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Vegetation characteristics associated with small mammal populations in the Las Vegas Wash

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VEGETATION CHARACTERISTICS ASSOCIATED

WITH SMALL MAMMAL POPULATIONS

IN THE LAS VEGAS WASH

by

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ABSTRACT

Vegetation Characteristics Associated
with Small Mammal Populations
in the Las Vegas Wash

by

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Percent litter, average litter depth, percent bare ground, vegetation density, vegetation canopy, and distance to an ecotone boundary were measured and compared to small mammal capture locations in the Las Vegas Wash. *Neotoma lepida* appear to be greatly dependent upon the foliage litter of *T. ramosissima*. Alternatively, ecotone boundaries appear to be the most important factor affecting *Dipodomys merriami* distributions. *Peromyscus eremicus* distributions may be predicted based on vegetation density and increased canopy during shorter, winter torpor periods. *Chaetodipus penicillatus* were consistently associated with dense, seed-bearing vegetation, although *C. penicillatus* is extremely opportunistic and vegetation density should not limit their distributions. Long-term management strategies for the Las Vegas Wash should include the diverse habitat requirements of small mammals and also acknowledge the dependence of certain species on non-native vegetation.

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CHAPTER 1

INTRODUCTION

Background

The Las Vegas Valley Wash serves as habitat for a variety of desert plant and animal species. Highly variable and infrequent precipitation events are a dominant factor in controlling the biological processes of deserts (Noy-Meir, 1973). Deserts have traditionally been described as hot and dry, but both abiotic and biotic influences contribute to the overall desert environment, including regional weather patterns that define the corresponding species communities (Whitford, 2002). The city of Las Vegas lies within the Mojave Desert, and is located between Frenchman Mountain range to the east, Spring Mountain range to the west, Sheep Mountain range to the north, and the McCullough Mountain range to the south. The spatial location of the Las Vegas Wash combined with climatic conditions define this arid, desert region (Whitford, 2002).

The wash serves several important ecological and economic roles, including providing habitat for many species and filtering urban and natural water pollutants. The wash contains mostly low-lying shrubs, such as White Bursage (*Ambrosia dumosa*) and Creosotebush (*Larrea tridentata*); however, the wash has been altered by invasive species such as Saltcedar (*Tamarix ramossissima*) and Tall Whitetop (*Lepidium latifolium*). Small mammals inhabit many areas of the wash, and their distribution, abundance, and density are important considerations when diagnosing ecological stability of the area.

Behavioral, morphological, and physiological adaptations are important determinants involved with flora and faunal population dynamics.

Due to the important functions and biological diversity of the wash, its integrity is vulnerable to both natural and anthropogenic changes that affect bank stabilization, vegetation diversity, and invasive species management (Las Vegas Wash Coordination Committee, 2003). The population of Las Vegas is expected to reach 2 million by 2005 (City of Las Vegas, 2002), and the growing population results in increased wash flows. Currently, approximately 153 million gallons of water from urban runoff, shallow groundwater, reclaimed water, and storm water return to Lake Mead (Fig. 1) via the Las Vegas Wash each day (Las Vegas Wash Coordination Committee, 2003); therefore, understanding the vegetative and edaphic habitat requirements of both flora and faunal species is both necessary and helpful in maintaining the integrity of the wash.

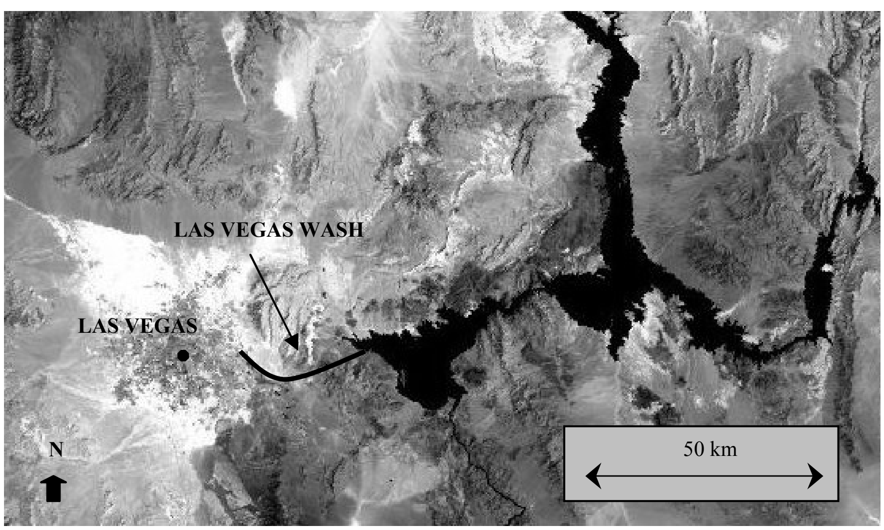


Fig. 1. Geographic location of the City of Las Vegas, Las Vegas Wash, and Lake Mead. (Landsat 7 Enhanced Thematic Mapper + Images obtained from W.M. Keck Earth Sciences and Mining Research Information Center; University of Nevada Reno).

Purpose of Study

Researchers from the University of Nevada Las Vegas, in conjunction with state and local agencies, conducted a small mammal monitoring survey in an area of the Las Vegas Wash from July 2002 to July 2003. The study selected and examined three distinct habitat communities based on ocular estimates of dominant vegetation. The mark-recapture survey achieved its goals of providing information on species presence and diversity and estimating population sizes of the following small mammals: Desert Pocket Mouse (*Chaetodipus penicillatus*), Kangaroo Rat (*Dipodomys merriami*), Cactus Mouse (*Peromyscus eremicus*), Little Pocket Mouse (*Perognathus longimembris*), and Desert Woodrat (*Neotoma lepida*) (Gerstenberger, 2003). Although the survey provided valuable information on population dynamics of species within the habitats, it did not fully characterize habitat use by small mammals, as the aforementioned study only characterized areas based on dominant vegetation at each sampling location. It is essential to understand vegetative, ecotonal, edaphic, and hydrologic components when making sound restoration, remediation, and species management decisions. Therefore, this study is designed to check for associations between small mammal captures and vegetation density, vegetation canopy, percent litter, average litter depth, basal vegetation cover, percent bare ground, distance to water, and distance to an ecotone boundary.

CHAPTER 2

LITERATURE REVIEW

Vegetation

The study area is representative of dominant vegetation types found in the Mojave Desert, such as Four Wing Saltbush, *Atriplex canescens*; Quailbush, *Atriplex lentiformis*; Creosotebush, *Larrea tridentata*; White Bursage, *Ambrosia dumosa*; Mormon Tea, *Ephedra nevadensis*; Saltcedar, *Tamarix ramosissima*; Tumbleweed, *Salsola tragus*; Littleleaf Ratany, *Krameria erecta*; and Catclaw Acacia, *Acacia greggii*.

A widely distributed and abundant type of *Atriplex* in the desert southwest is *A. canescens* (Mozingo, 1987). It typically grows among gravelly flats, slopes, and shrublands (Baldwin et al., 2003) with sandy, alkaline soils (Stubbendieck et al., 1986). In Nevada, *A. canescens* inhabits elevations from 2,000 to 2,300 meters (Kartesz, 1988) and typically grows between eight and twenty meters in height (Welsh et al., 1993). Over time *A. canescens* has become an increasingly dominant plant in the Mojave Desert (Vasek, 1977).

Atriplex lentiformis is a native, perennial shrub that grows in southern Nevada, and parts of Utah, Colorado, central Arizona, California and New Mexico (Pearcy, 1974). *Atriplex lentiformis* inhabits poorly drained, saline soils in desert habitats (Watson et al., 1987). It is usually found at elevations from 760 to 950 meters (Welsh et al., 1993), but can grow in elevations up to 1,372 meters (Vines, 1960). *Atriplex lentiformis* usually

grows to two meters in height (Vines, 1960), but can reach heights of three meters in areas where the water table is sufficiently high (Kearney, 1960). In addition, *A. lentiformis* provides foliage and seeds for several small mammals (Guillion, 1964).

Larrea tridentata is a perennial, low-lying shrub located throughout the Mojave, Sonoran, and Chihuahuan deserts (MacMahon, 1988). The shrub grows to approximately one to three meters in height (Welsh et al., 1993) and is found within sandy, alluvial plains (Stubbendieck et al., 1986), bajadas, gentle slopes, valley floors, and sand dunes (Burk, 1977). *Ambrosia dumosa*, another common Mojave Desert plant, is usually associated with *Larrea tridentata* (Ackerman, 1980). This native shrub grows between eight and twenty-four inches in height, with roots often five to fifteen times the length of the stems (Shreve, 1964). Open stands of *L. tridentata* and *A. dumosa* are often associated with *Ephedra nevadensis* (Holand, 1986), an evergreen shrub that grows from 0.05 to 1.25 meters that usually occurs on dry, open slopes, or floodplains with rocky, alkaline soils (Dayton, 1931).

Tamarix ramossissima is a non-native species dominating wash areas in the desert southwest. It is classified as either a shrub or tree, and grows to approximately eight meters in height (Baldwin et al., 2003). *Tamarix ramossissima* was originally planted as an ornamental and windbreak, but because of its deep, extensive roots and rapid reproduction, it has since out-competed several native species and become quite extensive in distribution (Mozingo, 1987). This halophilic plant has an unusually high tolerance for water stress, dominates dry, riparian sites (Horton et al., 2001) in washes, streambanks, and ditches (Baldwin et al., 2003), and inhabits elevations up to 2,000 meters (Szaro, 1989).

The largest distribution of *S. tragus* is found in semiarid regions (Young, 1991). *Salsola tragus* dominates alkaline soils, grows to approximately one meter in height, and is found at elevations up to 2,600 meters (Young, 1991). It also has been shown to provide cover for a variety of small mammals (Dittberner, 1983). *Krameria erecta*, another common desert shrub, is a native, perennial species that grows in sandy regions (Stubbendieck et al., 1986) and grows to approximately one meter in height while dominating alkaline soils (Texas, 2002).

Acacia greggii, dominates several regions of the southern Mojave Desert (Little, 1976). It is scattered throughout many plant communities and achieves highest density in desert washes (USDA, 1990). In desert washes, *A. greggii* is predominantly located in low regions of the wash, where the water table is typically shallow (Hastings, 1965). It grows to approximately three meters in height, but has been recorded to reach heights of nine meters (USDA, 1937).

Small Mammals

Desert Woodrats, *Neotoma lepida*, are found throughout desert southwest environments from sea level to 2,600 meters (Brylski, 1990) where they feed on buds, fruit, seeds, bark, leaves, and young shoots of *L. tridentata* and various cactus species. *Neotoma lepida* is herbivorous and stores foliage, seeds, berries, and parts of flowers in their nests (Cameron and Rainey, 1972). *L. tridentata* has been found in the stomach contents of *N. lepida* (Lieberman, 1969) and is considered a dominant food source (Meyer, 1989); however, *N. lepida* can utilize additional sources in other communities and habitats (Journal of Mammology, 1974). Nests of *N. lepida* are extremely important,

as they are used for cover, food storing, and predator escape (Brylski, 1990). *Neotoma lepida* instinctively construct shelters from natural materials, such as fallen twigs and debris (Cameron and Rainey, 1972), as well as artificial materials (Bonaccorso and Brown, 1972). Their shelters are recognizable as a pile of sticks in a conical or spherical shape (Stones and Hayward, 1968) (Fig. 2).

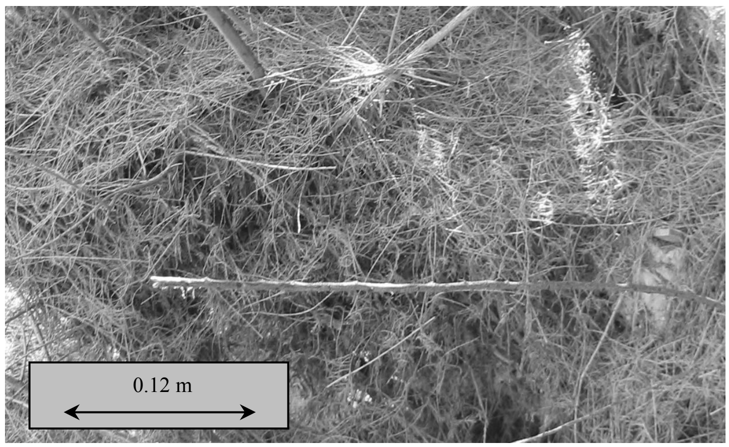


Fig. 2. *Neotoma lepida* nest constructed from Saltcedar foliage.

Neotoma lepida metabolically obtain water and therefore depend on vegetation such as *L. tridentata* for survival. *Neotoma lepida* are active year round, mainly nocturnal, and usually solitary (Brylski, 1990). Home ranges have been estimated from 0.04 to 0.2 ha (Bleich and Schwartz, 1975). They are extremely adaptable to changing vegetation conditions, and are perhaps one of the most adaptable rodents in the world (Cameron and Rainey, 1972).

Kangaroo Rats, *Dipodomys merriami*, heavily populate arid lands from sea level to 4,500 feet. (Reynolds, 1958) and feed opportunistically on seeds in relation to seed availability and abundance (Brylski, 1990). *Dipodomys merriami* are associated with low

precipitation and low percent shrub cover (Beatley, 1976). During spring and summer, *D. merriami* take food directly from the plant; rely on seed caching during the fall and winter (Reynolds, 1958); and obtain water metabolically from moisture in their food (Bylski, 1990). A study at the base of Spring Mountains in Nevada examined cheek contents of *D. merriami* and found grass seeds in approximately 75% of captured individuals while seeds from desert shrubs were rarely found (Bradley and Mauer, 1971). Other studies have also identified seeds in the cheek pouches of *D. merriami*, including grasses, forbs, and woody species (Reynolds, 1950). *Dipodomys merriami* usually burrow at the base of shrubs (Brylski, 1990), and nest location is dictated by soil, cover type, amount of precipitation, and winter temperatures (Reynolds, 1958); home ranges are not well documented in primary literature. Like all species, the ability of *D. merriami* to survive depends on their ability to respond to environmental variation (Bylski, 1990).

The cactus mouse, *Peromyscus eremicus*, is common in desert scrub and wash habitats (Brylski, 1990). *Peomyscus eremicus* appear to be patchily distributed (Whitford, 1976) and have seasonal populations (Chew and Chew, 1969), but home ranges are not well documented in primary literature. They feed primarily on green vegetation, seeds, fruits, and flowers, but are usually classified as omnivorous (Brylski, 1990). *Peromyscus eremicus* is generally associated with moderate to dense canopy coverage (Brylski, 1990); their distribution has been related to density of shrub cover (Bradley and Mauer, 1973); and population estimates are elevated in moist years (Beatley, 1976; Whitford, 1976). *Peromyscus eremicus* prefer sandy soils for burrow excavation and nest construction and demonstrate behavior indicative of aestivation, as winter population estimates are high while summer populations are low (Lewis, 1972).

Lack of water and high temperatures may directly or indirectly induce their unstable populations and aestivation tendencies (Lewis, 1972).

The Desert Pocket Mouse, *Chaetodipus penicillatus*, is a common inhabitant of desert wash and shrub communities (Brylski, 1990), preferring microhabitats with large shrubs and low vegetation density (Price, 1978), but home ranges are not well documented in primary literature. *Chaetopidus penicillatus* usually burrow in sandy soils (Hoover et al., 1977), which are comprised of small particles; however, they can chew their way through hard, larger particles in the soil. They feed primarily on the seeds of forbs, grasses, and shrubs (Brylski, 1990).

CHAPTER 3

METHODS

Small Mammal Trapping

A small mammal mark-recapture survey was conducted from July 2002 to July 2003 in the east end of the Las Vegas Wash. Three sampling transects were chosen based on ocular definitions of the three habitat types (Fig. 3): Creosote, Quailbush/Mesquite, and Tamarisk (Gerstenberger et al., 2002).

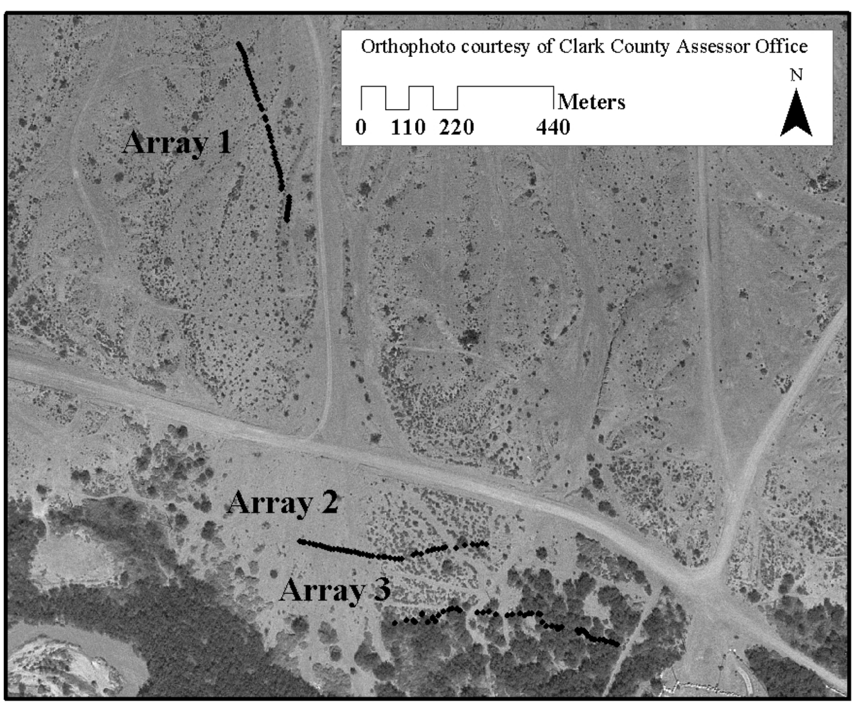


Fig. 3: Array locations of small mammal trapping and vegetation analysis in the Las Vegas Wash.

Fifty Sherman live traps (8 cm x 8cm x 30 cm) were placed approximately one meter apart along each transect for a total of 150 traps per night. The survey was conducted for five consecutive days in the third week of each month and repeated over a twelve month period. On each day, just before sunset, all traps were placed in their respective locations, baited with oats and birdseed, and set. From July 2002 to October 2002, and March 2003 to July 2003, traps were checked each morning along the transects. In the winter months, November 2002 to February 2003, the traps were checked late in the evening on the same day they were set in order to avoid freezing deaths due to cold temperatures. Traps were removed from the field at the end of each five-day trapping period to eliminate any accidental trap deaths.

If a small mammal was captured, data on the species type, morphological characteristics, weight, sex and animal fate were recorded. Morphological measurements including length of tail, body, hind-foot, and ear were measured in millimeters using a ruler and the weight was recorded in grams using a 100g x 1g hand-held scale. Both ears were tagged with self-piercing, ear tags and the identification numbers were recorded. If the animal had been captured previously, the tag numbers from both ears was recorded. This protocol was repeated for each five-day period during the twelve-month mark-recapture survey.

A real-time kinematic (RTK) survey was conducted at the trap locations using a Trimble 5700 Global Positioning System (GPS) measurement unit possessing a differential horizontal accuracy of ±10 mm and a vertical accuracy of ±20 mm. Locations were recorded in State Plane coordinates, NAD83 ellipsoid, and the units are reported in meters.

Vegetation Transects

All three study sites are approximately 500 meters above sea level. Array 1 begins at 8,149,078 northing, 253,587 easting and ends at 8,149,197 northing, 253,548 easting (Appendix 1). *Larrea tridentata, Ambrosia dumosa,* and *Salsola tragus* dominated vegetation in the array with soil comprised of 27% silt and 60% sand (Horn, 2003).

Array 2 begins at 8,148,853 northing, 253,595 easting and ends at 8,148,847 northing, 253,727 easting (Appendix 2). *Atriplex canescens* is the dominant vegetation type and the soil was mostly sandy with some percent clay and silt as before. Array 3 begins at 8,148,782 northing, 253,817 easting and ends at 8,148,797 northing, 253,662 easting (Appendix 3). *Tamarix ramossissima* characterizes vegetation of the third array and the soil is predominantly sand (Horn, 2003).

Vegetation Sampling

A vegetation study was conducted from September 2003 to January 2004. Sampling occurred throughout the three transects used for small mammal trapping. Vegetation was sampled at every fifth trap along the array, or approximately every 5 meters, totaling 11 sampling locations per array. In addition, buffering points were identified five meters on either side of each of the 11 points (Fig. 4).

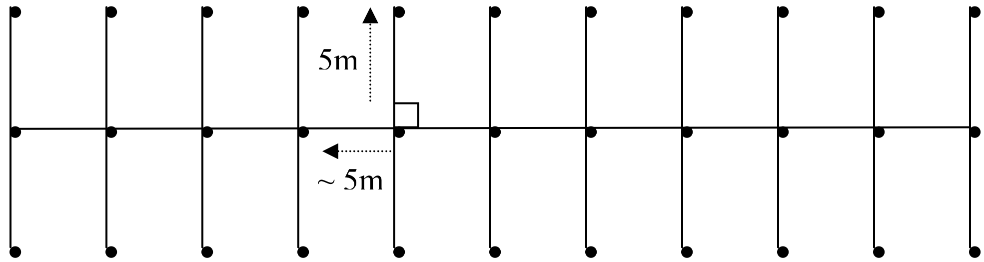


Fig. 4: Sampling and buffering points on array.

To ensure consistency, a compass was used to assure the buffer points were perpendicular to the array and a measuring tape was used to determine the distance. Buffering points were also located and identified using a Trimble 5700 GPS Data Collector.

A $1m^2$ quadrat was constructed using one inch PVC pipe, and it was further divided into four equal quadrants using string. The center of the quadrat was placed at each of the 11 sampling locations and 22 buffering points. At each quadrat, measurements were recorded for litter, vegetation canopy, and vegetation density as described below.

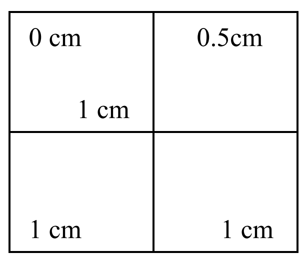
Litter was defined as anything lying directly on the ground, including seeds, leaves, as well as any human-generated litter (garbage). Percent litter was estimated ocularly to the nearest percent in each quadrant. The researcher stood on the west side of the quadrant facing east and moved in a clockwise direction starting from the northeast quadrant. Percent litter was estimated for each quadrant, and recorded as either natural or human litter. The four measurements from each quadrant were summed and divided by four to provide a percent litter estimate for the entire quadrat (Fig. 5). Basal vegetation cover was also estimated ocularly using the same principle. The area on the ground covered by stem structures defined basal cover.

45%	20%
60%	10%

45 + 20 + 60 + 10 = 135 135/4 = 33.75%

Fig. 5. Calculation method for percent litter and basal vegetation.

Depth of the litter was recorded in each of the four corners and center of the quadrat. The depths were recorded in centimeters, summed, and divided by five to obtain an estimate of average litter depth (Fig. 6).

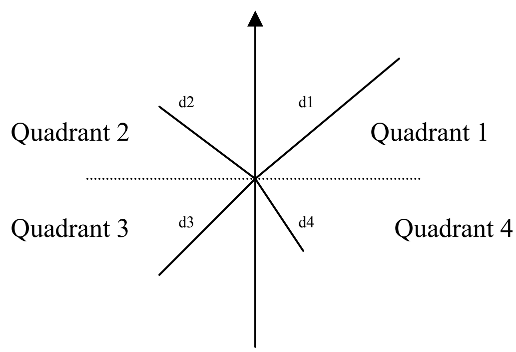


0 + 0.5 + 1 + 1 + 1 = 3.5 3.5/5 = 0.7 cm

Fig. 6. Calculation method for average litter depth.

Vegetation canopy was estimated using a concave densiometer (Model-A, Forestry Suppliers, Inc). The densiometer was held near the ground facing north at a ninety degree angle at the center of the quadrat. A correction factor of 1.04 was used to give approximate canopy cover from 100 percent.

Vegetation density was estimated using the Point Quarter Method, PQM (Bonham, 1989). From the center of each quadrat, distance to the closest vegetation in each of the four quadrants was recorded (Fig. 7). Density estimates were obtained by squaring the reciprocal of the average mean distance for each point to calculate the average number of shrubs per square meter.



$$\text{\# of shrubs/m}^2 = 1/\sum d^2$$

Fig. 7. Point quarter method for estimating plant density (Adopted from Bonham, 1989).

Distances to the closest ecotone and the closest perennial water source were delineated on an orthophoto. The outer boundary of the ecotone was visually delineated on an orthophoto along the northern border of Array 3 (Fig. 8), and the center of the perennial water source was delineated, instead of an edge, to account for seasonal and temporal changes in water levels (Fig. 9). Distance in meters was calculated from each of the fifty trap locations to both ecotone and water using Geographic Information System (GIS) software.

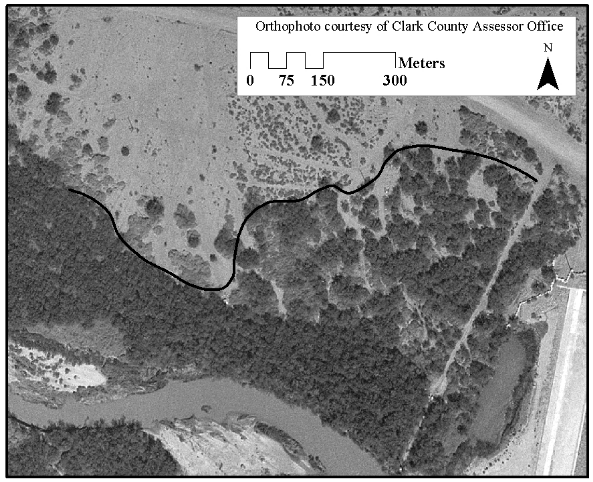


Fig. 8. Delineation of ecotone boundary on aerial photograph.

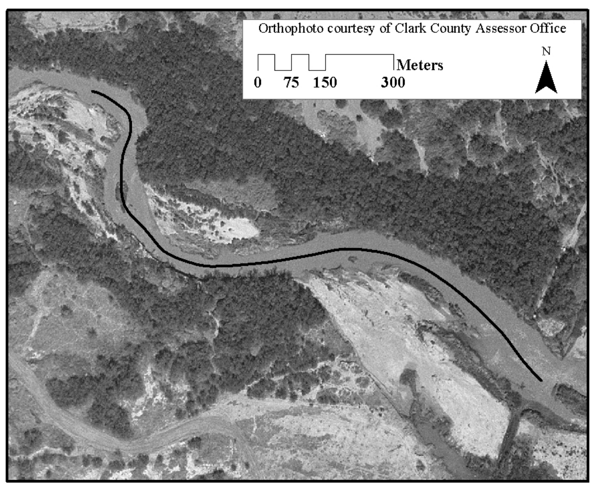


Fig. 9. Delineation of water boundary on aerial photograph.

Statistical Analysis

Statistical analyses (see Zar, 1999) were divided into three main groups: 1) vegetation among arrays, 2) vegetation and animal capture locations, and 3) vegetation and animal capture frequencies. All data were first tested for normality using a Shapiro-Wilk test. If the data represented a normal distribution, the equality of the variance was

tested and the corresponding parametric test was used. If the data did not represent a normal distribution, the appropriate non-parametric test was employed.

1. Vegetation among arrays

Differences in percent litter, average litter depth, vegetation density, vegetation canopy, percent bare ground and distances to an ecotone boundary were evaluated among the three arrays. Measurements from each of the 33 sampling points per array were used. A One-Way ANOVA was used to evaluate variables with normal distributions, while a Kruskal-Wallis test was used for variables that had non-normal distributions.. Measurements that ranged from 0 to 1, or 0 to 100, and did not return normal distributions, were transformed using the arcsine square root transformation. Distances to an ecotone boundary were also evaluated using either a One-Way-ANOVA or a Kruskal-Wallis, depending on normality. The sampling size was 50 for each array, as distance was calculated to the ecotone from each trap location.

2. Vegetation and capture locations

Differences in vegetation variables among traps where small mammals were captured and traps where they were not captured were evaluated. Small mammal trapping data were obtained from the twelve-month sampling period. Since vegetation estimates were conducted during fall and winter months, only data from September to January were included in the analysis. The data were organized first by array, then month, and finally trap day. Species presence was recorded using a '1' for present and a '0' for absent, and the species type was recorded by genus and species. Vegetation sampling data, which includes percent litter, average litter depth, vegetation density, bare ground, distance to an ecotone boundary, and distance to water were recorded at each

corresponding location. It was assumed measurements taken at the eleven locations characterized surrounding vegetation, which included two trap locations on either side of the sampling point (Fig. 10) to subdivide the array into sections.

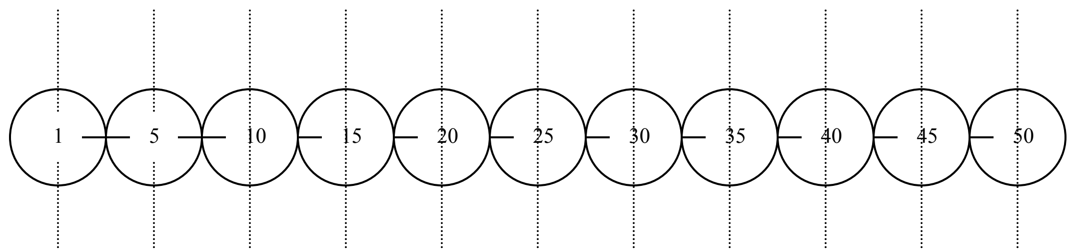


Fig. 10: Array subdivided into sections by sampling points.

For each mark-recapture sampling month, vegetation measurements were divided into traps where a small mammal was captured and traps where a small mammal was not captured. An independent t-test was used to evaluate variables with normal distributions, while a Mann-Whitney test was used for variables that had non-normal distributions. Measurements that ranged from 0 to 1, or 0 to 100, and did not return normal distributions, were transformed using the arcsine square root transformation.

3. Vegetation and capture frequencies

The frequency of small mammals trapped in different types of vegetation was tested. All vegetation variables were divided into quartiles. The number of small mammals trapped within each of those groups for the corresponding vegetation variables was recorded as the observed value. The expected value was calculated by taking the total number of small mammals trapped and dividing by 4. Due to small frequencies and discrepancies between observed and expected values, a G-statistic was calculated using the log likelihood ratio.

Hypotheses

Litter

Hypothesis 1(a): Litter will differ among the three habitat types.

Method: One-Way ANOVA of percent litter and average litter depth among arrays if data were normal, but otherwise, a Kruskal-Wallis was used.

Hypothesis 1(b): *Neotoma lepida* will be captured most frequently in habitats with more litter.

Method 1: Independent t-test among percent litter in sections of the array where *N. lepida* were trapped compared with empty traps if data were normal, but otherwise, a Mann-Whitney was used.

Method 2: G-statistic calculated from observed number of *N. lepida* trapped for each percent litter quartile and expected number.

Hypothesis 1(c): *Neotoma lepida* will be captured most frequently in habitats with greater litter depth.

Method 1: Independent t-test among average litter depth in sections of the array where *N. lepida* were trapped compared with empty traps if data were normal, but otherwise, a Mann-Whitney was used.

Method 2: G-statistic calculated from observed number of *N. lepida* trapped for each average litter depth quartile and expected number.

Vegetation Density

Hypothesis 2(a): Vegetation density will differ among the three habitat types.

Method: One-Way ANOVA of vegetation density among arrays if data were normal, but otherwise, a Kruskal-Wallis was used.

Hypothesis 2(b): *Peromyscus eremicus* will be captured most frequently in areas with higher vegetation density.

Method 1: Independent t-test among vegetation density in sections of the array where *P. eremicus* were trapped compared with empty traps if data were normal, but otherwise, a Mann-Whitney was used.

Method 2: G-statistic calculated from observed number of *P. eremicus* trapped for each vegetation density quartile and expected number.

Hypothesis 2(c): *Chaetodipus penicillatus* will be captured most frequently in areas with lower vegetation density.

Method 1: Independent t-test among vegetation density in sections of the array where *C. penicillatus* were trapped compared with empty traps if data were normal, but otherwise, a Mann-Whitney was used.

Method 2: G-statistic calculated from observed number of *C. penicillatus* trapped for each vegetation quartile and expected number.

<u>Vegetation Canopy</u>

Hypothesis 3(a): Vegetation canopy will differ among the three habitat types.

Method: One-Way ANOVA of vegetation canopy among arrays if data were normal, but otherwise, a Kruskal-Wallis was used.

Hypothesis 3(b): *Peromyscus eremicus* will be captured most frequently in habitats with greater vegetation canopy.

Method 1: Independent t-test among vegetation canopy in sections of the array where *P. eremicus* were trapped compared with empty traps if data were normal, but otherwise, a Mann-Whitney was used.

Method 2: G-statistic calculated from observed number of *P. eremicus* trapped for each vegetation canopy quartile and expected number.

Hypothesis 3(c): *Neotoma lepida* will be captured most frequently in habitats with greater vegetation canopy.

Method 1: Independent t-test among vegetation canopy in sections of the array where *N. lepida* were trapped compared with empty trap if data were normal, but otherwise, a Mann-Whitney was used..

Method 2: G-statistic calculated from observed number of *N. lepida* trapped for each vegetation canopy quartile and expected number.

<u>Percent Bare Ground</u>

Hypothesis 4(a): Percent bare ground will differ among the three habitat types.

Method: One-Way ANOVA of percent bare ground among arrays if data were normal, but otherwise, a Kruskal-Wallis was used.

Hypothesis 4(b): *Dipodomys merriami* will be captured most frequently in habitats with the greater percent bare ground.

Method 1: Independent t-test among bare ground cover in sections of the array where *D. merriami* were trapped compared with empty traps if data were normal, but otherwise, a Mann-Whitney was used.

Method 2: G-statistic calculated from observed number of *D. merriami* trapped for each bare ground quartile and expected number.

<u>Distance to Ecotone</u>

Hypothesis 5(a): Distance to the closest ecotone boundaries will differ among the three habitat types.

Method: One-Way ANOVA of distance to ecotone among arrays if data were normal, but otherwise, a Kruskal-Wallis was used.

Hypothesis 5(b): *Neotoma lepida* will be captured most frequently in traps closest from the ecotone.

Method 1: Independent t-test among distances to ecotone in sections of the array where *N. lepida* were trapped compared with empty traps if data were normal, but otherwise, a Mann-Whitney was used..

Method 2: G-statistic calculated from observed number of *N. lepida* trapped for each distance to ecotone quartile and expected number.

CHAPTER 4

RESULTS

Vegetation and Habitat Types

Array 1 was dominated by Creosotebush, *Larrea tridentata*; White Bursage, *Ambrosia dumosa*; Mormon Tea, *Ephedra nevadensis*; Catclaw Acacia, *Acacia greggii*; Four Wing Saltbush, *Atriplex canescens*; Littleleaf Ratany, *Krameria erecta*; and Tumbleweed, *Salsola tragus*. Several species were present, but for consistency, the array was labeled as a Creosote community. Array 2 also contained multiple dominant species, including Four Wing Saltbush, *Atriplex canescens*; Quailbush, *Atriplex lentiformis*; White Bursage, *Ambrosia dumosa*; and Tumbleweed, *Salsola tragus*, and this habitat type was labeled as a Saltbush community. Array 3 contained Four Wing Saltbush, *Atriplex canescens*, and Quailbush, *Atriplex lentiformis*, as well but was dominated by Saltcedar, *Tamarix ramosissima*; therefore, it was labeled as a Saltcedar community.

Percent litter, average litter depth, vegetation density, vegetation canopy, percent bare ground, and distances to an ecotone boundary were analyzed for differences among the three habitat types (Table 1, Table 2).

Table 1. A comparison of vegetation variables between three desert habitat types.

	Null Hypothesis	Alternate Hypothesis	Shapiro-Wilk Normality*	Test Statistic (H)	Overall p-value	Decision	Post Hoc (Nemenyi) Array**	Test Statistic	Critical Value	Decision
Percent Litter	Percent litter will not differ between the three arrays.	Percent litter will differ between the three arrays.	0.000	61.037	0.000	Reject Null	1 vs. 3 1 vs. 2 2 vs. 3	10.867 3.770 7.097	3.356	reject null reject nul reject null
Average Litter Depth	Average litter depth will not differ between the	Average litter depth will differ between the three	0.000	55.559	0.000	Reject Null	1 vs. 3 1 vs. 2 2 vs. 3	10.363 4.153 6.209	3.356	reject null reject nul reject null
Vegetation Density	Vegetation density will not differ between the three	Vegetation density will differ between the three arrays.	0.000	41.542	0.000	Reject Null	1 vs. 3 1 vs. 2 2 vs. 3	8.339 0.970 7.370	3.356	reject null fail to reject reject null
Vegetation Canopy	Vegetation canopy will not differ between the three	Vegetation canopy will differ between the three arrays.	0.000	57.399	0.000	Reject Null	1 vs. 3 1 vs. 2 2 vs. 3	9.537 1.684 7.853	3.356	reject null fail to reject reject null
Percent Bare ground	Percent bareground will not differ between	Bareground will differ between the three arrays.	0.000	5.627	0.060	Fail to Reject	n/a	n/a	n/a	n/a
Distance to Ecotone	Distance to ecotone will not differ between the	Distance to ecotone will differ between the three	0.000	109.311	0.000	Reject Null	1 vs. 3 1 vs. 2 2 vs. 3	26.885 18.570 8.315	3.356	reject null reject nul reject null

* Shapiro-Wilk tests if a random sample comes from a normal distribution. If $p < 0.05$, the distribution is NOT normal

** Array 1 Creosote Community

Array 2 Saltbush Community

Array 3 Saltcedar Community

Table 2. Descriptive statistics for vegetation variables in three different habitat types.

Array	Descriptive Statistic	Litter (%)	Avg. Litter Depth	Vegetation Density	Vegetation Canopy	Bare Ground (%)	Distance to Ecotone
1	Mean	6	0.1	0.33	4.73	91	942.41
	Std. Error	2	0.1	0.09	3.09	3	17.37
	Median	0	0.0	0.18	0.00	100	934.14
	Std. Deviation	13	0.3	0.52	17.78	16	122.85
	Minimum	0	0.0	0.01	0.00	40	754.75
	Maximum	55	1.5	3.00	99.84	100	1135.76
2	Mean	19	0.7	5.87	10.78	98	129.70
	Std. Error	5	0.2	5.37	4.11	1	2.18
	Median	6	0.3	0.15	0.00	100	131.82
	Std. Deviation	27	0.9	30.87	23.61	4	15.40
	Minimum	0	0.0	0.01	0.00	86	74.72
	Maximum	100	3.4	177.78	99.84	100	149.85
3	Mean	82	2.4	38.00	79.42	98	83.50
	Std. Error	5	0.3	8.74	5.69	1	8.01
	Median	100	2.3	2.19	99.84	100	97.50
	Std. Deviation	30	1.7	50.20	32.69	6	56.66
	Minimum	11	0.1	0.26	0.00	77	1.22
	Maximum	100	7.1	130.61	99.84	100	177.72

** Array 1 Creosote Community
Array 2 Saltbush Community
Array 3 Saltcedar Community

Percent Litter

An overall difference (W = 61.037, p = 0.000) was found in percent litter among the three habitat types (Table 1). Following post hoc analysis, significant differences in percent litter were evident among each habitat type with the Saltcedar community having the greatest percent litter followed by Saltbush and Creosote communities (Table 2).

Average Litter Depth

An overall difference (W = 55.559, p = 0.000) was found in average litter depth among the three habitat types (Table 1). Following post hoc analysis, significant differences in average litter depth were evident among each of the habitat types with the Saltcedar community having the greatest average litter depth followed by Saltbush and Creosote communities (Table 2).

Vegetation Density

An overall difference (W = 41.542, p = 0.000) was found in vegetation density among the three habitat types (Table 1). Following post hoc analysis, significant differences in vegetation density were evident among the three habitat types, except between the Creosote community and the Saltbush community. The Saltcedar community had the greatest vegetation density followed by Saltbush and Creosote communities (Table 2).

Vegetation Canopy

An overall difference (W = 57.399, p = 0.000) was found in vegetation canopy among the three habitat types (Table 1). Following post hoc analysis, significant differences in vegetation density were evident among the three habitat types, except between the Creosote and Saltbush communities. The Saltcedar community had the greatest vegetation density followed by Saltbush and Creosote (Table 2).

Percent Bare Ground

An overall difference (W = 5.627, p = 0.060) was not found in percent bare ground among the three habitat types (Table 1). No post hoc analysis was performed, but the Saltbush community had the greatest percent bare ground followed by Saltcedar and Creosote communities (Table 2).

Distance to Ecotone Boundaries

An overall difference (W = 109.311, p = 0.000) was found in distances to an ecotone boundary among the three habitat types (Table 1). Following post hoc analysis, significant differences in distances to ecotone were evident among each of the three habitat types with the Creosote community having the greatest distances to ecotone followed by Saltbush and Saltcedar communities (Table 2).

Small Mammals and Vegetation

Neotoma lepida

Vegetation characteristics were compared for *N. lepida* between capture and non-capture locations and examined collectively and individually by month. All analyses were completed where capture frequencies were greater than five to assure adequate sample size for the statistical test used. Tests for normality and equality of variance were performed for each month, and the appropriate test statistic and p-value were calculated (Appendix II). Capture frequencies within subdivided groups of the vegetation variables were also analyzed in all habitat types where *N. lepida* was captured (Table 3).

Percent litter was greater in trap locations where *N. lepida* was captured, as opposed to non-captured locations when all months were pooled for the Saltcedar community ($U = 200.50$, $p = 0.036$). However, percent bare ground was greater ($U = 233.00$, $p = 0.032$) in non-capture locations (mean = 99.26, median = 100.00), as opposed to capture locations (mean = 94.79, median = 55.64) when all months were pooled for the Saltcedar community.

When months were examined individually percent litter and percent bare ground were no longer significant (Appendix II). However, for the month of September, average litter depth and distance to ecotone were greater in capture locations (average litter depth $t = 1.83$, $p = 0.037$; distance to ecotone $t = 3.06$, $p = 0.002$).

No relationships could be identified between frequency of captures and any of the vegetation variables identified in the table (Table 3).

Table 3. *Neotoma lepida* capture frequencies* in relationship to vegetation variables in a Saltcedar community.

Vegetation Variable	Null Hypothesis	Alt Hypothesis	Shapiro-Wilk ** Normality	G statistic	DF***	Critical Value	P Value	Decision
Percent Litter	The observed number of captures based on percent litter will not differ from the expected.	The observed number of captures based on percent litter will differ from the expected.	0.000	0.205	2	5.991	$0.90 < p < 0.95$	fail to reject
Average Litter Depth	The observed number of captures based on average litter depth will not differ from the expected.	The observed number of captures based on average litter depth will differ from the expected.	0.000	1.248	2	5.991	$0.10 < p < 0.90$	fail to reject
Vegetation Density	The observed number of captures based on vegetation density will not differ from the expected.	The observed number of captures based on vegetation density will differ from the expected.	0.000	3.758	3	7.815	$0.90 < p < 0.95$	fail to reject
Vegetation Canopy	The observed number of captures based on vegetation canopy will not differ from the expected.	The observed number of captures based on vegetation canopy will differ from the expected.	0.000	3.484	2	5.991	$0.10 < p < 0.90$	fail to reject
Percent Bare Ground	The observed number of captures based on percent bareground will not differ from the expected.	The observed number of captures based on percent bareground will differ from the expected.	0.000	19.562	0	n/a	n/a	n/a
Distance to Ecotone	The observed number of captures based on distance to ecotone will not differ from the expected.	The observed number of captures based on distance to ecotone will differ from the expected.	0.002	4.786	3	7.815	$0.10 < p < 0.90$	fail to reject

* n = 41

* Shapiro-Wilk tests if a random sample comes from a normal distribution. If $p < 0.05$, the distribution is NOT normal

** Expected frequencies calculated based on an even distribution of animals between groups

Dipodomys merriami

Vegetation characteristics were compared for *D. merriami* between capture and non-capture locations and examined collectively and individually by month. All analyses were completed where capture frequencies were greater than five. Tests for normality and equality of variance were performed for each month, and the appropriate test statistic and p-value were calculated (Appendix III). Capture frequencies within subdivided groups of the vegetation variables were also analyzed in all habitat types where *D. merriami* was captured (Table 4).

Percent bare ground was greater in trap locations where *D. merriami* was captured, as opposed to non-captured locations when all months were pooled for the Creosote community ($U = 183.00$, $p = 0.041$). Percent litter, vegetation density, and distance to ecotone were greater (percent litter $U = 233.00$, $p = 0.032$; vegetation density $U = 125.50$, $p = 0.005$; distance to ecotone $t = 2.89$, $p = 0.006$) in capture locations (mean = 13.607, median = 20.000; mean = 0.467, median = 0.267; mean = 311.511, median = 335.293), as opposed to non-capture locations (mean = 3.432, median = 0.000; mean = 0.165, median = 0.121; mean = 279.499, median = 277.291).

When months were examined individually percent bare ground was only significant in November of the Creosote community ($U = 44.00$, $p = 0.007$) and January of the Saltbush community ($U = 59.00$, $p = 0.020$). However, percent litter, average litter depth, vegetation density, vegetation canopy, and distance to ecotone were intermittingly significant throughout the months (Appendix III).

Table 4. *Dipodomys merriami* capture frequencies* in relationship to vegetation variables in Creosote and Saltbush communities.

Vegetation Variable	Null Hypothesis	Alt Hypothesis	Shapiro-Wilk Normality	G statistic	DF**	Critical Value	P Value	Decision
Percent Litter	The observed number of captures based on percent litter will not differ from the expected.	The observed number of captures based on percent litter will differ from the expected.	0.001	0.379	3	7.815	$0.90 < p < 0.95$	fail to reject
Average Litter Depth	The observed number of captures based on average litter depth will not differ from the expected.	The observed number of captures based on average litter depth will differ from the expected.	0.000	6.103	2	5.991	$p < 0.05$	reject null
Vegetation Density	The observed number of captures based on vegetation density will not differ from the expected.	The observed number of captures based on vegetation density will differ from the expected.	0.000	0.415	3	7.815	$0.90 < p < 0.95$	fail to reject
Vegetation Canopy	The observed number of captures based on vegetation canopy will not differ from the expected.	The observed number of captures based on vegetation canopy will differ from the expected.	0.000	19.175	1	3.841	$p < 0.005$	reject null
Percent Bare Ground	The observed number of captures based on percent bareground will not differ from the expected.	The observed number of captures based on percent bareground will differ from the expected.	0.000	14.787	1	3.841	$p < 0.005$	reject null
Distance to Ecotone	The observed number of captures based on distance to ecotone will not differ from the expected.	The observed number of captures based on distance to ecotone will differ from the expected.	0.000	0.247	3	7.815	$0.95 < p < 0.975$	fail to reject

* n = 46

* Shapiro-Wilk tests if a random sample comes from a normal distribution. If $p < 0.05$, the distribution is NOT normal

** Expected frequencies calculated based on an even distribution of animals between groups

Relationships were identified between *D. merriami* captures and average litter depth, vegetation canopy, and percent bare ground. It appears that frequencies were greater between 0.00 and 0.25 centimeters of average litter depth (Fig. 11).

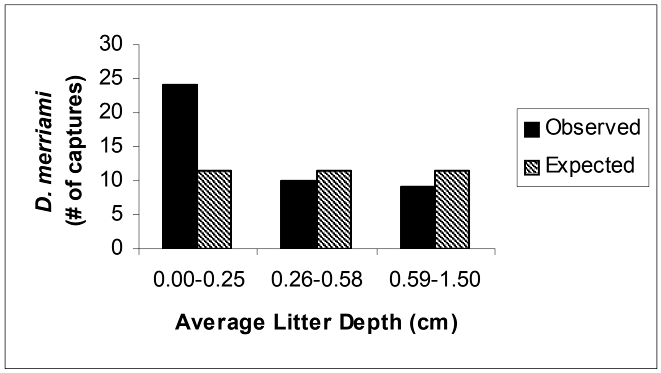


Fig. 11. *D. merriami* frequencies and average litter depth.

Capture frequencies were greater between 0.0 and 7.28 percent vegetation canopy (Fig. 12).

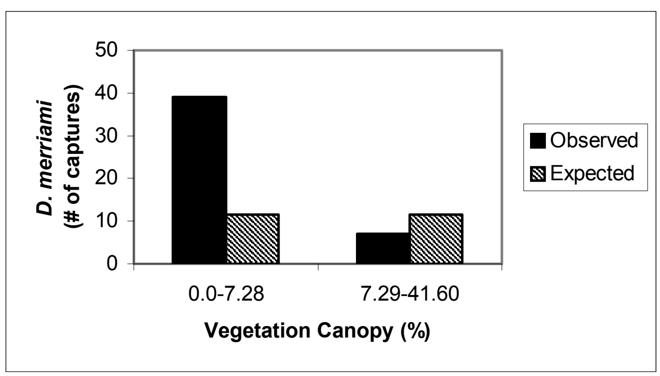


Fig. 12. *D. merriami* frequencies and vegetation canopy.

Frequencies were greater between 99.5% and 100.0% percent bare ground (Fig. 13).

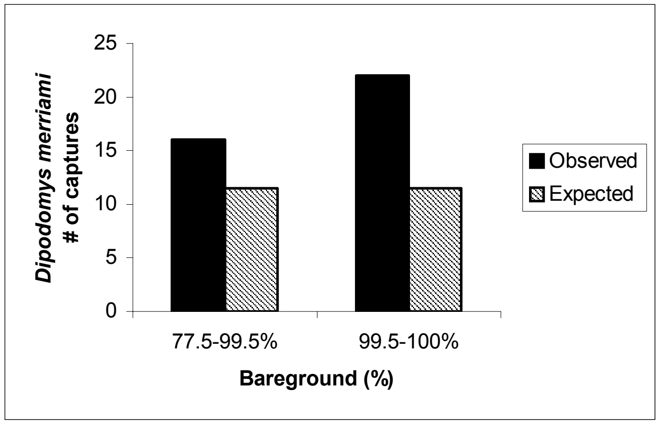


Fig. 13. *D. merriami* frequencies and percent bare ground.

Peromyscus eremicus

Vegetation characteristics were compared for *P. eremicus* between capture and non-capture locations and examined collectively and individually by month. All analyses were completed where capture frequencies were greater than five. Tests for normality and equality of variance were performed for each month, and the appropriate test statistic and p-value were calculated (Appendix IV). Capture frequencies within subdivided groups of the vegetation variables were also analyzed in all habitat types where *P. ermeicus* was captured (Table 5).

When all months were pooled, no vegetation variables were significant in capture versus non-capture locations. Findings were consistent when months were examined individually except in the month of January of the Saltcedar community. In January, vegetation density and vegetation canopy were greater in capture locations, as opposed to non-capture locations (vegetation density $U = 178.50$, $p = .001$; vegetation canopy $t = 0.462$, $p = 2.22$). In addition, percent litter and average litter depth were greater (percent

litter U = 119.00, p = 0.000; average litter depth t = 3.75, p = 0.001) in capture locations (mean = 85.057, median = 100.0; mean = 2.0636, median = 2.40).

Relationships were identified between *P. eremicus* captures and percent litter, average litter depth, and vegetation canopy. Frequencies were greater between 76.26 to 100.00 percent litter (Fig. 14).

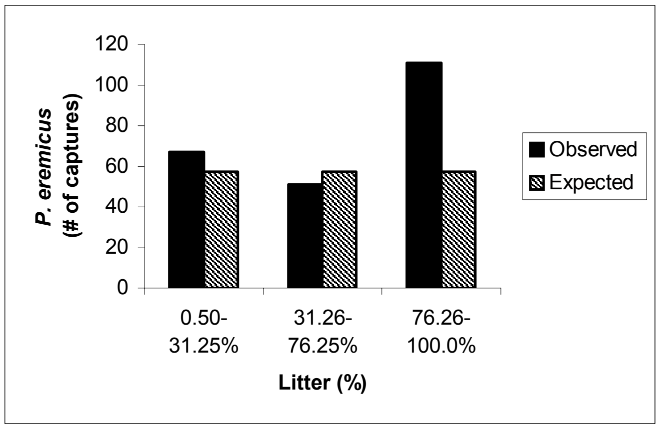


Fig. 14. *P. eremicus* frequencies and percent litter.

Capture frequencies were greater between 0.51 and 1.20 average litter depth (Fig. 15).

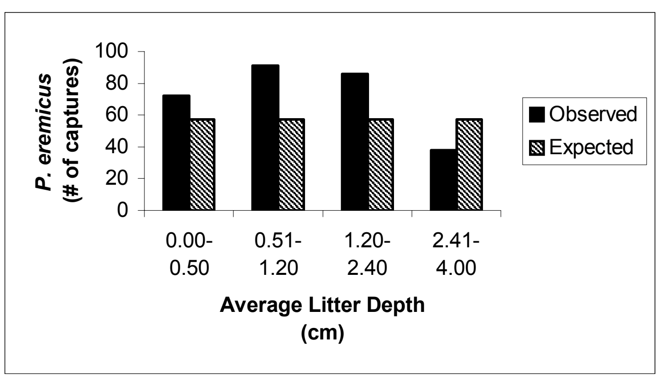


Fig. 15. *P. eremicus* frequencies and average litter depth.

Frequencies were also greater between 83.21 to 99.84 percent vegetation canopy (Fig. 16).

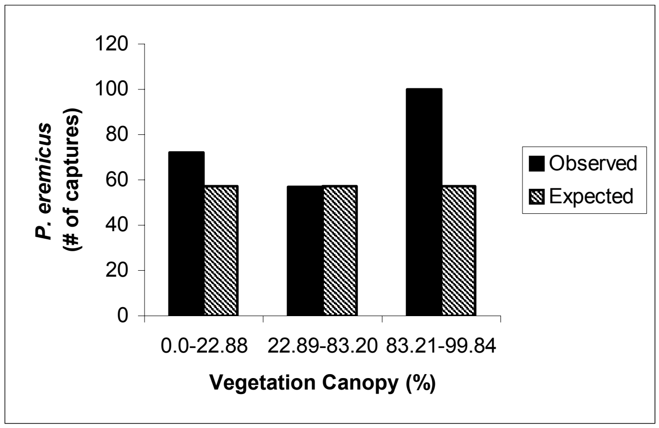


Fig. 16. *P. eremicus* frequencies and vegetation canopy.

Table 5. *Peromyscus eremicus* capture frequencies* in relationship to vegetation variables in Saltbush and Saltcedar communities.

Vegetation Variable	Null Hypothesis	Alt Hypothesis	Shapiro-Wilk Normality	G statistic	DF**	Critical Value	P Value	Decision
Percent Litter	The observed number of captures based on percent litter will not differ from the expected.	The observed number of captures based on percent litter will differ from the expected.	0.000	33.933	2	5.991	$p < 0.005$	reject null
Average Litter Depth	The observed number of captures based on average litter depth will not differ from the expected.	The observed number of captures based on average litter depth will differ from the expected.	0.000	33.918	3	7.815	$p < 0.005$	reject null
Vegetation Density	The observed number of captures based on vegetation density will not differ from the expected.	The observed number of captures based on vegetation density will differ from the expected.	0.000	0.686	3	7.815	$0.05 < p < 0.10$	fail to reject
Vegetation Canopy	The observed number of captures based on vegetation canopy will not differ from the expected.	The observed number of captures based on vegetation canopy will differ from the expected.	0.000	31.282	2	5.991	$p < 0.005$	reject null
Percent Bare Ground	The observed number of captures based on percent bareground will not differ from the expected.	The observed number of captures based on percent bareground will differ from the expected.	0.000	?	0	n/a	n/a	n/a
Distance to Ecotone	The observed number of captures based on distance to ecotone will not differ from the expected.	The observed number of captures based on distance to ecotone will differ from the expected.	0.000	0.000	3	7.815	$0.10< p < 0.90$	fail to reject

* n = 229
* Shapiro-Wilk tests if a random sample comes from a normal distribution. If $p < 0.05$, the distribution is NOT normal
** Expected frequencies calculated based on an even distribution of animals between groups

Chaetodipus penicillatus

Vegetation characteristics were compared for *C. penicillatus* between capture and non-capture locations and examined collectively and individually by month. All analyses were completed where capture frequencies were greater than five. Tests for normality and equality of variance were performed for each month, and the appropriate test statistic and p-value were calculated (Appendix V). Capture frequencies within subdivided groups of the vegetation variables were also analyzed in all habitat types where *C. penicillatus* was captured (Table 6).

Vegetation density was greater in trap locations where *C. penicillatus* was captured, as opposed to non-captured locations when all months were pooled for the Creosote community and the Saltbush community respectively ($U = 119.50$, $p = 0.042$; $U = 352.50$, $p = 0.010$). Percent litter, average litter depth, and vegetation density were greater (percent litter $t = 0.881$, $p = 0.025$; average litter depth $U = 387.50$, $p = 0.029$; vegetation density $U = 352.50$, $p = 0.010$) in capture locations (mean = 16.875, median = 18.75; mean = 0.5000, median = 0.5000; mean = 1.2857, median = 0.8675), as opposed to non-captured locations in the Saltbush community.

When months were examined individually, only months in the Saltbush community were significant in relation to the vegetation variables (Appendix V).

Frequency of captures was greater between 76.56 to 96.88 percent bare ground (Fig. 17).

Table 6. *Chaetodipus penicillatus* capture frequencies* in relationship to vegetation variables in Creosote, Saltbush, and Saltcedar communities.

Vegetation Variable	Null Hypothesis	Alt Hypothesis	Shapiro-Wilk Normality	G statistic	DF**	Critical Value	P Value	Decision
Percent Litter	The observed number of captures based on percent litter will not differ from the expected.	The observed number of captures based on percent litter will differ from the expected.	0.000	2.842	3	7.815	$0.10 < p < 0.90$	fail to reject
Average Litter Depth	The observed number of captures based on average litter depth will not differ from the expected.	The observed number of captures based on average litter depth will differ from the expected.	0.000	3.569	3	7.815	$0.10 < p < 0.90$	fail to reject
Vegetation Density	The observed number of captures based on vegetation density will not differ from the expected.	The observed number of captures based on vegetation density will differ from the expected.	0.000	0.280	3	7.815	$0.95 < p < 0.975$	fail to reject
Vegetation Canopy	The observed number of captures based on vegetation canopy will not differ from the expected.	The observed number of captures based on vegetation canopy will differ from the expected.	0.000	5.786	3	7.815	$0.10 < p < 0.90$	fail to reject
Percent Bare Ground	The observed number of captures based on percent bareground will not differ from the expected.	The observed number of captures based on percent bareground will differ from the expected.	0.000	37.341	1	3.841	$p < 0.005$	reject null
Distance to Ecotone	The observed number of captures based on distance to ecotone will not differ from the expected.	The observed number of captures based on distance to ecotone will differ from the expected.	0.000	0.113	3	7.815	$0.99 < p < 0.995$	fail to reject

* n = 111
* Shapiro-Wilk tests if a random sample comes from a normal distribution. If $p < 0.05$, the distribution is NOT normal
** Expected frequencies calculated based on an even distribution of animals between groups

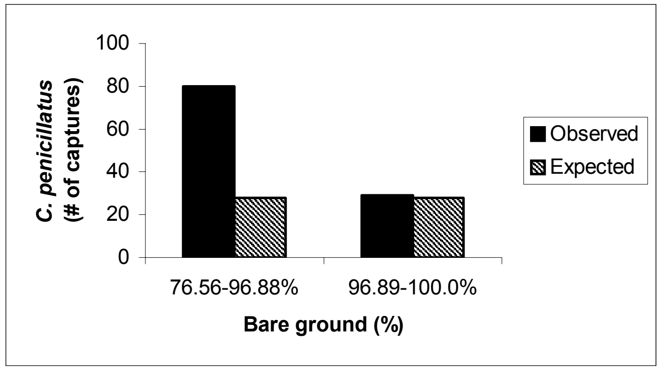


Fig. 17. *C. penicillatus* frequencies and percent bare ground.

CHAPTER 5

DISCUSSION

Habitat Heterogeneity

The three survey arrays differed with respect to percent litter, average litter depth, vegetation density, vegetation canopy, and distance to an ecotone boundary (Table 1). Because the arrays, or community types, were originally selected based on ocular estimates of site heterogeneity, and because statistical analysis upheld these differences, the investigation sites can be treated as individual habitat types both statistically and biologically. Percent bare ground, however, was not statistically different between the three community types. Most of the bare ground estimates were near 100 percent or slightly less, which is typical of sparsely vegetated desert environments; therefore, no variation between sites could be observed.

Species Response to Environmental Variables

Neotoma lepida

The majority of *N. lepida* captures occurred in the Saltcedar community, which was dominated by *T. ramosissima*. There is no known literature documenting the use of *T. ramosissima* by *N. lepida*, although it is known that adequate litter for nesting materials is critical to their survival (Cameron and Rainey, 1972). Throughout the year, a tremendous amount of foliage from *T. ramosissima* falls to the ground and creates an

abundant source of litter. Managing this non-native species along the banks of the Las Vegas Wash has been an important component in revegetation and bank stabilization efforts, which includes possible eradication (Las Vegas Wash Coordination Committee, 2003). This research demonstrates *T. ramosissima* serves as habitat for *N. lepida* and *N. lepida* populations must be considered in tamarisk removal or remediation plans.

Percent litter was more abundant where *N. lepida* was captured when pooling all months in the Saltcedar community. *Neotoma lepida* is extremely resourceful and adaptable to a variety of litter materials (Cameron and Rainey, 1972). Foliage usually makes up the outer covering of their nests (Stones and Hayward, 1968), and *N. lepida* are thought only to use materials on the surface because they are incapable of chewing off parts of vegetation (Bonaccorso and Brown, 1972); therefore, fallen *T. ramosissima* provides foliage and surface accessibility. Litter accessibility and availability appear to be more important in predicting *N. lepida* distributions than litter depth, as average litter depth was not greater in *N. lepida* capture locations. The relationship between percent bare ground and percent litter could also help predict population distribution. As percent bare ground increased, *N. lepida* captures decreased, and as percent litter increased, *N. lepida* captures increased. In short, shelter materials can dictate distribution, density, and home range of *N. lepida* (Bleich and Schwartz, 1975), and can be an important factor in determining species presence and abundance.

Neotoma lepida do have some habitat requirements in addition to litter, including metabolic water from plants (Cameron and Rainey, 1972); leaves, seeds, berries, and flowers from shrubs (Cameron and Rainey, 1972); and moderate to dense canopies (Brylski, 1990). Distances to an ecotone boundary were closer to capture locations in

nearly all tested relationships, which would indicate *N. lepida* travel between community types; however, this species was almost exclusively trapped in the Saltcedar community. The ecotone boundary was delineated from the observed Saltcedar community edge, and due to the narrow size of the community, short distances were inevitable and may incorrectly indicate *N. lepida* travel between ecotones. *Neotoma lepida* generally have small home ranges (Bleich and Schwartz, 1975) and are considered habitat generalists (Meserve, 1974). The Saltcedar community likely provided the additional habitat requirements of *N. lepida*, which may explain why the species was dominantly found in only this community. It should be noted, *L. tridentata*, a predominant food and water source for *N. lepida* (Meyer and Karasov, 1989), was not found in the Saltcedar community. Most likely, the Creosote community did not provide the necessary nesting materials for *N. lepida*.

Dipodomys merriami

Dipodomys merriami was found in both Creosote and Saltbush communities dominated by seed-bearing plants, such as *A. canescens* and *L. tridentata*. Seeds almost exclusively dominate the diet of *D. merriami*, a known granivorous species (Reynolds, 1950) that buries seeds in small, subsurface caches (Chew and Chew, 1970). *Dipodomys merriami*'s close proximity to vegetation, and subsequent seed availability, was the only consistent habitat variable throughout all communities. The remaining vegetation variables measured were not consistently associated with *D. merriami* capture locations in any of the community types. Changes in habitat requirements appeared to correlate with fluctuations in the temporal environment and diversity within the communities may predict *D. merriami* distributions.

Densely vegetated areas decrease the mobility of *D. merriami* and make them more susceptible to predators (Reynolds, 1950); therefore, bare ground may help predict population distributions. Percent bare ground was greater where *D. merriami* was captured when examining all months collectively in the Creosote community; however, percent bare ground was not greater in the Saltbush community. The captures in the Creosote community occurred in the section of the array dominated by *L. tridentata*. The seeds of *L. tridentata* are important in the diets of *D. merriami* (Bradley and Mauer, 1971), which may be attributed to the presence of *D. merriami* in only the Creosote community. These findings indicate that a combination of variables, not one specific variable, determines habitat use.

Dipodomys merriami was associated with increased vegetation density and vegetation canopy during colder trapping months even though increased vegetation density usually indicates a decrease in *D. merriami* activity (Beatley, 1976). *Dipodomys merriami* use several plants as both a food and water source to provide vitamins and nutrients for the most intensive period of reproduction during winter and early spring (Beatley, 1976), which may explain increased vegetation density and canopy during this time. Based on these results, summer populations should occupy habitats with sparse vegetation density and increased bare ground. Performing further vegetation sampling during those months may offer additional insight into habitat use by *D. merriami*.

Neither percent litter nor average litter depth has previously been found to predict presence or absence of *D. merriami*. The majority of litter in the Creosote and Saltbush communities was generated from fallen seeds of *A. canescens*, and seeds almost exclusively dominate diets of *D. merriami* (Reynolds, 1950). This also supports the

previous notion in this study that *D. merriami* select habitats with readily available food in times of scarcity and during peak reproductive activity.

Few differences could be found when evaluating distance to an ecotone boundary in relationship to *D. merriami* populations; however, average distance appears to be greater in non-capture locations. The ecotone boundary did not account for any subtle, less apparent boundaries that existed within a given habitat, as the ecotone used for analysis was manually delineated based on a definitive boundary observable from an aerial photograph. The majority of captures occurred within the diverse Saltbush community, which did contain a subtle ecotone boundary. The boundary created smaller micro-habitats that provided high vegetation density and seed availability before and during the reproductive season, yet also included a high percentage of bare ground, which would allow the species to travel between locations during post reproduction periods. The distribution of *D. merriami* might be predicted by the diversity of a habitat and its subsequent proximity to gradual or definitive ecotone boundaries.

Peromyscus eremicus

There are some documented associations between *P. eremicus* and vegetation variables; however, there is not enough evidence supporting the influence of one particular variable over any other. *Peromyscus eremicus* heavily populated both the Saltbush and Saltcedar communities in this study, which collectively contain a wide variety of vegetation variables and types. *Peromyscus eremicus* aestivate and seasonally enter into torpor under unfavorable conditions. Large winter populations usually indicate short periods of torpor, and small summer populations indicate extended hibernation periods during warmer, dryer months (Lewis, 1972). This behavioral

characteristic may explain the association, or perhaps disassociation, of *P. eremicus* with a variety of vegetation variables.

Peromyscus eremicus have been found in areas with dense vegetation (Bradley and Mauer, 1973) and canopy (Brylski, 1990); however, in this study density and canopy were only greater in the capture locations of the Saltcedar community during the month of January and *P. eremicus*'s tendency to aestivate may explain these findings. In the summer, torpor can occur for up to three months due to decreased water availability and food supply (Veal and Caire, 1979). In winter, torpor is based on circadian patterns and occurs in shorter periods due to lack of food (Veal and Caire, 1979). In the Mojave Desert, January tends to be one of the coldest months (Whitford, 2002) and food is the scarcest; therefore, habitats with increased vegetation density and canopy cover may compensate for the lack of resources. Similarly, percent litter and average litter depth were also only greater in the capture locations of the Saltcedar community during the month of January. The litter from *T. ramosissima* creates shelter, and the sandy soil (Horn, 2003) may combine with litter to provide a suitable habitat for *P. eremicus* during January, as they burrow when conditions are unfavorable. In short, it appears vegetation variables may help predict *P. eremicus* populations during some parts of the year, but *P. eremicus* aestivate whenever conditions are unfavorable. It is difficult to specify their habitat use, as they appear to fluctuate with seasonal trends in temperature, moisture and other resource availability.

Chaetodipus penicillatus

Chaetodipus penicillatus has been associated with dense, bushy vegetation (Rosenzweig and Winukar, 1969) that offers considerable cover (Rosenzweig, 1973).

Rosenzweig and Winukar (1969) suggest rodent density can be estimated based on vegetation density, moisture, and seed availability. *Chaetodipus penicillatus* was the only species captured in all three communities, but no literature could be found documenting their habitat usage in the Mojave Desert under the genus *Chaetodipus* or the synonym, *Perognathus*.

Vegetation density, vegetation canopy, percent litter, and average litter depth were all found to be greater in both the Creosote and Saltbush communities when months were pooled and when some months were examined individually. Shrubs in this area provide seeds and metabolic water through vegetation density and litter generated from fallen *A. canescens* seeds. Other plants may offer similar characteristics, as *C. penicillatus* are opportunistic in relation to their environment (Smigle and Rosenzweig, 1974).

Research Limitations

This study examined the effect of various habitat components on selected small mammal populations. Species presence and frequency data were used for comparisons; therefore, species density and diversity indices were not compared against vegetation variables. Future studies evaluating rodent density and diversity would provide additional habitat characterization analyses helpful in understanding small mammal requirements, as this study only compared presence and frequency of a species.

Small mammal distribution and population size has been attributed to habitat selection (Hoover et al., 1977); however, several studies have suggested rainfall patterns can predict density and diversity of rodent species (Brown, 1973; Whitford, 1976;

Beatley, 1969). This is especially true in this study area because the irregularity and unpredictably of rainfall can have significant effects on the biological composition and interactions in arid locations. This study used information from a previous small mammal survey, which did not record precipitation measurements during the trapping period, nor were estimates obtained during vegetation sampling. It would have been beneficial to evaluate rodent species with abiotic variables, such as precipitations affect on seed production (Whitford, 1976; Brown, 1973), available plant and soil moisture (Beatley, 1969), and plant density (Hafner, 1977).

Finally, the study sites for this research included three biologically different arrays. There was replication within the three arrays, but not among the arrays. Only one of each habitat type was present. Replication of the habitat types would strengthen characterizations associating the affect of different microhabitats on small mammals.

Summary

A variety of vegetation variables including percent litter, average litter depth, vegetation density, vegetation canopy, percent bare ground, and distance to ecotone were measured in the Las Vegas Wash and associated with small mammal populations in order to better characterize habitat use. Previous research has indicated some small mammals have an effect on plant cover and species composition (Heske et al., 1993), as small mammals are transporters of seeds. Relationships between abiotic and biotic factors have been shown to influence small mammal populations (Hafner, 1977).

Percent litter and average litter depth were greater in areas where *N. lepida* were captured. *Neotoma lepida* almost exclusively used leaf litter from *T. ramosissima* for

nest construction, and this is the only known research to indicate *T. ramosissima* use by this species. In areas undergoing Saltcedar remediation in the Las Vegas Wash, or other areas where *N. lepida* is present, some form of litter should probably be available to assist in their survival. *Dipodomys merriami* has a variety of habitat requirements that should all be present to some degree; therefore, abrupt changes to ecotone boundaries might affect *D. merriami* populations. *Dipodomys merriami* use densely vegetated areas to fulfill water and food requirement during resource scarcity, but also inhabit extremely bare areas to escape predators. *Peromyscus eremicus* aestivate when conditions are unfavorable. This occurs for extended periods of time in the summer, and this vegetation characteristic may not be as important during these periods. During shorter torpor periods, in the winter, vegetation density and canopy appear to be the best predictor of distribution and abundance. *Chaetodipus penicillatus* appear to be extremely adaptable and opportunistic. Vegetation density and subsequent seed availability most likely explains their apparent affinity for dense vegetation.

This research complimented and updated previous work and strengthened the limited existing small mammal research in the Las Vegas Wash. Small mammals are an extremely adaptable and diverse fauna. It is important to understand the habitat requirements of these species for future restoration and remediation decisions.

APPENDIX I

SMALL MAMMAL TRAPPING AND VEGETATION SAMPLING LOCATIONS

Creosote Community

Point	northing (m)	easting (m)	elevation (m)
1	8,149,078.23	253,587.04	477.52
01-E	8,149,077.68	253,591.86	477.59
01-W	8,149,078.91	253,582.35	476.15
2	8,149,080.23	253,587.17	477.48
3	8,149,081.50	253,587.27	477.48
4	8,149,082.92	253,587.42	477.54
5	8,149,084.36	253,587.79	477.62
05-E	8,149,083.94	253,592.74	477.49
05-W	8,149,084.82	253,583.04	476.29
6	8,149,086.40	253,587.92	477.63
7	8,149,087.80	253,588.22	477.71
8	8,149,089.58	253,588.47	477.80
9	8,149,091.53	253,588.73	477.83
10	8,149,093.44	253,589.02	477.92
10-E	8,149,095.30	253,593.72	477.94
10-W	8,149,091.96	253,584.28	476.50
11	8,149,099.16	253,583.32	475.61
12	8,149,101.15	253,583.76	475.66
13	8,149,104.55	253,583.64	475.73
14	8,149,107.69	253,582.86	475.85
15	8,149,109.68	253,582.37	475.95
15-E	8,149,111.25	253,586.94	476.18
15-W	8,149,108.40	253,577.94	475.93
16	8,149,111.82	253,581.83	475.99
17	8,149,113.58	253,581.40	475.99
18	8,149,115.49	253,580.76	476.03
19	8,149,117.58	253,580.22	476.09
20	8,149,119.69	253,579.51	476.17
20-E	8,149,121.07	253,584.19	476.30
20-W	8,149,118.27	253,574.73	476.21
21	8,149,122.36	253,578.97	476.30
22	8,149,124.76	253,578.38	476.36
23	8,149,128.03	253,577.61	476.35
24	8,149,132.17	253,576.70	476.52
25	8,149,134.57	253,576.09	476.57
25-E	8,149,135.55	253,580.77	476.63
25-W	8,149,133.50	253,571.01	476.49
26	8,149,137.05	253,575.38	476.56
27	8,149,139.69	253,574.67	476.56

Creosote Community

Point	northing (m)	easting (m)	elevation (m)
28	8,149,142.46	253,573.97	476.63
29	8,149,146.66	253,572.72	476.69
30	8,149,149.39	253,571.80	476.77
30-E	8,149,151.43	253,576.35	476.79
30-W	8,149,147.55	253,567.24	476.87
31	8,149,154.45	253,569.73	477.39
32	8,149,157.22	253,568.39	477.77
33	8,149,161.00	253,567.12	477.78
34	8,149,163.90	253,565.68	477.81
35	8,149,166.56	253,565.01	477.89
35-E	8,149,168.36	253,569.63	477.99
35-W	8,149,165.20	253,560.22	477.88
36	8,149,169.14	253,564.10	478.06
37	8,149,171.48	253,563.35	478.12
38	8,149,175.09	253,562.31	478.13
39	8,149,177.92	253,561.23	478.17
40	8,149,180.18	253,560.34	478.31
40-E	8,149,182.21	253,564.73	478.35
40-W	8,149,178.90	253,555.60	478.23
41	8,149,182.27	253,559.51	478.31
42	8,149,184.72	253,559.11	478.33
43	8,149,187.22	253,558.44	478.37
44	8,149,189.57	253,558.05	478.37
45	8,149,191.86	253,557.41	478.34
45-E	8,149,193.62	253,561.96	478.54
45-W	8,149,189.43	253,552.78	478.36
46	8,149,193.57	253,556.69	478.34
47	8,149,195.32	253,555.84	478.45
48	8,149,196.89	253,554.85	478.52
49	8,149,198.28	253,554.17	478.54
50	8,149,199.56	253,553.57	478.59
50-E	8,149,201.82	253,557.89	478.65
50-W	8,149,197.55	253,548.98	478.52

Saltbush Community

Point	northing (m)	easting (m)	elevation (m)
1	8,148,853.84	253,595.95	472.36
01-N	8,148,858.57	253,596.44	472.45
01-S	8,148,848.86	253,595.37	472.36
2	8,148,853.43	253,598.02	472.21
3	8,148,853.25	253,599.71	472.24
4	8,148,852.65	253,602.90	472.22
5	8,148,852.07	253,605.51	472.23
05-N	8,148,857.09	253,606.45	472.25
05-S	8,148,847.28	253,604.41	472.12
6	8,148,851.72	253,607.85	472.15
7	8,148,851.36	253,610.09	472.13
8	8,148,850.98	253,611.78	472.09
9	8,148,850.25	253,613.97	472.19
10	8,148,849.56	253,615.49	472.21
10-N	8,148,854.56	253,615.60	472.23
10-S	8,148,844.60	253,615.24	472.18
11	8,148,849.18	253,617.98	472.15
12	8,148,848.98	253,620.12	472.08
13	8,148,848.64	253,622.53	472.18
14	8,148,848.23	253,624.80	472.16
15	8,148,847.94	253,626.39	472.21
15-N	8,148,853.08	253,627.24	472.20
15-S	8,148,842.16	253,625.44	471.96
16	8,148,847.62	253,628.48	472.09
17	8,148,847.33	253,630.13	472.07
18	8,148,846.71	253,632.32	472.21
19	8,148,846.50	253,634.83	472.12
20	8,148,845.92	253,636.49	472.12
20-N	8,148,850.89	253,636.79	472.06
20-S	8,148,839.99	253,634.71	472.05
21	8,148,845.79	253,638.32	472.01
22	8,148,845.47	253,640.38	472.10
23	8,148,845.12	253,642.65	472.12
24	8,148,844.49	253,645.15	472.07
25	8,148,844.10	253,647.18	472.05
25-N	8,148,848.93	253,647.27	472.26
25-S	8,148,839.44	253,646.72	471.96
26	8,148,843.60	253,650.74	472.06
27	8,148,843.90	253,654.36	472.14

Saltbush Community

Point	northing (m)	easting (m)	elevation (m)
28	8,148,843.40	253,655.97	472.11
29	8,148,842.22	253,659.28	472.10
30	8,148,841.80	253,662.24	472.08
30-N	8,148,846.63	253,663.23	472.10
30-S	8,148,836.65	253,661.48	472.01
31	8,148,841.65	253,665.48	472.12
32	8,148,841.90	253,667.49	472.04
33	8,148,843.25	253,670.65	472.02
34	8,148,843.32	253,672.90	471.93
35	8,148,844.92	253,675.58	472.02
35-N	8,148,850.03	253,674.45	472.22
35-S	8,148,840.22	253,676.77	471.87
36	8,148,846.17	253,677.59	472.03
37	8,148,845.52	253,680.38	471.92
38	8,148,847.05	253,685.47	471.94
39	8,148,848.18	253,688.32	471.98
40	8,148,848.30	253,690.02	472.05
40-N	8,148,852.94	253,688.33	472.18
40-S	8,148,844.03	253,692.41	471.93
41	8,148,848.66	253,693.02	472.00
42	8,148,849.59	253,695.55	472.08
43	8,148,850.21	253,697.31	472.08
44	8,148,849.87	253,705.03	472.03
45	8,148,850.60	253,709.04	472.01
45-N	8,148,855.93	253,707.82	472.11
45-S	8,148,845.78	253,709.70	471.95
46	8,148,851.63	253,710.89	471.94
47	8,148,852.35	253,716.20	471.92
48	8,148,851.45	253,720.02	471.83
49	8,148,852.85	253,723.52	471.83
50	8,148,852.26	253,725.70	471.94
50-N	8,148,856.62	253,723.31	471.86
50-S	8,148,847.56	253,727.47	471.77

Saltcedar Community

Point	northing (m)	easting (m)	elevation (m)
1	8,148,782.98	253,817.11	470.66
01-N	8,148,787.98	253,817.61	470.66
01-S	8,148,777.98	253,816.61	470.66
2	8,148,783.80	253,814.82	470.62
3	8,148,784.45	253,812.78	470.61
4	8,148,784.57	253,809.63	470.76
5	8,148,785.66	253,807.52	470.65
05-N	8,148,790.66	253,808.02	470.65
05-S	8,148,780.66	253,807.02	470.65
6	8,148,785.65	253,804.85	470.73
7	8,148,785.55	253,801.88	470.97
8	8,148,786.65	253,799.71	471.02
9	8,148,789.02	253,797.15	471.03
10	8,148,790.51	253,795.86	471.00
10-N	8,148,795.51	253,796.36	471.00
10-S	8,148,785.51	253,795.36	471.00
11	8,148,791.80	253,794.26	470.88
12	8,148,792.60	253,792.14	470.99
13	8,148,790.84	253,790.69	470.67
14	8,148,792.02	253,790.23	470.75
15	8,148,792.24	253,789.72	470.71
15-N	8,148,797.24	253,790.22	470.71
15-S	8,148,787.24	253,789.22	470.71
16	8,148,793.99	253,776.78	470.87
17	8,148,793.90	253,776.43	470.90
18	8,148,793.93	253,776.74	470.92
19	8,148,794.97	253,778.73	471.14
20	8,148,794.05	253,776.76	470.90
20-N	8,148,799.05	253,777.26	470.90
20-S	8,148,789.05	253,776.26	470.90
21	8,148,794.92	253,775.08	470.86
22	8,148,795.52	253,771.64	471.23
23	8,148,795.76	253,768.20	471.28
24	8,148,798.12	253,765.20	471.14
25	8,148,803.48	253,764.03	471.29
25-N	8,148,808.48	253,764.53	471.29
25-S	8,148,798.48	253,763.53	471.29
26	8,148,803.78	253,762.42	471.35
27	8,148,803.82	253,757.72	471.19

Saltcedar Community

Point	northing (m)	easting (m)	elevation (m)
28	8,148,804.06	253,755.69	471.00
29	8,148,803.14	253,752.86	471.34
30	8,148,803.81	253,749.33	471.03
30-N	8,148,808.81	253,749.83	471.03
30-S	8,148,798.81	253,748.83	471.03
31	8,148,803.57	253,744.50	471.13
32	8,148,803.13	253,740.74	470.93
33	8,148,803.43	253,732.82	471.17
34	8,148,805.16	253,728.22	471.43
35	8,148,804.85	253,723.69	471.33
35-N	8,148,809.85	253,724.19	471.33
35-S	8,148,799.85	253,723.19	471.33
36	8,148,804.68	253,719.59	471.19
37	8,148,806.53	253,707.88	471.32
38	8,148,807.92	253,705.50	471.29
39	8,148,807.91	253,702.55	471.27
40	8,148,807.41	253,700.29	471.35
40-N	8,148,812.41	253,700.79	471.35
40-S	8,148,802.41	253,699.79	471.35
41	8,148,805.12	253,696.14	471.32
42	8,148,802.68	253,692.97	471.20
43	8,148,798.43	253,691.04	471.05
44	8,148,801.14	253,688.48	471.16
45	8,148,798.27	253,685.22	471.03
45-N	8,148,803.27	253,685.72	471.03
45-S	8,148,793.27	253,684.72	471.03
46	8,148,803.74	253,681.39	471.27
47	8,148,797.75	253,676.81	471.15
48	8,148,798.92	253,675.53	471.22
49	8,148,799.20	253,670.34	471.41
50	8,148,797.65	253,662.19	471.38
50-N	8,148,802.65	253,662.69	471.38
50-S	8,148,792.65	253,661.69	471.38

APPENDIX II

NEOTOMA LEPIDA CAPTURES IN RELATIONSHIP TO VEGETATION VARIABLES IN A SALTCEDAR COMMUNITY

Neotoma lepida captures in relationship to vegetation variables in a Saltcedar community.

Vegetation Variable	Array*	Month**	n (Total)	n (Captured)	n (Not-Captured)	Null Hypothesis	Alt Hypothesis	Shapiro-Wilk ***	Test	Levene's Equality of Variance	Test Statistic (U or t)	1 or 2 Tailed Test	p-value	Decision
Percent Litter	3	All	50	18	32	Percent litter will not be greater in capture versus non-capture locations.	Percent litter will be greater in capture versus non-capture locations.	0.050	Mann Whitney	n/a	200.50	1	0.036	reject null
Average Litter Depth	3	All	50	18	32	Average litter depth will not be greater in capture versus non-capture locations.	Average litter depth will be greater in capture versus non-capture locations.	0.102	Ind. T-test	0.177	1.06	1	0.147	fail to reject
Vegetation Density	3	All	50	18	32	Vegetation density will be the same in capture versus non-capture locations.	Vegetation density will not be the same in capture versus non-capture locations.	0.000	Mann Whitney	n/a	283.00	2	0.919	fail to reject
Vegetation Canopy	3	All	50	18	32	Vegetation canopy will not be greater in capture versus non-capture locations.	Vegetation canopy will be greater in capture versus non-capture locations.	0.127	Ind. T-test	0.984	-0.19	1	0.427	fail to reject

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.
** Missing months not analyzed owing to small sample size ($n < 5$)
*** If $p < 0.05$, the distribution is NOT normal.

Neotoma lepida captures in relationship to vegetation variables in a Saltcedar community.

Vegetation Variable	Array*	Month**	Total n	Captured n	Not-Captured n	Null Hypothesis	Alt Hypothesis	Shapiro-Wilk ***	Test	Levene's Equality of Variance	U or t Test Statistic	1 or 2 Tailed Test	p-value	Decision
Percent Bare Ground	3	All	50	18	32	Percent bare ground will be the same in capture versus non-capture locations.	Percent bare ground will not be the same in capture versus non-capture locations.	0.000	Mann Whitney	n/a	233.00	2	0.032	reject null
Distance to Ecotone	3	All	50	18	32	Distance to ecotone boundaries will not be greater in capture versus non-capture locations.	Distance to ecotone boundaries will be greater in capture versus non-capture locations.	0.258	Ind. T-test	0.063	2.50	1	0.080	fail to reject
Percent Litter	3	Sept	50	11	39	Percent litter will not be greater in capture versus non-capture locations.	Percent litter will be greater in capture versus non-capture locations.	0.050	Mann Whitney	n/a	148.00	1	0.056	fail to reject
Average Litter Depth	3	Sept	50	11	39	Average litter depth will not be greater in capture versus non-capture locations.	Average litter depth will be greater in capture versus non-capture locations.	0.102	Ind. T-test	0.177	1.83	1	0.037	reject null

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.
** Missing months not analyzed owing to small sample size ($n < 5$)
*** If $p < 0.05$, the distribution is NOT normal.

Neotoma lepida captures in relationship to vegetation variables in a Saltcedar community.

Vegetation Variable	Array*	Month**	Total n	Captured n	Not-Captured n	Null Hypothesis	Alt Hypothesis	Shapiro-Wilk ***	Test	Levene's Equality of Variance	U or t Test Statistic	1 or 2 Tailed Test	p-value	Decision
Vegetation Density	3	Sept	50	11	39	Vegetation density will be the same in capture versus non-capture locations.	Vegetation density will not be the same in capture versus non-capture locations.	0.000	Mann Whitney	n/a	208.00	2	0.876	fail to reject
Vegetation Canopy	3	Sept	50	11	39	Vegetation canopy will not be greater in capture versus non-capture locations.	Vegetation canopy will be greater in capture versus non-capture locations.	0.127	Ind. T-test	0.984	0.20	1	0.420	fail to reject
Percent Bare Ground	3	Sept	50	11	39	Percent bare ground will be the same in capture versus non-capture locations.	Percent bare ground will not be the same in capture versus non-capture locations.	0.000	Mann Whitney	n/a	212.00	2	0.910	fail to reject
Distance to Ecotone	3	Sept	50	11	39	Distance to ecotone will not be greater in capture versus non-capture locations.	Distance to ecotone will be greater in capture versus non-capture locations.	0.258	Ind. T-test	0.063	3.06	1	0.002	reject null

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.

** Missing months not analyzed owing to small sample size ($n < 5$)

*** If $p < 0.05$, the distribution is NOT normal.

Neotoma lepida captures in relationship to vegetation variables in a Saltcedar community.

			Total	Captured	Not-Captured						U or t			
Vegetation Variable	**Array***	**Month****	**n**	**n**	**n**	**Null Hypothesis**	**Alt Hypothesis**	**Shapiro-Wilk *****	**Test**	**Levene's Equality of Variance**	**Test Statistic**	**1 or 2 Tailed Test**	**p-value**	**Decision**
Percent Litter	3	Oct	56	5	51	Percent litter will not be greater in capture versus non-capture locations.	Percent litter will be greater in capture versus non-capture locations.	0.050	Mann Whitney	n/a	84.50	1	0.112	fail to reject
Average Litter Depth	3	Oct	56	5	51	Average litter depth will not be greater in capture versus non-capture locations.	Average litter depth will be greater in capture versus non-capture locations.	0.102	Ind. T-test	0.177	0.09	1	0.465	fail to reject
Vegetation Density	3	Oct	56	5	51	Vegetation density will be the same in capture versus non-capture locations.	Vegetation density will not be the same in capture versus non-capture locations.	0.000	Mann Whitney	n/a	75.50	2	0.139	fail to reject
Vegetation Canopy	3	Oct	56	5	51	Vegetation canopy will not be greater in capture versus non-capture locations.	Vegetation canopy will be greater in capture versus non-capture locations.	0.127	Ind. T-test	0.984	0.29	1	0.386	fail to reject

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.
** Missing months not analyzed owing to small sample size ($n < 5$)
*** If $p < 0.05$, the distribution is NOT normal.

Neotoma lepida captures in relationship to vegetation variables in a Saltcedar community.

Vegetation Variable	Array*	Month**	Total n	Captured n	Not-Captured n	Null Hypothesis	Alt Hypothesis	Shapiro-Wilk ***	Test	Levene's Equality of Variance	U or t Test Statistic	1 or 2 Tailed Test	p-value	Decision
Percent Bare Ground	3	Oct	56	5	51	Percent bare ground will be the same in capture versus non-capture locations.	Percent bare ground will not be the same in capture versus non-capture locations.	0.000	Mann Whitney	n/a	86.50	2	0.247	fail to reject
Distance to Ecotone	3	Oct	56	5	51	Distance to ecotone will not be greater in capture versus non-capture locations.	Distance to ecotone will be greater in capture versus non-capture locations.	0.258	Ind. T-test	0.063	0.04	1	0.485	fail to reject
Percent Litter	3	Dec	52	5	47	Percent litter will not be greater in capture versus non-capture locations.	Percent litter will be greater in capture versus non-capture locations.	0.050	Mann Whitney	n/a	82.00	1	0.144	fail to reject
Average Litter Depth	3	Dec	52	5	47	Average litter depth will not be greater in capture versus non-capture locations.	Average litter depth will be greater in capture versus non-capture locations.	0.102	Ind. T-test	0.177	1.09	1	0.142	fail to reject

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.
** Missing months not analyzed owing to small sample size ($n < 5$)
*** If $p < 0.05$, the distribution is NOT normal.

Neotoma lepida captures in relationship to vegetation variables in a Saltcedar community.

			Total	Captured	Not-Captured						U or t			
Vegetation Variable	Array*	Month**	n	n	n	Null Hypothesis	Alt Hypothesis	Shapiro-Wilk ***	Test	Levene's Equality of Variance	Test Statistic	1 or 2 Tailed Test	p-value	Decision
Vegetation Density	3	Dec	52	5	47	Vegetation density will be the same in capture versus non-capture locations.	Vegetation density will not be the same in capture versus non-capture locations.	0.000	Mann Whitney	n/a	116.00	2	0.976	fail to reject
Vegetation Canopy	3	Dec	52	5	47	Vegetation canopy will not be greater in capture versus non-capture locations.	Vegetation canopy will be greater in capture versus non-capture locations.	0.127	Ind. T-test	0.984	0.31	1	0.761	fail to reject
Percent Bare Ground	3	Dec	52	5	47	Percent bare ground will be the same in capture versus non-capture locations.	Percent bare ground will not be the same in capture versus non-capture locations.	0.000	Mann Whitney	n/a	104.00	2	0.695	fail to reject
Distance to Ecotone	3	Dec	52	5	47	Distance to ecotone will not be greater in capture versus non-capture locations.	Distance to ecotone will be greater in capture versus non-capture locations.	0.258	Ind. T-test	0.063	0.85	1	0.199	fail to reject

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.
** Missing months not analyzed owing to small sample size ($n < 5$)
*** If $p < 0.05$, the distribution is NOT normal.

APPENDIX III

DIPODOMYS MERRIAMI CAPTURES IN RELATIONSHIP TO VEGETATION VARIABLES IN CREOSOTE AND SALTBUSH COMMUNITIES

Dipodomys merriami captures in relationship to vegetation variables in a Creosote and Saltbush communities.

Vegetation Variable	Array*	Month**	Total n	Captured n	Not-Captured n	Null Hypothesis	Alt Hypothesis	Shapiro-Wilk ***	Test	Levene's Equality of Variance	U or t Test Statistic	1 or 2 Tailed Test	p-value	Decision
Percent Litter	1	All	51	14	37	Percent litter will be the same in capture versus non-capture locations.	Percent litter will not be the same in capture versus non-capture locations.	0.001	Mann Whitney	n/a	119.00	2	0.001	reject null
Average Litter Depth	1	All	51	14	37	Average litter depth density will be the same in capture versus non-capture locations.	Average litter depth will not be the same in capture versus non-capture locations.	0.000	Mann Whitney	n/a	255.00	2	0.912	fail to reject
Vegetation Density	1	All	51	14	37	Vegetation density will be the same in capture versus non-capture locations.	Vegetation density will not be the same in capture versus non-capture locations.	0.000	Mann Whitney	n/a	125.50	2	0.005	reject null
Vegetation Canopy	1	All	51	14	37	Vegetation canopy will be the same in capture versus non-capture locations.	Vegetation canopy will not be the same in capture versus non-capture locations.	0.000	Mann Whitney	n/a	249.50	2	0.697	fail to reject

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.
** Missing months not analyzed owing to small sample size ($n < 5$)
*** If $p < 0.05$, the distribution is NOT normal.

Dipodomys merriami captures in relationship to vegetation variables in a Creosote and Saltbush communities.

Vegetation Variable	Array*	Month**	Total n	Captured n	Not-Captured n	Null Hypothesis	Alt Hypothesis	Shapiro-Wilk ***	Test	Levene's Equality of Variance	U or t Test Statistic	1 or 2 Tailed Test	p-value	Decision
Percent Bare Ground	1	All	51	14	37	Percent bare ground will not be greater in capture versus non-capture locations.	Percent bare ground will be greater in capture versus non-capture locations.	0.000	Mann Whitney	n/a	183.00	1	0.041	reject null
Distance to Ecotone	1	All	51	14	37	Distance to ecotone boundaries will be the same in capture versus non-capture locations.	Distance to ecotone boundaries will not be the same in capture versus non-capture locations.	0.507	Ind. T-test	0.128	2.89	2	0.006	reject null
Percent Litter	1	Oct	50	7	43	Percent litter will be the same in capture versus non-capture locations.	Percent litter will not be the same in capture versus non-capture locations.	0.001	Mann Whitney	n/a	147.00	2	0.915	fail to reject

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.
** Missing months not analyzed owing to small sample size ($n < 5$)
*** If $p < 0.05$, the distribution is NOT normal.

Dipodomys merriami captures in relationship to vegetation variables in a Creosote and Saltbush communities.

Vegetation Variable	Array*	Month**	Total n	Captured n	Not-Captured n	Null Hypothesis	Alt Hypothesis	Shapiro-Wilk ***	Test	Levene's Equality of Variance	U or t Test Statistic	1 or 2 Tailed Test	p-value	Decision
Average Litter Depth	1	Oct	50	7	43	Average litter depth density will be the same in capture versus non-capture locations.	Average litter depth will not be the same in capture versus non-capture locations.	0.000	Mann Whitney	n/a	147.00	2	0.899	fail to reject
Vegetation Density	1	Oct	50	7	43	Vegetation density will be the same in capture versus non-capture locations.	Vegetation density will not be the same in capture versus non-capture locations.	0.000	Mann Whitney	n/a	114.50	2	0.322	fail to reject
Vegetation Canopy	1	Oct	50	7	43	Vegetation canopy will be the same in capture versus non-capture locations.	Vegetation canopy will not be the same in capture versus non-capture locations.	0.000	Mann Whitney	n/a	133.00	2	0.346	fail to reject

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.
** Missing months not analyzed owing to small sample size ($n < 5$)
*** If $p < 0.05$, the distribution is NOT normal.

Dipodomys merriami captures in relationship to vegetation variables in a Creosote and Saltbush communities.

Vegetation Variable	Array*	Month**	Total n	Captured n	Not-Captured n	Null Hypothesis	Alt Hypothesis	Shapiro-Wilk ***	Test	Levene's Equality of Variance	U or t Test Statistic	1 or 2 Tailed Test	p-value	Decision
Percent Bare Ground	1	Oct	50	7	43	Percent bare ground will not be greater in capture versus non-capture locations.	Percent bare ground will be greater in capture versus non-capture locations.	0.000	Mann Whitney	n/a	124.00	1	0.209	fail to reject
Distance to Ecotone	1	Oct	50	7	43	Distance to ecotone boundaries will be the same in capture versus non-capture locations.	Distance to ecotone boundaries will not be the same in capture versus non-capture locations.	0.507	Ind. T-test	0.128	0.15	2	0.885	fail to reject
Percent Litter	1	Nov	52	5	47	Percent litter will be the same in capture versus non-capture locations.	Percent litter will not be the same in capture versus non-capture locations.	0.001	Mann Whitney	n/a	20.00	2	0.001	reject null

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.
** Missing months not analyzed owing to small sample size ($n < 5$)
*** If $p < 0.05$, the distribution is NOT normal.

Dipodomys merriami captures in relationship to vegetation variables in a Creosote and Saltbush communities.

Vegetation Variable	Array*	Month**	Total n	Captured n	Not-Captured n	Null Hypothesis	Alt Hypothesis	Shapiro-Wilk ***	Test	Levene's Equality of Variance	U or t Test Statistic	1 or 2 Tailed Test	p-value	Decision
Average Litter Depth	1	Nov	52	5	47	Average litter depth density will be the same in capture versus non-capture locations.	Average litter depth will not be the same in capture versus non-capture locations.	0.000	Mann Whitney	n/a	110.00	2	0.759	fail to reject
Vegetation Density	1	Nov	52	5	47	Vegetation density will be the same in capture versus non-capture locations.	Vegetation density will not be the same in capture versus non-capture locations.	0.000	Mann Whitney	n/a	5.00	2	0.000	reject null
Vegetation Canopy	1	Nov	52	5	47	Vegetation canopy will be the same in capture versus non-capture locations.	Vegetation canopy will not be the same in capture versus non-capture locations.	0.000	Mann Whitney	n/a	104.00	2	0.412	fail to reject

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.
** Missing months not analyzed owing to small sample size ($n < 5$)
*** If $p < 0.05$, the distribution is NOT normal.

Dipodomys merriami captures in relationship to vegetation variables in a Creosote and Saltbush communities.

Vegetation Variable	Array*	Month**	Total n	Captured n	Not-Captured n	Null Hypothesis	Alt Hypothesis	Shapiro-Wilk ***	Test	Levene's Equality of Variance	U or t Test Statistic	1 or 2 Tailed Test	p-value	Decision
Percent Bare Ground	1	Nov	52	5	47	Percent bare ground will not be greater in capture versus non-capture locations.	Percent bare ground will be greater in capture versus non-capture locations.	0.000	Mann Whitney	n/a	44.00	1	0.007	reject null
Distance to Ecotone	1	Nov	52	5	47	Distance to ecotone boundaries will be the same in capture versus non-capture locations.	Distance to ecotone boundaries will not be the same in capture versus non-capture locations.	0.507	Ind. T-test	0.128	2.39	2	0.021	reject null
Percent Litter	2	All	71	19	52	Percent litter will be the same in capture versus non-capture locations.	Percent litter will not be the same in capture versus non-capture locations.	0.075	Ind. T-test	0.589	1.53	2	0.132	fail to reject

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.
** Missing months not analyzed owing to small sample size ($n < 5$)
*** If $p < 0.05$, the distribution is NOT normal.

Dipodomys merriami captures in relationship to vegetation variables in a Creosote and Saltbush communities.

			Total	Captured	Not-Captured						U or t			
Vegetation Variable	**Array***	**Month****	**n**	**n**	**n**	**Null Hypothesis**	**Alt Hypothesis**	**Shapiro-Wilk *****	**Test**	**Levene's Equality of Variance**	**Test Statistic**	**1 or 2 Tailed Test**	**p-value**	**Decision**
Average Litter Depth	2	All	71	19	52	Average litter depth density will be the same in capture versus non-capture locations.	Average litter depth will not be the same in capture versus non-capture locations.	0.021	Mann Whitney	n/a	383.50	2	0.144	fail to reject
Vegetation Density	2	All	71	19	52	Vegetation density will be the same in capture versus non-capture locations.	Vegetation density will not be the same in capture versus non-capture locations.	0.002	Mann Whitney	n/a	413.50	2	0.293	fail to reject
Vegetation Canopy	2	All	71	19	52	Vegetation canopy will be the same in capture versus non-capture locations.	Vegetation canopy will not be the same in capture versus non-capture locations.	0.000	Mann Whitney	n/a	379.50	2	0.124	fail to reject

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.
** Missing months not analyzed owing to small sample size ($n < 5$)
*** If $p < 0.05$, the distribution is NOT normal.

Dipodomys merriami captures in relationship to vegetation variables in a Creosote and Saltbush communities.

Vegetation Variable	Array*	Month**	Total n	Captured n	Not-Captured n	Null Hypothesis	Alt Hypothesis	Shapiro-Wilk ***	Test	Levene's Equality of Variance	U or t Test Statistic	1 or 2 Tailed Test	p-value	Decision
Percent Bare Ground	2	All	71	19	52	Percent bare ground will not be greater in capture versus non-capture locations.	Percent bare ground will be greater in capture versus non-capture locations.	0.000	Mann Whitney	n/a	475.00	1	0.387	fail to reject
Distance to Ecotone	2	All	71	19	52	Distance to ecotone boundaries will be the same in capture versus non-capture locations.	Distance to ecotone boundaries will not be the same in capture versus non-capture locations.	0.003	Mann Whitney	n/a	458.00	2	0.640	fail to reject
Percent Litter	2	Sept	60	11	49	Percent litter will be the same in capture versus non-capture locations.	Percent litter will not be the same in capture versus non-capture locations.	0.075	Ind. T-test	0.764	184.00	2	0.100	fail to reject

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.
** Missing months not analyzed owing to small sample size ($n < 5$)
*** If $p < 0.05$, the distribution is NOT normal.

Dipodomys merriami captures in relationship to vegetation variables in a Creosote and Saltbush communities.

			Total	Captured	Not-Captured						U or t			
Vegetation Variable	**Array***	**Month****	**n**	**n**	**n**	**Null Hypothesis**	**Alt Hypothesis**	**Shapiro-Wilk *****	**Test**	**Levene's Equality of Variance**	**Test Statistic**	**1 or 2 Tailed Test**	**p-value**	**Decision**
Average Litter Depth	2	Sept	60	11	49	Average litter depth density will be the same in capture versus non-capture locations.	Average litter depth will not be the same in capture versus non-capture locations.	0.021	Mann Whitney	n/a	180.00	2	0.082	fail to reject
Vegetation Density	2	Sept	60	11	49	Vegetation density will be the same in capture versus non-capture locations.	Vegetation density will not be the same in capture versus non-capture locations.	0.002	Mann Whitney	n/a	239.50	2	0.564	fail to reject
Vegetation Canopy	2	Sept	60	11	49	Vegetation canopy will be the same in capture versus non-capture locations.	Vegetation canopy will not be the same in capture versus non-capture locations.	0.000	Mann Whitney	n/a	172.50	2	0.053	fail to reject

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.
** Missing months not analyzed owing to small sample size ($n < 5$)
*** If $p < 0.05$, the distribution is NOT normal.

Dipodomys merriami captures in relationship to vegetation variables in a Creosote and Saltbush communities.

Vegetation Variable	Array*	Month**	Total n	Captured n	Not-Captured n	Null Hypothesis	Alt Hypothesis	Shapiro-Wilk ***	Test	Levene's Equality of Variance	U or t Test Statistic	1 or 2 Tailed Test	p-value	Decision
Percent Bare Ground	2	Sept	60	11	49	Percent bare ground will not be greater in capture versus non-capture locations.	Percent bare ground will be greater in capture versus non-capture locations.	0.000	Mann Whitney	n/a	231.50	1	0.193	fail to reject
Distance to Ecotone	2	Sept	60	11	49	Distance to ecotone boundaries will be the same in capture versus non-capture locations.	Distance to ecotone boundaries will not be the same in capture versus non-capture locations.	0.003	Mann Whitney	n/a	242.50	2	0.385	fail to reject
Percent Litter	2	Nov	50	5	45	Percent litter will be the same in capture versus non-capture locations.	Percent litter will not be the same in capture versus non-capture locations.	0.075	Ind. T-test	0.115	1.59	2	0.118	fail to reject

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.
** Missing months not analyzed owing to small sample size ($n < 5$)
*** If $p < 0.05$, the distribution is NOT normal.

Dipodomys merriami captures in relationship to vegetation variables in a Creosote and Saltbush communities.

			Total	Captured	Not-Captured						U or t			
Vegetation Variable	Array*	Month**	n	n	n	Null Hypothesis	Alt Hypothesis	Shapiro-Wilk ***	Test	Levene's Equality of Variance	Test Statistic	1 or 2 Tailed Test	p-value	Decision
Average Litter Depth	2	Nov	50	5	45	Average litter depth density will be the same in capture versus non-capture locations.	Average litter depth will not be the same in capture versus non-capture locations.	0.021	Mann Whitney	n/a	78.50	2	0.259	fail to reject
Vegetation Density	2	Nov	50	5	45	Vegetation density will be the same in capture versus non-capture locations.	Vegetation density will not be the same in capture versus non-capture locations.	0.002	Mann Whitney	n/a	80.50	2	0.299	fail to reject
Vegetation Canopy	2	Nov	50	5	45	Vegetation canopy will be the same in capture versus non-capture locations.	Vegetation canopy will not be the same in capture versus non-capture locations.	0.000	Mann Whitney	n/a	56.00	2	0.050	reject null

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.
** Missing months not analyzed owing to small sample size ($n < 5$)
*** If $p < 0.05$, the distribution is NOT normal.

Dipodomys merriami captures in relationship to vegetation variables in a Creosote and Saltbush communities.

Vegetation Variable	Array*	Month**	Total n	Captured n	Not-Captured n	Null Hypothesis	Alt Hypothesis	Shapiro-Wilk ***	Test	Levene's Equality of Variance	U or t Test Statistic	1 or 2 Tailed Test	p-value	Decision
Percent Bare Ground	2	Nov	50	5	45	Percent bare ground will not be greater in capture versus non-capture locations.	Percent bare ground will be greater in capture versus non-capture locations.	0.000	Mann Whitney	n/a	87.00	1	0.164	fail to reject
Distance to Ecotone	2	Nov	50	5	45	Distance to ecotone boundaries will be the same in capture versus non-capture locations.	Distance to ecotone boundaries will not be the same in capture versus non-capture locations.	0.003	Mann Whitney	n/a	78.00	2	0.265	fail to reject
Percent Litter	2	Jan	50	5	45	Percent litter will be the same in capture versus non-capture locations.	Percent litter will not be the same in capture versus non-capture locations.	0.075	Ind. T-test	0.115	2.33	2	0.024	reject null

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.
** Missing months not analyzed owing to small sample size ($n < 5$)
*** If $p < 0.05$, the distribution is NOT normal.

Dipodomys merriami captures in relationship to vegetation variables in a Creosote and Saltbush communities.

			Total	Captured	Not-Captured						U or t			
Vegetation Variable	**Array***	**Month****	**n**	**n**	**n**	**Null Hypothesis**	**Alt Hypothesis**	**Shapiro-Wilk *****	**Test**	**Levene's Equality of Variance**	**Test Statistic**	**1 or 2 Tailed Test**	**p-value**	**Decision**
Average Litter Depth	2	Jan	50	5	45	Average litter depth density will be the same in capture versus non-capture locations.	Average litter depth will not be the same in capture versus non-capture locations.	0.021	Mann Whitney	n/a	38.00	2	0.012	reject null
Vegetation Density	2	Jan	50	5	45	Vegetation density will be the same in capture versus non-capture locations.	Vegetation density will not be the same in capture versus non-capture locations.	0.002	Mann Whitney	n/a	20.00	2	0.003	reject null
Vegetation Canopy	2	Jan	50	5	45	Vegetation canopy will be the same in capture versus non-capture locations.	Vegetation canopy will not be the same in capture versus non-capture locations.	0.000	Mann Whitney	n/a	66.50	2	0.110	fail to reject

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.
** Missing months not analyzed owing to small sample size ($n < 5$)
*** If $p < 0.05$, the distribution is NOT normal.

Dipodomys merriami captures in relationship to vegetation variables in a Creosote and Saltbush communities.

Vegetation Variable	Array*	Month**	Total n	Captured n	Not-Captured n	Null Hypothesis	Alt Hypothesis	Shapiro-Wilk ***	Test	Levene's Equality of Variance	U or t Test Statistic	1 or 2 Tailed Test	p-value	Decision
Percent Bare Ground	2	Jan	50	5	45	Percent bare ground will not be greater in capture versus non-capture locations.	Percent bare ground will be greater in capture versus non-capture locations.	0.000	Mann Whitney	n/a	59.00	1	0.020	reject null
Distance to Ecotone	2	Jan	50	5	45	Distance to ecotone boundaries will be the same in capture versus non-capture locations.	Distance to ecotone boundaries will not be the same in capture versus non-capture locations.	0.003	Mann Whitney	n/a	83.00	2	0.340	fail to reject

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.
** Missing months not analyzed owing to small sample size ($n < 5$)
*** If $p < 0.05$, the distribution is NOT normal.

APPENDIX IV

PEROMYSCUS EREMICUS CAPTURES IN RELATIONSHIP TO VEGETATION VARIABLES IN SALTBUSH AND SALTCEDAR COMMUNITIES

Peromyscus eremicus captures in relationship to vegetation variables in a Saltbush and Saltcedar communities.

Vegetation Variable	Array*	Month**	Total n	Captured n	Not-Captured n	Null Hypothesis	Alt Hypothesis	Shapiro-Wilk ***	Test	Levene's Equality of Variance	U or t Test Statistic	1 or 2 Tailed Test	p-value	Decision
Percent Litter	2	All	71	7	64	Percent litter will be the same in capture versus non-capture locations.	Percent litter will not be the same in capture versus non-capture locations.	0.075	Ind. T-test	0.892	0.42	2	0.675	fail to reject
Average Litter Depth	2	All	71	7	64	Average litter depth will be the same in capture versus non-capture locations.	Average litter depth will not be the same in capture versus non-capture locations.	0.021	Mann Whitney	n/a	197.00	2	0.596	fail to reject
Vegetation Density	2	All	71	7	64	Vegetation density will not be greater in capture versus non-capture locations.	Vegetation density will be greater in capture versus non-capture locations.	0.002	Mann Whitney	n/a	221.00	1	0.477	fail to reject
Vegetation Canopy	2	All	71	7	64	Vegetation canopy will not be greater in capture versus non-capture locations.	Vegetation canopy will be greater in capture versus non-capture locations.	0.000	Mann Whitney	n/a	217.00	1	0.445	fail to reject

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.
** Missing months not analyzed owing to small sample size ($n < 5$)
*** If $p < 0.05$, the distribution is NOT normal.

Peromyscus eremicus captures in relationship to vegetation variables in a Saltbush and Saltcedar communities.

Vegetation Variable	Array*	Month**	n (Total)	n (Captured)	n (Not-Captured)	Null Hypothesis	Alt Hypothesis	Shapiro-Wilk ***	Test	Levene's Equality of Variance	Test Statistic (U or t)	1 or 2 Tailed Test	p-value	Decision
Percent Bare Ground	2	All	71	7	64	Percent bare ground will be the same in capture versus non-capture locations.	Percent bare ground will not be the same in capture versus non-capture locations.	0.000	Mann Whitney	n/a	195.00	2	0.516	fail to reject
Distance to Ecotone	2	All	71	7	64	Distance to ecotone boundaries will be the same in capture versus non-capture locations.	Distance to ecotone boundaries will not be the same in capture versus non-capture locations.	0.003	Mann Whitney	n/a	216.00	2	0.877	fail to reject
Percent Litter	2	Sept	60	7	53	Percent litter will be the same in capture versus non-capture locations.	Percent litter will not be the same in capture versus non-capture locations.	0.075	Ind. T-test	0.898	0.56	2	0.578	fail to reject

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.
** Missing months not analyzed owing to small sample size ($n < 5$)
*** If $p < 0.05$, the distribution is NOT normal.

Peromyscus eremicus captures in relationship to vegetation variables in a Saltbush and Saltcedar communities.

Vegetation Variable	Array*	Month**	Total n	Captured n	Not-Captured n	Null Hypothesis	Alt Hypothesis	Shapiro-Wilk ***	Test	Levene's Equality of Variance	U or t Test Statistic	1 or 2 Tailed Test	p-value	Decision
Average Litter Depth	2	Sept	60	7	53	Average litter depth will be the same in capture versus non-capture locations.	Average litter depth will not be the same in capture versus non-capture locations.	0.021	Mann Whitney	n/a	155.00	2	0.474	fail to reject
Vegetation Density	2	Sept	60	7	53	Vegetation density will not be greater in capture versus non-capture locations.	Vegetation density will be greater in capture versus non-capture locations.	0.002	Mann Whitney	n/a	174.50	1	0.400	fail to reject
Vegetation Canopy	2	Sept	60	7	53	Vegetation canopy will not be greater in capture versus non-capture locations.	Vegetation canopy will be greater in capture versus non-capture locations.	0.000	Mann Whitney	n/a	171.50	1	0.368	fail to reject

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.
** Missing months not analyzed owing to small sample size ($n < 5$)
*** If $p < 0.05$, the distribution is NOT normal.

Peromyscus eremicus captures in relationship to vegetation variables in a Saltbush and Saltcedar communities.

			Total	Captured	Not-Captured						U or t			
Vegetation Variable	Array*	Month**	n	n	n	Null Hypothesis	Alt Hypothesis	Shapiro-Wilk ***	Test	Levene's Equality of Variance	Test Statistic	1 or 2 Tailed Test	p-value	Decision
Percent Bare Ground	2	Sept	60	7	53	Percent bare ground will be the same in capture versus non-capture locations.	Percent bare ground will not be the same in capture versus non-capture locations.	0.000	Mann Whitney	n/a	170.00	1	0.335	fail to reject
Distance to Ecotone	2	Sept	60	7	53	Distance to ecotone boundaries will be the same in capture versus non-capture locations.	Distance to ecotone boundaries will not be the same in capture versus non-capture locations.	0.003	Mann Whitney	n/a	179.50	2	0.953	fail to reject
Percent Litter	3	All	87	49	38	Percent litter will be the same in capture versus non-capture locations.	Percent litter will not be the same in capture versus non-capture locations.	0.050	Mann Whitney	n/a	852.50	2	0.491	fail to reject

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.
** Missing months not analyzed owing to small sample size ($n < 5$)
*** If $p < 0.05$, the distribution is NOT normal.

Peromyscus eremicus captures in relationship to vegetation variables in a Saltbush and Saltcedar communities.

Vegetation Variable	Array*	Month**	Total n	Captured n	Not-Captured n	Null Hypothesis	Alt Hypothesis	Shapiro-Wilk ***	Test	Levene's Equality of Variance	U or t Test Statistic	1 or 2 Tailed Test	p-value	Decision
Average Litter Depth	3	All	87	49	38	Average litter depth will be the same in capture versus non-capture locations.	Average litter depth will not be the same in capture versus non-capture locations.	0.102	Ind. T-test	0.418	-0.80	2	0.426	fail to reject
Vegetation Density	3	All	87	49	38	Vegetation density will not be greater in capture versus non-capture locations.	Vegetation density will be greater in capture versus non-capture locations.	0.000	Mann Whitney	n/a	914.00	1	0.442	fail to reject
Vegetation Canopy	3	All	87	49	38	Vegetation canopy will not be greater in capture versus non-capture locations.	Vegetation canopy will be greater in capture versus non-capture locations.	0.127	Ind. T-test	0.922	0.36	1	0.361	fail to reject

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.
** Missing months not analyzed owing to small sample size ($n < 5$)
*** If $p < 0.05$, the distribution is NOT normal.

Peromyscus eremicus captures in relationship to vegetation variables in a Saltbush and Saltcedar communities.

			Total	Captured	Not-Captured						U or t			
Vegetation Variable	**Array***	**Month****	**n**	**n**	**n**	**Null Hypothesis**	**Alt Hypothesis**	**Shapiro-Wilk *****	**Test**	**Levene's Equality of Variance**	**Test Statistic**	**1 or 2 Tailed Test**	**p-value**	**Decision**
Percent Bare Ground	3	All	87	49	38	Percent bare ground will be the same in capture versus non-capture locations.	Percent bare ground will not be the same in capture versus non-capture locations.	0.000	Mann Whitney	n/a	903.50	1	0.061	fail to reject
Distance to Ecotone	3	All	87	49	38	Distance to ecotone boundaries will be the same in capture versus non-capture locations.	Distance to ecotone boundaries will not be the same in capture versus non-capture locations.	0.258	Ind. T-test	0.088	-1.62	2	0.109	fail to reject
Percent Litter	3	Sept	63	31	32	Percent litter will be the same in capture versus non-capture locations.	Percent litter will not be the same in capture versus non-capture locations.	0.050	Mann Whitney	n/a	443.50	2	0.461	fail to reject

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.
** Missing months not analyzed owing to small sample size ($n < 5$)
*** If $p < 0.05$, the distribution is NOT normal.

Peromyscus eremicus captures in relationship to vegetation variables in a Saltbush and Saltcedar communities.

Vegetation Variable	Array*	Month**	Total n	Captured n	Not-Captured n	Null Hypothesis	Alt Hypothesis	Shapiro-Wilk ***	Test	Levene's Equality of Variance	U or t Test Statistic	1 or 2 Tailed Test	p-value	Decision
Average Litter Depth	3	Sept	63	31	32	Average litter depth will be the same in capture versus non-capture locations.	Average litter depth will not be the same in capture versus non-capture locations.	0.102	Ind. T-test	0.118	-0.81	2	0.422	fail to reject
Vegetation Density	3	Sept	63	31	32	Vegetation density will not be greater in capture versus non-capture locations.	Vegetation density will be greater in capture versus non-capture locations.	0.000	Mann Whitney	n/a	480.00	1	0.413	fail to reject
Vegetation Canopy	3	Sept	63	31	32	Vegetation canopy will not be greater in capture versus non-capture locations.	Vegetation canopy will be greater in capture versus non-capture locations.	0.127	Ind. T-test	0.855	0.61	1	0.271	fail to reject

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.
** Missing months not analyzed owing to small sample size ($n < 5$)
*** If $p < 0.05$, the distribution is NOT normal.

Peromyscus eremicus captures in relationship to vegetation variables in a Saltbush and Saltcedar communities.

Vegetation Variable	Array*	Month**	Total n	Captured n	Not-Captured n	Null Hypothesis	Alt Hypothesis	Shapiro-Wilk ***	Test	Levene's Equality of Variance	U or t Test Statistic	1 or 2 Tailed Test	p-value	Decision
Percent Bare Ground	3	Sept	63	31	32	Percent bare ground will be the same in capture versus non-capture locations.	Percent bare ground will not be the same in capture versus non-capture locations.	0.000	Mann Whitney	n/a	450.00	1	0.089	fail to reject
Distance to Ecotone	3	Sept	63	31	32	Distance to ecotone boundaries will be the same in capture versus non-capture locations.	Distance to ecotone boundaries will not be the same in capture versus non-capture locations.	0.258	Ind. T-test	0.123	-1.29	2	0.101	fail to reject
Percent Litter	3	Oct	56	21	35	Percent litter will be the same in capture versus non-capture locations.	Percent litter will not be the same in capture versus non-capture locations.	0.050	Mann Whitney	n/a	327.50	2	0.489	fail to reject

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.
** Missing months not analyzed owing to small sample size ($n < 5$)
*** If $p < 0.05$, the distribution is NOT normal.

Peromyscus eremicus captures in relationship to vegetation variables in a Saltbush and Saltcedar communities.

Vegetation Variable	Array*	Month**	n (Total)	n (Captured)	n (Not-Captured)	Null Hypothesis	Alt Hypothesis	Shapiro-Wilk ***	Test	Levene's Equality of Variance	U or t Test Statistic	1 or 2 Tailed Test	p-value	Decision
Average Litter Depth	3	Oct	56	21	35	Average litter depth will be the same in capture versus non-capture locations.	Average litter depth will not be the same in capture versus non-capture locations.	0.102	Ind. T-test	0.587	0.56	2	0.577	fail to reject
Vegetation Density	3	Oct	56	21	35	Vegetation density will not be greater in capture versus non-capture locations.	Vegetation density will be greater in capture versus non-capture locations.	0.000	Mann Whitney	n/a	336.00	1	0.296	fail to reject
Vegetation Canopy	3	Oct	56	21	35	Vegetation canopy will not be greater in capture versus non-capture locations.	Vegetation canopy will be greater in capture versus non-capture locations.	0.127	Ind. T-test	0.954	0.89	1	0.189	fail to reject

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.
** Missing months not analyzed owing to small sample size (n < 5)
*** If $p < 0.05$, the distribution is NOT normal.

Peromyscus eremicus captures in relationship to vegetation variables in a Saltbush and Saltcedar communities.

			Total	Captured	Not-Captured						U or t			
Vegetation Variable	**Array***	**Month****	**n**	**n**	**n**	**Null Hypothesis**	**Alt Hypothesis**	**Shapiro-Wilk *****	**Test**	**Levene's Equality of Variance**	**Test Statistic**	**1 or 2 Tailed Test**	**p-value**	**Decision**
Percent Bare Ground	3	Oct	56	21	35	Percent bare ground will be the same in capture versus non-capture locations.	Percent bare ground will not be the same in capture versus non-capture locations.	0.000	Mann Whitney	n/a	360.50	1	0.413	fail to reject
Distance to Ecotone	3	Oct	56	21	35	Distance to ecotone boundaries will be the same in capture versus non-capture locations.	Distance to ecotone boundaries will not be the same in capture versus non-capture locations.	0.258	Ind. T-test	0.638	-0.35	2	0.731	fail to reject
Percent Litter	3	Nov	53	25	28	Percent litter will be the same in capture versus non-capture locations.	Percent litter will not be the same in capture versus non-capture locations.	0.050	Mann Whitney	n/a	338.50	2	0.834	fail to reject

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.
** Missing months not analyzed owing to small sample size ($n < 5$)
*** If $p < 0.05$, the distribution is NOT normal.

Peromyscus eremicus captures in relationship to vegetation variables in a Saltbush and Saltcedar communities.

Vegetation Variable	Array*	Month**	Total n	Captured n	Not-Captured n	Null Hypothesis	Alt Hypothesis	Shapiro-Wilk ***	Test	Levene's Equality of Variance	U or t Test Statistic	1 or 2 Tailed Test	p-value	Decision
Average Litter Depth	3	Nov	53	25	28	Average litter depth will be the same in capture versus non-capture locations.	Average litter depth will not be the same in capture versus non-capture locations.	0.102	Ind. T-test	0.477	-0.64	2	0.528	fail to reject
Vegetation Density	3	Nov	53	25	28	Vegetation density will not be greater in capture versus non-capture locations.	Vegetation density will be greater in capture versus non-capture locations.	0.000	Mann Whitney	n/a	277.00	1	0.096	fail to reject
Vegetation Canopy	3	Nov	53	25	28	Vegetation canopy will not be greater in capture versus non-capture locations.	Vegetation canopy will be greater in capture versus non-capture locations.	0.127	Ind. T-test	0.120	-0.28	1	0.391	fail to reject

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.
** Missing months not analyzed owing to small sample size ($n < 5$)
*** If $p < 0.05$, the distribution is NOT normal.

Peromyscus eremicus captures in relationship to vegetation variables in a Saltbush and Saltcedar communities.

Vegetation Variable	Array*	Month**	n (Total)	n (Captured)	n (Not-Captured)	Null Hypothesis	Alt Hypothesis	Shapiro-Wilk ***	Test	Levene's Equality of Variance	U or t Test Statistic	1 or 2 Tailed Test	p-value	Decision
Percent Bare Ground	3	Nov	53	25	28	Percent bare ground will be the same in capture versus non-capture locations.	Percent bare ground will not be the same in capture versus non-capture locations.	0.000	Mann Whitney	n/a	314.00	1	0.103	fail to reject
Distance to Ecotone	3	Nov	53	25	28	Distance to ecotone boundaries will be the same in capture versus non-capture locations.	Distance to ecotone boundaries will not be the same in capture versus non-capture locations.	0.258	Ind. T-test	0.036	-1.05	2	0.300	fail to reject
Percent Litter	3	Dec	52	18	34	Percent litter will be the same in capture versus non-capture locations.	Percent litter will not be the same in capture versus non-capture locations.	0.050	Mann Whitney	n/a	257.00	2	0.336	fail to reject

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.
** Missing months not analyzed owing to small sample size ($n < 5$)
*** If $p < 0.05$, the distribution is NOT normal.

Peromyscus eremicus captures in relationship to vegetation variables in a Saltbush and Saltcedar communities.

Vegetation Variable	Array*	Month**	Total n	Captured n	Not-Captured n	Null Hypothesis	Alt Hypothesis	Shapiro-Wilk ***	Test	Levene's Equality of Variance	U or t Test Statistic	1 or 2 Tailed Test	p-value	Decision
Average Litter Depth	3	Dec	52	18	34	Average litter depth will be the same in capture versus non-capture locations.	Average litter depth will not be the same in capture versus non-capture locations.	0.102	Ind. T-test	0.965	0.43	2	0.672	fail to reject
Vegetation Density	3	Dec	52	18	34	Vegetation density will not be greater in capture versus non-capture locations.	Vegetation density will be greater in capture versus non-capture locations.	0.000	Mann Whitney	n/a	273.50	1	0.265	fail to reject
Vegetation Canopy	3	Dec	52	18	34	Vegetation canopy will not be greater in capture versus non-capture locations.	Vegetation canopy will be greater in capture versus non-capture locations.	0.127	Ind. T-test	0.369	-0.86	1	0.196	fail to reject

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.
** Missing months not analyzed owing to small sample size ($n < 5$)
*** If $p < 0.05$, the distribution is NOT normal.

Peromyscus eremicus captures in relationship to vegetation variables in a Saltbush and Saltcedar communities.

			Total	Captured	Not-Captured						U or t			
Vegetation Variable	**Array***	**Month****	**n**	**n**	**n**	**Null Hypothesis**	**Alt Hypothesis**	**Shapiro-Wilk *****	**Test**	**Levene's Equality of Variance**	**Test Statistic**	**1 or 2 Tailed Test**	**p-value**	**Decision**
Percent Bare Ground	3	Dec	52	18	34	Percent bare ground will be the same in capture versus non-capture locations.	Percent bare ground will not be the same in capture versus non-capture locations.	0.000	Mann Whitney	n/a	299.00	1	0.396	fail to reject
Distance to Ecotone	3	Dec	52	18	34	Distance to ecotone boundaries will be the same in capture versus non-capture locations.	Distance to ecotone boundaries will not be the same in capture versus non-capture locations.	0.258	Ind. T-test	0.860	0.91	2	0.369	fail to reject
Percent Litter	3	Jan	50	22	28	Percent litter will be the same in capture versus non-capture locations.	Percent litter will not be the same in capture versus non-capture locations.	0.050	Mann Whitney	n/a	119.00	2	0.000	reject null

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.
** Missing months not analyzed owing to small sample size ($n < 5$)
*** If $p < 0.05$, the distribution is NOT normal.

Peromyscus eremicus captures in relationship to vegetation variables in a Saltbush and Saltcedar communities.

Vegetation Variable	Array*	Month**	n (Total)	n (Captured)	n (Not-Captured)	Null Hypothesis	Alt Hypothesis	Shapiro-Wilk ***	Test	Levene's Equality of Variance	U or t Test Statistic	1 or 2 Tailed Test	p-value	Decision
Average Litter Depth	3	Jan	50	22	28	Average litter depth will be the same in capture versus non-capture locations.	Average litter depth will not be the same in capture versus non-capture locations.	0.102	Ind. T-test	0.000	3.75	2	0.001	reject null
Vegetation Density	3	Jan	50	22	28	Vegetation density will not be greater in capture versus non-capture locations.	Vegetation density will be greater in capture versus non-capture locations.	0.000	Mann Whitney	n/a	178.50	1	0.001	reject null
Vegetation Canopy	3	Jan	50	22	28	Vegetation canopy will not be greater in capture versus non-capture locations.	Vegetation canopy will be greater in capture versus non-capture locations.	0.127	Ind. T-test	0.462	2.22	1	0.016	reject null

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.
** Missing months not analyzed owing to small sample size ($n < 5$)
*** If $p < 0.05$, the distribution is NOT normal.

Peromyscus eremicus captures in relationship to vegetation variables in a Saltbush and Saltcedar communities.

Vegetation Variable	Array*	Month**	Total n	Captured n	Not-Captured n	Null Hypothesis	Alt Hypothesis	Shapiro-Wilk ***	Test	Levene's Equality of Variance	U or t Test Statistic	1 or 2 Tailed Test	p-value	Decision
Percent Bare Ground	3	Jan	50	22	28	Percent bare ground will be the same in capture versus non-capture locations.	Percent bare ground will not be the same in capture versus non-capture locations.	0.000	Mann Whitney	n/a	288.00	1	0.226	fail to reject
Distance to Ecotone	3	Jan	50	22	28	Distance to ecotone boundaries will be the same in capture versus non-capture locations.	Distance to ecotone boundaries will not be the same in capture versus non-capture locations.	0.258	Ind. T-test	0.300	0.48	2	0.635	fail to reject

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.
** Missing months not analyzed owing to small sample size ($n < 5$)
*** If $p < 0.05$, the distribution is NOT normal.

APPENDIX V

CHAETODIPUS PENICILLATUS CAPTURES IN RELATIONSHIP TO VEGETATION VARIABLES IN CREOSOTE, SALTBUSH, AND SALTCEDAR COMMUNITIES

Chaetodipus penicillatus captures in relationship to vegetation variables in a Creosote, Saltbush, and Saltcedar communities.

			Total	Captured	Not-Captured						U or t			
Vegetation Variable	**Array***	**Month****	**n**	**n**	**n**	**Null Hypothesis**	**Alt Hypothesis**	**Shapiro-Wilk *****	**Test**	**Levene's Equality of Variance**	**Test Statistic**	**1 or 2 Tailed Test**	**p-value**	**Decision**
Percent Litter	1	All	51	10	41	Percent litter will be the same in capture versus non-capture locations.	Percent litter will not be the same in capture versus non-capture locations.	0.001	Mann-Whitney	n/a	163.00	2	0.279	fail to reject
Average Litter Depth	1	All	51	10	41	Average litter depth will be the same in capture versus non-capture locations.	Average litter depth will not be the same in capture versus non-capture locations.	0.000	Mann-Whitney	n/a	190.50	2	0.653	fail to reject
Vegetation Density	1	All	51	10	41	Vegetation density will not be greater in capture versus non-capture locations.	Vegetation density will be greater in capture versus non-capture locations.	0.000	Mann-Whitney	n/a	119.50	1	0.042	reject null
Vegetation Canopy	1	All	51	10	41	Vegetation canopy will be the same in capture versus non-capture locations.	Vegetation canopy will not be the same in capture versus non-capture locations.	0.000	Mann-Whitney	n/a	180.00	2	0.250	fail to reject

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.
** Missing months not analyzed owing to small sample size ($n < 5$)
*** If $p < 0.05$, the distribution is NOT normal.

Chaetodipus penicillatus captures in relationship to vegetation variables in a Creosote, Saltbush, and Saltcedar communities.

Vegetation Variable	Array*	Month**	Total n	Captured n	Not-Captured n	Null Hypothesis	Alt Hypothesis	Shapiro-Wilk ***	Test	Levene's Equality of Variance	U or t Test Statistic	1 or 2 Tailed Test	p-value	Decision
Percent Bare Ground	1	All	51	10	41	Percent bare ground will be the same in capture versus non-capture locations.	Percent bare ground will not be the same in capture versus non-capture locations.	0.000	Mann-Whitney	n/a	193.00	2	0.757	fail to reject
Distance to Ecotone	1	All	51	10	41	Distance to ecotone boundaries will be the same in capture versus non-capture locations.	Distance to ecotone boundaries will not be the same in capture versus non-capture locations.	0.507	Ind. t-test	0.451	-1.16	2	0.127	fail to reject
Percent Litter	1	Sept	50	6	44	Percent litter will be the same in capture versus non-capture locations.	Percent litter will not be the same in capture versus non-capture locations.	0.001	Mann-Whitney	n/a	98.00	2	0.268	fail to reject
Average Litter Depth	1	Sept	50	6	44	Average litter depth will be the same in capture versus non-capture locations.	Average litter depth will not be the same in capture versus non-capture locations.	0.000	Mann-Whitney	n/a	93.00	2	0.130	fail to reject

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.
** Missing months not analyzed owing to small sample size ($n < 5$)
*** If $p < 0.05$, the distribution is NOT normal.

Chaetodipus penicillatus captures in relationship to vegetation variables in a Creosote, Saltbush, and Saltcedar communities.

Vegetation Variable	Array*	Month**	Total n	Captured n	Not-Captured n	Null Hypothesis	Alt Hypothesis	Shapiro-Wilk ***	Test	Levene's Equality of Variance	U or t Test Statistic	1 or 2 Tailed Test	p-value	Decision
Vegetation Density	1	Sept	50	6	44	Vegetation density will not be greater in capture versus non-capture locations.	Vegetation density will be greater in capture versus non-capture locations.	0.000	Mann-Whitney	n/a	83.00	1	0.071	fail to reject
Vegetation Canopy	1	Sept	50	6	44	Vegetation canopy will be the same in capture versus non-capture locations.	Vegetation canopy will not be the same in capture versus non-capture locations.	0.000	Mann-Whitney	n/a	117.00	2	0.389	fail to reject
Percent Bare Ground	1	Sept	50	6	44	Percent bare ground will be the same in capture versus non-capture locations.	Percent bare ground will not be the same in capture versus non-capture locations.	0.000	Mann-Whitney	n/a	123.00	2	0.769	fail to reject

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.
** Missing months not analyzed owing to small sample size ($n < 5$)
*** If $p < 0.05$, the distribution is NOT normal.

Chaetodipus penicillatus captures in relationship to vegetation variables in a Creosote, Saltbush, and Saltcedar communities.

Vegetation Variable	Array*	Month**	Total n	Captured n	Not-Captured n	Null Hypothesis	Alt Hypothesis	Shapiro-Wilk ***	Test	Levene's Equality of Variance	U or t Test Statistic	1 or 2 Tailed Test	p-value	Decision
Distance to Ecotone	1	Sept	50	6	44	Distance to ecotone boundaries will be the same in capture versus non-capture locations.	Distance to ecotone boundaries will not be the same in capture versus non-capture locations.	0.507	Ind. t-test	0.543	-1.61	2	0.113	fail to reject
Percent Litter	2	All	71	24	47	Percent litter will be the same in capture versus non-capture locations.	Percent litter will not be the same in capture versus non-capture locations.	0.075	Ind. t-test	0.881	2.30	2	0.025	reject null
Average Litter Depth	2	All	71	24	47	Average litter depth will be the same in capture versus non-capture locations.	Average litter depth will not be the same in capture versus non-capture locations.	0.021	Mann-Whitney	n/a	387.50	2	0.029	reject null
Vegetation Density	2	All	71	24	47	Vegetation density will not be greater in capture versus non-capture locations.	Vegetation density will be greater in capture versus non-capture locations.	0.002	Mann-Whitney	n/a	352.50	1	0.010	reject null

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.

** Missing months not analyzed owing to small sample size ($n < 5$)

*** If $p < 0.05$, the distribution is NOT normal.

Chaetodipus penicillatus captures in relationship to vegetation variables in a Creosote, Saltbush, and Saltcedar communities.

Vegetation Variable	Array*	Month**	Total n	Captured n	Not-Captured n	Null Hypothesis	Alt Hypothesis	Shapiro-Wilk ***	Test	Levene's Equality of Variance	U or t Test Statistic	1 or 2 Tailed Test	p-value	Decision
Vegetation Canopy	2	All	71	24	47	Vegetation canopy will be the same in capture versus non-capture locations.	Vegetation canopy will not be the same in capture versus non-capture locations.	0.000	Mann-Whitney	n/a	420.00	2	0.070	fail to reject
Percent Bare Ground	2	All	71	24	47	Percent bare ground will be the same in capture versus non-capture locations.	Percent bare ground will not be the same in capture versus non-capture locations.	0.000	Mann-Whitney	n/a	503.50	2	0.393	fail to reject
Distance to Ecotone	2	All	71	24	47	Distance to ecotone boundaries will be the same in capture versus non-capture locations.	Distance to ecotone boundaries will not be the same in capture versus non-capture locations.	0.003	Mann-Whitney	n/a	455.00	2	0.185	fail to reject
Percent Litter	2	Sept	60	13	47	Percent litter will be the same in capture versus non-capture locations.	Percent litter will not be the same in capture versus non-capture locations.	0.075	Ind. t-test	0.497	3.25	2	0.002	reject null

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.
** Missing months not analyzed owing to small sample size ($n < 5$)
*** If $p < 0.05$, the distribution is NOT normal.

Chaetodipus penicillatus captures in relationship to vegetation variables in a Creosote, Saltbush, and Saltcedar communities.

			Total	Captured	Not-Captured						U or t			
Vegetation Variable	**Array***	**Month****	**n**	**n**	**n**	**Null Hypothesis**	**Alt Hypothesis**	**Shapiro-Wilk *****	**Test**	**Levene's Equality of Variance**	**Test Statistic**	**1 or 2 Tailed Test**	**p-value**	**Decision**
Average Litter Depth	2	Sept	60	13	47	Average litter depth will be the same in capture versus non-capture locations.	Average litter depth will not be the same in capture versus non-capture locations.	0.021	Mann-Whitney	n/a	126.50	2	0.001	reject null
Vegetation Density	2	Sept	60	13	47	Vegetation density will not be greater in capture versus non-capture locations.	Vegetation density will be greater in capture versus non-capture locations.	0.002	Mann-Whitney	n/a	150.50	1	0.003	reject null
Vegetation Canopy	2	Sept	60	13	47	Vegetation canopy will be the same in capture versus non-capture locations.	Vegetation canopy will not be the same in capture versus non-capture locations.	0.000	Mann-Whitney	n/a	181.50	2	0.020	reject null
Percent Bare Ground	2	Sept	60	13	47	Percent bare ground will be the same in capture versus non-capture locations.	Percent bare ground will not be the same in capture versus non-capture locations.	0.000	Mann-Whitney	n/a	241.50	2	0.170	fail to reject

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.

** Missing months not analyzed owing to small sample size ($n < 5$)

*** If $p < 0.05$, the distribution is NOT normal.

Chaetodipus penicillatus captures in relationship to vegetation variables in a Creosote, Saltbush, and Saltcedar communities.

Vegetation Variable	Array*	Month**	Total n	Captured n	Not-Captured n	Null Hypothesis	Alt Hypothesis	Shapiro-Wilk ***	Test	Levene's Equality of Variance	U or t Test Statistic	1 or 2 Tailed Test	p-value	Decision
Distance to Ecotone	2	Sept	60	13	47	Distance to ecotone boundaries will be the same in capture versus non-capture locations.	Distance to ecotone boundaries will not be the same in capture versus non-capture locations.	0.003	Mann-Whitney	n/a	234.50	2	0.203	fail to reject
Percent Litter	2	Oct	49	17	32	Percent litter will be the same in capture versus non-capture locations.	Percent litter will not be the same in capture versus non-capture locations.	0.075	Ind. t-test	0.975	2.02	2	0.049	reject null
Average Litter Depth	2	Oct	49	17	32	Average litter depth will be the same in capture versus non-capture locations.	Average litter depth will not be the same in capture versus non-capture locations.	0.021	Mann-Whitney	n/a	181.00	2	0.050	fail to reject
Vegetation Density	2	Oct	49	17	32	Vegetation density will not be greater in capture versus non-capture locations.	Vegetation density will be greater in capture versus non-capture locations.	0.002	Mann-Whitney	n/a	114.50	1	0.001	reject null

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.

** Missing months not analyzed owing to small sample size ($n < 5$)

*** If $p < 0.05$, the distribution is NOT normal.

Chaetodipus penicillatus captures in relationship to vegetation variables in a Creosote, Saltbush, and Saltcedar communities.

Vegetation Variable	Array*	Month**	Total n	Captured n	Not-Captured n	Null Hypothesis	Alt Hypothesis	Shapiro-Wilk ***	Test	Levene's Equality of Variance	U or t Test Statistic	1 or 2 Tailed Test	p-value	Decision
Vegetation Canopy	2	Oct	49	17	32	Vegetation canopy will be the same in capture versus non-capture locations.	Vegetation canopy will not be the same in capture versus non-capture locations.	0.000	Mann-Whitney	n/a	189.00	2	0.062	fail to reject
Percent Bare Ground	2	Oct	49	17	32	Percent bare ground will be the same in capture versus non-capture locations.	Percent bare ground will not be the same in capture versus non-capture locations.	0.000	Mann-Whitney	n/a	221.50	2	0.210	fail to reject
Distance to Ecotone	2	Oct	49	17	32	Distance to ecotone boundaries will be the same in capture versus non-capture locations.	Distance to ecotone boundaries will not be the same in capture versus non-capture locations.	0.003	Mann-Whitney	n/a	270.00	2	0.966	fail to reject
Percent Litter	2	Nov	50	9	41	Percent litter will be the same in capture versus non-capture locations.	Percent litter will not be the same in capture versus non-capture locations.	0.075	Ind. t-test	0.078	3.99	2	0.000	reject null

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.
** Missing months not analyzed owing to small sample size (n < 5)
*** If p < 0.05, the distribution is NOT normal.

Chaetodipus penicillatus captures in relationship to vegetation variables in a Creosote, Saltbush, and Saltcedar communities.

Vegetation Variable	Array*	Month**	n (Total)	n (Captured)	n (Not-Captured)	Null Hypothesis	Alt Hypothesis	Shapiro-Wilk ***	Test	Levene's Equality of Variance	U or t Test Statistic	1 or 2 Tailed Test	p-value	Decision
Average Litter Depth	2	Nov	50	9	41	Average litter depth will be the same in capture versus non-capture locations.	Average litter depth will not be the same in capture versus non-capture locations.	0.021	Mann-Whitney	n/a	75.50	2	0.005	reject null
Vegetation Density	2	Nov	50	9	41	Vegetation density will not be greater in capture versus non-capture locations.	Vegetation density will be greater in capture versus non-capture locations.	0.002	Mann-Whitney	n/a	97.50	1	0.014	reject null
Vegetation Canopy	2	Nov	50	9	41	Vegetation canopy will be the same in capture versus non-capture locations.	Vegetation canopy will not be the same in capture versus non-capture locations.	0.000	Mann-Whitney	n/a	61.00	2	0.001	reject null
Percent Bare Ground	2	Nov	50	9	41	Percent bare ground will be the same in capture versus non-capture locations.	Percent bare ground will not be the same in capture versus non-capture locations.	0.000	Mann-Whitney	n/a	131.00	2	0.108	fail to reject

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.
** Missing months not analyzed owing to small sample size ($n < 5$)
*** If $p < 0.05$, the distribution is NOT normal.

Chaetodipus penicillatus captures in relationship to vegetation variables in a Creosote, Saltbush, and Saltcedar communities.

Vegetation Variable	Array*	Month**	Total n	Captured n	Not-Captured n	Null Hypothesis	Alt Hypothesis	Shapiro-Wilk ***	Test	Levene's Equality of Variance	U or t Test Statistic	1 or 2 Tailed Test	p-value	Decision
Distance to Ecotone	2	Nov	50	9	41	Distance to ecotone boundaries will be the same in capture versus non-capture locations.	Distance to ecotone boundaries will not be the same in capture versus non-capture locations.	0.003	Mann-Whitney	n/a	93.00	2	0.021	reject null
Percent Litter	3	All	87	19	68	Percent litter will be the same in capture versus non-capture locations.	Percent litter will not be the same in capture versus non-capture locations.	0.050	Mann-Whitney	n/a	583.00	2	0.507	fail to reject
Average Litter Depth	3	All	87	19	68	Average litter depth will be the same in capture versus non-capture locations.	Average litter depth will not be the same in capture versus non-capture locations.	0.102	Ind. t-test	0.843	0.21	2	0.831	fail to reject
Vegetation Density	3	All	87	19	68	Vegetation density will not be greater in capture versus non-capture locations.	Vegetation density will be greater in capture versus non-capture locations.	0.000	Mann-Whitney	n/a	632.00	1	0.443	fail to reject

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.
** Missing months not analyzed owing to small sample size ($n < 5$)
*** If $p < 0.05$, the distribution is NOT normal.

Chaetodipus penicillatus captures in relationship to vegetation variables in a Creosote, Saltbush, and Saltcedar communities.

Vegetation Variable	Array*	Month**	Total n	Captured n	Not-Captured n	Null Hypothesis	Alt Hypothesis	Shapiro-Wilk ***	Test	Levene's Equality of Variance	U or t Test Statistic	1 or 2 Tailed Test	p-value	Decision
Vegetation Canopy	3	All	87	19	68	Vegetation canopy will be the same in capture versus non-capture locations.	Vegetation canopy will not be the same in capture versus non-capture locations.	0.127	Ind. t-test	0.990	-0.71	2	0.479	fail to reject
Percent Bare Ground	3	All	87	19	68	Percent bare ground will be the same in capture versus non-capture locations.	Percent bare ground will not be the same in capture versus non-capture locations.	0.000	Mann-Whitney	n/a	594.00	2	0.338	fail to reject
Distance to Ecotone	3	All	87	19	68	Distance to ecotone boundaries will be the same in capture versus non-capture locations.	Distance to ecotone boundaries will not be the same in capture versus non-capture locations.	0.258	Ind. t-test	0.566	0.28	2	0.782	fail to reject
Percent Litter	3	Sept	63	11	52	Percent litter will be the same in capture versus non-capture locations.	Percent litter will not be the same in capture versus non-capture locations.	0.050	Mann-Whitney	n/a	255.00	2	0.566	fail to reject

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.
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*** If $p < 0.05$, the distribution is NOT normal.

Chaetodipus penicillatus captures in relationship to vegetation variables in a Creosote, Saltbush, and Saltcedar communities.

Vegetation Variable	Array*	Month**	Total n	Captured n	Not-Captured n	Null Hypothesis	Alt Hypothesis	Shapiro-Wilk ***	Test	Levene's Equality of Variance	U or t Test Statistic	1 or 2 Tailed Test	p-value	Decision
Average Litter Depth	3	Sept	63	11	52	Average litter depth will be the same in capture versus non-capture locations.	Average litter depth will not be the same in capture versus non-capture locations.	0.102	Ind. t-test	0.144	1.85	2	0.069	fail to reject
Vegetation Density	3	Sept	63	11	52	Vegetation density will not be greater in capture versus non-capture locations.	Vegetation density will be greater in capture versus non-capture locations.	0.000	Mann-Whitney	n/a	226.50	1	0.140	fail to reject
Vegetation Canopy	3	Sept	63	11	52	Vegetation canopy will be the same in capture versus non-capture locations.	Vegetation canopy will not be the same in capture versus non-capture locations.	0.127	Ind. t-test	0.121	1.09	2	0.279	fail to reject
Percent Bare Ground	3	Sept	63	11	52	Percent bare ground will be the same in capture versus non-capture locations.	Percent bare ground will not be the same in capture versus non-capture locations.	0.000	Mann-Whitney	n/a	258.50	2	0.288	fail to reject

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.
** Missing months not analyzed owing to small sample size ($n < 5$)
*** If $p < 0.05$, the distribution is NOT normal.

Chaetodipus penicillatus captures in relationship to vegetation variables in a Creosote, Saltbush, and Saltcedar communities.

			Total	Captured	Not-Captured						U or t			
Vegetation Variable	**Array***	**Month****	**n**	**n**	**n**	**Null Hypothesis**	**Alt Hypothesis**	**Shapiro-Wilk *****	**Test**	**Levene's Equality of Variance**	**Test Statistic**	**1 or 2 Tailed Test**	**p-value**	**Decision**
Distance to Ecotone	3	Sept	63	11	52	Distance to ecotone boundaries will be the same in capture versus non-capture locations.	Distance to ecotone boundaries will not be the same in capture versus non-capture locations.	0.258	Ind. t-test	0.033	-0.37	2	0.716	fail to reject
Percent Litter	3	Oct	56	9	47	Percent litter will be the same in capture versus non-capture locations.	Percent litter will not be the same in capture versus non-capture locations.	0.050	Mann-Whitney	n/a	149.00	2	0.154	fail to reject
Average Litter Depth	3	Oct	56	9	47	Average litter depth will be the same in capture versus non-capture locations.	Average litter depth will not be the same in capture versus non-capture locations.	0.102	Ind. t-test	0.922	-0.86	2	0.392	fail to reject
Vegetation Density	3	Oct	56	9	47	Vegetation density will not be greater in capture versus non-capture locations.	Vegetation density will be greater in capture versus non-capture locations.	0.000	Mann-Whitney	n/a	157.50	1	0.113	fail to reject

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.
** Missing months not analyzed owing to small sample size ($n < 5$)
*** If $p < 0.05$, the distribution is NOT normal.

Chaetodipus penicillatus captures in relationship to vegetation variables in a Creosote, Saltbush, and Saltcedar communities.

			Total	Captured	Not-Captured						U or t			
Vegetation Variable	**Array***	**Month****	**n**	**n**	**n**	**Null Hypothesis**	**Alt Hypothesis**	**Shapiro-Wilk *****	**Test**	**Levene's Equality of Variance**	**Test Statistic**	**1 or 2 Tailed Test**	**p-value**	**Decision**
Vegetation Canopy	3	Oct	56	9	47	Vegetation canopy will be the same in capture versus non-capture locations.	Vegetation canopy will not be the same in capture versus non-capture locations.	0.127	Ind. t-test	0.056	-1.74	2	0.088	fail to reject
Percent Bare Ground	3	Oct	56	9	47	Percent bare ground will be the same in capture versus non-capture locations.	Percent bare ground will not be the same in capture versus non-capture locations.	0.000	Mann-Whitney	n/a	184.50	2	0.261	fail to reject
Distance to Ecotone	3	Oct	56	9	47	Distance to ecotone boundaries will be the same in capture versus non-capture locations.	Distance to ecotone boundaries will not be the same in capture versus non-capture locations.	0.258	Ind. t-test	0.202	0.30	2	0.763	fail to reject

* Array 1-Creosote Comm., 2-Saltbush Comm., 3-Saltcedar Comm.
** Missing months not analyzed owing to small sample size ($n < 5$)
*** If $p < 0.05$, the distribution is NOT normal.

REFERENCES

Ackerman, T.L., Romney, E.M. & Kinnear, J.E. (1980). Phenology of desert shrubs in southern Nye County, Nevada (4-23). In: *The Great Basin Naturalist Memoirs No. 4. Nevada desert ecology*. Provo, UT: Brigham Young University.

Baldwin, B.G., Boyd, S., Ertter, B.J., Patterson, R.W., Rosatti, T.J., & Wilken, D.H. (2002). *The Jepson desert manual: Vascular plants of southeastern California*. Berkeley: University of California Press.

Beatley, J.C. (1976). Rainfall and fluctuating plant populations in relation to distributions and numbers of desert rodents in Southern Nevada. *Oecologia*, *24*, 21-42.

Bleich, V.C., & Schwartz, O.A. (1975). Observations on the home range of the Desert Woodrat, *Neotoma lepida Intermedia*. *Journal of Mammalogy*, *56(2)*, 518-519.

Bonaccorso, F.J., & Brown, J.H. (1972). House construction of the Desert Woodrat, *Neotoma lepida lepida*. *Journal of Mammalogy*, *53(2)*, 283-288.

Bonham, C.D. (1989). *Measurements of Terrestrial Vegetation*. New York: John Wiley and Sons.

Bradley, W. G., & Mauer, R.A. (1973). Rodents of a creosote-bush community in southern Nevada. *Southwestern Naturalist*, *17*, 333-344.

Bradley, W.G., & Mauer, R.A. (1971). Reproduction and food habits of *Merriam's* Kangaroo Rat, *Dipodomys merriami*. *Journal of Mammalogy*, *52(3)*, 497-512.

Brown, J.H., & Lieberman, G.A. (1973). Resources utilization and coexistence of seed eating desert rodents in sand dune habitats. *Ecology*, *54*, 788-797.

Brylski, P. (1988-1990). Volume III. In Zeiner, D.C., Laudenslayer, W.F., Mayer, K.E. & White, M. (Eds.), *California's Wildlife*. California Department of Fish and Game.

Burk, J.H. (1977). Sonoran desert (869-899). In: Barbour, M.G. & Major, J. (Eds.) *Terrestrial vegetation of California*. New York: John Wiley and Sons.

Cameron, G.N., & Rainey, D.G. (1972). Habitat utilization by *Neotoma lepida* in the Mohave Desert. *Journal of Mammalogy*, *53(2)*, 251-266.

Center for Business and Economic Research, University of Nevada Las Vegas. (2003). Retrieved from the World Wide Web: http://cber.unlv.edu/stats.html

Chew, R.M., & Chew, A.E. (1970). Energy relationships of the mammals of a desert shrub (*Larrea tridentata*) community. *Ecological Monographs*, *40(1)*, 1-20.

Dayton, W.A. (1931). *Important western browse plants. Misc. Publ. 101*. Washington, DC: United States Department of Agriculture.

Dittberner, P.L., & Olson, M.R. (1983). *The plant information network (PIN) database: Colorado, Montana, North Dakota, Utah, and Wyoming*. *FWS/OBS-83/86*. Washington, DC: United States Department of the Interior, Fish and Wildlife Service.

Gerstenberger, S.L., personal interview, September 5, 2003.

Gerstenberger, S.L., Cross, C.L., & Divine, D. (2002). An investigation of small mammal diversity in the Las Vegas Wash [Grant Proposal]. Las Vegas (NV). University of Nevada, Las Vegas. Available from: University of Nevada Las Vegas.

Gullion, G.W. (1964). *Contributions toward a flora of Nevada. No. 49: Wildlife uses of Nevada plants.* CR-24-64. Beltsville, MD: U.S. Department of Agriculture, Agricultural Research Service, National Arboretum Crops Research Division.

Hafner, M.S. (1977). Density and diversity in Mojave Desert rodent and shrub communities. *Journal of Animal Ecology*, *46*, 925-938.

Hastings, J.R., & Turner, R.M. (1965). *The changing mile: An ecological study of vegetation change with time in the lower mile of an arid and semiarid region*. Tuscon, AZ: University of Arizona Press.

Heske, E.J., Brown, J.H., & Guo, Q. (1993). Effects of kangaroo rat exclusion on vegetation structure and plant species diversity in the Chihuahuan Desert. *Oecologia*, *95*, 520-524.

Holand, R.F. (1986). *Preliminary descriptions of the terrestrial natural communities of California*. Sacramento, CA: California Department of Fish and Game.

Hoover, K.D., Whitford, W.G., & Flavill, P. (1977). Factors influencing the distributions of two species of *Perognathus*. *Ecology*, *58*, 877-884.

Horn, L. (2003). An analysis of *Merriam's* kangaroo rat's (*Dipodomys merriami*) macro-habitat near the Las Vegas Wash, Nevada. (Bachelor thesis, University of Nevada Las Vegas, 2003).

Horton, J.L., Kolb, T.E. & Hart, S.C. (2001). Responses of riparian trees to interannual variation in ground water depth in a semi-arid river basin. *Plant, Cell and Environment*, *24(3)*, 293-304.

Howard, J.L. (2004, April 25). Ailanthus altissima. In: *Fire Effects Information System*, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain

Research Station, Fire Sciences Laboratory (Producer). Retrieved October 1, 2003 from the World Wide Web: http://www.fs.fed.us/database/feis

Kartesz, J.T. (1988). *A flora of Nevada*. (Doctoral dissertation, University of Nevada Reno, 1988).

Kearney, T.H., Peebles, R.H., Thomas, J., & McClintock, E. (1960). *Arizona flora* (2nd ed.). Berkeley, CA: University of California Press.

Las Vegas Wash Coordination Committee. (2003). What is the wash?: Wash facts. Retrieved November 12, 2003 from the World Wide Web: http://www.lvwash.org/wash/wash_facts/washfacts.html

Lewis, A.W. (1972). Seasonal population changes in the Cactus Mouse, *Peromyscus eremicus*. *The Southwestern Naturalist*, *17(1)*, 85-93.

Lieberman, M.E. (1969). *The evolutionary dynamics of the Desert Woodrat, Neotoma lepida*. (Doctoral dissertation, University of California, Irvine, 1969).

Little, E.L. (1976). *Atlas of United States trees. Volume 3: Minor western hardwoods*. U.S. Deparment of Agriculture Forest Service Miscellaneous Publication 1314.

MacMahon, J.A. (1988). Warm deserts (231-264). In: Barbour, M.G., Billings, W.D. (Eds.), *North American terrestrial vegetation*. Cambridge; New York: Cambridge University Press.

Meserve, P.L. (1974). Ecological relationships of two sympatric woodrats in a California coastal sage scrub community. *Journal of Mammalogy*, *55*, 442-447.

Meyer, M.W., & Karasov, W.H. (1989). Antiherbivore chemistry of *Larrea tridentata*: Effects on Woodrat (*Neotoma lepida*) feeding and nutrition. *Ecology*, *70(4)*, 953-961.

Mozingo, H. (1987). *Shrubs of the great basin*. Reno, NV: University of Nevada Press.

Noy-Meir, I. (1973). Desert Ecosystems: environment and producers. Annual *Review of Ecology and Systematics, 4,* 25-41.

Pearcy, R.W., & Harrison, A.T. (1974). Comparative photosynthetic and respiratory gas exchange characteristics of Atriplex lentiformis (Torr.) Wats. in coastal and desert habitats. *Ecology, 55(5),* 1104-1111.

Price, M.V. (1978). The role of microhabitat in structuring desert rodent communities. *Ecology*, *59(5)*, 910-921.

Reichman, O.J., & Van De Graaff, K.M. (1973). Seasonal activity and reproductive patterns of five species of Sonoran Desert rodents. *American Midland Naturalist*, *90*, 118-126.

Reynolds, H.G. (1958). The ecology of *Merriam* Kangaroo Rat (*Dipodomys merriami merarns*) on the grazing lands of Southern Arizona. *Ecological Monographs*, *28(2)*, 111-127.

Reynolds, H.G. (1950). Relation of *Merriam* Kangaroo Rats to range vegetation in Southern Arizona. *Ecology*, *31(3)*, 456-463.

Rosenzweig, M.L. (1973). Habitat selection experiments with a pair of coexisting heteromyid rodent species. *Ecology*, *54*, 111-117.

Rosenzweig, M.L, & Winukar, J. (1969). Populatio ecology of desert rodent communities: habitats and environmental complexity. *Ecology*, *50*, 558-572.

Shreve, F. (1942). The desert vegetation of North America. *Botanical Review, 8(4),* 195-246.

Smigel, B., & Rosenzweig, M.L. Seed select in *Dipodomys merriami* and *Perognathus penicillatus*. *Ecology*, *55*, 329-339.

Stones, R.C., & Hayward, C.L. (1968). Natural history of the Desert Woodrat, *Neotoma lepida*. *American Midland Naturalist*, *80*, 458-476.

Stubbendieck, J., Hatch, S.L., & Hirsch, K.J. *North American range plants* (3rd ed.). Lincoln, NE: University of Nebraska Press.

Szaro, R.C. (1989). Riparian forest and scrubland community types of Arizona and New Mexico. *Desert Plants*, *9(3-4)*, 70-138.

Simpson, B. (2002). Texas Native Shrubs. Retrieved October 1, 2003 from the World Wide Web: http://aggie-horticulture.tamu.edu/ornamentals/nativeshrubs/krameriaerecta.htm

United States Department of Agriculture, Forest Service. (1937). *Range plant handbook*. Washington, DC.

Vasek, F.C., & Barbour, M.G. (1977). Mojave Desert scrub vegetation (835-867). In Barbour, M.G. & Major, J. (Eds.), *Terrestrial vegetation of California*. New York: John Wiley and Sons.

Veal, R., & Caire, W. (1979). Peromyscus eremicus. *Mammal. Species No. 118*.

Vines, R.A. (1960). *Trees, shrubs, and woody vines of the Southwest.* Austin, TX: University of Texas Press.

Watson, M.C., O'Leary, J.W. & Glenn, E.P. (1987). Evaluation of Atriplex lentiformis (Torr.) S. Wats. and Atriplex nummularia Lindl. as irrigated forage crops. *Journal of Arid Environments, 13,* 293-303.

Welsh, S.L., Atwood, N.D., Goodrich, S., & Higgins, L.C. (1993). *A Utah flora* (2nd ed.). Provo, UT: Brigham Young University Press.

Whitford, W.G. (2002). *Ecology of desert systems*. London: Academic Press.

Whitford, W.G. (1976). Temporal fluctuations in density and diversity of desert rodent populations. *Journal of Mammalogy*, *57(2)*, 351-369.

Young, J.A. (1991). Tumbleweed. *Scientific American*, *264(3)*, 82-87.

Zar, J.H. (1999). *Biostatistical Analysis* (4th ed.). Upper Saddle River, New Jersey: Prentice Hall.

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