A COMPARATIVE SURVEY OF REPTILES AND AMPHIBIANS WITHIN RIPARIAN AND OAK WOODLAND HABITATS OF THE LOS PADRES NATIONAL FOREST

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Table of Contents

List of Figures

List of Tables

PAGE

PAGE iii

INTRODUCTION

Hi Mountain Lookout is located on a 3198-foot peak in the Santa Lucia Mountain range of the Los Padres National Forest in San Luis Obispo County, California. The city of San Luis Obispo is located to the west, the quiet town of Pozo is located to the northeast and recreational Lopez Lake is located to the southwest. A regional view of Hi Mountain Lookout is provided in Figure 1. Historically, Hi Mountain Lookout acted as a fire lookout for the United States Forest Service. Abandoned for nearly a decade, it has been completely restored and functions as a California condor watch station. The lookout allows people to generate important data on the movements of the endangered California condor. The lookout's modest museum serves as an educational center for visitors who are interested in the California condor and the ecology of the surrounding area. Hi Mountain Lookout acts as headquarters for our project and the surrounding wilderness provides us with our study grounds.

Our project focused on the identification of the herpetofauna (reptiles and amphibians) within two different habitat types in the vicinity of Hi Mountain Lookout. The two habitat types included oak woodland and riparian. The habitats chosen make up two of the three dominant plant communities surrounding the lookout. The third dominant habitat type is mixed chaparral, which we omitted from our study. Our hypothesis is that we will observe the highest diversity of herpetofauna in riparian habitats versus oak woodland habitats. The higher diversity of herpetofauna will be due to the presence of a water source often found in riparian habitats. The presence of a water source is essential for variety of amphibians, reptiles, and their food source. Therefore, a higher diversity of herpetofauna will be observed in the riparian habitats.

Our project is part of an overall comprehensive study that is intended to identify the flora and fauna found in the area surrounding Hi Mountain Lookout. The methods used in the design of the project will be standardized to offer statistical power and repeatability. Other projects focused on identifying vegetation, birds, insects, and mammals in the same area. Cal Poly students under the guidance of Dr. Francis Villablanca conducted these projects. All of these projects are important in that they provide pertinent information to the overall biological knowledge of the wilderness surrounding Hi Mountain Lookout. They also provide a sturdy foundation for future studies.

METHODS

The first work of this project began in the summer of 2002 with the location of potential study sites using the following methods of GIS and plot selection. This is an excerpt from Daniel Bohlman's The Ethnobotany of Hi Mountain.

We identified the primary vegetative communities of Hi Mountain by using geographic information systems (GIS) mapping. This software allows for a spatial analysis of mapped areas by performing queries against a database generated from the area in question. Compiling shape files or mapping layers for all areas of interest created the maps (example: rivers, county boundaries, roadways, etc.). For our particular areas of interest, shape files were gathered from the San Luis Obispo County GIS database located in Cal Poly's GIS server (http://discover.lib.calpoly.edu/gis/) (Clay, et al, 2001). The files were then compiled into a single Arc View database. To identify the major vegetative communities surrounding Hi Mountain, a high-resolution vegetation shape file was displayed in Arc View (Arc View 3.2). Shape files of San Luis Obispo County and Los Padres Park boundaries were then projected on top of the vegetation shape file. Secondary roads, highways, and watershed shape files were also added to the map. Finally, a San Luis Obispo County sections grid was projected over the vegetation GIS map. An overview of the vegetative community identification of Los Padres National Forest is provided in Figure 2. The use of county sections provided a means of connecting the GIS map to standard 7.5-minute topographic maps for this area.

Using this data set, a query was conducted to eliminate those areas of the vegetation, roadway, and watershed layers that fell outside the boundary of the Los Padres Park. Another query was performed to eliminate all vegetation polygons (a single vegetative type) that were not of sufficient size to hold our research design. The design required a minimum of 150 hectares of a single vegetation type, from which 25 one-hectare plots could be randomly selected. An overview of the dominant vegetative habitats surrounding Hi Mountain Lookout is provided in Figure 3.

As a result of these queries, the vegetative communities of mixed chaparral, mixed hardwood/oak woodland, and riparian corridors were isolated as those of primary importance around the Hi Mountain area. Communities were identified and defined using "California Vegetation" (Holland and Keil, 1995). After being identified, the dominant communities' vegetative composition was ground-truthed for accuracy against the GIS shape-files. With the use of handheld Global Positioning System (GPS) devices, waypoints were taken at the intersection of roads and county sections occurring in the plant communities of the research area. Since county sections are roughly one square mile each, we calculated that 256 one-hectare plots fall within each county section. From these calculations, a one-hectare grid was overlaid onto each of the confirmed GIS San Luis Obispo County section. By placing the grid on a known point (based on collected GPS data above) the centers of each prospective plot were determined through simple addition and subtraction of decimal degrees in 100-meter increments. To respect a 50-meter road buffer, plots whose centers fell within 150 meters of a road were eliminated. Plots that straddled another vegetative community were also rejected. An overview of San Luis Obispo County section numbers where the surveys were performed is provided in Figure 4.

The remaining viable plots' coordinates were then entered into a handheld GPS unit as a unique waypoint. Using the device as a navigational tool, these plots were further assessed for potential workability (slope angle, accessibility, etc.) by physically visiting each of their centers. The routes to these plots were cut and marked to ensure accessibility. Some plots were far too steep to safely survey and/or too distant for realistic access and were therefore eliminated from the pool of potential survey sites. However, candidates were not eliminated based on vegetative characteristics (i.e. extremely dense chaparral, poison oak, etc.) (Bohlman, 2003). A list of surveyed plots with center point coordinates is provided in Table 1. Overviews of the surveyed plot locations are provided in Figures 5 and 6.

Each plot used was 100 meters by 100 meters (1 hectare) and occurred in one of two communities: oak woodland or riparian. The riparian plots need to have a water source within the plot and the associated riparian plant species (Willows, Bay Laurels, Sycamores, etc.), while the oak woodland plots had to have a total canopy cover of 50% or 30% cover from the shrub layer. Plot centers are located with GPS (Global Positioning System) technology. Once we are at the plot center, a 50 meter by 5 meter transect line is set up going north of the center. In the unusual event that we found north unsampleable, we selected South, East or West respectively, until we found a direction within our sampleable criterion. This criterion limits our exposure to poison EMBED Word.Picture.8

Figure 1. Regional view of Hi Mountain Lookout.

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Figure 2. Overview of the vegetative community identification of Los Padres National Forest.

Figure 3. Overview of the dominant vegetative habitats around Hi Mountain Lookout.

Figure 4. Overview of San Luis Obispo County section numbers where surveys were performed.

Table 1. Surveyed plots with center point coordinates.

Oak Woodland	Coordinates	Riparian	Coordinates
H10134	35^{O}14.734' N 120^{O}21.320' W	R01114	35^{O}15.004' N 120^{O}25.337' W
H10145	35^{O}14.736' N 120^{O}21.725' W	R01115	35^{O}15.000' N 120^{O}25.275' W
H10147	35^{O}14.736' N 120^{O}21.595' W	R01116	35^{O}14.974' N 120^{O}25.214' W
H10148	35^{O}14.895' N 120^{O}21.725' W	R04173	35^{O}15.141' N 120^{O}22.755' W
H10151	35^{O}14.842' N 120^{O}21.530' W	R04174	35^{O}15.141' N 120^{O}22.690' W
H10166	35^{O}14.842' N 120^{O}21.595' W	R04208	35^{O}15.141' N 120^{O}22.820' W
H10178	35^{O}14.630' N 120^{O}21.660' W	R04223	35^{O}14.982' N 120^{O}22.365' W
H10197	35^{O}14.683' N 120^{O}21.530' W	R04236	35^{O}14.929' N 120^{O}22.300' W
H30015	35^{O}16.829' N 120^{O}24.108' W	R04237	35^{O}14.929' N 120^{O}22.235' W
H30016	35^{O}16.829' N 120^{O}24.043' W	R05181	35^{O}15.278' N 120^{O}23.244' W
H30019	35^{O}16.988' N 120^{O}24.303' W	R05182	35^{O}15.276' N 120^{O}23.181' W
H30030	35^{O}16.640' N		

120^{O}24.124' W R07077 35^{O}14.915' N 120^{O}24.611' W

H30031 35^{O}16.776' N 120^{O}24.108' W R07078 35^{O}14.915' N

120^{O}24.546' W H30032 35^{O}16.776' N 120^{O}24.043' W

R07079 35^{O}14.915' N 120^{O}24.481' W H30054 35^{O}16.882' N

120^{O}24.108' W R07098 35^{O}14.968' N 120^{O}25.066' W

H31181 35^{O}15.740' N 120^{O}24.624' W R07099 35^{O}14.968' N

120^{O}25.001' W H31182 35^{O}15.740' N 120^{O}24.559' W

R07102 35^{O}14.968' N 120^{O}24.806' W H31184 35^{O}15.740' N

120^{O}24.429' W R07103 35^{O}14.968' N 120^{O}24.741' W

H31234 35^{O}15.846' N 120^{O}24.624' W R10187 35^{O}14.471' N

120^{O}21.465' W H31235 35^{O}15.846' N 120^{O}24.559' W

R10188 35^{O}14.736' N 120^{O}21.855' W H31245 35^{O}15.793' N

120^{O}24.949' W R10189 35^{O}14.683' N 120^{O}21.790' W

H31250 35^{O}15.793' N 120^{O}24.624' W R10190 35^{O}14.418' N

120^{O}21.400' W H31251 35^{O}15.793' N 120^{O}24.559' W

R10191 35^{O}14.736' N 120^{O}21.790' W H31252 35^{O}15.793' N

120^{O}24.494' W R10192 35^{O}14.630' N 120^{O}21.725' W

H31253 35^{O}15.793' N 120^{O}24.429' W R10225 35^{O}14.482' N

120^{O}21.855' W

Figure 5. Overview of surveyed plots in SLO Co. section numbers 1, 7, 30 and 31.

Figure 6. Overview of surveyed plots in SLO Co. section numbers 4, 5 and 10.

oak or danger from cliffs and keeps us within the desired plot type (i.e. creek bed or oak woodland plant species instead of chaparral).

Two people collected the data by thoroughly searching the transect line for approximately 15 minutes. The search area is 5 meters by 50 meters from the plot center. We wore work gloves to protect our hands from hazards found under the numerous leaves, rocks and logs we looked under. When tadpoles were encountered in a plot, they were counted and identified if possible. A snake stick was used for looking under debris and for reaching under poison oak to look under leaves or objects. Since a compass is easier to use for cardinal direction than the GPS, we used one to determine north at the plot center. The identification of the species we found (including tadpoles) is defined in Stebbins 2003.

RESULTS

A total of 50 one hectare plots were surveyed which were dominated by two different habitat types. Half of the plots were dominated by riparian habitat and the other half were dominated by oak woodland (hardwood) habitat. A total of 6 days were spent out in the field hiking to, from and surveying the plots. The total number of hours actually spent collecting data was 11.73 hours with a minimum of 7 minutes and a maximum of 22 minutes spent on the collection of data in each plot. The average time spent on the collection of data in each plot was 14.08 minutes.

A total of 10 different species of herpetofauna were observed within the 50 plots with 9 of the 10 species found in riparian plots and 5 of the 10 species found in oak woodland plots. The total number of individual herpetofauna observed within the 50 plots was 108 with 73 individuals found in riparian plots and 35 individuals found in oak woodland plots. Of the total number of individuals observed within the surveyed plots 39.81% were Pacific chorus frogs (*Hyla regilla*) with 100% found in riparian plots, 25.93% were Western fence lizards (*Sceloporus occidentalis*) with 21.43% found in riparian plots and 78.57% found in oak woodland plots, 15.74% were black-bellied slender salamanders (*Batrachoseps nigriventris*) with 70.59% found in riparian plots and 29.41% found in oak woodland plots, 4.63% were Southern alligator lizards (*Elgaria multicarinata*) with 60.00% found in riparian plots and 40.00% found in oak woodland plots, 4.63% were Southwestern pond turtles (*Clemmys marmorata pallida*) with 40.00% found in riparian plots and 60.00% found in oak woodland plots, 2.78% were Western skinks (*Eumeces skiltonianus*) with 100.00% found in oak woodland, 1.85% were ring-necked snake (*Diadophis punctatus*) with 100.00% found in riparian plots, 1.85% were Santa Cruz garter snake (*Thamnophis atratus*) with 100.00% found in riparian plots, 1.85% were California treefrog (*Hyla cadaverina*) with 100.00% found in riparian plots, and 0.93% were California whipsnake (*Masticophis lateralis*) with 100.00% found in riparian plots. A list of herpetofauna observed and the habitat they were found in is provided in Table 2. A list of herpetofauna observed, the habitat they were found, the amount of individuals found and the percentage breakdown is provided in Table 3.

A number of herpetofauna were incidentally observed during this project. Most of them composed the same species that were seen within the plot surveys. Incidental observations that were made and not seen in the plot surveys were of California whiptails (*Cnemidophorus tigris* mundus), coast horned lizards (*Phrynosoma coronatum*), a Monterey salamander (*Ensatina eschscholtzii eschscholtzii*), a night snake (*Hypsiglena* *torquata*) and side-blotched lizards (*Uta stansburiana*). Matt Tyner observed a Western rattlesnake (*Crotalus viridis*) and Matt Willis

Table 2. Observed plot herpotofauna and the habitat type which found in.

Common Name	Family	Genus species	R	H
black-bellied slender salamander	Plethodontidae	*Batrachoseps nigriventris*	x	x
California treefrog	Hylidae	*Hyla cadaverina*	x	
California whipsnake	Colubridae	*Masticophis lateralis*	x	
Pacific chorus frog	Hylidae	*Hyla regilla*	x	
ring-necked snake	Colubridae	*Diadophis punctatus*	x	
Santa Cruz garter snake	Colubridae	*Thamnophis atratus*	x	
Southwestern pond turtle	Emydidae	*Clemmys marmorata pallida*	x	x
Southern alligator lizard	Anguidae	*Elgaria multicarinata*	x	x
Western fence lizard	Phrynosomatidae	*Sceloporus occidentalis*	x	x
Western skink	Scincidae	*Eumeces skiltonianus*		x

Table 3. Observed plot herpetofauna, amount of individuals found and percentages.

Common Name	Species Totals In Riparian	Species % In Riparian	Species Totals In H	Species % In H	Species Totals In Both Habitats	Species % In Both Habitats
black-bellied slender salamander	12	70.59%	5	29.41%	17	15.74%
California treefrog	2	100.00%	0	0.00%	2	1.85%
California whipsnake	1	100.00%	0	0.00%	1	0.93%
Pacific chorus frog	43	100.00%	0	0.00%	43	39.81%
ring-necked snake	2	100.00%	0	0.00%	2	1.85%
Santa Cruz garter snake	2	100.00%	0	0.00%	2	1.85%
Southwestern pond turtle	2	40.00%	3	60.00%	5	4.63%
Southern alligator lizard	3	60.00%	2	40.00%	5	4.63%
Western fence lizard	6	21.43%	22	78.57%	28	25.93%
Western skink	0	0.00%	3	100.00%	3	2.78%
TOTALS	73		35		108	100.00%

Key: R = riparian and H = oak woodland (hardwood)

observed a Western toad (*Bufo boreas*) around the study area. A list of herpetofauna incidentally observed and the habitat they were found in is provided in Table 4. The computerized version of the data collected from the field is provided in Appendix I. Pictures of the herpetofauna observed are provided in Appendix II.

DISCUSSION

In the results section we looked at percentages and other relationships between herpetofauna and habitat type. There seemed to be a relationship which would have supported our hypothesis, but this is the section for proof and opinion.

Due to the small number of experimental plots within each habitat type, and the small number of reptiles and amphibians captured on each plot, ANOVA testing could not be performed because the variances were unequal (Equality of Variances F test, $p<0.0001$). Therefore, a non-parametric two-sample test was selected. The Kolmogorov-Smirnov two-sample test was chosen because it is an unranked test (ranked tests such as the Kruskal-Wallis test would be mildly ineffective because all the plots hovered around 1-3 animals per plot) and its null hypothesis is that the two samples are distributed equally, that's not spatial distribution but distributed around the mean. Two different statistics were tested: number of animals per plot and number of species per plot. The grouping variable was habitat type. Interestingly, number of species per plot did show an equality of variances, and therefore was okay for an ANOVA, but we stuck with the Kolmogorov-Smirnov for consistency.

Results follow:

Number of Individuals per Plot

Hardwood Mean= 1.400, Standard Deviation= 1.732

Riparian Mean= 2.920, Standard Deviation= 6.806

25 samples per habitat

Kolmogorov-Smirnov Test

Degrees of Freedom = 2

Maximum Difference= 0.160

Chi-squared= 1.280

P > 0.9999

Number of Species per Plot

Hardwood Mean= 1.040, Standard Deviation= 1.241

Riparian Mean= 1.000, Standard Deviation= 1.000

25 samples per habitat

Kolmogorov-Smirnov Test

Degrees of Freedom = 2

Maximum Difference= 0.080

Chi-squared= 0.320

$P > 0.9999$

The p value associated with both tests suggests there is no significant difference between samples in each habitat type. I think this is due to the relatively small sample size of 25 plots per vegetation type.

Also, the Shannon-Weiner Diversity Index (H) was calculated for each habitat type. As this is a descriptive statistic that needs all the samples taken to calculate it, it cannot be subjected to statistical analysis to determine if they are significantly different. We can however state that they do appear different, and if a literature search turned up a baseline Diversity Index for that habitat type, we could compare it to that. The Diversity Indices are as follows:

Hardwood, H=1.11

Riparian, H=1.42

We would be able to run statistical analysis on this index if we had repetition in our data. That is to say if we recollected the same plots or used a similar study from nearby to compare our data to.

In essence, our data would be more useful if we had another similar study to compare it to, or if we had collected data from more transects. There do appear to be some trends, so further study of this area may yield some better results for future biologists.

The methods of sample collection described before were selected for their ease and thoroughness at collecting the most number of species from the plot area. We had to keep in mind methods for reducing take (which is defined as touching, molesting, killing, maiming, etc) of protected species. This is why we chose to avoid methods such as pitfall traps, where we could not control what was captured. Perhaps because some of these effective methods were left out of this study, we did not encounter as many species as we expected to find. A list of herpetofauna that we expected to observe and the habitat that they are commonly found in is provided in Table 5.

Table 4. Observed incidental herpetofauna and the habitat type which found in.

Common Name	Family	Genus species	Where Observed
black-bellied slender salamander	Plethodontidae	*Batrachoseps nigriventris*	C
California whiptail	Teiidae	*Cnemidophorus tigris mundus*	R
coast horned lizard	Phrynosomatidae	*Phrynosoma coronatum*	C
gopher snake	Colubridae	*Pituophis catenifer*	C/H
Monterey salamander	Plethodontidae	*Ensatina eschscholtzii eschscholtzii*	C
night snake	Colubridae	*Hypsiglena torquata*	C
side-blotched lizard	Phrynosomatidae	*Uta stansburiana*	C
Western fence lizard	Phrynosomatidae	*Sceloporus occidentalis*	C
Western rattlesnake	Viperidae	*Crotalus viridis*	C
Western toad	Bufonidae	*Bufo boreas*	C

Table 5. Expected herpetofauna not observed and habitat commonly found in.

Common Name	Family	Genus species	Habitat
arboreal salamander	Plethodontidae	*Aneides lugubris*	C/H/R
bullfrog	Ranidae	*Rana cetesbeiana*	R
California legless lizard	Anniellidae	*Anniella pulchra*	C/H
California mountain kingsnake	Colubridae	*Lampropeltis zonata*	C/H/R
California tiger salamander	Ambistomatidae	*Ambistoma californiense*	C/H/R
coast range newt	Salamandridae	*Taricha torosa torosa*	H/R
common garter snake	Colubridae	*Thamnophis sirtalis*	C/H/R
common kingsnake	Colubridae	*Lampropeltis getula*	C/H/R
foothill yellow-legged frog	Ranidae	*Rana boylii*	H/R
racer	Colubridae	*Coluber constrictor*	C/H/R
red-legged frog	Ranidae	*Rana aurora*	H/R
rubber boa	Boidae	*Charina bottae*	C/H/R
sharp tailed snake	Colubridae	*Contia tenuis*	C/H/R
two-striped garter snake	Colubridae	*Thamnophis hammondii*	H/R
Western spadefoot	Pelobatidae	*Spea hammondii*	

C/H/R	Western terrestrial garter snake	Colubridae	*Thamnophis elegans*
	C/H/R		

*Key: R = riparian, H = oak woodland (hardwood) and C = chaparral.

Snakes were highly under represented, with species being found having very low numbers, and many species not occurring at all. Amazingly, common species like the California kingsnake (*Lampropeltis getul*) was not encountered. Burrowing species like the western spade foot toad (*Spea hammondii*) and the California legless lizard (*Anniella pulchra*) were not encountered either.

A combination of factors led to us not finding these species. These factors are the time of year we collected our data and the lifestyle of the species we pursued. We will discuss a few important species that were not observed and why they were not encountered.

The California tiger salamander (*Ambystoma californiense*) is a species of special concern in California and an endangered species in Santa Barbara County (Department of Fish and Game website). This protected species uses burrows of other animals and is very susceptible to housing developments, vineyards and gopher (Geomyidae) and ground squirrel (*Citellus beecheyi*) eradication (Stebbins 2003). They depend on temporary and permanent sources of water for breeding and the development of their larvae. If nonnative fish and bullfrogs (*Rana catesbeiana*) are introduced to the system then the salamanders are hurt by predation of the adults and larvae. There is also increased interspecific competition for resources. According to Stebbins (1973) the bullfrog larvae are 3 inches at metamorphosis and eat amphipods, copepods, ostrocods, midges, snails, and tadpoles.

While we found no bullfrogs (*Rana catesbeiana*) in our study area, there is a high likelihood that they are present. A personal observation revealed a strong, breeding population in the Salinas creek crossing outside of Pozo. This location is just a few miles downstream of the National Forest. Nonnative fish were seen in Trout Creek and were identified as the California roach (*Hesperoleucus symmetricus)* which could give competition for afore mentioned food resources. Rainbow trout (*Oncorhynchus mykiss*) were observed in good numbers in many areas of Trout Creek. These predators could feed on the aquatic larvae as well as the breeding adults. One of the largest killers of adult California tiger salamander (*Ambystoma californiense*) is vechicles as the salamanders travel to their breeding pools. Luckily, this is probably at a minimum here because road traffic is uncommon. We believe the primary reason they were not encountered is because they emerge from their burrows with the autumn rains for breeding and then go back underground. We were not sampling during this wet period, so we missed the window of opportunity. Collection of this species in this area might require a study focusing on California tiger salamanders (*Ambystoma californiense*) with the permits for take collection allowing pitfall traps with drift fencing around breeding pools.

Another subterranean dweller we did not encounter was the western spade foot toad (*Spea hammondii*). It is a species of special concern in California and is protected (Lovell, 1997). This species can be found in many types of habitats including washes, floodplains of rivers, alluvial fans, playas, and alkali flats. They are attracted to areas with sandy or gravelly soil that have open vegetation and short grass. According to Stebbins (1972), they construct a burrow in loose soil to a depth of at least 3 feet. The loose soil of the burrow surrounds the toad. They have also been known to use the burrows of kangaroo rats (*Dipodomys* sp.) and other animals. This species was most likely not encountered due to our lack of sampling temporary pools for tadpoles, lack of night observations when they are active and not sampling at the peak of the rainy season.

In this county, there is a lot of controversy surrounding the red-legged frog (*Rana aurora draytonii*). This frog is a species of special concern in California and federally threatened (DFG website). Because of its status it can halt construction projects and streambed maintenance. Suffice to say we wanted to encounter this species in the National Forest, but we did not.

Red-legged frog (*Rana aurora draytonii*) tends to be a pond frog, especially where riparian plants provide dense cover. They are also found in marshes, streams, lakes, reservoirs, and other usually permanent water sources. They are not totally dependent on water, and overland movements of over 2 miles have been recorded in the Santa Cruz Mountains (Stebbins, 2003). They tend to breed from late November to April depending on location. A personal observation at Julia Pfeifer State Beach on March 19, 2004 during a new moon supports this timeframe.

This species has disappeared from 75% of its former range in California. This is due to over harvesting in the 1900's, then the introduction of nonnative bullfrogs (*Rana catesbeiana*), which out competes and eats red-legged frogs (*Rana aurora draytonii*). Introduction of nonnative fish, especially predatory fish, to the state waters added predators to both adults and larvae. The use of pesticides, other pollutants and the loss of habitat to developments also had a play in the equation. Our guess to why this species was not encountered was our lack of night surveys and our focus on riparian habitat rather than permanent water sources.

The last species I will discuss in detail is the two-striped garter snake (*Thamnophis hammondii*). This species of special concern is protected in California (Lovell, 1997). It is found in or near permanent or temporary freshwater sources. This is a highly aquatic species that frequents streams with rocky beds bordered by willows and other streamside growth. This species eats tadpoles, California newt larvae (*Taricha torosa*), frogs, fish, fish eggs and earthworms. Its population has been diminished by 40 % due to urban development and other human impacts (Stebbins, 2003).

The two-striped garter snake (*Thamnophis hammondii*) was likely not encountered because of interspecific competition. According to the exploitative competition theory, when two species use the same resource, the use by one reduces availability for another. The outcome is determined by how effectively each competitor uses the resource. In essence, if two species coexist they must possess ecological differences (Smith, 1996).

Two-striped garter snakes (*Thamnophis hammondii*) and Santa Cruz garter snakes (*Thamnophis atratus*) both overlap in range here and are so similar in habit that they were the same species (*Thamnophis couchi*) in Stebbins 1972. In the study area it seems as though Santa Cruz garter snakes (*Thamnophis atratus*) out competed two-striped garter snakes (*Thamnophis hammondii*).

An interesting observation is the complete lack of California newt (*Taricha torosa*) and Monterey salamander (*Ensatina eschscholtzii*) in any large numbers (only one observed). Monterey salamander (*Ensatina eschscholtzii*) is a batesian mimic of the highly toxic California newt (*Taricha torosa*). I find it curious that they are both absent in any numbers here, when they are both quite common in all the areas surrounding our study area (personal observation). It is quite possible that California newt (*Taricha torosa*) is absent for some unknown reason, but Monterey salamander (*Ensatina eschscholtzii*) is heavily predated because of this lower level of protection from its bright mimic coloration.

The arboreal salamander (*Aneides Lugubris*) was probably not found because of our lack of ability to search inside of cliff faces and oak trees. They are only out and about when the ground is quite moist. We were not sampling at that time.

As previously mentioned, the bullfrog (*Rana catesbeiana*) was not encountered in the study area, but we believe it to be present because of its presence farther down the stream. This population I observed had adults and young frogs with breeding calls, which implies a breeding population. The foothill yellow-legged frog (*Rana boylii*) is a protected species that is probably not present in this area, as it is extinct in many areas of its range.

The California legless lizard (*Anniella pulchra*) was likely not encountered because of its subterranean lifestyle. There was good habitat with loose soil for burrowing with lots of insects present and bush lupine, which they are known to accumulate under.

The sharp tailed snake (*Contia tenuis*) has the southernmost extent of it range right in our study area. It is not common in any part of its range and tends to be quite secretive. So it is not surprising we did not encounter this snake, even though the preferred food, slugs, were quite abundant.

We were quite surprised to not find the common garter snake (*Thamnophis sirtalis*) or the terrestrial garter snake (*Thamnophis elegans*) in our study area. These once extremely common species have become more and more rare. It has reached a point that they have had to be protected in San Diego, Orange, and Los Angeles counties. We think they are present, possibly in good numbers and we believe that we would have encountered them if we had spent more time in the field.

We did find two protected species in our study area. They were the southwestern pond turtle (*Clemmys marmorata*) and the coast horned lizard (*Phrynosoma coronatum*). This should be noted because they're presence should have an effect on how this land can be used and maintained.

There is room for improvement with the study design. It might have been more beneficial to focus on one vegetation habitat type and survey more plots. This increase in plot number would have smoothed out some of the problems we had with our statistics. Even though there appeared to be a difference, one could not be statistically determined because of this void of data. The methods should be redone with finding one to three species per plot in mind.

Even with its flaws, this study is useful for future biologists who will be looking at this area. They will be able to see what was physically observed and what we expected to have observed and they can model future studies accordingly for a better understanding of the area.

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Poly San Luis Obispo.

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APPENDIX I:

Herpetofauna Visual Encounter Survey Sheets for Hi Mountain Senior Project