Hi Mountain small mammal diversity and Kangaroo Rat population size

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Introduction

This senior project was designed to assess the diversity of small mammals around the Hi Mountain Lookout. Of particular interest for this diversity list was the kangaroo rat (*Dipodomys sp*). Although range maps show that Hi Mountain is a theoretical habitat for two species of *Dipodymys*, there has been only one recorded capture which, occurred in the fall of 2004. The recent trapping of *D. venustus*, or narrow faced kangaroo rat, is what prompted this project. In addition to determining if one or more species of kangaroo rat inhabits Hi Mountain, I also wished to determine an estimated population size in the suitable habitat around the Hi Mountain Lookout. Data collection for this project took place during the months of September through November of 2004 with a total of 6 trapping nights. On each night 60 Sherman live traps were set and divided into three transects covering the variable slope aspects and vegetation types adjacent to the lookout.

Hi Mountain is a 3100 ft peak situated on the crest of the Santa Lucia Mountains along the Coast Range of California. The vegetation of Hi Mountain is dominated by native chaparral species such as scrub oak (*Quercas berberidifolia*), big berry manzanita (*Arctostaphylos glauca*), and chamise (*Adenostema fasiculatum*). The herbaceous under story is virtually non-existent due in part to germination inhibitors released by the chaparral, a dense canopy cover, and foraging herbivores (Holland and Keil 1995). There were several grassland patches that formed sharp ecotones with the dominant chaparral. These grassland areas are dominated by common and slender wild oat, *Avena fatua* and *A. barbada* respectively, as well as the invasive yellow star thistle (*Centaurea solstitialis)*. These ecotones were sharply defined by1-2 feet of bare substrate, a result of both frequent herbivore traffic and allelopathy from the chaparral species (Holland and Keil 1995). The combination of ample cover, open

foraging runways, and seed production from annual grasses make Hi Mountain a suitable habitat for several types of small mammals such as *Peromyscus*, *Chaetodipus*, and *Dipodomys*.

Although current range maps show the Hi Mountain area of the Santa Lucia range as potential habitat for two species of kangaroo rat, *Dipodomys venustus* and *D. heemanni (Heermans kangaroo rat)*, there were no records of a successful capture prior to 2004. During the fall of 2004 the Mammalogy class from Cal Poly San Luis Obispo State University successfully captured *Dipodomys venustus*. While *D. venustus* and *D. herrmanni* have overlapping ranges along the central coast, San Luis Obispo County represents the southern distribution for *D. venustus* as its habitat continues north along the coast to Santa Cruz. *D. heermanni* on the other hand occurs in California south from a line roughly extending between Lake Tahoe to slightly north of Point Conception, and west from the Tehachapi Mountains to the Pacific ocean (Kelt 1988). A possible explanation for the limited range of the narrow faced kangaroo rat may be its dependence on exogenous water sources, and its inability to compensate for drought like conditions through decreased pulmocutaneous water output (Church 1960). Both species are five toed, medium sized kangaroo rats with an overall dark pelage. Compared with *D. heermanni*, the nasals and the premaxillae of *D. venustus* are broader, yet the most conspicuous difference is the darker and much larger ear size of *D. venustus* (Grinnel 1922). *D. venustus* however is thought to be closely related to *D. agilis* and *D. elephantinus*, and it has been reported that *D. elephantinus* is only superficially distinct from *D. venustus* (Hall 1981).

It was the lack of documented kangaroo rat captures that prompted this study to determine the species and relative size of the kangaroo rat population in the Hi Mountain vicinity. Because the lookout is extensively as a research facility and home base for studies and surveys,

it is important to generate species diversity lists as well as baseline population estimates in order to track changes over time. It becomes especially vital to have these data in a time of dramatic changes such as fire or disease in order to determine the effects of such factors on local species.

Methods

A species diversity list as well as a population estimate for the kangaroo rat was the goal of this trapping project. The plan was to conduct a capture re-capture study to establish a population estimate from three two-night trapping sessions, using the highest count as the final estimate. Due to the small number of captures per each trapping session, the methods were modified such that a estimate a population density estimate would be achieved based on the total area of the trapping site divided by the total number of successful kangaroo rat captures. The species diversity list is simply a list of all the small mammals caught and the location they were captured. In order to determine what habitat type yielded the most captures, transect success was calculated using the average captures per night divided by number of traps. Species diversity was also included in the comparison of transects (Table 1). Generating population estimates for all species caught was beyond the scope of this study, but a relative frequency of capture was calculated for each species using an average captures per night per species divided by total trapping nights (Table 2).

A total of sixty Sherman live traps were used during each of the 6 trapping nights. Three transects were established, all centered around the Hi Mountain lookout. Each transect was located on a different slope aspect of the mountain (Fig.1). A transect north of the lookout named N of LO, was placed in a north to south line situated on a north facing slope. This transect was composed of 15 traps set at 2m increments. The vegetation of this trap line was

Fir Mountain Trapping Transects

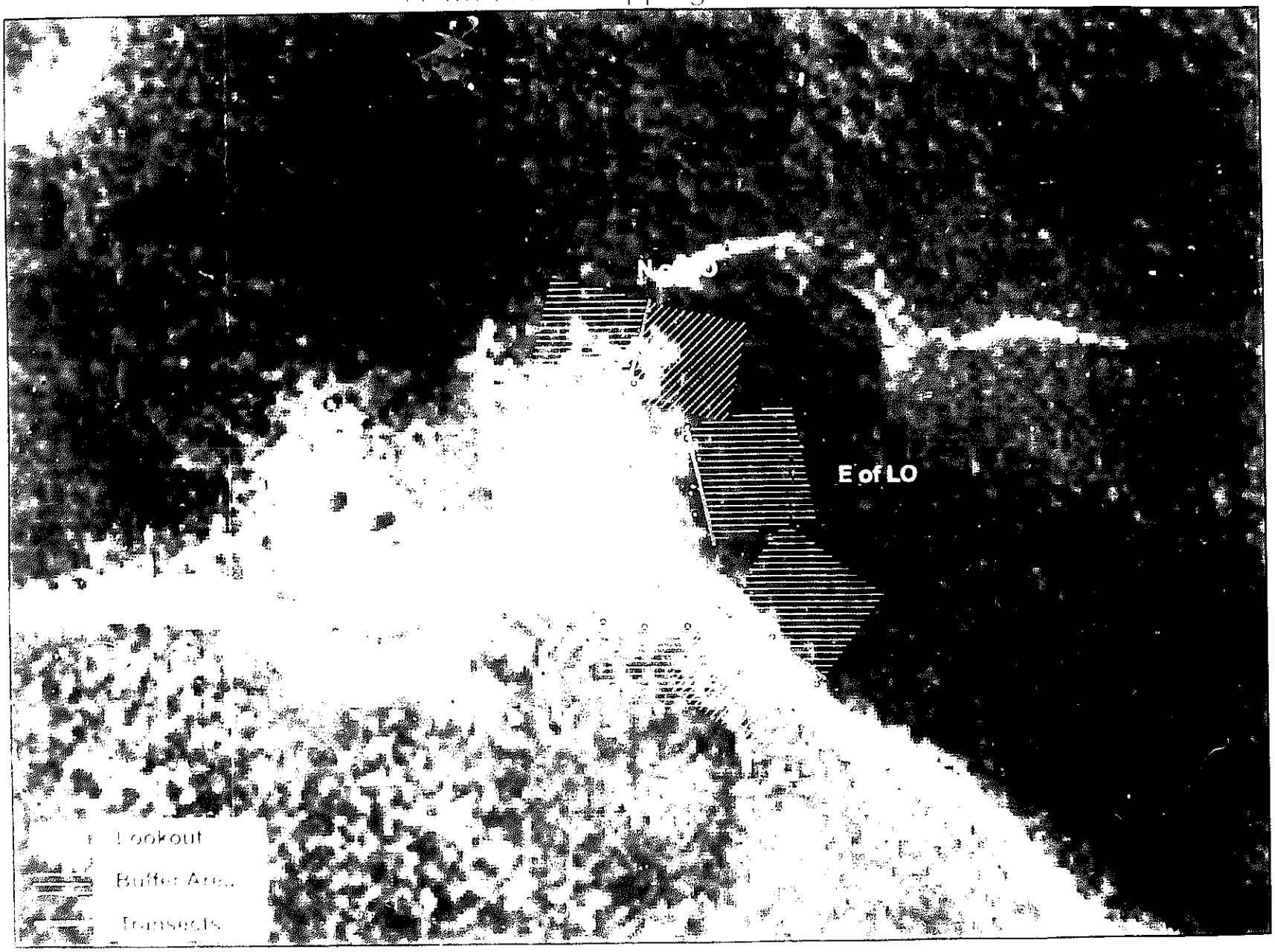

Figure 1 Fir Mountain trapping transects

Dominated by big berry manzanita (Arctostaphylos glauca and scrub oak (*Quercas berberidifolia*). The under story was relatively open with 1 ½ to 2 feet of space between the lower vegetation and the substrate. The E of LO transect was placed on an east facing slope at the convergence of bare substrate separating the grassy hill and the chaparral line. This trap line traversed in a north to south direction until reaching the entrance to the Hi Valley Trail (Fig.1). This transect was composed of 20 traps spaced in 2m increments. The S of LO transect ran along the south facing hill which included part of Hi Valley Trail, or HVT, and was comprised of 25 traps spaced 3m apart to cover the extent of the grassy area separating the road and chaparral line. This south-facing hill was dominated by chamise (*Adenostema fasiculatum*) as well the invasive yellow star thistle (*Centaurea solstitialis*). The HVT consisted of a narrow, hard packed substrate approximately 3.5 feet in width and was densely bordered by chamise, scrub oak and manzanita. When determining total area sampled, each transect was buffered by 30 meters on the appropriate side (downhill slope of the transect) to account for the foraging distance away from the burrow of the *Dipodomys* (Fig.1). The use of a 30 m buffer was applied based on capture/re-capture study determining foraging range of *D. heermanni*, where over 50% of marked kangaroo rats that were recaptured were found approximately 30m away from their original location (Fitch 1948). A study observing the behavior of *Dipodomys* found that when burrows are located on steep slopes (such as slopes surrounding the lookout) foraging occurs on or above the lowest burrow entrance (Fitch, 1941). For this reason the buffers were applied on the down hill side of each transect.

The sixty Sherman live traps were set each evening of the two night trapping sessions. All traps were baited with rolled oats both inside and outside the trap to encourage the mammals to enter, and to provide food when caught. The following morning each line was

checked for capture. All traps containing a mammal received a masking tape tag, which specified the trap location and brought to the lookout for processing. Empty traps were closed for the day to prevent incidental capture. Each animal was weighed and measured for body, tail, and foot lengths. These measurements were recorded mainly for identification purposes, as many of the rodents captured, especially species of *Peromyscus* and *Dipodomys*, are difficult to identify without measurements. Each kangaroo rat caught received an identification mark in the form of a hair clipping above the hip stripe (to revealed the dark under-fur). This marking technique was useful in that it was distinguishable for enough time to complete the trapping and could also be modified each week of trapping in order to identify on which weekend a particular rat was captured. Accurate measurements were required for the kangaroo rats processed due to the similarities between the two local species. Ear length was the primary characteristic used to make the identification, as this was a distinct difference between the two species. *D. venustus* is characterized as having large ears, 20-25 mm in length relative to *D. heermanni*, ranging 11-17mm in length (Best 1992; Kelt 1988). Data generated from each night of trapping were recorded onto daily spreadsheets (Appendix B). After all animals were processed, each was released in the same location in which it was caught.

Results

Six nights of trapping produced a total of fifty-two small mammals, which included nine different species. The most successful transect was the S of LO transect with 26% capture success per night, followed by E of LO and N of LO transects respectively (Table 1). Of the nine species trapped, the most actively captured was the Piñyon pine mouse (*Peromyscus truei*) with a frequency of about three captures per night. The spiny pocket mouse (*Chaetodipus californicus*) followed with a capture rate of about two per night. The lowest frequency of

Table 1: Transect coordinates, dates set, average success rates per night, and species diversity

Hi Mountain Transects	
N of LO	
# of traps	15
Start	35°15'37" N-120°25' 30 W"
End	35°15'37" N-120°25' 30 W"
Dates set	10/23-10/24; 11/13-11/14; 11/20-11/21
Ave success rate per night	0.10
Number of Species	4
E of LO	
# of traps	22
Start	35°15'36" N-120°25' 30 W"
End	35°15'35" N-120°25' 30 W"
Dates set	10/23-10/24; 11/13-11/14; 11/20-11/21
Ave success rate per night	0.19
Number of Species	8
S of LO	
# of traps	23
Start	35°15'35" N-120°25' 31 W"
End	35°15'33" N-120°25' 27 W"
Dates set	10/23-10/24; 11/13-11/14; 11/20-11/21
Ave success rate per night	0.26
Number of Species	6

Table 2: Relative frequency of capture based on capture per night

	Captures Per Night							
	Trapping Dates							
Species	23-Oct	24-Oct	13-Nov	14-Nov	21-Nov	22-Nov	Total	**Relative Capture Frequency**
Peromyscus maniculatus	0	0	1	2	0	2	**5**	0.83
Peromyscus boylii	0	1	1	1	2	1	**6**	1.00
Peromyscus truei	3	3	3	4	2	2	**17**	2.83
Peromyscus californicus	0	0	0	0	1	1	**2**	0.33
Reithrodontomys megalotis	0	0	0	0	1	0	**1**	0.17
Chaetodipus californicus	2	4	2	2	2	3	**15**	2.50
Tamias merriami	0	0	0	1	0	1	**2**	0.33
Dipodomys heermanii	0	1	1	0	0	1	**3**	0.50
Neotoma fuscipes	1	0	1	0	0	0	**2**	0.33
Total	6	9	9	10	8	11	53	8.83

capture occurred with the dusky footed wood rat (*Neotoma lepida*) and Merriams chipmunk (*Tamias merriami*) with only two captures each over the six nights. A total of three *Dipodomys heermanni* were caught during the 6 trapping nights, the second lowest rate of capture for the project. There were no recaptured individuals during any trapping night. Two of the three k-rats were caught along the S of LO transect, and one was caught on the E of LO transect (Appendix A). Each of the kangaroo rats caught had ear measurements from 16-17 mm in length, decidedly less than the average of 20mm for *D. venustus*, while tail size ranged from 165 mm to 205 mm. All kangaroo rats caught were female. With a total trapping area of 0.70 ha, a density estimate of 4.28 kangaroo rats per ha is calculated (D= 3/0.70).

Discussion

The first and third kangaroo rat trapped over the six nights were caught along the S of LO transect, which ran along the chaparral-grassland border. The second kangaroo rat was trapped along the E of LO transect where the grassy eastern facing slope met Hi Mountain Road adjacent the lookout. Both of these areas provided suitable foraging habitat of large patches of annual grasses adjacent to chaparral cover. This cover consisted of manzanita and chamise with about 12-18 inches of clearance between the substrate and foliage. No kangaroo rats were captured along the N of LO transect. While this transect provided similar chaparral cover, the bare substrate on either side of the trap line was devoid of grasses. This may have reduced the suitability of this area as a foraging habitat, as well as a burrowing habitat. The characteristics of the N of LO transect resemble those of the Hi Valley trail portion of the south transect. As previously mentioned, the HVT consisted of hard packed substrate bordered by chamise and scruboak, with a few patches of grassland between the trail and chaparral line. While several other small mammals were caught on this portion of the transect, no kangaroo

rats were caught.

Although a narrow faced kangaroo rat was recently captured in the area west of the Hi Mountain trapping site, none were captured during this study. Both *D. heermanni* and *D.venustus* utilize similar habitats of costal chaparral and both forage on annual seeds (Best 1992). Due to the lack of information of both species in this area it was not possible to make inferences about interspecific competition. Likewise it is difficult to measure intraspecific competition as *D. heermanni* densities can range from 2 to 30 individuals per ha. (Fitch 1948). The density estimate of *D. heermanni* for the Hi Mountain lookout was 4.28 kangaroo rats per ha. This density estimate may be biased, as it does not take into account the edge effect of a trapping area. Despite the 30-meter buffers, an animal on the edge or just outside of an established coverage area can bias the results by entering the area and getting trapped. In order to account for this edge effect, one has to have more data on home range size, as well as a substantial amount of recapture data to determine movement of the animals for that trapping area.

Two of the three kangaroo rats were trapped on the second night of a two night trapping session. A reason for this trend may be the fact that traps set on the first night of each session were set an average of 4 hours later than that of the second nights. Due to the time needed to get to the lookout and set out the traps, the transects set on the first night of each session were done so well after dark often at 2300 hours or later. Generally kangaroo rats will begin foraging shortly after sundown, which during the trapping weeks occurred around 1730 hours. Light intensity is one of the most important factors governing the emergence of *D. heermanni*, and in the absence of rain or a full moon, a kangaroo rat will emerge from its burrow to forage as soon as it has become dark (Tappe 1941). Thus on each of the first trapping nights, traps

were set 5-6 hours after sunset, decreasing the time each trap was open during foraging hours. Another factor affecting capture rates in week two of trapping may have been the inclement environmental conditions. Sustained winds of 25+ mph occurred on both trapping nights along with a low and heavy fog, which increased relative humidity to 95%. In a study observing the feeding and burrowing habits for *D. venustus*, it was determined that during heavy precipitations and subsequent soaked soils, kangaroo rats avoided foraging. It was not until the pooled water on the soil had dried that the kangaroo rats resumed their normal foraging behavior (Hawbecker 1940).

Future trapping studies in the Hi Mountain area might utilize more trapping nights to establish a substantial capture recapture ratio of kangaroo rats. It may be useful to utilize a standard 10m x 10m trapping grid which would also allow for an accurate assessment of foraging patterns, and habitat use. It would also be beneficial to establish a separate trapping area west of the lookout where the first narrow faced kangaroo rat was captured. This would not only allow for a population estimate of *D. venustus*, but provides for the opportunity to collect data on both species in the same trapping area leading to analysis of interspecific habitat use and spatial distribution on Hi Mountain.

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Appendix A

Small Mammal species diversity list for the Hi Mountain Lookout

Deer Mouse – *Peromyscus maniculatus*

Brush Mouse – *Peromyscus boylii*

Pinyon Pine Mouse – *Peromyscus truei*

California Mouse (Parasitic Mouse) – *Peromyscus californicus*

Western Harvest Mouse – *Reithrodontomys megalotis*

Spiny Pocket Mouse – *Chaetodipus californicus*

Merriams Chipmunk – *Tamias merriami*

Heermans Kangaroo Rat – *Dipodomys heermanii*

Dusky Footed Woodrat – *Neotoma fuscipes*

Appendix B

WEEK 1

DAY1

Date: 10/23/2004 Name: Jeremy White, Mike Tor

Weather Conditions: Partly Cloudy 52 degrees

Species	trap area	weight	body length	tail length	ear	hind foot	other observations
Chaetodipus californicus	E of LO		8.5	11	1	2.5	female
Peromyscus truei	E of LO		7.5	9	1.7	2	female
Chaetodipus californicus	HVT		7.7	10.5	1.2	2.5	female
Peromyscus truei	E of LO		8.5	11	2	2.4	male
Neotoma fuscipes	E of LO						
Peromyscus truei	S of LO		8	8.25	1.9	2	male

DAY2

Date: 10/24/2005

Weather Conditions: Partly Cloudy 50 degrees

Species	trap area	weight	body length	tail length	ear	hind foot	other observations
Chaetodipus californicus	E of LO		9.5	7	1.2	2.6	female
Peromyscus truei	E of LO		7.5	8.7	1.8	2.2	male
Dipodomys heermanni	**S of LO**		**12.6**	**18.4**	**1.7**	**4.2**	**female**
Peromyscus truei	E of LO		7.1	8.5	1.7	2.1	male
Chaetodipus californicus	HVT		8.4	10.5	1.2	2.3	female
Chaetodipus californicus	N of LO		8.5	10.9	1	2.3	female
Chaetodipus californicus	E of LO		8.5	10.5	1	2.7	female
Peromyscus truei	E of LO		6.3	8.6	1.8	2.1	male
Peromyscus boylii	N of LO		8.3	12.7	1.8	2.4	female

WEEK 2

DAY3
Date: 11/13/2004 Name: Jeremy White, Mike Tom
Weather Conditions: Cloudy 48 degrees, wind 15 mph

Species	trap area	weight	body length	tail length	ear	hind foot	other observations
Peromyscus maniculatus	S of LO	18	6.5	8	1.7	2.1	male
Chaetodipus californicus	S of LO	17	8.2	11	0.9	2.4	male
Peromyscus truei	S of LO	18	7	7.2	2.1	2.2	female with molt line
Peromyscus truei	E of LO	16	7.5	8.5	1.7	2.2	male
Peromyscus truei	E of LO	20	8.3	8.7	2.1	2.1	male
Neotoma fuscipes	E of LO	212	19	17	2.5	3.5	female
Chaetodipus californicus	E of LO	20	8.5	11.6	1	2.4	female
Peromyscus boylii	N of LO	50	9	12.3	2.1	2.5	male
Dipodomys heermanni	**E of LO**	**73**	**11.3**	**16.5**	**1.7**	**4**	**female- hair clipped above right hipstripe**

DAY4
Date: 11/14/2004
Weather Conditions: Partly Cloudy 50 degrees

Species	trap area	weight	body length	tail length	ear	hind foot	other observations
Chaetodipus californicus	HVT	22	7.5	10.8	1	2.3	female
Peromyscus truei	HVT	20	8.2	8.2	1.9	2	male
Peromyscus truei	E of LO	20	8	9	2	2	female
Chaetodipus californicus	E of LO	21	8.2	11.5	0.8	2.4	female
Peromyscus maniculatus	E of LO	20	8.5	8.2	1.6	2	male
Tamias merriami	E of LO	80	14.5	10.5	1.5	3.6	female
Peromyscus maniculatus	E of LO	28	8.2	10.1	1.8	2.2	male
Peromyscus truei	N of LO	24	8.4	10.1	2.1	2.1	male
Peromyscus truei	N of LO	23	8.6	9.3	2	2.1	male
Peromyscus boylii	N of LO	30	8.9	9.5	2	2.4	female