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

2012 Annual Data Summary

Prepared for:

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

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

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By Suellen Lynn and Barbara E. Kus

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EXECUTIVE SUMMARY

Surveys for the endangered Least Bell's Vireo (*Vireo bellii pusillus*) were conducted at Marine Corps Base Camp Pendleton (MCBCP or Base), California, between 10 May and 27 July 2012. Surveys in 2012 began later than usual (mid-May vs. late March/early April) because of contract delays. Consequently, data collected in 2012 may not be directly comparable to other years and represents a minimum population estimate. Drainages containing riparian habitat suitable for vireos were surveyed two to four times. A minimum of 636 male vireos and 40 transient vireos were detected on 20 out of the 23 drainages/sites surveyed. Ninety-three percent of all vireo territories occurred on the seven most populated drainages, with the Santa Margarita River containing 60% of all territories on Base. Sixty-nine percent of male vireos were confirmed as paired.

The number of documented Least Bell's Vireo territories (636) dropped 19% from 2011 to 2012. The number of territories on 17% (4/23) of drainages surveyed increased from 2011, while 26% of drainages (6/23) decreased by three or more territories, and 57% of drainages (13/23) showed no change or decreased by two or fewer territories.

The majority of vireo territories occurred in habitat characterized as willow riparian, with 79% of males in the study area found in this habitat. An additional 6% of birds occupied willow (*Salix* spp.) habitat co-dominated by cottonwoods (*Populus fremontii*) or sycamores (*Platanus racemosa*). Twelve percent of territories were found in riparian scrub dominated by mule fat (*Baccharis salicifolia*) and/or sandbar willow (*S. exigua*). Two percent of the vireos used drier habitats characterized by a mix of sycamores and oaks (*Quercus agrifolia*). Approximately 1% of vireo territories occurred in habitat dominated by non-native vegetation.

One hundred and twenty-five Least Bell's Vireos were banded for the first time during the 2012 season. These included 26 adult vireos, 98 hatch-year vireos, and one vireo of unknown age. All adult vireos, the vireo of unknown age, and two hatch-year birds were banded with unique color combinations. The remaining 96 hatch-year vireos (all nestlings) were banded with a single gold numbered federal band on the left leg.

Sixty Least Bell's Vireos banded prior to the 2012 breeding season were resighted and identified on Base in 2012. Ten of these were originally banded on the San Luis Rey River, one was originally banded at Marine Corps Air Station, Camp Pendleton, and the remaining birds were banded at MCBCP. Adult birds of known age ranged from 1-8 years old. Adult survivorship, or the proportion of individuals known to survive from 2011 to 2012, was 54% (53/99). Survivorship of first-year birds that fledged from MCBCP in 2011 and were documented on Base or elsewhere in 2012 was 10% (2/20), based on the number of uniquely banded individuals detected. Both of these uniquely color banded first-year birds detected were male.

Adult vireo return rate was higher than last year and similar to years prior to that. The dip in return rate in 2011 suggests that over-winter survivorship may have been low between 2010 and 2011. Alternatively, our 2011 survey and resighting effort was reduced more than in 2012 as a consequence of contracting delays and this affected our ability to resight and confirm survivorship of vireos that may have been present in 2011, but not in 2012.

The majority of returning adult vireos showed strong between-year site fidelity. Overall vireo territory fidelity between 2011 and 2012 was 82% (23/28). The average between-year movement for returning adult vireos was 0.1 ± 0.0 km (standard deviation [SD]). The one first-year vireo detected in 2012 that fledged from a known nest on MCBCP in 2011 dispersed 2.3 km to his 2012 breeding location. The other first-year vireo banded as a juvenile in 2011 was originally captured as a juvenile and not associated with a specific natal territory.

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 were giant reed was removed 13-15 years ago (Reference site). Adult survivorship of vireos at Removal sites and Reference sites was 43% and 53%, respectively. First-year survivorship was 7% and 0%, respectively. One hundred percent of adults from Removal and Reference sites that were detected in both 2011 and 2012 returned in 2012 to the same territory occupied in 2011. The one male nestling from a 2011 Removal site dispersed to an area outside of monitoring sites.

One vireo that originated at MCBCP moved off Base and was detected elsewhere in 2012. This was a female, banded as a nestling on MCBCP in 2009, and detected on the San Luis Rey River in 2012.

Nesting activity was monitored between 10 May and 26 July in 47 territories within the Removal and Reference monitoring sites. Forty-five of these territories were known to be occupied by pairs. Sixty-eight nests (33 in Removal sites and 35 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 2012. Sixty-five percent (20/31) of Removal nests and 44% (14/32) of Reference nests successfully fledged young. Predation was believed to be the primary source of nest failure at both sites. Predation accounted for 82% (9/11) and 72% (13/18) of nest failures at Removal and Reference sites, respectively. Of the remaining seven nests that failed, two were abandoned when eggs were punctured or failed to hatch and five failed from unknown causes. No nest parasitism of Least Bell’s Vireos by Brown-headed Cowbirds (*Molothrus ater*) was documented in 2012.

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

In 2012, 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 and in taller host plants than nests in Reference sites. Twelve plant species were used as hosts for vireo nests in 2012. Seventy-one percent of all nests were placed in arroyo willow (*S. lasiolepis*), sandbar willow, black willow (*S. gooddingii*), or mule fat.

The decrease in vireo numbers on MCBCP (19%) mirrored similar population changes on the San Diego River (18% decrease), the lower San Luis Rey River (42%), the middle San Luis Rey River (20% decrease), and at MCAS (33% decrease), suggesting a general population decline 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 February 2012, we found a female vireo in southern Baja California, Mexico that was a nestling at MCBCP in 2008, and then detected her on MCBCP in April 2012. 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 13-15 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 10 May and 27 July 2012 (Fig. 1). Vireo surveys began late in 2012 as a result of contractual delays. Although four surveys were conducted, these surveys began after the vireo breeding season was well underway and therefore may have missed vireos that held territories earlier in the year but subsequently moved away or became less detectable as singing became less frequent with the solidification of territory boundaries. Therefore, summary numbers for 2012 should be considered a minimum. Field work was conducted by USGS biologists Armando Aispuro, Lisa Allen, Ryan Evans, PJ Falatek, Aaron Gallagher, Scarlett Howell, Barbara Kus, Maia Lipshutz, Suellen Lynn, Sarah Nichols, Eric Nolte, Jason Pietrzak, Ryan Pottinger, 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. 11, Fig. 12).
   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. 11).

2. ***De Luz Creek,*** between the confluence with the Santa Margarita River and the Base boundary (Appendix A, Fig. 11).

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. 11).

4. ***Lake O'Neill/Fallbrook Creek:***
   a. All riparian habitat around Lake O'Neill (Appendix A, Fig. 11).
   b. Between Lake O'Neill and the Base boundary with FNWS (Appendix A, Fig. 11).

5. ***Basilone and Roblar Roads,*** a small patch of habitat straddling Basilone Road at the intersection of Basilone and Roblar Roads (Appendix A, Fig. 11).

6. ***22 Area,*** all riparian habitat within the 22 Area, east of Vandegrift Road and the Supply Depot (Appendix A, Fig. 12).

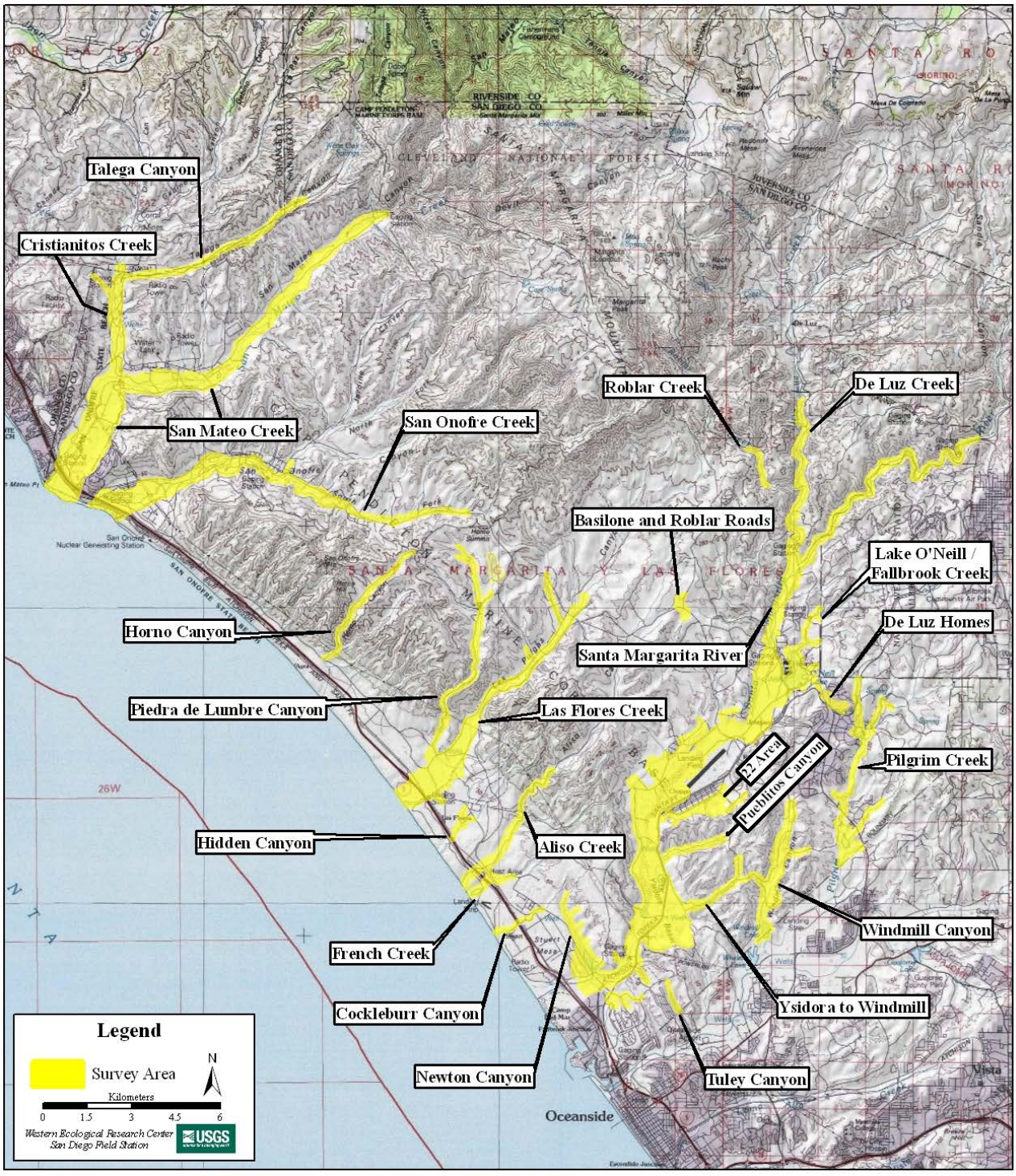

Fig. 1. Least Bell's Vireo survey areas at Marine Corps Base Camp Pendleton, 2012.

7. ***Pueblitos Canyon,*** between Vandegrift Road and a point approximately 2.5 km upstream (Appendix A, Fig. 12).

8. ***Tuley Canyon,*** between the Base boundary and a point approximately 1.1 km upstream (Appendix A, Fig. 12).

9. ***Newton Canyon,*** between the confluence with the Santa Margarita River and the upstream limit of riparian habitat (Appendix A, Fig. 12).

10. ***Cockleburr Canyon,*** between the Pacific Ocean and a point 0.25 km east of Interstate 5 (Appendix A, Fig. 12).

11. ***French Creek,*** between the Pacific Ocean and the Edson Range Impact Area (Appendix A, Fig. 12).

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

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

14. ***Las Flores Creek (within Las Pulgas Canyon):***
    a. Between Stuart Mesa Road and the high voltage electrical transmission lines (Appendix A, Fig. 13).
    b. Between the Pacific Ocean and Stuart Mesa Road (Appendix A, Fig. 13).
    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. 13).

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 (in 2012 only, includes Ammunition Supply Point compound) (Appendix A, Fig. 13).

16. ***Horno Canyon,*** between Old Highway 101 and the upstream limit of riparian habitat (Appendix A, Fig. 13).

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. 13, Fig. 14).
    b. From Basilone Road upstream to the access road to Range 219 (Appendix A, Fig. 13).

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. 14).
    b. From San Mateo Road upstream to the Base boundary (Appendix A, Fig. 14, Fig. 15).

19. Cristianitos Creek, between the confluence with San Mateo Creek and the Base boundary (Appendix A, Fig. 14).

20. Talega Canyon, between the confluence with Cristianitos Creek and a point approximately 6.5 km upstream (Appendix A, Fig. 14).

21. Pilgrim Creek:

a. Between the southern Base boundary and Vandegrift Boulevard, including the two side drainages east of Pilgrim Creek (Appendix A, Fig. 16).
b. From Vandegrift Boulevard upstream to the limit of riparian habitat (Appendix A, Fig. 16).

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. 16).

23. Ysidora Basin to Windmill Canyon, between Upper Ysidora Basin and Windmill Canyon/ Pueblitos Canyon (Appendix A, Fig. 16).

24. De Luz Homes Habitat, patches of habitat adjacent to the De Luz Homes development (Appendix A, Fig. 16).

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, and Pilgrim Creek (21a). Sites surveyed three times were: Fallbrook Creek (4b), Basilone and Roblar Roads, 22 Area, Pueblitos Canyon, Tuley Canyon, Newton Canyon, French Creek, Hidden Canyon, Horno Canyon, Piedra de Lumbre Canyon, San Onofre Creek (17b), San Mateo Creek (18b), Talega Canyon, Pilgrim Creek (21b), Windmill Canyon, Ysidora Basin to Windmill Canyon, and De Luz Homes habitat. The upper portion of the Santa Margarita River (1b) was surveyed twice for vireos. Because of range access restrictions, Roblar Canyon was surveyed only twice in 2012.

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 2012 to determine whether giant reed removal influenced vireo productivity. Nest monitoring was limited in 2012 because we were unable to begin field work until 10 May as a result of contractual delays. Because of the late start, we likely missed first nesting attempts for many pairs and therefore did not run breeding productivity analyses comparing Removal and Reference sites that involved annual pair productivity (number of nests/fledglings per pair) or first nest initiation. However, we were able to determine if many pairs had successfully produced young in 2012 by noting the presence of dependent fledglings. For the nests that were active during the dates we could monitor, we were able to collect summary information on clutch size, hatching rate, fledging rate, nest success, minimum number of fledglings per pair, nest placement, predation rate, and cowbird parasitism rate.

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

Finally, we compiled annual density within the Removal and Reference sites by delineating the boundary surrounding all monitored nests at each Removal and Reference site (Fig. 2), then counting the number of vireo territories that occurred within those boundaries each year from 1997 through 2012. 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.

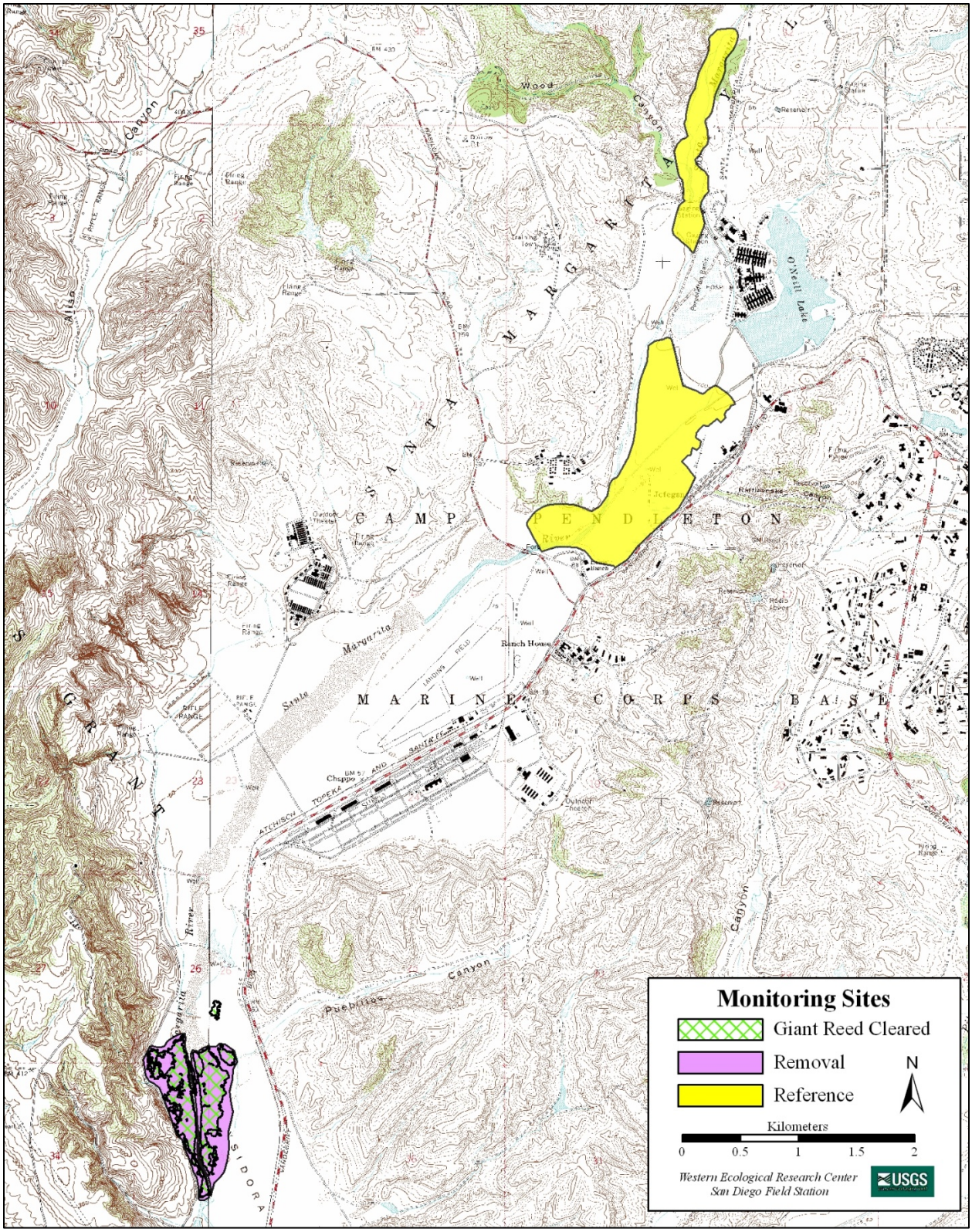

Fig. 2. Location of Least Bell's Vireo nest monitoring areas at Marine Corps Base Camp Pendleton, 2012.

We monitored vireo nesting activity at 22 territories in Removal sites and 25 territories in Reference sites between 10 May and 26 July 2012. 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 seventh day of incubation to minimize the possibility of nest abandonment in response to the removal. Cowbird eggs are removed from nests containing three or more vireo eggs as they are found. Cowbird nestlings are removed immediately from nests.

Banding

The primary goals of banding Least Bell's Vireos on MCBCP were (1) 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 left leg. Adult vireos within Removal and Reference sites were captured in mist nets and banded with a unique combination of colored plastic and anodized metal bands, including either an anodized gold or orange plastic band to designate MCBCP as the bird's site of origin. Returning adults previously banded as nestlings with a single numbered federal band were target netted to determine their identity, and their original band was supplemented with other bands to generate 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 2011-2012 was calculated for known individuals that were: (1) adults in 2011 on Base and were resighted anywhere on Base in 2012; (2) adult vireos that held territories in Removal or Reference sites in 2011 and were resighted anywhere on Base in 2012; (3) first-year vireos that were banded as nestlings or juveniles anywhere on Base in 2011 and were resighted anywhere in 2012 (including off Base); and (4) first-year vireos that were banded as nestlings or juveniles in Removal or Reference sites in 2011 and were resighted anywhere in 2012. 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 2011 and the center of the same vireo's breeding territory in 2012. Vireos exhibited site fidelity if they returned to within 100 m of their 2011 territory. Site fidelity and movement were calculated for the same four categories analyzed for survivorship (see above), except that only individuals with known territory locations during the last year they were detected prior to 2012 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, 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. We used Pearson's correlation to investigate the association between annual population size and prior years' breeding productivity and survivorship. 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, and 2011 used in comparisons with current data can be found in Rourke and Kus 2006a, 2007a, 2008, and Lynn and Kus 2009, 2010a, 2010b, and 2011. 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 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 676 male Least Bell's Vireos were identified during Base-wide surveys (Table 1; Appendix B, Figs. 17-37). This included 636 territorial male vireos, 69% of which were confirmed as paired, and 40 transients. Transient vireos were observed on 12 of the 23 (52%) drainages/sites surveyed. Ninety-three percent of all vireo territories occurred on the seven most populated drainages/sites (Santa Margarita River, Las Flores Creek, San Onofre Creek, San Mateo Creek, De Luz Creek, Pilgrim Creek, and Cristianitos Creek), and the majority of vireo territories (60%) occurred along the Santa Margarita River, the largest expanse of riparian vegetation on Base (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 2012 shifted only slightly compared to that in 2011 (Table 2). Three of the four drainages without vireos in 2011 continued to have no vireo territories in 2012, while the fourth (Cockleburr Canyon) gained one territory. No drainages that had territories in 2011 lost all of their vireo territories in 2012. The four most heavily populated drainages on MCBCP contained 86% of all vireo territories in 2011 and 84% of all territories in 2012. In 2012, the vireo population increased in 17% of drainages surveyed (4/23). Thirteen drainages (57%) showed no change or decreased by two or fewer territories between 2011 and 2012 and six drainages (26%) decreased by 3-85 territories. The drainages with the largest numeric increases in vireo territories were Basilone and Roblar Roads and Piedra de Lumbre Canyon, increasing by two territories each (100% and 67%, respectively). The site with the largest numeric loss in vireo numbers was the Santa Margarita River, losing 85 territories (18%). Overall, the vireo population on Base decreased by 19% from 2011 to 2012 (Fig. 3).

Table 1. Number and distribution of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2012.

Drainage/Survey Site	Known Pairs	Single/ Status Undetermined	Transient	Total Territories
Santa Margarita River:				
I-5 to De Luz Creek	249	91	16	340
De Luz Creek to Base Boundary	16	17	0	33
22 Area	6	3	0	9
De Luz Creek	22	6	1	28
Roblar Creek	1	0	0	1
Lake O'Neill/Fallbrook Creek	4	1	2	5
Basilone-Roblar Roads	2	2	2	4
Pueblitos Canyon	0	0	0	0
Newton Canyon	3	1	1	4
Cockleburr Creek	0	1	0	1
French Canyon	1	1	0	2
Aliso Creek	4	4	3	8
Hidden Canyon	2	1	0	3
Las Flores Creek:				
Pacific Ocean to Stuart Mesa Road	0	2	0	2
Stuart Mesa Road to Power Lines	28	1	1	29
Power Lines to Zulu Impact Area	21	9	2	30
Piedra de Lumbre Canyon	3	2	3	5
Horno Canyon	1	0	1	1
San Onofre Creek:				
Pacific Ocean to Basilone Road	21	18	1	39
Basilone Road to Access Road to Range 219	3	4	2	7
San Mateo Creek				
Pacific Ocean to San Mateo Road	31	10	0	41
San Mateo Road to Yankee Training Area	2	2	0	4
Cristianitos Creek	4	6	4	10
Talega Canyon	0	0	0	0
Tuley Canyon	0	0	0	0
Pilgrim Creek:				
Base Boundary upstream to Vandegrift Boulevard	5	7	0	12
Vandegrift Boulevard to upstream riparian limit	2	6	0	8
Windmill Canyon	2	4	0	6
Ysidora Basin to Windmill Canyon	1	0	1	1
De Luz Homes	3	0	0	3
Total	437	199	40	636

Table 2. Number of territorial male Least Bell's Vireos at Marine Corps Base Camp Pendleton, by drainage, 2004-2012. Numeric change is the positive or negative change in the number of vireo territories between 2011 and 2012.

	Number of Territorial Males									Numeric Change
Drainage	**2004**[a]	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	
Santa Margarita River[b]	440	472	417	423	463	599	678	467	382	-85
De Luz Creek	26	18	25	24	25	39	34	27	28	1
Roblar Creek	1	0	0	0	0	2	1	1	1	0
Lake O'Neill/Fallbrook Creek	16	20	10	9	11	11	15	6	5	-1
Basilone-Roblar Roads	-	2	0	0	0	5	4	2	4	2
Pueblitos Canyon	3	5	3	2	2	1	0	0	0	0
Newton Canyon	9	8	8	5	4	6	7	6	4	-2
Cockleburr Creek	0	2	2	2	1	2	0	0	1	1
French Canyon	5	6	4	2	2	2	2	2	2	0
Aliso Creek	21	21	11	9	11	21	16	9	8	-1
Hidden Canyon	5	8	5	4	4	2	4	3	3	0
Las Flores Creek	84	85	76	81	70	107	124	92	61	-31
Piedra de Lumbre Canyon	5	8	9	6	3	5	6	3	5	2
Horno Canyon	0	1	0	0	0	1	1	4	1	-3
San Onofre Creek	56	52	43	44	41	62	54	57	46	-11
San Mateo Creek	68	56	59	46	53	83	71	56	45	-11
Cristianitos Creek	8	6	8	8	4	13	10	11	10	-1
Talega Canyon	0	1	0	0	0	1	0	0	0	0
Tuley Canyon	2	-	0	0	0	0	0	0	0	0
Pilgrim Creek	37	36	23	26	26	27	24	25	20	-5
Windmill Canyon	20	12	7	8	12	13	10	7	6	-1
Ysidora Basin to Windmill Canyon	8	4	6	5	4	5	2	1	1	0
De Luz Homes	5	4	2	3	2	6	5	5	3	-2
Total	819	827	718	707	738	1,013	1,068	784	636	-148

[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.

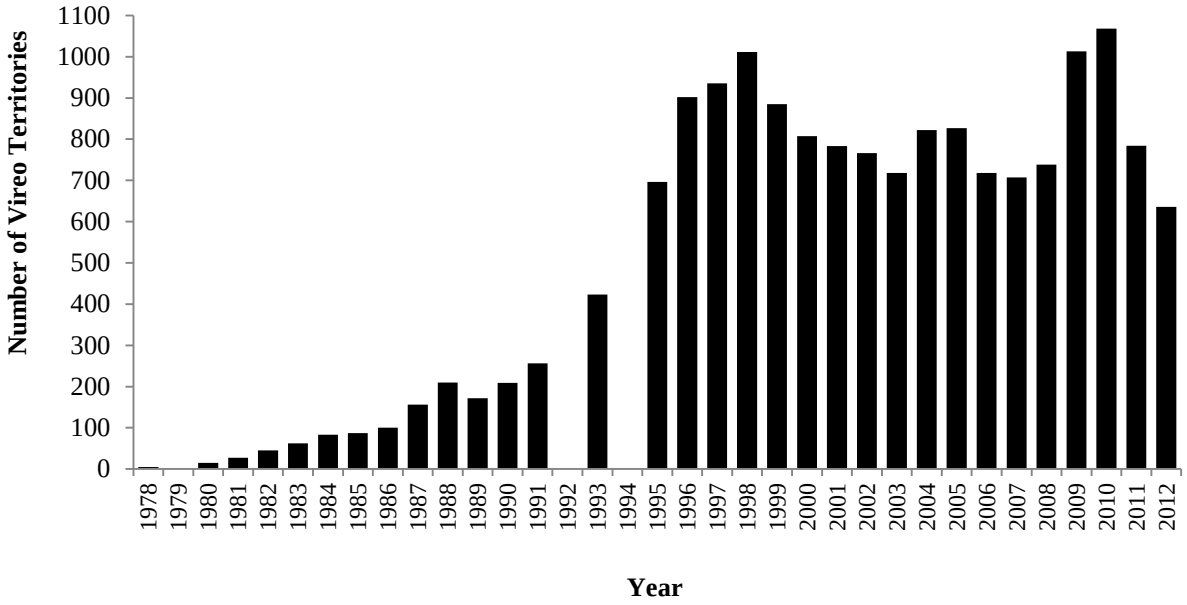

Fig. 3. Number of Least Bell's Vireo territories at Marine Corps Base Camp Pendleton, 1978–2012.

Because we were not able to begin surveys on MCBCP until mid-May, we could not determine the arrival dates of Least Bell's Vireos on Base in 2012.

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 79% of males in the study area found in this habitat. An additional 6% 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. Two percent of the vireos used drier habitats characterized by a mix of sycamore and oaks. Approximately 1% of vireo territories occurred in habitat consisting exclusively of non-native vegetation.

Table 3. Habitat types used by Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2012.

	Number of Territories			
Habitat Type	**>50% Native**	**>50% Exotic**	**Total**	**Percent of Total**
Mixed Willow	479	25	504	79%
Riparian Scrub	64	12	76	12%
Willow/Sycamore	37	1	38	6%
Oak/Sycamore	12	1	13	2%
Non-native	0	4	4	1%
Willow/Cottonwood	1	0	1	<1%
Total	593	43	636	100%

A smaller proportion of vireo territories were documented in exotic vegetation in 2012 than in 2011 (Table 4). Seven percent (43/636) of vireo territories in 2012 and 12% in 2011 were in areas where exotic species such as giant reed, poison hemlock (*Conium maculatum*), black mustard (*Brassica nigra*), and salt cedar comprised at least 50% of the habitat. The same number of drainages (nine) contained territories dominated by non-native vegetation in 2012 as in 2011, although eight of the drainages changed: Cristianitos Creek, San Onofre Creek, Pilgrim Creek, and San Mateo Creek had territories dominated by non-native vegetation in 2011 but not in 2012, and French Canyon, Aliso Creek, Basilone and Roblar Roads, and De Luz Creek had no territories dominated by non-native vegetation in 2011 but did 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, 2005-2012. Numbers in parentheses are the number of territories on the drainage.

	Proportion of Territories															
Drainage	**2005**		**2006**		**2007**		**2008**		**2009**		**2010**		**2011**		**2012**	
French Canyon	0	(6)	0	(4)	0	(2)	0	(2)	0	(2)	0	(2)	0	(2)	0.50	(2)
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)
Aliso Creek	0.05	(21)	0	(11)	0.11	(9)	0	(11)	0	(21)	0.06	(16)	0	(9)	0.25	(8)
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)
Piedra de Lumbre Canyon	1	(8)	0	(9)	0	(6)	0.67	(3)	0.20	(5)	0	(6)	0.33	(3)	0.20	(5)
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)
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)
De Luz Creek	0.06	(18)	0.04	(25)	0	(24)	0	(25)	0	(39)	0	(34)	0	(28)	0.04	(28)
Cristianitos Creek	0.5	(6)	0.13	(8)	0.25	(8)	0	(4)	0.08	(13)	0.10	(10)	0.09	(11)	0	(10)
San Onofre Creek	0.23	(52)	0	(43)	0	(44)	0.13	(41)	0.21	(62)	0.11	(54)	0.07	(57)	0	(46)
Pilgrim Creek	0	(36)	0	(23)	0	(26)	0	(26)	0.15	(27)	0.04	(24)	0.04	(25)	0	(20)
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)
Lake O'Neill/ Fallbrook Creek	0.15	(20)	0	(10)	0.11	(9)	0	(11)	0	(11)	0	(15)	0	(6)	0	(5)
De Luz Homes	0	(4)	0	(2)	0	(3)	0	(2)	0	(6)	0	(5)	0	(5)	0	(3)
Horno Canyon	1	(1)	-	-	-	-	-	-	0	(1)	0	(1)	0	(4)	0	(1)
Hidden Canyon	0	(8)	0	(5)	0	(4)	0	(4)	0.50	(2)	0	(4)	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)
Roblar Creek	-	-	-	-	-	-	-	-	0	(2)	0	(1)	0	(1)	0	(1)
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)

[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 838 adult Least Bell's Vireos (621 males, 92% of all males, and 217 females, 49% of all females) on Base well enough to determine banding status in 2012, although not all banded vireos were observed well enough to conclusively identify the individual. Seventy-four of these had been banded prior to the 2012 breeding season, 14 of which we could not identify because band combinations were not confirmed (four) or because the vireos were banded with only a single numbered metal federal band as nestlings and not recaptured ("natal"; ten total; Table 5). Therefore, we were able to identify 60 vireos on Base that were banded with unique color band combinations in 2012 (Table 5, Appendix C). Of these, 49 vireos had been banded on Base and 11 vireos were originally banded off Base (ten on the San Luis Rey River; Ferree and Kus 2008a, 2008b, Ferree et al. 2010a, Ferree et al. 2011, USGS unpubl. data; and one on MCAS; Lynn and Kus 2010c; Table 6). Adult birds of known age ranged from 1-8 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 2012.

	Detected on Base[a]		Total on	Emigrants		
Banding Status	Male	Female	Base	Male	Female	Total
Uniquely banded prior to 2012	45	6	51	-	-	51
Natal[b] recaptured in 2012	6	3	9	-	1	10
Subtotal of known identity vireos	51	9	60	0	1	61
Unidentified (Partial resights)	3	1	4	-	-	4
Natal[b], not recaptured	4	6	10	-	-	10
Grand total	58	16	74	0	1	75

[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 2012, by original year banded, age, original banding location, and sex.

Year Originally Banded	Age in 2012	Number of Vireos Observed by Origin: Marine Corps Base Camp Pendleton Male	Marine Corps Base Camp Pendleton Female	San Luis Rey River Male	San Luis Rey River Female	Marine Corps Air Station, Camp Pendleton Female	Total[b]
2005	≥ 8 yrs.	2	0	0	0	0	2
2007	≥ 6 yrs.	2	0	0	0	0	2
	5 yrs.	0	2	2	1	0	5
2008	≥ 5 yrs.	4	0	0	0	0	4
	4 yrs.	4	2	1	0	0	7
2009	≥ 4 yrs.	2	2	0	0	0	4
	3 yrs.	2	0	1	0	0	3
2010	≥ 4 yrs.	1	0	0	0	0	1
	≥ 3 yrs.	9	1	0	0	0	10
	≥ 2 yrs.	1	0	0	0	0	1
	2 yrs.	4	0	0	0	1	5
2011	≥ 2 yrs.	9	0	2	0	0	11
	1 yr.	2	0	3	0	0	5
Subtotal		42	7	9	1	1	60
Unknown[a]	≥ 1 yr.	2	5	2	1	0	10
Total		44	12	11	2	1	70

[a] Natal vireos banded with single numbered metal federal band or identity unknown because of inadequate resight, so natal year is not known.
[b] Does not include four unidentified banded vireos for which origin could not be determined.

Ten natal vireos (four males and six females) were resighted on Base in 2012 (Table 5). Two males and one female were banded as nestlings off Base on the San Luis Rey River and the remaining seven were banded as nestlings on Base or at MCAS. Efforts to recapture and identify these vireos were unsuccessful.

One vireo that was originally banded on Base (with gold numbered metal federal bands) was detected off Base in San Diego County for the first time in 2012 (Table 5). This was a three-year-old female that was recaptured on the San Luis Rey River near Bonsall (Houston and Kus 2012).

New Banded Birds

A total of 125 Least Bell's Vireos were captured and banded for the first time during 2012 (Table 7). These included 26 adult vireos caught for the first time and banded with a unique color combination, 98 hatch-year birds (96 of which were banded as nestlings with a single gold numbered federal band and 2 of which were incidentally caught while attempting to target net an adult vireo and given unique color combinations), and one vireo of unknown age that was caught and given a unique color combination. 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 2012.

Age Banded	Males	Females	Unknown Sex	Total
Adult	23	2	1	26
Unknown Age	0	0	1	1
Juvenile			2[a]	2
Nestling			96	96
Total	23	2	100	125

[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 2012. 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 2011-2012

Of 74 uniquely color banded adult vireos present on Base during the 2011 breeding season, 38% (28/74) returned in 2012 (Table 8). Twenty-five additional adult vireos (24 on Base and 1 at the San Luis Rey River) identified in 2012 but not detected on Base in 2011 were added to the calculations to yield an adjusted annual survivorship of 54% (53/99; Table 8).

Forty-four of the 88 adult male vireos known to be alive in 2011 were resighted in 2012, an over-winter survivorship rate of 50%. Nine of the 11 adult female vireos known to be alive in 2011 were resighted in 2012, an over-winter survivorship rate of 82%. The remaining 44 males and 2 females were not resighted in 2012.

Table 8. Number of banded adult Least Bell's Vireos detected in 2011 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 2012. Numbers in parentheses include the adjustments resulting from vireos that were identified in 2012 but not in 2011.

Year/Sex	Removal Sites	Reference Sites	Other Areas	Total
2011				
Male	14	18	40	72 (88)
Female	0	1	1	2 (11)
Total	14	19	41	74 (99)
2012				
Male	6[a]	10[b]	12	28 (44)
Female	0	0	0	0 (9)
Total	6	10	12	28 (53)

[a] All occupied territories at Removal sites in 2011.
[b] All occupied territories at Reference sites in 2011.

First-year Survivorship from 2011-2012

Of the 20 hatch-year vireos banded in 2011 that survived to fledge, two (both males) were resighted with or captured and given unique color band combinations on Base in 2012 (Table 9). This yields a conservative first-year survivorship of 10% (2/20) (Table 9, Table 10). Assuming an equal sex ratio of banded nestlings, first-year survivorship of males was 20% (2/10) and females was 0%.

Table 9. Number of Least Bell's Vireos banded as nestlings or fledglings at old giant reed (*Arundo donax*) Removal sites, Reference sites, and other areas on Marine Corps Base Camp Pendleton in 2011, and where those that returned were detected in 2012.

Year/Sex	Removal Sites	Reference Sites	Other Areas	Total
2011				
Unknown	11	8[a]	1[b]	20
2012				
Male	1[c]	0	1[d]	2

[a] Two banded as juveniles, could not be certain of their origin.
[b] Banded as a juvenile, could not be certain of its origin.
[c] Banded as a nestling at a Removal site.
[d] One of the two juveniles with uncertain origin banded at a Reference site in 2011 and detected along the Santa Margarita River outside of the monitoring areas in 2012.

Adjusted Annual Survivorship

Twenty-five adult banded vireos (16 males and 9 females) that were detected in 2012 were not observed in 2011 (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, 2012. These numbers update survivorship estimates presented in Rourke and Kus 2007a, 2008, Lynn and Kus 2009, 2010a, 2010b, and 2011.

	First-year Survivorship			Adult Survivorship		
Years	Original	Last Year	New	Original	Last Year	New
2005-2006	10%	16%	-	30%	41%	-
2006-2007	10%	26%	-	63%	75%	-
2007-2008	12%	22%	23%	49%	62%	-
2008-2009	10%	14%	14%	53%	58%	60%
2009-2010	7%	-	9%	50%	52%	54%
2010-2011	5%	-	11%	27%	-	34%
2011-2012	-	-	10%	-	-	54%

Survivorship at Removal and References Sites

Of the 14 banded adult vireos of known sex (all males) that were detected within Removal sites in 2011, six were resighted in 2012 for a 43% survival rate (Table 8 and Appendix D). Of the 19 banded adult vireos of known sex (18 males and 1 female) that were detected within Reference sites in 2011, ten (all males) were resighted in 2012 for a 53% survival rate (56% for males and 0% for females). No vireos moved between Removal or Reference sites between 2011 and 2012. Over-winter survival rate did not differ between Removal and Reference sites ($\chi^2 = 0.31$, $P = 0.58$).

Nineteen of the 20 banded juveniles that were known to fledge in 2011 were banded on a Removal or Reference site. Of these, one was recaptured on MCBCP and given a unique color band combination in 2012 for an overall first-year survival rate of 5% for fledglings from Removal sites and 0% for fledglings from Reference sites (Table 9). One other juvenile that was captured and banded at a Reference site in 2011 was redetected in 2012. 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). Twenty-eight adult vireos that were identified in 2011 were resighted in 2012, all of which occupied known territories both years. The majority of returning adult vireos showed strong between-year site fidelity. Of the 28 returning adults, 23 (82%) occupied a breeding site in 2012 that they had defended in 2011 (within 100 m). Five additional vireos (18%) returned to sites adjacent to their previous territories (within 300 m). The average distance moved by returning adult vireos was 0.1 ± 0.0 km (standard deviation [SD]). Two additional adult male vireos moved from 2011 breeding territories along the San Luis Rey River to their 2012 breeding territories along the Santa Margarita River, an average distance of 6.0 ± 1.0 km (SD).

One first-year vireo that was banded as a nestling in 2011 on MCBCP was resighted in 2012 and occupied a known territory. One additional vireo was excluded from analysis because it was originally captured as a juvenile in 2011 and therefore could not be associated with an exact natal territory. The vireo that returned to MCBCP dispersed 2.3 km from his 2011 natal site (Table 11). Three other first-year vireos that were originally banded as nestlings along the San Luis Rey River in 2011 dispersed an average 11.6 ± 11.9 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 2011 and detected in 2012.

Year Last Detected	Drainage / Territory / Treatment[a]		Dispersal Distance (km)	Band Combination[b]		Sex[c]
	2011	2012		Left Leg	Right Leg	
2011	SMR / MIN / REM	SMR / RR26	2.3	WHWH	BKBK/Mgo	M
2011	SMR / HDX / REF[d]	SMR / WSP / REF	0.5	ORPU	ORPU/Mgo	M
2011	SLR / FO17[e]	SMR / YB05	4.5	WHWH	DBWH/Mdb	M
2011	SLR / CBUT[e]	SMR / YB04	4.9	WHWH	BYST/Mdb	M
2011	SLR / WH25[e]	SOF / OE16	25.4	WHWH	DPDB/Mdb	M

[a] Drainage Codes: SLR = San Luis Rey River; SMR = Santa Margarita River; SOF = San Onofre Creek. Treatment Codes: REF = Reference; REM = Removal.
[b] Band colors: Mdb = dark blue numbered federal band; Mgo = gold numbered federal band; BKBK = plastic black; BYST = plastic black-yellow striped; DBWH = plastic dark blue-white split; DPDB = plastic dark pink-dark blue split; ORPU = plastic orange-purple split; WHWH = plastic white.
[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 San Luis Rey River.

Site Fidelity and Movement – Removal and Reference Sites

Fidelity to Removal and Reference sites was the same, as 100% (7/7) of adult vireos from Removal sites and 100% (10/10) of adult vireos from territories at Reference sites returned to the same treatment type they had defended in 2011 (Appendix D).

One vireo detected in 2012 fledged from a Removal site in 2011 and dispersed 2.3 km out of the Removal site to a territory outside of our monitoring areas but within the Santa Margarita River drainage. No first-year females were detected in 2012.

Movement between breeding and wintering areas

One banded vireo, a female that was originally banded as a nestling at a Reference site in 2008, was detected on the San Jose River in Baja California Sur, Mexico, in February 2012 where she was captured and given a full color band combination (USGS unpubl. data). In April 2012, she was redetected on MCBCP. This female moved approximately 1,340 km between her breeding area and her wintering area.

Nest Monitoring

Nesting activity was monitored in a total of 47 territories within the Removal and Reference monitoring areas (Table 12, Figs. 4-7, Appendix E). All 47 territories were considered "partially monitored" because monitoring did not begin until 10 May; therefore, nests that failed or fledged before 10 May were not found and monitored. Forty-five of these territories were known to be occupied by pairs; only single males were detected at the remaining two territories (both in Reference sites), although these territories may have been occupied by pairs prior to the initiation of our monitoring effort. Therefore, these two territories were excluded from breeding analyses. A total of 68 nests were monitored during the breeding season; 5 of these were not completed (three coded as "INC" and two coded as "FAL" in Appendix E) and have been excluded from calculations of nest success and productivity. Nesting activity was monitored at the remaining 63 nests. Completed nests were found in 42 of the 45 monitored territories with pairs.

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, 2012.

	Nest Monitoring Area Type	
	Removal	**Reference**
Territories monitored	22	23
Nests in monitored territories (# complete)	33 (31)	35 (32)
Completed nests per pair[a]	1.4 ± 0.9 (SD)	1.5 ± 0.9 (SD)

[a] This is a minimum because it does not include nests that were missed as a result of delayed commencement of monitoring activities.

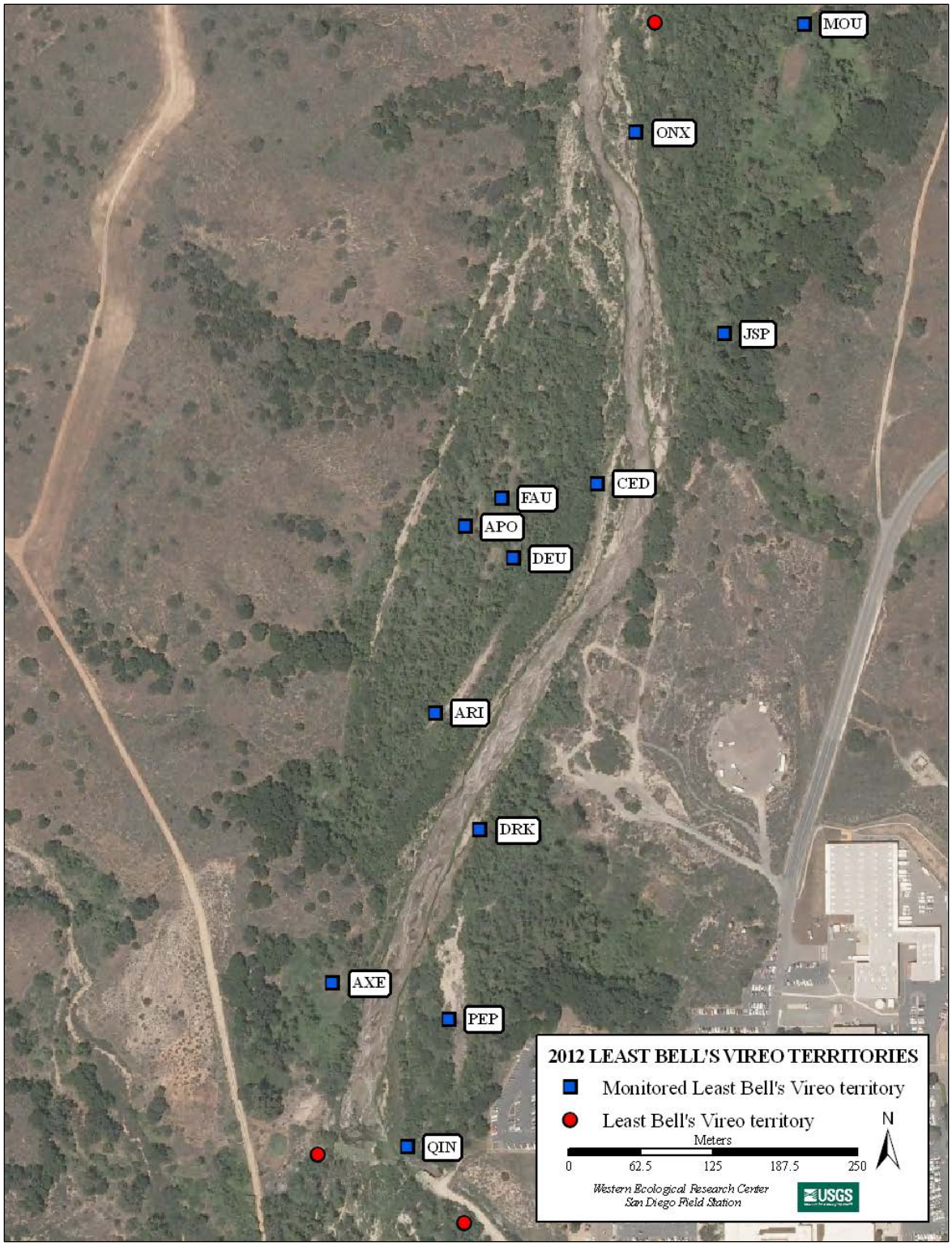

Fig. 4. Locations of monitored Least Bell's Vireo territories at the Above Hospital Reference site, Marine Corps Base Camp Pendleton, 2012.

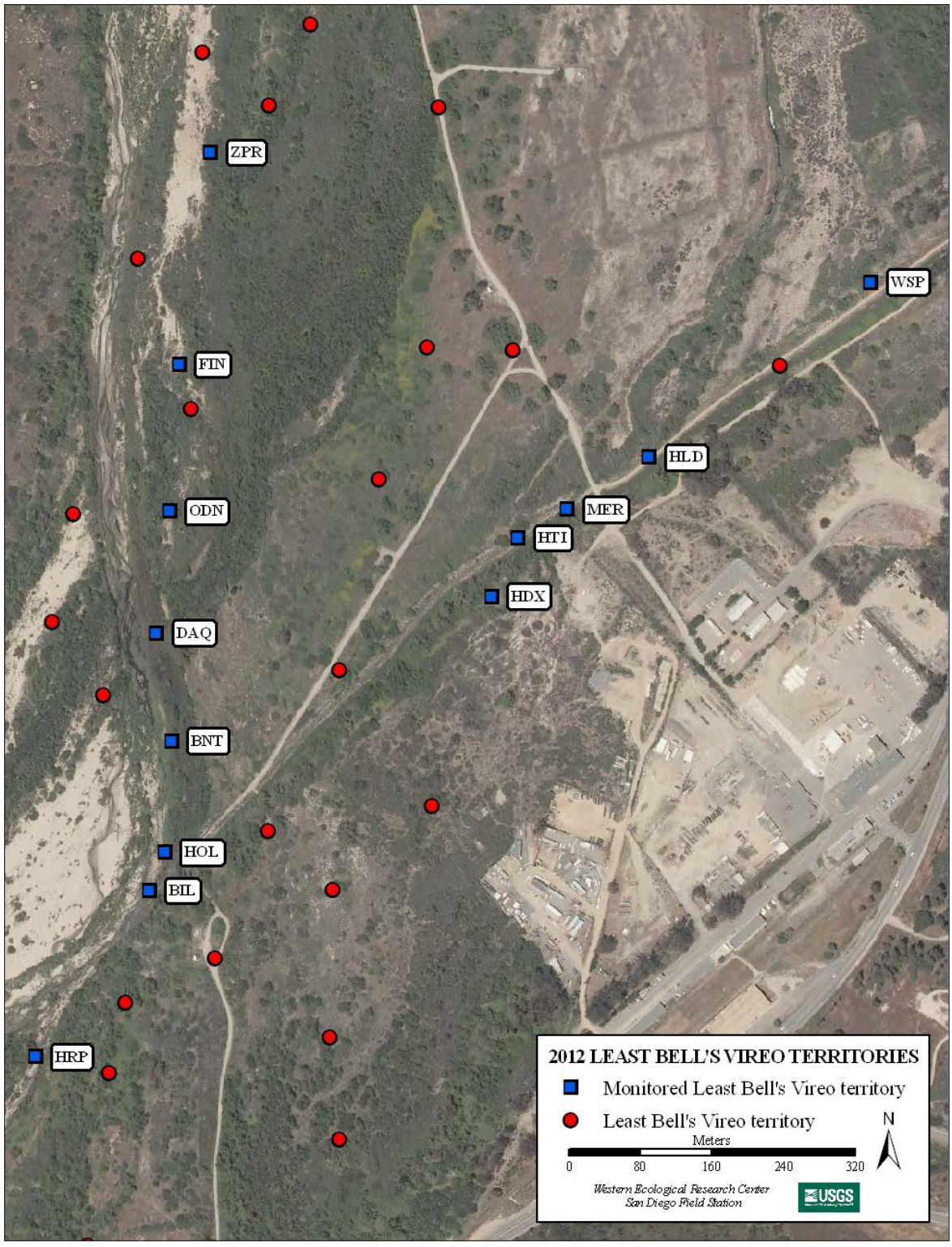

Fig. 5. Locations of monitored Least Bell's Vireo territories at the Below Hospital Reference site, Marine Corps Base Camp Pendleton, 2012.

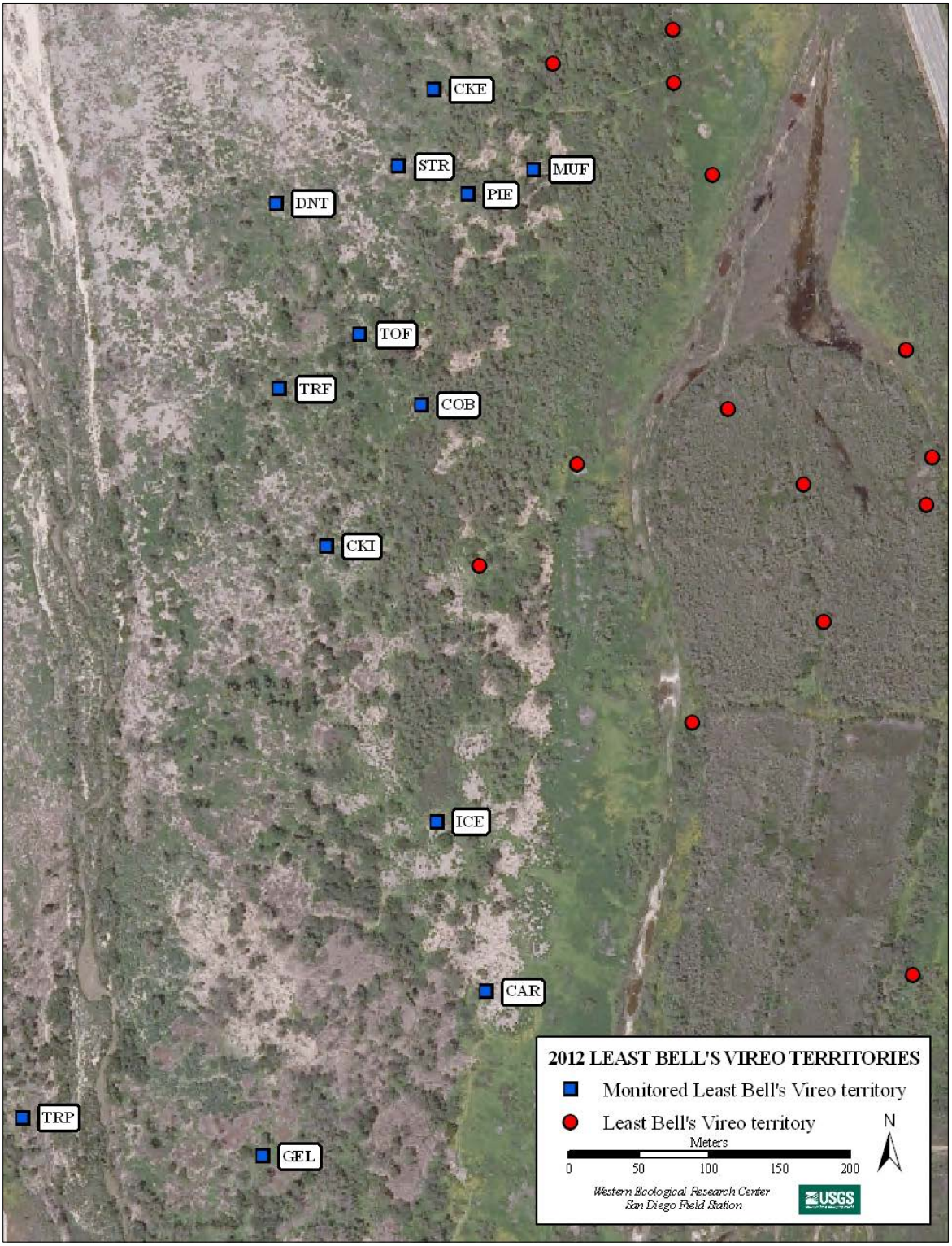

Fig. 6. Locations of monitored Least Bell's Vireo territories at the Bell giant reed (*Arundo donax*) Removal site, Marine Corps Base Camp Pendleton, 2012.

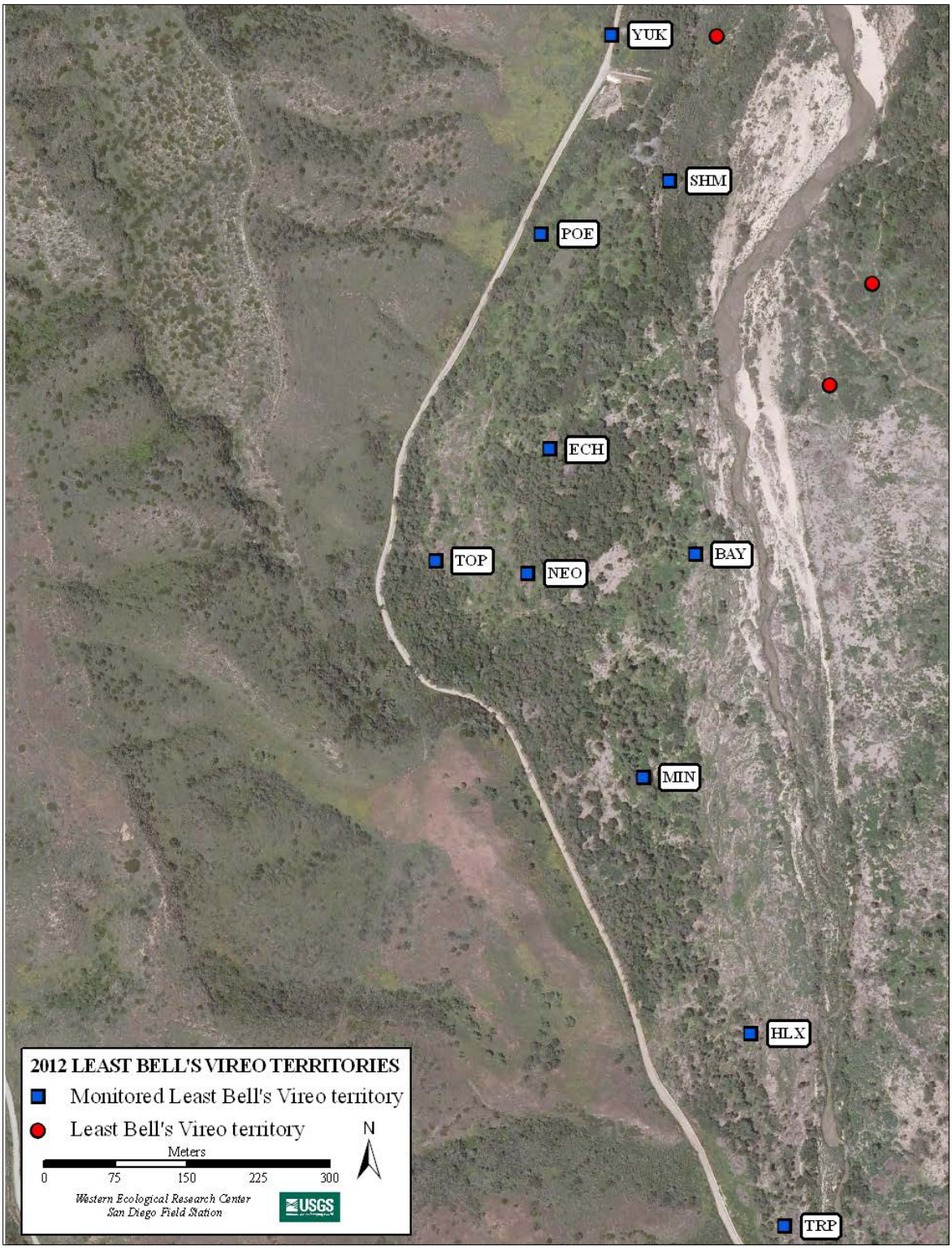

Fig. 7. Locations of monitored Least Bell's Vireo territories at the Pump Road giant reed (*Arundo donax*) Removal site, Marine Corps Base Camp Pendleton, 2012.

Nesting Attempts

Pairs at Reference sites had the same number of nesting attempts as pairs at Removal sites over the course of the 2012 breeding season (Table 12; $t = 0.08$, $P = 0.94$). Pairs at Removal sites were as likely to re-nest after their initial attempt as were pairs at Reference sites ($\chi^2 = 0.09$; $P = 0.77$), as 50% of Removal pairs and 45% of Reference pairs initiated a second attempt. Incidence of re-nesting after a failed first nesting attempt did not differ between Removal sites (75%; 6/8) and Reference sites (82%; 9/11; Fisher's Exact $P > 0.99$). Re-nesting rate after a successful first nesting attempt also did not differ between Removal sites (33%; 4/12) and Reference sites (9%; 1/11; Fisher's Exact $P = 0.32$). However, vireos were more likely to renest after a failed first nesting attempt than after a successful first nesting attempt (Fisher's Exact $P < 0.001$). Overall, 79% (15/19) of vireo pairs attempted to re-nest after a failed first nesting attempt in 2012, slightly less than the proportion that attempted to re-nest after a failed first nesting attempt in previous years (Fig. 8). The rate of re-nesting attempts following a successful nesting attempt in 2012 (22%; 5/23) was lower than all previous years (Fig. 8). Two pairs at Removal sites and one pair at a Reference site attempted three or more nests in 2012, and one pair at a Removal site initiated four nesting attempts in 2012.

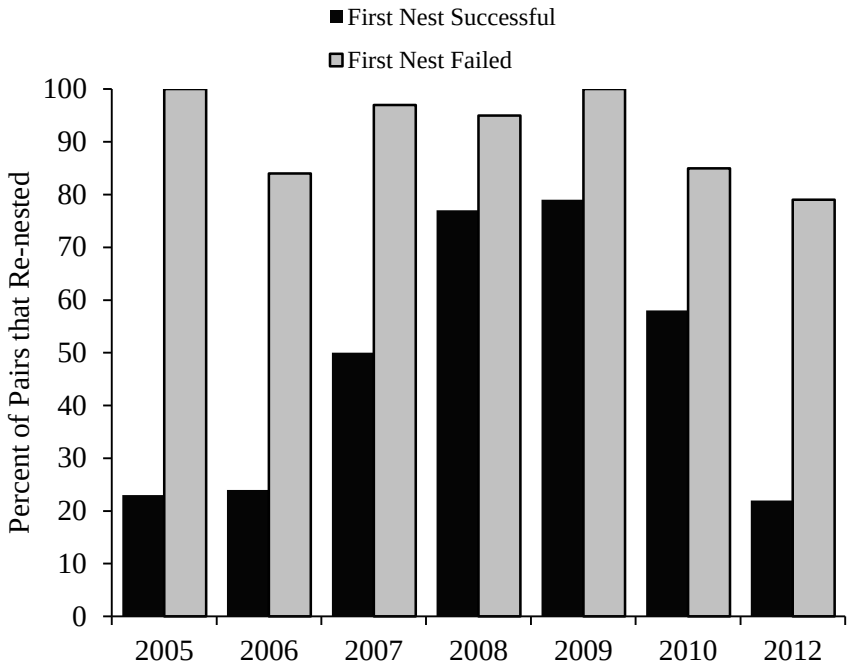

Fig. 8. Percent of Least Bell's Vireo pairs that re-nested after a successful or failed first nesting attempt on Marine Corps Base Camp Pendleton, 2005-2010 and 2012. Figures for 2012 are a minimum because they do not include early nests that were missed as a result of delayed commencement of monitoring activities.

Nest Success

Completed nests in Removal sites were more likely to be successful than completed nests in Reference sites ($\chi^2 = 2.73$, $P = 0.10$), as 65% (20/31) of nests in Removal sites successfully fledged young while 44% (14/32) of those in Reference sites successfully fledged young (Table 13). First detected nesting attempts were equally likely to be successful at Removal sites (60%) as at Reference sites (50%; $\chi^2 = 0.42$; $P = 0.52$) in 2012 (Fig. 9A). Overall, 55% of first detected nesting attempts were successful in 2012. Fate of the first detected nesting attempt differed significantly across years (2005 = 39%, 2006 = 40%, 2007 = 26%, 2008 = 61%, 2009 = 51%, 2010 = 41%; $\chi^2 = 15.1$, $P = 0.02$, df = 6; Fig. 9B), with 2012 showing the second highest success rate after 2008, although this may be inflated given that early nests that failed were likely missed as a result of delayed commencement of monitoring activities in 2012.

Table 13. Fate of Least Bell's Vireo nests in fully and partially monitored territories, Marine Corps Base Camp Pendleton, 2012. Numbers in parentheses are proportions of total nests.

	Number of Nests		
Nest Fate	**Removal**	**Reference**	**Total**
Successful	20	14	34 (0.54)
Failed			
Predation	9	13	22 (0.35)
Parasitism	0	0	0 (0.00)
Other/Unknown	2	5	7 (0.11)
Total Completed Nests	31	32	63 (1.00)

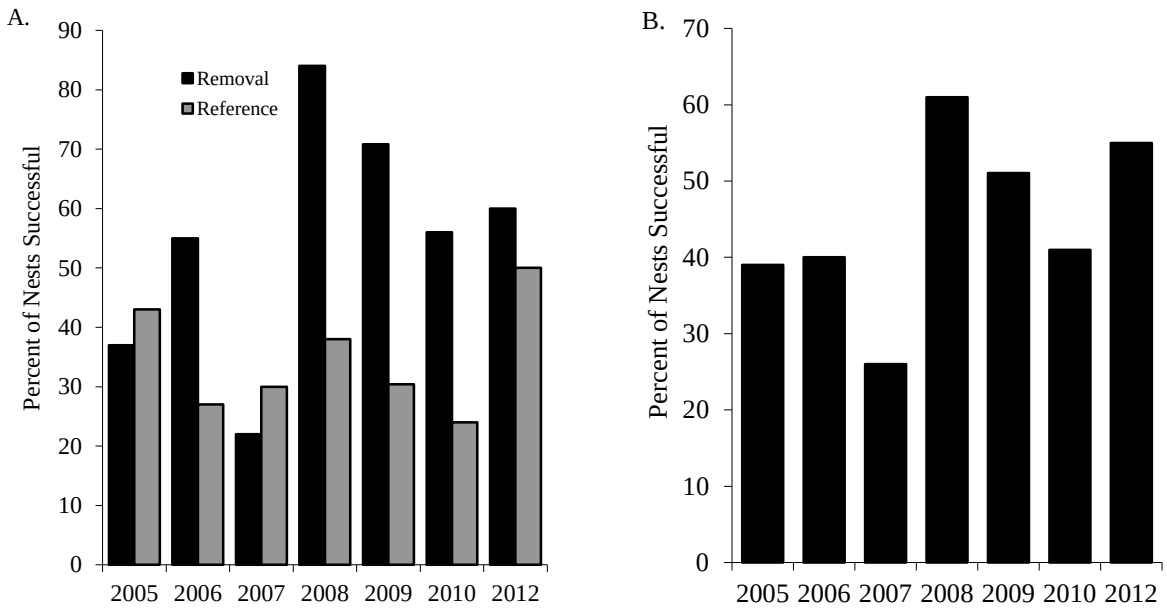

Fig. 9. Percent of successful Least Bell's Vireo nesting attempts (A) for first nests at Removal and Reference sites, and (B) for first nests overall, on Marine Corps Base Camp Pendleton, 2005-2010 and 2012. Figures for 2012 may be inflated because they do not include early nests that were missed as a result of delayed commencement of monitoring activities.

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 82% (9/11) of nest failures at Removal sites and 72% (13/18) of nest failures at Reference sites. We also documented seven nests that failed for other known and unknown reasons at our study sites. One nest at a Removal site failed because the branches supporting the nest broke. One nest with nestlings at a Removal site failed from unknown causes. Two nests at Reference sites failed between nest-building and egg-laying from unknown causes. In one Reference site nest, the single egg had been punctured, possibly by a bird. One nest at a Reference site was abandoned when the eggs failed to hatch. One nest with eggs at a Reference site failed from unknown causes. Overall, 35% and 56% 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 2012.

Productivity

Clutch size did not differ between Removal and Reference sites (Table 14). Measures of hatching and fledging success were similar between Removal and Reference sites. Overall productivity per pair was slightly higher at Removal sites than at Reference sites (2.3 vs. 1.8 young fledged per pair, respectively; Table 14), although these averages may not include early nests that were not detected. Eighty-five percent (17/20) of pairs at Removal sites and 64% (14/22) of pairs at Reference sites were ultimately successful in fledging young from at least one nest. Two pairs at Removal sites (10%) successfully double-brooded, fledging young from two nests during the 2012 breeding season. Overall, vireo pairs at monitored sites on MCBCP fledged 2.0 vireo young per pair, and 74% (31/42) of all monitored pairs were successful in fledging at least one young in 2012.

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, 2012.

Parameter	Removal Sites	Reference Sites	Total
Nests with eggs	31	30	61
Eggs laid	96	93	189
Average clutch size[a]	3.2 ± 0.6 (SD)	3.3 ± 0.5 (SD)	3.3 ± 0.6 (SD)
Hatchlings	59	59	118
Nests with hatchlings	25	19	44
Hatching success:			
Eggs[b]	61%	63%	62%
Nests[c]	81%	63%	72%
Fledglings	45	40	85
Nests with fledglings	20	14	34
Fledging success:			
Hatchlings[d]	76%	68%	72%
Nests[e]	80%	74%	77%
Fledglings per egg	0.5	0.4	0.4
Fledglings per nest	1.5	1.3	1.4
Average number of young fledged per pair[f]	2.3 ± 1.5 (SD)	1.8 ± 1.5 (SD)	2.0 ± 1.5 (SD)
Pairs fledging ≥ 1 young[f]	17 (85%)	14 (64%)	31 (74%)

[a] Based on 27 Removal and 25 Reference non-parasitized nests with a full clutch (t = -0.37; P = 0.71).
[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 20 Removal and 22 Reference pairs.

Nest Survival

Analysis of DSR showed that type of monitoring site (Removal or Reference) was not a good predictor of vireo nest survival (Table 15). Using AIC, the model including type of monitoring site was not better supported than the constant model and the analysis of odds ratios showed that the confidence interval for type of monitoring site included 1, which indicates that it was not a contributing factor to the model (Table 16).

Table 15. Logistic regression models for the effect of treatment on nest survival of Least Bell's Vireos in Reference and Removal sites on Marine Corps Base Camp Pendleton, 2012. Models are ranked from best to worst based on Akaike's Information Criteria for small samples (AIC_C), ΔAIC_C, and Akaike weights (w). AIC_C is based on -2 x $\log_e$ likelihood (L) and the number of parameters (K) in the model.

Model	Deviance	# Parameters	AIC_C	ΔAIC_C	AIC_C Weight
Constant + Treatment	175.55	2	179.56	0.00	0.60
Constant	178.33	1	180.33	0.78	0.40

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, 2012.

Effect	**β**	SE	Odds Ratio	95% CI
Treatment	0.64	0.39	1.89	0.88 – 4.03

Population Density

The density of the vireo population decreased in 2012 at Removal sites but remained stable at Reference sites (Fig. 10). However, vireo density at the Removal sites remained higher than before the removal of giant reed. Vireo density at the Reference sites remained low relative to the highest density recorded in 2009. In 2012, density at Reference sites was similar to density at Removal sites ($t = 1.16$, $P = 0.45$, 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.

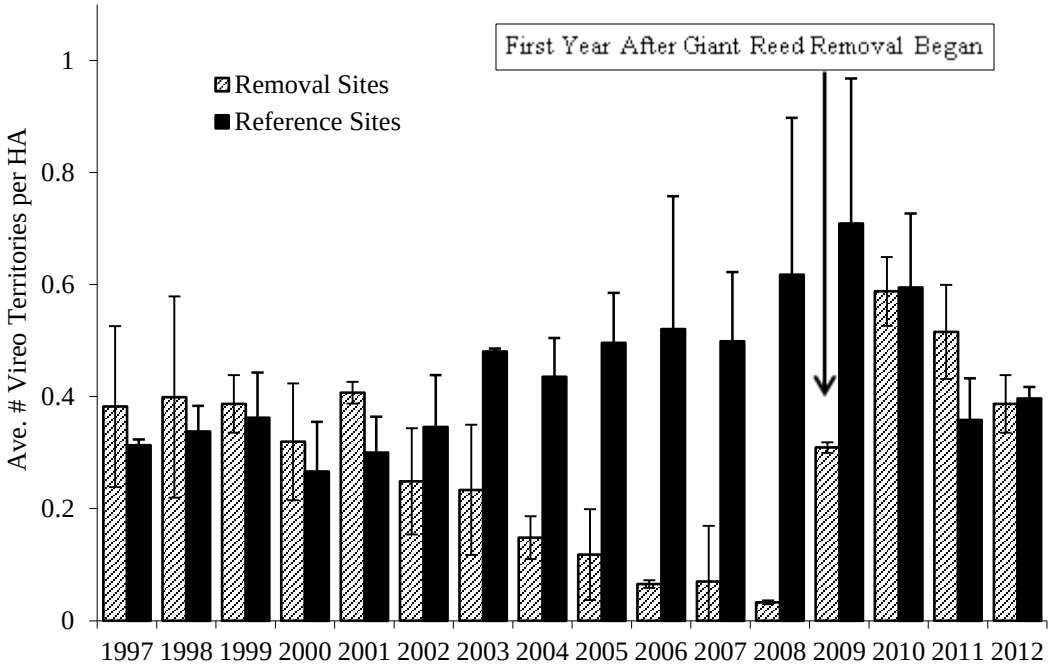

Fig. 10. Annual density of Least Bell's Vireo territories (± SD) at Reference and giant reed (*Arundo donax*) Removal sites by year, averaged across sites.

Nest Characteristics

Least Bell's Vireos used 12 plant species for nesting at Removal and Reference sites in 2012, although not all were used within each treatment (Table 17). Vireos used seven species at Removal sites and nine species at Reference sites. Seventy-one percent of all nests (67% at Removal sites and 74% at Reference sites) were placed in arroyo willow, sandbar willow, mule fat, or black willow. Eleven vireo nests were built in an exotic plant species (nine in poison hemlock and two in salt cedar).

In 2012, successful and unsuccessful nests within Removal and Reference sites were similar in placement except nests at Reference sites were placed further from the edge of the nest clump (closer to the center) than at Removal sites. Vireo nests at Removal sites were placed higher in the host plants and in taller host plants 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, 2012. Numbers in parentheses are proportions of total nests within treatment types.

	Number of Nests	
Host Species	**Removal**	**Reference**
Arroyo or red willow	16 (0.48)	15 (0.43)
Poison hemlock	7 (0.21)	2 (0.06)
Sandbar willow	2 (0.06)	7 (0.20)
Mule fat	3 (0.09)	4 (0.11)
Mexican elderberry (*Sambucus nigra*)	2 (0.06)	-
Wild grape (*Vitis spp.*)	-	2 (0.06)
Mugwort (*Artemisia douglasiana*)	-	2 (0.06)
Salt cedar (*Tamarix* sp.)	2 (0.06)	-
California blackberry (*Rubus ursinus*)	-	1 (0.03)
Coastal live oak (*Quercus agrifolia*)	-	1 (0.03)
California sycamore	-	1 (0.03)
Black willow	1 (0.03)	-

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, 2012.

	Nest Fate				
Nest Characteristic	**Successful**	**Unsuccessful**	***n*[a]**	***t*[b]**	***P*[c]**
Removal Site					
Average nest height (m)	1.12	1.09	(20, 13)	0.23	0.82
Average host height (m)	4.55	4.65	(20, 13)	-0.09	0.93
Average distance to edge of host (m)	0.84	0.99	(20, 13)	-0.57	0.57
Average distance to edge of clump (m)	2.01	2.52	(20, 13)	-0.12	0.91
Reference Site					
Average nest height (m)	0.69	0.78	(14, 21)	-0.94	0.36
Average host height (m)	2.69	3.90	(14, 20)	-1.58	0.12
Average distance to edge of host (m)	0.70	0.73	(14, 19)	-0.15	0.88
Average distance to edge of clump (m)	1.30	2.32	(14, 19)	-1.67	**0.10**
Overall	**Removal**	**Reference**	*n*[d]	***t*[b]**	***P*[c]**
Average nest height (m)	1.11	0.74	(33, 35)	-4.01	< **0.001**
Average host height (m)	4.59	3.40	(33, 34)	-1.80	**0.08**
Average distance to edge of host (m)	0.90	0.71	(33, 33)	-1.14	0.26
Average distance to edge of clump (m)	2.45	1.89	(33, 33)	-0.97	0.34

[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 2012, the number of documented Least Bell's Vireo territories (636) on MCBCP dropped by 19% from 2011. This is the second year that the MCBCP vireo population has decreased, and may represent a true decrease in the subspecies as a whole. A similar decrease in population from 2011 to 2012 was documented on the San Diego River (18%; Lynn and Kus 2012), on the lower San Luis Rey River (42%; Ferree et al. 2012), the middle San Luis Rey River (20%; Houston and Kus), and at MCAS (33%; Lynn et al. 2012). Vireo populations in all of these areas also decreased between 2010 and 2011.

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, and MCAS. The range-wide vireo population gradually increased through the 1980's and 1990's, reaching a peak in 2009-2010 before declining over the past 2-3 years (Ferree and Kus 2007, 2008a, 2008b, Ferree et al. 2010a, 2010b, 2011, 2012, Jones 1985; Kus 1988, 1989, 1991a, 1991b, 1994, 1995; Kus and Beck 1998; Peterson et al. 2002; Rourke and Kus 2006b, 2007b; Lynn and Kus 2008, Lynn et al. 2010a, USGS unpubl. data). 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.

As in past years, in 2012 we detected vireos that originated outside of MCBCP holding territories on drainages on MCBCP, as well as a vireo 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 addition to documenting movements between drainages within the breeding grounds, in February 2012, we found a vireo spending the winter in southern Baja California, Mexico. She was captured and identified as a nestling from one of the MCBCP Reference sites in 2008. This vireo returned to MCBCP in 2012 and was detected breeding with a male in the Santa Margarita River drainage, outside of our monitoring areas. Such inter-seasonal connections provide valuable insight into possible impacts to the vireo population outside of the breeding grounds.

Differences between Removal sites and Reference sites were minimal in 2012. In 2012, the vireo territory density at Removal and Reference sites was similar, although this was the second year of a decrease at the Removal sites while the Reference sites remained stable for the past two years. Few breeding productivity measures differed between Removal and Reference sites, and when there was a difference, the results suggested that Removal sites had slightly higher breeding productivity than Reference sites. These results suggest that vireo habitat continues to improve at Removal sites and vireos have responded quickly and positively to the habitat improvement.

In 2012, we began surveying and monitoring vireos later than normal, on 10 May, as a result of contractual delays. This late start likely contributed to a depression in breeding productivity estimates in 2012. However, 2012 was clearly an improvement over the late start in 2011 (24 June), because we were able to observe more early breeding activity. These factors likely explain in part why breeding productivity was higher in 2012 than in 2011 but still low compared to all other years. The percent of pairs that fledged at least one young in 2012 (74%) was higher than in 2011 (67%) though 2012 was still the third lowest recorded since 2005 (2010 = 72%, 2009 = 89%, 2008 = 94%, 2007 = 89%, 2006 = 79%, 2005 = 89%). Similarly, the number of young fledged per pair in 2012 (2.0) was higher than in 2011 (1.2) but still lower than any other year since 2005 (range 2.4-4.4).

Similarly, the delay in the onset of surveys likely depressed adult survivorship estimates over the past two winters. Adult survivorship from 2011 to 2012 (54%) was higher than adult survivorship from 2010 to 2011 (34%), even after correcting for vireos that were not seen in 2011 but were detected in 2012. A large percentage of adults holding territories were not resighted in 2011 (43%), and thus we were unable to determine their identities. Adult survivorship from 2011 to 2012, although at the low end, was within the range of annual adult survivorship since 2005 (41%-75%).

CONCLUSIONS

Generally, the vireo population on MCBCP has tracked the overall increase in Least Bell's Vireos in southern California since the late 1970s (USFWS 2006), and also the recent decrease from 2010 to 2012. 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 2012. Cowbird control has a demonstrably positive effect on vireo productivity (Kus 1999, Kus and Whitfield 2005), but must be consistently practiced to maintain the desired reduction in parasitism. The decrease in the vireo population from 2010 to 2012 may have been caused by regional factors, such as weather patterns and climate change, suitability of habitat on migration, and environmental conditions on the wintering grounds. Ultimately, the recent decrease 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 of removing giant reed to native bird species, especially when such activities overlap with the breeding season. Further investigation into habitat, prey, and predation pressures as associated with vireo breeding productivity would 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 2012, although continued attention to potential impacts (weed control, off-road vehicle traffic) is warranted. While some human impacts can only be mitigated by extreme action (e.g., closing high-speed roads in vireo habitat during vireo breeding season), other impacts may be mitigated by education and adjustments to schedules. Increased communication between the Assistant Chief of Staff, Environmental Security, and other military departments may reduce the instances of human-related impacts to vireos and occupied vireo habitat by allowing all participants to understand needs and flexibilities and adjust their activities accordingly. Coordination of military training exercises and maintenance activities such as vegetation clearing will minimize impacts to active territories by either arranging these activities outside of the vireo breeding season or in areas with less potential to impact breeding birds. This coordination and cooperation among various departments will help maintain a balance between the sometimes competing land uses on Base, including military activities, recreation, habitat protection, and endangered species management.

Even though we began vireo surveys and monitoring late in 2012, we were able to collect essential data including a reasonable population count consistent with range-wide population numbers, resighting information for survivorship and movement calculations, territory density estimates in Removal and Reference sites, estimates of pair breeding success, and continuity in data collection and preparation for subsequent years' analyses. Nevertheless, contracting delays impacted the precision of these estimates. In future years, timely identification and resolution of administrative constraints would allow the field season to begin on time and enable collection of a more complete dataset.

LITERATURE CITED

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

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

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

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

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

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

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

Ferree, K., L. D. Allen, and B. E. Kus. 2011. Least Bell's Vireos and Southwestern Willow Flycatchers at the San Luis Rey River Flood Control Project area in San Diego County, California: Breeding activities and habitat use. 2011 Annual Report. Prepared for RECON Environmental, Inc., San Diego, California.

Ferree, K., L. D. Allen, and B. E. Kus. 2012. Least Bell's Vireos and Southwestern Willow Flycatchers at the San Luis Rey River Flood Control Project area in San Diego County, California: Breeding activities and habitat use. 2012 Annual Report. Prepared for RECON Environmental, Inc., San Diego, California.

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

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

Houston, A. and B. E. Kus. 2012. Distribution, abundance, and breeding activities of the Least Bell's Vireo at the Middle San Luis Rey River, San Diego County, California. 2012 Annual Data Summary.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Lynn, S. and B. E. Kus. 2010a. Distribution, abundance and breeding activities of the Least Bell's Vireo at Marine Corps Base Camp Pendleton, California. 2009 Annual Report. Prepared for Assistant Chief of Staff, Environmental Security, Marine Corps Base Camp Pendleton.

Lynn, S. and B. E. Kus. 2010b. Distribution, abundance and breeding activities of the Least Bell's Vireo at Marine Corps Base Camp Pendleton, California. 2010 Annual Report. Prepared for Assistant Chief of Staff, Environmental Security, Marine Corps Base Camp Pendleton.

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

Lynn, S. and B. E. Kus. 2011. Distribution, abundance and breeding activities of the Least Bell's Vireo at Marine Corps Base Camp Pendleton, California. 2011 Annual Report. Prepared for Assistant Chief of Staff, Environmental Security, Marine Corps Base Camp Pendleton.

Lynn, S., and B. E. Kus. 2012. Distribution, abundance, and breeding activities of the Least Bell's Vireo along the San Diego River, California. 2012 Annual Data Summary. Prepared for the San Diego River Conservancy, San Diego, California.

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

Lynn, S., R. Pottinger, and B. E. Kus. 2012. Distribution, abundance, and breeding activities of Least Bell's Vireo and Southwestern Willow Flycatcher at Marine Corps Air Station, Camp Pendleton, California. 2012 Data Summary. Prepared for Naval Facilities Engineering Command Southwest, San Diego, California.

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

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

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

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

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

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

Rourke, J. W. and B. E. Kus. 2008. Distribution, abundance, and breeding activities of the Least Bell's Vireo at Marine Corps Base Camp Pendleton, California. 2007 Annual Data

Summary. Prepared for Assistant Chief of Staff, Environmental Security, Marine Corps Base Camp Pendleton.

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

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

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

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

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

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

APPENDICES

APPENDIX A. LEAST BELL'S VIREO SURVEY AREAS AT MARINE CORPS BASE CAMP PENDLETON, 2012

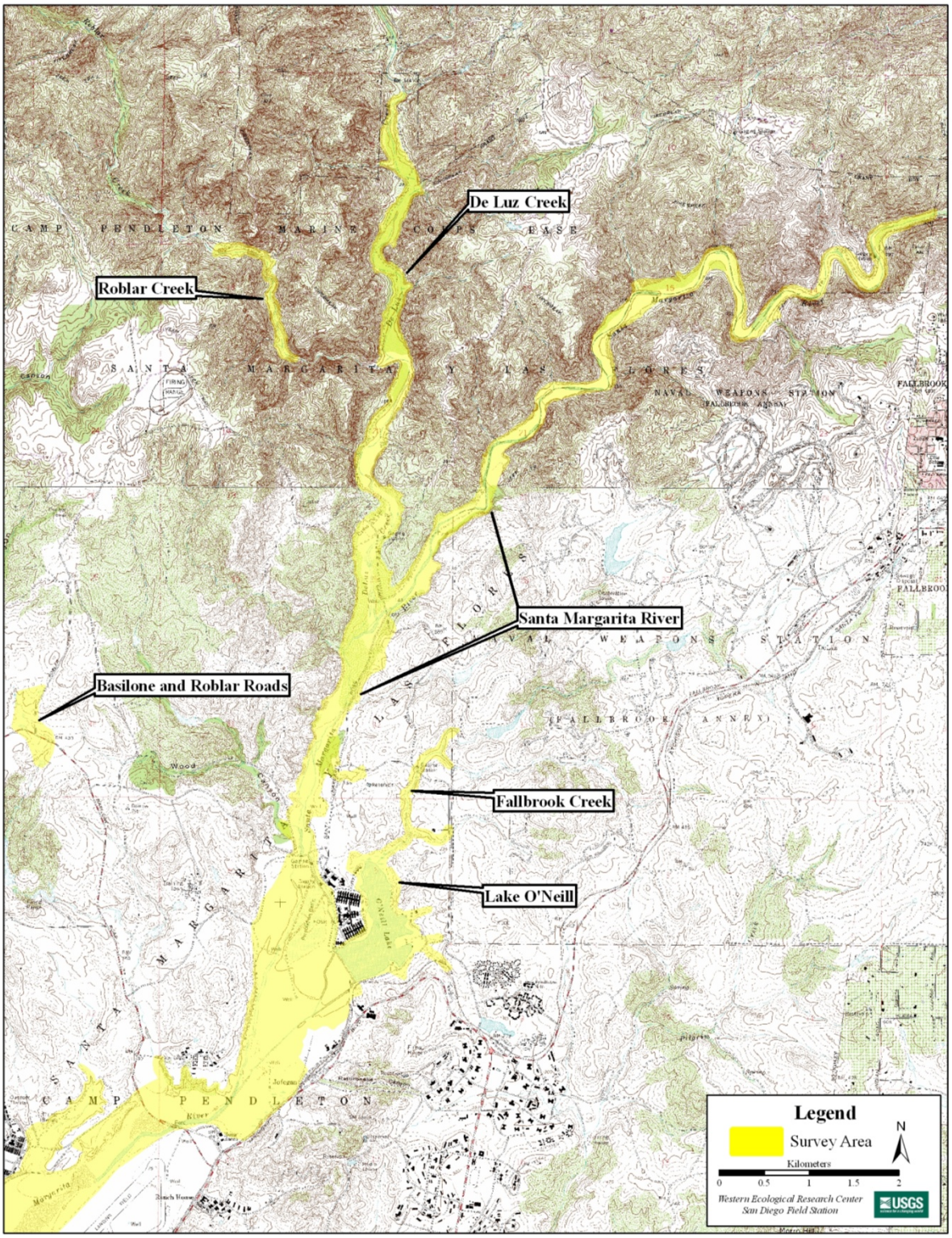

Fig. 11. Least Bell's Vireo survey areas at Marine Corps Base Camp Pendleton, 2012: Upper Santa Margarita River, Fallbrook Creek, Lake O'Neill, De Luz Creek, Roblar Creek, and Basilone and Roblar Roads.

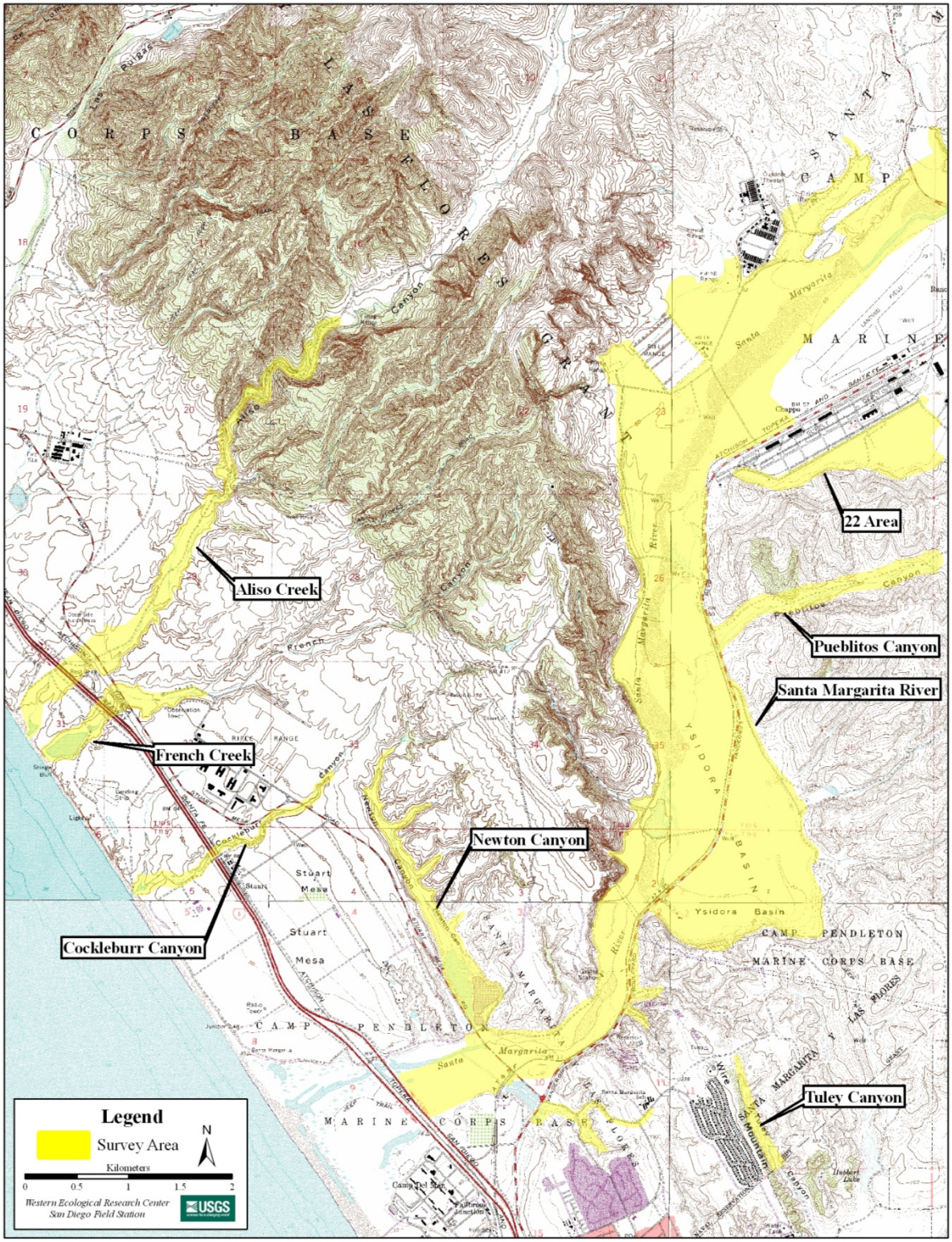

Fig. 12. Least Bell's Vireo survey areas at Marine Corps Base Camp Pendleton, 2012: Lower Santa Margarita River, 22 Area, Pueblitos Canyon, Tuley Canyon, Newton Canyon, Cockleburr Canyon, French Creek, and Aliso Creek.

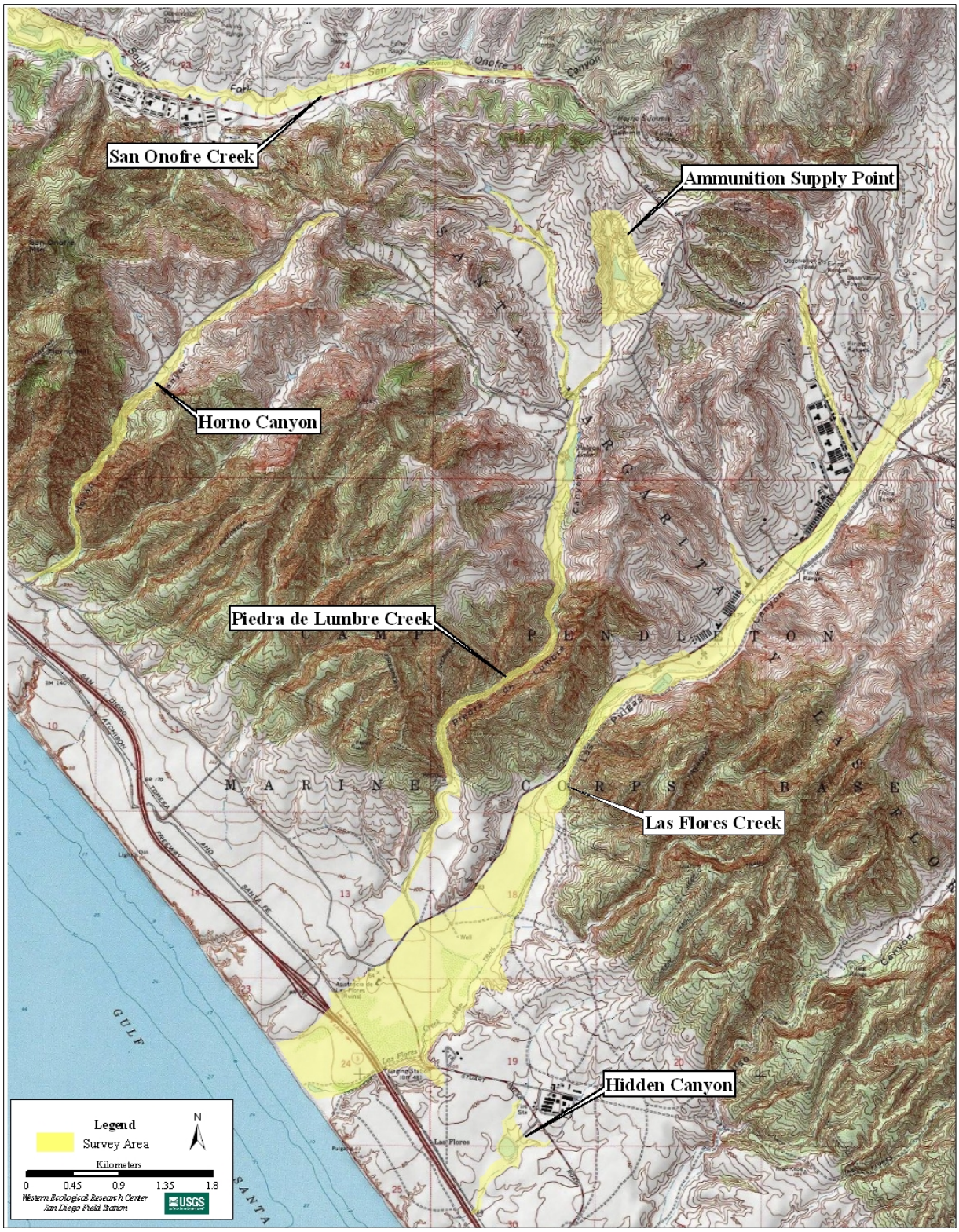

Fig. 13. Least Bell's Vireo survey areas at Marine Corps Base Camp Pendleton, 2012: San Onofre Creek South Fork, Ammunition Supply Point, Horno Canyon, Piedra de Lumbre Creek, Las Flores Creek, and Hidden Canyon.

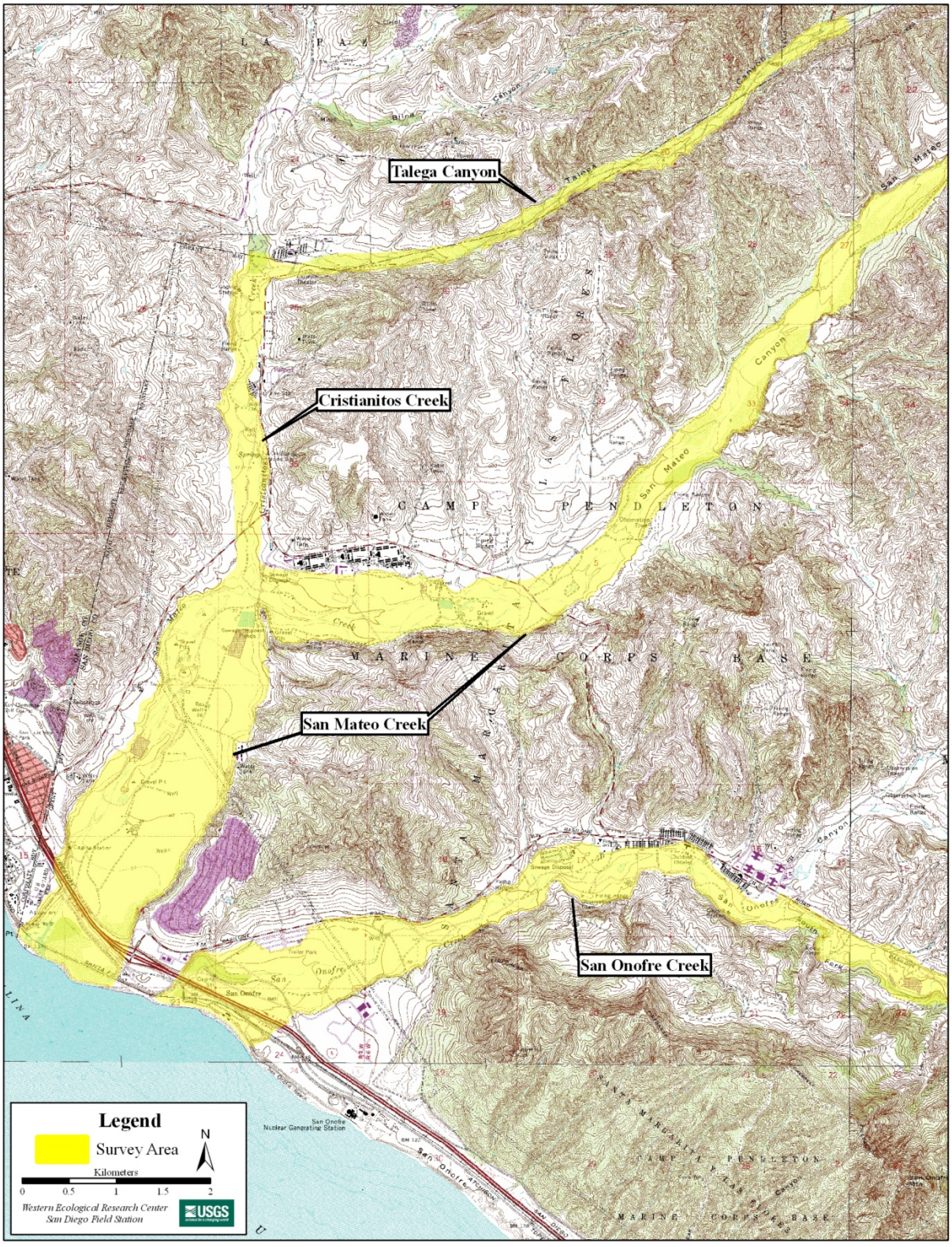

Fig. 14. Least Bell's Vireo survey areas at Marine Corps Base Camp Pendleton, 2012: Talega Canyon, Cristianitos Creek, San Mateo Creek, and San Onofre Creek.

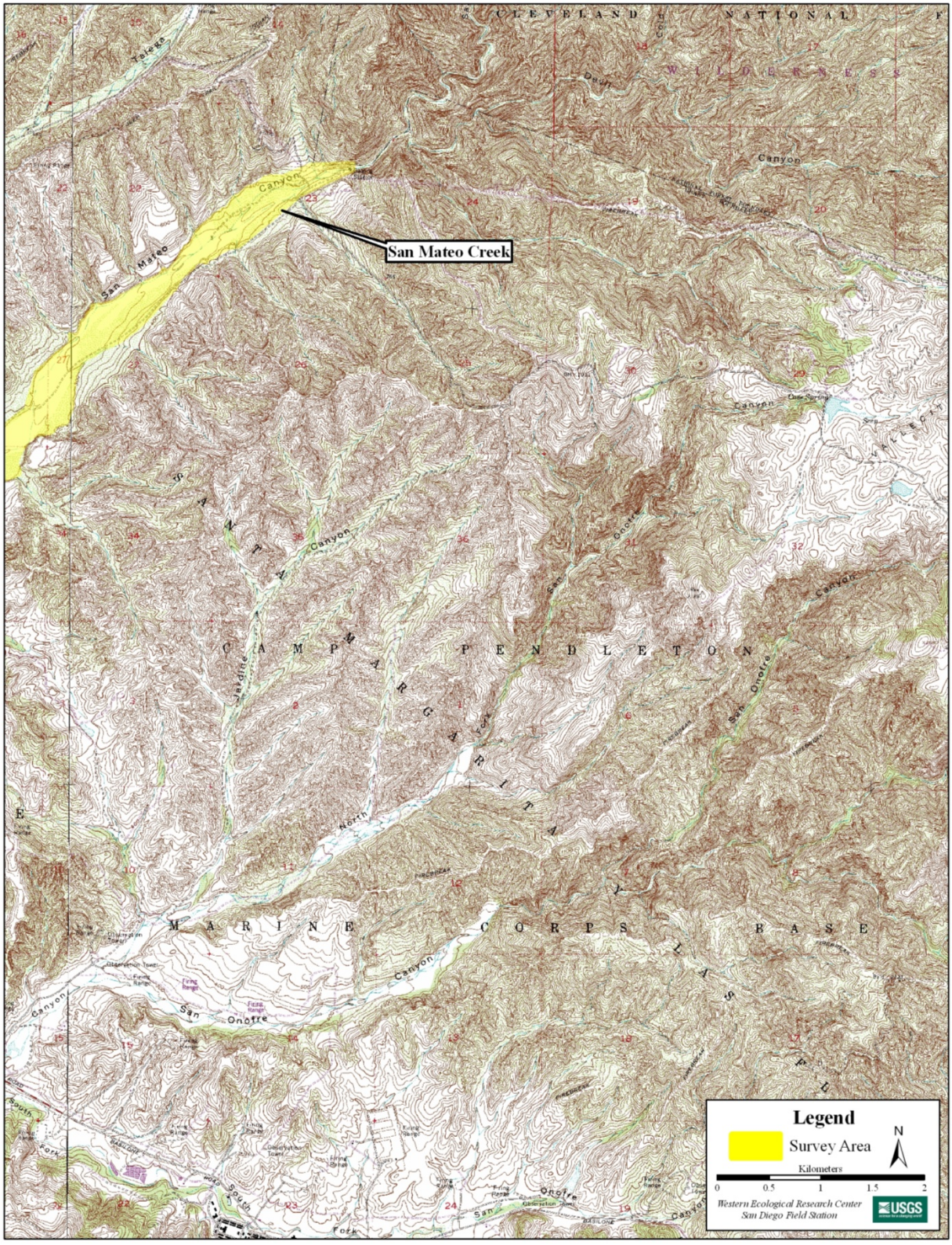

Fig. 15. Least Bell's Vireo survey areas at Marine Corps Base Camp Pendleton, 2012: Upper San Mateo Creek.

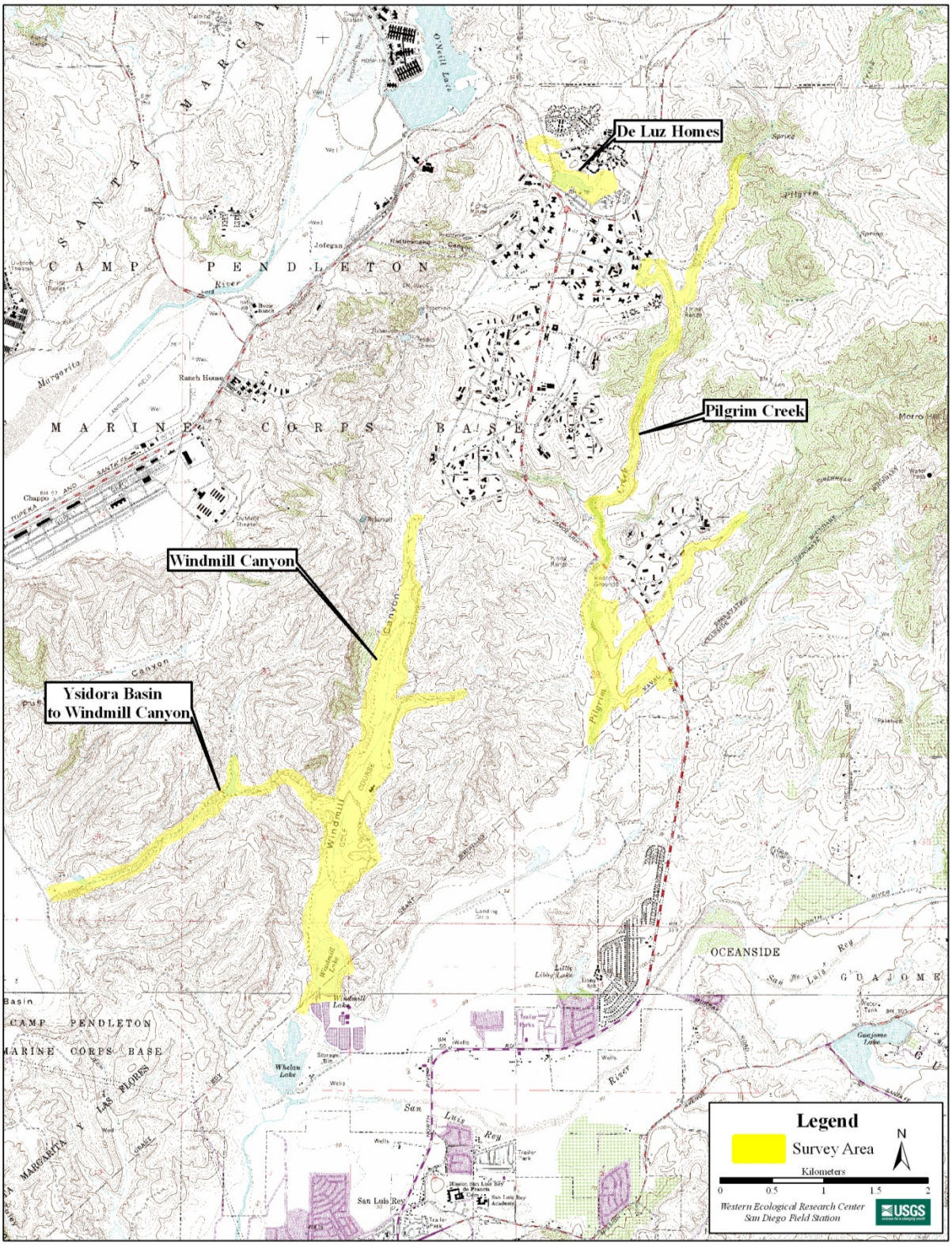

Fig. 16. Least Bell's Vireo survey areas at Marine Corps Base Camp Pendleton, 2012: Windmill Canyon, Ysidora Basin to Windmill Canyon, Pilgrim Creek, and De Luz Homes Habitat.

APPENDIX B. LOCATIONS OF LEAST BELL'S VIREOS AT MARINE CORPS BASE CAMP PENDLETON, 2012

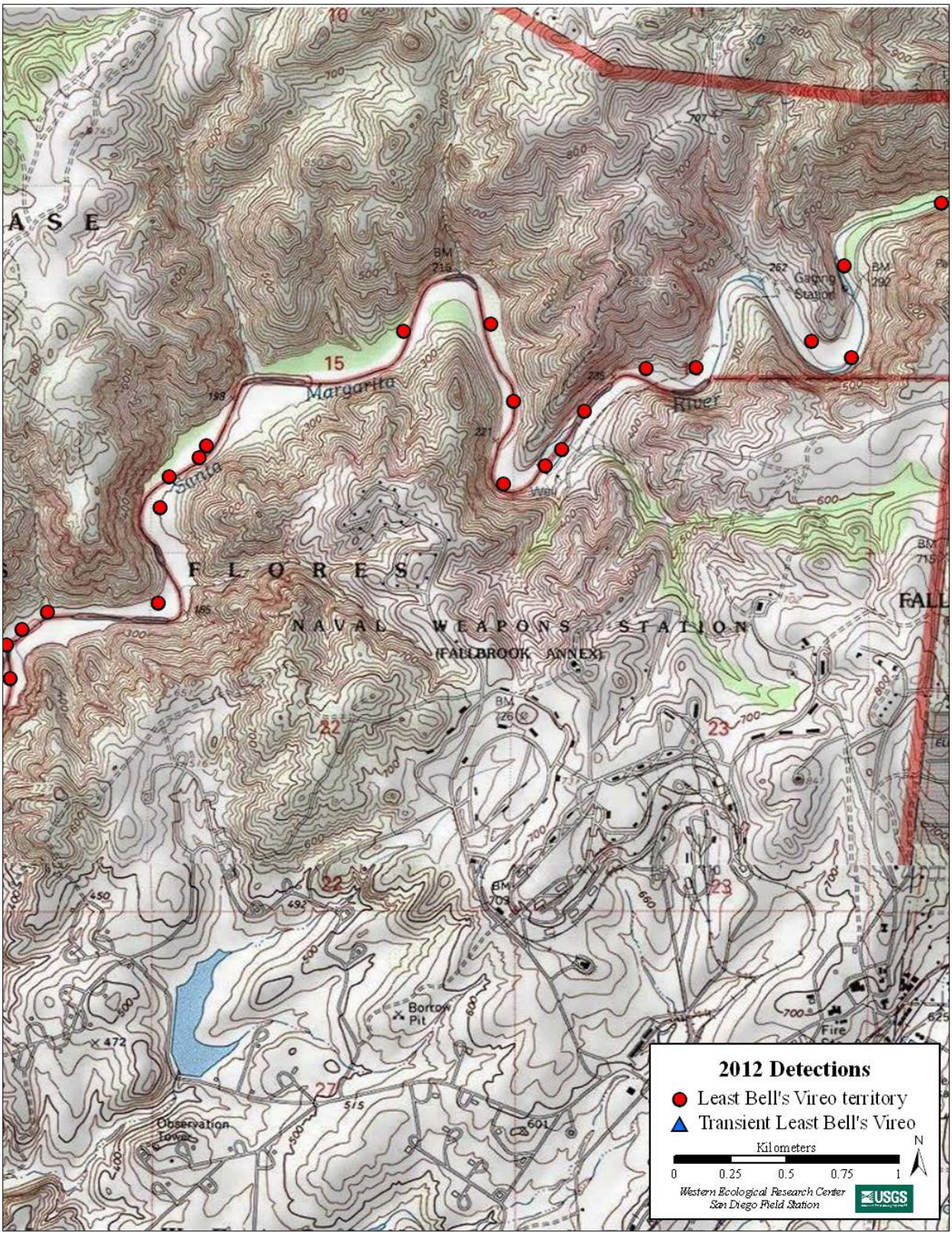

Fig. 17. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2012: Upper Santa Margarita River.

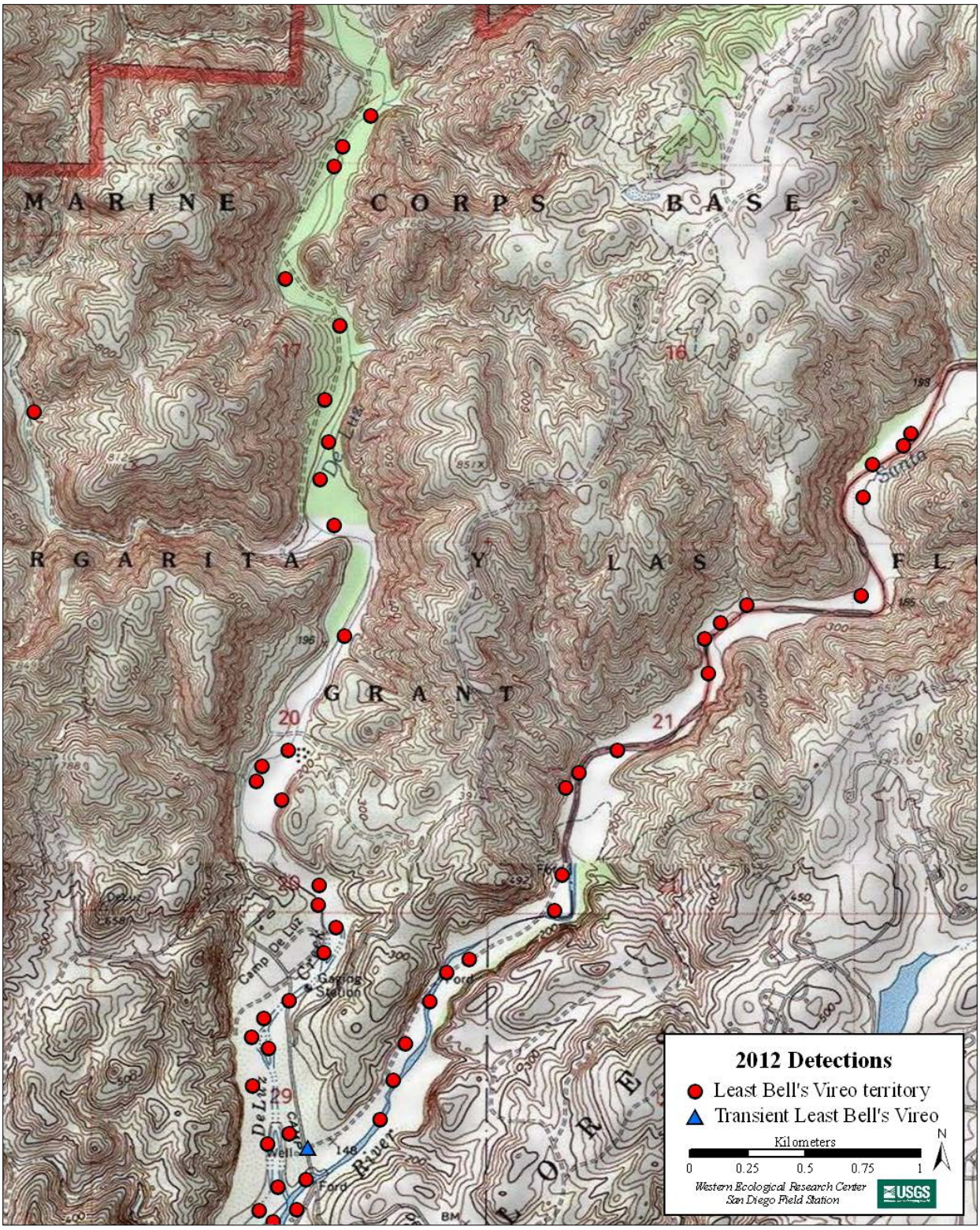

Fig. 18. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2012: Upper Santa Margarita River, De Luz Creek, and Roblar Creek.

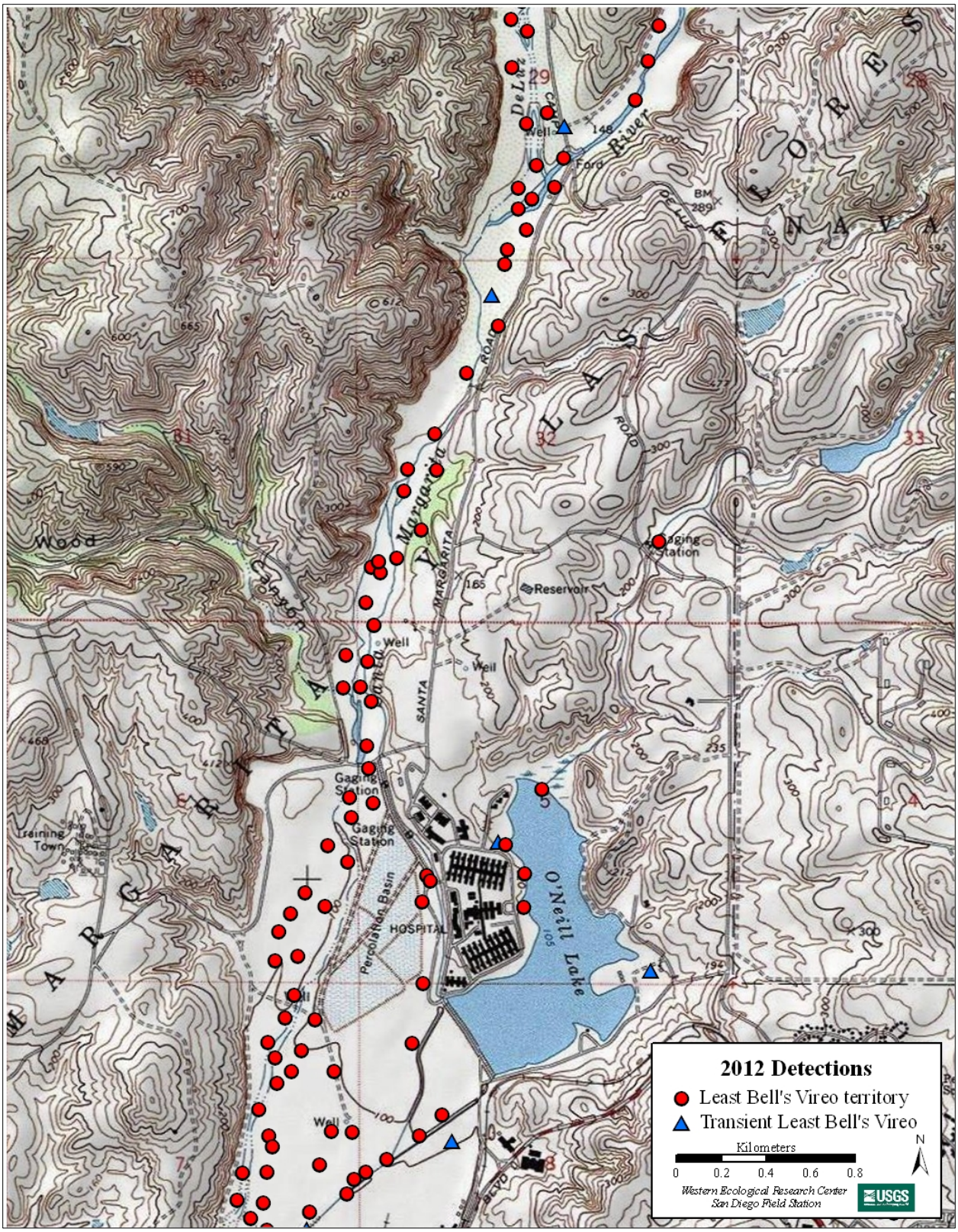

Fig. 19. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2012 Santa Margarita River, Lake O'Neill, and Fallbrook Creek.

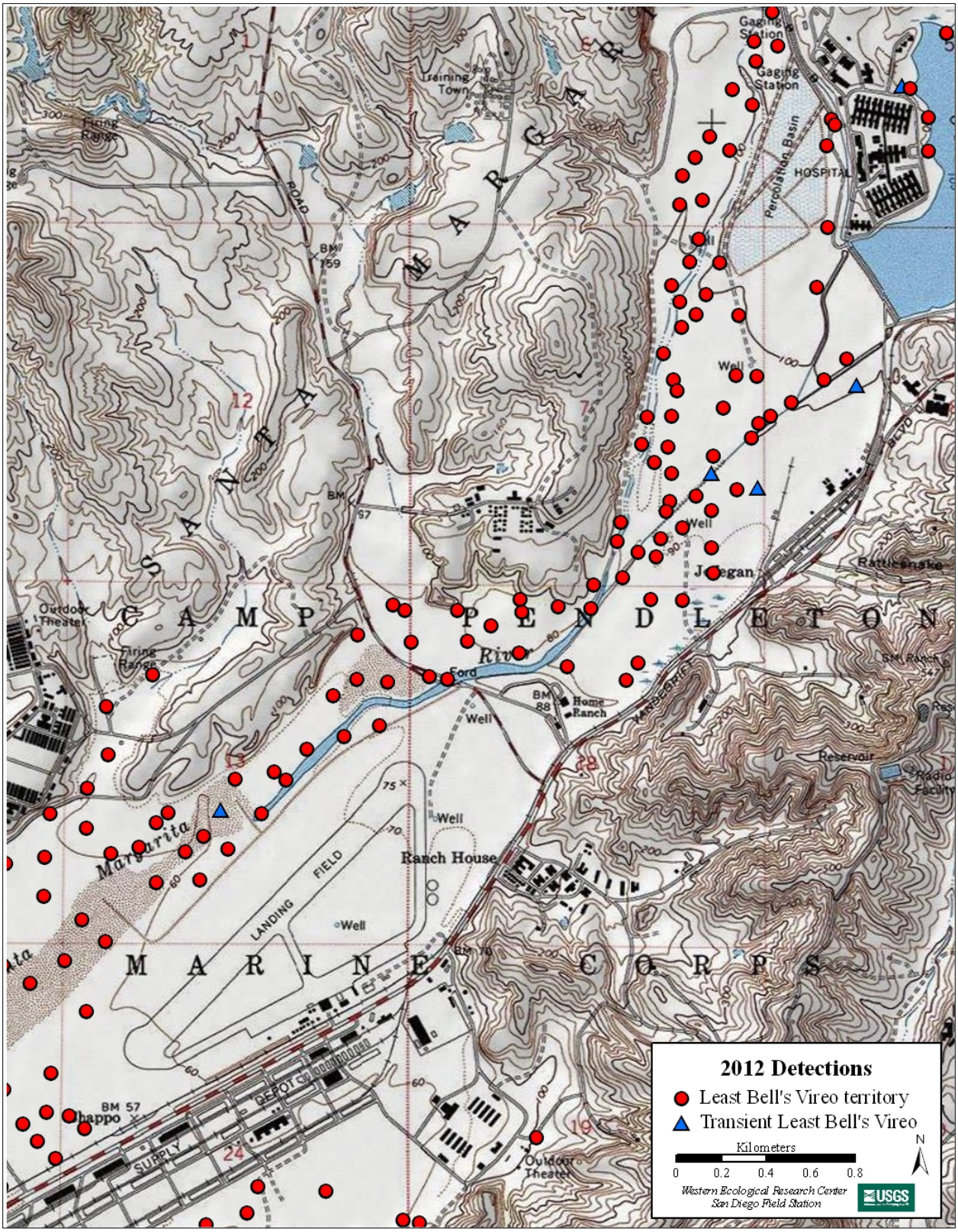

Fig. 20. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2012: Santa Margarita River.

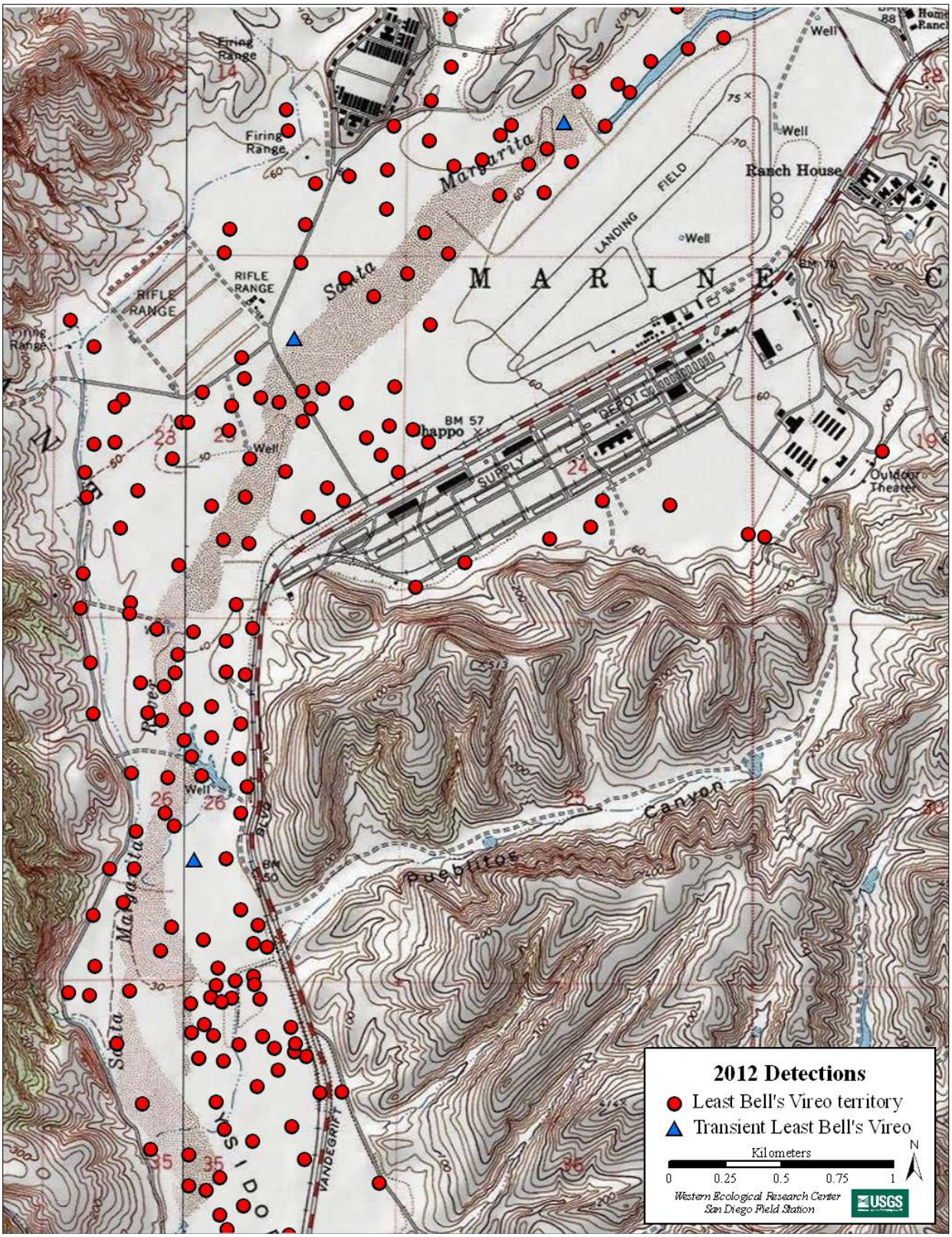

Fig. 21. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2012: Santa Margarita River, 22 Area, and Pueblitos Canyon.

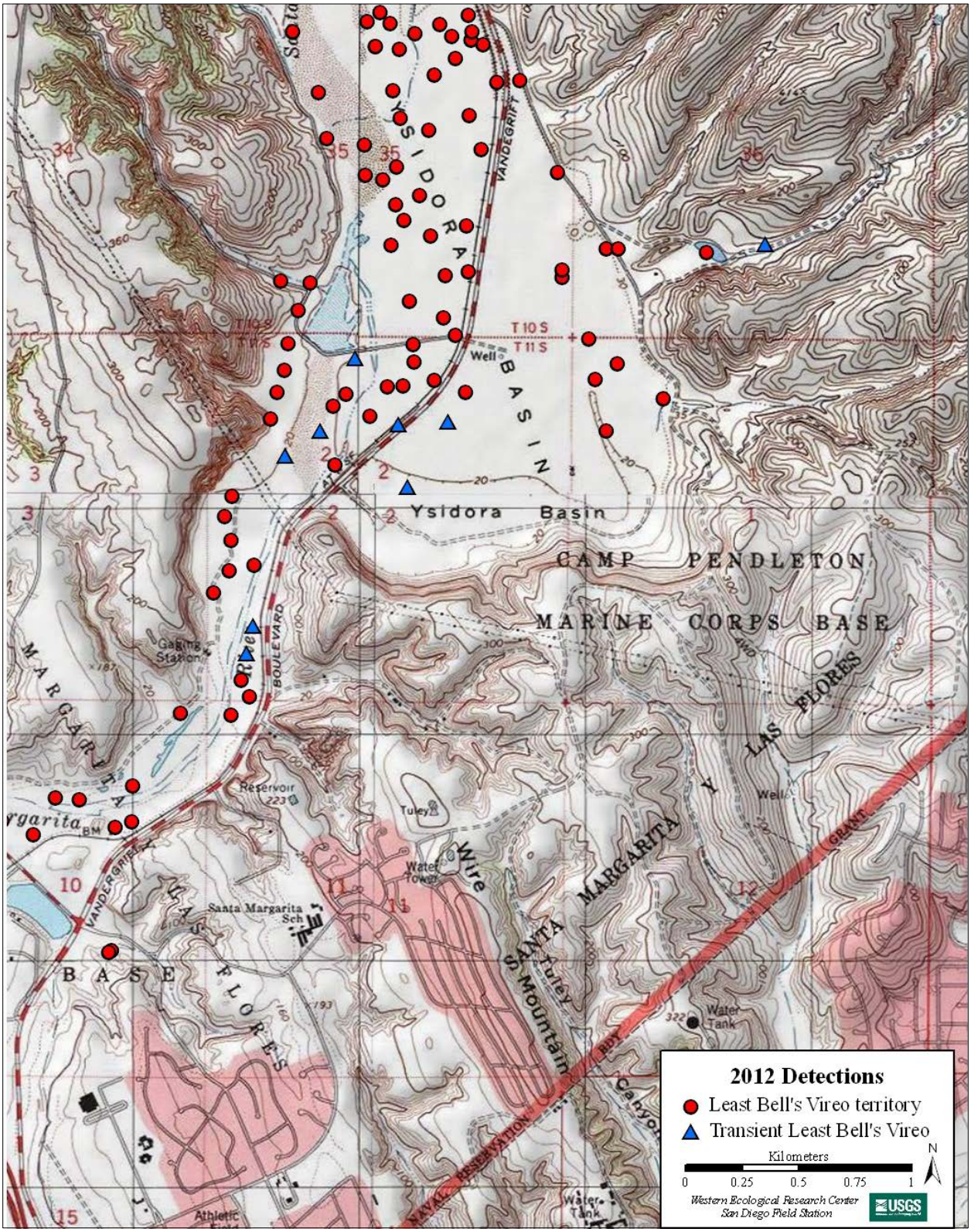

Fig. 22. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2012: Santa Margarita River, Ysidora Basin, and Ysidora Basin to Windmill Canyon.

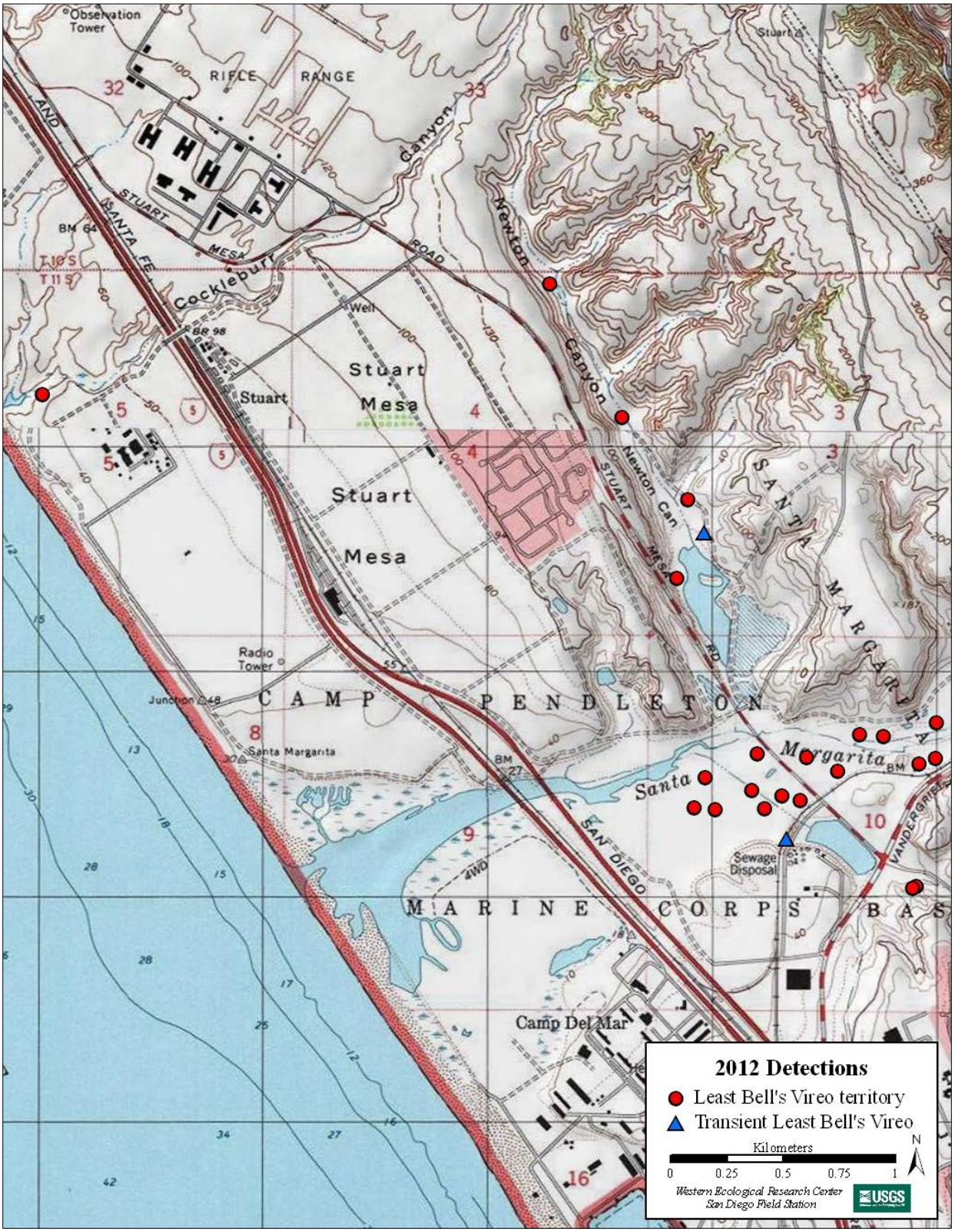

Fig. 23. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2012: Lower Santa Margarita River, Newton Canyon, and Cockleburr Canyon.

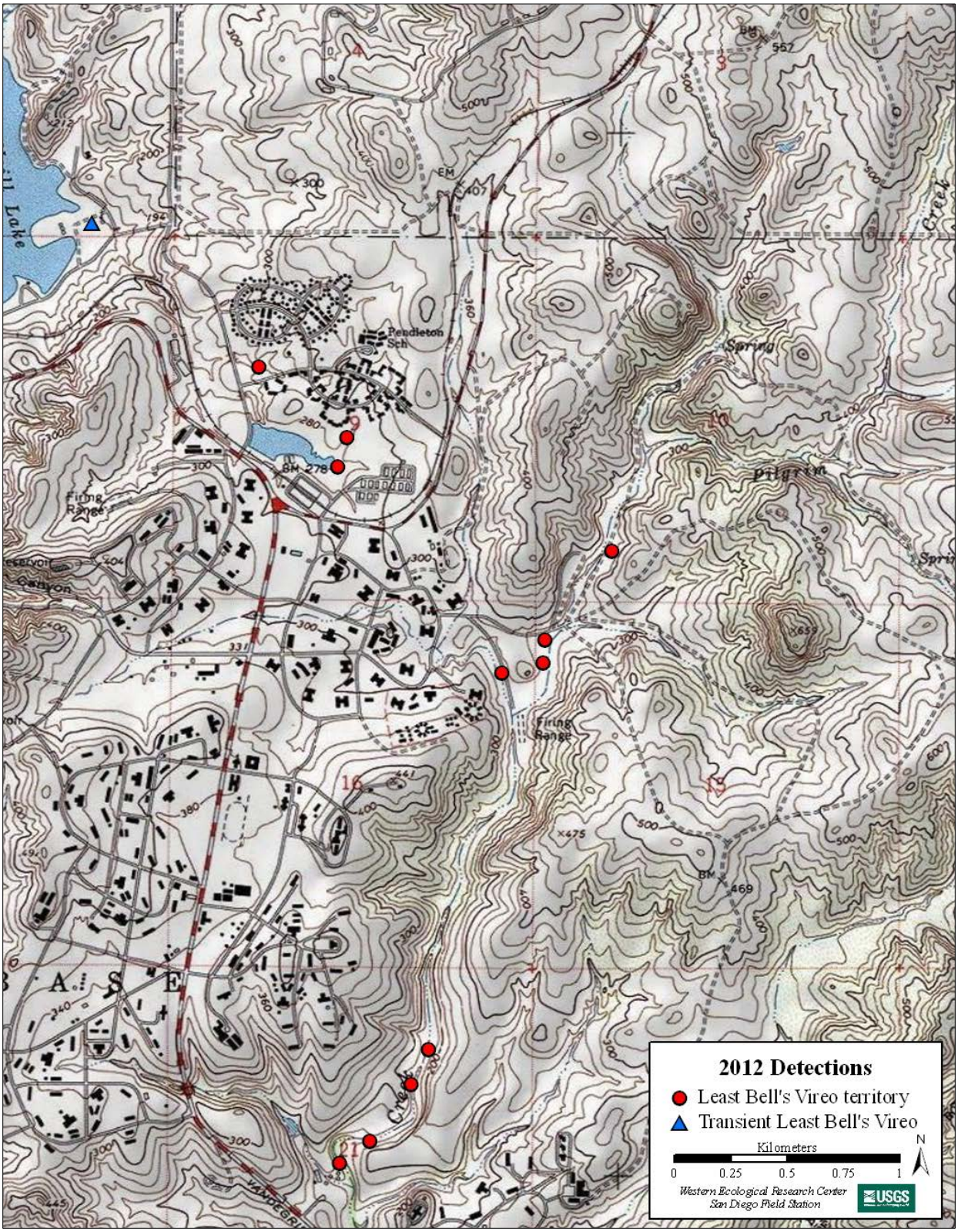

Fig. 24. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2012: Upper Pilgrim Creek, De Luz Homes Habitat, and Lake O'Neill.

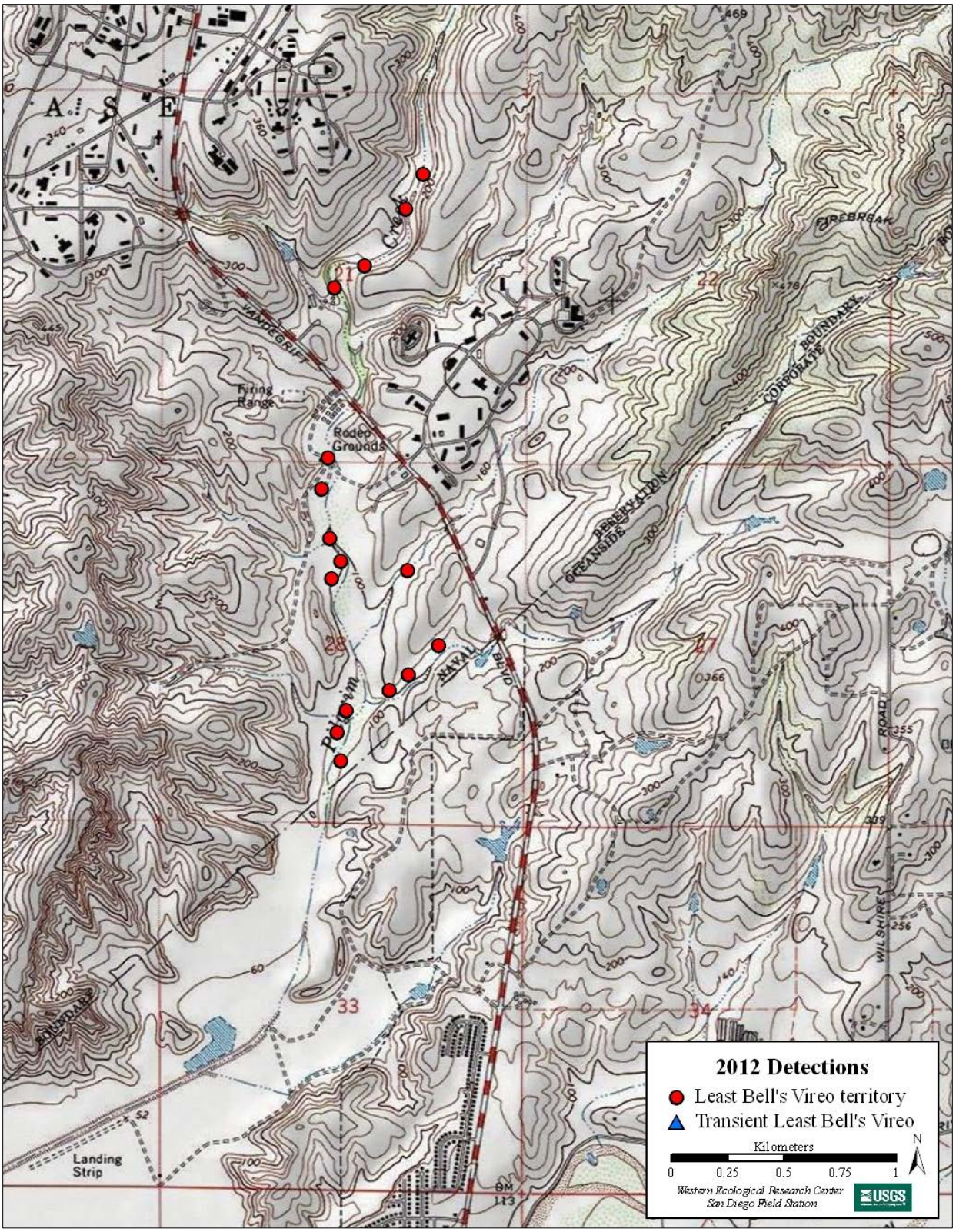

Fig. 25. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2012: Upper and Lower Pilgrim Creek.

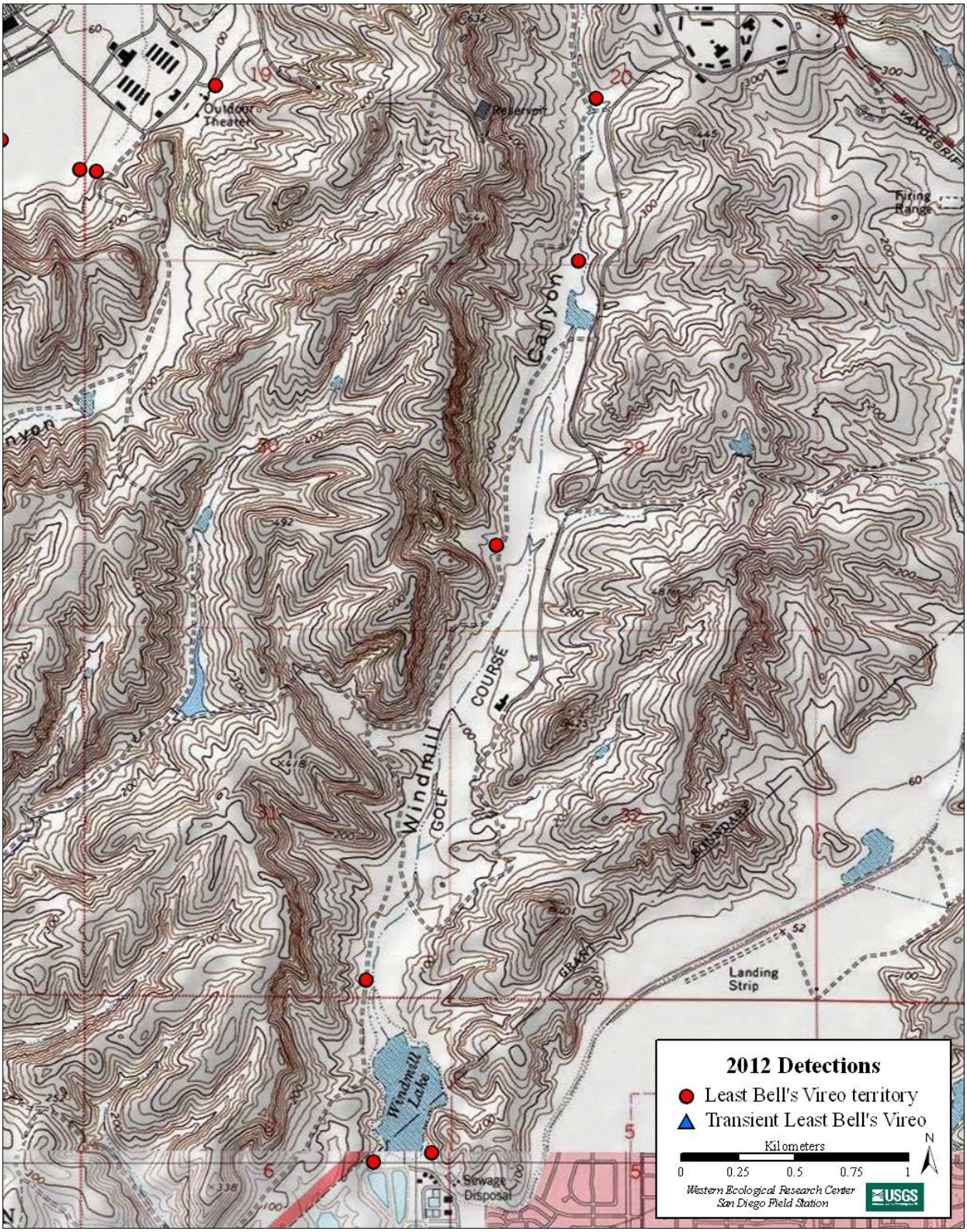

Fig. 26. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2012: Windmill Canyon and Ysidora Basin to Windmill Canyon.

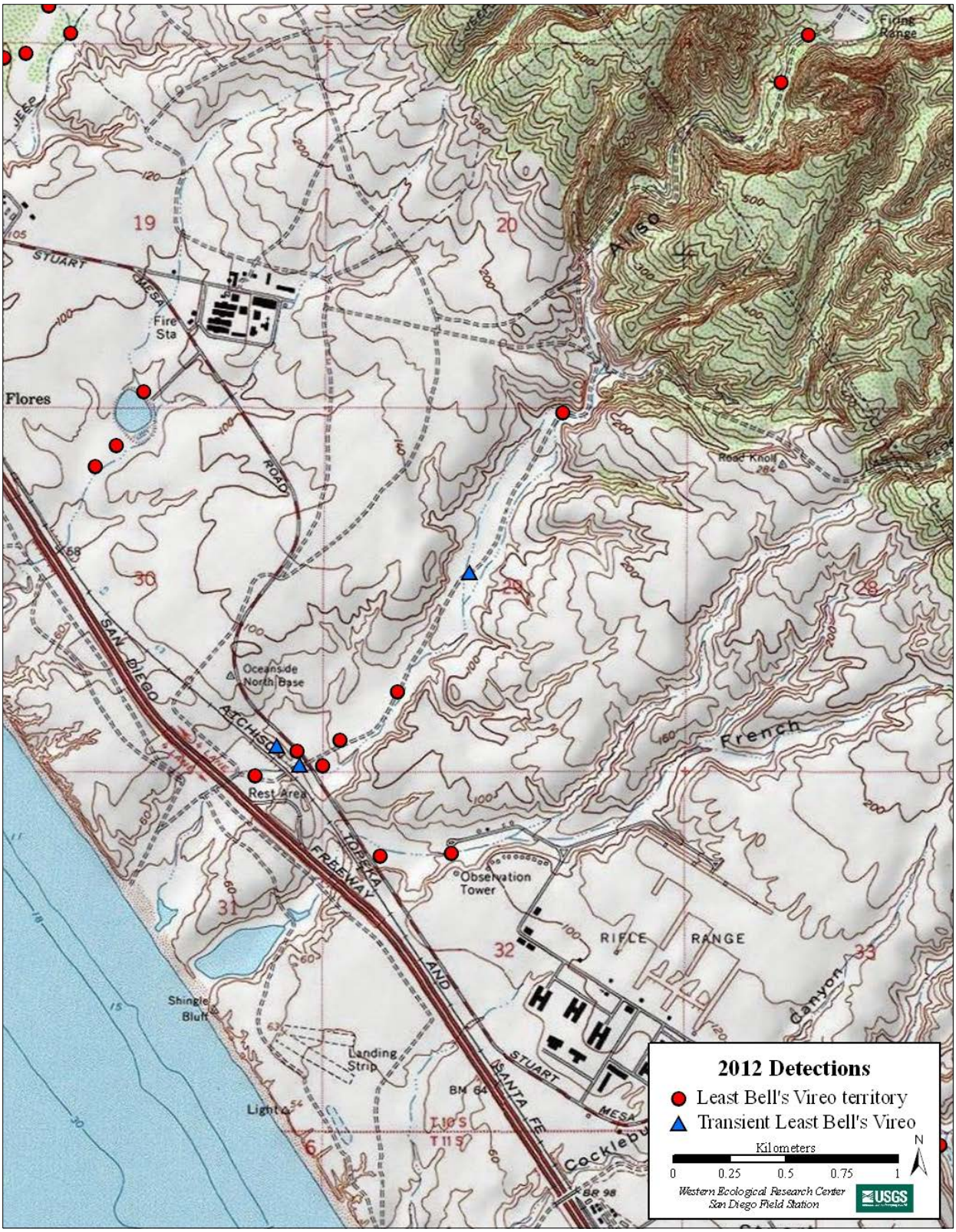

Fig. 27. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2012: French Creek, Aliso Creek, and Hidden Canyon.

Fig. 28. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2012: Basilone and Roblar Roads.

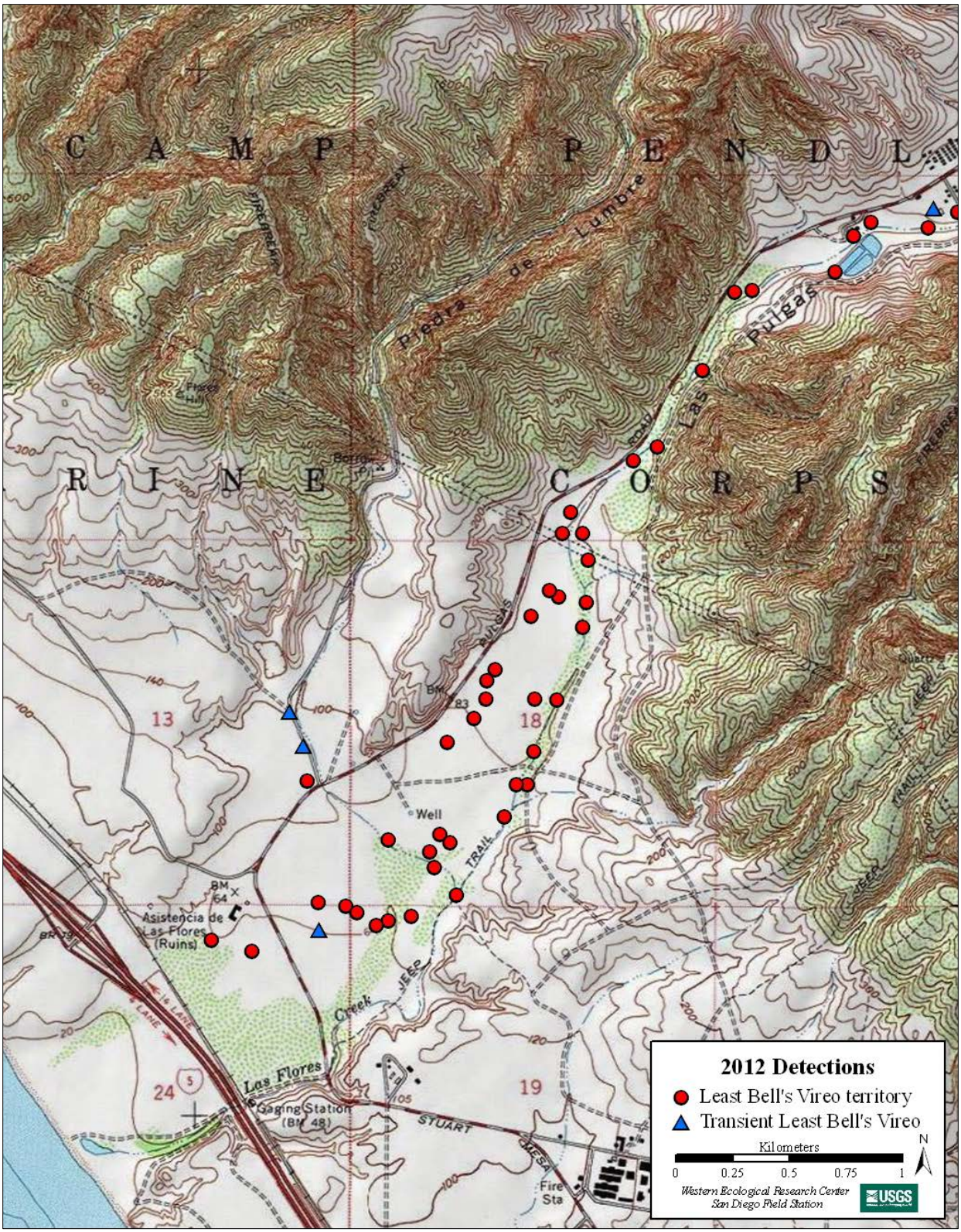

Fig. 29. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2012: Lower Las Flores Creek and Piedra de Lumbre Canyon.

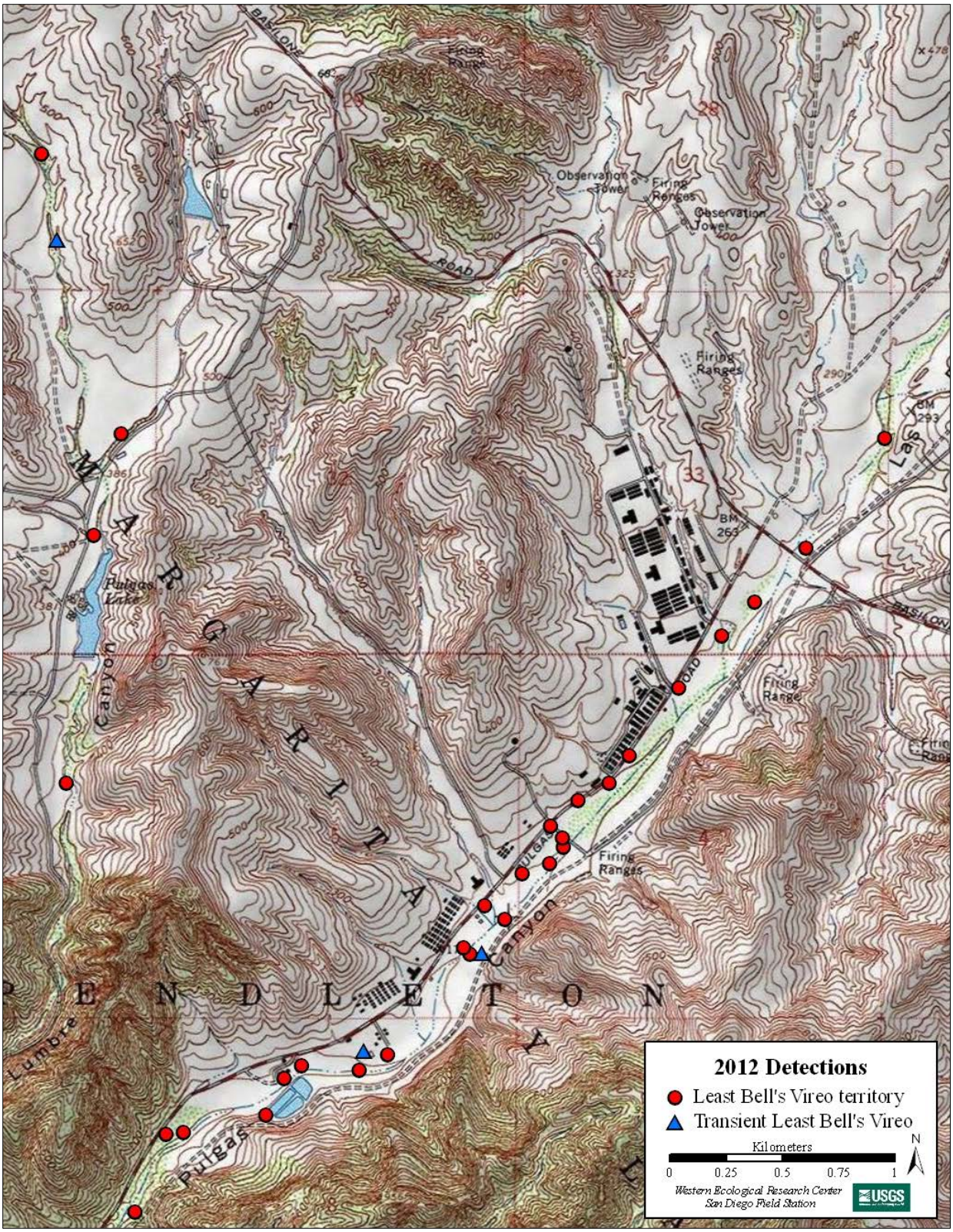

Fig. 30. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2012: Piedra de Lumbre Canyon and Upper Las Flores Creek.

Fig. 31. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2012: Horno Canyon.

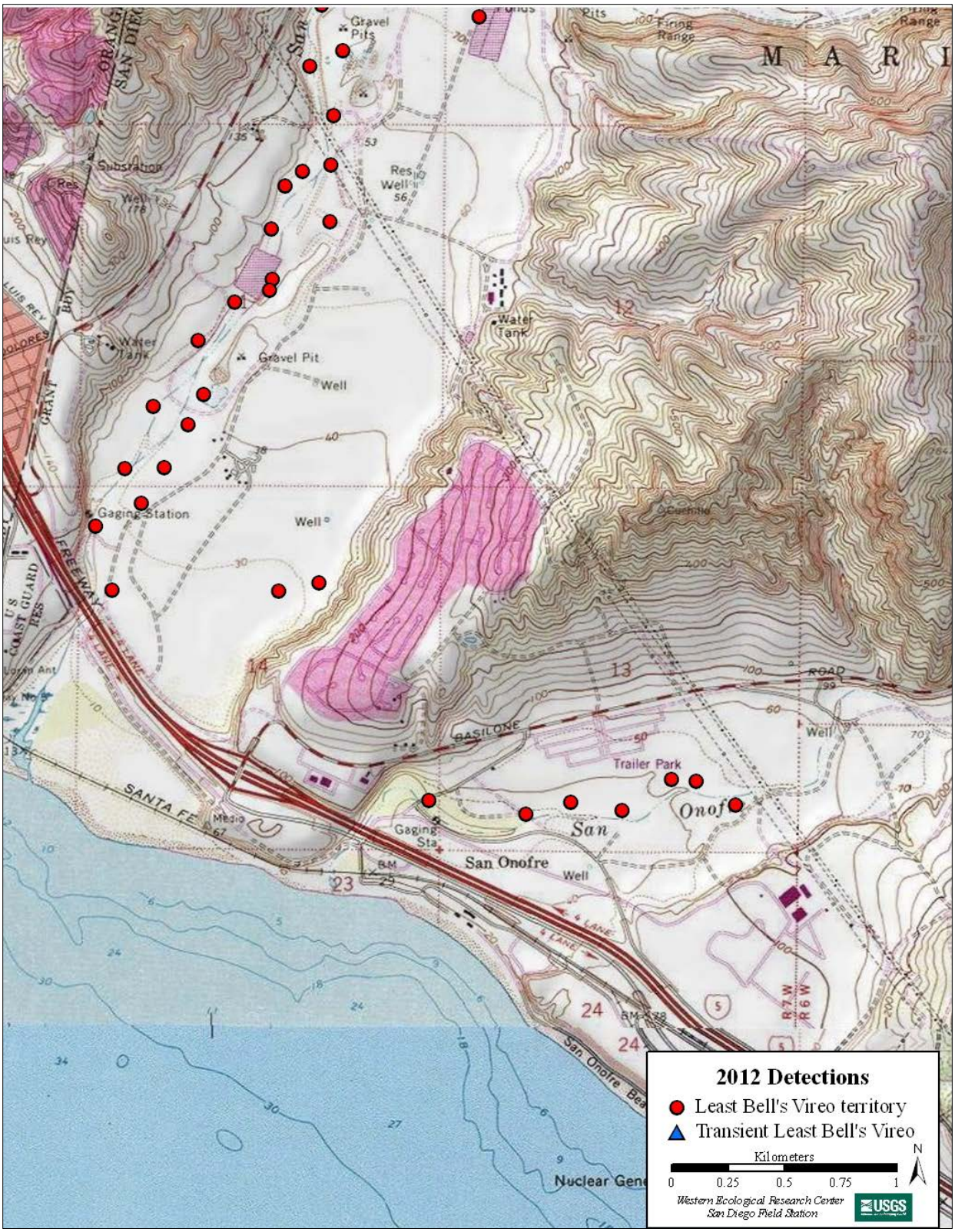

Fig. 32. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2012: Lower San Onofre Creek and Lower San Mateo Creek.

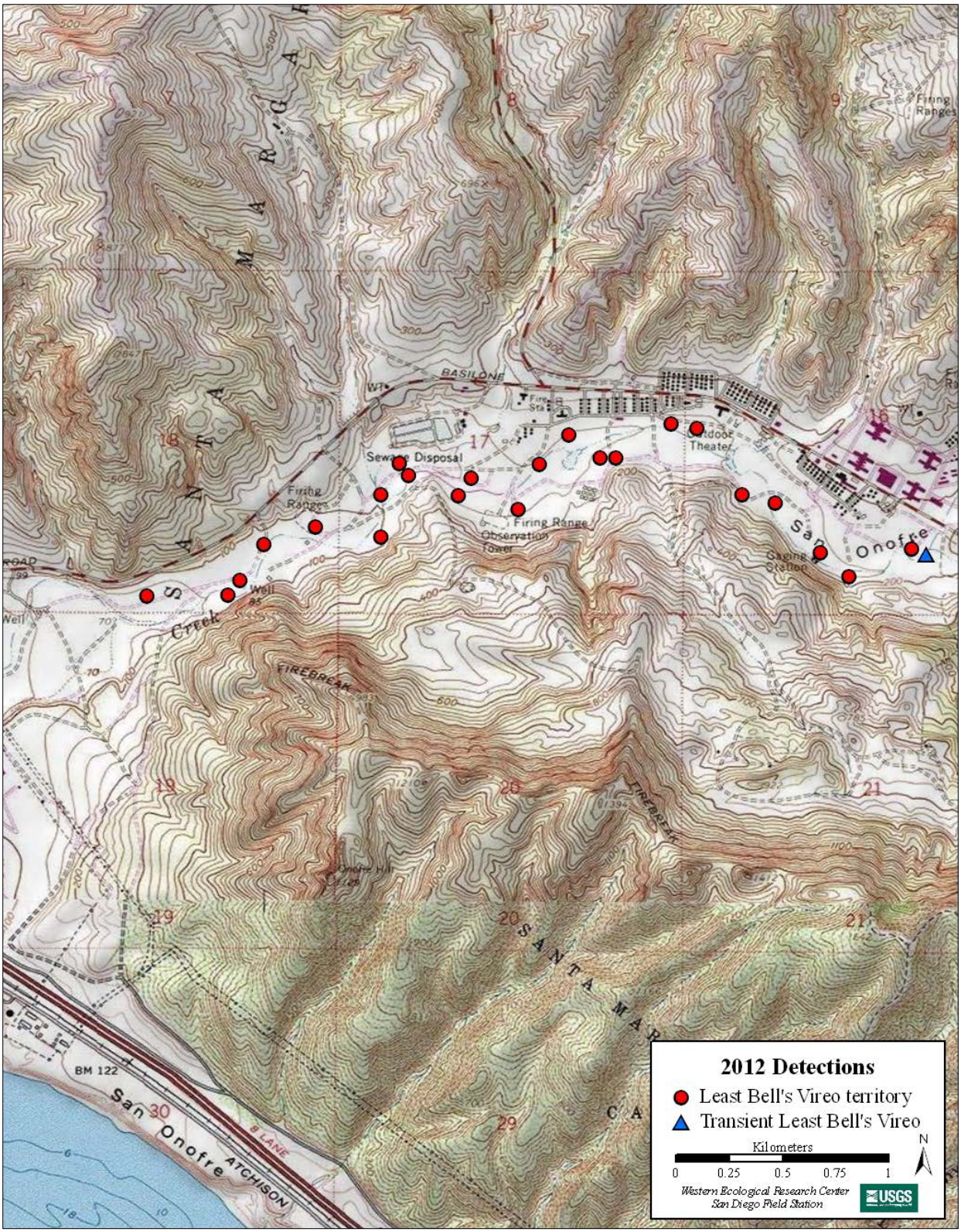

Fig. 33. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2012: San Onofre Creek.

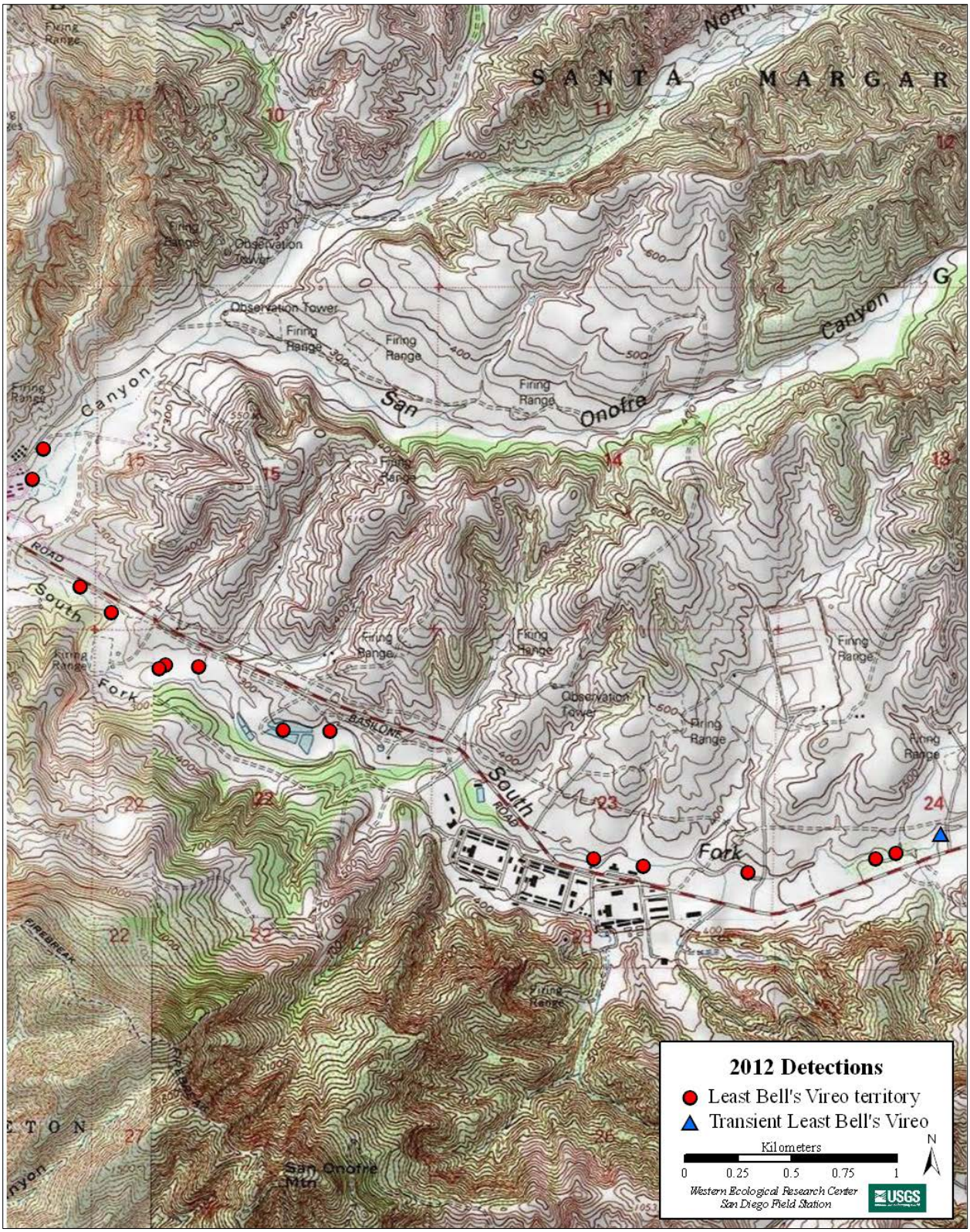

Fig. 34. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2012: South Fork San Onofre Creek.

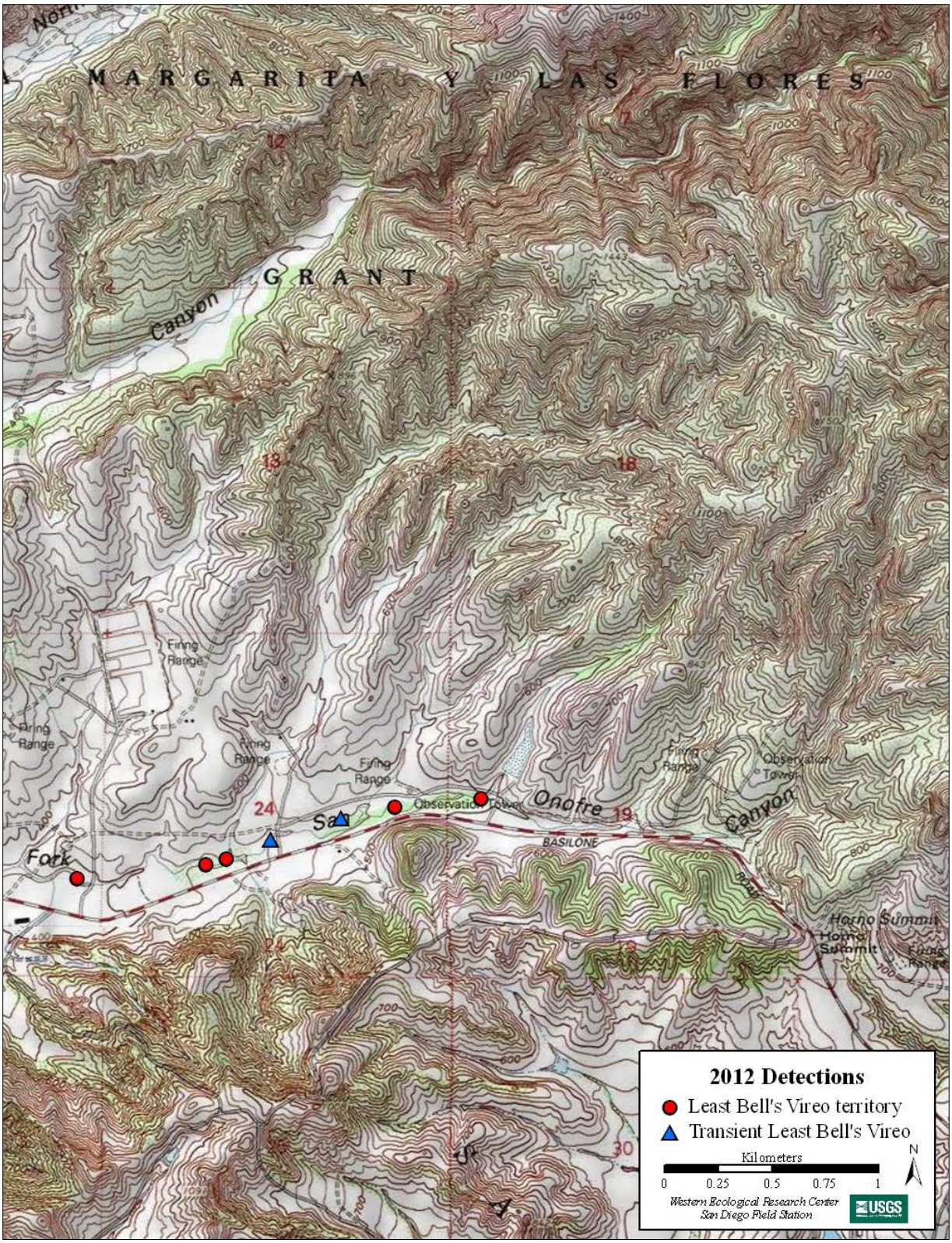

Fig. 35. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2012: San Onofre Creek.

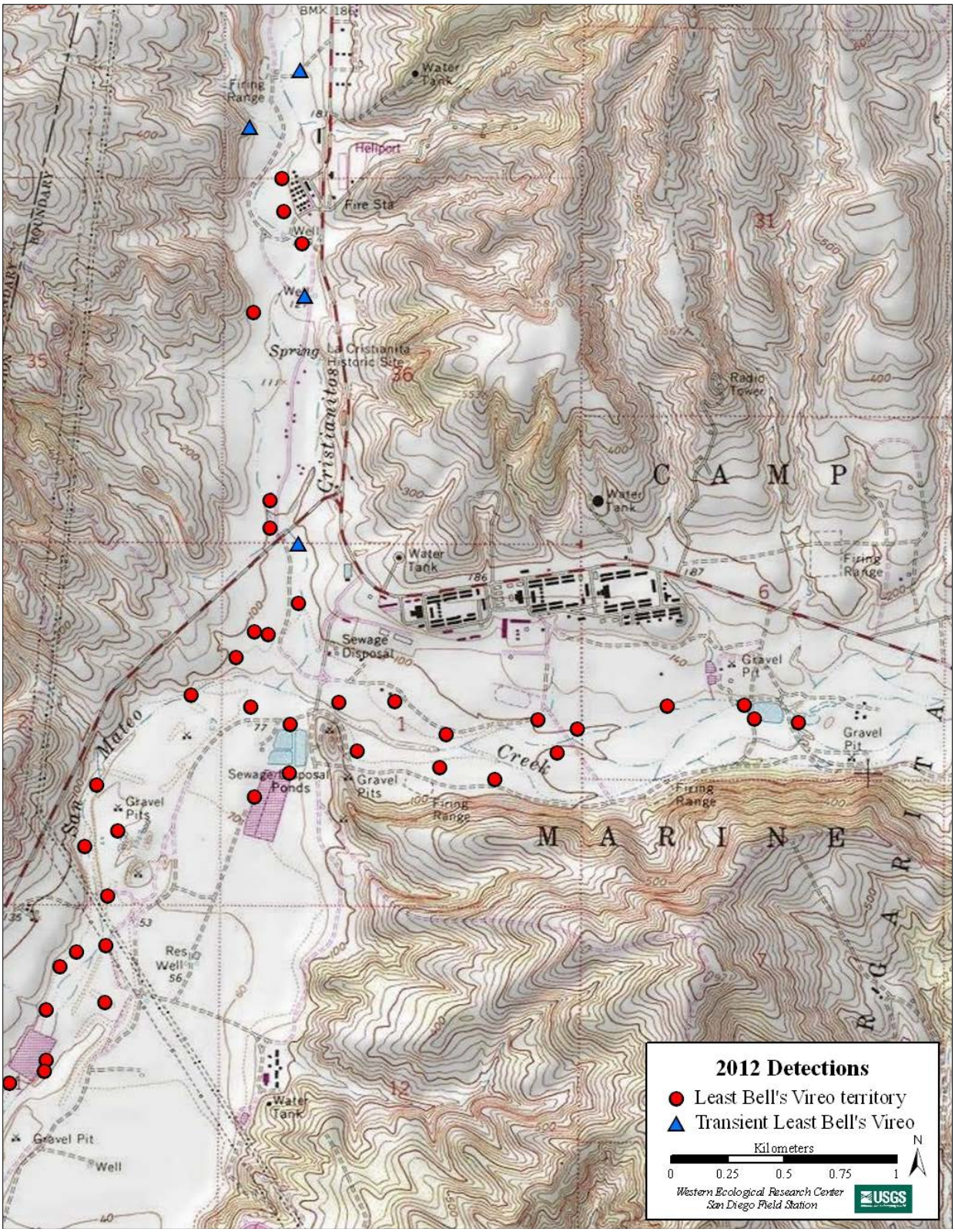

Fig. 36. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2012: San Mateo Creek and Cristianitos Creek.

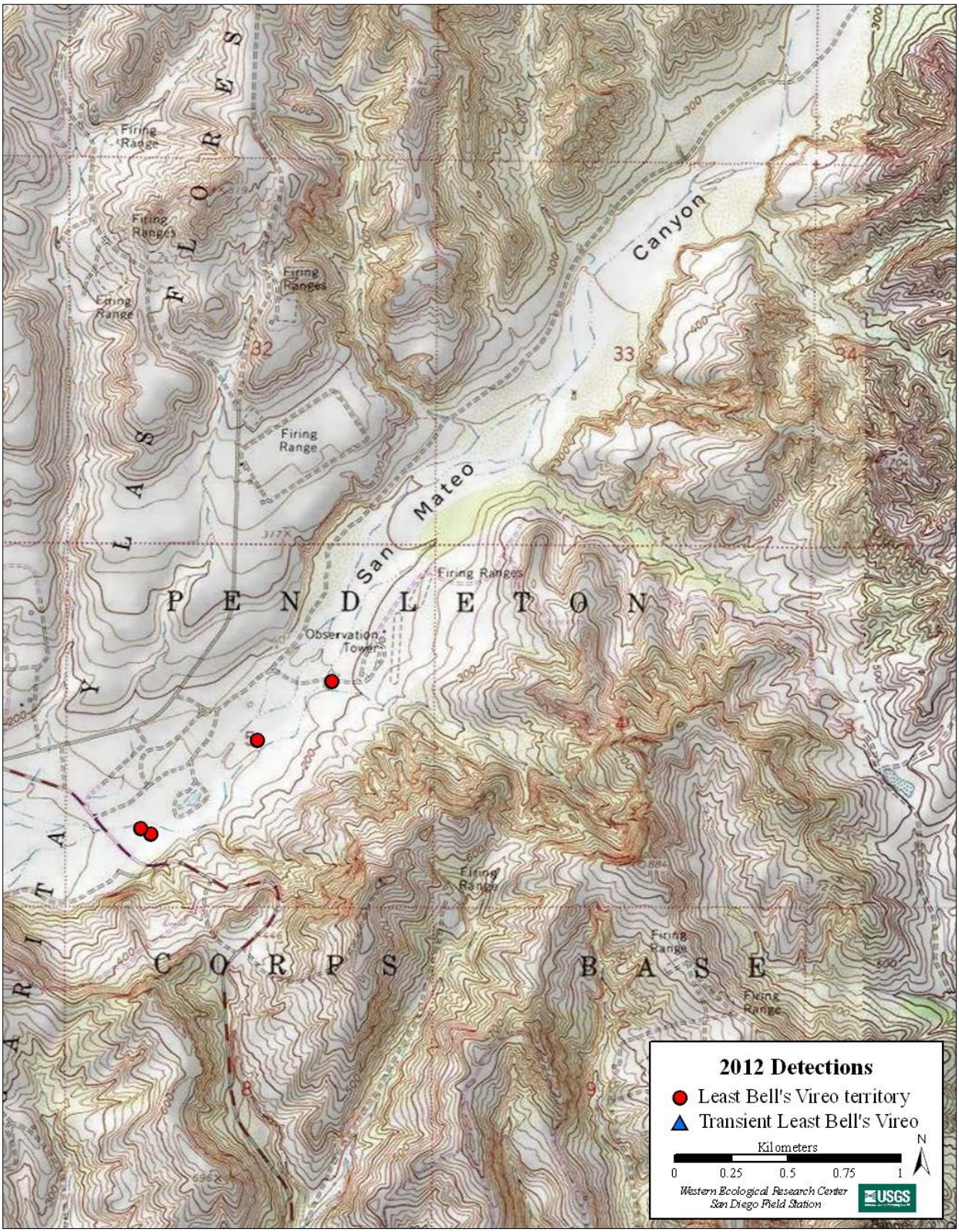

Fig. 37. Locations of Least Bell's Vireos at Marine Corps Base Camp Pendleton, 2012: Upper San Mateo Creek.

APPENDIX C. BANDED LEAST BELL'S VIREOS AT MARINE CORPS BASE CAMP PENDLETON, 2012

Drainage	Band Combination[a]			
Sex	**Left Leg**	**Right Leg**	**Age (yrs.)[b]**	**Comments[c]**
De Luz Creek				
Female	Mgo		≥ 1	Banded as a nestling at MCBCP prior to 2012.
Male	WHDP/Mgo	WHWH	≥ 4	Banded as an adult at DL in 2010.
Male	DPWH	YEPU/Mgo	3	Banded as a nestling at the SMR in 2009.
Las Flores Creek				
Male	PUWH/pupu	Mdb	5	Banded as a nestling at the SLR in 2007.
Male	DGOR/Mgo	WHWH	2	Banded as a juvenile at the SMR in 2010.
Male	PUYE/Mgo	WHWH	2	Banded as a juvenile at DL in 2010.
Pilgrim Creek				
Female	Msi		≥ 1	Banded prior to 2012, unknown age.
Male	pupu	OROR/Mgo	≥ 6	Banded as an adult at PC in 2007.
San Luis Rey River				
Female	BKLP/gogo	Mgo	3	Banded as a nestling at the SMR in 2009.
San Mateo Creek				
Female	pupu	ORPU/Mgo	5	Banded as a nestling at the SMR in 2007.
Female	Mgo		≥ 1	Banded as a nestling at MCBCP prior to 2012.
Male	Mgo	PUOR/sisi	≥ 5	Banded as an adult at the SMO in 2008.
San Onofre Creek				
Female	LPBK/Mgo	WHWH	Unk.	Banded as unknown age at OE16 in 2012.
Male	LPBK	DBWH/Mdb	5	Banded as a nestling at the SLR in 2007.
Male	WHWH	DPDB/Mdb	1	Banded as a nestling at the SLR in 2011.
Santa Margarita River				
Female	DPWH	Mgo	5	Banded as a nestling at the SMR in 2007.
Female	WHDB	DPDB/Mdb	5	Banded as a nestling at the SLR in 2007.
Female	YEYE/sisi	Mgo	≥ 4	Banded as an adult at the SMR in 2009.
Female	PUPU/Mgo	PUPU	≥ 4	Banded as an adult at the SMR in 2009.
Female	DPDP/Mgo	WHWH	4	Banded as a nestling at DL in 2008.
Female	Mgo	Mye	4	Banded as a nestling at the SMR in 2008.
Female	DPDP	BKBK/Mgo	≥ 3	Banded as an adult at the SMR in 2010.
Female	ORPU/Mgo	WHWH	2	Banded as a nestling at MCAS in 2010.
Female	DGOR/Mgo	PUPU	≥ 1	Banded as an adult at QIN in 2012.
Female	Mgo	?	≥ 1	Banded prior to 2012, unknown age.
Female	Mgo		≥ 1	Banded as a nestling at MCBCP prior to 2012.
Female		Mdb	≥ 1	Banded as a nestling at the SLR prior to 2012.
Female	Mgo		≥ 1	Banded as a nestling at MCBCP prior to 2012.
Male	PUWH/Mgo		≥ 8	Banded as an adult at the SMR in 2005.
Male	PUWH/Mgo	pupu	≥ 8	Banded as an adult at the SMR in 2005.
Male	Mgo	DPDP/pupu	≥ 6	Banded as an adult at the SMR in 2007.
Male	PUYE/Mgo	pupu	≥ 5	Banded as an adult at the SMR in 2008.
Male	DPWH/sisi	Mgo	≥ 5	Banded as an adult at the SMR in 2008.
Male	ORPU/gogo	Msi	≥ 5	Banded as an adult at the SMR in 2008.
Male	YEPU/sisi	Mgo	≥ 4	Banded as an adult at the SMR in 2009.
Male	BKLP	Mgo	≥ 4	Banded as an adult at the SMR in 2009.
Male	Mdb	WHDB/sisi	4	Banded as a nestling at the SLR in 2008.
Male	WHWH/Mgo	ORPU	4	Banded as a nestling at the SMR in 2008.
Male	Mgo	BYST/sisi	4	Banded as a nestling at the SMR in 2008.
Male	Mgo	WHPU/sisi	4	Banded as a nestling at the SMR in 2008.

Appendix C. Continued.

Drainage	Band Combination[a]			
Sex	Left Leg	Right Leg	Age (yrs.)[b]	Comments[c]
Santa Margarita River continued				
Male	Msi	DGOR	4	Banded as a juvenile at the SMR in 2008.
Male	WHDP	WHWH/Mgo	≥ 3	Banded as an adult at the SMR in 2010.
Male	ORPU	OROR/Mgo	≥ 3	Banded as an adult at the SMR in 2010.
Male	YEPU	Mgo	≥ 3	Banded as an adult at DL in 2010.
Male	WHPU	Mgo	≥ 3	Banded as an adult at the SMR in 2010.
Male	Mgo	WHDP	≥ 3	Banded as an adult at the SMR in 2010.
Male	YEPU/Mgo	DPDP	≥ 3	Banded as an adult at the SMR in 2010.
Male	OROR/Mgo	DPDP	≥ 3	Banded as an adult at the SMR in 2010.
Male	DPDP	WHPU/Mgo	≥ 3	Banded as an adult at the SMR in 2010.
Male	DPDP	YEYE/Mgo	≥ 3	Banded as an adult at the SMR in 2010.
Male	Mgo	OROR/sisi	3	Banded as a juvenile at the SMR in 2009.
Male	DPWH	DPDP/Mdb	3	Banded as a nestling at the SLR in 2009.
Male	PUPU	BYST/Mgo	≥ 2	Banded as an adult at the SMR in 2011.
Male	WHWH	PUPU/Mgo	≥ 2	Banded as an adult at the SMR in 2011.
Male	WHWH	YEPU/Mgo	≥ 2	Banded as an adult at the SMR in 2011.
Male	WHWH	LPBK/Mgo	≥ 2	Banded as an adult at the SMR in 2011.
Male	WHWH	OROR/Mgo	≥ 2	Banded as an adult at the SMR in 2011.
Male	BYST/Mgo	PUWH	≥ 2	Banded as an adult at the SMR in 2011.
Male	WHWH/Mdb	WHDB	≥ 2	Banded as an adult at the SMR in 2011.
Male	PUWH	DGOR/Mgo	≥ 2	Banded as an adult at the SMR in 2010.
Male	BYST/Mgo	DPWH	≥ 2	Banded as an adult at the SMR in 2011.
Male	DPWH	PUPU/Mgo	≥ 2	Banded as an adult at the SMR in 2011.
Male	DPDB	YEPU/Mdb	≥ 2	Banded as an adult at the SLR in 2011.
Male	PUPU	BKBK/Mdb	≥ 2	Banded as an adult at the SLR in 2011.
Male	PUWH/Mgo	WHWH	2	Banded as a nestling at the SMR in 2010.
Male	Mgo	ORDG/gogo	2	Banded as a nestling at the SMR in 2010.
Male	BYST/Mgo	WHWH	≥ 1	Banded as an adult at STR in 2012.
Male	PUPU	PUPU/Mgo	≥ 1	Banded as an adult at DNT in 2012.
Male	PUPU	BKLP/Mgo	≥ 1	Banded as an adult at JSP in 2012.
Male	WHWH	PUWH/Mgo	≥ 1	Banded as an adult at QIN in 2012.
Male	ORPU	BKLP/Mgo	≥ 1	Banded as an adult at GEL in 2012.
Male	WHWH	BKBK/Mgo	≥ 1	Banded as an adult at MOU in 2012.
Male	OROR/Mgo	WHWH	≥ 1	Banded as an adult at DEU in 2012.
Male	PUPU	PUWH/Mgo	≥ 1	Banded as an adult at ES01 in 2012.
Male	ORPU	PUOR/Mgo	≥ 1	Banded as an adult at MUF in 2012.
Male	WHWH	ORPU/Mgo	≥ 1	Banded as an adult at COB in 2012.
Male	ORPU	PUYE/Mgo	≥ 1	Banded as an adult at CED in 2012.
Male	PUPU	PUOR/Mgo	≥ 1	Banded as an adult at HOL in 2012.
Male	PUPU	ORDG/Mgo	≥ 1	Banded as an adult at HRP in 2012.
Male	PUPU	PUYE/Mgo	≥ 1	Banded as an adult at RR17 in 2012.
Male	DPDP/Mgo	PUPU	≥ 1	Banded as an adult at ES01 in 2012.
Male	DPWH	ORPU/Mgo	≥ 1	Banded as an adult at FIN in 2012.
Male	LPBK/Mgo	DPWH	≥ 1	Banded as an adult at ZPR in 2012.
Male	DPWH	OROR/Mgo	≥ 1	Banded as an adult at AW01 in 2012.
Male	ORDG/Msi	pupu	≥ 1	Banded as an adult at CKE in 2012.

Appendix C. Continued.

Drainage / Sex	Band Combination[a] Left Leg	Right Leg	Age (yrs.)[b]	Comments[c]
Santa Margarita River continued				
Male	OROR/Mgo	PUWH	≥ 1	Banded as an adult at TRP in 2012.
Male	BKBK	ORDG/Mgo	≥ 1	Banded as an adult at POE in 2012.
Male	YEPU	BYST/Mgo	≥ 1	Banded as an adult at YUK in 2012.
Male	BKBK	WHDP/Mgo	≥ 1	Banded as an adult at BAY in 2012.
Male		Mdb	≥ 1	Banded as a nestling at the SLR prior to 2012.
Male	?	?	≥ 1	Banded prior to 2012, unknown age.
Male		Msi	≥ 1	Banded prior to 2012, unknown age.
Male	?	?	≥ 1	Banded prior to 2012, unknown age.
Male		Mgo	≥ 1	Banded as a nestling at MCBCP prior to 2012.
Male	?	Mdb	≥ 1	Banded prior to 2012, unknown age.
Male	ORPU	ORPU/Mgo	1	Banded as a juvenile at the SMR in 2011.
Male	WHWH	BKBK/Mgo	1	Banded as a nestling at the SMR in 2011.
Male	WHWH	BYST/Mdb	1	Banded as a nestling at the SLR in 2011.
Male	WHWH	DBWH/Mdb	1	Banded as a nestling at the SLR in 2011.
Unknown	DPWH/Mgo	WHWH	≥ 1	Banded as an adult at ES24 in 2012.
Unknown	YEPU/Mgo	WHWH	HY	Banded as a juvenile at RR17 in 2012.
Unknown	ORPU	ORDG/Mgo	HY	Banded as a juvenile at AXE in 2012.
Unknown	PUPU/Mgo	WHWH	Unk.	Banded as unknown age at CAR in 2012.
Unknown	Mgo		HY	Banded as a nestling at CED in 2012.
Unknown	Mgo		HY	Banded as a nestling at CED in 2012.
Unknown	Mgo		HY	Banded as a nestling at COB in 2012.
Unknown	Mgo		HY	Banded as a nestling at COB in 2012.
Unknown	Mgo		HY	Banded as a nestling at ICE in 2012.
Unknown	Mgo		HY	Banded as a nestling at ICE in 2012.
Unknown	Mgo		HY	Banded as a nestling at QIN in 2012.
Unknown	Mgo		HY	Banded as a nestling at QIN in 2012.
Unknown	Mgo		HY	Banded as a nestling at QIN in 2012.
Unknown	Mgo		HY	Banded as a nestling at DRK in 2012.
Unknown	Mgo		HY	Banded as a nestling at DRK in 2012.
Unknown	Mgo		HY	Banded as a nestling at DRK in 2012.
Unknown	Mgo		HY	Banded as a nestling at JSP in 2012.
Unknown	Mgo		HY	Banded as a nestling at JSP in 2012.
Unknown	Mgo		HY	Banded as a nestling at JSP in 2012.
Unknown	Mgo		HY	Banded as a nestling at JSP in 2012.
Unknown	Mgo		HY	Banded as a nestling at APO in 2012.
Unknown	Mgo		HY	Banded as a nestling at APO in 2012.
Unknown	Mgo		HY	Banded as a nestling at APO in 2012.
Unknown	Mgo		HY	Banded as a nestling at APO in 2012.
Unknown	Mgo		HY	Banded as a nestling at TRF in 2012.
Unknown	Mgo		HY	Banded as a nestling at ICE in 2012.
Unknown	Mgo		HY	Banded as a nestling at AXE in 2012.
Unknown	Mgo		HY	Banded as a nestling at AXE in 2012.
Unknown	Mgo		HY	Banded as a nestling at AXE in 2012.
Unknown	Mgo		HY	Banded as a nestling at AXE in 2012.
Unknown	Mgo		HY	Banded as a nestling at ONX in 2012.

Appendix C. Continued.

Drainage / Sex	Band Combination[a] Left Leg	Right Leg	Age (yrs.)[b]	Comments[c]
Santa Margarita River continued				
Unknown	Mgo		HY	Banded as a nestling at ONX in 2012.
Unknown	Mgo		HY	Banded as a nestling at ONX in 2012.
Unknown	Mgo		HY	Banded as a nestling at COB in 2012.
Unknown	Mgo		HY	Banded as a nestling at COB in 2012.
Unknown	Mgo		HY	Banded as a nestling at CKE in 2012.
Unknown	Mgo		HY	Banded as a nestling at GEL in 2012.
Unknown	Mgo		HY	Banded as a nestling at CKI in 2012.
Unknown	Mgo		HY	Banded as a nestling at FAU in 2012.
Unknown	Mgo		HY	Banded as a nestling at FAU in 2012.
Unknown	Mgo		HY	Banded as a nestling at DRK in 2012.
Unknown	Mgo		HY	Banded as a nestling at DRK in 2012.
Unknown	Mgo		HY	Banded as a nestling at ARI in 2012.
Unknown	Mgo		HY	Banded as a nestling at ARI in 2012.
Unknown	Mgo		HY	Banded as a nestling at PIE in 2012.
Unknown	Mgo		HY	Banded as a nestling at PIE in 2012.
Unknown	Mgo		HY	Banded as a nestling at DNT in 2012.
Unknown	Mgo		HY	Banded as a nestling at DNT in 2012.
Unknown	Mgo		HY	Banded as a nestling at DNT in 2012.
Unknown	Mgo		HY	Banded as a nestling at DNT in 2012.
Unknown	Mgo		HY	Banded as a nestling at MUF in 2012.
Unknown	Mgo		HY	Banded as a nestling at MUF in 2012.
Unknown	Mgo		HY	Banded as a nestling at MUF in 2012.
Unknown	Mgo		HY	Banded as a nestling at TRF in 2012.
Unknown	Mgo		HY	Banded as a nestling at TRF in 2012.
Unknown	Mgo		HY	Banded as a nestling at JSP in 2012.
Unknown	Mgo		HY	Banded as a nestling at JSP in 2012.
Unknown	Mgo		HY	Banded as a nestling at CAR in 2012.
Unknown	Mgo		HY	Banded as a nestling at CAR in 2012.
Unknown	Mgo		HY	Banded as a nestling at CAR in 2012.
Unknown	Mgo		HY	Banded as a nestling at HLD in 2012.
Unknown	Mgo		HY	Banded as a nestling at HLD in 2012.
Unknown	Mgo		HY	Banded as a nestling at HLD in 2012.
Unknown	Mgo		HY	Banded as a nestling at DAQ in 2012.
Unknown	Mgo		HY	Banded as a nestling at DAQ in 2012.
Unknown	Mgo		HY	Banded as a nestling at DAQ in 2012.
Unknown	Mgo		HY	Banded as a nestling at DAQ in 2012.
Unknown	Mgo		HY	Banded as a nestling at FIN in 2012.
Unknown	Mgo		HY	Banded as a nestling at FIN in 2012.
Unknown	Mgo		HY	Banded as a nestling at TOP in 2012.
Unknown	Mgo		HY	Banded as a nestling at TOP in 2012.
Unknown	Mgo		HY	Banded as a nestling at TOP in 2012.
Unknown	Mgo		HY	Banded as a nestling at ECH in 2012.
Unknown	Mgo		HY	Banded as a nestling at ECH in 2012.
Unknown	Mgo		HY	Banded as a nestling at ECH in 2012.
Unknown	Mgo		HY	Banded as a nestling at BIL in 2012.

Appendix C. Continued.

Drainage	Band Combination[a]			
Sex	Left Leg	Right Leg	Age (yrs.)[b]	Comments[c]
Santa Margarita River continued				
Unknown	Mgo		HY	Banded as a nestling at BIL in 2012.
Unknown	Mgo		HY	Banded as a nestling at BIL in 2012.
Unknown	Mgo		HY	Banded as a nestling at TRP in 2012.
Unknown	Mgo		HY	Banded as a nestling at TRP in 2012.
Unknown	Mgo		HY	Banded as a nestling at TRP in 2012.
Unknown	Mgo		HY	Banded as a nestling at HTI in 2012.
Unknown	Mgo		HY	Banded as a nestling at HTI in 2012.
Unknown	Mgo		HY	Banded as a nestling at HTI in 2012.
Unknown	Mgo		HY	Banded as a nestling at BAY in 2012.
Unknown	Mgo		HY	Banded as a nestling at BAY in 2012.
Unknown	Mgo		HY	Banded as a nestling at BAY in 2012.
Unknown	Mgo		HY	Banded as a nestling at NEO in 2012.
Unknown	Mgo		HY	Banded as a nestling at NEO in 2012.
Unknown	Mgo		HY	Banded as a nestling at NEO in 2012.
Unknown	Mgo		HY	Banded as a nestling at HLX in 2012.
Unknown	Mgo		HY	Banded as a nestling at HLX in 2012.
Unknown	Mgo		HY	Banded as a nestling at HLX in 2012.
Unknown	Mgo		HY	Banded as a nestling at MER in 2012.
Unknown	Mgo		HY	Banded as a nestling at MER in 2012.
Unknown	Mgo		HY	Banded as a nestling at MER in 2012.
Unknown	Mgo		HY	Banded as a nestling at SHM in 2012.
Unknown	Mgo		HY	Banded as a nestling at SHM in 2012.
Unknown	Mgo		HY	Banded as a nestling at SHM in 2012.
Unknown	Mgo		HY	Banded as a nestling at SHM in 2012.
Windmill Creek				
Male	Mdb		≥ 1	Banded as a nestling at the SLR prior to 2012.

[a] Band colors: Mdb = dark blue numbered federal band; Mgo = gold numbered federal band; Msi = silver numbered federal band; gogo = metal gold; pupu = metal purple; sisi = metal silver; BKBK = plastic black; BKLP = plastic black-light pink split; BYST = plastic black-yellow striped; 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; MCAS = Marine Corps Air Station, Camp Pendleton; MCBCP = Marine Corps Base Camp Pendleton; PC = Pilgrim Creek; SLR = San Luis Rey River; SMO = San Mateo Creek; SMR = Santa Margarita River; SOF = San Onofre Creek; Unk. = Unknown drainage

APPENDIX D. BETWEEN-YEAR MOVEMENT OF ADULT LEAST BELL'S VIREOS AT MARINE CORPS BASE CAMP PENDLETON, 2012

Year Last Detected	Drainage[a] / Territory / Treatment[a]		Distance Moved (km)	Band Combination[b]		Age in 2012 (yrs.)	Sex[c]
	Last Seen	2012		Left Leg	Right Leg		
2011	SLR / WH25	SOF / OE16	25.4	WHWH	DPDB/Mdb	1	M
2011	SLR / WALE	SMR / ES03	6.8	DPDB	YEPU/Mdb	≥ 2	M
2011	SLR / DGWE	SMR / PO02	5.3	PUPU	BKBK/Mdb	≥ 2	M
2011	SLR / CBUT	SMR / YB04	4.9	WHWH	BYST/Mdb	1	M
2011	SLR / FO17	SMR / YB05	4.5	WHWH	DBWH/Mdb	1	M
2011	SMR / MIN / REM	SMR / RR26	2.3	WHWH	BKBK/Mgo	1	M
2011	SMR / HDX / REF	SMR / WSP / REF	0.5	ORPU	ORPU/Mgo	1	M
2011	SMR / HLD / REF	SMR / HLD / REF	0.1	PUWH/Mgo	pupu	≥ 8	M
2011	PL / PN02	PL / PN01	0.1	pupu	OROR/Mgo	≥ 6	M
2011	DL / DS06	DL / DS08	0.1	WHDP/Mgo	WHWH	≥ 4	M
2011	SMR / HOL / REF	SMR / BNT / REF	0.1	WHWH/Mgo	ORPU	4	M
2011	SMR / ES43	SMR / ES27	0.1	Mgo	BYST/sisi	4	M
2011	SMR / HW20	SMR / HW01	0.1	Mdb	WHDB/sisi	4	M
2011	SMR / BN01	SMR / BN06	0.1	DPDP	WHPU/Mgo	≥ 3	M
2011	SMR / BRI / REM	SMR / ICE / REM	0.1	OROR/Mgo	DPDP	≥ 3	M
2011	SMR / HLX / REM	SMR / HLX / REM	0.1	WHWH	LPBK/Mgo	≥ 2	M
2011	SMR / LIF / REF	SMR / ODN / REF	0.1	BYST/Mgo	PUWH	≥ 2	M
2011	SMR / DRK / REF	SMR / DRK / REF	0.1	DPWH	PUPU/Mgo	≥ 2	M
2011	SMR / FAU / REF	SMR / FAU / REF	0.1	PUPU	BYST/Mgo	≥ 2	M
2011	SMR / TOF / REM	SMR / TOF / REM	0.1	WHWH	OROR/Mgo	≥ 2	M
2011	SMR / ES44	SMR / ES26	0.0	Mgo	DPDP/pupu	≥ 6	M
2011	SMO / MT13	SMO / MT04	0.0	Mgo	PUOR/sisi	≥ 5	M
2011	SOF / OW04	SOF / OW07	0.0	LPBK	DBWH/Mdb	5	M
2011	LF / LL16	LF / LL07	0.0	PUWH/pupu	Mdb	5	M
2011	SMR / ES21	SMR / ES14	0.0	YEPU/sisi	Mgo	≥ 4	M
2011	SMR / ARI / REF	SMR / ARI / REF	0.0	BKLP	Mgo	≥ 4	M
2011	SMR / TRF / REM	SMR / TRF / REM	0.0	YEPU/Mgo	DPDP	≥ 3	M
2011	SMR / MER / REF	SMR / MER / REF	0.0	Mgo	WHDP	≥ 3	M
2011	SMR / CKI / REM	SMR / CKI / REM	0.0	DPDP	YEYE/Mgo	≥ 3	M
2011	SMR / NEO / REM	SMR / NEO / REM	0.0	DPWH	DPDP/Mdb	3	M
2011	SMR / PEP / REF	SMR / PEP / REF	0.0	BYST/Mgo	DPWH	≥ 2	M
2011	SMR / HTI / REF	SMR / HTI / REF	0.0	WHWH	PUPU/Mgo	≥ 2	M
2011	SMR / UM22	SMR / UM12	0.0	WHWH/Mdb	WHDB	≥ 2	M
2011	SMR / PIE / REM	SMR / PIE / REM	0.0	WHWH	YEPU/Mgo	≥ 2	M
2011	SMR / BIL / REF	SMR / BIL / REF	0.0	Mgo	ORDG/gogo	2	M
2010	MCAS / VIC	SMR / BN07	7.1	ORPU/Mgo	WHWH	2	F
2010	SMR / SMMAPS[d]	SMR / BN04	0.4	DPDP	BKBK/Mgo	≥ 3	F
2010	DL / DLMAPS[d]	LF / FS15	10.9	PUYE/Mgo	WHWH	2	M
2010	SMR / SMMAPS[d]	LF / LL09	8.0	DGOR/Mgo	WHWH	2	M
2010	SMR / SMMAPS[d]	SMR / ES12	0.9	PUWH	DGOR/Mgo	≥ 2	M
2010	SMR / BRW / REM	SMR / ES85	0.8	PUWH/Mgo	WHWH	2	M
2010	DL / DS02	SMR / AH10	0.2	YEPU	Mgo	≥ 3	M
2010	SMR / RR23	SMR / RR08	0.1	DPWH/sisi	Mgo	≥ 5	M
2010	SMR / DEU / REF	SMR / APO / REF	0.1	WHDP	WHWH/Mgo	≥ 3	M
2010	SMR / TOP / REM	SMR / TOP / REM	0.1	ORPU	OROR/Mgo	≥ 3	M

Appendix D. Continued.

Year Last Detected	Drainage[a] / Territory / Treatment[a]		Distance Moved (km)	Band Combination[b]		Age in 2012 (yrs.)	Sex[c]
	Last Seen	2012		Left Leg	Right Leg		
2010	SMR / OOR / REM	SMR / ECH / REM	0.0	PUWH/Mgo		≥ 8	M
2010	SMR / HW27	SMR / HW16	0.0	ORPU/gogo	Msi	≥ 5	M
2010	SMR / ES63	SMR / ES23	0.0	Mgo	WHPU/sisi	4	M
2010	SMR / AE50	SMR / AE04	0.0	WHPU	Mgo	≥ 3	M
2010	SMR / ES54	SMR / ES04	0.0	Mgo	OROR/sisi	3	M
2009	SMR / APO / REF	SLR / CHR	11.8	BKLP/gogo	Mgo	3	F
2009	SMR / PR43	SMR / MUF / REM	0.9	PUPU/Mgo	PUPU	≥ 4	F
2009	SMR / ARI / REF	SMR / APO / REF	0.1	DPWH	Mgo	5	F
2009	SMR / SMMAPS[d]	SMR / ES26	0.1	YEYE/sisi	Mgo	≥ 4	F
2009	SMR / HDX / REF	DL / DN06	9.1	DPWH	YEPU/Mgo	3	M
2009	SMR / JSP / REF	SMR / HE37	3.5	PUYE/Mgo	pupu	≥ 5	M
2008	SMR / BEK / REF	SMR / PR05	6.7	Mgo	Mye	4	F
2008	DL / DS14	SMR / JSP / REF	3.5	DPDP/Mgo	WHWH	4	F
2008	SMR / SMMAPS[d]	SMR / ES34	24.6	Msi	DGOR	4	M
2007	SMR / ODN / REF	SMO / MB17	24.9	pupu	ORPU/Mgo	5	F
2007	SLR / WG2	SMR / AW01	15.1	WHDB	DPDB/Mdb	5	F
< 2012	SLR	SMR / AE21	6.0[e]		Mdb	≥ 1	M
< 2012	SLR	SMR / ES01	5.8[e]		Mdb	≥ 1	F
< 2012	SLR	WC / WC03	3.7[e]	Mdb		≥ 1	M
< 2012	SLR	SMR / SE17	3.1[e]	?	Mdb	≥ 1	M

[a] Drainage Codes: DL = De Luz Creek; LF = Las Flores Creek; MCAS = Marine Corps Air Station, Camp Pendleton; PL = Pilgrim Creek; SLR = San Luis Rey River; SMO = San Mateo Creek; SMR = Santa Margarita River; SOF = San Onofre Creek; WC = Windmill Creek; Treatment Codes: REM = Removal; REF = Reference.

[b] Band colors: Mdb = dark blue numbered federal band; Mgo = gold numbered federal band; Msi = silver numbered federal band; gogo = metal gold; pupu = metal purple; sisi = metal silver; BKBK = plastic black; BKLP = plastic black-light pink split; BYST = plastic black-yellow striped; 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.

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

APPENDIX E. STATUS AND NESTING ACTIVITIES OF LEAST BELL'S VIREOS AT MARINE CORPS BASE CAMP PENDLETON, 2012

Territory	Nest	Monitoring[a]	Nest Fate[b]	# Fledged	Comments
Giant Reed (*Arundo donax*) Removal Site Territories					
BAY	1	P	SUC	3	
CAR	1	P	SUC	3	
CAR	2	P	PRE		
CAR	3	P	SUC	3	
CKE	1	P	SUC	1	
CKI	1	P	INC		Nest not completed.
CKI	2	P	SUC	1	
COB	1	P	PRE		
COB	2	P	SUC	2	
DNT	1	P	PRE		
ECH	1	P	SUC	3	
GEL	1	P	SUC	1	
HLX	1	P	SUC	3	
ICE	1	P	SUC	1	
ICE	2	P	SUC	2	
MUF	1	P	PRE		
MUF	2	P	SUC	3	
NEO	1	P	PRE		
NEO	2	P	SUC	3	
PIE	1	P	SUC	2	
SHM	1	P	SUC	4	
STR	1	P	PRE		
STR	2	P	INC		Nest not completed.
TOF	1	P	PRE		
TOF	2	P	OTH		Nest support failed.
TOF	3	P	PRE		
TOF	4	P	SUC	1	
TOP	1	P	SUC	3	
TRF	1	P	SUC	1	
TRF	2	P	SUC	2	
TRP	1	P	SUC	3	
TRP	2	P	PRE		
YUK	1	P	OTH		Nestlings died of starvation.
Reference Site Territories					
APO	1	P	SUC	4	
ARI	1	P	SUC	2	
AXE	1	P	SUC	4	
BIL	1	P	SUC	3	
BNT	1	P	UNK		Nest abandoned. Cause of failure unknown.
BNT	2	P	OTH		Incubation lasted longer than normal, eggs likely infertile or dead.
CED	1	P	FAL		Incomplete nest, only male seen building.
CED	2	P	SUC	2	
DAQ	1	P	SUC	4	
DEU	1	P	PRE		
DEU	2	P	FAL		Incomplete nest, only male seen building.

Appendix E. Continued.

Reference Site Territories

Territory	Nest	Monitoring[a]	Nest Fate[b]	# Fledged	Comments
DEU	3	P	PRE		
DRK	1	P	PRE		
DRK	2	P	SUC	3	
FAU	1	P	SUC	2	
FIN	1	P	SUC	2	
FIN	2	P	PRE		
HDX	1	P	UNK		Nest abandoned between nest-building and egg-laying. Cause of failure unknown
HDX	2	P	OTH		Single punctured egg in failed nest.
HDX	3	P	PRE		
HLD	1	P	SUC	3	
HOL	1	P	PRE		
HOL	2	P	INC		Nest not completed.
HOL	3	P	PRE		
HRP	1	P	PRE		
HRP	2	P	PRE		
HTI	1	P	SUC	3	
JSP	1	P	PRE		
JSP	2	P	SUC	2	
MER	1	P	UNK		No eggs observed in nest but nest lining disturbed. Cause of failure unknown
MER	2	P	PRE		
MOU	1	P	PRE		
ODN	1	P	PRE		
ONX	1	P	SUC	3	
QIN	1	P	SUC	3	

[a] Monitoring: P = partially monitored territory.

[b] Nest Fate: FAL = false nest; INC = nest not completed; OTH = nest failed for reasons other than predation that are known; PRE = nest failure caused by predation; SUC = fledged at least one Least Bell's Vireo young; UNK = reason for nest failure/abandonment unknown.