Western Riverside County
Multiple Species Habitat Conservation Plan (MSHCP)
Biological Monitoring Program

San Diego Banded Gecko (*Coleonyx variegatus abbotti*) Survey Report 2009

23 April 2010

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NOTE TO READER:

This report is an account of survey activities conducted by the Biological Monitoring Program for the Western Riverside County Multiple Species Habitat Conservation Plan (MSHCP). The MSHCP was permitted in June 2004. The Monitoring Program monitors the distribution and status of the 146 Covered Species within the Conservation Area to provide information to Permittees, land managers, the public, and the Wildlife Agencies (i.e., the California Department of Fish and Game and the U.S. Fish and Wildlife Service). Monitoring Program activities are guided by the MSHCP species objectives for each Covered Species, the information needs identified in MSHCP Section 5.3 or elsewhere in the document, and the information needs of the Permittees.

MSHCP reserve assembly is ongoing and it is expected to take 20 or more years to assemble the final Conservation Area. The Conservation Area includes lands acquired for conservation under the terms of the MSHCP and other lands that have conservation value in the Plan Area (called public or quasi-public lands in the MSHCP). In this report, the term "Conservation Area" refers to the Conservation Area as understood by the Monitoring Program at the time the surveys were planned and conducted.

We would like to thank and acknowledge the land managers in the MSHCP Plan Area, who in the interest of conservation and stewardship facilitate Monitoring Program activities on the lands for which they are responsible. A list of the lands where data collection activities were conducted in 2009 is included in Section 7.0 of the Western Riverside County Regional Conservation Authority (RCA) Annual Report to the Wildlife Agencies. Partnering organizations and individuals contributing data to our projects are acknowledged in the text of appropriate reports.

While we have made every effort to accurately represent our data and results, it should be recognized that data management and analysis are ongoing activities. Any reader wishing to make further use of the information or data provided in this report should contact the Monitoring Program to ensure that they have access to the best available or most current data.

The primary preparer of this report was the 2009, Herpetofauna Program Lead, Robert Packard. If there are any questions about the information provided in this report, please contact the Monitoring Program Administrator. If you have questions about the MSHCP, please contact the Executive Director of the RCA. Further information on the MSHCP and the RCA can be found at www.wrc-rca.org.

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INTRODUCTION

The Species Objectives for San Diego banded gecko (*Coleonyx variegatus abbotti*), as defined by the Western Riverside County MSHCP, require conservation of the following 7 Core Areas and their associated linkages: 1) San Jacinto foothills, 2) Lake Skinner-Diamond Valley Lake, 3) Lake Mathews-Estelle Mountain, 4) San Jacinto Wildlife Area-Lake Perris, 5) Badlands, 6) Santa Ana Mountains, and 7) Sage-Vail Lake. Species Objectives also require continued use of at least 75 percent of the listed Core Areas, as documented at least once every 8 years (Dudek & Associates 2003). San Diego banded gecko is a California species of special concern. It is a microhabitat generalist that occurs in a wide variety of sage scrub and chaparral vegetation communities where suitable cover exists (e.g., rocks, organic debris). Rock outcrops with some associated ground cover is often a preferred habitat (Stebbins 2003, Lemm 2006).

We conducted nocturnal-lizard surveys in the summer and fall of 2008 to document the presence of San Diego banded gecko and granite night lizard (*Xantusia henshawi*) in the MSHCP Conservation Area. These surveys were effective at locating granite night lizard (129 records), but not at detecting San Diego banded gecko (2 records). The 2008 surveys were area searches that specifically targeted rock outcrops, habitat known to be used by both species (Stebbins 2003, Lemm 2006). The 2 areas where banded geckos were found during these surveys were the Multi-species and Motte Rimrock Reserves, the latter being a non-Core Area. However, whether resulting from targeted surveys or incidental observations, more San Diego banded gecko were found diurnally (n = 7) under cover in 2008 and 2009 than during nocturnal surveys (n = 2). Moreover, we observed San Diego banded gecko diurnally under cover at Sage-Vail Lake, but did not detect the species at this location during nocturnal surveys. The failure to effectively detect San Diego banded gecko at night in rock outcrops has directed us to attempt other methods for locating this species that can account for animals present but not detected.

Herp arrays consisting of pit-fall traps and drift fences have proven a useful tool for finding San Diego banded gecko (Fisher and Case 1999), but require a substantial investment in personnel and equipment. Pit-fall traps also involve semi-permanent structures that can disturb the natural habitat. Using artificial cover may be a less labor-intensive and more cost-effective method of surveying for cryptic species. Artificial cover does not require digging, and cover can easily be transported among survey sites. Geckos utilize cover objects during the day to avoid high temperatures (Behler and King 1979), and use of artificial cover has been shown to be an effective means of detecting the species (Klauber 1945, Parker 1972). San Diego banded gecko can also be found under natural cover such as rocks, logs, and other debris during the day (Stebbins 2003). Artificial-cover designs can also easily be adapted to an occupancy framework (MacKenzie et al. 2006) that can allow for estimation of detection probabilities.

We examined the utility of artificial-cover stations versus natural-cover transects, and diurnal and nocturnal surveys to detect San Diego banded gecko by comparing detection probabilities derived from each method. We also estimated detection probabilities for co-occurring Covered Species (e.g., granite night lizard) to examine the utility of these methods to address multiple species objectives. We focused our 2009

effort in suitable San Diego banded gecko habitat at Lake Perris-San Jacinto Wildlife Area (SJWA) where the species is known to occur. Specifically, our survey goals in 2009 were as follows:

Goals and Objectives

1. Compare the effectiveness of artificial-cover stations vs. belt transects to detect San Diego banded gecko.
    a. Estimate detection probability following an occupancy-design framework.
2. Compare ability of diurnal vs. nocturnal surveys to detect San Diego banded gecko.
    a. Estimate detection probability following an occupancy-design framework.
3. Work in collaboration with USGS to collect genetic material for an ongoing population study of reptiles in southern California.
    a. Retrieve tissue samples from USGS target species for genetic analysis.

METHODS

Personnel and Training

Crew members were trained by the Herpetofauna Program Lead and experienced staff on survey techniques and species identification. Training consisted of studying identification materials developed by the Biological Monitoring Program based on local and national field guides. All crew members also received in-field training on survey protocol, animal identification, and learned to take tissue samples according to USGS protocol (Appendix A). Collection of tissue samples was also practiced in the office on live specimens (e.g., side-blotched lizard-*Uta stansburiana*) when available. Lastly, field personnel were versed in safety precautions and procedures when dealing with venomous animals. All San Diego banded gecko survey personnel in summer/fall 2009 also participated in the artificial-cover survey during the fall of 2008 and spring of 2009, which had similar protocol and species identification requirements. All personnel were able to navigate using a GPS unit, and were trained in the identification of herpetofauna of southern California. Biological Monitoring Program staff was funded by either the Regional Conservation Authority or California Department of Fish and Game. Staff that conducted surveys for San Diego banded gecko in 2009 are listed below.

- Robert Packard (Project Lead, Biological Monitoring Program)
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- Ashley Ragsdale (Biological Monitoring Program)
- Bill Kronland (Biological Monitoring Program)
- Conan Guard (Biological Monitoring Program)
- Elizabeth Dionne (Biological Monitoring Program)
- Esperanza Sandoval (Biological Monitoring Program)
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- Karyn Lee-Drennen (Biological Monitoring Program)

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- Masanori Abe (Biological Monitoring Program)
- Misty Gray (Biological Monitoring Program)
- Nate Zalik (Biological Monitoring Program)
- Nicholas Peterson (Biological Monitoring Program)
- Nydia Celis (Biological Monitoring Program)

Survey Design

We used Arc GIS v. 9.3 (ESRI 2008) and a GIS-based vegetation map (CDFG et al. 2005) to identify coastal sage scrub and chaparral vegetation communities at Lake Perris-SJWA and Sage-Vail Lake Core Areas. We identified and removed from our area of inference all chaparral with cover density ≥ 40% and slopes > 25 degrees, because these landscapes cannot be safely or practicably accessed by surveyors. We used Hawth's Tools extension (Beyer 2004) for Arc GIS to distribute regular points across each Core Area, stratified by the habitat characteristics defined above. Points were spaced 800 m apart at Lake Perris-SJWA and 850 m apart at Sage-Vail Lake to maintain a density among cores of approximately 1 point per 70 ha [Lake Perris-SJWA (n =16), Sage-Vail Lake (n =35); Figures 1 and 2].

We centered artificial-cover stations on each of the regular points generated in Arc GIS v. 9.3. Each artificial-cover station consisted of 4 pieces of indoor/outdoor carpeting (0.6 m x 1.2 m) arranged into a grid with 1-m spacing and aligned along a north-south bearing. We also extended 100-m (diurnal surveys) or 200-m (nocturnal surveys) transects north of each artificial-cover station at Lake Perris-SJWA Core Area. We then conducted diurnal surveys at Lake Perris-SJWA by checking cover stations and 100-m transects following a repeat-visit design, maintaining a 7-day interval between visits for a total of 4 visits (7 July to 20 August). We limited diurnal surveys to 4 weeks so that stations and transects could be sampled entirely during the warm months of the year when we believed San Diego banded gecko to be active (Parker 1972), and to control for seasonal variation in detectability. Nocturnal surveys also followed a repeat-visit design over 4 visits (31 August and 23 October), but with a 14-day interval between surveys due to the difficulty of sampling multiple transects at night. We also did not check natural or artificial cover during nocturnal surveys, because we believed that the target species would be active and in the open.

We opportunistically checked artificial-cover stations at Lake Perris-SJWA and Sage-Vail Lake Core Areas in the fall as survey personnel became available (5 to 23 November). We checked each station once to gain insight into seasonal effects of artificial-cover use by San Diego banded gecko.

Field Methods

Artificial Cover

We established artificial-cover stations by first navigating to points with GPS units and setting carpet pieces with the backing side facing up. All artificial cover was clearly marked with a "California Department of Fish and Game/MSHCP Research Material/Do Not Disturb" label affixed to the carpet. We also weighted down each piece

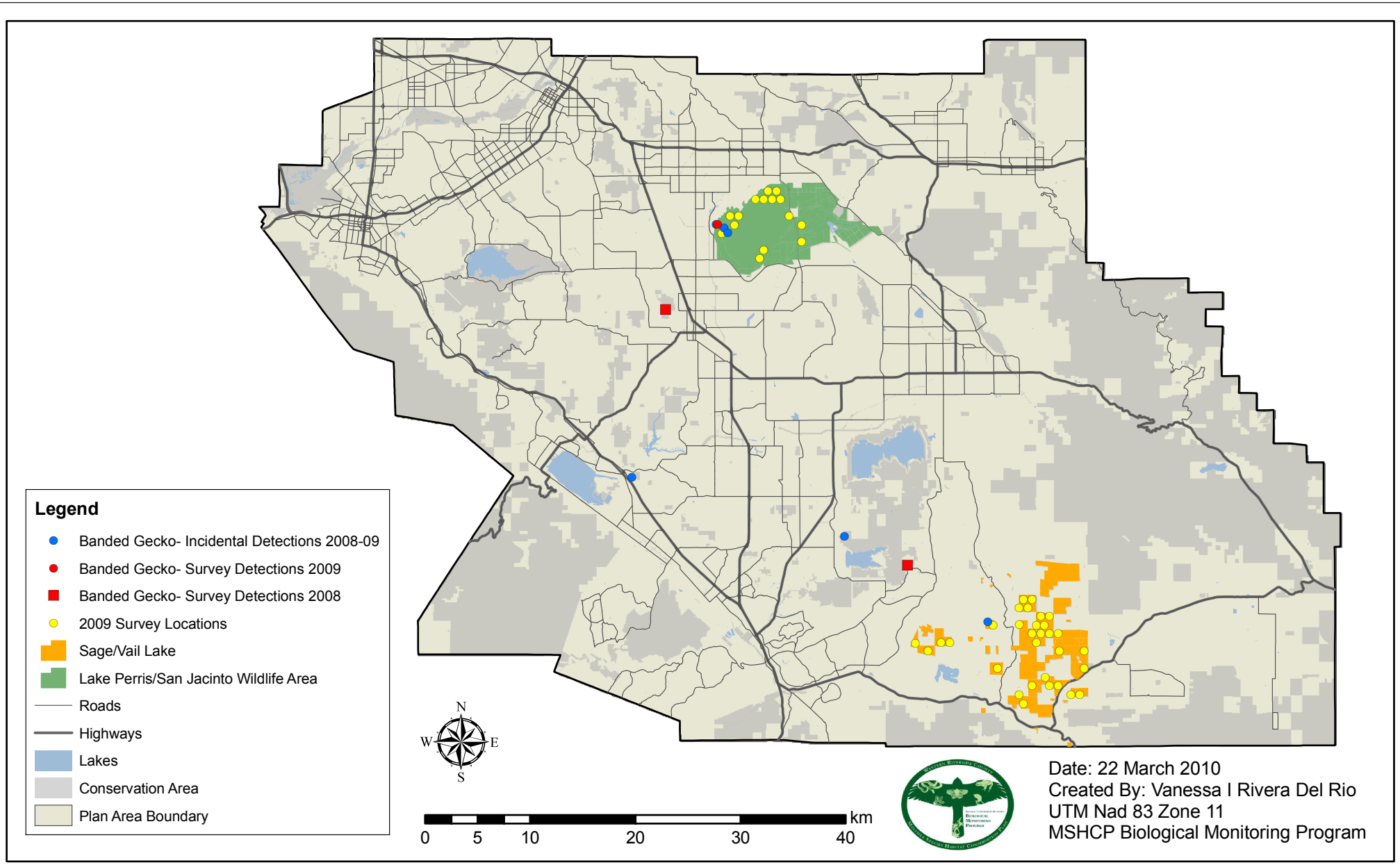

Figure 1. Banded gecko survey locations and detections 2008- 2009.

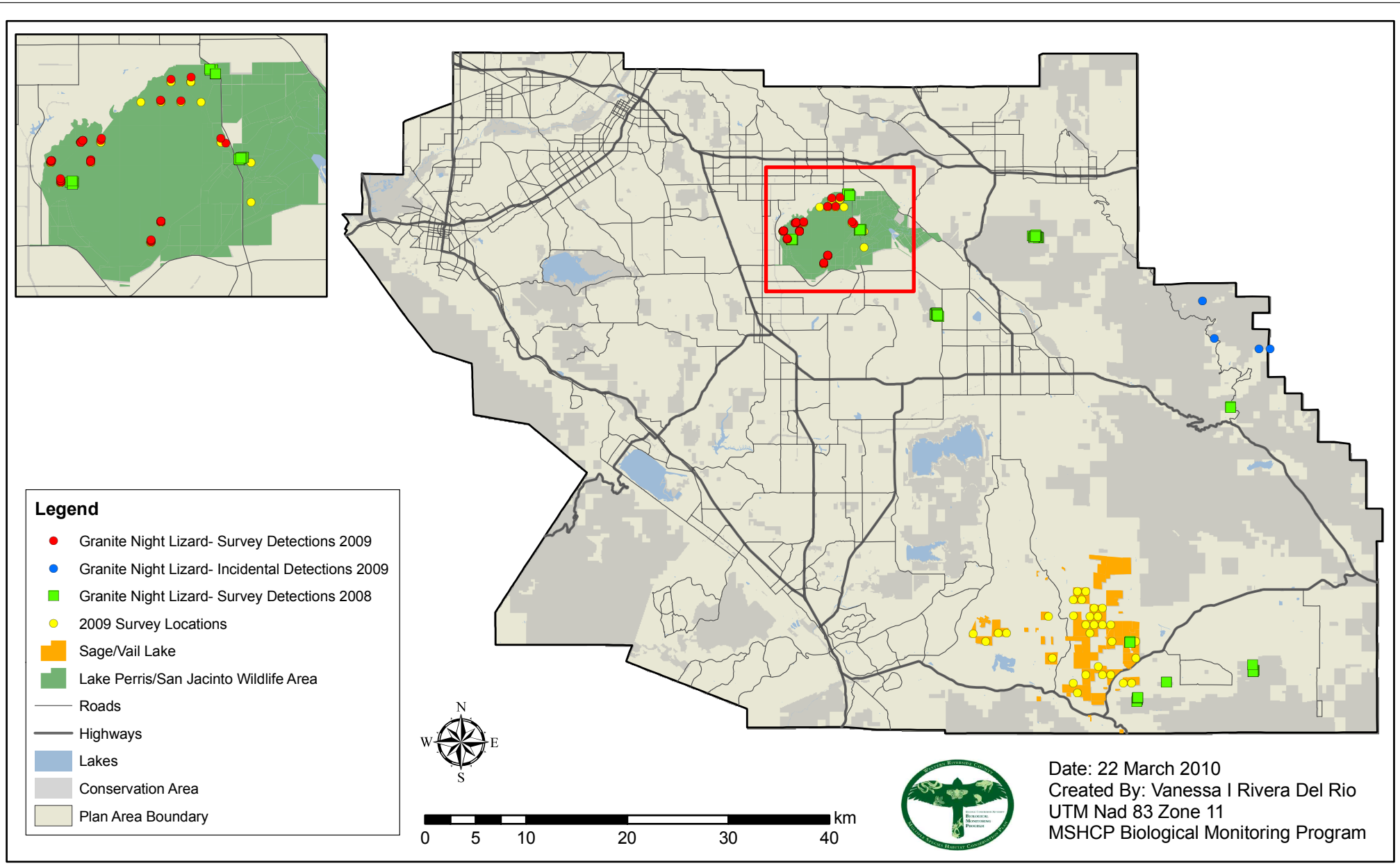

Figure 2. Granite night lizard survey locations and detections 2008-2009.

of carpet with natural objects found nearby (e.g., rocks) to prevent them from being blown away. We installed artificial-cover stations at least 2 weeks before conducting surveys, and with a minimum interval of 7-days between visits to allow animals to reacclimatize to cover (Grant et al. 1992, Monti et al. 2000).

We checked under each carpet piece during summer (diurnal only) and fall surveys, and recorded every reptile, amphibian, and mammal species found. Animals were captured and identified in-hand whenever possible, and we collected the following information for each captured MSHCP Covered Species and USGS target species: weight (g), snout-to-vent length (mm), tail length (mm), sex (male, female, unknown), age (adult, juvenile, unknown), and any irregularities (e.g., regrown tail, scars, injuries, etc.). We marked each captured MSHCP Covered Species and USGS target species on the ventral surface, just anterior to the cloaca, with a black-permanent marker to determine the number of individuals detected during surveys. We also collected tissue samples from each USGS target species captured by taking 3 ventral scale clips (~ 1 mm x ~ 3 mm) from the largest non-adjoining mid-body scales from each larger snake (Appendix A). We snipped the tip of the tail (~ 3 mm) of each lizard and small snake with scissors, and collected the sample in a centrifuge tube, except at California State Parks where snake tail tips were not collected due to concern by State Parks management about the permanence of the injury. We sterilized scissors with ethanol before and after collecting each sample. We only recorded the species code and number detected in each life stage for non-covered species and non-USGS target species. All animals were released at the cover station where they were found after data were collected. Processing time ranged between 30 s and 5 min depending on the species. Finally, we recorded the USGS sky condition (0 = clear or few clouds, 1 = party cloudy or variable, 2 = cloudy or overcast, 3 = fog, 4 = mist or drizzle, 5 = showers or light rain, 6 = heavy rain, 7 = sleet or hail, 8 = snow), wind speed (km/hr), and temperature (°C) at each station before and after checking all cover. No surveys were conducted during heavy rain or when temperatures exceeded 38 degrees C. Artificial cover-station checks took from 1 to 23 minutes with an average of 5 minutes, depending on whether any animals were found and processed.

Diurnal Transect Surveys

We conducted diurnal-transect surveys by checking under each piece of natural cover along transects (100 m x 20 m) that could be manipulated without permanently altering the ability of the object to provide refuge. Surveys were conducted between 0600 h and 1300 h, and we captured and identified animals in-hand whenever possible. No surveys were conducted during heavy rain or when temperatures exceeded 38 degrees C. We recorded the same information as taken for MSHCP Covered Species and USGS target species found at artificial-cover stations. We also recorded a GPS waypoint for each MSHCP Covered Species and USGS target species, and noted the natural cover along each transect as a tally of cover substrate [large rocks (diam > 40 cm), small rocks (diam ≤ 40 cm), woody debris, and trash] that was checked by surveyors. We surveyed diurnal natural-cover transects immediately after checking artificial-cover stations, and each survey lasted from 7 to 50 minutes (avg. 21 minutes), depending on the number of animals detected and the terrain traversed.

Nocturnal Transect Surveys

We flagged the centerline of a 200-m transect extending north from each artificial-cover station with reflective tape, and planted a wooden stake with reflective tape at the north end of each transect. Two observers surveyed each transect starting 30 min after sunset and finishing no later than 2400 h. Surveyors used flashlights and headlamps to search all terrestrial surfaces and rock crevices within 10 meters on either side of the transect centerline. No artificial or natural cover was checked during nocturnal surveys, as it was assumed nocturnal animals would not be under cover at night. We recorded the same information as we did for diurnal surveys, with the addition of moon phase (new, ¼, ½, ¾, full). Nocturnal surveys were not done during any significant precipitation, or when temperature was above 38 C or below 5 C. Nocturnal surveys lasted from 30 to 94 minutes (avg. 57 minutes), depending on the number of animals detected and the terrain traversed.

Specimen Collection

We recorded and collected all skins and dead reptiles found under artificial- or natural-cover while conducting transect surveys or while traveling to or from survey locations. We placed specimens in a labeled plastic bag and brought them back to the office for identification and future training purposes. We also took digital photos of any unusual live animals (e.g., neonates, odd color morphs, etc.) and all Covered Species captured.

Data Analysis

We detected too few San Diego banded gecko to model estimates of detection probability regardless of method used. Overall detections of any species at artificial-cover stations were also few, and did not support statistical analysis. Therefore, we estimated nightly-detection probabilities (p) for granite night lizard recorded along nocturnal transects, and granite spiny lizard (*Sceloporus orcutti*) detected along diurnal transects. We did detect sufficient numbers of other Covered Species to model p.

We used a closed-capture occupancy model in Program MARK to construct 2 candidate models that examined time-constant and time-varying (i.e., varying across visits) effects on p, while considering the occupancy parameter as constant (White and Burnham 1999, MacKenzie et al. 2006). We then ranked candidate models in each set according to Akaike's Information Criterion for small samples (AICc), calculated Akaike weights (w_i), and derived weighted-average estimates for p across the entire candidate set, unless a single model showed clear support (i.e., $w_i > 0.9$) (Burnham and Anderson 2002). We calculated cumulative detection probability (P^*) using the following formula where p_i is the detection probability on a given survey night: $P^* = 1 - \prod_{i=1}^{3} 1 - p_i$. Variances for P^* were calculated using the delta method (MacKenzie et al. 2006).

RESULTS

We only recorded 2 individual side-blotched lizards (*Uta stansburiana*) under artificial cover in the summer, and did not detect San Diego banded gecko during either artificial-cover or diurnal-transect surveys. We detected granite spiny lizard (n = 43), orange-throated whiptail (*Aspidoscelis hyperthra*, n = 6), red diamond rattlesnake

(*Crotalus ruber ruber*, *n* = 1), and the following non-Covered Species during diurnal-transect surveys: side-blotched lizard (*Uta stansburiana*, *n* = 14), southern alligator lizard (*Elgaria multicarinata*, *n* = 1), western fence lizard (*Sceloporus occidentalis*, *n* = 1), common kingsnake (*Lampropeltis getula*, *n* = 1), longnose snake (*Rhinocheilus lecontei*, *n* = 1), and 4 unidentified lizards and 3 unidentified snakes. We checked an average number of 33.71 (SE = 3.57) pieces of natural cover per transect per survey. Most (*n* = 66) animals were detected in the open, with only 7 total reptiles found under natural cover (4 Side-blotched lizards, 2 unknown lizard species, and one skin of a southern alligator lizard).

We recorded 1 San Diego banded gecko during nocturnal transects, and 2 while traveling between nocturnal transects. We also recorded granite night lizard (*n* = 54), northern red diamond rattlesnake (*n* = 9), granite spiny lizard (*n* = 3), San Diego pocket mouse (*Chaetodipus fallax fallax*, *n* = 1), and the following non-Covered Species during nocturnal-transect surveys: lyre snake (*Trimorphodon lyrophanes*, *n* = 2), southern alligator lizard (*Elgaria multicarinata*, *n* = 1), common kingsnake (*Lampropeltis getula*, *n* = 1), deer mouse (*Peromyscus maniculatus*, *n* = 4), cactus mouse (*Peromyscus eremicus*, *n* = 1), 2 unidentified *Peromyscus* species and 1 unidentified snake.

We considered estimates of *p* derived from a time-constant model for granite night lizard and granite spiny lizard based on Akaike weights (Table 1). Nightly detection probabilities were similar between granite night lizard (*p* = 0.43, SE = 0.08) and granite spiny lizard (*p* = 0.42, SE = 0.09), and cumulative detection probabilities fell below 1 (granite night lizard: *P** = 0.89, SE = 0.06; granite spiny lizard: *P** = 0.88, SE = 0.07).

We only recorded 8 individual lizards under artificial cover in the fall, 7 side-blotched lizards (Lake Perris-SJWA: *n* = 5; Wilson Valley: *n* = 2), and 1 unidentified lizard in the Wilson Valley Core.

Table 1. Model-selection results from candidate sets used to estimate detection probabilities for granite night lizard and granite spiny lizard. Akaike's Information Criterion for small samples (AICc), Akaike weights (wi), number of parameters estimated (K), and log likelihood presented.

Model	AICc	ΔAICc	w_i	K	2Log(L)	Deviance
granite night lizard						
p(time-constant)	87.17	0	0.99	2	82.25	10.16
p(time-varying)	96.16	8.99	0.01	5	80.16	8.01
granite spiny lizard						
p(time-constant)	79.53	0	0.99	5	74.61	12.93
p(time-varying)	88.82	9.29	0.01	2	72.82	11.15

DISCUSSION

Diurnal transects and artificial-cover stations performed poorly at detecting San Diego banded gecko, with no individuals found using either method. Artificial cover typically takes an extended period of time to mold to the ground, retain moisture, and attract invertebrates and rodents (Grant et al. 1992, Monti et al. 2000). We only allowed cover to sit for 2 weeks before beginning surveys, and checked stations for only 4 weeks in the summer and once in the fall. We detected few individuals of any species under

artificial cover, and it is plausible that our carpet pieces required more time to take on characteristics of cover that is attractive to reptiles. Checking natural cover along diurnal transect was not productive, and the majority of animals detected were out in the open. It is possible that gecko may have been underground in mammal burrows to avoid the typical daytime summer temperatures and aridity. Most of the cover objects we checked had a few various-sized burrows underneath them, and the few that did not generally lacked any space underneath to allow animals to enter.

We detected many granite night lizards during nocturnal surveys, but only 1 San Diego banded gecko on transects, and 2 individuals while traveling between transects. All 3 geckos were located away from rock surfaces, unlike the 2 detections made during nocturnal surveys in 2008 that targeted rock outcrops. It is possible that animals may have been missed in 2008 because surveys were limited to a single landscape feature. Still, San Diego banded gecko is a small and cryptic species that is difficult to detect among vegetation. Density of vegetation varied across our transects, with most containing at least some portion of high-density shrub cover. It is possible that we missed animals in 2009 as well, especially if underneath shrub cover.

Seasonal activity may have also negatively impacted our 2009 survey results. All 3 San Diego banded gecko were detected as cooler temperatures (17-24 degrees C) prevailed later in the season (14 Sept to 29 Sept), in contrast to reported peak activity for the species occurring in temperature range of 24 – 33 degrees C (Vance 1973). Male San Diego banded gecko are also typically more active when they emerge from hibernation as temperatures rise in the Spring, and are on the move searching for females (Lemm 2006). Staff at Lake Perris State Park has also reported that they often see gecko on roads and trails at night during the Spring (*Ken Kietzer, personal communication*).

Nocturnal- and diurnal-transect surveys were successful at detecting Covered Species other than San Diego banded gecko, especially granite night lizard and granite spiny lizard (Appendix B). Still, our probability of detecting either of these species fell below 1. Difficulty in consistently detecting granite night lizard may be explained by inter-observer variability. Finding granite night lizard requires experience in knowing which rock crevices are most attractive to the species, good eyesight, and some degree of motivation and persistence to check deep inside pencil-thin crevices. In contrast, granite spiny lizard is relatively easy to detect, being diurnally active at rock surfaces, but likely temperature dependent. The median temperature that we detected granite spiny lizard on transects known to be occupied was 24.9 degrees C, with 50% of detections occurring in a range of 23.4 – 26.4 degrees C. In contrast, 80% of missed detections occurred above or below that range. Diurnal surveys began at 0600 h and ended at 1300 h, spanning a thermal range of 19.6 – 35.9 degrees C. We did not hold constant the time of day transects were surveyed across rounds, and it is likely that granite spiny lizard activity (i.e., detectability) varied across the day, and impacted our estimated detection probability.

We have conducted either nocturnal-lizard or species-specific surveys in 6 of 7 San Diego banded gecko Core Areas, and have found the species in only 3 (43%) of them (Lake Skinner-Diamond Valley Lake, Lake Perris-San Jacinto Wildlife Area, and Sage-Vail Lake). We must find individuals at 3 additional Core Areas to meet the Species

Objective of being present in at least 75% (n = 6) of MSHCP-defined Cores. We have not yet surveyed the Santa Ana Mountains for San Diego banded gecko, due to the scarcity of suitable habitat and the difficulties associated with traveling in this area at night. We have also not adequately surveyed the northern portion of the San Jacinto Foothills (The Sage-Vail Lake Core is included within the larger San Jacinto Foothills Core). We installed artificial cover (2 x 4 foot sections of carpeting and plywood) in the Santa Ana Mountains, Agua Tibia area, portions of the San Jacinto Mountains, the Santa Margarita Ecological Reserve, and the Iron Springs area in 2008 and 2009 as part of a survey for San Diego mountain kingsnake (*Lampropeltis zonata pulchra*), San Bernardino mountain kingsnake (*L. z. parvirubra*), southern rubber boa (*Charina umbratica*), and southern sagebrush lizard (*Sceloporus vandenbugianus*). These surveys may prove useful in detecting San Diego banded gecko in these areas.

Recommendations for Future Surveys

Methods for detecting San Diego banded gecko should continue to be tested and nocturnal transects should be surveyed at Lake Perris State Park during the Spring when the species has been reported to be most active. Transect surveys should also be considered for other Covered Species when field personnel are available, but take into consideration appropriate habitat and factors that can impact animal activity (e.g., season, daily temperature, diurnal vs. nocturnal). Effort should also be made to keep field crew motivated, and emphasize the importance of carefully searching transects for difficult to detect species.

Artificial cover should continue to be checked at Lake Perris-SJWA and Sage-Vail Lake Cores to determine if time and weatherization is a significant factor in utilization of artificial cover by San Diego banded gecko. Herp arrays should be considered only if all other methods fail to effectively detect San Diego banded gecko, because the labor requirement associated with this method can be prohibitive. Moreover, herp arrays are not completely applicable to our survey goals, as it would require many arrays to quantify detection and confirm species absence. Design of herp arrays should therefore maximize the area of suitable habitat that is sampled in Core Areas, possibly by arranging drift fences linearly in long transects with pit-fall traps spaced throughout.

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Appendix A. Western Riverside County MSHCP Biological Monitoring Program, Protocol for Reptile Tissue Sampling, March 2009

Tissue sampling has been shown to be a valuable component of scientific and genetic studies. Many genetic studies have revealed important results about local populations (Richmond, Jockusch 2007; Wood, Fisher, Reeder 2007), and tissue sampling allows for analyses of population genetics to be conducted without killing individuals in the population. Reptiles generally recover quickly from injuries sustained during acquisition of a small tissue sample, and the resulting scars can be used to aid in recapture identification analysis. Scale clipping and taking tail tips rarely draws blood, and the application of a tissue adhesive (e.g., New Skin) will speed the healing process and stem any blood loss. The tissue adhesive should also help minimize the risk of bacterial infection, although this is a possible deleterious side-effect. Some species of lizards also readily shed their tails as a defense mechanism and although care will be taken to process all animals as quickly and carefully as possible it is likely that a small number of individuals will lose their tails during handling. Although there are some risks associated with tissue sampling, this method should have less impact on target populations than taking specimens for vouchering and still provide valuable monitoring data.

The protocol outlined below will be followed by Monitoring Program staff processing reptiles in the field. All current herpetological personnel were trained in taking tissue samples by a USGS biologist at the USGS office in San Diego on March 5, 2009, or trained by those who attended said training. Tissue samples were taken by all crew from dead specimens; however a live specimen was used for demonstrating handling techniques while taking tissue samples. Future personnel will be trained by our crew on live specimens in the field. All tissue samples will be temporarily stored in refrigeration at the MSHCP's Biological Monitoring Office at 4500 Glenwood Drive, Riverside, CA, and then transported to the USGS Western Ecological Research Center's San Diego Field Office at 4165 Spruance Road, San Diego, CA for genetic analysis.

USGS TARGET SPECIES Processing Methods

Target Species include: Gilbert's skink (*Plestiodon gilberti*), western skink (*P. skiltonianus*), rosy boa (*Lichanura trivirgata*), southern rubber boa (*Charina umbratica*), glossy snake (*Arizona occidentalis*), shovel-nosed snake (*Chionactis occipitalis*), San Diego mt. kingsnake (*Lampropeltis zonata pulchra*), San Bernardino mt. kingsnake (*L. z. parvirubra*), red coachwhip (*Masticophis flagellum*), striped whipsnake (*M. lateralis*), red-sided garter snake (*Thamnophis sirtalis infernalis*), two-striped garter snake (*T. hammondii*), southwestern blind snake (*Leptotyphlops humilis humilis*) San Diego banded gecko (*Coleonyx variegatus abbotti*), western banded gecko (*C. v. variegatus*), granite night lizard (*Xantusia henshawi henshawi*), and sagebrush lizard (*Sceloporus vandenburgianus*).

1. Gender/Age
    - Male, female or unknown
2. Measurements
    - Using metric ruler

i. Snout-Vent length (mm)
ii. Tail length (mm)

- Using pesola scale
  i. Weight (g): tare scale first with sampling bag, then place animal in bag.
     1. Use the smallest scale possible for the most accuracy.

3. Take tissue sample (y/n) (Do not take a sample if the animal is too small to safely do so)
   i. Label micro-centrifuge tubes with sample # [date, full board name(site#-board#), 4-letter species code, and individual sequential # (ex. 20091125_MS12-02_EUSK_1)]
   - Sterilize scissors with alcohol.
   - For larger snakes: Take three ventral scale clips from the largest midbody scales, the three samples not from adjoining scales. The clip should be ~1 mm x ~3 mm, but try to clip all the way across each scale, and try to get some of the pigmentation of each scale.
   - For small snakes and lizards: Snip ~3 mm of the tail tip with scissors into centrifuge tube.

     Place drop of tissue adhesive (New Skin) on cut, allow to air dry. Place micro-centrifuge tube in designated container in specimen freezer at the office.
4. Take photos (Optional except for Mt. Kingsnakes and Rubber Boa)
   - Minimum of 3 (1 dorsal, 1 ventral, 1 close-up of dorsal portion of head).
     i. Place, in each photo, ruler and tape with date and specimen # (corresponding to order entered on datasheet).
     ii. Label the photos with photo #s [date, photographer initials, and photo file number (ex. 20091125_SLP_362)].
5. Notes - Record unusual morphology
   - Take notes on any unusual characteristics of the animal (e.g. coloration, injuries, regrown tail, etc.).
6. Return animal to exact location where found.

Non-Target Species Processing Methods (DO NOT PROCESS ANY VENOMOUS REPTILES!)

1. Gender/Age

   Male, female or unknown
2. Measurements
   a. Using metric ruler
      i. Snout-Vent length (mm)
      ii. Tail length (mm)
   b. Using Pesola scale
      i. Weight (g): tare scale first with bag, then place animal in bag.
         1. Use the smallest scale possible for the most accuracy.
3. Take photos (optional)
   i. Record photo #s on datasheet.

ii. Label the photos with photo #s [date, photographer initials, and photo file number (ex. 20091125_SLP_362)].

4. Return animal to exact location where found.

REFERENCES

Richmond JQ, Jockusch EL 2007. Body size evolution simultaneously creates and collapses species boundaries in a clade of scincid lizards. Proc R Soc Lond B. 274:1701–1708.

Wood DA, Fisher AN, Reeder TW 2008. Novel patterns of historical isolation, dispersal, and secondary contact across Baja California in the Rosy Boa (Lichanura trivirgata). Molecular Phylogenetics and Evolution.; 46:484–502.

Appendix B. Abundance (*n*) of species detected at transects and artificial-cover stations during diurnal and nocturnal surveys at Lake Perris State Park and San Jacinto Wildlife Area (SJWA).

Transect	*n*	Common Name	Scientific Name	Covered Species
Lake Perris S.P.				
LP01T	3	Granite spiny lizard	*Sceloporus orcutti*	Yes
	1	Side-blotched lizard	*Uta stansburiana*	No
	1	Orangethroat whiptail	*Aspidoscelis hyperthra*	Yes
	4	Granite night lizard	*Xantusia henshawi*	Yes
	2	Red diamond rattlesnake	*Crotalus ruber*	Yes
	1	Unidentified rattlesnake	*Crotalus* sp.	N/A
	2	Unidentified mouse species	*Peromyscus* sp.	No
LP02T	1	Western fence lizard	*Sceloporus occidentalis*	No
	4	Granite spiny lizard	*Sceloporus orcutti*	Yes
	7	Granite night lizard	*Xantusia henshawi*	Yes
	2	Unidentified snake		N/A
LP04T	7	Granite spiny lizard	*Sceloporus orcutti*	Yes
	3	Side-blotched lizard	*Uta stansburiana*	No
	7	Granite night lizard	*Xantusia henshawi*	Yes
	1	Red diamond rattlesnake	*Crotalus ruber*	Yes
LP05T	1	Southern alligator lizard	*Elgaria multicarinata*	No
	1	San Diego banded gecko	*Coleonyx variegatus*	Yes
	9	Granite night lizard	*Xantusia henshawi*	Yes
LP06T	1	Granite spiny lizard	*Sceloporus orcutti*	Yes
	2	Side-blotched lizard	*Uta stansburiana*	No
	1	Lyre snake	*Trimorphodon lyrophanes*	No
	1	Deer Mouse	*Peromyscus maniculatus*	No
LP07T	1	Granite spiny lizard	*Sceloporus orcutti*	Yes
	2	Orangethroat whiptail	*Aspidoscelis hyperthra*	Yes
	4	Granite night lizard	*Xantusia henshawi*	Yes
	1	Unidentified snake		N/A
LP08T	1	Side-blotched lizard	*Uta stansburiana*	No
	10	Granite night lizard	*Xantusia henshawi*	Yes
	1	California kingsnake	*Lampropeltis getula*	No
	1	Lyre snake	*Trimorphodon lyrophanes*	No
	1	Red diamond rattlesnake	*Crotalus ruber*	Yes
	1	Deer Mouse	*Peromyscus maniculatus*	No
LP09T	1	Granite spiny lizard	*Sceloporus orcutti*	Yes
	2	Granite night lizard	*Xantusia henshawi*	Yes
	3	Red diamond rattlesnake	*Crotalus ruber*	Yes

Appendix B. cont.

Transect	*n*	Common Name	Scientific Name	Covered Species
Lake Perris S.P.				
LP10T	1	Granite night lizard	*Xantusia henshawi*	Yes
	1	Unidentified lizard		N/A
LP11T	1	Southern alligator lizard	*Elgaria multicarinata*	No
	3	Side-blotched lizard	*Uta stansburiana*	No
LP12T	11	Granite spiny lizard	*Sceloporus orcutti*	Yes
	2	Side-blotched lizard	*Uta stansburiana*	No
	1	Red diamond rattlesnake	*Crotalus ruber*	Yes
LP13T	2	Granite night lizard	*Xantusia henshawi*	Yes
	2	Deer Mouse	*Peromyscus maniculatus*	No
LP14T	3	Orangethroat whiptail	*Aspidoscelis hyperthra*	Yes
LP15T	6	Granite spiny lizard	*Sceloporus orcutti*	Yes
	2	Granite night lizard	*Xantusia henshawi*	Yes
	1	Unidentified lizard		N/A
LP16T	12	Granite spiny lizard	*Sceloporus orcutti*	Yes
	2	Side-blotched lizard	*Uta stansburiana*	No
	4	Granite night lizard	*Xantusia henshawi*	Yes
	1	Unidentified lizard		N/A
	1	Longnose snake	*Rhinocheilus lecontei*	No
	1	San Diego pocket mouse	*Chaetodipus fallax fallax*	Yes
SJWA				
LP03T	1	Granite spiny lizard	*Sceloporus orcutti*	Yes
	1	Unidentified lizard		N/A
	1	California kingsnake	*Lampropeltis getula*	No
	2	Red diamond rattlesnake	*Crotalus ruber*	Yes
	1	Unidentified snake		N/A