Removal sites were placed significantly higher above ground, in taller host plants, further from the edge of the plant in which they were placed, further from the edge of the vegetation clump in which they were placed, and further from the edge of riparian vegetation than nests at Reference sites (Table 20).

Table 20. Least Bell's Vireo nest characteristics and results of Mann-Whitney *U*-tests of successful vs. unsuccessful nesting attempts at giant reed (*Arundo donax*) Removal and Reference sites, Marine Corps Base Camp Pendleton, 2009.

| | Nest Fate | | | | |
|---|---|---|---|---|---|
| **Nest Characteristic** | **Successful** | **Unsuccessful** | ***n*[a]** | ***U*[b]** | ***P*[c]** |
| **Removal Site** | | | | | |
| Average nest height (m) | 0.97 | 0.92 | (36, 13) | 260.5 | 0.55 |
| Average host height (m) | 4.94 | 7.40 | (37, 15) | 189.5 | 0.08 |
| Average distance to edge of host (m) | 0.93 | 1.78 | (37, 15) | 159.5 | 0.02 |
| Average distance to edge of clump (m) | 5.56 | 4.27 | (37, 16) | 320.0 | 0.64 |
| Average distance to edge of riparian vegetation (m) | 115.63 | 168.73 | (38, 19) | 233.5 | 0.03 |
| **Reference Site** | | | | | |
| Average nest height (m) | 0.82 | 0.78 | (21, 40) | 474.5 | 0.41 |
| Average host height (m) | 3.06 | 3.61 | (21, 40) | 370.0 | 0.45 |
| Average distance to edge of host (m) | 0.27 | 0.48 | (21, 42) | 351.0 | 0.19 |
| Average distance to edge of clump (m) | 2.44 | 3.15 | (21, 42) | 435.5 | 0.94 |
| Average distance to edge of riparian vegetation (m) | 31.76 | 38.10 | (21, 44) | 408.5 | 0.45 |
| **Overall** | **Removal** | **Reference** | | | |
| Average nest height (m) | 0.96 | 0.79 | (49, 61) | 930.5 | < 0.01 |
| Average host height (m) | 5.65 | 3.42 | (52, 61) | 825.5 | < 0.01 |
| Average distance to edge of host (m)[d] | 1.17 | 0.41 | (52, 63) | 895.5 | < 0.01 |
| Average distance to edge of clump (m) | 5.17 | 2.91 | (53, 63) | 1053.0 | < 0.01 |
| Average distance to edge of riparian vegetation (m) | 133.33 | 36.05 | (57, 65) | 658.0 | < 0.01 |

[a] *n* = number of nests in sample (Successful, Unsuccessful)
[b] *U* = Mann-Whitney *U* statistic
[c] *P* = P-value

## DISCUSSION

In 2009, the number of documented Least Bell's Vireo territories (1,013) exceeded the greatest recorded number of vireo territories on Marine Corps Base Camp Pendleton over the past 14 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; Fig. 3), although this high number includes MCAS, which is no longer counted as part of the Marine Corps Base Camp Pendleton vireo population. Adding the vireos detected at MCAS in 2009 (Lynn and Kus, in prep.) brings the total vireo population (corresponding to the same areas surveyed in 1998) to 1,031 territories. From 1998-2003, the vireo population steadily declined to 718 territories. In 2004 and 2005, the vireo population increased to 823 and 827 territories, respectively. Between 2006 and 2008, the population decreased again, fluctuating between 707 and 738 territories. In 2009, the vireo population increased by 137 territories from 2008 numbers. This substantial increase can mainly be attributed to higher than usual breeding productivity in 2008, where vireos produced more fledglings than in previous years. Vireo breeding productivity was high in several drainages in San Diego County in 2008 (Ferree and Kus 2009b, Lynn and Kus 2008, 2009, Wellik et al. 2009), and these drainages also showed increased population numbers in 2009 (Ferree and Kus, in prep., Lynn et al. in prep., USGS unpublished data).

Fluctuations in the vireo population on Marine Corps Base Camp Pendleton generally reflect similar population trends along the lower San Luis Rey River, where a gradually increasing population peaked in 2003, then remained relatively stable through 2008, and increased again between 2008 and 2009 (Ferree and Kus 2007, 2008, 2009b, in prep.). The vireo population in the middle San Luis Rey River, between South Mission Road and Interstate 15, has also demonstrated a gradual increase since the mid-1980s, fluctuating between 60 and 80 pairs between 2002 and 2008, then increasing substantially to 109 territories in 2009 (Jones 1985; Kus 1988, 1989, 1991a, 1991b, 1994, 1995; Kus and Beck 1998; Peterson et al. 2002; Rourke and Kus 2006b, 2007b; USGS unpublished data).

The substantial increase in the vireo population on Marine Corps Base Camp Pendleton was not proportional across all drainages. While the Base experienced a 37% increase in vireo territories, the vireo population increased at least 50% along ten drainages and vireos occupied four drainages that had not been occupied since 2005. Vireo populations increased more than 50% in all five of the drainages that were substantially burned in 2007 (Fig. 1). This disproportional increase in vireo numbers in areas recovering from fire may reflect vireo habitat associations, as vireos tend to nest in areas that have a patchy shrub layer that includes willow and mule fat, characteristic of post-fire recovery sites (Ferree and Kus 2009a). The redistribution of the vireo population may also reflect less catastrophic changing conditions at different sites, where habitat suitability changed by gradual alterations in floristic structure or composition.

Redistribution of the vireo population may also be driven by demographic parameters, particularly site fidelity. Male vireos have a strong tendency to return to or near to the same breeding sites each year; however, first-year male vireos tend to disperse from their natal territories. Therefore, younger vireos are more likely to move to colonize new or recovering

habitat that recently became suitable, while older vireos occupying their traditional territories may gradually die off and not be replaced if habitat becomes less suitable.

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. Since 2006, 9-22% of vireos that fledged the previous year survived and were detected holding territories on Base their first breeding year. This first-year survivorship is likely an underestimate because (1) the number is skewed toward male vireos because females are cryptic, and thus more difficult to detect, and so it likely under-represents female survivorship; and (2) the number does not include vireos with single gold numbered bands that may have been banded as nestlings the previous year but could not be confirmed. There was no difference in first-year survivorship between Removal and Reference sites for vireos that hatched in 2008. This suggests that the habitat disturbed the by removal of giant reed has recovered sufficiently so that it no longer differs substantially from naturally occurring riparian vegetation.

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 Marine Corps Base Camp Pendleton. In 2009, two female vireos that had been banded as nestlings on Marine Corps Base Camp Pendleton were detected breeding along the San Luis Rey River. Neither of these females was recaptured to determine their natal year and territory. Since 2006, 35 vireos originally banded on the San Luis Rey River have been resighted on Base, demonstrating that dispersal between the drainages is occurring. In addition, one female vireo that had been banded as a nestling on Marine Corps Base Camp Pendleton was detected breeding along the Sweetwater River (Rogne and Kus, in prep.), one male vireo banded as a nestling along the San Diego River in 2008 was recaptured in his breeding territory along the Santa Margarita River on Marine Corps Base Camp Pendleton, and one male vireo banded as a nestling along the Santa Margarita River, was detected breeding on the San Gabriel River in Duarte, Los Angeles County (B. Daniels, pers. comm.). Finally, a vireo banded as a nestling on Marine Corps Base Camp Pendleton in 2009 was detected in Los Osos, California, near Morro Bay. These movements demonstrate the ability of vireos to disperse far beyond their natal drainages. 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.

Breeding productivity in general, while not reaching 2008 levels, was higher in 2009 than 2005-2007. The proportion of pairs that fledged at least one young overall in 2009 (89%) was similar to previous years (2008 = 94%, 2005 = 89%, 2006 = 79%, 2007 = 89%, and 2008 = 94%; Rourke and Kus 2006a, 2007a, 2008, Lynn and Kus 2009), and echoed the trend in average clutch size. Similar to 2008, the number of young fledged per pair was significantly higher in Removal sites than in Reference sites in 2009, unlike in previous years when pair productivity

did not differ significantly between sites. In 2009, breeding productivity continued to be enhanced by the number of pairs that fledged two broods. In 2009, 14 of 47 pairs fledged two broods (30%), which more closely resembled 2008 (20/51 or 39%) than 2005 (1/33 or 3%), 2006 (2/42 or 5%), and 2007 (4/46 or 9%). Similar to 2008, vireos in 2009 initiated their first nests earlier than in previous years, potentially extending the breeding season and allowing time for multiple successful nesting attempts. Successful nesting attempts take longer than failed attempts, and it is possible that in previous years, vireos with successful early nest attempts may have been less likely to attempt a second brood because what remained of the breeding season was not sufficient to successfully fledge a second nest. Not only did nesting commence early relative to previous years (except 2008), the majority of first nests were successful, enhancing the potential for pairs to double brood.

Our analysis of daily nest survival using MARK supported our findings that reproductive performance of vireos was not negatively influenced by removal of giant reed. The best-fitting model describing nest survival revealed an effect of Treatment in four of the five study years, and showed the effect to be positive, i.e. nest survival was higher in Removal than in Reference sites. Taken together, our results suggest that vireos nesting on Marine Corps Base Camp Pendleton were not adversely affected by vegetation removal operations. Through continued monitoring of areas where giant reed is removed, we will accumulate support for the lack of difference in vireo reproductive success and productivity in Removal and Reference sites.

The proportion of pairs that successfully fledged young was higher at Removal sites than at Reference sites (100% and 78%, respectively). Additionally, the number of pairs that successfully fledged two broods in 2009 was higher at Removal sites (50%) than at Reference sites (9%). We did not measure general habitat, prey, or predator-related variables at Removal and Reference sites to determine what factors may explain this discrepancy. However, assuming that Removal and Reference sites were equal in all characteristics except for our test variable (the timing of giant reed removal), it may be concluded that in recent years (2008 and 2009), Removal sites were superior to Reference sites with respect to vireo breeding habitat. We did not detect significant differences in vireo nesting parameters between giant reed Removal sites and Reference sites, indicating that the process of removing giant reed did not have a negative effect on vireo breeding productivity. We did not measure vireo productivity before or during giant reed removal activities; however, the increase in number of fledglings produced per pair in 2008 and 2009 may indicate that recent giant reed Removal sites are providing better nesting habitat for vireos than the Reference plots. Given the varied results from previous years, 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 giant reed removal has an effect(s) on vireo productivity, we believe the accumulation of data in the future, and potentially increasing the number of sample plots, is warranted.

Vireo territory density did not differ between Removal and Reference sites in 2009. However, we observed a trend in vireo density at Removal sites associated with the timing of giant reed removal. Vireo density was consistently higher at Removal sites than at Reference sites from 1997-2000, before giant reed removal began. From 2000-2002, during the non-breeding season when vireos were absent, giant reed was manually removed and chemically treated at Removal sites (J. Giessow, pers. comm.). Vireo density increased at Reference sites

during this period while density decreased at Removal sites to its lowest point in 2002. Giant reed typically grows in thick stands that crowd out the native plant understory and also frequently the canopy species. Removal of this thick vegetation necessarily entails clearing of vegetation in the area, leaving a somewhat sparse understory and therefore little breeding habitat for vireos. As the native understory and canopy plant species recover, we would expect to see a corresponding recovery in vireo numbers. In 2003, vireo density began increasing at Removal sites, presumably in response to recovery of understory vegetation, and surpassed Reference sites by 2005. Since 2005, vireo density at Removal sites has been similar to that at Reference sites, and reached a high point of 0.8 vireos per ha in 2009.

Annual precipitation for the bioyear preceding the 2009 breeding season continued below the average for the past 13 years (30.2 cm). Despite the sparse precipitation, we saw an increase in vireo breeding productivity in 2008 and 2009 (clutch size and number of young fledged per pair) over 2006 and 2007. Although annual differences in the amount and timing of precipitation may affect vireo productivity by increasing primary productivity and prey numbers, we were not able to detect strong associations between annual precipitation and our measures of vireo productivity. Greater precipitation was associated with higher productivity in song sparrows (*Melospiza melodia*) in a long-term study and also Darwin's finches (*Geospiza* spp.) in extreme conditions (Boag and Grant 1984, Grant and Grant 1987, Chase et al. 2005). Conversely, Paxton et al. (2007) found very low productivity in Southwestern Willow Flycatchers associated with a year of extreme drought. Our five-year time frame may not be sufficient to detect these annual differences. Although we did detect a positive association between annual precipitation and total number of vireo territories detected on Base between 1997 and 2008, this relationship did not hold for 2009. Because vireos do not winter on Base and the bulk of the annual precipitation occurs when vireos are not present, a direct connection between vireo numbers and precipitation is not clear.

Nest site characteristics did not differ greatly between successful and unsuccessful nests, either at Reference sites or at Removal sites. Similarly, Kus et al. (2008) found that fine-scale and intermediate-scale nest placement factors were not significantly related to nest survival along the San Luis Rey River, just south of Marine Corps Base Camp Pendleton. However, we found that nest placement in 2008 and 2009 was significantly different between Removal and References sites, and may have contributed to the higher productivity of vireo pairs at Removal sites. At Removal sites, nests were placed higher and further from the edge of the host plant, the nest vegetation clump, and the riparian vegetation than at Reference sites. Further investigation into habitat variables at these sites may explain whether or not nest placement is a factor of what is available or if vireos are selecting particular nest sites out of proportion to their availability.

## CONCLUSIONS

Generally, the vireo population on Marine Corps Base Camp Pendleton has tracked the overall increase in Least Bell's Vireos in southern California since the late 1970s (USFWS 2006). This population increase can be attributed, at least partially, to management actions, including control of Brown-headed Cowbirds and protection and restoration of riparian habitat. On Marine Corps Base Camp Pendleton, Brown-headed Cowbird control has reduced cowbird parasitism to a negligible level since the mid-1990s, releasing a major limit on vireo breeding productivity. There was no cowbird parasitism documented on Marine Corps Base Camp Pendleton during 2009. Cowbird control has a demonstrably positive effect on vireo productivity (Kus 1999, Kus and Whitfield 2005), but must be constantly practiced to maintain the pressure on cowbird populations.

Control of giant reed and other invasive riparian plant species has increased vireo breeding habitat, also contributing to increases in the vireo population. We expected short-term negative responses by vireos to the removal of the understory at giant reed Removal sites. Vireos did experience a short-term dip in population density immediately following the removal of giant reed, but there was little evidence that vireo reproductive indices experienced a similar dip. In fact, it is evident that although there may have not been as many vireos breeding at the Removal sites immediately following giant reed removal, vireo reproductive success was never lower at Removal sites than at Reference sites, indicating that giant reed removal did not negatively impact vireo breeding productivity. Further investigation into habitat, prey, and predation pressures as associated with vireo breeding productivity would likely help to tease out the variables that directly affect vireo productivity and may be subject to management actions to help augment vireo populations.

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## APPENDIX A

## LEAST BELL'S VIREO SURVEY AREAS AT MARINE CORPS BASE CAMP PENDLETON, 2009

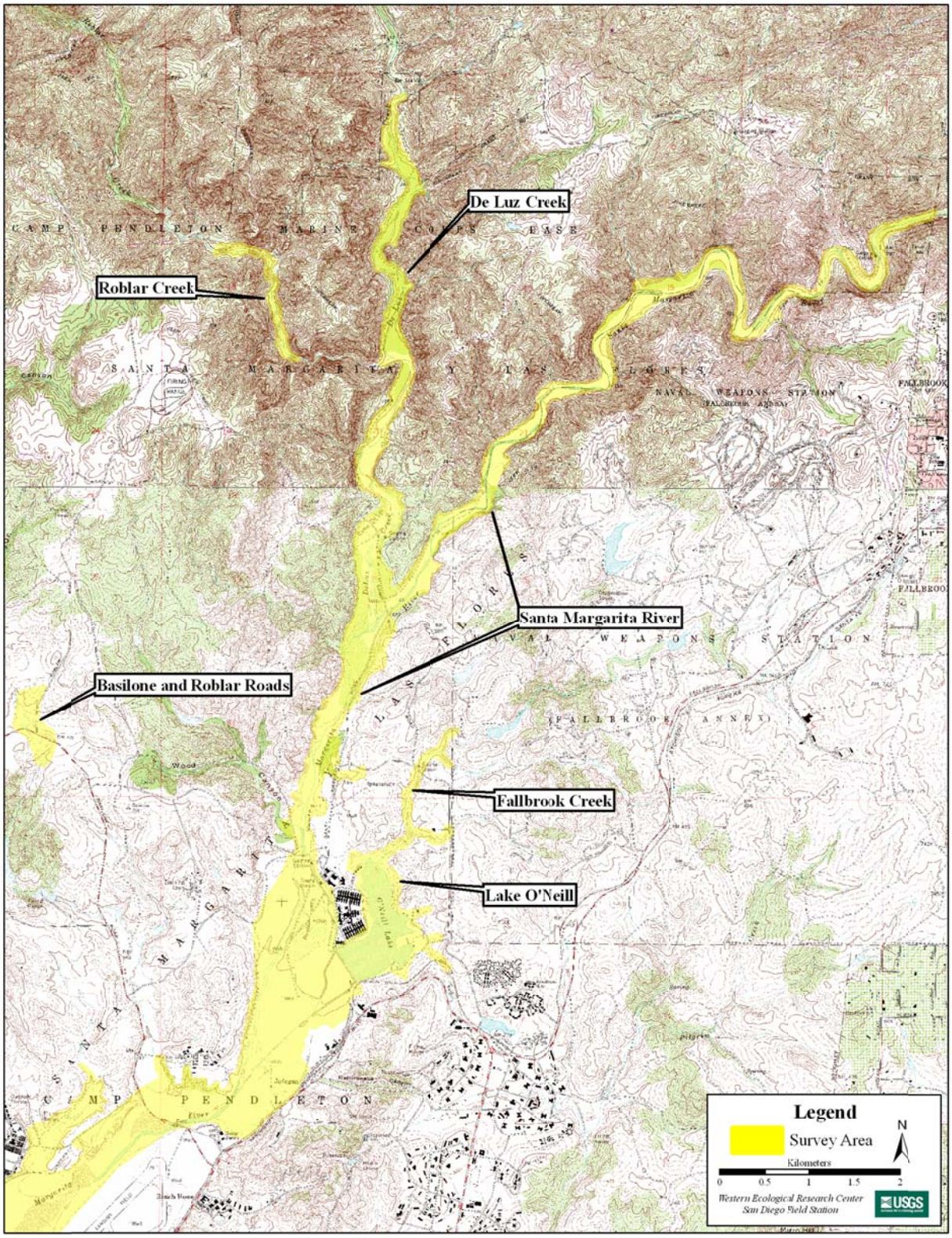


Fig. 18. Least Bell's Vireo survey areas at Marine Corps Base Camp Pendleton, 2009: Upper Santa Margarita River, Fallbrook Creek, Lake O'Neill, De Luz Creek, Roblar Creek, and Basilone and Roblar Roads.

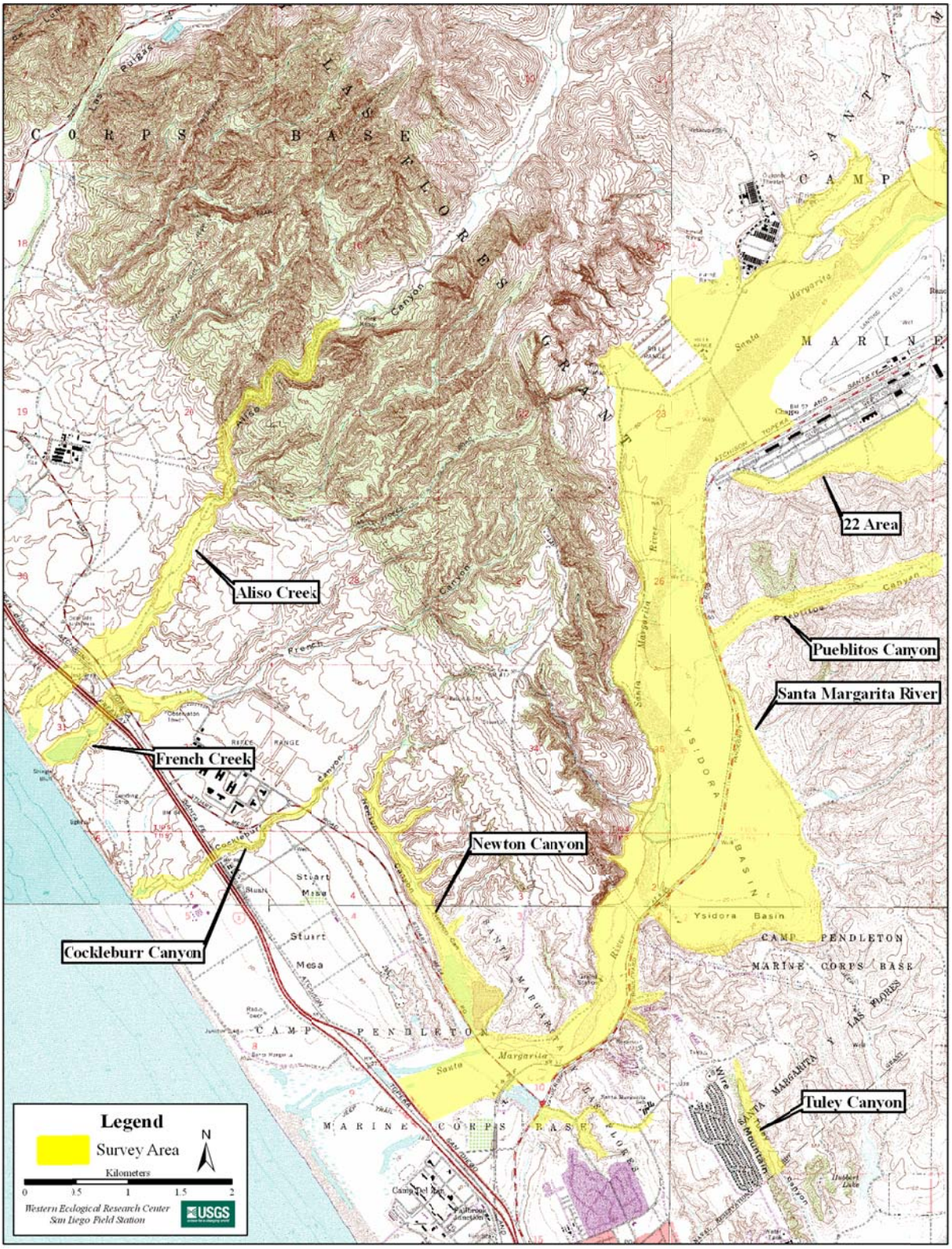


Fig. 19. Least Bell's Vireo survey areas at Marine Corps Base Camp Pendleton, 2009: Lower Santa Margarita River, 22 Area, Pueblitos Canyon, Tuley Canyon, Newton Canyon, Cockleburr Canyon, French Creek, and Aliso Creek.

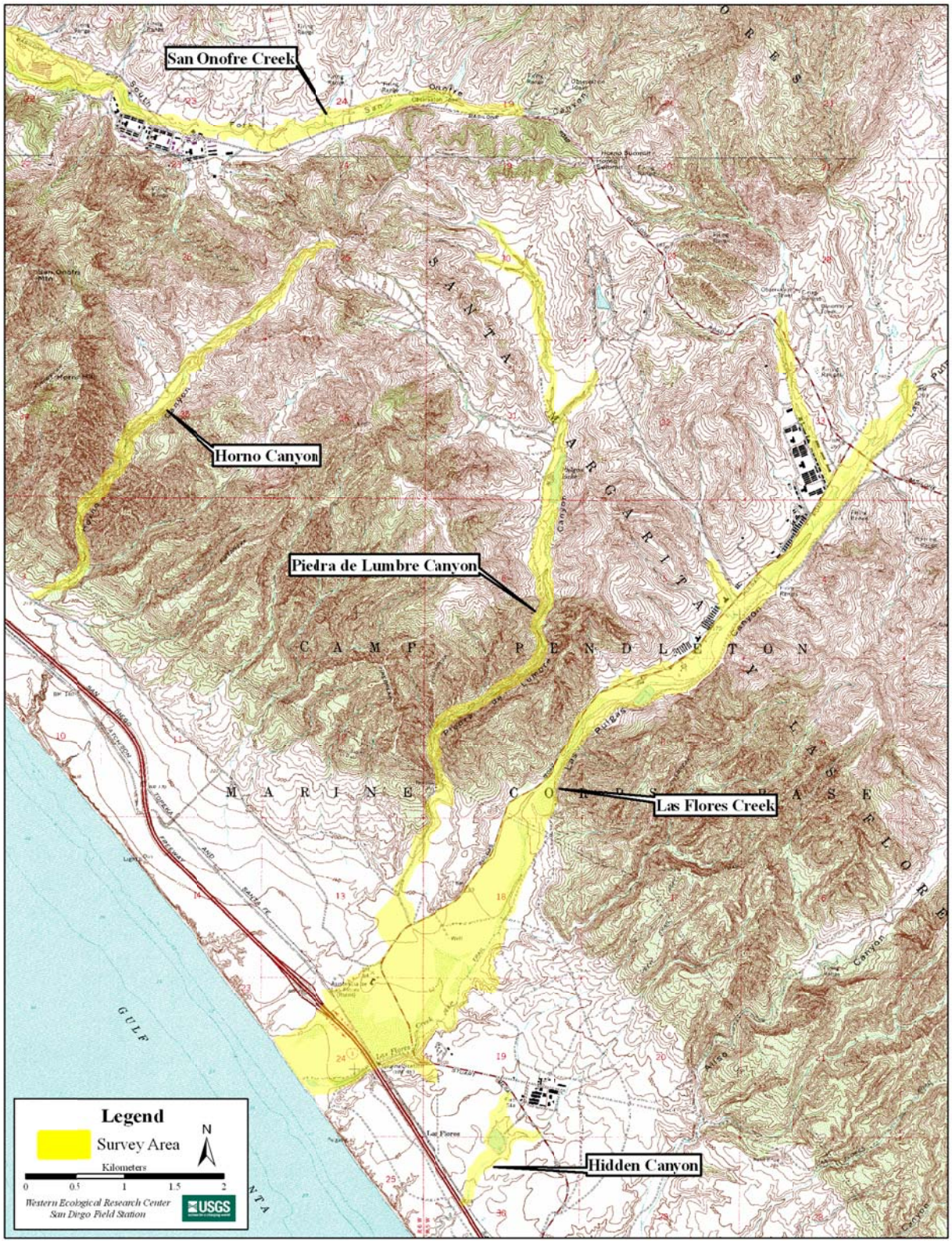


Fig. 20. Least Bell's Vireo survey areas at Marine Corps Base Camp Pendleton, 2009: San Onofre Creek South Fork, Horno Canyon, Piedra de Lumbre Canyon, Las Flores Creek, and Hidden Canyon.

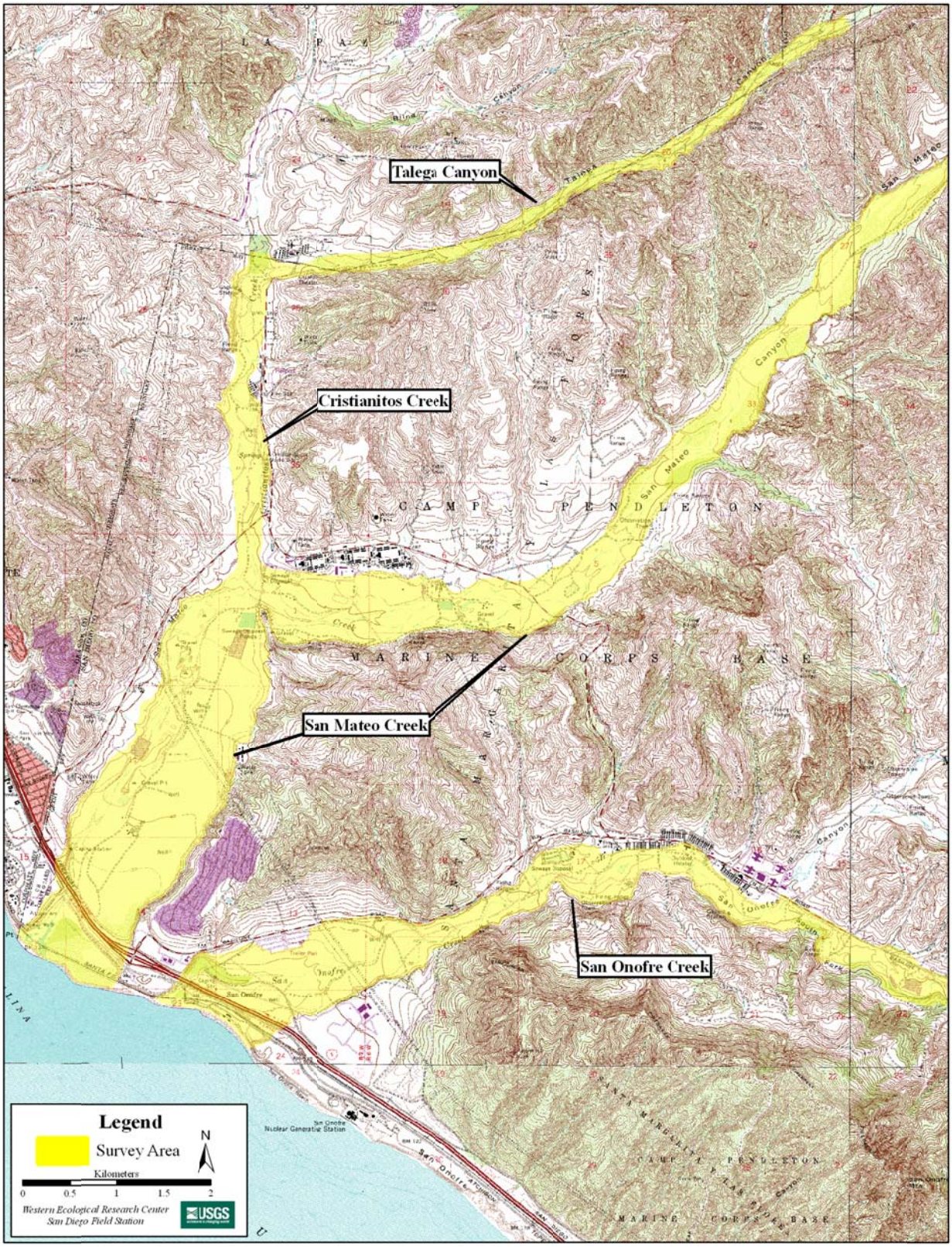


Fig. 21. Least Bell's Vireo survey areas at Marine Corps Base Camp Pendleton, 2009: Talega Canyon, Cristianitos Creek, San Mateo Creek, and San Onofre Creek.

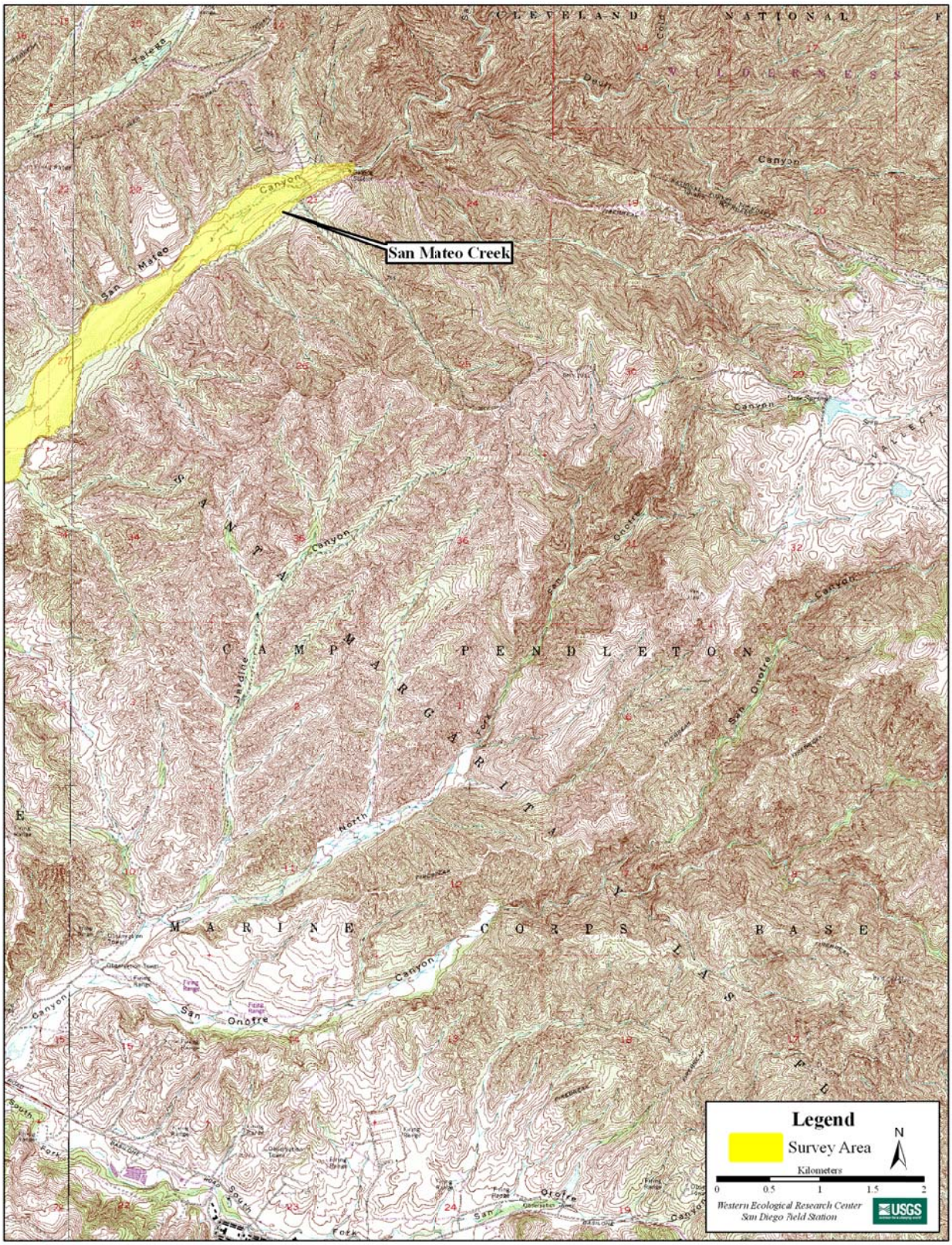


Fig. 22. Least Bell's Vireo survey areas at Marine Corps Base Camp Pendleton, 2009: Upper San Mateo Creek.

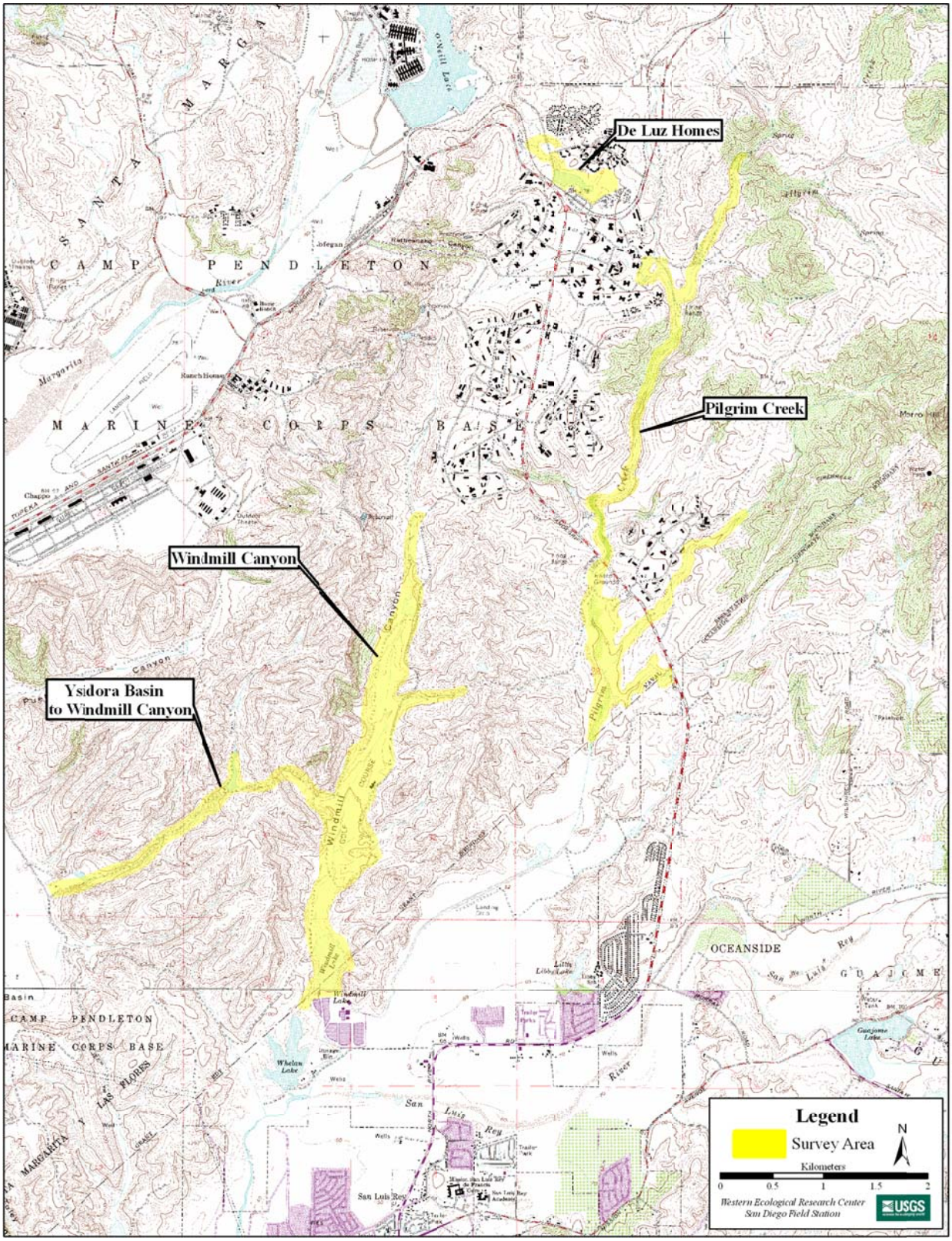


Fig. 23. Least Bell's Vireo survey areas at Marine Corps Base Camp Pendleton, 2009: Windmill Canyon, Ysidora Basin to Windmill Canyon, Pilgrim Creek, and De Luz Homes Habitat.

## APPENDIX B

## LOCATIONS OF LEAST BELL'S VIREOS AT MARINE CORPS BASE CAMP PENDLETON, 2009


Fig. 24. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2009: Upper Santa Margarita River.

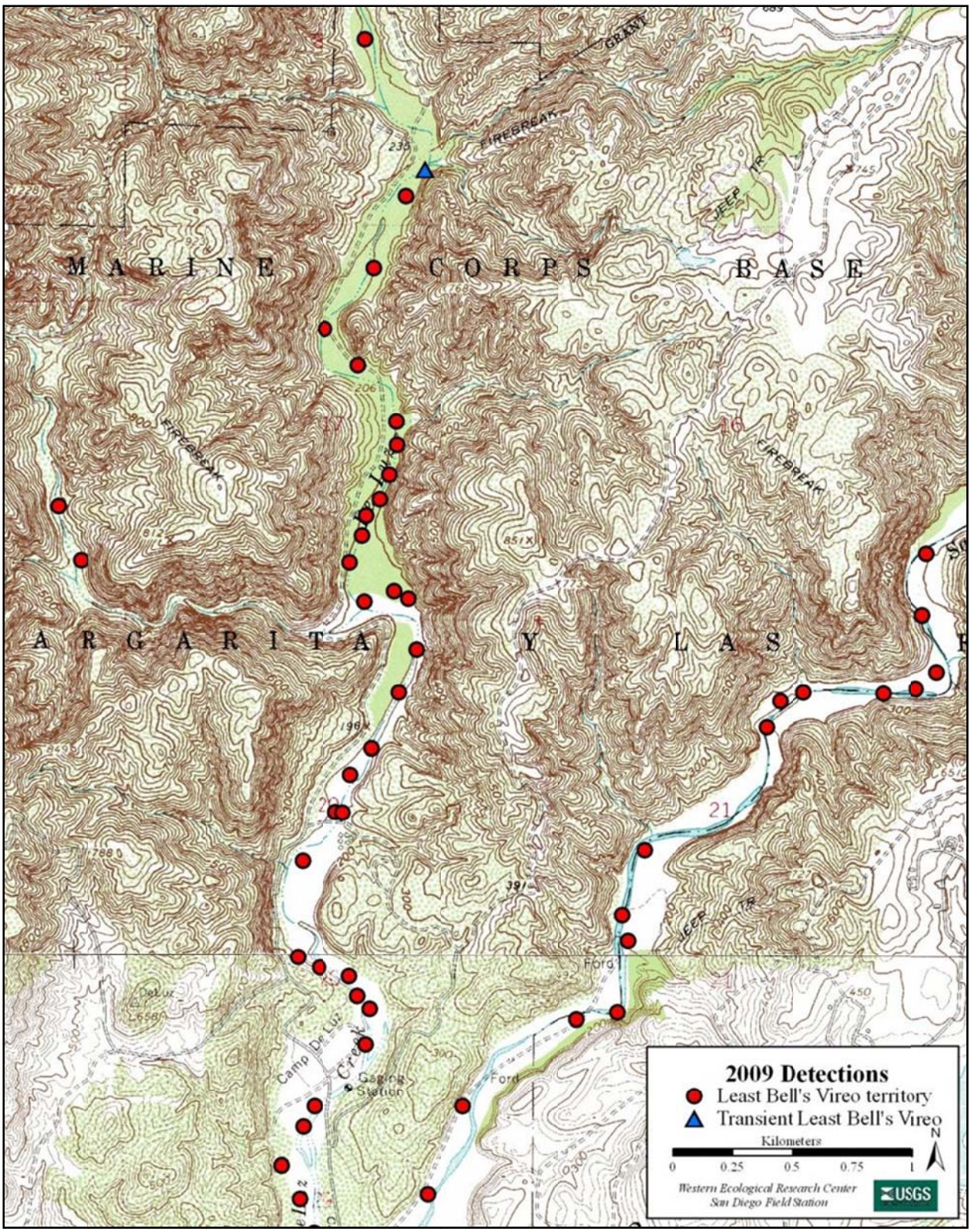


Fig. 25. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2009: Upper Santa Margarita River, De Luz Creek, and Roblar Creek.

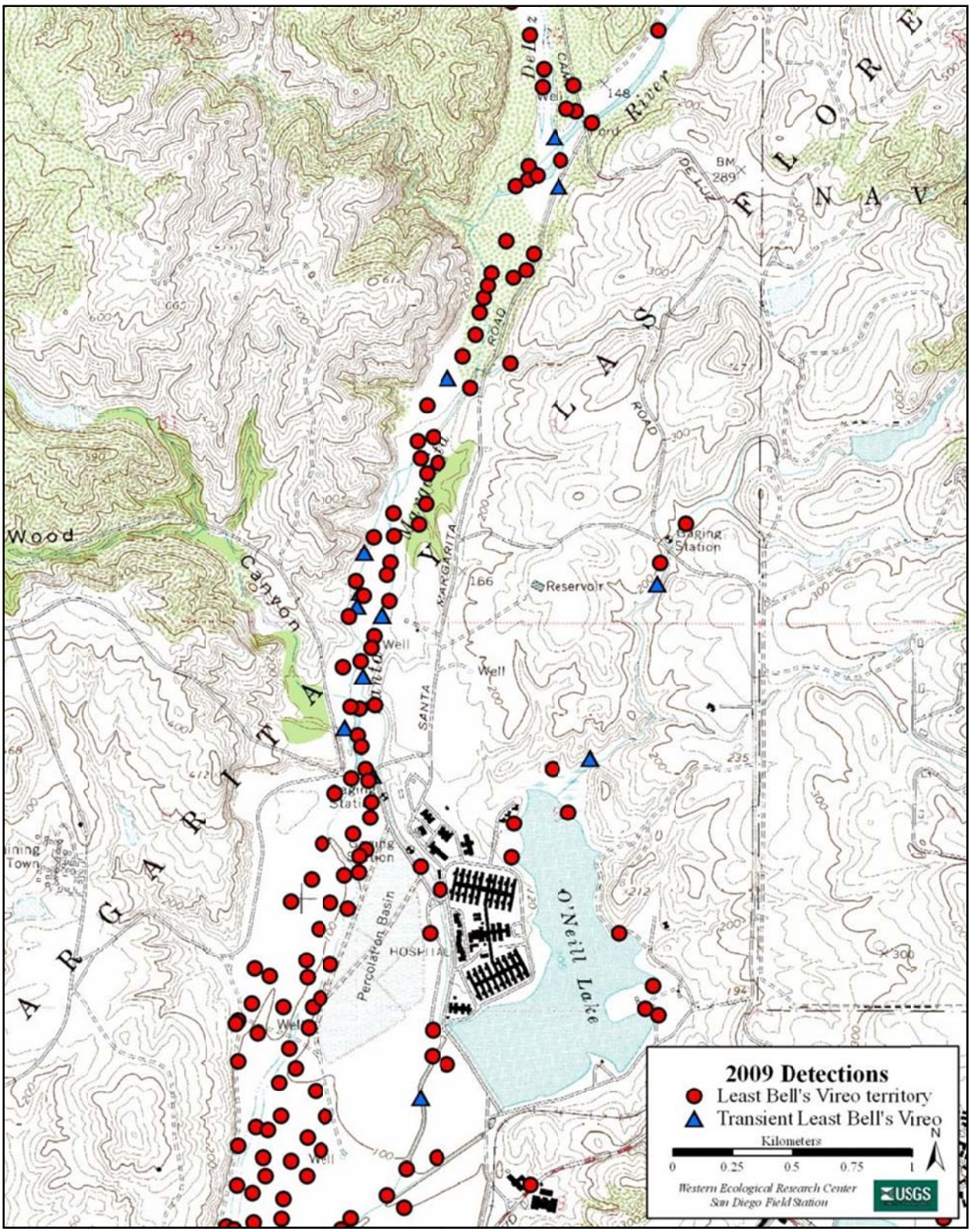


Fig. 26. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2009: Santa Margarita River, Lake O'Neill, and Fallbrook Creek.

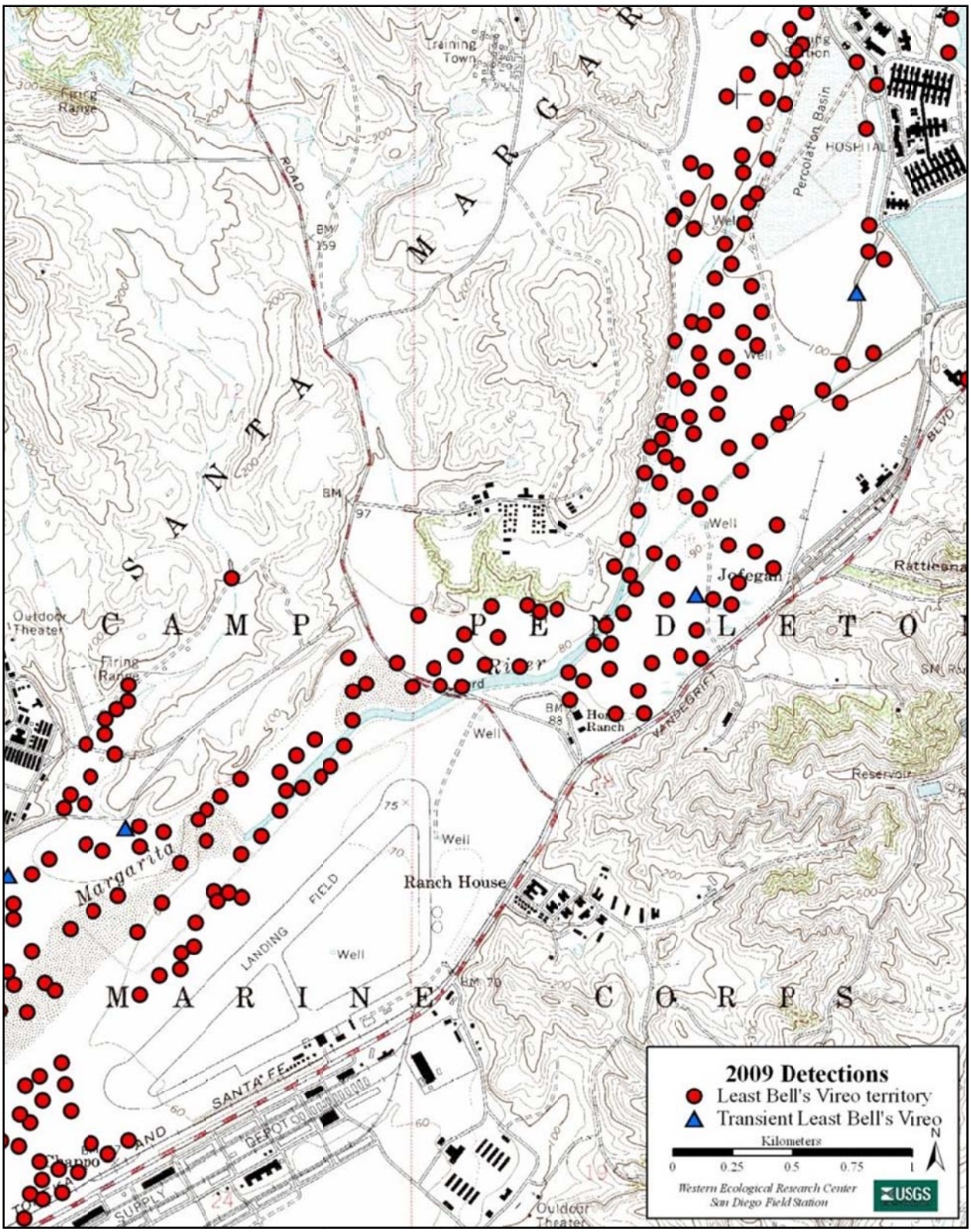


Fig. 27. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2009: Santa Margarita River.

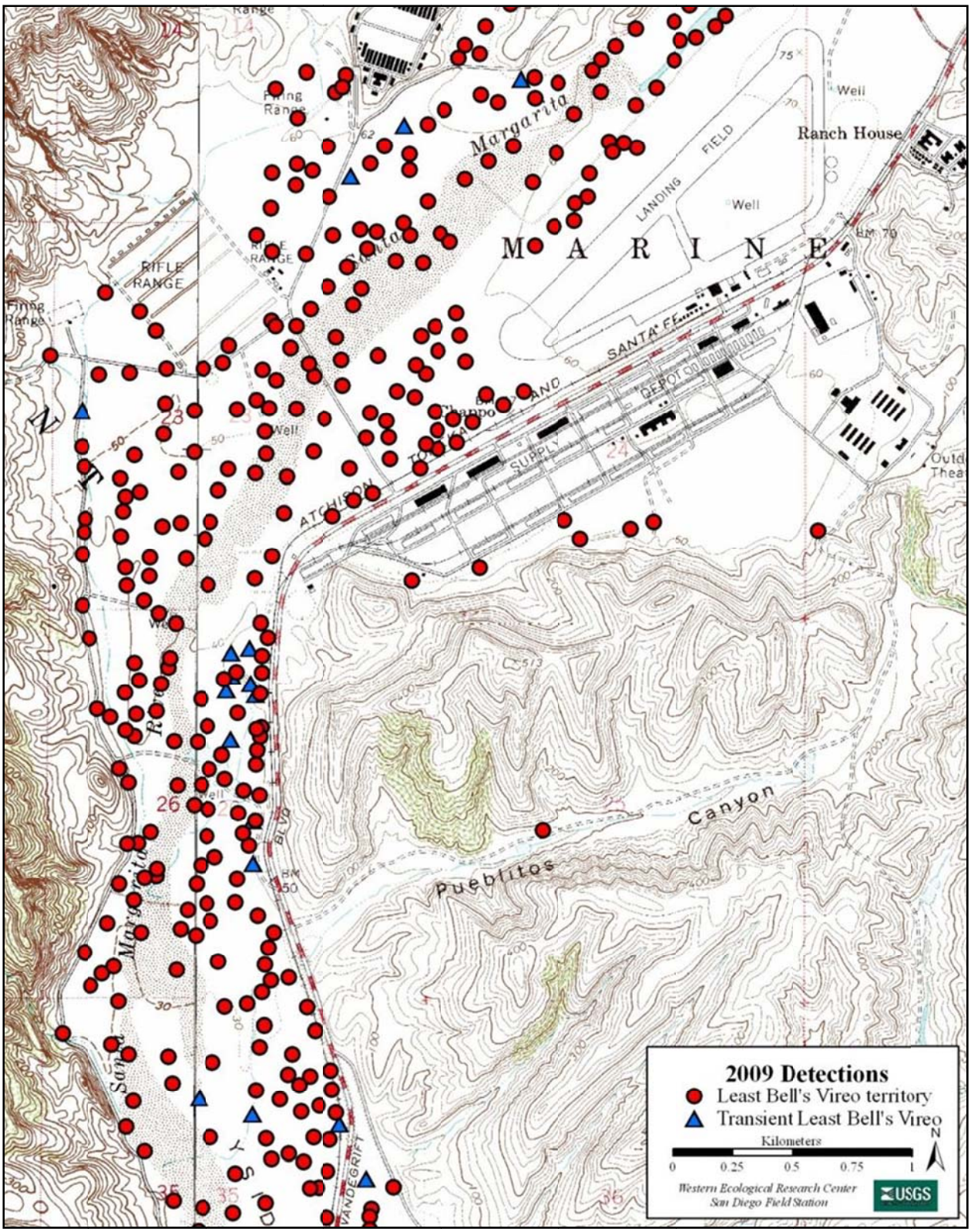


Fig. 28. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2009: Santa Margarita River, 22 Area, and Pueblitos Canyon.

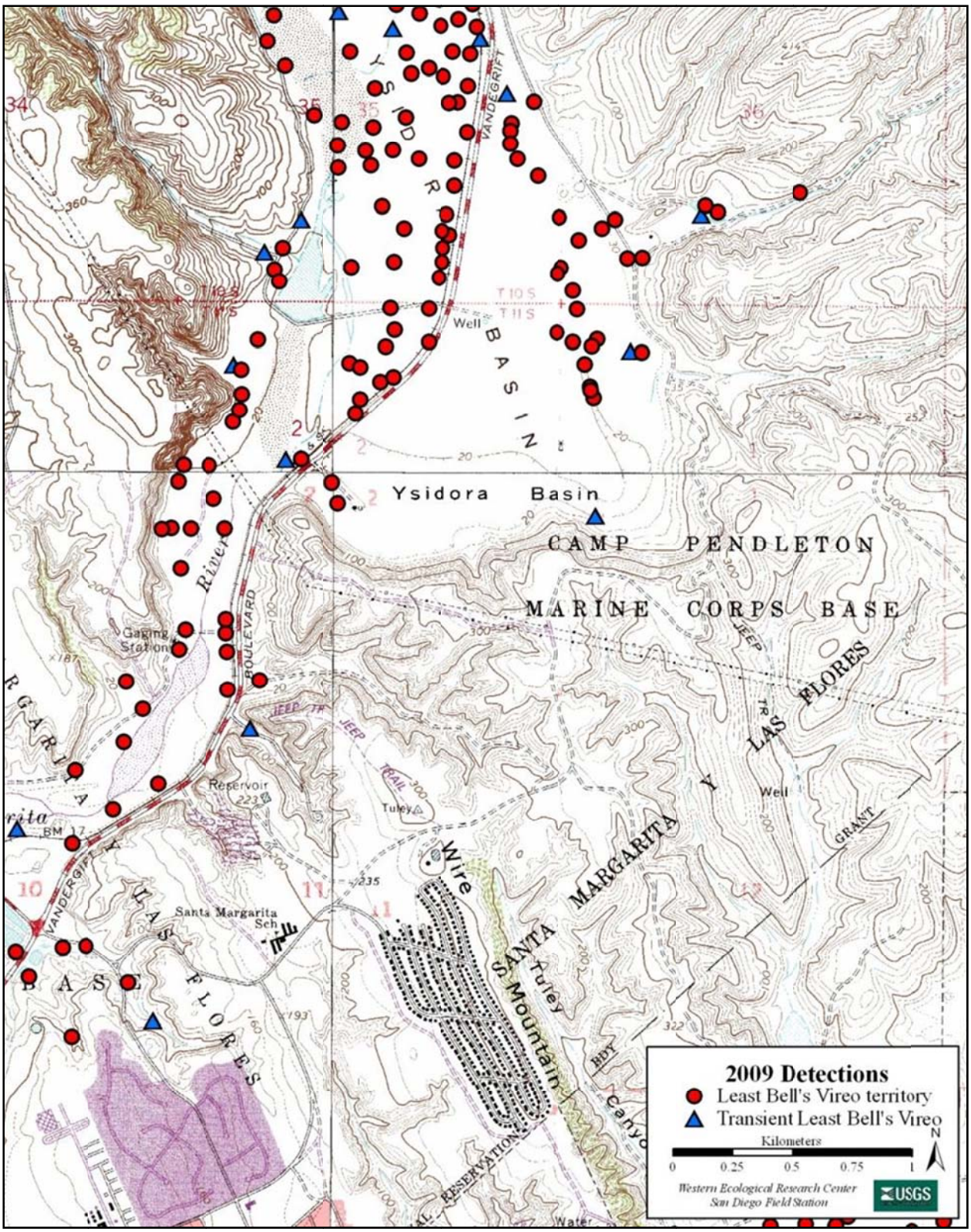


Fig. 29. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2009: Santa Margarita River, Ysidora Basin, and Ysidora Basin to Windmill Canyon.

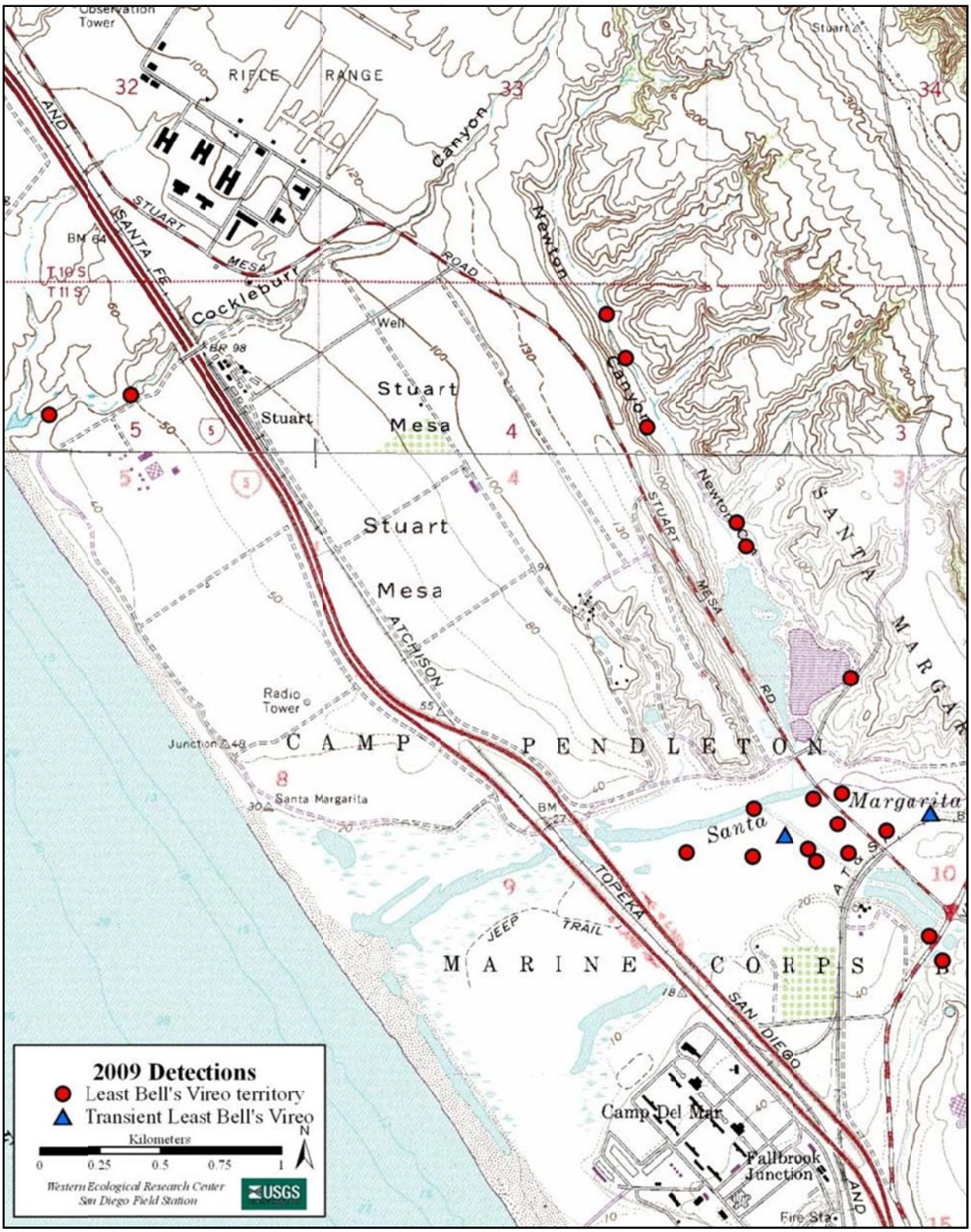


Fig. 30. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2009: Lower Santa Margarita River, Newton Canyon, and Cockleburr Canyon..

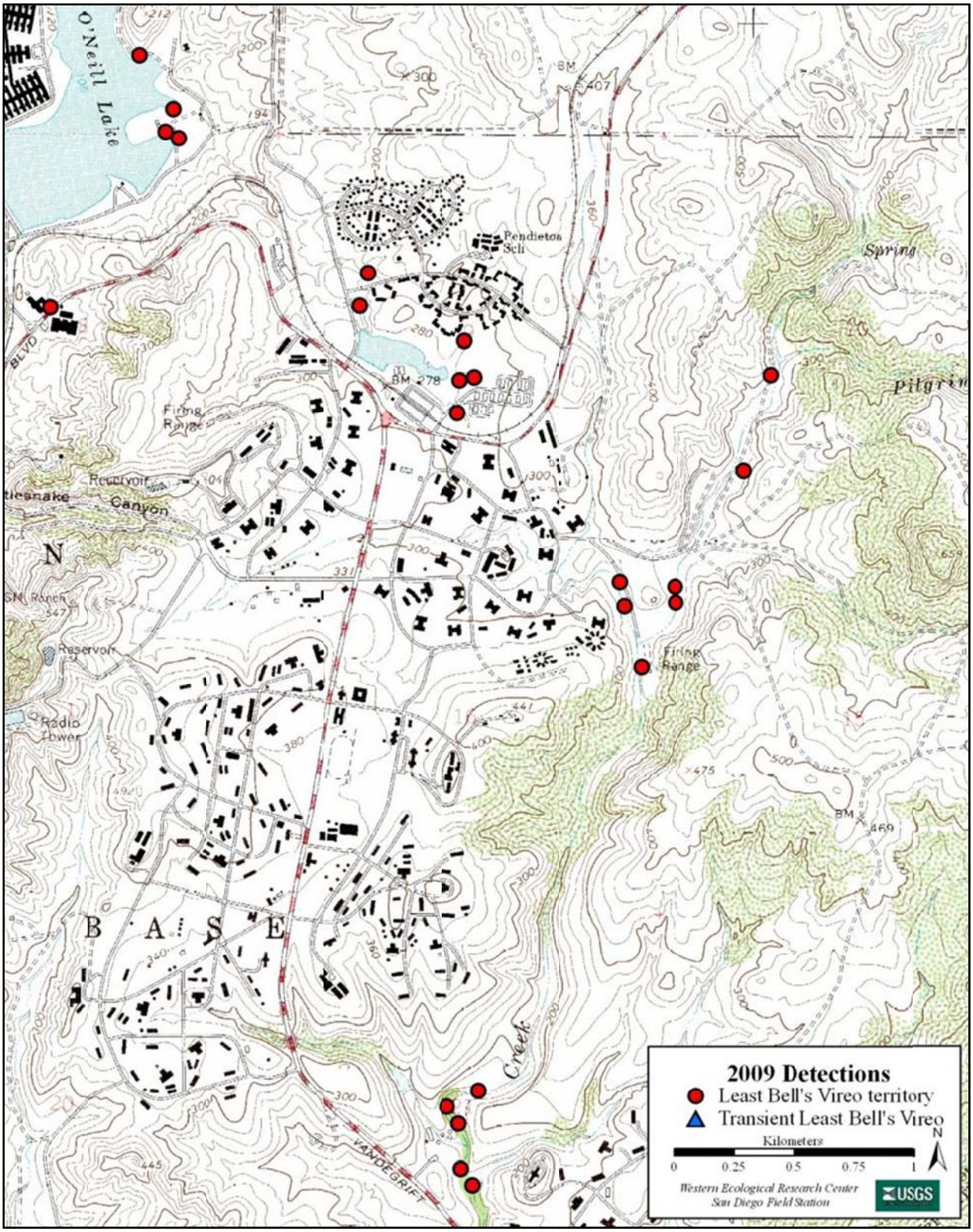


Fig. 31. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2009: Upper Pilgrim Creek, De Luz Homes Habitat, and Lake O'Neill.

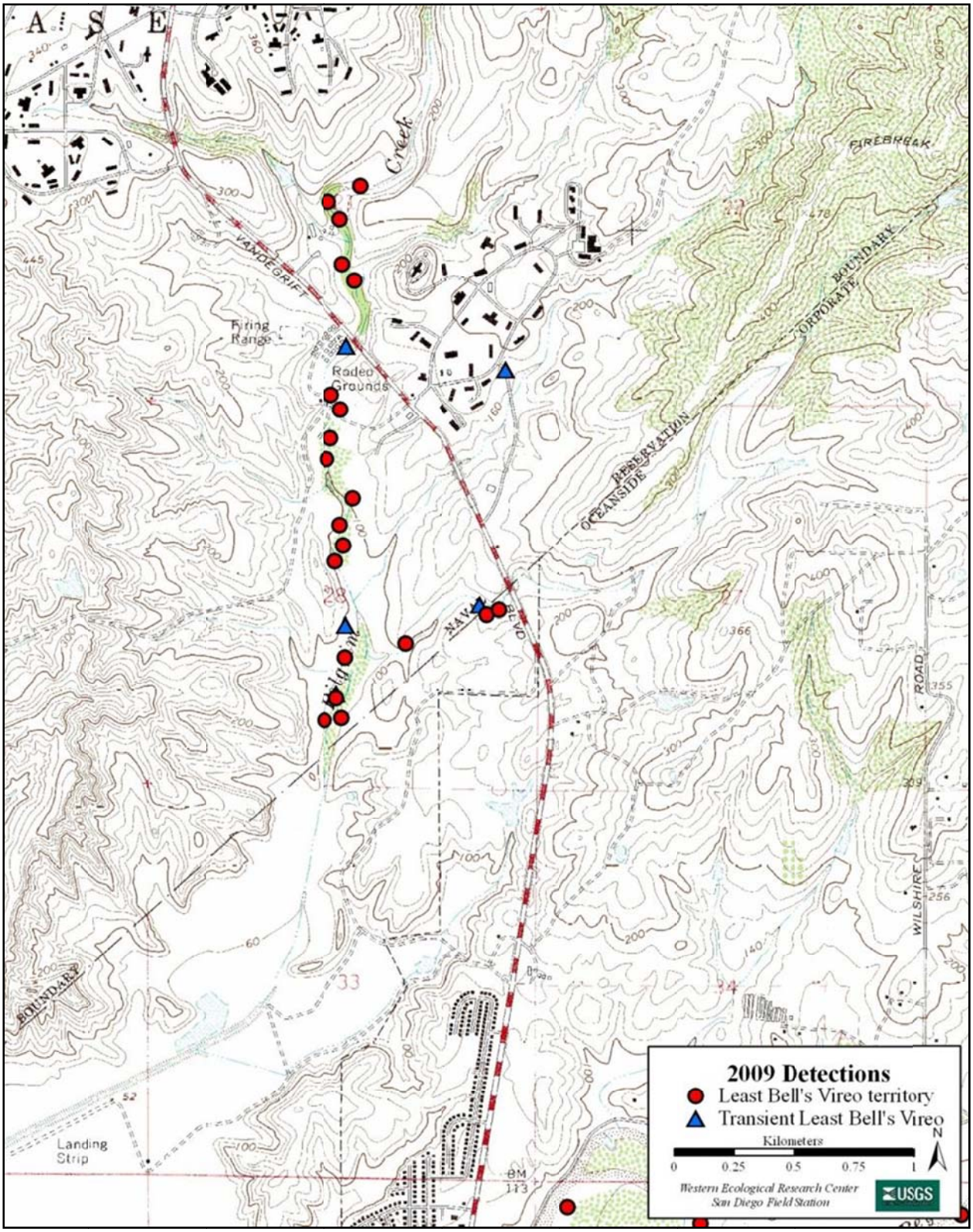


Fig. 32. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2009: Upper and Lower Pilgrim Creek.

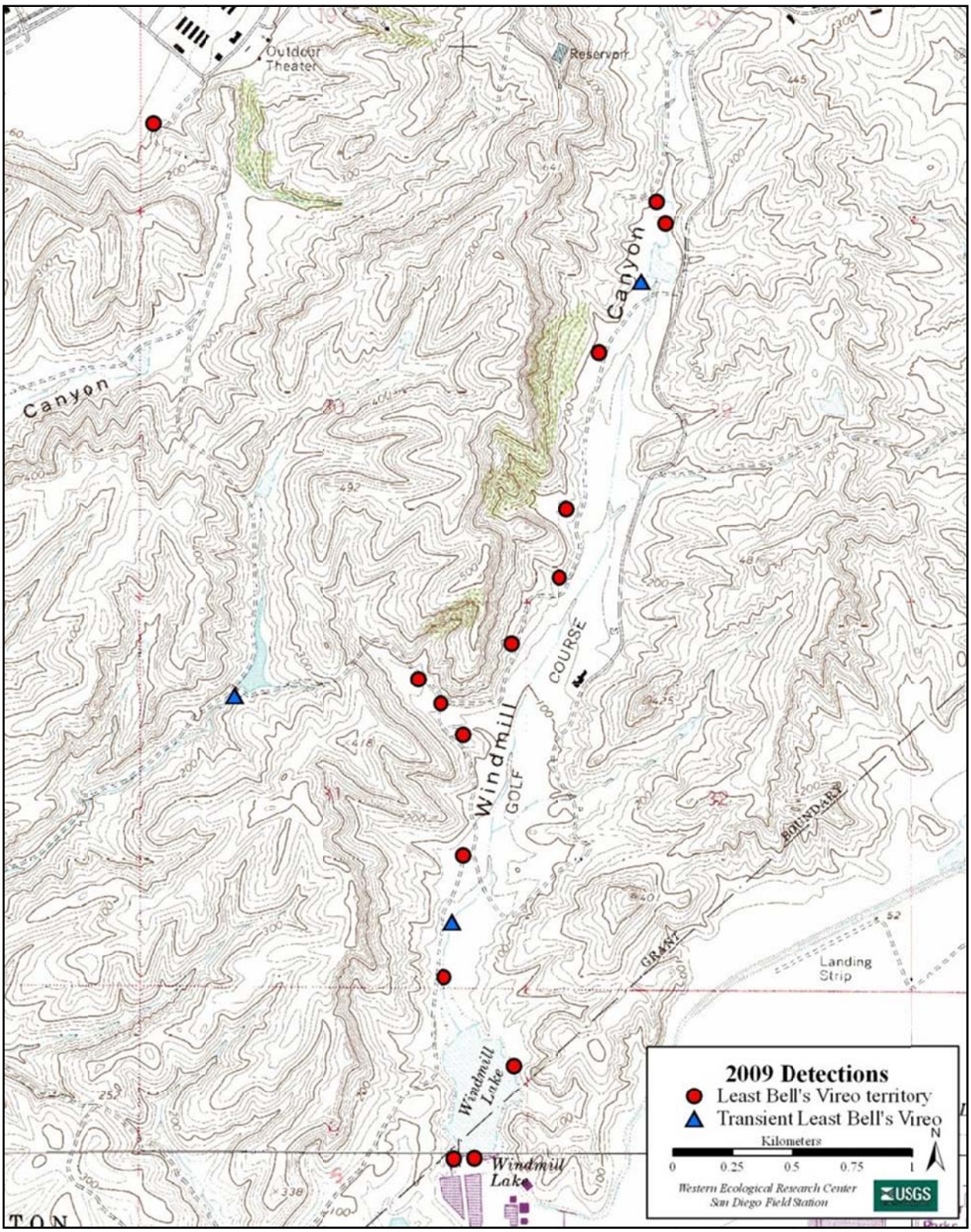


Fig. 33. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2009: Windmill Canyon and Ysidora Basin to Windmill Canyon.

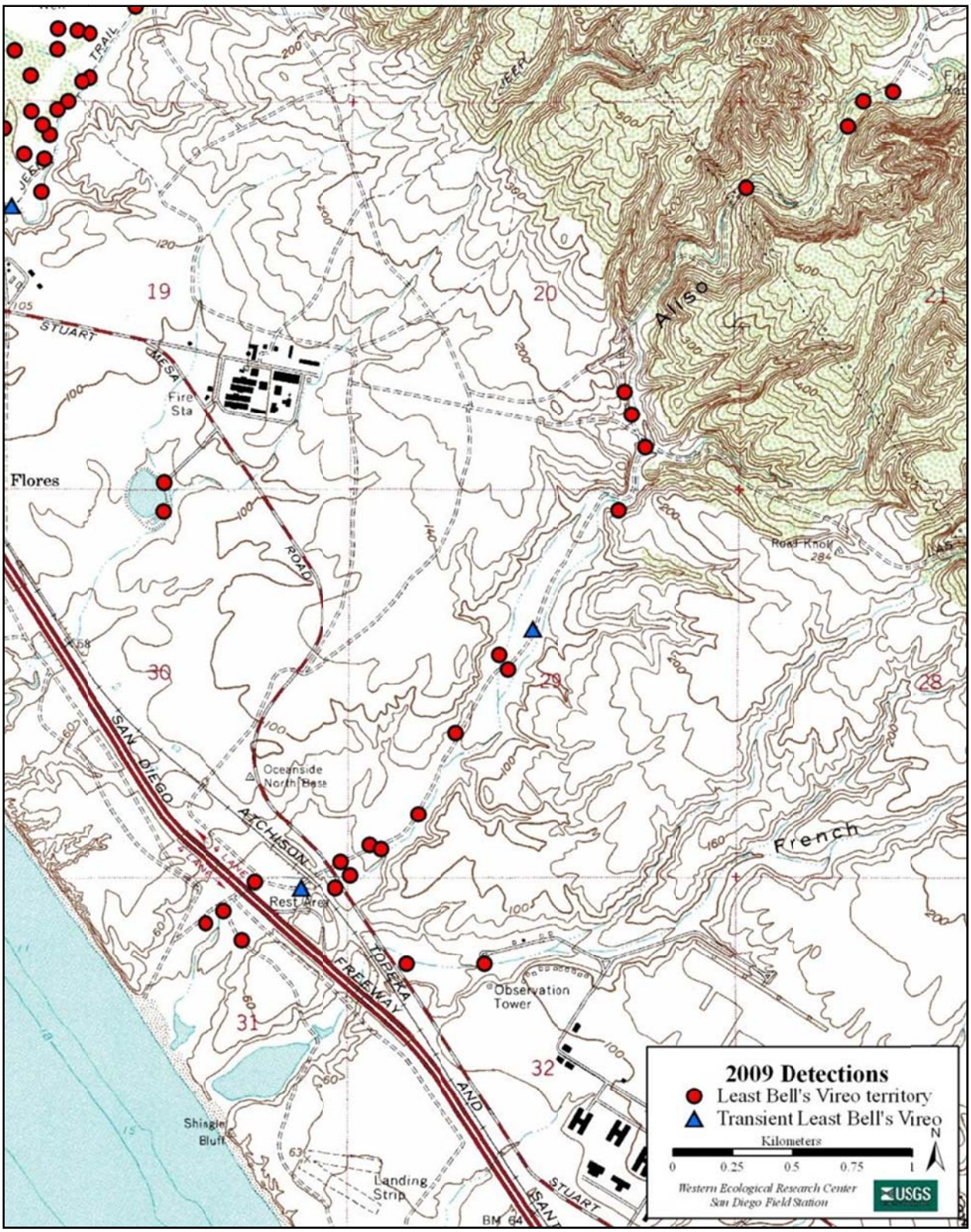


Fig. 34. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2009: French Creek, Aliso Creek, and Hidden Canyon.

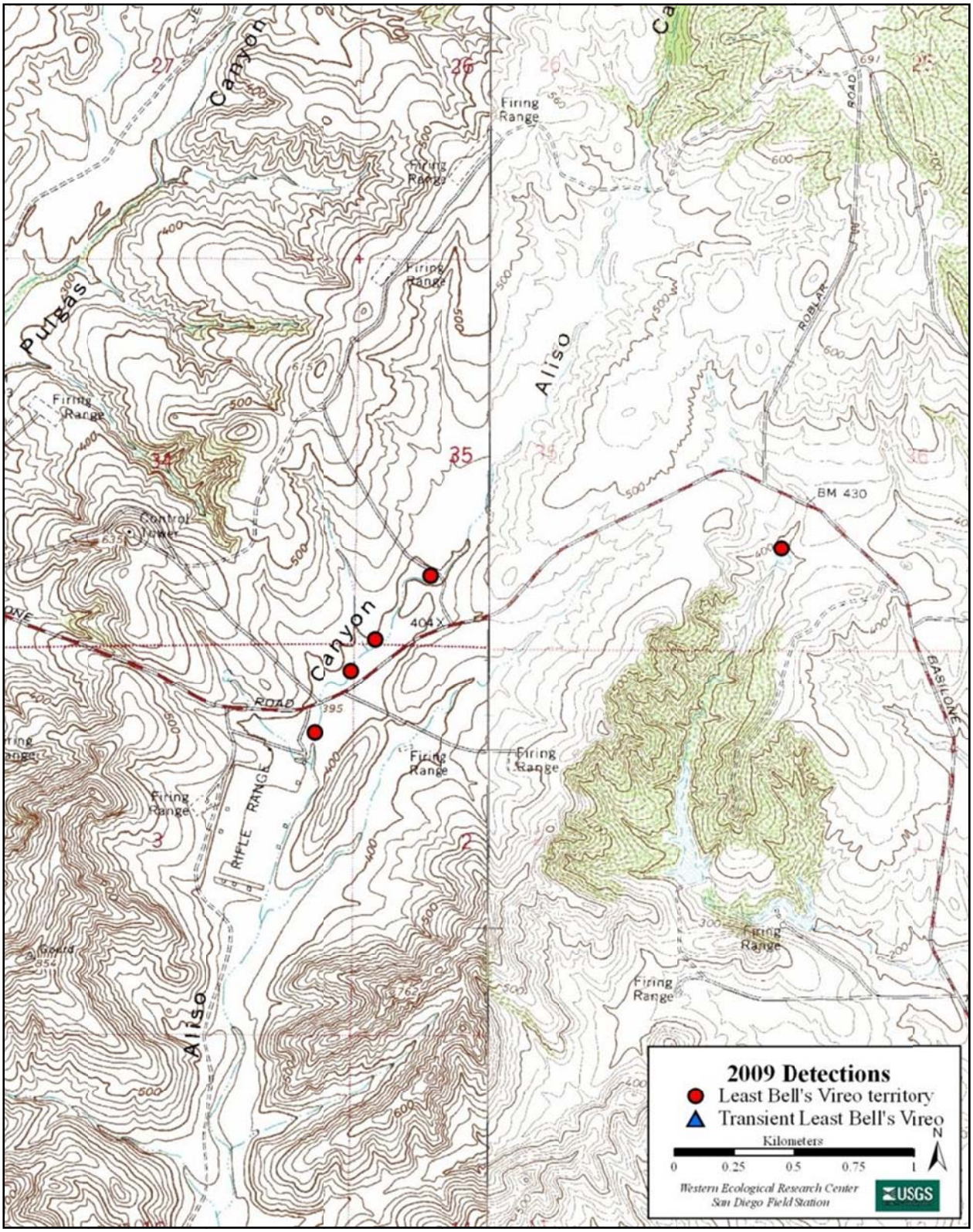


Fig. 35. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2009: Basilone and Roblar Roads.

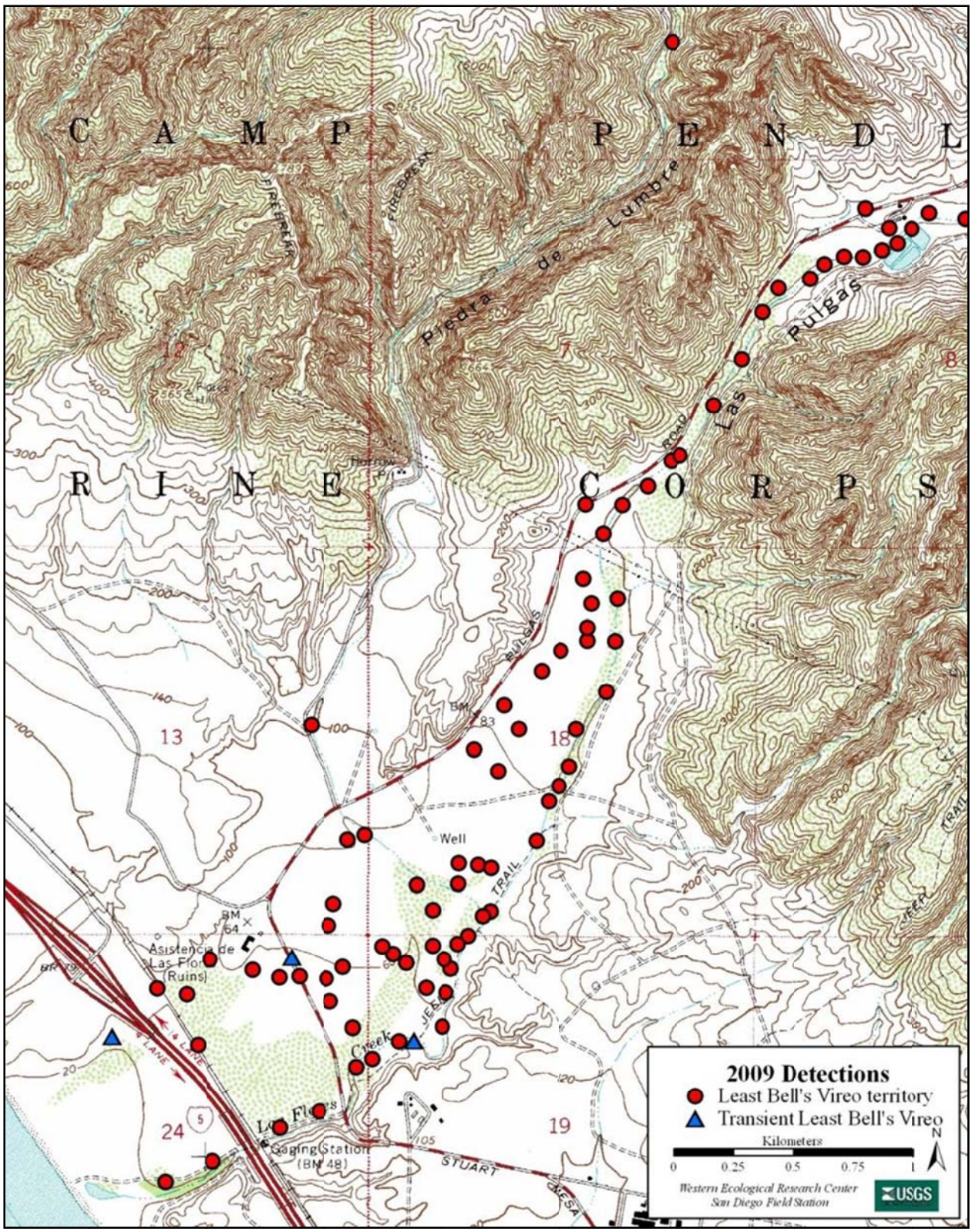


Fig. 36. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2009: Lower Las Flores Creek.

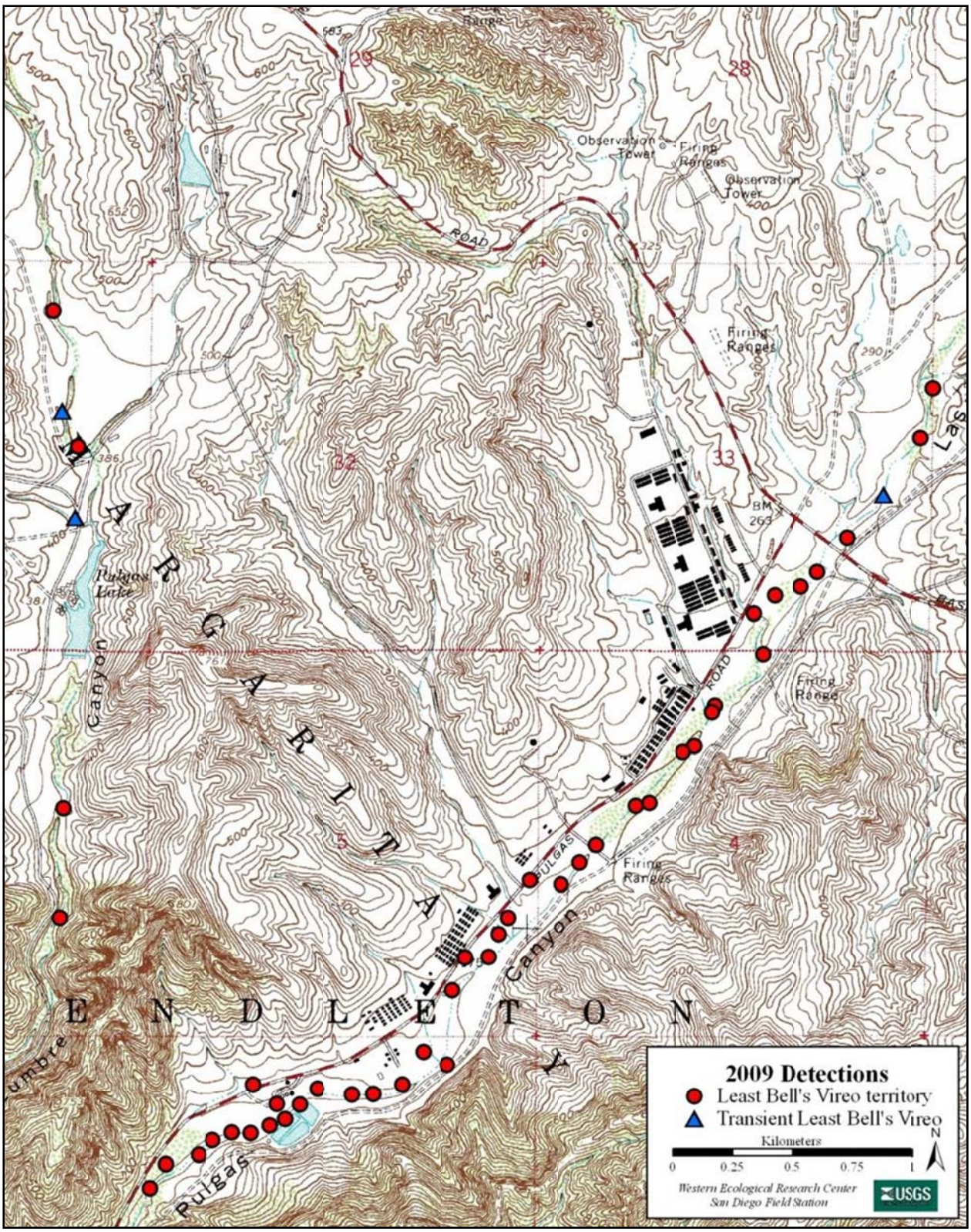


Fig. 37. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2009: Piedra de Lumbre Canyon and Upper Las Flores Creek.

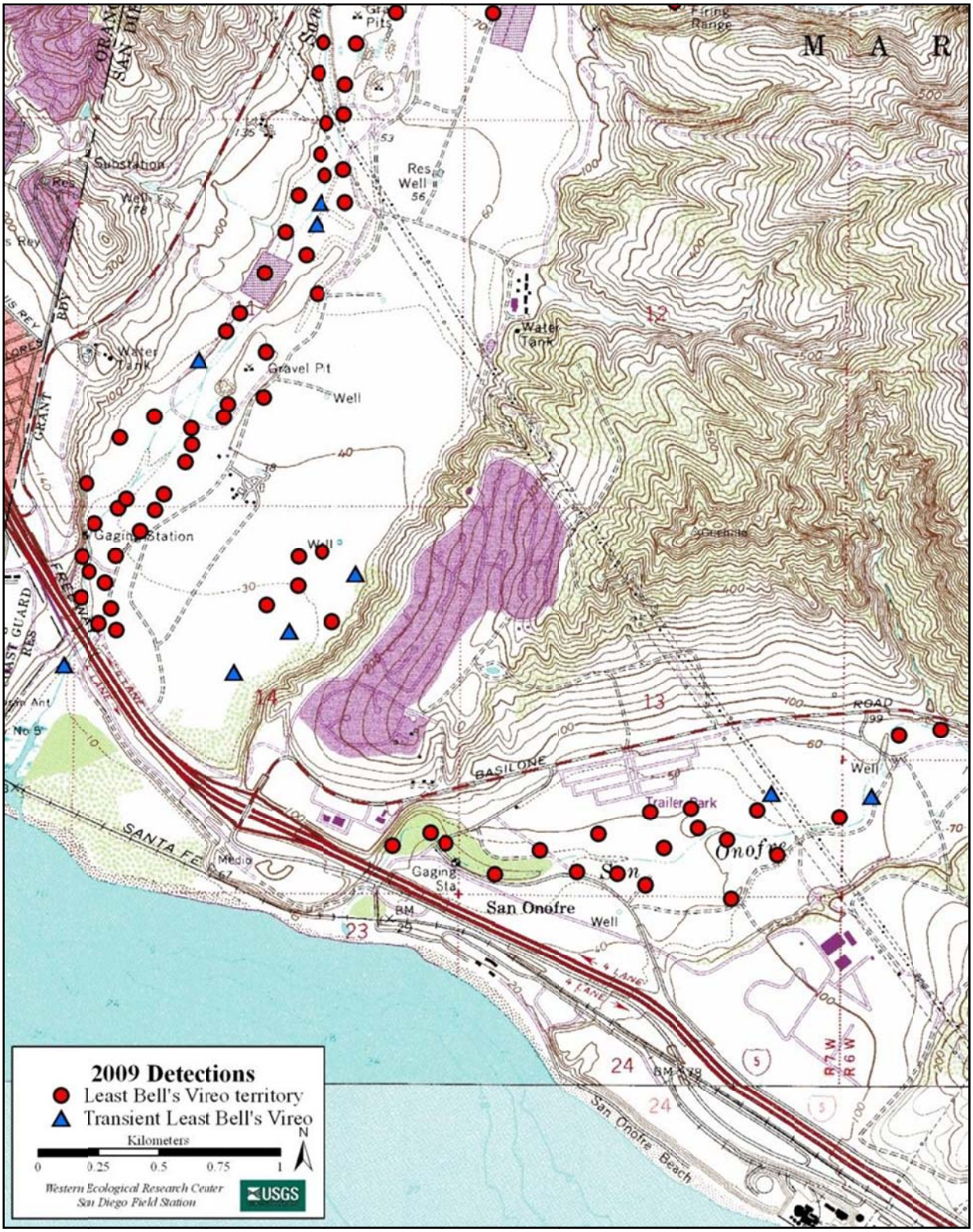


Fig. 38. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2009: Lower San Onofre Creek and Lower San Mateo Creek.

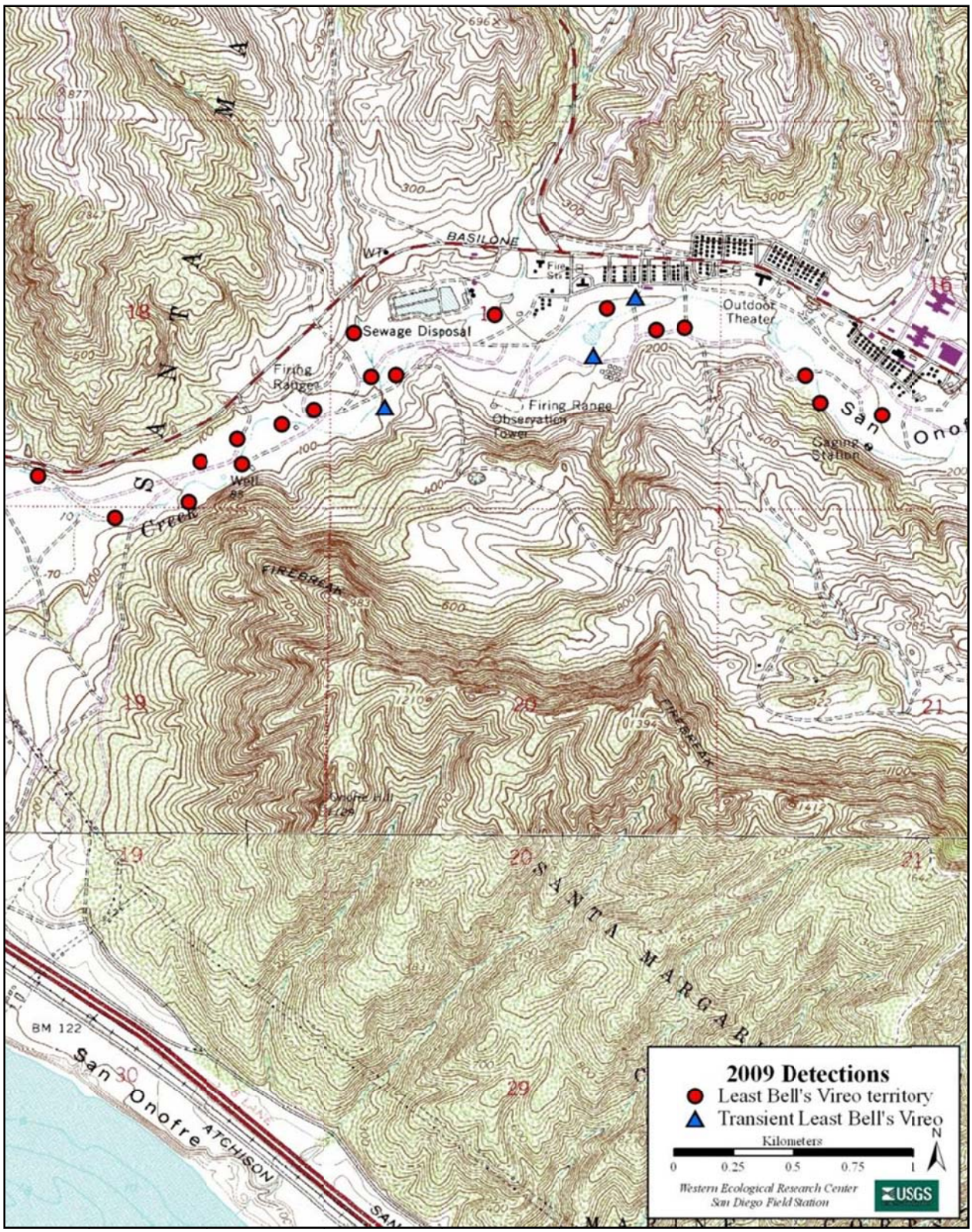


Fig. 39. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2009: San Onofre Creek.

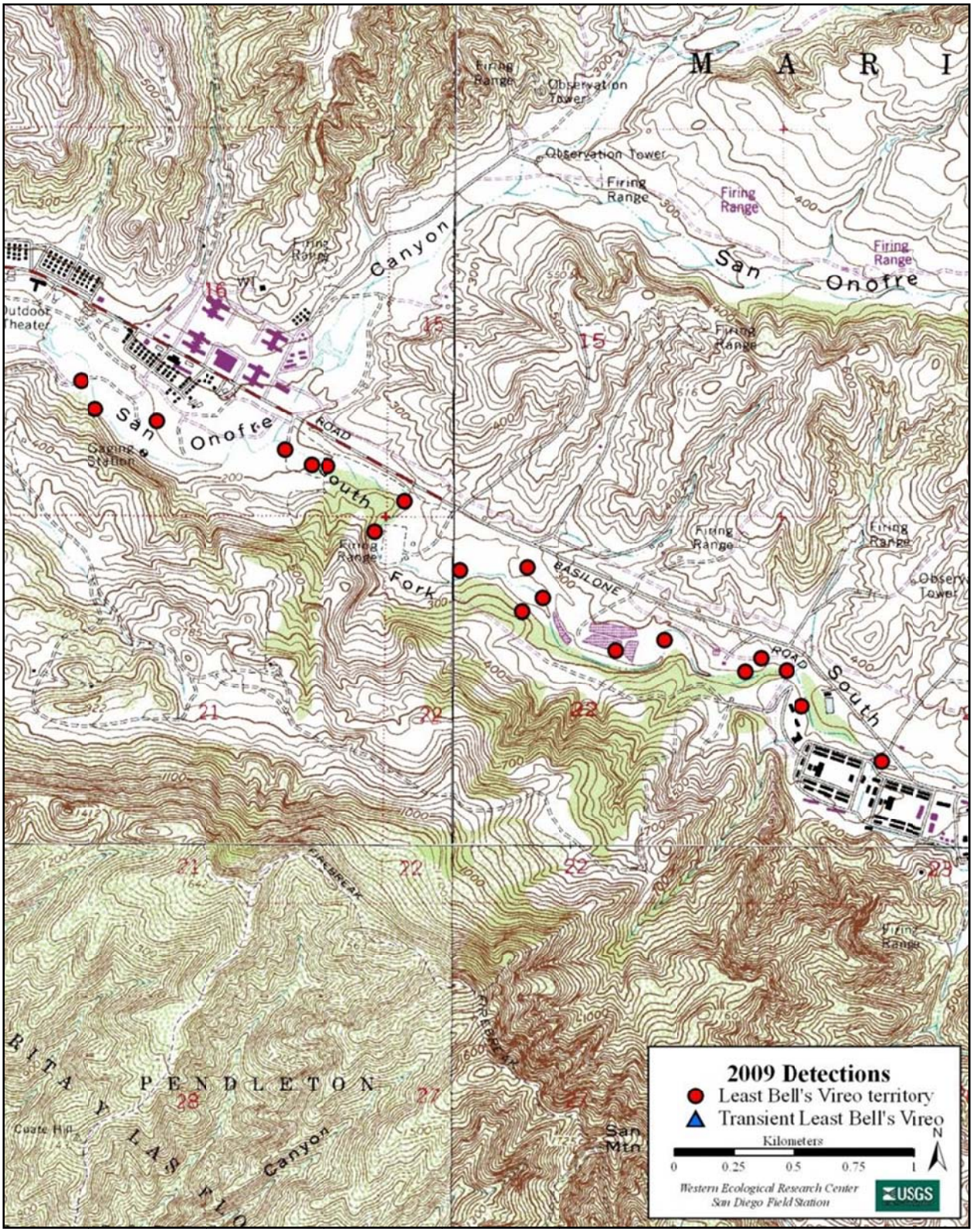


Fig. 40. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2009: South Fork San Onofre Creek.

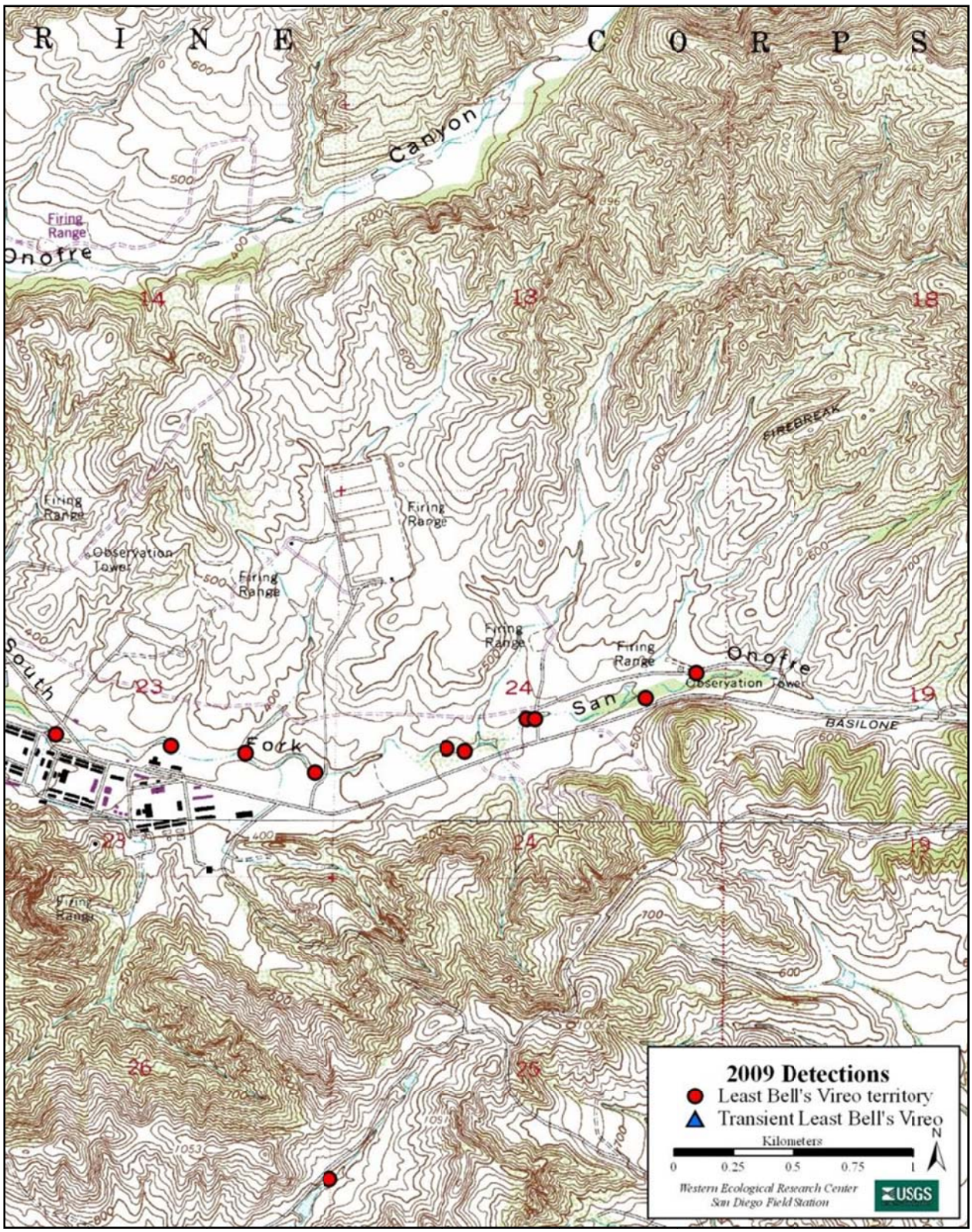


Fig. 41. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2009: San Onofre Creek.

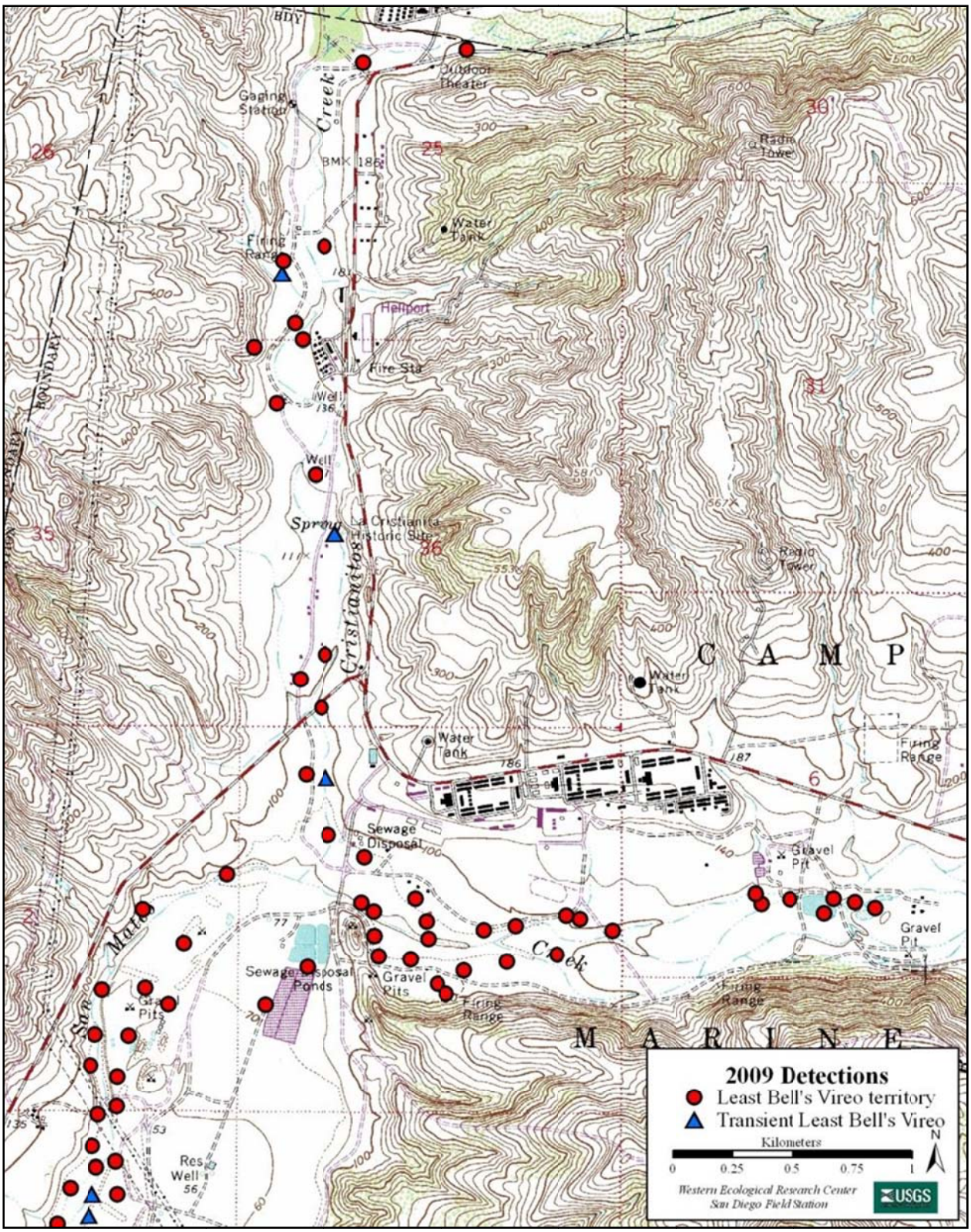


Fig. 42. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2009: San Mateo Creek and Cristianitos Creek.

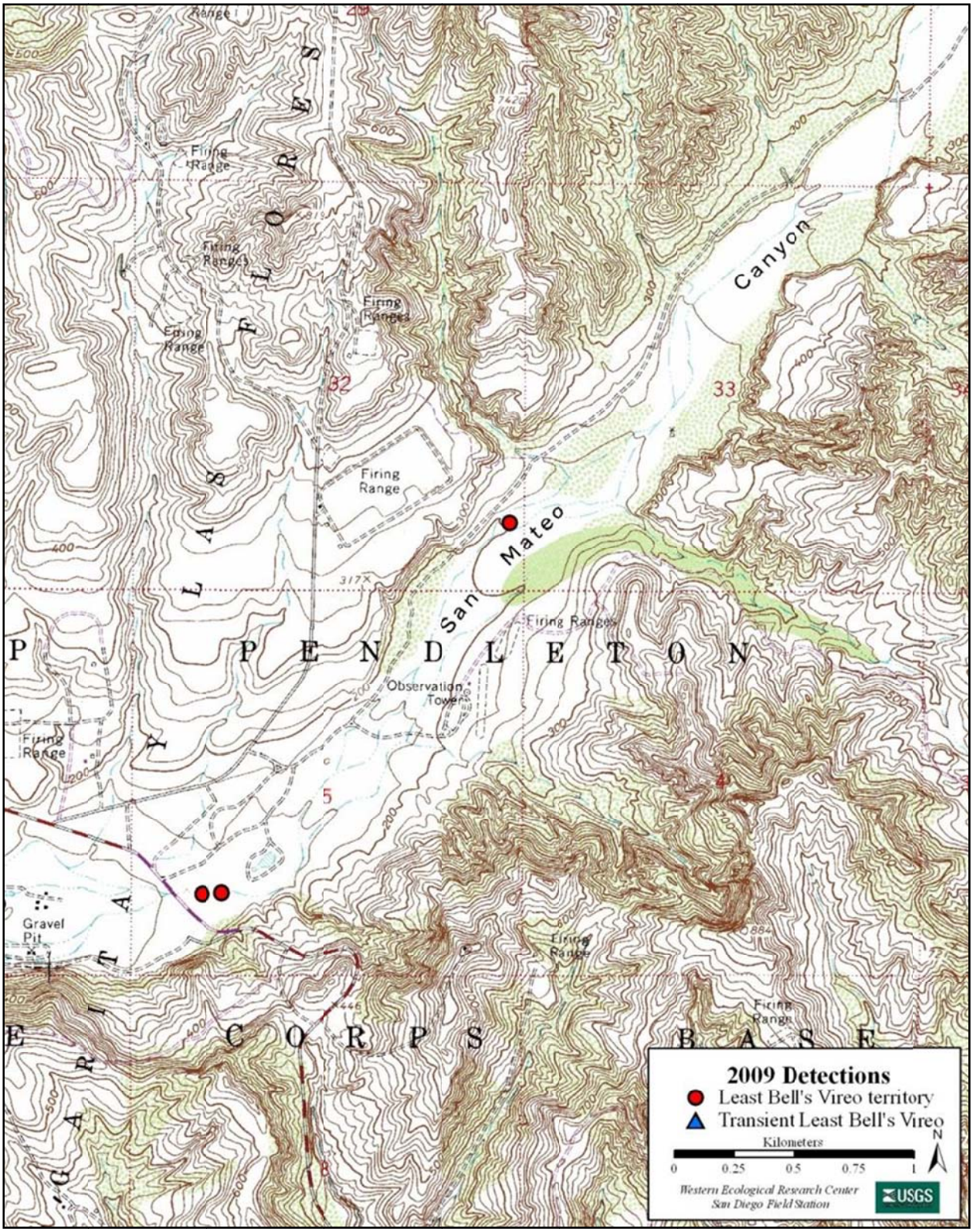


Fig. 43. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2009: Upper San Mateo Creek.

## APPENDIX C

## BANDED LEAST BELL'S VIREOS AT MARINE CORPS BASE CAMP PENDLETON, 2009

| Drainage / Sex | Band Combination[a] Left Leg | Right Leg | Age[b] | Comments[c] |
|---|---|---|---|---|
| Aliso Creek | | | | |
| Male | YEPU/gogo | Mdb | 2 yr. | Banded as a nestling at the SLRR in 2007. |
| Male | Mgo | - | ≥ 1 yr. | Banded as a nestling in or before 2008 on MCBCP. |
| De Luz Creek | | | | |
| Female | WHPU/Msi | gogo | ≥ 1 yr. | Banded as an adult at the DLC MAPS Station in 2009. |
| Female | Mgo | PUPU/gogo | ≥ 1 yr. | Banded as an adult at the DLC MAPS Station in 2009. |
| Female | pupu | ORDG/Msi | ≥ 1 yr. | Banded as an adult at the DLC MAPS Station in 2009. |
| Female | Msi | PUOR/pupu | ≥ 1 yr. | Banded as an adult at the DLC MAPS Station in 2009. |
| Male | gogo | DGOR/Msi | 3 yr. | Banded as an adult at the DLC MAPS Station in 2007. |
| Male | gogo | OROR/Msi | ≥ 2 yr. | Banded as an adult at DLC in 2007. |
| Male | PUWH | PUPU/Mgo | 2 yr. | Banded as a nestling on the SMR in 2007. |
| Male | gogo | BYST/Msi | ≥ 1 yr. | Banded as an adult at the DLC MAPS Station in 2009. |
| Male | - | Mgo | ≥ 1 yr. | Banded as a nestling in or before 2008 on MCBCP. |
| Male | BKBK/Mgo | BKBK | 1 yr. | Banded as a nestling on the SMR in 2008. |
| Unknown | ORDG/sisi | Mgo | ≥ 1 yr. | Banded as an adult at the DLC MAPS Station in 2009. |
| Unknown | BYST/gogo | Msi | ≥ 1 yr. | Banded as an adult at the DLC MAPS Station in 2009. |
| Unknown | DGOR/sisi | Mgo | HY | Banded as a juvenile at the DLC MAPS Station in 2009. |
| Unknown | ORDG | Msi | HY | Banded as a juvenile at the DLC MAPS Station in 2009. |
| Unknown | ORDG/pupu | Msi | HY | Banded as a juvenile at the DLC MAPS Station in 2009. |
| Unknown | Msi | ORDG/pupu | HY | Banded as a juvenile at the DLC MAPS Station in 2009. |
| Unknown | - | PUYE/Mdb | HY | Banded as a juvenile at the DLC MAPS Station in 2009. |
| Las Flores Creek | | | | |
| Female | LPLP/gogo | Mgo | 2 yr. | Banded as a nestling on the SMR in 2007. |
| Male | LPBK/Mgo | pupu | ≥ 4 yr. | Banded with unknown age on the SMR in 2005. |
| Male | PUWH/pupu | Mdb | 2 yr. | Banded as a nestling at the SLRR in 2007. |
| Pilgrim Creek | | | | |
| Male | pupu | OROR/Mgo | ≥ 3 yr. | Banded as an adult at Pilgrim Creek in 2007. |
| Male | pupu | LPBK/Mdb | 2 yr. | Banded as a nestling at the SLRR in 2007. |
| Male | Mgo | BKLP | ≥ 1 yr. | Banded as an adult at Pilgrim Creek in 2009. |
| Male | Mdb | - | ≥ 1 yr. | Banded as a nestling in or before 2008 on the SLRR. |
| Male | DBWH/Mdb | LPBK | 1 yr. | Banded as a nestling at the SLRR in 2008. |
| Santa Margarita River | | | | |
| Female | Mdb | YEYE/pupu | ≥ 4 yr. | Banded as an adult at the SLRR in 2006. |
| Female | - | WHDP/Mdb | 4 yr. | Banded as a nestling at the SLRR in 2005. |
| Female | ORPU/pupu | Mgo | 4 yr. | Banded as a nestling on the SMR in 2005. |
| Female | PUYE | Mgo | 4 yr. | Banded as a nestling on the SMR in 2005. |
| Female | BKBK/gogo | Msi | ≥ 3 yr. | Banded as an adult on the SMR in 2007. |
| Female | PUWH/pupu | Mgo | ≥ 3 yr. | Banded as an adult on the SMR in 2007. |
| Female | PUWH/Mdb | BKBK | 3 yr. | Banded as a nestling at the SLRR in 2006. |
| Female | Mgo | DPWH/gogo | ≥ 2 yr. | Banded as an adult on the SMR in 2008. |
| Female | DGOR/Msi | - | ≥ 2 yr. | Banded as an adult on the SMR in 2008. |
| Female | Msi | PUYE/gogo | ≥ 2 yr. | Banded as an adult on the SMR in 2008. |
| Female | pupu | ORDG/Mgo | ≥ 2 yr. | Banded as an adult on the SMR in 2008. |
| Female | Msi | PUWH/gogo | ≥ 2 yr. | Banded as an adult on the SMR in 2008. |
| Female | pupu | PUOR/Msi | ≥ 2 yr. | Banded as an adult at the SMR MAPS Station in 2008. |
| Female | PUOR/pupu | Msi | ≥ 2 yr. | Banded as an adult at the SMR MAPS Station in 2008. |
| Female | YEPU/gogo | Msi | 2 yr. | Banded as an adult at the SMR MAPS Station in 2009. |

| Drainage | Band Combination[a] | | | |
|---|---|---|---|---|
| Sex | Left Leg | Right Leg | Age[b] | Comments |
| Santa Margarita River continued | | | | |
| Female | PUPU | YEYE/Mgo | 2 yr. | Banded as a nestling on the SMR in 2007. |
| Female | DPWH | Mgo | 2 yr. | Banded as a nestling on the SMR in 2007. |
| Female | WHDP/pupu | Mgo | 2 yr. | Banded as a nestling on the SMR in 2007. |
| Female | WHPU | BKBK/Mgo | 2 yr. | Banded as a nestling on the SMR in 2007. |
| Female | LPLP | Mgo | 2 yr. | Banded as a nestling on the SMR in 2007. |
| Female | Msi | BKBK/gogo | ≥ 1 yr. | Banded as an adult at the SMR MAPS Station in 2009. |
| Female | ORORO | Msi | ≥ 1 yr. | Banded as an adult in 2009 - ODN territory. |
| Female | pupu | DGOR/Msi | ≥ 1 yr. | Banded as an adult in 2009 - HDX territory. |
| Female | PUOR/Msi | - | ≥ 1 yr. | Banded as an adult in 2009 - CHE territory. |
| Female | WHWH/gogo | Mgo | ≥ 1 yr. | Banded as an adult at the SMR MAPS Station in 2009. |
| Female | YEYE/gogo | Mgo | ≥ 1 yr. | Banded as an adult in 2009 - ES23 territory. |
| Female | YEYE/sisi | Mgo | ≥ 1 yr. | Banded as an adult at the SMR MAPS Station in 2009. |
| Female | LPBK/Mgo | PUWH | ≥ 1 yr. | Banded as an adult in 2009 - SG25 territory. |
| Female | Mgo | DPDP | ≥ 1 yr. | Banded as an adult in 2009 - ES35 territory. |
| Female | Mgo | PUYE | ≥ 1 yr. | Banded as an adult in 2009 - YB03 territory. |
| Female | - | Msi | ≥ 1 yr. | Resighted near SMR MAPS Station. |
| Female | Mdb | - | ≥ 1 yr. | Banded as a nestling in or before 2008 on the SLRR. |
| Female | Mdb | - | ≥ 1 yr. | Banded as a nestling in or before 2008 on the SLRR. |
| Female | Mdb | - | ≥ 1 yr. | Banded as a nestling in or before 2008 on the SLRR. |
| Female | Mdb | - | ≥ 1 yr. | Banded as a nestling in or before 2008 on the SLRR. |
| Female | Mgo | - | ≥ 1 yr. | Banded as a nestling in or before 2008 on MCBCP. |
| Female | DBWH/sisi | Mdb | 1 yr. | Banded as a nestling at the SLRR in 2008. |
| Male | PUWH/Mgo | pupu | ≥ 5 yr. | Banded as an adult on the SMR in 2005. |
| Male | ORORO/Msi | pupu | ≥ 5 yr. | Banded as an adult on the SMR in 2005. |
| Male | pupu | BYST/Mgo | ≥ 4 yr. | Banded as an adult on the SMR in 2006. |
| Male | DGOR | Mgo | ≥ 4 yr. | Banded as an adult on the SMR in 2006. |
| Male | - | YEPU/Mgo | ≥ 4 yr. | Banded as an adult on the SMR in 2006. |
| Male | Mgo | PUPU/pupu | ≥ 4 yr. | Banded as an adult on the SMR in 2006. |
| Male | pupu | WHWH/Mgo | ≥ 4 yr. | Banded as an adult on the SMR in 2006. |
| Male | - | BWST/Mgo | ≥ 4 yr. | Banded as an adult on the SMR in 2006. |
| Male | DPDP/pupu | Mgo | ≥ 4 yr. | Banded as an adult on the SMR in 2006. |
| Male | - | ORORO/Mgo | ≥ 4 yr. | Banded as an adult on the SMR in 2006. |
| Male | pupu | DPWH/Mgo | ≥ 4 yr. | Banded as an adult on the SMR in 2006. |
| Male | Mgo | - | ≥ 4 yr. | Banded as an adult on the SMR in 2006. |
| Male | - | PUOR/Msi | ≥ 3 yr. | Banded as an adult on the SMR in 2007. |
| Male | WHDP/Msi | gogo | ≥ 3 yr. | Banded as an adult on the SMR in 2007. |
| Male | gogo | LPBK/Msi | ≥ 3 yr. | Banded as an adult on the SMR in 2007. |
| Male | pupu | BKLP/Mgo | ≥ 3 yr. | Banded as an adult on the SMR in 2007. |
| Male | WHDP/Mgo | pupu | ≥ 3 yr. | Banded as an adult on the SMR in 2007. |
| Male | Mgo | BYST/pupu | ≥ 3 yr. | Banded as an adult on the SMR in 2007. |
| Male | Msi | DPDP/gogo | ≥ 3 yr. | Banded as an adult on the SMR in 2007. |
| Male | WHWH/Msi | gogo | ≥ 3 yr. | Banded as an adult on the SMR in 2007. |
| Male | - | Mgo/LGLG | ≥ 3 yr. | Banded as an adult on FNWS in 2007. |
| Male | Mgo | DBDB | ≥ 3 yr. | Banded as an adult on FNWS in 2007. |
| Male | - | DBDB/Mgo | ≥ 3 yr. | Banded as an adult on FNWS in 2007. |

| Drainage | Band Combination[a] | | | |
|---|---|---|---|---|
| Sex | Left Leg | Right Leg | Age[b] | Comments |
| Santa Margarita River continued | | | | |
| Male | - | Mgo/WHWH | ≥ 3 yr. | Banded as an adult on FNWS in 2007. |
| Male | Mdb | DPDP/sisi | 3 yr. | Banded as a nestling at the SLRR in 2006. |
| Male | BKLP/Mgo | pupu | 3 yr. | Banded as a nestling on the SMR in 2006. |
| Male | Mgo | YEYE/gogo | 3 yr. | Banded as a nestling on the SMR in 2006. |
| Male | WHDP/Mdb | - | 3 yr. | Banded as a nestling at the SLRR in 2006. |
| Male | YEPU/pupu | Mgo | ≥ 2 yr. | Banded as an adult on the SMR in 2008. |
| Male | PUYE/Mgo | pupu | ≥ 2 yr. | Banded as an adult on the SMR in 2008. |
| Male | BYST/gogo | Mgo | ≥ 2 yr. | Banded as an adult on the SMR in 2008. |
| Male | DPWH/sisi | Mgo | ≥ 2 yr. | Banded as an adult on the SMR in 2008. |
| Male | Mgo | BYST/gogo | ≥ 2 yr. | Banded as an adult on the SMR in 2008. |
| Male | Mgo | WHWH/sisi | ≥ 2 yr. | Banded as an adult on the SMR in 2008. |
| Male | DPDP/Msi | gogo | ≥ 2 yr. | Banded as an adult on the SMR in 2008. |
| Male | PUYE/Msi | gogo | ≥ 2 yr. | Banded as an adult on the SMR in 2008. |
| Male | ORPU/gogo | Msi | ≥ 2 yr. | Banded as an adult on the SMR in 2008. |
| Male | WHDP/gogo | Msi | ≥ 2 yr. | Banded as an adult on the SMR in 2008. |
| Male | WHPU/gogo | Msi | ≥ 2 yr. | Banded as an adult on the SMR in 2008. |
| Male | - | DGOR/Msi | ≥ 2 yr. | Banded as an adult on the SMR in 2008. |
| Male | Mgo | PUPU/sisi | ≥ 2 yr. | Banded as an adult on the SMR in 2008. |
| Male | gogo | ORPU/Msi | ≥ 2 yr. | Banded as an adult on the SMR in 2008. |
| Male | BKLP/Msi | gogo | 2 yr. | Banded as an adult in 2009 - BN37 territory. |
| Male | DPWH/gogo | Mgo | 2 yr. | Banded as a nestling on the SMR in 2007. |
| Male | DGOR/gogo | Mgo | 2 yr. | Banded as a nestling on the SMR in 2007. |
| Male | pupu | ORPU/Mdb | 2 yr. | Banded as a nestling at the SLRR in 2007. |
| Male | pupu | ORPU/Msi | 2 yr. | Banded as an adult on the SMR in 2008. |
| Male | Mgo | LPLP/gogo | 2 yr. | Banded as an adult at the SMR MAPS Station in 2009. |
| Male | PUWH/sisi | Mgo | 2 yr. | Banded as a nestling on the SMR in 2007. |
| Male | WHWH/sisi | Mgo | 2 yr. | Banded as a nestling on the SMR in 2007. |
| Male | LPBK | Mgo | 2 yr. | Banded as a nestling on the SMR in 2007. |
| Male | YEPU/gogo | Mgo | 2 yr. | Banded as a nestling on the SMR in 2007. |
| Male | - | ORDG/Mgo | 2 yr. | Banded as a nestling on the SMR in 2007. |
| Male | LPBK/gogo | Msi | 2 yr. | Banded as an adult at the SMR MAPS Station in 2009. |
| Male | Msi | WHDP/gogo | ≥ 1 yr. | Banded as an adult at the SMR MAPS Station in 2009. |
| Male | ORPU/Msi | gogo | ≥ 1 yr. | Banded as an adult in 2009 - DAQ territory. |
| Male | PUOR/Msi | pupu | ≥ 1 yr. | Banded as an adult in 2009 - SNP territory. |
| Male | - | ORPU/Msi | ≥ 1 yr. | Banded as an adult in 2009 - AE34 territory. |
| Male | Msi | ORPU | ≥ 1 yr. | Banded as an adult in 2009 - LAP territory. |
| Male | Mgo | BKBK/gogo | ≥ 1 yr. | Banded as an adult in 2009 - ES56 territory. |
| Male | ORPU | WHWH/Mgo | ≥ 1 yr. | Banded as an adult in 2009 - PR16 territory. |
| Male | PUWH | Mgo | ≥ 1 yr. | Banded as an adult in 2009 - AE34 territory. |
| Male | ORDG/Mgo | - | ≥ 1 yr. | Banded as an adult in 2009 - DS13 territory. |
| Male | Mgo | PUYE/pupu | ≥ 1 yr. | Banded as an adult in 2009 - HDX territory. |
| Male | YEPU/sisi | Mgo | ≥ 1 yr. | Banded as an adult in 2009 - ES35 territory. |
| Male | BYST/sisi | Mgo | ≥ 1 yr. | Banded as an adult in 2009 - ALP territory. |
| Male | BKLP | Mgo | ≥ 1 yr. | Banded as an adult in 2009 - ARI territory. |
| Male | Mgo | BKBK/sisi | ≥ 1 yr. | Banded as an adult in 2009 - LIF territory. |

| Drainage | Band Combination[a] | | | |
|---|---|---|---|---|
| Sex | Left Leg | Right Leg | Age[b] | Comments |
| Santa Margarita River continued | | | | |
| Male | WHDP | Mgo | ≥ 1 yr. | Banded as an adult in 2009 - CED territory. |
| Male | Mgo | PUYE/gogo | ≥ 1 yr. | Banded as an adult in 2009 - HW16 territory. |
| Male | PUYE/gogo | Mgo | ≥ 1 yr. | Banded as an adult in 2009 - PO15 territory. |
| Male | Mgo | DPWH/sisi | ≥ 1 yr. | Banded as an adult in 2009 - PO18 territory. |
| Male | BKBK/sisi | Mgo | ≥ 1 yr. | Banded as an adult in 2009 - ALC territory. |
| Male | BKLP/sisi | Mgo | ≥ 1 yr. | Banded as an adult in 2009 - ARH territory. |
| Male | PUPU | BKBK/Mgo | ≥ 1 yr. | Banded as an adult in 2009 - FNR territory. |
| Male | WHDP/sisi | Mgo | ≥ 1 yr. | Banded as an adult in 2009 - ZPR territory. |
| Male | ORPU | DPDP/Mgo | ≥ 1 yr. | Banded as an adult in 2009 - SE02 territory. |
| Male | DGOR | PUWH/Mgo | ≥ 1 yr. | Banded as an adult in 2009 - BS02 territory. |
| Male | BYST/Mgo | ORPU | ≥ 1 yr. | Banded as an adult in 2009 - DAT territory. |
| Male | gogo | BKBK/Msi | ≥ 1 yr. | Banded as an adult at the SMR MAPS Station in 2009. |
| Male | - | Mdb | ≥ 1 yr. | Banded as a nestling in or before 2008 on the SLRR. |
| Male | - | Mgo | ≥ 1 yr. | Banded as a nestling in or before 2008 on MCBCP. |
| Male | Mdb | - | ≥ 1 yr. | Banded as a nestling in or before 2008 on the SLRR. |
| Male | Mgo | - | ≥ 1 yr. | Banded as a nestling in or before 2008 on MCBCP. |
| Male | Mgo | - | ≥ 1 yr. | Banded as a nestling in or before 2008 on MCBCP. |
| Male | Mgo | - | ≥ 1 yr. | Banded as a nestling in or before 2008 on MCBCP. |
| Male | Mgo | - | ≥ 1 yr. | Banded as a nestling in or before 2008 on MCBCP. |
| Male | BKLP/Mdb | DPWH | 1 yr. | Banded as a nestling at the SLRR in 2008. |
| Male | WHDB/Mdb | DPWH | 1 yr. | Banded as a nestling at the SLRR in 2008. |
| Male | WHDP/sisi | Mdb | 1 yr. | Banded as a nestling at the SLRR in 2008. |
| Male | ORDG/Msi | gogo | 1 yr. | Banded as a juvenile on the SMR in 2009. |
| Male | Mgo | WHPU | 1 yr. | Banded as a nestling on the SMR in 2008. |
| Male | Mdb | WHDB/sisi | 1 yr. | Banded as a nestling at the SLRR in 2008. |
| Male | WHWH/Mgo | ORPU | 1 yr. | Banded as a nestling on the SMR in 2008. |
| Male | Mgo | WHPU/gogo | 1 yr. | Banded as a nestling on the SMR in 2008. |
| Male | Mgo | BYST/sisi | 1 yr. | Banded as a nestling on the SMR in 2008. |
| Male | Mgo | ORPU/sisi | 1 yr. | Banded as a nestling on the SMR in 2008. |
| Male | Mgo | ORDG/pupu | 1 yr. | Banded as a nestling on the SMR in 2008. |
| Male | Mgo | DPDP/sisi | 1 yr. | Banded as a nestling on the SMR in 2008. |
| Male | DPWH/Mgo | DPDP | 1 yr. | Banded as a nestling on the SMR in 2008. |
| Male | Mgo | YEPU/sisi | 1 yr. | Banded as a nestling on the SMR in 2008. |
| Male | Mgo | LPBK/sisi | 1 yr. | Banded as a nestling on the SMR in 2008. |
| Male | Mgo | YEPU | 1 yr. | Banded as a nestling on the SMR in 2008. |
| Male | DGOR/Mgo | DGOR | 1 yr. | Banded as a nestling on the SMR in 2008. |
| Male | Mgo | WHPU/sisi | 1 yr. | Banded as a nestling on the SMR in 2008. |
| Male | Mgo | BYST | 1 yr. | Banded as a nestling on the SMR in 2008. |
| Male | Mgo | PUOR | 1 yr. | Banded as a nestling on the SMR in 2008. |
| Male | Mgo | WHDP/sisi | 1 yr. | Banded as a nestling on the SMR in 2008. |
| Male | YEYE/Mgo | PUPU | 1 yr. | Banded as a nestling on the SMR in 2008. |
| Male | Mlb | WHWH/gogo | 1 yr. | Banded as a nestling at the SDR in 2008. |
| Unknown | Msi | WHPU/gogo | ≥ 2 yr. | Banded as an adult at the SMR MAPS Station in 2009. |
| Unknown | DPDP/gogo | Mgo | 2 yr. | Banded as an adult at the SMR MAPS Station in 2009. |
| Unknown | gogo | ORDG/Msi | 2 yr. | Banded as an adult at the SMR MAPS Station in 2009. |

| Drainage | Band Combination[a] | | | |
|---|---|---|---|---|
| Sex | Left Leg | Right Leg | Age[b] | Comments |
| Santa Margarita River continued | | | | |
| Unknown | OROR/gogo | Msi | ≥ 1 yr. | Banded as an adult in 2009 - BN32 territory. |
| Unknown | DGOR/Msi | pupu | ≥ 1 yr. | Banded as an adult in 2009 - YB03 territory. |
| Unknown | DGOR | Msi | ≥ 1 yr. | Banded as an adult in 2009 - CHE territory. |
| Unknown | PUOR/sisi | Mgo | ≥ 1 yr. | Banded as an adult in 2009 - DAQ territory. |
| Unknown | WHWH/Mgo | WHWH | ≥ 1 yr. | Banded as an adult in 2009 - HW27 territory. |
| Unknown | Mgo | PUWH/sisi | ≥ 1 yr. | Banded as an adult in 2009 - PO02 territory. |
| Unknown | ORPU/sisi | Mgo | ≥ 1 yr. | Banded as an adult in 2009 - YB03 territory. |
| Unknown | WHPU/sisi | Mgo | ≥ 1 yr. | Banded as an adult in 2009 - HE39 territory. |
| Unknown | PUPU/Mgo | pupu | ≥ 1 yr. | Banded as an adult in 2009 - PR43 territory. |
| Unknown | ORPU | WHWH/Mgo | ≥ 1 yr. | Banded as an adult in 2009 - PR43 territory. |
| Unknown | DGOR | DPDP/Mgo | ≥ 1 yr. | Banded as an adult in 2009 - PR43 territory. |
| Unknown | gogo | YEPU/Msi | ≥ 1 yr. | Banded as an adult at the SMR MAPS Station in 2009. |
| Unknown | Msi | ORPU | ≥ 1 yr. | Banded as an adult at the SMR MAPS Station in 2009. |
| Unknown | Msi | ORDG | ≥ 1 yr. | Banded as an adult at the SMR MAPS Station in 2009. |
| Unknown | ORPU | Msi | ≥ 1 yr. | Banded as an adult at the SMR MAPS Station in 2009. |
| Unknown | OROR/sisi | Mgo | Unk | Banded with unknown age in 2009 - PO02 territory. |
| Unknown | Mgo | OROR/sisi | HY | Banded as a juvenile in 2009 - VIC territory. |
| Unknown | Mgo | LPLP/sisi | HY | Banded as a juvenile in 2009 - VIC territory. |
| Unknown | Mgo | DGOR | HY | Banded as a juvenile in 2009 - ARH territory. |
| Unknown | pupu | WHWH/Mgo | HY | Banded as a juvenile in 2009 - ES79 territory. |
| Unknown | pupu | DPWH/Mgo | HY | Banded as a juvenile in 2009 - CHE territory. |
| Unknown | ORPU/gogo | Mgo | HY | Banded as a juvenile in 2009 - CHE territory. |
| Unknown | PUOR/Mgo | ORPU | HY | Banded as a juvenile in 2009 - PR43 territory. |
| Unknown | DGOR | YEPU/Mgo | HY | Banded as a juvenile in 2009 - PO15 territory. |
| Unknown | Msi | PUOR | HY | Banded as a juvenile at the SMR MAPS Station in 2009. |
| Unknown | ORDG/gogo | Mgo | HY | Banded as a nestling in 2009 - AH02 territory. |
| Unknown | PUOR | Mgo | HY | Banded as a nestling in 2009 - AER territory. |
| Unknown | PUOR | Msi | HY | Banded as a juvenile at the SMR MAPS Station in 2009. |
| San Mateo Creek | | | | |
| Female | - | Mgo | ≥ 1 yr. | Banded as a nestling in or before 2008 on MCBCP. |
| Male | Mgo | PUOR/sisi | ≥ 2 yr. | Banded as an adult at SMC in 2008. |
| Male | - | Mdb | ≥ 1 yr. | Banded as a nestling in or before 2008 on the SLRR. |
| Unknown | YEYE/Mgo | DGOR | ≥ 1 yr. | Banded as an adult at SMC in 2009. |
| Unknown | WHPU/Mgo | ORPU | ≥ 1 yr. | Banded as an adult at SMC in 2009. |
| Unknown | BKLP/Mgo | DGOR | HY | Banded as a juvenile at SMC in 2009. |
| San Onofre Creek | | | | |
| Female | Mgo | - | ≥ 1 yr. | Banded as a nestling in or before 2008 on MCBCP. |
| Male | LPBK | DBWH/Mdb | 2 yr. | Banded as a nestling at the SLRR in 2007. |
| Male | Mgo | - | ≥ 1 yr. | Banded as a nestling in or before 2008 on MCBCP. |
| Male | Mgo | - | ≥ 1 yr. | Banded as a nestling in or before 2008 on MCBCP. |
| Unknown | ORPU | BKBK/Mgo | ≥ 1 yr. | Banded as an adult at SOC in 2009. |

| Drainage | Band Combination[a] | | | |
|---|---|---|---|---|
| **Sex** | **Left Leg** | **Right Leg** | **Age[b]** | **Comments** |
| Windmill Creek | | | | |
| Male | LPBK | BYST/Mdb | 2 yr. | Banded as a nestling at the SLRR in 2007. |

[a] Band colors: Mdb = dark blue numbered federal band; Mgo = gold numbered federal band; Msi = silver numbered federal band; gogo = metal gold; pupu = metal purple; sisi = metal silver; BKBK = plastic black; BKLP = plastic black-light pink split; BWST = plastic blue-white striped; BYST = plastic black-yellow striped; DBDB = plastic dark blue; DBWH = plastic dark blue-white split; DGOR = plastic dark green-orange split; DPDP = plastic dark pink; DPWH = plastic dark pink-white split; LGLG = plastic light green; 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; PUWH = plastic purple-white split; PUYE = plastic purple-yellow split; WHDB = plastic white-dark blue 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: HY = hatch-year.

[c] SLRR = San Luis Rey River, MCBCP = Marine Corps Base Camp Pendleton, DLC = De Luz Creek, SMR = Santa Margarita River, FNWS = Fallbrook Naval Weapons Station, SDR = San Diego River, SMC = San Mateo Creek, SOC = San Onofre Creek.

## APPENDIX D

## STATUS AND NESTING ACTIVITIES OF LEAST BELL'S VIREOS AT MARINE CORPS BASE CAMP PENDLETON, 2009

**Reference Site Territories**

| Territory | Nest | Monitoring[a] | Nest Fate[b] | # Fledged | Comments |
|---|---|---|---|---|---|
| AH02 | 1 | P | SUC | 3 | |
| ARI | 1 | F | PRE | 0 | |
| ARI | 2 | F | PRE | 0 | |
| ARI | 3 | F | PRE | 0 | |
| AXE | 1 | F | PRE | 0 | |
| AXE | 2 | F | SUC | 3 | |
| BER | 1 | F | SUC | 3 | |
| BER | 2 | F | SUC | 2 | |
| BOW | 1 | F | SUC | 4 | |
| CED | 1 | F | PRE | 0 | |
| CED | 2 | F | PRE | 0 | |
| CED | 3 | F | PRE | 0 | |
| DAQ | 1 | F | PRE | 0 | |
| DAQ | 2 | F | PRE | 0 | |
| DAT | 1 | F | SUC | 2 | |
| DEL | 1 | F | PRE | 0 | |
| DEL | 2 | F | PRE | 0 | |
| DEL | 3 | F | SUC | 3 | |
| DEU | 1 | F | PRE | 0 | |
| DEU | 2 | F | PRE | 0 | |
| DEU | 3 | F | PRE | 0 | |
| DEU | 4 | F | SUC | 3 | |
| DRK | 1 | F | PRE | 0 | |
| DRK | 2 | F | SUC | 3 | |
| FIN | 1 | F | INC | 0 | Nest-building was never completed |
| FIN | 2 | F | PRE | 0 | |
| FIN | 3 | F | PRE | 0 | |
| FIN | 4 | F | PRE | 0 | |
| FIN | 5 | F | SUC | 3 | |
| HDX | 1 | F | INC | 0 | Nest-building was never completed |
| HDX | 2 | F | PRE | 0 | |
| HDX | 3 | F | UNK | 0 | Nest abandoned between nest-building and egg-laying, cause of failure unknown. |
| HDX | 4 | F | SUC | 3 | |
| HE02 | 1 | P | SUC | 3 | |
| HLD | 1 | F | SUC | 2 | |
| HOL | 1 | F | SUC | 3 | |
| HOL | 2 | F | PRE | 0 | |
| HRP | 1 | F | PRE | 0 | |
| HRP | 2 | F | PRE | 0 | |
| HRP | 3 | F | SUC | 2 | |
| HTI | 1 | F | PRE | 0 | |
| HTI | 2 | F | INC | 0 | Nest-building was never completed |
| HTI | 3 | F | SUC | 4 | |
| JSP | 1 | F | INC | 0 | Nest-building was never completed |
| JSP | 2 | F | PRE | 0 | |
| JSP | 3 | F | PRE | 0 | |

| Territory | Nest | Monitoring[a] | Nest Fate[b] | # Fledged | Comments |
|---|---|---|---|---|---|
| **Reference Site Territories** (*continued*) | | | | | |
| LIF | 1 | F | PRE | 0 | |
| LIF | 2 | F | PRE | 0 | |
| LIF | 3 | F | PRE | 0 | |
| LIF | 4 | F | PRE | 0 | |
| LIF | 5 | F | SUC | 4 | |
| ODN | 1 | F | PRE | 0 | |
| ODN | 2 | F | PRE | 0 | |
| ODN | 3 | F | SUC | 3 | |
| QIN | 1 | F | PRE | 0 | |
| QIN | 2 | F | PRE | 0 | |
| QIN | 3 | F | PRE | 0 | |
| VOL | 1 | F | SUC | 4 | |
| VOL | 2 | F | SUC | 3 | |
| WSP | 1 | F | SUC | 4 | |
| WSP | 2 | F | PRE | 0 | |
| ZPR | 1 | F | INC | 0 | Nest-building was never completed |
| ZPR | 2 | F | INC | 0 | Nest-building was never completed |
| ZPR | 3 | F | SUC | 4 | |
| **Giant Reed (*Arundo donax*) Removal Site Territories** | | | | | |
| ABB | 1 | F | PRE | 0 | |
| ABB | 2 | F | SUC | 2 | |
| AE23 | 1 | P | SUC | 3 | |
| AER | 1 | F | PRE | 0 | |
| AER | 2 | F | SUC | 3 | |
| ALC | 1 | F | UNK | 0 | May have failed from ant depredation. |
| ALC | 2 | F | UNK | 0 | Nest abandoned with eggs. |
| ALC | 3 | F | SUC | 4 | |
| ALP | 1 | F | SUC | 2 | |
| ALP | 2 | F | SUC | 4 | |
| ANA | 1 | F | UNK | 0 | Nest abandoned between nest-building and egg-laying. |
| ANA | 2 | F | UNK | 0 | Nest abandoned between nest-building and egg-laying. |
| ANA | 3 | F | UNK | 0 | Nest abandoned between nest-building and egg-laying. |
| ANA | 4 | F | INC | 0 | Nest-building was never completed |
| ANA | 5 | F | PRE | 0 | |
| ANA | 6 | F | SUC | 1 | |
| ANI | 1 | F | OTH | 0 | Nest failed when supporting branch broke. |
| ANI | 2 | F | UNK | 0 | Nest abandoned with two undamaged eggs on the ground. Cause of failure unknown. |
| ANI | 3 | F | SUC | 3 | |
| ARH | 1 | F | SUC | 2 | |
| ARH | 2 | F | INC | 0 | Nest-building was never completed |
| ARS | 1 | F | OTH | 0 | Eggs likely infertile. |
| ARS | 2 | F | SUC | 4 | |
| ARS | 3 | F | SUC | 4 | |

**Giant Reed (*Arundo donax*) Removal Territories** (*continued*)

| Territory | Nest | Monitoring[a] | Nest Fate[b] | # Fledged | Comments |
|---|---|---|---|---|---|
| AST | 1 | F | SUC | 2 | |
| AST | 2 | F | PRE | 0 | |
| ATK | 1 | F | SUC | 3 | |
| ATK | 2 | F | INC | 0 | Nest-building was never completed |
| ATT | 1 | F | SUC | 2 | |
| ATT | 2 | F | PRE | 0 | |
| CAG | 1 | F | SUC | 3 | |
| CAG | 2 | F | SUC | 1 | |
| CHE | 1 | F | SUC | 2 | |
| CHE | 2 | F | SUC | 2 | |
| ES04 | 1 | P | INC | 0 | Nest-building was never completed |
| ES04 | 2 | P | SUC | 3 | |
| FNR | 1 | F | SUC | 4 | |
| FNR | 2 | F | SUC | 3 | |
| IND | 1 | F | SUC | 3 | |
| IND | 2 | F | PRE | 0 | |
| LAP | 1 | F | SUC | 2 | |
| LAP | 2 | F | SUC | 4 | |
| LIA | 1 | F | SUC | 3 | |
| LIA | 2 | F | SUC | 3 | |
| LND | 1 | F | INC | 0 | Nest-building was never completed |
| LND | 2 | F | SUC | 1 | |
| ORN | 1 | F | SUC | 4 | |
| ORN | 2 | F | SUC | 3 | |
| SNP | 1 | F | SUC | 3 | |
| TUL | 1 | F | SUC | 3 | |
| TUL | 2 | F | SUC | 3 | |
| VEG | 1 | F | SUC | 4 | |
| VEG | 2 | F | SUC | 3 | |
| VIC | 1 | F | SUC | 2 | |
| WNS | 1 | F | SUC | 3 | |
| WNS | 2 | F | SUC | 3 | |

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

[b] Nest Fate: INC = nest never completed; SUC = fledged at least one Least Bell's Vireo young; PRE = nest failure caused by predation; OTH = reason for nest failure known, such as substrate failure; UNK = reason for nest failure/abandonment unknown; FAL = false/bachelor nest built by unpaired male.