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Small Mammal Study of Sandia Canyon, 1994 and 1995

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Small Mammal Study of Sandia Canyon, 1994 and 1995

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Small Mammal Study of Sandia Canyon,

1994 and 1995

by

Kathryn Bennett and James Biggs

ABSTRACT

A wide range of plant and wildlife species utilize water discharged from facilities at Los Alamos National Laboratory (LANL). The purpose of this study was to gather baseline data of small mammal populations and compare small mammal characteristics (species diversity and composition, small mammal density, biomass, physical characteristics, and lean body mass) within three areas of Sandia Canyon (a canyon that receives outfall effluents from multiple sources). The head of Sandia Canyon is near the University House in Technical Area 3 at LANL. Three small mammal trapping webs were placed in the upper portion of Sandia Canyon, the first two webs were centered within a cattail-dominated marsh with a ponderosa pine overstory and the third web was placed in a transition area with a ponderosa pine overstory. This third area was much drier than the habitat surrounding the first two webs and is more riparian than marsh in nature. Capture-recapture trapping of small mammals took place for 1 to 2 weeks. Webs 1 and 2 had the highest species diversity indices with deer mice the most commonly captured species in all webs. However, at Web 1, voles, shrews, and harvest mice, species more commonly found in moist habitats, made up a much greater overall percentage (65.6%) than did deer mice and brush mice (34.5%). The highest densities and biomass of animals were found in Web 1 with a continual decrease in density estimates in each web downstream. Results from the General Linear Model (GLM) demonstrate that there is no statistical difference between the mean body weights of deer mice and brush mice between sites (GLM [deer mouse], $F = 1.0$, $p = 0.3705$; GLM [brush mouse], $F = 2.49$, $p = 0.10$). Mean body length was also determined not to be statistically different between the webs (GLM [deer mouse], $F = 0.89$, $p = 0.4117$; GLM [brush mouse], $F = 2.49$, $p = 0.0999$). Furthermore, no statistical difference between webs was found for the mean lean body masses of deer and brush mice (GLM [deer mouse], $F = 2.54$, $p = 0.0838$; GLM [brush mouse], $F = 1.60$, $p = 0.2229$). Additional monitoring studies should be conducted in Sandia Canyon so comparisons over time can be made. In addition, rodent tissues should be sampled for contaminants and then compared to background or control populations elsewhere at the Laboratory or at an off-site location.

1.0 INTRODUCTION

A wide range of plant and wildlife species utilize water discharged from facilities at Los Alamos National Laboratory (LANL). Discharges from these outfalls are regulated

by the National Pollutant Discharge Elimination System (NPDES) under the Clean Water Act. The waters of these outfalls are routinely monitored for compliance with the NPDES permit. In addition, as part of the Environmental Surveillance Program at LANL, sediment samples are taken and the data published annually in LANL's Environmental Surveillance Report. Although chemical analyses of sediment and water can tell us the concentration of a chemical substance present, they are not sufficient to assess or describe affects on wildlife populations. The purpose of this study was to gather baseline data of the nocturnal small mammal population and compare characteristics of the small mammal populations found within three areas of Sandia Canyon (a canyon that receives outfall effluents from multiple sources) to each other and, where data were available, to other areas within Los Alamos County. The characteristics evaluated were species diversity and composition, small mammal density, biomass, and physical characteristics (weight, length, and lean body mass). This information can be helpful in determining the general health of the small mammal population. With this study, we hope to provide information that can be used to assess the health of the small mammal population in Sandia Canyon and relate the population conditions to environmental conditions.

2.0 ENVIRONMENTAL SETTING

2.1 General Setting

Sandia Canyon is located within the boundaries of LANL. The Laboratory is located in north-central New Mexico on the Pajarito Plateau, approximately 120 km (80 mi) north of Albuquerque and 40 km (25 mi) west of Santa Fe (Fig. 1). The plateau is an apron of volcanic rock stretching 33–40 km (20–25 mi) in a north-south direction and 8–

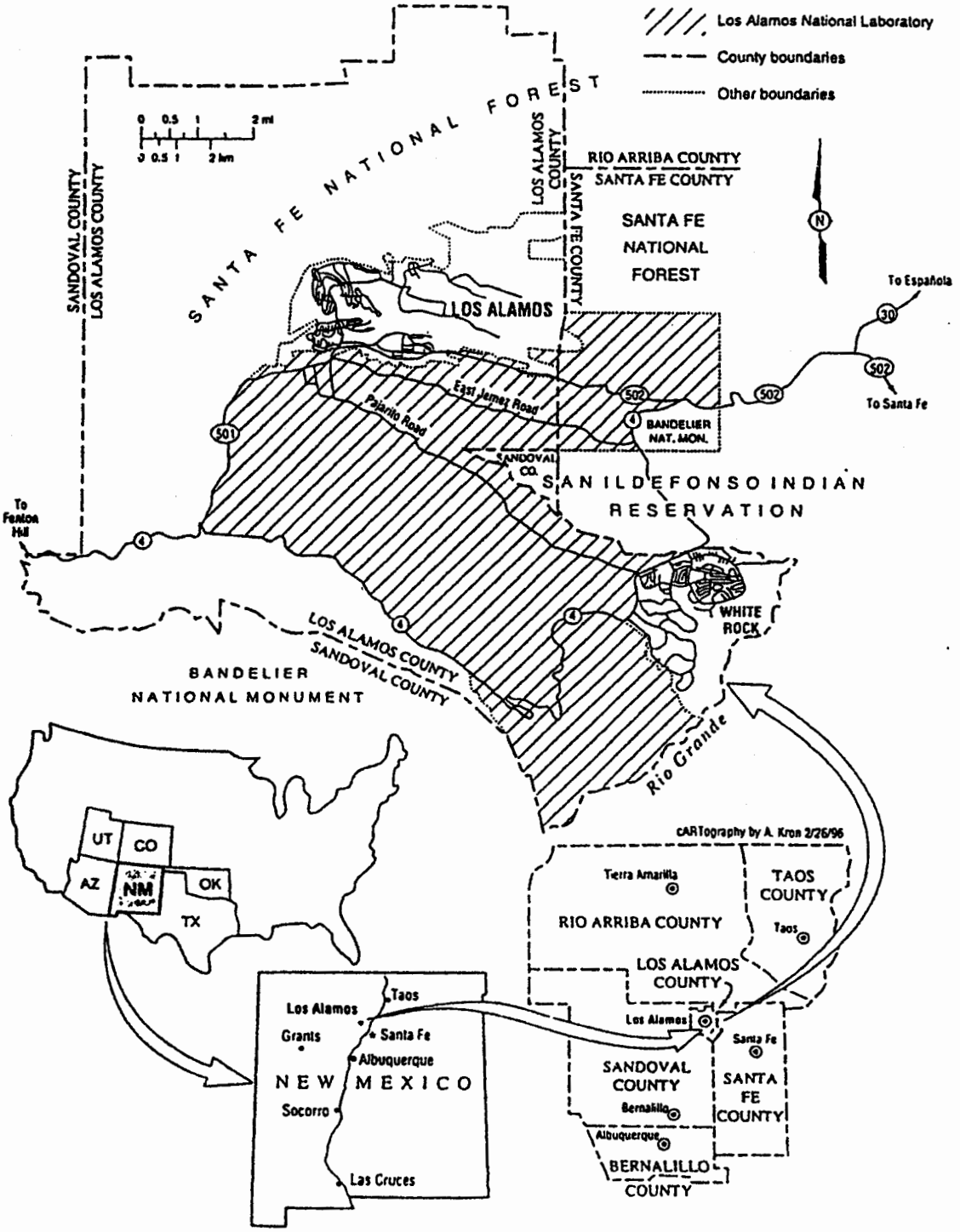


Figure 1. Location of Los Alamos National Laboratory.

16 km (5–10 mi) from east to west. The average elevation of the plateau is 2286 m (7500 ft). It slopes gradually eastward from the edge of the Jemez Mountains, a complex pile of volcanic rock situated along the northwest margin of the Rio Grande rift. From an elevation of approximately 1890 meters (6200 ft) at White Rock, the plateau scarp drops to 1646 meters (5400 ft) at the Rio Grande. Intermittent streams flowing southeastward have dissected the plateau into a number of finger-like, narrow mesas separated by deep, narrow canyons. The bedrock consists of Bandelier tuff that erupted from the Jemez Mountains about 1.1 to 1.4 million years ago. The tuff overlaps other volcanics that in turn overlay the Puye Formation conglomerate. This conglomerate intermixes with Chino Mesa basalts along the Rio Grande (LANL 1988).

The LANL area is characterized by a semiarid, temperate mountain climate. In the summer months, temperatures typically range from a daily low of around 10 deg C (50 deg F) to a high of 27 deg C (80 deg F). Winter temperatures generally range from near -10 deg C (14 deg F) to about 10 deg C (50 deg F) during a 24-h period. Annual precipitation varies from 33 to 46 cm (13 to 18 in.), with most of it falling as rain in July and August (Bowen 1990).

2.1.1 Description of Sandia Canyon

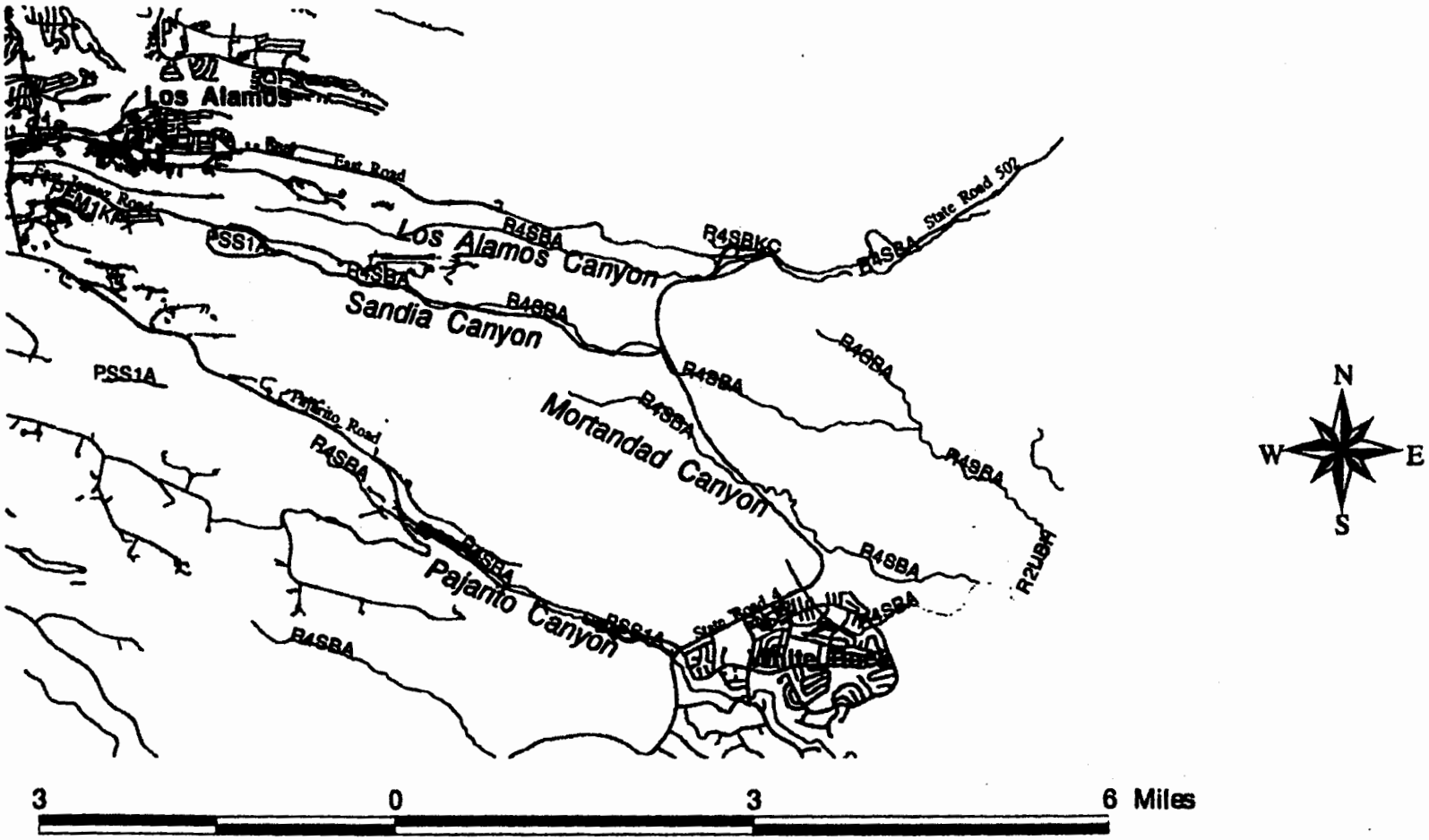
The head of Sandia Canyon is near the University House in Technical Area 3 (TA-3) at LANL in Los Alamos, New Mexico, and the canyon extends southeastward to the Rio Grande. The area of the drainage basin is approximately 13.5 km^2 (5.6 mi^2). Industrial and sanitary effluents from LANL activities maintain stream flow in portions of Sandia Canyon year-round.

The National Wetlands Inventory conducted by the US Fish and Wildlife Service shows three types of wetlands, or water systems, in Sandia Canyon. Primarily, our research effort was concentrated in the uppermost wetland area, a "persistent, artificially flooded, palustrine wetland" (Cowardin et al. 1979). Situated below TA-3, this wetland receives or received effluent from a steam power plant, a sewage treatment plant, and an asphalt plant. Additional sources of effluent include treated cooling water and noncontact cooling water. Storm water runoff and snowmelt also contribute to the stream seasonally.

Farther downstream where the stream meets East Jemez Road, the wetland area changes to a "temporarily flooded, palustrine wetland" type, and the lower section is an "intermittent, temporarily flooded, riverine streambed" (Cowardin et al. 1979). The National Wetland Inventory Map of Sandia Canyon is Figure 2.

2.1.2 Description of the Study Site

Three small mammal trapping webs were placed in the upper portion of Sandia Canyon. The first two webs were centered within a cattail-dominated marsh with a ponderosa pine overstory (persistent, artificially flooded, palustrine wetland). The third web was placed in a transition area between the persistent, artificially flooded, palustrine wetland and the temporarily flooded, palustrine wetland with a ponderosa pine overstory. This area was much drier than the habitat surrounding the first two webs and is more riparian than marsh in nature. The three webs were placed in a downstream gradient with Web 1 being closest to the outfall discharges and Web 3 farthest away. A rubble landfill is located to the west of the study area and immediately adjacent to Web 1. A sanitary landfill (for Los Alamos County) is located on the mesa top to the north of the study



PEM1KFX = Palustrine, emergent, persistent,artificially flooded.
PSS1A = Palustrine, shrub-scrub, broadleaf deciduous, temporarily flooded.
R4SBA = Riverine, intermittent, streambed, temporarily flooded.
R4SBKC = Riverine, intermittent, streambed, artificially flooded.
R2UBH = Riverine, lower perennial, unconsolidated bottom, permanently flooded.

Fig. 2. National Wetland Inventory map for Sandia Canyon.

location and Webs 1 and 2 were located below the landfill. Web 3 was located downstream from these landfills (Fig. 3).

3.0 METHODOLOGY

3.1 Field Methods

Capture-recapture trapping of small mammals was performed at three locations within Sandia Canyon. A web method of 148 traps was utilized and data was analyzed (population density) using Buckland et al. (1993) and Laake et al. (1994). Each web consisted of 12 lines of traps spaced at 5- to 10-m intervals with 4 traps placed in the center (Parmenter 1994). Each web was placed at least 200 m apart to prevent overlap of species between webs. Data on small mammals for each web were pooled for analysis. Trapping took place over 4 to 8 consecutive nights. Traps were baited in late afternoon with a molasses-coated horse feed and a dry mixture of peanut butter and checked in early morning to record nocturnal species. Animals were marked with size #FF rodent ear tags. Location of capture, species name, sex, presence of physical aberrations, weight, body length, tail length, ear length, foot length, tag number, and E-value were recorded. An E-value was obtained for each animal using the EM-SCAN Model SA-2. The EM-SCAN is a rapid, nondestructive method for determining lean body mass. Incidental kills were kept for species confirmation/accuracy rates, stomach analysis for habitat information, and chemical analysis for percent body fat. Additionally, on the final day of trapping, all or a portion of the total number of animals captured were sacrificed for species confirmation/accuracy rates, stomach analysis for habitat information, and chemical analysis for percent body fat.

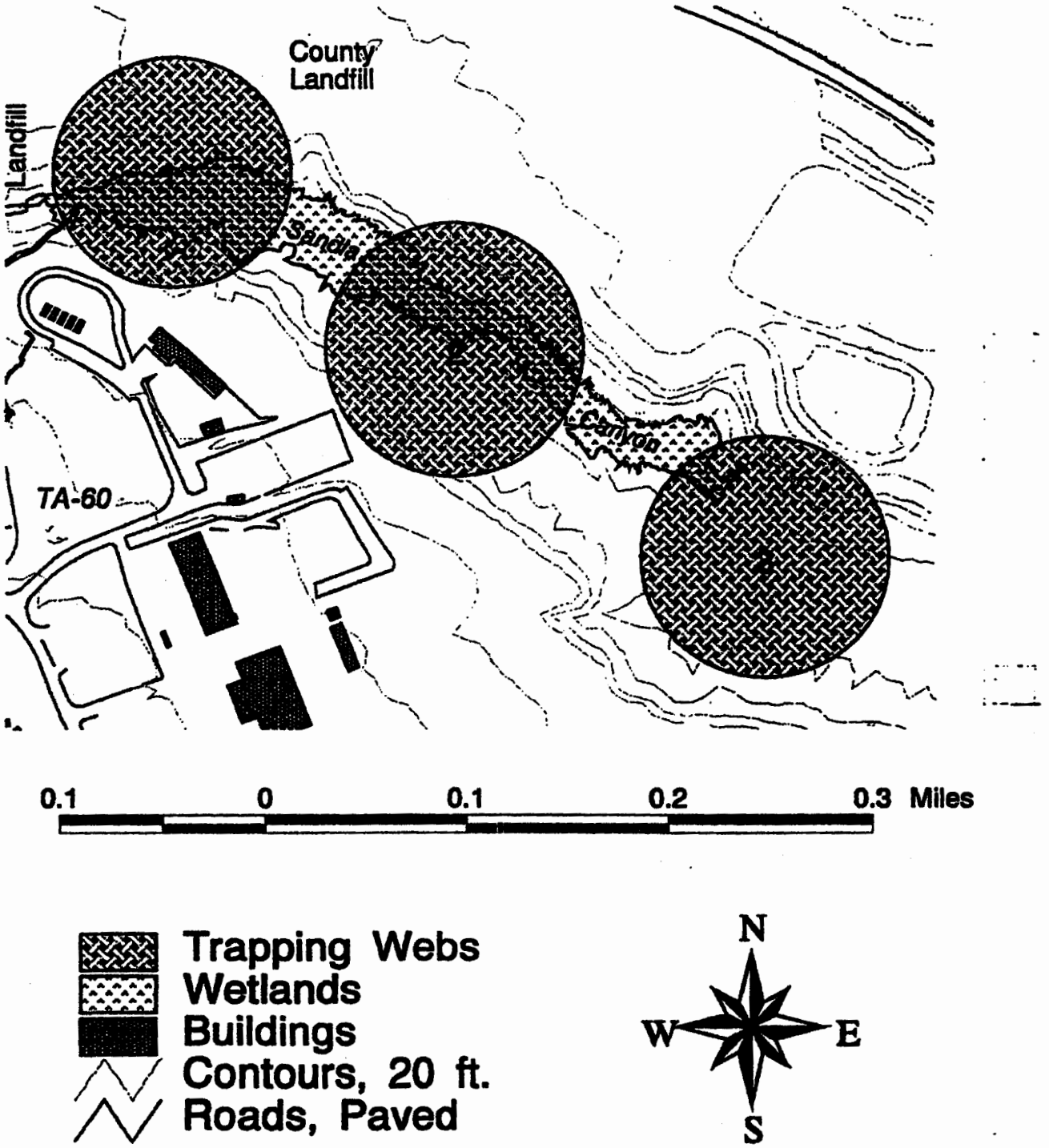


Fig. 3. Locations of webs within Sandia Canyon.

Fat-free mass (FFM), or lean body mass, was also calculated for each animal. A regression equation was developed to calculate FFM from the EM-SCAN, E-value, and the length of the animal. A subset of the Sandia Canyon small mammal population (n = 30) was analyzed for percent body fat. This was converted to the grams of lean body mass for the animals. A regression analysis was conducted to develop the regression equation. The F value generated from the analysis of variance in the regression procedure was 117.115 and the probability was 0.0001. The model equation used was

$$FFM = -17.43 + (E\ value \times 0.021) + (Animal\ Length\ in\ cm \times 3.01).$$

The R^2 generated from the analysis was 0.9001. Therefore, 90.01% of the measured variation in animal lean body mass was accounted for by the regression model.

Biomass was calculated for each of the three webs. The following equation was used :

$$Biomass\ (g/ha) = Density\ (\#/ha) \times Mean\ Body\ Weight\ (g).$$

3.2 Data Analysis

Data were initially entered into a Lotus spreadsheet and then converted for compatibility with the Statistical Analysis System (SAS). To determine which kind of test was most appropriate for the data, we used the SAS univariate normal procedure to determine if the data collected were normally distributed at each site. If data were normally distributed, a parametric test was conducted. If data were not normal the equivalent nonparametric test was performed. Most of the data were found to be normally distributed, therefore parametric analysis was chosen.

Because most data had unequal sample sizes between the webs, a General Linear Model (GLM) was used to test if there were differences in the mean weight, mean length, or mean lean body mass of small mammals between the three webs, as well as used to test differences in mean daily number of captures and mean daily number of species captured between the three webs. If a difference was detected with the GLM, a Multiple Range Test, Student-Newman-Keuls (SNK), was used to determine where the difference occurred. The number of density and biomass estimates was limited to two per web. Analysis on differences in density, diversity indices, and biomass between webs could not be performed. However, a GLM was used to compare density estimates of Sandia Canyon (pooled Webs 1, 2, and 3 data) with other animal density estimates obtained in other areas within the County.

Qualitative information on physical aberrations such as tissue swelling, cuts, etc. were recorded for each animal, if observed. There were no statistical analyses run on this data as this was a subjective measurement.

4.0 RESULTS

4.1 Species Diversity

Table 1 lists small mammal species captured in the project area of Sandia Canyon and Table 2 lists species captured by web. A mixture of species common to both dry habitats (i.e., deer mice, pinyon mice, brush mice) and moist or riparian habitats (i.e., voles, shrews) were captured in the project area. Webs 1 and 2 had the highest species diversity indices (Table 3). In addition, there was a statistical difference (alpha = 0.05) in the mean daily number of species captured between the three webs (GLM, F = 18.37, p=

0.0001). Mean daily number of species was the highest in Web 1 and Web 2, and Web 3 had the lowest mean daily number of species captured (SNK, alpha = 0.05, Web 1 = Web 2 > Web 3). Figure 4 shows the mean daily number of species captured for each web for all years combined.

Table 1. Small Mammal Species Captured in Sandia Canyon, 1994–95.

Common Name	**Scientific Name**
Long-tailed vole	*Microtus longicaudus*
Montane vole	*Microtus montanus*
Brush mouse	*Peromyscus boylii*
Deer mouse	*Peromyscus maniculatus*
Pinyon mouse	*Peromyscus trueii*
Harvest mouse	*Reithrodontomys megalotis*
Vagrant shrew	*Sorex vagrans*
Shrew (unid. species)	*Sorex* sp.

Table 2. Small Mammal Species Captured in Sandia Canyon, by Web, 1994–95.

Common Name	**Web 1**	**Web 2**	**Web 3**
Long-tailed vole	x	x	
Montane vole	x	x	x
Brush mouse	x	x	x
Deer mouse	x	x	x
Pinyon mouse			x
Harvest mouse	x	x	
Vagrant shrew		x	
Shrew (unid. spp.)	x	x	

Table 3. Species Diversity Indices of Sandia Canyon, by Web for 1994 and 1995 Data Combined.

WEB NUMBER	SPECIES DIVERSITY INDEX
1	1.60
2	1.65
3	0.67

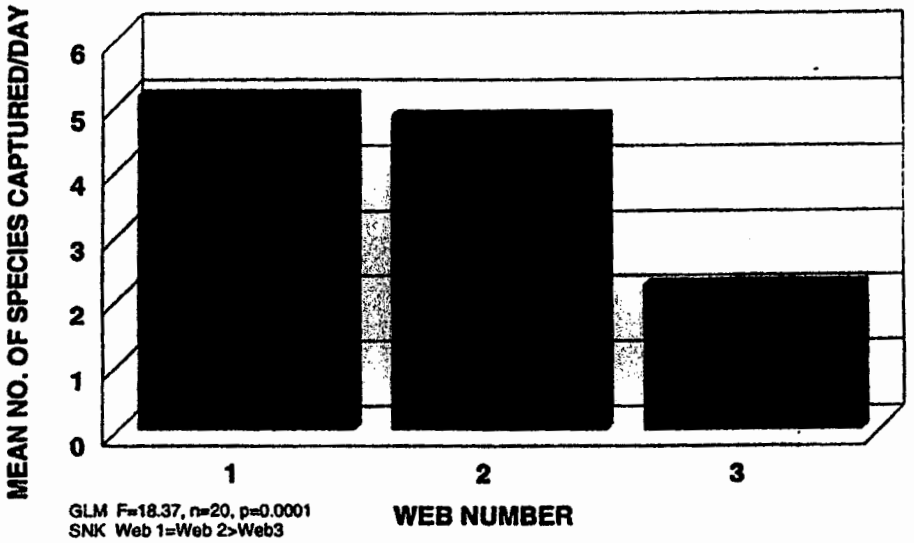


Figure 4. Mean number of species captures per day by web.

Figures 5, 6, and 7 show relative species composition in Sandia Canyon, by web, for 1994-95. As shown in the figures, deer mice were the most commonly captured species in all webs. However, at Web 1, voles, shrews, and harvest mice, species more commonly found in moist habitats, made up a much greater overall percentage (65.6%) than did deer mice and brush mice (34.5%), which are more commonly found in drier habitats. At Web 2, voles, shrews, and harvest mice made up only 37.8% of the overall species composition while deer mice, brush mice, and pinyon mice made up 62.2%. Furthermore, deer mice and brush mice made up 96.7% of the species composition at Web 3 compared to 3.3% for voles.

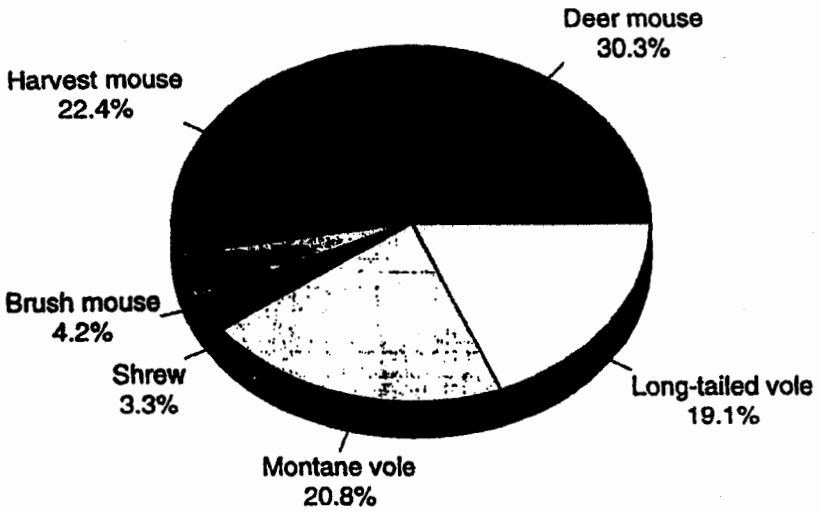


Figure 5. Relative species composition for Web 1, Sandia Canyon, 1994-95.

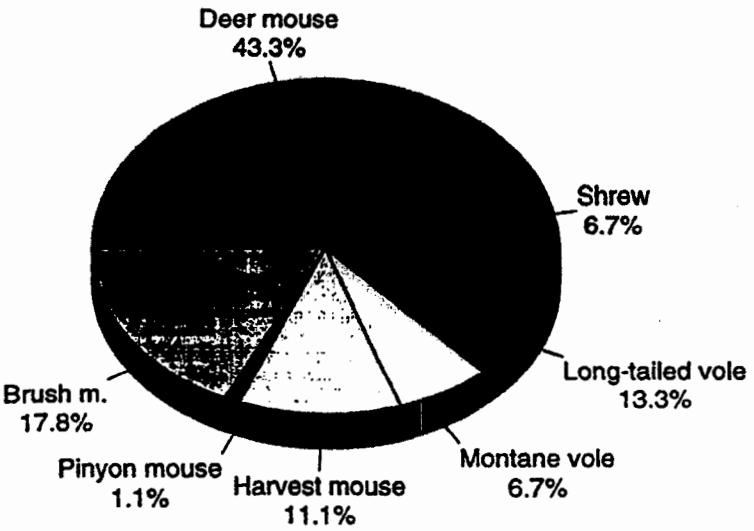


Figure 6. Relative species composition for Web 2, Sandia Canyon, 1994-95.

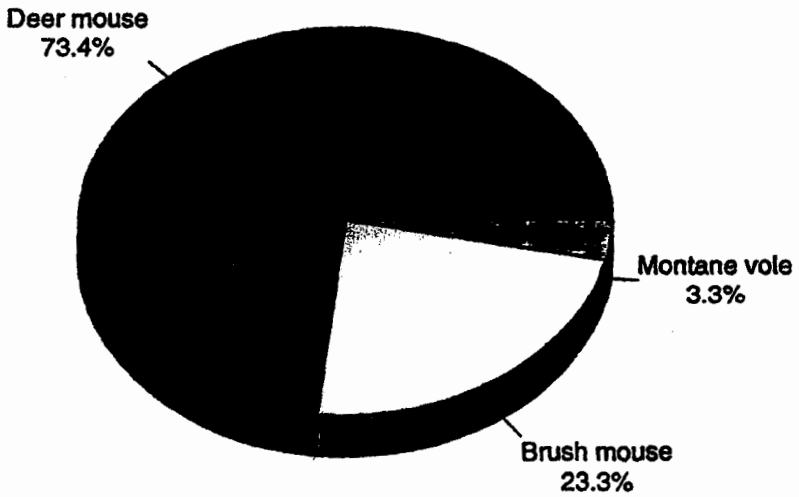


Figure 7. Relative species composition for Web 3, Sandia Canyon, 1994-95.

4.2 Density Estimates

Table 4 gives the estimated density (# animals/ha) of each web by year and for both years of data combined. The highest densities of animals were found in Web 1, the uppermost portion of Sandia Canyon, with a continual decrease in density estimates in each web downstream. Because the study was limited to only two years, statistical analysis on density estimates between the webs within Sandia Canyon could not be conducted because of insufficient sample size. However, the difference in the daily mean number of small mammals captured could be compared between the webs. Web 1 was found to have a statistically significantly higher number of daily captures than Web 2 or Web 3 (GLM, $F = 33.09$, $p = 0.0001$; SNK alpha = 0.05, Web 1 > Web 2 = Web 3). Figure 8 shows the mean daily number of animals captured at each web.

All density estimates calculated for Sandia Canyon were used to compare the density of small mammals in Sandia Canyon to other canyons and mesas within the area. Figure 9 shows the mean density estimate of Sandia Canyon, Ecological Risk (ECO Risk) Study Canyons (Los Alamos and Guaje Canyons), Mortandad Canyon, and Mesita del Buey. The plot indicates that Sandia Canyon has the highest density estimate. However, no statistical difference (alpha = 0.05) was found between the mean density estimate of Sandia Canyon and the density estimates of the ECO Risk study canyons, Mortandad Canyon, and Mesita del Buey (GLM, $F = 3.32$, $p = 0.057$).

Table 4. Small Mammal Density Estimates of Sandia Canyon, Webs 1, 2, and 3.

Density Estimation for All Webs, 1994-95		
YEAR	LOCATION	DENSITY EST.
1994	Web 1	103.7
1994	Web 2	53.9
1994	Web 3	31.8
1995	Web 1	165.8
1995	Web 2	65.7
1995	Web 3	23.9
Average Density (#/ha)		74.1
Standard Deviation (n=6)		53.1

Density Estimation for All Webs, 1994		
YEAR	LOCATION	DENSITY EST.
1994	Web 1	103.7
1994	Web 2	53.9
1994	Web 3	31.8
Average Density (#/ha)		63.1
Standard Deviation (n=3)		36.8

Density Estimation for All Webs, 1995		
YEAR	LOCATION	DENSITY EST.
1995	Web 1	165.8
1995	Web 2	65.7
1995	Web 3	23.9
Average Density (#/ha)		85.1
Standard Deviation (n=3)		72.9

Density Estimation for Web 1, 1994-95		
YEAR	LOCATION	DENSITY EST.
1994	Web 1	103.7
1995	Web 1	165.8
Average Density (#/ha)		134.8
Standard Deviation (n=2)		43.9

Density Estimation for Web 2, 1994-95		
YEAR	LOCATION	DENSITY EST.
1994	Web 2	53.9
1995	Web 2	65.7
Average Density (#/ha)		59.8
Standard Deviation (n=2)		8.3

Density Estimation for Web 3, 1994-95		
YEAR	LOCATION	DENSITY EST.
1994	Web 3	31.8
1995	Web 3	23.9
Average Density (#/ha)		27.9
Standard Deviation (n=2)		5.6

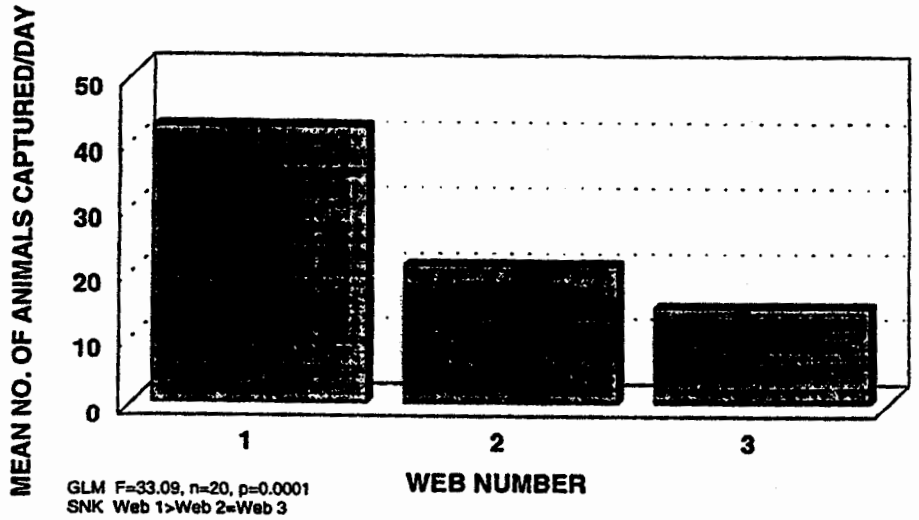


Figure 8. Mean daily number of captures of small mammals by web.

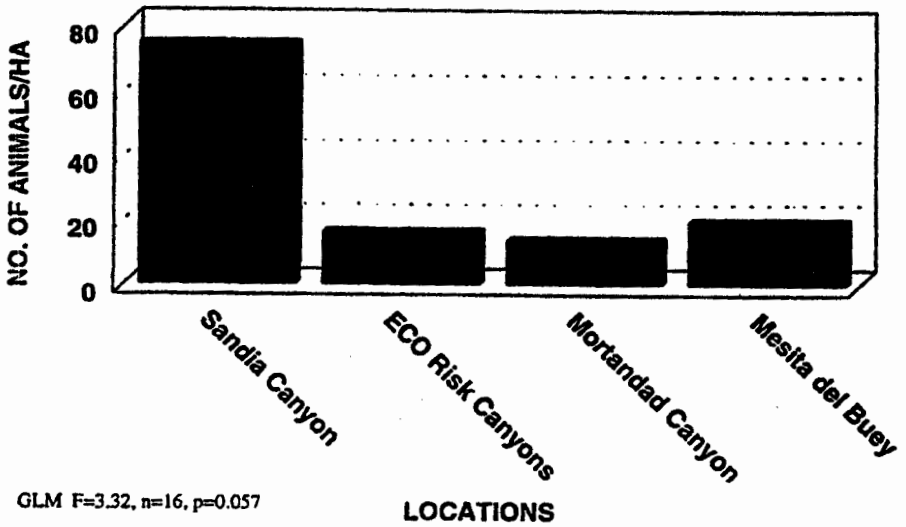


Figure 9. Estimated number of small mammals per hectare by location.

4.3 Biomass Estimates

Average weights for each species by web and year and average weights for all species combined by web and year are given in Table 5. The highest mean weights given are for voles followed by brush mice and deer mice. This data were used to calculate the

small mammal biomass (Table 6). The table indicates that Web 1 has the highest biomass. However, because only two years of biomass estimates are available for each web, statistical differences between webs could not be determined.

4.4 Evaluation of Physical Parameters

4.4.1 Body Weight

Deer mice and brush mice were the only two species captured in sufficient numbers in all three webs to conduct statistical analysis on mean body weight, mean body length, and mean lean body mass. Figure 10 shows the mean body weights of brush mice and deer mice for each web. Results from the GLM demonstrate there is no statistical difference between the mean body weights of deer mice and brush mice between sites (GLM [deer mouse], $F = 1.0$, $p = 0.3705$; GLM [brush mouse], $F = 2.49$, $p = 0.10$).

Table 5. Mean Weights of Small Mammals Sampled in Sandia Canyon, 1994-95.

YEAR	WEB	SPECIES	N	MEAN WEIGHT (grams)	STANDARD ERROR OF MEAN
1994	1	Vagrant Shrew	3	5.23	0.28
	1	Harvest mouse	7	12.36	1.75
	1	Deer mouse	47	17.57	0.56
	1	Brush mouse	2	17.5	3.50
	1	Montane vole	6	16.42	2.68
	1	Long-tailed vole	13	31.38	1.43
1995	1	Shrews (unid. and vagrant)	7	4.57	0.52
	1	Harvest mouse	47	10.33	0.38
	1	Deer mouse	27	16.44	1.00
	1	Brush mouse	8	19.56	1.44
	1	Montane vole	44	27.40	1.37
	1	Long-tailed vole	34	29.56	2.02

Table 5 (cont.)

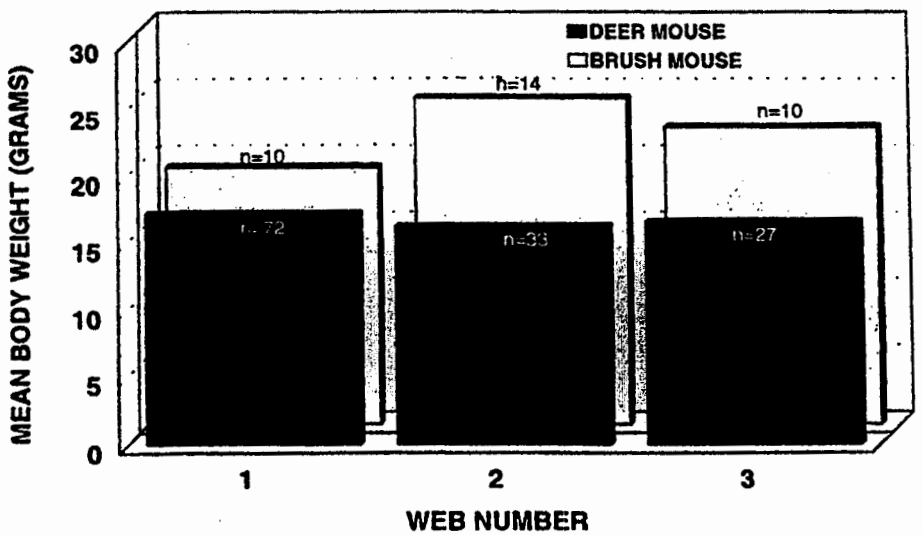
YEAR	WEB	SPECIES	N	MEAN WEIGHT (grams)	STANDARD ERROR OF MEAN
1994	2	Vagrant shrew	1	4.5	*
	2	Harvest mouse	1	10	*
	2	Pinyon mouse	1	20.5	*
	2	Montane vole	1	22	*
	2	Deer mouse	23	16.63	0.77
	2	Brush mouse	5	22.40	2.15
	2	Long-tailed vole	7	35.36	3.04
1995	2	Shrews (unid. and vagrant)	7	4.79	0.46
	2	Harvest mouse	9	10.94	0.65
	2	Deer mouse	11	15.32	1.98
	2	Brush mouse	9	25.50	2.96
	2	Montane vole	5	39.80	2.83
	2	Long-tailed vole	5	41.8	3.13
1994	3	Montane vole	1	20.5	*
	3	Deer mouse	19	16.14	1.16
	3	Brush mouse	3	26.50	1.26
1995	3	Deer mouse	10	17.35	2.26
	3	Brush mouse	7	20.36	3.00
1994	1	All species	78	18.84	0.85
1995	1	All species	167	19.91	0.88
1994	2	All species	39	20.49	1.44
1995	2	All species	46	20.86	1.90
1994	3	All species	23	17.75	1.24
1995	3	All species	17	19.00	1.86
1994-95	1	All species	245	19.57	0.66
1994-95	2	All species	83	20.69	1.30
1994-95	3	All species	39	18.28	1.05
1994	All webs	All species	140	19.13	0.65
1995	All webs	All species	230	20.03	0.77

4.4.2 Body Length

Mean body length was also determined not to be statistically different between the webs (GLM [deer mouse], $F = 0.89$, $p = 0.4117$; GLM [brush mouse], $F = 2.49$, $p = 0.0999$). Figure 11 shows the mean body lengths of deer and brush mice captured at the three webs.

Table 6. Rodent Biomass Estimates for Sandia Canyon, 1994 and 1995.

YEAR	WEB #	DENSITY EST. (#/ha)	MEAN WEIGHT (grams)	BIOMASS EST. (g/ha)
1994	1	103.7	18.84	1,953.7
	2	53.9	20.49	1,104.4
	3	31.8	17.75	564.5
1995	1	165.8	19.91	3,301.1
	2	65.7	20.86	1,370.5
	3	23.9	19.00	454.1
1994-95	1	134.8	19.57	2,638.4
1994-95	2	59.8	20.69	1,237.3
1994-95	3	27.9	18.28	510.0
1994	1,2,3	63.1	19.13	1,209.0
1995	1,2,3	85.1	20.03	1,704.6



GLM
Deer mouse F=1.00, n=134, p=0.3705
Brush mouse F=2.49, n=33, p=0.10

Figure 10. Mean body weights of mice by web.

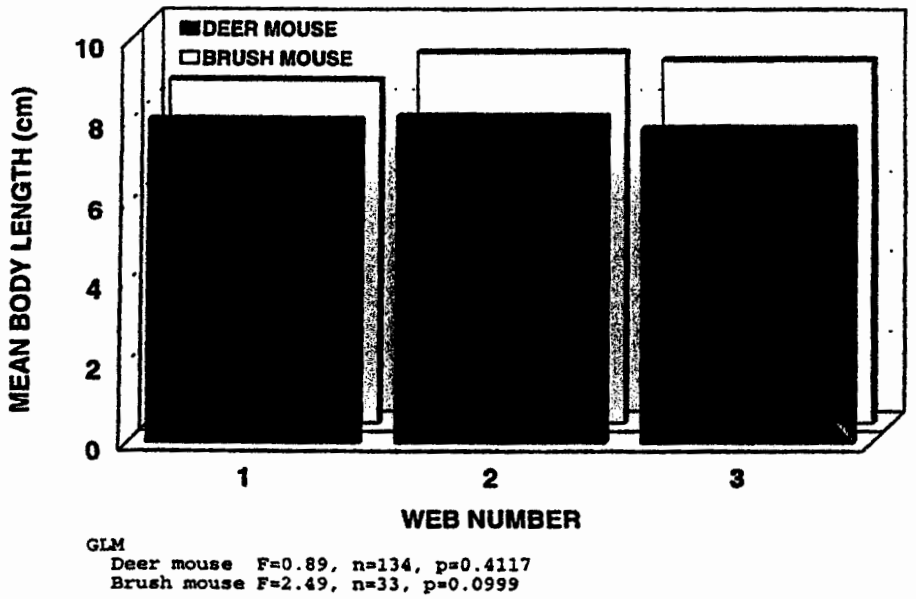


Figure 11. Mean body length of mice by web.

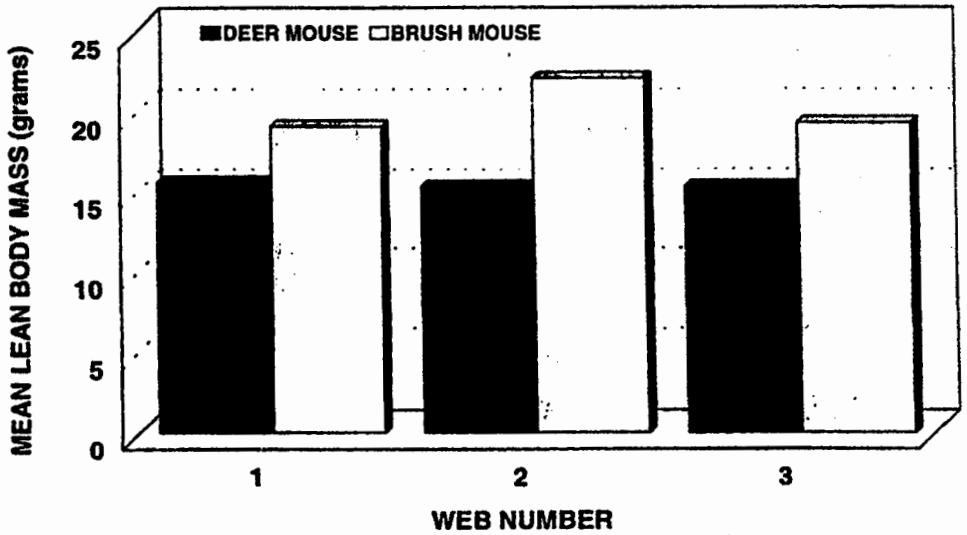
4.4.3 Lean Body Mass

Lean body mass was calculated from the derived regression equation (See Methods) and the mean lean body masses of deer and brush mice at each web is shown in Figure 12. Again, no statistical difference between webs was found for the mean lean body masses of deer and brush mice (GLM [deer mouse], $F = 2.54$, $p = 0.0838$; GLM [brush mouse], $F = 1.60$, $p = 0.2229$).

4.4.4 Physical Aberrations

Based on a qualitative evaluation of each animal, there did not appear to be a significantly high amount of surface or subdermal abnormalities on the animals. Several individuals contained small lumps that appeared to be infections from physical contact with one another or possibly from insect bites. The amount and degree of physical

abnormalities did not appear to be dissimilar from small mammal studies conducted elsewhere at the Laboratory.



GLM
Deer mouse F=2.54, n=134, p=0.0838
Brush mouse F=1.60, n=33, p=0.2229

Lean Body Mass=-17.43+(E Value x 0.02)+(Body Length x 3.01)

Figure 12. Lean body mass of mice by web.

5.0 DISCUSSION

The purpose of this study was to gather baseline nocturnal small mammal data and compare characteristics of the small mammal populations found within three areas within Sandia Canyon (a canyon that receives outfall effluents from multiple sources) to each other and, where data were available, to other areas within Los Alamos County. The characteristics evaluated were species diversity and composition, small mammal density, biomass, and physical characteristics (weight, length, and lean body mass).

This study showed that Web 1 and Web 2 had a greater number of different species captured daily than Web 3. This is mostly due to habitat differences. Web 1 and

Web 2 were centered within a cattail-dominated marsh and the ends of the web lines were in an upland area. These webs captured species indicative of wet environments (shrews and voles) as well as upland environments (deer and brush mice). Web 3, however, was centered over a very narrow riparian stream channel. Therefore, the majority of the species captured were more from upland environments.

Although there was insufficient data to statistically determine if the species diversity index was different between the three webs, Web 1 (1.60) and Web 2 (1.65) had similar calculated species diversity indices and Web 3 had a much lower calculated index (0.67). When these values are compared to other species diversity indices from similar habitats within the area, the values are also very similar (Raymer and Biggs 1994). During the summer of 1993, Raymer and Biggs conducted a series of small mammal studies in various locations within Los Alamos County. They trapped an area within Sandia Canyon within a cattail marsh as well as a cattail marsh in Mortandad Canyon. They calculated species diversity index of 1.79 for Sandia Canyon and an index of 1.46 for Mortandad Canyon. Raymer and Biggs (1994) also trapped an area in Three-Mile Canyon with similar habitat to the Web 3 location. However, the Three-Mile Canyon site was much drier with no standing or flowing water. The species diversity index for the Three-Mile Canyon location was 0.33, somewhat lower than the Web 3 index of 0.67. The differences in species diversity indices appear to be directly related to habitat.

Density estimates were calculated for all three webs. Web 1 had the highest density estimate. Statistical analysis could not be performed on the estimates because of insufficient sample size. However, the mean daily number of rodent captures was

compared between the webs. Web 1 was found to have a statistically higher number of rodents captured. When the density estimates for each web were pooled and compared to other areas within the County, no differences were found. However, the analysis was conducted at the alpha level of 0.05 and the probability generated was 0.057. If the sample size was increased, statistical significance may be determined. The location of Web 1, within the marsh habitat, may be the primary driver for the possible high density estimate and the higher number of rodent captures. Web 1 is located within the widest portion of the marsh. The species composition is comprised of approximately 40% voles (montane and long-tail voles). This habitat is extremely favorable to voles (Raymer and Biggs 1994). Web 2 was located further downstream from Web 1 where the cattail marsh decreases in width and the percent of vole captures also decreases to 20%. The habitat within Web 3 has a low amount of cattails and voles only contributed 3.3% to the species composition.

Statistical analysis was not performed on the biomass estimates due to insufficient sample size. However, it appears that Web 1 (2,638 g/ha) has a higher estimate than Web 2 (1,237 g/ha) and Web 3 (510 g/ha). Considering that voles make up 40% of the species composition of Web 1 and also have the highest body weight of the species captured, it is not surprising that Web 1 has such a high biomass.

Some health conditions can be manifested in decreased body weight, body length, and percent body fat (or an increase in lean body mass). These factors were evaluated for rodents captured within each web. For all of these factors, no statistical differences were found between Web 1 and the two downstream webs (Webs 2 and 3). Furthermore, no

significant degree of physical aberrations were found on individual animals. Food source availability is an important factor influencing body weight, body length, and lean body mass. These data should be compared to data collected at a comparable site in habitat type and size. However, for this study, an appropriate control site was never located. Deer and brush mice captured within the three webs appear to have a mean body weight and body length within the normal range for these species (Whitaker 1980). Data on lean body mass were only available from a site in northwestern New Mexico. The habitat was extremely different from Sandia Canyon, therefore no comparisons were made. Comparisons of lean body mass will be made in the future when additional data are collected within similar habitats within the County.

Further monitoring studies (i.e., repeating study every 3 to 5 years) should be conducted in Sandia Canyon so comparisons over time can be made. In addition, rodent tissues should be sampled for contaminants and then compared to the rodent population characteristics. These data over time may be very useful in assessing impacts to the rodent community in Sandia Canyon.

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