



Monitoring Terrestrial Reptiles and Amphibians in the Mediterranean Coast Network, 2012-2017 Project Report

Santa Monica Mountains National Recreation Area

Natural Resource Report NPS/MEDN/NRR—2019/2016





ON THIS PAGE

Gopher snake (*Pituophis catenifer*)
Photograph by Katy Delaney (NPS)

ON THE COVER

Western whiptail (*Aspidoscelis tigris*)
Photograph by Sarah Wenner (NPS)

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Contents

	Page
Figures.....	v
Tables.....	vi
Abstract.....	vii
Acknowledgments.....	vii
Introduction.....	1
Methods.....	3
Brief history of monitoring efforts	3
Field sampling	3
Site selection and sampling frequency	4
Data Management.....	9
Data Analysis.....	9
Results and Discussion	11
Weather	11
Captures and Recaptures	12
Trends in Unique Captures.....	15
Year to Year	15
Habitat Type	17
Literature Cited	23
Appendix A. Capture maps by species.	25

Figures

	Page
Figure 1. Map of all pitfall trap arrays by number, habitat type, and driving group.....	5
Figure 2. The normalized Reconnaissance Drought Index (RDI) for SAMO (Leo Carillo weather station).....	11
Figure 3. Average rainfall, maximum temperature ($T_{\max}$), and minimum temperature ($T_{\min}$) for SAMO.	12
Figure 4. The total number of unique captures by group.....	15
Figure 5. The total number of unique captures (abundance) of amphibians by water year (rarely captured species are not shown in the graph).....	16
Figure 6. The total number of unique captures (abundance) of lizards by water year (rarely captured species are not shown in the graph).....	16
Figure 7. The total number of unique captures (abundance) of snakes by water year.....	17
Figure 8. Mean capture numbers by habitat type (chaparral, coastal sage scrub, grasslands, and woodlands) for Black-bellied Slender Salamander (BANI).....	19
Figure 9. Mean capture numbers by habitat type (chaparral, coastal sage scrub, grasslands, and woodlands) for Coastal Whiptail (CNTI).	19
Figure 10. Mean capture numbers by habitat type (chaparral, coastal sage scrub, grasslands, and woodlands) for Ringneck Snake (DIPU).....	20
Figure 11. Mean capture numbers by habitat type (chaparral, coastal sage scrub, grasslands, and woodlands) for Side-blotched Lizard (UTST).....	20
Figure 12. Mean capture numbers by habitat type (chaparral, coastal sage scrub, grasslands, and woodlands) for Western Skink (EUSK).	21
Figure 13. Mean capture numbers by habitat type (chaparral, coastal sage scrub, grasslands, and woodlands) for Alligator Lizard (ELMU).	21
Figure 14. Mean capture numbers by habitat type (chaparral, coastal sage scrub, grasslands, and woodlands) for California Kingsnake (LAGE).	22

Tables

	Page
Table 1. Pitfall array numbers within each driving group.....	5
Table 2. Sampling sessions (marked with ‘X’) for each driving group of pitfall trap arrays by month and year.....	6
Table 3. The number of individual captures, re-captures, and the proportion re-captured for each species.	13
Table 4. Results of the Kruskal-Wallis (KW) test for association with habitat type and amphibian, lizard, or snake abundance	18

Abstract

Santa Monica Mountains National Recreation Area (SAMO), a highly fragmented urban national park, is home to a large diversity of terrestrial reptiles and amphibians. Through pitfall trap sampling, we collected species data to determine the status and trend in: (1) annual occupancy, (2) community dynamics (species richness, evenness, and extinction and colonization rates), and (3) capture rates for herpetofaunal species in selected vegetation communities. Species richness has been suggested as a good indicator of ecosystem quality and integrity for reptiles because of the group's broad diversity, habitat requirements, and diet specificity. Distribution and abundance information is critical for the design of restoration strategies and land management programs to protect or recover reptile and amphibian populations from decline. This report summarizes the monitoring of terrestrial reptiles and amphibians conducted from October 2012 to September 2017. Here we provide mainly simple summary statistics and for selected species, an analysis of abundance with habitat type.

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Introduction

Reptiles and amphibians in the parks of the Mediterranean Coast Network (MEDN) of the Inventory and Monitoring Program in Southern California are affected by numerous stressors and impacts to their environment and habitat. Global fluctuations in temperature, increased exposure to ultraviolet radiation, interaction with exotic species, and changes in air and water quality have all been linked to declines in lizard and amphibian populations (e.g. Blaustein & Wake 1990; Sinervo et al. 2010). In addition, urban development has significantly altered or destroyed critical habitat for many reptile and amphibian species. This is especially so at Santa Monica Mountains National Recreation Area (SAMO). Eight of the 31 native species of herpetofauna found in the Santa Monica Mountains are listed as rare, threatened or endangered by the California Department of Fish and Wildlife (CDFW) (Thomson et al. 2016) or the U.S. Fish and Wildlife Service (USFWS). Eight additional species are species of concern for SAMO. A number of reptile species in the Santa Monica Mountains appear to be in decline (NPS unpublished data; De Lisle et al. 1987; Gamradt & Kats 1996, 1997). Habitat fragmentation decreases herpetofaunal species richness and species diversity at SAMO (Delaney et al. in review). In addition, lizard genetic diversity is decreased and genetic divergence between habitat patches is increased within the highly fragmented Simi Hills area of SAMO (Delaney et al. 2010). We are interested in using our long-term monitoring data to determine the current and potential impacts of expanding urbanization on herpetofauna populations in southern California.

Long-term monitoring objectives for SAMO include determining the status and trend in: (1) annual occupancy, (2) community dynamics (species richness, evenness, and extinction and colonization rates), and (3) capture rates for herpetofaunal species in selected vegetation communities. Species richness has been suggested as a good indicator of ecosystem quality and integrity for reptiles because of the group's broad diversity, habitat requirements, and diet specificity. Additionally, distribution and abundance information is critical for the design of restoration strategies and land management programs to protect or recover reptile and amphibian populations from decline. This information is invaluable to NPS resource managers in evaluating the ecological health of these important indicator species and of the broader ecosystem.

This report summarizes the monitoring of terrestrial reptiles and amphibians conducted from October 2012 to September 2017. Here we provide mainly simple summary statistics, but future analyses will directly address the objectives of the protocol such as determining the status and trends of herpetofaunal occupancy rates, community dynamics, and abundance indices.

Methods

The methods and procedures generally followed Busteed et al. (2006), however, between 2010 and 2012 the sampling design was revised to incorporate probabilistic sampling to allow statistical inference of findings to all of the Santa Monica Mountains and Simi Hills. Details of the field sampling, data collection, and new sampling locations are provided below.

Brief history of monitoring efforts

Terrestrial herpetofauna monitoring has been ongoing in the parks of the MEDN since 1993 for Channel Islands National Park (CHIS) and Cabrillo National Monument (CABR). The regional significance of reptiles and amphibians as indicators of ecosystem health lead to initiation of monitoring in the broader Santa Monica Mountains ecosystem in 2000. The initial SAMO sampling sites were chosen using the judgement of several experts. Because these initial sites were chosen non-randomly, the design was evaluated in 2010. New sites were selected (details below) and monitoring began at them beginning in October 2012.

Field sampling

Because of their small size, cryptic coloration, and nocturnal or fossorial behavior, effective sampling of reptile and amphibian populations can be difficult, and many techniques have been developed to assess the diversity and abundance of these species. Of the various methods tested, pitfall trapping with supplemental funnel snake-traps has been found to be an effective sampling methodology (Fisher & Case 2000a, 2000b; Case & Fisher 2001).

Pitfall trapping consists of the deployment of a series of sampling arrays that are based on the premise that ambulatory reptiles and amphibians can be directed by “drift” fences into bucket traps (pits) embedded in the ground. In this design each pitfall array consists of seven 5-gallon buckets buried so that the lip of the bucket is flush with the surface of the ground to serve as a “pitfall” (Campbell & Christman 1982; Corn 1994; Fisher & Case 2000b). Buried buckets are situated approximately 7.5 meters apart along a “Y” configured drift fence. There are two buckets along each arm and one at the vertex of the three arms. Snake traps are placed along each arm of the drift fence. Drift fences intercept reptiles and amphibians directing them into either pitfall buckets or snake traps (Fitch 1992; Corn 1994; Greenberg et al. 1994; Fisher & Case 2000b; Enge 2001).

Temperature data for 2012 to 2017 was downloaded for the area from www.climateanalyzer.org. We downloaded monthly precipitation (inches), monthly average maximum temperature ($T_{\max}$), and monthly average minimum temperature ($T_{\min}$). These values were used to calculate average yearly precipitation, $T_{\max}$, and $T_{\min}$ for each water year. We also used the website to calculate the normalized reconnaissance drought index, which is a normalized ratio of potential evapotranspiration to precipitation for each water year (October 1 through September 30). Temperature data using HOBOs and iButtons (Onset Corporation) for some arrays was collected during this period and will be included in future analyses.

Date, site location, array number, and bucket or snake trap number was recorded on an iPad or field notebook for each captured individual. Species identification, weight, age, sex, disposition (dead,

released, or escaped), and tissue sampling information are recorded for all captures. We measured snout-vent length (SVL) using a small plastic ruler for lizards and a tape measure for snakes. Weight was measured with tared bags and Pesola-type scales. Lizards were toe-clipped with a unique number (Perry et al. 2011) for individual identification upon recapture and a small tail sample was taken from each lizard, snake, and amphibian (excluding anurans, where no tissue sample was taken). Samples were placed in 1.7 ml microcentrifuge tubes filled with 95% ethanol and stored at room temperature or -20°C at a secure Park facility.

Site selection and sampling frequency

In June 2010, terrestrial herpetofauna monitoring at SAMO was suspended in order to reevaluate the site selection for pitfall trap arrays. As outlined in the protocol (Busteed et al. 2006), original sites were selected by examining topographic maps and picking sites subjectively. However, in order to allow statistical inference from the trapping sites to the entire area of interest (i.e. SAMO and the nearby Simi Hills), sampling must be done at probabilistically selected locations (Thompson 2002). In 2010, we selected new, probabilistic sites using Generalized Random Tessellation Stratification (GRTS) sampling (Stevens and Olsen 2003, 2004). The sample draw was stratified among four habitat types: grass, coastal sage scrub (CSS), chaparral, and woodland. Points were visited in numerical order and evaluated for their suitability for pitfall trap arrays. Reasons for rejecting GRTS sites included: wrong vegetation type despite the original mapping, terrain too steep to install buckets, sites too far from trails or other access routes, sites not hidden from public view, land ownership changed or was not approved for study, or sites near an archaeological site.

By the fall of 2012, 60 new pitfall trap arrays were installed and 20 existing arrays that were near (<500m) a GRTS point that was next in order were rehabilitated and considered part of the GRTS draw for a total of 80 arrays. All other previous pitfall trap arrays were removed. Twenty arrays are installed in each general habitat type. Grasslands are dominated mostly by non-native with some native bunchgrasses (*Stipa* spp.). Coastal sage scrub is dominated by sage species (*Salvia* spp. and *Artemesia californica*) and buckwheat species (*Eriogonum* spp.). Chaparral is dominated by chemise (*Adenostoma fasciculatum*), California lilac species (*Ceanothus* spp.), and laurel sumac (*Malosma laurina*). Woodlands where pitfall traps are installed are dominated by coast live oak (*Quercus agrifolia*), with some California black walnut (*Juglans californica*) and poison oak (*Toxicodendron diversilobum*).

Pitfall trap arrays were grouped into four sets of ‘driving groups’ (Table 1) which consisted of approximately 20 arrays for each driving group. Two staff or intern volunteers visit approximately half of the arrays in the driving group (Figure 1) for each sampling session (see below). Pitfall trapping is labor intensive, and it is important that all sites be visited in a relatively short period of time each morning in order to reduce the mortality from overheating of incidentally captured small mammals.

Table 1. Pitfall array numbers within each driving group.

Driving Group	Number of Arrays
Mugu North & South	20
Simi West & Mid	21
Malibu & Westlake	19
Simi East & Topanga	20
Total	80

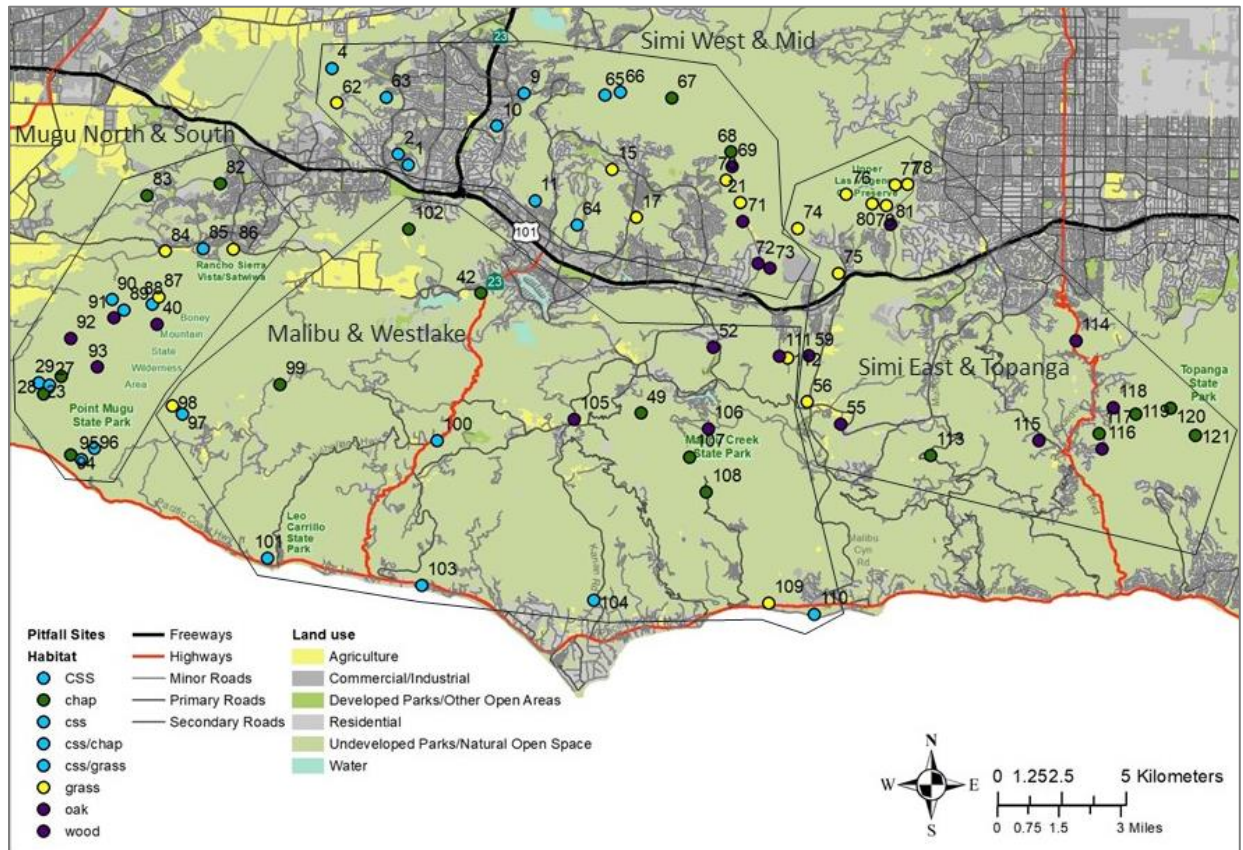


Figure 1. Map of all pitfall trap arrays by number, habitat type, and driving group.

Sampling sessions, where data is collected from captured animals, were periods of 4 days. For each driving group, each pitfall array was sampled for the same 4 consecutive days. Traps were typically opened on Monday and closed on Friday, with captures being processed on Tuesday, Wednesday, Thursday, and Friday mornings. Sampling sessions occurred every other week throughout the year (Table 2) except for the coldest 6 weeks of the year (mid-December to late January).

Table 2. Sampling sessions (marked with 'X') for each driving group of pitfall trap arrays by month and year. In May 2013, the Springs fire burned most arrays in groups Mugu North and Mugu South and these arrays took several months to rebuild and reestablish monitoring (sampling sessions marked with 'fire').

Water Year	Year Sampled	Month	Mugu North	Mugu South	Malibu	West-Lake	Simi East	Topanga	Simi West	Simi Mid
2012-2013	2012	October	X	X	–	–	–	–	X	X
	2012	November	–	–	X	X	X	X	–	–
	2012	December	X	X	–	–	–	–	–	–
	2013	January	–	–	–	–	–	–	X	X
	2013	February	–	–	X	X	X	X	–	–
	2013	March	X	X	–	–	–	–	X	X
	2013	April	–	–	X	X	X	X	–	–
	2013	May	fire	fire	–	–	–	–	X	X
	2013	June	X	fire	X	X	X	X	–	–
	2013	July	–	–	–	–	X	X	X	X
	2013	August	X	X	X	X	–	–	–	–
	2013	September					X	X	X	X
2014-2015	2014	October	–	–	–	–	X	X	X	X
	2014	November	X	X	X	X	–	–	–	–
	2014	December	–	–	–	–	–	–	X	X
	2015	January	–	–	–	–	X	X	–	–
	2015	February	X	X	X	X	–	–	–	–
	2015	March	–	–	–	–	X	X	X	X
	2015	April	X	X	X	X	–	–	–	–

Table 2 (continued). Sampling sessions (marked with 'X') for each driving group of pitfall trap arrays by month and year. In May 2013, the Springs fire burned most arrays in groups Mugu North and Mugu South and these arrays took several months to rebuild and reestablish monitoring (sampling sessions marked with 'fire').

Water Year	Year Sampled	Month	Mugu North	Mugu South	Malibu	West-Lake	Simi East	Topanga	Simi West	Simi Mid
2014-2015 (continued)	2015	May	–	–	–	–	X	X	X	X
	2015	June	X	X	X	X	–	–	–	–
	2015	July	–	–	X	X	X	X	X	X
	2015	August	X	X	–	–	X	X	X	X
	2015	September	X	X	X	X	–	–	–	–
2015-2016	2015	October	–	–	–	–	–	–	X	X
	2015	November	X	X	X	X	X	X	–	–
	2015	December	–	–	–	–	–	–	–	–
	2016	January	–	–	–	–	–	–	X	X
	2016	February	–	–	X	X	X	X	–	–
	2016	March	X	–	–	–	–	–	X	X
	2016	April	–	–	X	X	X	X	–	–
	2016	May	X	X	–	–	X	X	X	X
	2016	June	X	X	X	X	–	–	X	X
	2016	July	–	–	X	X	X	X	–	–
	2016	August	X	X	–	–	–	–	X	X
	2016	September	–	–	X	X	X	X	–	–
2016-2017	2016	October	X	X	–	–	X	X	X	X
	2016	November	X	X	X	X	–	–	–	–

Table 2 (continued). Sampling sessions (marked with 'X') for each driving group of pitfall trap arrays by month and year. In May 2013, the Springs fire burned most arrays in groups Mugu North and Mugu South and these arrays took several months to rebuild and reestablish monitoring (sampling sessions marked with 'fire').

Water Year	Year Sampled	Month	Mugu North	Mugu South	Malibu	West-Lake	Simi East	Topanga	Simi West	Simi Mid
2016-2017 (continued)	2016	December	–	–	–	–	–	–	–	–
	2017	January	–	–	–	–	–	–	–	–
	2017	February	–	–	–	–	X	X	X	X
	2017	March	X	–	X	X	–	–	–	–
	2017	April	–	–	–	–	X	X	X	X
	2017	May	X	X	X	X	–	–	X	X
	2017	June	–	–	X	X	X	X	–	–
	2017	July	X	X	–	–	–	–	X	X
	2017	August	–	–	X	X	X	X	–	–
	2017	September	X	X	–	–	–	–	X	X
Total sampling sessions		28	25	28	28	28	28	29	29	

Data Management

Data was entered on iPad Minis (Apple Corporation) using a program developed by the MEDN data manager in Filemaker Pro 9. Data entered each day was sent via e-mail to the program lead and data manager. Daily data was then added to the central database and QA/QC sheets were printed for review by field staff. Any changes and errors were noted in the database and approved by the program lead. Periodically throughout each year, the program lead ran validation queries on the entire dataset to correct for any anomalies not caught during daily checks.

Data Analysis

Data were presented graphically using Excel. To test for significant relationships between the number of captures (abundance) and habitat type, we performed non-parametric Kruskal-Wallis (KW) tests (Kruskal and Wallis 1952) in R (R Core Team 2018) because capture data was not normally distributed among pitfall trap arrays. We performed this test with any amphibian or lizard species with about 20 or more captures per year, and any snake species with about 10 or more captures per year.

Results and Discussion

In this report, five years of data are presented by water year. In southern California, the water year begins in October and ends the following September. Note that each water year includes the last three months of the previous calendar year (e.g. water year 2013 includes the last 3 months of 2012).

Because of cold temperatures and a marked decrease in capture rate for herpetofauna, we did not monitor traps during parts of December and January each year (Table 2).

The total number of sampling sessions per driving group varied, with Mugu South being monitored several times less than other arrays (Table 2). The Springs Fire burned much of Pt. Mugu State Park, where the Mugu North and Mugu South arrays are installed. Eighteen pitfall arrays were destroyed in the fire from three different driving groups: 2 from Westlake, 9 from Mugu South, and 7 from Mugu North. It took several months to rebuild the arrays and restart monitoring.

Weather

During our study period, California experienced a severe drought (Figure 2). Rainfall increased significantly in 2017 and there was little change in temperature (Figure 3).

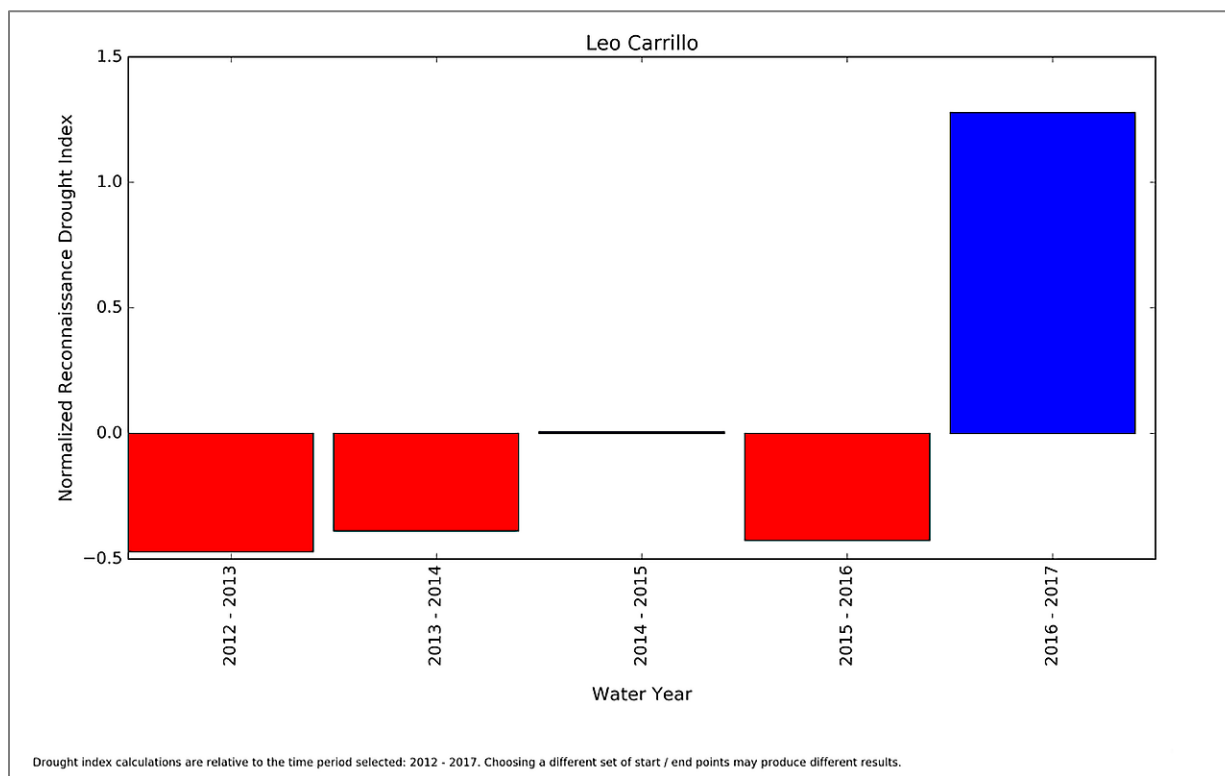


Figure 2. The normalized Reconnaissance Drought Index (RDI) for SAMO (Leo Carrillo weather station). The zero horizontal line is the average RDI for the time period considered. Red bars were years that were drier than average, blue bars were years that were wetter than average.

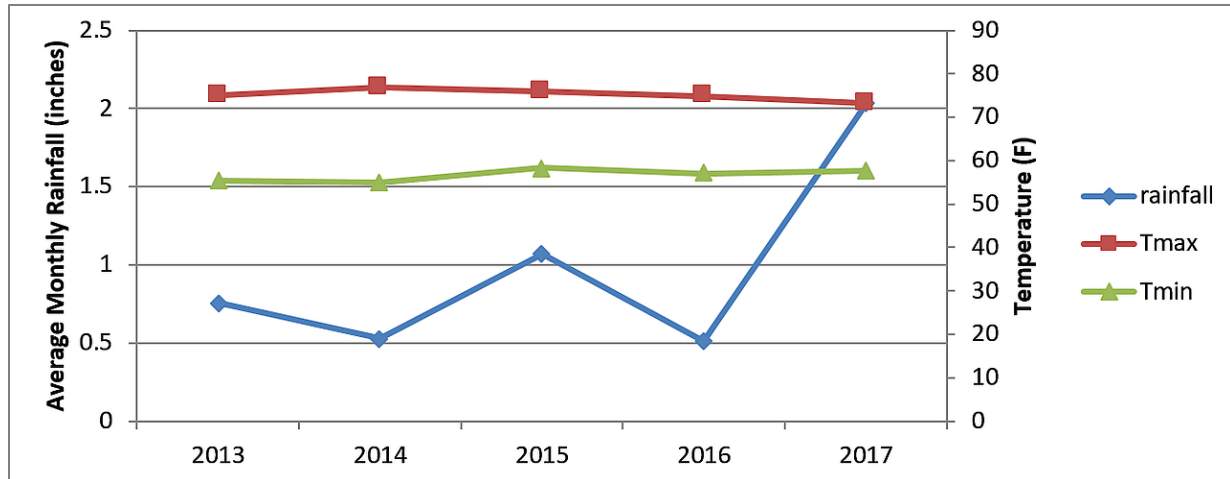


Figure 3. Average rainfall, maximum temperature ($T_{\max}$), and minimum temperature ($T_{\min}$) for SAMO. Note the large increase in rainfall in 2017 over very low drought conditions in previous years.

Captures and Recaptures

We captured individuals from 24 different reptile and amphibian species between October 2012 and September 2017 (Table 3). Lizards were captured most, followed by amphibians and then snakes (Figure 4). Six species of lizards were uniquely marked by toe-clipping, allowing for identification of individual recaptures. Some natural toe loss and mistakes made in the field sometimes made it difficult to determine if lizards were actually recaptured or not. These cases are listed in the “Unknown if New or Recapture” column (Table 3). Recapture rates for the lizards ranged from 10-19% (Western Fence lizard, 16%; Side-blotched lizard, 18%; Western skink, 14%; Coastal whiptail, 10%; Southern Alligator lizard, 10%; and Blainville’s horned lizard, 19%).

We plotted the number of individuals captured during the 5-year period on a map of the study area for 12 species (Appendix A).

Table 3. The number of individual captures, re-captures, and the proportion re-captured for each species.

Group	Species Code	Common Name.	Scientific Name	Total Captures	Recaptures	Unknown if New or Recapture	Unique Captures
Lizards	SCOC	Western Fence Lizard	<i>Sceloporus occidentalis</i>	2434	392	64	1978
	UTST	Side-blotched Lizard	<i>Uta stansburiana</i>	1087	201	31	855
	EUSK	Western Skink	<i>Plestiodon skiltonianus</i>	615	85	29	501
	CNTI	Coastal Whiptail	<i>Aspidoscelis tigris</i>	396	40	23	333
	ELMU	Southern Alligator Lizard	<i>Elgaria multicarinata</i>	294	29	12	253
	PHCO	Blainville's Horned Lizard	<i>Phrynosoma blainvillii</i>	32	6	1	25
	UNLI	Unknown lizard	–	10	0	0	10
	ANPU	Silvery Legless Lizard	<i>Anniella pulchra</i>	5	0	0	5
Amphibians	BANI	Black-bellied Slender Salamander	<i>Batrachoseps nigriventris</i>	1054	28	–	1026
	BUBO	California Toad	<i>Bufo boreas</i>	418	3	–	415
	HYRE	Pacific Treefrog	<i>Pseudacris regilla</i>	79	0	–	79
	ENES	Monterey Ensatina	<i>Ensatina eschscholtzii</i>	17	0	–	17
	TATO	California Newt	<i>Taricha torosa</i>	1	0	–	1
Snakes	MALA	California Striped racer	<i>Masticophis lateralis</i>	60	1	–	59
	DIPU	San Bernardino Ringneck Snake	<i>Diadophis punctatus</i>	38	0	–	38
	LAGE	California Kingsnake	<i>Lampropeltis getula</i>	38	0	–	38
	CRVI	Southern Pacific Rattlesnake	<i>Crotalus viridis</i>	34	0	–	34
	PICA	San Diego Gopher Snake	<i>Pituophis catenifer</i>	34	2	–	32
	HYTO	San Diego Night Snake	<i>Hypsiglena torquata</i>	12	0	–	12

Table 3 (continued). The number of individual captures, re-captures, and the proportion re-captured for each species.

Group	Species Code	Common Name.	Scientific Name	Total Captures	Recaptures	Unknown if New or Recapture	Unique Captures
Snakes (continued)	MAFL	Red Coachwhip	<i>Masticophis flagellum</i>	13	2	–	11
	TAPL	Western Blackhead Snake	<i>Tantilla planiceps</i>	11	0	–	11
	COCO	Western Yellowbelly Racer	<i>Coluber constrictor</i>	4	0	–	4
	LEHU	Southwestern Blind Snake	<i>Leptotyphlops humilis</i>	2	0	–	2
	SAHE	Coast Patchnose Snake	<i>Salvadora hexalepis</i>	1	0	–	1
	THHA	Two-striped Garter Snake	<i>Thamnophis hammondi</i>	1	0	–	1

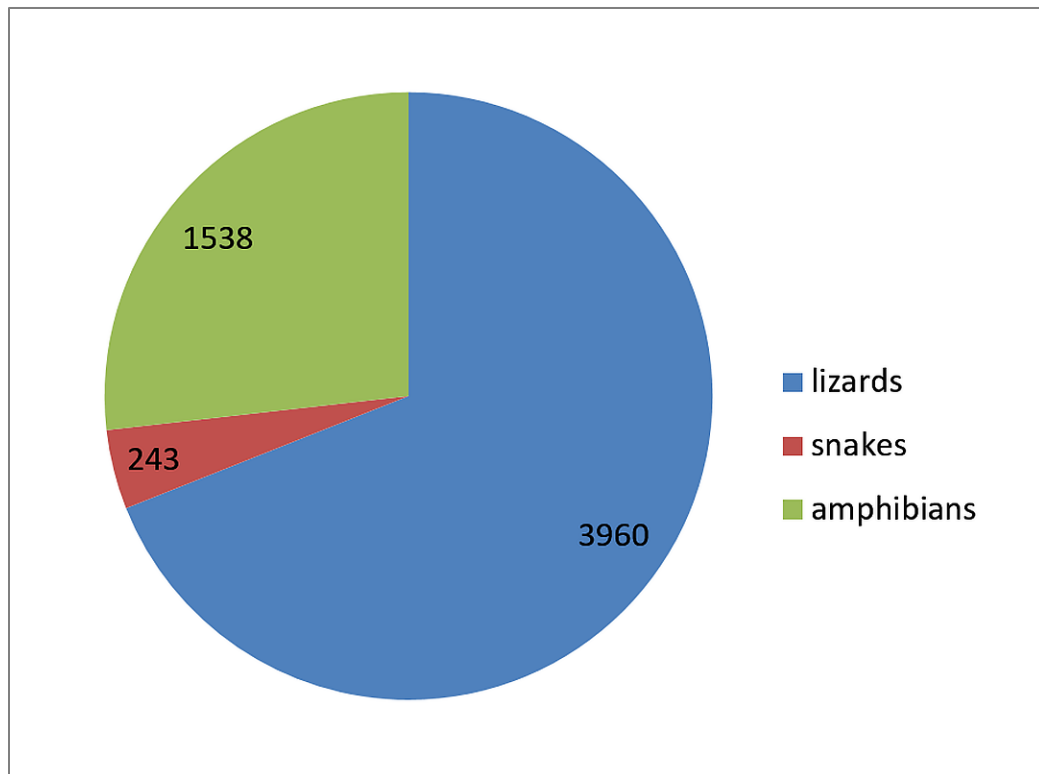


Figure 4. The total number of unique captures by group.

Trends in Unique Captures

Year to Year

Amphibians

The most abundant amphibian captured in the five years of our study was the Black-bellied Slender Salamander (*Batrachoseps nigriventris*, Table 3, Figure 5). However, the number of captures by year varied more than other amphibian species (Figure 5). The Monterey Ensatina (*Ensatina eschscholtzii*) and Pacific Treefrog (*Pseudacris regilla*) were uncommonly captured in the pitfall traps, however, trends in capture numbers appear to be fairly stable. Western Toads (*Bufo boreas*) showed a marked increase in abundance during 2017. This was mainly due to one very active week where approximately 200 juvenile Western Toads were captured over one sampling session (four days) in a pitfall trap array that is near a Western Toad breeding pond. The California Newt (*Taricha torosa*) is rarely captured in pitfall traps and only one individual was captured during this 5-year period. However, in our long-term monitoring of stream breeding amphibians at SAMO, California Newts are detected in approximately 40% of our streams (e.g. Delaney & Riley 2013).

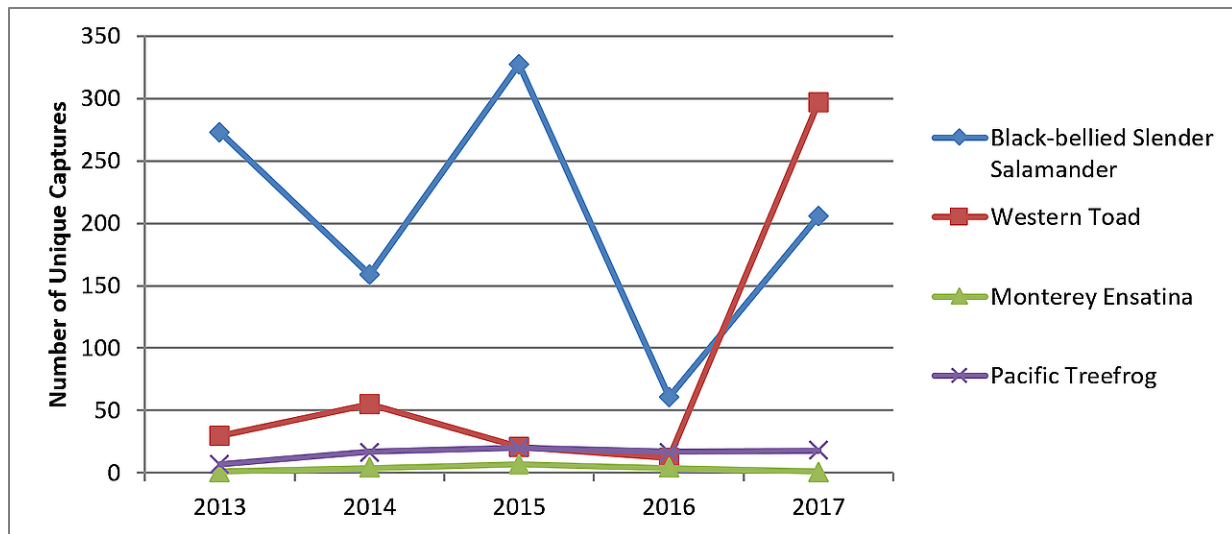


Figure 5. The total number of unique captures (abundance) of amphibians by water year (rarely captured species are not shown in the graph).

Lizards

Although the most commonly captured lizard was the Western Fence Lizard (*Sceloporus occidentalis*; Table 3, Figure 6), there was a slight downward trend in abundance for this species (Figure 6). In contrast, there was a strong upward trend for Coastal Whiptail (*Cnemidophorus tigris*) abundance (Figure 6). We did not include abundance data for the two rarely captured lizards. Silvery Legless Lizards (*Anniella pulchra*) ranged from 0 to 2 captures per year and Blainville's Horned Lizard (*Phrynosoma blainvillii*) ranged from 1 to 9 captures per year.

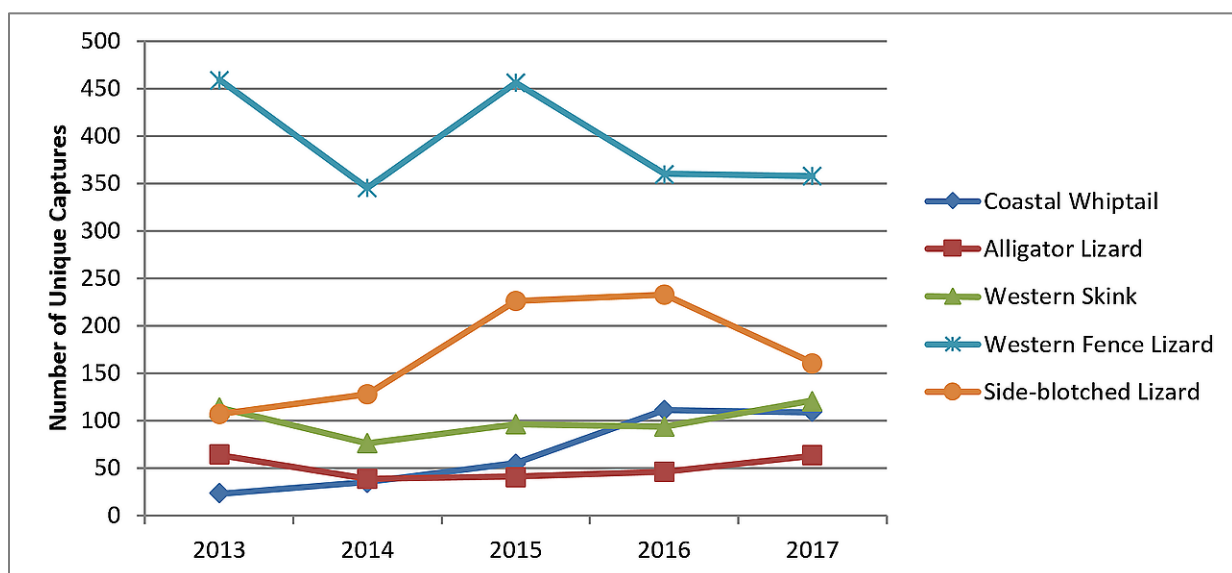


Figure 6. The total number of unique captures (abundance) of lizards by water year (rarely captured species are not shown in the graph).

Snakes

We capture far fewer snakes than lizards and amphibians. Large snakes can escape pitfall trap buckets and small snakes can escape funnel traps because the mesh is porous for very thin animals. All snake species captured are shown in Figure 7 regardless of rarity. Snake species with close to ten captures per year were the Striped Racer (*Masticophis lateralis*), Ringneck Snake (*Diadophis punctatus*), California Kingsnake (*Lampropeltis getula*), Gopher Snake (*Pituophis catenifer*), and Southern Pacific Rattlesnake (*Crotalus viridis*). There were upward trends in captures of Striped Racers and Ringneck Snakes over five years (Figure 7). Downward trends were seen in California Kingsnakes and Gopher Snakes, although there was quite a lot of year to year variation for this species.

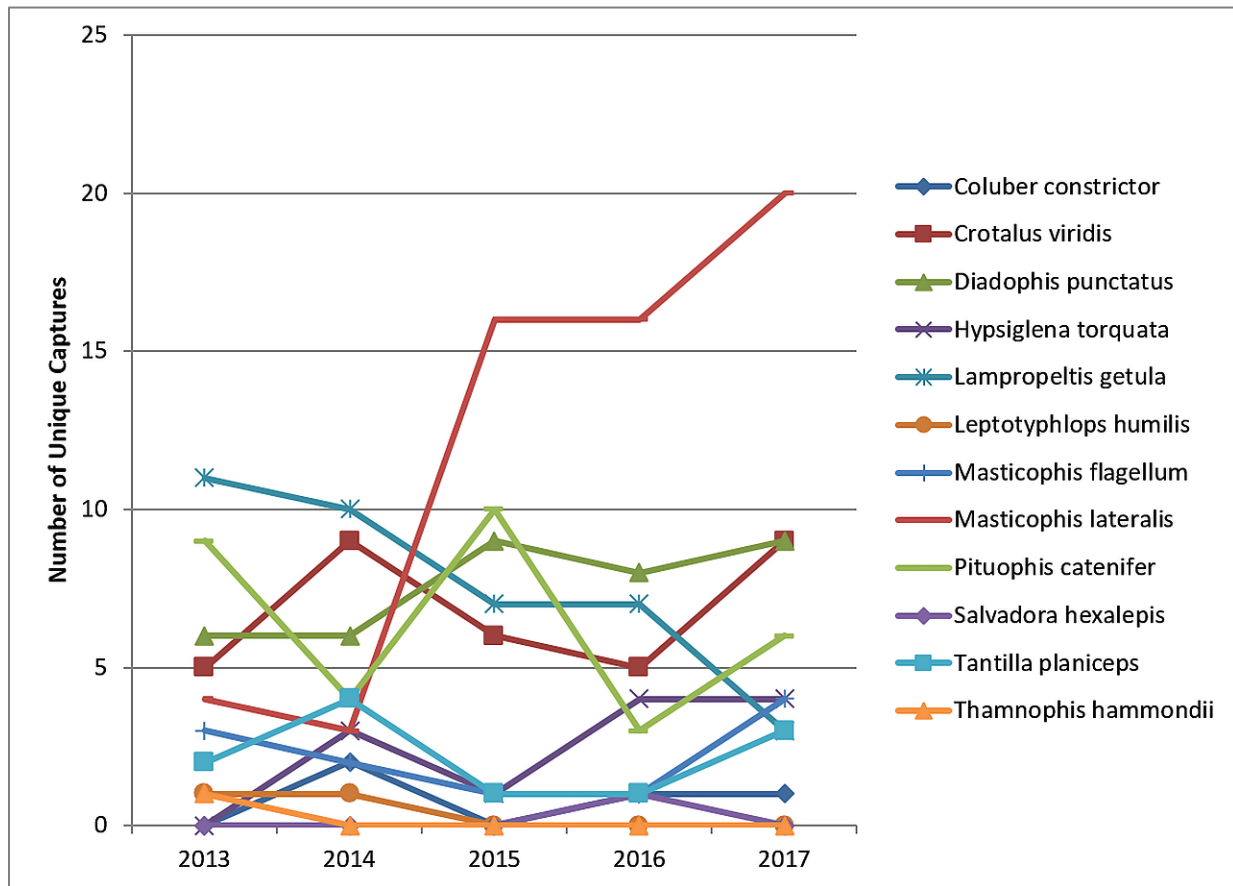


Figure 7. The total number of unique captures (abundance) of snakes by water year.

Habitat Type

Pitfall trap arrays were installed in various general habitat types throughout SAMO. These generalized types were grasslands, CSS, chaparral, and woodlands. Because capture data was not normally distributed among pitfall trap arrays, we performed non-parametric Kruskal-Wallis tests to look for significant relationships between the number of captures (abundance) and habitat type. We performed this test with any amphibian or lizard species with about 20 or more captures per year, and any snake species with about 10 or more captures per year (Figures 4, 5, and 6). Other species had

very low capture rate and there for a low sample size for this test. One amphibian, four lizards, and two snakes were significantly more likely to be associated with one or more habitat types (Table 4, Figures 8 -14).

Table 4. Results of the Kruskal-Wallis (KW) test for association with habitat type and amphibian, lizard, or snake abundance. Significant tests are indicated with bolded p-values.

Species Code	Common Name	KW χ^2	DF	p-value
BANI	Black-bellied Slender Salamander	30.69	3	9.86E-07
BUBO	California Toad	4.77	3	0.189
HYRE	Pacific Treefrog	4.37	3	0.225
CNTI	Coastal Whiptail	19.31	3	0.000236
ELMU	Southern Alligator Lizard	17.73	3	0.0005
EUSK	Western Skink	32.42	3	4.28E-07
SCOC	Great Basin Fence Lizard	3.21	3	0.361
UTST	Side-blotched Lizard	30.05	3	1.35E-06
CRVI	Southern Pacific Rattlesnake	0.267	3	0.966
DIPU	San Bernardino Ringneck Snake	14.88	3	0.0019
LAGE	California Kingsnake	19.06	3	0.000266
MALA	California Striped racer	6.56	3	0.0873
PICA	San Diego Gopher Snake	3.56	3	0.314

Plots of abundance by species reveal the habitat type(s) with the highest abundance for each species with a significant KW test (Table 4). Graphs for species with significant associations with one or more habitat types are presented in Figures 8 - 14. Black-bellied Slender Salamanders (Figure 8) were much more abundant in woodland habitats than any other. Coastal Whiptails were more abundant in two habitat types, chaparral and coastal sage scrub (Figure 9). Ringneck Snakes were more abundant in grass and woodland habitat (Figure 10).

Side-blotched Lizards were more abundant in coastal sage scrub and grasslands (Figure 11). In another analysis of Side-blotched Lizard abundance in our study area found that this species abundance is significantly different in habitat patches of different sizes (unpublished data, manuscript in prep). Side-blotched Lizards are more abundant in small patches made up of coastal sage scrub, grasslands, and open ground (trails).

Western Skinks (Figure 12), Southern Alligator Lizard (Figure 13), and California Kingsnakes (Figure 14) were all significantly associated with grasslands. In our area, non-native grasses dominate the grasslands.

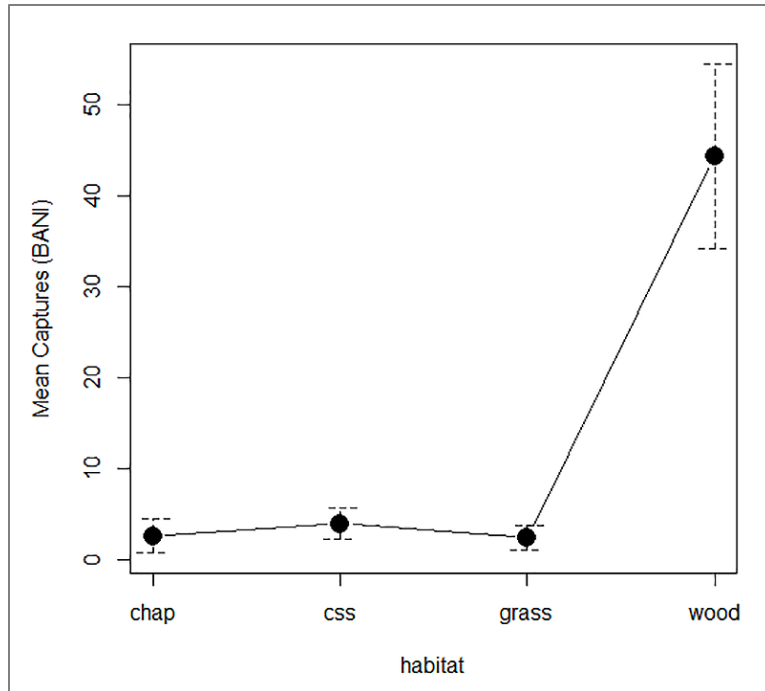


Figure 8. Mean capture numbers by habitat type (chaparral, coastal sage scrub, grasslands, and woodlands) for Black-bellied Slender Salamander (BANI).

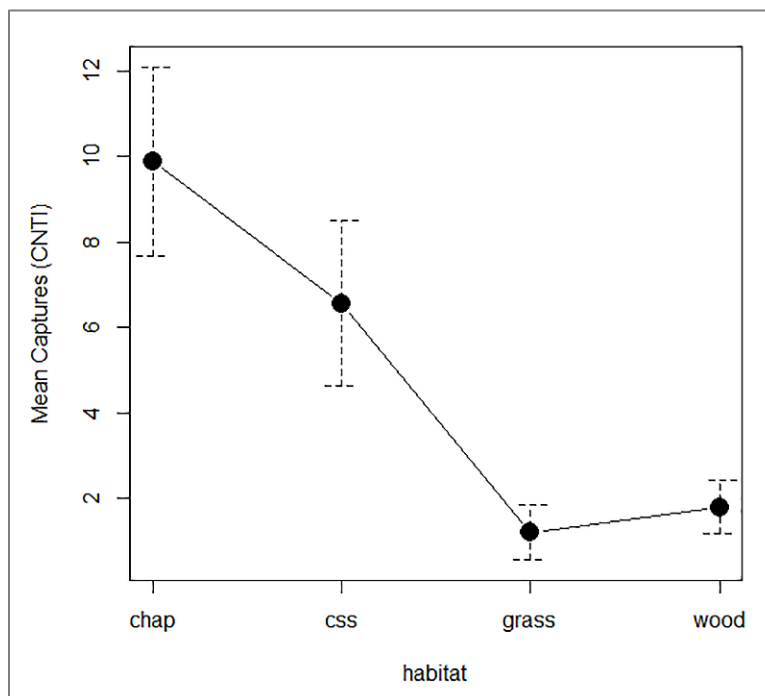


Figure 9. Mean capture numbers by habitat type (chaparral, coastal sage scrub, grasslands, and woodlands) for Coastal Whiptail (CNTI).

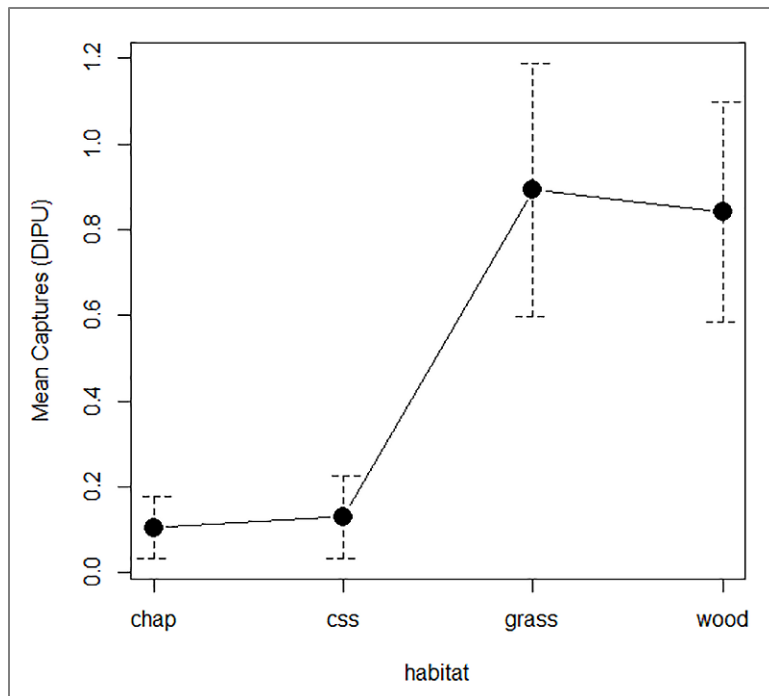


Figure 10. Mean capture numbers by habitat type (chaparral, coastal sage scrub, grasslands, and woodlands) for Ringneck Snake (DIPU).

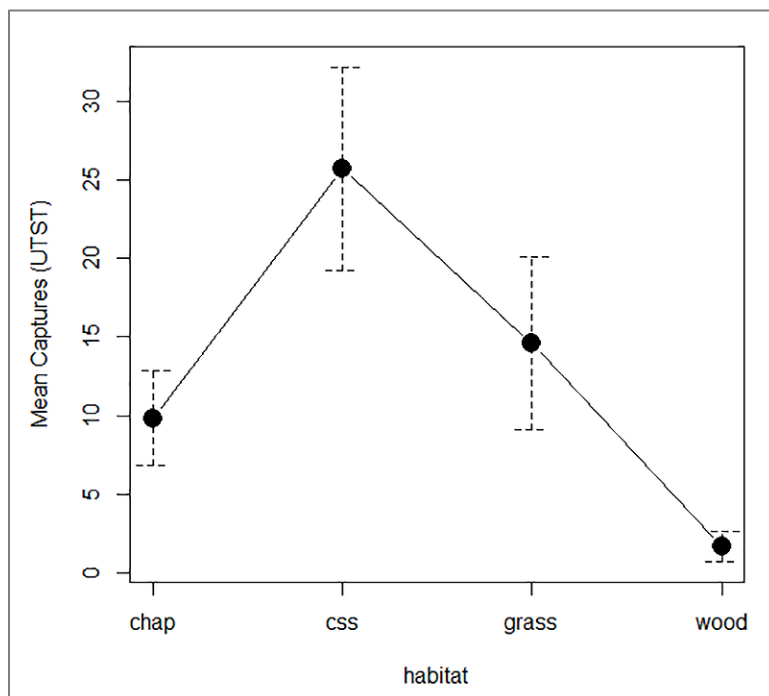


Figure 11. Mean capture numbers by habitat type (chaparral, coastal sage scrub, grasslands, and woodlands) for Side-blotched Lizard (UTST).

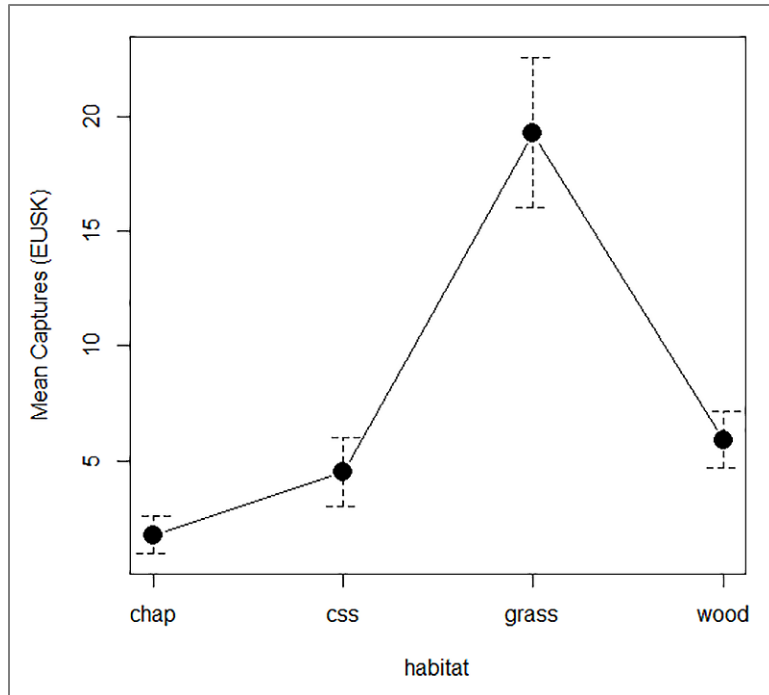


Figure 12. Mean capture numbers by habitat type (chaparral, coastal sage scrub, grasslands, and woodlands) for Western Skink (EUSK).

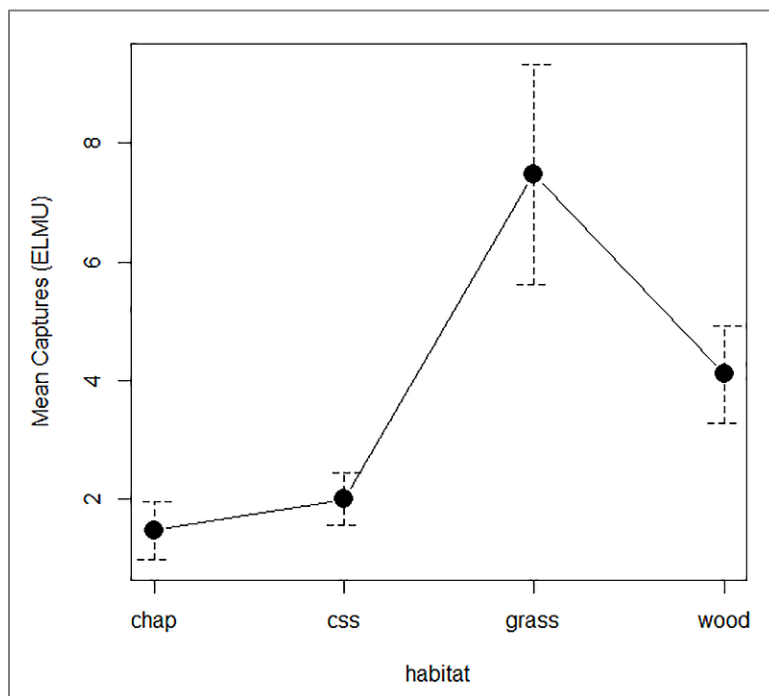


Figure 13. Mean capture numbers by habitat type (chaparral, coastal sage scrub, grasslands, and woodlands) for Alligator Lizard (ELMU).

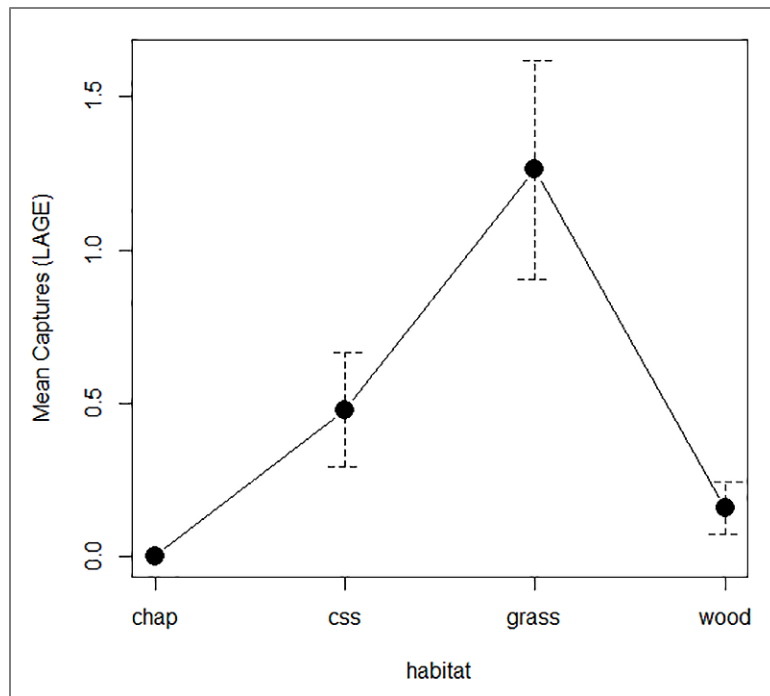


Figure 14. Mean capture numbers by habitat type (chaparral, coastal sage scrub, grasslands, and woodlands) for California Kingsnake (LAGE).

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Appendix A. Capture maps by species.

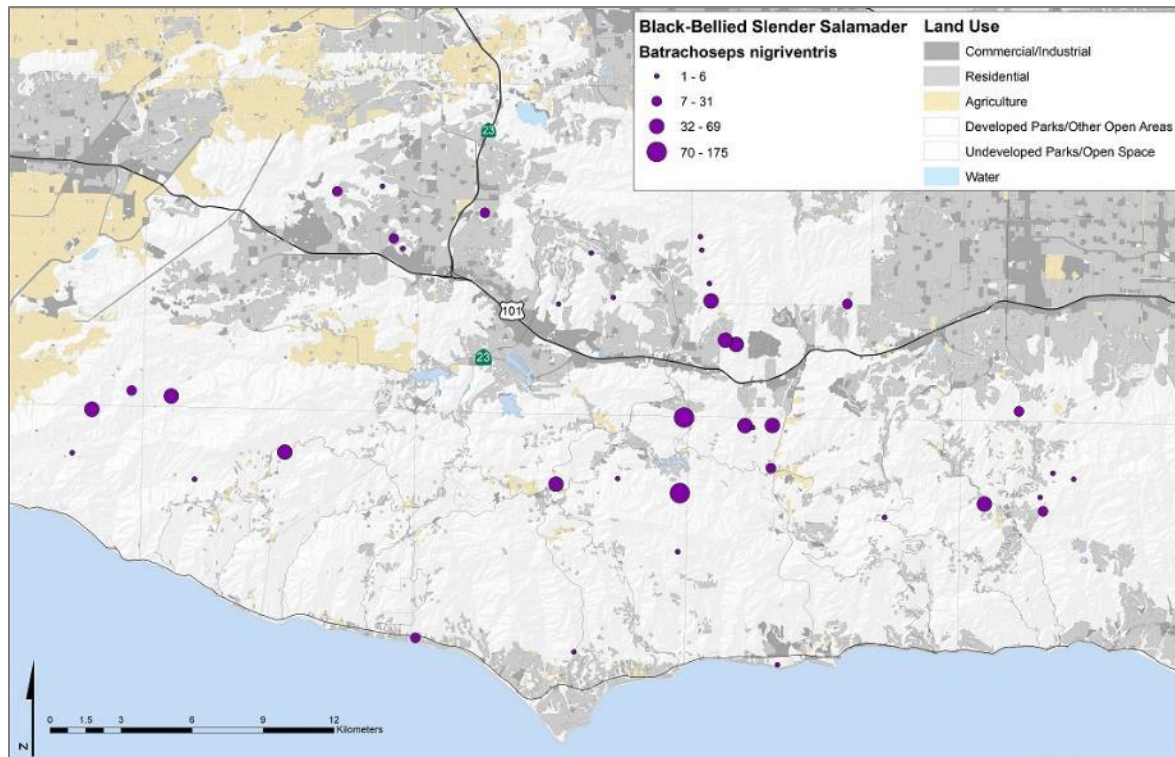


Figure A-1. Capture locations for Black-bellied slender salamander (*Batrachoseps nigriventris*).

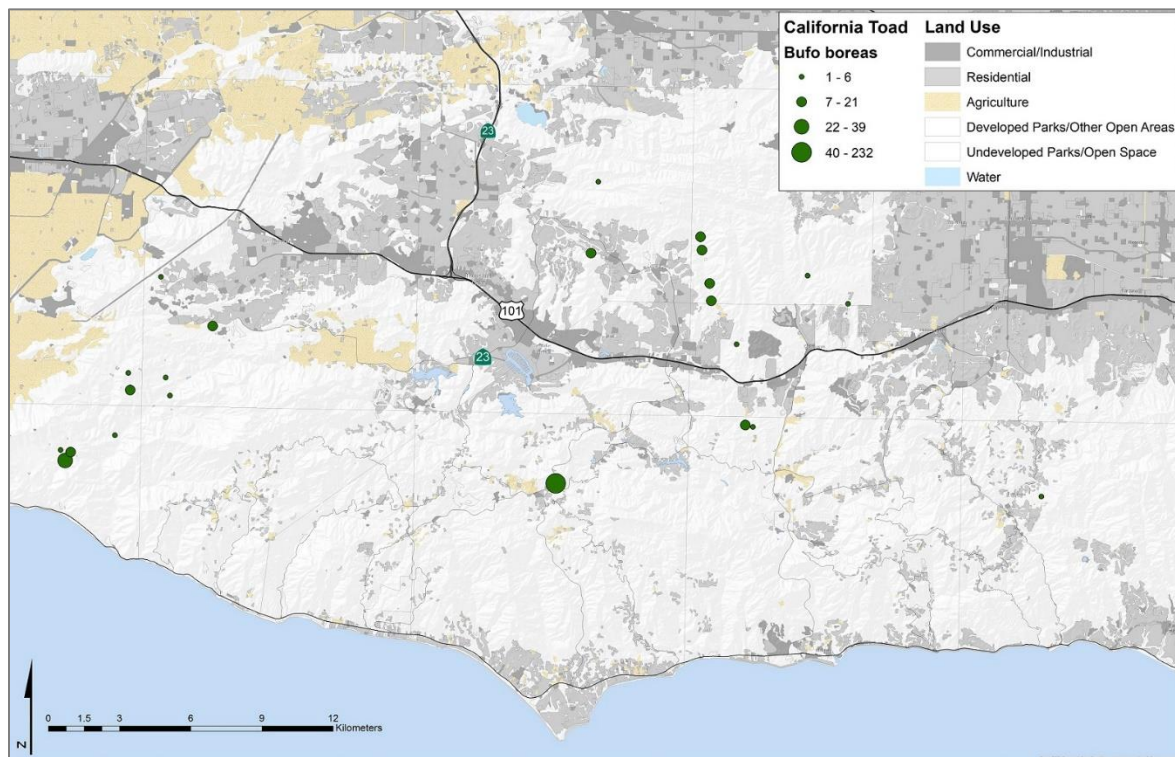


Figure A-2. Capture locations for California toad (*Bufo boreas*).

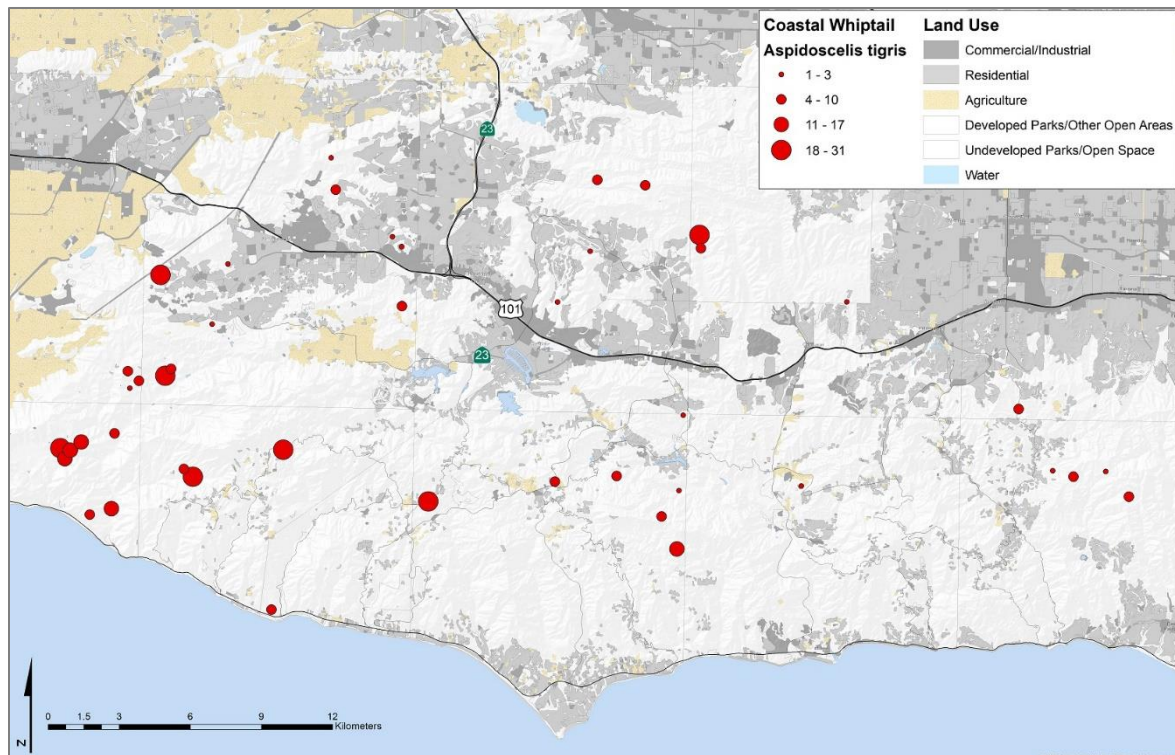


Figure A-3. Capture locations for Coastal whiptail (*Aspidoscelis tigris*).

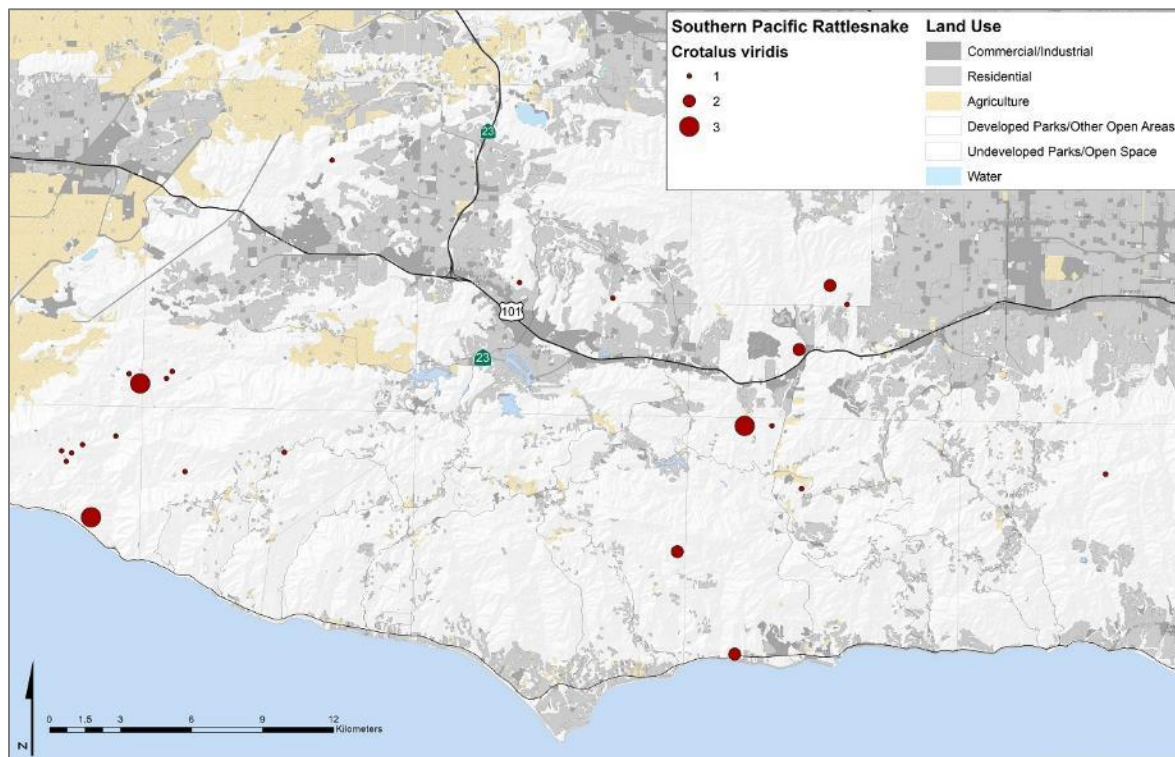


Figure A-4. Capture locations for southern Pacific rattlesnake (*Crotalus viridis*).

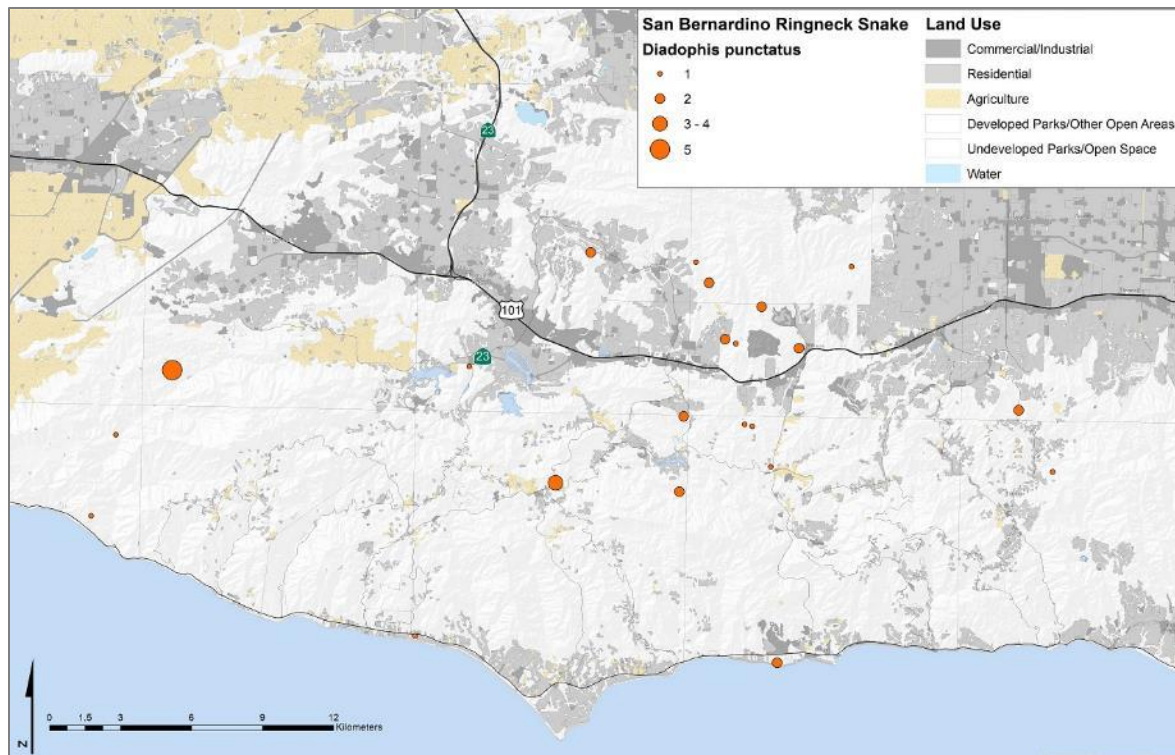


Figure A-5. Capture locations for San Bernardino ringneck snake (*Diadophis punctatus*).

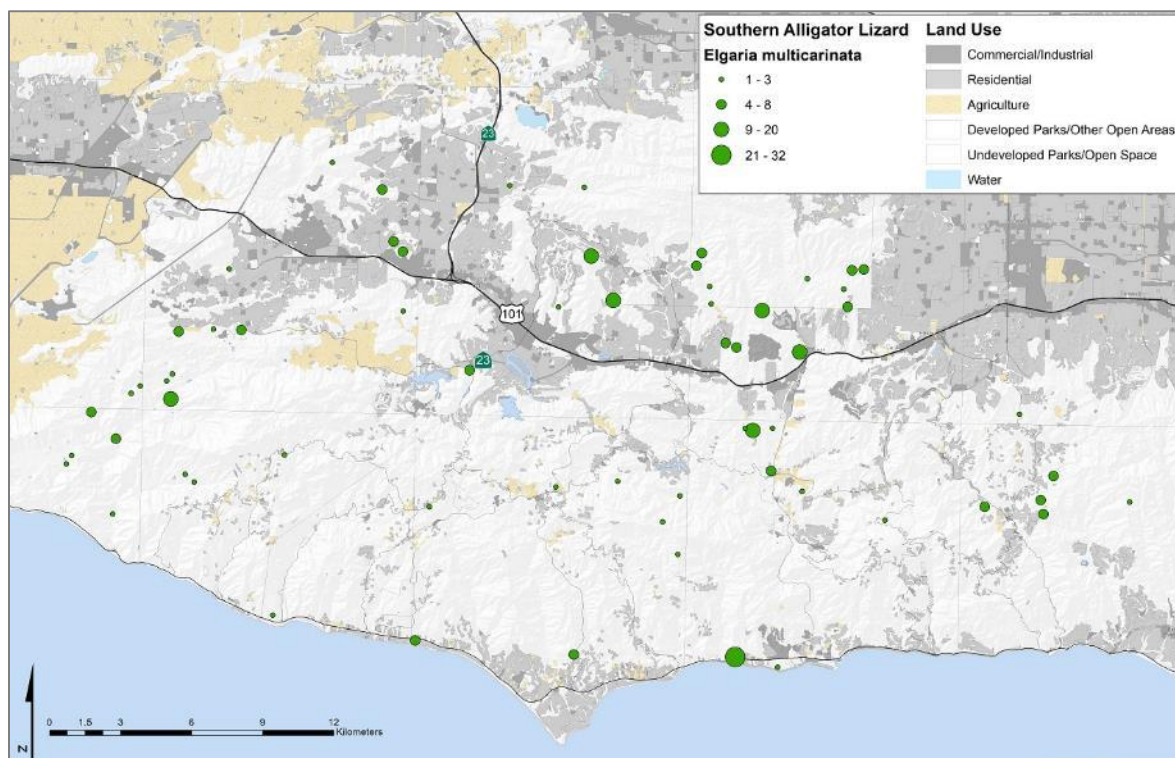


Figure A-6. Capture locations for southern alligator lizard (*Elgaria multicarinata*).

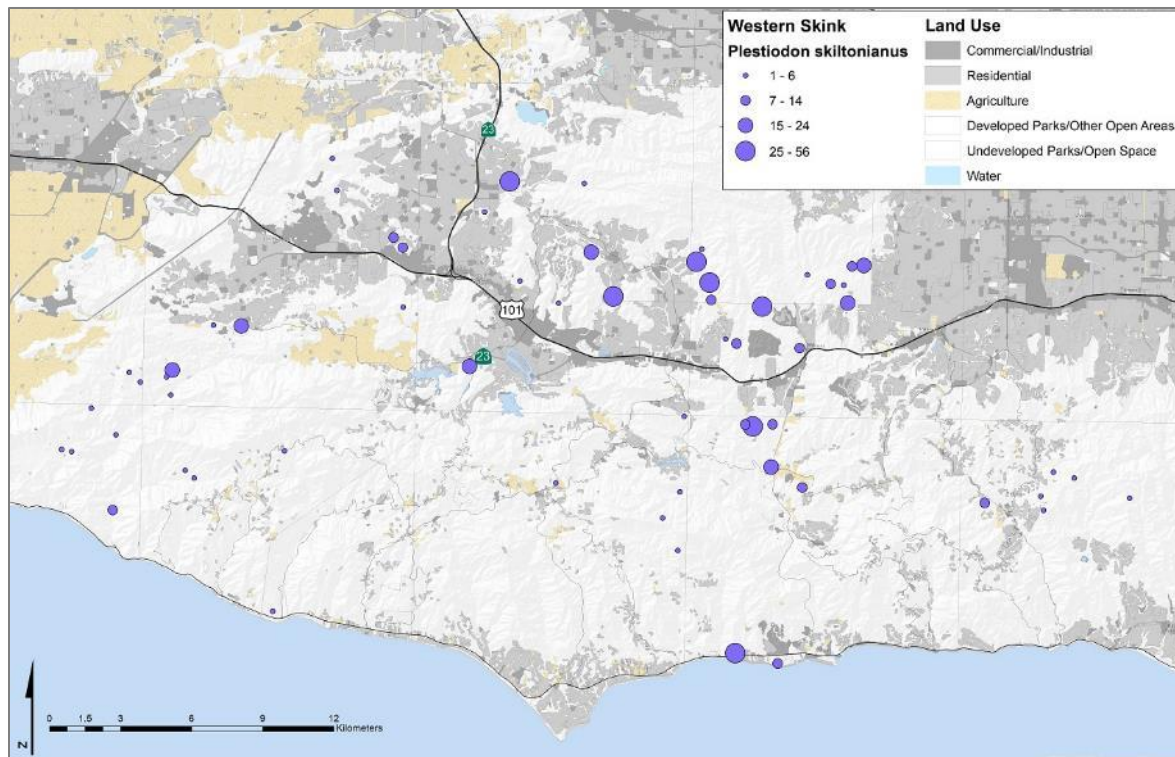


Figure A-7. Capture locations for western skink (*Plestiodon skiltonianus*).

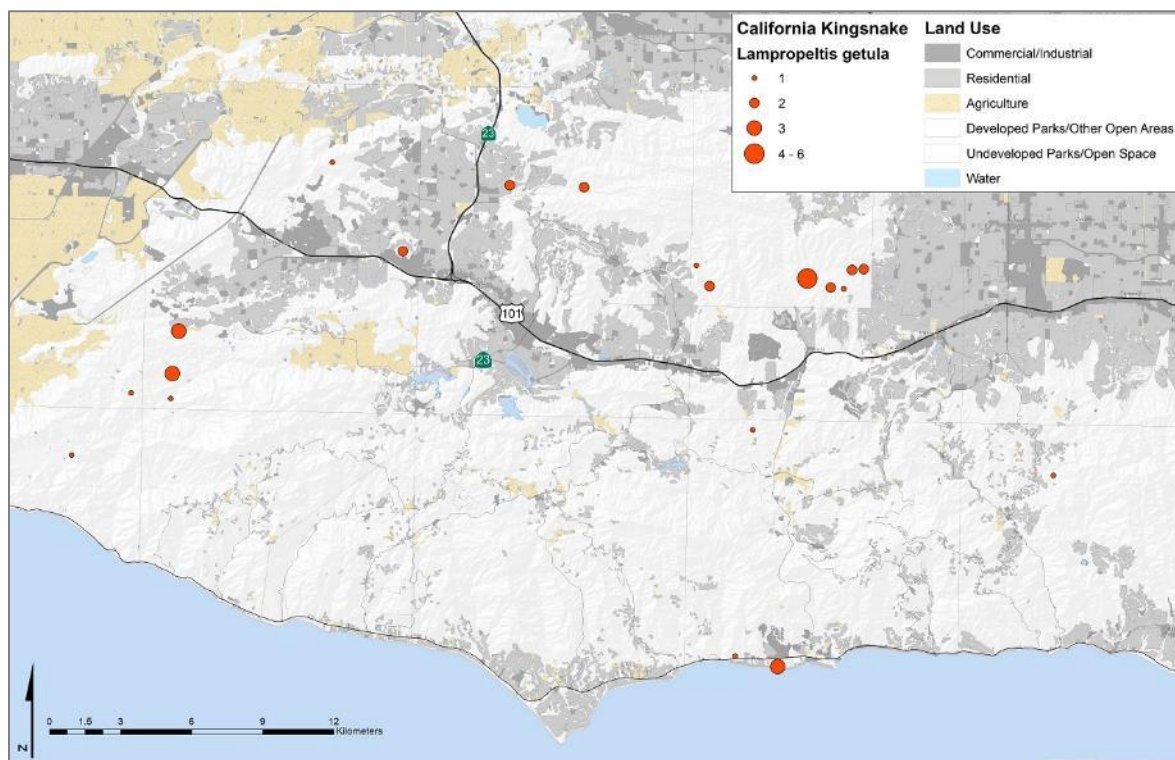


Figure A-8. Capture locations for California kingsnake (*Lampropeltis getula*).

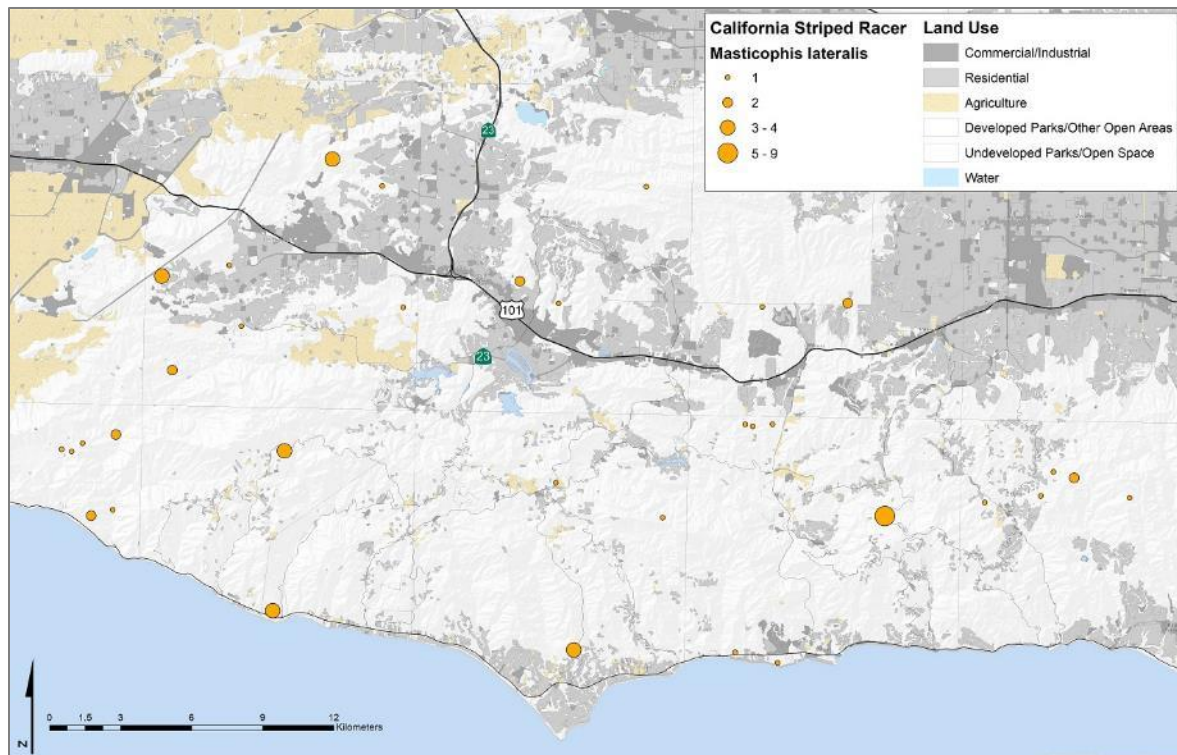


Figure A-9. Capture locations for California striped racer (*Masticophis lateralis*).

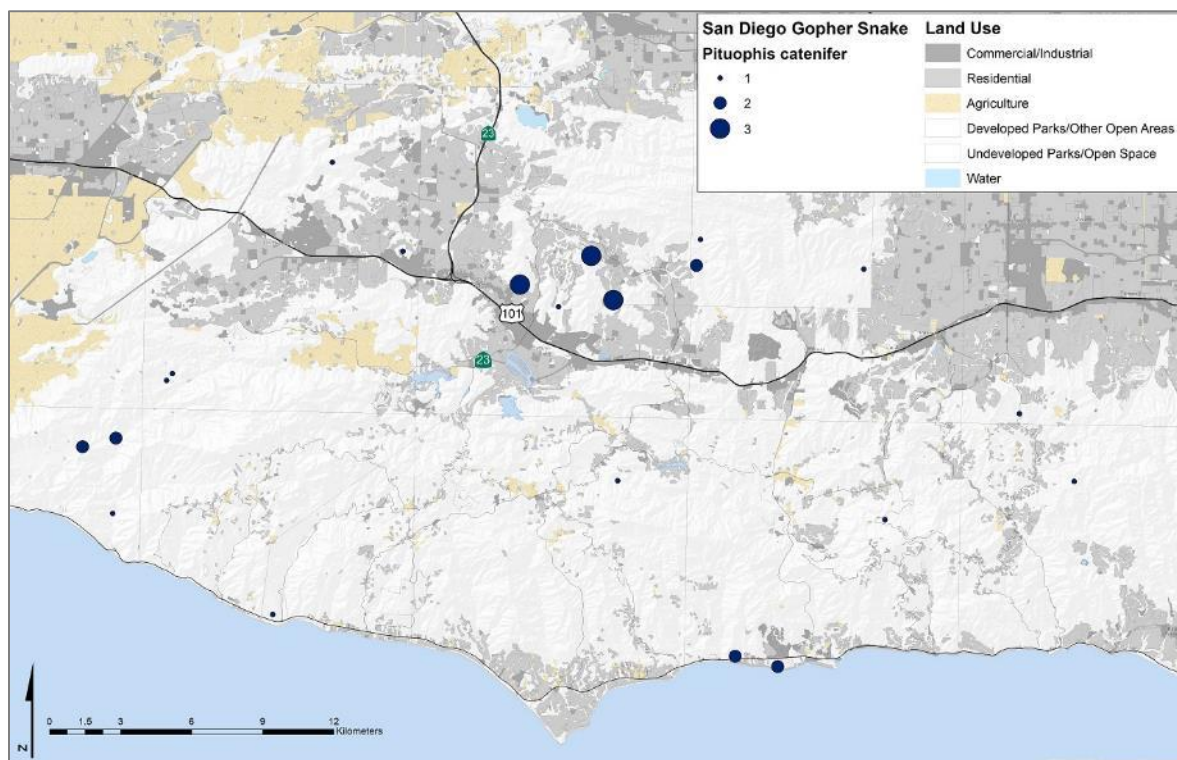


Figure A-10. Capture locations for San Diego gopher snake (*Pituophis catenifer*).

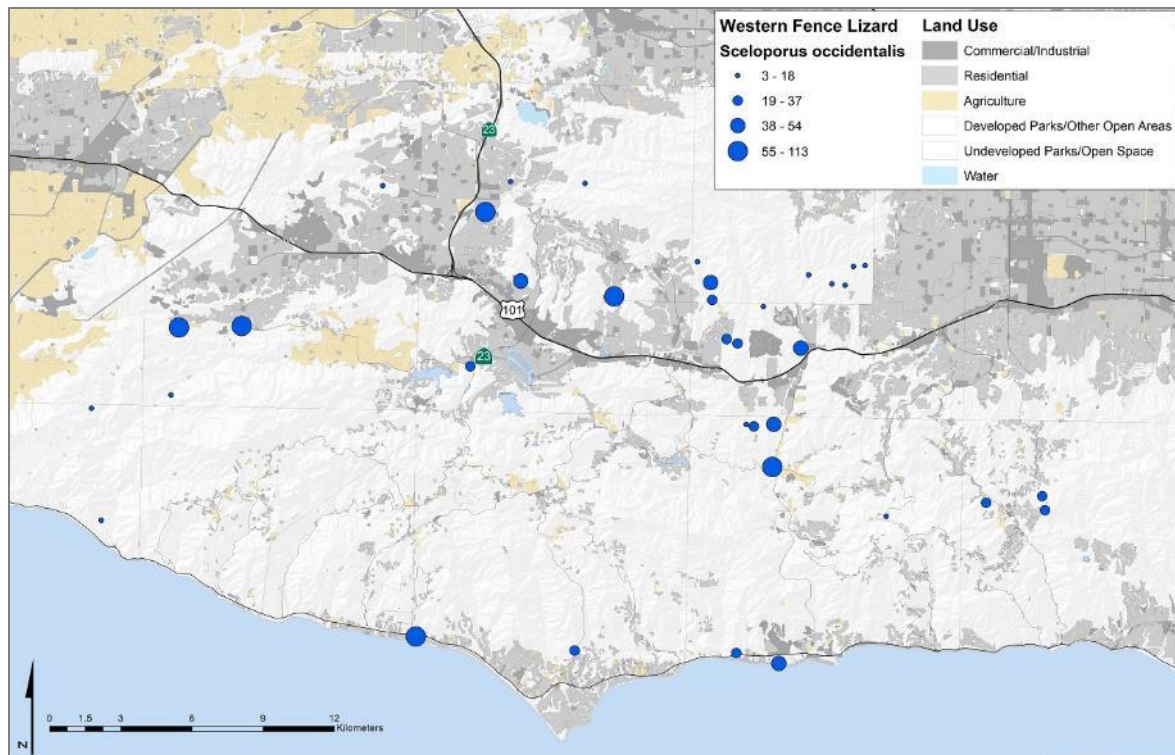


Figure A-11. Capture locations for western fence lizard (*Sceloporus occidentalis*).

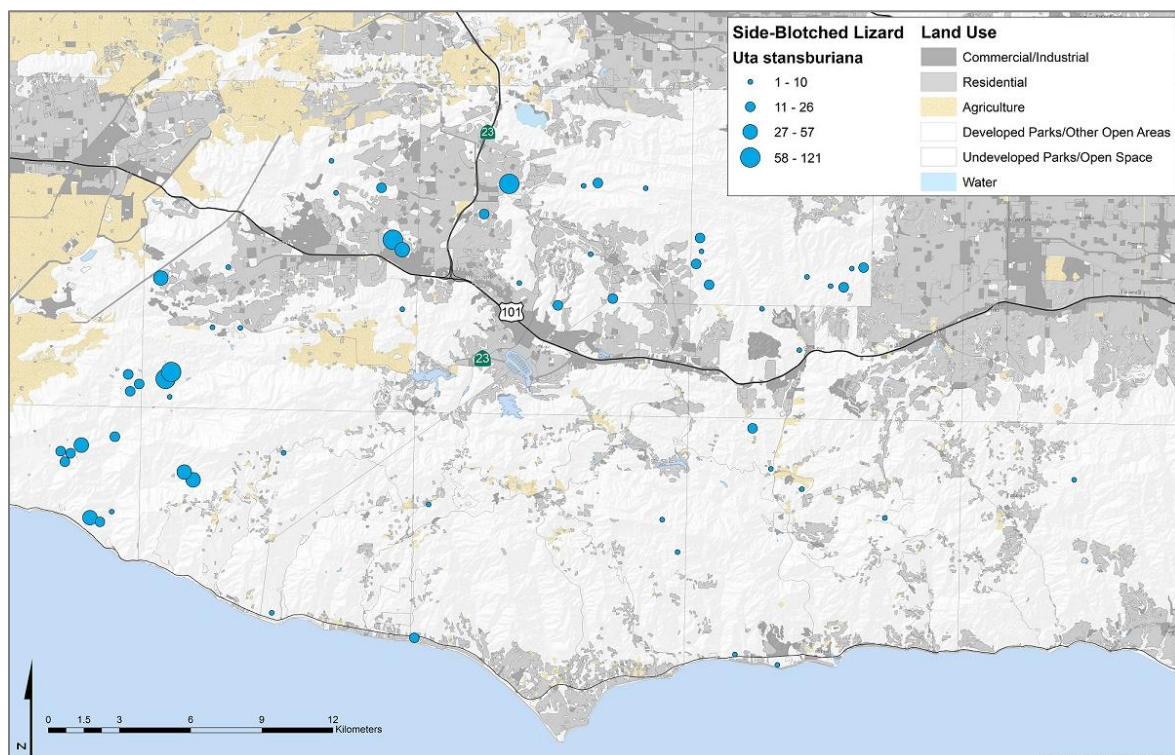


Figure A-12. Capture locations for side-blotched lizard (*Uta stansburiana*).

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