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

2010 Annual Data Summary

Prepared for:

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

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

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EXECUTIVE SUMMARY

Surveys for the endangered Least Bell's Vireo (*Vireo bellii pusillus*) were conducted at Marine Corps Base Camp Pendleton (MCBCP or Base), California, between 29 March and 12 July 2010. Drainages containing riparian habitat suitable for vireos were surveyed two to seven times. One thousand and sixty-eight territorial male vireos and 60 transient vireos were detected on 19 out of the 23 drainages/sites surveyed. Ninety-seven percent of all vireo territories occurred on the ten most populated drainages, with the Santa Margarita River containing 62% of all territories on Base. Seventy-one percent of male vireos were confirmed as paired.

In 2010, the number of documented Least Bell's Vireo territories (1,068) exceeded the highest recorded number of vireo territories on MCBCP over the past 15 years. The number of territories on 26% (6/23) of drainages surveyed increased from 2009, while nine drainages showed no change or decreased by two or fewer territories. Overall, the vireo population on Base increased by 5% from 2009 to 2010.

The majority of vireo territories occurred in habitat characterized as Willow Riparian, with 75% of males in the study area found in this habitat. An additional 7% of birds occupied willow (*Salix* spp.) habitat co-dominated by cottonwoods (*Populus fremontii*) or sycamores (*Platanus racemosa*). Twelve percent of territories were found in riparian scrub, dominated by mule fat (*Baccharis salicifolia*) and/or sandbar willow (*S. exigua*). Five percent of the vireos used drier habitats including areas dominated by white alder (*Alnus rhombifolia*; 2% of total), a mix of sycamores and oaks (*Quercus agrifolia*; 2% of total) or upland vegetation (1%). Approximately 1% of vireo territories were placed in habitat dominated by non-native vegetation.

Two hundred four Least Bell's Vireos were banded during the 2010 season. These included 42 adult vireos, 161 hatch-year vireos, and 1 vireo of unknown age. The 42 adult vireos, 1 vireo of unknown age, and 19 hatch-year birds were banded with unique color combinations. The remaining 142 birds (140 nestlings and 2 hatch-year birds captured post-fledging) were banded with a single gold numbered federal band on the left leg.

One hundred and twelve Least Bell's Vireos banded prior to the 2010 breeding season were resighted and identified on Base in 2010. Twelve of these were originally banded on the San Luis Rey River. Adult birds of known age ranged from 1-6 years old. Adult survivorship, or the proportion of individuals known to survive from 2009 to 2010, was 50% (101/201). Survivorship of first-year birds fledged from MCBCP in 2009 and documented on Base or elsewhere in 2010 was 7% (13/197), based on the number of uniquely banded individuals. First-year survivorship may be as high as 12% (23/197) if we include birds with single gold federal bands that may have fledged in 2009 but were not recaptured to confirm fledge year. Of the 13 uniquely color banded first-year birds detected, seven were male, five were female, and sex of one was undetermined.

The majority of returning adult vireos showed strong between-year site fidelity. Overall vireo territory fidelity between 2009 and 2010 was 72% (50/69). The average between-year movement for returning adult vireos was 0.1 ± 0.3 km (SD). Dispersal distance of first-year vireos fledged from MCBCP nests ranged from 0.1-9.2 km. Two first-year vireos that fledged

from nests on the San Luis Rey River in 2009 (both males) were documented on Base. Overall, the average distance first-year vireos dispersed was 4.5 ± 7.5 km (SD).

In Fall 2008, a large area in the Santa Margarita River drainage was cleared of giant reed (*Arundo donax*). In 2010, we began monitoring nests at two "new" Removal sites within these newly cleared areas. We did not monitor nests in the "old" Removal sites that had been monitored from 2005-2009; however, we continued to follow birds that had been banded in the "old" Removal sites for survivorship and movement analyses.

Adult survivorship of vireos on old giant reed Removal sites and Reference sites was 34% and 50%, respectively. First-year survivorship was 5% and 7%, respectively. One hundred percent of adults at Removal sites and Reference sites returned in 2010 to the same territory occupied in 2009. Two 2009 male nestlings from Removal sites returned to a Removal site in 2010, one male dispersed to a Reference site, and one male and two females dispersed to areas outside of monitoring sites. All five nestlings from Reference sites dispersed outside of monitoring sites in 2010.

Several vireos moved between drainages to their 2010 sites. Eight vireos moved from other areas to MCBCP. Seven of these were originally banded on the San Luis Rey River. One male, originally banded on MCBCP, moved to the San Gabriel River, Los Angeles County, in 2009 and returned to MCBCP in 2010. Four vireos moved from MCBCP and were detected elsewhere in 2010. One male, banded as a nestling on MCBCP in 2006, was recaptured in Trabuco Canyon, Orange County, California. Two females, banded as nestlings on MCBCP in 2007 and 2009, were recaptured on the San Luis Rey River. One other female was detected on Ballona Creek in Los Angeles County in 2010.

Nesting activity was monitored in 51 territories within two "new" giant reed Removal and two Reference monitoring areas. A total of 120 nests were monitored during the breeding season; however, 17 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 2010, regardless of the outcome of their first nesting attempt. Twenty-four percent of pairs at Removal sites and 10% of pairs at Reference sites fledged young from two nests in 2010. There was no difference in timing of first nesting attempts at Removal and Reference sites, although the first nests overall in 2010 were initiated a week later than in all previous years.

Nest success was higher for pairs breeding in Removal sites compared to Reference sites. Fifty-eight percent (26/45) of Removal nests and 26% (15/58) of Reference nests successfully fledged young. First nesting attempts were more likely to be successful at Removal sites (56%) than at Reference sites (24%), and the 41% of successful first nest attempts in 2010 was intermediate between extremes in previous years. Predation was believed to be the primary source of nest failure at both sites. Predation accounted for 74% (14/19) and 79% (34/43) 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 destruction of eggs by other birds.

Two nests failed after the surrounding vegetation was sprayed with herbicide. At one of these nests, the supporting vegetation died and collapsed. At the second nest, the eggs were abandoned with developed embryos. A third nest successfully fledged three of four young after the surrounding vegetation was sprayed with herbicide.

No nest parasitism of Least Bell's Vireos by Brown-headed Cowbirds (*Molothrus ater*) was documented. Most productivity measures of Least Bell's Vireos nesting at Removal and Reference sites were similar. In 2010, 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 2010.

Density of vireo territories increased at old and new Removal sites but decreased at Reference sites in 2010. Density at the new Removal sites was lowest in 2008, immediately prior to giant reed removal, and has increased both years following giant reed removal.

Primary productivity and the types of prey consumed by vireos have been shown to vary with annual precipitation (Cody 1981, Grant and Grant 1987). We found that annual precipitation, and by association primary productivity and prey abundance, affected clutch size but not number of young fledged per pair between 2005 and 2010. Annual precipitation was not associated with the total number of vireo territories on MCBCP during the subsequent breeding season.

In 2010, successful and unsuccessful nests within Removal and Reference sites were generally similar in placement. However, at Reference sites, successful nests were placed significantly closer to the edge of the host plant than unsuccessful nests. Vireo nests at Removal sites were placed higher in the host plant, were further from the edge of the host plant, and were further from the edge of riparian vegetation than nests in Reference sites. Fourteen plant species were used as hosts for vireo nests in 2010. Sixty-five percent of nests were placed in arroyo willow (*S. lasiolepis*), sandbar willow, and mule fat.

Recent stability and the subsequent increase in the vireo population over the past two years on MCBCP reflect similar population trends on the nearby San Luis Rey River, although the population on the San Luis Rey River did not increase between 2009 and 2010. The increase in the MCBCP vireo population from 2009 to 2010 varied across drainages, with two drainages showing substantial increases and one drainage showing a substantial decrease. However, the vireo populations in most drainages remained relatively stable. This adjustment of the vireo population distribution may reflect changing conditions at some sites. Vireos moved between MCBCP and surrounding drainages, most frequently detected moving from the San Luis Rey River to MCBCP. Vireos from MCBCP were detected on the San Luis Rey River, Trabuco Canyon in Orange County, and Ballona Creek in Los Angeles County.

Contrary to what was observed in the lower San Luis Rey vireo population, productivity in 2010 was lower than in recent years on MCBCP and may possibly be associated with a later commencement of the breeding season on Base. We also observed higher breeding productivity (number of pairs that fledged young and number of pairs that fledged more than one brood) at the new Removal sites than at Reference sites. 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 and may have higher quality vireo breeding habitat than Reference sites, at least during the early successional recovery of the riparian vegetation.

Vireo population density at the new Removal sites decreased annually prior to giant reed removal, and has doubled each year (from 2008-2010) since removal occurred. Vireo population density at the old Removal sites increased significantly more than at Reference sites, suggesting that vireo breeding habitat continues to improve at the old Removal sites. The population of vireos across MCBCP was significantly related to annual precipitation during the prior year, although precipitation did not seem to affect breeding productivity.

Nest site characteristics did not differ greatly between successful and unsuccessful nests, either at Removal sites or at Reference sites. However, the new Removal sites were similar to the old Removal sites in that vireos at both new and old Removal sites placed nests higher and further from the edge (of the host plant, the nest clump, and of riparian vegetation) than vireos in the Reference sites. Further investigation into habitat variables at these sites may explain whether or not nest placement is a function of what is available or if vireos are selecting particular nest sites out of proportion to their availability.

Military training exercises, brush control, habitat restoration, and vehicle collisions all impacted vireos and vireo habitat in 2010. Many of these impacts could be reduced by coordinating activities between departments and communicating needs and potential sources of flexibility associated with military training, recreation, habitat protection and endangered species management.

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 (MCBCP or Base).

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, although double-brooding can be more common during some years when breeding conditions are favorable (early initiation, high early fledging success; Ferree and Kus 2008b, Ferree et al. 2010a, Lynn and Kus 2009, 2010a). 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 (2008) 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 MCBCP, 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 MCBCP, 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, MCBCP, California.

STUDY AREAS AND METHODS

Field Surveys

All of MCBCP's major drainages, and several minor ones supporting riparian habitat, were surveyed for vireos between 29 March and 12 July 2010 (Fig. 1). Field work was conducted by Kristen Dillon, PJ Falatek, Julia Fromfeld, Aaron Gallagher, Brett Hartl, Alexandra Houston, Scarlett Howell, Jennifer Kendrick, Barbara Kus, Suellen Lynn, Melanie Madden-Smith, Ryan Pottinger, Michelle Rogne, and Jason Thomas. 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. 19 and 20).
   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. 19).

2. ***De Luz Creek,*** between the confluence with the Santa Margarita River and the Base boundary (Appendix A, Fig. 19).

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. 19).

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. 19).

5. ***Basilone and Roblar Roads,*** a small patch of habitat straddling Basilone Road at the intersection of Basilone and Roblar Roads (Appendix A, Fig. 19).

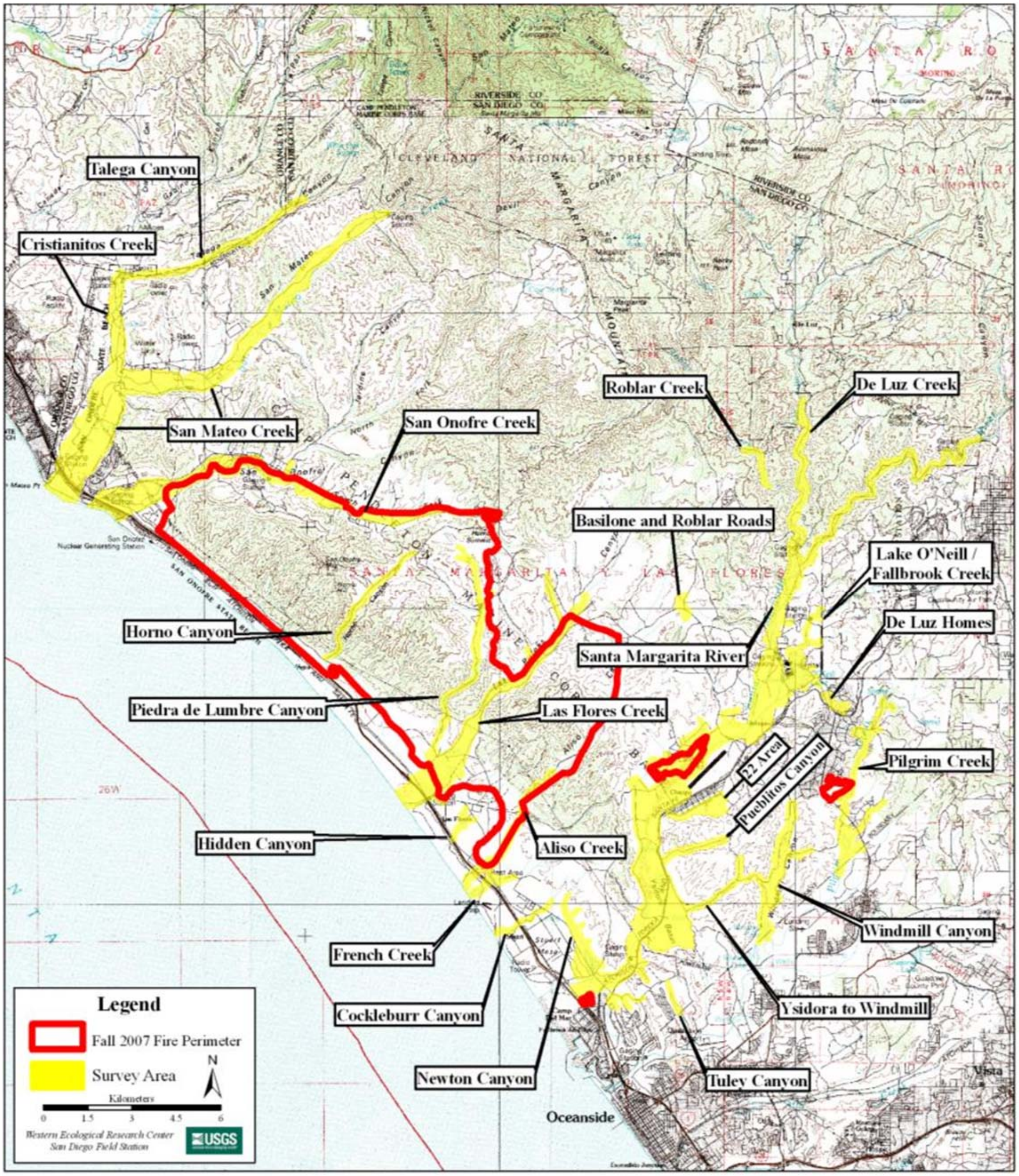

Fig. 1. Least Bell's Vireo survey areas and the Fall 2007 fire perimeter at Marine Corps Base Camp Pendleton, 2010.

6. ***22 Area,*** all riparian habitat within the 22 Area, east of Vandegrift Road and the Supply Depot (Appendix A, Fig. 20).

7. ***Pueblitos Canyon,*** between Vandegrift Road and a point approximately 2.5 km upstream (Appendix A, Fig. 20).

8. ***Tuley Canyon,*** between the Base boundary and a point approximately 1.1 km upstream (Appendix A, Fig. 20).

9. ***Newton Canyon,*** between the confluence with the Santa Margarita River and the upstream limit of riparian habitat (Appendix A, Fig. 20).

10. ***Cockleburr Canyon,*** between the Pacific Ocean and a point 0.25 km east of Interstate 5 (Appendix A, Fig. 20).

11. ***French Creek,*** between the Pacific Ocean and the Edson Range Impact Area (Appendix A, Fig. 20).

12. ***Aliso Creek,*** between the Pacific Ocean and 0.5 km upstream of the electrical transmission lines (Appendix A, Fig. 20).

13. ***Hidden Canyon,*** between Interstate 5 and Stuart Mesa Road (Appendix A, Fig. 21).

14. ***Las Flores Creek (within Las Pulgas Canyon):***
    a. Between Stuart Mesa Road and the high voltage electrical transmission lines (Appendix A, Fig. 21).
    b. Between the Pacific Ocean and Stuart Mesa Road (Appendix A, Fig. 21).
    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. 21).

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. 21).

16. ***Horno Canyon,*** between Old Highway 101 and the upstream limit of riparian habitat (Appendix A, Fig. 21).

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. 21 and 22).
    b. From Basilone Road upstream to the access road to Range 219 (Appendix A, Fig. 21).

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. 22).
    b. From San Mateo Road upstream to the Base boundary (Appendix A, Figs. 22 and 23).

19. ***Cristianitos Creek,*** between the confluence with San Mateo Creek and the Base boundary (Appendix A, Fig. 22).

20. ***Talega Canyon,*** between the confluence with Cristianitos Creek and a point approximately 6.5 km upstream (Appendix A, Fig. 22).

21. ***Pilgrim Creek:***
    a. Between the southern Base boundary and Vandegrift Boulevard, including the two side drainages east of Pilgrim Creek (Appendix A, Fig. 24).
    b. From Vandegrift Boulevard upstream to the limit of riparian habitat (Appendix A, Fig. 24).

22. ***Windmill Canyon,*** from the Base boundary past the golf course to the upstream extent of habitat (includes both 2004 Windmill Canyon and Horse Pasture sites; Appendix A, Fig. 24).

23. ***Ysidora Basin to Windmill Canyon,*** between Upper Ysidora Basin and Windmill Canyon/ Pueblitos Canyon (Appendix A, Fig. 24).

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

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, 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, Tuley Canyon, Newton Canyon, French Creek, Hidden Canyon, Horno Canyon, Piedra de Lumbre Canyon, San Onofre Creek (17b), San Mateo Creek (18b), Talega Canyon, Pilgrim Creek (21b), Windmill Canyon, Ysidora Basin to Windmill Canyon, and De Luz Homes habitat. The upper portion of the Santa Margarita River (1b) was surveyed twice for vireos. Because of range access restrictions, Roblar Canyon was surveyed only once in 2010.

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 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, MCBCP 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.

From 2005 to 2009, we monitored vireos within four study sites, two giant reed Removal sites (hereafter "old Removal" sites) where extensive areas of giant reed had been cleared between 2000 and 2002, and two Reference sites (hereafter "Reference" sites) where some peripheral giant reed removal occurred, mainly between 1997 and 1999, and the native vegetation had recovered. In Fall 2008, giant reed was cleared in a new area within the Santa Margarita River drainage downstream of Marine Corps Air Station (MCAS; Fig. 2). In 2010, we began monitoring vireos within two new monitoring areas inside this extensive clearing (hereafter "new Removal" sites) and continued monitoring vireos within the two established Reference sites (Fig. 2). The new and old Removal sites differ in two distinct ways: (1) we began our monitoring at the new Removal sites sooner after giant reed was removed than we did in the old Removal sites (1.5 years vs. 3-5 years post-clearing); and (2) clearing in the new Removal sites was more extensive and less patchy than clearing in the old Removal sites.

We compared vireo breeding productivity and factors that potentially influence productivity between new Removal and Reference sites in 2010 to determine whether giant reed removal influenced vireo productivity. We also examined differences between the first year of vireo breeding productivity in our old Removal sites (2005) and the first year of vireo breeding productivity in our new Removal study sites (2010) and compared those differences with vireo productivity in the Reference sites for those two years to determine whether or not the new Removal sites exhibited similar patterns as the old Removal sites. 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 new and old 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 new and old Removal and Reference sites.

Finally, we compiled annual density within the new and old 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 2010. 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.

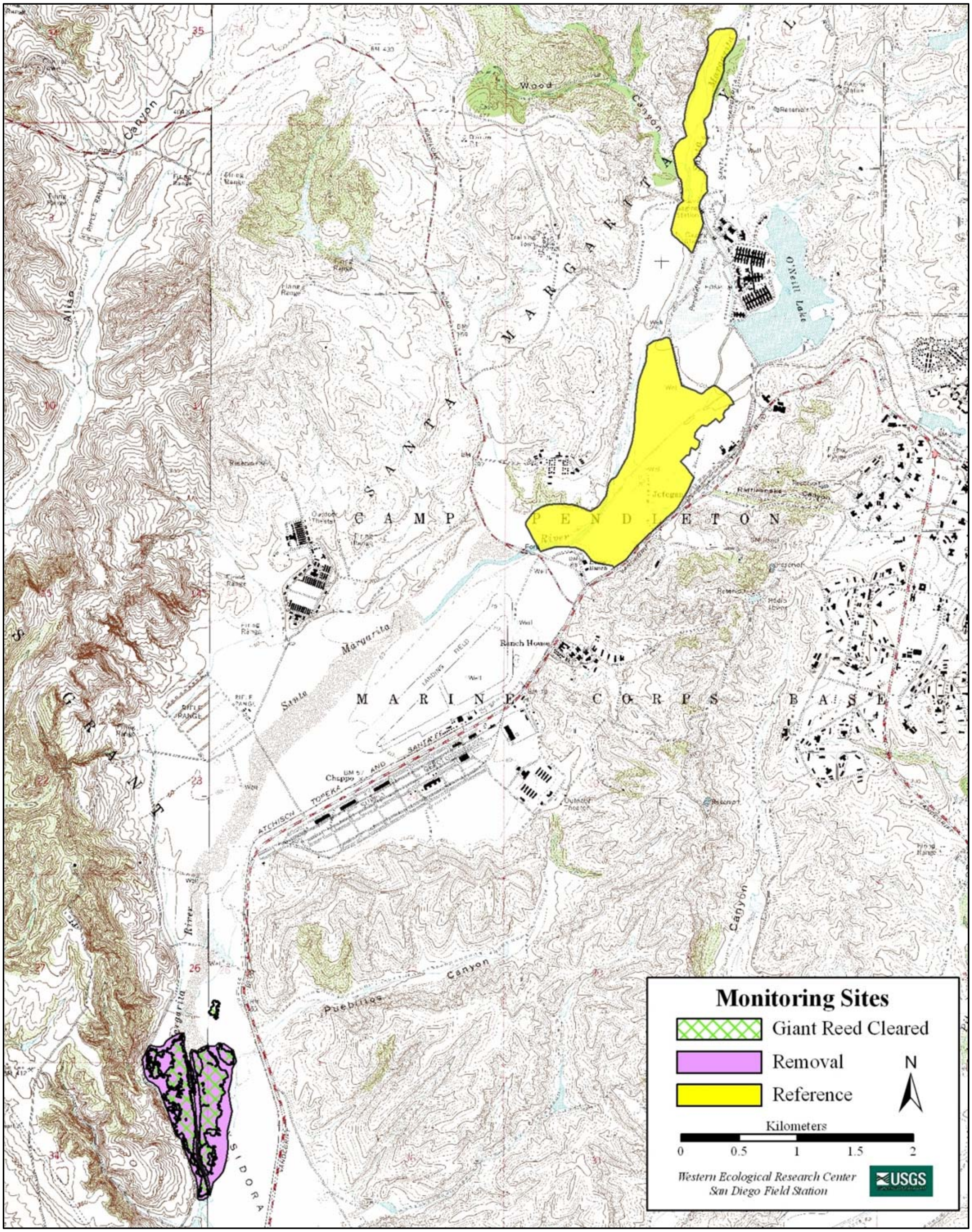

Fig. 2. Location of Least Bell's Vireo nest monitoring areas at Marine Corps Base Camp Pendleton, 2010.

Nesting activity was documented for 25 pairs in Removal sites and 22 pairs in Reference sites throughout the breeding season. A subset of nests was monitored for four additional pairs (one at a Removal site and three at Reference sites) 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, to the edge of the vegetation clump in which they were placed, and to the edge of the riparian vegetation 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 a central weather station on MCBCP, Target Range 408 (NWS ID #045732; OWR 2009, OWR unpublished data), 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 2009 through June 2010 is associated with vireo data from 2010). 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 MCBCP were (1) to better understand adult vireo site fidelity within a potential source population, (2) to investigate natal dispersal on Base, and the role MCBCP young play in potentially supporting vireo populations off Base, and (3) to understand how giant reed removal affects vireo site fidelity, dispersal, and survivorship. Nestlings from monitored nests were banded at 6-7 days of age with a single anodized gold numbered federal band on the left leg. 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 MCBCP as the bird's site of origin. Returning adults previously banded as nestlings 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. Finally, any Least Bell's Vireos captured at one of two MAPS stations on Base were banded with unique color combinations and used in some analyses.

During surveys and nest monitoring activities, we attempted to resight all vireos to determine whether or not they were banded, and if so, to confirm their identity by reading their unique color band combination or by recapturing birds with single federal bands. We used resighting and recapture data to calculate annual survivorship, or the fraction of all individuals known to be present on Base in one year that returned the following year. Individuals "known to be present" in a given year included birds observed directly as well as individuals not observed but whose presence was inferred retroactively by their detection in a subsequent year. Imperfect detectability of banded individuals is typical of mark-recapture studies and occurs for various reasons (e.g., females are more cryptic and may be missed on surveys, birds are detected as banded but their full color combinations [and thus identities] are not obtained; birds with single federal bands are not recaptured and thus their identities not determined). Our previous estimates of annual survivorship therefore require adjustment each year to incorporate data for individuals not "seen" previously but known to have been alive.

Survivorship from 2009-2010 was calculated for known individuals that were: (1) adults in 2009 on Base and were resighted anywhere on Base in 2010; (2) adult vireos that held territories in old Removal or Reference sites in 2009 and were resighted anywhere on Base in 2010; (3) first-year vireos that were banded as nestlings or juveniles anywhere on Base in 2009 and were resighted anywhere in 2010 (including off Base); and (4) first-year vireos that were banded as nestlings or juveniles in old Removal or Reference sites in 2009 and were resighted anywhere in 2010. Unlike for estimates of overall survivorship of adults and juveniles (i.e., (1) and (3)), we did not adjust survivorship (see above) for analyses involving old Removal and Reference sites because we could not confirm the presence of birds in those sites during years that they were not detected.

Site fidelity and movements of vireos were determined by measuring the distance between the center of a vireo's breeding or natal territory in 2009 and the center of the same vireo's breeding territory in 2010. Vireos exhibited site fidelity if they returned to within 100 m of their 2009 territory. Site fidelity and movement were calculated for the same four categories analyzed for survivorship (see above), except that only individuals with known territory locations during the last year they were detected prior to 2010 were included (e.g., juveniles banded after fledging were excluded because their natal territories could not be confirmed in light of their capacity for substantial movement; vireos captured at MAPS stations were excluded unless their territory locations were known from surveys).

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 or 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 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. 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 MCBCP. 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 MCBCP from 2005, 2006, 2007, 2008, and 2009 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, 2010a.

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 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.

RESULTS

Population Size and Distribution

A total of 1,128 Least Bell's Vireo sites were identified during Base-wide surveys (Table 1, Appendix B, Figs. 25-44). This included 1,068 territorial male vireos, 71% of which were confirmed as paired, and 60 transients. Transient vireos were observed on 13 of the 23 (57%) drainages/sites surveyed. Ninety-seven 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, Lake O'Neill/Fallbrook Creek, Cristianitos Creek, and Windmill Creek), and the majority of vireo territories (62%) occurred along the Santa Margarita River, the largest expanse of riparian vegetation on Base (Tables 1, 2). The remaining 13 drainages/sites each contained fewer than ten territories.

The distribution of Least Bell's Vireo territories documented on Base in 2010 was similar to that in 2009 (Fig. 3, Table 2), and continued to increase in areas that had been burned in 2007. In 2010, the vireo population increased in 26% of drainages surveyed (6/23). Nine drainages (39%) showed no change or decreased by two or fewer territories between 2009 and 2010 and eight drainages (35%) decreased by 3-12 territories. The drainage with the largest numeric increase in vireo territories continued to be the Santa Margarita River, increasing by 79 territories (13%). The site with the largest numeric loss in vireo numbers was San Mateo Creek, losing 12 territories (14%). Overall, the vireo population on Base increased by 5% from 2009 to 2010.

Table 1. Number and distribution of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2010.

Drainage/Survey Site	Known Pairs	Single/ Status Undetermined	Transient	Total Territories
Santa Margarita River:				
I-5 to De Luz Creek	472	145	20	617
De Luz Creek to Base Boundary	24	20	0	44
22 Area	11	6	1	17
De Luz Creek	34	0	0	34
Roblar Creek	1	0	0	1
Lake O'Neill/Fallbrook Creek	10	5	2	15
Basilone-Roblar Roads	4	0	1	4
Pueblitos Canyon	0	0	0	0
Newton Canyon	5	2	3	7
Cockleburr Creek	0	0	1	0
French Canyon	1	1	1	2
Aliso Creek	7	9	2	16
Hidden Canyon	3	1	0	4
Las Flores Creek:				
Pacific Ocean to Stuart Mesa Road	4	7	1	11
Stuart Mesa Road to Power Lines	30	22	1	52
Power Lines to Zulu Impact Area	41	20	4	61
Piedra de Lumbre Canyon	4	2	1	6
Horno Canyon	1	0	0	1
San Onofre Creek:				
Pacific Ocean to Basilone Road	31	14	10	45
Basilone Road to Access Road to Range 219	6	3	0	9
San Mateo Creek				
Pacific Ocean to San Mateo Road	38	31	9	69
San Mateo Road to Yankee Training Area	1	1	0	2
Cristianitos Creek	6	4	1	10
Talega Canyon	0	0	0	0
Tuley Canyon	0	0	0	0
Pilgrim Creek:				
Base Boundary upstream to Vandegrift Boulevard	15	3	2	18
Vandegrift Boulevard to upstream riparian limit	5	1	0	6
Windmill Canyon	1	9	0	10
Ysidora Basin to Windmill Canyon	2	0	0	2
De Luz Homes	5	0	0	5
Total	762	306	60	1,068

Table 2. Number of territorial males at Marine Corps Base Camp Pendleton, by drainage, 2004-2010. Numeric change is the positive or negative change in the number of vireo territories between 2009 and 2010.

	Number of Territorial Males							Numeric
Drainage	**2004[a]**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**Change**
Santa Margarita River[b]	440	472	417	423	463	599	678	+79
De Luz Creek	26	18	25	24	25	39	34	-5
Roblar Creek	1	0	0	0	0	2	1	-1
Lake O'Neill/Fallbrook Creek	16	20	10	9	11	11	15	+4
Pueblitos Canyon	3	5	3	2	2	1	0	-1
Newton Canyon	9	8	8	5	4	6	7	+1
Cockleburr Creek	0	2	2	2	1	2	0	-2
French Canyon	5	6	4	2	2	2	2	0
Aliso Creek	21	21	11	9	11	21	16	-5
Hidden Canyon	5	8	5	4	4	2	4	+2
Las Flores Creek	84	85	76	81	70	107	124	+17
Piedra de Lumbre Canyon	5	8	9	6	3	5	6	+1
Horno Canyon	0	1	0	0	0	1	1	0
San Onofre Creek	56	52	43	44	41	62	54	-8
San Mateo Creek	68	56	59	46	53	83	71	-12
Cristianitos Creek	8	6	8	8	4	13	10	-3
Talega Canyon	0	1	0	0	0	1	0	-1
Pilgrim Creek	37	36	23	26	26	27	24	-3
Windmill Canyon	20	12	7	8	12	13	10	-3
Ysidora Basin to Windmill Canyon	8	4	6	5	4	5	2	-3
De Luz Homes	5	4	2	3	2	6	5	-1
Basilone-Roblar Roads	-	2	0	0	0	5	4	-1
Tuley Canyon	2	-	0	0	0	0	0	0
Total	819	827	718	707	738	1,013	1,068	+55

[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.

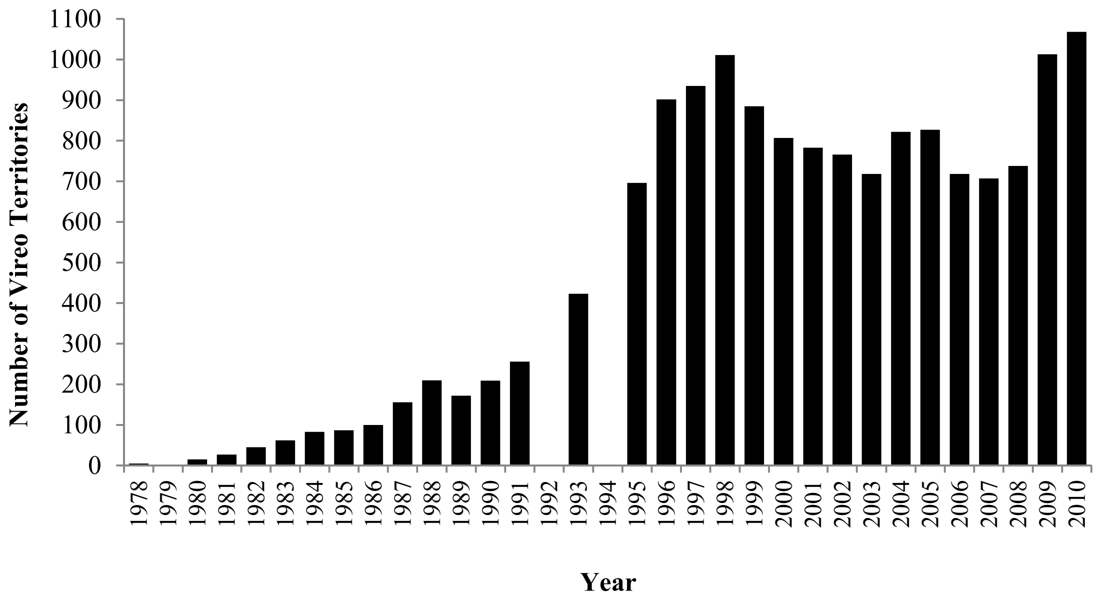

Fig. 3. Number of Least Bell's Vireo territories at Marine Corps Base Camp Pendleton, 1978–2010. (Source: Griffith Wildlife Biology 2004, Rourke and Kus 2006a, 2007a, 2008, Lynn and Kus 2009, 2010a).

Overall, areas that burned in 2007 (Fig. 1) showed an increase in vireo numbers again in 2010 (Fig. 4). Four of the six drainages that burned in 2007 had a higher number of vireos inside the burned areas than before the fire. Base-wide, the number of vireo territories in areas that burned in 2007 (126 territories) decreased by 29% in 2008 (89 territories), then increased by 102% in 2009 (180 territories) and again by 5% in 2010 (189 territories), for an overall increase of 50% from before the fire to 2010.

Least Bell's Vireos began arriving on Base during the last week of March (Fig. 5), with 157 territories established by 31 March. By 1 April 2010, 15% of males had established territories. By 15 April 49% of males were present, and by the end of April, 76% of males were detected at their territories. This generally follows the pattern of territory establishment on MCBCP over the past five years.

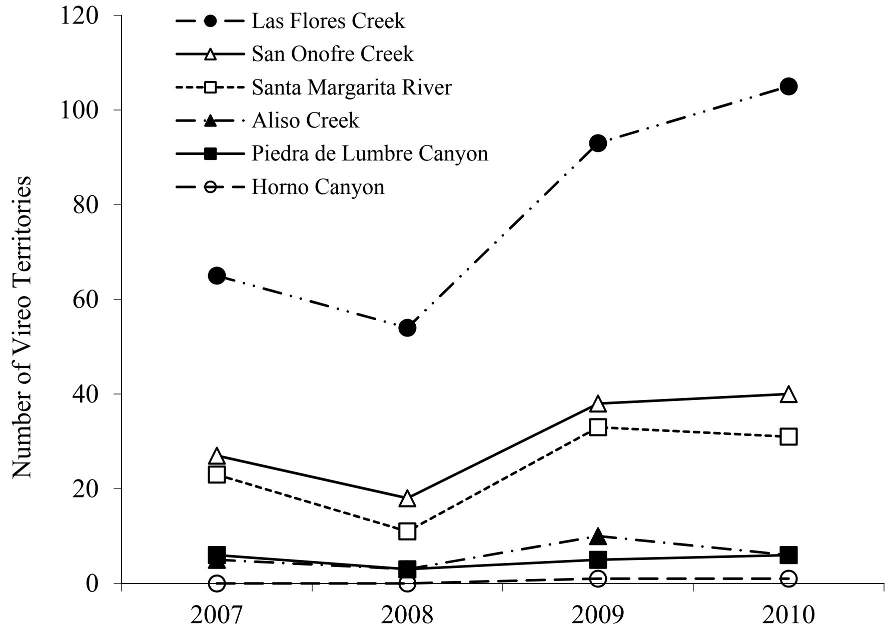

Fig. 4. Change in the number of Least Bell's Vireo territories in areas that burned in 2007 at Marine Corps Base Camp Pendleton, 2007–2010.

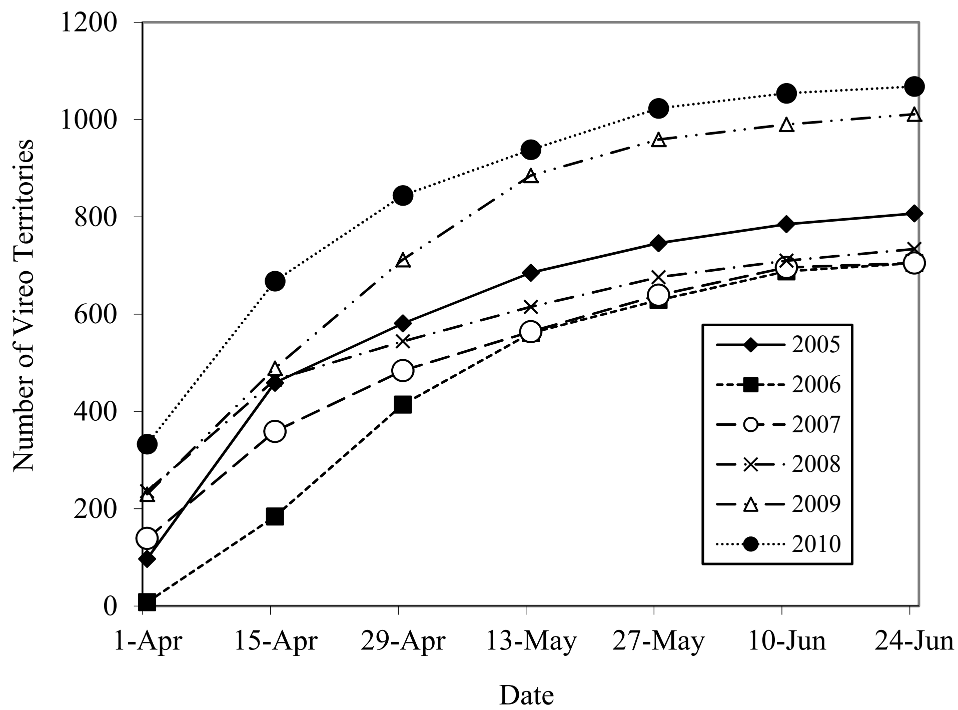

Fig. 5. Territory establishment of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2005-2010.

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 75% of males in the study area found in this habitat. An additional 7% of birds occupied willow habitat co-dominated by cottonwoods or sycamores. Twelve percent of territories were found in riparian scrub, dominated by mule fat and/or sandbar willow. Five percent of the vireos used drier habitats including areas dominated by white alder (*Alnus rhombifolia*; 2%), a mix of sycamore and oaks (2%), or upland vegetation (1%). 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, 2010.

	Number of Territories			
Habitat Type	**>50% Native**	**>50% Exotic**	**Total**	**Percent of Total**
Mixed Willow	747	51	798	75%
Riparian Scrub	105	24	129	12%
Willow/Sycamore	63	9	72	7%
Alder	15	5	20	2%
Oak/Sycamore	14	4	18	2%
Upland Scrub	11	2	13	1%
Non-native	0	6	6	1%
Willow/Cottonwood	3	0	3	< 1%
Total	958	101	1,059[a]	100%

[a] Data not recorded in all territories.

A similar proportion of vireo territories were documented in exotic vegetation in 2010 as in 2009 (Table 4). Ten percent (101/1,059) of vireo territories in 2010 and 10% in 2009 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 2010, fewer drainages contained territories dominated by non-native vegetation than in 2009. Exotic vegetation dominated at least one territory in nine drainages in 2010 compared to eleven drainages in 2009. 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, 2005-2010. Numbers in parentheses are the number of territories on the drainage.

	Proportion of Territories											
Drainage	**2005**		**2006**		**2007**		**2008**		**2009**		**2010**	
Windmill Creek	0.67	(12)	0.14	(7)	0.13	(8)	0.67	(12)	0.92	(13)	0.60	(10)
Ysidora Basin to Windmill Canyon	0.25	(4)	0.5	(6)	0	(5)	0.25	(4)	0.2	(5)	0.50	(2)
San Mateo Creek	0.66	(56)	0.12	(59)	0	(46)	0.14	(53)	0.1	(83)	0.25	(68)
Las Flores Creek	0.02	(85)	0.14	(76)	0	(81)	0.29	(70)	0.22	(107)	0.21	(124)
San Onofre Creek	0.23	(52)	0	(43)	0	(44)	0.13	(41)	0.21	(62)	0.11	(54)
Cristianitos Creek	0.5	(6)	0.13	(8)	0.25	(8)	0	(4)	0.08	(13)	0.10	(10)
Aliso Creek	0.05	(21)	0	(11)	0.11	(9)	0	(11)	0	(21)	0.06	(16)
Santa Margarita River[a]	0.17	(472)	0.05	(417)	0.04	(423)	0.03	(463)	0.06	(599)	0.06	(676)
Pilgrim Creek	0	(36)	0	(23)	0	(26)	0	(26)	0.15	(27)	0.04	(24)
Hidden Canyon	0	(8)	0	(5)	0	(4)	0	(4)	0.5	(2)	0	(4)
Newton Canyon	0.63	(8)	0.13	(8)	0	(5)	0.5	(4)	0.2	(6)	0	(4)
Piedra de Lumbre Canyon	1	(8)	0	(9)	0	(6)	0.67	(3)	0.2	(5)	0	(6)
Basilone-Roblar Roads	0	(2)	-	-	-	-	-	-	0	(5)	0	(3)
Cockleburr Canyon	0	(2)	0	(2)	0	(2)	0	(1)	0	(2)	-	-
De Luz Creek	0.06	(18)	0.04	(25)	0	(24)	0	(25)	0	(39)	0	(34)
De Luz Homes	0	(4)	0	(2)	0	(3)	0	(2)	0	(6)	0	(5)
French Canyon	0	(6)	0	(4)	0	(2)	0	(2)	0	(2)	0	(2)
Horno Canyon	1	(1)	-	-	-	-	-	-	0	(1)	0	(1)
Lake O'Neill/ Fallbrook Creek	0.15	(20)	0	(10)	0.11	(9)	0	(11)	0	(11)	0	(15)
Pueblitos Canyon	0	(5)	0	(3)	0	(2)	0.5	(2)	0	(1)	-	-
Roblar Creek	-	-	-	-	-	-	-	-	0	(2)	0	(1)
Talega Canyon	0	(1)	-	-	-	-	-	-	0	(1)	-	-
Total	0.19	(827)	0.06	(718)	0.03	(707)	0.09	(703[b])	0.10	(1,009[b])	0.10	(1,059[b])

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

Banded Birds

Returning Banded Birds

We were able to observe 1,463 adult Least Bell's Vireos (1,026 males, 91% of all males, and 435 females, 56% of all females) on Base well enough to determine banding status in 2010, although not all banded vireos were observed well enough to conclusively identify the individual. One hundred and forty-six of these had been banded prior to the 2010 breeding season, 34 of which we could not identify because band combinations were not confirmed (21) or because the vireos were banded with only a single numbered metal federal band ("natal"; 13; Table 5). We were able to identify 112 vireos on Base that were banded with unique color band combinations in 2010 (Table 5, Appendix C). Of these, 99 vireos had been banded on Base or at

FNWS and 13 vireos were originally banded off Base (all on the San Luis Rey River; Ferree and Kus 2007, 2008a, 2008b, Ferree et al. 2010a, USGS unpublished data; Table 6). Adult birds of known age ranged from 1-6 years old.

Table 5. Banding status of Least Bell's Vireos detected on Marine Corps Base Camp Pendleton and those that emigrated off Base in 2010.

Banding Status	Detected on Base[a] Male	Female	Unknown Sex	Total on Base	Emigrants Male	Female	Total
Uniquely banded prior to 2010	75	12	-	87	-	-	87
Natal[b] recaptured in 2010	15	2	-	17	1	2	20
MAPS uniquely banded prior to 2010[c]	-	5	2	7	-	-	7
MAPS natal recaptured in 2010[c]	-	1	-	1	-	-	1
Subtotal of known identity vireos	90	20	2	112	1	3	116
Unidentified (Partial resights)	10	11	-	21	-	1	22
Natal[b], not recaptured	4	9	-	13	2	1	16
Grand total	104	40	2	146	3	4	153

[a] Includes immigrants. First-year immigrants (2) were not included in survivorship, fidelity, or movement analyses.
[b] Natal vireos were originally banded as nestlings with a single numbered metal federal band.
[c] Vireos that were not identified on territories but were identified at MAPS banding stations (Rogne and Kus 2010).

Table 6. Number of banded adult Least Bell's Vireos at Marine Corps Base Camp Pendleton in 2010, by original year banded, age, original banding location, and sex.

Year Originally Banded	Age in 2010	Number of Vireos Observed by Origin: Marine Corps Base Camp Pendleton Male	Female	Unknown Sex	San Luis Rey River Male	Female
2005	≥ 6 yrs.	2	0	0	0	0
	≥ 5 yrs.	1	0	0	0	0
	5 yrs.	0	1	0	0	0
2006	≥ 5 yrs.	4	0	0	0	0
	4 yrs.	1	0	0	2	0
2007	≥ 4 yrs.	5[a]	0	0	0	0
	3 yrs.	6	2	0	4	0
2008	≥ 3 yrs.	9	4	0	0	0
	2 yrs.	13	1	0	5	0
2009	≥ 2 yrs.	27	7	0	0	0
	2 yrs.	1	1	1	0	0
	≥ 1 yr.	1	0	0	0	0
	1 yr.	7	4	1	2	0
Subtotal		77	20	2	13	0
Unknown[b]	≥ 1 yr.	3	9	0	1	0
Total		80	29	2	14	0

[a] Two vireos were originally banded at FNWS.
[b] Natal vireos banded with single numbered metal federal band so natal year is not known.

Thirteen natal vireos (four males and nine females) were resighted on Base in 2010 (Table 5). One male was banded as a nestling off Base on the San Luis Rey River and the remaining 12 were banded as nestlings on 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 2009, but because we did not recapture them this could not be confirmed.

Seven vireos that were originally banded on Base (with gold numbered metal federal bands) were detected off Base in 2010 (Table 5). Three of these vireos were recaptured or were resighted with unique color band combinations, two on the San Luis Rey River and one in Trabuco Canyon, Orange County, California (Table 7). Four other vireos, one with a partial band resight at Ballona Creek, Los Angeles County, California and three natal vireos on the San Luis Rey River, were detected in 2010 but we were unable to recapture or fully resight these birds to confirm natal year or exact natal location.

Table 7. Number of Least Bell's Vireos detected off Base in 2010 that originated on Marine Corps Base Camp Pendleton, by original year banded, age, 2010 location, and sex.

		2010 Location Drainage							
Year Originally	Age in	Ballona Creek[a]		Marine Corps Air Station		San Luis Rey River		Trabuco Canyon[b]	
Banded	2010	Male	Female	Male	Female	Male	Female	Male	Female
2006	4 yrs.	-	-	-	-	-	-	1	-
2007	3 yrs.	-	-	-	-	-	1	-	-
2008	2 yrs.	-		-	-	-	-	-	-
2009	1 yr.	-	-	-	-	-	1	-	-
Unknown	≥ 1 yr.	-	1	1	-	1	1	-	-
Total		0	1	1	0	1	3	1	0

[a] Los Angeles County, California.
[b] Orange County, California.

One additional adult vireo was found dead on the shoulder of Vandegrift Boulevard on 11 May, 2010, presumably killed by collision with a vehicle. This vireo had a single numbered metal federal band and had been banded as a nestling in 2008. Because the carcass was desiccated, we cannot determine when the vireo died, and therefore it is not included in the total number of banded vireos alive in 2010.

New Banded Birds

A total of 204 Least Bell's Vireos were captured and banded during 2010 (Table 8). These included 42 adult vireos caught for the first time and banded with a unique color combination, 161 hatch-year birds (142 of which were banded as nestlings or fledglings with a single gold numbered federal band and 19 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 given unique color combinations), and 1 vireo of unknown age. These vireos are not included in survivorship, fidelity, or movement analyses.

Table 8. Summary of new Least Bell's Vireos captured and banded on Marine Corps Base Camp Pendleton in 2010.

Age Banded	Males	Females	Unknown Sex	Total
Adult	23	13	6	42
Juvenile	.	.	21[a]	21
Unknown	.	.	1	1
Nestling	.	.	140	140
Total	23	13	168	204

[a] Incidentally captured post-fledging; 19 given unique color band combinations and 2 given single numbered metal federal bands.

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 (e.g., transients or individuals captured at MAPS stations) in 2010. 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. However, this baseline number can be used to calculate minimum annual survivorship for the vireo population on Base and is adjusted annually to add in individuals that were not identified in a particular year but were detected in subsequent years (see Methods: Banding).

Adult Survivorship from 2009-2010

Of 178 uniquely color banded adult vireos present on Base during the 2009 breeding season, 44% (79/178) returned to MCBCP in 2010 (Table 9). Twenty-two additional adult vireos (21 alive and 1 dead) identified in 2010 but not detected on Base in 2009 were added to the calculations to yield an adjusted annual survivorship of 50% (100/200; Tables 9 and 10).

Eighty-two of the 145 adult male vireos known to be alive in 2009 were resighted in 2010, an over-winter survivorship rate of 57%. Seventeen of the 41 adult female vireos known to be alive in 2009 were resighted in 2010, an over-winter survivorship rate of 41%. One of the 14 vireos of unknown sex known to be alive in 2009 was resighted in 2010. The remaining 63 males, 24 females, and 13 vireos of unknown sex were not resighted or were found dead in 2010. The difference 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 9. Number of banded adult Least Bell's Vireos detected in 2009 at old giant reed (*Arundo donax*) Removal sites, Reference sites, and other areas on Marine Corps Base Camp Pendleton, and those that were detected in 2010. Numbers in parentheses include the adjustments resulting from vireos that were identified in 2010 but not in 2009, including three vireos (two males and one female) that were detected or assumed to be off Base in 2009.

Year/Sex	Removal Sites	Reference Sites	Other Areas	Total
2009				
Male	24	31	73	128 (145[a])
Female	5	11	21	37 (41[b])
Unknown	1	1	11	13 (14[c])
Total	30	43	105	178 (200)
2010				
Male	10	16	39	65 (82[a])
Female	0	5	8	13 (17[b])
Unknown	0	0	1	1
Total	10	21	48	79 (100)

[a] Includes two male vireos, one that was originally banded on Base in 2006 and was detected on the San Luis Rey River off Base in 2010, and one that was originally banded on Base in 2008, was detected on the San Gabriel River off Base in 2009, and then returned to Base in 2010.

[b] Includes one female vireo that was originally banded on Base in 2007 and was detected on the San Luis Rey River off Base in 2010.

c Includes one vireo of unknown sex that was presumed alive in 2009 but found dead in 2010 (not confirmed alive in 2010).

Table 10. Number and location of adult Least Bell's Vireos detected in 2010 that were not detected in 2009.

Year Originally Banded	Age in 2010	2010 Location: Marine Corps Base Camp Pendleton			San Luis Rey River		Trabuco Canyon		Total
		Male	Female	Unknown	Male	Female	Male	Female	
2005	> 5 yrs.	1	-	-	-	-	-	-	1
2006	> 4 yrs.	3	-	-	-	-	-	-	3
	4 yrs.	-	-	-	-	-	1	-	1
2007	>3 yrs.	2	-	-	-	-	-	-	2
	3 yrs.	1	-	-	-	1	-	-	2
2008	> 2 yrs.	1	2	-	-	-	-	-	3
	2 yrs.	8[a]	1	1	-	-	-	-	10[a]
Total		16[a]	3	1	0	1	1	0	22[a]

[a] Includes one male vireo that was found dead in 2010 and was assumed alive in 2009 but not 2010.

First-year Survivorship from 2009-2010

Of the 197 hatch-year vireos banded in 2009 that survived to fledge, 12 (7 males, 4 females, and 1 vireo of unknown sex) were resighted with or captured and given unique color band combinations on Base in 2010 (Table 11). One other hatch-year female vireo, banded on Base in 2009, was recaptured in 2010 on the lower San Luis Rey River and given a unique color band combination (Ferree et al. 2010b). The addition of this vireo yields a conservative first-year survivorship of 7% (Table 12). Assuming an equal sex ratio of banded nestlings, first-year survivorship of males was 7% (7/98.5) and females was 5% (5/98.5).

Table 11. Number of Least Bell's Vireos banded as nestlings or fledglings at old giant reed (*Arundo donax*) Removal sites, Reference sites, and other areas on Marine Corps Base Camp Pendleton in 2009, and those that returned in 2010.

Year/Sex	Removal Sites	Reference Sites	Other Areas	Total
2009				
Unknown	112	67	18	197
2010				
Male	4	3	0	7
Female	2	2	1[a]	5[a]
Unknown	0	0	1	1

[a] One female vireo detected on the San Luis Rey River.

Adjusted Annual Survivorship

Twenty-two adult banded vireos (21 live and 1 dead) that were detected in 2010 were not observed in 2009 (Table 10). These detections were used to adjust estimates of annual survivorship for previous years (see Methods: Banding). Incorporating these detections into calculations increased first-year survivorship estimates 1-5% and increased adult survivorship estimates 2-5% (Table 12).

Table 12. Adjustments to first-year and adult Least Bell's Vireo survivorship on Marine Corps Base Camp Pendleton, 2010.

	First-year Survivorship		Adult Survivorship	
Years	Previous	New	Previous	New
2005-2006[a]	16%	-	38%	41%
2006-2007[b]	25%	26%	70%	75%
2007-2008[c]	21%	22%	59%	61%
2008-2009[d]	9%	14%	53%	57%
2009-2010	-	7%	-	51%

[a] Rourke and Kus 2006b.
[b] Rourke and Kus 2008.
[c] Lynn and Kus 2009.
[d] Lynn and Kus 2010a.

Survivorship at Removal and References Sites

Of the 29 banded adult vireos of known sex (24 males and 5 females) that were detected within old Removal sites in 2009, 10 (all males) were resighted in 2010 for a 34% survival rate (42% for males, 0% for females; Table 9). Of the 42 banded adult vireos of known sex (31 males and 11 females) that were detected within Reference sites in 2009, 21 (16 males and 5 females) were resighted in 2010 for a 50% survival rate (52% for males and 45% for females). No vireos moved between Removal and Reference sites between 2009 and 2010, although one banded male moved into a Reference site from another area of the Base. Over-winter survival rate did not differ between Removal and Reference sites ($\chi^2 = 0.30$, $P = 0.58$).

All but 18 of the 197 banded juveniles that were known to fledge in 2009 were banded on an old Removal or Reference site. Of these 179, 11 were recaptured and given unique color band combinations in 2010 (ten on MCBCP and one on the San Luis Rey River) for an overall first-year survival rate of 5% for fledglings from Removal sites and 7% for fledglings from Reference sites (Table 12). First-year survivorship for juveniles from Removal sites did not differ from Reference sites ($\chi^2 = 0.06$, $P = 0.81$).

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 (Appendix D). Seventy-nine adult vireos that were identified in 2009 were resighted in 2010, 69 of which occupied known territories both years. Ten vireos were excluded from analysis because they were recaptured at either the De Luz or Santa Margarita MAPS stations in 2009 or 2010 and their exact territory locations were thus unknown. The majority of returning adult vireos showed strong between-year site fidelity. Of the 69 returning adults, 50 (72%) occupied a breeding site in 2010 that they had defended in 2009 (within 100 m). Fourteen additional vireos (20%) returned to sites adjacent to their previous territories (within 300 m). Five vireos (four males and one female) moved between 0.4 and 1.6 km from their 2009 breeding territories to their 2010 breeding territories, but remained within the same drainage. The average distance moved by returning adult vireos was 0.1 ± 0.3 km (SD).

Thirteen first-year vireos from MCBCP were resighted in 2010, nine of which were banded as nestlings in 2009 and returned in 2010 to occupy known territories. Four vireos were excluded from analysis because they were originally captured as juveniles in 2009 and therefore could not be associated with an exact natal territory. These nine vireos dispersed an average of 3.8 ± 2.5 km from their 2009 natal sites (range 1.2–5.0 km for males and 1.5–9.2 km for females; Table 13). One female fledged from a nest on Base and dispersed 6.3 km to the San Luis Rey River (Ferree et al. 2010b).

Table 13. Between-year dispersal of Least Bell's Vireos banded as juveniles in 2009 and present at Marine Corps Base Camp Pendleton in 2010.

Year Last Detected	Drainage[a] / Territory / Treatment		Dispersal Distance (km)	Band Combination[b]		Sex[c]
	2009	2010		Left Leg	Right Leg	
2009	SMR / AH02 / REF	DL / DS12	1.5	ORDG/gogo	Mgo	F
2009	SMR / BER / REF	SMR / UM13	3.8	ORPU	PUWH/Mgo	M
2009	SMR / CAG / REM	SMR / HE44 / REF	5.0	YEPU	DPDP/Mgo	M
2009	SMR / SNP / REM	SMR / PR96	2.2	ORDG	Mgo	F
2009	SMR / ARH / REM	SMR / ES50	2.4	DGOR	DGOR/Mgo	M
2009	SMR / AXE / REF	SMR / MIN	9.2	BKBK	WHWH/Mgo	F
2009	SMR / HTI / REF	SMR / HW06	1.2	DGOR	DPWH/Mgo	M
2009	SMR / TUL / REM	SLR / BMUL	6.3	-	WHPU/Mgo	F
2009	SMR / APO / REF	SMR / UM01	2.2	YEPU	PUWH/Mgo	M

[a] Drainage Codes: DL = De Luz Creek; SLR = San Luis Rey River; SMO = San Mateo Creek; SMR = Santa Margarita River. Treatment Codes: REF = Reference; REM = Removal.

[b] Band colors: Mdb = dark blue numbered federal band; Mgo = gold numbered federal band; gogo = metal gold; BKBK = plastic black; DGOR = plastic dark green-orange split; DPDP = plastic dark pink; DPWH = plastic dark pink-white split; ORDG = plastic orange-dark green split; ORPU = plastic orange-purple split; PUWH = plastic purple-white split; WHPU = plastic white-purple split; WHWH = plastic white; YEPU = plastic yellow-purple split.

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

Site Fidelity and Movement – Removal and Reference Sites

Fidelity to treatment type was also very high and did not differ between treatments, as 100% (10/10) of vireos from old Removal sites and 100% (19/19) of adult vireos from territories at Reference sites returned to the same treatment type they had defended in 2010 (Appendix D).

Eleven of the 13 first-year vireos detected in 2010 fledged from either a Removal site or a Reference site, and 9 of the 11 dispersed to territories located within the Santa Margarita River drainage. One female from a Reference site dispersed 1.5 km from her natal site to the De Luz Creek drainage and one female from an old Removal site dispersed 6.3 km from her natal site to the San Luis Rey River. Of the six vireos that fledged from old Removal sites, two males returned to the same old Removal sites, one male dispersed to a Reference site, and one male and two females dispersed to areas on Base outside of our monitoring areas. All of the five vireos that fledged from Reference sites dispersed to areas outside of the monitoring sites. Males from old Removal sites dispersed 0.1-5.0 km from their natal sites. Females from old Removal sites dispersed 2.2-6.3 km from their natal sites. Males from Reference sites dispersed 1.2-3.8 km from their natal sites and females from Reference sites dispersed 1.5-9.2 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 14, Figs. 7-10, Appendix E). At one territory within a Reference area, the male remained single for the entire breeding season and therefore no nesting activity occurred. Of the remaining 50 territories, 46 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; 17 of these were not completed (14 coded as “INC” and 3 coded as “FAL” in Appendix E) and have been excluded from calculations of nest success and productivity. Of the remaining 103 nests, 97 were in fully monitored territories.

Table 14. 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, 2010.

	Nest Monitoring Area Type	
	Removal	**Reference**
Territories fully monitored	25	21
Nests in fully monitored territories (# complete)	45 (44)	68 (53)
Completed nests per pair (fully monitored territories)	1.76 ± 0.72 (SD)	2.52 ± 1.21 (SD)
Territories partially monitored	1	3
Nests in partially monitored territories (# complete)	2 (1)	5 (5)
Total # of nests monitored	47	73

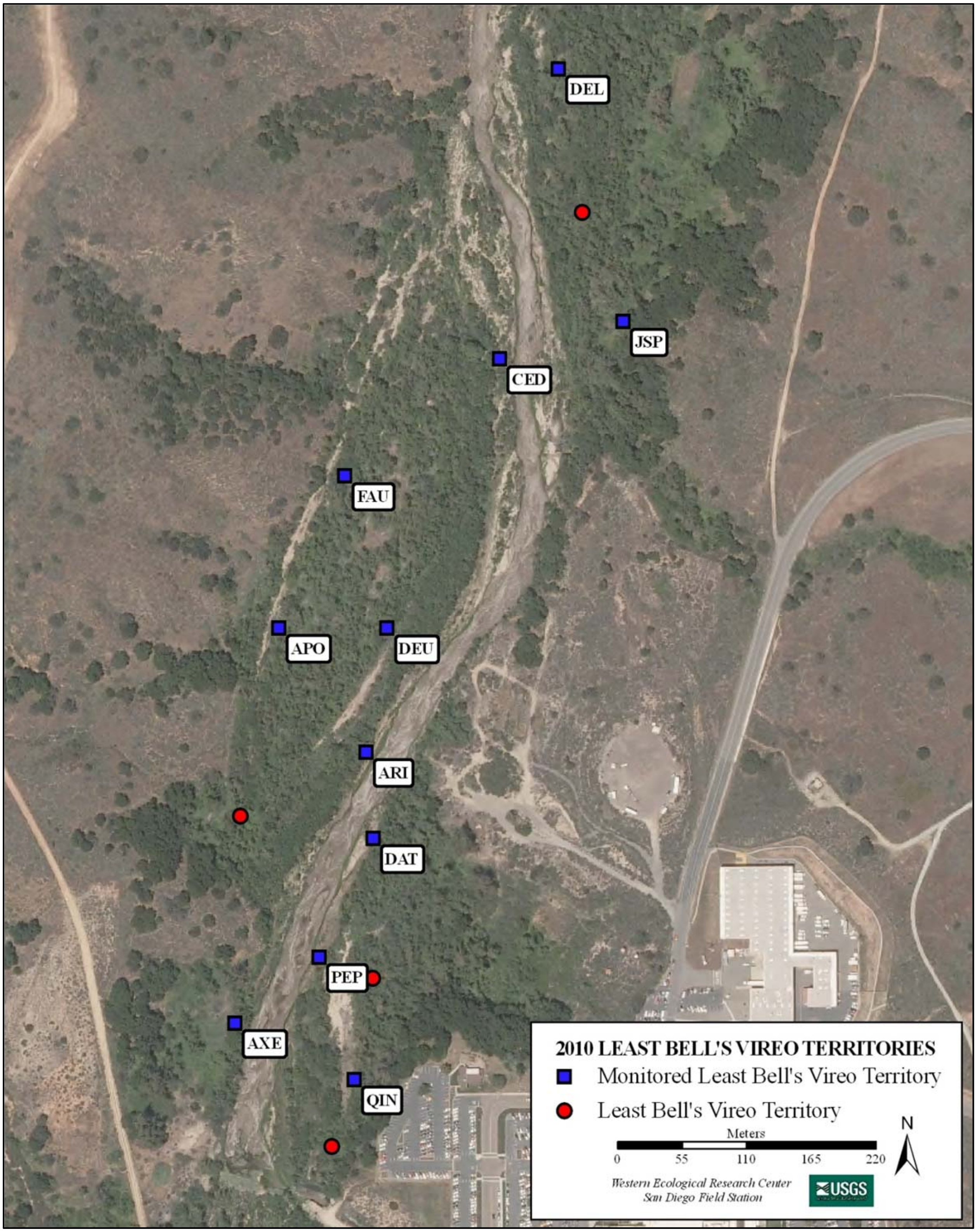

Fig. 7. Locations of monitored Least Bell's Vireo territories at the Above Hospital Reference site, Marine Corps Base Camp Pendleton, 2010.

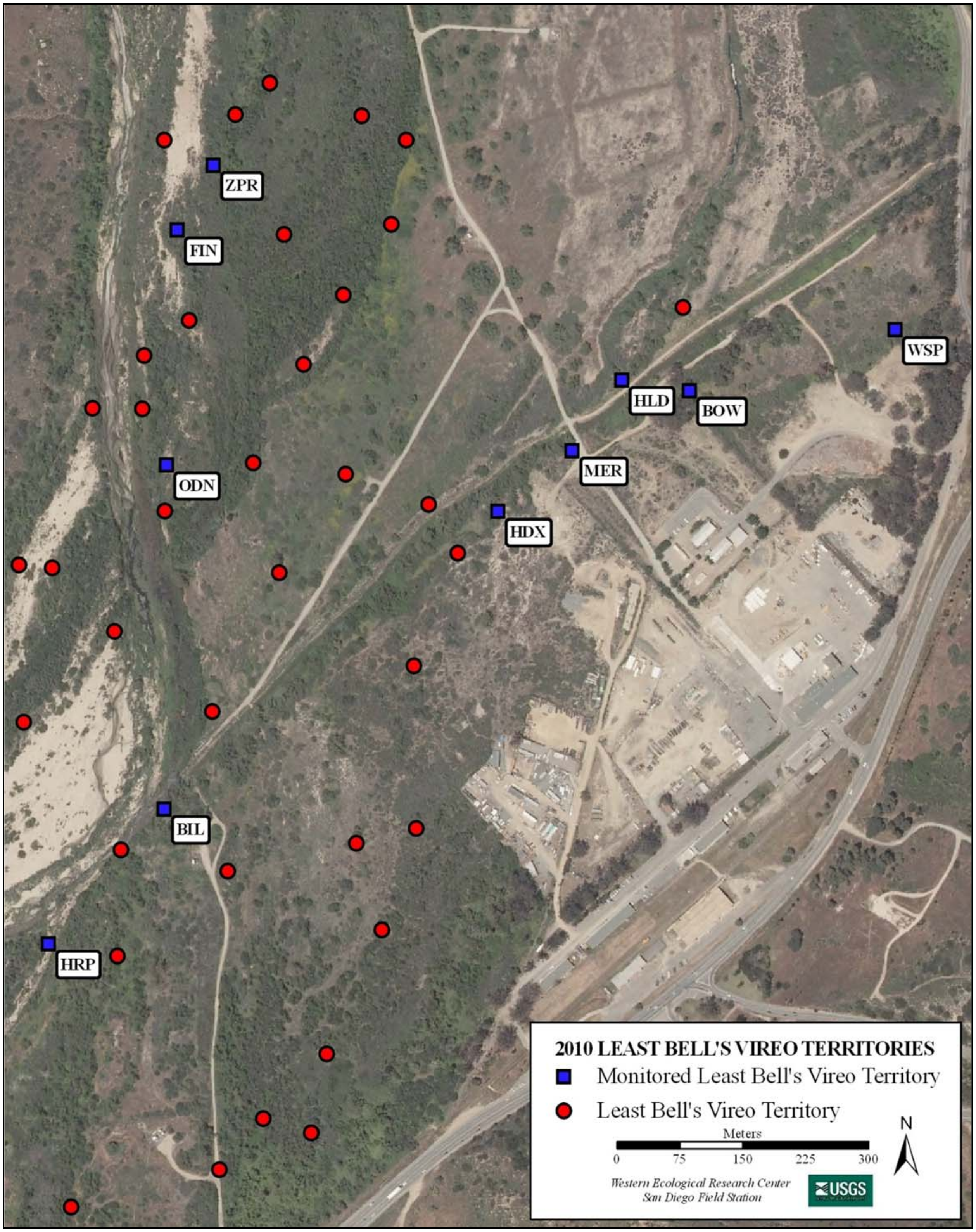

Fig. 8. Locations of monitored Least Bell's Vireo territories at the Below Hospital Reference site, Marine Corps Base Camp Pendleton, 2010.

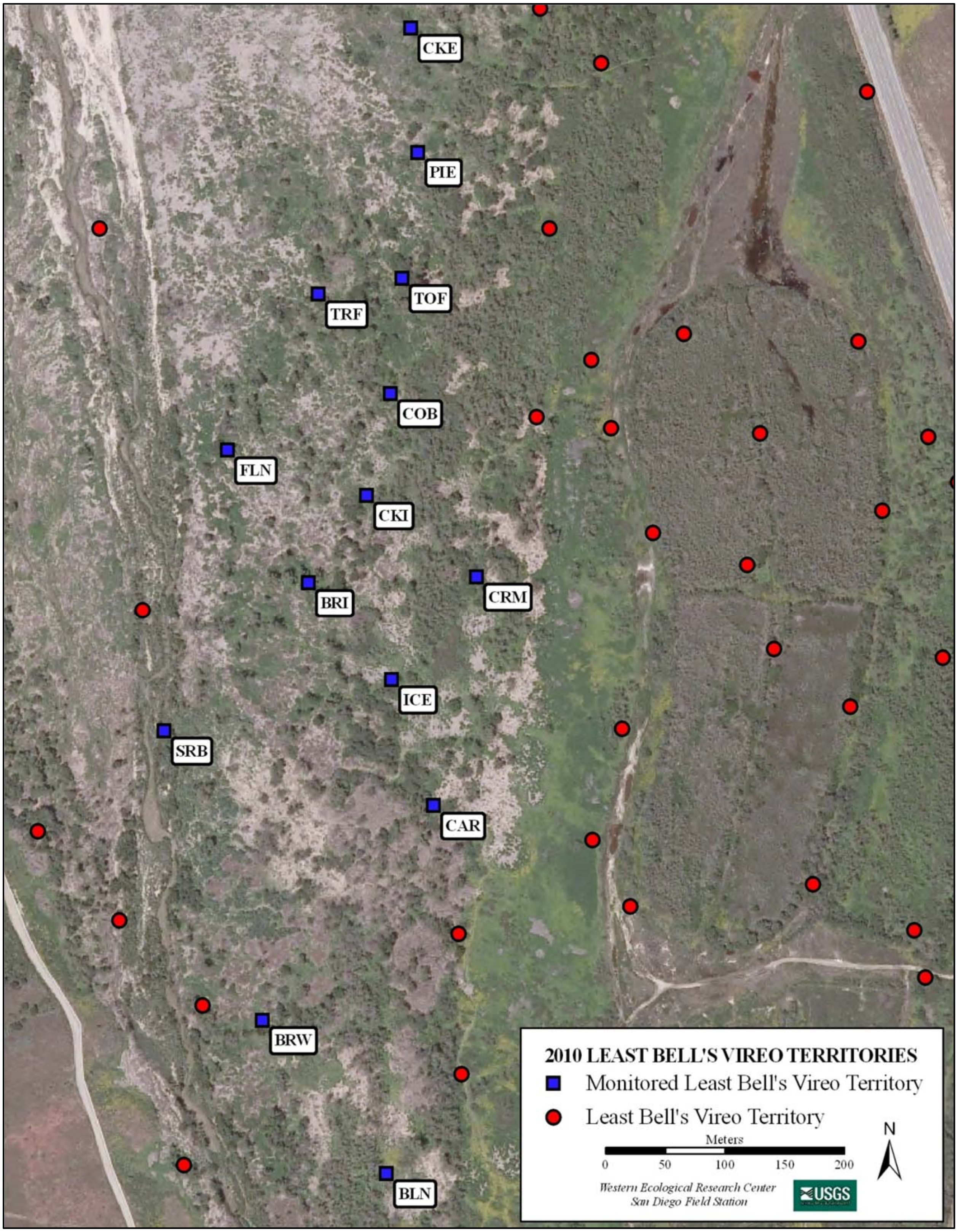

Fig. 9. Locations of monitored Least Bell's Vireo territories at the Bell giant reed (*Arundo donax*) Removal site, Marine Corps Base Camp Pendleton, 2010.

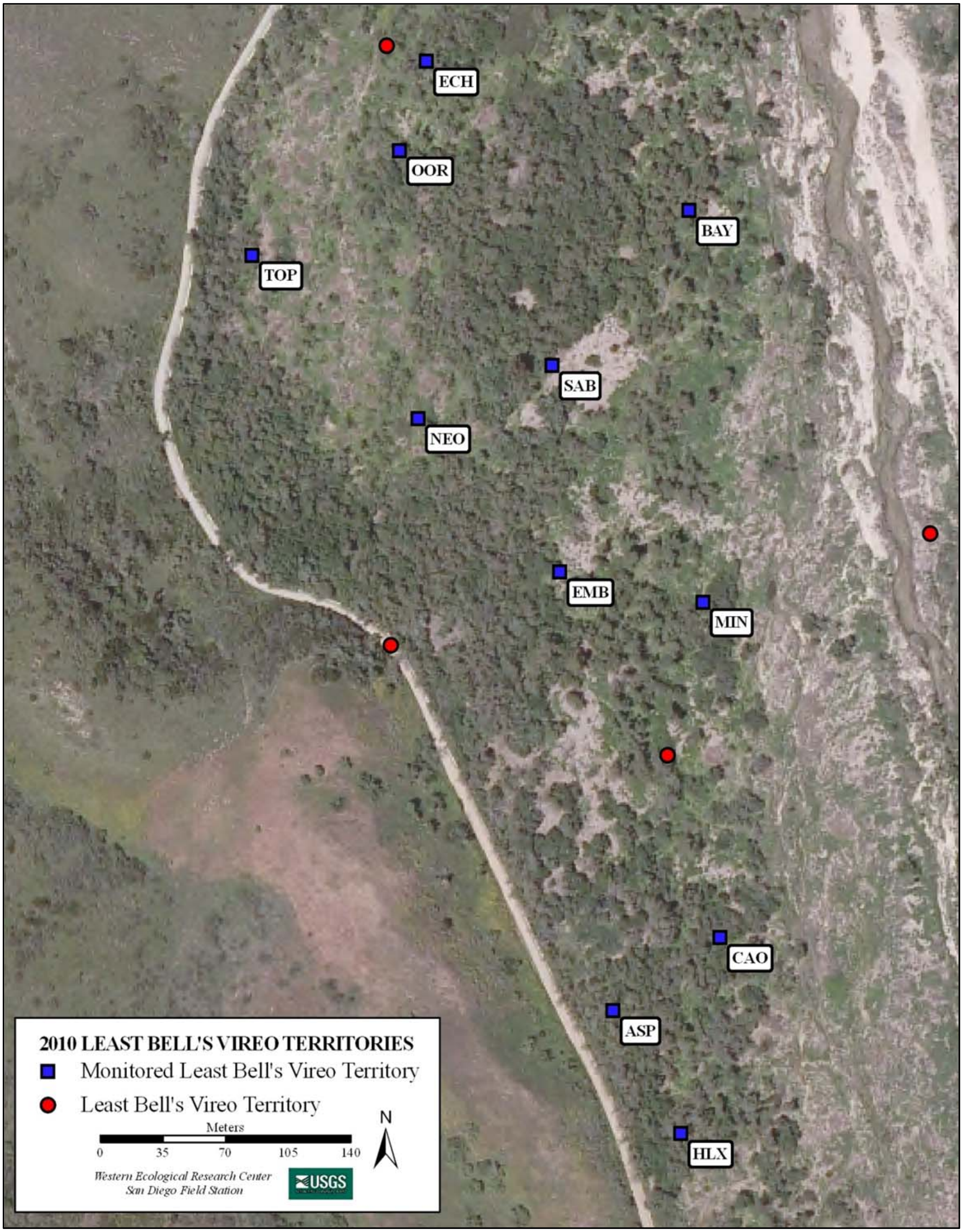

Fig.10. Locations of monitored Least Bell's Vireo territories at the Pump Road giant reed (*Arundo donax*) Removal site, Marine Corps Base Camp Pendleton, 2010.

Nesting Attempts

Within fully monitored territories, pairs at References sites had more nesting attempts than pairs at Removal sites (Table 14; $t = 2.79$, $P = 0.01$) over the course of the 2010 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 $P = 0.18$), as 64% of Removal pairs and 86% of Reference pairs initiated a second attempt. Nest fate did not influence the likelihood that pairs would re-nest. Seventy-three percent of pairs at Removal sites (8/11) and 94% of pairs at Reference sites (15/16) attempted a second nest after a failed first nesting attempt. At Removal sites, 57% attempted to re-nest after a successful nesting attempt (Fisher's Exact $P = 0.67$) and at Reference sites, 60% of pairs attempted second nests after a successful first nesting attempt (Fisher's Exact $P = 0.13$). Overall, 85% (23/27) of vireo pairs attempted to re-nest after a failed first nesting attempt in 2010, slightly less than the proportion that attempted to re-nest after a failed first nesting attempt in previous years (Fig. 11). The rate of re-nesting attempts following a successful nesting attempt in 2010 (58%; 11/19) was lower than in 2008 and 2009, but higher than in previous years (Fig. 11). Seventeen pairs at Removal sites and thirteen pairs at Reference sites attempted three or more nests in 2010, and one pair at a Reference site initiated six nesting attempts in 2010.

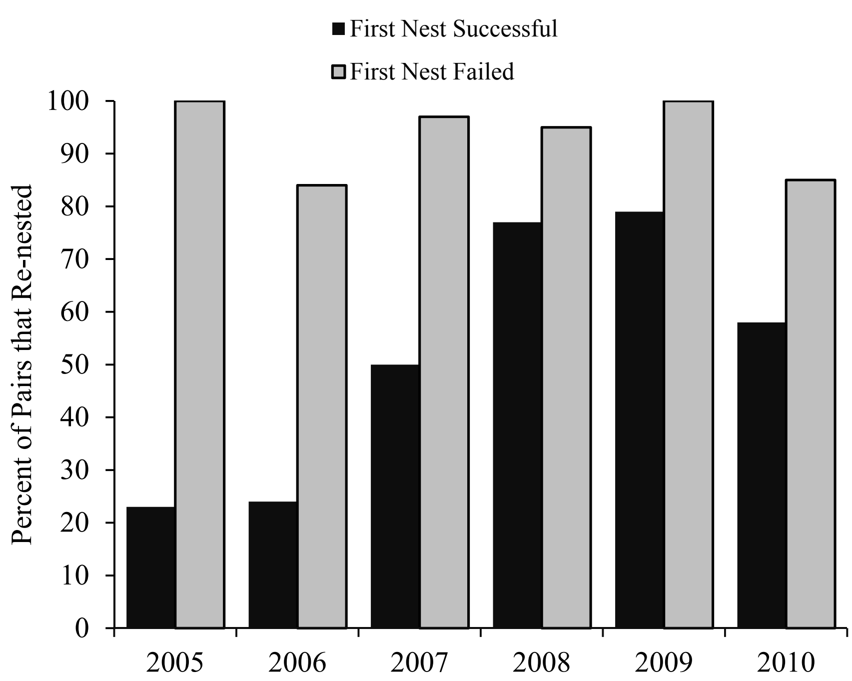

Fig. 11. Percent of vireo pairs that re-nested after a successful or failed first nesting attempt on Marine Corps Base Camp Pendleton, 2005-2010.

First nesting attempts at Removal and Reference sites in 2010 were initiated one week later than in 2008 and 2009. In 2010, the majority of first nesting attempts were initiated during the second two weeks of April (12-25 April), while the majority of first nests in 2008 and 2009 were initiated during the first two weeks of April (5-18 April). The median date of first nest initiation did not differ between treatment types (median at Removal sites = 27 April, median at Reference sites = 19 April; t = -1.19, P = 0.24). Median first nesting attempts differed significantly by year, with 2010, 2007, and 2005 representing the approximate average median first nest attempt date for all years (median for 2010 = 21 April; 2009 = 17 April; 2008 = 15 April; 2007 = 28 April; 2006 = 10 May; 2005 = 23 April;; F = 27.758; P < 0.001; Fig. 12).

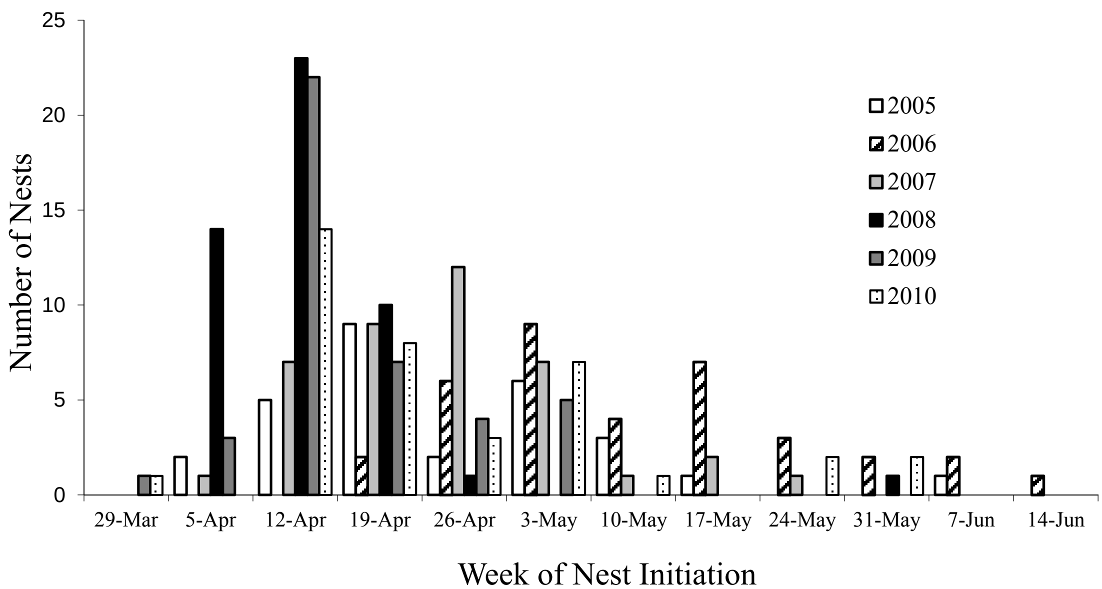

Fig. 12. Number of first Least Bell's Vireo nests initiated by week at Marine Corps Base Camp Pendleton, 2005-2010.

Nest Success

Nests in Removal sites were more likely to be successful than nests in Reference sites (χ^2 = 9.48, P = 0.002), as 58% (26/45) of Removal nests successfully fledged young while 26% (15/58) of Reference nests successfully fledged young (Table 15). First nesting attempts were significantly more likely to be successful at Removal sites (56%) than at Reference sites (24%; χ^2 = 3.64; P = 0.06) in 2010 (Fig. 13A). Overall, 41% of first nesting attempts were successful in 2010. Fate of the first nesting attempt differed significantly across years (2005 = 39%, 2006 = 40%, 2007 = 26%, 2008 = 61%, 2009 = 51%; χ^2 = 13.41, P = 0.02, df = 5; Fig. 13B), although the proportion of first nests that were successful in 2010 was intermediate between the two extreme years (2007 and 2008).

Table 15. Fate of Least Bell's Vireo nests in fully and partially monitored territories, Marine Corps Base Camp Pendleton, 2010. Numbers in parentheses are proportions of total nests.

	Number of Nests		
Nest Fate	**Removal**	**Reference**	**Total**
Successful	26	15	41 (0.40)
Failed			
Predation	14	34	48 (0.47)
Parasitism	0	0	0 (0.00)
Other/Unknown	5	9	14 (0.14)
Total Completed Nests	45	58	103 (1.00)

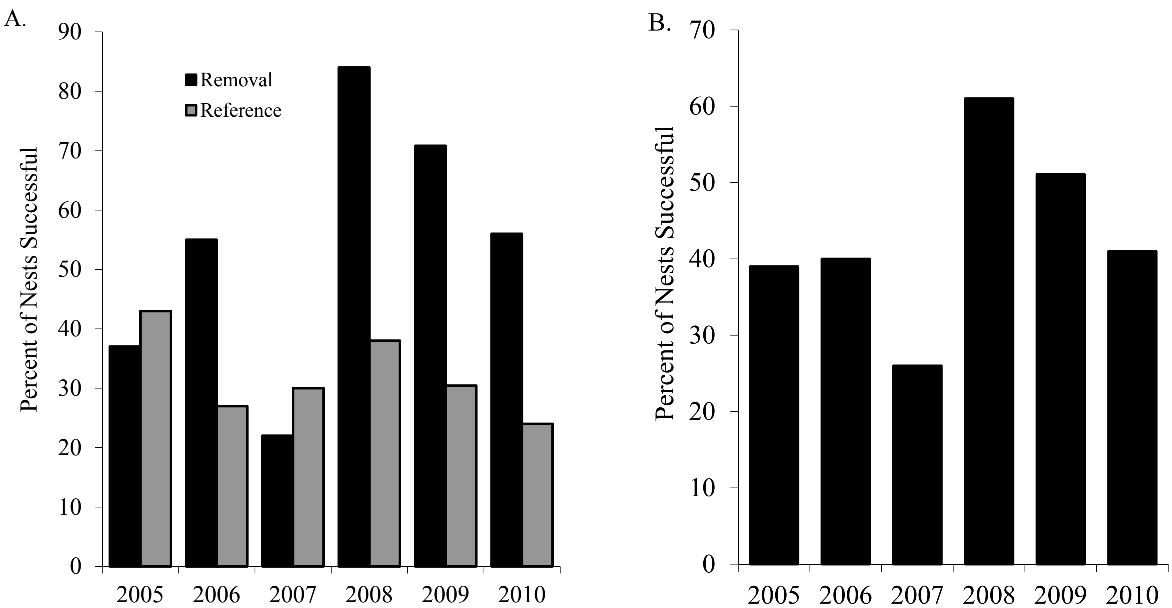

Fig. 13. Percent of successful Least Bell's Vireo nesting attempts (A) for first nests at Removal and Reference sites, and (B) for first nests overall, on Marine Corps Base Camp Pendleton, 2005-2010.

Causes of nest failure were similar at Removal and Reference sites. Predation was believed to be the primary source of nest failure at both types of sites, although only one predation event [Common Ravens (*Corvus corax*) were observed depredating one nest at a Reference site] was witnessed (Table 15). Predation accounted for 74% (14/19) of nest failures at Removal sites and 79% (34/43) of nest failures at Reference sites. We also documented 14 nests that failed for other known and unknown reasons at our study sites. One nest at a Reference site failed because the branches supporting the nests broke or caused the nest to move excessively. Two nests at Removal sites and seven nests at Reference sites failed between nest-building and egg-laying from unknown causes. One nest with nestlings at a Removal site failed from unknown causes, although one nestling was missing. The single egg had been punctured in one Reference site nest, possibly by a bird. Finally, the area surrounding two Removal site nests was sprayed with herbicide (see Appendix F for summary). The vegetation supporting one of these nests died and collapsed, causing the nest to tip and spill its contents. At another nest, the vireo pair continued to incubate after the supporting vegetation had died but eventually abandoned when the eggs did not hatch. The eggs contained partially formed embryos, indicating that they were fertile and died sometime during development. The area surrounding a third vireo nest also was sprayed by herbicide; however, the nest was ultimately successful (fledging three of four young), although the supporting vegetation died and the nest tipped on its side. Overall, 42% and 74% of completed vireo nests at Removal and Reference sites, respectively, were lost to predation or other causes.

Cowbird Parasitism

No nest parasitism of Least Bell's Vireos by Brown-headed Cowbirds was documented in 2010.

Productivity

Clutch size and number of young fledged per pair did not differ between Removal and Reference sites (Table 16). Measures of hatching success were greater at Removal sites. A higher percentage of nests at Removal sites reached the nestling stage (77% vs. 48%; $\chi^2 = 6.89$; $P < 0.01$), translating into a greater percentage of eggs hatching at Removal sites than at Reference sites (78% vs. 50%; $\chi^2 = 23.4$; $P < 0.01$). Measures of fledging success were similar between Removal and Reference sites. Of the nests containing nestlings, a slightly higher percentage of Removal nests (79%) successfully fledged young than Reference nests (63%; $\chi^2 = 1.11$; $P = 0.29$). Overall productivity per pair was not significantly different at Removal sites (3.2 young per pair) than at Reference sites (2.5 young per pair; Table 16). Eighty percent (20/25) of pairs at Removal sites and 62% (13/21) of pairs at Reference sites were ultimately successful in fledging young from at least one nest. Six pairs at Removal (24%) and two pairs at Reference (10%) sites successfully double-brooded, fledging young from two nests during the 2010 breeding season. Overall, vireo pairs at monitored sites on MCBCP fledged 2.9 vireo young per pair, and 72% (33/46) of all monitored pairs were successful in fledging at least one young in 2010.

Table 16. Reproductive success and productivity of nesting Least Bell's Vireos at giant reed (*Arundo donax*) Removal and Reference sites, Marine Corps Base Camp Pendleton, 2010.

Parameter	Removal Sites	Reference Sites	Total
Nests with eggs	43	50	93
Eggs laid	137	161	298
Average clutch size[a]	3.6 ± 0.6 (SD)	3.7 ± 0.4 (SD)	3.7 ± 0.5 (SD)
Hatchlings	107	81	188
Nests with hatchlings	33	24	57
Hatching success:			
Eggs[b]	78%	50%	63%
Nests[c]	77%	48%	61%
Fledglings	79	53	132
Nests with fledglings	26	15	41
Fledging success:			
Hatchlings[d]	74%	65%	70%
Nests[e]	79%	63%	72%
Fledglings per egg	0.6	0.3	0.4
Fledglings per nest	1.8	1.1	1.4
Average number of young fledged per pair[f]	3.2 ± 2.3 (SD)	2.5 ± 2.4 (SD)	2.9 ± 2.3 (SD)
Pairs fledging ≥ 1 young[g]	20 (80%)	13 (62%)	33 (72%)

[a] Based on 31 Removal and 34 Reference non-parasitized nests with a full clutch (t = 1.22; P = 0.23).
[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 25 Removal and 21 Reference pairs who were fully monitored (two-sample t-test; t = -0.91, P = 0.37).
[g] Based on fully monitored pairs.

Nest Survival

Analysis of DSR showed that type of monitoring site (Removal or Reference) was a good predictors of vireo nest survival (Table 17). Type of monitoring site appeared in the best supported model and the analysis of odds ratios showed that the confidence interval for type of monitoring site did not include 1, which indicates that it was a significant contributing factor to the model (Table 18). Vireo nest survival was higher at Removal sites.

Table 17. Logistic regression models for the effect of treatment on nest survival of Least Bell's Vireos in Reference and Removal sites on Marine Corps Base Camp Pendleton, 2010. Models are ranked from best to worst based on Akaike's Information Criteria for small samples (AIC_C), ΔAIC_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	ΔAIC_C	AIC_C Weight
Constant + Treatment	299.26	2	303.27	0.00	0.98
Constant	309.46	1	311.46	8.19	0.02

Table 18. Parameter estimate (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, 2010.

Effect	**β**	SE	Odds Ratio	95% CI
Treatment	0.93	0.30	2.52	1.40 – 4.55

Annual Comparisons between Removal and Reference Sites

In 2010, we switched our nest monitoring effort from the old Removal sites (which had been monitored from 2005-2009) to the new Removal sites (where giant reed had been removed more recently). We analyzed breeding productivity data from the first year of nest monitoring at each of these sites (old Removal and new Removal) and data for the corresponding years at Reference sites to determine if there were annual differences and/or differences between new and old Removal sites. Clutch size did not differ between Removal and Reference sites in either 2005 or 2010, or when year and treatment type were combined (Fig. 14, Table 19). Similarly, the number of young fledged per pair did not differ between Removal and Reference sites in either year or when year and treatment type were combined (Fig. 15, Table 20).

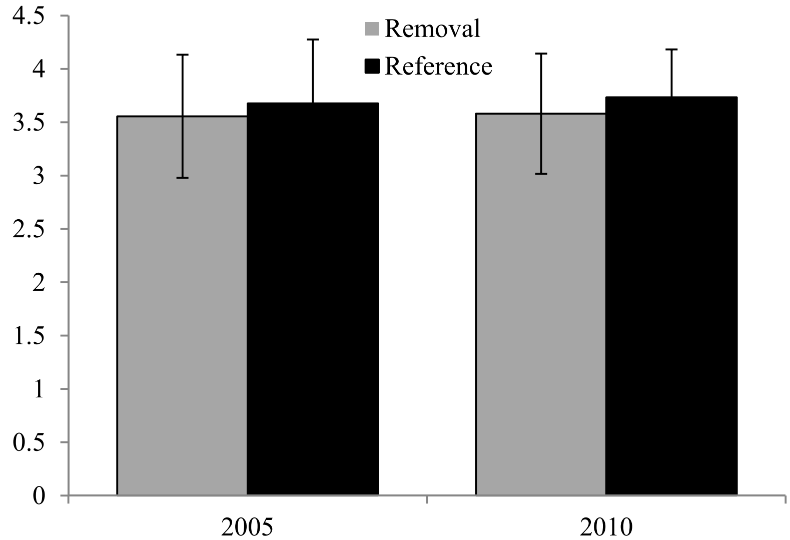

Fig. 14. Average annual Least Bell's Vireo clutch size (± SD) of nests at old (2005) and new (2010) giant reed (*Arundo donax*) Removal and Reference sites at Marine Corps Base Camp Pendleton.

Table 19. Results from two-way ANOVA testing for differences in average clutch size of Least Bell's Vireos nesting at old (2005) and new (2010) giant reed (*Arundo donax*) Removal and Reference sites at Marine Corps Base Camp Pendleton.

Source	SS	df	MS	*F*	*P*
Treatment	0.58	1	0.58	1.95	0.17
Year	0.05	1	0.05	0.18	0.68
Treatment * Year	0.01	1	0.01	0.03	0.87
Error	35.61	119	0.30		

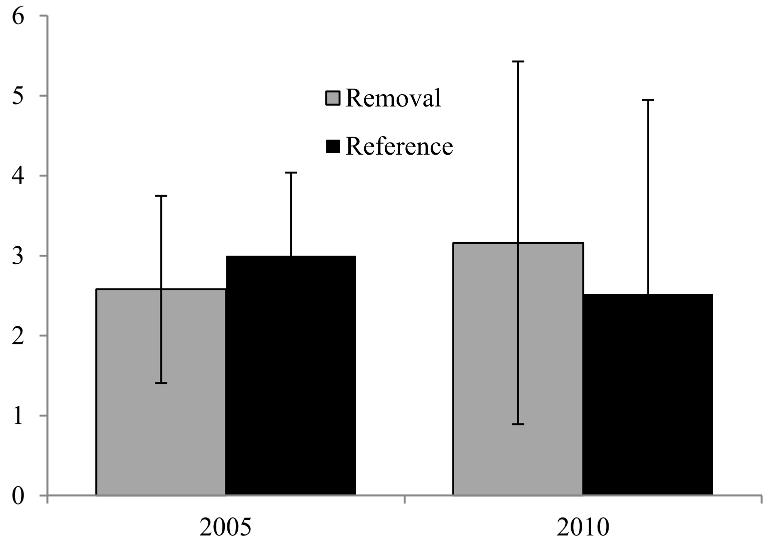

Fig. 15. Average number of Least Bell's Vireo young fledged per pair (± SD) at old (2005) and new (2010) giant reed (*Arundo donax*) Removal and Reference sites by year at Marine Corps Base Camp Pendleton.

Table 20. Results from two-way ANOVA testing for differences in the average number of young fledged per pair of Least Bell's Vireos nesting at old (2005) and new (2010) giant reed (*Arundo donax*) Removal and Reference sites at Marine Corps Base Camp Pendleton.

Source	SS	df	MS	*F*	*P*
Year	0.05	1	0.05	0.01	0.91
Treatment	0.22	1	0.22	0.06	0.81
Year * Treatment	5.28	1	5.28	1.42	0.24
Error	279.23	75	3.72		

Population Density

The density of the vireo population increased in 2010 at both the old Removal and the new Removal sites, and was the highest observed in both sites since 1997 (Fig. 16). However, vireo density decreased at the Reference sites relative to recent years. The change in vireo density was significantly different in the new Removal sites (0.31 to 0.59 territories/ha) versus the Reference sites (0.71 to 0.60 territories/ha; $\chi^2 = 5.04$, $P = 0.03$, df = 1). Vireo density at the new Removal sites was consistently lower than that at Reference sites in the years before giant reed removal. Vireo density at new Removal sites increased 10-fold during the first year following treatment, and doubled to match that of Reference sites by the second post-treatment year (Griffith Wildlife Biology 2004; Rourke and Kus 2006a, 2007a, 2008, Lynn and Kus 2009, 2010a).

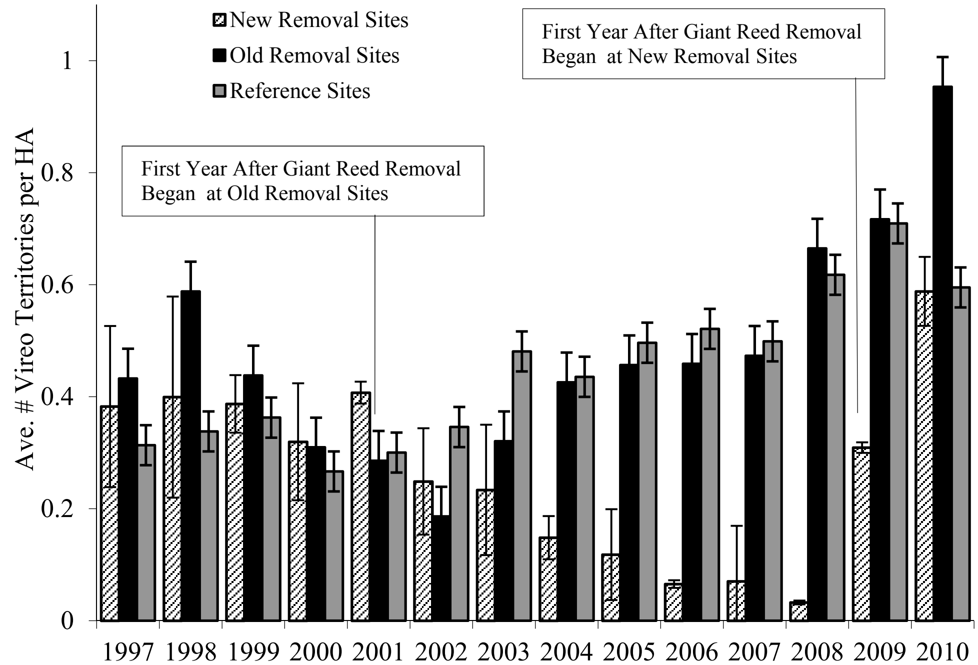

Fig. 16 Annual density of Least Bell's Vireo territories (± SD) at Reference and giant reed (*Arundo donax*) Removal sites by year, averaged across sites. (Source: Griffith Wildlife Biology 2004, Rourke and Kus 2006a, 2007a, 2008, Lynn and Kus 2009, 2010a).

Annual Precipitation Effects on Vireo Productivity and Population Size

Vireo breeding productivity was marginally affected by precipitation during the previous bioyear. Annual precipitation was positively related to vireo clutch size (r = 0.79, P = 0.06) but not related to young/pair (r = 0.37, P = 0.47; Fig. 17), or total number of vireo territories on MCBCP (r = 0.34, P = 0.23; Fig. 18).

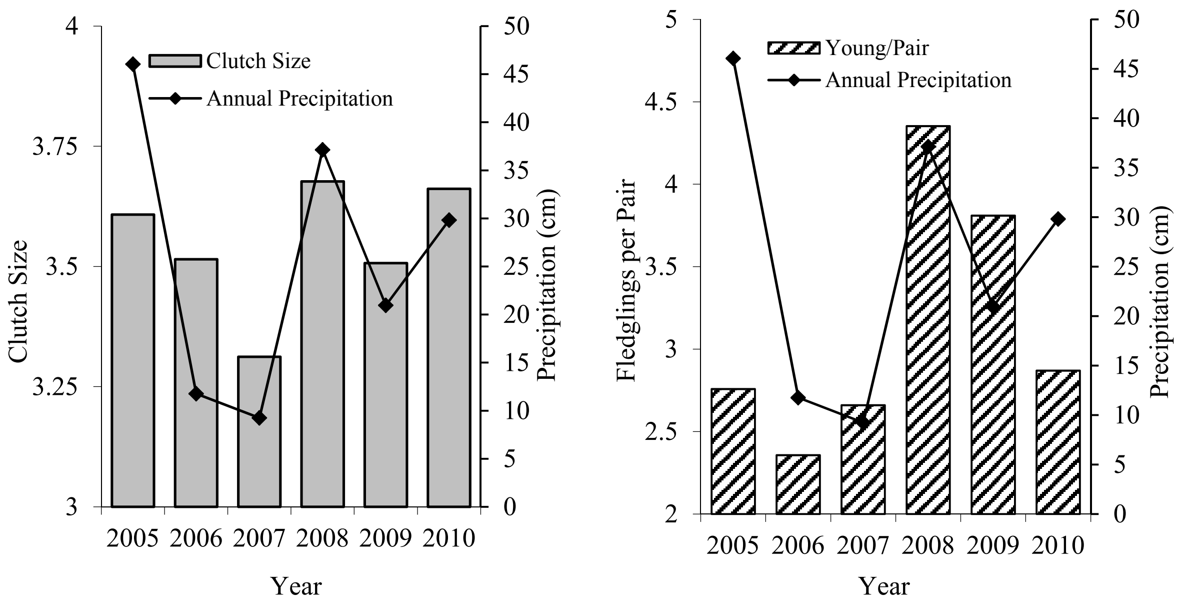

Fig. 17. Average Least Bell's Vireo clutch size and number of young fledged per pair in relation to total precipitation in the preceding bioyear (July–June), 2005-2010.

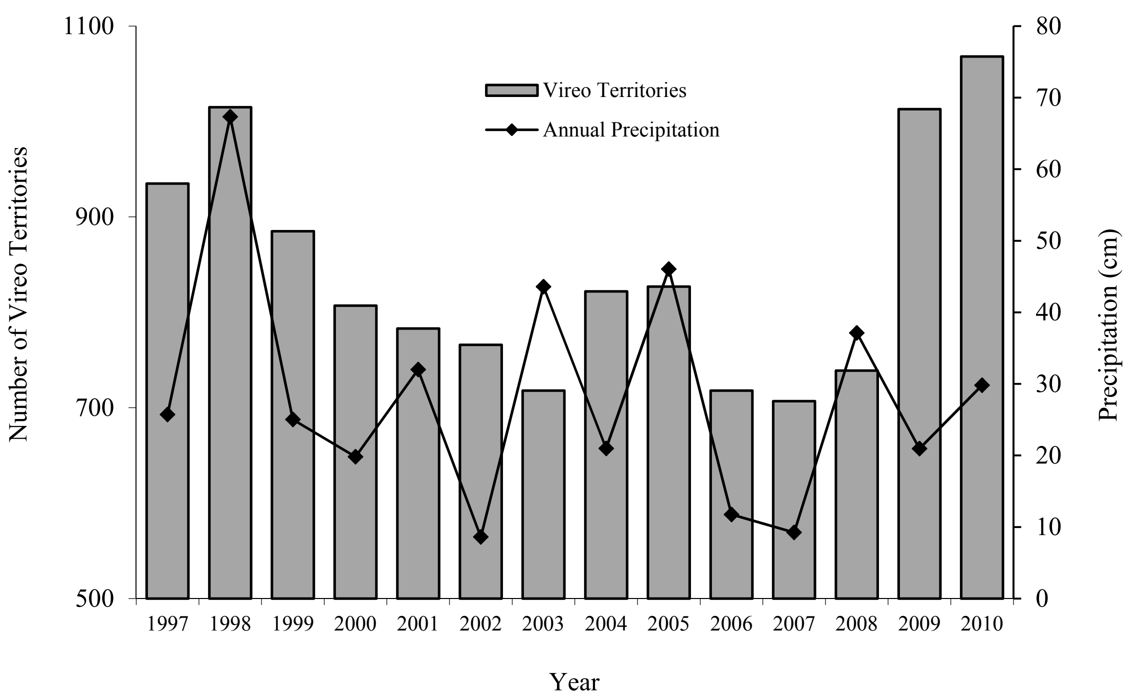

Fig. 18 Relationship between number of Least Bell's Vireo territories on Marine Corps Base Camp Pendleton and total precipitation in the preceding bioyear (July–June), 1997-2010.

Nest Characteristics

Fourteen plant species were used as hosts for vireo nests at Removal and Reference sites in 2010, although not all were used within each treatment (Table 21). Vireos used 9 of the 14 species at Removal sites and 12 of the 14 species at Reference sites. Despite this difference, vireos at Removal and Reference sites were comparable in their selection of host species, as 63-70% of nests were placed in arroyo willow, sandbar willow, and mule fat (Table 21). Ten vireo nests were built in exotic plant species, nine in poison hemlock (five at a Removal and four at a Reference site) and one in salt-cedar (at a Removal site). The remaining 26% of nests were placed in nine plant species. Of these, four were used as host plants at Removal sites and eight were used as hosts at Reference sites.

Table 21. Host plant species used by Least Bell's Vireos at giant reed (*Arundo donax*) Removal and Reference sites, Marine Corps Base Camp Pendleton, 2010. Numbers in parentheses are proportions of total nests.

	Number of Nests	
Host Species	**Removal**	**Reference**
Arroyo or red willow	24 (0.52)	20 (0.29)
Sandbar willow	1 (0.02)	16 (0.24)
Mule fat	7 (0.15)	7 (0.10)
Poison hemlock	5 (0.11)	4 (0.06)
Wild grape (*Vitis spp.*)	1 (0.02)	4 (0.06)
Poison oak (*Toxicodendron diversilobum*)	1 (0.02)	4 (0.06)
Blue elderberry (*Sambucus nigra ssp. caerulea*)	2 (0.04)	2 (0.03)
Black willow	4 (0.09)	0 (0.00)
California blackberry (*Rubus ursinus*)	0 (0.00)	3 (0.04)
Mugwort (*Artemisia douglasiana*)	0 (0.00)	3 (0.04)
Coast live oak	0 (0.00)	3 (0.04)
Coyote brush (*Baccharis pilularis*)	0 (0.00)	1 (0.01)
California sage (*Artemisia californica*)	0 (0.00)	1 (0.01)
Salt-cedar	1 (0.02)	0 (0.00)

In 2010, successful and unsuccessful nests within Removal and Reference sites were generally similar in placement. However, at Reference sites, successful nests were placed significantly closer to the edge of the nest clump than unsuccessful nests (Table 22). Vireo nests at Removal sites were placed higher in the host plant, were further from the edge of the host plant, and were further from the edge of riparian vegetation than nests in Reference sites (Table 22).

Table 22. Least Bell's Vireo nest characteristics and results of *t*-tests of successful vs. unsuccessful nesting attempts at giant reed (*Arundo donax*) Removal and Reference sites, Marine Corps Base Camp Pendleton, 2010.

Nest Characteristic	Nest Fate: Successful	Nest Fate: Unsuccessful	*n*[a]	*t*[b]	*P*[c]
Removal Site					
Average nest height (m)	1.03	1.02	(25, 19)	0.19	0.85
Average host height (m)	4.93	5.14	(25, 20)	-0.18	0.86
Average distance to edge of host (m)	1.29	1.41	(24, 20)	-0.26	0.79
Average distance to edge of clump (m)	2.73	2.83	(26, 20)	-0.16	0.87
Average distance to edge of riparian vegetation (m)	121.70	105.05	(23, 19)	1.08	0.29
Reference Site					
Average nest height (m)	0.65	0.71	(14, 46)	-0.67	0.51
Average host height (m)	3.81	3.88	(14, 50)	-0.07	0.94
Average distance to edge of host (m)	0.47	0.48	(14, 48)	-0.05	0.96
Average distance to edge of clump (m)	1.15	2.64	(15, 49)	-3.30	**< 0.01**
Average distance to edge of riparian vegetation (m)	26.33	21.38	(15, 55)	0.66	0.52
Overall	**Removal**	**Reference**	*n*[d]	*t*[b]	*P*[c]
Average nest height (m)	1.03	0.70	(44, 60)	-5.78	**< 0.01**
Average host height (m)	5.02	3.86	(45, 64)	-1.53	0.13
Average distance to edge of host (m)	1.34	0.48	(44, 62)	-3.95	**< 0.01**
Average distance to edge of clump (m)	2.78	2.29	(46, 64)	-1.10	0.27
Average distance to edge of riparian vegetation (m)	114.17	22.44	(42, 70)	-11.10	**< 0.01**

[a] *n* = number of nests in sample (Successful, Unsuccessful)
[b] *t* = Student's *t* statistic
[c] *P* = *P*-value
[d] *n* = number of nests in sample (Removal, Reference)

DISCUSSION

In 2010, the number of documented Least Bell's Vireo territories (1,068) exceeded the highest recorded number of vireo territories on MCBCP over the past 15 years. The vireo population has fluctuated between a low of 696 territories in 1995, increasing to 1,011 territories in 1998 (Griffith Wildlife Biology 2004; Fig. 3), then dropping below 900 for several years until it began increasing again in 2008. In 2009 and 2010, the vireo population increased by 330 territories over 2008 numbers. The increase can mainly be attributed to higher than usual breeding productivity in 2008, where vireos produced more fledglings than in previous years, and subsequent high return rates in 2009 and 2010. Vireo breeding productivity was high in several drainages in San Diego County in 2008 (Ferree and Kus 2008b, Lynn and Kus 2008, 2009, Wellik et al. 2009), and these drainages also showed increased population numbers in 2009 (Ferree et al. 2010b, Lynn et al. 2010b; USGS unpublished data).

Fluctuations in the vireo population on MCBCP 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, 2008a, 2008b). However, the vireo population on the lower San Luis Rey River decreased slightly in 2010 (Ferree et al. 2010b). The vireo population in the middle San Luis Rey River, between South Mission Road and Interstate 15, also demonstrated an increase since the mid-1980s, fluctuating between 60 and 80 pairs between 2002 and 2008, then increasing substantially to 109 territories in 2009 and, similar to the lower San Luis Rey, dropping back to 82 territories in 2010 (Jones 1985; Kus 1988, 1989, 1991a, b, 1994, 1995; Kus and Beck 1998; Peterson et al. 2002; Rourke and Kus 2006b, 2007b; Lynn and Kus 2008, Lynn et al. 2010a, USGS unpublished data).

The increase in the vireo population on MCBCP varied across drainages, with increases of at least ten territories in two drainages and a decrease of at least ten territories in one drainage. In the remaining 20 drainages, the population remained relatively stable. Small populations (1-2 territories) disappeared from three drainages. Vireo populations remained stable in the drainages that were substantially burned in 2007 with the exception of that at Las Flores Creek, which continued to increase (Figs. 1 and 4). The stabilization of vireo populations in these drainages may indicate that the suitable vireo habitat, patchy shrub layer that includes willow and mule fat, characteristic of post-fire sites, has recovered sufficiently to support a stable pre-fire numbers of vireos. The redistribution of the vireo population may 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, 7-26% 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; and (3) the percent first-year survivorship increases each year as vireos that had not been detected in prior years are discovered and identified. There was no difference in first-year survivorship between Removal and Reference sites for vireos that hatched in 2009, and the dispersal of 2009 fledglings across Removal, Reference, and other areas on MCBCP suggest that first-year vireos were equally likely to settle in areas with recovered vegetation than in areas dominated by 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 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 MCBCP. In 2010, two female vireos that had been banded as nestlings on MCBCP were detected breeding along the San Luis Rey River. Since 2006, 41 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 male vireo banded as a nestling along the Santa Margarita River was detected on the San Gabriel River in Duarte, Los Angeles County in 2009 (B. Daniels, pers. comm.), and then returned to occupy a territory on MCBCP in 2010. Another female vireo that was banded along the Santa Margarita River was detected breeding on Ballona Creek, Playa Vista, Los Angeles County in 2010. Finally, a vireo banded as a nestling on MCBCP in 2006 was detected in Trabuco Canyon, Orange County, in 2010. 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 did not differ between new Removal and Reference sites, nor was there a difference in breeding productivity between new and old Removal sites during the first year we monitored at each site. The percentage of pairs that fledged at least one young overall in 2010 (72%) was lower than in all previous years (2009 = 89%, 2008 = 94%, 2005 = 89%, 2006 = 79%, 2007 = 89%, and 2008 = 94%; Rourke and Kus 2006a, 2007a, 2008, Lynn and Kus 2009, 2010a), driven by the low percentage of pairs that fledged young at Reference sites (60%). This is also lower than the San Luis Rey River, where 81% of pairs fledged at least one young in 2010 (Ferree et al. 2010b). In 2010, the number of young fledged per pair was not significantly higher at Removal sites than at Reference sites. Fewer pairs successfully fledged two broods in 2010 than during the previous two years [2010 = 17% (8/46);

2009 = 30% (14/47); 2008 = 39% (20/51)], although this was still higher than the three prior years [2005 = 3% (1/33); 2006 = 5% (2/42); 2007 = 9% (4/46)]. Vireos in 2010 initiated their first nests later than in previous years, potentially contracting the breeding season compared to the previous two years. Successful nesting attempts take longer than failed attempts, and it is possible that in 2010, 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.

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 2010, similar to the 5-year analysis from the old Removal and Reference sites (Lynn and Kus 2010a), 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.

During the past five years of monitoring, we collected vireo breeding productivity and survivorship data in the old Removal sites after the habitat had 3-5 years to recover. Our results suggested that vireos nesting on MCBCP were not adversely affected by vegetation removal operations (Lynn and Kus 2010a). In 2010, we began monitoring vireo breeding productivity and survivorship in two new Removal areas where the habitat had only one year to recover, and therefore may have a more refined perspective on the time-frame for habitat recovery after giant reed was removed. Through continued monitoring of areas where giant reed is removed, we will accumulate data to support or refute 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 (80% and 62%, respectively). Additionally, the number of pairs that successfully fledged two broods in 2010 was higher at Removal sites (24%) than at Reference sites (10%). We did not measure general habitat, prey, or predator-related variables at Removal and Reference sites to determine what factors may explain this difference. 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 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 consistent difference in number of fledglings produced per pair between Removal and Reference sites 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 increased significantly more at old Removal sites than at the Reference sites between 2009 and 2010, suggesting that vireo habitat continues to improve at the old Removal sites. Additionally, vireo territory density at the new Removal sites has doubled each year since 2008, when giant reed was removed. Prior to giant reed removal at the new Removal sites, vireo territory density had decreased consistently from year-to-year, starting in 2002, which likely reflects the progress of giant reed encroachment on the native vegetation. Giant reed typically grows in thick stands that crowd out the native plant understory and also frequently the canopy species. By 2008, giant reed was an impenetrable monoculture in these areas. In the Fall of 2008, during the non-breeding season when vireos were absent, giant reed was manually removed and chemically treated at these new Removal sites (J. Giessow, pers. comm.). 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 2009, vireo density began increasing at the new Removal sites, presumably in response to recovery of understory vegetation, and equaled the Reference sites by 2010.

Annual precipitation for the bioyear preceding the 2010 breeding season increased from 2009 but remained below the peak rainfall years of 2005 and 2008. Despite the increase in precipitation, we saw a decrease in number of young fledged per pair in 2010 compared to 2008 and 2009. Although annual differences in the amount and timing of precipitation may affect vireo productivity by increasing primary productivity and prey numbers, we were only able to detect a positive association between annual precipitation and clutch size, which varies little from year to year (between 3.25 and 3.75 eggs/clutch). 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 six-year time-frame may not be sufficient to detect these annual differences. We did not detect an association between annual precipitation and total number of vireo territories detected on Base between 1997 and 2010. 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 MCBCP. However, we found that nest placement in 2008, 2009, and 2010 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 edge of the nest vegetation clump, and the edge of the riparian vegetation than at Reference sites. Further investigation into habitat variables at these sites may explain whether or not nest placement is a function of what is available or if vireos are selecting particular nest sites out of proportion to their availability.

Human activities in vireo habitat were a source of disturbance to vireos in 2010, including disturbance of vireo habitat by military training exercises and brush control, direct impacts to vireos by vehicular collision, and management activities associated with habitat restoration. We documented impacts to areas known to be occupied by vireos along the unpaved access road that parallels the northwest side of the Santa Margarita River, running from Range 102 to Stuart Mesa Road. Two different activities impacted vireo habitat in this area: (1) brush clearing associated with a pipeline, noticed and photographed on 9April 2010, removed a strip of riparian vegetation along the edge of the unpaved road, potentially affecting nesting vireos that typically place their nests near vegetation edges; (2) apparent off-road activity and consequent destruction of riparian vegetation commonly used by vireos for nesting was noticed and photographed on 24 and 29 June 2010, immediately following training exercises (Appendix G).

Biologists also noted vehicles moving at excessive speed on the same unpaved road during vireo surveys. On 11 May 2010, a banded adult vireo was found dead on the other side of the river on the shoulder of Vandegrift Road. Cause of death was attributed to vehicular collision.

Additionally, herbicide application associated with removal of giant reed and other exotic vegetation may have affected nesting success for a limited number of vireos on our Removal sites. In 2010, three active vireo nests in our monitoring plots were potentially compromised when the surrounding vegetation was sprayed with an herbicide. Two of these nests failed, one when the supporting vegetation collapsed and one when developing eggs died, while a third nest fledged three of the original four nestlings. It is not possible to determine whether or not the herbicide application caused the nests to fail. However, the herbicide application may have contributed to the failure of these nests in several ways, including the disturbance caused by the applicator in the area, the death of the supporting vegetation in response to the application of herbicide, and the potential chemical contamination of nest contents and/or adult birds.

While some human impacts can only be mitigated by extreme action (e.g., closing high-speed roads in vireo habitat during vireo breeding season), other impacts may be mitigated by education and adjustments to schedules. Increased communication between the Assistant Chief of Staff, Environmental Security, and other military departments may reduce the instances of human-related impacts to vireos and occupied vireo habitat by allowing all participants to understand needs and flexibilities and adjust their activities accordingly. Coordination of military training exercises and maintenance activities such as vegetation clearing will minimize impacts to active territories by either arranging these activities outside of the vireo breeding season or in areas with less potential to impact breeding birds. This coordination and cooperation among various departments will help maintain a balance between the sometimes competing land uses on Base, including military activities, recreation, habitat protection, and endangered species management.

CONCLUSIONS

Generally, the vireo population on MCBCP 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 MCBCP, 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 MCBCP during 2010. Cowbird control has a demonstrably positive effect on vireo productivity (Kus 1999, Kus and Whitfield 2005), but must be consistently practiced to maintain the desired reduction in parasitism.

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 at the old Removal sites, but there was little evidence that vireo reproductive indices experienced a similar dip. In fact, it is evident that although there may not have been as many vireos breeding at the old Removal sites immediately following giant reed removal, vireo reproductive success was never lower at Removal sites than at Reference sites, indicating that over the long term, giant reed removal did not negatively impact vireo breeding productivity. However, it is also worth noting that the method and timing of giant reed removal are important factors to consider when weighing the proximate costs and benefits of removing giant reed to native bird species, especially when such activities overlap with the breeding season. 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.

Marine Corps Base Camp Pendleton is subject to a variety of competing land uses, including military activities, recreation, habitat protection, and endangered species management. Communication and cooperation between various departments on Base can ease conflicts between these sometimes conflicting land-uses and minimize impacts directly to vireos and to vireo habitat.

LITERATURE CITED

Boag, P. T. and P. R. Grant. 1984. Darwin's Finches (*Geospiza*) on Isla Daphne Major, Galapagos: Breeding and feeding ecology in a climatically variable environment. Ecological Monographs 54:463-489.

Brown, B. T. 1993. Bell's Vireo (*Vireo bellii*). *In* The Birds of North America, No. 35 (A. Poole, P. Stettenheim, and F. Gill, Eds.). The Academy of Natural Sciences, Philadelphia, Pennsylvania; The American Ornithologists' Union, Washington, D.C.

Burnham, K. P., and D. R. Anderson. 2002. Model Selection and Multimodel Inference: A Practical Information-theoretic Approach, 2nd ed. Springer-Verlag, New York.

Chase, M. K., N. Nur, and G. R. Geupel. 2005. Effects of weather and population density on reproductive success and population dynamics in a Song Sparrow (*Melospiza melodia*) population: a long-term study. Auk 122:571-592.

Cody, M. L. 1981. Habitat selection in birds: The roles of vegetation structure, competitors, and productivity. BioScience 31:107-113.

Dinsmore S. J., G. C. White, F. L. Knopf. 2002. Advanced techniques for modeling avian nest survival. Ecology 83:3476–3488.

Ferree, K. and B. E. Kus. 2007. Least Bell's Vireos and Southwestern Willow Flycatchers at the San Luis Rey River Flood Control Project area in San Diego County, California: Breeding activities and habitat use. 2006 Annual Data Summary. Prepared for RECON Environmental, Inc., San Diego, California.

Ferree, K. and B. E. Kus. 2008a. Least Bell's Vireos and Southwestern Willow Flycatchers at the San Luis Rey River Flood Control Project area in San Diego County, California: Breeding activities and habitat use. 2007 Annual Data Summary. Prepared for RECON Environmental, Inc., San Diego, California.

Ferree, K. and B. E. Kus. 2008b. Least Bell's Vireos and Southwestern Willow Flycatchers at the San Luis Rey River Flood Control Project area in San Diego County, California: Breeding activities and habitat use. 2008 Annual Report. Prepared for RECON Environmental, Inc., San Diego, California.

Ferree, K. L. D. Allen, M. A. Blundell, B. E. Kus, and S. Lynn. 2010. Least Bell's Vireos and Southwestern Willow Flycatchers at the San Luis Rey River Flood Control Project area in San Diego County, California: Breeding activities and habitat use. 2009 Annual Report. Prepared for RECON Environmental, Inc., San Diego, California.

Ferree, K., L. D. Allen, B. E. Kus, and S. Lynn. In prep. Least Bell's Vireos and Southwestern Willow Flycatchers at the San Luis Rey River Flood Control Project area in San Diego County, California: Breeding activities and habitat use. 2010 Annual Report. Prepared for RECON Environmental, Inc., San Diego, California.

Franzreb, K. E. 1989. Ecology and conservation of the endangered Least Bell's Vireo. Biological Report 89 (1). U.S. Fish and Wildlife Service, Department of Interior, Washington, D.C. March 1989.

Grant, P. R., and B. R. Grant. 1987. The extraordinary El Nino event of 1982-83: Effects on Darwin's Finches on Isla Genovesa, Galapagos. Oikos 49:55-66.

Griffith Wildlife Biology. 2004. The status of the Least Bell's Vireo at Marine Corps Base Camp Pendleton in 2004. Unpublished draft report for Assistant Chief of Staff, Environmental Security, Camp Pendleton, California, by Jane C. Griffith and John T. Griffith, Griffith Wildlife Biology, Calumet, Michigan.

Jones, B. L. 1985. A report on the status of the Least Bell's Vireo on the San Diego, Sweetwater and San Luis Rey Rivers, San Diego County, California. Unpublished report for U.S. Fish and Wildlife Service, Portland, Oregon.

Kus, B. E. 1988. Status and management of the Least Bell's Vireo at the San Luis Rey River, San Diego County, California, 1988. Unpublished report for the State of California Department of Transportation, District 11, San Diego, California.

Kus, B. E. 1989. Status of the Least Bell's Vireo at the San Luis Rey River, San Diego County, California 1989. Unpublished report for the State of California Department of Transportation, District 11, San Diego, California.

Kus, B. E. 1991a. Status of the Least Bell's Vireo at the San Luis Rey River, San Diego County, California 1990. Unpublished report for the State of California Department of Transportation, District 11, San Diego, California.

Kus, B. E. 1991b. Distribution and breeding status of the Least Bell's Vireo at the San Luis Rey River, San Diego County, California 1991. Unpublished report for the State of California Department of Transportation, District 11, San Diego, California.

Kus, B. E. 1994. Distribution and breeding status of the Least Bell's Vireo at the San Luis Rey River, San Diego County, California 1992-1993. Unpublished report for the State of California Department of Transportation, District 11, San Diego, California.

Kus, B. E. 1995. Distribution and breeding status of the Least Bell's Vireo at the San Luis Rey River, San Diego County, California 1994. Unpublished report for the State of California Department of Transportation, District 11, San Diego, California.

Kus, B. E. 1998. Use of restored riparian habitat by the endangered Least Bell's Vireo (*Vireo bellii pusillus*). Restoration Ecology 6:75-82.

Kus, B. E. 1999. Impacts of Brown-headed Cowbird parasitism on the productivity of the endangered Least Bell's Vireo. Studies in Avian Biology 18:160-166.

Kus, B. E. and P. P. Beck. 1998. Distribution and abundance of the Least Bell's Vireo (*Vireo bellii pusillus*) and the Southwestern Willow Flycatchers (*Empidonax traillii extimus*) at selected Southern California sites in 1997. Unpublished report for the California Department of Fish and Game, Sacramento, California.

Kus, B. E., B. L. Peterson, and D. H. Deutschman. 2008. A multiscale analysis of nest predation on Least Bell's Vireos (*Vireo bellii pusillus*). Auk 125:277-284.

Kus, B. E. and M. J. Whitfield. 2005. Parasitism, productivity, and population growth: Response of Least Bell's Vireos (*Vireo bellii pusillus*) and Southwestern Willow Flycatchers (*Empidonax traillii extimus*) to cowbird (*Molothrus spp*.) control. Ornithological Monographs 57:16-27.

Lynn, S. and B. E. Kus. 2008. Least Bell's Vireo surveys on the San Luis Rey River, College Boulevard in Oceanside to Interstate 15 in Fallbrook, San Diego County, California. 2008 Data Summary. Prepared for Mission Resource Conservation District, Fallbrook, California.

Lynn, S. and B. E. Kus. 2009. Distribution, abundance and breeding activities of the Least Bell's Vireo at Marine Corps Base Camp Pendleton, California. 2008 Annual Report. Prepared for Assistant Chief of Staff, Environmental Security, Marine Corps Base Camp Pendleton.

Lynn, S. and B. E. Kus. 2010a. 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, Marine Corps Base Camp Pendleton.

Lynn, S. and B. E. Kus. 2010b. Distribution, abundance, and breeding activities of Least Bell's Vireo and Southwestern Willow Flycatcher at Marine Corps Air Station, Camp Pendleton, California. 2010 Data Summary. Prepared for Naval Facilities Engineering Command Southwest, San Diego, California.

Lynn, S. M. M. Rogne, and B. E. Kus. 2010a. Breeding activities of Least Bell's Vireo on the San Luis Rey River, College Boulevard in Oceanside to Interstate 15 in Fallbrook, San Diego County, California. 2010 Data Summary. Prepared for Mission Resource Conservation District, Fallbrook, California.

Lynn, S., M. J. Wellik, and B. E. Kus. 2010b. Distribution, abundance, and breeding activities of the Least Bell's Vireo along the San Diego River, California. 2009 Annual Data Summary. Prepared for the San Diego River Conservancy, San Diego, California.

OWR (Office of Water Resources). 2009. Climatic Summary for the Precipitation Year 2008-2009, Camp Pendleton, California. Administrative Report. Prepared for Assistant Chief of Staff, Facilities, Marine Corps Base Camp Pendleton, California.

Paxton, E. H., M. K. Sogge, S. L. Durst, T. C. Theimer, and J. R. Hatten. 2007. The ecology of the Southwestern Willow Flycatcher in central Arizona – a 10-year synthesis report. U.S. Geological Survey Open-File Report, 2007-1381.

Peterson, B. L., B. E. Kus, and M. J. Wellik. 2002. Surveys for the Least Bell's Vireo and Southwestern Willow Flycatcher at the San Luis Rey River. 2002 Annual Summary. Unpublished report for the State of California Department of Transportation, District 11, San Diego, California.

RHJV (Riparian Habitat Joint Venture). 2004. Version 2.0. The riparian bird conservation plan: A strategy for reversing the decline of riparian associated birds in California. California Partners in Flight. [Online.] Available at http://www.prbo.org/calpif/pdfs/riparian_v-2.pdf.

Rotenberry, J. T. and J. A. Wiens. 1989. Reproductive biology of shrubsteppe passerine birds: Geographical and temporal variation in clutch size, brood size, and fledging success. Condor 91:1-14.

Rotenberry, J. T. and J. A. Wiens. 1991. Weather and reproductive variation in shrubsteppe sparrows: A hierarchical analysis. Ecology 72:1325-1335.

Rourke, J. W. and B. E. Kus. 2006a. Distribution, abundance, and breeding activities of the Least Bell's Vireo at Marine Corps Base Camp Pendleton, California. 2005 Annual Report. Prepared for Assistant Chief of Staff, Environmental Security, Marine Corps Base Camp Pendleton.

Rourke, J. W. and B. E. Kus. 2006b. Distribution and breeding activities of the Least Bell's Vireo and Southwestern Willow Flycatcher at the San Luis Rey River, San Diego, California. 2005 Annual Report. Unpublished report for the State of California Department of Transportation, District 11, San Diego, California.

Rourke, J. W. and B. E. Kus. 2007a. Distribution, abundance, and breeding activities of the Least Bell's Vireo at Marine Corps Base Camp Pendleton, California. 2006 Annual Data Summary. Prepared for Assistant Chief of Staff, Environmental Security, Marine Corps Base Camp Pendleton.

Rourke, J. W. and B. E. Kus. 2007b. Distribution and breeding activities of the Least Bell's Vireo and Southwestern Willow Flycatcher at the San Luis Rey River, San Diego, California. 2006 Data Summary. Unpublished report for the State of California Department of Transportation, District 11, San Diego, California.

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

SYSTAT Software, Inc. 2005. Systat user's guide. Version 11 for Windows, SYSTAT Software, Inc., Point Richmond, CA.

USFWS (U.S. Fish and Wildlife Service). 1986. Endangered and Threatened Wildlife and Plants; Determination of Endangered Status for the Least Bell's Vireo. Federal Register 51(85):16474-16482.

USFWS (U.S. Fish and Wildlife Service). 1998. Draft recovery plan for the Least Bell's Vireo. U.S. Fish and Wildlife Service, Portland, OR.

USFWS (U.S. Fish and Wildlife Service). 2001. Least Bell's Vireo survey guidelines. Unpublished document prepared by the USFWS Carlsbad Office, Carlsbad, California. 19 January 2001.

USFWS (U.S. Fish and Wildlife Service). 2006. Least Bell's Vireo (*Vireo bellii pusillus*) 5-year review summary and evaluation. Carlsbad Fish and Wildlife Office, Carlsbad, California.

Wellik, M. J., S. Lynn, and B. E. Kus. 2009. Distribution, abundance, and breeding activities of the Least Bell's Vireo along the San Diego River, California. 2008 Annual Data Summary. Prepared for the San Diego River Conservancy, San Diego, California.

White, G. C., and K. P. Burnham. 1999. Program MARK: Survival estimation from populations of marked animals. Bird Study 46:120–139.

APPENDIX A

LEAST BELL'S VIREO SURVEY AREAS AT MARINE CORPS BASE CAMP PENDLETON, 2010

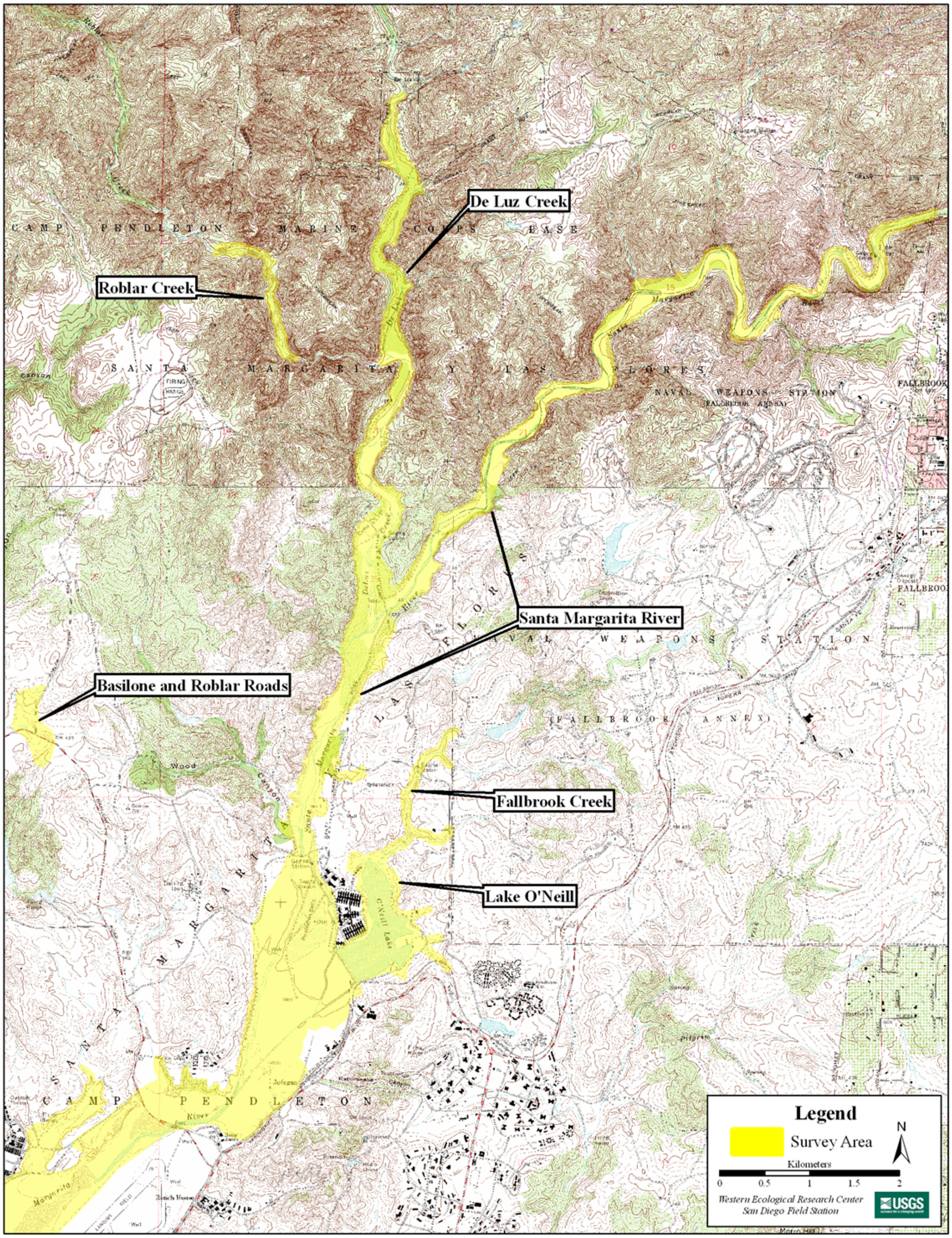

Fig. 19. Least Bell's Vireo survey areas at Marine Corps Base Camp Pendleton, 2010: Upper Santa Margarita River, Fallbrook Creek, Lake O'Neill, De Luz Creek, Roblar Creek, and Basilone and Roblar Roads.

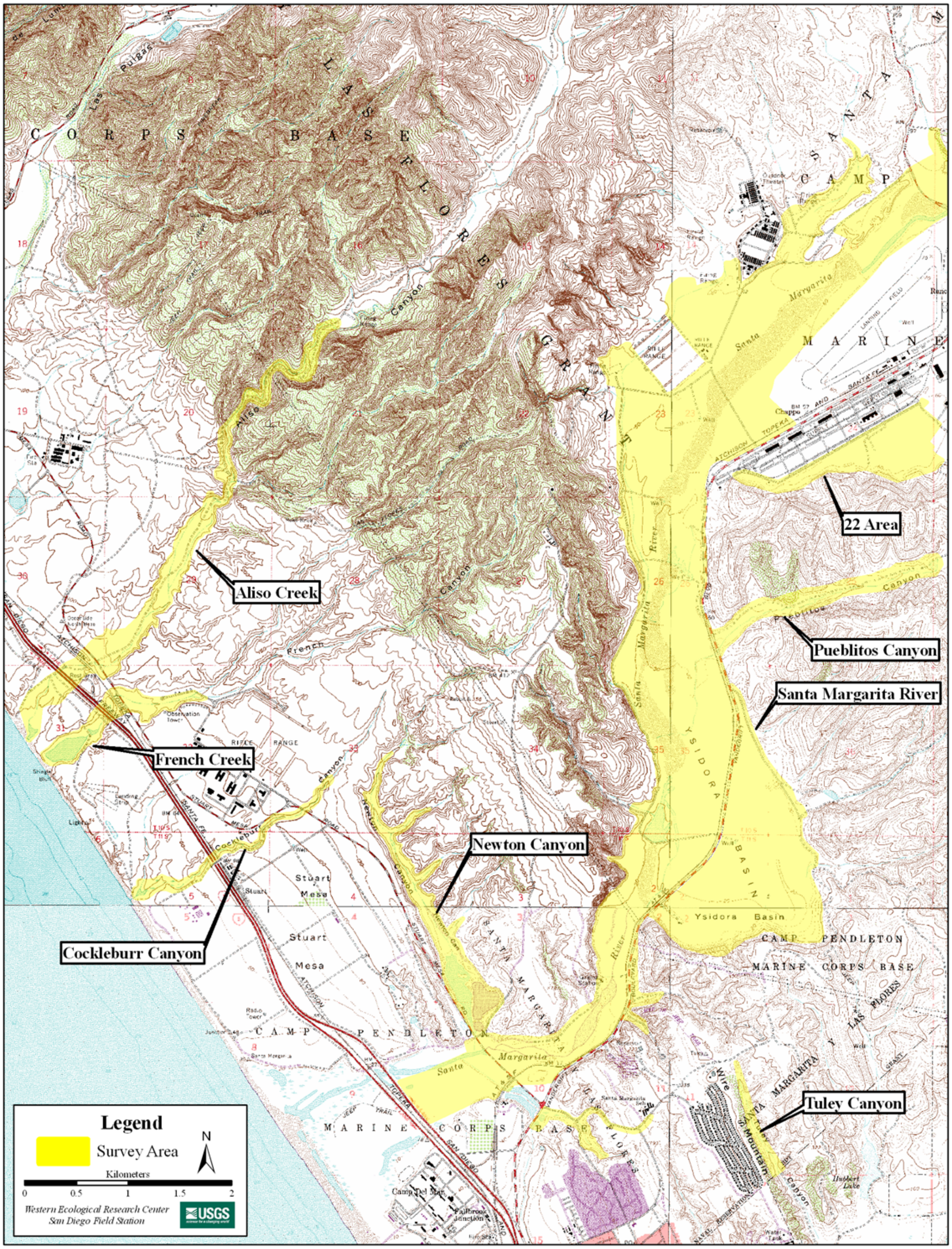

Fig. 20. Least Bell's Vireo survey areas at Marine Corps Base Camp Pendleton, 2010: Lower Santa Margarita River, 22 Area, Pueblitos Canyon, Tuley Canyon, Newton Canyon, Cockleburr Canyon, French Creek, and Aliso Creek.

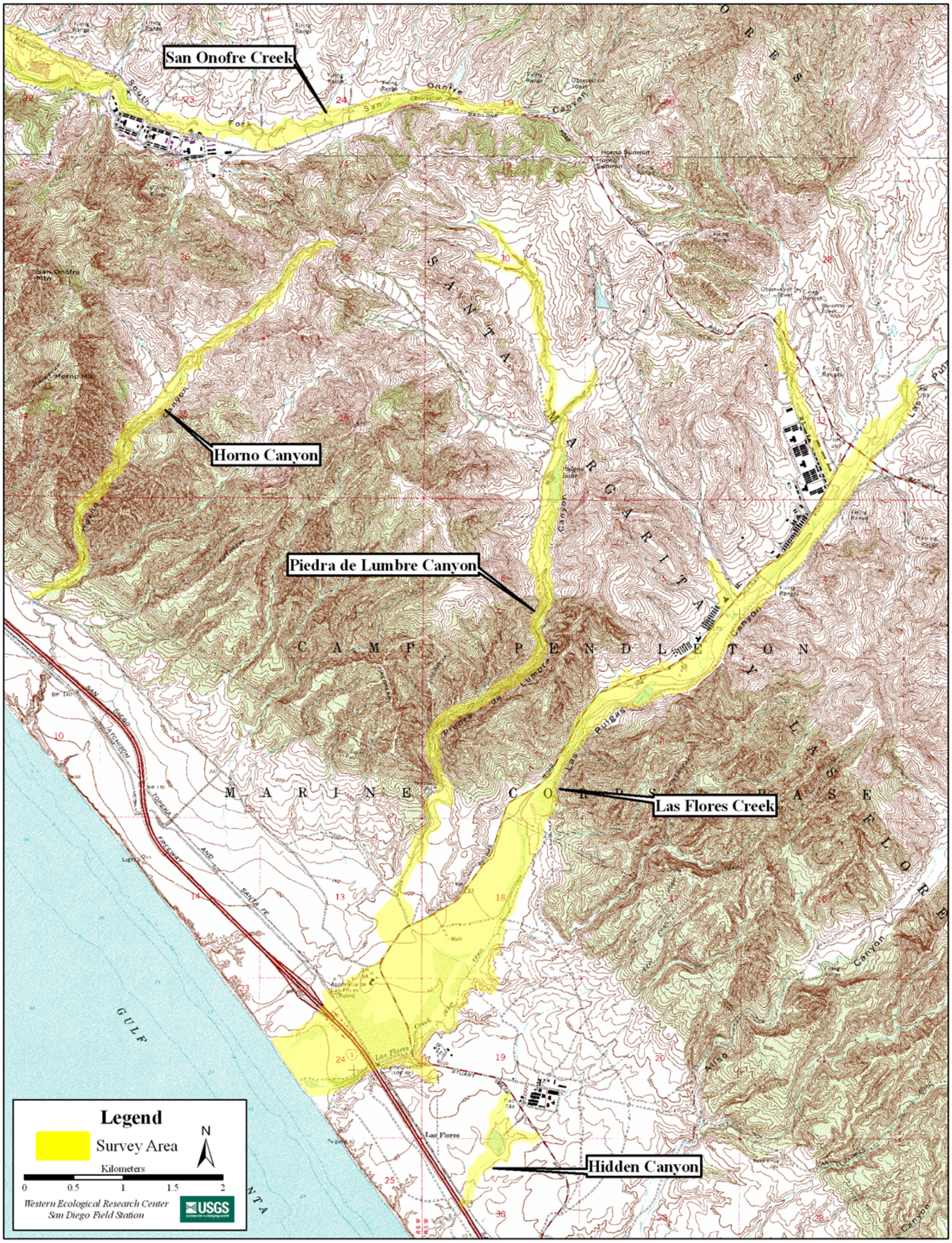

Fig. 21. Least Bell's Vireo survey areas at Marine Corps Base Camp Pendleton, 2010: San Onofre Creek South Fork, Horno Canyon, Piedra de Lumbre Canyon, Las Flores Creek, and Hidden Canyon.

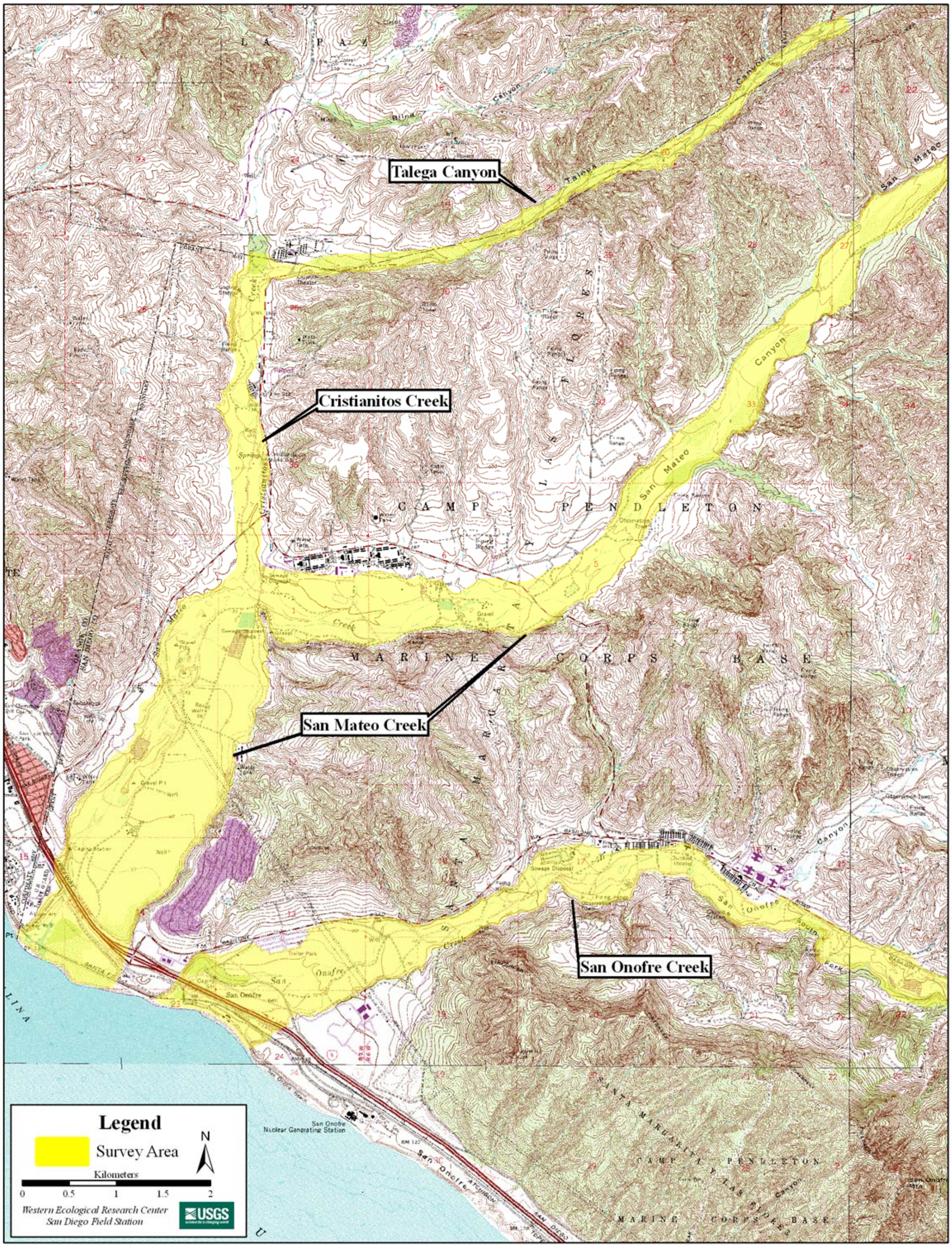

Fig. 22. Least Bell's Vireo survey areas at Marine Corps Base Camp Pendleton, 2010: Talega Canyon, Cristianitos Creek, San Mateo Creek, and San Onofre Creek.

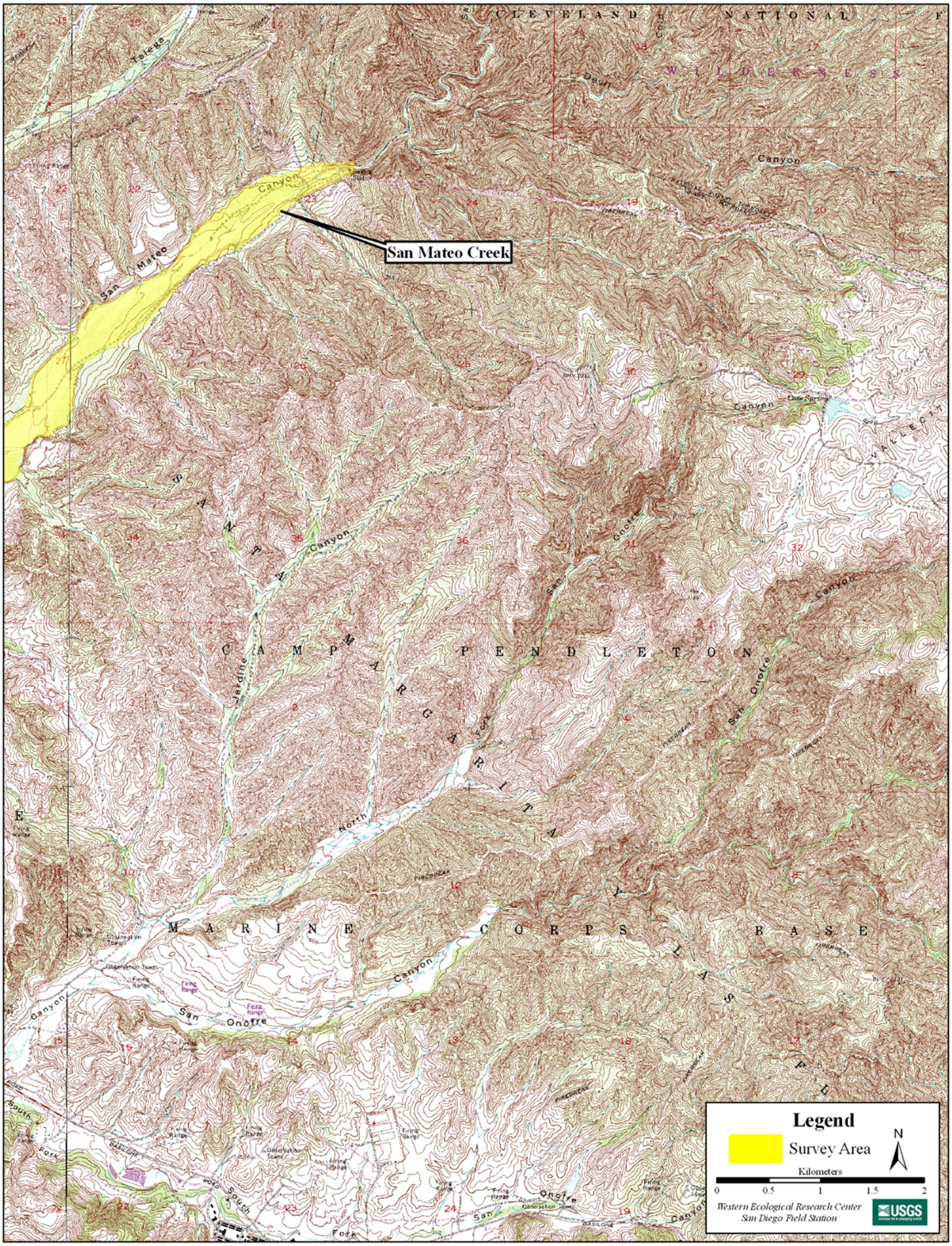

Fig. 23. Least Bell's Vireo survey areas at Marine Corps Base Camp Pendleton, 2010: Upper San Mateo Creek.

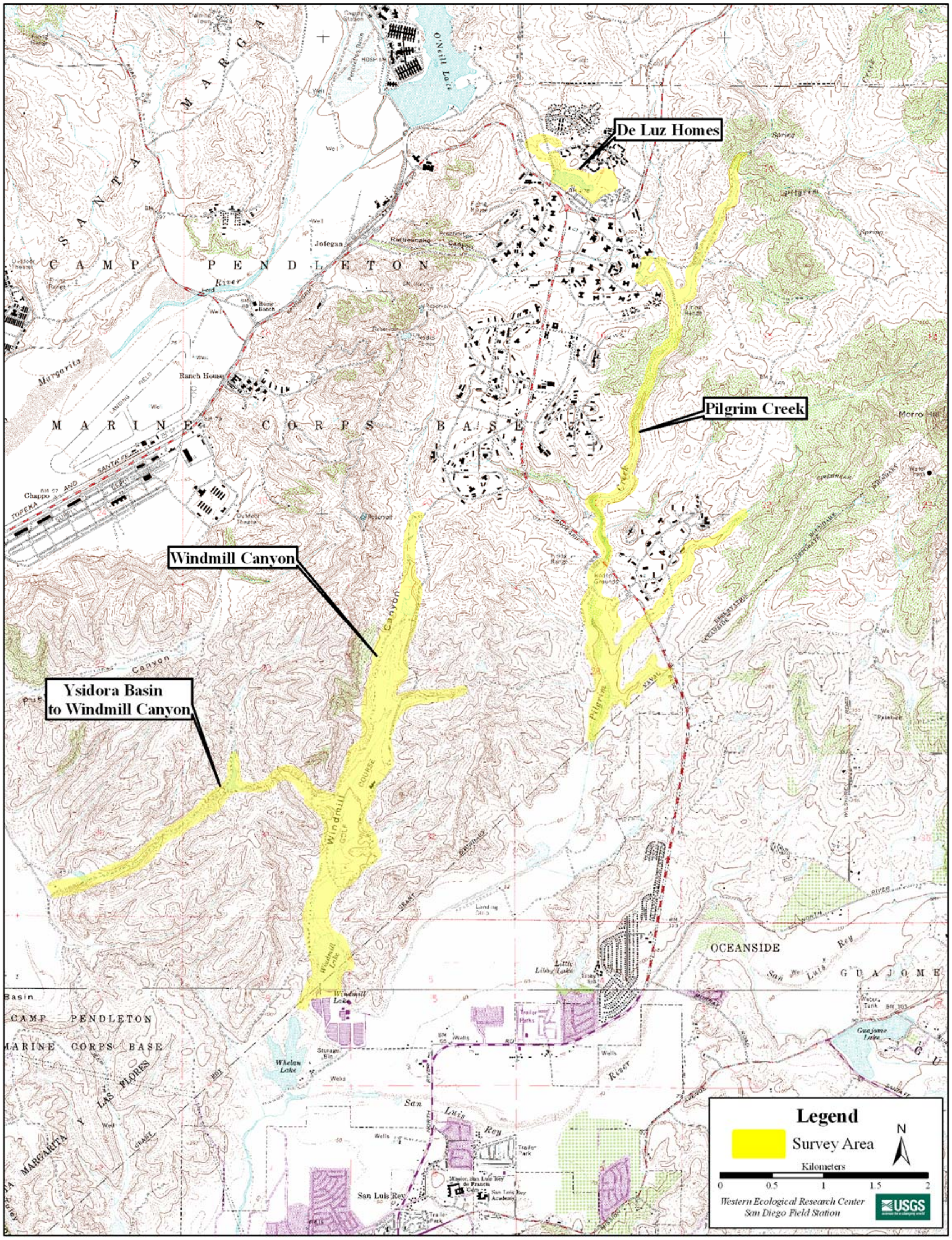

Fig. 24. Least Bell's Vireo survey areas at Marine Corps Base Camp Pendleton, 2010: Windmill Canyon, Ysidora Basin to Windmill Canyon, Pilgrim Creek, and De Luz Homes Habitat.

APPENDIX B

LOCATIONS OF LEAST BELL'S VIREOS AT MARINE CORPS BASE CAMP PENDLETON, 2010

Fig. 25. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2010: Upper Santa Margarita River.

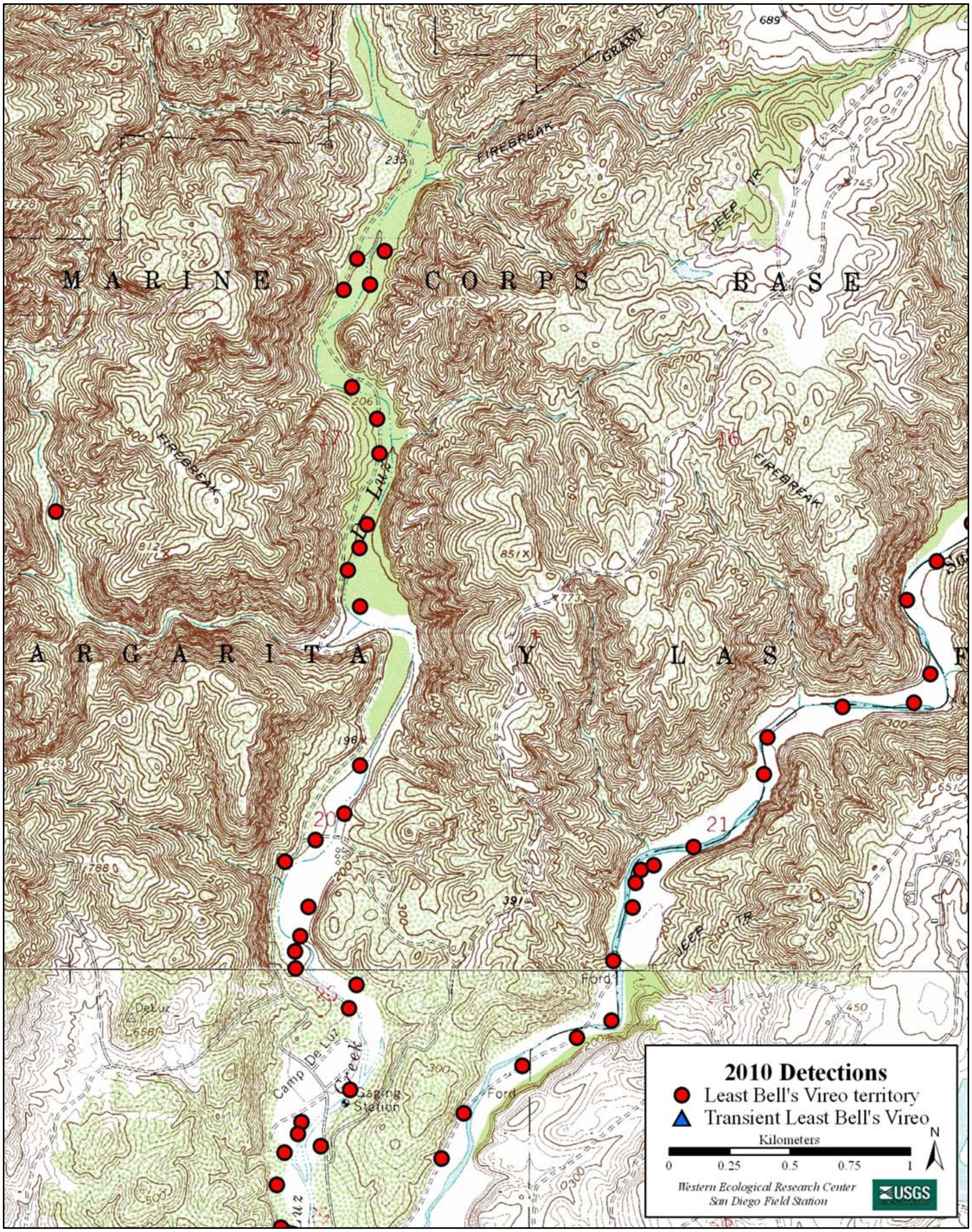

Fig. 26. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2010: Upper Santa Margarita River, De Luz Creek, and Roblar Creek.

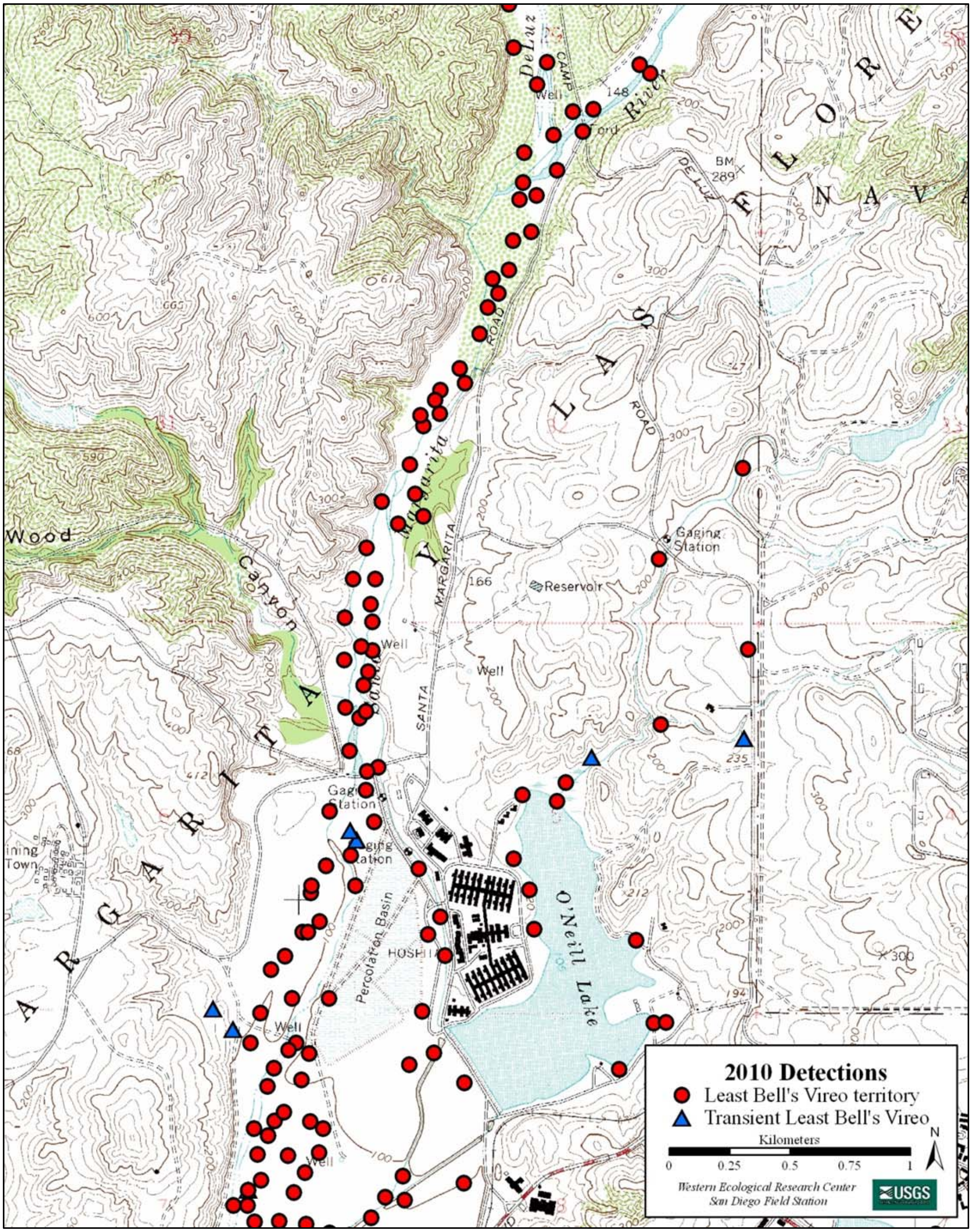

Fig. 27. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2010: Santa Margarita River, Lake O'Neill, and Fallbrook Creek.

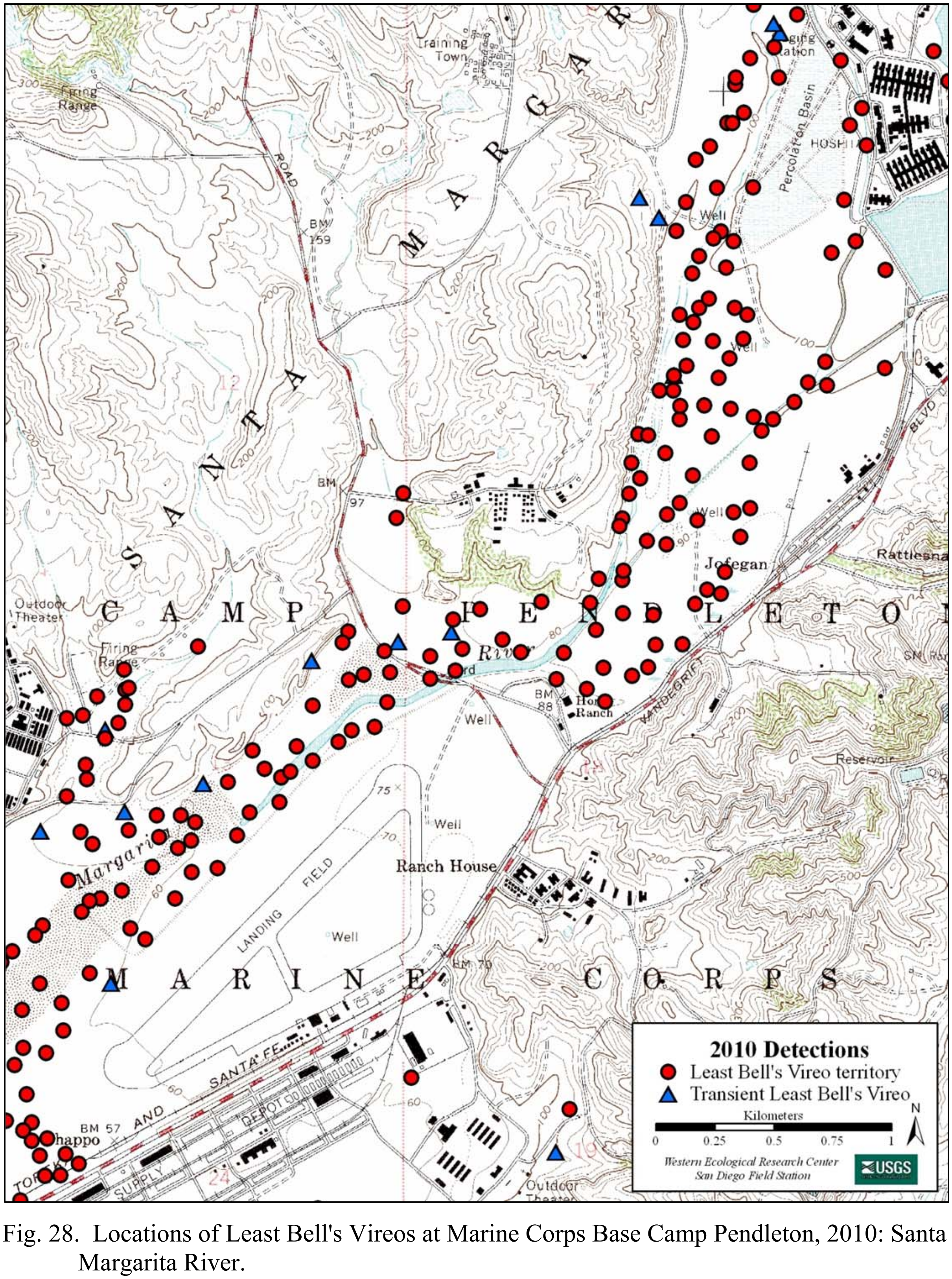

Fig. 28. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2010: Santa Margarita River.

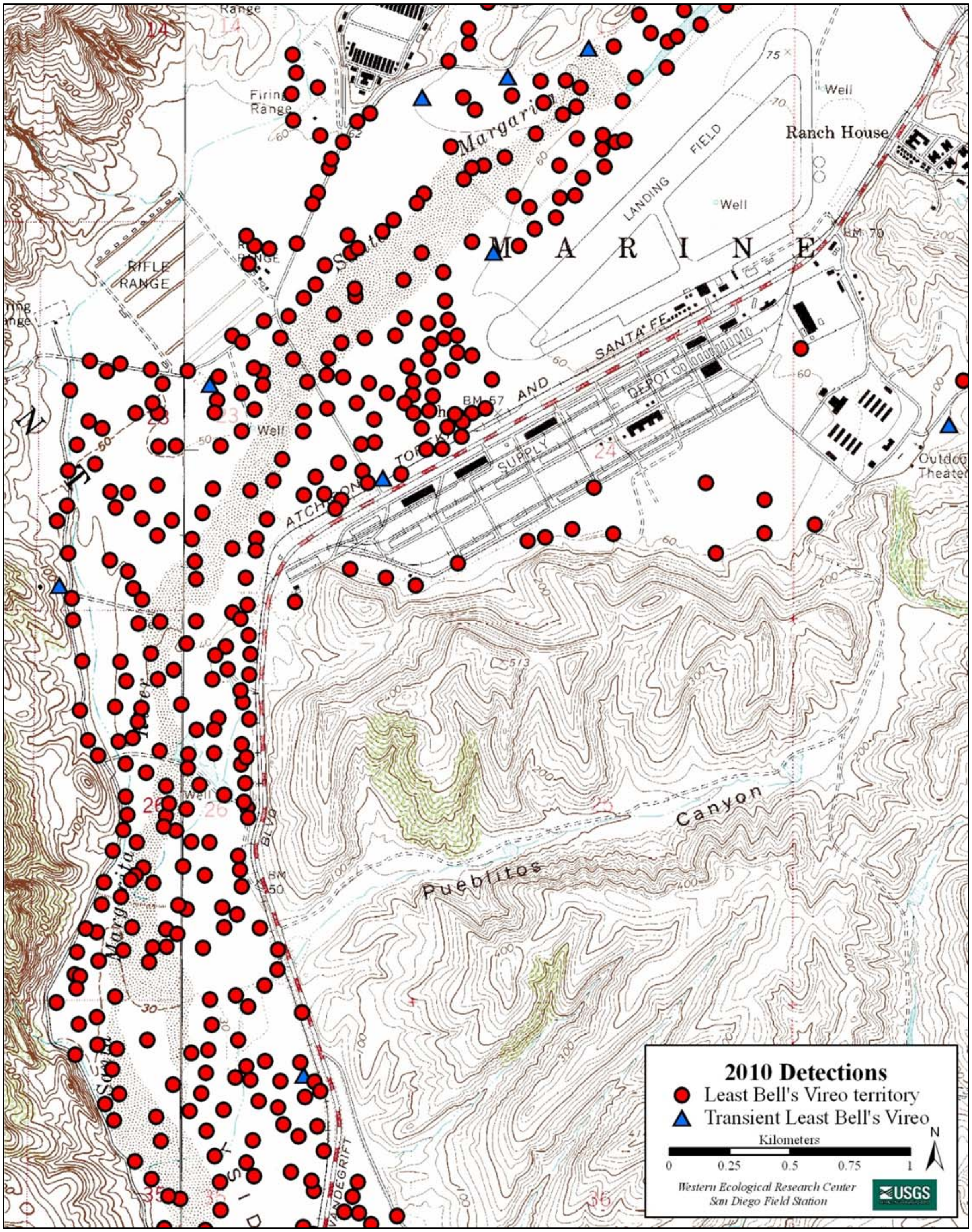

Fig. 29. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2010: Santa Margarita River, 22 Area, and Pueblitos Canyon.

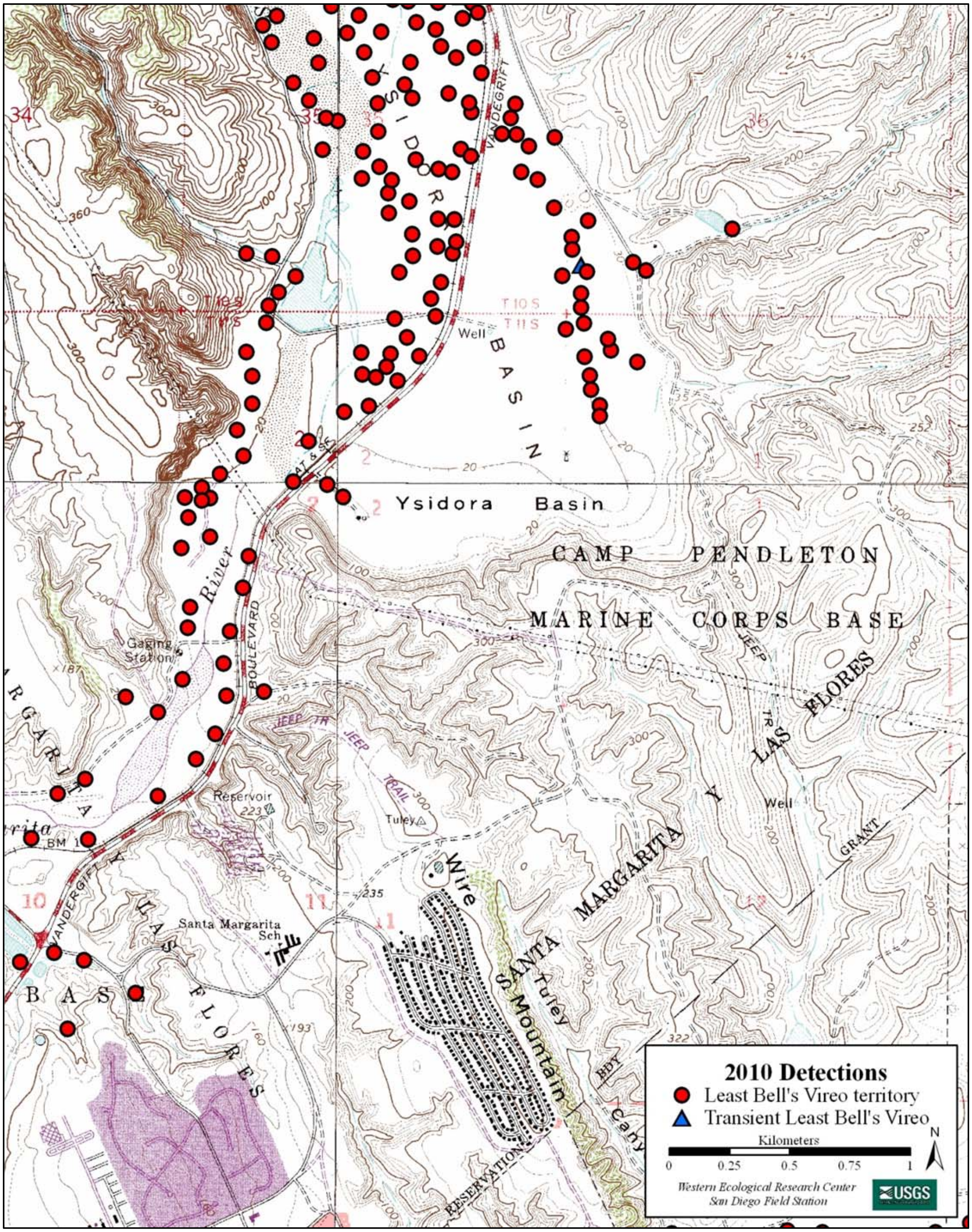

Fig. 30. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2010: Santa Margarita River, Ysidora Basin, and Ysidora Basin to Windmill Canyon.

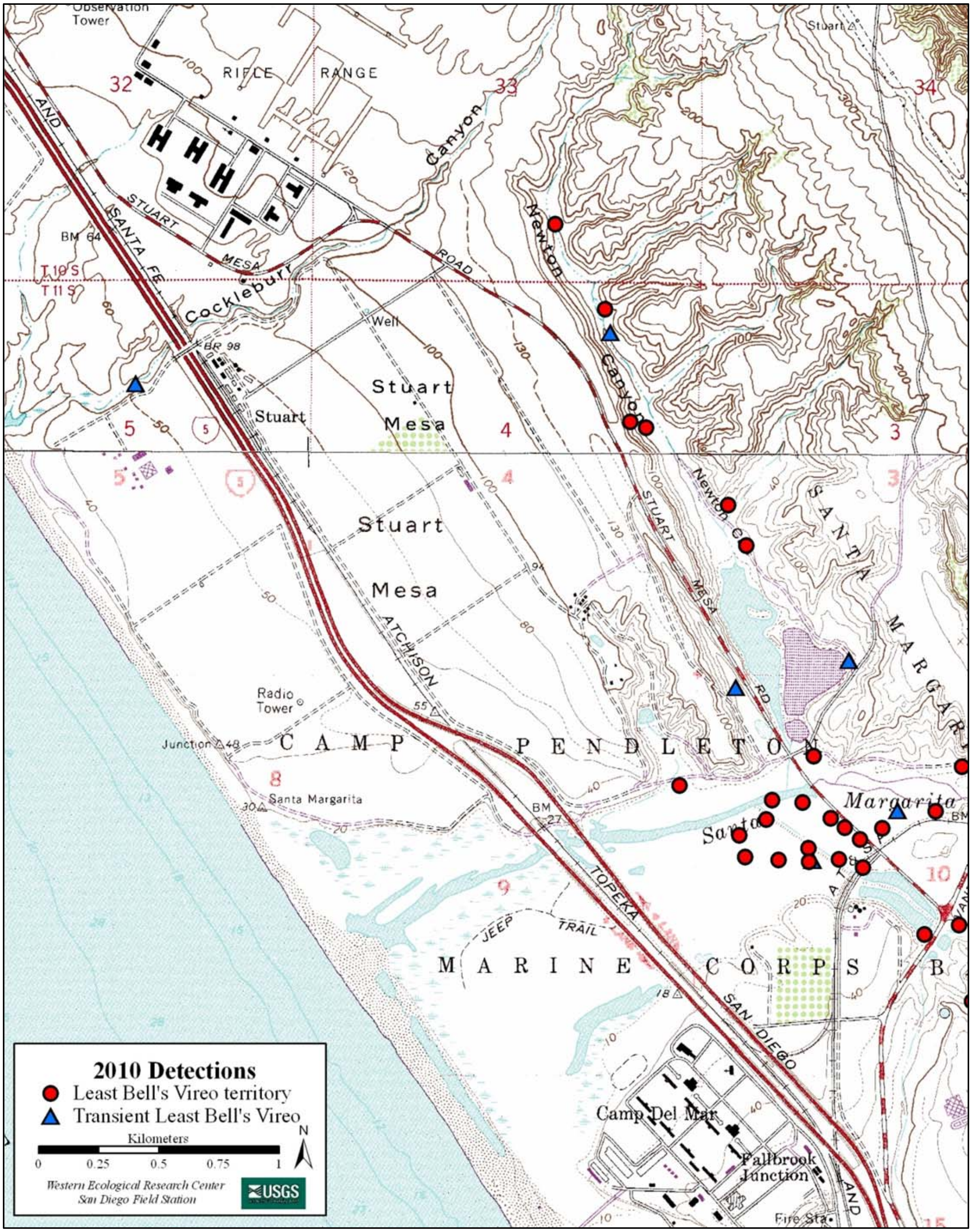

Fig. 31. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2010: Lower Santa Margarita River, Newton Canyon, and Cockleburr Canyon.

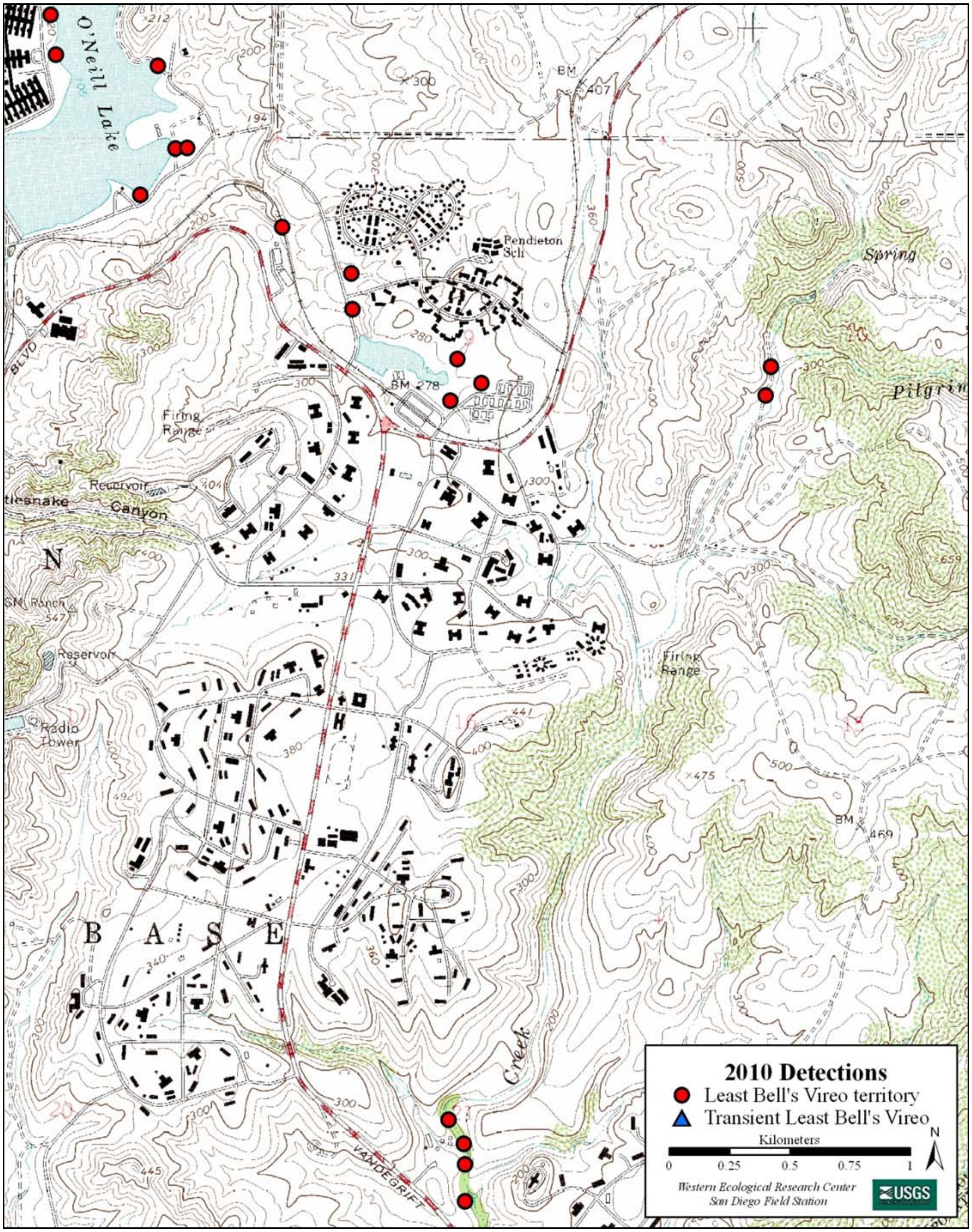

Fig. 32. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2010: Upper Pilgrim Creek, De Luz Homes Habitat, and Lake O'Neill.

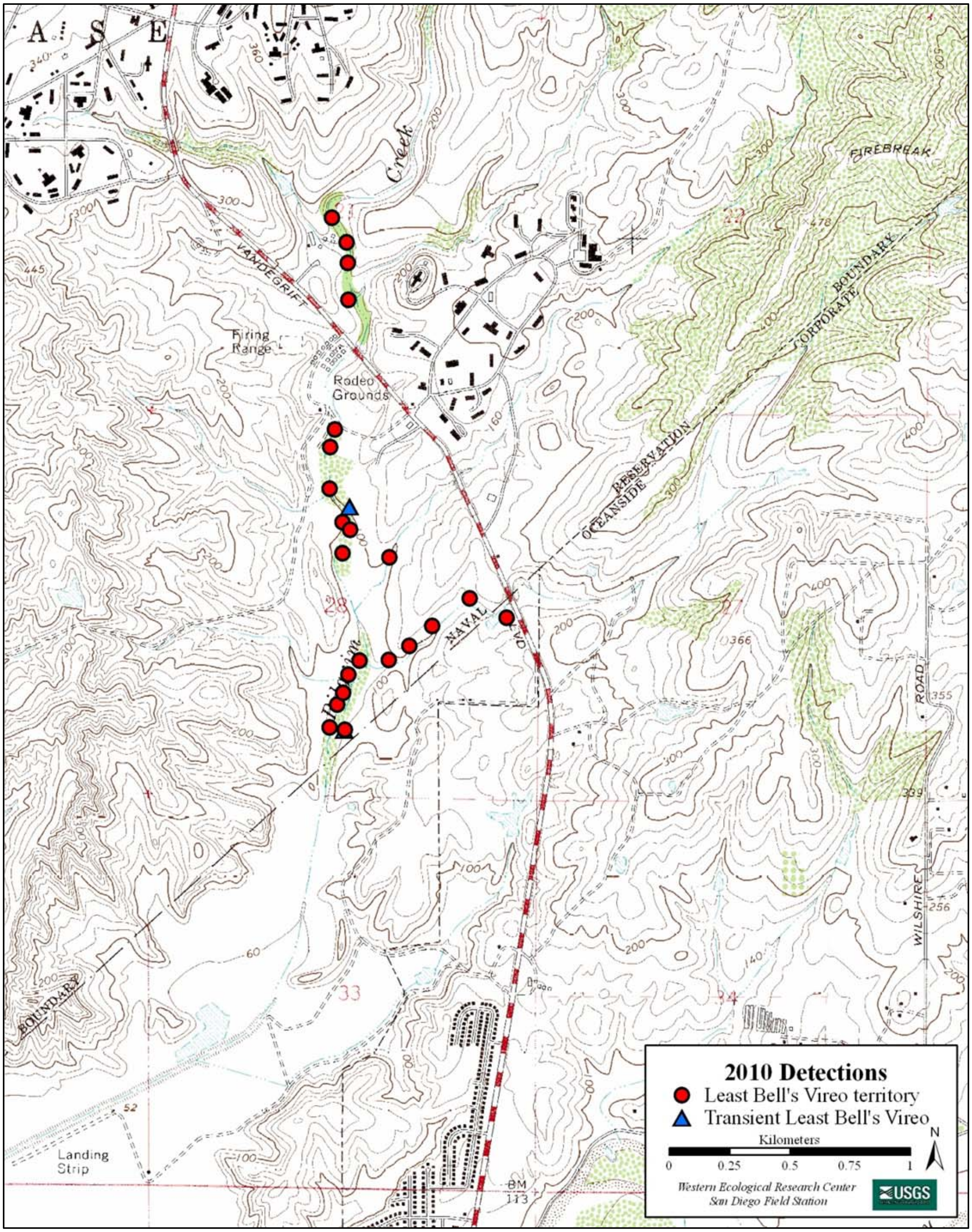

Fig. 33. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2010: Upper and Lower Pilgrim Creek.

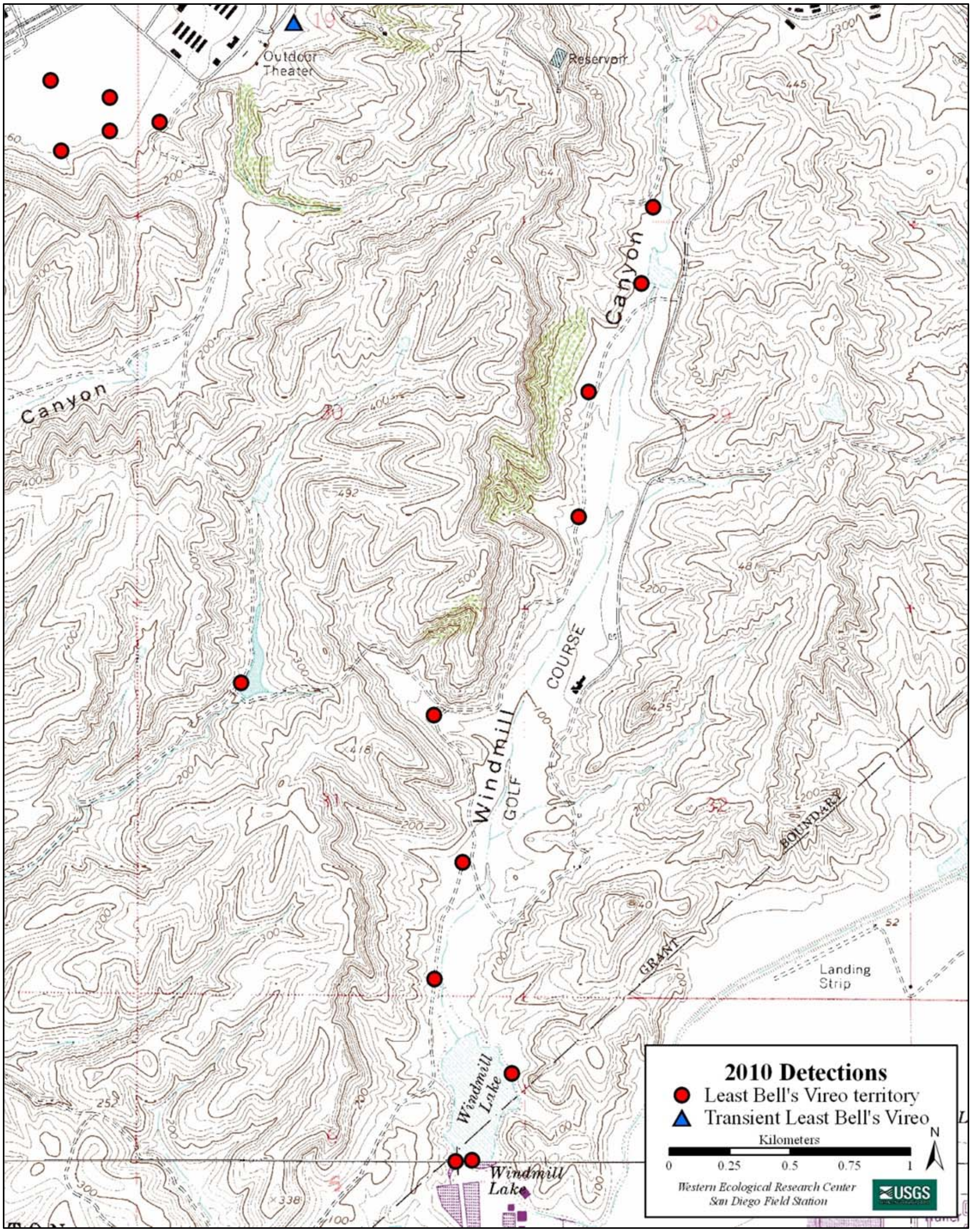

Fig. 34. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2010: Windmill Canyon and Ysidora Basin to Windmill Canyon.

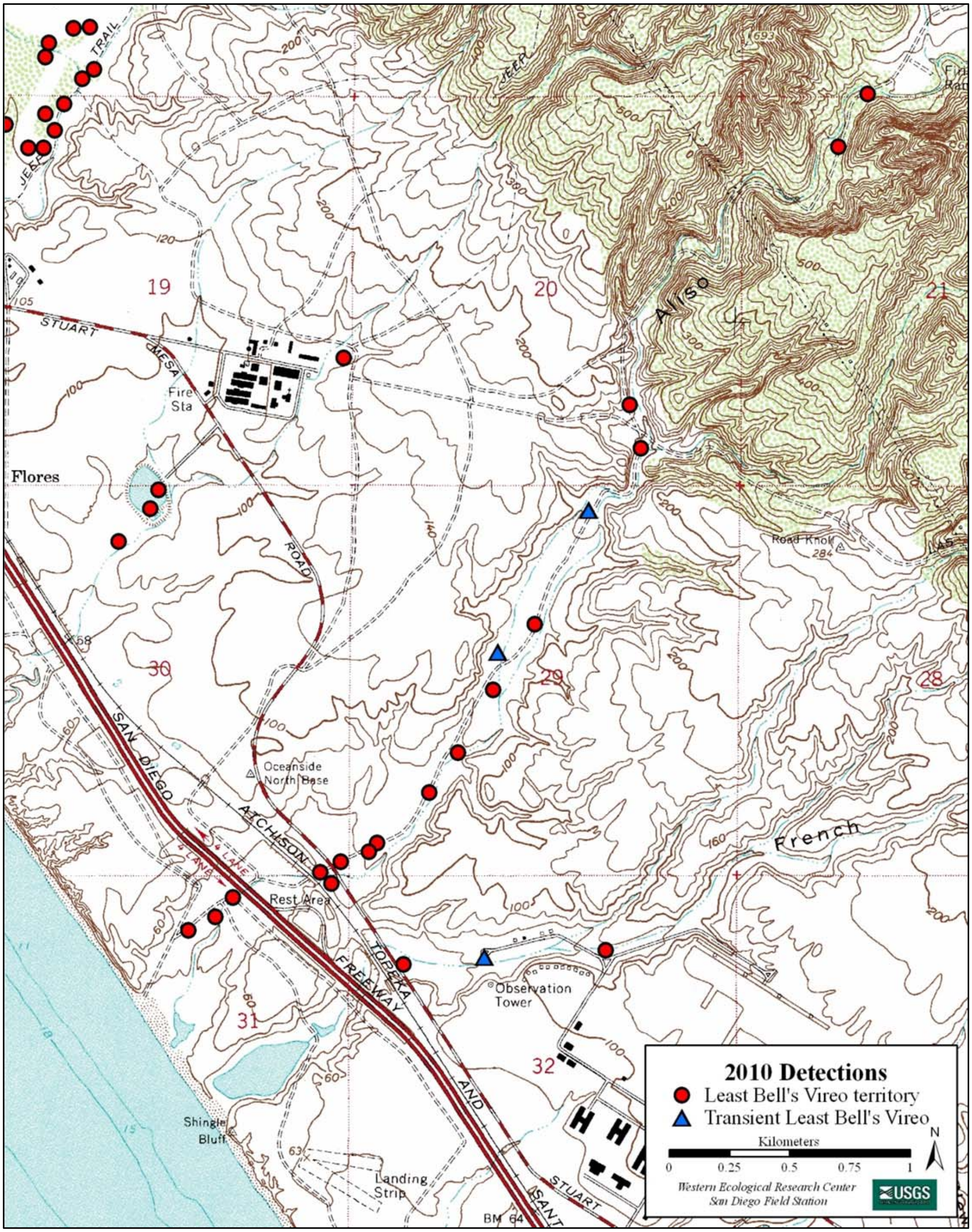

Fig. 35. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2010: French Creek, Aliso Creek, and Hidden Canyon.

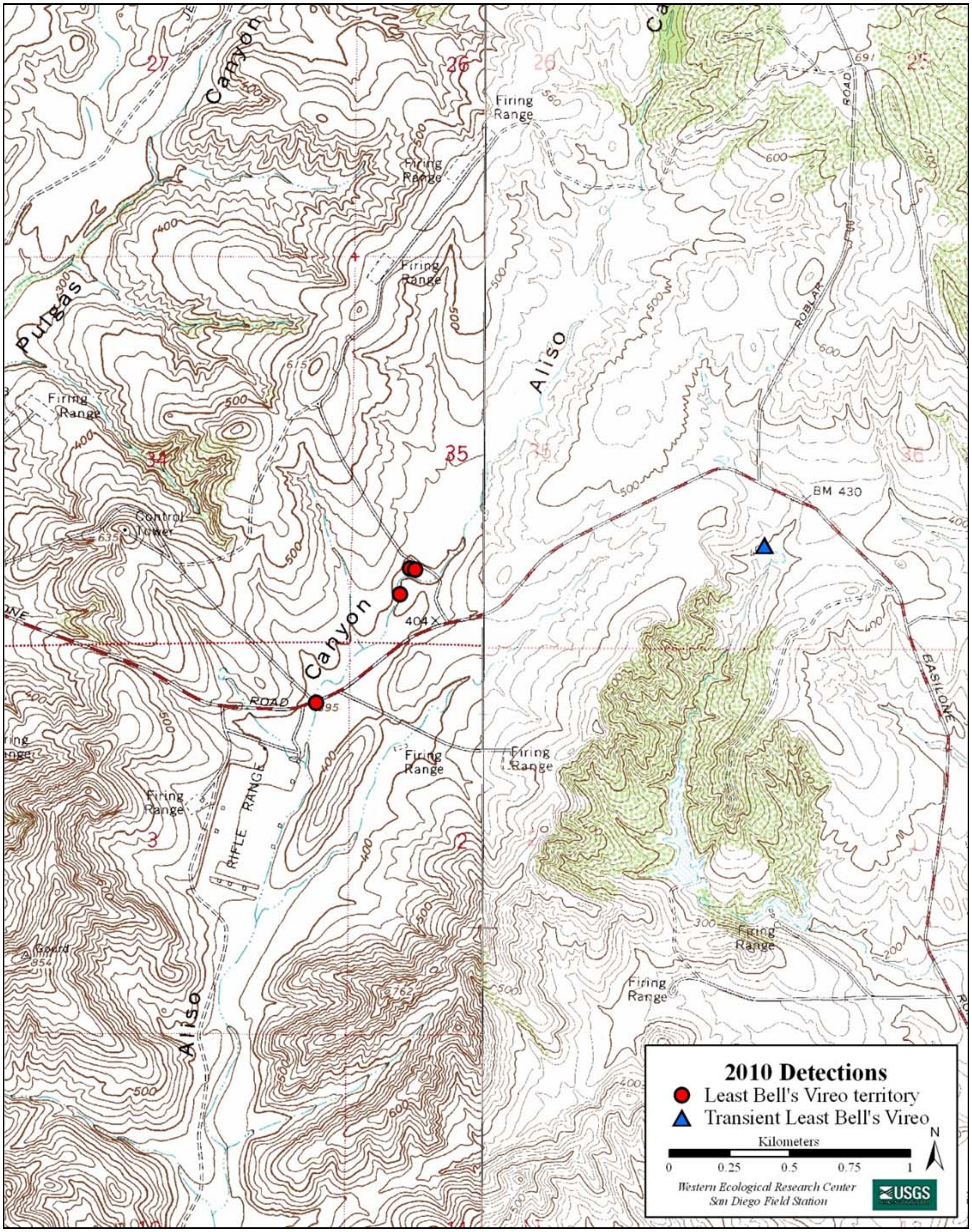

Fig. 36. Locations of Least Bell’s Vireos at Marine Corps Base Camp Pendleton, 2010: Basilone and Roblar Roads.

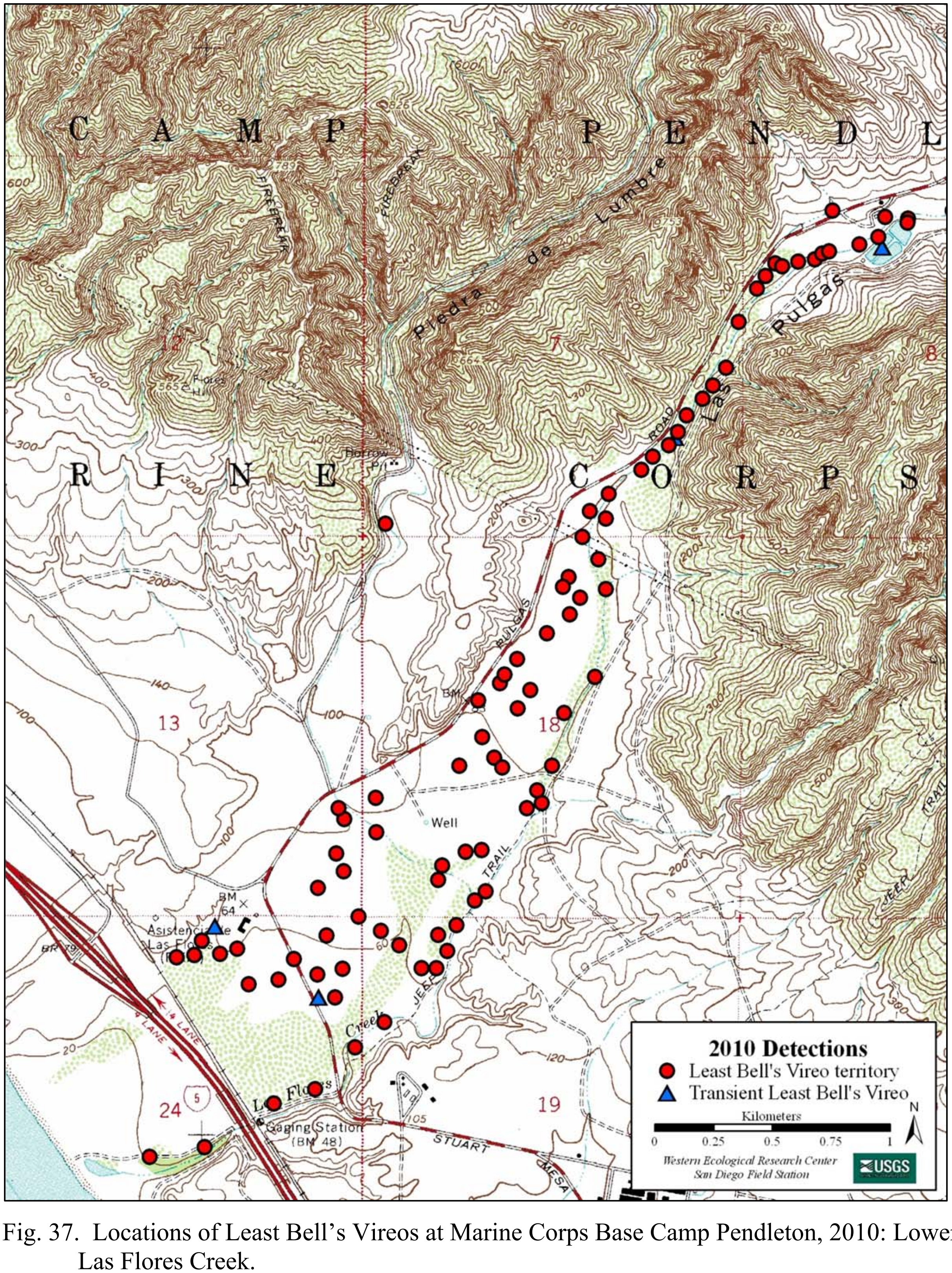

Fig. 37. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2010: Lower Las Flores Creek.

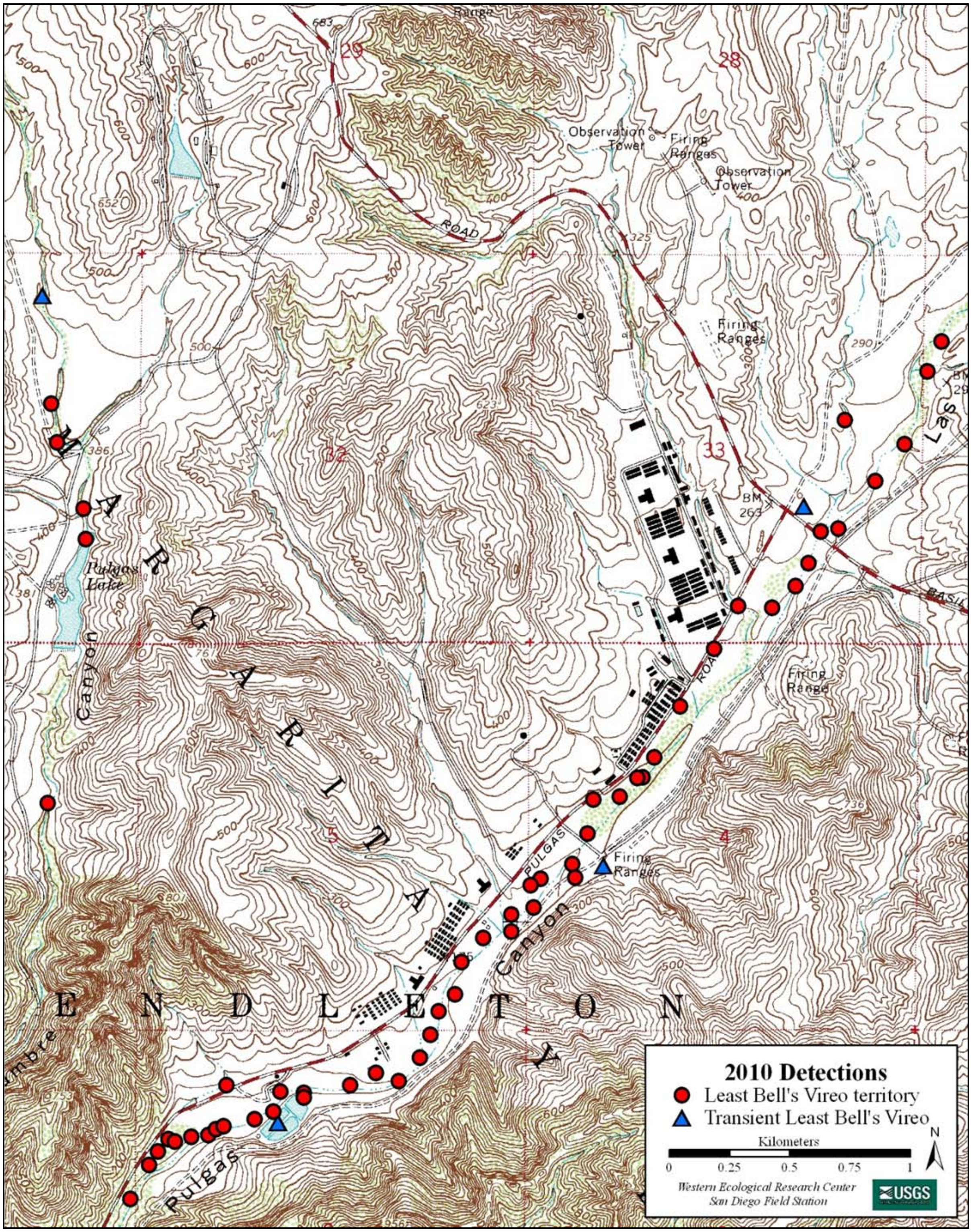

Fig. 38. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2010: Piedra de Lumbre Canyon and Upper Las Flores Creek.

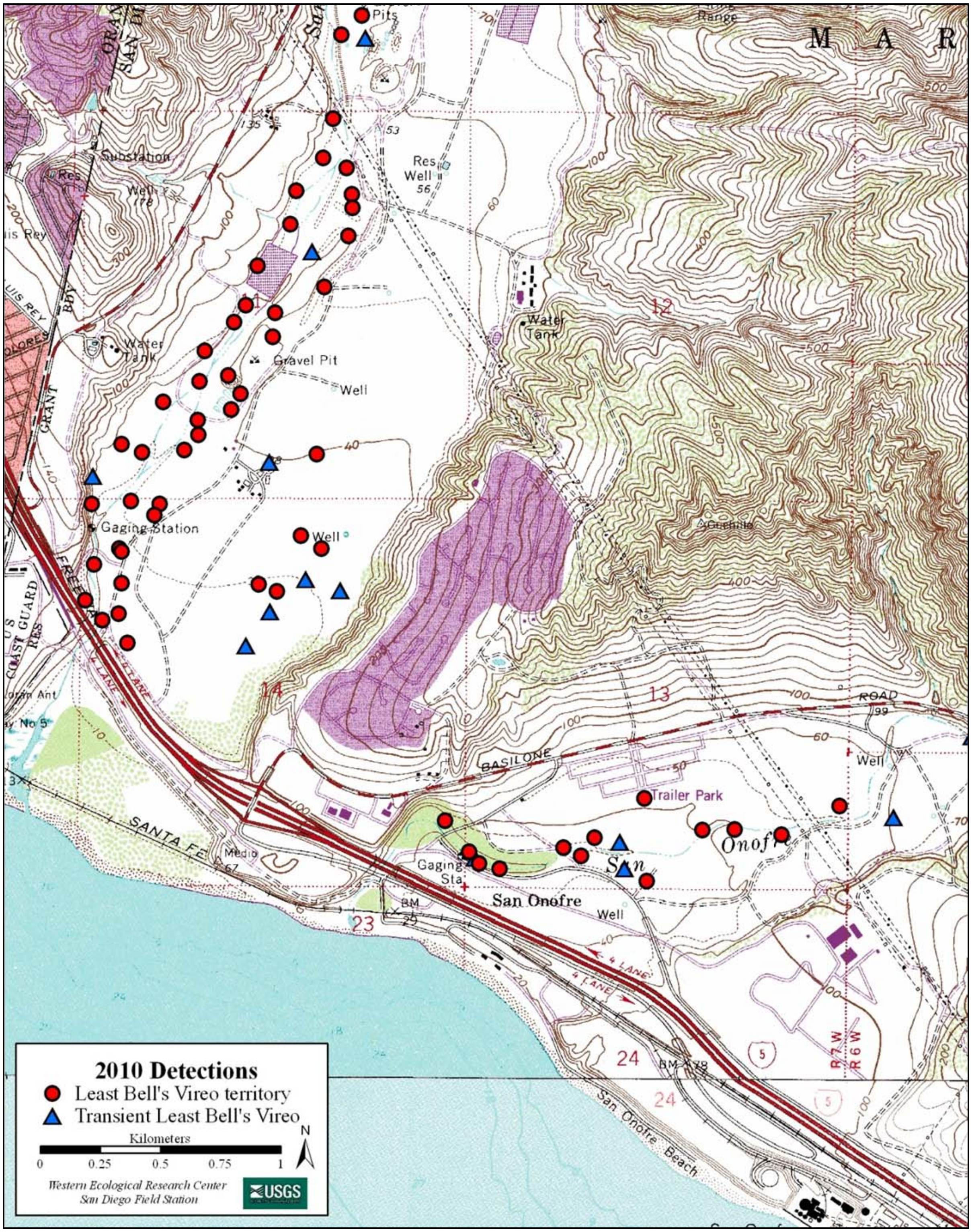

Fig. 39. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2010: Lower San Onofre Creek and Lower San Mateo Creek.

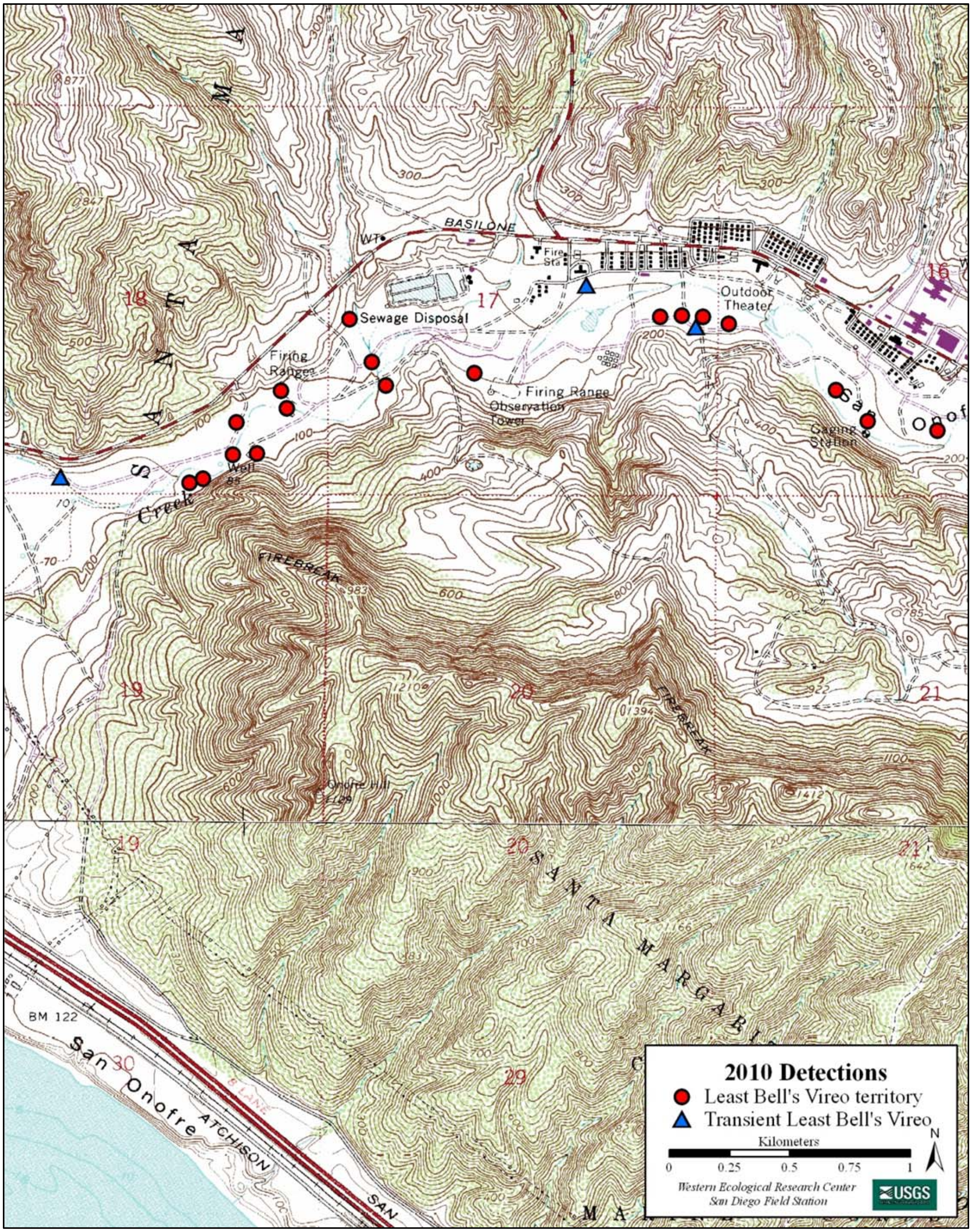

Fig. 40. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2010: San Onofre Creek.

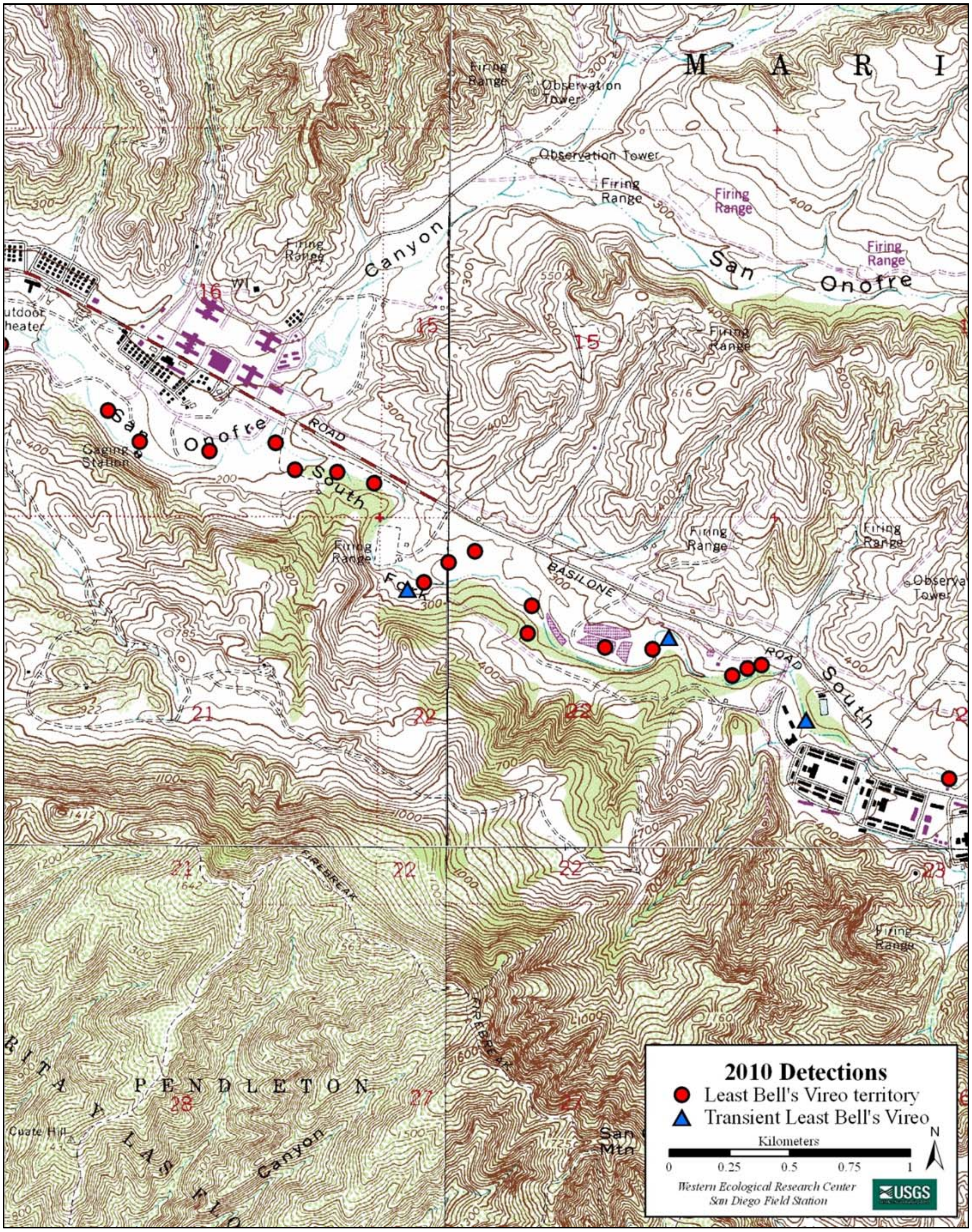

Fig. 41. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2010: South Fork San Onofre Creek.

Fig. 42. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2010: San Onofre Creek.

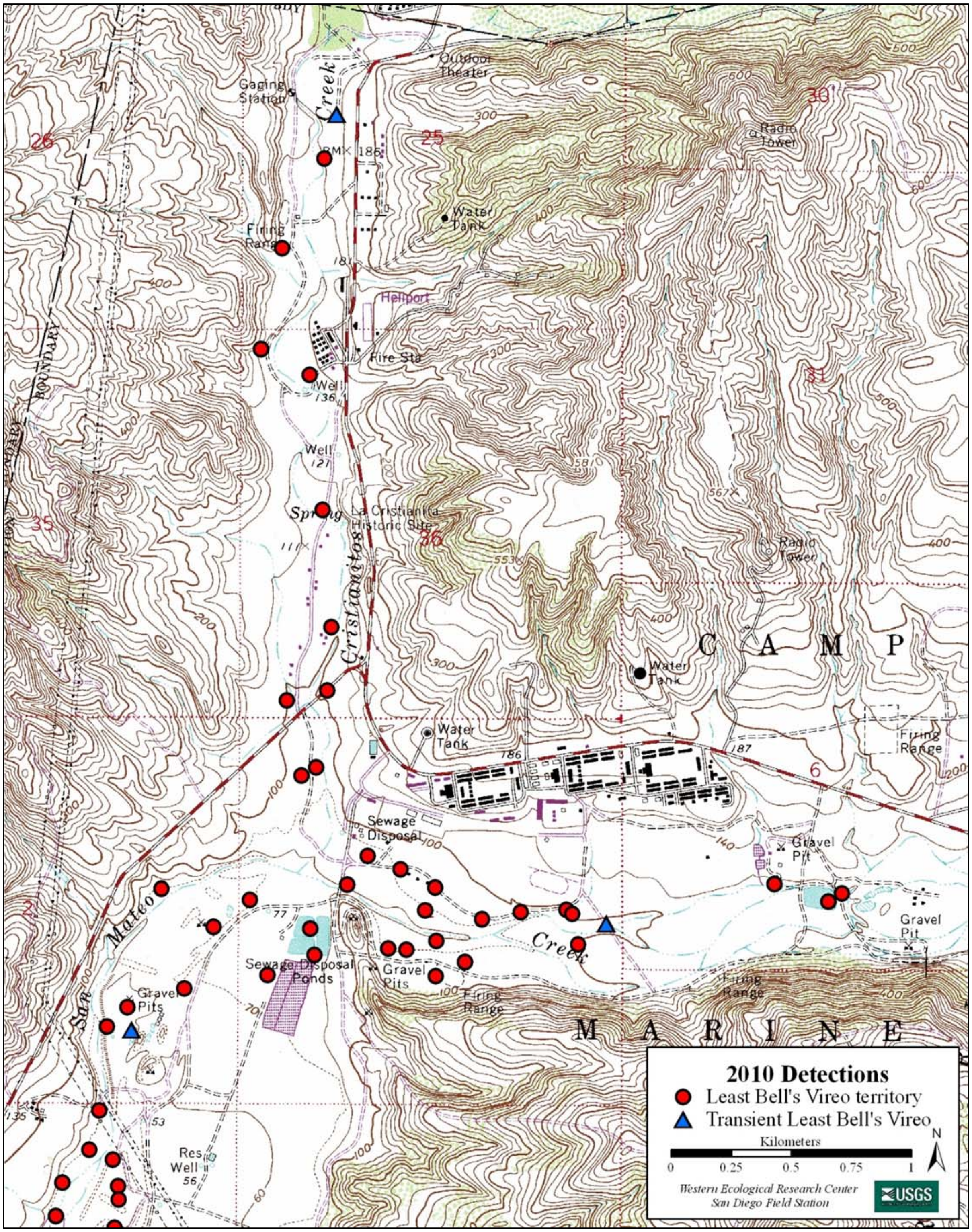

Fig. 43. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2010: San Mateo Creek and Cristianitos Creek.

Fig. 44. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2010: Upper San Mateo Creek.

APPENDIX C

BANDED LEAST BELL'S VIREOS AT MARINE CORPS BASE CAMP PENDLETON, 2010

Drainage	Band Combination[a]			
Sex	Left Leg	Right Leg	Age[b]	Comments[c]
Aliso Creek				
Male	YEPU/gogo	Mdb	3 yrs.	Banded as a nestling in 2007 on the SLR.
Male	WHPU/gogo	Mdb	3 yrs.	Banded as a nestling in 2007 on the SLR.
De Luz Creek				
Female	Mgo	PUPU/gogo	≥ 2 yrs.	Banded as an adult in 2009 on DL.
Female	ORDG/sisi	Mgo	≥ 2 yrs.	Banded as an adult in 2009 on DL.
Female		Mgo	≥ 2 yrs.	Banded as an adult at DL MAPS in 2009
Female	PUWH/Mgo	DPDP	2 yrs.	Banded as a nestling in 2008 on the SMR.
Female	Mgo	DGOR/sisi	≥ 1 yrs.	Banded as an adult at DL MAPS in 2010.
Female	WHWH	DGOR/Mgo	≥ 1 yrs.	Banded as an adult at DL MAPS in 2010.
Female	DPDP	PUPU/Mgo	≥ 1 yrs.	Banded as an adult at DL MAPS in 2010.
Female	Mgo		≥ 1 yrs.	Banded as a nestling in or before 2009 on MCBCP.
Female	DGOR/sisi	Mgo	1 yrs.	Banded as a juvenile in 2009 on DL.
Female	ORDG/gogo	Mgo	1 yrs.	Banded as a nestling in 2009 on the SMR.
Male	Msi	YEPU/gogo	≥ 5 yrs.	Banded as an adult in 2006 on DL.
Male	BYST/Msi	gogo	≥ 5 yrs.	Banded as an adult in 2006 on the SMR.
Male	PUWH	PUPU/Mgo	3 yrs.	Banded as a nestling in 2007 on the SMR.
Male	ORDG/Mgo		≥ 2 yrs.	Banded as an adult in 2009 on the SMR.
Male	gogo	BYST/Msi	≥ 2 yrs.	Banded as an adult in 2009 on DL.
Male	WHDP/Mgo	WHWH	≥ 2 yrs.	Banded as an adult at DL MAPS in 2010.
Male	Mgo	WHWH/gogo	2 yrs.	Banded as a nestling in 2008 on the SMR.
Male	Mgo		≥ 1 yrs.	Banded as a nestling in or before 2009 on MCBCP.
Unknown	YEPU	Mgo	≥ 1 yrs.	Banded as an adult in 2010 - DS02 territory.
Unknown	PUPU/Mgo	DPDP	HY	Banded as a juvenile at DL MAPS in 2010.
Unknown	PUOR/Mgo	WHWH	HY	Banded as a juvenile at DL MAPS in 2010.
Unknown	ORDG/Mgo	WHWH	HY	Banded as a juvenile at DL MAPS in 2010.
Unknown	PUYE/Mgo	WHWH	HY	Banded as a juvenile at DL MAPS in 2010.
Unknown	DPDP	WHDP/Mgo	HY	Banded as a juvenile at DL MAPS in 2010.
Unknown	PUWH	PUWH/Mgo	HY	Banded as a juvenile at DL MAPS in 2010.
Unknown	PUWH	BKBK/Mgo	HY	Banded as a juvenile at DL MAPS in 2010.
Unknown	PUWH	WHDP/Mgo	HY	Banded as a juvenile at DL MAPS in 2010.
Unknown	PUWH	WHPU/Mgo	HY	Banded as a juvenile at DL MAPS in 2010.
Unknown	LPBK/Mgo	DPDP	Unk	Banded as unknown age at DL MAPS in 2010.
Las Flores Creek				
Female	LPLP/gogo	Mgo	3 yrs.	Banded as a nestling in 2007 on the SMR.
Male	LPBK/Mgo	pupu	≥ 5 yrs.	Banded with unknown age in 2005 on the SMR.
Male	PUWH/pupu	Mdb	3 yrs.	Banded as a nestling in 2007 on the SLR.
Male	BKBK/Mdb	BWST	2 yrs.	Banded as a nestling in 2008 on the SLR.
Pilgrim Creek				
Male	pupu	OROR/Mgo	≥ 4 yrs.	Banded as an adult in 2007 on PC.
Male	Mgo	BKLP	≥ 2 yrs.	Banded as an adult in 2009 on PC.
San Mateo Creek				
Male	Mgo	PUOR/sisi	≥ 3 yrs.	Banded as an adult in 2008 on SMO.
Male	Mdb		≥ 1 yrs.	Banded as a nestling in or before 2009 on MCBCP.
Male	DPWH	Mdb	1 yrs.	Banded as a nestling in 2009 on the SLR.
San Onofre Creek				
Male	LPBK	DBWH/Mdb	3 yrs.	Banded as a nestling in 2007 on the SLR.
Male	ORPU	BKBK/Mgo	≥ 2 yrs.	Banded as an adult in 2009 on SOF.

Appendix C. Continued.

Drainage	Band Combination[a]			
Sex	**Left Leg**	**Right Leg**	**Age[b]**	**Comments**
Santa Margarita River				
Female	PUYE	Mgo	5 yrs.	Banded as a nestling in 2005 on the SMR.
Female	Mgo	PUWH/gogo	≥ 3 yrs.	Banded as an adult in 2008 on the SMR.
Female	Msi	WHWH/gogo	≥ 3 yrs.	Banded as an adult in 2008 on the SMR.
Female	Msi	PUYE/gogo	≥ 3 yrs.	Banded as an adult in 2008 on the SMR.
Female	PUOR/pupu	Msi	≥ 3 yrs.	Banded as an adult in 2008 on the SMR.
Female	WHDP/pupu	Mgo	3 yrs.	Banded as a nestling in 2007 on the SMR.
Female	OROR	Msi	≥ 2 yrs.	Banded as an adult in 2009 on the SMR.
Female	pupu	DGOR/Msi	≥ 2 yrs.	Banded as an adult in 2009 on the SMR.
Female	WHWH/gogo	Mgo	≥ 2 yrs.	Banded as an adult in 2009 on the SMR.
Female	YEYE/gogo	Mgo	≥ 2 yrs.	Banded as an adult in 2009 on the SMR.
Female		Mgo	≥ 2 yrs.	Banded as a nestling in or before 2008 on MCBCP.
Female		Mgo	≥ 2 yrs.	Banded as a nestling in or before 2008 on MCBCP.
Female		Mgo	≥ 2 yrs.	Banded as a nestling in or before 2008 on MCBCP.
Female		Mgo	≥ 2 yrs.	Banded as a nestling in or before 2008 on MCBCP.
Female		Mgo	≥ 2 yrs.	Banded as a nestling in or before 2008 on MCBCP.
Female	YEPU/gogo	Msi	2 yrs.	Banded as an adult in 2009 on the SMR.
Female	YEYE/Mgo	ORPU	≥ 1 yrs.	Banded as an adult in 2010 - DEU territory.
Female	ORPU	PUPU/Mgo	≥ 1 yrs.	Banded as an adult in 2010 - AE50 territory.
Female	DPDP/Mgo	DGOR	≥ 1 yrs.	Banded as an adult in 2010 - BAY territory.
Female	ORPU	DPWH/Mgo	≥ 1 yrs.	Banded as an adult in 2010 - HDX territory.
Female	DGOR	WHWH/Mgo	≥ 1 yrs.	Banded as an adult in 2010 - HE26 territory.
Female	ORPU	LPBK/Mgo	≥ 1 yrs.	Banded as an adult in 2010 - FAU territory.
Female	WHWH	WHDP/Mgo	≥ 1 yrs.	Banded as an adult at SM MAPS in 2010.
Female	WHPU/Mgo	WHWH	≥ 1 yrs.	Banded as an adult at SM MAPS in 2010.
Female	DPDP	BKBK/Mgo	≥ 1 yrs.	Banded as an adult at SM MAPS in 2010.
Female	Mgo		≥ 1 yrs.	Banded as a nestling in or before 2009 on MCBCP.
Female	Mgo		≥ 1 yrs.	Banded as a nestling in or before 2009 on MCBCP.
Female	Mgo		≥ 1 yrs.	Banded as a nestling in or before 2009 on MCBCP.
Female	ORDG	Mgo	1 yrs.	Banded as a nestling in 2009 on the SMR.
Female	BKBK	WHWH/Mgo	1 yrs.	Banded as a nestling in 2009 on the SMR.
Female	Mgo	ORDG/sisi	1 yrs.	Banded as an adult at SM MAPS in 2010.
Female	Mgo	PUYE/sisi	1 yrs.	Banded as an adult at SM MAPS in 2010.
Male	PUWH/Mgo		≥ 6 yrs.	Banded as an adult in 2005 on the SMR.
Male	PUWH/Mgo	pupu	≥ 6 yrs.	Banded as an adult in 2005 on the SMR.
Male	pupu	WHWH/Mgo	≥ 5 yrs.	Banded as an adult in 2006 on the SMR.
Male	Msi	LPBK/gogo	≥ 5 yrs.	Banded as an adult in 2006 on the SMR.
Male	pupu	BKLP/Mgo	≥ 4 yrs.	Banded as an adult in 2007 on the SMR.
Male	WHDP/Mgo	pupu	≥ 4 yrs.	Banded as an adult in 2007 on the SMR.
Male	Mdb	DPDP/sisi	4 yrs.	Banded as a nestling in 2006 on the SLR.
Male	BKLP/Mgo	pupu	4 yrs.	Banded as a nestling in 2006 on the SMR.
Male	WHDP/Mdb		4 yrs.	Banded as a nestling in 2006 on the SLR.
Male	YEPU/pupu	Mgo	≥ 3 yrs.	Banded as an adult in 2008 on the SMR.
Male	DPWH/sisi	Mgo	≥ 3 yrs.	Banded as an adult in 2008 on the SMR.
Male	LPBK/sisi	Mgo	≥ 3 yrs.	Banded as an adult in 2008 on the SMR.
Male	DPDP/Msi	gogo	≥ 3 yrs.	Banded as an adult in 2008 on the SMR.

Appendix C. Continued.

Drainage	**Band Combination**[a]			
Sex	**Left Leg**	**Right Leg**	**Age**[b]	**Comments**
Santa Margarita River continued				
Male	ORPU/gogo	Msi	≥ 3 yrs.	Banded as an adult in 2008 on the SMR.
Male	WHPU/gogo	Msi	≥ 3 yrs.	Banded as an adult in 2008 on the SMR.
Male		DGOR/Msi	≥ 3 yrs.	Banded as an adult in 2008 on the SMR.
Male	DPDP	Mgo	≥ 3 yrs.	Banded as an adult in 2007 at FNWS.
Male	Mgo	PUPU/sisi	≥ 3 yrs.	Banded as an adult in 2008 on the SMR.
Male	DPWH/gogo	Mgo	3 yrs.	Banded as a nestling in 2007 on the SMR.
Male	DGOR/gogo	Mgo	3 yrs.	Banded as a nestling in 2007 on the SMR.
Male	WHWH/sisi	Mgo	3 yrs.	Banded as a nestling in 2007 on the SMR.
Male	LPBK	Mgo	3 yrs.	Banded as a nestling in 2007 on the SMR.
Male	YEPU/gogo	Mgo	3 yrs.	Banded as a nestling in 2007 on the SMR.
Male	DGOR/Msi	pupu	≥ 2 yrs.	Banded as an adult in 2009 on the SMR.
Male	Msi	OROR	≥ 2 yrs.	Banded as an adult in 2009 on the SMR.
Male	PUWH	Mgo	≥ 2 yrs.	Banded as an adult in 2009 on the SMR.
Male	Mgo	PUYE/pupu	≥ 2 yrs.	Banded as an adult in 2009 on the SMR.
Male	YEPU/sisi	Mgo	≥ 2 yrs.	Banded as an adult in 2009 on the SMR.
Male	BYST/sisi	Mgo	≥ 2 yrs.	Banded as an adult in 2009 on the SMR.
Male	BKLP	Mgo	≥ 2 yrs.	Banded as an adult in 2009 on the SMR.
Male	Mgo	BKBK/sisi	≥ 2 yrs.	Banded as an adult in 2009 on the SMR.
Male	WHDP	Mgo	≥ 2 yrs.	Banded as an adult in 2009 on the SMR.
Male	WHWH/Mgo	WHWH	≥ 2 yrs.	Banded as an adult in 2009 on the SMR.
Male	PUYE/gogo	Mgo	≥ 2 yrs.	Banded as an adult in 2009 on the SMR.
Male	Mgo	DPWH/sisi	≥ 2 yrs.	Banded as an adult in 2009 on the SMR.
Male	Mgo	PUWH/sisi	≥ 2 yrs.	Banded as an adult in 2009 on the SMR.
Male	BKBK/sisi	Mgo	≥ 2 yrs.	Banded as an adult in 2009 on the SMR.
Male	ORPU/sisi	Mgo	≥ 2 yrs.	Banded as an adult in 2009 on the SMR.
Male	WHDP/sisi	Mgo	≥ 2 yrs.	Banded as an adult in 2009 on the SMR.
Male	WHPU/sisi	Mgo	≥ 2 yrs.	Banded as an adult in 2009 on the SMR.
Male	ORPU	WHWH/Mgo	≥ 2 yrs.	Banded as an adult in 2009 on the SMR.
Male	DGOR	DPDP/Mgo	≥ 2 yrs.	Banded as an adult in 2009 on the SMR.
Male	ORPU	DPDP/Mgo	≥ 2 yrs.	Banded as an adult in 2009 on the SMR.
Male	DGOR	PUWH/Mgo	≥ 2 yrs.	Banded as an adult in 2009 on the SMR.
Male	BYST/Mgo	ORPU	≥ 2 yrs.	Banded as an adult in 2009 on the SMR.
Male	Msi	ORDG	≥ 2 yrs.	Banded as an adult in 2009 on the SMR.
Male		Mgo	≥ 2 yrs.	Banded as a nestling in or before 2008 on MCBCP.
Male		Mgo	≥ 2 yrs.	Banded as a nestling in or before 2008 on MCBCP.
Male	BKLP/Msi	gogo	2 yrs.	Banded as an adult in 2009 on the SMR.
Male	DBDP/Mdb	DPWH	2 yrs.	Banded as a nestling in 2008 on the SLR.
Male	WHDB/Mdb	DPWH	2 yrs.	Banded as a nestling in 2008 on the SLR.
Male	Mgo	WHPU	2 yrs.	Banded as a nestling in 2008 on the SMR.
Male	Mdb	WHDB/sisi	2 yrs.	Banded as a nestling in 2008 on the SLR.
Male	DPDB/Mdb	gogo	2 yrs.	Banded as a nestling in 2008 on the SLR.
Male	WHWH/Mgo	ORPU	2 yrs.	Banded as a nestling in 2008 on the SMR.
Male	Mgo	WHPU/gogo	2 yrs.	Banded as a nestling in 2008 on the SMR.
Male	Mgo	BYST/sisi	2 yrs.	Banded as a nestling in 2008 on the SMR.
Male	Mgo	ORDG/pupu	2 yrs.	Banded as a nestling in 2008 on the SMR.

Appendix C. Continued.

Drainage	**Band Combination**[a]			
Sex	**Left Leg**	**Right Leg**	**Age**[b]	**Comments**
Santa Margarita River continued				
Male	DPWH/Mgo	DPDP	2 yrs.	Banded as a nestling in 2008 on the SMR.
Male		Mgo	2 yrs.	Banded as a nestling in 2008 on the SMR.
Male	DGOR/Mgo	DGOR	2 yrs.	Banded as a nestling in 2008 on the SMR.
Male	Mgo	WHPU/sisi	2 yrs.	Banded as a nestling in 2008 on the SMR.
Male	PUYE/Mgo	DGOR	2 yrs.	Banded as a nestling in 2008 on the SMR.
Male	WHDP/Mgo	ORPU	2 yrs.	Banded as a nestling in 2008 on the SMR.
Male	YEYE/Mgo	pupu	2 yrs.	Banded as a nestling in 2008 on the SMR.
Male		LGLG/Mgo	≥ 1 yrs.	Banded as an adult in 2007 at FNWS.
Male	ORPU	YEPU/Mgo	≥ 1 yrs.	Banded as an adult in 2010 - FAU territory.
Male	WHDP	WHWH/Mgo	≥ 1 yrs.	Banded as an adult in 2010 - DEU territory.
Male	DGOR	BYST/Mgo	≥ 1 yrs.	Banded as an adult in 2010 - CAO territory.
Male	ORPU	OROR/Mgo	≥ 1 yrs.	Banded as an adult in 2010 - TOP territory.
Male	WHPU	Mgo	≥ 1 yrs.	Banded as an adult in 2010 - AE50 territory.
Male	BKLP/Mgo	ORPU	≥ 1 yrs.	Banded as an adult in 2010 - EMB territory.
Male	ORPU	WHDP/Mgo	≥ 1 yrs.	Banded as an adult in 2010 - BAY territory.
Male	WHDP	DPWH/Mgo	≥ 1 yrs.	Banded as an adult in 2010 - HRP territory.
Male	ORDG/Mgo	DGOR	≥ 1 yrs.	Banded as an adult in 2010 - BIL territory.
Male	YEPU/Mgo	pupu	≥ 1 yrs.	Banded as an adult in 2010 - HE16 territory.
Male	BKBK/Mgo	PUWH	≥ 1 yrs.	Banded as an adult in 2010 - MIN territory.
Male	YEPU	LPBK/Mgo	≥ 1 yrs.	Banded as an adult in 2010 - DEL territory.
Male	OROR/sisi	Mgo	≥ 1 yrs.	Banded with unknown age in 2009 on the SMR.
Male	Mgo	WHDP	≥ 1 yrs.	Banded as an adult in 2010 - MER territory.
Male	DPDP	Mgo/DPDP	≥ 1 yrs.	Banded as an adult in 2010 - PIE territory.
Male	YEPU/Mgo	DPDP	≥ 1 yrs.	Banded as an adult in 2010 - TRF territory.
Male	OROR/Mgo	DPDP	≥ 1 yrs.	Banded as an adult in 2010 - ICE territory.
Male	DPDP	BYST/Mgo	≥ 1 yrs.	Banded as an adult in 2010 - FLN territory.
Male	WHWH/Mgo	DPDP	≥ 1 yrs.	Banded as an adult in 2010 - BRW territory.
Male	DPDP	ORPU/Mgo	≥ 1 yrs.	Banded as an adult in 2010 - SRB territory.
Male	DPDP	YEYE/Mgo	≥ 1 yrs.	Banded as an adult in 2010 - CKI territory.
Male	DPDP/	DPWH/Mgo	≥ 1 yrs.	Banded as an adult in 2010 - BRI territory.
Male	Mgo	OROR/sisi	1 yrs.	Banded as a nestling in 2009 on the SMR.
Male	pupu	DPWH/Mgo	1 yrs.	Banded as a nestling in 2009 on the SMR.
Male	ORPU	PUWH/Mgo	1 yrs.	Banded as a nestling in 2009 on the SMR.
Male	YEPU	DPDP/Mgo	1 yrs.	Banded as a nestling in 2009 on the SMR.
Male	DGOR	DGOR/Mgo	1 yrs.	Banded as a nestling in 2009 on the SMR.
Male	DGOR	DPWH/Mgo	1 yrs.	Banded as a nestling in 2009 on the SMR.
Male	YEPU	PUWH/Mgo	1 yrs.	Banded as a nestling in 2009 on the SMR.
Male	DPWH	DPDP/Mdb	1 yrs.	Banded as a nestling in 2009 on the SLR.
Unknown	WHWH	WHPU/Mgo	≥ 2 yrs.	Banded as an adult at SM MAPS in 2010.
Unknown	DPDP/gogo	Mgo	2 yrs.	Banded as an adult in 2009 on the SMR.
Unknown	Mgo	-	2 yrs.	Banded as a nestling in 2008 on the SMR, found dead in 2010.
Unknown	PUYE/sisi	Mgo	≥ 1 yrs.	Banded as an adult at SM MAPS in 2010.
Unknown	DPDP	WHPU/Mgo	≥ 1 yrs.	Banded as an adult at SM MAPS in 2010.
Unknown	PUWH	LPBK/Mgo	≥ 1 yrs.	Banded as an adult at SM MAPS in 2010.

Appendix C. Continued.

Drainage	**Band Combination**[a]			
Sex	**Left Leg**	**Right Leg**	**Age**[b]	**Comments**
Santa Margarita River continued				
Unknown	PUOR	Msi	1 yrs.	Banded as a nestling in 2009 on the SMR.
Unknown	WHWH	BKLP/Mgo	1 yrs.	Banded as an adult at SM MAPS in 2010.
Unknown	WHWH	PUOR/Mgo	HY	Banded as a juvenile at SM MAPS in 2010.
Unknown	WHWH	ORDG/Mgo	HY	Banded as a juvenile at SM MAPS in 2010.
Unknown	WHWH	PUYE/Mgo	HY	Banded as a juvenile at SM MAPS in 2010.
Unknown	DGOR/Mgo	WHWH	HY	Banded as a juvenile at SM MAPS in 2010.
Unknown	DPDP	LPBK/Mgo	HY	Banded as a nestling in 2010 - COB territory.
Unknown	BKLP/Mgo	WHWH	HY	Banded as a juvenile at SM MAPS in 2010.
Unknown	DPDP	PUWH/Mgo	HY	Banded as a juvenile at SM MAPS in 2010.
Unknown	DPDP	DGOR/Mgo	HY	Banded as a juvenile at SM MAPS in 2010.
Unknown	DPDP	BKLP/Mgo	HY	Banded as a juvenile at SM MAPS in 2010.
Unknown	PUWH	DGOR/Mgo	HY	Banded as a juvenile at SM MAPS in 2010.
Unknown	Mgo		HY	Banded as a nestling in 2010 - SRB territory.
Unknown	Mgo		HY	Banded as a juvenile in 2010 - PIE territory.

[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; DBDP = plastic dark blue-dark pink split; DBWH = plastic dark blue-white split; DGOR = plastic dark green-orange split; DPDB = plastic dark pink-dark blue 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] SLR = San Luis Rey River, MCBCP = Marine Corps Base Camp Pendleton, DL = De Luz Creek, SMR = Santa Margarita River, FNWS = Fallbrook Naval Weapons Station, SDR = San Diego River, SMO = San Mateo Creek, SOF = San Onofre Creek.

APPENDIX D

BETWEEN-YEAR MOVEMENT OF ADULT LEAST BELL'S VIREOS AT MARINE CORPS BASE CAMP PENDLETON, 2010

Year Last Detected	Drainage[a] / Territory / Treatment		Distance Moved (km)	Band Combination[b]		Age in 2010	Sex[c]
	Last Seen	2010		Left Leg	Right Leg		
2009	SMR / HLD / REF	SMR / HLD / REF	0.0	PUWH/Mgo	pupu	≥ 6 yr.	M
2009	LF / LL45	LF / LL25	0.6	LPBK/Mgo	pupu	≥ 5 yr.	M
2009	SMR / SG09	SMR / SG02	0.0	pupu	WHWH/Mgo	≥ 5 yr.	M
2009	SMR / ANA / REM	SMR / AE67 / REM	0.0	pupu	BKLP/Mgo	≥ 4 yr.	M
2009	SMR / BOW / REF	SMR / BOW / REF	0.0	WHDP/Mgo	pupu	≥ 4 yr.	M
2009	PL / PN03	PL / PN01	0.0	pupu	OROR/Mgo	≥ 4 yr.	M
2009	SMR / IND / REM	SMR / ES01 / REM	0.0	Mdb	DPDP/sisi	4 yr.	M
2009	SMR / UM01	SMR / AH109	0.1	BKLP/Mgo	pupu	4 yr.	M
2009	SMR / HW07 / REF	SMR / HW01 / REF	0.0	WHDP/Mdb		4 yr.	M
2009	SMR / AER / REM	SMR / AE45 / REM	0.0	YEPU/pupu	Mgo	≥ 3 yr.	M
2009	SMR / RR15	SMR / RR23	0.1	DPWH/sisi	Mgo	≥ 3 yr.	M
2009	SMO / MT04	SMO / MT05	0.0	Mgo	PUOR/sisi	≥ 3 yr.	M
2009	SMR / AST / REM	SMR / AE37 / REM	0.0	DPDP/Msi	gogo	≥ 3 yr.	M
2009	SMR / HW32	SMR / HW27 / REF	0.1	ORPU/gogo	Msi	≥ 3 yr.	M
2009	SMR / AE04	SMR / AE06	0.0	WHPU/gogo	Msi	≥ 3 yr.	M
2009	SMR / FIN / REF	SMR / FIN / REF	0.0		DGOR/Msi	≥ 3 yr.	M
2009	SMR / ABB / REM	SMR / AE39 / REM	0.0	Mgo	PUPU/sisi	≥ 3 yr.	M
2009	SOF / OW09	SOF / OW08	0.2	LPBK	DBWH/Mdb	3 yr.	M
2009	SMR / QIN / REF	SMR / PEP / REF	0.1	DPWH/gogo	Mgo	3 yr.	M
2009	SMR / YB16	SMR / YB16	0.1	DGOR/gogo	Mgo	3 yr.	M
2009	AL / AL02	AL / AL04	0.0	YEPU/gogo	Mdb	3 yr.	M
2009	LF / LL12	LF / LL09	0.0	PUWH/pupu	Mdb	3 yr.	M
2009	SMR / HE12 / REF	SMR / HE05 / REF	0.1	WHWH/sisi	Mgo	3 yr.	M
2009	SMR / AE14	SMR / AE25	0.0	LPBK	Mgo	3 yr.	M
2009	DL / DS08	DL / DS06	0.0	PUWH	PUPU/Mgo	3 yr.	M
2009	SMR / ES60 / REM	SMR / ES25 / REM	0.0	YEPU/gogo	Mgo	3 yr.	M
2009	SMR / YB03	SMR / YB22	0.1	DGOR/Msi	pupu	≥ 2 yr.	M
2009	SMR / LAP / REM	SMR / ES41 / REM	0.0	Msi	OROR	≥ 2 yr.	M
2009	SMR / AE34	SMR / AE10	0.3	PUWH	Mgo	≥ 2 yr.	M
2009	DL / DS13	DL / DS03	0.1	ORDG/Mgo		≥ 2 yr.	M
2009	SMR / HDX / REF	SMR / HDX / REF	0.0	Mgo	PUYE/pupu	≥ 2 yr.	M
2009	SMR / ES35 / REM	SMR / ES18 / REM	0.0	YEPU/sisi	Mgo	≥ 2 yr.	M
2009	SMR / ALP / REM	SMR / AE54 / REM	0.0	BYST/sisi	Mgo	≥ 2 yr.	M
2009	SMR / ARI / REF	SMR / ARI / REF	0.0	BKLP	Mgo	≥ 2 yr.	M
2009	SMR / LIF / REF	SMR / LIF / REF	0.0	Mgo	BKBK/sisi	≥ 2 yr.	M
2009	SMR / CED / REF	SMR / JSP / REF	0.2	WHDP	Mgo	≥ 2 yr.	M
2009	SMR / HW27	SMR / QIN / REF	1.6	WHWH/Mgo	WHWH	≥ 2 yr.	M
2009	SMR / PO15	SMR / PO09	0.0	PUYE/gogo	Mgo	≥ 2 yr.	M
2009	SMR / PO18	SMR / PO18	0.0	Mgo	DPWH/sisi	≥ 2 yr.	M
2009	SMR / PO02	SMR / PO02	0.1	Mgo	PUWH/sisi	≥ 2 yr.	M
2009	SMR / ALC / REM	SMR / AE58 / REM	0.0	BKBK/sisi	Mgo	≥ 2 yr.	M
2009	SMR / YB03	SMR / YB04	0.0	ORPU/sisi	Mgo	≥ 2 yr.	M
2009	SMR / ZPR / REF	SMR / ZPR / REF	0.0	WHDP/sisi	Mgo	≥ 2 yr.	M
2009	SMR / HE39	SMR / HE33	0.0	WHPU/sisi	Mgo	≥ 2 yr.	M

Appendix D. Continued.

Year Last Detected	Drainage[a] / Territory / Treatment		Distance Moved (km)	Band Combination[b]		Age in 2010	Sex[c]
	Last Seen	2010		Left Leg	Right Leg		
2009	SMR / PR43	SMR / PR22	0.1	ORPU	WHWH/Mgo	≥ 2 yr.	M
2009	SMR / PR43	SMR / PR30	0.1	DGOR	DPDP/Mgo	≥ 2 yr.	M
2009	SOF / OE22	SOF / OE05	1.0	ORPU	BKBK/Mgo	≥ 2 yr.	M
2009	SMR / SE02	SMR / SE12	0.0	ORPU	DPDP/Mgo	≥ 2 yr.	M
2009	SMR / BS02	SMR / BS09	0.0	DGOR	PUWH/Mgo	≥ 2 yr.	M
2009	SMR / DAT / REF	SMR / DAT / REF	0.1	BYST/Mgo	ORPU	≥ 2 yr.	M
2009	PL / PS19	PL / PS04	0.0	Mgo	BKLP	≥ 2 yr.	M
2009	SMR / SMMAPS	SMR / ES10	0.3	Msi	ORDG	≥ 2 yr.	M
2009	DL / DLMAPS	DL / DS11	0.1	gogo	BYST/Msi	≥ 2 yr.	M
2009	SMR / BN37	SMR / CRM	0.2	BKLP/Msi	gogo	2 yr.	M
2009	SMR / DAQ / REF	SMR / DAQ / REF	0.0	WHDB/Mdb	DPWH	2 yr.	M
2009	SMR / PO03	SMR / PO08	0.1	Mgo	WHPU	2 yr.	M
2009	SMR / HW51 / REF	SMR / HW19 / REF	0.1	Mdb	WHDB/sisi	2 yr.	M
2009	SMR / SG17	SMR / SG25	0.1	Mgo	WHPU/gogo	2 yr.	M
2009	SMR / BN21	SMR / ES62	0.4	Mgo	BYST/sisi	2 yr.	M
2009	SMR / AE33	SMR / AE27	0.0	Mgo	ORDG/pupu	2 yr.	M
2009	SMR / SG25	SMR / SG08	0.3	DPWH/Mgo	DPDP	2 yr.	M
2009	SMR / RR50	SMR / RR04	0.0	DGOR/Mgo	DGOR	2 yr.	M
2009	SMR / BN32	SMR / ES63	0.3	Mgo	WHPU/sisi	2 yr.	M
2009	SMR / AW24	SMR / AW05	0.1	YEYE/Mgo	pupu	2 yr.	M
2009	SMR / PO02	SMR / PO01	0.2	OROR/sisi	Mgo	≥ 1 yr.	M
2009	SMR / LIF / REF	SMR / ZPR / REF	0.3	PUYE	Mgo	5 yr.	F
2009	SMR / HE02 / REF	SMR / HE29 / REF	0.0	Msi	PUYE/gogo	≥ 3 yr.	F
2009	SMR / SMMAPS	SMR / ES62	0.0	PUOR/pupu	Msi	≥ 3 yr.	F
2009	LF / LN01	LF / LN03	1.0	LPLP/gogo	Mgo	3 yr.	F
2009	SMR / HE12 / REF	SMR / HE05 / REF	0.1	WHDP/pupu	Mgo	3 yr.	F
2009	SMR / ODN / REF	SMR / ODN / REF	0.0	OROR	Msi	≥ 2 yr.	F
2009	SMR / HDX / REF	SMR / MER / REF	0.1	pupu	DGOR/Msi	≥ 2 yr.	F
2009	SMR / ES23	SMR / SMMAPS	0.2	YEYE/gogo	Mgo	≥ 2 yr.	F
2009	DL / DLMAPS	DL / DLMAPS	0.0	Mgo	PUPU/gogo	≥ 2 yr.	F
2009	DL / DLMAPS	DL / DLMAPS	0.1		Mgo	≥ 2 yr.	F
2009	SMR / SMMAPS	SMR / SMMAPS	0.1	YEPU/gogo	Msi	2 yr.	F
2009	SMR / SMMAPS	SMR / SMMAPS	0.2	WHWH/gogo	Mgo	≥ 1 yr.	F
2009	DL / DLMAPS	DL / DN08	0.7	ORDG/sisi	Mgo	≥ 1 yr.	F
2009	SMR / SMMAPS	SMR / SMMAPS	0.1	DPDP/gogo	Mgo	2 yr.	U
2008	DL / DS16	DL / DS10	0.1	Msi	YEPU/gogo	≥ 5 yr.	M
2008	SMR / DEU / REF	SMR / HW24	2.1	LPBK/sisi	Mgo	≥ 3 yr.	M
2008	SMR / UM56	SMR / UM35	0.0	DPDP	Mgo	≥ 3 yr.	M
2008	SLR / CACA	SMR / SE22	7.4	DBDP/Mdb	DPWH	2 yr.	M
2008	SLR / CQTI	LF / UL14	14.9	BKBK/Mdb	BWST	2 yr.	M
2008	SLR / CBUC	SMR / HE20	9.9	DPDB/Mdb	gogo	2 yr.	M
2008	SMR / ZPR / REF	SMR / HE49 / REF	0.6	WHWH/Mgo	ORPU	2 yr.	M

Appendix D. Continued.

Year Last Detected	Drainage[a] / Territory / Treatment: Last Seen	Drainage[a] / Territory / Treatment: 2010	Distance Moved (km)	Band Combination[b]: Left Leg	Band Combination[b]: Right Leg	Age in 2010	Sex[c]
2008	SMR / VEG / REM	SMR / HE54 / REF	5.7		Mgo	2 yr.	M
2008	SMR / ALI / REM	SMR / ES43 / REM	1.4	PUYE/Mgo	DGOR	2 yr.	M
2008	SGR	DL / DS12	103.6	Mgo	WHWH/gogo	2 yr.	M
2008	SMR / AER / REM	SMR / ES59	1.9	WHDP/Mgo	ORPU	2 yr.	M
2008	SMR / OCM / REF	SMR / HLD / REF	0.6	Mgo	PUWH/gogo	≥ 3 yr.	F
2008	SMR / SMMAPS	SMR / FIN / REF	7.0	Msi	WHWH/gogo	≥ 3 yr.	F
2008	SMR / AH04 / REF	DL / DLMAPS	2.2	PUWH/Mgo	DPDP	2 yr.	F
2007	SMR	SMR / UM36	1.6		LGLG/Mgo	≥ 4 yr.	M
2007	SLR / WMON	AL / AL01	9.8	WHPU/gogo	Mdb	3 yr.	M
2007	SMR / CED / REF	SLR / LLT	13.3	YEPU	PUPU/Mgo	3 yr.	F
2006	SMR / SMMAPS	SMR / BN28	0.1	Msi	LPBK/gogo	≥ 5 yr.	M
2006	SMR / SMMAPS	DL / DS23	13.0	BYST/Msi	gogo	≥ 5 yr.	M
2006	SMR / HLD / REF	TB	40.0	Mgo	ORDG	4 yr.	M
2005	SMR / PR24	SMR / OOR	0.3	PUWH/Mgo		≥ 6 yr.	M
≤ 2009	SLR	SMO / MT16	28.9[d]	Mdb		≥ 1 yr.	M
Unknown	SMR	BC	123.5[e]	Mgo	?/pupu[f]	≥ 1 yr.	F

[a] Drainage Codes: AL = Aliso Creek; BC = Ballona Creek; DL = De Luz Creek; LF = Las Flores Creek; PL = Pilgrim Creek; SGR = San Gabriel River; SLR = San Luis Rey River; SMO = San Mateo Creek; SMR = Santa Margarita River; SOF = San Onofre Creek; TB = Trabuco 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; DBDP = plastic dark blue-dark pink split; DBWH = plastic dark blue-white split; DGOR = plastic dark green-orange split; DPDB = plastic dark pink-dark blue 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.

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

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

[e] Distance derived from the nearest of the two potential original banding locations on the Santa Margarita River.

[f] Upper right band not seen.

APPENDIX E

STATUS AND NESTING ACTIVITIES OF LEAST BELL'S VIREOS AT MARINE CORPS BASE CAMP PENDLETON, 2010

Reference Site Territories					
Territory	Nest	Monitoring[a]	Nest Fate[b]	# Fledged	Comments
APO	1	F	SUC	4	
APO	2	F	SUC	4	
ARI	1	F	SUC	3	
ARI	2	F	PRE	0	
AXE	1	F	INC	0	Nest not completed.
AXE	2	F	INC	0	Nest not completed.
AXE	3	F	INC	0	Nest not completed.
AXE	4	F	PRE	0	
AXE	5	F	UNK	0	Nest abandoned between nest-building and egg-laying, cause of failure unknown.
BER	1	P	PRE	0	
BER	2	P	PRE	0	
BIL	1	F	INC	0	Nest not completed.
BIL	2	F	INC	0	Nest not completed.
BIL	3	F	PRE	0	
BIL	5	F	INC	0	
BIL	6	F	PRE	0	
BOW	1	F	PRE	0	
BOW	2	F	PRE	0	
BOW	3	F	SUC	4	
CED	1	F	UNK	0	Nest abandoned between nest-building and egg-laying, cause of failure unknown.
CED	2	F	PRE	0	
CED	3	F	PRE	0	
DAQ	1	P	PRE	0	
DAT	1	F	UNK	0	Support branch broke.
DAT	2	F	PRE	0	
DAT	3	F	PRE	0	
DAT	4	F	UNK	0	Nest abandoned between nest-building and egg-laying, cause of failure unknown.
DAT	5	F	OTH	0	Egg had a hole pecked in it by a bird.
DAT	6	F	SUC	4	
DEL	1	F	PRE	0	
DEL	2	F	SUC	4	
DEU	1	F	SUC	4	
DEU	2	F	SUC	3	
DRK	1	P	PRE	0	
DRK	2	P	PRE	0	
FAU	1	F	PRE	0	
FAU	2	F	PRE	0	
FAU	3	F	SUC	2	
FIN	1	F	FAL	0	
FIN	2	F	PRE	0	
FIN	3	F	FAL	0	
FIN	4	F	PRE	0	
FIN	5	F	PRE	0	

Territory	Nest	Monitoring[a]	Nest Fate[b]	# Fledged	Comments
Reference Site Territories (*continued*)					
HDX	1	F	UNK	0	Nest abandoned between nest-building and egg-laying, cause of failure unknown.
HDX	2	F	PRE	0	
HDX	3	F	INC	0	Nest not completed.
HDX	4	F	SUC	2	
HLD	1	F	INC	0	Nest not completed.
HLD	2	F	SUC	4	
HRP	1	F	PRE	0	
HRP	2	F	INC	0	Nest not completed.
HRP	3	F	INC	0	Nest not completed.
HRP	4	F	INC	0	Nest not completed.
HRP	5	F	PRE	0	
JSP	1	F	SUC	4	
MER	1	F	SUC	3	
ODN	1	F	INC	0	Nest not completed.
ODN	2	F	PRE	0	
ODN	3	F	INC	0	Nest not completed.
ODN	4	F	PRE	0	
ODN	5	F	UNK	0	Nest abandoned between nest-building and egg-laying, cause of failure unknown.
PEP	1	F	PRE	0	
PEP	2	F	UNK	0	Nest abandoned between nest-building and egg-laying, cause of failure unknown.
PEP	3	F	UNK	0	Nest abandoned between nest-building and egg-laying, cause of failure unknown.
PEP	4	F	SUC	4	
QIN	1	F	PRE	0	
QIN	2	F	PRE	0	
QIN	3	F	PRE	0	
QIN	4	F	PRE	0	Ravens observed depredating nest.
WSP	1	F	PRE	0	
ZPR	1	F	PRE	0	
ZPR	2	F	PRE	0	
ZPR	3	F	SUC	4	

Territory	Nest	Monitoring[a]	Nest Fate[b]	# Fledged	Comments
Giant Reed (*Arundo donax*) Removal Site Territories					
ANR	1	P	FAL	0	
ANR	2	P	UNK	0	Nest abandoned between nest-building and egg-laying, cause of failure unknown.
ASP	1	F	PRE	0	
BAY	1	F	INC	0	Nest not completed.
BAY	2	F	SUC	2	
BLN	1	F	SUC	4	
BRI	1	F	PRE	0	
BRW	1	F	SUC	2	
BRW	2	F	PRE	0	
BRW	3	F	SUC	4	

Giant Reed (*Arundo donax*) Removal Territories (*continued*)					
Territory	**Nest**	**Monitoring[a]**	**Nest Fate[b]**	**# Fledged**	**Comments**
CAO	1	F	PRE	0	
CAO	2	F	SUC	3	
CAR	1	F	SUC	4	
CKE	1	F	SUC	3	
CKI	1	F	SUC	1	
COB	1	F	SUC	2	
COB	2	F	UNK	0	One nestling missing and two dead nestlings in nest, cause of failure unknown.
CRM	1	F	SUC	4	
CRM	2	F	SUC	2	
ECH	1	F	SUC	4	
ECH	2	F	SUC	3	
EMB	1	F	UNK	0	Nest abandoned between nest-building and egg-laying, cause of failure unknown.
EMB	2	F	PRE	0	
EMB	3	F	SUC	4	
FLN	1	F	OTH	0	Nest abandoned with eggs. Surrounding vegetation sprayed with herbicide and withered. Eggs contained mostly formed embryos.
FLN	2	F	PRE	0	
HLX	1	F	PRE	0	
ICE	1	F	SUC	3	
MIN	1	F	PRE	0	
MIN	2	F	PRE	0	
NEO	1	F	SUC	4	
NEO	2	F	SUC	2	
OOR	1	F	SUC	3	
OOR	2	F	PRE	0	
OOR	3	F	SUC	4	
PIE	1	F	PRE	0	
PIE	2	F	SUC	2	
SAB	1	F	SUC	3	
SAB	2	F	SUC	3	
SRB	1	F	SUC	3	Host plant and surroundings sprayed with herbicide, support branch withered, nest tilted.
TOF	1	F	SUC	3	
TOF	2	F	PRE	0	
TOP	1	F	PRE	0	
TOP	2	F	SUC	4	
TRF	1	F	PRE	0	
TRF	2	F	OTH	0	Nest abandoned. Nest host sprayed with herbicide and withered.
TRF	3	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.

APPENDIX F

SUMMARY OF COMMUNICATIONS REGARDING HERBICIDE APPLICATION NEAR LEAST BELL'S VIREO NESTS, MARINE CORPS BASE CAMP PENDLETON, 2010

May 26, 2010

Sherri Sullivan
AC/S Environmental Security
Building 22165
Box 555008
Camp Pendleton, CA 92055-5008

Re: Herbicide Spraying near Endangered Species

This letter is to inform that *Arundo donax* was sprayed with herbicide in close proximity to two active Least Bell's vireo nests. A map with coordinates of known nests was given to the bio-monitor (David King, amec) on the morning of 3 May 2010, at approximately 0630. On 8 May 2010, the two nests were checked by Scarlett Howell during nest monitoring activities. The following conditions were noted:

Tammi Nest 1, located at 33.2688, -117.37461, had *Arundo donax* sprayed with herbicide within one meter of the nest. The herbicide had also been sprayed on native vegetation (poison oak) that was surrounding the *Arundo donax* sprig. Update 24 May 2010 – all vegetation surrounding the nest is dying, including vegetation behind the nest, therefore, it is likely that the nest itself received overspray. Nest is directly under the pink flag in the photo.

Flan Nest 1, located at 33.26788, -117.37619, in a red/arroyo willow tree surrounded by *Arundo donax.* All stands of *Arundo donax* surrounding the nest were sprayed with herbicide. The nest flag was hung approximately five meters from the nest in *Arundo donax*, and the nest flag was also coated with blue herbicide. Update 24 May 2010 – the nest did not hatch after 20 days of incubation and the pair abandoned the nest with two vireo eggs. Both eggs in the nest were black indicating that the embryo had died at some stage during incubation. Thistle located directly under the nest is dying, suggesting that it was sprayed. Willow leaves are turning yellow and falling off, suggesting that they were sprayed. A*rundo donax* and poison hemlock less than one meter from nest was sprayed and is dying. Nest is directly under the pink flag in the photo.

Two additional nests have been affected since the initial report:

Sorbet Nest 1, located at 33.26576, -117.37675, in a young black willow tree surrounded by *Arundo donax.* This nest was located after spraying occurred, but nest chronology indicates the nest was in the laying stage during spraying. On 24 May 2010, the leaves on the willow tree are shriveling up and dying, suggesting that it was sprayed with herbicide. All *Arundo donax* and poison hemlock less than one meter from nest was sprayed and is dying. One support branch has withered leaving the nest tilted on its side with four vireo nestlings.

Teigh Nest 2, located at 33.26931, -117.37582, in a poison hemlock plant surrounded by *Arundo donax.* This nest was built after the vegetation was sprayed. On 24 May 2010, the poison hemlock plant had begun to wither and support branch died, causing the nest containing three vireo eggs to tilt on its side. The pair abandoned the nest.

Thank You,

Scarlett Howell

Biologist, U.S. Geological Survey

APPENDIX G

PHOTOS DOCUMENTING IMPACTS TO LEAST BELL'S VIREO HABITAT, MARINE CORPS BASE CAMP PENDLETON, 2010

Fig. 45. Pre- and post-brush-clearing at two locations in Least Bell's Vireo habitat northwest of the Santa Margarita River between Stagecoach and Stuart Mesa Roads, Marine Corps Base Camp Pendleton, 8-9 April 2010. .

Fig. 46. Off-road impacts to Least Bell's Vireo habitat noticed after military training exercises, northwest of the Santa Margarita River between Stagecoach and Stuart Mesa Roads, Marine Corps Base Camp Pendleton, 24-29 June, 2010. .