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

2013 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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Cover photograph by Lisa Allen

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## TABLE OF CONTENTS

## LIST OF TABLES

## LIST OF FIGURES

## LIST OF FIGURES CONTINUED

## LIST OF APPENDICES

## 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 1 April and 26 July 2013. Drainages containing riparian habitat suitable for vireos were surveyed two to four times. Seven hundred and twenty-four male vireos and 45 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 63% of all territories on Base. Seventy-seven percent of male vireos were confirmed as paired.

The number of documented Least Bell's Vireo territories (724) increased 14% from 2012 to 2013. The number of territories on 43% (10/23) of drainages surveyed increased from 2012, while 9% of drainages (2/23) decreased by three or more territories, and 48% of drainages (11/23) showed no change or decreased by two or fewer territories.

The majority of vireo territories occurred in habitat characterized as willow riparian, with 71% of males in the study area found in this habitat. An additional 16% of birds occupied willow (*Salix* spp.) habitat co-dominated by sycamores (*Platanus racemosa*) or cottonwoods (*Populus fremontii*). Twelve percent of territories were found in riparian scrub dominated by mule fat (*Baccharis salicifolia*) and/or sandbar willow (*S. exigua*). Fewer than 1% of the vireos used drier habitats characterized by a mix of sycamores and oaks (*Quercus agrifolia*), non-native vegetation, or upland scrub.

Two hundred and fifty-nine Least Bell's Vireos were banded for the first time during the 2013 season. These included 40 adult vireos and 219 hatch-year vireos. All adult vireos and 11 hatch-year birds were banded with unique color combinations. The remaining 208 hatch-year vireos (all nestlings) were banded with a single gold numbered federal band on the right leg.

One hundred and four Least Bell's Vireos banded prior to the 2013 breeding season were resighted and identified on Base in 2013. Thirteen of these were originally banded on the San Luis Rey River, three were originally banded at Marine Corps Air Station, Camp Pendleton (MCAS), one was originally banded on the San Diego River, and the remaining birds were banded at MCBCP. Adult birds of known age ranged from 1-9 years old. Adult survivorship, or the proportion of individuals known to survive from 2012 to 2013, was 76% (84/110). Survivorship of first-year birds that fledged from MCBCP in 2012 and were documented on Base or elsewhere in 2013 was 16% (13/83), based on the number of uniquely banded individuals detected. Of the 13 first-year vireos detected in 2013, nine were male and four were female.

Adult and first-year vireo return rate was the highest recorded since 2006, and did not correlate with higher-than-average annual precipitation either on the breeding grounds or the wintering grounds. This suggests that there may be other factors contributing to fluctuations in survivorship for both adult and juvenile vireos.

The majority of returning adult vireos showed strong between-year site fidelity. Overall vireo territory fidelity between 2012 and 2013 was 75% (46/61). The average between-year movement for returning adult vireos was 0.2 ± 0.4 km (standard deviation [SD]). The 11 first-

year vireos detected in 2013 that fledged from known nests on MCBCP in 2012 dispersed 6.3 ± 7.1 km to their 2013 breeding locations.

We monitored Least Bell's Vireo nests to evaluate the effects of giant reed removal on survivorship, nest success, and productivity. Vireos were monitored at two sites where giant reed (*Arundo donax*) was removed in 2008 (Removal sites) and two sites where giant reed was removed 14-16 years ago (Reference sites). Adult survivorship of vireos at Removal sites and Reference sites was 85% and 67%, respectively. First-year survivorship was 17% and 10%, respectively. One hundred percent of adults from Removal and Reference sites that were detected in both 2012 and 2013 returned in 2013 to the same territory occupied in 2012. One male nestling from a 2012 Reference site returned to occupy a breeding territory at a Reference site in 2013. The remaining ten vireos that fledged from Removal and Reference sites in 2012 dispersed to areas outside of monitoring sites.

Three vireos (one female and two males) that originated at MCBCP moved off Base and were detected elsewhere in 2013. All three of these vireos were banded originally as nestlings in 2012 on MCBCP and were redetected on the San Luis Rey River in 2013.

Nesting activity was monitored between 1 April and 23 July in 49 territories within the Removal and Reference monitoring sites. All 49 territories were known to be occupied by pairs, and 48 were considered “fully” monitored. One hundred and twenty-four nests (49 in Removal sites and 75 in Reference sites) were monitored during the monitoring period.

Completed nests at Removal sites were more likely to be successful than nests at Reference sites in 2013. Seventy-two percent (33/46) of Removal nests and 34% (22/64) of Reference nests successfully fledged young. Predation was believed to be the primary source of nest failure at both sites. Predation accounted for 69% (11/16) and 66% (35/53) of nest failures at Removal and Reference sites, respectively. Of the remaining nine nests that failed, one was abandoned when eggs were punctured, nestlings were found dead in another nest from unknown causes, and seven failed from unknown causes. No nest parasitism of Least Bell’s Vireos by Brown-headed Cowbirds (*Molothrus ater*) was documented in 2013.

Vireos at Removal sites fledged significantly more young per pair than vireo pairs at Reference sites (4.2 versus 3.0). Additionally, a significantly higher proportion of Removal pairs successfully fledged at least one young than did Reference pairs in 2013 (92% versus 71%).

Density of vireo territories was similar at Reference sites and Removal sites in 2013, and increased slightly from 2012. Density at Removal sites was lowest in 2008, immediately prior to giant reed removal, and then increased for 2 years following giant reed removal to reach or surpass vireo territory density at the Reference site by 2010.

In 2013, successful and unsuccessful nests within Removal and Reference sites were similar in placement. Vireo nests at Removal sites were placed higher in the host plants, in taller host plants, further from the edge of the host plant, and further from the edge of the riparian vegetation than nests in Reference sites. Seventeen plant species were used as hosts for vireo

nests in 2013. Seventy percent of all nests were placed in arroyo willow (*S. lasiolepis*), sandbar willow, or mule fat.

The increase in vireo numbers on MCBCP (14%) mirrored similar population changes on the lower San Luis Rey River (36%), the middle San Luis Rey River (9%), at MCAS (33%), at the Sweetwater Reservoir (29%), and in the Prado Basin of the Santa Ana River (24%), suggesting a general population rebound throughout the region. Local management activities, such as Brown-headed Cowbird control and giant reed removal, have positively affected vireo populations on the breeding grounds, but other factors in migration and wintering areas may also be affecting the vireo population.

Vireos have been documented moving between drainages on the breeding grounds for several years. In 2012, we observed a breeding female vireo on MCBCP that had been detected in southern Baja California, Mexico in February 2012. This female was detected in October 2012 at her wintering territory in Mexico but was not found on MCBCP during the 2013 breeding season. This vireo moved over 1,300 km between her breeding and wintering grounds.

## 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 (U. S. Geological Survey [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 14-16 years earlier, between 1997 and 1999. 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 1 April and 26 July 2013 (Fig. 1). Field work was conducted by USGS biologists Katie Allen, Lisa Allen, PJ Falatek, Aaron Gallagher, Jonathan Gunther, Alex Houston, Scarlett Howell, Barbara Kus, Suellen Lynn, Melanie Madden, Sarah Nichols, Eric Nolte, Jason Pietrzak, Ryan Pottinger, Devin Taylor, and Anne Winters. 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, Fig. 13, Fig. 14).
   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. 13).

2. ***De Luz Creek,*** between the confluence of the Santa Margarita River with the Base boundary (Appendix A, Fig. 13).

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. 13).

4. ***Lake O'Neill/Fallbrook Creek:***
   a. All riparian habitat around Lake O'Neill (Appendix A, Fig. 13).
   b. Between Lake O'Neill and the Base boundary with FNWS (Appendix A, Fig. 13).

5. ***Basilone and Roblar Roads,*** a small patch of habitat straddling Basilone Road at the intersection of Basilone and Roblar Roads (Appendix A, Fig. 13).

6. ***22 Area,*** all riparian habitat within the 22 Area, east of Vandegrift Road and the Supply Depot (Appendix A, Fig. 14).

7. ***Pueblitos Canyon,*** between Vandegrift Road and a point approximately 2.5 km upstream (Appendix A, Fig. 14).

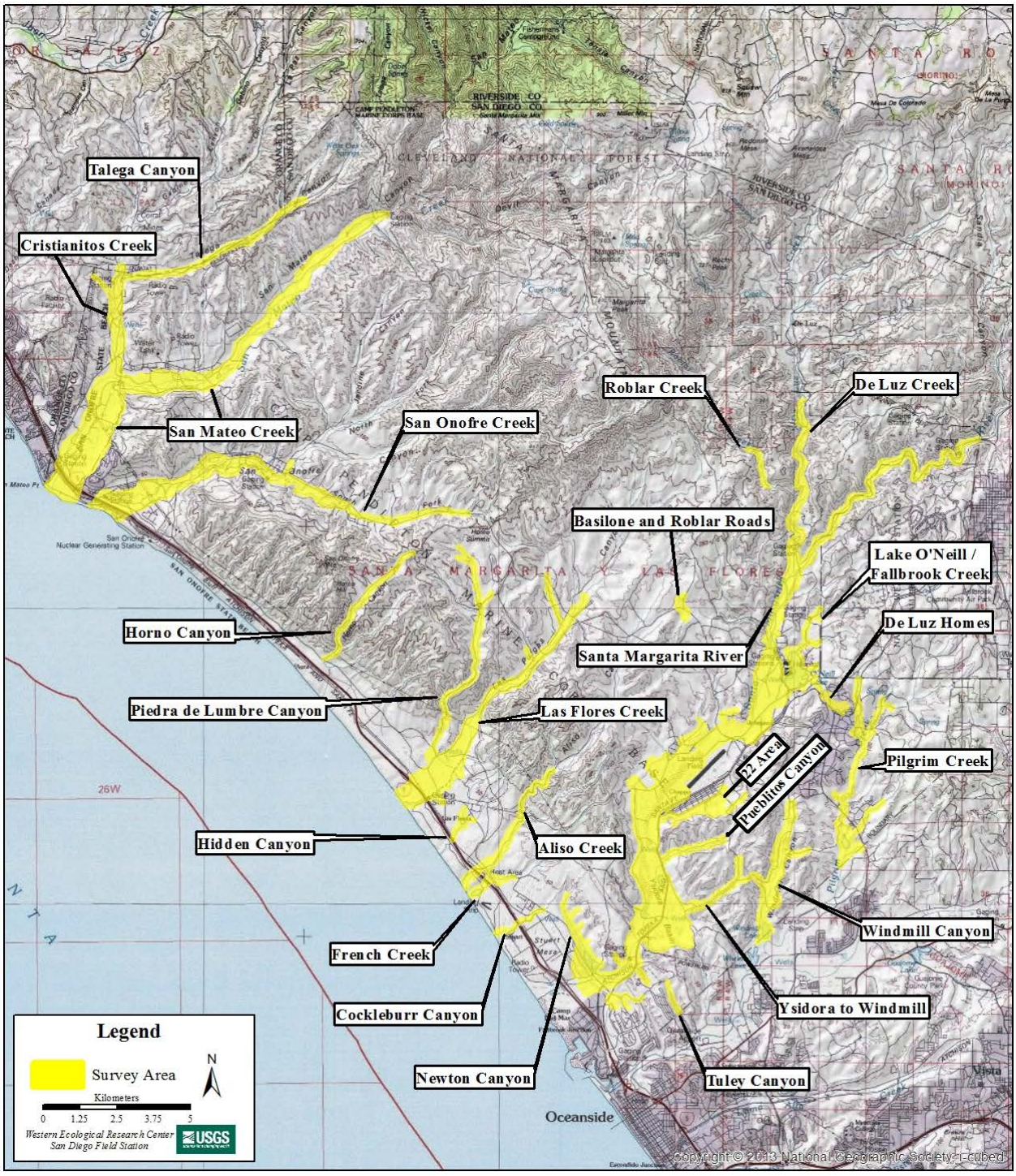


Fig. 1. Least Bell's Vireo survey areas at Marine Corps Base Camp Pendleton, 2013.

8. ***Tuley Canyon,*** between the Base boundary and a point approximately 1.1 km upstream (Appendix A, Fig. 14).

9. ***Newton Canyon,*** between the confluence with the Santa Margarita River and the upstream limit of riparian habitat (Appendix A, Fig. 14).

10. ***Cockleburr Canyon,*** between the Pacific Ocean and a point 0.25 km east of Interstate 5 (Appendix A, Fig. 14).

11. ***French Creek,*** between the Pacific Ocean and the Edson Range Impact Area (Appendix A, Fig. 14).

12. ***Aliso Creek,*** between the Pacific Ocean and 0.5 km upstream of the electrical transmission lines (Appendix A, Fig. 14).

13. ***Hidden Canyon,*** between Interstate 5 and Stuart Mesa Road (Appendix A, Fig. 15).

14. ***Las Flores Creek (within Las Pulgas Canyon):***
    a. Between Stuart Mesa Road and the high voltage electrical transmission lines (Appendix A, Fig. 15).
    b. Between the Pacific Ocean and Stuart Mesa Road (Appendix A, Fig. 15).
    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. 15).

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. 15).

16. ***Horno Canyon,*** between Old Highway 101 and the upstream limit of riparian habitat (Appendix A, Fig. 15).

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, Fig. 15, Fig. 16).
    b. From Basilone Road upstream to the access road to Range 219 (Appendix A, Fig. 15).

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. 16).
    b. From San Mateo Road upstream to the Base boundary (Appendix A, Fig. 16, Fig. 17).

19. ***Cristianitos Creek,*** between the confluence with San Mateo Creek and the Base boundary (Appendix A, Fig. 16).

***20. Talega Canyon,*** between the confluence with Cristianitos Creek and a point approximately 6.5 km upstream (Appendix A, Fig. 16).

***21. Pilgrim Creek:***

a. Between the southern Base boundary and Vandegrift Boulevard, including the two side drainages east of Pilgrim Creek (Appendix A, Fig. 18).
b. From Vandegrift Boulevard upstream to the limit of riparian habitat (Appendix A, Fig. 18).

***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. 18).

***23. Ysidora Basin to Windmill Canyon,*** between Upper Ysidora Basin and Windmill Canyon/ Pueblitos Canyon (Appendix A, Fig. 18).

***24. De Luz Homes Habitat,*** patches of habitat adjacent to the De Luz Homes development (Appendix A, Fig. 18).

The majority of drainages were surveyed from 3-4 times at least 10 days apart. Sites surveyed four times throughout the breeding season were: Santa Margarita River (1a), De Luz Creek, Lake O'Neill/Fallbrook Creek (4a), Cockleburr Canyon, Aliso Creek, Las Flores Creek, San Onofre Creek (17a), San Mateo Creek (18a), Cristianitos Creek, Talega Canyon, and Pilgrim Creek (21a). Sites surveyed three times were: Basilone and Roblar Roads, 22 Area, Pueblitos Canyon, Tuley Canyon, Newton Canyon, French Creek, Hidden Canyon, Horno Canyon, Piedra de Lumbre Canyon, San Onofre Creek (17b), San Mateo Creek (18b), Pilgrim Creek (21b), Windmill Canyon, Ysidora Basin to Windmill Canyon, and De Luz Homes habitat. The upper portion of the Santa Margarita River (1b) was surveyed twice for vireos. Because of range access restrictions, Roblar Canyon was surveyed only twice in 2013.

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”, a unique 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. Vireo locations were mapped on 1:12,000 aerial photographs as well as 1:24,000 USGS topographic maps, using a Garmin GPS 60 (Olathe, KS) Global Positioning System (GPS) or Trimble Juno SB (Sunnyvale, CA) 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 2013 to determine whether giant reed removal influenced vireo productivity. The following parameters were examined: clutch size, hatching rate, fledging rate, nest success, re-nesting rate, total number of fledglings per pair, nest placement, predation rate, and cowbird parasitism rate.

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

Finally, we compiled annual density within 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 2013. 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.

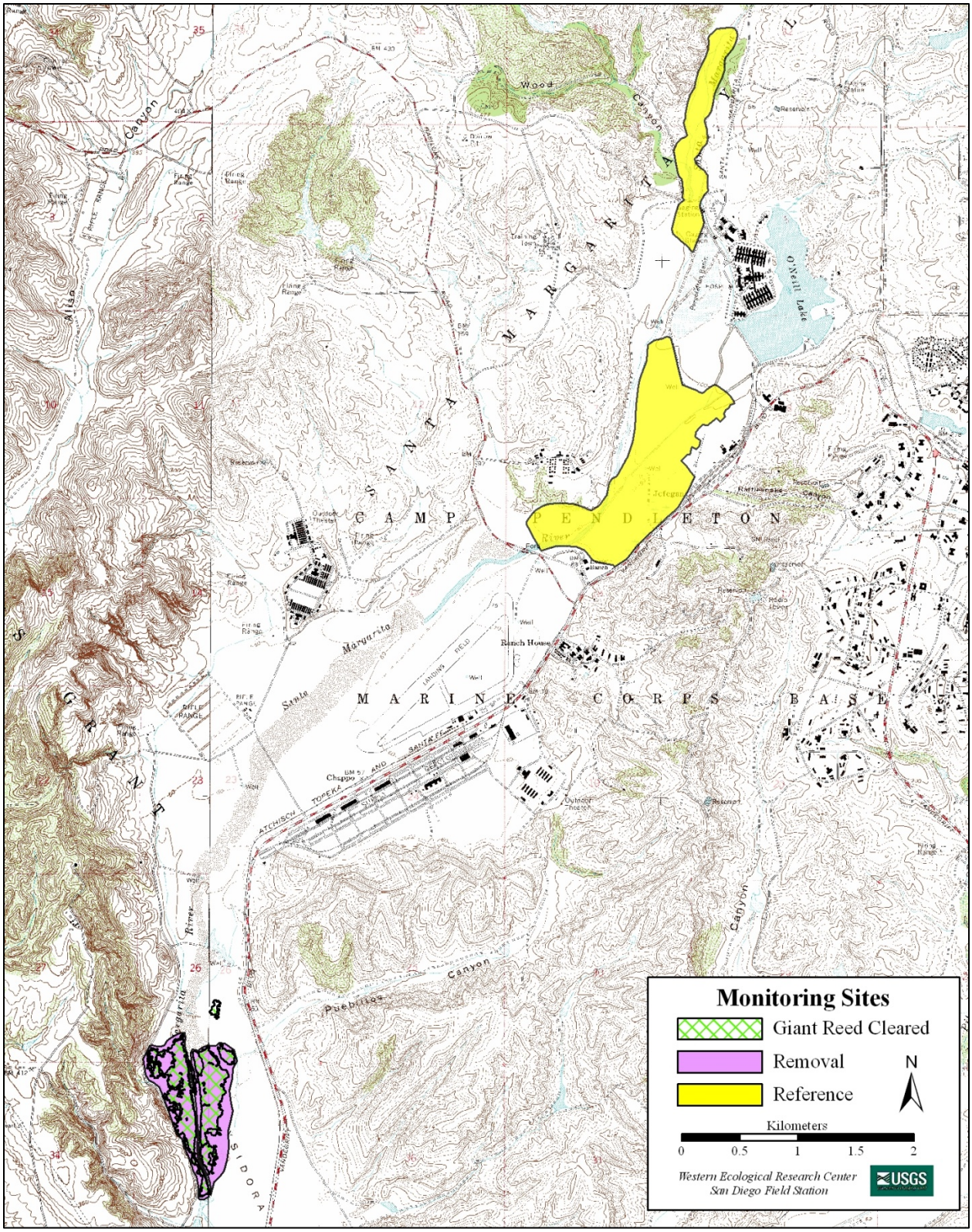


Fig. 2. Location of Least Bell's Vireo nest monitoring areas at Marine Corps Base Camp Pendleton, 2013.

We monitored vireo nesting activity at 24 territories in Removal sites and 25 territories in Reference sites between 1 April and 23 July 2013. 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 (identified by the acronym 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 7th 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 evaluate 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 evaluate 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.

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 2012-2013 was calculated for known individuals that were: (1) adults in 2012 on Base and were resighted anywhere on Base in 2013; (2) adult vireos that held territories in Removal or Reference sites in 2012 and were resighted anywhere on Base in 2013; (3) first-year vireos that were banded as nestlings or juveniles anywhere on Base in 2012 and were resighted anywhere in 2013 (including off Base); and (4) first-year vireos that were banded as nestlings or juveniles in Removal or Reference sites in 2012 and were resighted anywhere in 2013. 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 2012 and the center of the same vireo's breeding territory in 2013. Vireos exhibited site fidelity if they returned to within 100 m of their 2012 territory (Kus et al. 2012). 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 2013 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 between Removal and Reference sites in adult over-winter survivorship, likelihood of re-nesting after a first nesting attempt, likelihood of re-nesting if the first nesting attempt failed or was successful, nest success, and whether or not the first nest attempt was successful. We also used Chi-square or Fisher's Exact tests to determine if there were annual differences in the fate of the first nesting attempt. Chi-square tests were used when sample sizes were sufficient; Fisher's Exact tests were used when one or more category contained fewer than five samples. We used *t*-

tests to determine if there were differences in the number of nesting attempts, clutch size, the number of pairs that fledged young, vireo territory density, nest height, host plant height, distance to the edge of the host plant, and distance to the edge of the vegetation clump 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, Chicago, IL). Two-tailed tests were considered significant if $P \leq 0.10$. Means are presented with standard deviations. All data from MCBCP from 2005, 2006, 2007, 2008, 2009, 2010, 2011, and 2012 used in comparisons with current data can be found in Rourke and Kus 2006a, 2007a, 2008, and Lynn and Kus 2009, 2010a, 2010c, 2011c, and 2012b. See Griffith Wildlife Biology 2004 for data prior to 2005.

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

## RESULTS

### Population Size and Distribution

A total of 769 male Least Bell's Vireos were identified during Base-wide surveys (Table 1; Appendix B, Figs. 19-38). This included 724 territorial male vireos, 77% of which were confirmed as paired, and 45 transients. Transient vireos were observed on 12 of the 23 (52%) 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 (63%) occurred along the Santa Margarita River, the largest expanse of riparian vegetation on Base (Table 1, Table 2). The remaining 16 drainages/sites each contained fewer than ten territories.

The distribution of Least Bell's Vireo territories documented on Base in 2013 shifted only slightly compared to that in 2012 (Table 2). The three drainages without vireos in 2012

continued to have no vireo territories in 2013. Seven survey areas have fluctuated between zero and five territories over the past 8 years. Two of these (Cockleburr Canyon and Basilone and Roblar Roads) lost territories between 2012 and 2013 and were unoccupied in 2013, one (Roblar Creek) gained one territory, and four remained the same as in 2012 (Pueblitos Canyon, Horno Canyon, Talega Canyon, and Tuley Canyon). The four most heavily populated drainages on MCBCP contained 84% of all vireo territories in 2012 and 84% of all territories in 2013. In 2013, the vireo population increased in 43% of drainages surveyed (10/23). Eleven drainages (48%) showed no change or decreased by two or fewer territories between 2012 and 2013 and two drainages (9%) decreased by four territories. The drainages with the largest numeric increases in vireo territories were the Santa Margarita River and Pilgrim Creek, increasing by 71 territories and 10 territories (19% and 50%, respectively). The sites with the largest numeric loss in vireo numbers were San Mateo Creek and Basilone and Roblar Roads, losing four territories each (9% and 100% respectively). Overall, the vireo population on Base increased by 14% from 2012 to 2013 (Fig. 3).

Table 1. Number and distribution of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2013.

| Drainage/Survey Site | Known Pairs | Single/ Status Undetermined | Transient | Total Territories |
|---|---|---|---|---|
| Santa Margarita River: | | | | |
| I-5 to De Luz Creek | 334 | 60 | 18 | 394 |
| De Luz Creek to Base Boundary | 28 | 20 | 0 | 48 |
| 22 Area | 8 | 3 | 0 | 11 |
| De Luz Creek | 31 | 0 | 0 | 31 |
| Roblar Creek | 2 | 0 | 0 | 2 |
| Lake O'Neill/Fallbrook Creek | 5 | 0 | 1 | 5 |
| Basilone-Roblar Roads | 0 | 0 | 0 | 0 |
| Pueblitos Canyon | 0 | 0 | 0 | 0 |
| Newton Canyon | 3 | 3 | 2 | 6 |
| Cockleburr Creek | 0 | 0 | 1 | 0 |
| French Canyon | 1 | 2 | 0 | 3 |
| Aliso Creek | 2 | 7 | 3 | 9 |
| Hidden Canyon | 1 | 2 | 1 | 3 |
| Las Flores Creek: | | | | |
| Pacific Ocean to Stuart Mesa Road | 0 | 0 | 0 | 0 |
| Stuart Mesa Road to Power Lines | 22 | 10 | 3 | 32 |
| Power Lines to Zulu Impact Area | 25 | 8 | 2 | 33 |
| Piedra de Lumbre Canyon | 3 | 0 | 0 | 3 |
| Horno Canyon | 1 | 0 | 1 | 1 |
| San Onofre Creek: | | | | |
| Pacific Ocean to Basilone Road | 29 | 15 | 2 | 44 |
| Basilone Road to Access Road to Range 219 | 7 | 1 | 1 | 8 |
| San Mateo Creek | | | | |
| Pacific Ocean to San Mateo Road | 23 | 17 | 6 | 40 |
| San Mateo Road to Yankee Training Area | 1 | 0 | 0 | 1 |
| Cristianitos Creek | 10 | 1 | 0 | 11 |
| Talega Canyon | 0 | 0 | 0 | 0 |
| Tuley Canyon | 0 | 0 | 0 | 0 |
| Pilgrim Creek: | | | | |
| Base Boundary upstream to Vandegrift Boulevard | 7 | 4 | 3 | 11 |
| Vandegrift Boulevard to upstream riparian limit | 13 | 6 | 0 | 19 |
| Windmill Canyon | 3 | 2 | 1 | 5 |
| Ysidora Basin to Windmill Canyon | 0 | 1 | 0 | 1 |
| De Luz Homes | 2 | 1 | 0 | 3 |
| Total | 561 | 163 | 45 | 724 |

Table 2. Number of territorial male Least Bell's Vireos at Marine Corps Base Camp Pendleton, by drainage, 2004-2013. Numeric change is the positive or negative change in the number of vireo territories between 2012 and 2013.

| | Number of Territorial Males | | | | | | | | | | Numeric Change |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Drainage** | **2004[a]** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | |
| Santa Margarita River[b] | 440 | 472 | 417 | 423 | 463 | 599 | 678 | 467 | 382 | 453 | 71 |
| De Luz Creek | 26 | 18 | 25 | 24 | 25 | 39 | 34 | 27 | 28 | 31 | 3 |
| Roblar Creek | 1 | 0 | 0 | 0 | 0 | 2 | 1 | 1 | 1 | 2 | 1 |
| Lake O'Neill/Fallbrook Creek | 16 | 20 | 10 | 9 | 11 | 11 | 15 | 6 | 5 | 5 | 0 |
| Basilone-Roblar Roads | - | 2 | 0 | 0 | 0 | 5 | 4 | 2 | 4 | 0 | -4 |
| Pueblitos Canyon | 3 | 5 | 3 | 2 | 2 | 1 | 0 | 0 | 0 | 0 | 0 |
| Newton Canyon | 9 | 8 | 8 | 5 | 4 | 6 | 7 | 6 | 4 | 6 | 2 |
| Cockleburr Creek | 0 | 2 | 2 | 2 | 1 | 2 | 0 | 0 | 1 | 0 | -1 |
| French Canyon | 5 | 6 | 4 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 1 |
| Aliso Creek | 21 | 21 | 11 | 9 | 11 | 21 | 16 | 9 | 8 | 9 | 1 |
| Hidden Canyon | 5 | 8 | 5 | 4 | 4 | 2 | 4 | 3 | 3 | 3 | 0 |
| Las Flores Creek | 84 | 85 | 76 | 81 | 70 | 107 | 124 | 92 | 61 | 65 | 4 |
| Piedra de Lumbre Cyn | 5 | 8 | 9 | 6 | 3 | 5 | 6 | 3 | 5 | 3 | -2 |
| Horno Canyon | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 4 | 1 | 1 | 0 |
| San Onofre Creek | 56 | 52 | 43 | 44 | 41 | 62 | 54 | 57 | 46 | 52 | 6 |
| San Mateo Creek | 68 | 56 | 59 | 46 | 53 | 83 | 71 | 56 | 45 | 41 | -4 |
| Cristianitos Creek | 8 | 6 | 8 | 8 | 4 | 13 | 10 | 11 | 10 | 11 | 1 |
| Talega Canyon | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Tuley Canyon | 2 | - | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pilgrim Creek | 37 | 36 | 23 | 26 | 26 | 27 | 24 | 25 | 20 | 30 | 10 |
| Windmill Canyon | 20 | 12 | 7 | 8 | 12 | 13 | 10 | 7 | 6 | 5 | -1 |
| Ysidora Basin-Windmill Cyn | 8 | 4 | 6 | 5 | 4 | 5 | 2 | 1 | 1 | 1 | 0 |
| De Luz Homes | 5 | 4 | 2 | 3 | 2 | 6 | 5 | 5 | 3 | 3 | 0 |
| Total | 819 | 827 | 718 | 707 | 738 | 1,013 | 1,068 | 784 | 636 | 724 | 88 |

[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.

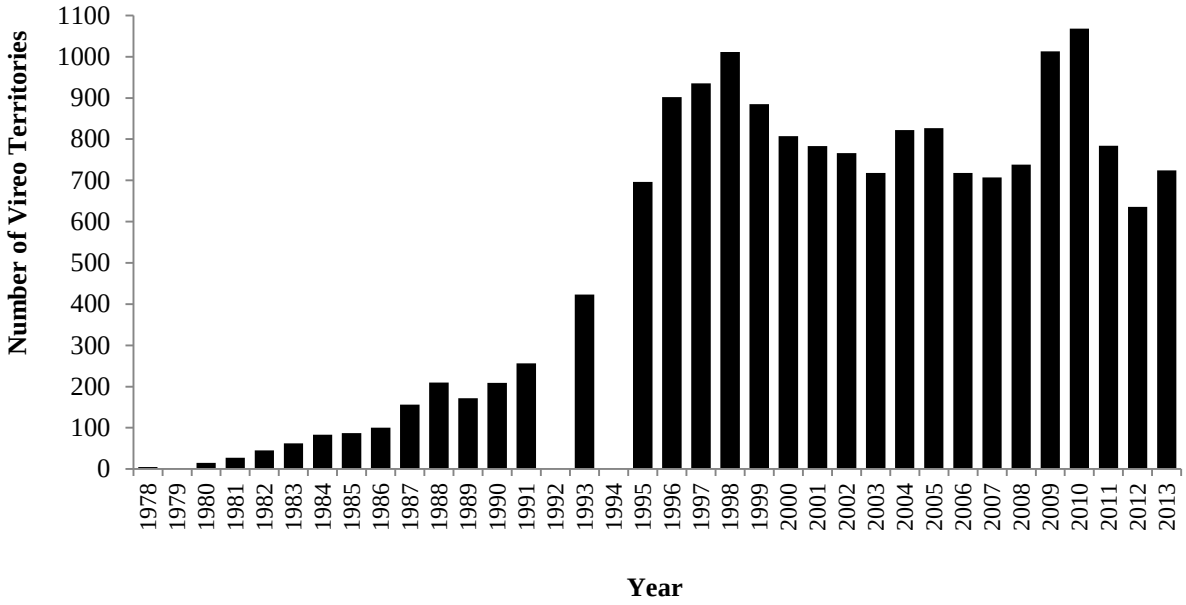


Fig. 3. Number of Least Bell's Vireo territories at Marine Corps Base Camp Pendleton, 1978–2013.

Least Bell's Vireos began arriving on Base during the last week of March 2013 (Fig. 4), with 109 territories (15% of all territories) established by the end of the first week of April. By the end of the third week of April, 55% of territories had been established, and by the first week of May, 62% of vireos had been detected on their territories. This generally follows the same pattern of male arrival dates observed in previous years. A slight dip in arrival rate at the end of April/beginning of May may be explained by the timing of the four surveys in 2013; i.e., only one survey was conducted in April 2013 versus up to two surveys conducted in April in previous years when we conducted seven surveys throughout the breeding season.

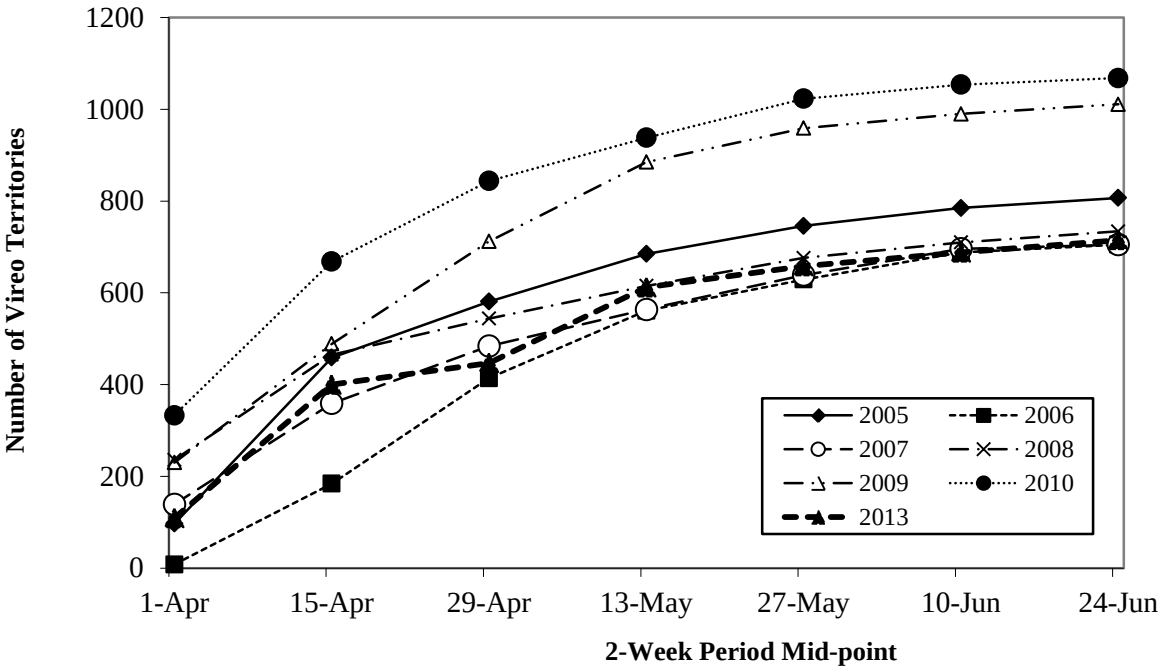


Fig. 4. Territory establishment of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2005-2013. Surveys began late in 2011 and 2012; therefore, arrival dates for these years are not included.

**Habitat Characteristics**

Vireos used a number of different habitat types ranging from willow-dominated thickets along stream courses to areas primarily dominated by non-native annual vegetation (Table 3). The majority of vireo territories occurred in habitat characterized as mixed willow riparian, with 71% of males in the study area found in this habitat. An additional 16% of birds occupied willow habitat co-dominated by cottonwoods or sycamores. Twelve percent of territories were found in riparian scrub, dominated by mule fat and/or sandbar willow. Fewer than 1% of the vireos used drier habitats characterized by a mix of sycamore and oaks, non-native vegetation, or upland scrub.

Table 3. Habitat types used by Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2013.

| | Number of Territories | | | |
|---|---|---|---|---|
| **Habitat Type** | **>50% Native** | **>50% Exotic** | **Total** | **Percent of Total** |
| Mixed Willow | 496 | 16 | 512 | 71% |
| Willow/Sycamore | 110 | 3 | 113 | 16% |
| Riparian Scrub | 76 | 8 | 84 | 12% |
| Willow/Cottonwood | 4 | 0 | 4 | <1% |
| Oak/Sycamore | 5 | 0 | 5 | <1% |
| Non-native | 2 | 0 | 2 | <1% |
| Upland Scrub | 2 | 0 | 2 | <1% |
| Total | 695 | 27 | 722[a] | 100% |

[a] Exotic species composition was not evaluated for two territories.

A smaller proportion of vireo territories were documented in exotic vegetation in 2013 than in 2012 (Table 4). Four percent (27/722) of vireo territories in 2013 and 7% in 2012 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. Only three drainages contained territories dominated by non-native vegetation in 2013, compared to nine in 2012. Two of these drainages (the Santa Margarita River and Las Flores Creek) also contained territories dominated by non-native vegetation in 2012, and one (San Onofre Creek) did not contain any territories dominated by non-native vegetation in 2012. Overall, 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, 2005-2013. Numbers in parentheses are the number of territories on the drainage.

| | Proportion of Territories | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Drainage** | **2005** | | **2006** | | **2007** | | **2008** | | **2009** | | **2010** | | **2011** | | **2012** | | **2013** | |
| Las Flores Creek | 0.02 | (85) | 0.14 | (76) | 0 | (81) | 0.29 | (70) | 0.22 | (107) | 0.21 | (124) | 0.20 | (92) | 0.16 | (61) | 0.11 | (65) |
| 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) | 0.06 | (382) | 0.04 | (451) |
| San Onofre Creek | 0.23 | (52) | 0 | (43) | 0 | (44) | 0.13 | (41) | 0.21 | (62) | 0.11 | (54) | 0.07 | (57) | 0 | (46) | 0.04 | (52) |
| French Canyon | 0 | (6) | 0 | (4) | 0 | (2) | 0 | (2) | 0 | (2) | 0 | (2) | 0 | (2) | 0.50 | (2) | 0 | (3) |
| Windmill Creek | 0.67 | (12) | 0.14 | (7) | 0.13 | (8) | 0.67 | (12) | 0.92 | (13) | 0.60 | (10) | 0.71 | (7) | 0.33 | (6) | 0 | (5) |
| Aliso Creek | 0.05 | (21) | 0 | (11) | 0.11 | (9) | 0 | (11) | 0 | (21) | 0.06 | (16) | 0 | (9) | 0.25 | (8) | 0 | (9) |
| Basilone-Roblar Roads | 0 | (2) | - | - | - | - | - | - | 0 | (5) | 0 | (3) | 0 | (2) | 0.25 | (4) | - | - |
| Newton Canyon | 0.63 | (8) | 0.13 | (8) | 0 | (5) | 0.50 | (4) | 0.20 | (6) | 0 | (4) | 0.17 | (6) | 0.25 | (4) | 0 | (6) |
| Piedra de Lumbre Canyon | 1 | (8) | 0 | (9) | 0 | (6) | 0.67 | (3) | 0.20 | (5) | 0 | (6) | 0.33 | (3) | 0.20 | (5) | 0 | (3) |
| De Luz Creek | 0.06 | (18) | 0.04 | (25) | 0 | (24) | 0 | (25) | 0 | (39) | 0 | (34) | 0 | (28) | 0.04 | (28) | 0 | (31) |
| Cristianitos Creek | 0.5 | (6) | 0.13 | (8) | 0.25 | (8) | 0 | (4) | 0.08 | (13) | 0.10 | (10) | 0.09 | (11) | 0 | (10) | 0 | (11) |
| Pilgrim Creek | 0 | (36) | 0 | (23) | 0 | (26) | 0 | (26) | 0.15 | (27) | 0.04 | (24) | 0.04 | (25) | 0 | (20) | 0 | (30) |
| San Mateo Creek | 0.66 | (56) | 0.12 | (59) | 0 | (46) | 0.14 | (53) | 0.10 | (83) | 0.25 | (68) | 0.04 | (56) | 0 | (45) | 0 | (41) |
| Lake O'Neill/ Fallbrook Creek | 0.15 | (20) | 0 | (10) | 0.11 | (9) | 0 | (11) | 0 | (11) | 0 | (15) | 0 | (6) | 0 | (5) | 0 | (5) |
| De Luz Homes | 0 | (4) | 0 | (2) | 0 | (3) | 0 | (2) | 0 | (6) | 0 | (5) | 0 | (5) | 0 | (3) | 0 | (3) |
| Horno Canyon | 1 | (1) | - | - | - | - | - | - | 0 | (1) | 0 | (1) | 0 | (4) | 0 | (1) | 0 | (1) |
| Hidden Canyon | 0 | (8) | 0 | (5) | 0 | (4) | 0 | (4) | 0.50 | (2) | 0 | (4) | 0 | (3) | 0 | (3) | 0 | (3) |
| Ysidora Basin to Windmill Canyon | 0.25 | (4) | 0.50 | (6) | 0 | (5) | 0.25 | (4) | 0.20 | (5) | 0.50 | (2) | 0 | (1) | 0 | (1) | 0 | (1) |
| Roblar Creek | - | - | - | - | - | - | - | - | 0 | (2) | 0 | (1) | 0 | (1) | 0 | (1) | 0 | (2) |
| Cockleburr Canyon | 0 | (2) | 0 | (2) | 0 | (2) | 0 | (1) | 0 | (2) | - | - | - | - | 0 | (1) | - | - |
| Pueblitos Canyon | 0 | (5) | 0 | (3) | 0 | (2) | 0.50 | (2) | 0 | (1) | - | - | - | - | - | - | - | - |
| Talega Canyon | 0 | (1) | - | - | - | - | - | - | 0 | (1) | - | - | - | - | - | - | - | - |
| Total | 0.19 | (827) | 0.06 | (718) | 0.03 | (707) | 0.09 | (703[b]) | 0.10 | (1,009[b]) | 0.10 | (1,059[b]) | 0.12 | (784) | 0.07 | (636) | 0.04 | (722[b]) |

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

## Banded Birds

*Returning Banded Birds*

We were able to observe 1,089 adult Least Bell's Vireos (724 males, 94% of all males, and 365 females, 65% of all females) on Base well enough to determine banding status in 2013, although not all banded vireos were observed well enough to conclusively identify the individual. One hundred and eleven of these had been banded prior to the 2013 breeding season, seven of which we could not identify because band combinations were not confirmed (two) or because the vireos were banded with only a single numbered metal federal band as nestlings and not recaptured ("natal"; five total; Table 5). Therefore, we were able to identify 104 vireos on Base that were banded with unique color band combinations in 2013 (Table 5, Appendix C). Of these, 87 vireos had been banded on Base and 17 vireos were originally banded off Base (13 on the San Luis Rey River, Ferree and Kus 2008a, 2008b, Ferree et al. 2010b, Ferree et al. 2011, Ferree et al. 2012, USGS unpubl. data; three on MCAS, Lynn and Kus 2010d, 2011b, Lynn et al. 2012; and one on the San Diego River, Lynn and Kus 2011a; Table 6). Adult birds of known age ranged from 1-9 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 2013.

| | Detected on Base[a] | | Total on | Emigrants | | |
|---|---|---|---|---|---|---|
| Banding Status | Male | Female | Base | Male | Female | Total |
| Uniquely banded prior to 2013 | 67 | 14 | 81 | - | - | 81 |
| Natal[b] recaptured in 2013 | 14 | 9 | 23 | 2 | 1 | 26 |
| Subtotal of known identity vireos | 81 | 23 | 104 | 2 | 1 | 107 |
| Unidentified (Partial resights) | 0 | 2 | 2 | - | - | 2 |
| Natal[b], not recaptured | 2 | 3 | 5 | - | - | 5 |
| Grand total | 83 | 28 | 111 | 2 | 1 | 114 |

[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 2013, by original year banded, age, original banding location, and sex.

| | | Number of Vireos Observed by Origin | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Marine Corps Base Camp Pendleton | | San Luis Rey River | | Marine Corps Air Station, Camp Pendleton | | San Diego River | |
| Year Originally Banded | Age in 2013 | Male | Female | Male | Female | Male | Female | Female | Total |
| 2005 | ≥ 9 yrs. | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 2006 | ≥ 8 yrs. | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| | 7 yrs. | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| 2007 | ≥ 7 yrs. | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| | 6 yrs. | 0 | 3 | 3 | 0 | 0 | 0 | 0 | 6 |
| 2008 | ≥ 6 yrs. | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| | 5 yrs. | 3 | 1 | 1 | 0 | 0 | 0 | 0 | 5 |
| 2009 | ≥ 6 yrs. | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | ≥ 5 yrs. | 1 | 4 | 0 | 0 | 0 | 0 | 0 | 5 |
| | 4 yrs. | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 5 |
| 2010 | ≥ 5 yrs. | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | ≥ 4 yrs. | 8 | 4 | 0 | 0 | 0 | 0 | 0 | 12 |
| | 3 yrs. | 2 | 1 | 1 | 0 | 0 | 1 | 0 | 5 |
| 2011 | ≥ 3 yrs. | 9 | 1 | 2 | 1 | 0 | 0 | 0 | 13 |
| | 2 yr. | 3 | 0 | 2 | 1 | 1 | 0 | 1[a] | 8 |
| 2012 | ≥ 2 yrs. | 19 | 1 | 0 | 0 | 0 | 0 | 0 | 20 |
| | 1 yr. | 7 | 3 | 2 | 0 | 1 | 0 | 0 | 13 |
| Subtotal | | 68 | 19 | 11 | 2 | 2 | 1 | 1 | 104 |
| Unknown[b] | ≥ 1 yr. | 2 | 5 | 0 | 0 | 0 | 0 | 0 | 7 |
| Total | | 70 | 24 | 11 | 2 | 2 | 1 | 1 | 111 |

[a] This female was detected breeding at Fallbrook Naval Weapons Station in 2012.

[b] Natal vireos banded with single numbered metal federal band or identity unknown because of inadequate resight, so natal year is not known. All seven vireos were seen with a metal gold numbered band, indicating that they were originally banded at Marine Corps Base Camp Pendleton or Marine Corps Air Station, Camp Pendleton.

Five natal vireos (two males and three females) were resighted on Base in 2013 (Table 5). All five were banded as nestlings on Base or at MCAS. Efforts to recapture and identify these vireos were unsuccessful.

Three vireos that were originally banded on Base in 2012 (with gold numbered metal federal bands) were detected off Base in San Diego County in 2013 (Table 5). All three were 1-

year-olds (two males and one female) that were recaptured on the San Luis Rey River (Ferree et al. 2013, Houston and Kus 2013, USGS unpubl. data).

*New Banded Birds*

A total of 259 Least Bell's Vireos were captured and banded for the first time during 2013 (Table 7). These included 40 adult vireos caught for the first time and banded with a unique color combination and 219 hatch-year birds (208 of which were banded as nestlings with a single gold numbered federal band and 11 of which were incidentally caught while attempting to target net an adult vireo or at one of the two MAPS stations on Base and given unique color combinations). These newly banded 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 2013.

| Age Banded | Males | Females | Unknown Sex | Total |
|---|---|---|---|---|
| Adult | 15 | 13 | 12 | 40 |
| Juvenile | | | 11[a] | 11 |
| Nestling | | | 208 | 208 |
| Total | 15 | 13 | 231 | 259 |

[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 as non-territorial birds) in 2013. 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 2012-2013*

Of 87 uniquely color banded adult vireos detected on Base during the 2012 breeding season, 70% (61/87) returned in 2013 (Table 8). Twenty-three additional adult vireos identified in 2013 but not detected on Base in 2012 were added to the calculations to yield an adjusted annual survivorship of 76% (84/110; Table 8). Sixty-eight of the 89 adult male vireos known to be alive in 2012 were resighted in 2013, an over-winter survivorship rate of 76%. Sixteen of the 21 adult female vireos known to be alive in 2012 were resighted in 2013, an over-winter survivorship rate of 76%. The remaining 21 males and 5 females were not resighted in 2013.

Table 8. Number of banded adult Least Bell's Vireos detected in 2012 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 2013. Numbers in parentheses include the adjustments resulting from vireos that were identified in 2013 but not in 2012.

| Year/Sex | Removal Sites | Reference Sites | Other Areas | Total |
|---|---|---|---|---|
| 2012 | | | | |
| Male | 19 | 21 | 36 | 76 (89) |
| Female | 1 | 3 | 7 | 11 (21) |
| Total | 20 | 24 | 43 | 87 (110) |
| 2013 | | | | |
| Male | 16[a] | 14[b] | 25 | 55 (68) |
| Female | 3[c] | 2[b] | 1 | 6 (16) |
| Total | 19 | 16 | 26 | 61 (84) |

[a] All occupied territories at Removal sites in 2012.
[b] All occupied territories at Reference sites in 2012.
[c] One occupied a Removal site in 2012, the other two occupied territories outside of our monitoring area in 2012.

*First-year Survivorship from 2012-2013*

Of the 83 hatch-year vireos banded in 2012 that survived to fledge, 13 (nine males and four females) were resighted with or captured and given unique color band combinations in 2013 (Table 9). This yields a conservative first-year survivorship of 16% (13/83) (Table 9, Table 10). Assuming an equal sex ratio of banded juveniles, first-year survivorship of males was 22% (9/41.5) and females was 10% (4/41.5).

Table 9. Number of Least Bell's Vireos banded as nestlings or fledglings at giant reed (*Arundo donax*) Removal sites, Reference sites, and other areas on Marine Corps Base Camp Pendleton in 2012, and where those that returned were detected in 2013.

| Year/Sex | Removal Sites | Reference Sites | Other Areas | Total |
|---|---|---|---|---|
| 2012 | | | | |
| Unknown | 41 | 41[a] | 1[a] | 83 |
| 2013 | | | | |
| Male | 0 | 0 | 9[b] | 9 |
| Female | 0 | 1[c] | 3[d] | 4 |
| Total | 0 | 1 | 12 | 13 |

[a] One banded as a juvenile, could not be certain of its origin.
[b] Four were banded as nestlings at Removal sites, three were banded as nestlings at Reference sites, one was banded as a fledged juvenile at a Reference site, and one was banded as a juvenile outside of the monitoring area in 2012. Two males banded as nestlings at Removal sites emigrated to the San Luis Rey River in 2013.
[c] Banded as a nestling at a Reference site in 2012.
[d] All were banded as nestlings at Removal sites in 2012. One female banded at a Removal site emigrated to the San Luis Rey River in 2013.

*Adjusted Annual Survivorship*

Twenty-three adult banded vireos (13 males and 10 females) that were detected in 2013 were not observed in 2012 (Table 8). These detections were used to adjust estimates of annual survivorship for previous years (see Methods: Banding). Incorporating these detections into calculations increased first-year survivorship estimates 1-6% and adult survivorship 2-5% over original estimates (Table 10).

Table 10. Adjustments to first-year and adult Least Bell's Vireo survivorship on Marine Corps Base Camp Pendleton, 2013. These numbers update survivorship estimates presented in Rourke and Kus 2007a, 2008, Lynn and Kus 2009, 2010a, 2010c, 2011c, and 2012b.

| | First-year Survivorship | | | Adult Survivorship | | |
|---|---|---|---|---|---|---|
| Years | Original | Previous Estimate | New | Original | Previous Estimate | New |
| 2005-2006 | 10% | 16% | - | 30% | 41% | - |
| 2006-2007 | 10% | 26% | 27% | 63% | 75% | 76% |
| 2007-2008 | 12% | 23% | 24% | 49% | 62% | 63% |
| 2008-2009 | 10% | 14% | 15% | 53% | 60% | 61% |
| 2009-2010 | 7% | 9% | 10% | 50% | 54% | 56% |
| 2010-2011 | 5% | 11% | 12% | 27% | 34% | 39% |
| 2011-2012 | 10% | - | 15% | 54% | - | 66% |
| 2012-2013 | - | - | 16% | - | - | 76% |

*Survivorship at Removal and References Sites*

Of the 20 banded adult vireos of known sex (19 males and 1 female) that were detected within Removal sites in 2012, 17 (16 males and 1 female) were resighted in 2013 for 85% survival rate (84% for males and 100% for females; Table 8 and Appendix D). Of the 24 banded adult vireos of known sex (21 males and 3 females) that were detected within Reference sites in 2012, 16 (14 males and 2 females) were resighted in 2013 for a 67% survival rate (67% for both males and females). No vireos moved between Removal or Reference sites between 2012 and 2013. Over-winter survival rate did not differ between vireos that occupied Removal or Reference sites in 2012 ($\chi^2 = 0.09$, $P = 0.77$).

Eighty-one of the 83 banded juveniles that were known to fledge in 2012 were banded on a Removal or Reference site (41 at Removal sites and 40 at Reference sites). Of these, 11 (seven at Removal sites and four at Reference sites) were recaptured on MCBCP and given unique color band combinations in 2013 for an overall first-year survival rate of 17% for fledglings from Removal sites and 10% for fledglings from Reference sites (Table 9). One other juvenile that was captured and banded at a Reference site in 2012 was redetected in 2013. However, because this individual was caught as a fledgling, we could not confirm that it originated within the Reference site.

*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). Sixty-one adult vireos (55 males and 6 females) that were identified in 2012 were resighted in 2013, all of which occupied known territories both years. The majority of returning adult vireos showed strong between-year site fidelity. Of the 61 returning adults, 46 (all males; 75% of all vireos and 84% of males) occupied a breeding site in 2013 that they had defended in 2012 (within 100 m). Nine additional vireos (six males and three females; 15% of all vireos, 11% of males and 50% of females) returned to sites adjacent to their previous territories (within 300 m). The average distance moved by returning adult vireos was 0.2 ± 0.4 km (standard deviation [SD]; 0.1 ± 0.4 km (SD) for males and 0.4 ± 0.3 km (SD) for females). Two additional adult female vireos moved from 2012 breeding territories along the San Luis Rey River and Fallbrook Naval Weapons Station (FNWS) to their 2013 breeding territories along the Santa Margarita River, an average distance of 5.4 ± 3.1 km (SD).

Eleven first-year vireos that were banded as a nestling in 2012 on MCBCP were resighted in 2013 and occupied a known territory. Eight of these returned to MCBCP and three emigrated to the San Luis Rey River (Ferree et al. 2013). Two additional vireos were excluded from analysis because they were originally captured as juveniles in 2012 and therefore could not be associated with an exact natal territory. The eight first-year vireos that returned to MCBCP dispersed 5.3 ± 7.7 km (SD) from their 2012 natal site (7.2 ± 8.7 km (SD) for males, 0.9 ± 0.7 km (SD) for females; Table 11). Including the three vireos that were banded as nestlings on MCBCP in 2012 and were redetected off Base in 2013, the average dispersal distance was 6.3 ± 7.1 km (SD) (8.3 ± 7.8 km (SD) for males, 2.0 ± 2.2 km (SD) for females). Three other first-year vireos that were originally banded as nestlings along the San Luis Rey River (two males) and on MCAS (one male) in 2012 dispersed an average 3.8 ± 2.7 km (SD) to MCBCP.

Table 11. Between-year dispersal into or out of Marine Corps Base Camp Pendleton by Least Bell's Vireos banded as juveniles in 2012 and detected in 2013.

| Year Last Detected | Drainage / Territory / Treatment[a] | | Dispersal Distance (km) | Band Combination[b] | | Sex[c] |
|---|---|---|---|---|---|---|
| | 2012 | 2013 | | Left Leg | Right Leg | |
| 2012 | SMR / ICE / REM | SMR / AE88 | 3.5 | ORPU/Mgo | DPDP | M |
| 2012 | SMR / ECH / REM | SMR / ES35 | 0.9 | PUWH/Mgo | ORPU | M |
| 2012 | SMR / CKE / REM | SMR / AE91 | 2.7 | DPWH/Mgo | DPWH | M |
| 2012 | SMR / BAY / REM | SMR / AE98 | 2.6 | BYST/Mgo | DPDP | M |
| 2012 | SMR / TRF / REM | SMR / ES01 | 1.6 | LPBK/Mgo | PUPU | F |
| 2012 | SMR / PIE / REM | SMR / ES22 | 0.3 | WHDP/Mgo | DPDP | F |
| 2012 | SMR / AXE / REF | SMR / MOU / REF | 0.9 | OROR/Mgo | PUPU | F |
| 2012 | SMR / AXE / REF[d] | SMR / YB15 | 9.7 | ORPU | ORDG/Mgo | M |
| 2012 | SMR / HTI / REF | CS / CS07 | 25.8 | PUPU/Mgo | ORPU | M |
| 2012 | SMR / RR17[d] | LF / UL08 | 5.4 | YEPU/Mgo | WHWH | M |
| 2012 | SMR / DRK / REF | SLR / MSL40 | 12.6 | WHWH/Mgo | BKBK | M |
| 2012 | SMR / DAQ / REF | SLR / WFE | 11.4 | ORPU/Mgo | PUWH | M |
| 2012 | SMR / BAY / REM | SLR / WHAR | 5.2 | Mgo | PUOR/gogo | F |
| 2012 | MCAS / LUC[e] | SMR / AE85 | 0.7 | DGOR | WHPU/Mgo | M |
| 2012 | SLR / WDID[f] | SMR / EMB / REM | 5.4 | BYST/Mdb | DBDP | M |
| 2012 | SLR / DTOS[f] | SMR / MAC / REM | 5.2 | YEYE/Mdb | LPBK | M |

[a] Drainage Codes: CS = Cristianitos Creek; LF = Las Flores Creek; MCAS = Marine Corps Air Station, Camp Pendleton; SLR = San Luis Rey River; SMR = Santa Margarita River. Treatment Codes: REF = Reference; REM = Removal.

[b] Band colors: Mdb = dark blue numbered federal band; Mgo = gold numbered federal band; gogo = metal gold; BKBK = plastic black; BYST = plastic black-yellow striped; DBDP = plastic dark blue-dark pink split; DGOR = plastic dark green-orange split; DPWH = plastic dark pink-white split; DPDP = plastic dark pink; LPBK = plastic light pink-black split; ORDG = plastic orange-dark green split; OROR = plastic orange; ORPU = plastic orange-purple split; PUOR = plastic purple-orange split; PUPU = plastic purple; PUWH = plastic purple-white split; 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.

[d] Banded as a dispersing juvenile and therefore not positively associated with this site. This distance represents an estimation of juvenile dispersal.

[e] Immigrant to MCBCP from the Marine Corps Air Station, Camp Pendleton.

[f] Immigrant to MCBCP from the San Luis Rey River.

*Site Fidelity and Movement – Removal and Reference Sites*

Fidelity to Removal and Reference sites was the same, as 100% (17/17) of adult vireos from Removal sites and 100% (16/16) of adult vireos from territories at Reference sites returned to the same treatment type they had defended in 2012 (Appendix D).

One vireo detected in 2013 fledged from a Reference site in 2012 and returned to occupy a breeding territory at a Reference site in 2013. The remaining ten vireos that fledged from Removal and Reference sites in 2012 dispersed to territories outside of our monitoring areas.

*Movement between breeding and wintering areas*

One banded vireo, a female that was detected on MCBCP in April 2012, was resighted on the San Jose River in Baja California Sur, Mexico, in October 2012. This female moved approximately 1,340 km between her breeding area and her wintering area. She was not resighted on MCBCP in 2013.

## Nest Monitoring

Nesting activity was monitored in a total of 49 territories within the Removal and Reference monitoring areas (Table 12, Fig. 5-8, Appendix E). All 49 territories were known to be occupied by pairs. Forty-eight of the territories were considered "fully" monitored, meaning that all nests within the territory were found and documented during the breeding season. The pair within the remaining territory was documented nesting; however, only a subset of nests was found and monitored ("partially monitored"). A total of 124 nests were monitored during the breeding season; 14 of these were not completed (coded as "INC" in Appendix E) and have been excluded from calculations of nest success and productivity. Of the remaining 110 nests, 109 were in fully monitored territories.

Table 12. Number of Least Bell's Vireo territories and nests monitored at giant reed (*Arundo donax*) Removal and Reference sites on Marine Corps Base Camp Pendleton, 2013.

| | **Nest Monitoring Area Type** | |
|---|---|---|
| | **Removal** | **Reference** |
| Territories fully monitored | 24 | 24 |
| Nests in fully monitored territories (# complete) | 49 (46) | 74 (63) |
| Completed nests per pair (fully monitored territories) | 1.9 ± 0.7 (SD) | 2.6 ± 0.9 (SD) |
| Total number of nests per pair (includes incomplete nests fully monitored territories only) | 2.0 ± 0.8 (SD) | 3.1 ± 1.2 (SD) |
| Territories partially monitored | 0 | 1 |
| Nests in partially monitored territories (# complete) | 0 | 1 (1) |
| Total # of nests monitored | 49 | 75 |

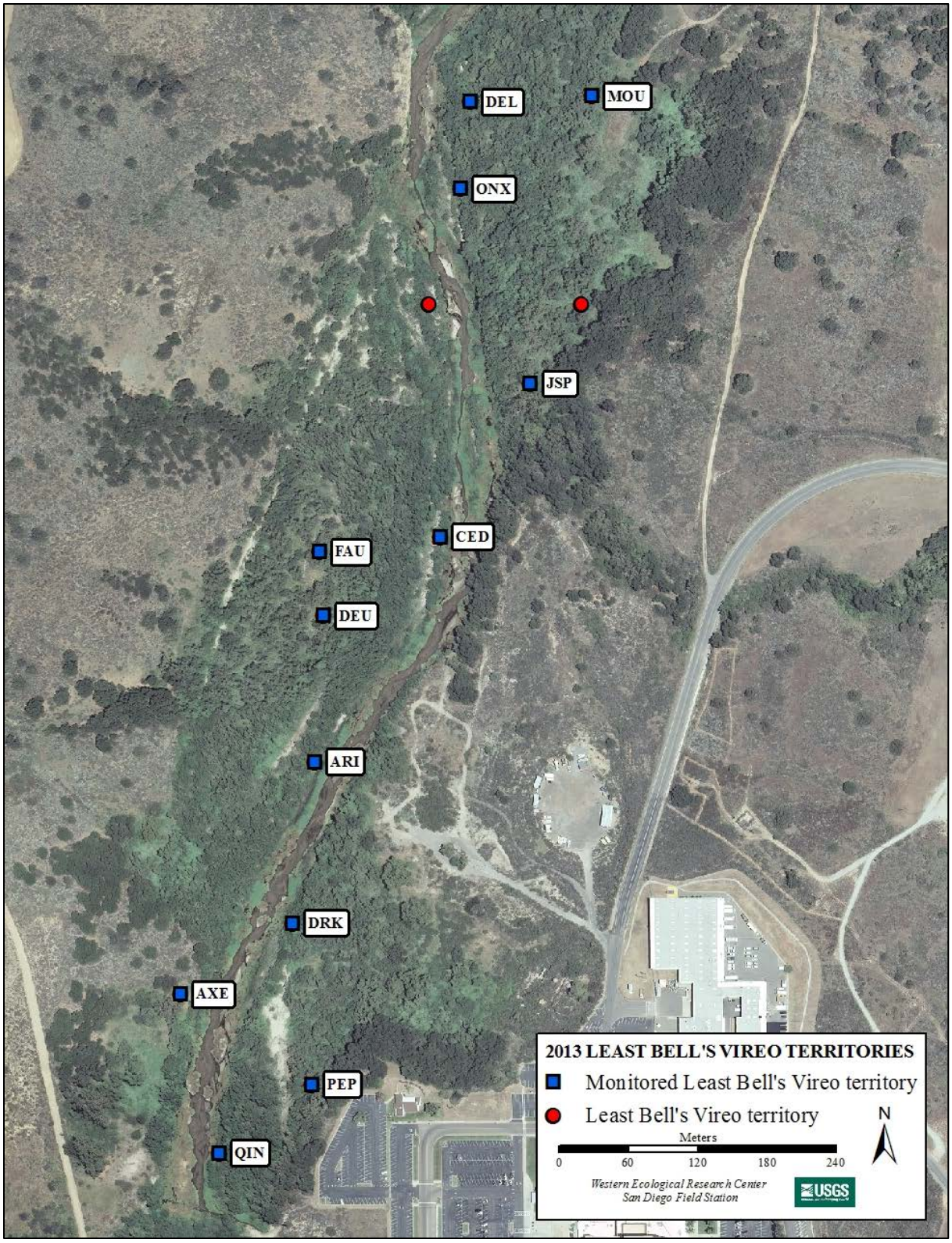


Fig. 5. Locations of monitored Least Bell's Vireo territories at the Above Hospital Reference site, Marine Corps Base Camp Pendleton, 2013.

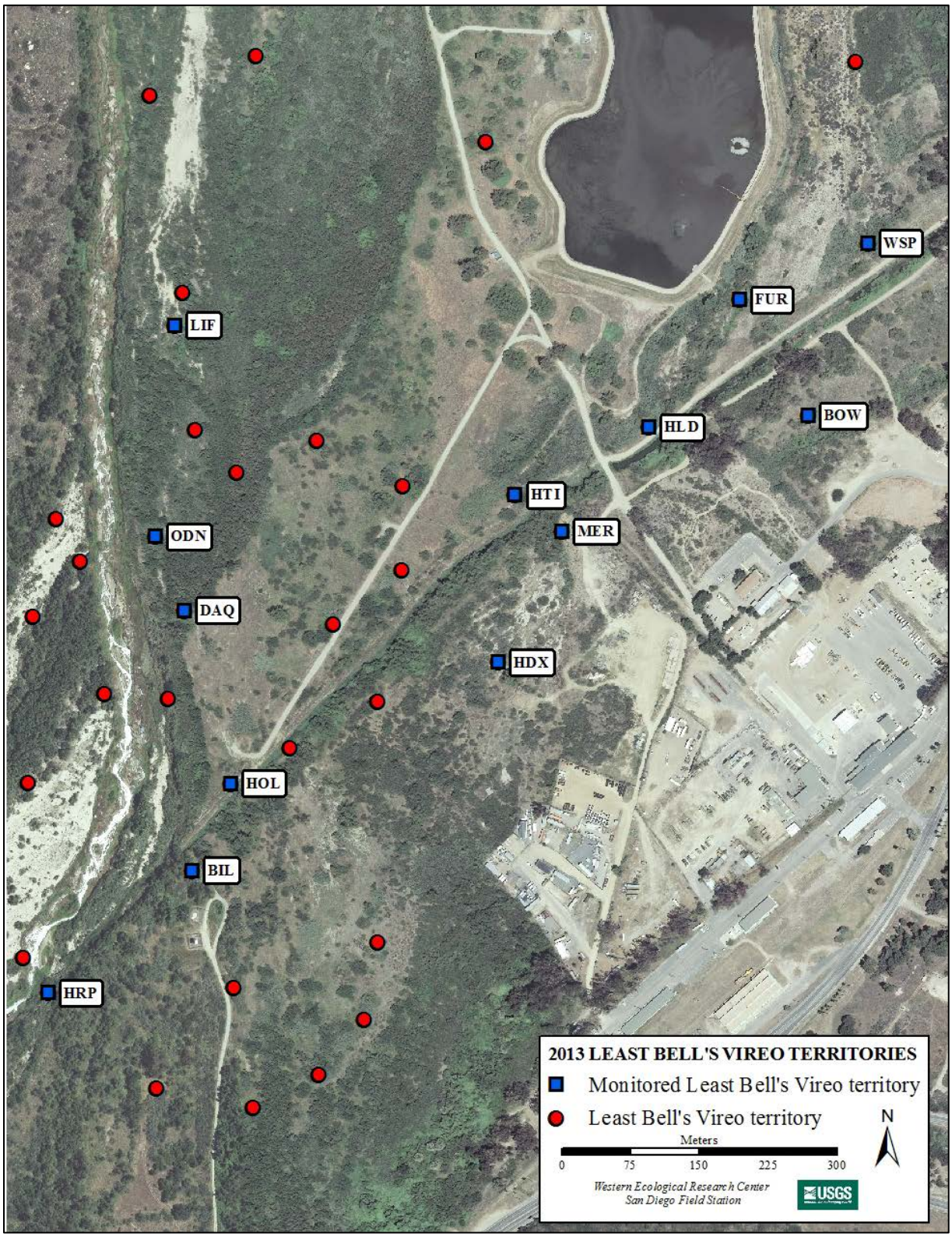


Fig. 6. Locations of monitored Least Bell's Vireo territories at the Below Hospital Reference site, Marine Corps Base Camp Pendleton, 2013.

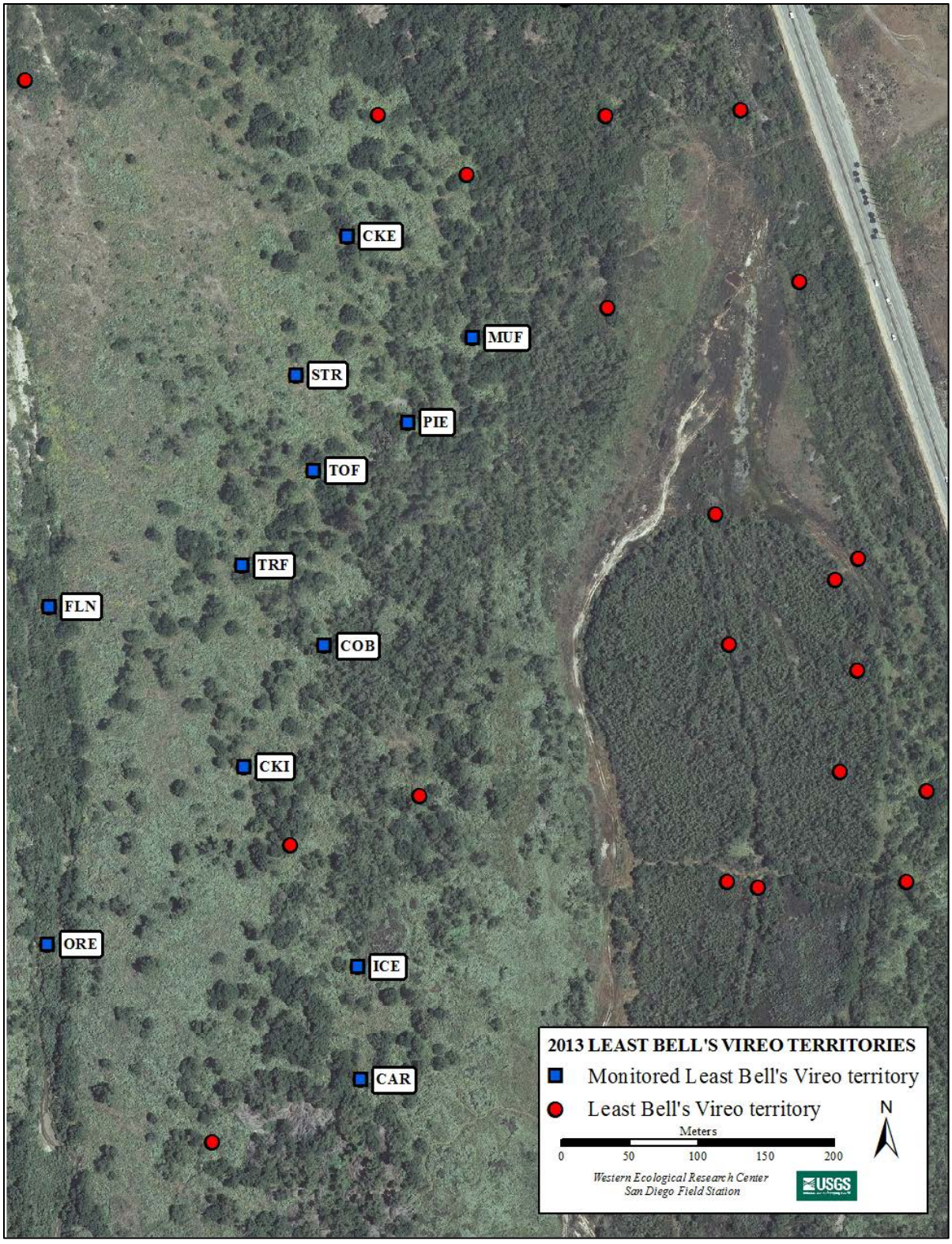


Fig. 7. Locations of monitored Least Bell's Vireo territories at the Bell giant reed (*Arundo donax*) Removal site, Marine Corps Base Camp Pendleton, 2013.

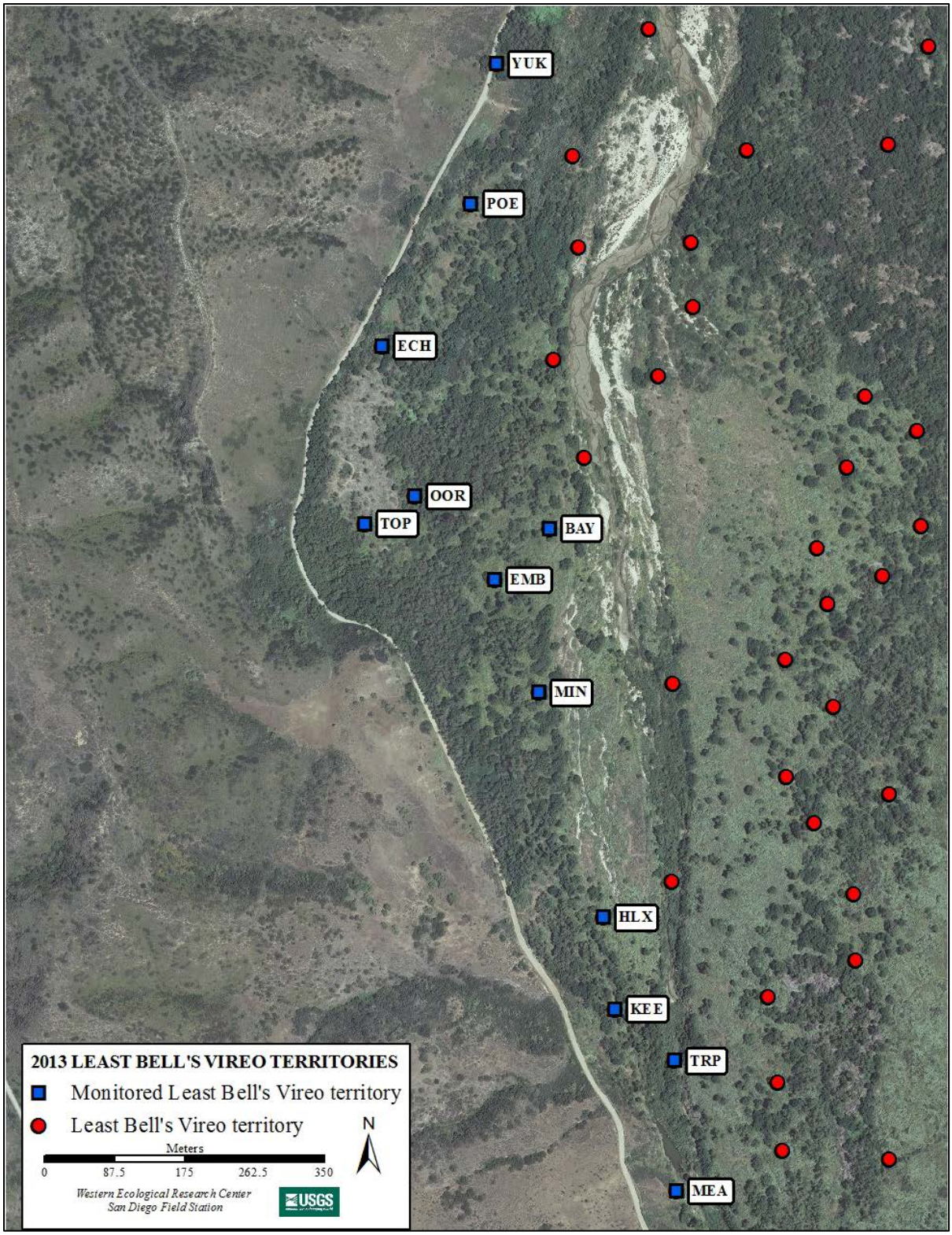


Fig. 8. Locations of monitored Least Bell's Vireo territories at the Pump Road giant reed (*Arundo donax*) Removal site, Marine Corps Base Camp Pendleton, 2013.

*Nesting Attempts*

Pairs at Reference sites had significantly more nesting attempts (including incomplete nests) than pairs at Removal sites over the course of the 2013 breeding season (Table 12; $t$ = 3.66, $P < 0.01$). Pairs at Removal sites were as likely to re-nest after their initial attempt as were pairs at Reference sites (Fisher's Exact $P = 0.42$), as 79% of Removal pairs and 92% of Reference pairs initiated a second attempt. Incidence of re-nesting after a failed first nesting attempt did not differ between Removal sites (88%; 7/8) and Reference sites (100%; 16/16; Fisher's Exact $P = 0.33$). Re-nesting rate after a successful first nesting attempt also did not differ between Removal sites (75%; 12/16) and Reference sites (75%; 6/8; Fisher's Exact $P = 1$). However, vireos were more likely to re-nest after a failed first nesting attempt than after a successful first nesting attempt (Fisher's Exact $P = 0.097$). Overall, 96% (23/24) of vireo pairs attempted to re-nest after a failed first nesting attempt in 2013, slightly more than the proportion that attempted to re-nest after a failed first nesting attempt in previous years (Fig. 9). The rate of re-nesting attempts following a successful nesting attempt in 2013 (75%; 18/24) was higher than most previous years (Fig. 9). Five pairs at Removal sites and 16 pairs at Reference sites attempted three or more nests in 2013. Six pairs at Reference sites initiated four nesting attempts and three pairs at Reference sites initiated five nesting attempts in 2013.

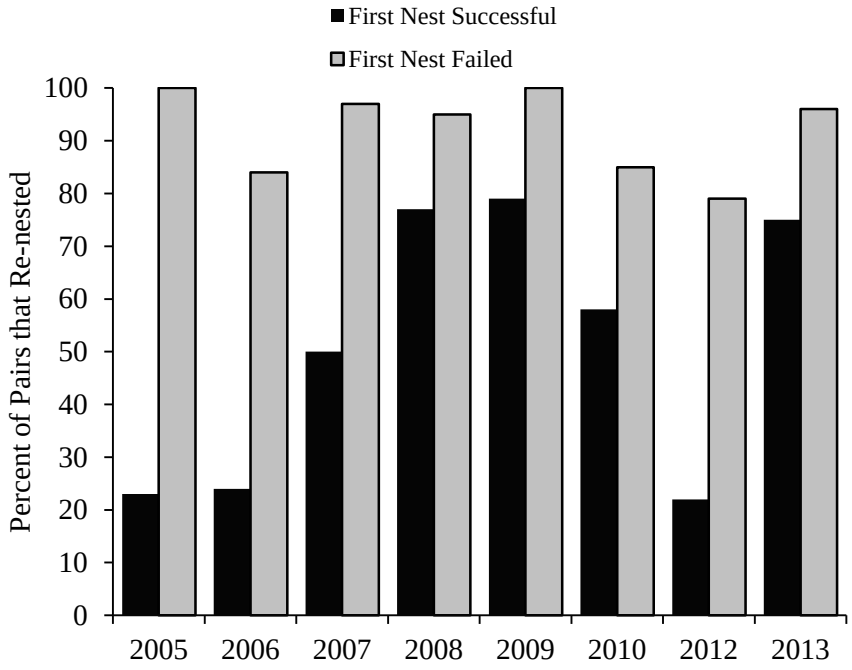


Fig. 9. Percent of Least Bell's Vireo pairs that re-nested after a successful or failed first nesting attempt on Marine Corps Base Camp Pendleton, 2005-2010 and 2012-2013.

*Nest Success*

Completed nests in Removal sites were more likely to be successful than completed nests in Reference sites ($\chi^2 = 13.49$, $P < 0.01$), as 72% (33/46) of nests in Removal sites successfully fledged young while 34% (22/64) of those in Reference sites successfully fledged young (Table 13). First nesting attempts were more likely to be successful at Removal sites (67%) than at Reference sites (33%; $\chi^2 = 4.09$; $P = 0.04$) in 2013 (Fig. 10A). Overall, 50% of first detected nesting attempts were successful in 2013. Fate of the first detected nesting attempt differed significantly across years (2005 = 39%, 2006 = 40%, 2007 = 26%, 2008 = 61%, 2009 = 51%, 2010 = 41%, 2012 = 55%; $\chi^2 = 15.4$, $P = 0.03$, df = 7; Fig. 10B), with 2013 slightly higher than the mean of all years (45%).

Table 13. Fate of Least Bell's Vireo nests in fully and partially monitored territories, Marine Corps Base Camp Pendleton, 2013. Numbers in parentheses are proportions of total nests.

| | Number of Nests | | |
|---|---|---|---|
| **Nest Fate** | **Removal** | **Reference** | **Total** |
| Successful | 33 | 22 | 55 (0.50) |
| Failed | | | |
| Predation | 11 | 35 | 46 (0.42) |
| Parasitism | 0 | 0 | 0 (0.00) |
| Other/Unknown | 2 | 7 | 9 (0.08) |
| Total Completed Nests | 46 | 64 | 110 (1.00) |

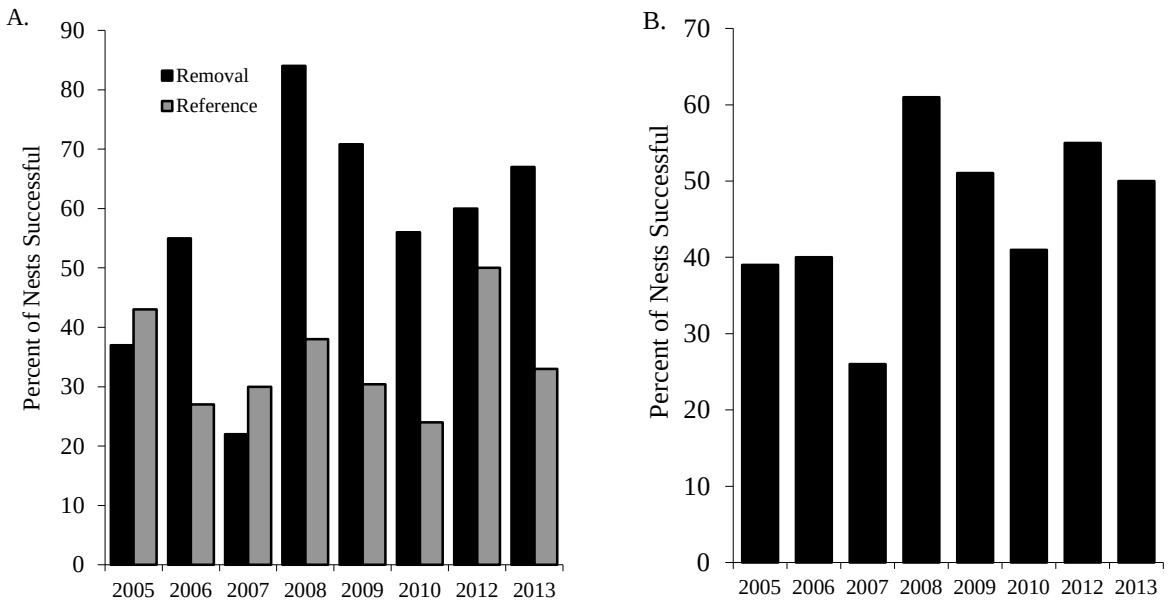


Fig. 10. Percent of nests that were successful among first nests by Least Bell's Vireos (A) at Removal and Reference sites, and (B) overall on Marine Corps Base Camp Pendleton, 2005-2010 and 2012-2013.

Causes of nest failure were similar at Removal and Reference sites. Predation was believed to be the primary source of nest failure at both types of sites, although no predation events were witnessed (Table 13). Predation accounted for 69% (11/16) of nest failures at Removal sites and 66% (35/53) of nest failures at Reference sites. We also documented nine nests that failed for other known and unknown reasons at our study sites. Seven nests (one at a Removal site and six at Reference sites) failed between nest-building and egg-laying from unknown causes. The nestlings in one nest at a Removal site were found dead or in very poor condition, possibly starved. In one Reference site nest, one of the three eggs had been punctured, possibly by a bird. Overall, 28% and 66% 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 2013.

*Productivity*

Clutch size did not differ between Removal and Reference sites (Table 14). Measures of hatching and fledging success were higher at Removal sites compared to Reference sites. Overall productivity per pair was significantly higher at Removal sites than at Reference sites (4.2 vs. 3.0 young fledged per pair, respectively; Table 14). Ninety-two percent of pairs at

Removal sites and 71% of pairs at Reference sites were ultimately successful in fledging young from at least one nest. Eleven pairs at Removal sites (46%) and four pairs at Reference sites (17%) successfully double-brooded, fledging young from two nests during the 2013 breeding season. Overall, vireo pairs at monitored sites on MCBCP fledged 3.6 vireo young per pair, and 81% of all monitored pairs were successful in fledging at least one young in 2013.

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, 2013.

| Parameter | Removal Sites | Reference Sites | Total |
|---|---|---|---|
| Nests with eggs | 45 | 56 | 101 |
| Eggs laid | 151 | 172 | 323 |
| Average clutch size[a] | 3.5 ± 0.6 (SD) | 3.3 ± 0.6 (SD) | 3.5 ± 0.6 (SD) |
| Hatchlings | 124 | 106 | 230 |
| Nests with hatchlings | 40 | 32 | 72 |
| Hatching success: | | | |
| Eggs[b] | 82% | 62% | 71% |
| Nests[c] | 89% | 57% | 71% |
| Fledglings | 100 | 71 | 171 |
| Nests with fledglings | 33 | 21 | 54 |
| Fledging success: | | | |
| Hatchlings[d] | 81% | 67% | 74% |
| Nests[e] | 83% | 66% | 75% |
| Fledglings per egg | 0.7 | 0.4 | 0.5 |
| Fledglings per nest | 2.2 | 1.3 | 1.7 |
| Average number of young fledged per pair[f] | 4.2 ± 2.4 (SD) | 3.0 ± 2.3 (SD) | 3.6 ± 2.4 (SD) |
| Pairs fledging ≥ 1 young[f] | 22 (92%) | 17 (71%) | 39 (81%) |

[a] Based on 40 Removal and 36 Reference non-parasitized nests with a full clutch ($t = 0.16$; $P = 0.87$).
[b] Percent of all eggs that hatched.
[c] Percent of all nests with eggs in which at least one egg hatched.
[d] Percent of all nestlings that fledged.
[e] Percent of all nests with nestlings in which at least one young fledged.
[f] Based on 24 Removal and 24 Reference pairs ($t = -1.77$, $P = 0.08$).

*Nest Survival*

Analysis of DSR showed that type of monitoring site (Removal or Reference) was a good predictor of vireo nest survival, and the best supported model included both type of monitoring site and year (Table 15). This means that nests at Removal sites were 2.5 times more likely to fledge young than nests at Reference sites (Fig. 11, Table 16). There was a trend toward

increasing nest success by year for Removal sites, but not for Reference sites. The best supported model had a lower AIC than the next best model, and the odds ratios for both the type of monitoring site and year had confidence intervals that did not include 1, which indicates that they were both significant contributing factors to the model (Table 16). The second best model, which included only type of monitoring site, had some support, as indicated by the AIC weight (27% likelihood of being the correct model), and in this model, the confidence interval for the type of monitoring site also did not include 1. Both of these models were significantly better supported than the constant model.

Table 15. Logistic regression models for the effect of Treatment (whether a nest was in a Removal or Reference site) on nest survival of Least Bell's Vireos on Marine Corps Base Camp Pendleton, 2010-2013. Models are ranked from best to worst based on Akaike's Information Criteria for small samples ($AIC_C$), $\Delta AIC_C$, and Akaike weights (w). $AIC_C$ is based on -2 x $\log_e$ likelihood (L) and the number of parameters (K) in the model.

| Model | Deviance | # Parameters | $AIC_C$ | $\Delta AIC_C$ | $AIC_C$ Weight |
|---|---|---|---|---|---|
| Treatment + Year | 775.61 | 3 | 781.61 | 0.00 | 0.729 |
| Treatment | 779.59 | 2 | 783.59 | 1.98 | 0.271 |
| Constant | 804.97 | 1 | 806.98 | 25.36 | 0.000 |

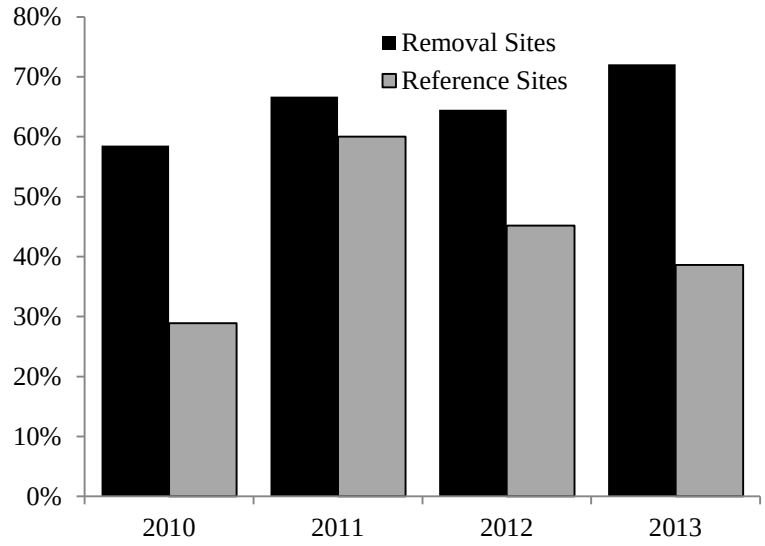


Fig. 11. Percent of nests that survived to fledge young at Removal and Reference sites, Marine Corps Base Camp Pendleton, 2010-2013.

Table 16. Parameter estimate (β), standard error (SE), odds ratios and 95% confidence intervals (CI) for the best supported model explaining daily survival rate of Least Bell's Vireos at Reference and Removal sites on Marine Corps Base Camp Pendleton, 2010-2013.

| Effect | β | SE | Odds Ratio | 95% CI |
|---|---|---|---|---|
| Treatment | 0.91 | 0.19 | 2.49 | 1.723 – 3.597 |
| Year | 0.14 | 0.07 | 1.15 | 1.003 – 1.307 |

**Population Density**

The density of the vireo population increased slightly at both Removal and Reference sites in 2013 (Fig. 12). Vireo density at the Reference sites remained low relative to the highest density recorded in 2009, although density at the Removal sites increased to the level observed in 2011. In 2013, density at Reference sites did not differ from density at Removal sites ($t$ = -0.37, $P$ = 0.74, df = 1). 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.

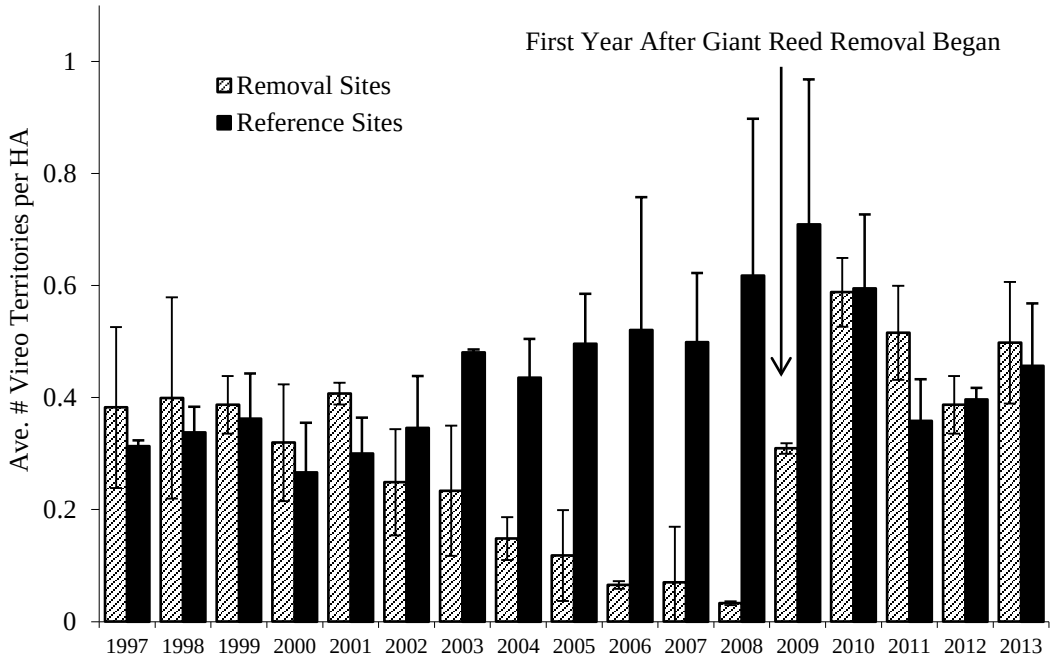


Fig. 12. Annual density of Least Bell's Vireo territories (± SD) at Reference and giant reed (*Arundo donax*) Removal sites by year, averaged across sites, Marine Corps Base Camp Pendleton, 1997-2013.

## Nest Characteristics

Least Bell's Vireos used 17 plant species for nesting at Removal and Reference sites in 2013, although not all were used within each treatment (Table 17). Vireos used ten species at Removal sites and 15 species at Reference sites. Seventy percent of all nests (76% at Removal sites and 67% at Reference sites) were placed in arroyo willow, mule fat, or sandbar willow. Eight vireo nests were built in an exotic plant species (four in poison hemlock, two in salt cedar, one in black mustard, and one in white sweet clover (*Melilotus alba*).

In 2013, successful and unsuccessful nests within Removal and Reference sites were similar in placement except that at Removal sites, successful nests were placed higher than unsuccessful nests and at Reference sites, successful nests were placed closer to the edge of the nest host (further from the center). Vireo nests at Removal sites were placed higher in the host plants, in taller host plants, further from the edge of the host plant, and further from the edge of the host nest clump than nests in Reference sites (Table 18).

Table 17. Host plant species used by Least Bell's Vireos at giant reed (*Arundo donax*) Removal and Reference sites, Marine Corps Base Camp Pendleton, 2013. Numbers in parentheses are proportions of total nests within treatment types.

| | Number of Nests | |
|---|---|---|
| **Host Species** | **Removal** | **Reference** |
| Arroyo or red willow | 27 (0.55) | 22 (0.29) |
| Mule fat | 7 (0.14) | 15 (0.20) |
| Sandbar willow | 3 (0.06) | 13 (0.17) |
| Mexican elderberry (*Sambucus nigra*) | 4 (0.08) | 5 (0.07) |
| Poison hemlock | 1 (0.02) | 3 (0.04) |
| Poison oak (*Toxicodendron diversilobum)* | 1 (0.02) | 3 (0.04) |
| Wild grape (*Vitis spp.*) | 0 | 3 (0.04) |
| Black willow | 2 (0.04) | 1 (0.01) |
| California blackberry (*Rubus ursinus*) | 0 | 2 (0.03) |
| Coastal live oak | 0 | 2 (0.03) |
| Wild rose (*Rosa californica*) | 1 (0.02) | 1 (0.01) |
| California sycamore | 0 | 2 (0.03) |
| Salt cedar | 2 (0.04) | 0 |
| White sweet clover | 0 | 1 (0.01) |
| Coyote brush (*Baccharis pilularis*) | 0 | 1 (0.01) |
| Black mustard | 0 | 1 (0.01) |
| Sedge (*Carex* spp.) | 1 (0.02) | 0 |

Table 18. Least Bell's Vireo nest characteristics and results of Student's *t*-tests of successful vs. unsuccessful nesting attempts at giant reed (*Arundo donax*) Removal and Reference sites, Marine Corps Base Camp Pendleton, 2013.

| | Nest Fate | | | | |
|---|---|---|---|---|---|
| **Nest Characteristic** | **Successful** | **Unsuccessful** | ***n*[a]** | ***t*[b]** | ***P*[c]** |
| **Removal Site** | | | | | |
| Average nest height (m) | 0.97 | 0.83 | (32, 16) | 1.69 | **0.10** |
| Average host height (m) | 5.44 | 4.59 | (32, 16) | 0.91 | 0.37 |
| Average distance to edge of host (m) | 1.06 | 0.90 | (32, 16) | 0.73 | 0.47 |
| Average distance to edge of clump (m) | 2.04 | 2.23 | (32, 16) | -0.65 | 0.52 |
| **Reference Site** | | | | | |
| Average nest height (m) | 0.76 | 0.74 | (22, 52) | 0.34 | 0.74 |
| Average host height (m) | 2.85 | 3.25 | (22, 53) | -0.69 | 0.50 |
| Average distance to edge of host (m) | 0.40 | 0.59 | (22, 52) | -1.92 | **0.06** |
| Average distance to edge of clump (m) | 1.59 | 1.81 | (22, 52) | -0.82 | 0.42 |
| **Overall** | **Removal** | **Reference** | ***n*[d]** | ***t*[b]** | ***P*[c]** |
| Average nest height (m) | 0.93 | 0.75 | (48, 74) | -4.03 | < **0.001** |
| Average host height (m) | 5.16 | 3.13 | (48, 74) | -4.21 | < **0.001** |
| Average distance to edge of host (m) | 1.01 | 0.54 | (48, 74) | -4.68 | < **0.001** |
| Average distance to edge of clump (m) | 2.10 | 1.74 | (48, 74) | -1.95 | **0.05** |

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

## DISCUSSION

In 2013, the number of documented Least Bell's Vireo territories (724) on MCBCP increased by 14% from 2012. This follows 2 years of vireo population decline on MCBCP, and reflects a similar increase for this subspecies across San Diego County. Vireo populations increased from 2012 to 2013 on the lower San Luis Rey River (36%; Ferree et al. 2013), the middle San Luis Rey River (9%; Houston and Kus 2013), at MCAS (33%; Allen et al. 2013), at the Sweetwater Reservoir (29%; Pottinger and Kus 2013), and in the Prado Basin of the Santa Ana River (24%; Pike et al. 2013). Vireo populations in all of these areas also decreased between 2010 and 2012.

Fluctuations in the vireo population over the past several years have been manifested relatively consistently across several study areas in San Diego County, including the San Luis Rey River, the San Diego River, MCAS, and the Sweetwater Reservoir. The range-wide vireo population gradually increased through the 1980's and 1990's, reaching a peak in 2009-2010 before declining through 2012 and then increasing again in 2013 (Ferree and Kus 2007, 2008a, 2008b, Ferree et al. 2010a, 2010b, 2011, 2012, 2013, 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, 2010a, 2010b, 2011a, 2012a, Lynn et al. 2010, USGS unpubl. data). Doubtless, local management for vireos has affected the vireo population positively, especially with the

implementation of cowbird control and exotic plant removal in vireo habitat during the early 1980's. However, the similarity between population trends across drainages in San Diego County indicates that demographic stresses on the entire population are not necessarily restricted to local conditions. Instead, more regional factors such as weather patterns and the potential impacts of climate change, suitability of migratory habitat, and environmental conditions on the wintering grounds probably affect population size and productivity.

From 2012 to 2013, we observed the highest adult (76%) and juvenile (16%) annual survivorship documented since 2005. This high over-winter survivorship followed a year of average precipitation on both the breeding grounds (July 2011 – June 2012; Lake O'Neill, OWR 2013) and the wintering grounds (July 2012 – June 2013; San Jose del Cabo, Baja California Sur, Mexico; Weather Underground 2013). We also saw high adult survivorship from 2006 to 2007, when annual precipitation was well below normal at both the breeding grounds and the wintering grounds. This suggests that annual precipitation may not be the primary influence on over-winter survivorship. Other potential factors that may contribute to survivorship include weather during migration, cumulative effects of lower-than-average (or adequate/higher-than-average) annual precipitation on the wintering grounds, temperature, and dynamics of predator prey relationships that may also be affected by climatic variability. We expect that survivorship rates of both adults and juveniles from 2012 to 2013 will increase as we detect vireos in future years that were alive but not detected in 2013.

As in past years, in 2013 we detected vireos that originated outside of MCBCP holding territories on drainages on MCBCP, as well as vireos that hatched on MCBCP breeding off Base on the San Luis Rey River, providing further evidence of the connection between vireo populations in drainages across southern California. These movements demonstrate the ability of vireos to disperse well beyond their natal drainages. Further banding and resighting of vireos within southern California continues to increase our understanding 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.

In April 2012, we detected a breeding female vireo on MCBCP that had hatched on MCBCP in 2008 and was then recaptured and banded in southern Baja California, Mexico, in February 2012 (Lynn and Kus 2012b). This female was resighted in Baja California in October 2012, near her February 2012 location. Such inter-seasonal connections provide valuable insight into possible impacts to the vireo population outside of the breeding grounds.

Removal sites had higher breeding productivity than Reference sites. Pairs at Removal sites had higher nest success, fledged more young, had more successful nests, and had a higher DSR than pairs at Reference sites. We have observed slightly but consistently higher vireo breeding productivity at Removal sites than at Reference sites over the past 4 years. These results suggest that vireo habitat continues to improve at Removal sites and vireos have responded quickly and positively to the habitat improvement.

The percent of pairs that fledged at least one young in 2013 (81%) was average compared to all previous years (2012 = 74%, 2011 = 67%, 2010 = 72%, 2009 = 89%, 2008 = 94%, 2007 = 89%, 2006 = 79%, 2005 = 89%). However, the number of young fledged per pair in 2013 (3.6) was higher than the average between 2005 and 2012 (range 1.2 – 4.4), though lower than the 2 highest years documented since 2005 (4.4 in 2008 and 3.8 in 2009).

## 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). The increasing pattern in the 1980s and 1990s can largely be attributed 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 2013. 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. Ultimately, the recent fluctuations in the vireo population may indicate that carrying capacity of the current habitat (whether breeding, migratory, or wintering) 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 (after removal of giant reed) than at Reference sites, indicating that over the long term, giant reed removal did not negatively impact vireo breeding productivity. However, it is worth noting that the method and timing of giant reed removal are important factors to consider when weighing the proximate costs and benefits to native bird species of removing giant reed, especially when such activities overlap with the breeding season. Further investigation into habitat, prey, and predation pressures as associated with vireo breeding productivity would identify 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 2013, 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.

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# APPENDICES

## APPENDIX A. LEAST BELL'S VIREO SURVEY AREAS AT MARINE CORPS BASE CAMP PENDLETON, 2013

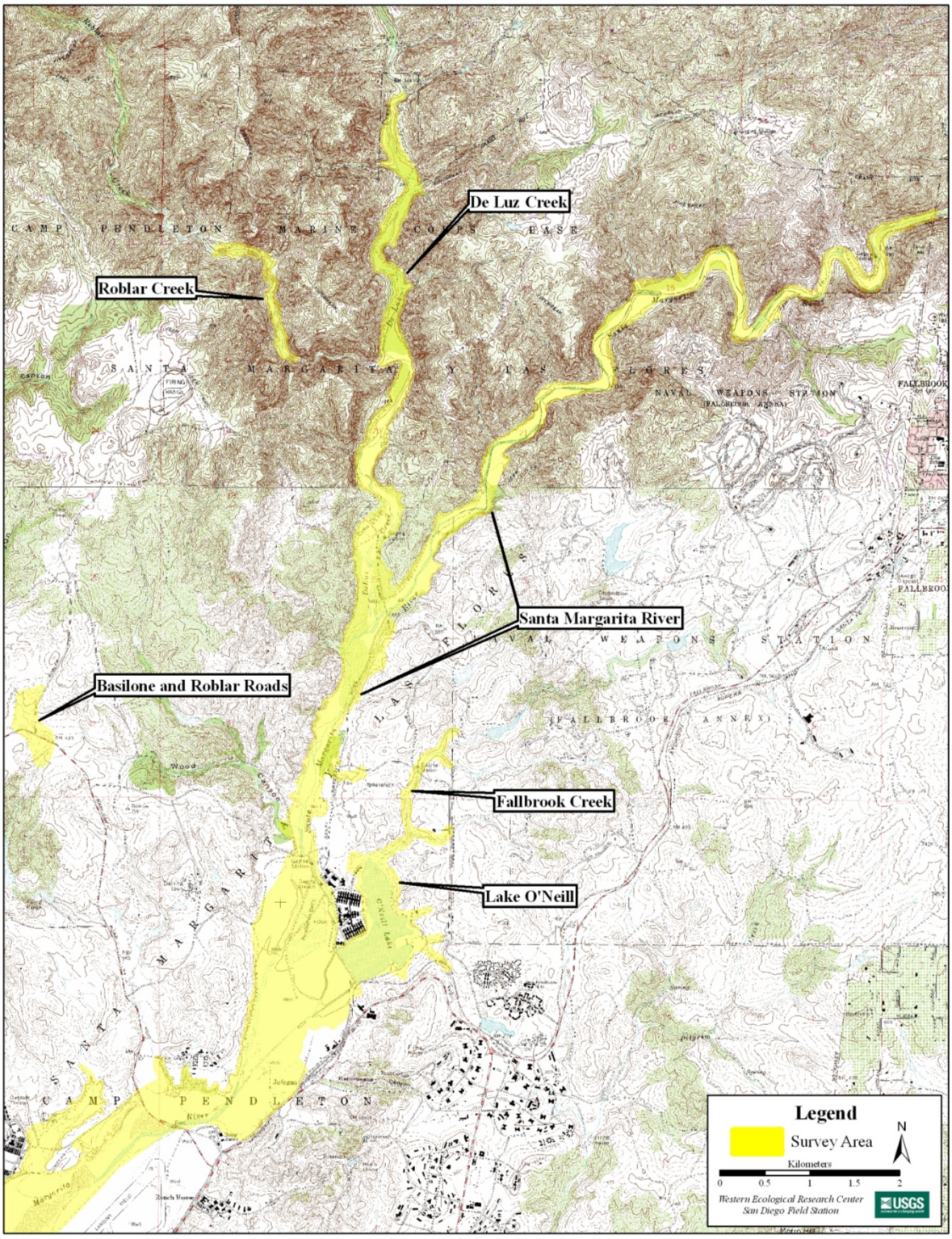


Fig. 13. Least Bell's Vireo survey areas at Marine Corps Base Camp Pendleton, 2013: Upper Santa Margarita River, Fallbrook Creek, Lake O'Neill, De Luz Creek, Roblar Creek, and Basilone and Roblar Roads.

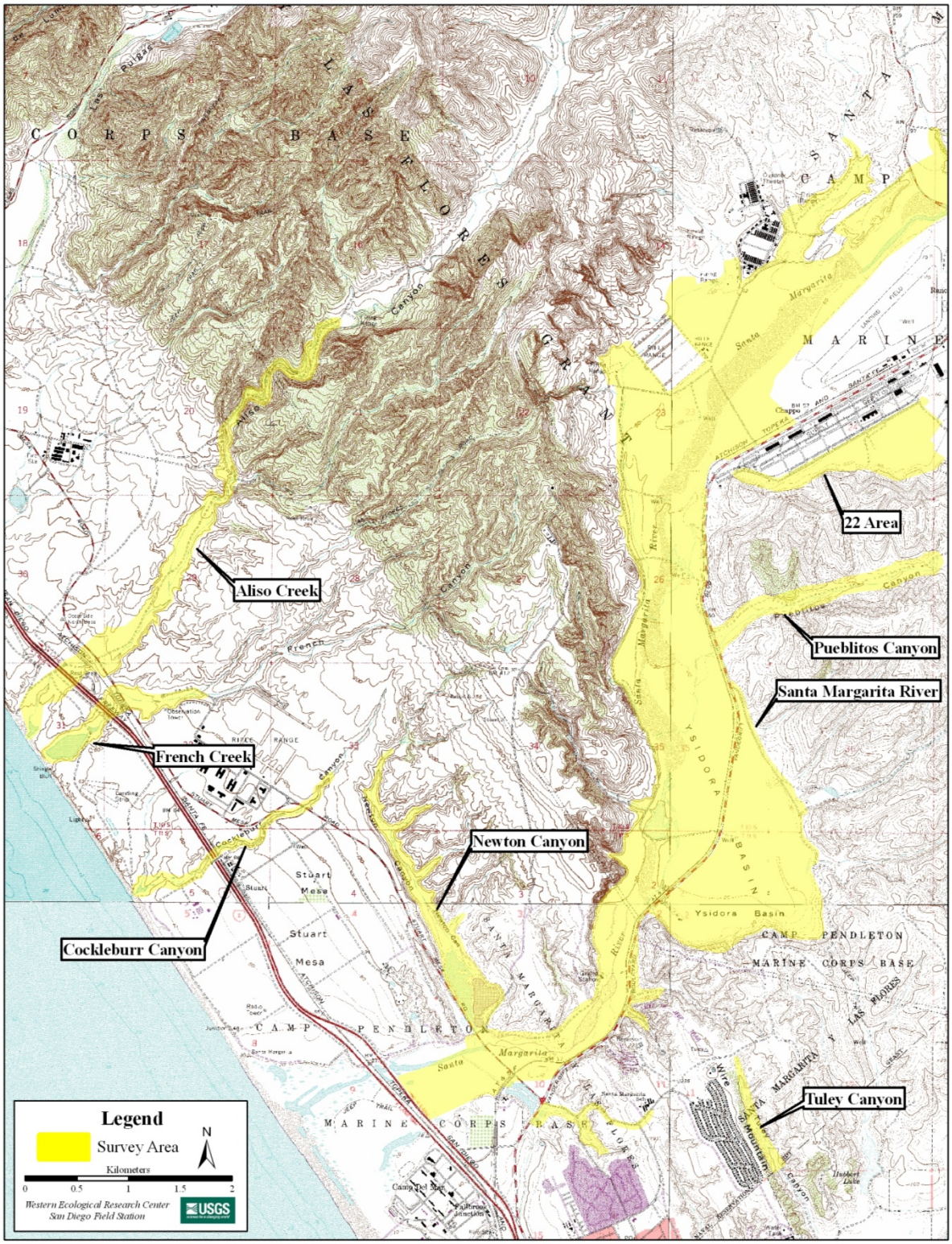


Fig. 14. Least Bell's Vireo survey areas at Marine Corps Base Camp Pendleton, 2013: Lower Santa Margarita River, 22 Area, Pueblitos Canyon, Tuley Canyon, Newton Canyon, Cockleburr Canyon, French Creek, and Aliso Creek.

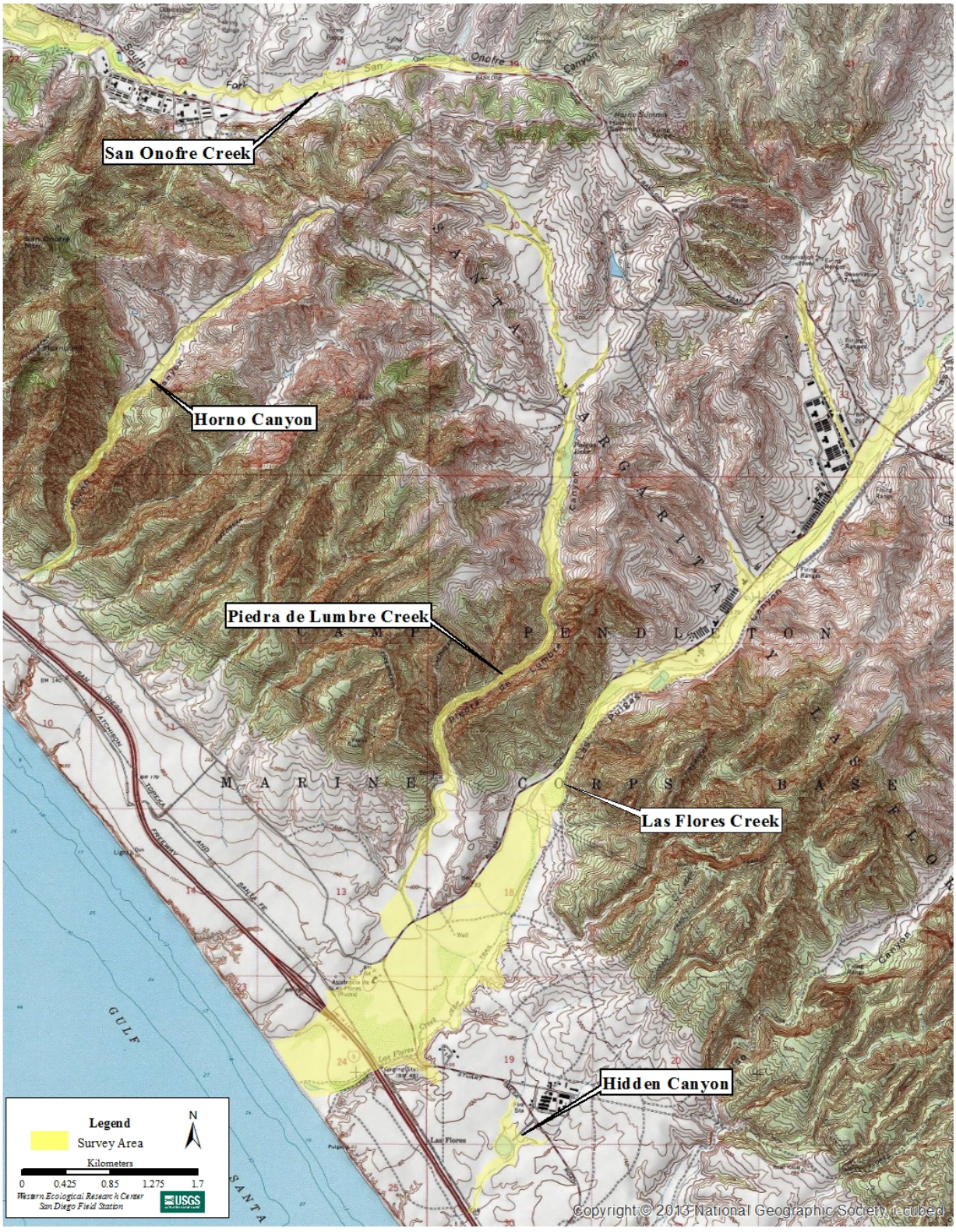


Fig. 15. Least Bell's Vireo survey areas at Marine Corps Base Camp Pendleton, 2013: San Onofre Creek South Fork, Ammunition Supply Point, Horno Canyon, Piedra de Lumbre Creek, Las Flores Creek, and Hidden Canyon.

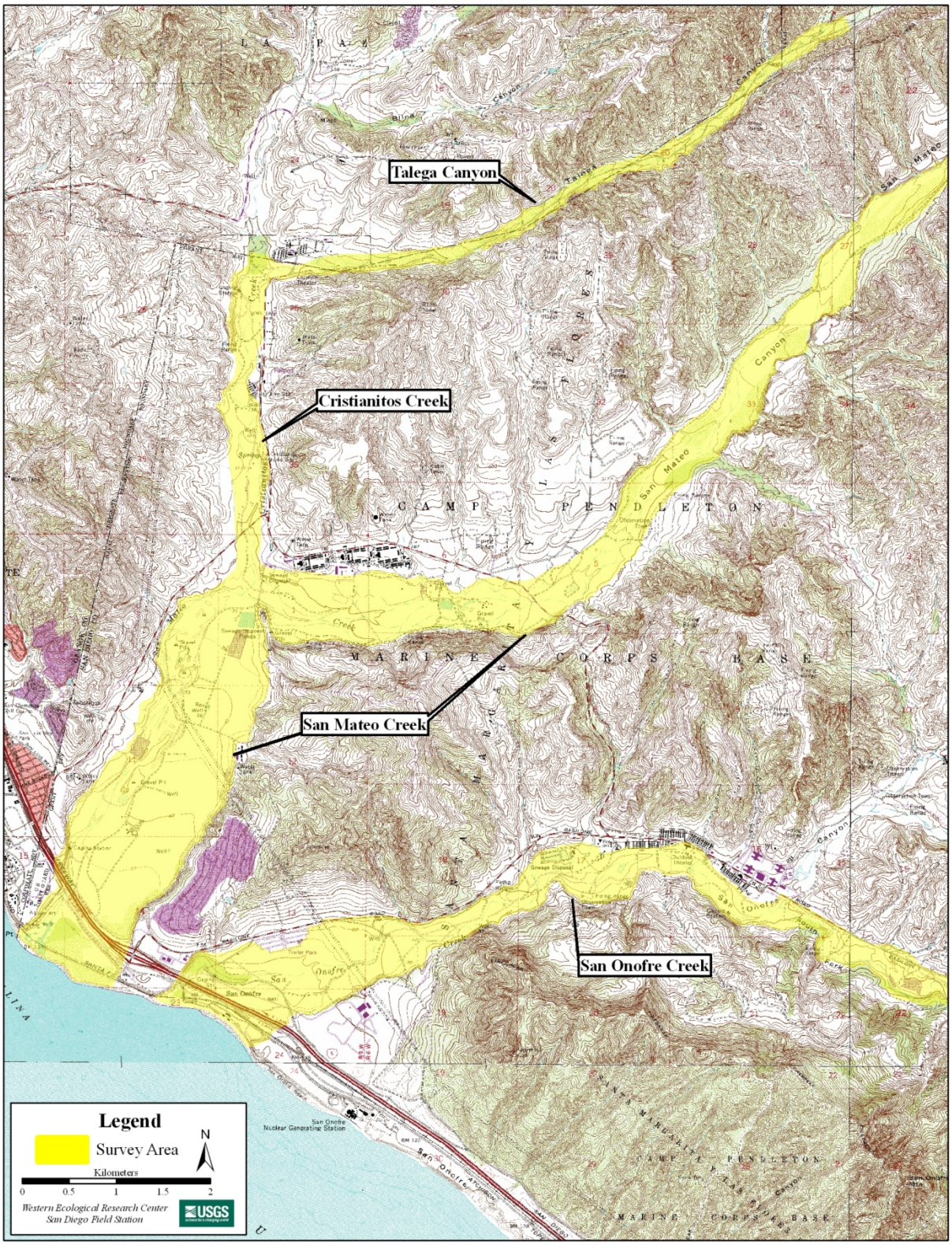


Fig. 16. Least Bell's Vireo survey areas at Marine Corps Base Camp Pendleton, 2013: Talega Canyon, Cristianitos Creek, San Mateo Creek, and San Onofre Creek.

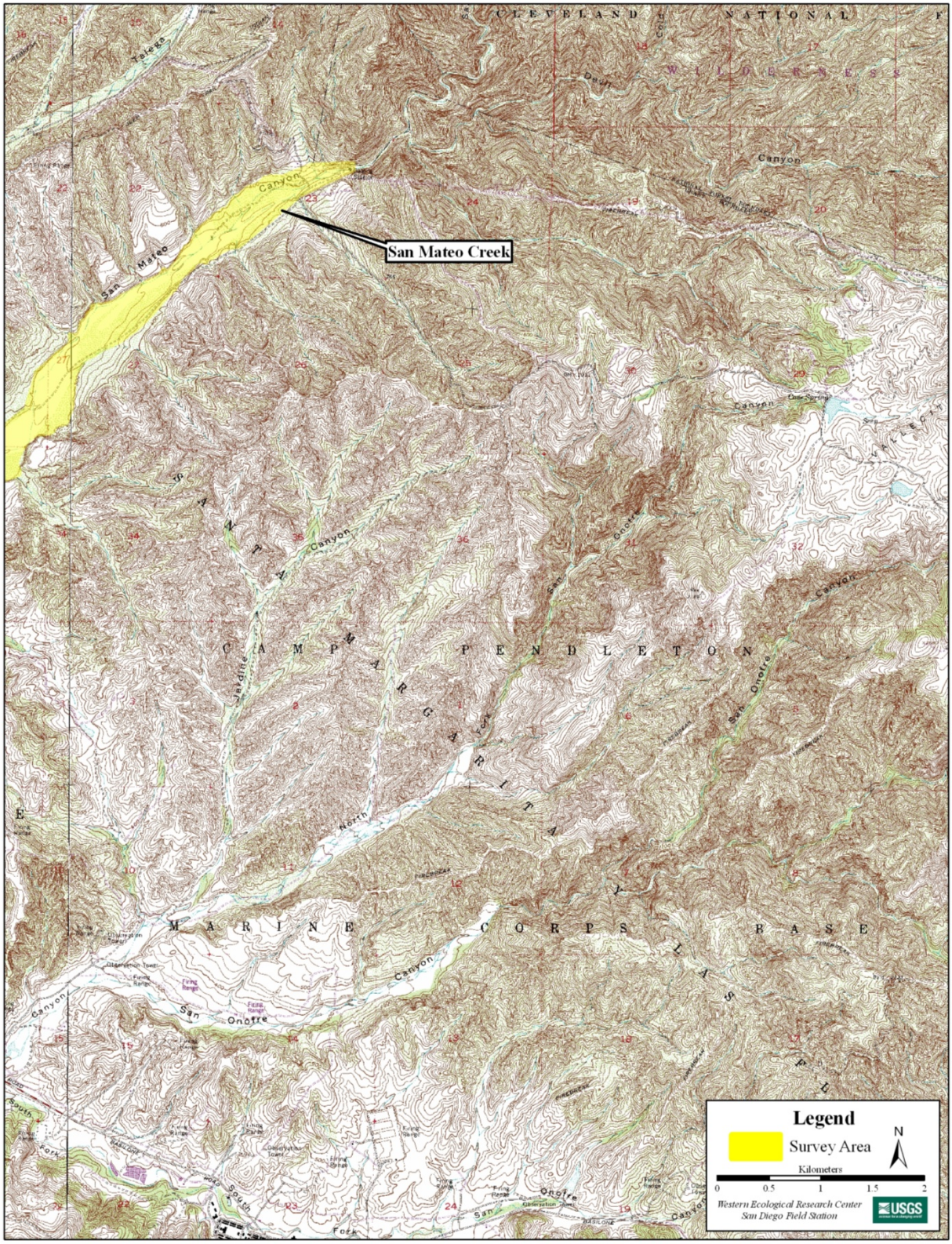


Fig. 17. Least Bell's Vireo survey areas at Marine Corps Base Camp Pendleton, 2013: Upper San Mateo Creek.

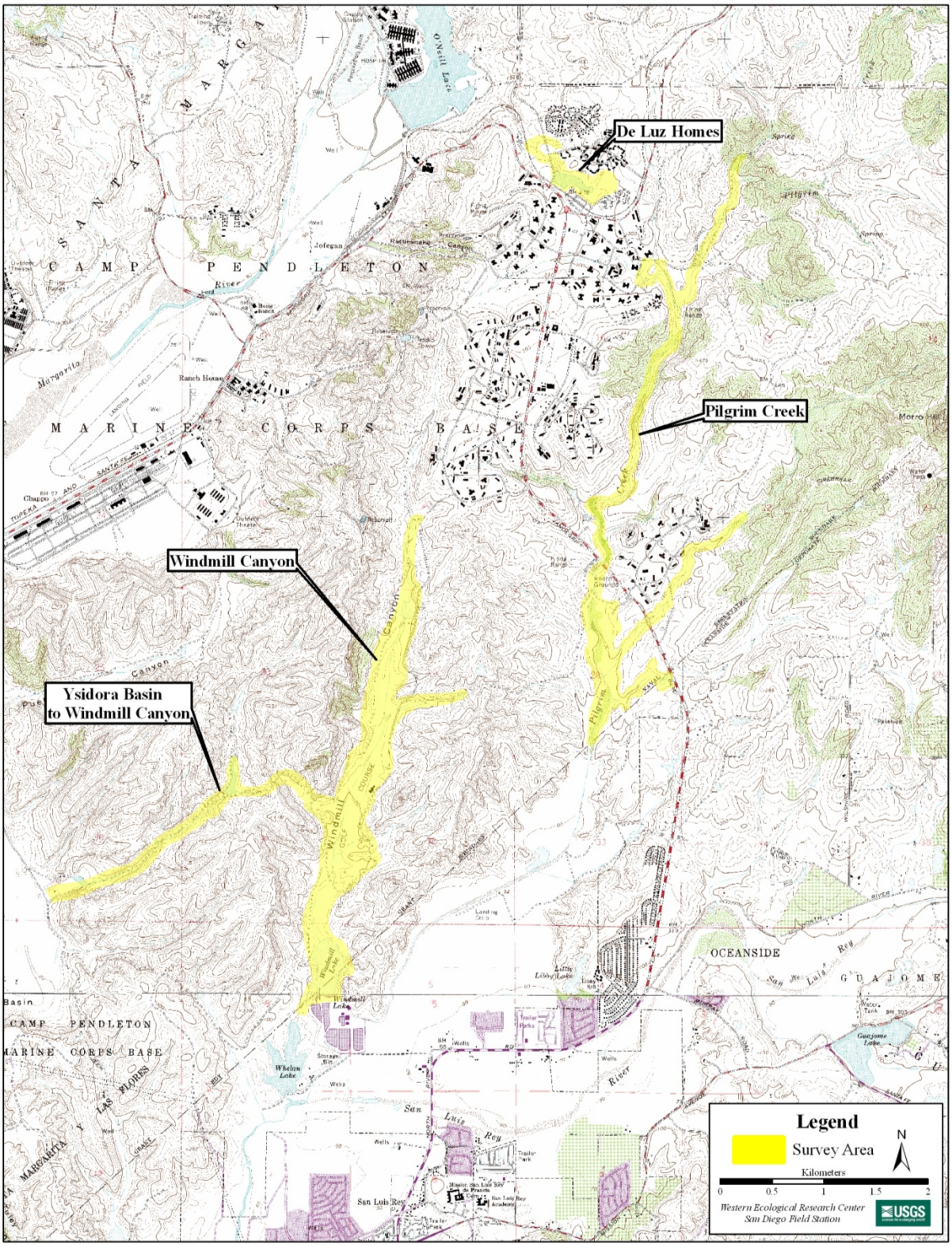


Fig. 18. Least Bell's Vireo survey areas at Marine Corps Base Camp Pendleton, 2013: Windmill Canyon, Ysidora Basin to Windmill Canyon, Pilgrim Creek, and De Luz Homes Habitat.

## APPENDIX B. LOCATIONS OF LEAST BELL'S VIREOS AT MARINE CORPS BASE CAMP PENDLETON, 2013

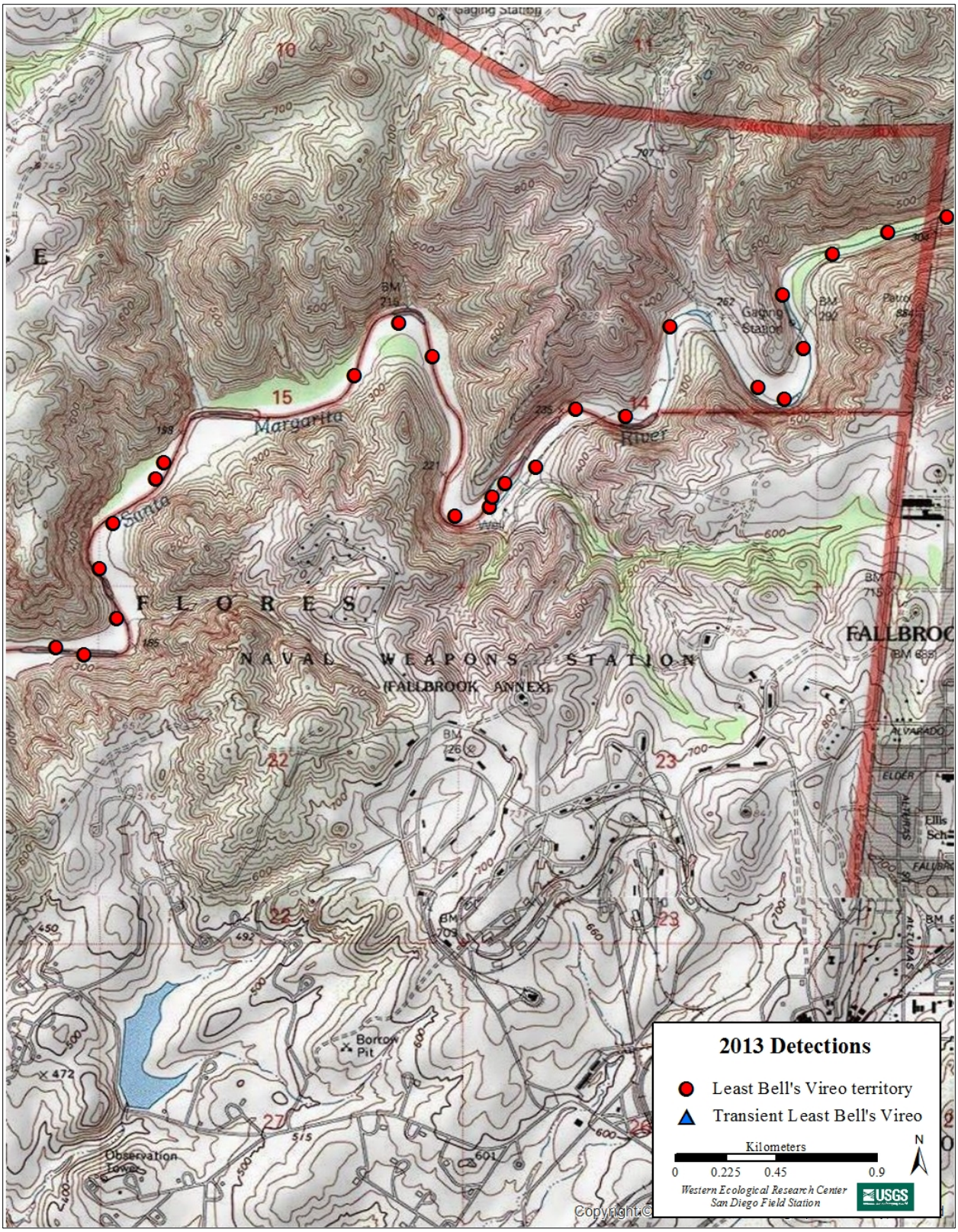


Fig. 19. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2013: Upper Santa Margarita River.

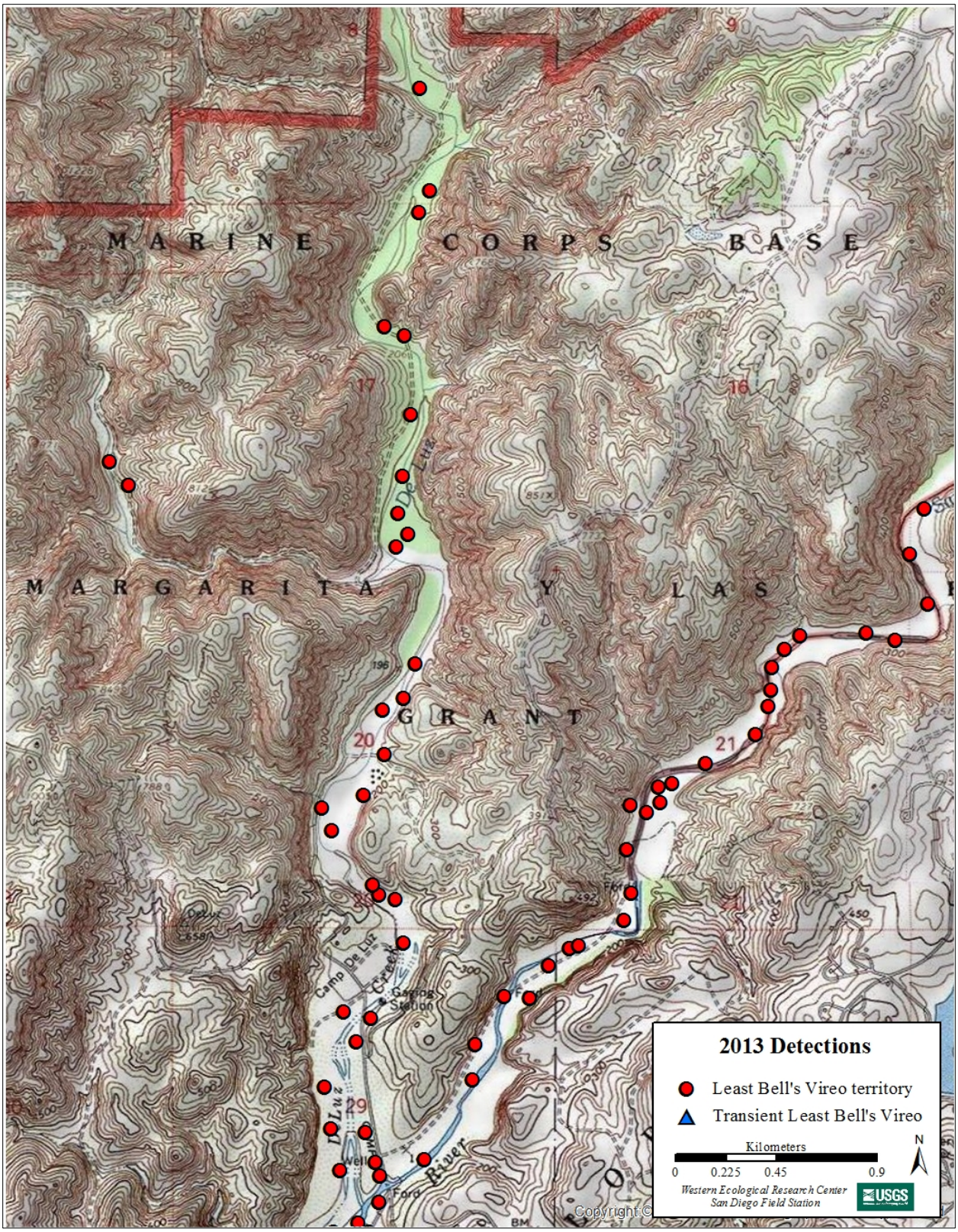


Fig. 20. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2013: Upper Santa Margarita River, De Luz Creek, and Roblar Creek.

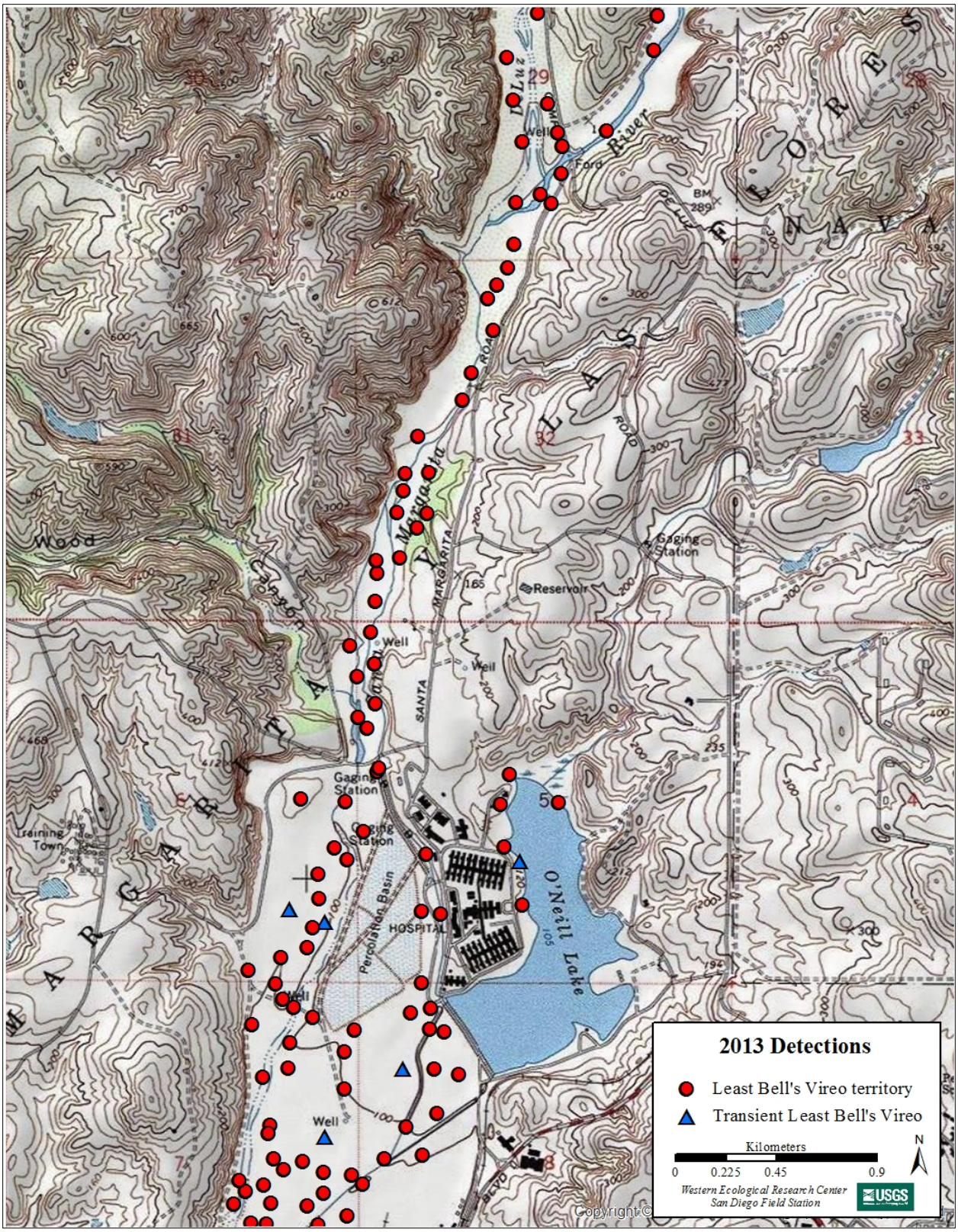


Fig. 21. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2013 Santa Margarita River, Lake O'Neill, and Fallbrook Creek.

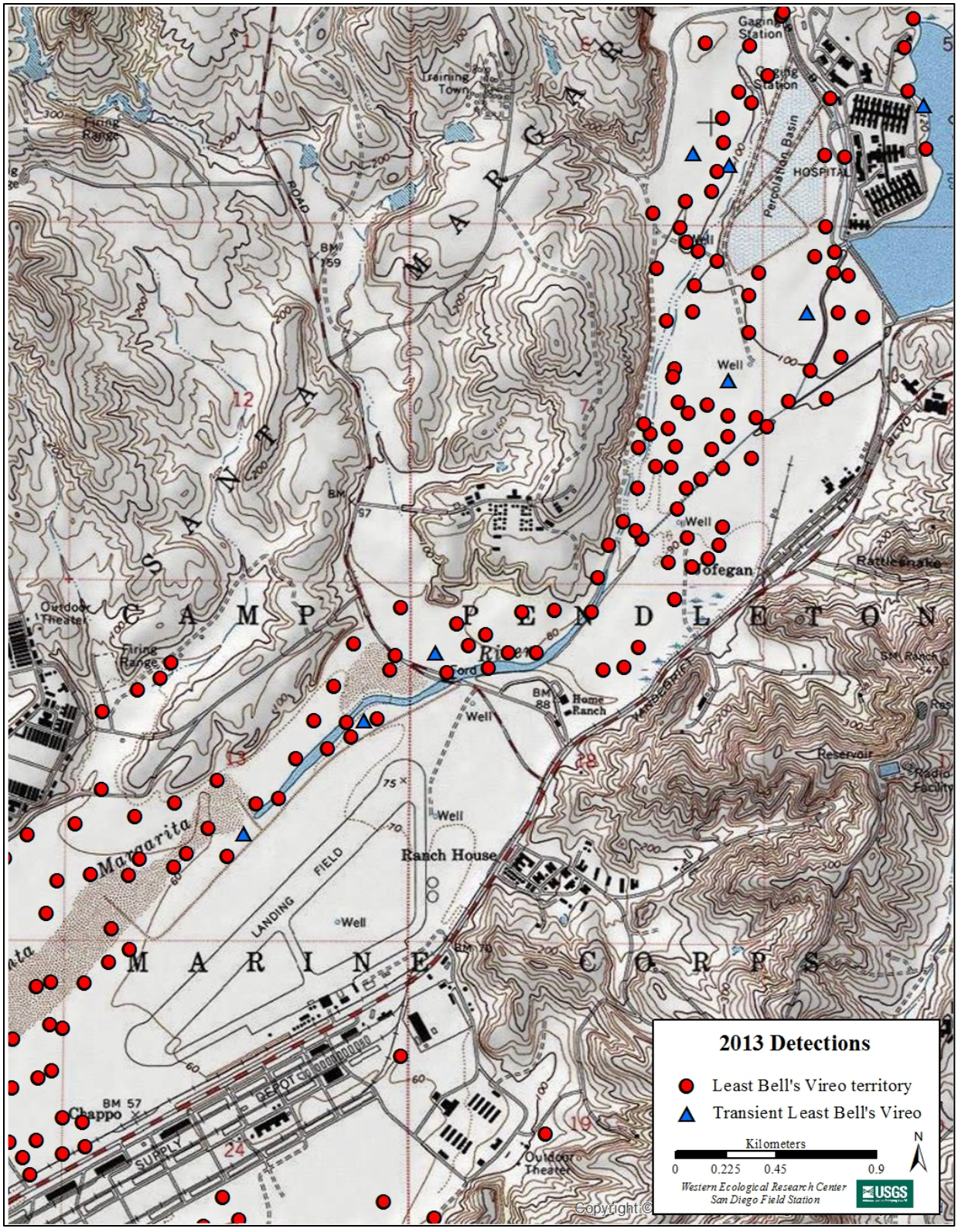


Fig. 22. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2013: Santa Margarita River.

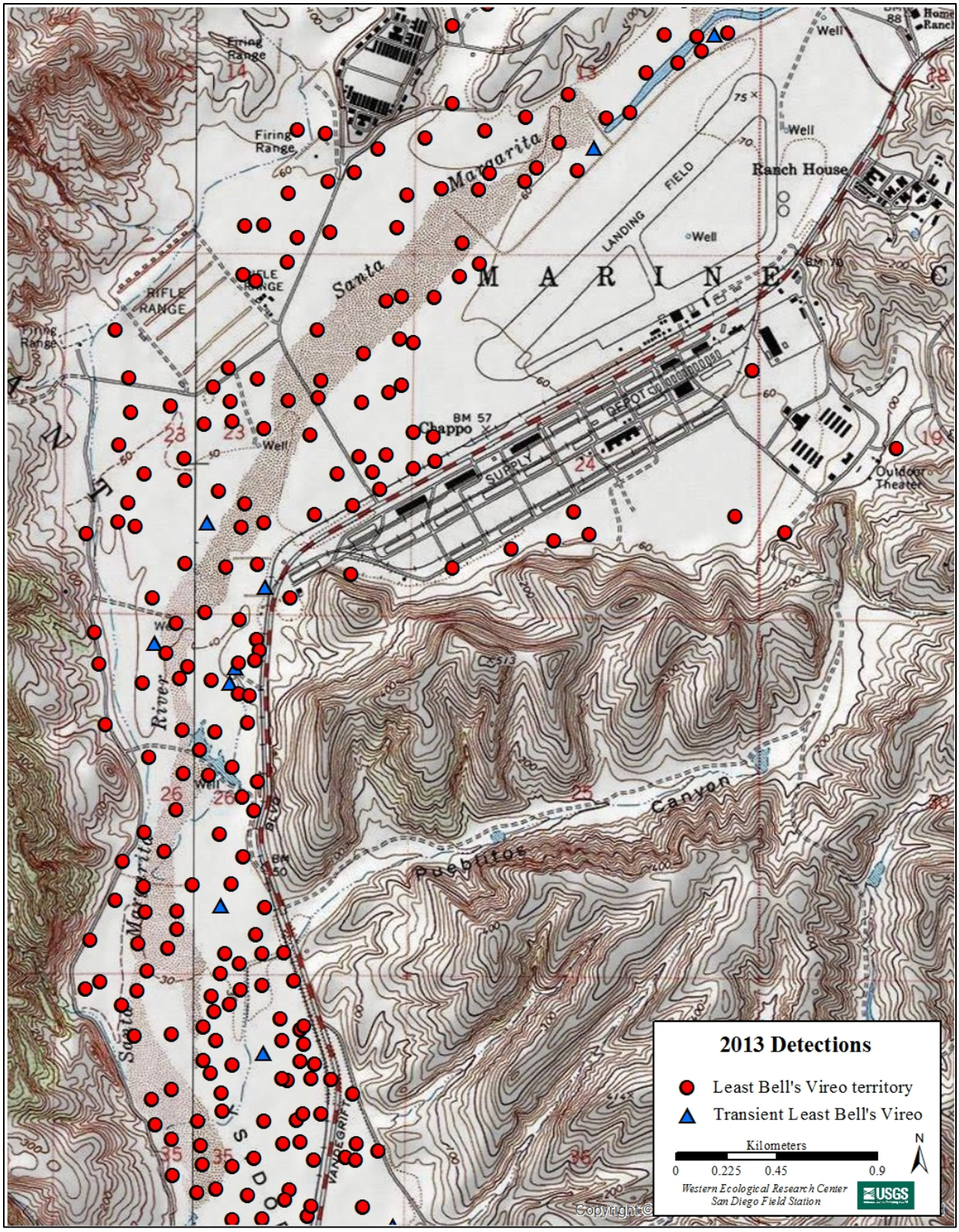


Fig. 23. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2013: Santa Margarita River, 22 Area, and Pueblitos Canyon.

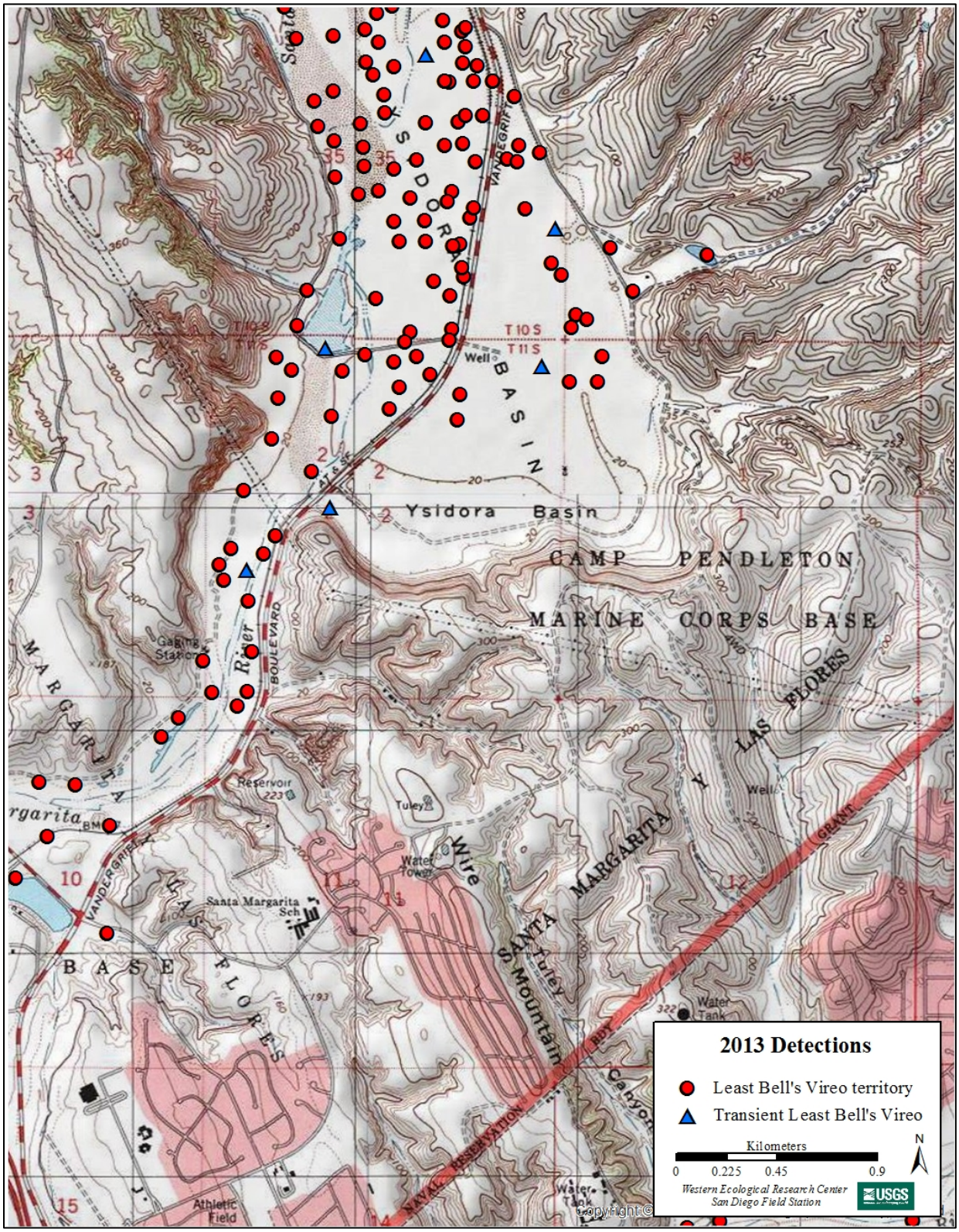


Fig. 24. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2013: Santa Margarita River, Ysidora Basin, and Ysidora Basin to Windmill Canyon.

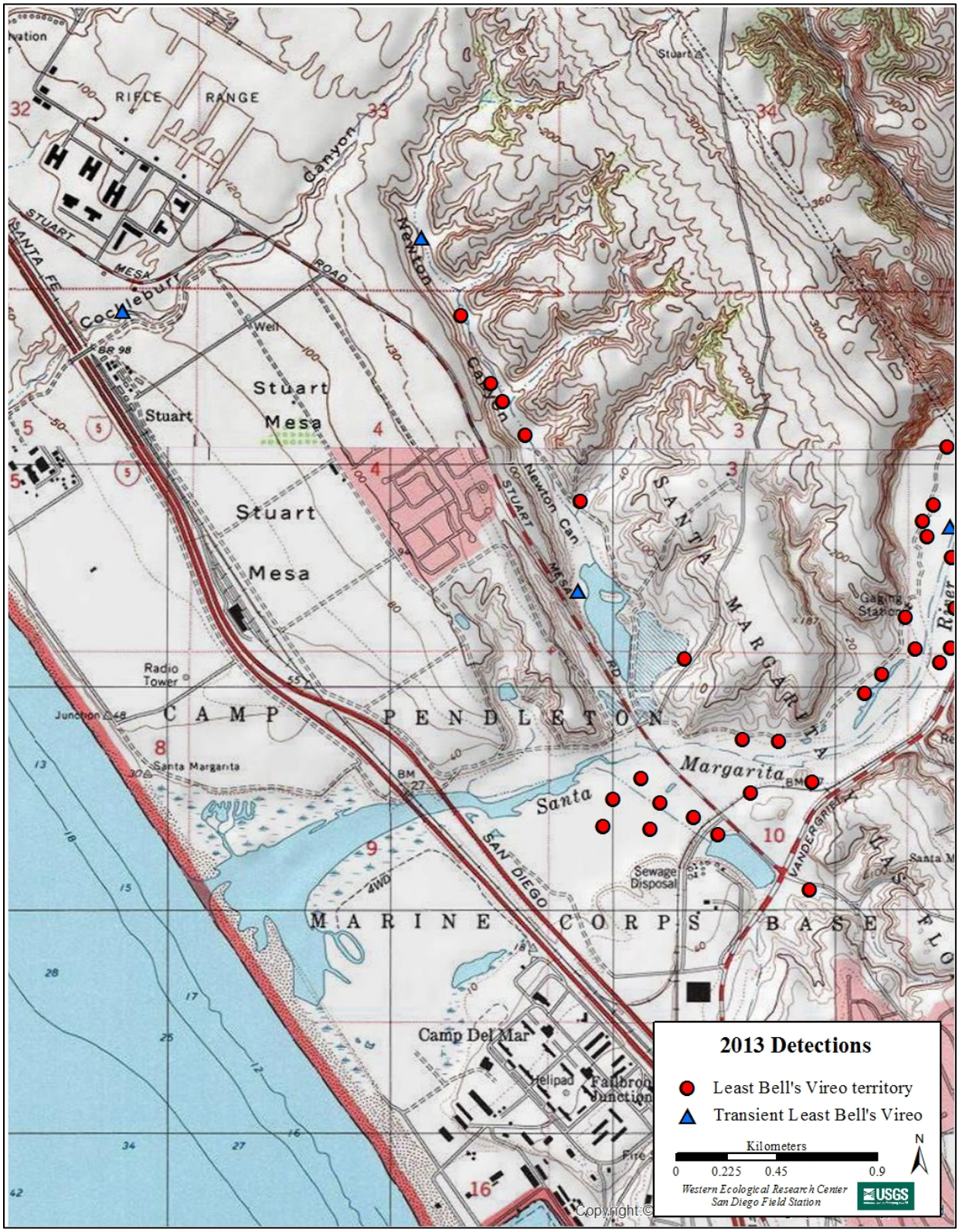


Fig. 25. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2013: Lower Santa Margarita River, Newton Canyon, and Cockleburr Canyon.

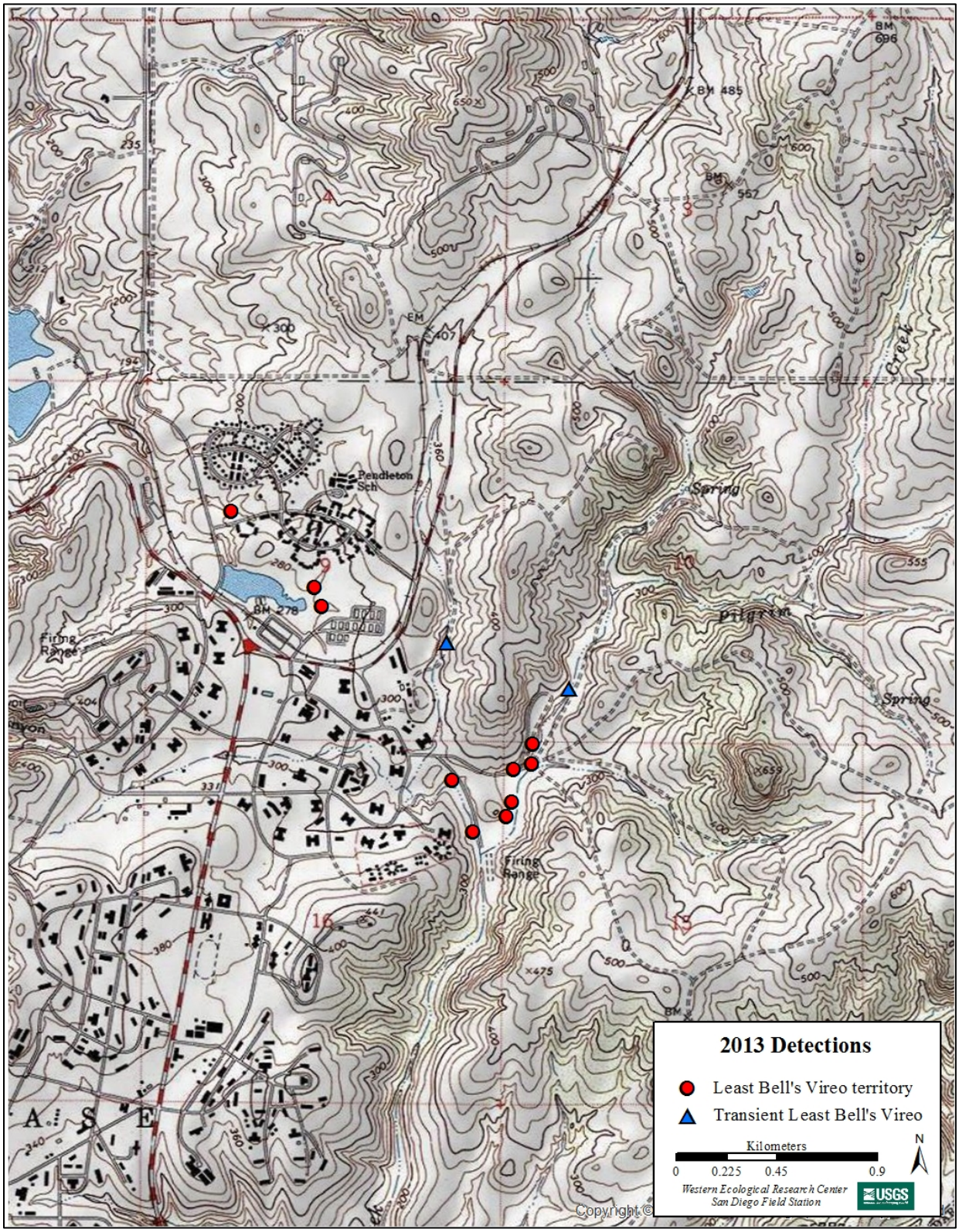


Fig. 26. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2013: Upper Pilgrim Creek, De Luz Homes Habitat, and Lake O'Neill.

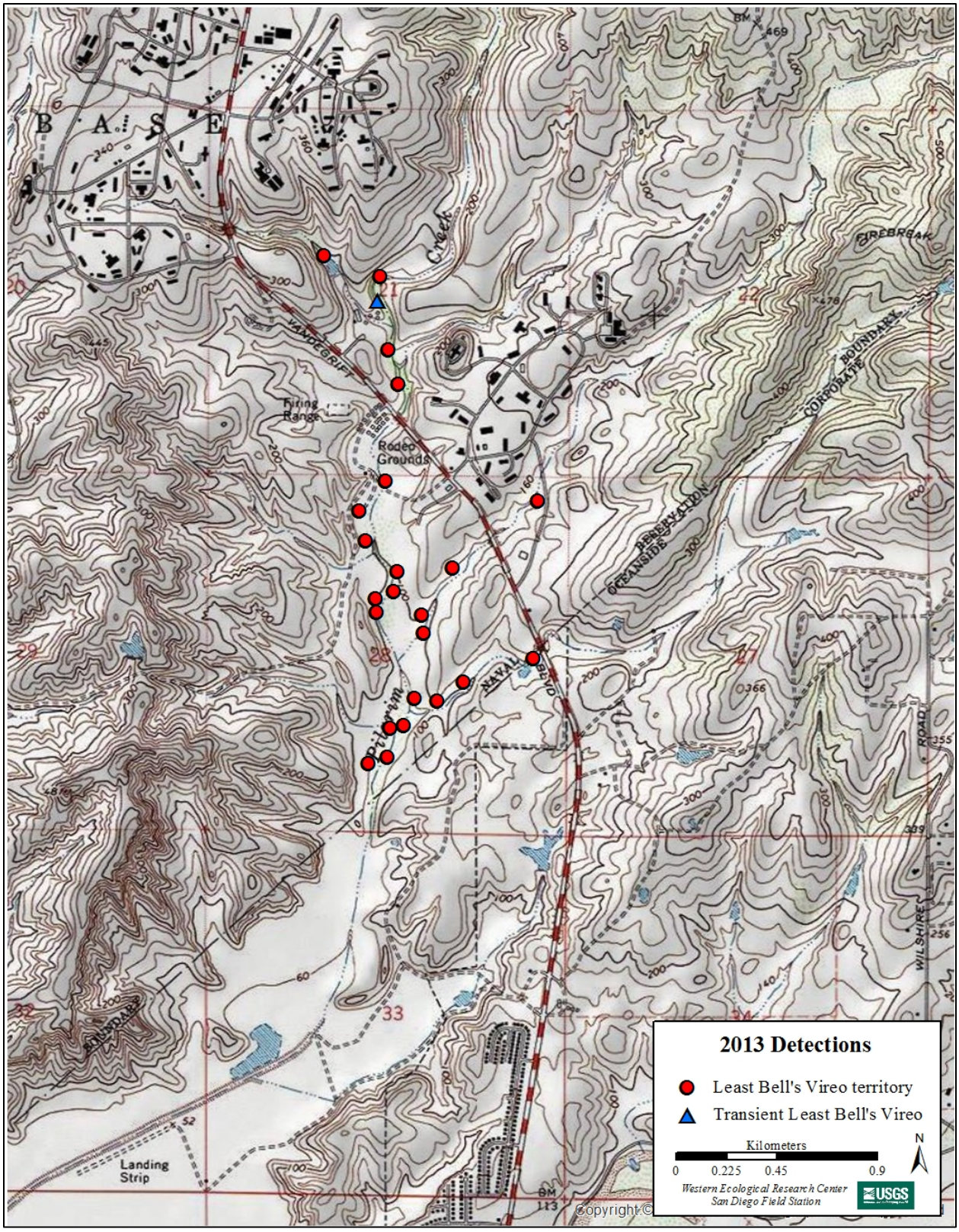


Fig. 27. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2013: Upper and Lower Pilgrim Creek.

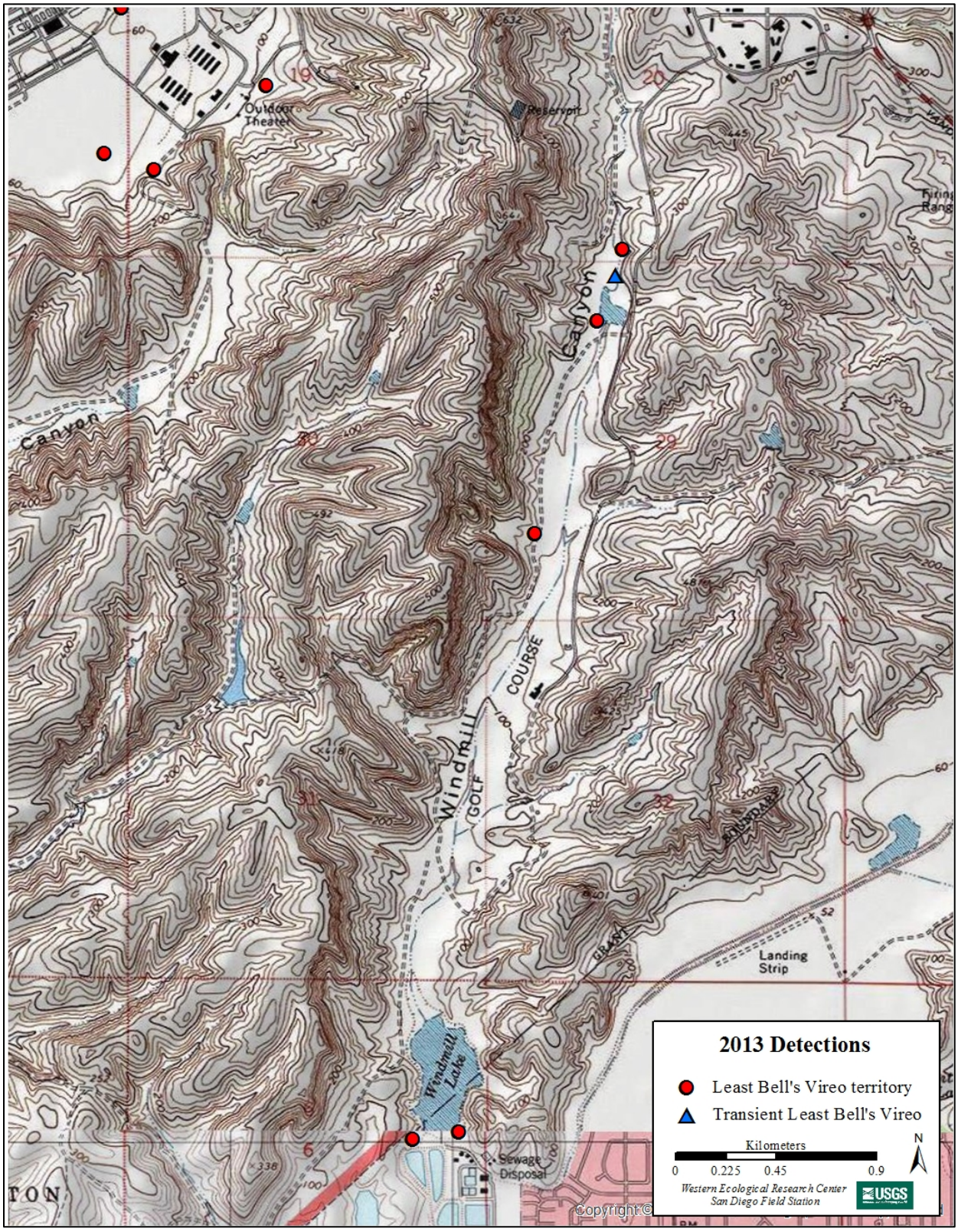


Fig. 28. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2013: Windmill Canyon and Ysidora Basin to Windmill Canyon.

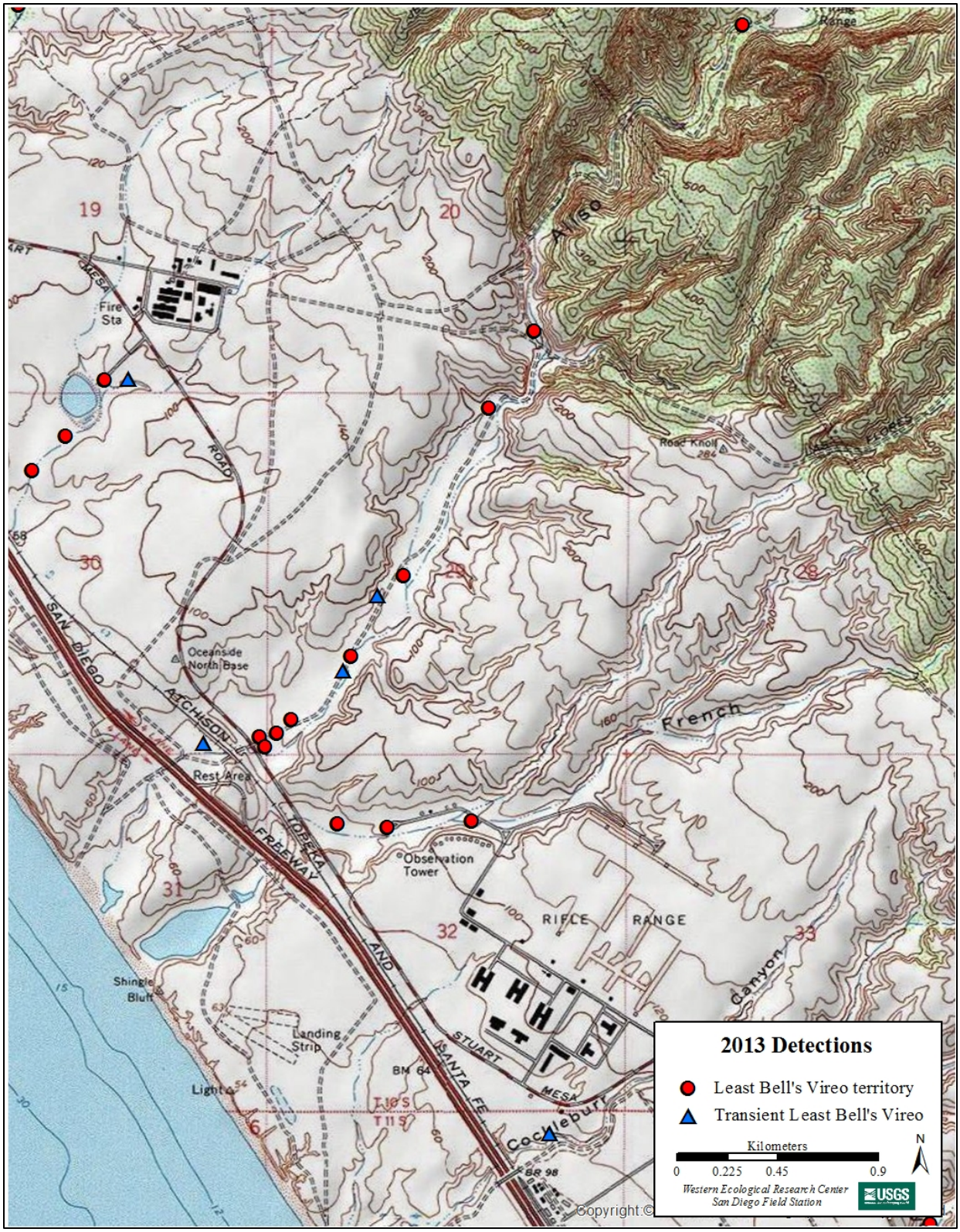


Fig. 29. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2013: French Creek, Aliso Creek, and Hidden Canyon.

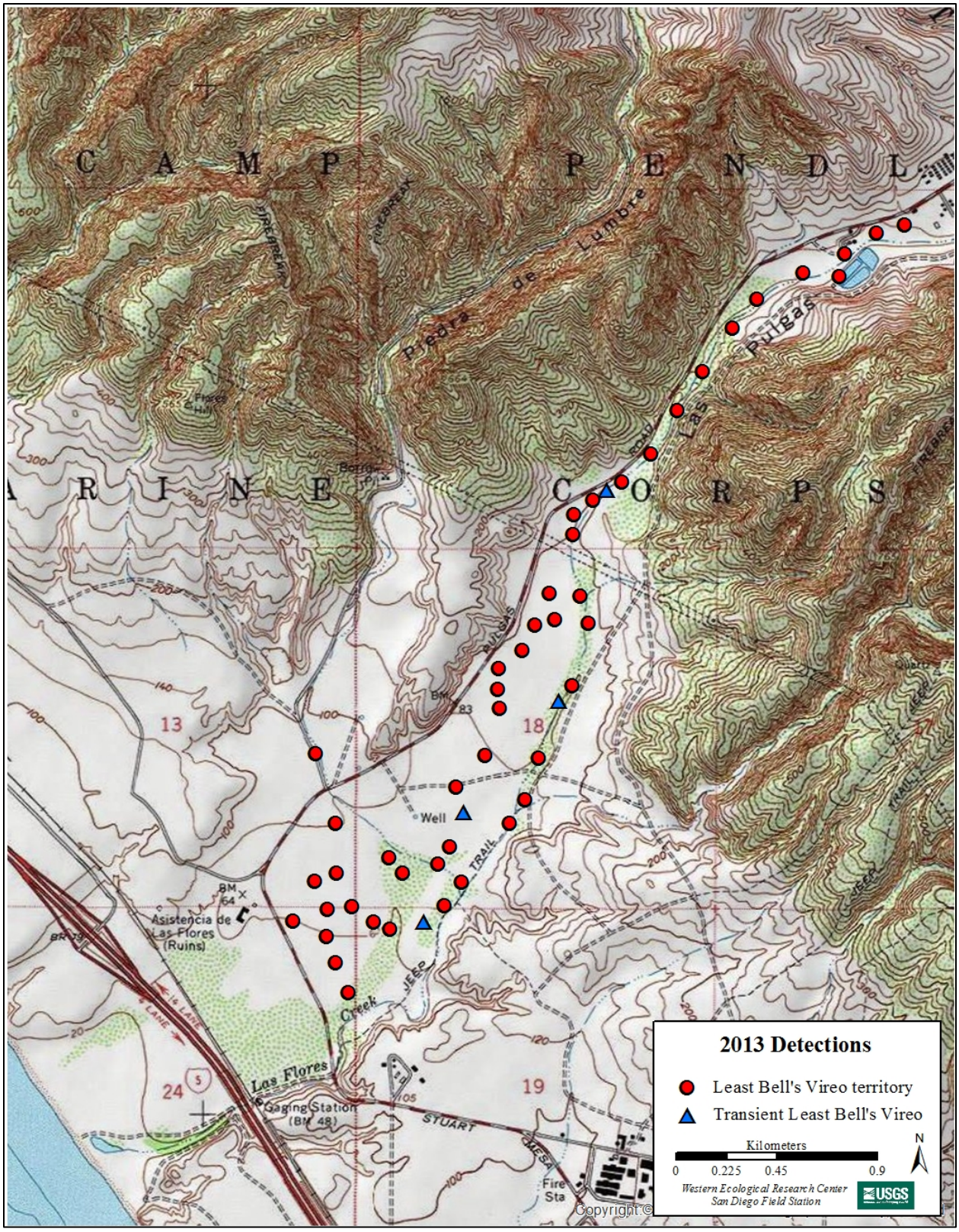


Fig. 30. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2013: Lower Las Flores Creek and Piedra de Lumbre Canyon.

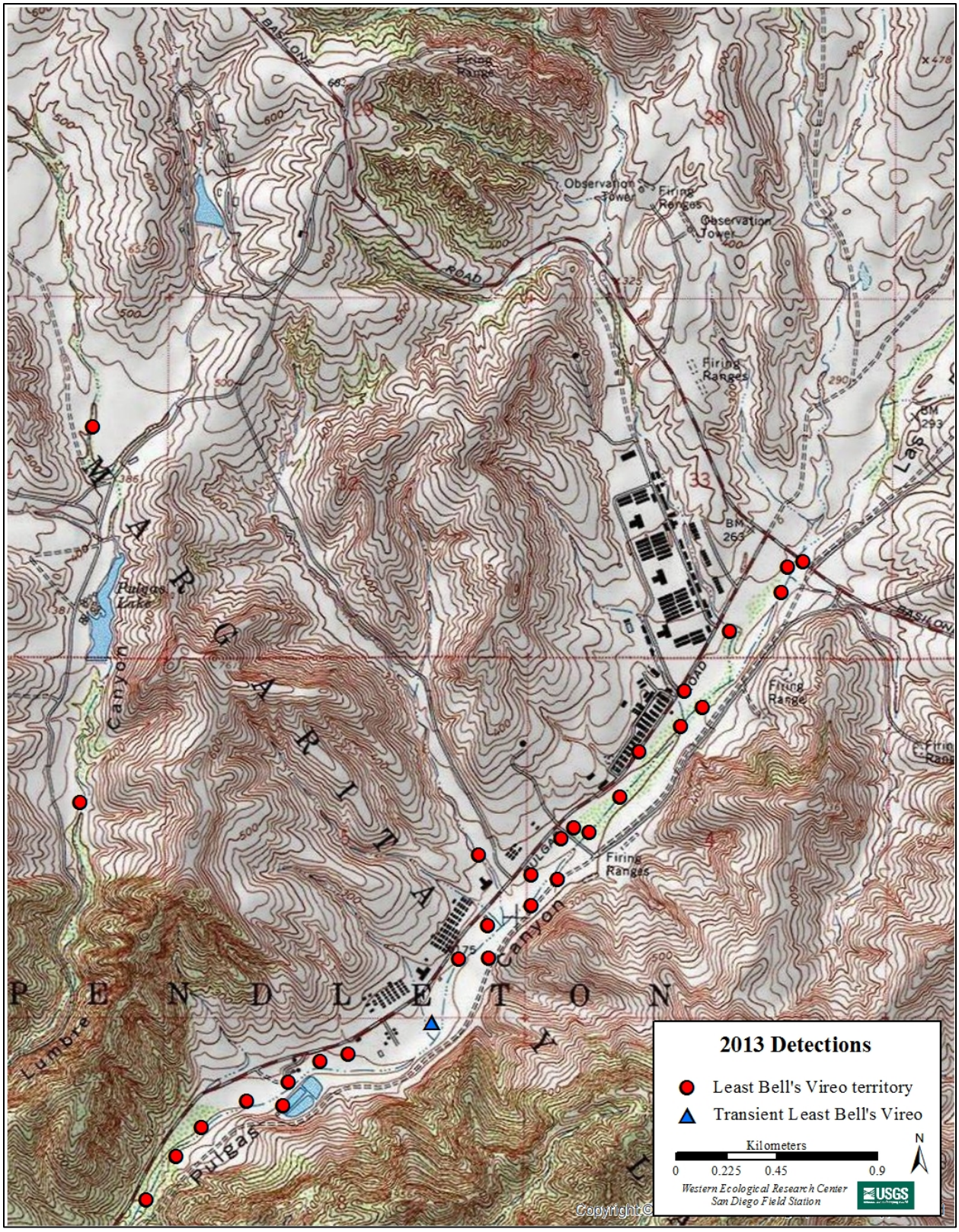


Fig. 31. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2013: Piedra de Lumbre Canyon and Upper Las Flores Creek.


Fig. 32. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2013: Horno Canyon.

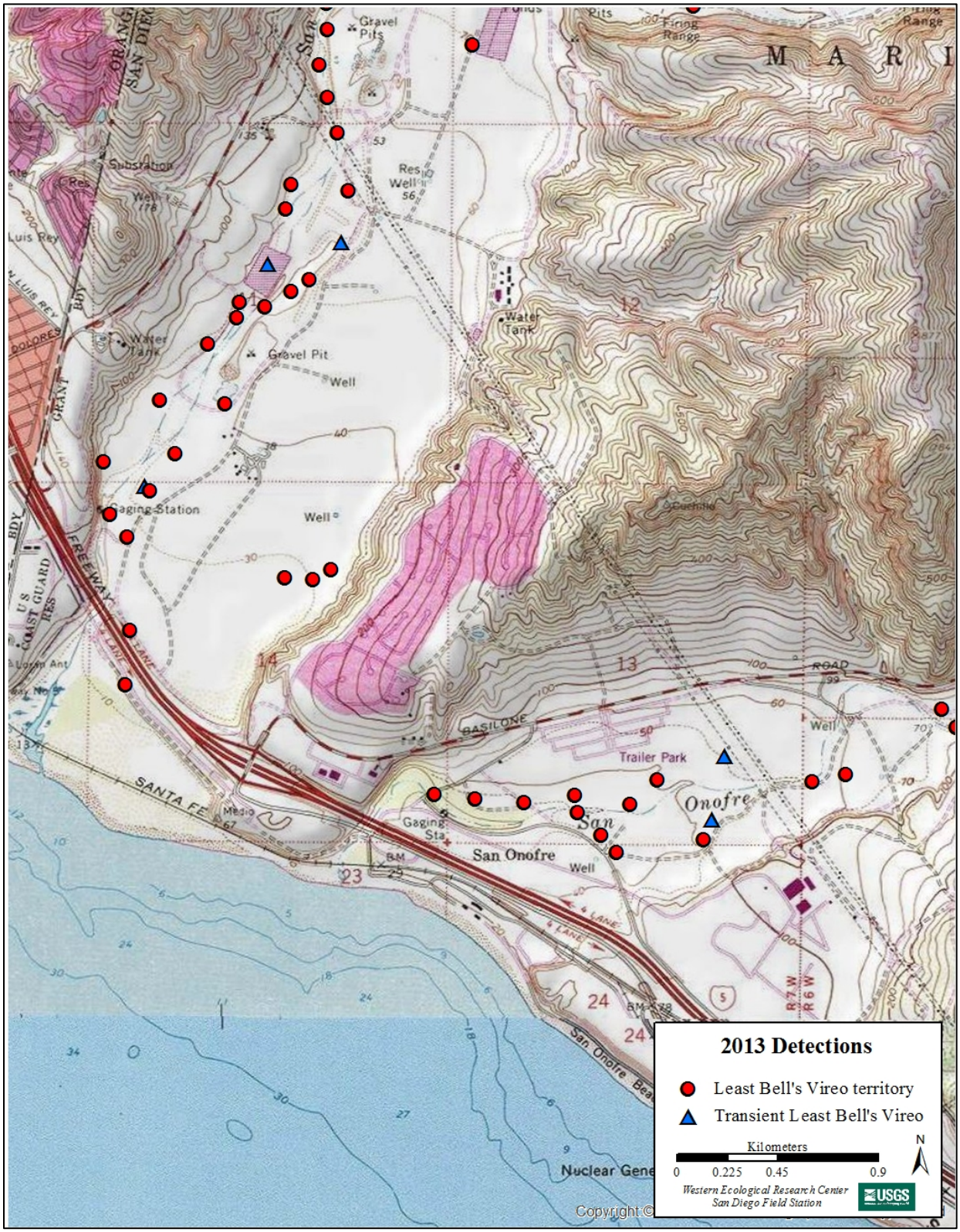


Fig. 33. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2013: Lower San Onofre Creek and Lower San Mateo Creek.

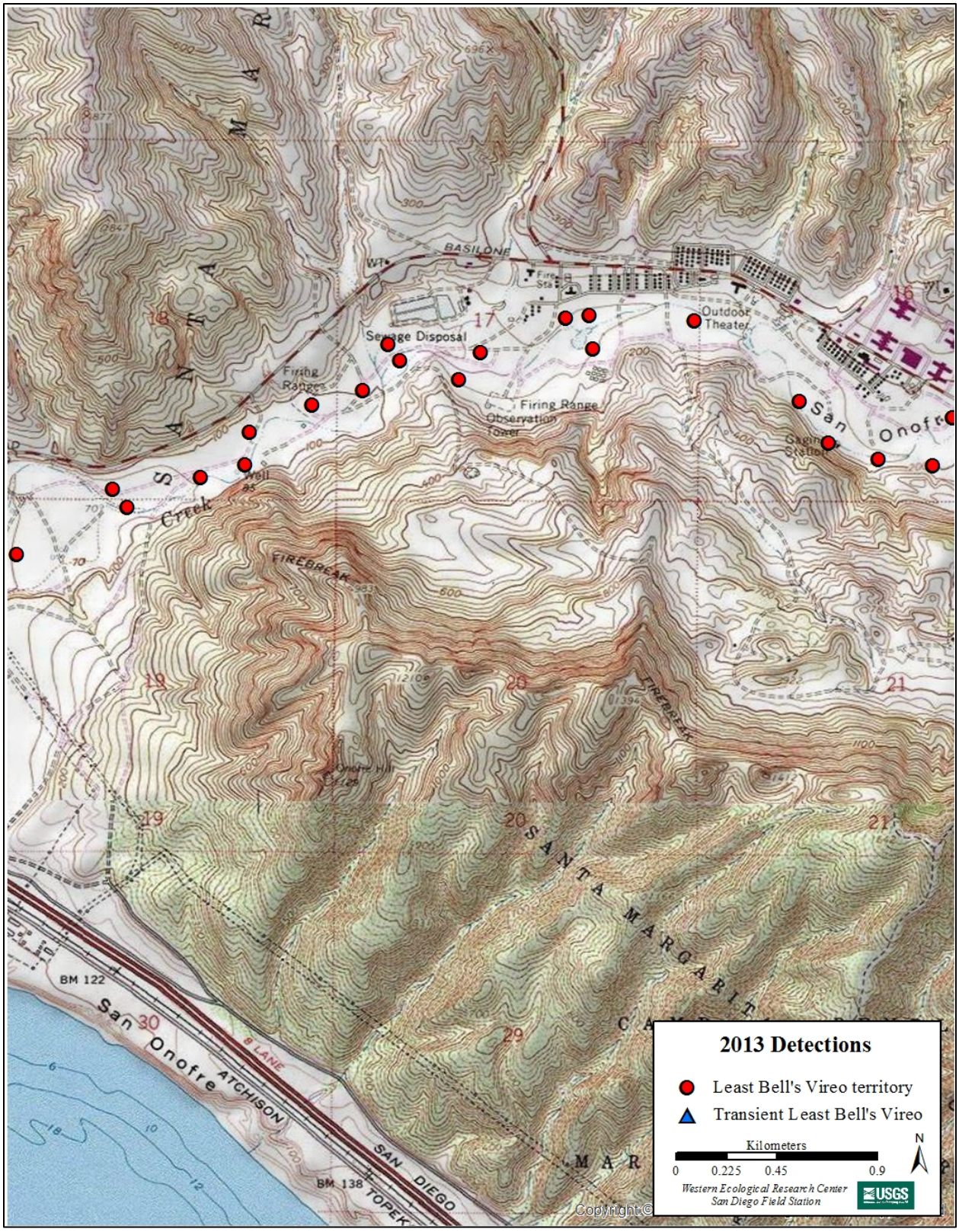


Fig. 34. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2013: San Onofre Creek.

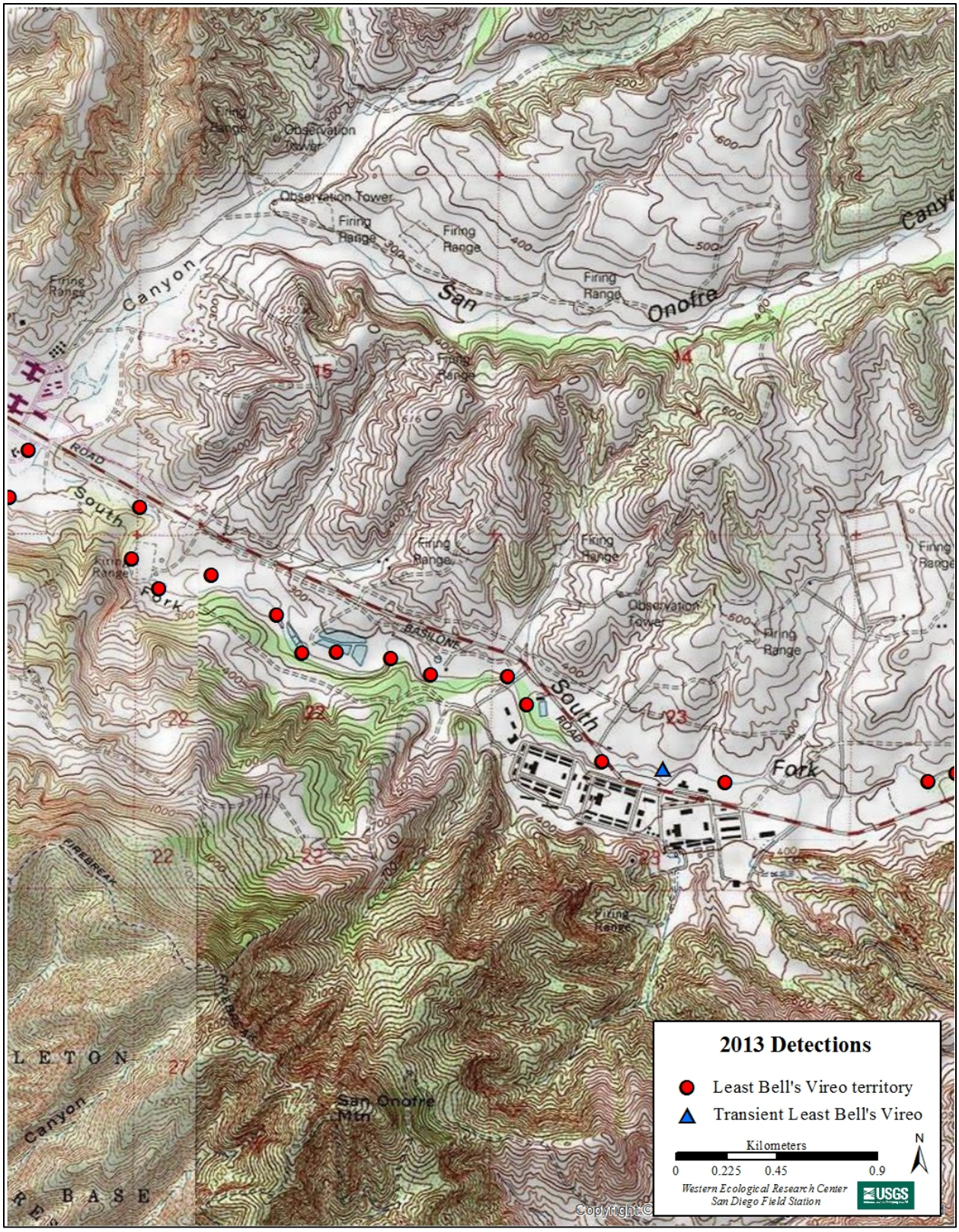


Fig. 35. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2013: South Fork San Onofre Creek.

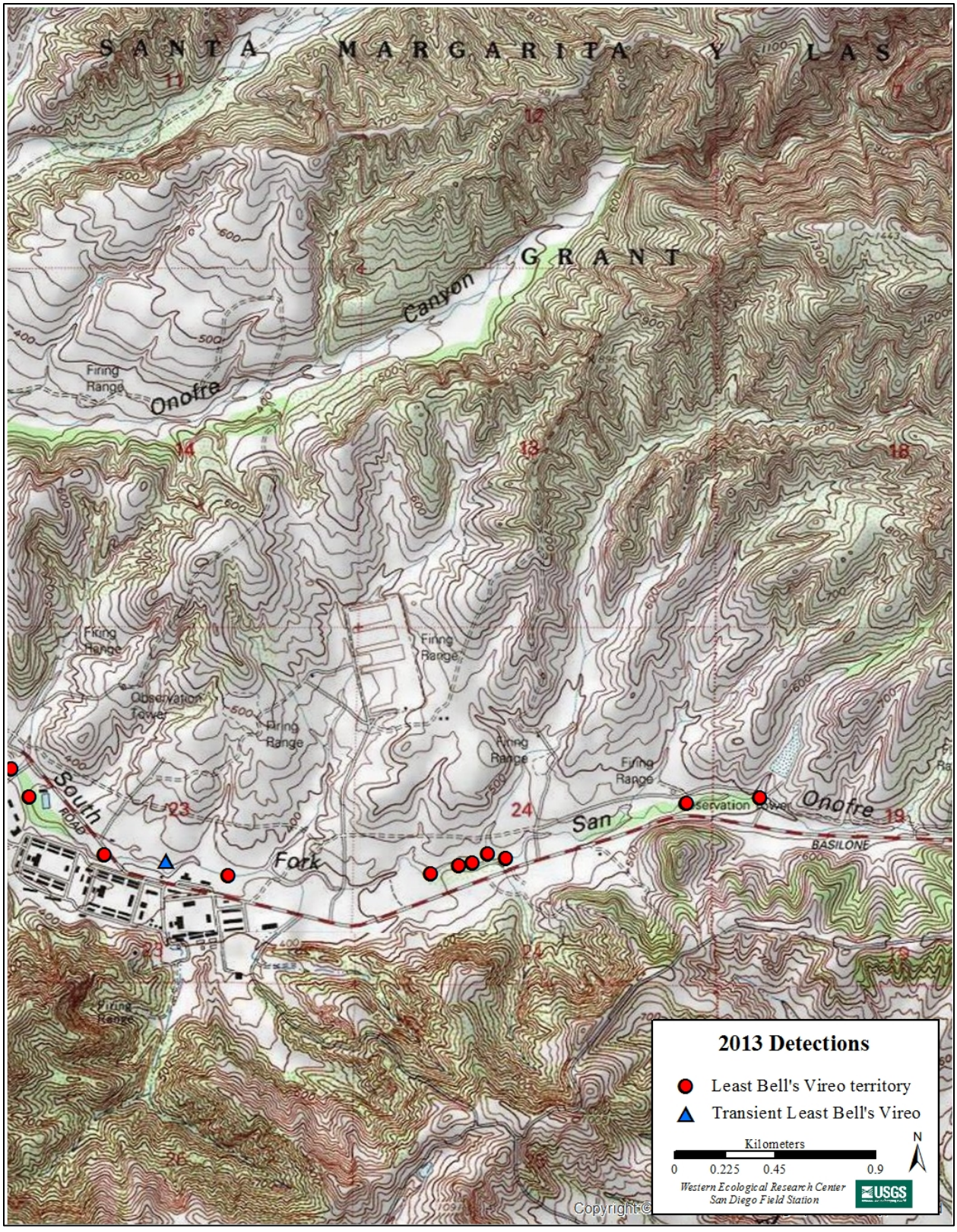


Fig. 36. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2013: San Onofre Creek.

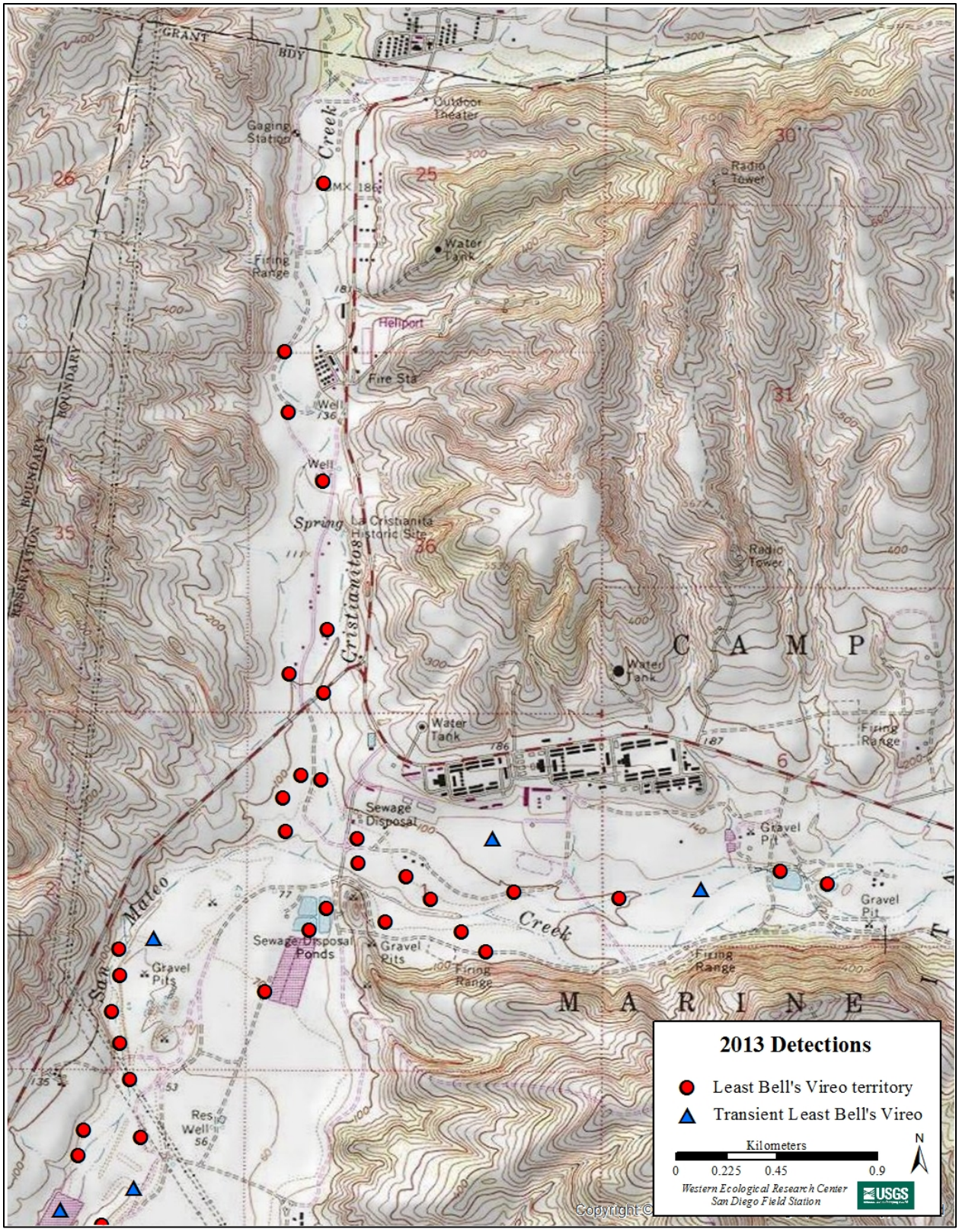


Fig. 37. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2013: San Mateo Creek and Cristianitos Creek.

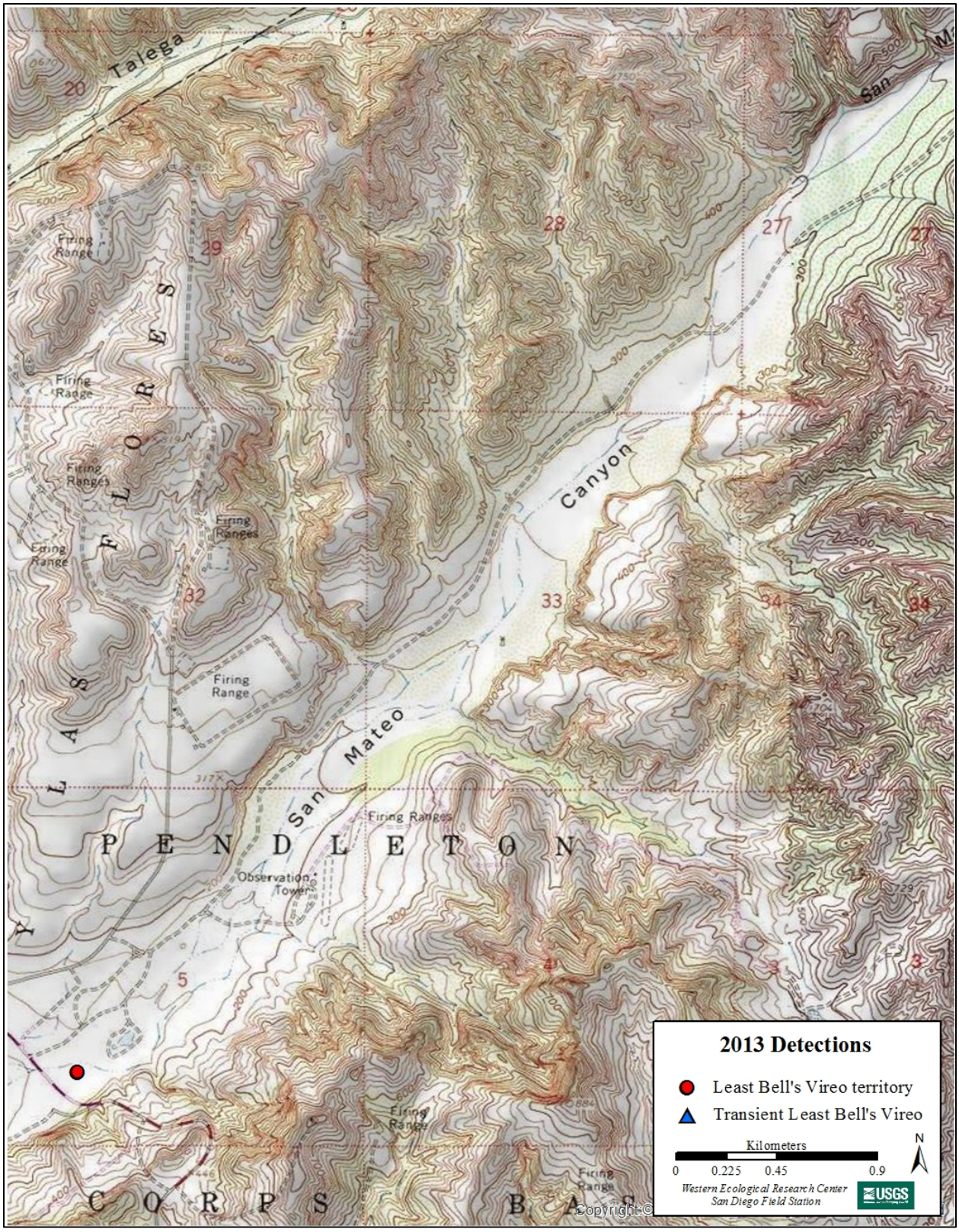


Fig. 38. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2013: Upper San Mateo Creek.

## APPENDIX C. BANDED LEAST BELL'S VIREOS AT MARINE CORPS BASE CAMP PENDLETON, 2013

| Drainage / Sex | Band Combination[a] Left Leg | Right Leg | Age (yrs.)[b] | Comments[c] |
|---|---|---|---|---|
| Cristianitos Creek | | | | |
| Male | PUPU/Mgo | ORPU | 1 | Banded as a nestling on the SMR in 2012. |
| De Luz Creek | | | | |
| Female | Mgo | PUPU/gogo | > 5 | Banded as an adult on DL in 2009. |
| Female | DPDP/Mgo | DGOR | > 4 | Banded as an adult on the SMR in 2010. |
| Female | Mgo | DGOR/sisi | > 4 | Banded as an adult on DL in 2010. |
| Female | BKLP/Mgo | DPDP | > 1 | Banded as an adult on DL in 2013. |
| Female | LPBK | PUPU/Mgo | > 1 | Banded as an adult on DL in 2013. |
| Male | | Mgo/YEYE | > 7 | Banded as an adult at FNWS in 2007. |
| Male | WHDP/Mgo | WHWH | > 5 | Banded as an adult on DL in 2010. |
| Male | DPWH | YEPU/Mgo | 4 | Banded as a nestling on the SMR in 2009. |
| Male | DPDP | ORDG/Mgo | > 1 | Banded as an adult on DL in 2013. |
| Male | LPBK | DPWH/Mgo | > 1 | Banded as an adult on DL in 2013. |
| Male | LPBK | BKBK/Mgo | > 1 | Banded as an adult on DL in 2013. |
| Unknown | ORDG/Mgo | LPBK | > 1 | Banded as an adult on DL in 2013. |
| Unknown | WHPU/Mgo | DPDP | > 1 | Banded as an adult on DL in 2013. |
| Unknown | PUWH | PUYE/Mgo | > 1 | Banded as an adult on DL in 2013. |
| Unknown | WHDP/Mgo | PUWH | > 1 | Banded as an adult on DL in 2013. |
| Unknown | DGOR/Mgo | PUWH | > 1 | Banded as an adult on DL in 2013. |
| Unknown | LPBK | YEPU/Mgo | > 1 | Banded as an adult on DL in 2013. |
| Las Flores Creek | | | | |
| Male | PUWH/pupu | Mdb | 6 | Banded as a nestling on the SLR in 2007. |
| Male | DGOR/Mgo | WHWH | 3 | Banded as a juvenile on the SMR in 2010. |
| Male | YEPU/Mgo | WHWH | 1 | Banded as a juvenile on the SMR in 2012. |
| Pilgrim Creek | | | | |
| Female | Mgo | | > 1 | Banded as a nestling at MCBCP or MCAS prior to 2013. |
| San Mateo Creek | | | | |
| Female | pupu | ORPU/Mgo | 6 | Banded as a nestling on the SMR in 2007. |
| Male | Mgo | PUOR/sisi | > 6 | Banded as an adult on the SMO in 2008. |
| San Onofre Creek | | | | |
| Male | LPBK | DBWH/Mdb | 6 | Banded as a nestling on the SLR in 2007. |
| Santa Margarita River | | | | |
| Female | YEPU/Mgo | PUPU | 7 | Banded as a nestling on the SMR in 2006. |
| Female | BKBK | PUPU/Mgo | 6 | Banded as a nestling on the SMR in 2007. |
| Female | DPWH | Mgo | 6 | Banded as a nestling on the SMR in 2007. |
| Female | YEYE/sisi | Mgo | > 5 | Banded as an adult on the SMR in 2009. |
| Female | Mgo | PUYE | > 5 | Banded as an adult on the SMR in 2009. |
| Female | PUPU/Mgo | PUPU | > 5 | Banded as an adult on the SMR in 2009. |
| Female | OROR/Mgo | ORPU | 5 | Banded as a nestling on the SMR in 2008. |
| Female | WHPU/Mgo | WHWH | > 4 | Banded as an adult on the SMR in 2010. |
| Female | DPDP | BKBK/Mgo | > 4 | Banded as an adult on the SMR in 2010. |
| Female | YEPU/Mgo | PUWH | > 3 | Banded as an adult on the SMR in 2011. |
| Female | DPWH/Mdb | DBDP | > 3 | Banded as an adult on the LSLR in 2011. |
| Female | BKBK/Mgo | PUPU | 3 | Banded as a nestling at MCAS in 2010. |
| Female | YEPU/Mgo | DGOR | 3 | Banded as a nestling on the SMR in 2010. |
| Female | DGOR/Mgo | PUPU | > 2 | Banded as an adult on the SMR in 2012. |
| Female | pupu | LPBK/Mlb | 2 | Banded as a nestling on the SDR in 2011. |

Appendix C. Continued.

| Drainage / Sex | Band Combination[a] Left Leg | Right Leg | Age (yrs.)[b] | Comments[c] |
|---|---|---|---|---|
| Santa Margarita River continued | | | | |
| Female | BWST | PUYE/Mdb | 2 | Banded as a nestling on the SLR in 2011. |
| Female | DPWH/Mgo | PUPU | > 1 | Banded as an adult on the SMR in 2013. |
| Female | DGOR | OROR/Mgo | > 1 | Banded as an adult on the SMR in 2013. |
| Female | WHWH/Mgo | DGOR | > 1 | Banded as an adult on the SMR in 2013. |
| Female | YEPU/Mgo | ORPU | > 1 | Banded as an adult on the SMR in 2013. |
| Female | PUOR/Mgo | PUWH | > 1 | Banded as an adult on the SMR in 2013. |
| Female | YEPU | DGOR/Mgo | > 1 | Banded as an adult on the SMR in 2013. |
| Female | DPDP | PUYE/Mgo | > 1 | Banded as an adult on the SMR in 2013. |
| Female | PUWH | PUOR/Mgo | > 1 | Banded as an adult on the SMR in 2013. |
| Female | LPBK | WHWH/Mgo | > 1 | Banded as an adult on the SMR in 2013. |
| Female | PUOR/Mgo | DPDP | > 1 | Banded as an adult on the SMR in 2013. |
| Female | ORDG/Mgo | DPDP | > 1 | Banded as an adult on the SMR in 2013. |
| Female | | Mgo | > 1 | Banded as a nestling at MCBCP or MCAS prior to 2013. |
| Female | Mgo | | > 1 | Banded as a nestling at MCBCP or MCAS prior to 2013. |
| Female | ?/Mgo | DPDP | > 1 | Banded prior to 2013, unknown age. |
| Female | Mgo | ? | > 1 | Banded prior to 2013, unknown age. |
| Female | OROR/Mgo | PUPU | 1 | Banded as a nestling on the SMR in 2012. |
| Female | WHDP/Mgo | DPDP | 1 | Banded as a nestling on the SMR in 2012. |
| Female | LPBK/Mgo | PUPU | 1 | Banded as a nestling on the SMR in 2012. |
| Male | PUWH/Mgo | pupu | > 9 | Banded as an adult on the SMR in 2005. |
| Male | YEYE/Mgo | | > 8 | Banded as an adult on the SMR in 2006. |
| Male | pupu | WHWH/Mgo | > 8 | Banded as an adult on the SMR in 2006. |
| Male | Mgo | DPDP/pupu | > 7 | Banded as an adult on the SMR in 2007. |
| Male | DPDP | Mgo | > 7 | Banded as an adult at FNWS in 2007. |
| Male | Msi | WHPU/gogo | > 6 | Banded as an adult on the SMR in 2009. |
| Male | DPWH/sisi | Mgo | > 6 | Banded as an adult on the SMR in 2008. |
| Male | ORPU/gogo | Msi | > 6 | Banded as an adult on the SMR in 2008. |
| Male | WHWH/Mdb | WHDB | 6 | Banded as a nestling on the SLR in 2007. |
| Male | BKLP | Mgo | > 5 | Banded as an adult on the SMR in 2009. |
| Male | Mdb | WHDB/sisi | 5 | Banded as a nestling on the SLR in 2008. |
| Male | Mgo | BYST/sisi | 5 | Banded as a nestling on the SMR in 2008. |
| Male | DPWH/Mgo | BKBK | 5 | Banded as a nestling on the SMR in 2008. |
| Male | Msi | DGOR | 5 | Banded as a juvenile on the SMR in 2008. |
| Male | ORPU | OROR/Mgo | > 4 | Banded as an adult on the SMR in 2010. |
| Male | YEPU | Mgo | > 4 | Banded as an adult on DL in 2010. |
| Male | WHPU | Mgo | > 4 | Banded as an adult on the SMR in 2010. |
| Male | Mgo | WHDP | > 4 | Banded as an adult on the SMR in 2010. |
| Male | YEPU/Mgo | DPDP | > 4 | Banded as an adult on the SMR in 2010. |
| Male | OROR/Mgo | DPDP | > 4 | Banded as an adult on the SMR in 2010. |
| Male | DPDP | WHPU/Mgo | > 4 | Banded as an adult on the SMR in 2010. |
| Male | DPDP | YEYE/Mgo | > 4 | Banded as an adult on the SMR in 2010. |
| Male | Mgo | OROR/sisi | 4 | Banded as a juvenile on the SMR in 2009. |
| Male | BKBK | BKLP/Mgo | 4 | Banded as a nestling on the SMR in 2009. |
| Male | YEPU | DPDP/Mgo | 4 | Banded as a nestling on the SMR in 2009. |
| Male | DGOR | BKBK/Mgo | 4 | Banded as a nestling on the SMR in 2009. |

Appendix C. Continued.

| Drainage | Band Combination[a] | | | |
|---|---|---|---|---|
| Sex | Left Leg | Right Leg | Age (yrs.)[b] | Comments[c] |
| Santa Margarita River continued | | | | |
| Male | PUPU | BYST/Mgo | > 3 | Banded as an adult on the SMR in 2011. |
| Male | WHWH | DPDP/Mgo | > 3 | Banded as an adult on the SMR in 2011. |
| Male | WHWH | PUPU/Mgo | > 3 | Banded as an adult on the SMR in 2011. |
| Male | WHWH | YEPU/Mgo | > 3 | Banded as an adult on the SMR in 2011. |
| Male | WHWH | LPBK/Mgo | > 3 | Banded as an adult on the SMR in 2011. |
| Male | WHWH | ORPU/Mgo | > 3 | Banded as an adult on the SMR in 2011. |
| Male | BKBK | BKBK/Mgo | > 3 | Banded as an adult on the SMR in 2011. |
| Male | YEPU | BKBK/Mgo | > 3 | Banded as an adult on the SMR in 2011. |
| Male | DPWH | PUPU/Mgo | > 3 | Banded as an adult on the SMR in 2011. |
| Male | DPDB | YEPU/Mdb | > 3 | Banded as an adult on the LSLR in 2011. |
| Male | PUPU | BKBK/Mdb | > 3 | Banded as an adult on the LSLR in 2011. |
| Male | DPWH/Mgo | ORPU | 3 | Banded as a nestling on the SMR in 2010. |
| Male | BYST/Mgo | WHWH | > 2 | Banded as an adult on the SMR in 2012. |
| Male | PUPU | BKLP/Mgo | > 2 | Banded as an adult on the SMR in 2012. |
| Male | WHWH | PUWH/Mgo | > 2 | Banded as an adult on the SMR in 2012. |
| Male | DPWH/Mgo | WHWH | > 2 | Banded as an adult on the SMR in 2012. |
| Male | ORPU | BKLP/Mgo | > 2 | Banded as an adult on the SMR in 2012. |
| Male | ORPU/Mgo | WHWH | > 2 | Banded as an adult on the SMR in 2012. |
| Male | ORPU | PUOR/Mgo | > 2 | Banded as an adult on the SMR in 2012. |
| Male | WHWH | ORPU/Mgo | > 2 | Banded as an adult on the SMR in 2012. |
| Male | ORPU | PUYE/Mgo | > 2 | Banded as an adult on the SMR in 2012. |
| Male | PUPU | PUOR/Mgo | > 2 | Banded as an adult on the SMR in 2012. |
| Male | PUPU | ORDG/Mgo | > 2 | Banded as an adult on the SMR in 2012. |
| Male | DPDP/Mgo | PUPU | > 2 | Banded as an adult on the SMR in 2012. |
| Male | LPBK/Mgo | DPWH | > 2 | Banded as an adult on the SMR in 2012. |
| Male | DPWH | ORPU/Mgo | > 2 | Banded as an adult on the SMR in 2012. |
| Male | ORDG/Msi | pupu | > 2 | Banded as an adult on the SMR in 2012. |
| Male | ORPU/Mgo | PUWH | > 2 | Banded as an adult on the SMR in 2012. |
| Male | BKBK | ORDG/Mgo | > 2 | Banded as an adult on the SMR in 2012. |
| Male | YEPU | BYST/Mgo | > 2 | Banded as an adult on the SMR in 2012. |
| Male | BKBK | WHDP/Mgo | > 2 | Banded as an adult on the SMR in 2012. |
| Male | YEPU | ORPU/Mgo | 2 | Banded as a juvenile on the SMR in 2011. |
| Male | DPWH | WHWH/Mgo | 2 | Banded as a nestling on the SMR in 2011. |
| Male | LPBK | PUWH/Mgo | 2 | Banded as a nestling at MCAS in 2011. |
| Male | WHWH | BKBK/Mgo | 2 | Banded as a nestling on the SMR in 2011. |
| Male | BKBK | BYST/Mdb | 2 | Banded as a nestling on the SLR in 2011. |
| Male | WHWH | DBWH/Mdb | 2 | Banded as a nestling on the SLR in 2011. |
| Male | DGOR | PUPU/Mgo | > 1 | Banded as an adult on the SMR in 2013. |
| Male | DGOR | LPBK/Mgo | > 1 | Banded as an adult on the SMR in 2013. |
| Male | LPBK/Mgo | ORPU | > 1 | Banded as an adult on the SMR in 2013. |
| Male | DGOR | ORPU/Mgo | > 1 | Banded as an adult on the SMR in 2013. |
| Male | BKBK/Mgo | ORPU | > 1 | Banded as an adult on the SMR in 2013. |
| Male | BKBK/Mgo | DGOR | > 1 | Banded as an adult on the SMR in 2013. |
| Male | YEYE/Mgo | DPWH | > 1 | Banded as an adult on the SMR in 2013. |
| Male | YEPU | ORPU/Mgo | > 1 | Banded as an adult on the SMR in 2013. |

Appendix C. Continued.

| Drainage / Sex | Band Combination[a] Left Leg | Right Leg | Age (yrs.)[b] | Comments[c] |
|---|---|---|---|---|
| Santa Margarita River continued | | | | |
| Male | BKBK/Mgo | DPWH | > 1 | Banded as an adult on the SMR in 2013. |
| Male | DGOR/Mgo | ORPU | > 1 | Banded as an adult on the SMR in 2013. |
| Male | PUWH | ORDG/Mgo | > 1 | Banded as an adult on DL in 2013. |
| Male | BKLP/Mgo | PUWH | > 1 | Banded as an adult on the SMR in 2013. |
| Male | | Mgo | > 1 | Banded as a nestling at MCBCP or MCAS prior to 2013. |
| Male | | Mgo | > 1 | Banded as a nestling at MCBCP or MCAS prior to 2013. |
| Male | ORPU | ORDG/Mgo | 1 | Banded as a juvenile on the SMR in 2012. |
| Male | PUWH/Mgo | ORPU | 1 | Banded as a nestling on the SMR in 2012. |
| Male | BYST/Mgo | DPDP | 1 | Banded as a nestling on the SMR in 2012. |
| Male | DGOR | WHPU/Mgo | 1 | Banded as a nestling at MCAS in 2012. |
| Male | DPWH/Mgo | DPWH | 1 | Banded as a nestling on the SMR in 2012. |
| Male | ORPU/Mgo | DPDP | 1 | Banded as a nestling on the SMR in 2012. |
| Male | YEYE/Mdb | LPBK | 1 | Banded as a nestling on the SLR in 2012 |
| Male | BYST/Mdb | DBDP | 1 | Banded as a nestling on the SLR in 2012. |
| Unknown | BKBK | PUWH/Mgo | > 1 | Banded as an adult on the SMR in 2013. |
| Unknown | DPDP/Mgo | BKBK | > 1 | Banded as an adult on the SMR in 2013. |
| Unknown | PUWH | BKLP/Mgo | > 1 | Banded as an adult on the SMR in 2013. |
| Unknown | DGOR/Mgo | DPDP | > 1 | Banded as an adult on the SMR in 2013. |
| Unknown | WHPU/Mgo | PUWH | > 1 | Banded as an adult on DL in 2013. |
| Unknown | BKLP/Mgo | LPBK | > 1 | Banded as an adult on the SMR in 2013. |
| Unknown | PUOR/Mgo | LPBK | HY | Banded as a juvenile on the SMR in 2013. |
| Unknown | BKBK | DGOR/Mgo | HY | Banded as a juvenile on the SMR in 2013. |
| Unknown | PUYE/Mgo | LPBK | HY | Banded as a juvenile on the SMR in 2013. |
| Unknown | BKBK | DPWH/Mgo | HY | Banded as a juvenile on the SMR in 2013. |
| Unknown | LPBK | LPBK/Mgo | HY | Banded as a juvenile on the SMR in 2013. |
| Unknown | LPBK | BYST/Mgo | HY | Banded as a juvenile on the SMR in 2013. |
| Unknown | LPBK | OROR/Mgo | HY | Banded as a juvenile on the SMR in 2013. |
| Unknown | DGOR/Mgo | LPBK | HY | Banded as a juvenile on the SMR in 2013. |
| Unknown | WHDP/Mgo | LPBK | HY | Banded as a juvenile on the SMR in 2013. |
| Unknown | WHPU/Mgo | LPBK | HY | Banded as a juvenile on the SMR in 2013. |
| Unknown | LPBK | DGOR/Mgo | HY | Banded as a juvenile on the SMR in 2013. |
| Windmill Creek | | | | |
| Male | WHDB/Mdb | DPDB | 3 | Banded as a nestling on the SLR in 2010. |

[a] Band colors: Mdb = dark blue numbered federal band; Mgo = gold numbered federal band; Mlb = light blue numbered federal band; Msi = silver numbered federal band; gogo = metal gold; pupu = metal purple; sisi = metal silver; BKBK = plastic black; BKLP = plastic black-light pink split; BWST = plastic dark blue-white striped; BYST = plastic black-yellow striped; DBDP = plastic dark blue-dark pink split; DBWH = plastic dark blue-white split; DGOR = plastic dark green-orange split; DPDB = plastic dark pink-dark blue split; DPDP = plastic dark pink; DPWH = plastic dark pink-white split; LPBK = plastic light pink-black split; ORDG = plastic orange-dark green split; OROR = plastic orange; ORPU = plastic orange-purple split; PUOR = plastic purple-orange split; PUPU = plastic purple; PUWH = plastic purple-white split; PUYE = plastic purple-yellow split; 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; MCBCP = Marine Corps Base Camp Pendleton; SLR = San Luis Rey River; SMO = San Mateo Creek; SMR = Santa Margarita River.

## APPENDIX D. BETWEEN-YEAR MOVEMENT OF ADULT LEAST BELL'S VIREOS AT MARINE CORPS BASE CAMP PENDLETON, 2013

| Year Last Detected | Drainage[a] / Territory / Treatment[a] | | Distance Moved (km) | Band Combination[b] | | Age in 2013 (yrs.) | Sex[c] |
|---|---|---|---|---|---|---|---|
| | Last Seen | 2013 | | Left Leg | Right Leg | | |
| 2012 | SMR / HTI / REF | CS / CS07 | 25.8 | PUPU/Mgo | ORPU | 1 | M |
| 2012 | SMR / DRK / REF | SLR / MSL40 | 12.6 | WHWH/Mgo | BKBK | 1 | M |
| 2012 | SMR / DAQ / REF | SLR / WFE | 11.4 | ORPU/Mgo | PUWH | 1 | M |
| 2012 | SMR / AXE / REF | SMR / YB15 | 9.7 | ORPU | ORDG/Mgo | 1 | M |
| 2012 | SLR / WDID | SMR / EMB / REM | 5.4 | BYST/Mdb | DBDP | 1 | M |
| 2012 | SMR / RR17 | LF / UL08 | 5.4 | YEPU/Mgo | WHWH | 1 | M |
| 2012 | SLR / DTOS | SMR / MAC / REM | 5.2 | YEYE/Mdb | LPBK | 1 | M |
| 2012 | SMR / ICE / REM | SMR / AE88 | 3.5 | ORPU/Mgo | DPDP | 1 | M |
| 2012 | SMR / PO02 | SMR / PR56 | 2.8 | PUPU | BKBK/Mdb | > 3 | M |
| 2012 | SMR / CKE / REM | SMR / AE91 | 2.7 | DPWH/Mgo | DPWH | 1 | M |
| 2012 | SMR / BAY / REM | SMR / AE98 | 2.6 | BYST/Mgo | DPDP | 1 | M |
| 2012 | DL / DN06 | DL / DN02 | 1.5 | DPWH | YEPU/Mgo | 4 | M |
| 2012 | SMR / ECH / REM | SMR / ES35 | 0.9 | PUWH/Mgo | ORPU | 1 | M |
| 2012 | MCAS / LUC | SMR / AE85 | 0.7 | DGOR | WHPU/Mgo | 1 | M |
| 2012 | SOF / OW07 | SOF / OW06 | 0.4 | LPBK | DBWH/Mdb | 6 | M |
| 2012 | SMR / COB / REM | SMR / FLN / REM | 0.2 | WHWH | ORPU/Mgo | > 2 | M |
| 2012 | SMR / ZPR / REF | SMR / LIF / REF | 0.2 | LPBK/Mgo | DPWH | > 2 | M |
| 2012 | SMR / BN06 | SMR / ES41 | 0.2 | DPDP | WHPU/Mgo | > 4 | M |
| 2012 | SMR / ES03 | SMR / ES04 | 0.1 | DPDB | YEPU/Mdb | > 3 | M |
| 2012 | SMR / ES24 | SMR / ES25 | 0.1 | DPWH/Mgo | WHWH | > 2 | M |
| 2012 | SMR / ES01 | SMR / ES31 | 0.1 | DPDP/Mgo | PUPU | > 2 | M |
| 2012 | DL / DS08 | DL / DS12 | 0.1 | WHDP/Mgo | WHWH | > 5 | M |
| 2012 | SMR / RR08 | SMR / RR09 | 0.1 | DPWH/sisi | Mgo | > 6 | M |
| 2012 | SMR / AW01 | SMR / AW12 | 0.1 | DPWH | OROR/Mgo | > 2 | M |
| 2012 | LF / LL07 | LF / LL07 | 0.1 | PUWH/pupu | Mdb | 6 | M |
| 2012 | SMR / POE / REM | SMR / POE / REM | 0.1 | BKBK | ORDG/Mgo | > 2 | M |
| 2012 | SMR / ES27 | SMR / ES23 | 0.1 | Mgo | BYST/sisi | 5 | M |
| 2012 | SMR / HRP / REF | SMR / HRP / REF | 0.1 | PUPU | ORDG/Mgo | > 2 | M |
| 2012 | SMR / MER / REF | SMR / MER / REF | 0.1 | Mgo | WHDP | > 4 | M |
| 2012 | SMR / HOL / REF | SMR / BIL / REF | 0.1 | PUPU | PUOR/Mgo | > 2 | M |
| 2012 | SMR / RR26 | SMR / RR03 | 0.1 | WHWH | BKBK/Mgo | 2 | M |
| 2012 | SMR / ES34 | SMR / ES29 | 0.1 | Msi | DGOR | 5 | M |
| 2012 | SMR / TRP / REM | SMR / TRP / REM | 0.1 | OROR/Mgo | PUWH | > 2 | M |
| 2012 | SMR / HW01 | SMR / HW27 | 0.0 | Mdb | WHDB/sisi | 5 | M |
| 2012 | SMR / ARI / REF | SMR / ARI / REF | 0.0 | BKLP | Mgo | > 5 | M |
| 2012 | SMO / MT04 | SMO / MT12 | 0.0 | Mgo | PUOR/sisi | > 6 | M |
| 2012 | SMR / STR / REM | SMR / STR / REM | 0.0 | BYST/Mgo | WHWH | > 2 | M |
| 2012 | SMR / QIN / REF | SMR / QIN / REF | 0.0 | WHWH | PUWH/Mgo | > 2 | M |
| 2012 | SMR / CKI / REM | SMR / CKI / REM | 0.0 | DPDP | YEYE/Mgo | > 4 | M |
| 2012 | SMR / FAU / REF | SMR / FAU / REF | 0.0 | PUPU | BYST/Mgo | > 3 | M |
| 2012 | SMR / PIE / REM | SMR / PIE / REM | 0.0 | WHWH | YEPU/Mgo | > 3 | M |
| 2012 | SMR / DRK / REF | SMR / DRK / REF | 0.0 | DPWH | PUPU/Mgo | > 3 | M |
| 2012 | SMR / CKE / REM | SMR / CKE / REM | 0.0 | ORDG/Msi | pupu | > 2 | M |
| 2012 | SMR / TOP / REM | SMR / TOP / REM | 0.0 | ORPU | OROR/Mgo | > 4 | M |
| 2012 | SMR / BAY / REM | SMR / BAY / REM | 0.0 | BKBK | WHDP/Mgo | > 2 | M |

Appendix D. Continued.

| Year Last Detected | Drainage[a] / Territory / Treatment[a] | | Distance Moved (km) | Band Combination[b] | | Age in 2013 (yrs.) | Sex[c] |
|---|---|---|---|---|---|---|---|
| | Last Seen | 2013 | | Left Leg | Right Leg | | |
| 2012 | SMR / TOF / REM | SMR / TOF / REM | 0.0 | WHWH | OROR/Mgo | > 3 | M |
| 2012 | SMR / HW16 | SMR / HW18 | 0.0 | ORPU/gogo | Msi | > 6 | M |
| 2012 | SMR / AH10 | SMR / AH07 | 0.0 | YEPU | Mgo | > 4 | M |
| 2012 | SMR / AE04 | SMR / AE09 | 0.0 | WHPU | Mgo | > 4 | M |
| 2012 | SMR / ICE / REM | SMR / ICE / REM | 0.0 | OROR/Mgo | DPDP | > 4 | M |
| 2012 | LF / LL09 | LF / LL06 | 0.0 | DGOR/Mgo | WHWH | 3 | M |
| 2012 | SMR / YB05 | SMR / YB16 | 0.0 | WHWH | DBWH/Mdb | 2 | M |
| 2012 | SMR / HTI / REF | SMR / HTI / REF | 0.0 | WHWH | PUPU/Mgo | > 3 | M |
| 2012 | SMR / WSP / REF | SMR / WSP / REF | 0.0 | ORPU | ORPU/Mgo | 2 | M |
| 2012 | SMR / JSP / REF | SMR / JSP / REF | 0.0 | PUPU | BKLP/Mgo | > 2 | M |
| 2012 | SMR / UM12 | SMR / UM22 | 0.0 | WHWH/Mdb | WHDB | > 3 | M |
| 2012 | SMR / GEL / REM | SMR / GEL / REM | 0.0 | ORPU | BKLP/Mgo | > 2 | M |
| 2012 | SMR / CED / REF | SMR / CED / REF | 0.0 | ORPU | PUYE/Mgo | > 2 | M |
| 2012 | SMR / DEU / REF | SMR / DEU / REF | 0.0 | OROR/Mgo | WHWH | > 2 | M |
| 2012 | SMR / YUK / REM | SMR / YUK / REM | 0.0 | YEPU | BYST/Mgo | > 2 | M |
| 2012 | SMR / HLX / REM | SMR / HLX / REM | 0.0 | WHWH | LPBK/Mgo | > 3 | M |
| 2012 | SMR / ES04 | SMR / ES08 | 0.0 | Mgo | OROR/sisi | 4 | M |
| 2012 | SMR / ES23 | SMR / ES22 | 0.0 | Msi | WHPU/gogo | > 6 | M |
| 2012 | SMR / TRF / REM | SMR / TRF / REM | 0.0 | YEPU/Mgo | DPDP | > 4 | M |
| 2012 | SMR / HLD / REF | SMR / HLD / REF | 0.0 | PUWH/Mgo | pupu | > 9 | M |
| 2012 | SMR / MUF / REM | SMR / MUF / REM | 0.0 | ORPU | PUOR/Mgo | > 2 | M |
| 2012 | SMR / ES26 | SMR / ES37 | 0.0 | Mgo | DPDP/pupu | > 7 | M |
| 2012 | SLR / WH01 | SMR / AE04 | 7.6 | DPWH/Mdb | DBDP | > 3 | F |
| 2012 | SMR / BAY / REM | SLR / WHAR | 5.2 | Mgo | PUOR/gogo | 1 | F |
| 2012 | FC / FC1 | SMR / UM40 | 3.2 | pupu | LPBK/Mlb | 2 | F |
| 2012 | SMR / TRF / REM | SMR / ES01 | 1.6 | LPBK/Mgo | PUPU | 1 | F |
| 2012 | SMR / AXE / REF | SMR / MOU / REF | 0.9 | OROR/Mgo | PUPU | 1 | F |
| 2012 | SMO / MB17 | SMO / MB22 | 0.9 | pupu | ORPU/Mgo | 6 | F |
| 2012 | SMR / BN04 | SMR / GEL / REM | 0.5 | DPDP | BKBK/Mgo | > 4 | F |
| 2012 | SMR / ES26 | SMR / BRT / REM | 0.3 | YEYE/sisi | Mgo | > 5 | F |
| 2012 | SMR / PIE / REM | SMR / ES22 | 0.3 | WHDP/Mgo | DPDP | 1 | F |
| 2012 | SMR / QIN / REF | SMR / DRK / REF | 0.2 | DGOR/Mgo | PUPU | > 2 | F |
| 2012 | SMR / APO / REF | SMR / ARI / REF | 0.2 | DPWH | Mgo | 6 | F |
| 2012 | SMR / MUF / REM | SMR / STR / REM | 0.1 | PUPU/Mgo | PUPU | > 5 | F |
| 2011 | SLR / DCAL | SMR / YB21 | 4.1 | BKBK | BYST/Mdb | 2 | M |
| 2011 | MCAS / MNV | SMR / BN09 | 3.3 | LPBK | PUWH/Mgo | 2 | M |
| 2011 | SMR / SG09 | SMR / ES02 | 3.1 | | | > 8 | M |
| 2011 | SMR / LIF / REF | SMR / HW23 | 1.0 | DPWH | WHWH/Mgo | 2 | M |
| 2011 | SMR / OOR / REM | SMR / ECH / REM | 0.2 | YEPU | BKBK/Mgo | > 3 | M |
| 2011 | SMR / UM07 | SMR / UM19 | 0.1 | DPDP | Mgo | > 7 | M |
| 2011 | SMR / BOW / REF | SMR / BOW / REF | 0.1 | WHWH | DPDP/Mgo | > 3 | M |
| 2011 | SMR / YB13 | SMR / YB05 | 0.1 | DPWH/Mgo | OROR | 3 | M |
| 2011 | SMR / OCM / REF | SMR / OCM / REF | 0.0 | BKBK | BKBK/Mgo | > 3 | M |
| 2011 | SLR / BGOO | SMR / PR04 | 7.5 | BWST | PUYE/Mdb | 2 | F |
| 2011 | SMR / OCM / REF | SMR / HLD / REF | 0.6 | YEPU/Mgo | PUWH | > 3 | F |

Appendix D. Continued.

| Year Last Detected | Drainage[a] / Territory / Treatment[a] | | Distance Moved (km) | Band Combination[b] | | Age in 2013 (yrs.) | Sex[c] |
|---|---|---|---|---|---|---|---|
| | Last Seen | 2013 | | Left Leg | Right Leg | | |
| 2011 | DL / DS16 | DL / DS01 | 0.3 | Mgo | DGOR/sisi | > 4 | F |
| 2010 | SLR / DSAN | WC / WC06 | 5.0 | WHDB/Mdb | DPDB | 3 | M |
| 2010 | SMR / HE04 | SMR / HW14 | 0.8 | YEPU/Msi | | 4 | M |
| 2010 | SMR / BAY / REM | DL / DS02 | 13.4 | DPDP/Mgo | DGOR | > 4 | F |
| 2010 | MCAS / KRM | SMR / 2207 | 1.5 | BKBK/Mgo | PUPU | 3 | F |
| 2010 | SMR / ZPR / REF | SMR / HW26 | 1.4 | YEPU/Mgo | DGOR | 3 | F |
| 2010 | DL / DLMAPS | DL / DLMAPS | 0.1 | Mgo | PUPU/gogo | > 5 | F |
| 2010 | SMR / SMMAPS | SMR / BN09 | 0.0 | WHPU/Mgo | WHWH | > 4 | F |
| 2009 | SMR / BER / REF | SMR / SG01 | 6.0 | DGOR | BKBK/Mgo | 4 | M |
| 2009 | SMR / AE15 | SMR / HE18 | 0.8 | BKBK | BKLP/Mgo | 4 | M |
| 2009 | DL / DS14 | DL / DS16 | 0.0 | | Mgo/YEYE | > 7 | M |
| 2009 | SMR / YB03 | SMR / YB04 | 0.2 | Mgo | PUYE | > 5 | F |
| 2008 | SMR / LND / REM | SMR / PR02 | 0.7 | DPWH/Mgo | BKBK | 5 | M |
| 2008 | SMR / AER / REM | SMR / AE11 | 2.1 | OROR/Mgo | ORPU | 5 | F |
| 2007 | SMR / WNS / REM | SMR / PR11 | 0.5 | BKBK | PUPU/Mgo | 6 | F |
| 2006 | SMR / SGE / REM | SMR / ES12 | 0.1 | YEYE/Mgo | | > 8 | M |
| 2006 | SMR / VIC / REM | SMR / RR02 | 0.8 | YEPU/Mgo | PUPU | 7 | F |

[a] Drainage Codes: CS = Cristianitos Creek; DL = De Luz Creek; FC = Fallbrook 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; WC = Windmill Creek; Treatment Codes: REM = Removal; REF = Reference.

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

## APPENDIX E. STATUS AND NESTING ACTIVITIES OF LEAST BELL'S VIREOS AT MARINE CORPS BASE CAMP PENDLETON, 2013

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

| Territory | Nest | Monitoring[a] | Nest Fate[b] | # Fledged | Comments |
|---|---|---|---|---|---|
| BAY | 1 | F | SUC | 3 | |
| CAR | 1 | F | SUC | 4 | |
| CAR | 2 | F | PRE | | |
| CAR | 3 | F | SUC | 3 | |
| CKE | 1 | F | SUC | 2 | |
| CKE | 2 | F | SUC | 4 | |
| CKI | 1 | F | SUC | 4 | |
| CKI | 2 | F | INC | | Nest not completed |
| CKI | 3 | F | SUC | 3 | |
| COB | 1 | F | SUC | 1 | |
| ECH | 1 | F | SUC | 4 | |
| ECH | 2 | F | SUC | 3 | |
| EMB | 1 | F | SUC | 2 | |
| EMB | 2 | F | SUC | 1 | |
| FLN | 1 | F | PRE | | |
| FLN | 2 | F | PRE | | |
| FLN | 3 | F | SUC | 3 | |
| HLX | 1 | F | INC | | Nest not completed |
| HLX | 2 | F | UNK | | Nest completed but no eggs confirmed. |
| HLX | 3 | F | SUC | 3 | |
| ICE | 1 | F | PRE | | |
| ICE | 2 | F | SUC | 3 | |
| KEE | 1 | F | PRE | | |
| KEE | 2 | F | PRE | | |
| MEA | 1 | F | SUC | 3 | |
| MEA | 2 | F | INC | | Nest not completed |
| MIN | 1 | F | SUC | 3 | |
| MUF | 1 | F | SUC | 4 | |
| OOR | 1 | F | UNK | | Nest completed but no eggs confirmed. |
| ORE | 1 | F | SUC | 4 | |
| ORE | 2 | F | SUC | 3 | |
| PIE | 1 | F | SUC | 4 | |
| PIE | 2 | F | SUC | 3 | |
| POE | 1 | F | SUC | 4 | |
| POE | 2 | F | SUC | 4 | |
| STR | 1 | F | PRE | | |
| STR | 2 | F | SUC | 3 | |
| TOF | 1 | F | SUC | 3 | |
| TOF | 2 | F | SUC | 2 | |
| TOP | 1 | F | PRE | | |
| TOP | 2 | F | SUC | 2 | |
| TRF | 1 | F | SUC | 3 | |
| TRF | 2 | F | SUC | 4 | |
| TRP | 1 | F | SUC | 3 | |
| TRP | 2 | F | SUC | 3 | |
| YUK | 1 | F | PRE | | |

Appendix E. Continued.

| Territory | Nest | Monitoring[a] | Nest Fate[b] | # Fledged | Comments |
|---|---|---|---|---|---|
| **Giant Reed (*Arundo donax*) Removal Site Territories** | | | | | |
| YUK | 2 | F | PRE | | |
| YUK | 3 | F | PRE | | |
| YUK | 4 | F | SUC | 2 | |
| **Reference Site Territories** | | | | | |
| ARI | 1 | F | SUC | 4 | |
| ARI | 2 | F | PRE | | |
| AXE | 1 | F | INC | | Nest not completed |
| AXE | 2 | F | PRE | | |
| AXE | 3 | F | UNK | | Nest completed but no eggs confirmed. |
| AXE | 4 | F | PRE | | |
| AXE | 5 | F | PRE | | |
| BIL | 1 | F | PRE | | |
| BIL | 2 | F | PRE | | |
| BIL | 3 | F | PRE | | |
| BOW | 1 | F | PRE | | |
| BOW | 2 | F | PRE | | |
| BOW | 3 | F | PRE | | |
| CED | 1 | F | PRE | | |
| CED | 2 | F | INC | | Nest not completed |
| CED | 3 | F | UNK | | Nest completed but no eggs confirmed. |
| CED | 4 | F | PRE | | |
| CED | 5 | F | SUC | 3 | |
| DAQ | 1 | F | SUC | 3 | |
| DEL | 1 | F | SUC | 3 | |
| DEU | 1 | F | SUC | 2 | |
| DEU | 2 | F | PRE | | |
| DEU | 3 | F | SUC | 3 | |
| DRK | 1 | F | SUC | 3 | |
| DRK | 2 | F | PRE | | |
| DRK | 3 | F | UNK | | Egg punctured. |
| FAU | 1 | F | PRE | | |
| FAU | 2 | F | SUC | 3 | |
| FUR | 1 | P | SUC | 3 | |
| HDX | 1 | F | PRE | | |
| HDX | 2 | F | PRE | | |
| HDX | 3 | F | INC | | Nest not completed |
| HDX | 4 | F | SUC | 4 | |
| HLD | 1 | F | UNK | | Nest completed but no eggs confirmed. |
| HLD | 2 | F | PRE | | |
| HLD | 3 | F | INC | | Nest not completed |
| HOL | 1 | F | SUC | 4 | |
| HOL | 2 | F | SUC | 3 | |
| HRP | 1 | F | SUC | 3 | |
| HRP | 2 | F | SUC | 3 | |
| HTI | 1 | F | PRE | | |

Appendix E. Continued.

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

| Territory | Nest | Monitoring[a] | Nest Fate[b] | # Fledged | Comments |
|---|---|---|---|---|---|
| HTI | 2 | F | PRE | | |
| HTI | 3 | F | PRE | | |
| HTI | 4 | F | PRE | | |
| JSP | 1 | F | INC | | Nest not completed |
| JSP | 2 | F | UNK | | Nest completed but no eggs confirmed. |
| JSP | 3 | F | PRE | | |
| LIF | 1 | F | PRE | | |
| LIF | 2 | F | PRE | | |
| LIF | 3 | F | INC | | Nest not completed |
| LIF | 4 | F | SUC | 3 | |
| MER | 1 | F | INC | | Nest not completed |
| MER | 2 | F | PRE | | |
| MER | 3 | F | PRE | | |
| MER | 4 | F | SUC | 4 | |
| MOU | 1 | F | UNK | | Nestlings died for unknown reasons. |
| MOU | 2 | F | SUC | 4 | |
| ODN | 1 | F | INC | | Nest not completed |
| ODN | 2 | F | PRE | | |
| ODN | 3 | F | SUC | 3 | |
| ONX | 1 | F | SUC | 4 | |
| ONX | 2 | F | SUC | 4 | |
| PEP | 1 | F | PRE | | |
| PEP | 2 | F | PRE | | |
| PEP | 3 | F | PRE | | |
| PEP | 4 | F | INC | | Nest not completed |
| QIN | 1 | F | PRE | | |
| QIN | 2 | F | PRE | | |
| QIN | 3 | F | PRE | | |
| QIN | 4 | F | SUC | 4 | |
| WSP | 1 | F | INC | | Nest not completed |
| WSP | 2 | F | UNK | | Nest completed but no eggs confirmed. |
| WSP | 3 | F | PRE | | |
| WSP | 4 | F | INC | | Nest not completed |
| WSP | 5 | F | SUC | 4 | |

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

[b] Nest Fate: INC = nest not completed; PRE = nest failure caused by predation; SUC = fledged at least one Least Bell's Vireo young; UNK = reason for nest failure/abandonment unknown.