



Herpetofauna Monitoring in the Mediterranean Coast Inventory and Monitoring Network

Cabrillo National Monument 2014 Annual Report

Natural Resource Report NPS/MEDN/NRR—2019/1888



ON THE COVER

San Diego Nightsnake, *Hypsiglena orchrorhyncha klauberi* in pitfall bucket during 2014 herpetofauna monitoring efforts
Photograph by: Don Endicott, VIP, Cabrillo National Monument

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Abstract

The use of pitfall traps and drift fencing is an effective method for monitoring many small animal species. This method has been used at Cabrillo National Monument in San Diego, California since 1995 to monitor trends in reptile and amphibian species within the park as part of the National Park Service - Mediterranean Coast Network Inventory and Monitoring Program. The park is located at the southern tip of the Point Loma peninsula near downtown San Diego and is surrounded by water and developed land essentially creating an island of native coastal sage scrub habitat. Twelve species of herptiles are currently found within the 163-acre park and nearby Navy land and species diversity has declined according to historical records. In 2014, 10 of the 12 herptile species were captured during sampling periods. Herptile species' populations are an indicator of ecosystem health, therefore continuous monitoring is important to detect any significant changes in the herptile populations within an urban "island" park and to manage the park for future generations to enjoy.

Acknowledgments

Many thanks go to the NPS Volunteers in Parks (VIPs) who dedicated their time and efforts in assisting with this project. Specifically, B. Sharp, D. Endicott, W. Tam, B. Greenberg, P. Simpson, B. Alderman, K. Lion, G. Sharpe, and others offered great assistance during the 2014 herpetofauna survey. I would like to thank the US Navy for their partnership with this study by allowing NPS to conduct work on military property. Much appreciation also goes to all NPS staff who educate the public of the flora and fauna of Cabrillo National Monument. L. Lee provided data management assistance throughout the project. S. Ostermann-Kelm provided helpful review comments on an earlier draft of this report.

List of Terms

CABR – Cabrillo National Monument

NPS – National Park Service, U.S.

PLECA – Point Loma Ecological Conservation Area, 650 acres of land on the Point Loma Peninsula with multi-agency management designated for conservation of native species.

USGS – U.S. Geological Survey

Introduction

Reptiles and amphibians (herptiles) 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 amphibian populations (c.f. Blaustein and Wake 1990). In addition, urban development has significantly altered or destroyed critical habitat for many reptile and amphibian species. This is especially true in Cabrillo National Monument (CABR), located on the southern tip of the Point Loma peninsula in San Diego. There are currently twelve species of herptiles found within CABR. It is thought that seven of the nineteen species of herptiles historically known to occur within the PLECA are now extirpated (Fisher et al. 2002, Fisher 2004) likely due to landscape changes and habitat fragmentation on and around the Point Loma peninsula. Development and habitat fragmentation can negatively affect wildlife and the biodiversity of native reptile species by restricting natural movements of individuals as well as gene flow with adjacent populations (Busteed 2003).

Herptile monitoring via pitfall traps on Point Loma began in 1995 (Fisher et al. 2002). There were originally 17 pitfall trap arrays, each of which contained seven pitfall traps (buckets) and three funnel traps. Monitoring was performed by USGS until December 2001 for sampling periods of 11 days/10 nights every other month. Beginning in 2002, National Park Service (NPS) staff took over the management of the herptile surveys and at that time, herpetofauna was designated as a “Vital Sign” for the NPS Inventory and Monitoring Program’s Mediterranean Coast Network (Busteed et al. 2006). NPS “Vital Signs” are ecological parameters that are monitored to provide park natural resource managers and the greater scientific community with scientific information to assist with natural resource management.

Monitoring is important for detecting changes in the herptile population dynamics and species composition. This report summarizes trapping efforts for 2014. Only simple summary statistics are provided in this report; a more detailed trend analysis is in progress.

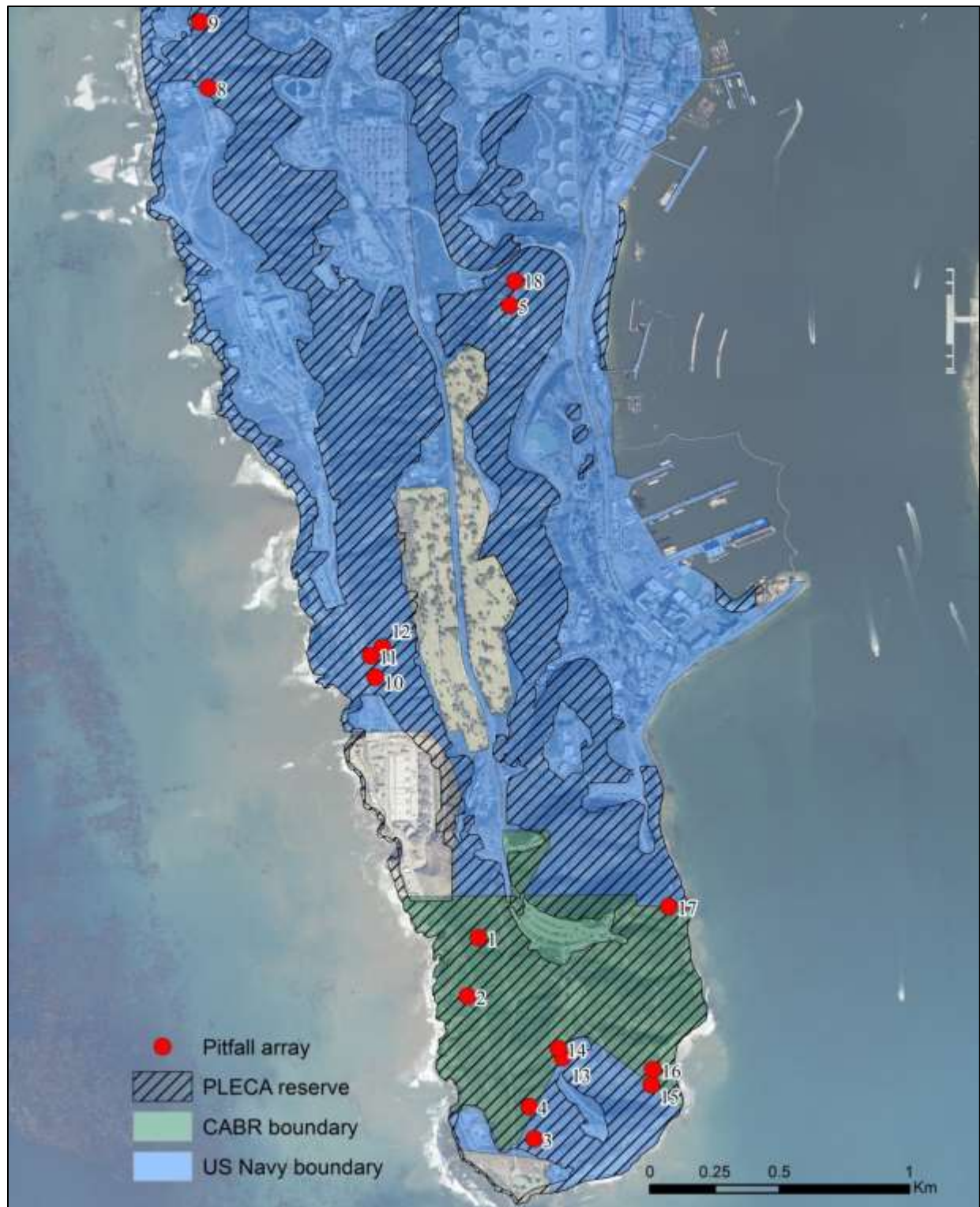


Figure 1. Map of the location of the herpetofauna arrays within the Point Loma Ecological Area in San Diego, CA.

Methods

Study Area

CABR is located at the southern tip of the Point Loma peninsula in San Diego, California USA (Fig. 1). The NPS manages 163 acres of land that is dominated by the coastal sage scrub vegetation community. The park is surrounded by a US Navy base, the City of San Diego wastewater treatment plant, and residential housing. Cabrillo National Monument is part of the Point Loma Ecological Conservation Area (PLECA) which is made up of 650 acres of land on Point Loma that is owned and managed by federal and local agencies (Fig. 1). The PLECA was designed to protect the cultural and biological resources that can be found on the Point Loma peninsula.

Weather

Temperature: Mean low temperatures in 2014 were lowest in January, at 52.03° F, and highest mean temps occurred in September, at 80.97 ° F. The highest maximum temperature occurred in May with 97° F, while lowest was recorded in December at 43° F (WRCC).

Precipitation: Annual rainfall in 2014 as reported from the Western Regional Climate Center was 7.77 inches of rain for 2014 at Lindbergh Field, approximately six miles away from Point Loma. The long-term mean precipitation (1914-2014) for Lindbergh Field is 9.93. No precipitation was recorded in May-July, September or October. The largest amount of precipitation occurred in December with 4.5 inches (WRCC; Appendix A).

Field Methods

Beginning in 2002, NPS conducted surveys on a five-day/four-night sampling period once a month for 11 months of the year. Atkinson et al. (2003) determined that a minimum of 40 trap nights per year are needed at CABR to detect changes in species richness and abundance of the target herptile species. The approved monitoring protocol (Busteed et al. 2006) was followed during 2014. This protocol was based on the initial monitoring and methods used by Fisher and Case (Fisher and Case 2000, Stokes et al. 2008).

Sixteen arrays were operated in 2014, nine of these were within Cabrillo National Monument, and the remaining seven arrays were on US Navy property north of CABR (Fig. 1; Appendix A). Each array consists of seven pitfall traps and three funnel traps in a “Y” configuration. The pitfall traps are five gallon buckets that are recessed so the tops of the buckets are flush with the surrounding ground. Cylindrical funnel traps are made from hardware fabric with plastic funnels attached at each end. Drift fencing between traps direct animals along the fencing and into the traps. Plywood coverboard measuring 24” x 48” was placed near each array to increase detection rates of cryptic or fossorial animals that may otherwise be difficult to observe as they are not easily captured in the pitfall or funnel traps.

Within each pitfall trap, there were two plastic PVC pipes of different sizes to serve as hiding places for captured animals. Cotton or polyester stuffing was used in the traps to offer bedding material for the small mammals in order to reduce hypothermia. A nine-ounce plastic cup containing mealworms and cotton or polyester stuffing was placed in the traps to provide food and cover for small

mammals. Moist sponges were also placed in the bottom of each trap to reduce desiccation of salamanders only during October through March.

From January to December 2014, the arrays were scheduled to be opened every month for a 4-night sampling period. To minimize mortality of captured animals, traps were closed or not opened if heavy precipitation was in the forecast or if a heavy infestation of Argentine ant (*Linepithema humile*) was present. A negative correlation has been shown between the density of *L. humile* and lizard capture rates (Atkinson et al 2003). Traps were also not opened if the ground was saturated with water which caused flooding from the drainage holes in the bottom of the trap. This usually occurred after heavy rains for only some of the traps depending on the soil and the slope at the site.

Data collected from captures included weight, snout/vent length (SVL), age class, and gender if possible. SVL measurement cut-off lengths were utilized to categorize lizards by age class (Table 1). Body condition was also noted if any abnormalities were observed. Each lizard was marked using toe clip numbers to assign it a unique number. The toe clips along with a small clip of the tail tissue samples were preserved in 95% ethanol for future genetic analysis. All animals were released in the area of capture after processing. If an animal was found dead in a trap, escaped or died during processing, it was noted.

Snake species were weighed and measured before release. Scale clipping was not performed due to the extremely low capture rate for snakes. Rattlesnakes were not handled for personnel safety. When captured, the total length of the rattlesnake was estimated and the number of rattles was noted.

Shrew (*Notiosorex crawfordi*; NOCR) captures were processed as quickly as possible in order to reduce stress and facilitate quick release. Animals were determined to be adults or juveniles, offered a mealworm during processing, and released. Other small mammals such as rodents were identified to species. Gender, age estimation, tail length, body length, hind foot length, and ear length were also recorded.

Weather data were also recorded for the surveys. Weather conditions including temperature, humidity, wind speed, wind direction and gust speed were recorded at the start and end of each survey day from the CABR Visitor's Center weather station located at -117.239493, 32.674827 decimal degrees. Monthly total precipitation data were obtained from the Western Regional Climate Center at the San Diego Airport station (Appendix B).

Data were collected by CABR or MEDN staff and interns and entered into the MEDN Terrestrial Herpetofauna Database. Data were quality checked and verified for errors by program staff. Validation queries were run to highlight field values that were not consistent with expected results (i.e., out-of-range values). These values were double-checked against field datasheets and discrepancies were corrected as appropriate and/or noted in the database. All data collected in 2014 have been verified, validated, and certified to ensure they are error-free to the greatest extent possible.

Table 1. Minimum measurement cut-off lengths for adult age class determination.

Species	Minimum SVL for adult classification, in millimeters
<i>Sceloporus occidentalis</i>	50
<i>Cnemidophorus hyperythrus</i>	50
<i>Uta stansburiana</i>	40
<i>Elgaria multicarinata</i>	Determined by collector
<i>Anniella pulchra</i>	Determined by collector

The capture rate of each species was calculated as the number of captures per trap day for each trapping session. The number of captures per trap type (pitfall vs. funnel trap) was also determined for the species that were captured in both trap types. Captures of each species per array was also determined. Recapture rate was calculated for each of the marked species. When age could be determined for *Sceloporus occidentalis* (SCOC), *Uta stansburiana* (UTST), *Elgaria multicarinata* (ELMU), *Cnemidophorus hyperythrus* (*Aspidoscelis hyperythra*) (CNHY), the number of juveniles and adults were calculated as well as recruitment by dividing the number of unique juveniles of a species captured in 2014 by the number of unique adults of that species captured in 2014.

Results

The 2014 herpetofauna monitoring yielded 19 species in 465 captures: herptiles ($n=302$), small mammals ($n=40$), and invertebrates ($n=123$) (Table 2). Surveys were conducted February to December. Captures only include pitfall traps or funnel traps of the 16 arrays, and do not include observations or animals under coverboards. Coverboard observations were included separately as supplemental sightings at or near arrays (Appendix C). There were a total of 10 trapping sessions with a total of 40 trapping nights, meeting the 40 trap night minimum required to detect changes in species richness and abundance (Appendix D).

Table 2. Herptile and small mammal captures in 2014 within the Point Loma Ecological Area.

Category	Scientific Name	Species Code	Common Name	Number of Captures
Amphibian	<i>Batrachoseps major</i>	BAPA	Pacific Garden slender salamander	1
Reptiles	<i>Anniella stebbinsi</i>	ANPU	Legless lizard	0
	<i>Aspidoscelis hyperythra</i>	CNHY	Orange-throated whiptail	83
	<i>Elgaria multicarinata</i>	ELMU	Southern alligator lizard	14
	<i>Sceloporus occidentalis</i>	SCOC	Western fence lizard	105
	<i>Uta stansburiana</i>	UTST	Side-blotched lizard	97
	<i>Crotalus oreganus helleri</i>	CRVI	Southern Pacific rattlesnake	1
	<i>Diadophis punctatus</i>	DIPU	Ring-necked snake	0
	<i>Hypsiglena ochrorhyncha klauberi</i>	HYTO	Night snake	1
	<i>Lampropeltis californiae</i>	LAGE	California kingsnake	3
	<i>Coluber lateralis lateralis</i>	MALA	Striped racer	5
	<i>Pituophis catenifer</i>	PIME	Gopher snake	1
Mammals	<i>Notiosorex crawfordi</i>	NOCR	Desert shrew	36
	<i>Chaetodipus fallax</i>	CHFA	San Diego pocketmouse	0
	<i>Mus musculus</i>	MUMU	House Mouse	4
	<i>Peromyscus californicus</i>	PECA	California mouse	0
	<i>Peromyscus fraterculus</i>	PEER	Cactus mouse	0
	<i>Peromyscus maniculatus</i>	PEMA	Deer mouse	2
	<i>Peromyscus</i> species	PESP	<i>Peromyscus</i> species	3
	<i>Reithrodontomys megalotis</i>	REME	Western harvest mouse	0
	<i>Neotoma lepida</i>	NELE	Desert woodrat	0

Lizards

Four of the five species of lizards known to occur in Point Loma were captured in 2014 (Fig. 2). The most productive array in 2014 was LOMA-3 (Fig. 3).

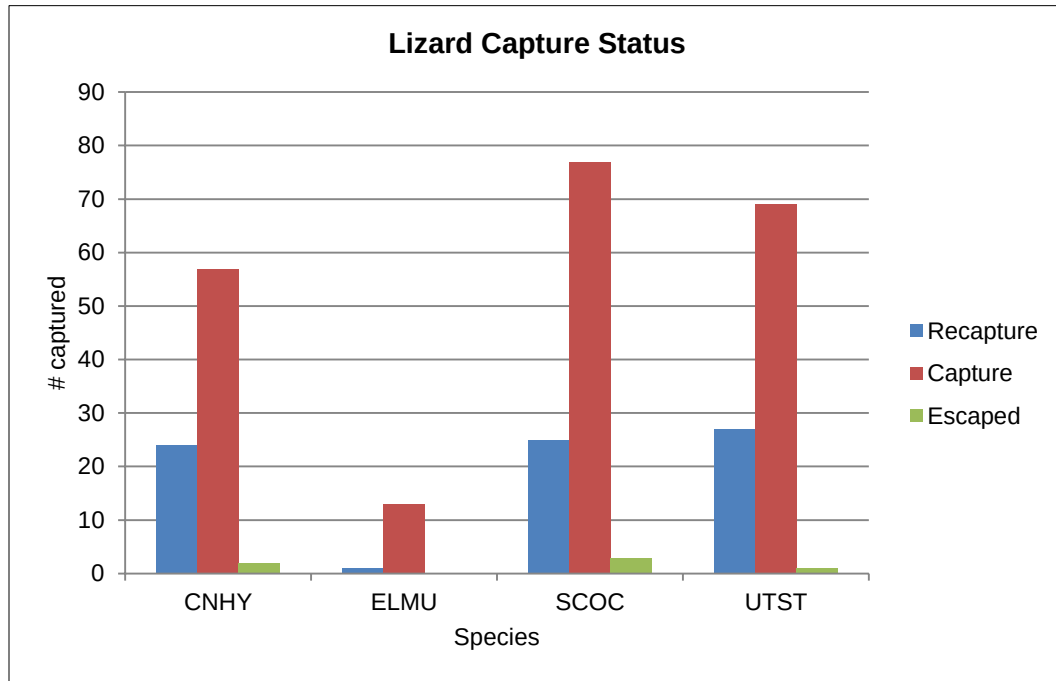


Figure 2. Capture status of 4 lizard species during the 2014 herpetofauna surveys. CNHY = *Aspidoscelis hyperythra* (n=83), ELMU = *Elgaria multicarinata* (n=14), SCOC = *Sceloporus occidentalis* (n=105), UTST = *Uta stansburiana* (n=97).

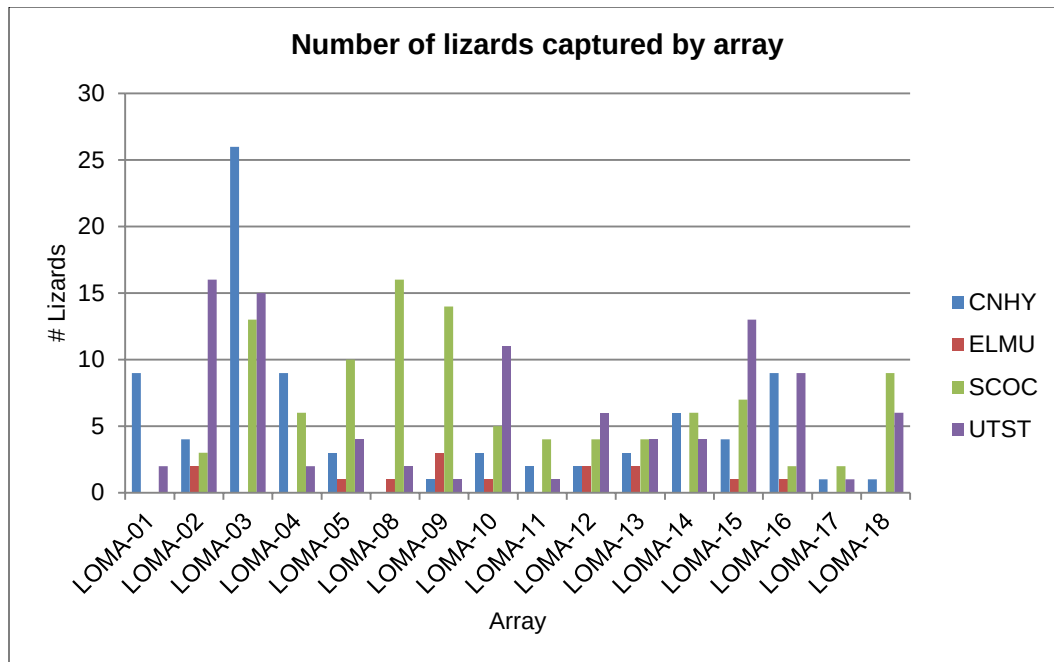


Figure 3. Lizard species captures by array in 2014. CNHY = *Aspidoscelis hyperythra*, ELMU = *Elgaria multicarinata*, SCOC = *Sceloporus occidentalis*, UTST = *Uta stansburiana*.

***S. occidentalis* (SCOC):** There were 105 SCOC captured in 2014. SCOC was not captured at array 1 (Fig. 4). Eighty-eight SCOC (83.5%) were captured in pitfall traps while 17 SCOC (16.5%) were captured in the funnel traps. In 2014, 77 SCOC were new captures (73.3%), 25 SCOC (23.8%) had previously been captured and marked. There were 31 (30.0%) juvenile captures and 74 (70.5%) adult captures in 2014.

Three SCOC had escaped before processing and were not marked or identified as being recaptured.

There were 27 (25.7%) unique juvenile captures and 49 (46.7%) unique adult captures. The recruitment index (the number of unique juveniles captured in 2014/ number of unique adults captured in 2014) for SCOC was 0.55.

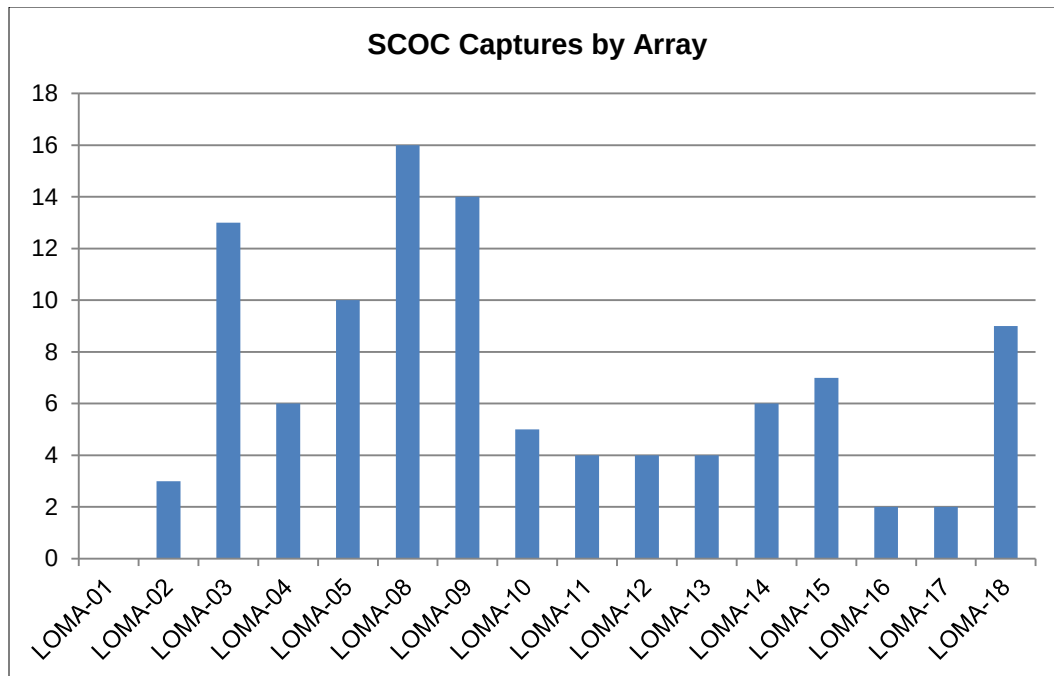


Figure 4. *S. occidentalis* captures by array in 2014.

***U. stansburiana* (UTST):** There were 97 UTST captured in 2014. At least one UTST was captured at every array this year (Fig 5). The greatest number of captures occurred at Array 2 and 3 with 31 total captures. Seventy-seven UTST (80%) were captured in the pitfall traps while 18 (18.7%) were captured in the funnel traps. Of the 96 captures, 66 (68.8%) were new captures, 29 were recaptures (30.2%) and one escaped before processing. This year, there were 24 (25%) known juvenile UTST (SVL < 40 mm) and 72 (75%) known adult UTST.

There were 22 (22.9%) unique juvenile captures and 43 (44.7%) unique adult captures. The recruitment index (the number of unique juveniles captured in 2014/ number of unique adults captured in 2014) for UTST was 0.51.

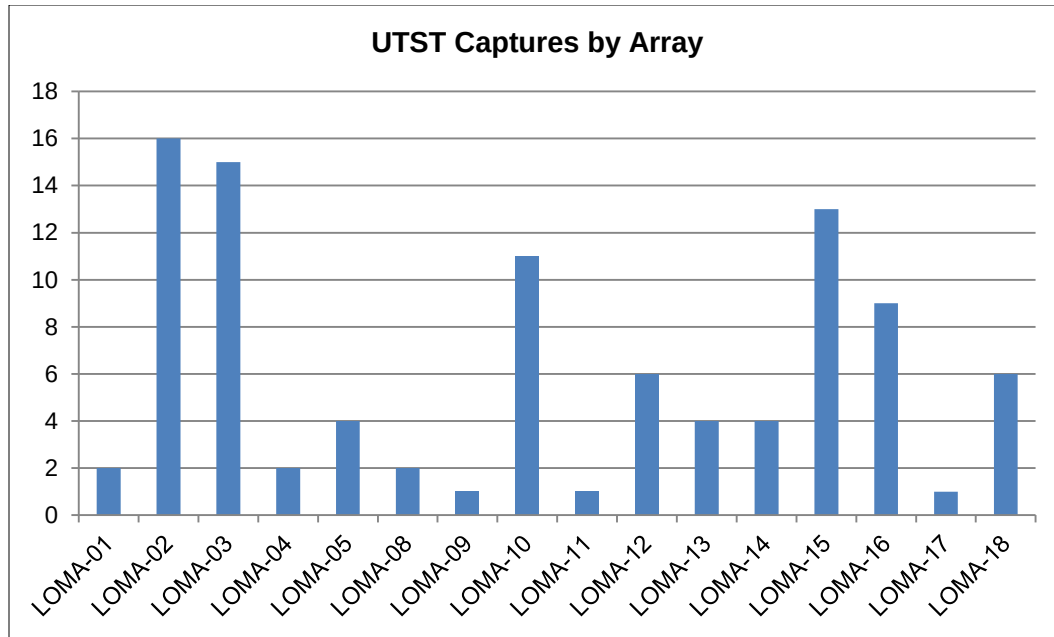


Figure 5. *U. stansburiana* captures by array in 2014.

***Aspidoscelis hyperythra* (CNHY):** There were 83 CNHY captured in 2014. CNHY was not captured at array 8 (Fig. 6). Sixty-seven CNHY (80.7%) were captured in pitfall traps while 16 CNHY (19.3%) were captured in the funnel traps. In 2014, 55 CNHY were new captures (66%), 26 CNHY (31.3%) had previously been captured and marked. There were five (6%) juvenile captures and 77 (92.7%) adult captures in 2014.

Two CNHY had escaped before processing and were not marked and/or identified as being recaptured.

There were five (6%) unique juvenile captures and 50 (60.2%) unique adult captures. Recruitment index for CNHY was 0.1 (the number of unique juveniles captured in 2014/ number of unique adults captured in 2014).

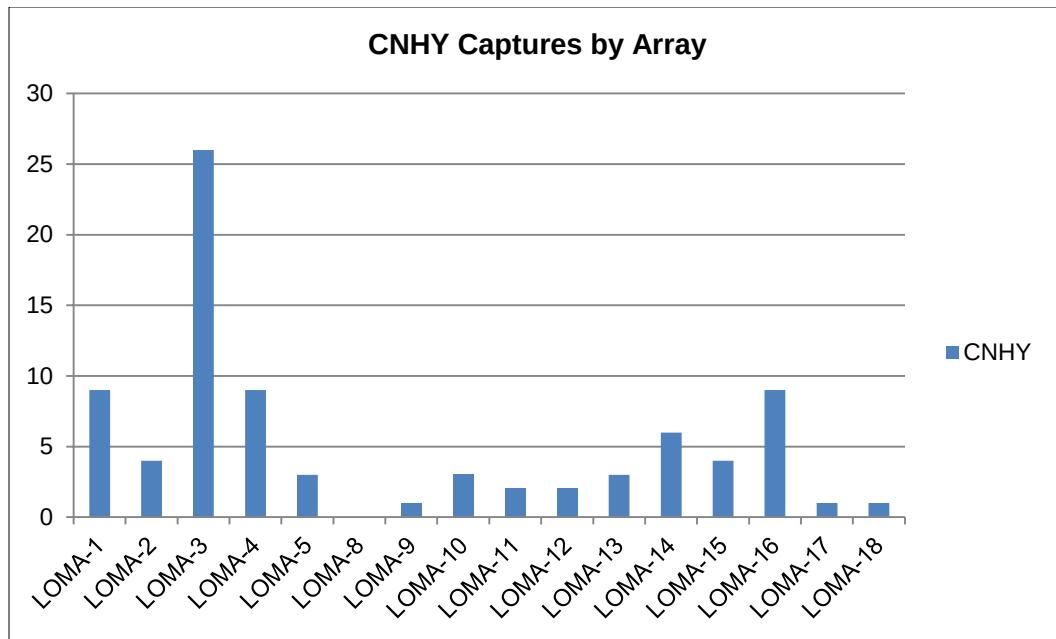


Figure 6. CNHY captures by array in 2014.

***E. multicarinata* (ELMU):** There were 14 ELMU captured in 2014. This species was present at eight arrays (Fig. 7). Of the 14 ELMU that were captured, eight were found in pitfall traps and six were found in funnel traps. All ELMU captures were classified as adult. Age was determined in the field at the discretion of the collector, as there is no formal classification protocol in place. Only one ELMU was a recapture this year.

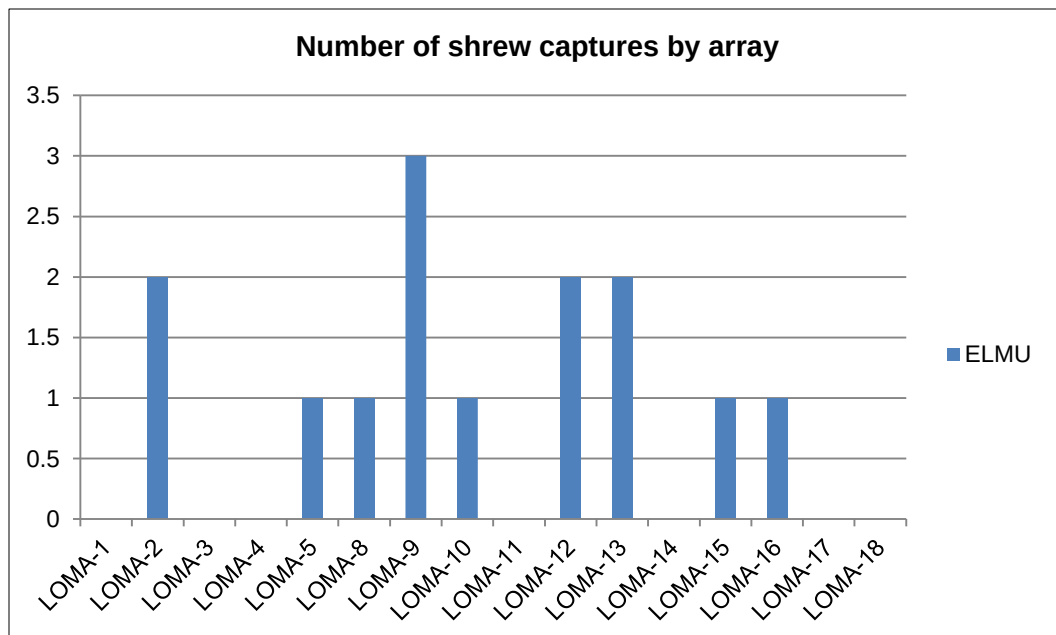


Figure 7. The number of shrews captured during herpetile monitoring in 2014 by array.

Snakes

Five of the six snake species known to occur in Point Loma were captured in 2014 (Figure 8). In addition to these numbers, an additional MALA, one CRVI and one HYTO were counted as incidental observations (see Appendix C).

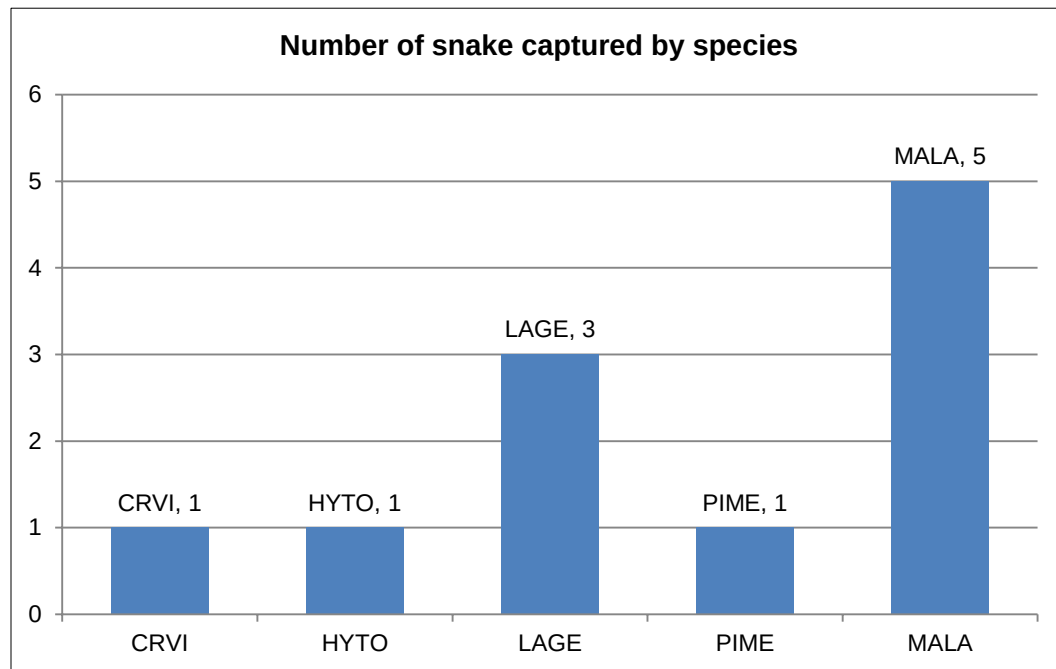


Figure 8. Snakes captured during herptile monitoring in 2014. CRVI = *Crotalus oreganus helleri*, PIME = *Pituophis catenifer annectens*, MALA (*Coluber lateralis lateralis*), LAGE = *Lampropeltis californiae*, and HYTO = *Hypsiglena ochrorhyncha klauberi*.

Other captures

B. major (pacificus) (BAPA): Only one BAPA was captured in 2014. It was classified as an adult, found in a bucket at LOMA-12.

N. crawfordi (NOCR): There were 36 NOCR captured in the traps in 2014. A greater number of mealworms were placed in buckets this year, significantly reducing mortality from 69.2% in 2013 to 25.8% in 2014.

Rodents: Other small mammals that were captured in the traps were: *Peromyscus maniculatus* ($n=2$), *Peromyscus* spp. ($n=3$), and *Mus musculus* ($n=4$). Rodents were not marked due to the low capture rate.

Invertebrates: Common arthropods captured in the traps included centipedes, millipedes, Jerusalem crickets, trapdoor spiders, scorpions, tarantulas, and wind scorpions.

Discussion

The 2014 herpetofauna surveys at the PLECA (including CABR) yielded captures of ten out of 12 known herptile species of the Point Loma Peninsula. The herptile species not detected this year during sampling (*Diadophis punctatus similis* and *Anniella stebbinsi*. *D. puncactus*), were observed and photo documented (see Appendix C) on the Bayside Trail near LOMA-17.

Low recruitment for CNHY continued again this year, though overall captures for the species are up from 2012 and 2013. Because CNHY is a state species of concern, park management should consider where habitat restoration efforts for CNHY could be focused. Regional trends should also be examined to determine potential population changes across its range.

Historically, mortality of shrews was high when they were caught in pitfall buckets. Shrew mortality was significantly reduced in 2014 from previous years by placing more and/or larger mealworms into the buckets. This practice should be continued in future sampling efforts.

Placement of wet sponges was altered beginning in 2014 because moisture is an attractant for Argentine ants. The sponges were only placed in buckets during months of highest activity for salamanders, which are generally October through March. Observations from staff and volunteers indicated the reduced use of wet sponges in traps resulted in fewer ants. Consequently, fewer pitfall trap were closed in 2014.

Precipitation recorded for 2013 and 2014 was much less than average (see Appendix A). The extremely low number of captures of BAPA ($n=1$) and small mammal species could be linked to the prolonged drought in Southern California. Monitoring should be completed during all winter months in order to properly assess BAPA populations. Continual monitoring of herptile species at Point Loma is essential to understand population dynamics.

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Appendix A. Array Locations.

Table A-1. Array locations.

Site Name	Habitat*	Lat	Long	Elevation (m)
LOMA-01	MSS	32.674013	-117.244035	26
LOMA-02	MSS	32.671983	-117.244416	22
LOMA-03	MSS	32.667026	-117.242105	22
LOMA-04	MSS	32.668135	-117.242283	33
LOMA-05	SMC	32.695869	-117.242972	83
LOMA-08	MSS	32.703438	-117.25337	33
LOMA-09	MSS	32.705717	-117.253678	42
LOMA-10	DIS	32.682951	-117.247596	35
LOMA-11	MSS	32.683725	-117.24777	37
LOMA-12	MSS	32.68407	-117.247368	31
LOMA-13	MSS	32.669871	-117.241146	109
LOMA-14	MSS	32.670186	-117.241322	113
LOMA-15	MSS	32.668927	-117.238106	54
LOMA-16	MSS	32.669427	-117.238058	55
LOMA-17	MSS	32.675123	-117.237491	37
LOMA-18	SMC	32.696728	-117.242787	75

* MSS: maritime succulent scrub, DIS: disturbed, SMC: southern maritime chaparral.

Appendix B. 2014 Precipitation Data

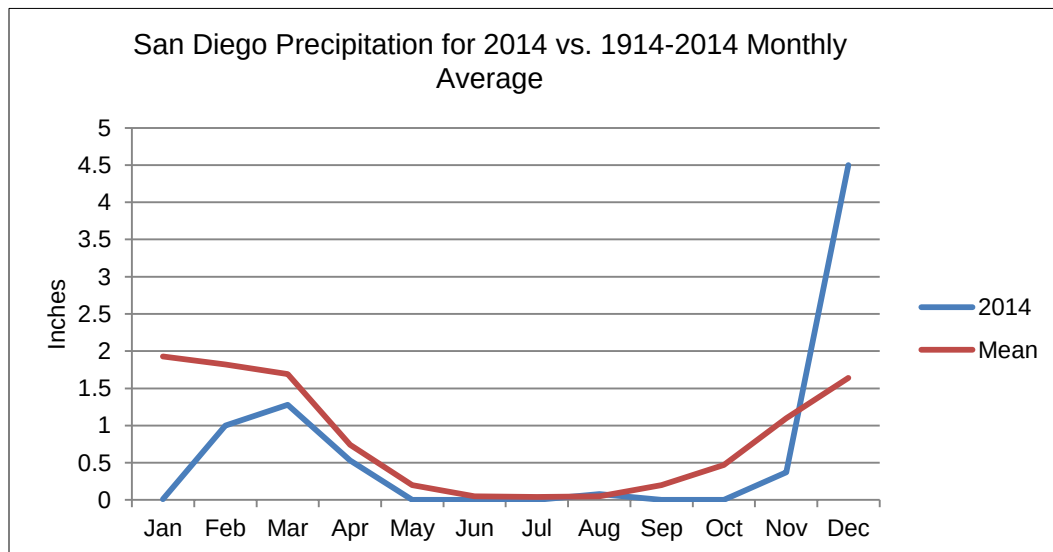


Figure B-1. Precipitation data from Western Regional Climate Center. (<http://www.wrcc.dri.edu/>).

San Diego WSO Airport weather station data was utilized, located at lat 32°44', long 117°10' at the elevation of three feet above sea level.

Appendix C. Coverboard and other incidental observations in 2014.

Table C-1. Coverboard and other incidental observations in 2014.

Location	Date	Trap Type	Species Category	Species Code
LOMA-08	12-Feb-14	COVERBOARD	Invertebrate	MILL
LOMA-18	22-May-14	COVERBOARD	Invertebrate	SCOR
LOMA-03	23-Oct-14	COVERBOARD	Invertebrate	SCOR
LOMA-04	24-Apr-14	COVERBOARD	Invertebrate	SCOR
LOMA-04	24-Apr-14	COVERBOARD	Invertebrate	SCOR
LOMA-10	22-Apr-14	NEARBY	Lizard	CNHY
LOMA-11	12-Mar-14	NEARBY	Lizard	ELMU
LOMA-13	14-Mar-14	NEARBY	Lizard	SCOC
LOMA-15	13-Aug-14	COVERBOARD	Lizard	SCOC
LOMA-15	14-Aug-14	COVERBOARD	Lizard	SCOC
LOMA-15	12-Aug-14	COVERBOARD	Lizard	UNLI
LOMA-15	12-Aug-14	COVERBOARD	Lizard	UNLI
LOMA-14	13-Aug-14	COVERBOARD	Lizard	UNLI
LOMA-17	12-Mar-14	NEARBY	Lizard	UTST
LOMA-17	25-Apr-14	COVERBOARD	Lizard	UTST
LOMA-15	12-Aug-14	COVERBOARD	Lizard	UTST
LOMA-16	23-Oct-14	COVERBOARD	Lizard	UTST
LOMA-03	23-Oct-14	COVERBOARD	Lizard	UTST
LOMA-04	23-Oct-14	COVERBOARD	Lizard	UTST
LOMA-18	15-Jul-14	NEARBY	Snake	MALA
LOMA-17*	17-Nov-14	N/A	Snake	DIPU

* Outside of sampling period.

Appendix D. Trap session dates and survey start times.

Table D-1. Trap session dates and survey start times.

Trap Session	Month	Date Opened	Date Closed	Survey Start Time	Trap Nights
1	January	21-Jan	25-Jan	715	4
2	February	10-Feb	14-Feb	715	4
3	March	10-Mar	14-Mar	715	4
4	April	21-Apr	25-Apr	715	4
5	May	19-May	23-May	715	4
6	June	9-Jun	13-Jun	715	4
7	July	14-Jul	18-Jul	715	4
8	August	11-Aug	15-Aug	715	4
9	September	15-Sep	19-Sep	715	4
10	October	20-Oct	24-Oct	715	4
11	December	15-Dec	19-Dec	715	4

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

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National Park Service
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