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

2011 Annual Data Summary

Prepared for:

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

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

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By Suellen Lynn and Barbara E. Kus

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EXECUTIVE SUMMARY

Surveys for the endangered Least Bell's Vireo (*Vireo bellii pusillus*) were conducted at Marine Corps Base Camp Pendleton (MCBCP or Base), California, between 24 June and 11 August 2011. Surveys in 2011 began later than usual (late June vs. late March/early April) because of contract delays. Consequently, data collected in 2011 may not be directly comparable to other years and represents a minimum population estimate. Drainages containing riparian habitat suitable for vireos were surveyed two to three times. A minimum of 784 male vireos and 19 transient vireos were detected on 19 out of the 23 drainages/sites surveyed. Ninety-four percent of all vireo territories occurred on the seven most populated drainages, with the Santa Margarita River containing 60% of all territories on Base. Fifty-seven percent of male vireos were confirmed as paired.

In 2011, the number of documented Least Bell's Vireo territories (784) dropped 27% from 2010, the year with the highest recorded number of vireo territories on MCBCP over the past 15 years. The number of territories on 17% (4/23) of drainages surveyed increased from 2010, while eleven drainages (48%) decreased by three or more territories, and eight drainages (35%) showed no change or decreased by two or fewer territories.

The majority of vireo territories occurred in habitat characterized as willow riparian, with 68% of males in the study area found in this habitat. An additional 13% of birds occupied willow (*Salix* spp.) habitat co-dominated by cottonwoods (*Populus fremontii*) or sycamores (*Platanus racemosa*). Seventeen percent of territories were found in riparian scrub, dominated by mule fat (*Baccharis salicifolia*) and/or sandbar willow (*S. exigua*). Two percent of the vireos used drier habitats including areas dominated by a mix of sycamores and oaks (*Quercus agrifolia*; 1% of total) or upland vegetation (<1%). Approximately 1% of vireo territories occurred in habitat dominated by non-native vegetation.

Forty-eight Least Bell's Vireos were banded for the first time during the 2011 season. These included 22 adult vireos, and 26 hatch-year vireos. All adult vireos and three hatch-year birds were banded with unique color combinations. The remaining 23 hatch-year vireos (all nestlings) were banded with a single gold numbered federal band on the right leg.

Sixty-three Least Bell's Vireos banded prior to the 2011 breeding season were resighted and identified on Base in 2011. Twelve of these were originally banded on the San Luis Rey River, one was originally banded at Marine Corps Air Station, Camp Pendleton, and the remaining birds were banded at MCBCP. Adult birds of known age ranged from 1-7 years old. Adult survivorship, or the proportion of individuals known to survive from 2010 to 2011, was 27% (43/160). Survivorship of first-year birds that fledged from MCBCP in 2010 and were documented on Base or elsewhere in 2011 was 5% (7/142), based on the number of uniquely banded individuals detected. All seven of the uniquely color banded first-year birds detected were male.

Adult vireo return rate was lower than in previous years, suggesting that over-winter survivorship may have been low between 2010 and 2011. However, we were unable to resight many vireos, particularly females, because of decreased detectability later in the season, so the

return rate may increase in future years when vireos that went undetected in 2011 are rediscovered.

The majority of returning adult vireos showed strong between-year site fidelity. Overall vireo territory fidelity between 2010 and 2011 was 71% (24/34). The average between-year movement for returning adult vireos was 0.1 ± 0.2 km (SD). Dispersal distance of first-year vireos fledged from MCBCP nests ranged from 0.9-88.9 km. Overall, the average distance first-year vireos dispersed was 23.1 ± 37.7 km (SD).

Adult survivorship of vireos on giant reed (*Arundo donax*) Removal sites and Reference sites was 47% and 28%, respectively. First-year survivorship was 3% and 6%, respectively. Fifty percent of adults at Removal sites and 100% of adults from Reference sites returned in 2011 to the same territory occupied in 2010. One 2010 male nestling from a Reference site returned to a Reference site in 2011, and four other 2010 male nestlings from Removal and Reference sites dispersed to areas outside of monitoring sites.

Three vireos moved from MCBCP and were detected elsewhere in 2011. One male, banded as a nestling on MCBCP in 2010, was recaptured on Dulzura Creek, San Diego County, California. One other male, banded as a nestling on MCBCP in 2008, was recaptured at Sweetwater Reservoir, San Diego County. One female, banded as a nestling on MCBCP in 2008, was detected at Marine Corps Air Station, Camp Pendleton, in 2011.

Nesting activity was monitored between 27 June and 5 August in 42 territories within two giant reed Removal and two Reference monitoring sites. Thirty-six of these territories were known to be occupied by pairs. Thirteen nests (eight in Removal sites and five in Reference sites) were monitored during the monitoring period.

Nest success was similar for pairs breeding in Removal sites and Reference sites. Fifty percent (4/8) of Removal nests and 60% (3/5) of Reference nests successfully fledged young. Predation was believed to be the primary source of nest failure at both sites. Predation accounted for 75% (3/4) and 50% (1/2) of nest failures at Removal and Reference sites, respectively. Cause of failure of the other two nests was unknown. No nest parasitism of Least Bell's Vireos by Brown-headed Cowbirds (*Molothrus ater*) was documented in 2011.

Density of vireo territories decreased at both Removal and Reference sites but decreased less at Removal sites from 2010 to 2011. Density at Removal sites was lowest in 2008, immediately prior to giant reed removal, increased for two years following giant reed removal, and exceeded the density in Reference sites in 2011. This shift in vireo density at Removal sites relative to Reference sites suggests that vireo breeding habitat continues to improve at the Removal sites.

In 2011, successful and unsuccessful nests within Removal and Reference sites were similar in placement. Vireo nests at Removal sites were placed further from the edge of the nest clump and were further from the edge of riparian vegetation than nests in Reference sites. Five plant species were used as hosts for vireo nests in 2011. Seventy-seven percent of all nests were placed in arroyo willow (*S. lasiolepis*), sandbar willow, and mule fat.

Although vireo surveys on MCBCP began late and were fewer in number than in previous years, the decrease in vireo numbers on MCBCP from 2010 to 2011 (27%) mirrors similar declines (17-31%) on the lower San Luis Rey River, the San Diego River, Sweetwater Reservoir, and Marine Corps Air Station, Camp Pendleton, indicating that there was a range-wide decrease in vireo numbers. The MCBCP population number is similar to the average population number between peak years of 1998 and 2009, and may be partially attributed to a lower number of young fledged per pair in 2010 compared to 2008 and 2009, and also to lower adult survivorship between 2010 and 2011. As in previous years, vireos moved between MCBCP and surrounding drainages. Vireos from MCBCP were detected on Dulzura Creek, at Sweetwater Reservoir, and on Marine Corps Air Station, Camp Pendleton.

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; Kus 1998, 1999; Kus et al. 2010), 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 unpubl. 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 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 11-13 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 24 June and 11 August 2011 (Fig. 1). Vireo surveys began late and were truncated in 2011 as a result of contractual delays. Although three surveys were conducted, these surveys occurred during the latter part of the vireo breeding season and therefore likely missed vireos that held territories earlier in the year but either moved away or became less detectable as singing became less frequent. Therefore, summary numbers for 2011 should be considered a minimum. Field work was conducted by Lisa Allen, Tom Dixon, Karl Fairchild, PJ Falatek, Aaron Gallagher, Alexandra Houston, Scarlett Howell, Barbara Kus, Suellen Lynn, Melanie Madden-Smith, Ryan Pottinger, and Sonya Steckler. The specific areas surveyed are as follows:

1. ***Santa Margarita River:***
   a. From 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. 10 and 11).
   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. 10).

2. ***De Luz Creek,*** between the confluence with the Santa Margarita River and the Base boundary (Appendix A, Fig. 10).

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. 10).

4. ***Lake O'Neill/Fallbrook Creek:***
   a. All riparian habitat around Lake O'Neill (Appendix A, Fig. 10).
   b. Between Lake O'Neill and the Base boundary with FNWS (Appendix A, Fig. 10).

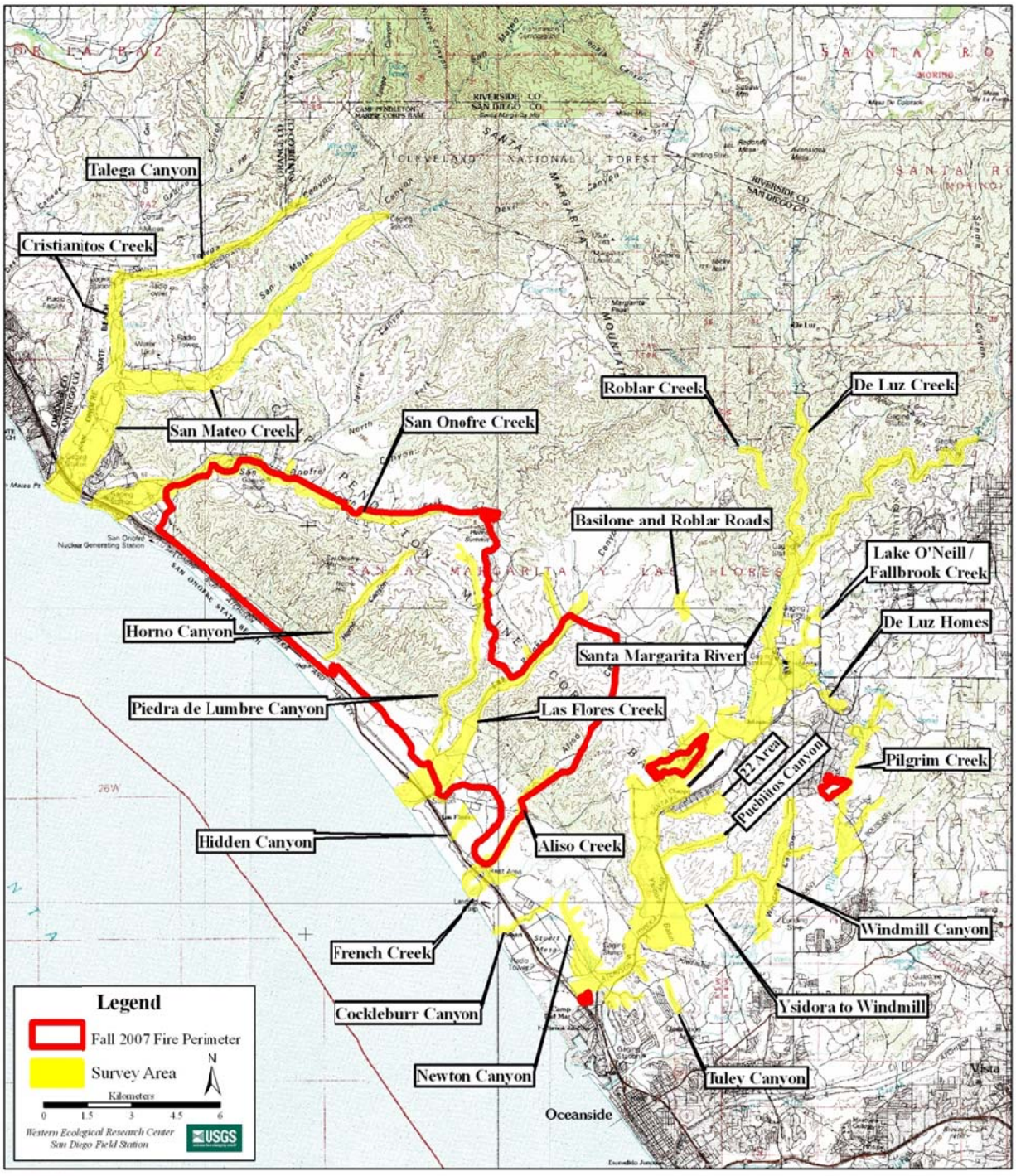

Fig. 1. Least Bell's Vireo survey areas and the Fall 2007 fire perimeter at Marine Corps Base Camp Pendleton, 2011.

5. ***Basilone and Roblar Roads,*** a small patch of habitat straddling Basilone Road at the intersection of Basilone and Roblar Roads (Appendix A, Fig. 10).

6. ***22 Area,*** all riparian habitat within the 22 Area, east of Vandegrift Road and the Supply Depot (Appendix A, Fig. 11).

7. ***Pueblitos Canyon,*** between Vandegrift Road and a point approximately 2.5 km upstream (Appendix A, Fig. 11).

8. ***Tuley Canyon,*** between the Base boundary and a point approximately 1.1 km upstream (Appendix A, Fig. 11).

9. ***Newton Canyon,*** between the confluence with the Santa Margarita River and the upstream limit of riparian habitat (Appendix A, Fig. 11).

10. ***Cockleburr Canyon,*** between the Pacific Ocean and a point 0.25 km east of Interstate 5 (Appendix A, Fig. 11).

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

12. ***Aliso Creek,*** between the Pacific Ocean and 0.5 km upstream of the electrical transmission lines (Appendix A, Fig. 11).

13. ***Hidden Canyon,*** between Interstate 5 and Stuart Mesa Road (Appendix A, Fig. 12).

14. ***Las Flores Creek (within Las Pulgas Canyon):***
    a. Between Stuart Mesa Road and the high voltage electrical transmission lines (Appendix A, Fig. 12).
    b. Between the Pacific Ocean and Stuart Mesa Road (Appendix A, Fig. 12).
    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. 12).

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. 12).

16. ***Horno Canyon,*** between Old Highway 101 and the upstream limit of riparian habitat (Appendix A, Fig. 12).

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. 12 and 13).
    b. From Basilone Road upstream to the access road to Range 219 (Appendix A, Fig. 12).

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 abandoned agricultural fields (Appendix A, Fig. 13).
b. From San Mateo Road upstream to the Base boundary (Appendix A, Figs. 13 and 14).

19. Cristianitos Creek, between the confluence with San Mateo Creek and the Base boundary (Appendix A, Fig. 13).

20. Talega Canyon, between the confluence with Cristianitos Creek and a point approximately 6.5 km upstream (Appendix A, Fig. 13).

21. Pilgrim Creek:

a. Between the southern Base boundary and Vandegrift Boulevard, including the two side drainages east of Pilgrim Creek (Appendix A, Fig. 15).
b. From Vandegrift Boulevard upstream to the limit of riparian habitat (Appendix A, Fig. 15).

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. 15).

23. Ysidora Basin to Windmill Canyon, between Upper Ysidora Basin and Windmill Canyon/ Pueblitos Canyon (Appendix A, Fig. 15).

24. De Luz Homes Habitat, patches of habitat adjacent to the De Luz Homes development (Appendix A, Fig. 15).

All but two drainages were surveyed 3 times at least 10 days apart. 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 2011.

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 audibly through the detection of the "pair call" elicited between mated birds, visually when observed traveling quietly with the male, or was inferred by observing a nest, breeding behavior such as a food carry, or the presence of dependent fledglings. 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. In 2011, we performed fewer surveys and thus had a decreased chance of seeing resident vireos on two or more consecutive surveys. Therefore, transient status was only assigned after carefully examining observer data for any signs of behavior which would indicate that the adult was resident and/or paired. In most cases, vireos that were observed only once with a female or with juveniles were given paired status. Exceptions occurred when a "new" territory was found near a vacant territory, suggesting that the individual or family group had moved. In this case, the "new" territory was considered part of the vacant territory. Vireo locations were mapped on 1:12,000 aerial photographs as well as 1:24,000 USGS topographic maps, using a Garmin 12 or a Garmin GPS 60 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.

In Fall 2008, giant reed was cleared in an area within the Santa Margarita River drainage downstream of Marine Corps Air Station, Camp Pendleton (MCAS; Fig. 2). In 2010, we began monitoring vireos within two monitoring areas inside this extensive clearing (hereafter "Removal" sites) and continued monitoring vireos within two established Reference sites where we have been monitoring vireos since 2005 (Fig. 2).

We compared vireo breeding productivity and factors that potentially influence productivity between Removal and Reference sites in 2011 to determine whether giant reed removal influenced vireo productivity. Nest monitoring was limited in 2011 because we were unable to begin field work until 24 June as a result of contractual delays. Because of our late start, we did not encounter enough active nests to run all of our standard breeding productivity analyses comparing Removal and Reference sites. However, we were able to determine if many pairs had successfully produced young in 2011 by noting the presence of dependent fledglings. For the nests that were active during the dates we could monitor, we were able to collect limited summary information on clutch size, hatching rate, fledging rate, nest success, minimum number of fledglings per pair, nest placement, predation rate, and cowbird parasitism rate.

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

Finally, we compiled annual density within the 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 2011. 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.

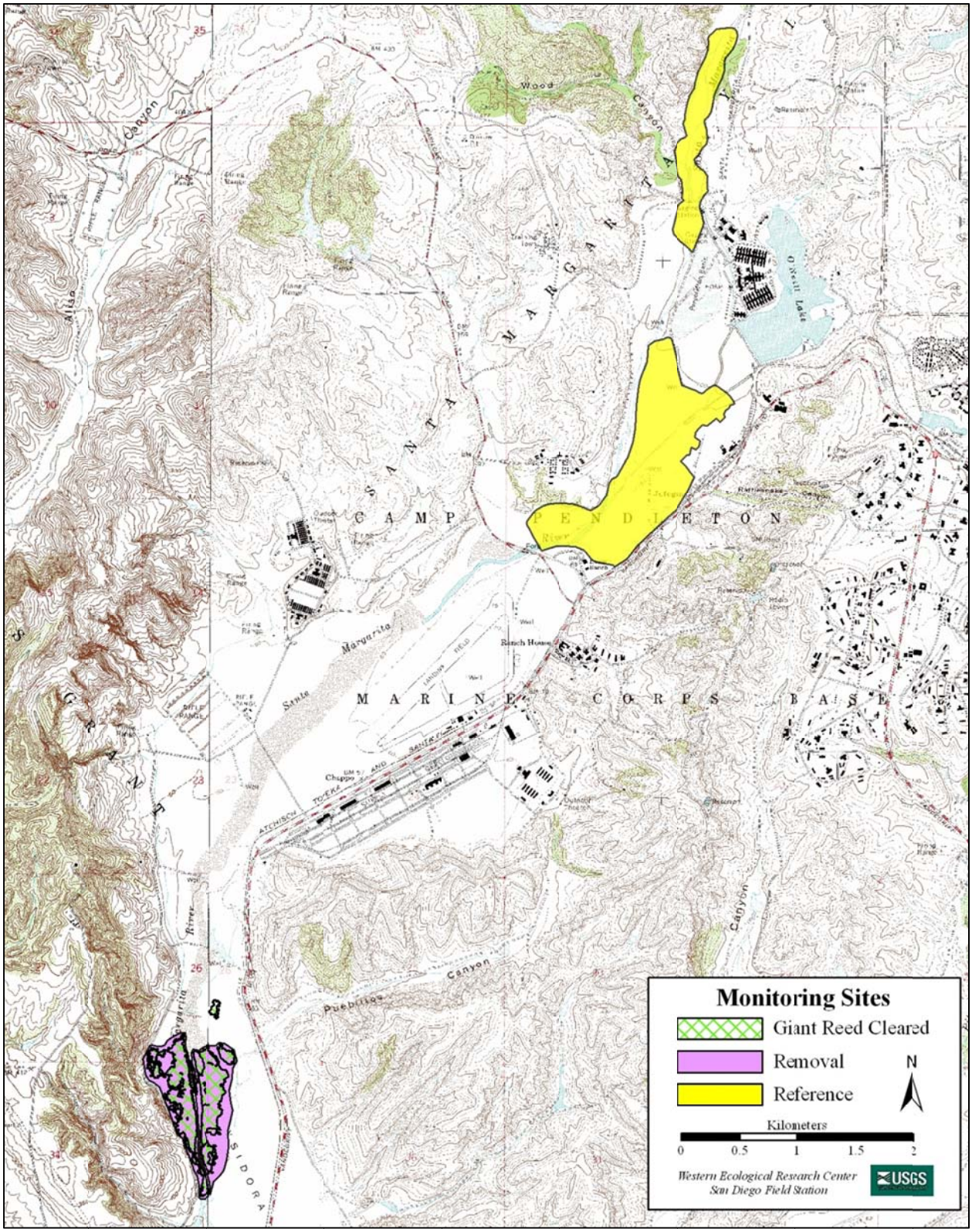

Fig. 2. Location of Least Bell's Vireo nest monitoring areas at Marine Corps Base Camp Pendleton, 2011.

We monitored vireo nesting activity at 19 territories in Removal sites and 23 territories in Reference sites between 27 June and 5 August, 2011. Territories were chosen based on their location within areas that were monitored in previous years. Vireos 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.

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 right 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 unique color combinations.

Finally, any Least Bell's Vireos captured at one of two migration monitoring 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 now known to have been alive.

Survivorship from 2010-2011 was calculated for known individuals that were: (1) adults in 2010 on Base and were resighted anywhere on Base in 2011; (2) adult vireos that held territories in Removal or Reference sites in 2010 and were resighted anywhere on Base in 2011; (3) first-year vireos that were banded as nestlings or juveniles anywhere on Base in 2010 and were resighted anywhere in 2011 (including off Base); and (4) first-year vireos that were banded as nestlings or juveniles in Removal or Reference sites in 2010 and were resighted anywhere in 2011. 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 Removal and Reference sites because we could not confirm the presence of birds in those specific 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 2010 and the center of the same vireo's breeding territory in 2011. Vireos exhibited site fidelity if they returned to within 100 m of their 2010 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 2011 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 one of the two Monitoring Avian Productivity and Survivorship (MAPS) stations on-Base were excluded unless their territory locations were known from surveys).

Data Analyses

We used Chi-square or Fisher's Exact tests to determine if there were differences in adult and juvenile over-winter survivorship, adult survivorship, survivorship for older versus younger adults, and nest success between Removal and Reference sites. 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 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 differences in nest placement characteristics between successful and failed nests within Removal and Reference sites. 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 $P < 0.10$. Means are presented with standard deviations. All data from MCBCP from 2005, 2006, 2007, 2008, 2009, and 2010 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, 2010b.

RESULTS

Population Size and Distribution

A total of 803 male Least Bell's Vireos were identified during Base-wide surveys (Table 1, Appendix B, Figs. 16-36). This included 784 territorial male vireos, 57% of which were confirmed as paired, and 19 transients. Transient vireos were observed on six of the 23 (26%) drainages/sites surveyed. Ninety-four percent of all vireo territories occurred on the seven most populated drainages/sites (Santa Margarita River, Las Flores Creek, San Onofre Creek, San Mateo Creek, De Luz Creek, Pilgrim Creek, and Cristianitos Creek), and the majority of vireo territories (60%) occurred along the Santa Margarita River, the largest expanse of riparian vegetation on Base (Tables 1, 2). The remaining 16 drainages/sites each contained fewer than ten territories.

The distribution of Least Bell's Vireo territories documented on Base in 2011 shifted only slightly compared to that in 2010 (Table 2). All of the drainages without vireos in 2010 continued to have no vireo territories in 2011, and no drainages that had territories in 2010 lost all of their vireo territories in 2011. The four most heavily populated drainages on MCBCP contained 86% of all vireo territories in 2010 and 87% of all territories in 2011. In 2011, the vireo population increased in 17% of drainages surveyed (4/23). Eleven drainages (48%) showed no change or decreased by two or fewer territories between 2010 and 2011 and eight drainages (35%) decreased by 3-211 territories. The drainages with the largest numeric increases in vireo territories were San Onofre Creek and Horno Canyon, increasing by three territories each (6% and 300%, respectively). The site with the largest numeric loss in vireo numbers was the Santa Margarita River, losing 211 territories (31%). Overall, the vireo population on Base decreased by 27% from 2010 to 2011 (Fig. 3).

Table 1. Number and distribution of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2011.

Drainage/Survey Site	Known Pairs	Single/ Status Undetermined	Transient	Total Territories
Santa Margarita River:				
I-5 to De Luz Creek	270	154	7	424
De Luz Creek to Base Boundary	12	20	0	32
22 Area	4	7	2	11
De Luz Creek	19	8	0	27
Roblar Creek	1	0	0	1
Lake O'Neill/Fallbrook Creek	5	1	0	6
Basilone-Roblar Roads	1	1	0	2
Pueblitos Canyon	0	0	0	0
Newton Canyon	4	2	0	6
Cockleburr Creek	0	0	0	0
French Canyon	0	2	0	2
Aliso Creek	5	4	0	9
Hidden Canyon	2	1	0	3
Las Flores Creek:				
Pacific Ocean to Stuart Mesa Road	1	2	0	3
Stuart Mesa Road to Power Lines	25	18	0	43
Power Lines to Zulu Impact Area	31	15	0	46
Piedra de Lumbre Canyon	1	2	0	3
Horno Canyon	3	1	0	4
San Onofre Creek:				
Pacific Ocean to Basilone Road	16	32	4	48
Basilone Road to Access Road to Range 219	5	4	0	9
San Mateo Creek				
Pacific Ocean to San Mateo Road	17	35	1	52
San Mateo Road to Yankee Training Area	2	2	0	4
Cristianitos Creek	3	8	1	11
Talega Canyon	0	0	0	0
Tuley Canyon	0	0	0	0
Pilgrim Creek:				
Base Boundary upstream to Vandegrift Boulevard	14	6	2	20
Vandegrift Boulevard to upstream riparian limit	1	4	1	5
Windmill Canyon	2	5	0	7
Ysidora Basin to Windmill Canyon	1	0	1	1
De Luz Homes	4	1	0	5
Total	449	335	19	784

Table 2. Number of territorial males at Marine Corps Base Camp Pendleton, by drainage, 2004-2011. Numeric change is the positive or negative change in the number of vireo territories between 2010 and 2011

	Number of Territorial Males								Numeric Change
Drainage	**2004[a]**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	
Santa Margarita River[b]	440	472	417	423	463	599	678	467	-211
De Luz Creek	26	18	25	24	25	39	34	27	-7
Roblar Creek	1	0	0	0	0	2	1	1	0
Lake O'Neill/Fallbrook Creek	16	20	10	9	11	11	15	6	-9
Basilone-Roblar Roads	-	2	0	0	0	5	4	2	-2
Pueblitos Canyon	3	5	3	2	2	1	0	0	0
Newton Canyon	9	8	8	5	4	6	7	6	-1
Cockleburr Creek	0	2	2	2	1	2	0	0	0
French Canyon	5	6	4	2	2	2	2	2	0
Aliso Creek	21	21	11	9	11	21	16	9	-7
Hidden Canyon	5	8	5	4	4	2	4	3	-1
Las Flores Creek	84	85	76	81	70	107	124	92	-32
Piedra de Lumbre Canyon	5	8	9	6	3	5	6	3	-3
Horno Canyon	0	1	0	0	0	1	1	4	+3
San Onofre Creek	56	52	43	44	41	62	54	57	+3
San Mateo Creek	68	56	59	46	53	83	71	56	-15
Cristianitos Creek	8	6	8	8	4	13	10	11	+1
Talega Canyon	0	1	0	0	0	1	0	0	0
Tuley Canyon	2	-	0	0	0	0	0	0	0
Pilgrim Creek	37	36	23	26	26	27	24	25	+1
Windmill Canyon	20	12	7	8	12	13	10	7	-3
Ysidora Basin to Windmill Canyon	8	4	6	5	4	5	2	1	-1
De Luz Homes	5	4	2	3	2	6	5	5	0
Total	819	827	718	707	738	1,013	1,068	784	-284

[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.

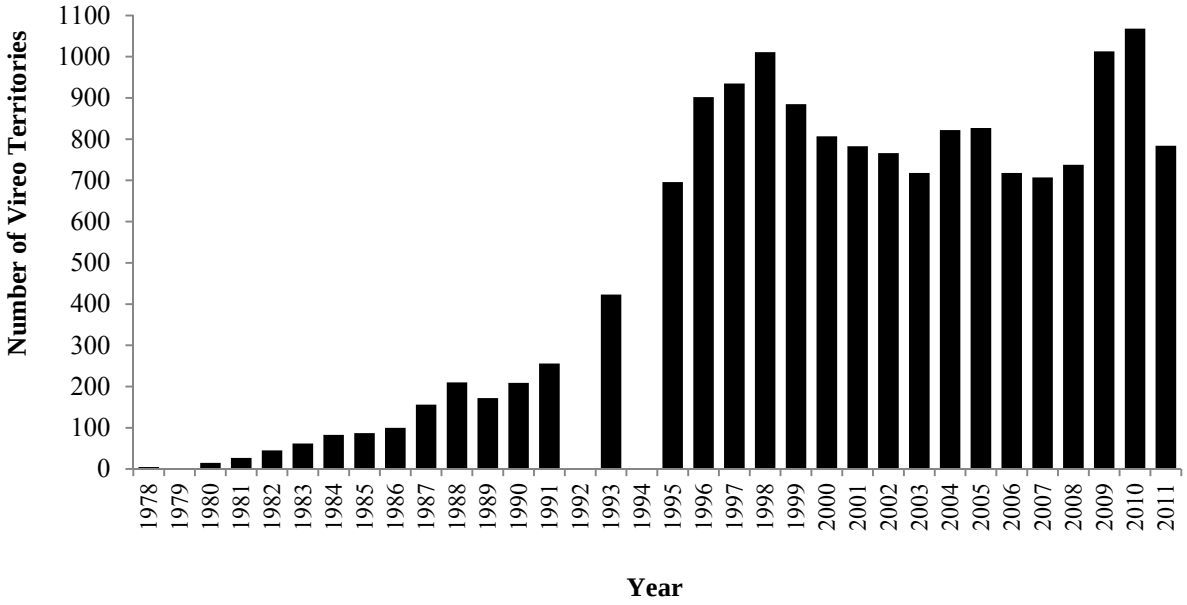

Fig. 3. Number of Least Bell's Vireo territories at Marine Corps Base Camp Pendleton, 1978–2011. (Source: Griffith Wildlife Biology 2004, Rourke and Kus 2006a, 2007a, 2008, Lynn and Kus 2009, 2010a, 2010b).

Unlike in previous years, drainages that had burned in 2007 (Fig. 1) did not uniformly show increases in vireo territories. Of the drainages that burned, all but Horno Canyon experienced decreases in vireo numbers within the areas that burned in 2007 (Fig. 4). Vireo numbers in Horno Canyon increased by 300% (from one to four territories) between 2010 and 2011. Base-wide, the number of vireo territories in areas that burned in 2007 (126 territories) decreased by 29% in 2008 (89 territories), increased by 102% in 2009 (180 territories), increased by 5% in 2010 (189 territories), and then decreased by 27% (138 territories) in 2011, for an overall increase of 10% from before the fire to 2011.

Because we were not able to begin surveys on MCBCP until late June, we could not determine the arrival dates of Least Bell's Vireos on Base in 2011.

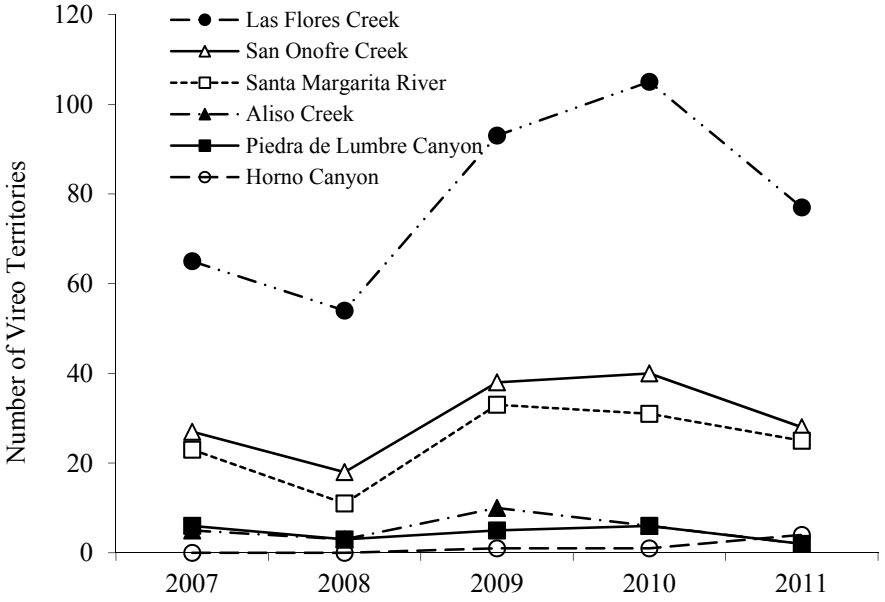

Fig. 4. Change in the number of Least Bell's Vireo territories in areas that burned in 2007 at Marine Corps Base Camp Pendleton, 2007–2011.

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 68% of males in the study area found in this habitat. An additional 13% of birds occupied willow habitat co-dominated by cottonwoods or sycamores. Seventeen percent of territories were found in riparian scrub, dominated by mule fat and/or sandbar willow. Two percent of the vireos used drier habitats including areas dominated by a mix of sycamore and oaks (1%) or upland vegetation (<1%). Approximately 1% of vireo territories occurred in habitat consisting exclusively of non-native vegetation.

Table 3. Habitat types used by Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2011.

	Number of Territories			
Habitat Type	**>50% Native**	**>50% Exotic**	**Total**	**Percent of Total**
Mixed Willow	476	55	531	68%
Riparian Scrub	110	26	136	17%
Willow/Sycamore	89	6	95	12%
Oak/Sycamore	10	0	10	1%
Non-native	0	5	5	1%
Willow/Cottonwood	4	0	4	1%
Upland Scrub	1	2	3	<1%
Total	690	94	784	100%

A slightly larger proportion of vireo territories were documented in exotic vegetation in 2011 than in 2010 (Table 4). Twelve percent (94/784) of vireo territories in 2011 and 10% in 2010 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. The same number of drainages (nine) contained territories dominated by non-native vegetation in 2011 as in 2010, although four of the drainages changed (Aliso Creek and Ysidora Basin to Windmill Canyon had territories dominated by non-native vegetation in 2010 but not in 2011; Piedra de Lumbre Canyon and Newton Canyon did not have any territories dominated by non-native vegetation in 2010 but did in 2011). 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, 2005-2011. Numbers in parentheses are the number of territories on the drainage.

	Proportion of Territories													
Drainage	**2005**		**2006**		**2007**		**2008**		**2009**		**2010**		**2011**	
Windmill Crk	0.67	(12)	0.14	(7)	0.13	(8)	0.67	(12)	0.92	(13)	0.60	(10)	0.71	(7)
Piedra de Lumbre Cyn	1.00	(8)	0	(9)	0	(6)	0.67	(3)	0.20	(5)	0	(6)	0.33	(3)
Las Flores Crk	0.02	(85)	0.14	(76)	0	(81)	0.29	(70)	0.22	(107)	0.21	(124)	0.20	(92)
Newton Cyn	0.63	(8)	0.13	(8)	0	(5)	0.50	(4)	0.20	(6)	0	(4)	0.17	(6)
Santa Margarita River[a]	0.17	(472)	0.05	(417)	0.04	(423)	0.03	(463)	0.06	(599)	0.06	(676)	0.13	(467)
Cristianitos Crk	0.50	(6)	0.13	(8)	0.25	(8)	0	(4)	0.08	(13)	0.10	(10)	0.09	(11)
San Onofre Crk	0.23	(52)	0	(43)	0	(44)	0.13	(41)	0.21	(62)	0.11	(54)	0.07	(57)
Pilgrim Crk	0	(36)	0	(23)	0	(26)	0	(26)	0.15	(27)	0.04	(24)	0.04	(25)
San Mateo Crk	0.66	(56)	0.12	(59)	0	(46)	0.14	(53)	0.10	(83)	0.25	(68)	0.04	(56)
De Luz Crk	0.06	(18)	0.04	(25)	0	(24)	0	(25)	0	(39)	0	(34)	0	(28)
Aliso Crk	0.05	(21)	0	(11)	0.11	(9)	0	(11)	0	(21)	0.06	(16)	0	(9)
Lake O'Neill/ Fallbrook Crk	0.15	(20)	0	(10)	0.11	(9)	0	(11)	0	(11)	0	(15)	0	(6)
De Luz Homes	0	(4)	0	(2)	0	(3)	0	(2)	0	(6)	0	(5)	0	(5)
Horno Cyn	1.00	(1)	-	-	-	-	-	-	0	(1)	0	(1)	0	(4)
Hidden Cyn	0	(8)	0	(5)	0	(4)	0	(4)	0.50	(2)	0	(4)	0	(3)
Basilone-Roblar Rds	0	(2)	-	-	-	-	-	-	0	(5)	0	(3)	0	(2)
French Cyn	0	(6)	0	(4)	0	(2)	0	(2)	0	(2)	0	(2)	0	(2)
Ysidora Basin to Windmill Cyn	0.25	(4)	0.5	(6)	0	(5)	0.25	(4)	0.20	(5)	0.50	(2)	0	(1)
Roblar Crk	-	-	-	-	-	-	-	-	0	(2)	0	(1)	0	(1)
Cockleburr Cyn	0	(2)	0	(2)	0	(2)	0	(1)	0	(2)	-	-	-	-
Pueblitos Cyn	0	(5)	0	(3)	0	(2)	0.50	(2)	0	(1)	-	-	-	-
Talega Cyn	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])	0.12	(784)

[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 705 adult Least Bell's Vireos (597 males, 75% of all males, and 108 females, 24% of all females) on Base well enough to determine banding status in 2011, although not all banded vireos were observed well enough to conclusively identify the individual. Sixty-three of these had been banded prior to the 2011 breeding season, 11 of which we could not identify because band combinations were not confirmed (six) or because the vireos were banded with only a single numbered metal federal band ("natal"; five; Table 5). Therefore, we were able to identify 52 vireos on Base that were banded with unique color band combinations in 2011 (Table 5, Appendix C). Of these, 42 vireos had been banded on Base and ten vireos were originally banded off Base (nine on the San Luis Rey River; Ferree and Kus 2008a, 2008b, Ferree et al. 2010a, USGS unpubl. data; and one on MCAS; Lynn and Kus 2010c; Table 6). Adult birds of known age ranged from 1-7 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 2011.

	Detected on Base[a]		Total on	Emigrants		
Banding Status	Male	Female	Base	Male	Female	Total
Uniquely banded prior to 2011	42	1	43	-	-	43
Natal[b] recaptured in 2011	9	-	9	2	1	12
Subtotal of known identity vireos	51	1	52	2	1	55
Unidentified (Partial resights)	4	2	6	-	-	6
Natal[b], not recaptured	4	1	5	-	-	5
Grand total	59	4	63	2	1	66

[a] Includes immigrants.
[b] Natal vireos were originally banded as nestlings with a single numbered metal federal band.

Table 6. Number of banded adult Least Bell's Vireos at Marine Corps Base Camp Pendleton in 2011, by original year banded, age, original banding location, and sex.

Year Originally Banded	Age in 2011	Number of Vireos Observed by Origin: Marine Corps Base Camp Pendleton Male	Marine Corps Base Camp Pendleton Female	San Luis Rey River Male	San Luis Rey River Female	Marine Corps Air Station, Camp Pendleton Male	Total
2005	≥ 7 yrs.	1	0	0	0	0	1
	6 yrs.	1	0	0	0	0	1
2006	≥ 6 yrs.	3	0	0	0	0	3
2007	≥ 5 yrs.	5[a]	0	0	0	0	5
	4 yrs.	0	0	3	0	0	3
2008	≥ 4 yrs.	2	0	0	0	0	2
	3 yrs.	4	0	3	0	0	7
2009	≥ 3 yrs.	5	0	0	0	0	5
	2 yrs.	1	0	3	0	0	4
2010	≥ 2 yrs.	14	1	0	0	0	15
	1 yr.	5	0	0	0	1	6
Subtotal		41	1	9	0	1	52
Unknown[b]	≥ 1 yr.	7	1	1	2	0	11
Total		48	2	10	2	1	63

[a] Three vireos were originally banded on the upper Santa Margarita River by FNWS personnel.
[b] Natal vireos banded with single numbered metal federal band or identity unknown because of inadequate resight, so natal year is not known.

Five natal vireos (four males and one female) were resighted on Base in 2011 (Table 5). One male and one female were banded as nestlings off Base on the San Luis Rey River and the remaining three were banded as nestlings on Base. Efforts to recapture and identify these vireos were unsuccessful.

Three vireos that were originally banded on Base (with gold numbered metal federal bands) were detected off Base in San Diego County in 2011 (Table 5). One first-year male was recaptured at Dulzura Creek (USGS unpubl. data), one three-year-old male was recaptured at Sweetwater Reservoir (Pottinger and Kus 2011), and one three-year-old female was recaptured at MCAS (Lynn and Kus 2011a).

New Banded Birds

A total of 48 Least Bell's Vireos were captured and banded for the first time during 2011 (Table 7). These included 22 adult vireos caught for the first time and banded with a unique

color combination and 26 hatch-year birds (23 of which were banded as nestlings or fledglings with a single gold numbered federal band and three of which were incidentally caught either while attempting to target net an adult vireo or at one of the Base's two migration monitoring stations and given unique color combinations). These vireos are not included in survivorship, fidelity, or movement analyses.

Table 7. Summary of new Least Bell's Vireos captured and banded on Marine Corps Base Camp Pendleton in 2011.

Age Banded	Males	Females	Unknown Sex	Total
Adult	21	1	0	22
Juvenile			3[a]	3
Nestling			23	23
Total	21	1	26	48

[a] Incidentally captured post-fledging and given unique color band combinations.

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 migration monitoring stations) in 2011. 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 2010-2011

Of 155 uniquely color banded adult vireos present on Base during the 2010 breeding season, 25% (38/155) returned in 2011 (Table 8). Five additional adult vireos (three on Base, one at MCAS, and one at Sweetwater Reservoir) identified in 2011 but not detected on Base in 2010 were added to the calculations to yield an adjusted annual survivorship of 27% (43/160; Table 8).

Forty-one of the 118 adult male vireos known to be alive in 2010 were resighted in 2011, an over-winter survivorship rate of 35%. Two of the 34 adult female vireos known to be alive in 2010 were resighted in 2011, an over-winter survivorship rate of 6%. The remaining 77 males, 32 females, and 8 vireos of unknown sex were not resighted in 2011. The difference in sex-related over-winter survivorship may be attributed to difficulty in resighting females, which was especially true in 2011. In any given year, the proportion of females that are resighted is lower than for males. Therefore, the chances of resighting a particular female are correspondingly smaller.

Table 8. Number of banded adult Least Bell's Vireos detected in 2010 at giant reed (*Arundo donax*) Removal sites, Reference sites, and other areas on Marine Corps Base Camp Pendleton, and where those that returned were detected in 2011. Numbers in parentheses include the adjustments resulting from vireos that were identified in 2011 but not in 2010.

Year/Sex	Removal Sites	Reference Sites	Other Areas	Total
2010				
Male	15	25	74	114 (118)
Female	2	11	20	33 (34)
Unknown	1	0	7	8
Total	18	36	101	155 (160)
2011				
Male	4[a]	14[b]	19	37 (41)
Female	0	0	1	1 (2)
Total	4	14	20	38 (43)

[a] All occupied territories at Removal sites in 2010.
[b] Four occupied territories at Removal sites in 2010, ten occupied territories at Reference sites in 2010.

Over-winter survivorship was low for 2-4-year-old males (Table 6; Lynn and Kus 2010b) compared to older males. Ten of 13 ≥5-year-old males were resighted in 2011 (77%) while only 26 of 64 2-4-year-old males were resighted (41%; Fisher's Exact Test, $P = 0.03$).

First-year Survivorship from 2010-2011

Of the 142 hatch-year vireos banded in 2010 that survived to fledge, six (all males) were resighted with or captured and given unique color band combinations on Base in 2011 (Table 9). One other hatch-year male vireo, banded on Base in 2010, was recaptured in 2011 at Dulzura Creek and given a unique color band combination (USGS unpubl. data). The addition of this vireo yields a conservative first-year survivorship of 5% (7/142) (Table 10). Assuming an equal sex ratio of banded nestlings, first-year survivorship of males was 10% (7/71) and females was 0%.

Table 9. 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 2010, and where those that returned were detected in 2011.

Year/Sex	Removal Sites	Reference Sites	Other Areas	Total
2010				
Unknown	71	51	20	142
2011				
Male	0	1	6	7[a]
Female	0	0	0	0

[a] One male vireo detected on Dulzura Creek.

Adjusted Annual Survivorship

Five adult banded vireos (four males and one female) that were detected in 2011 were not observed in 2010 (Table 8). These detections were used to adjust estimates of annual survivorship for previous years (see Methods: Banding). Incorporating these detections into calculations increased adult survivorship estimates 0-4% over original estimates (Table 10).

Table 10. Adjustments to first-year and adult Least Bell's Vireo survivorship on Marine Corps Base Camp Pendleton, 2011. These numbers update survivorship estimates presented in Rourke and Kus 2007a, 2008, Lynn and Kus 2009, 2010a, 2010b.

	First-year Survivorship			Adult Survivorship		
Years	Original	Last Year	New	Original	Last Year	New
2005-2006	10%	16%	-	30%	41%	-
2006-2007	10%	26%	-	63%	75%	-
2007-2008	12%	22%	-	49%	61%	62%
2008-2009	10%	14%	14%	53%	57%	58%
2009-2010	7%	-	-	50%	-	52%
2010-2011	-	-	5%	-	-	27%

Survivorship at Removal and References Sites

Of the 17 banded adult vireos of known sex (15 males and 2 females) that were detected within Removal sites in 2010, eight (all males) were resighted in 2011 for a 47% survival rate (53% for males, 0% for females; Table 8 and Appendix D). Of the 36 banded adult vireos of known sex (25 males and 11 females) that were detected within Reference sites in 2010, ten (all males) were resighted in 2011 for a 28% survival rate (40% for males and 0% for females). Four male vireos moved from a Removal site to a Reference sites between 2010 and 2011. Over-winter survival rate did not differ between Removal and Reference sites ($\chi^2 = 1.15$, $P = 0.28$).

All but 20 of the 142 banded juveniles that were known to fledge in 2010 were banded on a Removal or Reference site. Of these 122, five were recaptured and given unique color band combinations in 2011 (four on MCBCP and one at Dulzura Creek) for an overall first-year survival rate of 3% for fledglings from Removal sites and 6% for fledglings from Reference sites (Tables 9 and 11). First-year survivorship for juveniles from Removal sites did not differ from Reference sites (Fisher's Exact Test, $P = 0.65$).

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). Thirty-eight adult vireos that were identified in 2010 were resighted in 2011, 34 of which occupied known territories both years. Four vireos were excluded from analysis because they were recaptured at either the De Luz or Santa Margarita MAPS stations in 2010 or migration

monitoring stations in 2011 and their exact territory locations were thus unknown. The majority of returning adult vireos showed strong between-year site fidelity. Of the 34 returning adults, 24 (71%) occupied a breeding site in 2011 that they had defended in 2010 (within 100 m). Six additional vireos (18%) returned to sites adjacent to their previous territories (within 300 m). Four vireos (all males) moved between 0.4 and 0.7 km from their 2010 breeding territories to their 2011 breeding territories, but remained within the same drainage. The average distance moved by returning adult vireos was 0.1 ± 0.2 km (SD).

Seven first-year vireos from MCBCP were resighted in 2011, five of which were banded as nestlings in 2010 and returned in 2011 to occupy known territories, four on MCBCP and one at Dulzura Creek. Two vireos were excluded from analysis because they were originally captured as juveniles in 2010 and therefore could not be associated with an exact natal territory. The four vireos that returned to MCBCP dispersed an average of 6.8 ± 10.0 km from their 2010 natal sites (range 0.9–21.7 km; Table 11). The vireo that was redetected at Dulzura Creek dispersed 88.9 km from his natal site. Including this long-distance disperser, vireos that fledged from nests at MCBCP in 2010 dispersed an average of 23.1 ± 37.7 km to their 2011 sites. One other first-year vireo that was originally banded as a nestling at MCAS in 2010 dispersed 2.9 km to MCBCP.

Table 11. Between-year dispersal into or out of MCBCP by Least Bell's Vireos banded as juveniles in 2010 and detected in 2011.

Year Last Detected	Drainage / Territory / Treatment[a]		Dispersal Distance (km)	Band Combination[b]		Sex[c]
	2010	2011		Left Leg	Right Leg	
2010	SMR / APO / REF	DU / DC05	88.9	BKBK/Mgo	DPDP	M
2010	SMR / TRF / REM	SOF / OW10	21.7	DPWH/Mgo	ORPU	M
2010	SMR / DAT / REF	SMR / BIL / REF	3.0	Mgo	ORDG/gogo	M
2010	SMR / PIE / REM	SMR / YB13	1.6	DPWH/Mgo	OROR	M
2010	SMR / DAT / REF	FC / OL02	0.9	DPDP/Mgo	ORPU	M
2010	MCAS / YAX[d]	SMR / ES25	2.9	PUWH/Mgo	OROR	M
2010	DL / DLMAPS[e]	LF / LL21	14.3	ORDG/Mgo	WHWH	M
2010	DL / DLMAPS[e]	BE / BN53	13.2	WHWH	DGOR/Mgo	M

[a] Drainage Codes: DL = De Luz Creek; DU = Dulzura Creek; FC = Fallbrook Creek; LF = Las Flores Creek; MCAS = Marine Corps Air Station, Camp Pendleton; SMR = Santa Margarita River; SOF = San Onofre Creek. Treatment Codes: REF = Reference; REM = Removal.

[b] Band colors: 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; OROR = plastic orange; ORPU = plastic orange-purple split; PUWH = plastic purple-white split; WHWH = plastic white.

[c] Sex: M = male.

[d] Immigrant to MCBCP from MCAS.

[e] De Luz MAPS Station. Vireos banded as juveniles at the MAPS station had no known natal territory so distances were calculated from the location where they were trapped in 2010.

Site Fidelity and Movement – Removal and Reference Sites

Fidelity to Removal sites was significantly lower than fidelity to Reference sites, as only 50% (4/8) of adult vireos from Removal sites but 100% (10/10) of adult vireos from territories at Reference sites returned to the same treatment type they had defended in 2011 (Fisher's Exact Test; $P = 0.02$; Appendix D).

Five of the seven first-year vireos detected in 2011 fledged from either a Removal site or a Reference site, and two of the five dispersed to territories located within the Santa Margarita River drainage. Of the other three, one male from a Reference site and one male from a Removal site dispersed 0.9 – 21.7 km to other drainages on Base, and one male from a Reference dispersed 88.9 km off Base to Dulzura Creek. Both vireos that fledged from Removal sites dispersed to areas on Base outside of our monitoring areas. One vireo from a Reference site returned to a different Reference site in 2011 and the remaining two vireos from Reference sites dispersed to areas outside of the monitoring sites. Males from Removal sites dispersed 1.6-21.7 km from their natal sites. Males from Reference sites dispersed 0.9-88.9 km from their natal sites. No first-year females were detected in 2011.

Nest Monitoring

Nesting activity was monitored in 42 territories within the Removal and Reference monitoring areas from 27 June until 5 August (Table 12, Figs. 5-8, Appendix E). All 42 territories were considered "partially monitored" because monitoring did not begin until late June; therefore, nests that failed or fledged before 27 June were not found and monitored. Thirty-six of these territories were known to be occupied by pairs. Only males were detected at the remaining six territories, although these territories may have been occupied by pairs prior to the initiation of our monitoring effort. Thirteen nests were found and monitored during the monitoring period (Table 12).

Table 12. Number of Least Bell's Vireo territories and nests monitored at giant reed (*Arundo donax*) Removal and Reference sites on Marine Corps Base Camp Pendleton, 2011.

	Nest Monitoring Area Type	
	Removal	**Reference**
Territories monitored	19	23
Total # of nests monitored	5	8

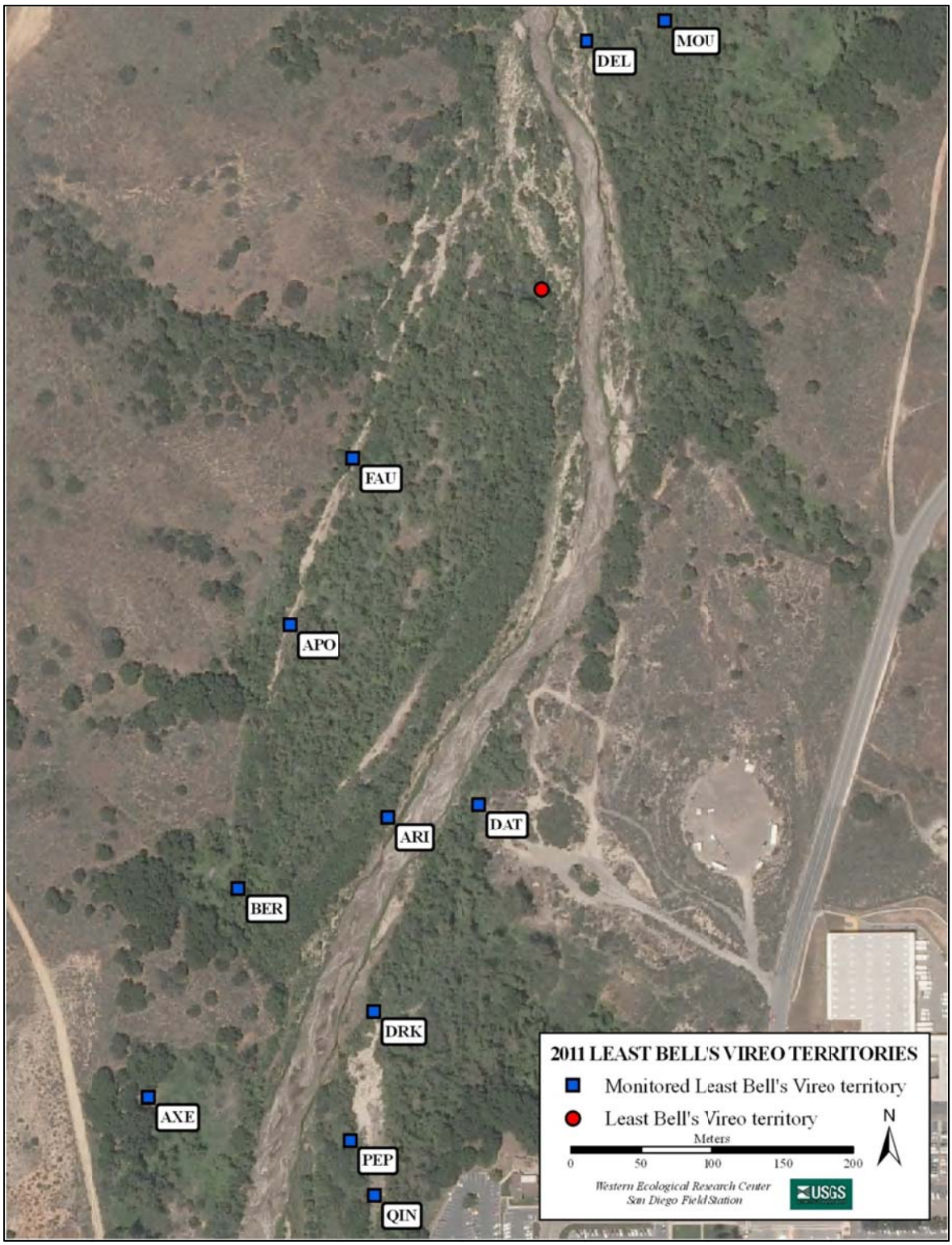

Fig. 5. Locations of monitored Least Bell's Vireo territories at the Above Hospital Reference site, Marine Corps Base Camp Pendleton, 2011.

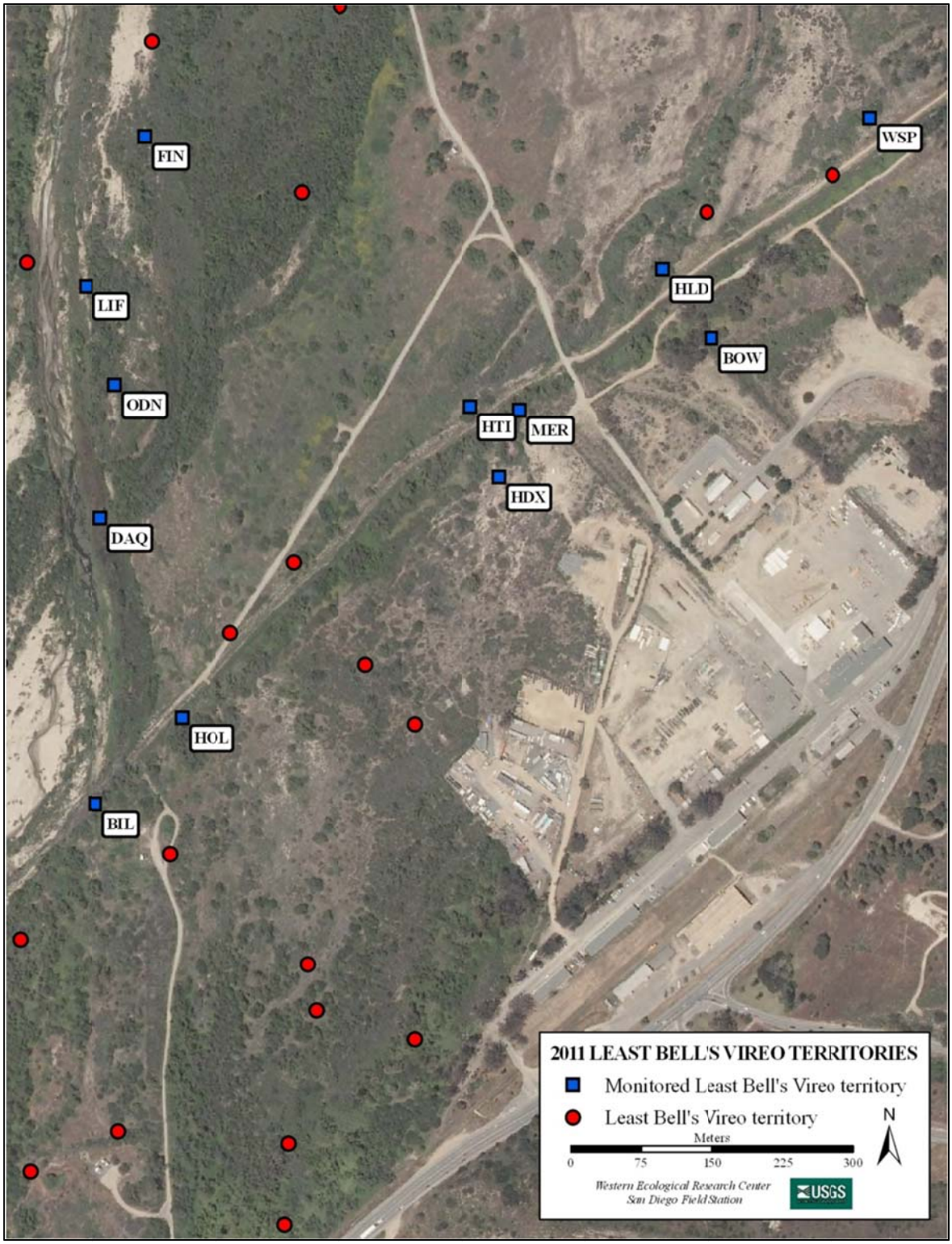

Fig. 6. Locations of monitored Least Bell's Vireo territories at the Below Hospital Reference site, Marine Corps Base Camp Pendleton, 2011.

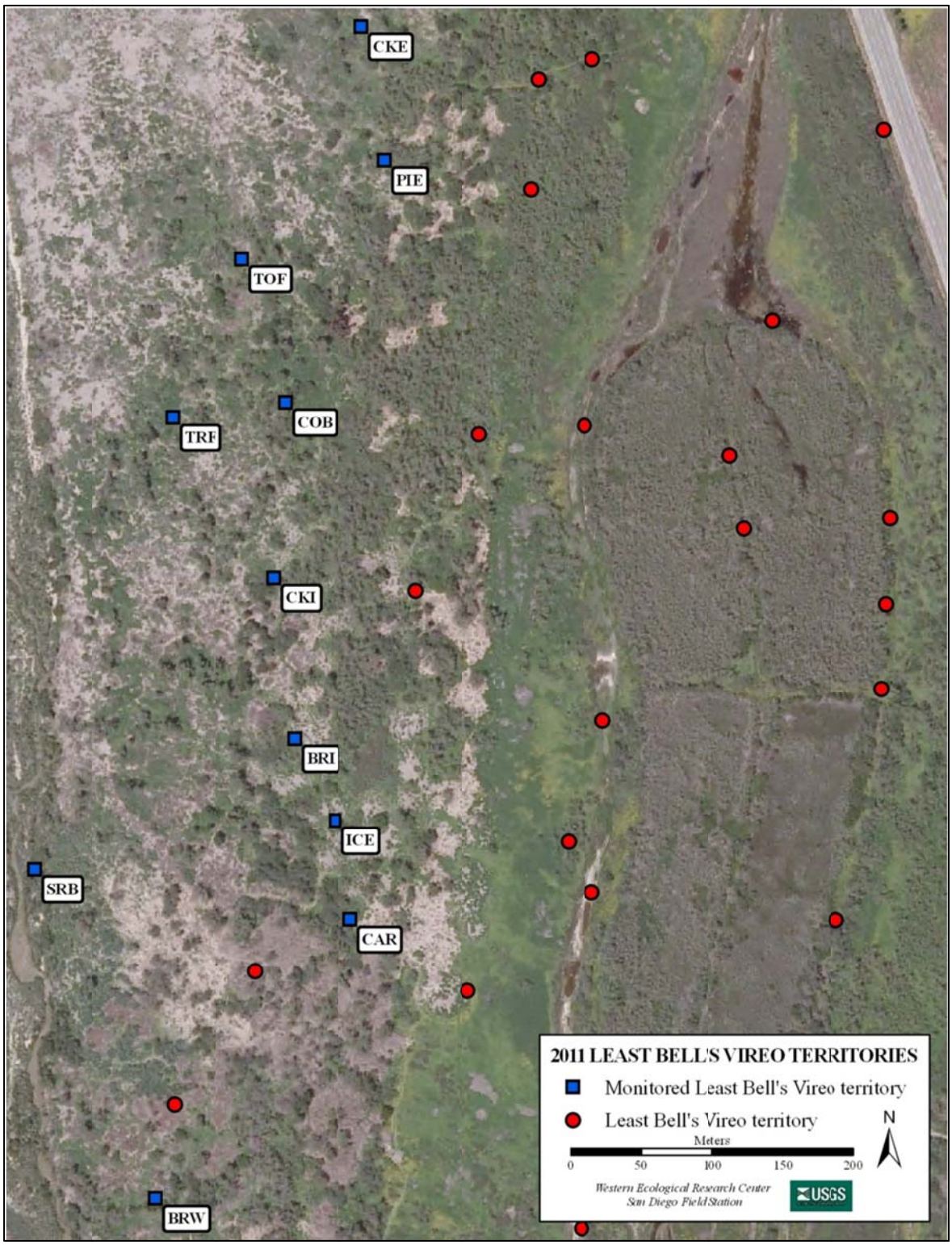

Fig. 7. Locations of monitored Least Bell's Vireo territories at the Bell giant reed (*Arundo donax*) Removal site, Marine Corps Base Camp Pendleton, 2011.

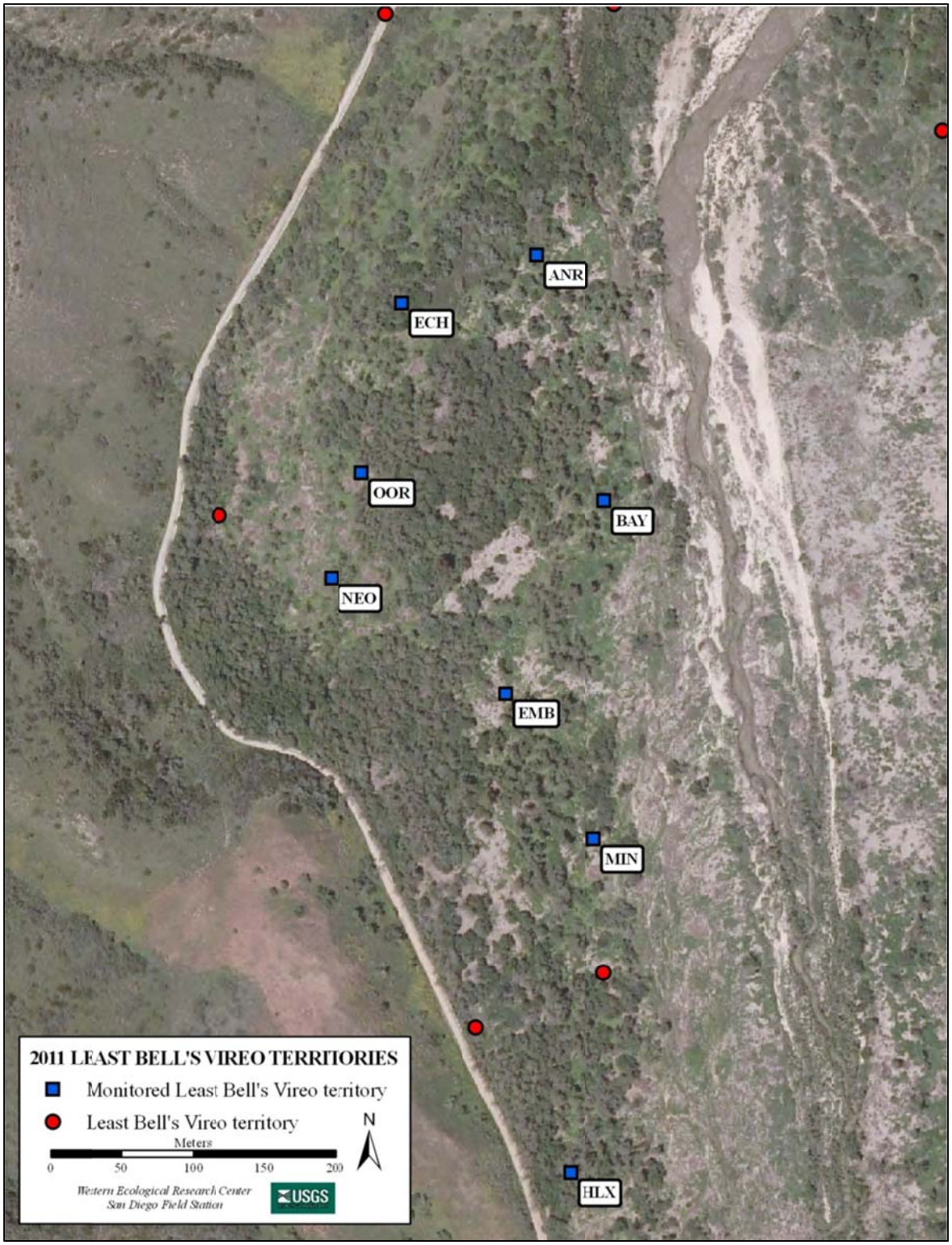

Fig. 8. Locations of monitored Least Bell's Vireo territories at the Pump Road giant reed (*Arundo donax*) Removal site, Marine Corps Base Camp Pendleton, 2011.

Nest Success

Nests in Removal sites were equally likely to be successful as nests in Reference sites (Fisher's Exact Test, $P > 0.99$), as 50% (4/8) of Removal nests successfully fledged young while 60% (3/5) of Reference nests successfully fledged young (Table 13).

Table 13. Fate of Least Bell's Vireo nests in monitored territories, Marine Corps Base Camp Pendleton, 2011. Numbers in parentheses are proportions of total nests.

	Number of Nests		
Nest Fate	**Removal**	**Reference**	**Total**
Successful	4	3	7 (0.54)
Failed			
Predation	3	1	4 (0.31)
Parasitism	0	0	0 (0.00)
Other/Unknown	1	1	2 (0.15)
Total Completed Nests	8	5	13 (1.00)

Causes of nest failure were similar at Removal and Reference sites. Predation was believed to be the primary source of nest failure, although no predation events were witnessed (Table 13). Predation accounted for 75% (3/4) of nest failures at Removal sites and 50% (1/2) of nest failures at Reference sites. We also documented two nests that failed for unknown reasons at our study sites. One nest at a Removal site failed between nest-building and egg-laying from unknown causes. One nest at a Reference site failed from unknown causes during incubation. Overall, 50% and 40% 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 2011.

Productivity

Clutch size was larger at Removal sites than at Reference sites (Table 14). Measures of hatching success were greater at Removal sites and measures of fledging success were greater at Reference sites, although the sample size was low for both of these comparisons. We documented 18 fledglings from seven monitored nests. In addition, we observed 36 dependent fledglings at 21 other monitored territories for a minimum of 54 fledglings produced by monitored pairs. Assuming these fledglings came from the territory where they were observed, 53% (10/19) of pairs at Removal sites and 78% (18/23) of pairs at Reference sites were ultimately successful in fledging young from at least one nest.

Table 14. Reproductive success and productivity of nesting Least Bell's Vireos at giant reed (*Arundo donax*) Removal and Reference sites, Marine Corps Base Camp Pendleton, 2011. Means are presented with standard deviations.

Parameter	Removal Sites	Reference Sites	Total
Nests with eggs	7	5	12
Eggs laid	22	14	36
Average clutch size[a]	3.5 ± 0.7	3.0 ± 0.0	3.3 ± 0.5
Hatchlings	21	8	29
Nests with hatchlings	7	3	10
Hatching success:			
Eggs[b]	95%	57%	81%
Nests[c]	100%	60%	83%
Fledglings	11	7	18
Nests with fledglings	4	3	7
Fledging success:			
Hatchlings[d]	52%	88%	62%
Nests[e]	57%	100%	70%
Fledglings per egg	0.5	0.5	0.5
Fledglings per nest	1.6	1.4	1.5
Minimum fledglings per pair[f]	1.1 ± 1.2	1.4 ± 1.0	1.2 ± 1.1
Pairs fledging ≥ 1 young[g]	10 (53%)	18 (78%)	28 (67%)

[a] Based on two Removal and two Reference non-parasitized nests with a full clutch.
[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] Minimum number of fledglings observed at all territories, including those where nests were not found.
[g] Based on territories where fledglings were detected.

Population Density

The density of the vireo population decreased in 2011 at both the Removal and Reference sites (Fig. 9). However, vireo density at the Removal sites remained higher than before the removal of giant reed. Vireo density at the Reference sites continued a decline that began in 2009, and in 2011, density at Reference sites dropped below the density at Removal sites although this difference was not significant ($t = 1.977$, $P = 0.19$, df = 2). Vireo density at 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.

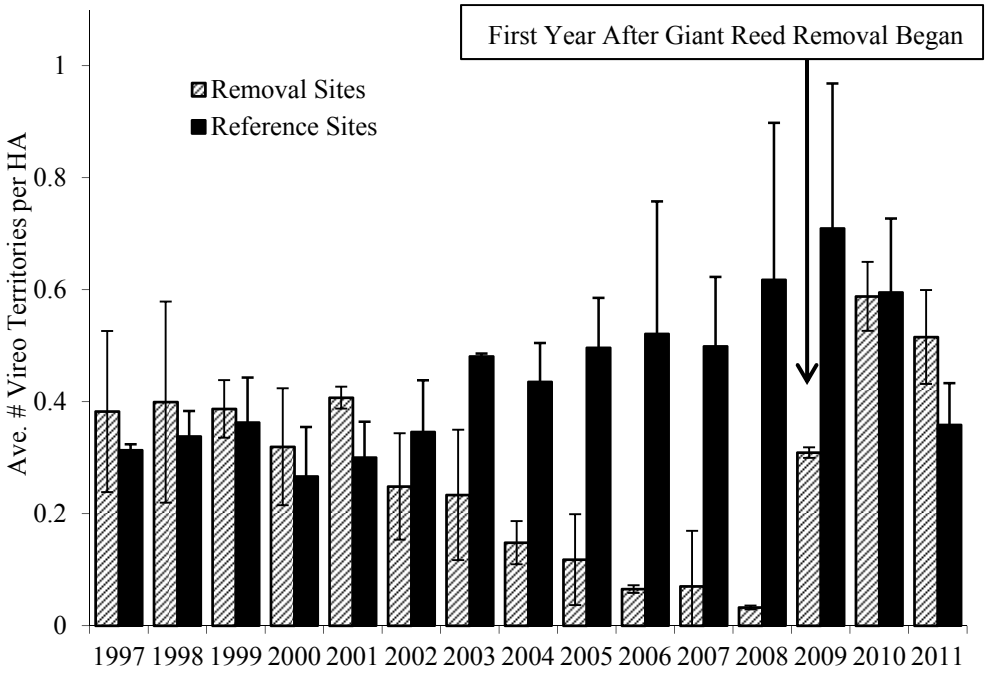

Fig. 9. Annual density of Least Bell's Vireo territories (± SD) at Reference and giant reed (*Arundo donax*) Removal sites by year, averaged across sites. (Source: Griffith Wildlife Biology 2004, Rourke and Kus 2006a, 2007a, 2008, Lynn and Kus 2009, 2010a, 2010b).

Nest Characteristics

Five plant species were used as hosts for vireo nests at Removal and Reference sites in 2011, although not all were used within each treatment (Table 15). Vireos used all five species at Removal sites and two of the five species at Reference sites. Seventy-seven percent of all nests (75% at Removal sites and 100% at Reference sites) were placed in arroyo willow, black willow, and mule fat (Table 15). One vireo nest was built in an exotic plant species (poison hemlock) at a Removal site.

Table 15. Host plant species used by Least Bell's Vireos at giant reed (*Arundo donax*) Removal and Reference sites, Marine Corps Base Camp Pendleton, 2011. Numbers in parentheses are proportions of total nests within treatment types.

	Number of Nests	
Host Species	**Removal**	**Reference**
Arroyo or red willow	3 (0.38)	3 (0.60)
Mule fat	2 (0.25)	2 (0.40)
Wild grape (*Vitis spp.*)	1 (0.13)	0 (0.00)
Poison hemlock	1 (0.13)	0 (0.00)
Black willow	1 (0.13)	0 (0.00)

In 2011, successful and unsuccessful nests within Removal and Reference sites were similar in placement. Vireo nests at Removal sites were placed further from the edge of the nest host, the nest clump, and the edge of riparian vegetation than nests in Reference sites (Table 16).

Table 16. Least Bell's Vireo nest characteristics and results of Mann-Whitney *U*-tests of successful vs. unsuccessful nesting attempts at giant reed (*Arundo donax*) Removal and Reference sites, Marine Corps Base Camp Pendleton, 2011.

	Nest Fate				
Nest Characteristic	**Successful**	**Unsuccessful**	***n*[a]**	***U*[b]**	***P*[c]**
Removal Site					
Average nest height (m)	1.60	0.91	(4, 3)	9.0	0.29
Average host height (m)	5.63	3.18	(4, 4)	13.0	0.15
Average distance to edge of host (m)	1.39	0.86	(4, 3)	8.0	0.48
Average distance to edge of clump (m)	1.61	1.55	(4, 3)	5.0	0.72
Average distance to edge of riparian vegetation (m)	77.75	75.00	(4, 4)	8.0	> 0.99
Reference Site					
Average nest height (m)	0.97	1.14	(3, 2)	2.0	0.56
Average host height (m)	5.50	3.75	(3, 2)	4.5	0.37
Average distance to edge of host (m)	0.24	1.22	(3, 2)	0.0	**0.08**
Average distance to edge of clump (m)	0.42	1.22	(3, 2)	1.0	0.25
Average distance to edge of riparian vegetation (m)	33.33	5.32	(3, 2)	5.5	0.14
Overall	**Removal**	**Reference**	*n*[d]	***U*[b]**	***P*[c]**
Average nest height (m)	1.30	1.04	(7, 5)	15.5	0.75
Average host height (m)	4.40	4.80	(8, 5)	24.0	0.56
Average distance to edge of host (m)	1.16	0.63	(7, 5)	7.0	**0.09**
Average distance to edge of clump (m)	1.58	0.74	(7, 5)	6.0	**0.06**
Average distance to edge of riparian vegetation (m)	76.38	22.13	(8, 5)	6.5	**0.04**

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

DISCUSSION

In 2011, the number of documented Least Bell's Vireo territories (784) on MCBCP dropped by 27% from the record high 2010 population. While this decrease may be partially explained by our late surveys, conducted during the time of year when vireo detectability is relatively low, there are indications that this may be a true population decline throughout much of the vireo's southern California range. A similar decrease in population from 2010 to 2011 was documented on the San Diego River (26%; Lynn and Kus 2011b), on the lower San Luis Rey River (17%; Ferree et al. 2011), at Sweetwater Reservoir (28%; Pottinger and Kus 2011), and at MCAS (31%; Lynn and Kus 2011a), where survey timing and frequency were consistent with previous years.

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, before declining in 2010 and again in 2011 (Ferree and Kus 2007, 2008a, 2008b, Ferree et al. 2010a, 2010b, 2011). 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 territories 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, and 49 territories in 2011 (Jones 1985; Kus 1988, 1989, 1991a, 1991b, 1994, 1995; Kus and Beck 1998; Peterson et al. 2002; Rourke and Kus 2006b, 2007b; Lynn and Kus 2008, Lynn et al. 2010a, USGS unpubl. data).

The 2011 vireo population on MCBCP (784) was similar to the average vireo population size between peak years (1998 and 2009; 777 ± 58), and may represent the lower end of the typical fluctuation in vireo population numbers with 1998, 2009, and 2010 representing the higher end. The increase from 2008 through 2010 can mainly be attributed to exceptionally high breeding productivity in 2008 and 2009, when vireos produced more fledglings than in previous years, and to subsequent high vireo survival 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. 2010a, Lynn et al. 2010a; USGS unpubl. data). Between 2006 and 2011, the annual vireo population size on MCBCP was strongly correlated with the number of vireo young fledged per pair the preceding year ($r = 0.93$). Therefore, the decrease in vireo numbers from 2010 to 2011 may partially be attributed to a decrease in number of young fledged per pair in 2010 compared to 2008 and 2009.

In addition to reduced productivity in 2010, adult survivorship from 2010 to 2011 was markedly lower than previous over-winter survivorship estimates. Many of the adult vireos that were not detected in 2011 were females, which generally have lower survivorship estimates because they are more difficult to detect than males. Typically, females are most easily observed early in the breeding season when they are travelling with males, building nests, and tending nestlings or fledglings. Later in the breeding season, females are less conspicuous and may even have moved away from their breeding territories, and their existence at a territory may often be

assumed only by the presence of fledglings. In 2011, only 24% of females were observed well enough to determine whether or not they were banded. Consequently, many females that were identified in 2010 may have been present in 2011 but not detected, causing us to under-estimate adult survivorship. Juvenile survivorship also appears to have declined in the two years since 2009, although our estimate for 2011 may be low for similar reasons. In subsequent years, as the likelihood of detecting and identifying color bands increases, adult and first-year survivorship are likely to increase to include those vireos that were alive in 2011 but were not identified.

Annual survivorship estimates for adult and/or first-year Least Bell's Vireos from MCBCP have been enhanced each year by the detection of emigrants off Base. In 2011, three vireos banded as nestlings on MCBCP were detected off Base, One first-year male was found on Dulzura Creek, having dispersed almost 90 km from his natal site. This represents the second longest dispersal distance recorded for juveniles that hatched at MCBCP since 2005. Another male, banded in 2008, was found at Sweetwater Reservoir. A third vireo (female) that was in 2008 was found at MCAS. 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, and in the past, a few vireos each year that had been banded as nestlings on MCBCP were detected breeding along the San Luis Rey River. Although no first-year vireos from MCBCP were detected on the San Luis Rey River in 2011, 12 vireos originally banded on the San Luis Rey River were resighted on Base (four newly found in 2011), demonstrating that dispersal between the drainages continues to occur. These movements demonstrate the ability of vireos to disperse well 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 lifetime 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.

Although vireo numbers were reduced Base-wide in 2011, territory density decreased less at Removal sites than at the Reference sites between 2010 and 2011, suggesting that vireo habitat continues to improve at Removal sites, and that this habitat improvement offset the apparent decrease in vireo density elsewhere where habitat was not exhibiting similar succession. Prior to giant reed removal at Removal sites, vireo territory density had decreased consistently from year-to-year, starting in 2002, likely in response to 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 left a somewhat sparse understory and therefore little breeding habitat for vireos. As the native understory and canopy plant species recover, we predict a corresponding recovery in vireo numbers. In 2009, vireo density began increasing at Removal sites, presumably in response to recovery of understory vegetation. Vireo density at Removal sites equaled that at the Reference sites by 2010, and exceeded it in 2011.

Breeding productivity in general did not differ between Removal and Reference sites, although this may be a result of low sample size of monitored nests in 2011. The percent of pairs that fledged at least one young overall in 2011 (67%) was lower than in all previous years (2010 = 72%, 2009 = 89%, 2008 = 94%, 2005 = 89%, 2006 = 79%, 2007 = 89%, and 2008 = 94%; Rourke and Kus 2006a, 2007a, 2008, Lynn and Kus 2009, 2010a, 2010b). However, the estimate for 2011 is based on the number of territories where fledglings were detected rather than through monitoring and known outcome of all nests at a territory as in past years. Nevertheless, our estimate is comparable to that for the San Luis Rey River, where 68% of pairs fledged at least one young in 2011 (Ferree et al. 2011). Similar to previous years, we did not find vireo nests parasitized by Brown-headed Cowbirds, nor did we detect any adult vireos feeding juvenile Brown-headed Cowbirds.

We found no difference in first-year survivorship between Removal and Reference sites for vireos that hatched in 2010, and the dispersal of 2010 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.

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), and also the current decrease from 2010 to 2011. This pattern 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 2011. 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. The decrease in the vireo population in 2011 may indicate that carrying capacity of the current habitat was reached or exceeded in 2010, and that the population number has corrected downward to better reflect what habitat quality and extent can sustain.

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 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 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.

Human impacts to vireo habitat were not documented in 2011, although continued attention to potential impacts (weed control, off-road vehicle traffic) is warranted. 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.

Even though we began vireo surveys and monitoring late in 2011, we were able to collect essential data including a reasonable population count consistent with range-wide population numbers, resighting information for survivorship and movement calculations, territory density estimates in Removal and Reference sites, estimates of pair breeding success, and continuity in data collection and preparation for subsequent years' analyses. Nevertheless, contracting delays impacted the precision of these estimates. Additionally, as a result of contractual delays, we were unable to achieve some of our objectives in resighting effectiveness and breeding productivity analyses. In future years, timely identification and resolution of administrative constraints would allow the field season to begin on time and enable collection of a more complete dataset.

LITERATURE CITED

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

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. 2010a. 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. 2010b. 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.

Ferree, K., L. D. Allen, and B. E. Kus. 2011. 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. 2011 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.

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. 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.

Kus, Barbara, Steven L. Hopp, R. Roy Johnson and Bryan T. Brown. 2010. Bell's Vireo (Vireo bellii), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/035.

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 the Least Bell's Vireo at Marine Corps Base Camp Pendleton, California. 2010 Annual Report. Prepared for Assistant Chief of Staff, Environmental Security, Marine Corps Base Camp Pendleton.

Lynn, S. and B. E. Kus. 2010c. Distribution, abundance, and breeding activities of the 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. and B. E. Kus. 2011a. Distribution, abundance, and breeding activities of Least Bell's Vireo and Southwestern Willow Flycatcher at Marine Corps Air Station, Camp Pendleton, California. 2011 Data Summary. Prepared for Naval Facilities Engineering Command Southwest, San Diego, California.

Lynn, S., and B. E. Kus. 2011b. Distribution, abundance, and breeding activities of the Least Bell's Vireo along the San Diego River, California. 2011 Annual Data Summary. Prepared for the San Diego River Conservancy, 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.

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.

Pottinger, R. E. and B. E. Kus. 2011. Distribution, abundance, and breeding activities of the Least Bell's vireo along the Sweetwater River, California. 2011 Annual Data Summary. Unpublished report for the Sweetwater Authority, Spring Valley, 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.

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, 2011

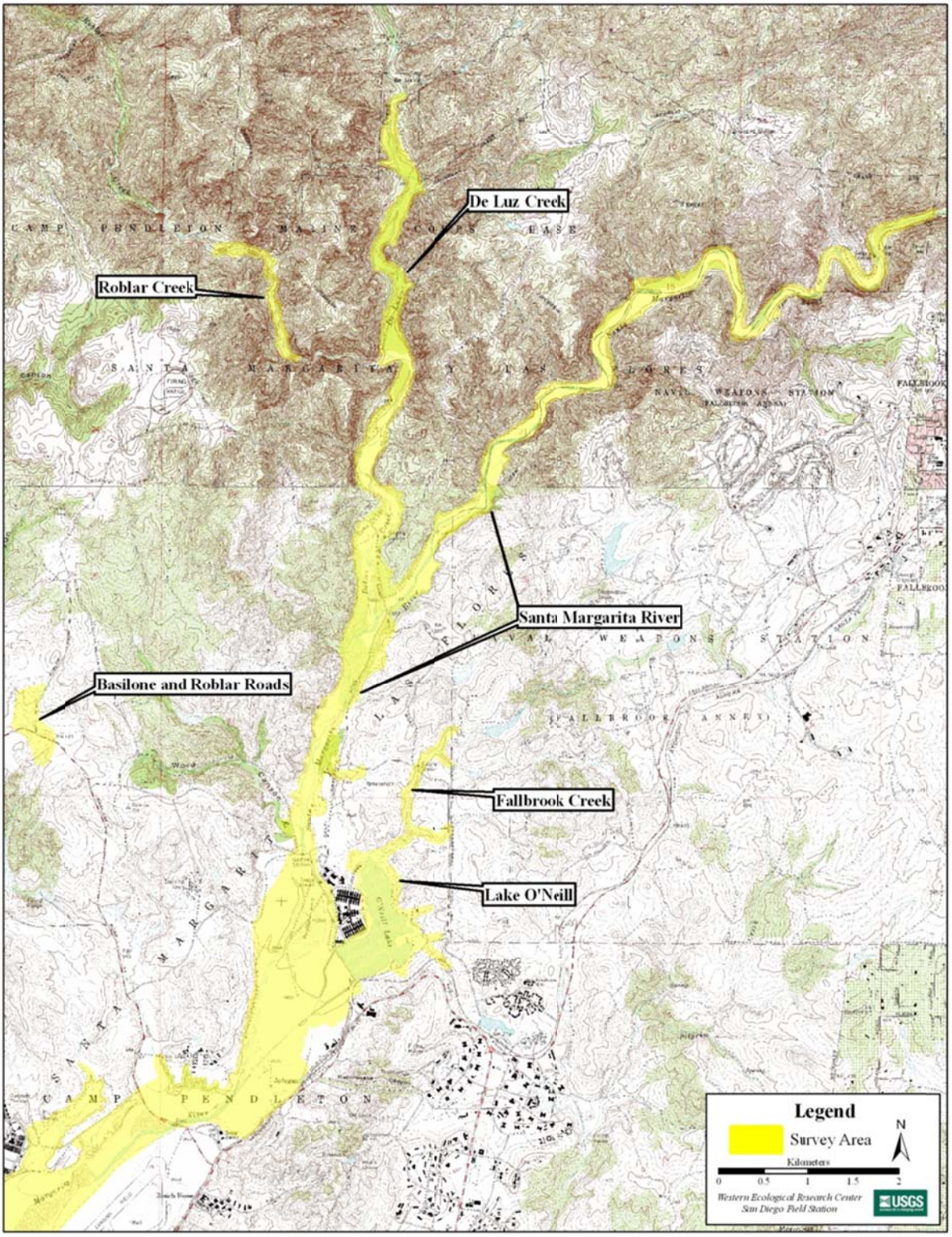

Fig. 10. Least Bell's Vireo survey areas at Marine Corps Base Camp Pendleton, 2011: Upper Santa Margarita River, Fallbrook Creek, Lake O'Neill, De Luz Creek, Roblar Creek, and Basilone and Roblar Roads.

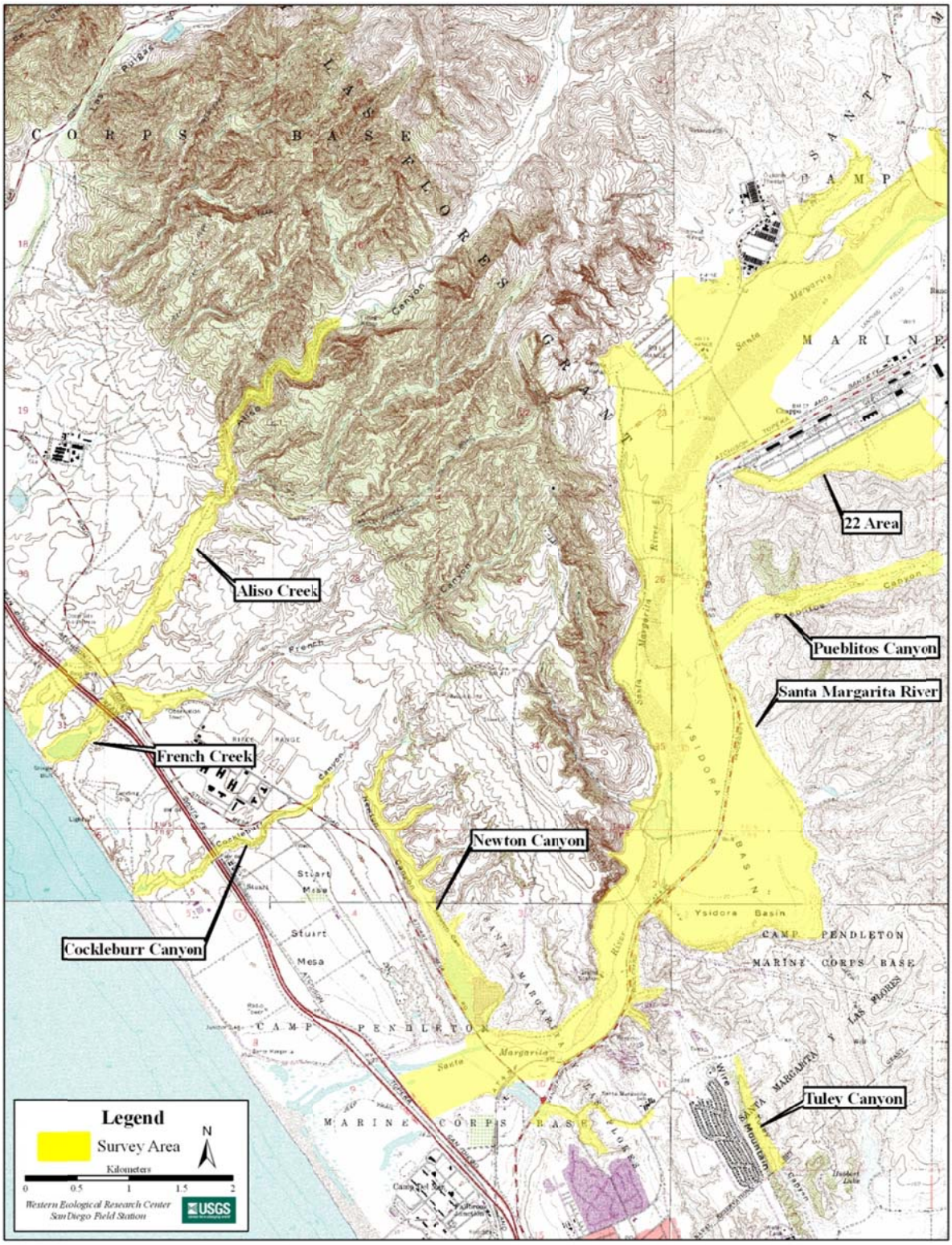

Fig. 11. Least Bell's Vireo survey areas at Marine Corps Base Camp Pendleton, 2011: Lower Santa Margarita River, 22 Area, Pueblitos Canyon, Tuley Canyon, Newton Canyon, Cockleburr Canyon, French Creek, and Aliso Creek.

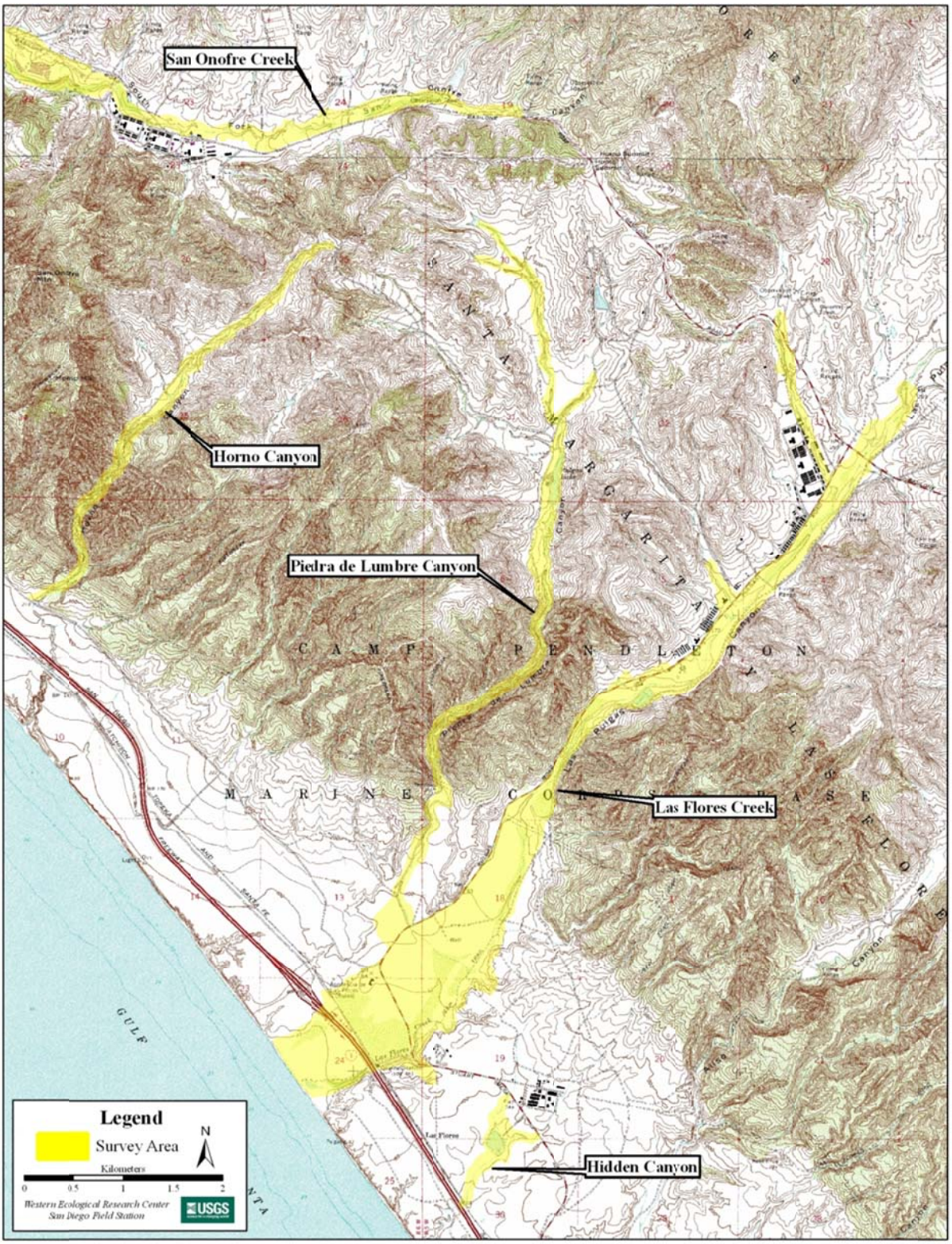

Fig. 12. Least Bell's Vireo survey areas at Marine Corps Base Camp Pendleton, 2011: San Onofre Creek South Fork, Horno Canyon, Piedra de Lumbre Canyon, Las Flores Creek, and Hidden Canyon.

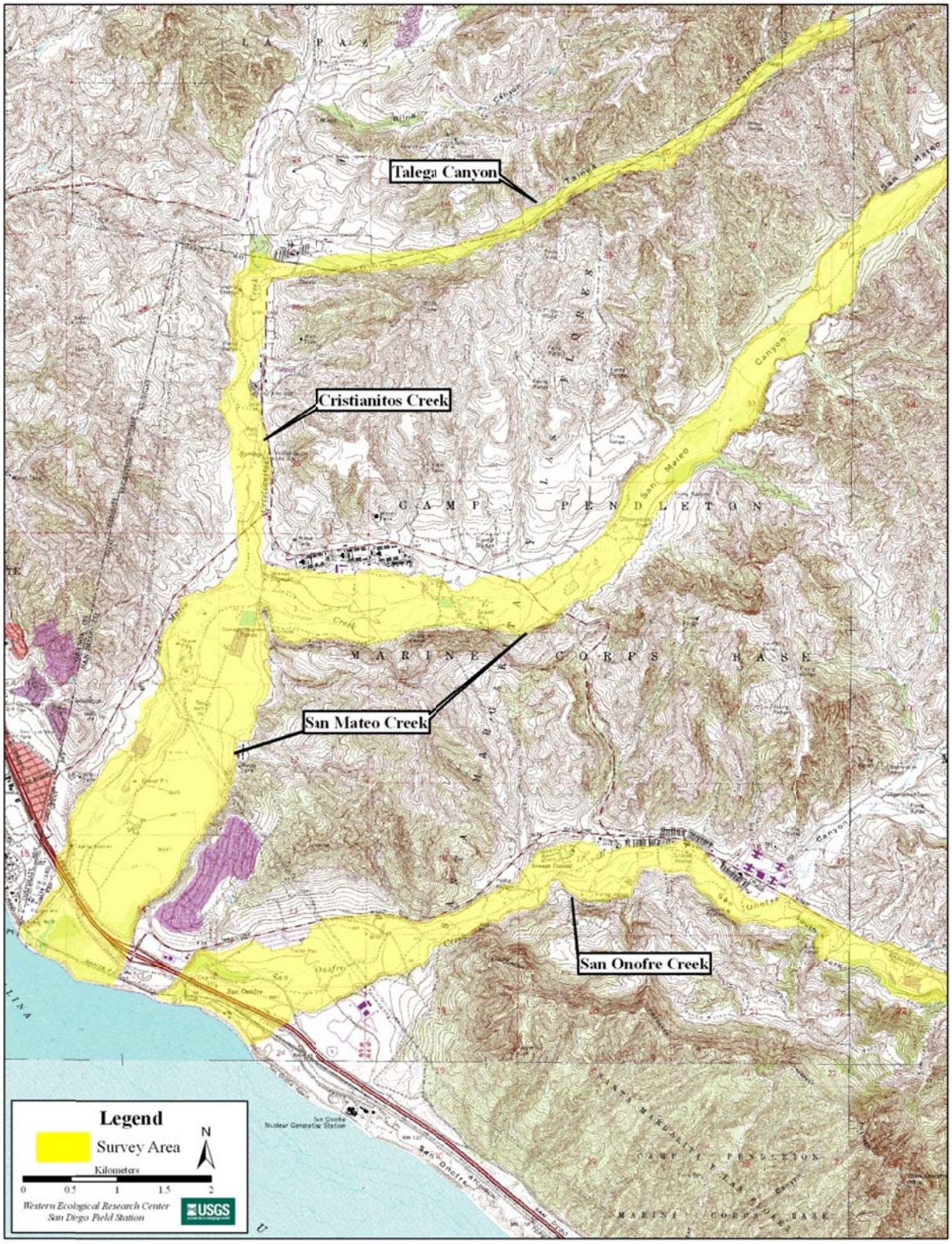

Fig. 13. Least Bell's Vireo survey areas at Marine Corps Base Camp Pendleton, 2011: Talega Canyon, Cristianitos Creek, San Mateo Creek, and San Onofre Creek.

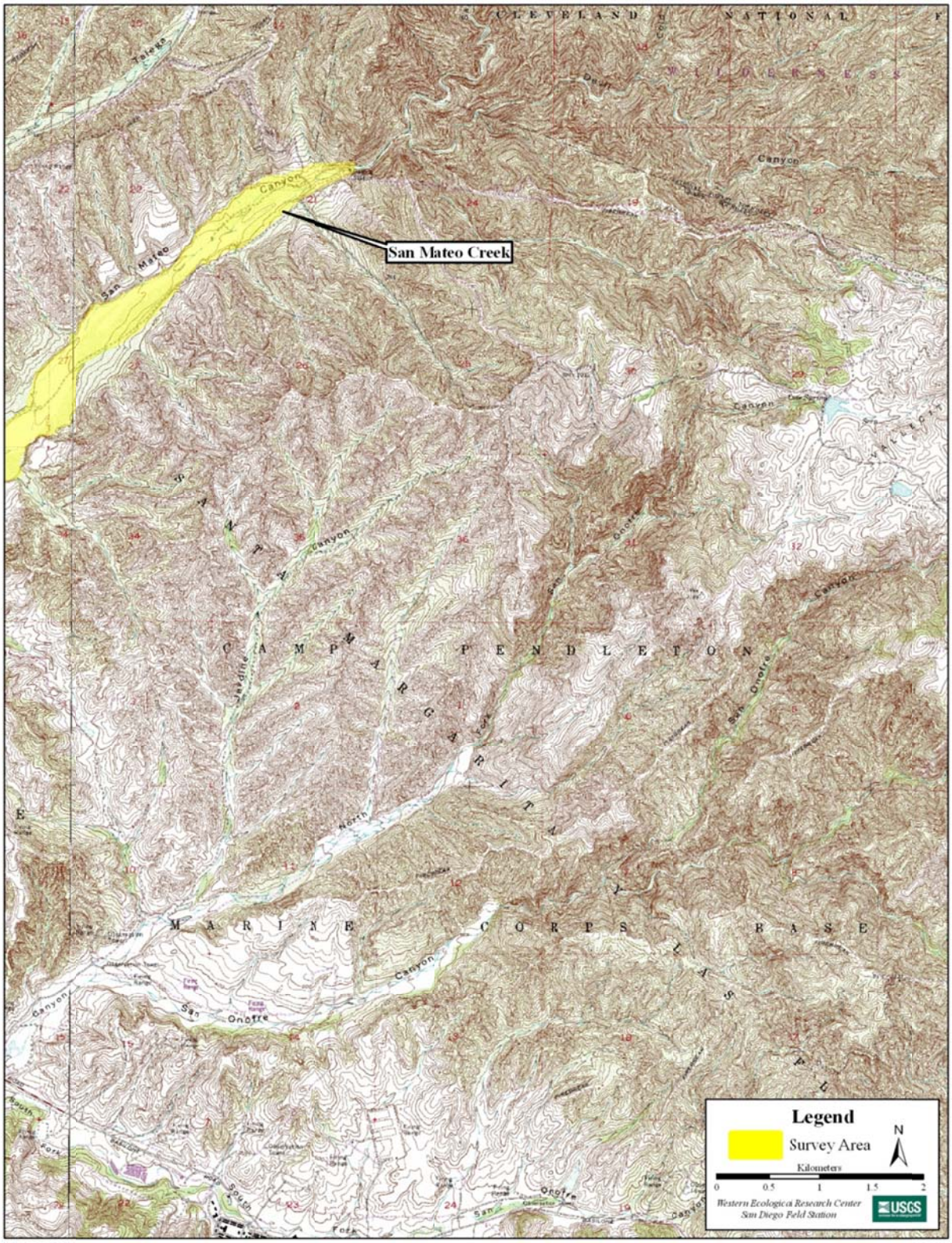

Fig. 14. Least Bell's Vireo survey areas at Marine Corps Base Camp Pendleton, 2011: Upper San Mateo Creek.

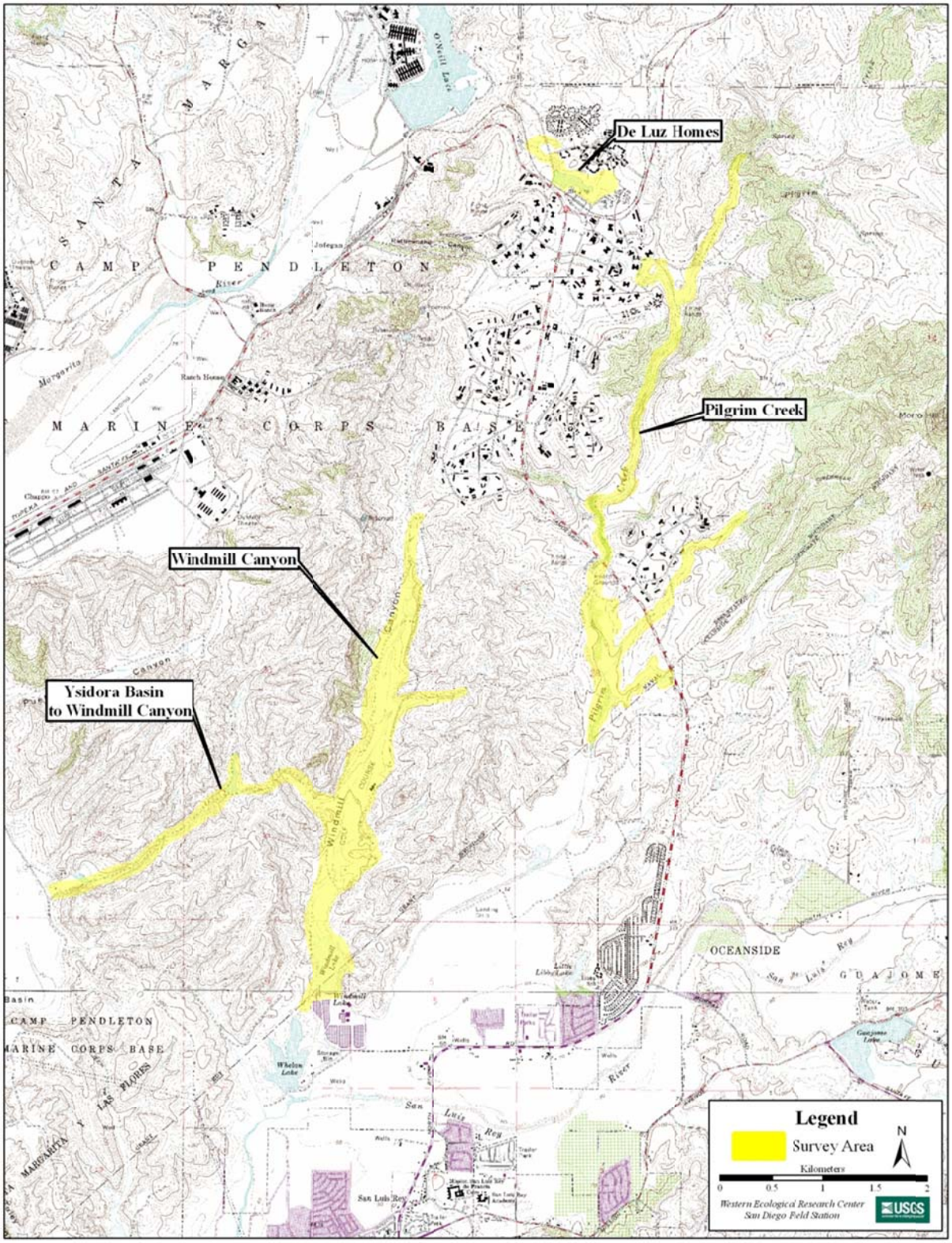

Fig. 15. Least Bell's Vireo survey areas at Marine Corps Base Camp Pendleton, 2011: Windmill Canyon, Ysidora Basin to Windmill Canyon, Pilgrim Creek, and De Luz Homes Habitat.

APPENDIX B

LOCATIONS OF LEAST BELL'S VIREOS AT MARINE CORPS BASE CAMP PENDLETON, 2011

Fig. 16. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2011: Upper Santa Margarita River.

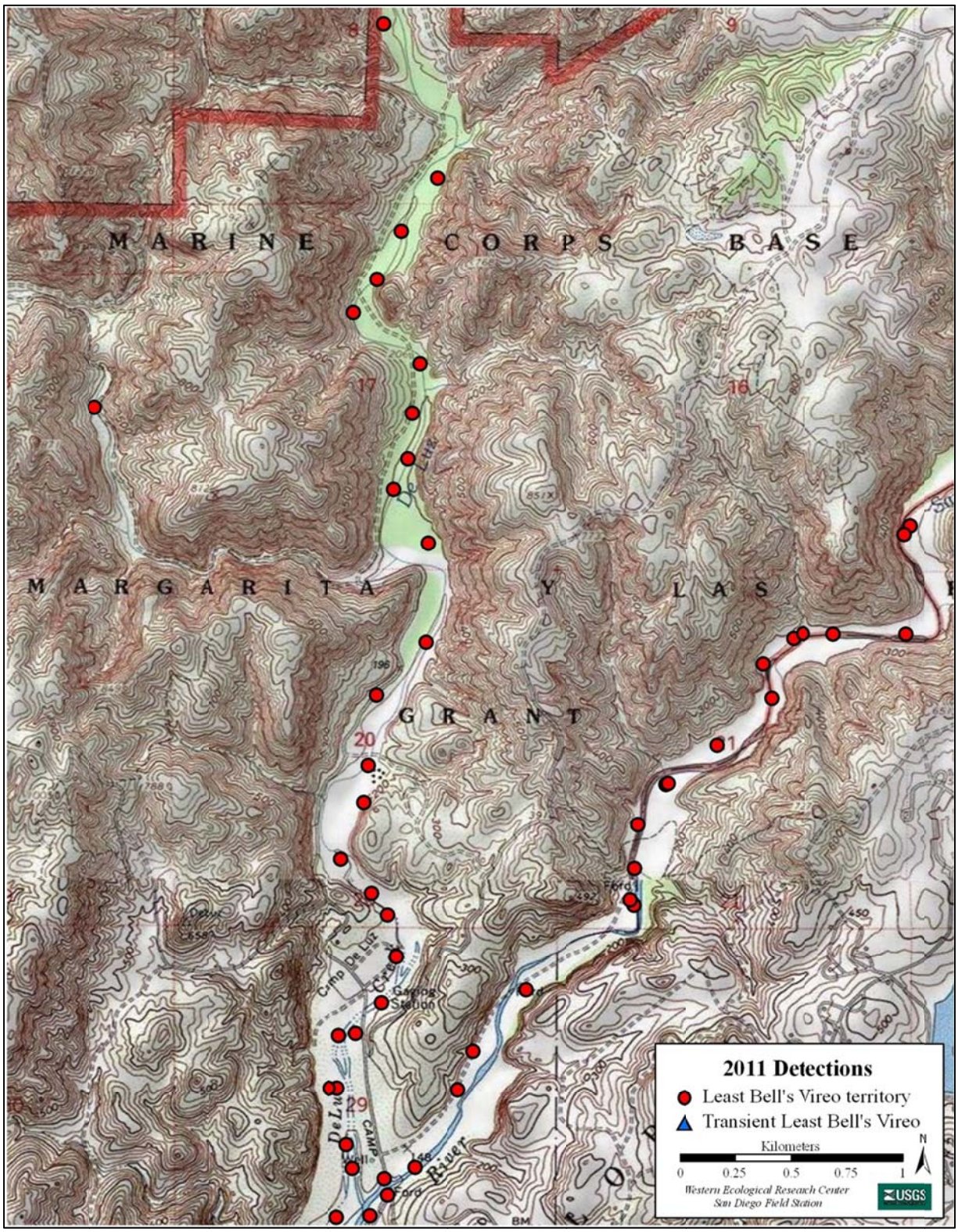

Fig. 17. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2011: Upper Santa Margarita River, De Luz Creek, and Roblar Creek.

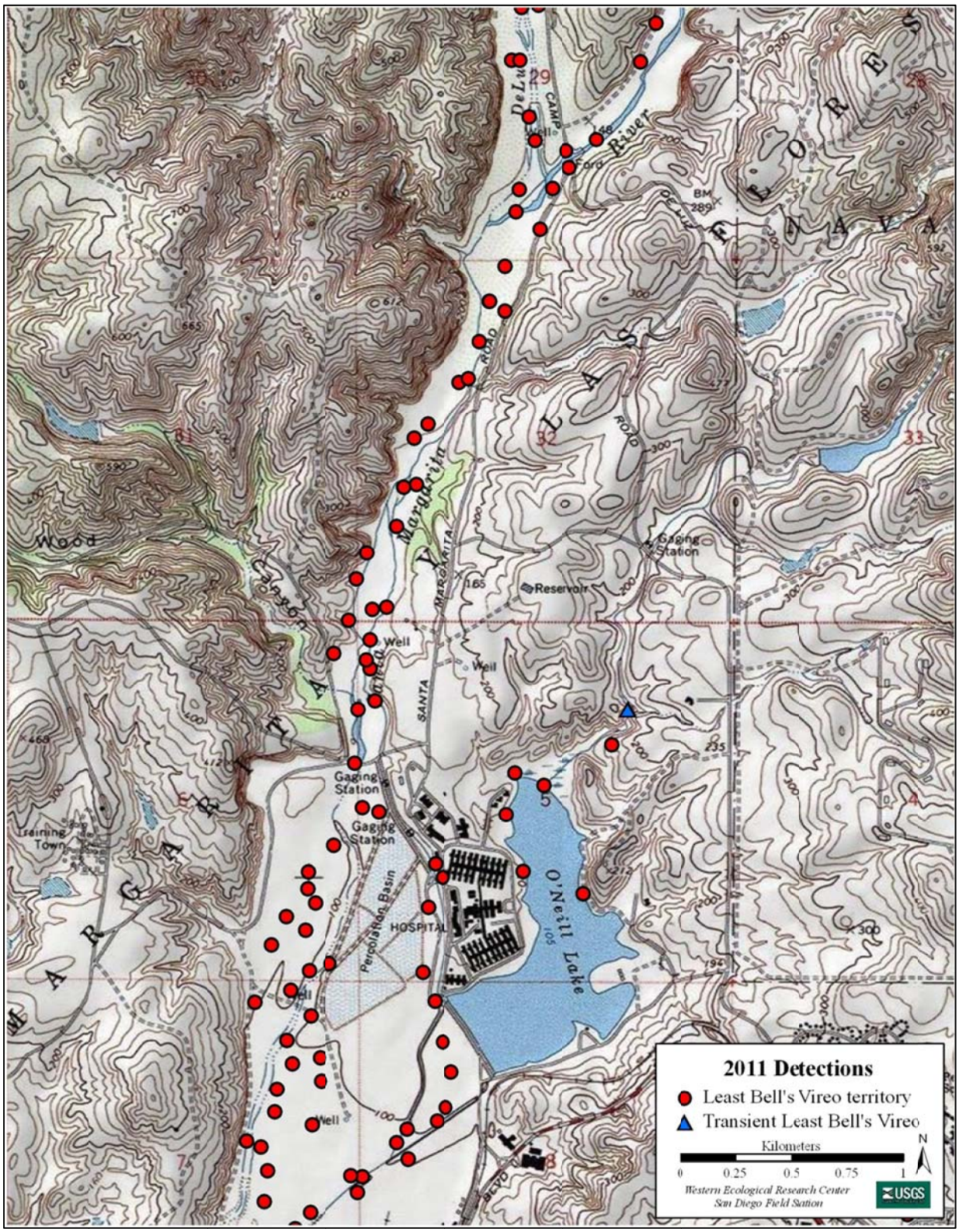

Fig. 18. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2011: Santa Margarita River, Lake O'Neill, and Fallbrook Creek.

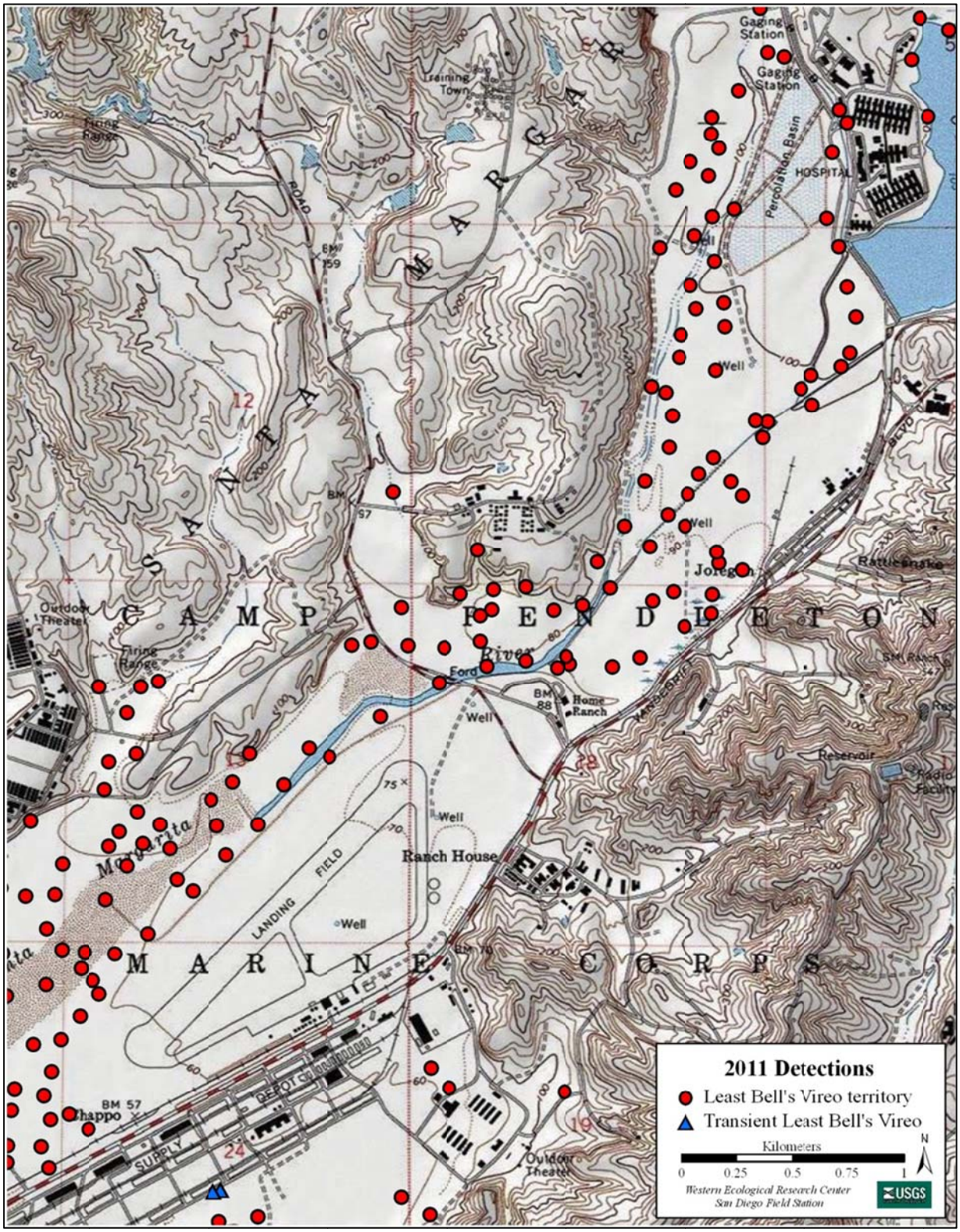

Fig. 19. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2011: Santa Margarita River.

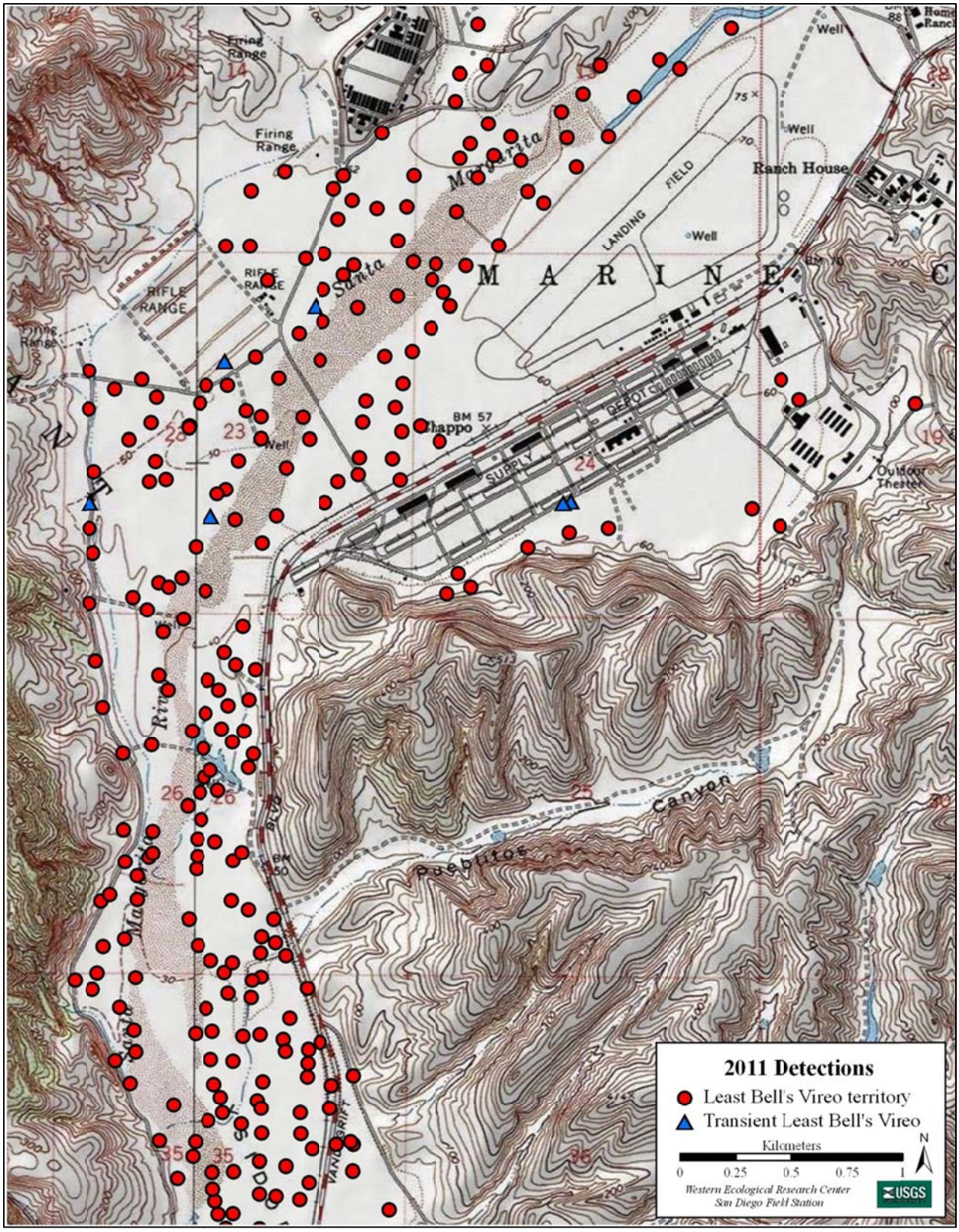

Fig. 20. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2011: Santa Margarita River, 22 Area, and Pueblitos Canyon.

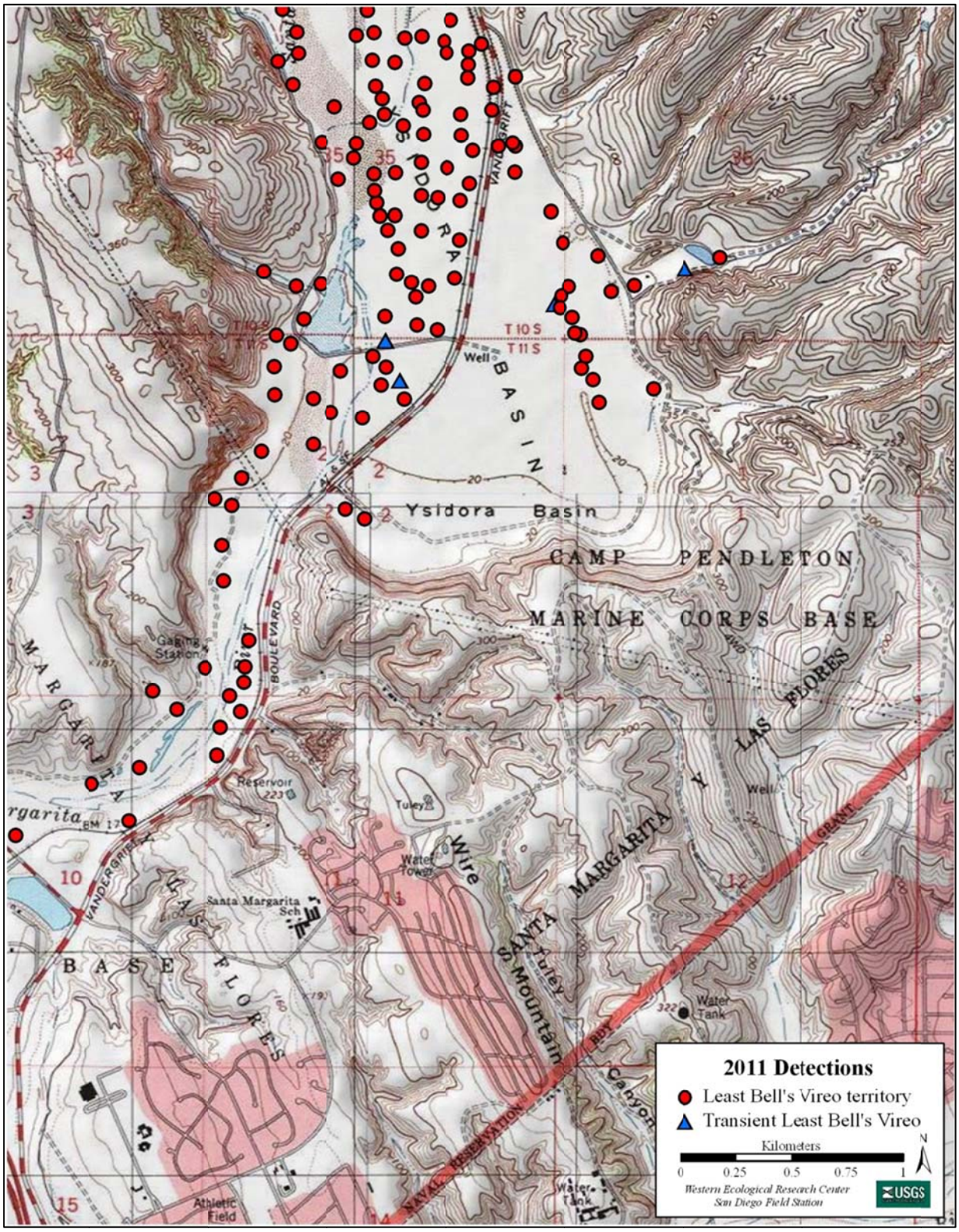

Fig. 21. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2011: Santa Margarita River, Ysidora Basin, and Ysidora Basin to Windmill Canyon.

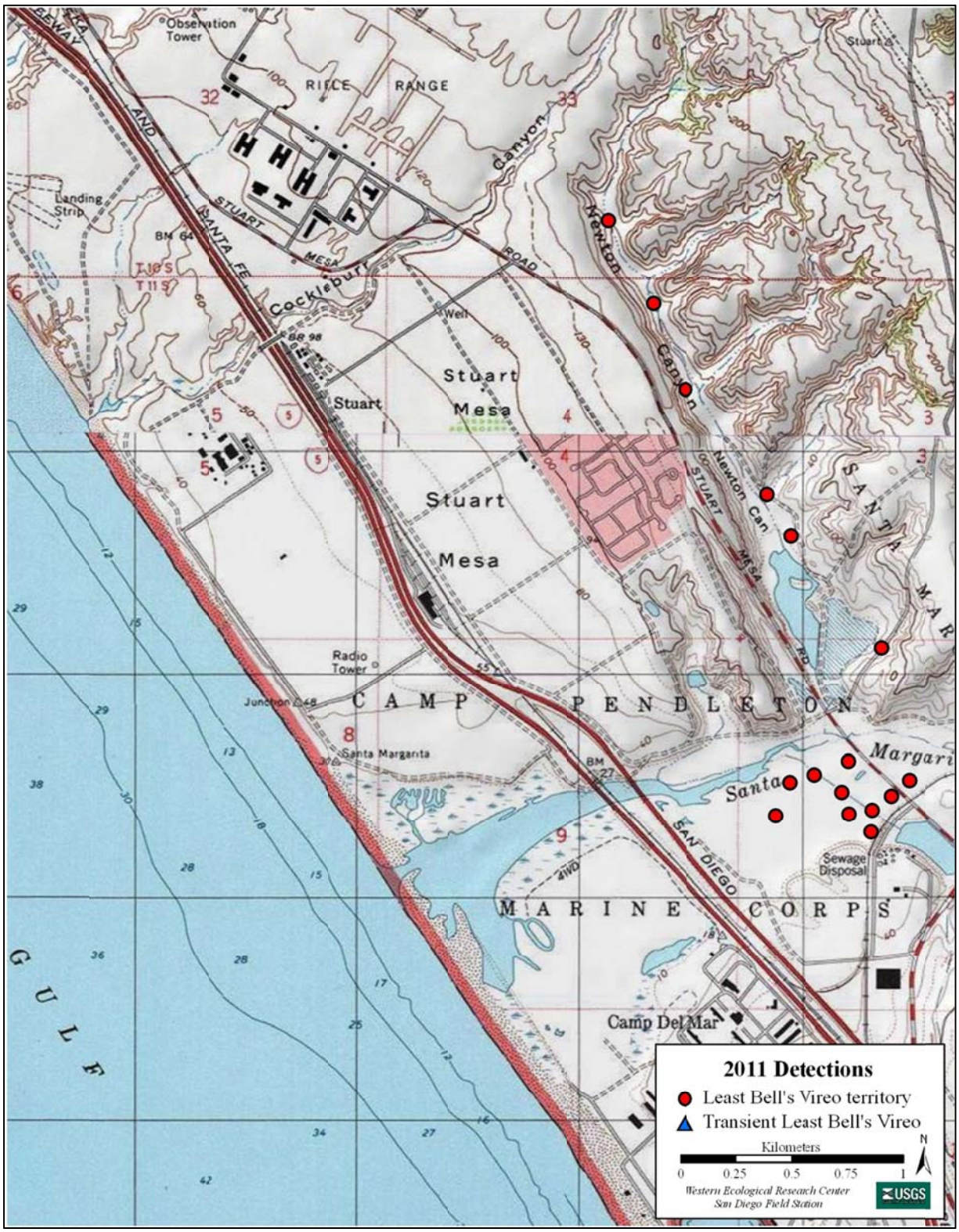

Fig. 22. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2011: Lower Santa Margarita River, Newton Canyon, and Cockleburr Canyon.

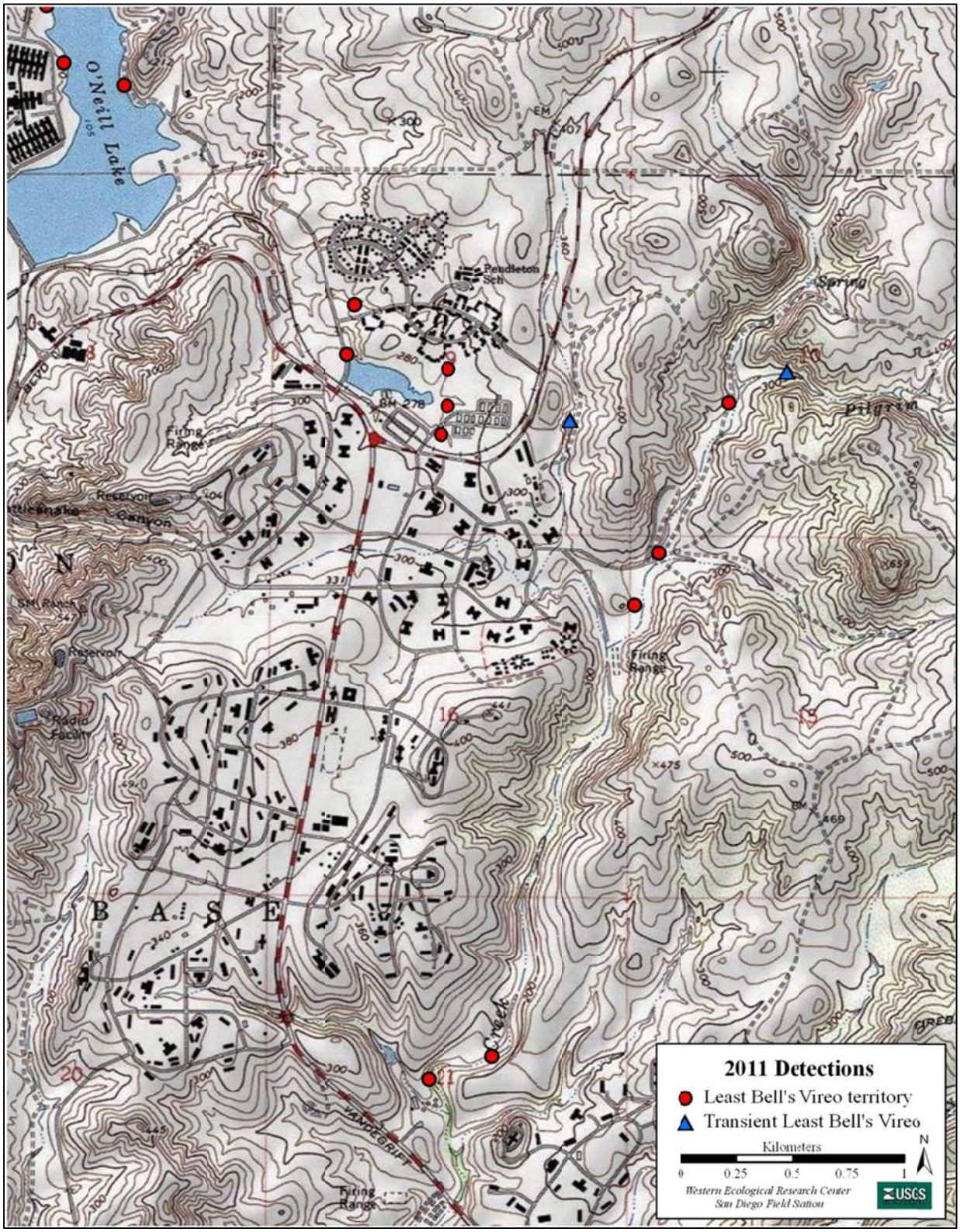

Fig. 23. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2011: Upper Pilgrim Creek, De Luz Homes Habitat, and Lake O'Neill.

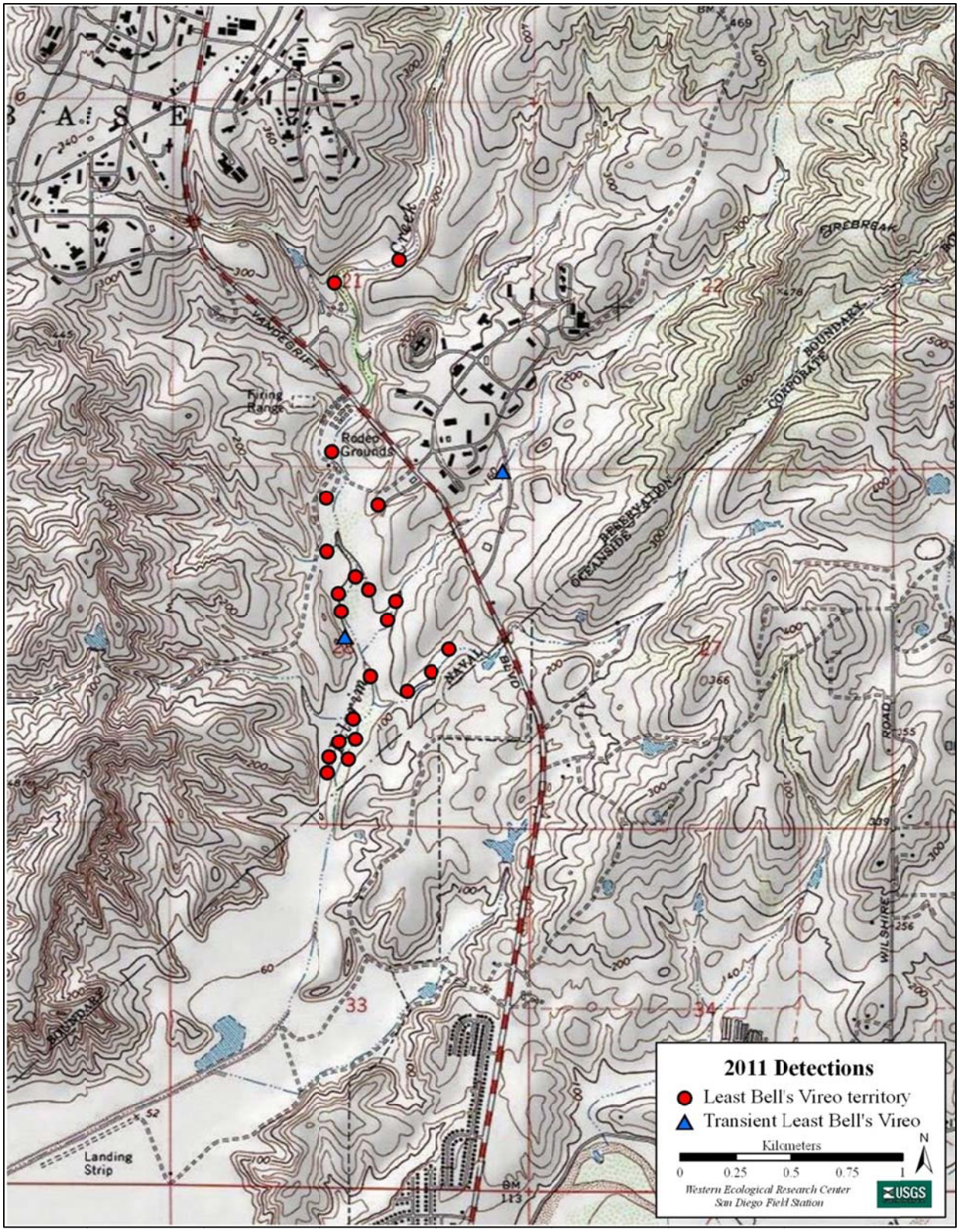

Fig. 24. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2011: Upper and Lower Pilgrim Creek.

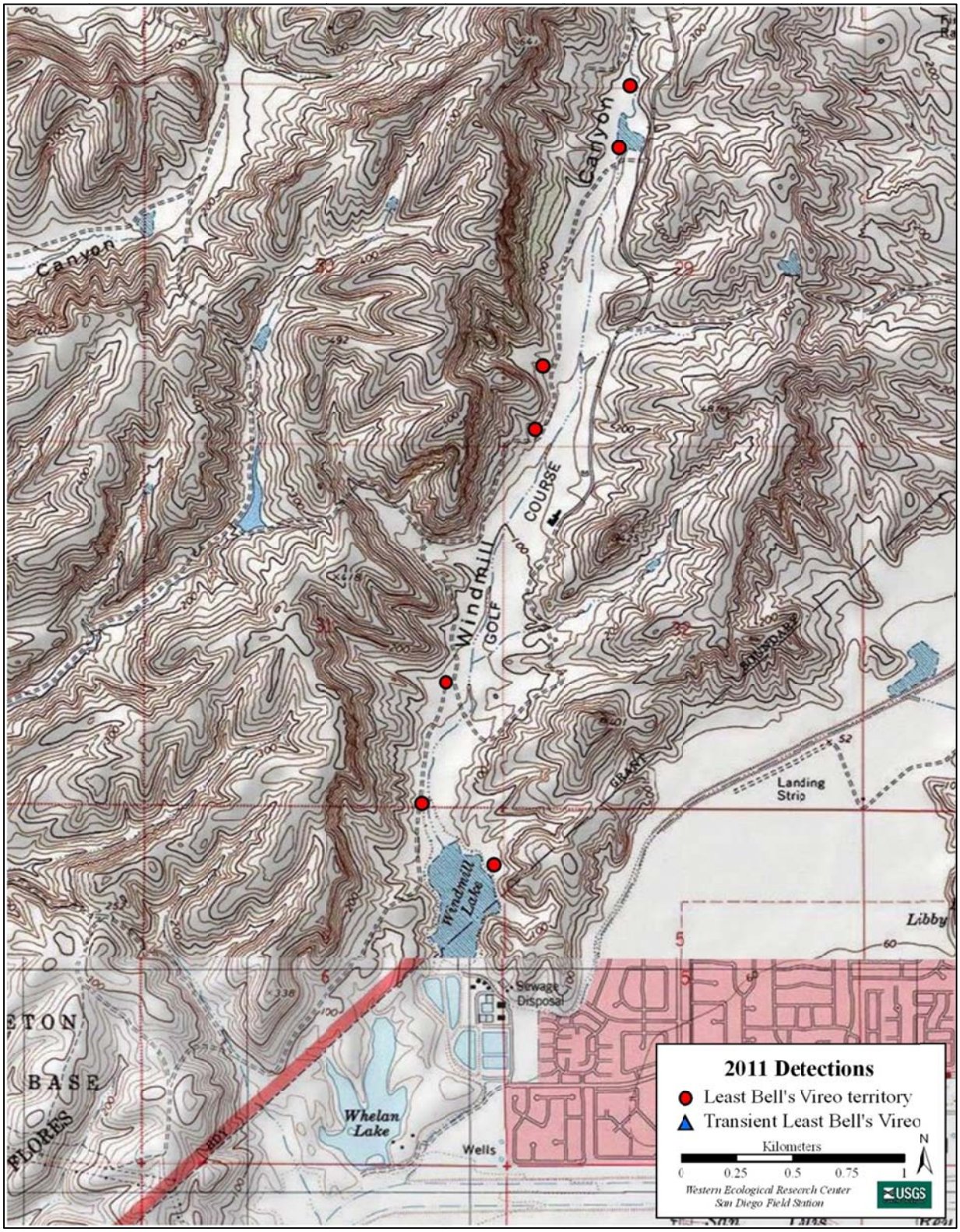

Fig. 25. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2011: Windmill Canyon and Ysidora Basin to Windmill Canyon.

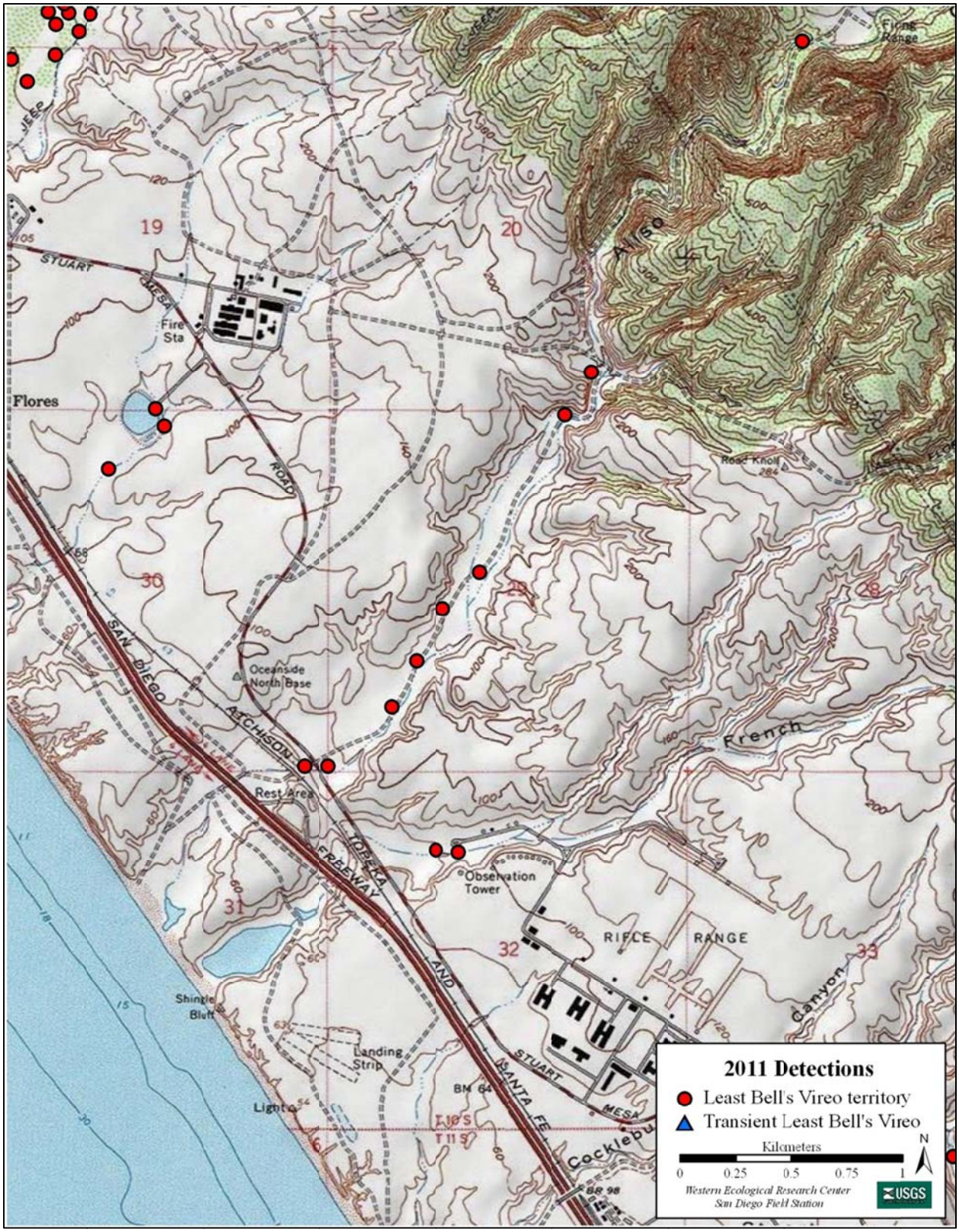

Fig. 26. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2011: French Creek, Aliso Creek, and Hidden Canyon.

Fig. 27. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2011: Basilone and Roblar Roads.

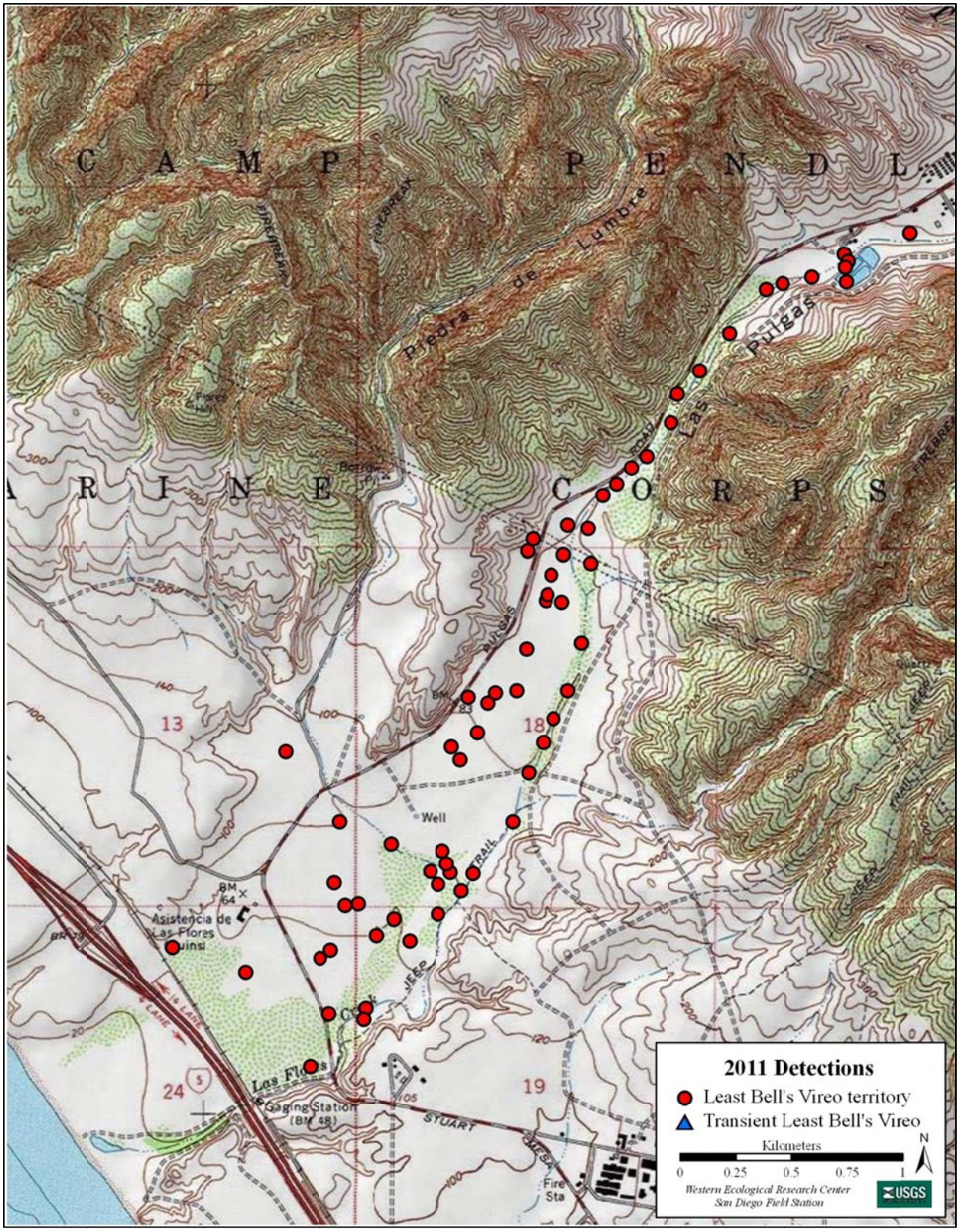

Fig. 28. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2011: Lower Las Flores Creek and Piedra de Lumbre Canyon.

Fig. 29. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2011: Piedra de Lumbre Canyon and Upper Las Flores Creek.

Fig. 30. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2011: Horno Canyon.

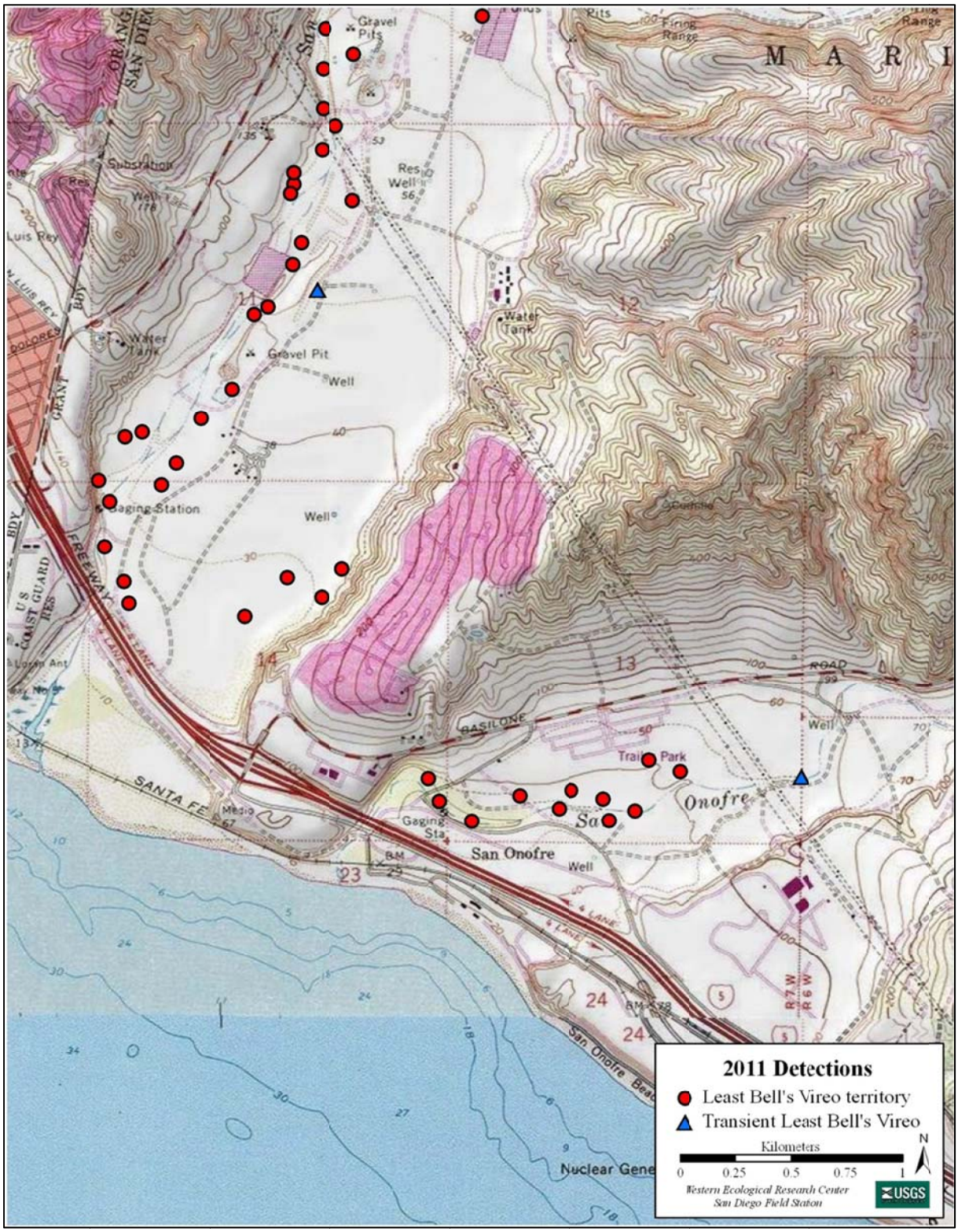

Fig. 31. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2011: Lower San Onofre Creek and Lower San Mateo Creek.

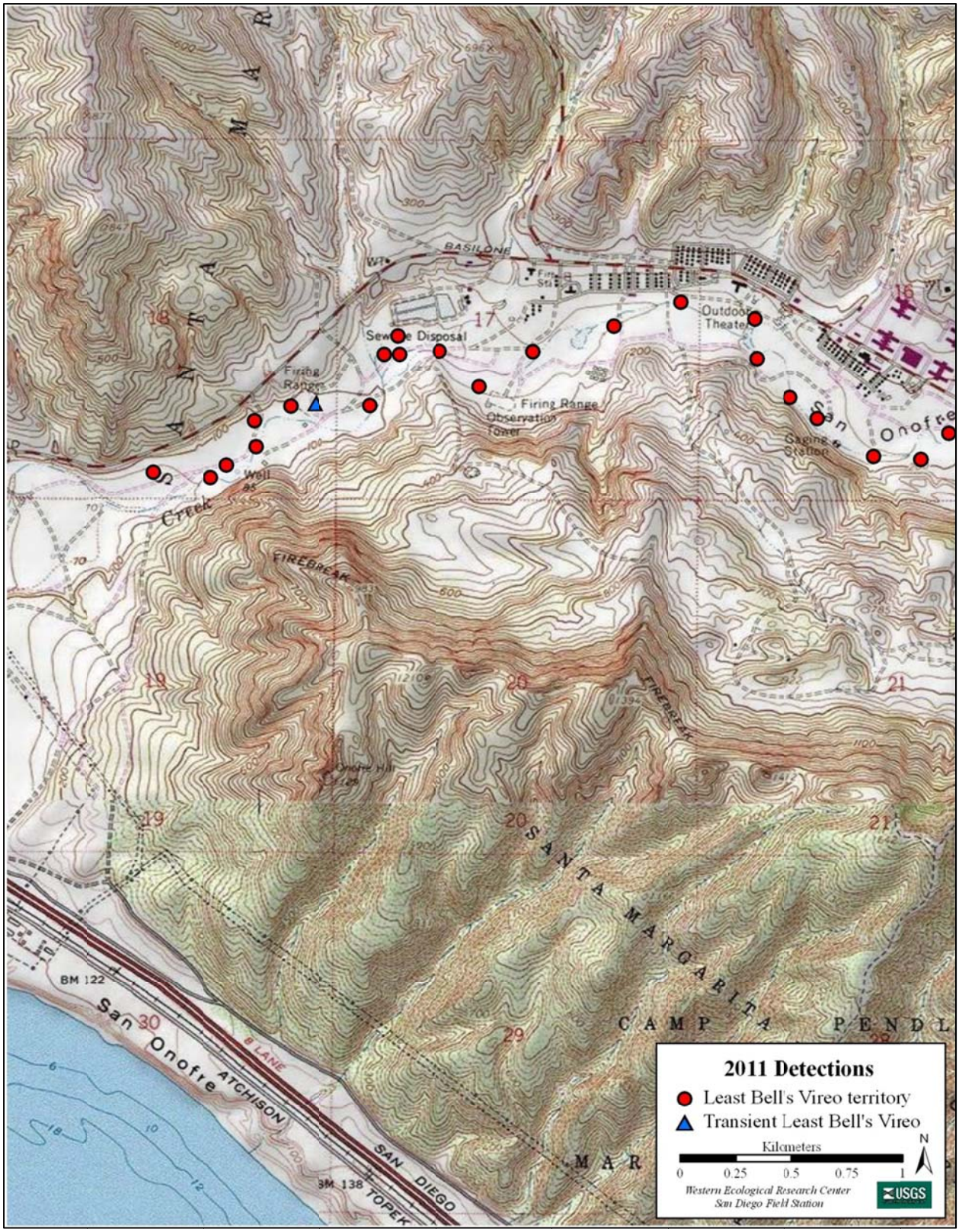

Fig. 32. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2011: San Onofre Creek.

Fig. 33. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2011: South Fork San Onofre Creek.

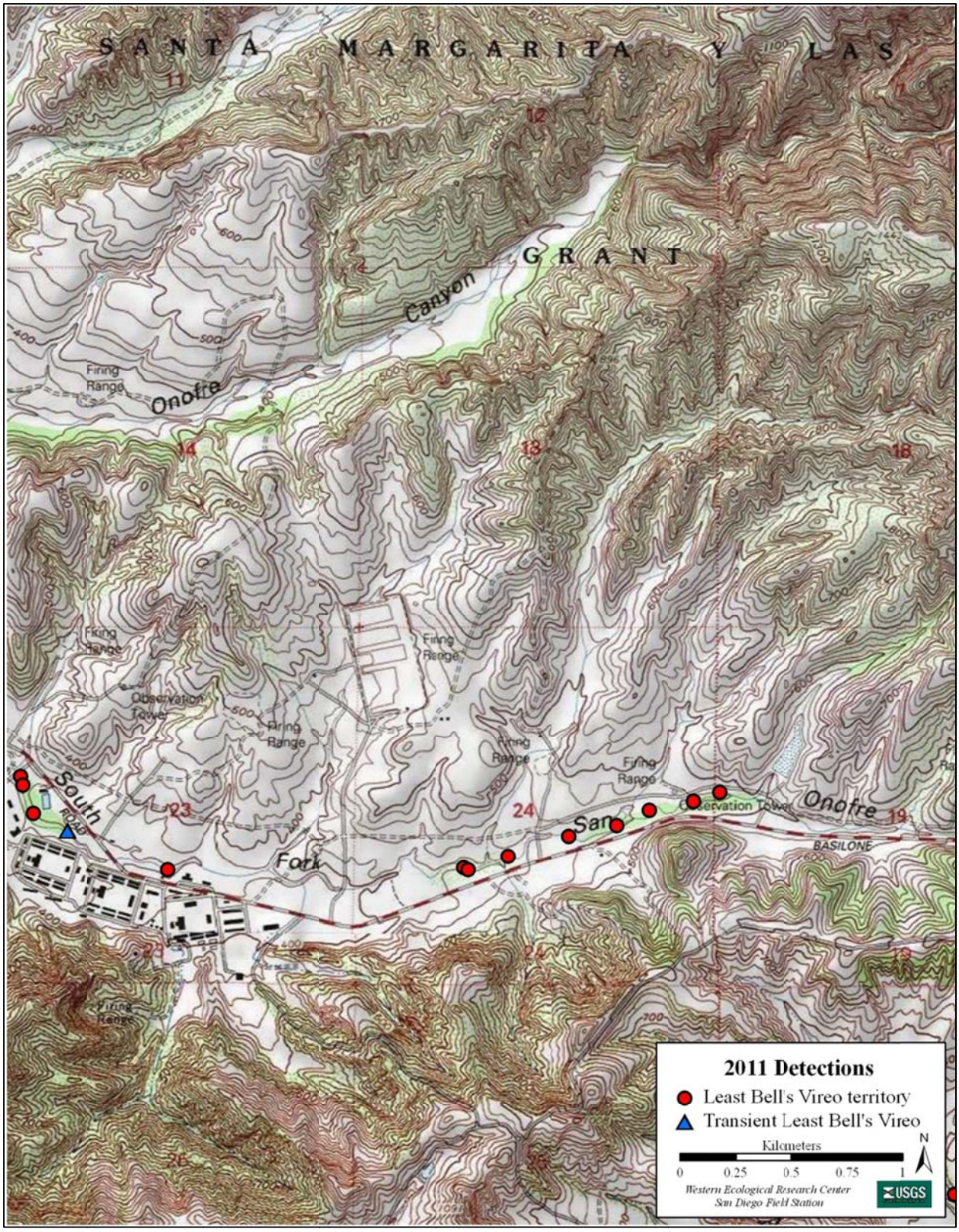

Fig. 34. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2011: San Onofre Creek.

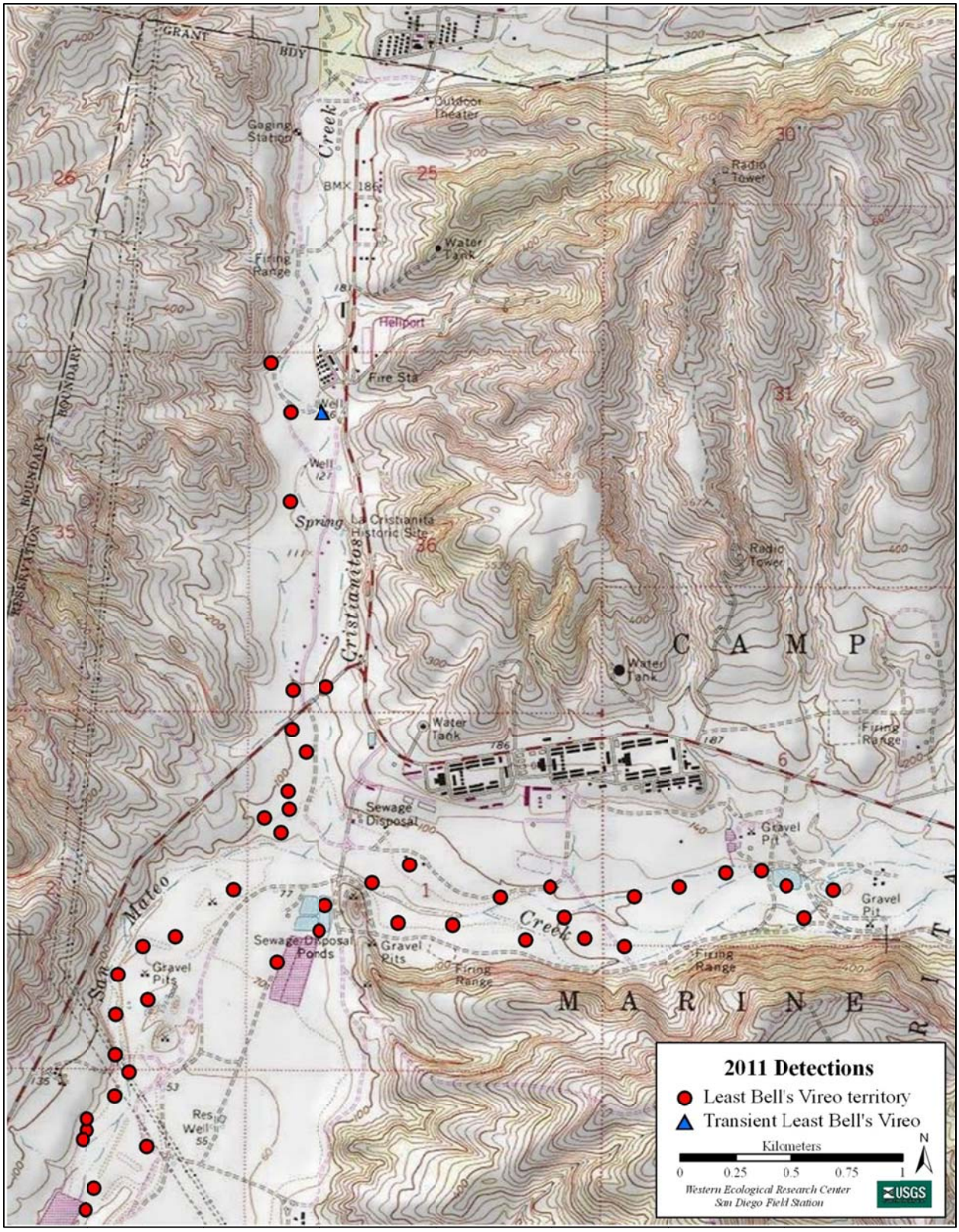

Fig. 35. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2011: San Mateo Creek and Cristianitos Creek.

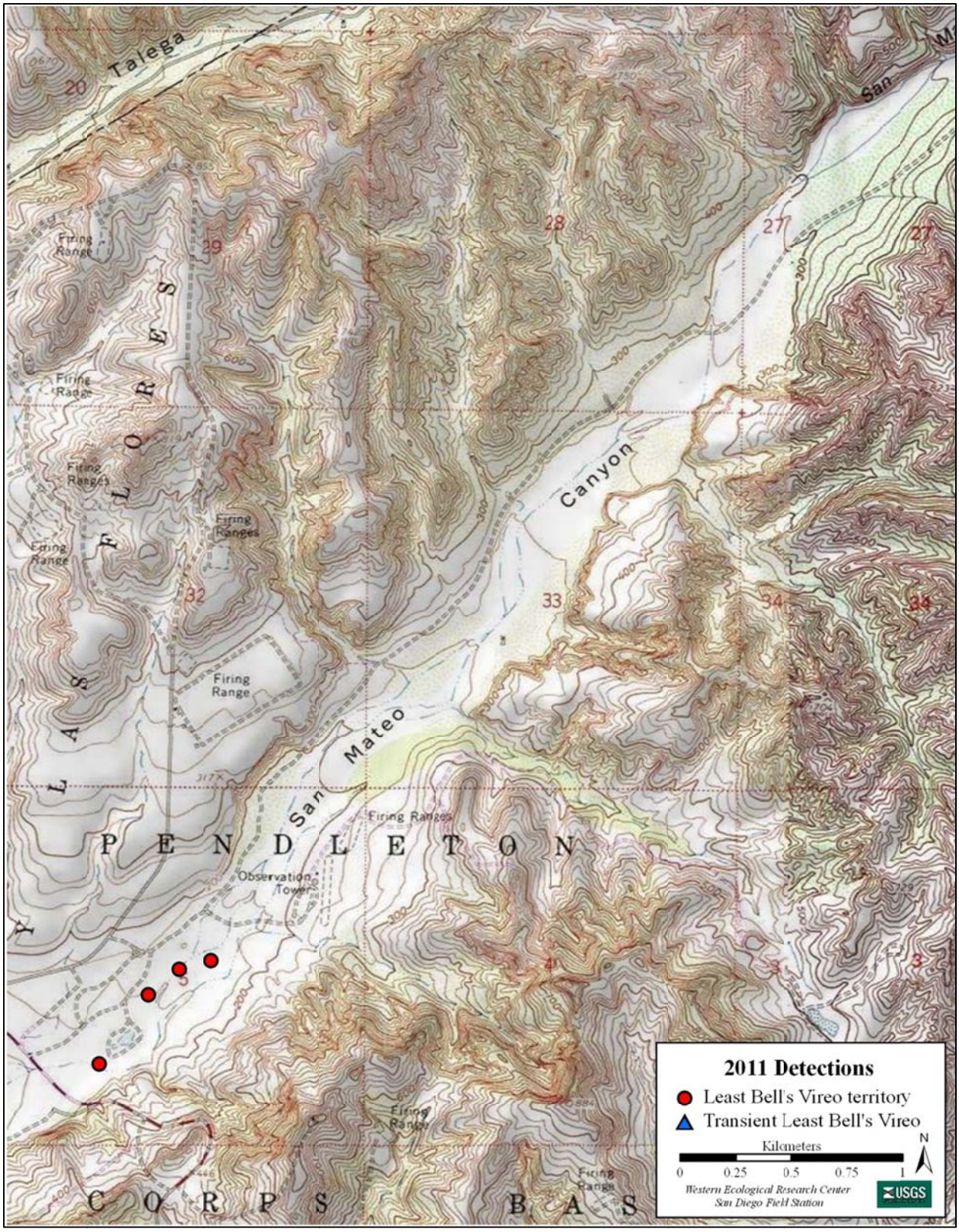

Fig. 36. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2011: Upper San Mateo Creek.

APPENDIX C

BANDED LEAST BELL'S VIREOS AT MARINE CORPS BASE CAMP PENDLETON, 2011

Drainage	Band Combination[a]			
Sex	Left Leg	Right Leg	Age (yrs.)[b]	Comments[c]
De Luz Creek				
Male	Msi	YEPU/gogo	≥ 6	Banded as an adult on the DL in 2006.
Male	BYST/Msi	gogo	≥ 6	Banded as an adult on the SMR in 2006.
Male	BKBK/Mgo		≥ 5	Banded as an adult at FNWS in 2007.
Male		PUWH/Mgo	≥ 5	Banded as an adult at FNWS in 2007.
Male	Mgo	WHWH/gogo	3	Banded as a nestling on the SMR in 2008.
Male	WHDP/Mgo	WHWH	≥ 2	Banded as an adult on the DL in 2010.
Male		Mgo	≥ 1	Banded as a nestling on the SMR before 2011.
Female	Mgo	DGOR/sisi	≥ 2	Banded as an adult on DL in 2010.
Fallbrook Creek				
Male	DPDP/Mgo	ORPU	1	Banded as a nestling on the SMR in 2010.
Las Flores Creek				
Male	LPBK/Mgo	pupu	≥ 6	Banded as an adult on the SMR in 2005.
Male	PUWH/pupu	Mdb	4	Banded as a nestling on the SLR in 2007.
Male	ORDG/Mgo	WHWH	1	Banded as a juvenile on DL in 2010.
Pilgrim Creek				
Male	pupu	OROR/Mgo	≥ 5	Banded as an adult on the PL in 2007.
Male		Mgo	≥ 1	Banded as a nestling on the SMR before 2011.
San Mateo Creek				
Male	LPBK	DBWH/Mdb	4	Banded as a nestling on the SLR in 2007.
San Onofre Creek				
Male	LPBK	DBWH/Mdb	4	Banded as a nestling on the SLR in 2007.
Male	ORPU	DGOR/Mgo	≥ 1	Banded as an adult on the SOF in 2011.
Male	ORPU	WHPU/Mgo	≥ 1	Banded as an adult on the SOF in 2011.
Male	DPWH/Mgo	ORPU	1	Banded as a nestling on the SMR in 2010.
Santa Margarita River				
Male	PUWH/Mgo	pupu	≥ 7	Banded as an adult on the SMR in 2005.
Male	pupu	WHWH/Mgo	≥ 6	Banded as an adult on the SMR in 2006.
Male	Mgo	DPDP/pupu	≥ 5	Banded as an adult on the SMR in 2007.
Male	DPDP	Mgo	≥ 5	Banded as an adult at FNWS in 2007.
Male		DGOR/Msi	> 4	Banded as an adult on the SMR in 2008.
Male	YEPU/sisi	Mgo	≥ 3	Banded as an adult on the SMR in 2009.
Male	BKLP	Mgo	≥ 3	Banded as an adult on the SMR in 2009.
Male	WHWH/Mgo	WHWH	≥ 3	Banded as an adult on the SMR in 2009.
Male	Mgo	PUWH/sisi	≥ 3	Banded as an adult on the SMR in 2009.
Male	BYST/Mgo	ORPU	≥ 3	Banded as an adult on the SMR in 2009.
Male	DBDP/Mdb	DPWH	3	Banded as a nestling on the SLR in 2008.
Male	DPDP/Mdb	BKBK	3	Banded as a nestling on the SLR in 2008.
Male	Mdb	WHDB/sisi	3	Banded as a nestling on the SLR in 2008.
Male	WHWH/Mgo	ORPU	3	Banded as a nestling on the SMR in 2008.
Male	Mgo	BYST/sisi	3	Banded as a nestling on the SMR in 2008.
Male	Mgo	YEPU	3	Banded as a nestling on the SMR in 2008.
Male	DGOR	BYST/Mgo	≥ 2	Banded as an adult on the SMR in 2010.
Male	BKLP/Mgo	ORPU	≥ 2	Banded as an adult on the SMR in 2010.
Male	ORPU	WHDP/Mgo	≥ 2	Banded as an adult on the SMR in 2010.
Male	ORDG/Mgo	DGOR	≥ 2	Banded as an adult on the SMR in 2010.
Male	YEPU/Mgo	pupu	≥ 2	Banded as an adult on the SMR in 2010.

Appendix C. Continued.

Drainage	Band Combination[a]			
Sex	Left Leg	Right Leg	Age (yrs.)[b]	Comments
Santa Margarita River continued				
Male	Mgo	WHDP	≥ 2	Banded as an adult on the SMR in 2010.
Male	YEPU/Mgo	DPDP	≥ 2	Banded as an adult on the SMR in 2010.
Male	OROR/Mgo	DPDP	≥ 2	Banded as an adult on the SMR in 2010.
Male	WHWH	DGOR/Mgo	≥ 2	Banded as an adult on DL in 2010.
Male	WHWH	WHPU/Mgo	≥ 2	Banded as an adult on the SMR in 2010.
Male	DPDP	WHPU/Mgo	≥ 2	Banded as an adult on the SMR in 2010.
Male	DPDP	ORPU/Mgo	≥ 2	Banded as an adult on the SMR in 2010.
Male	DPDP	YEYE/Mgo	≥ 2	Banded as an adult on the SMR in 2010.
Male	gogo	DBDP/Mdb	2	Banded as a nestling on the SLR in 2009.
Male	DPWH	DPDP/Mdb	2	Banded as a nestling on the SLR in 2009.
Male	ORPU	PUWH/Mgo	2	Banded as a nestling on the SMR in 2009.
Male	WHWH	WHWH/Mgo	≥ 1	Banded as an adult on the SMR in 2011.
Male	pupu	BYST/Mgo	≥ 1	Banded as an adult on the SMR in 2011.
Male	WHWH	DPDP/Mgo	≥ 1	Banded as an adult on the SMR in 2011.
Male	WHWH	PUPU/Mgo	≥ 1	Banded as an adult on the SMR in 2011.
Male	WHWH	DPWH/Mgo	≥ 1	Banded as an adult on the SMR in 2011.
Male	WHWH	BYST/Mgo	≥ 1	Banded as an adult on the SMR in 2011.
Male	WHWH	YEPU/Mgo	≥ 1	Banded as an adult on the SMR in 2011.
Male	WHWH/Mgo	pupu	≥ 1	Banded as an adult on the SMR in 2011.
Male	pupu	WHPU/Mgo	≥ 1	Banded as an adult on the SMR in 2011.
Male	WHWH	LPBK/Mgo	≥ 1	Banded as an adult on the SMR in 2011.
Male	WHWH	OROR/Mgo	≥ 1	Banded as an adult on the SMR in 2011.
Male	BKBK	BKBK/Mgo	≥ 1	Banded as an adult on the SMR in 2011.
Male	BYST/Mgo	PUWH	≥ 1	Banded as an adult on the SMR in 2011.
Male	YEPU	BKBK/Mgo	≥ 1	Banded as an adult on the SMR in 2011.
Male	YEPU	DPDP/Mgo	≥ 1	Banded as an adult on the SMR in 2011.
Male	PUPU/Mgo	OROR	≥ 1	Banded as an adult on the SMR in 2011.
Male	WHWH/Mdb	WHDB	≥ 1	Banded as an adult on the SLR in 2011.
Male	BYST/Mgo	DPWH	≥ 1	Banded as an adult on the SMR in 2011.
Male	DPWH	PUPU/Mgo	≥ 1	Banded as an adult on the SMR in 2011.
Male	DGOR/Mgo	DPWH	≥ 1	Banded as an adult on the SMR in 2011.
Male	Mgo		≥ 1	Banded as a nestling on the SMR before 2011.
Male	Mdb		≥ 1	Banded as a nestling on the SLR before 2011.
Male	PUWH/Mgo	OROR	1	Banded as a nestling at MCAS in 2010.
Male	DPWH/Mgo	OROR	1	Banded as a nestling on the SMR in 2010.
Male	Mgo	ORDG/gogo	1	Banded as a nestling on the SMR in 2010.
Female	YEPU/Mgo	PUWH	≥ 1	Banded as an adult on the SMR in 2011.
Female	Mgo		≥ 1	Banded as a nestling on the SMR before 2011.
Female		Mdb	≥ 1	Banded as a nestling on the SLR before 2011.
Unknown	ORPU	ORPU/Mgo	HY	Banded as a juvenile on the SMR in 2011.
Unknown	BKBK	DPDP/Mgo	HY	Banded as a juvenile on the SMR in 2011.
Unknown	DPDP	PUOR/Mgo	HY	Banded as a juvenile on the SMR in 2011.
Unknown		Mgo	HY	Banded as a nestling at ODN in 2011.
Unknown		Mgo	HY	Banded as a nestling at LIF in 2011.
Unknown		Mgo	HY	Banded as a nestling at BIL in 2011.

Appendix C. Continued.

Drainage	Band Combination[a]			
Sex	Left Leg	Right Leg	Age (yrs.)[b]	Comments
Santa Margarita River continued				
Unknown		Mgo	HY	Banded as a nestling at BIL in 2011.
Unknown		Mgo	HY	Banded as a nestling at ICE in 2011.
Unknown		Mgo	HY	Banded as a nestling at ICE in 2011.
Unknown		Mgo	HY	Banded as a nestling at ICE in 2011.
Unknown		Mgo	HY	Banded as a nestling at EMB in 2011.
Unknown		Mgo	HY	Banded as a nestling at EMB in 2011.
Unknown		Mgo	HY	Banded as a nestling at EMB in 2011.
Unknown		Mgo	HY	Banded as a nestling at MIN in 2011.
Unknown		Mgo	HY	Banded as a nestling at MIN in 2011.
Unknown		Mgo	HY	Banded as a nestling at BAY in 2011.
Unknown		Mgo	HY	Banded as a nestling at BAY in 2011.
Unknown		Mgo	HY	Banded as a nestling at BAY in 2011.
Unknown		Mgo	HY	Banded as a nestling at NEO in 2011.
Unknown		Mgo	HY	Banded as a nestling at NEO in 2011.
Unknown		Mgo	HY	Banded as a nestling at NEO in 2011.
Unknown		Mgo	HY	Banded as a nestling at TOF in 2011.
Unknown		Mgo	HY	Banded as a nestling at TOF in 2011.
Unknown		Mgo	HY	Banded as a nestling at TOF in 2011.
Unknown		Mgo	HY	Banded as a nestling at ARI in 2011.
Unknown		Mgo	HY	Banded as a nestling at ARI in 2011.
Windmill Creek				
Male	LPBK	WHWH/Mdb	2	Banded as a nestling on the SLR in 2009.

[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; BYST = plastic black-yellow striped; DBDP = plastic dark blue-dark pink split; DBWH = plastic dark blue-white split; DGOR = plastic dark green-orange split; DPDP = plastic dark pink; DPWH = plastic dark pink-white split; LPBK = plastic light pink-black split; ORDG = plastic orange-dark green split; OROR = plastic orange; ORPU = plastic orange-purple split; PUOR = plastic purple-orange split; PUPU = plastic purple; PUWH = plastic purple-white split; WHDB = plastic white-dark blue split; WHDP = plastic white-dark pink split; WHPU = plastic white-purple split; WHWH = plastic white; YEPU = plastic yellow-purple split; YEYE = plastic yellow.

[b] Age: HY = hatch-year.

[c] DL = De Luz Creek; FNWS = Fallbrook Naval Weapons Station; MCAS = Marine Corps Air Station, Camp Pendleton; PL = Pilgrim Creek; SLR = San Luis Rey River; SMR = Santa Margarita River; SOF = San Onofre Creek.

APPENDIX D

BETWEEN-YEAR MOVEMENT OF ADULT LEAST BELL'S VIREOS AT MARINE CORPS BASE CAMP PENDLETON, 2011

Year Last Detected	Drainage[a] / Territory / Treatment[a]		Distance Moved (km)	Band Combination[b]		Age in 2011 (yrs.)	Sex[c]
	Last Seen	2011		Left Leg	Right Leg		
2010	SMR / HLD / REF	SMR / HLD / REF	0.1	PUWH/Mgo	pupu	≥7	M
2010	DL / DS23	DL / DS17	0.4	BYST/Msi	gogo	≥6	M
2010	DL / DS10	DL / DS16	0.2	Msi	YEPU/gogo	≥6	M
2010	LF / LL25	LF / LL06	0.1	LPBK/Mgo	pupu	≥6	M
2010	SMR / SG02	SMR / SG09	0.1	pupu	WHWH/Mgo	≥6	M
2010	PL / PN01	PL / PN02	0.0	pupu	ORPU/Mgo	≥5	M
2010	SMR / UM35	SMR / UM07	0.0	DPDP	Mgo	≥5	M
2010	SMR / FIN / REF	SMR / FIN / REF	0.0		DGOR/Msi	≥4	M
2010	SMO / MT05	SMO / MT13	0.0	Mgo	PUOR/sisi	≥4	M
2010	LF / LL09	LF / LL16	0.2	PUWH/pupu	Mdb	4	M
2010	SOF / OW08	SOF / OW04	0.1	LPBK	DBWH/Mdb	4	M
2010	DL / DLMAPS[d]	DL / DS06	1.5	WHDP/Mgo	WHWH	≥3	M
2010	SMR / PO02	SMR / PO01	0.1	Mgo	PUWH/sisi	≥3	M
2010	SMR / DAT / REF	SMR / DAT / REF	0.1	BYST/Mgo	ORPU	≥3	M
2010	SMR / SMMAPS[d]	SMR / BN52	0.1	WHWH	WHPU/Mgo	≥3	M
2010	SMR / ES18	SMR / ES21	0.0	YEPU/sisi	Mgo	≥3	M
2010	SMR / ARI / REF	SMR / ARI / REF	0.0	BKLP	Mgo	≥3	M
2010	SMR / QIN / REF	SMR / QIN / REF	0.0	WHWH/Mgo	WHWH	≥3	M
2010	DL / DS12	DL / DS04	0.7	Mgo	WHWH/gogo	3	M
2010	SMR / AH108	SMR / AH10	0.2	Mgo	YEPU	3	M
2010	SMR / HW19 / REF	SMR / HW20 / REF	0.1	Mdb	WHDB/sisi	3	M
2010	SMR / SE22	SMR / SE14	0.0	DBDP/Mdb	DPWH	3	M
2010	SMR / HE49 / REF	SMR / HOL / REF	0.0	WHWH/Mgo	ORPU	3	M
2010	SMR / ES62	SMR / ES43	0.0	Mgo	BYST/sisi	3	M
2010	SMR / BIL / REF	SMR / HE08 / REF	0.4	ORDG/Mgo	DGOR	≥2	M
2010	SMR / SMMAPS[d]	SMR / BN01	0.1	DPDP	WHPU/Mgo	≥2	M
2010	SMR / CAO / REM	SMR / MIN / REF	0.1	DGOR	BYST/Mgo	≥2	M
2010	SMR / HE16 / REF	SMR / HE35 / REF	0.1	YEPU/Mgo	pupu	≥2	M
2010	SMR / TRF / REM	SMR / TRF / REM	0.1	YEPU/Mgo	DPDP	≥2	M
2010	SMR / MER / REF	SMR / MER / REF	0.1	Mgo	WHDP	≥2	M
2010	SMR / BAY / REM	SMR / BAY / REF	0.0	ORPU	WHDP/Mgo	≥2	M
2010	SMR / ICE / REM	SMR / BRI / REM	0.0	ORPU/Mgo	DPDP	≥2	M
2010	SMR / EMB / REM	SMR / EMB / REF	0.0	BKLP/Mgo	ORPU	≥2	M
2010	SMR / SRB / REM	SMR / SRB / REM	0.0	DPDP	ORPU/Mgo	≥2	M
2010	SMR / CKI / REM	SMR / CKI / REM	0.0	DPDP	YEYE/Mgo	≥2	M
2010	SMR / ASP / REM	SMR / NEO / REF	0.4	DPWH	DPDP/Mdb	2	M
2010	SMR / UM13	SMR / UM03	0.1	ORPU	PUWH/Mgo	2	M
2010	DL / DLMAPS[d]	DL / DS16	0.3	Mgo	DGOR/sisi	≥2	F
2009	SLR / CJAS	SMR / BN68	6.5	gogo	DBDP/Mdb	2	M
2009	SLR / WGAR	WC / WC08	2.4	LPBK	WHWH/Mdb	2	M
2008	SMR / UMM08	DL / DN01	5.3	BKBK/Mgo		≥5	M
2008	SMR / SMMAPS[d]	SMR / ES44	0.0	Mgo	DPDP/pupu	≥5	M
2008	SMR / AH14 / REF	SWR / D11	79.1	YEYE/Mgo	WHWH	3	M
2008	SLR / BPEA	SMR / BN63	5.8	DPDP/Mdb	BKBK	3	M
2008	SMR / ANI	MCAS / KRM	0.3	YEPU/Mgo	ORPU	3	F

Appendix D. Continued.

Year Last Detected	Drainage / Territory / Treatment[a]		Distance Moved (km)	Band Combination[b]		Age in 2011 (yrs.)	Sex[c]
	Last Seen	2011		Left Leg	Right Leg		
2007	SMR / UM04	DL / DS12	6.4		PUWH/Mgo	≥5	M
2007	SLR / BNG	SMR / UM22	12.1		Mdb	4	M
< 2010	SLR	SMR / HW30	8.1[e]	Mdb		≥1	M
< 2010	SLR	SMR / YB19	3.5[e]		Mdb	≥1	F

[a] Drainage Codes: DL = De Luz Creek; LF = Las Flores Creek; MCAS = Marine Corps Air Station, Camp Pendleton; PL = Pilgrim Creek; SLR = San Luis Rey River; SMO = San Mateo Creek; SMR = Santa Margarita River; SOF = San Onofre Creek; SWR = Sweetwater River; WC = Windmill Creek; 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; BYST = plastic black-yellow striped; DBDP = plastic dark blue-dark pink split; DBWH = plastic dark blue-white split; DGOR = plastic dark green-orange split; DPDP = plastic dark pink; DPWH = plastic dark pink-white split; LPBK = plastic light pink-black split; ORDG = plastic orange-dark green split; OROR = plastic orange; ORPU = plastic orange-purple split; PUOR = plastic purple-orange split; PUWH = plastic purple-white split; WHDB = plastic white-dark blue split; WHDP = plastic white-dark pink split; WHPU = plastic white-purple split; WHWH = plastic white; YEPU = plastic yellow-purple split; YEYE = plastic yellow.

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

[d] DLMAPS = De Luz MAPS Station; SMMAPS = Santa Margarita MAPS Station.

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

APPENDIX E

STATUS AND NESTING ACTIVITIES OF LEAST BELL'S VIREOS AT MARINE CORPS BASE CAMP PENDLETON, 2011

Territory	Nest	Monitoring[a]	Nest Fate[b]	# Fledged	Comments
Giant Reed (*Arundo donax*) Removal Site Territories					
BAY	1	P	SUC	3	
EMB	1	P	PRE	0	
EMB	2	P	UNK	0	Nest abandoned between nest-building and egg-laying. Cause of nest failure unknown.
HLX	1	P	PRE	0	
ICE	1	P	PRE	0	
MIN	1	P	SUC	2	
NEO	1	P	SUC	3	
TOF	1	P	SUC	3	
Reference Site Territories					
ARI	1	P	SUC	2	
BIL	2	P	SUC	2	
DAQ	1	P	SUC	3	
FAU	1	P	UNK	0	Nest abandoned. Cause of nest failure unknown.
HDX	1	P	PRE	0	

[a] Monitoring: P = partially monitored territory.

[b] Nest Fate: SUC = fledged at least one Least Bell's Vireo young; PRE = nest failure caused by predation; UNK = reason for nest failure/abandonment unknown.