AN ANALYSIS OF RODENT DISTRIBUTION PATTERNS IN ZACATECAS, MEXICO

By

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A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Department of Zoology

1979

ABSTRACT

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The purposes of this report are to document the occurrence and distribution of species of rodents in the state of Zacatecas, Mexico, and to examine whether or not the distribution patterns of rodents can be objectively grouped into biogeographical units.

Various aspects of the environment of Zacatecas are described, including: physiography, topography, climate, and vegetation. In essence, Zacatecas consists of a low, arid eastern region (desert), a higher, moister, central region (grasslands), a western montane region (pine-oak forests), and a western canyon region (tropical vegetation).

Distributional data for 46 rodent species in Zacatecas were analyzed using two numerical taxonomic techniques, Cluster Analysis and Factor Analysis. Initially, the state was divided into a grid system consisting of 73 quadrats for which data were available. I decided that only those quadrats which contained at least ten species would be adequate for analysis, resulting in the use of 57 quadrats.

Cluster analysis was carried out using the unweighted pair group method with arithmetic averages on three indices of association, Euclidean distance, Average Faunal Resemblance, and Similarity. These

three indices produced similar dendrograms from which I was able to recognize four major clusters in common to each. The four clusters represented ecogeographic units corresponding to: (1) an eastern desert unit; (2) a central grassland unit; (3) a western montane unit; and (4) a western canyon unit. Differences between the three dendrograms are discussed in terms of the nature of the calculation of each index. A major drawback of cluster analysis is that any given quadrat can be associated with only one cluster.

Factor analysis included data for 43 rodents species and five environmental variables. Seven factors, accounting for 60.9 per cent of the total variation, were extracted from a correlation matrix. The factor matrix was rotated by a varimax procedure to simple structure. The seven factors produced generalized patterns that proved to be biologically meaningful, defining essentially the same ecogeographic units recognized by cluster analysis. Three factors defined the same ecogeographic units; three others refined or subdivided these units. A seventh factor defined a riparian or mesic habitat association.

The results of cluster and factor analyses are synthesized into a classlification of Rodent Faunal Areas in Zacatecas. This classification and the geographical limits of the Faunal areas corresponds to a testable hypothesis of biogeographical areas. The four Rodent Faunal Areas recognized are: (1) Desert Faunal Area; (2) Grassland Faunal Area; (3) Montane Faunal Area; and (4) Tropical Faunal Area. In addition, a broad region of transition between Desert and Grassland Faunal Areas was recognized by factor analysis. Certain quadrats were found to be associated with more than one factor indicating either that they were ecotonal quadrats or that they contained parts of two or more faunal areas.

The effects that man has had and is having on the biological resources in Zacatecas is discussed. The status of various rodent species is considered in relation to habitat destruction or modification.

The remainder of the report concerns the documentation of species distribution and notes on natural history.

ACKNOWLEDGEMENTS

I thank the members of my guidance committee, Rollin H. Baker (Chairman), Marvin M. Hensley, J. Alan Holman, and Peter G. Murphy for their helpful suggestions and for critically reading the manuscript. I am particularly grateful to Rollin H. Baker for his invaluable assistance, encouragement, and support during all phases of this project.

Field work was supported by grants from the Jens Touborg Fund to The Museum and by Museum Research Assistantships. Travel support to visit various museums was provided by the Department of Zoology and my in-laws, Walter and Frances Jaffe.

I thank J. Paul Abravaya, William David Webster, Janet Hamilton, and Dan and Karen Bennack for their assistance in the field. I especially thank J. Paul Abravaya for his dedicated work during three summers in Zacatecas.

I thank the following curators and institutions for allowing me to examine specimens in their care: Sydney Anderson, American Museum of Natural History; Robert T. Orr, California Academy of Sciences; Robert S. Hoffmann, Museum of Natural History, University of Kansas; Lani A Lester and Donald R. Patten, Los Angeles County Museum; George H. Lowery, Jr., Louisiana State University; William Z. Lidicker and James L. Patton, Museum of Vertebrate Zoology, University of California; Philip Myers, Museum of Zoology, University of Michigan; Robert G. Hannum, Private Collection; David J. Schmidly, Texas Cooperative

Wildlife Collections, Texas A & M University; Robert J. Baker, The Museum, Texas Tech University; Donald F. Hoffmeister, Museum of Natural History, University of Illinois; J. Keever Greer, Stovall Museum of Science and History, University of Oklahoma; Don E. Wilson, Biological Survey Collection, United States Fish and Wildlife Laboratory. I thank Sr. Cornelio Sanchez for providing me with information on specimens housed in the Instituto de Biologia, Universidad Nacional Autonoma de Mexico. I am especially indebted to Lani A. Lester and Donald R. Patten of the Los Angeles County Museum for allowing me to borrow over 800 specimens from their collections.

Collecting permits were provided by the Director General de Fauna Silvestre, Departmento de Consevacion, Mexico, D. F.

I am deeply indebted to the people of Zacatecas for their generous hospitality and friendship. Special thanks are due Sr. Alejandro Delgadillo and family for allowing me to use the facilities of Rancho San Marcos during the summers of 1977 and 1978.

I thank Frances Jaffe for typing part of the original draft of the dissertation.

I thank my wife Natalie and son Jackie for their untiring help in the field, encouragement to pursue this study, and patience to put up with the rigors of field work and graduate studies.

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INTRODUCTION

In this day of rapid depletion of our natural resources, much attention is being given once again to surveys of the flora and fauna of various parts of North America. Usually, these are concerned with environmental impact statements of local areas that are about to be exploited. In the United States fairly good base-line data exist for such surveys. However, much of our knowledge of the biota of Latin America still remains meagre or spotty.

Mexico is currently faced with one of the greatest rates of population growth in the world today (Corzo, 1970; Wellhausen, 1976). Much of Mexico's land is rapidly being turned to cultivation to meet the demands of a growing population (Wellhausen, 1976). While this is a necessary consequence of population growth, the environmental changes can have a drastic effect on the native biota. Without the needed base-line data about the taxa and where they occur, the impact of these environmental perturbations cannot be adequately assessed in future years.

The Mexican state of Zacatecas represents an area for which little is known concerning its biota, in particular the mammals. Other than a few scattered records, there exists no comprehensive survey of the flora or fauna from Zacatecas. The recent reports by Baker _et al_. (1967), Genoways and Jones (1968), Best _et al_. (1972), Matson and Patten (1975), Matson (1977), Jones and Webster (1977), and Matson et al. (1978) have summarized our meagre knowledge of mammals in the state. Other mammals known from Zacatecas were reported in various taxonomic works most of which were summarized in Hall and Kelson (1959). The purpose of the present study is to help fill in the gaps in our knowledge of one Order of mammals from Zacatecas, the Rodentia.

The choice of the Order Rodentia as a taxon for study was based on the following considerations: First, it reflects my primary interest in mammals in general and rodents in particular. Second, the Order Rodentia represents a large and diverse group of animals which I believe would be adequate to demonstrate major patterns of distribution within the state. Third, Rodentia represents one of the easiest groups of mammals to sample because of their abundance. This allows for relatively complete checklists to be made in an area within a short time period. Fourth, rodents from Zacatecas are well represented in collections held by various institutions, thus facilitating the present study. For three summers (1976, 1977, 1978), I concentrated on studying rodents in areas of the state that had not been previously examined.

Selection of a study area for a faunal survey can be accomplished in two ways. First, one may select some defined "natural" area, such as the Chihuahuan Desert or Sierra Madre Occidental. This approach was the subject of a recently published symposium on the Chihuahuan Desert (Wauer and Riskind, 1978). Second, one may select a politically defined area. This has probably been the most common approach in faunal surveys.

Surveys of politically defined areas have been criticized as not leading to any general biological concepts (Mayr, 1971; Findley and

Caire, 1978). Both Armstrong (1972) and Anderson (1972) have countered such criticisms on a number of points. First, the limits of the area are precisely defined by the limits of the political unit. Second, the results of a faunal survey of a political unit are often complementary to other faunal surveys of adjacent units (eventually this would lead to a complete survey of the natural areas as well). Third, surveys of this type often provide more diversity than one of a "natural" area, thus providing the investigator with a broader view of the distributional patterns observed.

I selected the state of Zacatecas as a study area for a variety of reasons. I became interested in the mammalian fauna of Zacatecas when in 1972 I had the opportunity to help curate a rather large collection of mammals from that state at the Los Angeles County Museum. It quickly became apparent that many new state records were present (Matson and Patten, 1975; Matson, 1977). Also, there were few other published records of mammals from Zacatecas. Thus, the need for a comprehensive survey of the mammals of Zacatecas seemed warranted. In addition, fairly complete surveys existed for three contiguous states. These are: San Luis Potosi (Dalquest, 1953); Coahuila (Baker, 1956); and Durango (Baker and Greer, 1962). Also, a fourth contiguous state, Nayarit, is currently being surveyed by personnel of the United States Fish and Wildlife Service (Don Wilson, personal communication). Zacatecas and surrounding states lie in a portion of Mexico that Hershkovitz (1958) considered to be a transition between the Neotropical and Neartic Zoogeographical Regions. Thus, this area would have a theoretical appeal for understanding the distribution and evolution of faunas, although this last reason will not be realized until more survey work is completed. Lastly, the study of a state fauna allows me the opportunity to be involved with research in two main fields of biological science, systematics and biogeography.

The present study was designed to answer three questions concerning the rodents of Zacatecas: (1) What species of rodents occur in Zacatecas? (2) What is the distribution of each species within the state? Both of these questions represent the base-line data that can be used in future studies. (3) Can the distributions of species be objectively grouped into meaningful patterns associated with recognizable areas within the state? This question represents a theoretical problem that most earlier works on Mexican mammals have failed to deal with effectively. Only Anderson (1972) and Findley and Caire (1978) have approached this question for Mexican mammals on a more or less objective basis.

A note of caution is necessary at this point. The following discussion often take the attitude that the data are complete. This is by no means true. A study of the kind proposed is probably never finished. This is because one can continue to work for finer detail and also because of the dynamic nature of species distributions (Udvardy, 1969). In addition, man has been a major force in habitat modification for many centuries. It is possible, even probable, that the distributional pattern of many species have been highly modified especially since the coming of Europeans. At present we have no direct means by which to assess man's influence. However, the present study is believed to be representative of the major distributional patterns.

ENVIRONMENT OF ZACATECAS

Physiography and Topography

Zacatecas covers an area of approximately 72,800 sq. km at the southern portions of the Central Mexican Plateau and Sierra Madre Occidental. The Tropic of Cancer essentially bisects the state. The varied topography and climate allows for a complex of environmental situations throughout the state.

Physiographic provinces of Mexico were described and mapped by Raisz (1964). These provinces more or less correspond to the major areas of topographic relief (Figure 1). Most of the eastern half of Zacatecas is in the Central Mesa Province and corresponds to elevations usually below 2,000 m. It is an area of relatively flat to low hilly terrain that serves as a drainage basin for runoff from the higher lands to the east and west. In fact, the Central Mesa Province corresponds to two of the major internal drainage basins of the Chihuahuan Desert described by Henrickson (1978). These two major basins are the Río Aguanaval (whose major river originates in west central Zacatecas) and El Salado (the largest of the Chihuahuan drainage basins).

The extreme northeastern portion of Zacatecas is dominated by numerous isolated mountain ranges (areas above 2,500 m in Figure 1). These mountains represent the southern portion of the Cross Ranges Subprovince of the Sierra Madre Oriental Province described by Raisz (1964). Essentially, these mountains are a western extension of the

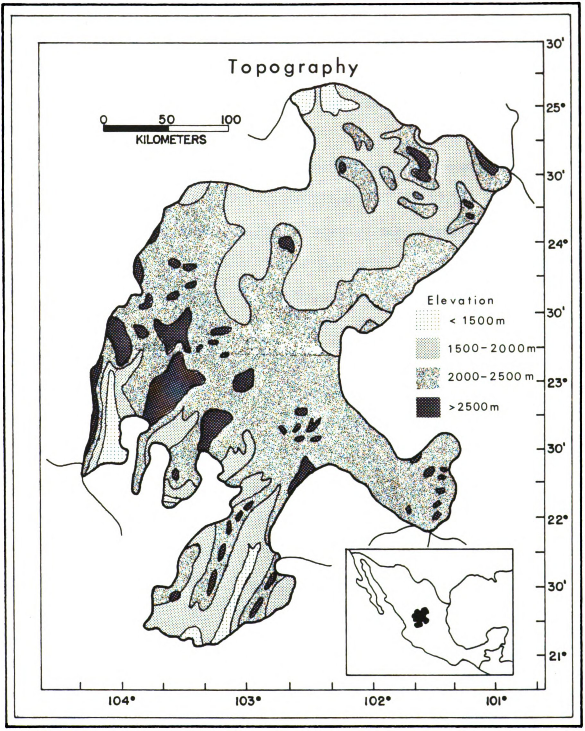

Figure 1. Topographic relief in Zacatecas in intervals of 500 m.

Sierra Madre Oriental. They form a connection between the Sierra Madre Oriental Province and the Sierra Madre Occidental Province in the area of Nasas, Durango. The highest peak (over, 3,000 m) in the Zacatecas portion of the Cross Ranges occurs at the border with Coahuila in the Sierra Antillero (referred to as the Sierra Encarnación by Goldman, 1951, and others).

The western half of Zacatecas lies at elevations mostly above 2,000 m and corresponds to the southern part of the Sierra Madre Occidental Province. Raisz (1964) recognizes two subprovinces of this area, the Eastern Uplands lies to the east of the main mountain mass of the Sierra Madre Occidental and represents an elevated plateau above the Central Mesa. The other subprovince is the Lava (Rhyolite) Plateau which represents the main backbone of the Sierra Madre Occidental. In Zacatecas the Lava Plateau is represented only by fingerlike extensions or isolated mountains of the sierra. In the extreme south and southwest these mountainous areas are cut deep by river canyons which drain the western and southern slopes of the sierra. The area of deep canyons was considered by Rzedowski and McVaugh (1966) to represent a distinct physiographic region they called the "Canyon Region". These canyons form the major western drainage system in Zacatecas. The rivers are all tributaries of the Río Grande de Santiago and include from west to east: The Río Atengo; Río Balaños (including the Río Jérez); and the Río Juchipila.

Climate

Climatic data were summarized from climatological maps (Secretaria de la Presidencia, Comisión de Estudios del Territorio Nacional, 1975) and the published data in Wernstedt (1972) and Soto and Jauregui (1965). These sources provided part of the raw data for the analyses of species distribution (see section on Material and Methods). Only the major climatological patterns are summarized in this section.

Most moisture in Zacatecas is precipitated as rain. Some snow falls during winter months and may occur almost anywhere (except in the extreme Southwest) within the state. Rainfall occurs mainly between June and September with little or no precipitation from November through April or May. Average annual precipitation (Figure 2) ranges from below 250 mm in some areas of the northeast to over 800 mm in the extreme southwest (the Canyon Region). The mountains of the northeast receive considerably more rainfall per year than surrounding areas. This is reflected in the different vegetation (see section on Vegetation).

Temperatures are moderate over most of the state (Figure 3). The coldest areas are found in the mountain regions, the warmest in the Canyon Region of the southwest. All areas in Zacatecas are probably subject to winter frost.

Vegetation

The vegetation of Zacatecas is complex and a comprehensive survey of the flora has not been made. The recent publication by Mata et al. (1971) considers the major vegetation types throughout Mexico. Rzedowski and McVaugh (1966) studied a region defined as "Nueva Galacia" which contained a large portion of southwestern Zacatecas. These two sources provided the primary data base and maps for the description of the vegetation in Zacatecas. In addition, personal

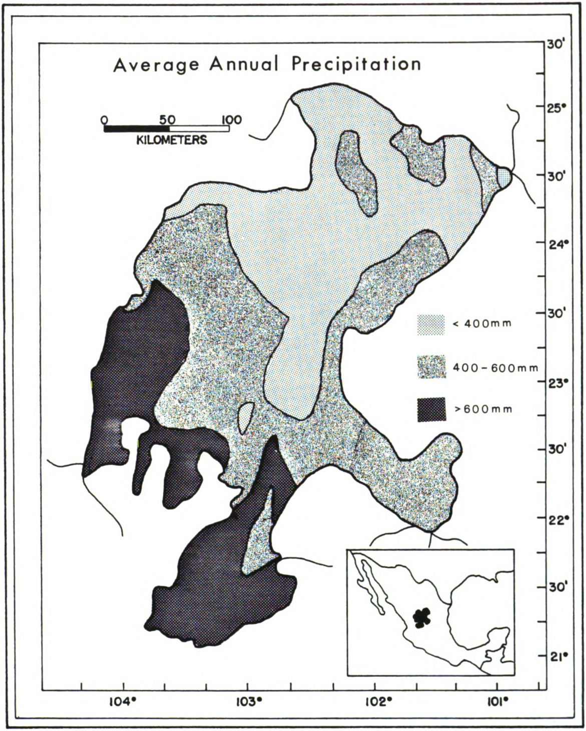

Figure 2. Distribution of Average Annual Precipitation in Zacatecas.

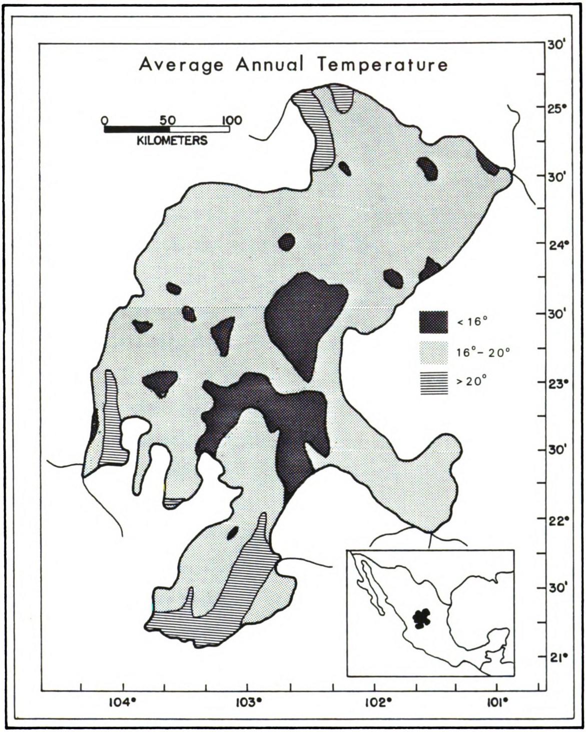

Figure 3. Distribution of Average Annual Temperature in Zacatecas.

observation and reference to Leopold (1950), Gentry (1957), Rzedowski (1957), and Johnston (1978) augmented the primary data. In the following descriptions, I have chosen to recognize six major vegetation types in Zacatecas (Figure 4). In essence, my classification most closely corresponds to that of Rzedowski and McVaugh (1966) with the exception of a Desert Scrub vegetation which they did not consider. The map of major vegetation types in Zacatecas should be considered only as a guide to the limits of the major types. Limits of vegetation are not nearly so clear-cut as the map would indicate.

Desert Scrub. -- This vegetation covers almost the entire northeastern half of Zacatecas. It more or less corresponds to those areas that receive less than 400 mm of precipitation per year.

Mata *et al*. (1971) recognized two distinct types of "desert" vegetation: A Microphyll Desert Scrub dominated by Cresote bush (*Larrea tridentata*) and tarbush (*Flourensia cernua*); and Rosetophyll Desert Scrub dominated by lechuguilla (*Agave lecheguilla*), tree yuccas (*Yucca filifera* and *Y. carnerosana*) and sotol (*Dasylirion* sp.). While Mata *et al*. (1971) recognized and mapped these two types, I have combined the two for simplicity. Besides, Johnston (1978) has shown that these two, along with other community types, represent a rather complex mosaic that is not as simple as Mata *et al*. (1971) have mapped.

Crassicaulescent Scrub. -- This vegetation type lies, for the most part, between the Desert Scrub and Grasslands. It could be considered an ecotone between the two but has sufficiently different plant associates to be assigned a distinct name (Mata *et al*., 1971 and Rzedowski and McVaugh, 1966). Some of its most characteristic plants are nopal cacti (*Opuntia* spp.), cholla (*Opuntia* spp.), catclaw (*Acacia* spp.), and

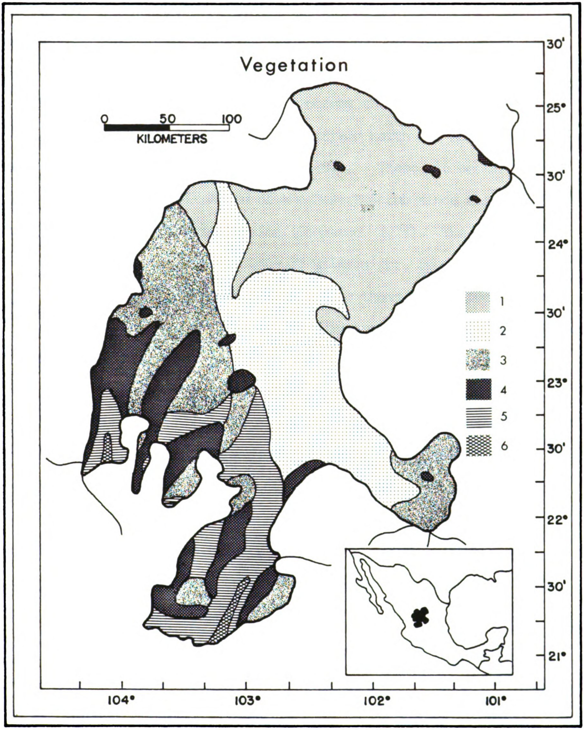

Figure 4. Distribution of major vegetation types in Zacatecas: (1) Desert Scrub; (2) Crassicaulescent Scrub; (3) Grasslands; (4) Montane Forests; (5) Subtropical Scrub; (6) Tropical Deciduous Forests.

an understory of short grasses (e.g., Bouteloua sp.). Leopold (1950) recognized essentially the same vegetation as a subgroup of his Mesquite-Grassland.

Grassland. -- Grasslands mostly occupy the western and southern parts of the state. However, in the extreme north and northeast there are isolated grasslands (Mata et al., 1971). These are better considered as a special situation of the Desert Scrub since they occur in the poorly drained interior basins (Johnston, 1978). The grasses that occur in these isolated areas include Hilaria sp., Sporobolus sp., Distichlis spicata, and Bouteloua sp. Also these areas often support mesquite (Prosopis sp.). They are not differentiated from Desert Scrub vegetation in Figure 4.

The more mesic grasslands of the west and south coincide with isohyets above 400 mm (usually above 500 mm) of average annual precipitation. Dominant grasses include grama grass (Bouteloua gracilis), beard grass (Andropogon sp.), muhly grasses (Muhlenbergia sp.), dropseed (Sporobolus sp.). In some areas the grasslands take on the appearance of a savannah or open woodland with tree acacias (Acacia tortuosa). This was observed in the broad open region above the Río Bolaños south of Monte Escobedo.

Montane Forests. -- Montane forests occur mostly in the western cordillera with a few isolated forests on the mountains in the northeast. For the most part, Montane Forests occur at elevations above 2,300 m.

In the northeast (Cerro de Teyra, 24°32'N-102°10'W, and the mountains surrounding Concepción del Oro, 24°30'N-101°25'W), the forests are composed of pinyon pine (Pinus cembroides), scrub oak (Quercus sp.)

and junipers (Juniperus sp.). In the Sierra Astillero (24°32'N-101°00'N), Johnston (1978) records Douglas fir (Pseudotsuga sp.) and fir (Abies sp.). I did not observe these in my one visit into that mountain range. I saw pinyon pine, oaks and Madrone (Arbutus sp.) at elevations up to about 2,500 m.

Montane Forests in the west and southwest can be pure stands of yellow pine (Pinus sp.), pure stands of various oaks (Quercus spp.) or a mixture of the two (Pine-Oak Forests). I am not aware of any references to fir forests in that part of the state.

Below the Montane Forests there is usually a transition type of vegetation from the lower altitude vegetations to the forests. This is the Chaparral which contain scrub oaks, manzanita (Arctostaphylos sp.) and chamise (Adenostoma fasiculatum). Mata et al. (1971) consider this to be a major vegetation type in Mexico. In Zacatecas it is so limited in extent that I have not included it as a major type.

Subtropical Scrub. -- This vegetation, sometimes called dry or arid tropical scrub, is found in the southwestern part of the state, usually between 1,500 m and 2,000 m. It is dominated by shrubby or thorny plants less than 5 m in height. Common plants include the tree morning glory (Ipomoea sp.), Mimosa sp., Bursera sp., columnar cacti (Pachycereus sp.), and an understory of various grasses (Mata et al., 1971 and Rzedowski and McVaugh, 1966).

Tropical Deciduous Forests. -- The Tropical Deciduous Forest is limited in Zacatecas to the deepest river valleys of the southwest below 1,500 m. Climatically it is characterized by occurring in the warmest, wettest areas. Tree species are usually between 8 m and 15 m in height. During the driest months of the year most, if not all, trees loose their leaves. The common plants occurring in this forest are the same as in the Subtropical Scrub with the addition of fig trees (*Ficus* sp.) and bald cypress (*Taxodium* sp.).

MATERIALS AND METHODS

Species Data

The species of rodents occurring in Zacatecas are the primary units of interest in this study. Data pertaining to each species distribution were obtained via collections housed in various museums, direct field work, or from published records. I have examined the great majority of specimens directly. Data from approximately 6,300 specimens (5,900 specimens examined) representing 46 species have been recorded. In the case of the Mexican ground squirrel, *Spermophilus mexicanus*, I have treated the widely-separated subspecies as distinct species in the analyses of distributional patterns (see the Species Accounts for justification of this usage).

Collecting sites for each species were located on 20'x15' topographic maps (published by the Secretaría de la Presidéncia, Comisión de Estudios del Territorio Nacional, 1975). Localities were plotted directly as recorded on the specimen labels unless the collectors field notes or other available information indicated deviations from the stated locality. For instance, specimens in the LACM labeled as "10 mi SW Concepción del Oro, 7600 ft." were collected by Percy L. Clifton in 1970. In Clifton's field notes, it was noted that this locality was near the small mining village of La Laja. Now, according to the topographic maps, La Laja is only about 5 km southwest of Concepción del Oro (straight line distance). In 1976 I visited this same area; it is about 16 km (10 miles) by road southwest of Concepción del Oro. I interviewed local inhabitants and they recalled that Percy Clifton had been in the area several years earlier. Thus, Clifton's locality is actually only about 5 km southwest of Concepción del Oro. Problems inherent in locality data were discussed by Anderson (1965). I believe that I have identified most of the discrepancies in locality data.

Species are treated individually in the section on Species Accounts. Included are specific notes on distribution, ecology, taxonomy, and a list of specimens examined. In addition to specimens examined, I have also included site records for various sciurid species. These are easily recognized in the field but are sometimes difficult to collect.

Quadrats

For the analyses of distributional patterns, I divided the state of Zacatecas into quadrats based upon the same 20'x15' topographic maps used to plot the species locality data. This grid system represents some 115 quadrats or partial quadrats located in Zacatecas. Of these, there were data available from 73 Quadrats (See Figure 5 for quadrat number system).

Since the quadrats are based upon lines of longitude and latitude, there is some variation in size from north to south. Lines of longitude converge toward the poles; thus, the size of quadrats decreases northward. This difference is only about 3 per cent in total area between the southernmost and northernmost quadrats. It is assumed that

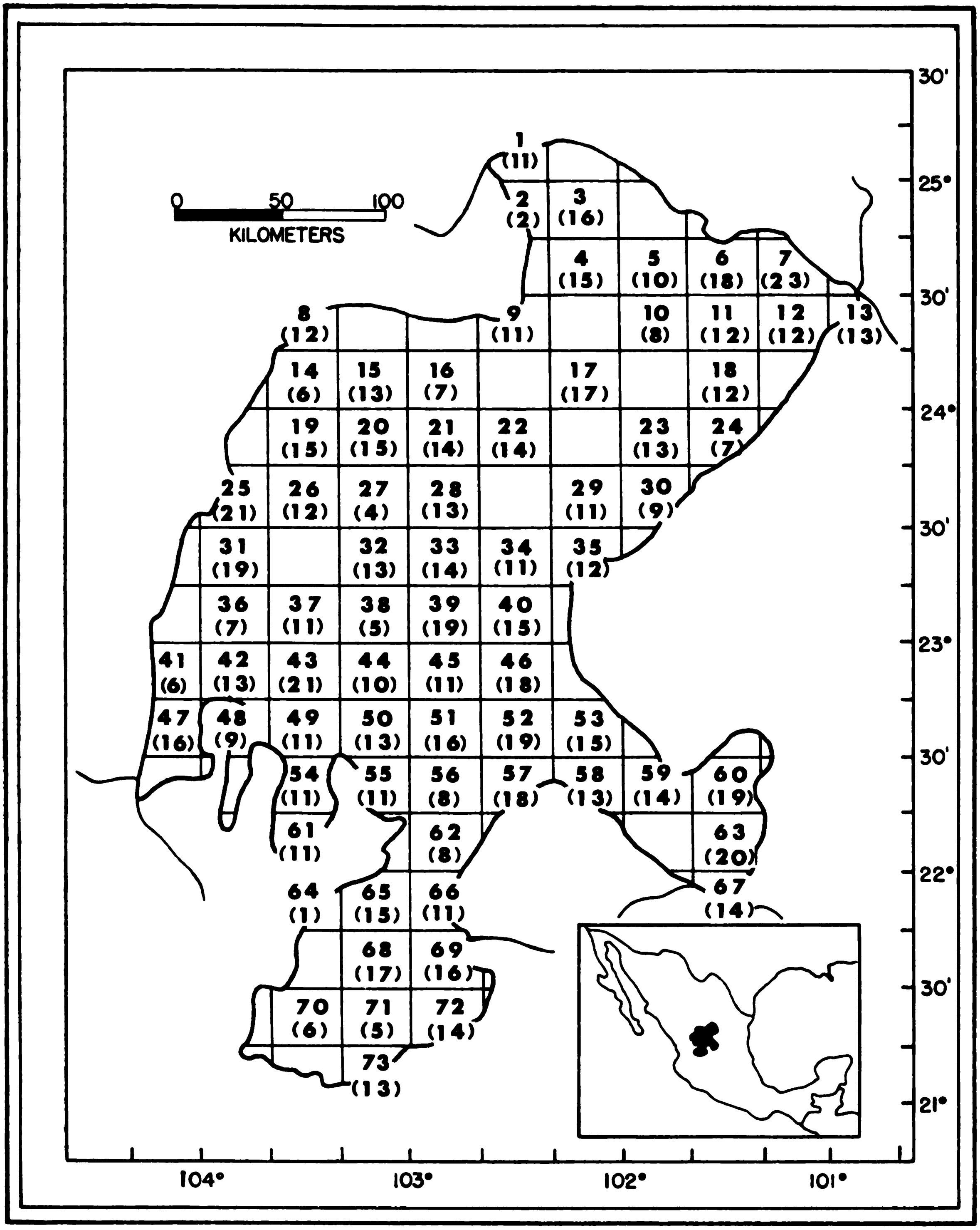

Figure 5. The quadrat numbering system (top number) and number of species per quadrat (bottom number in parentheses).

this difference does not affect the species composition of rodents within any quadrat.

The presence or absence of each rodent species was recorded for each quadrat. Since the political boundaries of Zacatecas are not contained by the quadrat boundaries, I included published data or known specimens from other states for a few of the quadrats. The quadrats thus augmented and references for the species included are as follows: Quadrat 8 (MSU); Quadrat 13 (Dalquest, 1953); Quadrat 48 (Hall and Genoways, 1970; Genoways and Jones, 1973); Quadrat 55 (Schmidly, 1972; Genoways and Jones, 1973); Quadrat 57 (Hooper, 1954, 1955; Lee and Hoffmeister, 1963); Quadrat 67 (Dalquest, 1953); and Quadrat 73 (Baker, 1954; KU). Species recorded for these quadrats are listed in the appropriate Species Accounts.

The number of species in each quadrat ranged from 1 to 23 (Figure 5). It is rather incredible to expect an area of any appreciable size to contain only one species. On the other hand, the quadrat with 23 species occurs in an area of high topographic relief, represented by at least three major vegetation types (see section on Environments of Zacatecas). The problem becomes: which of these 73 quadrats contain sufficient data to make a meaningful analysis? One could make a subjective decision that a quadrat with at least some arbitrary number of species be included in the analysis. However, a more objective decision can be made based upon the mean number of species per quadrat minus some multiple of the standard error. This method would assume a normal distribution of numbers of species among quadrats. A plot of the number of species against quadrats showed that this assumption was not violated by the present data. The mean number of species was 12.50

per quadrat (SE = .53). I elected to subtract 4SE from the mean to arrive at the number of species necessary per quadrat for subsequent analysis. This resulted in 10.38 species per quadrat which was rounded down to 10. Presumably this would insure that all quadrats with at least 10 species would accurately reflect the species composition of the quadrats. Thus, of the 73 quadrats with species data, only 57 were used in the final analysis. These 57 quadrats more or less cover the entire state and should be adequate for an analysis of distributional patterns.

Environmental Data

Data for five environmental variables were included for each of the quadrats analyzed. These included: Average Annual Precipitation (AAP); Average Annual Temperature (AAT); Average Temperature Range (TR); Highest Elevation (EH); and Elevation Range (ER). The two variables for elevation effectively define lowest elevation by subtraction, thus eliminating the redundancy of using a third parameter in the analyses.

The climatic variables are rather tenuous since they are taken from climatic maps (same source as topographic maps) and represent Isohyets and Isotherms drawn from a limited number of climatological stations. Isohyets in each quadrat were averaged to give AAP or data extrapolated from the nearest isohyets. In like manner, isotherms were averaged to give AAT. The difference between the highest and lowest isotherms gave the average temperature ranges for each quadrat. These data are believed to reflect only the major general climatic conditions within a quadrat (See Figures 2 and 3).

The data for the topographic variables (EH and ER) were recorded directly from the specimen labels. In many cases they were originally recorded in feet. These were subsequently converted to meters and rounded to the nearest 10 m. Elevation data were checked against the topographic maps (see Figure 1 for a summary of topographic relief in the state). In no case did I find any gross difference between recorded elevations and elevations on the topographic maps. Some collections did not have elevations recorded; these were given the elevation as plotted on the maps. In no case did these appear to deviate from the elevations recorded for other localities within a quadrat.

Methods of Faunal Analyses

The data matrix upon which the faunal analyses were based consisted of data for 46 rodent distributions and five environmental variables for each of the 57 quadrats. In the analyses, quadrats represent operational taxonomic units (OTU's) in the sense of Sokal and Sneath (1963) while the species and environmental data are the characters. Two different approaches to the analysis of the data were attempted: Cluster Analysis and Factor Analysis. All calculations were run on the CDC 6500 at the Michigan State University Computer Center.

Cluster Analysis. -- Cluster analysis is a means by which OTU's are grouped successively into more inclusive sets (Rohlf, 1970; Sokal and Sneath, 1963; and Sneath and Sokal, 1973). The general method utilized herein is called Hierarchial Clustering (Rohlf, 1970) since it generates a tree or dendrogram which merges the most similar OTU's first, adding less similar OTU's in succession. Ultimately, this results in an hierarchial scheme of OTU classification.

There are several algorithms available for clustering OTU's (for a review, see Sneath and Sokal, 1973). In the present study, the Unweighted Pair Group Method with arithmetic averages (UPGMA) described in Sneath and Sokal (1973) was used. Sneath and Sokal (1973) presented evidence that UPGMA gave the best results when compared with other clustering procedures. The UPGMA was carried out using a program "STRUCTR" written by R. C. Dubes of the MSU Department of Computer Science. Clustering via the UPGMA can be based upon indices of either dissimilarity or similarity. I have used both kinds of indices to perform cluster analysis of the quadrats (OTU's). McIntosh (1973) suggested using more than one measure of association since each coefficient differently assesses the relationships. In these analyses only species data were utilized.

Dissimilarity between OTU's was estimated using the Euclidean distance measure (d) as described by Sneath and Sokal (1973). It is calculated as follows:

$$d_{ij} = \sqrt{\Sigma(X_{ik} - X_{jk})^2}$$

where X_{ik} and X_{jk} represent the k^{th} species in OTU's i and j, respectively. Clustering based upon Euclidean distances groups OTU's with lowest values first (i.e., low values indicate closeness). In this index, only mismatches influence the values. The program "STRUCTR" performs the calculation of Euclidean distances.

Two indices of similarity were utilized: Average Faunal Resemblance (AFR) recommended by Long (1963); and, the Similarity Index

(S) derived by Baroni-Urbani and Buser (1976). The AFR, or some variation of it, is probably the most commonly used index of similarity in current use. It is calculated as follows:

$$AFR = \frac{A(ni + nj)}{2n_i n_j}$$

where A is the number of species held in common between OTU's i and j; and n_i and n_j are the total number of species in OTU's i and j, respectively. This index expresses the similarity of two OTU's as an average of the number of species in common between the two being considered. Both the positive matches (species common to both OTU's) and the mismatches influence the values of this index.

The Similarity Index (S) differs from the previous two indices by including negative matches (i.e., the common absence of species between two OTU's). Baroni-Urbani and Buser (1976) recognize five basic parameters that need to be considered for an index of similarity: (1) the number of species in common between two OTU's, A; (2) the number of species occurring in OTU i but not in OTU j, B; (3) the number of species in j not in i, C; (4) the number of species absent in both OTU's (negative matches) but present in other OTU's of the area being considered, D; and (5) the total number of species in the fauna under investigation, N. They believe that similarity can be expressed completely, only if four of these five parameters are used. They propose the following index:

$$S = \frac{\sqrt{AD} + A}{\sqrt{AD} + A + B + C}$$

where A, B, C, and D are defined above.

Baroni-Urbani and Buser (1976) discussed the concept of including negative matches recognizing that they can be due to inadequate sampling. They further note (p. 253) "But the wrong exclusion of a species from a sample affects both A and D in an equal manner and there are no mathematical methods allowing good conclusions to be drawn from a bad set of data." To be sure the data I have for at least some quadrats are probably not complete. I believe, however, that restricting the analysis to quadrats with at least 10 species minimizes this problem. In addition, I wanted to compare the two methods of estimating similarity.

Baroni-Urbani and Buser (1976) include a table of the distribution of S corresponding to faunas of different sizes based upon a simulation of an infinite number of random sets of data. This table (pp. 256-257) sets confidence limits on S, an advantage that other similarity indices do not have. In other words, the two tails of the distribution can be used to decide whether the S value is significant (i.e., a "true" estimate of the value S) or a random value. In the present study, a probability level of .05 at either end of the distribution corresponds to S values of .36 and .62, respectively, for an N of 46. Values between .37 and .61 can be considered as random values, possibly related to inadequate sampling.

A computer program to compute both AFR and S was written by Edward Rybak. The similarity matrices were then entered into the program STRUCTR for the clustering by UPGMA.

Factor Analysis. -- While the various indices of similarity and clustering techniques can shed light on the classification of similar faunal areas, they do not identify species with similar distributional patterns. Also, at least for the similarity indices, environmental variables cannot be included. These would have to be superimposed in some manner upon the final dendrogram. Factor analysis provides a powerful tool to isolate variables that are correlated and to reduce an original multi-variable data matrix to fewer uncorrelated factors. For reviews of the mathematical procedures involved with factor analysis, see Cooley and Lohnes (1971) and Harris (1975). The techniques, assumptions, and uses of factor analyses as applied to biological data were reviewed by Poole (1971), Fisher (1973), and Orloci (1973).

Factor analysis is a general term for a fairly large number of computational procedures which have in common the goal of reducing a large data matrix into a smaller set of common factors. In deciding which of the many procedures to use, I followed the guidelines suggested by Fisher (1973). He compared the five most common techniques of factor analysis, methods of selecting the number of factors to be extracted, and two methods of rotation to simple structure. Following Fisher's (1973) recommendations, I used a Principle Factor Analysis (PFA) using the squared multiple correlation coefficient of each variable as the diagonal in a correlation (Pearson product-moment correlation matrix) matrix. The data matrix utilized for PFA consisted of 43 rodent distribution and five environmental variables. Three rodent species had to be deleted from the analysis since they occurred in only one quadrat each. These were: Liomys pictus, Quadrat 47; Peromyscus hooperi, Quadrat 7; and Peromyscus melanotis, Quadrat 42. An initial factor matrix of 48 principle axes (factors) was extracted. I used this initial factor matrix to determine the number of factors to be extracted and rotated according to the procedures outlined by Fisher

(1968, 1973). The sum of the eigenvalues for each factor was plotted against the factor number, on log-log paper. The curve is straight until factor VII then the slope of the line changes abruptly. This indicates that seven factors is a good estimate of the relevant common factors in the data set. I also extracted 10 factors and rotated these but too many variables had loadings on the factors near zero, indicating that 10 factors were too many (Fisher, 1973). On the other hand, five factors did not summarize the data sufficiently to be useful. The seven factors accounted for 60.9 per cent of the total variation and 66.1 per cent of the common variation.

Rotating the initial factor matrix is a means by which the matrix is simplified for easier interpretation (Cooley and Lohnes; 1971, Davis, 1973). Two main procedures are available: orthogonal and oblique rotations. Fisher (1973) found no basis upon which to prefer one over the other. He suggested that both be attempted, compare the results, and select the technique that gives the most easily interpretable results. I tried both methods and each gave biologically meaningful results. In fact, each method gave somewhat similar results. However, I found that the orthogonal rotation gave what I believe to be the most easily interpretable factor matrix. Therefore, I used this method of rotation for the present study. The only other analyses of species distributions that I am aware of used only the oblique rotational procedures (Fisher, 1968; Smith and Fisher, 1970; Stevenson et al., 1974; Schnell et al., 1977). All factor analytic procedures were accomplished using the SPSS routine FACTOR with Varimax rotation described in Nie et al. (1975).

The loadings of variables onto each rotated factor are essentially correlation coefficients of those variables with the factor (Poole, 1971). As such, the loadings can be used as indices of the importance of a variable to a factor. Smith and Fisher (1970) used loadings of .300 (positive or negative) as limits for inclusion of a variable into a "Factor Group" (i.e., identifying variables with factors). Stevenson et al. (1974) and Schnell et al. (1977), on the other hand, used loadings of .400 to identify variables associated with a particular factor. As pointed out by Smith and Fisher (1970), this is an arbitrary aspect of factor analysis. I considered both .300 and .400 as well as .500 as cut-off points for variables associated with a factor. I found that variable loadings of .400 gave what appeared to be the most intuitively satisfying results in the present study.

Factor scores for each quadrat were computed using the standardized data matrix and the complete estimation method described in SPSS (Nie et al., 1975). Each quadrat can then be given a composite value on each factor. This score allows the quadrats to be ordinated with respect to their species composition and the environmental variables on each factor. The factors are then named or identified on the basis of the major habitat areas defined by the loadings of variables and factor scores of the quadrats.

RESULTS

Cluster Analysis

Dendrograms resulting from the UPGMA of d, AFR, and S matrices of species distributions are presented in Figures 6 to 8. Generally, all three indices produced rather similar clusters of quadrats. Most differences were simple reversals of order of entry into a cluster. For example, in the dendrogram of d and S values (Figures 6 and 8), a cluster of Quadrats 8 and 20 was joined next by Quadrat 39. However, in the dendrogram of AFR values (Figure 7), the initial cluster was of Quadrats 20 and 39 joined next by Quadrat 8. This kind of difference between dendrograms is considered a minor one. On the other hand, a few major differences occurred which involved shifts of one or more quadrats between clusters. For example, in both d and S dendrograms a cluster of three Quadrats (8, 20, and 39) can be discerned. This same cluster can be seen in the AFR dendrogram but with the addition of Quadrat 21. This quadrat formed a separate cluster with Quadrats 3 and 17 in the d and S dendrograms (discussed more fully below). Another major shift involved Quadrat 7 which in the d dendrogram is very distinct, not joining with a cluster until far down the tree. In both the AFR and S dendrograms, Quadrat 7 forms a cluster with Quadrats 4 and 6. Reasons for these (and other) major differences between dendrograms are not readily apparent. Presumably, they would have to do with the

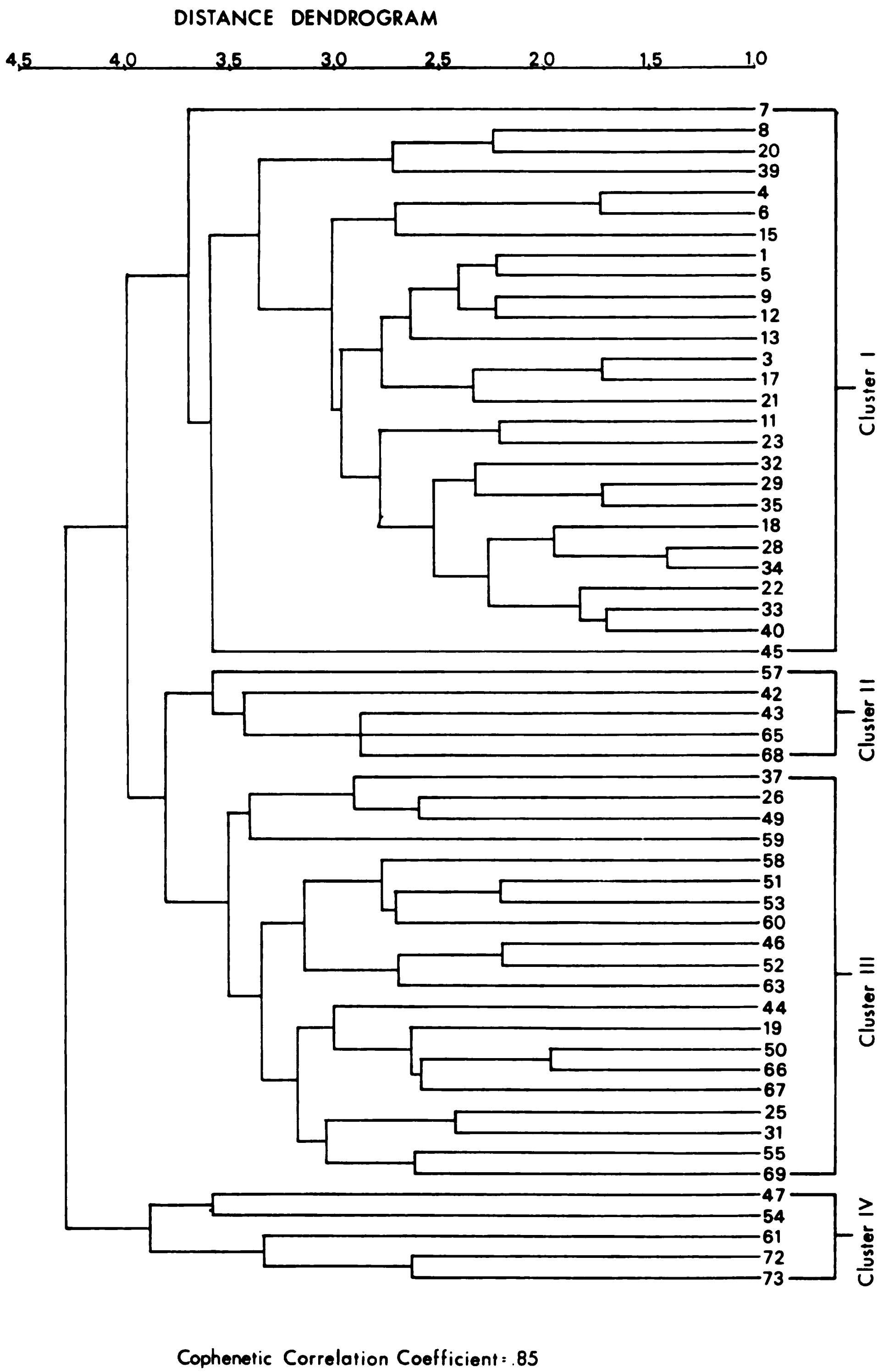

Figure 6. Dendrogram of quadrats (number on right) based upon UPGMA clustering of the distance index and showing the four major clusters.

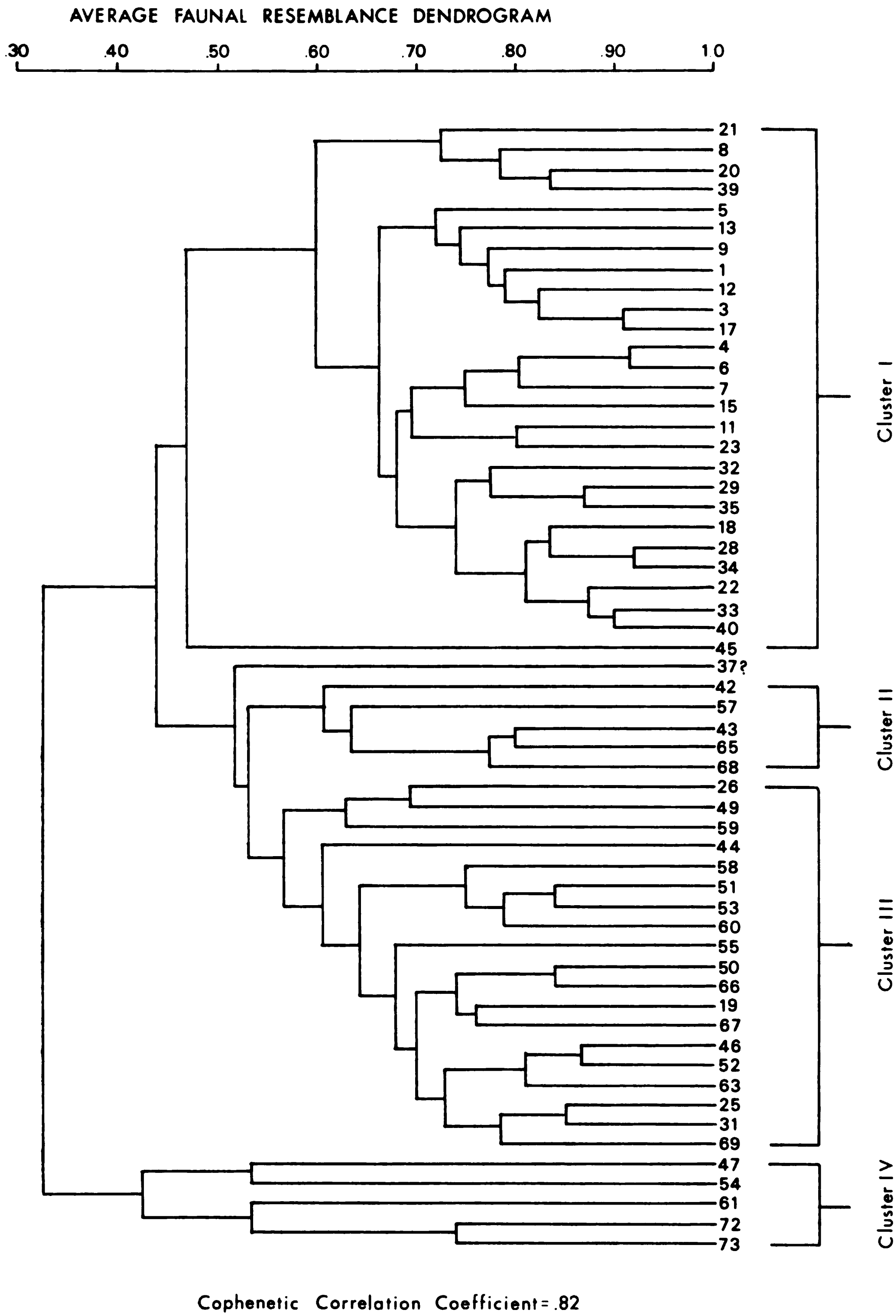

Figure 7. Dendrogram of quadrats (number on right) based upon UPGMA clustering of the Average Faunal Resemblance index and showing the four major clusters.

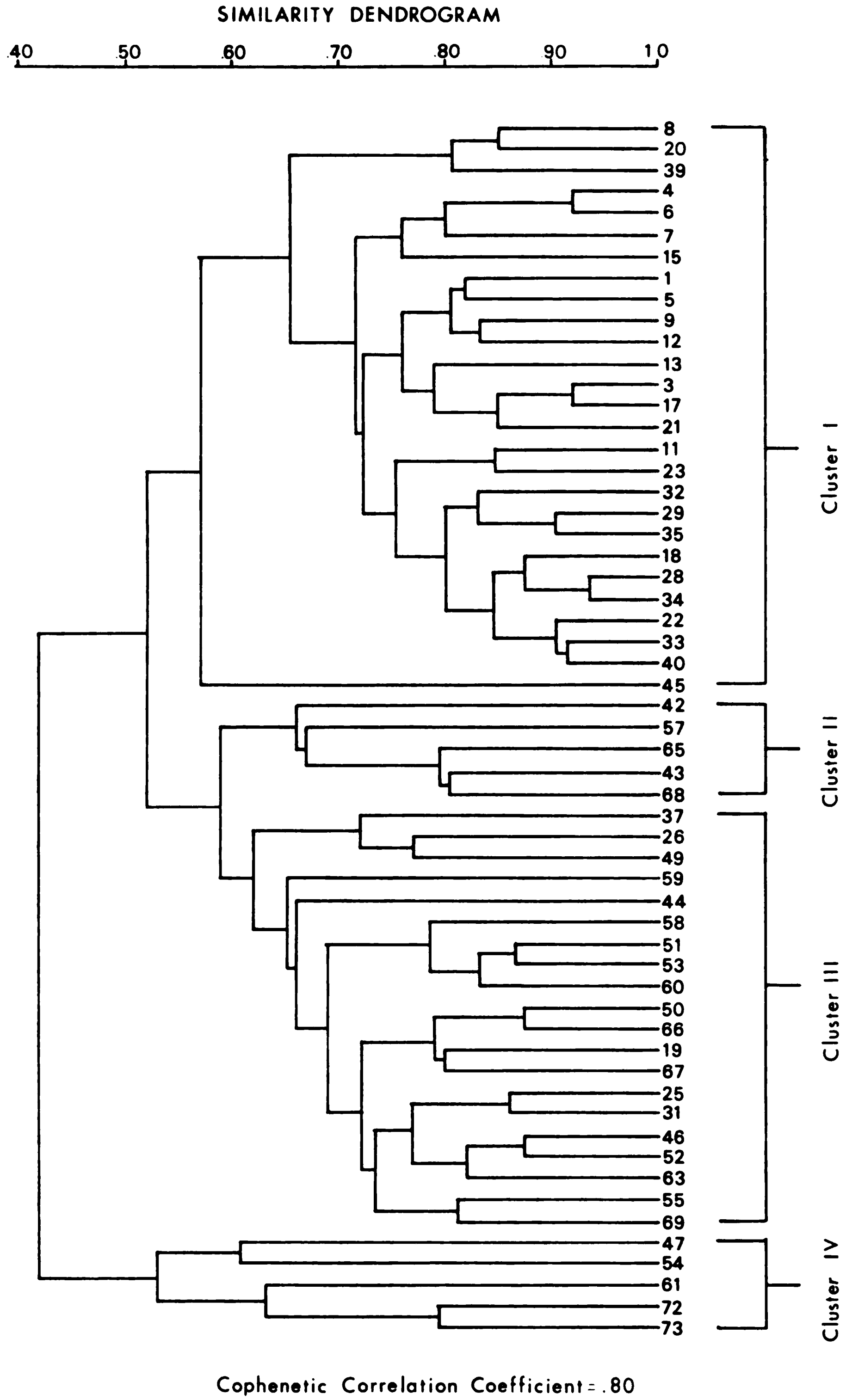

Figure 8. Dendrogram of quadrats (number on right) based upon UPGMA clustering of the similarity index and showing the four major clusters.

nature of the original similarity or dissimilarity matrices, since the same clustering technique was used to produce all three dendrograms.

Which of the three dendrograms produces the "best" clustering of quadrats? By "best" I mean the grouping of quadrats into a meaningful biogeographic classification (the recognition of fanual areas). Sneath and Sokal (1973) suggested that the best classification would be the one which most closely represented the original similarity (or dissimilarity matrix). They suggested using the cophenetic correlation coefficient (CC) as a basis for deciding which classification (or dendrogram) was best. In the present study, the CC for the d dendrogram was .85, while AFR and S dendrograms had CC values of .82 and .80, respectively. Thus, using the criteria of Sneath and Sokal (1973), the dendrogram of d values would be the best of the three. However, both AFR and S are reasonable dendrograms and the CC's of these are not too different from that of d. In addition, some of the clusters produced by both AFR and S are intuitively more reasonable for biogeographical classification than those produced by the d dendrogram (e.g., the relationship between Quadrats 4, 6, and 7).

There is no generally accepted method of determining the cut-off points for recognition of distinct clusters. Since all three dendrograms gave reasonable CC values, I critically inspected and compared the three dendrograms. I used two criteria to define clusters, as follows: (1) within a dendrogram the similarity values were approximately the same for each cluster; (2) the same clusters were common to the three dendrograms. From this comparison, I was able to recognize four major clusters in common between the three dendrograms. These four major clusters more or less correspond to the major geographic and vegetational areas within the state. Subclusters within these major clusters do not show the same congruence between dendrograms. Certain of these subclusters will be discussed later. The four major clusters and rodent species restricted to them are as follows:

Cluster I. -- Cluster I is defined by the following values on each dendrogram: d, 3.6-3.7; AFR, .60; and S, .65. This cluster of quadrats corresponds to the eastern half of Zacatecas. It includes areas of vegetation described earlier as Desert Scrub (including the atypical grasslands), Crassicaulescent Scrub (in part), and the Montane Forests of the north and northeast. Physiographically, it includes the Central Mesa and Cross Ranges. Cluster I has the greatest number of species associated with it. These are *Spermophilus mexicanus parvidens*, *Cynomys mexicanus*, *Thomomys bottae*, *Pappogeomys castanops*, *Perognathus penicillatus*, *Dipodomys nelsoni*, *Peromyscus eremicus*, and *P. hooperi*. Only four of these species (*P. castanops*, *P. penicillatus*, *D. nelsoni*, and *P. eremicus*) are regularly found throughout the area defined by Cluster I.

Cluster II. -- This cluster is defined by the following values: d, 3.6; AFR, .61; and S, .66. It corresponds, in part, to the Montane Forests of the west. Other quadrats that have western Montane Forests are defined in other clusters. Only one rodent species is confined to this cluster (*Peromyscus melanotis*) and it is found only in Quadrat 42. Other rodents that would normally be considered part of the Montane Forest habitat cannot be included since they are not restricted to this cluster. This represents one of the problems associated with cluster analysis.

Cluster III. -- This cluster is defined by the following values: d, 3.5; AFR, .57; and S, .62. It includes quadrats of the west and south that correspond to Grassland, and in part to Crassicaulescent Scrub and Subtropical Scrub vegetations. It is essentially the Eastern Upland Subprovince of the Sierra Madre Occidental Province. Subclusters within this cluster are more heterogeneous than can be observed in Cluster I. There are no species of rodent completely confined to this cluster.

Cluster IV. -- The last cluster is defined by the following values: d, 3.9; AFR, .42; and S, .54. The high d value and low AFR and S values indicated that this cluster is the most heterogeneous of the four. It essentially corresponds to areas of Tropical Deciduous Forests, and in part to Montane Forests, Grasslands, and Subtropical Scrub vegetations. The main common feature that quadrats have in this cluster is their geographic position associated with the Canyon Region of the south and southwest. Thus the cluster heterogeneity can be explained by the great amount of environmental diversity associated with the Canyon Region. Six species of rodents are restricted to this cluster: *Spermophilus mexicanus mexicanus*, *Sciurus*, *aureogaster*, *Liomys pictus*, *Peromyscus spicilegus*, *Sigmodon mascotensis*, and *Neotoma palatina*.

An interesting situation occurs with Quadrat 45 which was only weakly linked to Cluster I in all three dendrograms. Because of its geographical location, Quadrat 45 could be considered an area of ecotone between Clusters I and II. Also, in the AFR dendrogram, Quadrat 37 was only weakly linked to Clusters II and III. It would appear to be an ecotone between these two clusters. However, recognition of ecotonal areas are not as easily discernable by cluster analysis as they would be with an ordination technique (see below).

Factor Analysis

The seven factors extracted from the original data matrix group the rodent distributional and environmental variables into what I believe to be meaningful patterns. Factor analysis overcomes some of the inadequacies of clustering techniques to recognize associated species distributions and environmental variables. However, this is accomplished at the expense of not always being able to distinctly recognize groups of quadrats as faunal areas.

Results of the factor analysis are given in Tables 1 to 7 and in Figures 9 to 15. Variable loadings associated with each factor are essentially correlation coefficients indicating the relative contribution of each variable to a factor. Since a variable loading of .40 or greater was arbitrarily selected as the inclusion limit for a variable to a factor, it allows for a variable to be associated with more than one factor. Some rodent species did not have loadings of .40 or above on any factor. These species can be considered as representative or independent distributions. They are listed with the factor to which they have the highest correlation.

Factor scores computed for each quadrat were grouped into three classes representing low, intermediate, and high score, respectively, as follows: -1.00 or less; -.99 to +.99; and +1.00 or greater. These three classes allowed for easy interpretation of scores since the scores were computed from standardized data matrix. Thus the scores themselves are standardized to have mean zero and standard deviation of one. In all cases, high positive scores were easily interpreted in association with a given factor. With the exception of Factor I, negative scores were interpreted simply as "not being associated" with the positive scores.

The distributional patterns explained by the seven factors more or less correspond to major geographical and/or vegetational areas in the state. Factor VII was the only one that was not associated with a definite geographical or vegetational pattern. The seven factors are as follows:

Factor I: Desert versus Grassland Habitats. -- Seventeen species of rodents and three environmental variables were associated with Factor I (Table 1). The four highest loadings are negative and the species involved are usually considered to be desert inhabiting species (Table 1; compare these four with the species associated with Cluster I in the section on Cluster Analysis). The rodents that have high positive loading are usually associated with grassland though not necessarily restricted to it. *Peromyscus truei* has usually been considered a montane species but one with a highly diverse habitat range (Baker and Greer, 1962). In the present analysis, *P. truei* had its highest correlation with Factor I and does not load at .40 or above on any other Factor. This would indicate that, at least in Zacatecas, *P. truei* might best be considered associated with grassland (it was also found in montane areas).

Five species have their highest, although less than .40 loading on Factor I. Both *Spermophilus mexicanus parvidens* and *Perognathus lineatus* are known from only two quadrats each (see Species Accounts). Their low correlations may reflect either insufficient data to

TABLE 1

VARIABLES ASSOCIATED WITH FACTOR I: DESERT VS GRASSLAND HABITATS[1,2]

-.77	*Pappogeomys castanops*
-.75	*Dipodomys nelsoni*
-.69	*Perognathus penicillatus*
-.66	*Peromyscus eremicus*
+.62	*Dipodomys phillipsii*
+.58	*Peromyscus truei*
(-.54)	*Dipodomys merriami*
(+.52)	*Thomomys umbrinus*
+.52	Elevation High (+.62 on II)
+.51	*Spermophilus variegatus*
(+.50)	*Perognathus hispidus*
+.50	*Liomys irroratus* (+.56 on VII)
(+.46)	Average Annual Precipitation (+.48 on II)
-.45	Average Annual Temperature (+.55 on VII)
+.43	*Reithrodontomys megalotis*
+.39	*Reithrodontomys fulvescens*
+.36	*Sigmodon fulviventer*
-.35	*Spermophilus mexicanus parvidens*
+.30	*Perognathus flavus*
+.22	*Perognathus lineatus*

[1]Loadings associated with a variable are given on the left. Those loadings enclosed with parentheses indicate that a variable is also associated with another factor. Variables followed by parentheses indicate higher loadings on another factor.

[2]Variables with loadings below .40 are given only when that variable does not load any higher on another factor.

characterize their distributions or that their distributions are independent. On the other hand, Reithrodontomys fulvescens, Sigmodon fulviventer, and Perognathus flavus are known from a number of quadrats throughout the state. This would indicate that the distributions of these species are independent.

Four species (Dipodomys merriami, Thomomys umbrinus, Perognathus hispidus, and Liomys irroratus) were also associated with other factors.

The three environmental variables associated with Factor I were those that more or less correspond to differences between Desert Scrub and Grassland Vegetations. Elevation High and Average Annual Precipitation load positively, thus in the same direction as the grassland rodent species complex. Average Annual Temperature loads negatively indicating the relatively higher temperatures associated with the eastern (Desert Scrub vegetation) part of the state. All environmental variables had higher associations with other factors.

The map of factor scores (Figure 9) indicates the geographic separation of high and low scores. High scores were concentrated in the west and south in areas corresponding in part to Grassland, Crassicaulescent Scrub, and Subtropical Scrub vegetations (compare with Figure 4). Low scores, for the most part, were in quadrats that had Desert Scrub vegetation.

Factor II: Western Montane Habitats. -- Eight rodent distribution and four envirionmental variables were associated with Factor II (Table 2). All variable loadings were positive. The four highest loadings were with species that are restricted to areas associated with Montane Forests. Neotoma mexicana and Peromyscus difficilis had their highest

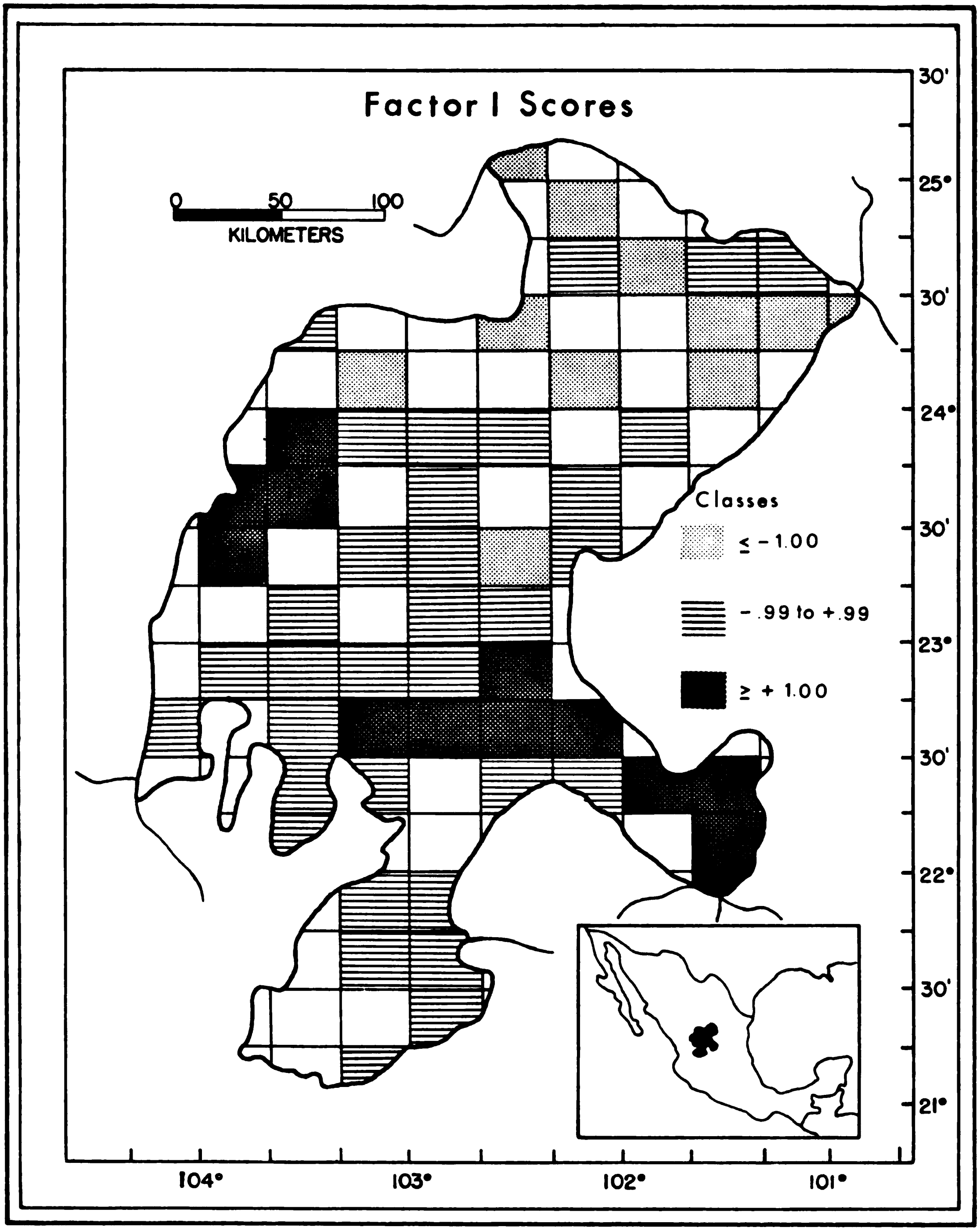

Figure 9. Distribution of the three classes of factor scores for Factor I in Zacatecas. Factor scores ranged from -2.64 to +1.96.

TABLE 2

VARIABLES ASSOCIATED WITH FACTOR II:
WESTERN MONTANE HABITATS[1,2]

+.84	Nelsonia neotomodon
+.72	Sigmodon leucotis
+.72	Sciurus nayaritensis
+.64	Eutamias bulleri
(+.64)	Neotoma mexicana
(+.62)	Elevation High
(+.56)	Elevation Range
(+.56)	Peromyscus difficilis
+.49	Peromyscus boylii (-.51 on V)
(+.48)	Average Annual Precipitation
+.48	Thomomys umbrinus (+.52 on I)
+.40	Temperature Range (+.45 on III)

[1]Loadings associated with a variable are given on the left. Those loadings enclosed with parentheses indicate that a variable is also associated with another factor. Variables followed by parentheses indicate higher loadings on another factor.

[2]Variables with loadings below .40 are given only when that variable does not load any higher on another factor.

loadings on this factor but were also associated with other factors. Both Peromyscus boylii and Thomomys umbrinus had higher loadings on other factors.

Of the environmental variables, Elevation High, Elevation Range, and Average Annual Precipitation all had their highest loadings on Factor II. These variables correspond to what one might expect in montane areas. Temperature Range was also associated with this factor but had a higher loading on Factor III.

Quadrats with high factor scores are found in areas of the west and southwest that have Montane Forests (Figure 10, compare with Figure 4).

Factor III: Cross Ranges Habitats. -- Four rodent distribution and two environmental variables were associated with Factor III (Table 3). Three of the rodents had their highest loadings on this factor while the fourth had a higher loading on Factor II. Both Thomomys bottae and Cynomys mexicanus have distributions in Zacatecas restricted to the Cross Ranges Subprovince (T. bottae to the mountains specifically and C. mexicanus to the intermontane valleys).

The two environmental variables (Temperature Range and Elevation Range) are indicative of desert mountain areas.

Factor scores above +1.00 are restricted to the three quadrats in the northeast (Figure 11) that correspond to the Cross Ranges described in the section on Physiography and Topography.

Factor IV: Canyon Region Habitats. -- Five rodent species and two environmental variables were correlated with Factor IV (Table 4). With the exception of Spermophilus spilosoma, all species load positively on this factor. Three species, Neotoma palatina, Sigmodon mascotensis,

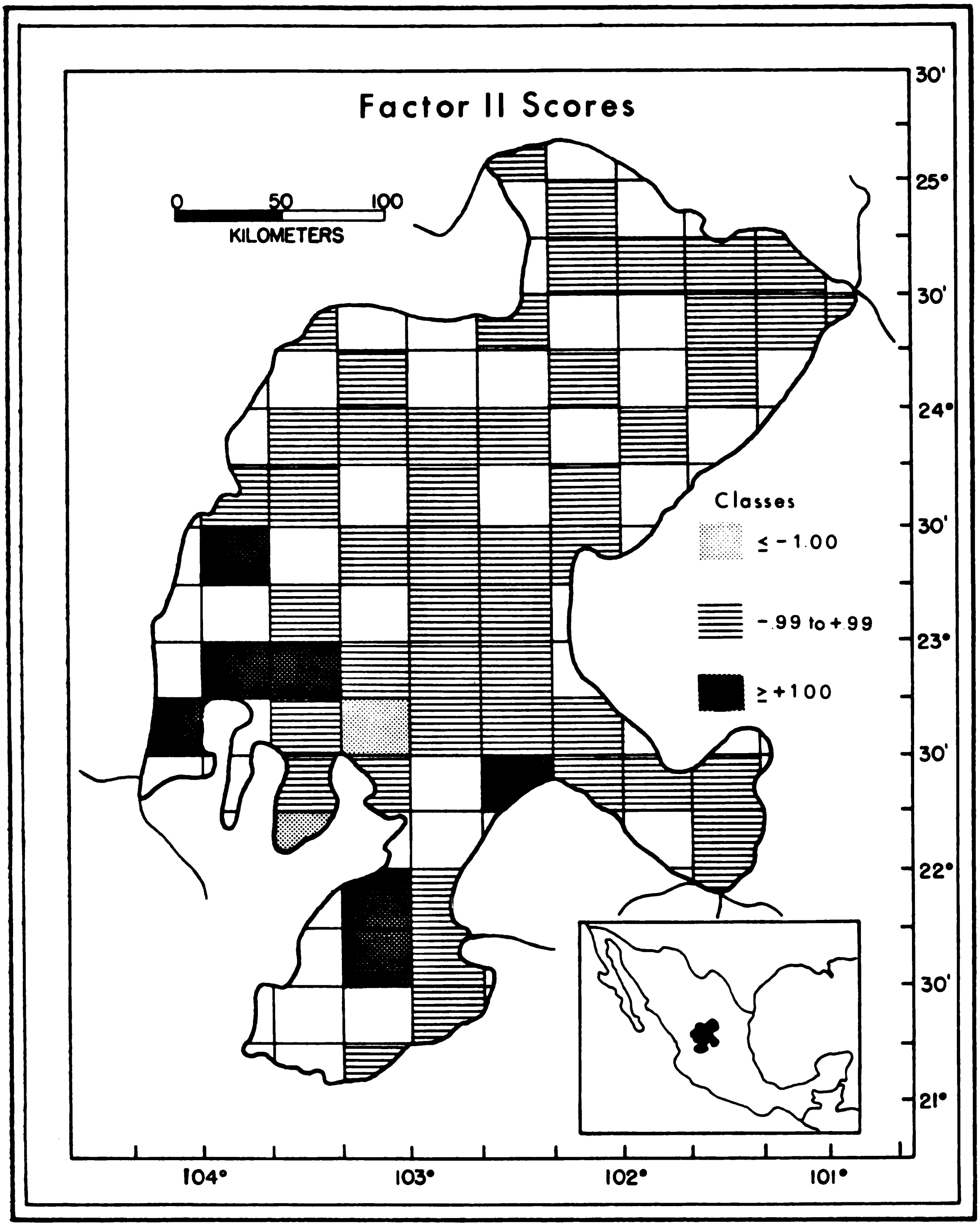

Figure 10. Distribution of the three classes of factor scores for Factor II in Zacatecas. Factor scores ranged from -1.46 to +2.81.

TABLE 3

VARIABLES ASSOCIATED WITH FACTOR III:
CROSS RANGES HABITATS[1,2]

+.78	Thomomys bottae
+.61	Neotoma goldmani
(+.45)	Temperature Range
+.44	Cynomys mexicanus
+.41	Elevation Range (+.56 on II; +.52 on IV)
+.40	Peromyscus difficilis (+.56 on II)

[1]Loadings associated with a variable are given on the left. Those loadings enclosed with parentheses indicate that a variable is also associated with another factor. Variables followed by parentheses indicate higher loadings on another factor.

[2]Variables with loadings below .40 are given only when that variable does not load any higher on another factor.

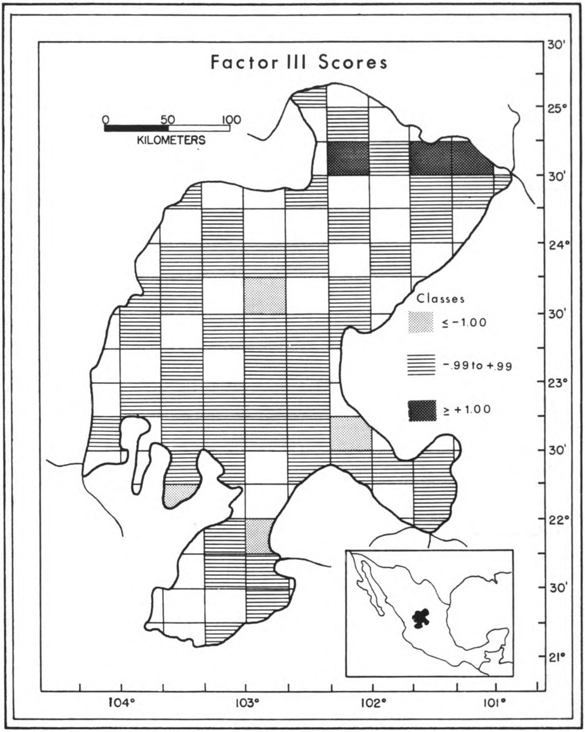

Figure 11. Distribution of the three classes of factor scores for Factor III in Zacatecas. Factor scores ranged from -1.58 to +4.30.

TABLE 4

VARIABLES ASSOCIATED WITH FACTOR IV: CANYON REGION HABITATS[1,2]

+.78	Neotoma palatina
+.76	Sigmodon mascotensis
(+.52)	Elevation Range (+.56 on II)
+.50	Peromyscus pectoralis
-.42	Spermophilus spilosoma (+.45 on V)
+.41	Spermophilis mexicanus mexicanus
(+.41)	Average Annual Precipitation (+.48 on II; +.46 on I)

[1]Loadings associated with a variable are given on the left. Those loadings enclosed with parentheses indicate that a variable is also associated with another factor. Variables followed by parentheses indicate higher loadings on another factor.

[2]Variables with loadings below .40 are given only when that variable does not load any higher on another factor.

and Spermophilus mexicanus mexicanus, are restricted to the Canyon Regions. Peromyscus pectoralis is widely distributed in Zacatecas but does not load above .40 on any other factor.

Of the two environmental variables, Elevation Range would be most indicative of the Canyon Region while Average Annual Precipitation corresponds to the tropical vegetation of the canyon bottoms.

High factor scores were associated with the quadrats of the Canyon Region described in the section on Physiography and Topography (Figure 12).

Factor V: Desert-Grassland Ecotone. -- Nine rodent distribution and one environmental variables were associated with Factor V (Table 5). Positive loadings were obtained for seven of the nine rodents. Only Dipodomys merriami had a higher, although negative, loading on another factor. These seven species have in common distributions in Desert Scrub, Grassland, and Crassicaulescent Scrub vegetations more or less centered in the central and east central part of the state. The two negative loading species (Peromyscus boylii and Baiomys taylori) have distributions more to the west and south.

The single environmental variable (Average Annual Precipitation) associated with Factor V had higher loadings on other factors. It would more or less correspond to the increased rainfall of the west as opposed to the eastern part of the state.

Factor scores for each quadrat show the highest values in areas that would correspond to an ecotone between grassland and desert habitats (Figure 13).

Factor VI: Southern Canyons Habitats. -- Five rodent species but no environmental variables were associated with Factor VI (Table 6).

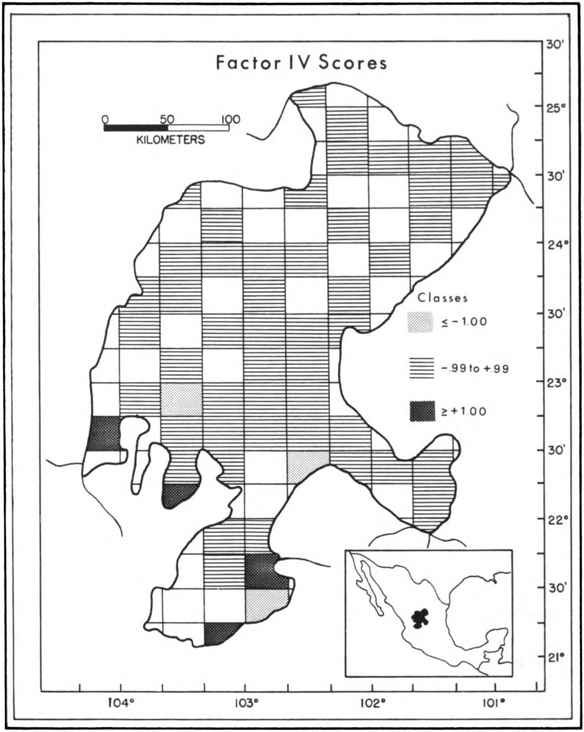

Figure 12. Distribution of the three classes of factor scores for Factor IV in Zacatecas. Factor scores ranged from -1.22 to +4.36.

TABLE 5

VARIABLES ASSOCIATED WITH FACTOR V:
DESERT-GRASSLAND ECOTONE[1,2]

+.67	*Dipodomys spectabilis*
+.64	*Dipodomys ordii*
+.57	*Onychomys torridus*
+.51	*Perognathus nelsoni*
(-.51)	*Peromyscus boylii*
+.50	*Dipodomys merriami* (-.54 on I)
-.46	*Baiomys taylori*
(+.45)	*Spermophilus spilosoma*
(-.41)	Average Annual Precipitation (+.48 on II; +.46 on I)
+.40	*Peromyscus melanophrys*

[1]Loadings associated with a variable are given on the left. Those loadings enclosed with parentheses indicate that a variable is also associated with another factor. Variables followed by parentheses indicate higher loadings on another factor.

[2]Variables with loadings below .40 are given only when that variable does not load any higher on another factor.

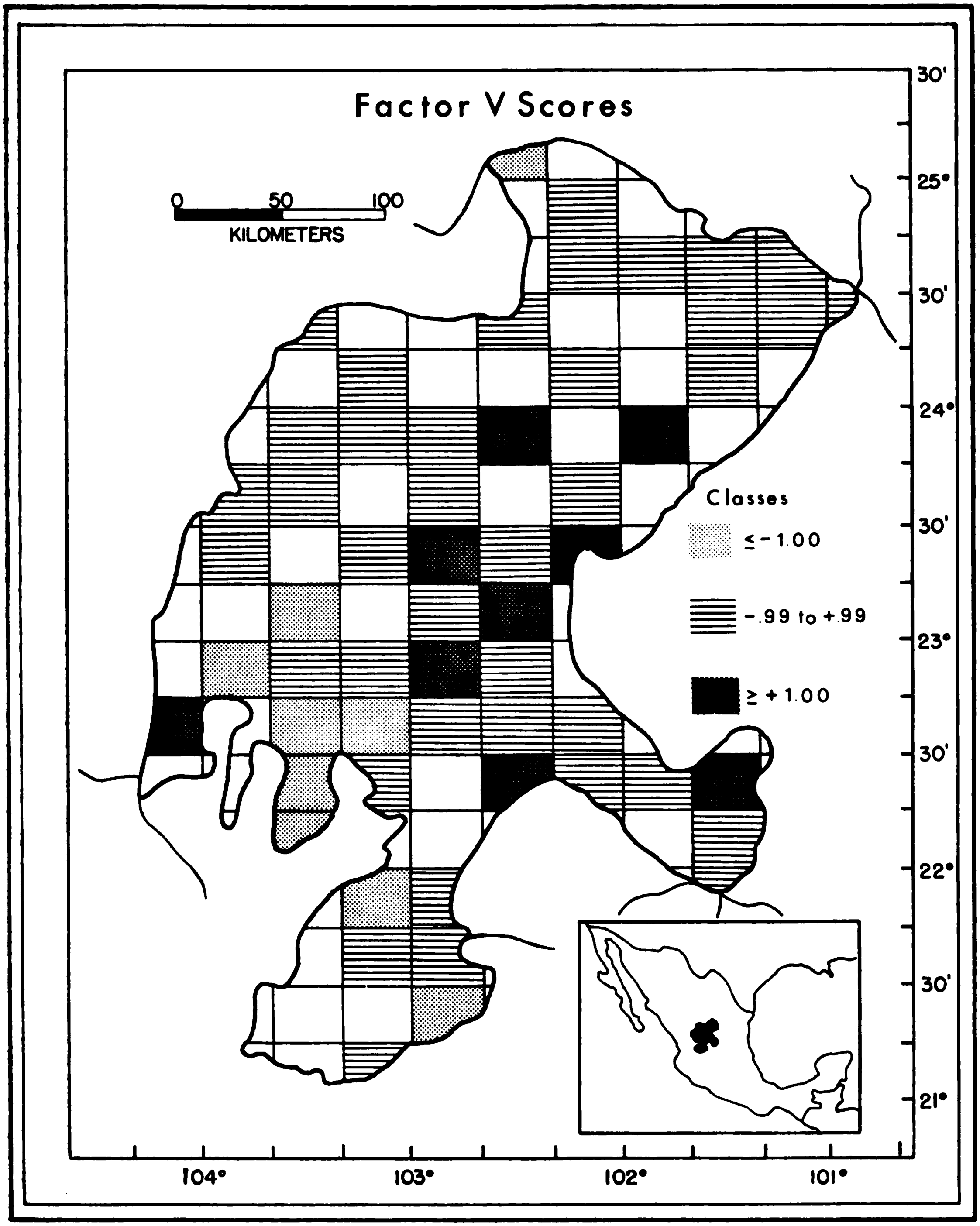

Figure 13. Distribution of the three classes of factor scores for Factor V in Zacatecas. Factor scores ranged from -2.65 to +2.22.

TABLE 6

VARIABLES ASSOCIATED WITH FACTOR VI:
SOUTHERN CANYONS HABITATS[1,2]

+.94	Sciurus aureogaster
+.82	Peromyscus spicilegus
-.43	Peromyscus maniculatus
+.40	Neotoma mexicana (+.64 on II)
-.35	Neotoma albigula

[1]Loadings associated with a variable are given on the left. Those loadings enclosed with parentheses indicate that a variable is also associated with another factor. Variables followed by parentheses indicate higher loadings on another factor.

[2]Variables with loadings below .40 are given only when that variable does not load any higher on another factor.

Three of the five species load positive with the greatest influence from Sciurus aureogaster and Peromyscus spicilegus. Neotoma mexicana loads low on this factor having more influence on Factor II. Peromyscus maniculatus was negatively associated with Factor IV. It is a widespread species but was absent from the two quadrats that had high factor scores (Figure 14). Neotoma albigula is only loosely associated with Factor VI. Its widespread distribution in Zacatecas and low loading on all factors would indicate an independent pattern for this species.

The high factor scores for two of the southernmost quadrats (Figure 14) reflects the influence of S. aureogaster on Factor VI. This species is known only from these two quadrats.

Factor VII: Sigmodon hispidus-Liomys irroratus Complex. -- Three rodent species and one environmental variables were associated with Factor VII (Table 7). Both Sigmodon hispidus and Liomys irroratus had their highest loadings on this factor. Perognathus hispidus had a higher loading on Factor I. Average Annual Temperature had its highest loading on Factor VII but was also associated with Factor I.

Factor scores for the quadrats (Figure 15) do not show any particular geographic association. Thus, this factor seems to be associated with the unique distributional patterns of the species involved. One common denominator that was found is an association with mesic or riparian situations (see Discussions below).

Of the 57 quadrats analyzed, only six did not score high on any factor. These are considered to be associated with the factor for which they had their highest scores. Quadrats 28 and 32 with scores of +.60 and +.42 on Factor V, respectively, are considered to be a part of

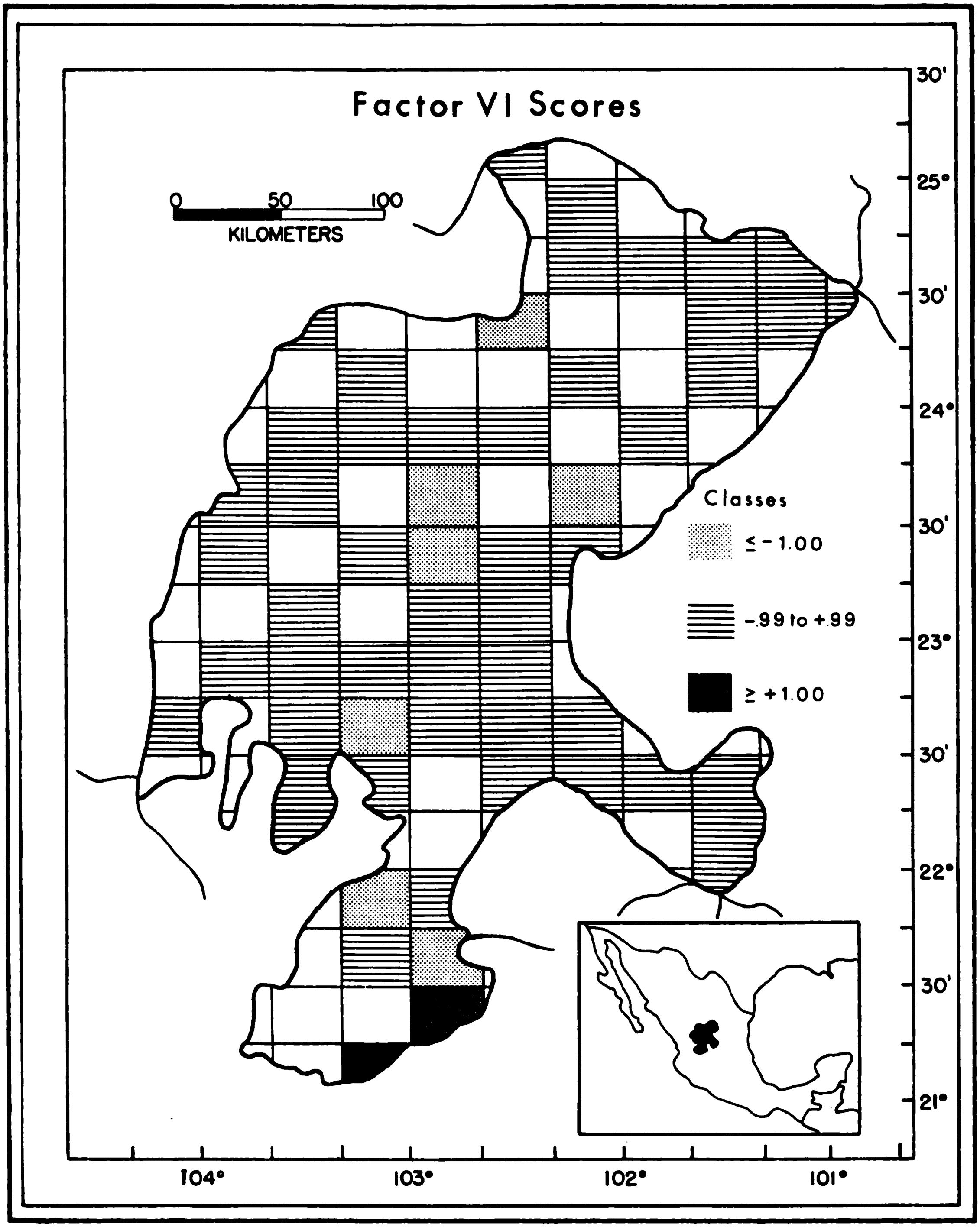

Figure 14. Distribution of the three classes of factor scores for Factor VI in Zacatecas. Factor scores ranged from -1.71 to +5.26.

TABLE 7

VARIABLES ASSOCIATED WITH FACTOR VII:
SIGMODON HISPIDUS-*LIOMYS IRRORATUS* COMPLEX[1, 2]

+.65	*Sigmodon hispidus*
(+.56)	*Liomys irroratus*
(+.55)	Average Annual Temperature
+.43	*Perognathus hispidus* (+.50 on I)

[1]Loadings associated with a variable are given on the left. Those loadings enclosed with parentheses indicate that a variable is also associated with another factor. Variables followed by parentheses indicate higher loadings on another factor.

[2]Variables with loadings below .40 are given only when that variable does not load any higher on another factor.

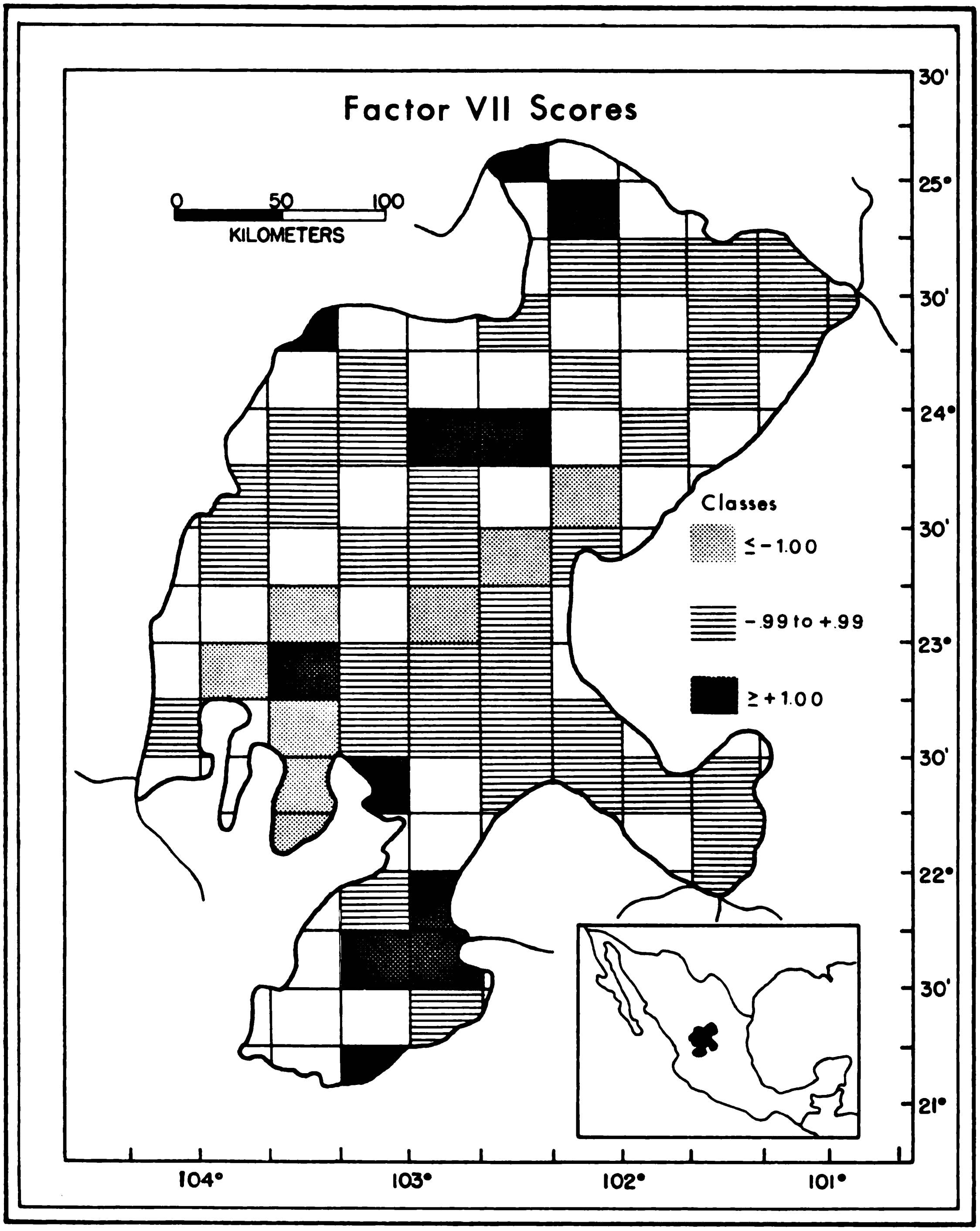

Figure 15. Distribution of the three classes of factor scores for Factor VII in Zacatecas. Factor scores ranged from -2.22 to +2.30.

the desert-grassland ecotone. Geographically, these quadrats would also fit that pattern. Quadrat 20 scored highest (+.48) on Factor I, indicating either a grassland association or an ecotone association. Similarly for Quadrat 49 (+.59) on Factor I. Quadrat 37 scored highest (+.39) on Factor II, the Western Montane habitats but also scored only slightly less (+.36) on Factor I. This may go along with its position in Cluster II or III of the AFR dendrogram (Figure 7). Quadrat 29 had its highest score (+.29) on Factor I, indicating only a weak association with the grasslands. It is probably better associated with the ecotonal area. Quadrat 54 scored highest (+.94) on Factor IV, indicating an association with the Canyon Region habitats.

DISCUSSION

Cluster Analysis

Differences between the various dendrograms of quadrats based on d, AFR, and S matrices were considered to reflect the nature of the original calculation of the indices. The distance index considered only differences (mismatches) between quadrats. Thus, even if two quadrats had many species in common, they may not be close by d-values when the number of differences is also large. For example, Quadrat 7 is only loosely associated with Cluster I in Figure 6. Quadrat 7 had its lowest d-value with Quadrat 6 ($d = 2.64$) with seven species differences. These two quadrats had 17 species in common. On the average, Quadrat 7 was very different from all other quadrats in Cluster I. This average difference is reflected in its inclusion at a d-value of 3.7. The distinctness of Quadrat 7 is not apparent in the AFR or S dendrograms (Figures 7 and 8). The d dendrogram distorts, to some extent, the relationship of Quadrat 7 to the other quadrats. While differences should be considered important in determining relationships between quadrats, complete reliance on differences would distort these relationships. On the other hand, d-values as used here provide a check on the other indices. McIntosh (1973) suggested that there is an advantage in comparing the results of more than one index of association. This is true because each index differently assesses relationships between the quadrats; thus, each will give slightly different results (McIntosh, 1973).

AFR and S matrices produced dendrograms that were, in general, more similar to each other than either was to the d dendrogram. Of course this might be expected since each gives more weight to common species. The S index, however, does include negative matches. There was some congruence between subclusters of S and d dendrograms that was not found in the AFR dendrogram. For instance, both d and S dendrograms (Figures 6 and 8) have a subcluster composed of Quadrats 8, 20, and 39. This same subcluster is present in AFR but with the addition of Quadrat 21 (Figure 1), Quadrat 21 formed another subcluster with Quadrats 3 and 17 in both d and S. This difference can be attributed to the total number of species that are different between any two of the quadrats. Table 8 gives the matrix of data upon which these subclusters are derived. The number of species in each quadrat is on the diagonal, the species in common between any two quadrats is above the diagonal, and the species differences below the diagonal. By the upper half of the matrix (species in common), it is not at all obvious where Quadrat 21 would be in relation to the other quadrats (i.e., Quadrats 8, 20, 39 on the one hand and 3, 17 on the other). Because a quadrat must be assigned to only one cluster by the method used here, the intermediate position (based on common species alone) of Quadrat 21 was masked by the AFR index. However, the lower diagonal clearly shows that there were fewer differences between Quadrats 21 and 3, 17 than for 8, 20, 39. A similar situation also occurs for Quadrat 37 in the AFR dendrogram.

TABLE 8

COMPARISON OF NUMBERS OF SPECIES IN SELECTED QUADRATS IN ZACATECAS

	Quadrats	8	20	39	3	17	21	
Species Differences	8	12	11	11	7	8	8	Species in Common
	20	5	15	14	11	12	11	
	39	8	6	19	12	14	13	
	3	13	9	11	16	15	12	
	17	13	8	8	3	17	13	
	21	10	7	7	6	5	14	

There were a number of quadrats that might also be candidates for other clusters but due to the dendritic nature of hierarchial clustering, a quadrat must be assigned only to one cluster (Fisher, 1968). This represents one of the major drawbacks to cluster analysis. A good example of this is Quadrat 47, identified with the Canyon Regions. Collecting localities in Quadrat 47 included areas that would be classically considered representative of montane habitats with the following species Eutamias bulleri, Sciurus nayaritensis, Peromyscus boylii, P. difficilis, Thomomys umbrinus, and Nelsonia neotomodon. In the canyon bottoms were collected Liomys pictus, Neotoma palatina, and Sigmodon mascotensis species associated with more tropical habitats. On the flatlands above the Río Atengo, Onychomys torridus, Dipodomys phillipsii, and Liomys irroratus were collected. These are indicative of the grassland habitats to the east. Thus, Quadrat 47 could possibly be a candidate for Clusters II or III but was clustered with IV, possibly because of this "unique" species association. The supposed "intelligent ignoramous" as defined by Sokal and Rohlf (1970) having no knowledge of the species involved would not recognize this problem. Thus, a classification of faunal units would be dictated by the defined clusters as given in Figure 16. Although this is a reasonable classification, it does tend to distort the real picture. I believe that the use of objective methodology must be tempered with common sense and experience. The methods of numerical taxonomy (Sneath and Sokal, 1973) should be used but not necessarily dogmatically accepted. Deviations from their use, however, should be explained on reasonable grounds.

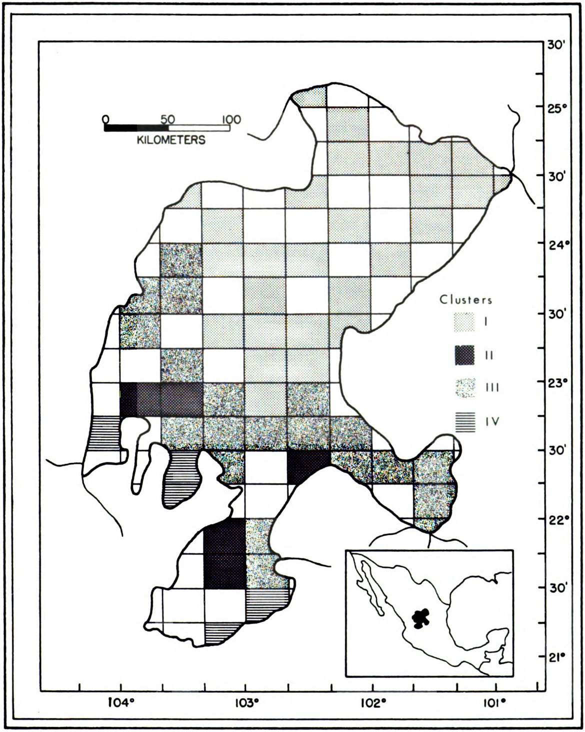

Figure 16. Distribution of the four major clusters of quadrats in Zacatecas based upon the dendrograms in Figures 6 through 8.

The four major clusters that were defined by all indices were based solely upon rodent distribution data. The map of these four clusters (Figure 16) shows that they are essentially geographically defined and conform to the major vegetational areas in the state. As such, they represent ecogeographic units (sensu Udvardy, 1969 and Armstrong, 1972).

Recognizing four ecogeographic units is intuitively appealing since they are more or less consistent with ecogeographic units of more classical studies (Life Zones of Merriam, 1898; Biotic Provinces of Dice, 1943, and Goldman and Moore, 1946; and faunal areas of Baker and Greer, 1962). Anderson (1972) recognized three ecogeographic units in Chihuahua (tropical, montane, and desert-grassland). He was not able to differentiate between a distinct desert and grassland fauna based on distributions of marsupials, insectivores, bats, lagomorphs, and rodents. Anderson (1972) used the AFR index to assess the relationships between a transect of nine quadrats across Chihuahua. At least three possible explanations could account for Anderson (1972) not distinguishing between desert and grassland faunas. First, it may be as Anderson (1972) suggested, there simply is no distinct differences between these two (at least in Chihuahua) based on mammalian distribution patterns. Second, Anderson (1972) included five orders of mammals in his analysis. It may be that the similarity values generated from the increased number of species would not show the distinction that rodents alone show. Also, many of the species in these other orders are not as restricted in their habitat requirements as are many rodents. This would tend to increase the similarity values since there would be more species in common between desert and grassland habitats. Using only one index, and that based only on common species, might bias the results. Third, Anderson (1972) used quadrats of varying sizes (100 x 30-100 kilometers on a side). Thus, it may be that the quadrats used were too large to detect the differences between desert and grassland faunas. A similar argument was given by Murray (1968) against some of the mammalian faunal units recognized by Hagmeier and Stults (1964).

Factor Analysis

Factor analysis allowed for the identification of important species and environmental variables associated with each factor. The factor scores permitted an evaluation of each quadrat relative to a factor. Restriction of factor scores to these classes (low, intermediate, and high), while permitting easier interpretation, defeats part of the objectives of factor analysis. This objective is an ordination of the quadrats with respect to a given factor. However, one of the objectives of the present study was to see if recognizable general patterns of distribution could be objectively determined. I believe that this objective has been realized in both the cluster and factor analyses. The distortion produced by using only three classes of factor scores is offset by its ease of interpretation. Since the factor scores are standardized (*i.e.*, mean of zero, standard deviation of one), the intermediate class should contain 66.7 per cent of the quadrats. This means that only about 16.7 per cent of the cases would have scores higher than +.99 (and likewise for low scores). In other words, I have set a confidence level of approximately .33 in recognizing distinct quadrats. In most cases, the quadrats associated with a given factor had scores far above the .99 cut-off point.

Of the seven factors extracted, three factors (I, II, and IV) define essentially the same ecogeographic units defined by cluster analysis. Three factors (III, V, and VI) subdivide these ecogeographic units, thus accounting for the differences between quadrats associated with Factors I, II, and IV and those in Clusters I to IV. The last factor (VII) represented a distribution unique to Sigmodon hispidus and Liomys irroratus.

The ecogeographic units defined by the six factors were shown in Figures 9 to 14. Quadrats associated with desert habitats (low scores in Figure 9) were moved somewhat to the east compared to desert distribution of Cluster I (Figure 16). This discrepancy was partly explained in Factor V, the desert-grassland ecotone. Similarly, high scores on Factor I (Figure 9) do not show the contiguous quadrat distribution shown in Cluster III (Figure 16). Some of the quadrats of Cluster III have their highest factor scores on Factor V (Figure 13). Essentially then, Factors I and V define a desert and grassland fauna with a rather broad area of transition between the two. This may be a reason for Anderson (1972) not being able to distinguish between these two faunal areas, especially with the large size of his quadrats.

Factor V (Figure 13) as an ecotonal area also corresponds geographically to the Saladan Filter Barrier described for the Chihuahuan Desert herpetofauna by Morafka (1977, 1978). One of the highest scores on Factor V occurs in Quadrat 23. This quadrat fits closely to the northeasternmost limit of the Saladan Filter Barrier as mapped by Morafka (1977, 1978). This filter barrier was described as an area of transition between the Saladan Subprovince of the Chihuahua Desert Biotic Province and the Transvolcanic Biotic Province further to the south (out of the present study area). Morafka (1977) described the transition of vegetation as one proceeds south from the desert in Zacatecas as a mixture of mesquite grassland with patches of desert scrub. To determine whether or not the Saladan Filter Barrier is in fact common to both the herpetofauna and to rodents (or mammals in general) would require further extensive field work in San Luis Potosi and south. The suggestion of its importance to rodent distribution pattern in Zacatecas, however, is clear by Factor V.

The integrity of a desert rodent fauna defined by Cluster I was also not upheld by Factor I for Quadrats 4, 6, and 7. These three quadrats were associated with Factor III, the Cross Ranges habitats (Figure 11). In this instance, the quadrats form a distinct subcluster of Cluster I in both AFR and S dendrograms Figures 7 and 8. Thus, it seems best to consider Factor III as a subunit of the desert fauna. It is not uncommon in desert areas to recognize isolated montane situations (Baker, 1956; Findley and Caire, 1978; Packard, 1978; Schmidly, 1978). In fact, montane habitats in desert areas have received much attention because of their importance as biogeographical models (Johnson, 1974, 1975; and Brown, 1971, 1978). In this sense, Factor III may be the only candidate as a factor demanding a historical argument. Smith and Fisher (1970) in their study were able to recognize two factors that demanded historical explanations. In the present case, Factor III scores highest on quadrats in the three mountain areas associated with the Cross Ranges which are an extension of the Sierra Madre Oriental (see section on Physiography and Topography). The actual factor scores decrease from east to west in these three quadrats as, 4.30, 3.86, and 1.01, respectively. If these scores are considered indicative of closeness to a source area (the Sierra Madre Oriental) then they would fit a model of island colonization patterns as given in MacArthur and Wilson (1967) or more appropriately that of montane islands by Brown (1971). These mountains are isolated from the source area by numerous intermontane valleys which are now not suitable for the "montane" species (Thomomys bottae, Spermophilus variegatus, Peromyscus difficilis, P. pectoralis, and P. truei). These species are not "true" Montane species; instead, they are mostly found in grassland to pinyon-juniper habitats. Brown (1978) discovered a similar species composition for Montane desert islands of the Great Basin in the United States. All five of these species occur in the Sierra Astillero (the easternmost range), the first four occur in the mountains around Concepción del Oro (Quadrat 6), and only S. variegatus and P. pectoralis are known from Cerro de Tayra (Quadrat 4). Colonization of these mountains would have to have occurred when climatic conditions were sufficiently mesic to support at least a pinyon-juniper woodland (similar to the habitats they occur in today). This situation could have occurred during the Wisconsin Glacial. Morafka (1977) has pointed out that the Saladan Subprovince (surrounding much of these mountain regions) was most likely entirely pinyon-juniper woodland at that time. This would require only a 200 m downward displacement of the vegetation. Wells (1978) has documented the downward movement of pinyon-juniper woodland by some 800 m in the Big Bend region of the Río Grande. These remarks are only tentative, more work is needed especially in the Sierra Astillero and Cerro de Tayra. Since it is possible that the entire Saladan Desert may have been a pinyon-juniper woodland (Morafka, 1977), the possibility that the source area was to the west cannot be ruled out. However, the subspecific relationships of at least two species Peromyscus difficilis (see Hoffmeister and De la Torre, 1961; and Diersing, 1976) and P. pectoralis (see Schmidly, 1972) and the distribution of T. bottae would argue for a relationship with the Sierra Madre Oriental. Hoffmeister (1951) tentatively assigned two specimens of P. truei from Sierra Astillero to the subspecies P. t. gentilis of western affinity but noted that they may prove to be distinct when more specimens become available.

Western montane habitats were defined by Factor II and correspond well with Cluster II (Figures 10 and 16). Cluster II had only five quadrats associated with it while Factor II has eight (Quadrat 37 seemed to be intermediate between grassland and montane). Quadrat 31 and 47 both scored high on other factors also. This would indicate the utility of factor analysis in allowing a sample to be associated with more than one factor. Both montane and grassland faunas occur in Quadrat 31, while Quadrat 47 has both montane and tropical faunas (it also scored high on Factor V, a result I am unable to interpret).

Factor IV (Figure 12) corresponds in part to Cluster IV (Figure 16). However, Quadrat 54 is only loosely associated with Factor IV and Quadrat 72 does not score high on this factor (in fact, the score for Quadrat 72 is high negative, -1.22). In addition, Quadrat 69 is associated with this factor but does not cluster with Cluster IV. Quadrat 69 includes the valley of the Rio Juchipila and from this it seems reasonable to associate it with the Canyon Regions. In any event, the species association of Factor IV is clearly with the tropical canyon bottoms (Table 4).

Factor VI represents an unusual faunal association in Zacatecas (Table 6). It is the only factor that did not include an environmental variable. It would appear to represent a distinct canyon association based primarily upon the presence of *Sciurus aureogaster* and *Peromyscus spicilegus*. Both Quadrats 72 and 73 score high on this factor (Figure 14) and are also a subcluster of Cluster IV (Figure 16).

Factor VII has no counterpart in the cluster analysis. The distribution of factor scores has no geographic continuity. However, there is a common denominator for the quadrats with high scores (Figure 15). This common denominator is a relationship to riparian (or at least more mesic) situations. *Sigmodon hispidus* and *Liomys irroratus* can be found in almost any of the habitats (except high montane) in Zacatecas. They are found in desert areas but are restricted in such cases to riparian situations (as along the Río Aguanaval) or in islands of grassland and mesquite in some of the internal drainage basins (*e.g.*, Quadrats 1, 3, 22). Each of the quadrats that had high scores on Factor VII were associated with some type of riparian habitat.

Six species in the analysis did not load high enough to be considered as associated, except loosely, with any factor. The criterion of a .40 loading as the cut-off level may have been too stringent. If the level were lowered to .30 as done by Smith and Fisher (1970), only one species would have been in this category. However, this was an arbitrary decision on my part. It does represent some intuitive problems. For instance, *Sigmodon fulviventer* is usually considered a good indicator of grassland habitats (Baker, 1969 and Petersen, 1973). Its low loading, whether or not .40 is considered a cut-off point, does not support this idea. Its known distribution in Zacatecas, however, would support its association with grassland habitats (see Species Accounts). Perognathus flavus, Reithrodontomys fulvescens and Neotoma albigula are sufficiently well known in Zacatecas and each is widely distributed so that their low loadings on the factors can easily represent independent patterns. Spermophilus mexicanus parvidens and Perognathus lineatus are known from only two quadrats each. Their low loadings could be the result of insufficient data on distributions or independent patterns. However, Sciurus aureogaster and Cynomys mexicanus were reported from only two quadrats. They were both definitely associated with Factors VI and III, respectively. Thus, it would appear that loading is not a function alone of the numbers of quadrats in which a species occurs.

Faunal Areas

It is now appropriate to synthesize the results of the two types of analyses into a reasonable system of classification of distributional patterns. Although it was pointed out in preceding sections that the patterns correspond to various vegetation types and other environmental parameters, I follow the suggestions of Hagmeier and Stults (1964) that patterns based on single groups of animals be referred to as faunal areas (more precisely in the present study to Rodent Faunal Areas). For simplicity, the units here defined will be called Faunal Areas.

I have projected the distribution of Faunal Areas in Zacatecas to those quadrats that either were not sampled or did not meet the species number requirement (i.e., a minimum of 10 species for inclusion in the analysis). For some quadrats, this presented no problem because they either had indicator species (those that loaded high on the factor analysis) or they were surrounded by other quadrats that were definitely associated with a faunal area. In other quadrats that were not sampled, the affinity was determined by a knowledge of the vegetation, topography, and climate. In essence then, this synthesis represents a best estimate or hypothesis of our current knowledge of the distributional patterns of rodents in Zacatecas. The distribution of four Faunal Areas is given in Figure 17.

The classification scheme represents an objective arrangement of the distributional patterns of rodents. As such, the classification can be considered a "natural" grouping of species. Natural is used in the context as defined by Goodall (1973). It represents areas that are relatively homogeneous internally in their composition and separated from other areas by discontinuities. However, the discontuinty between areas is not always a sharp one (Factor V, the desert-grassland ecotone). Various studies have been able to define "natural" faunal areas using objective numerical techniques (Webb, 1950; Hagmeier and Stults, 1964; Ryan, 1966; Armstrong, 1972; Anderson, 1972; Findley and Caire, 1978; Morafka, 1977, 1978; and others).

The "naturalness" of the present classification is also supported by the recognition of similar faunal areas in Chihuahua (Anderson, 1972, see discussion above). Findley and Caire (1978) were able to distinguish a distinct Chihuahuan Desert area based upon cluster analysis of mammalian distribution patterns. This would correspond with my Desert Faunal Area. Possibly the best support for my classification

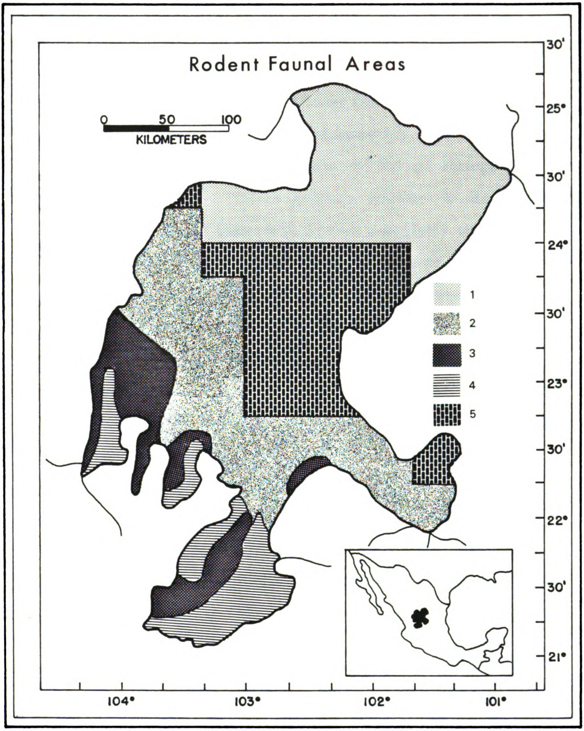

Figure 17. Distribution of Rodent Faunal Areas recognized in Zacatecas: (1) Desert Faunal Area; (2) Grassland Faunal Area; (3) Montane Faunal Area; (4) Tropical Faunal Area; (5) Desert-Grassland Ecotone.

comes from the independent recognition of a Saladan Subprovince of the Chihuhuan Desert (= Desert Faunal Area in the present study) and the Saladan Filter Barrier (= desert-grassland ecotone in the present study) by Morafka (1977, 1978). His study was based upon the distribution patterns of the herpetofauna; unfortunately, his primary concern was with the Chihuhuan Desert. Therefore, he did not attempt to define other faunal areas. In his analysis, however, he did consider the areas adjacent to the Chihuahuan Desert, especially the Sierra Madres and the grasslands. Morafka (1977, 1978) mapped his herpetofaunal units and these correspond closely to my map based on rodent distributions. Further work on other groups of animals would provide tests of the hypothesis of four faunal areas in Zacatecas and/or adjacent states.

Faunal areas (Figure 17) were named for the general habitat of the geographic area in which they occur. I believe that this general terminology for Faunal Areas in Zacatecas alleviates the confusion that might arise with comparisons of other works. In the following descriptions of the Faunal Areas, indicator species were, for the most part, those that showed high correlations with the various axes of the factor analysis.

Desert Faunal Area. -- As shown in Figure 17, the Desert Faunal Area occurs in the northern and eastern portion of Zacatecas. Its distribution corresponds fairly close with that of the Desert Scrub vegetation (Figure 4), low average annual precipitation (Figure 2), and elevations below 2,000 m (Figure 1). Included in the Desert Faunal Area are the subunits defined in Factors III and VII, Cross Ranges and riparian habitats, respectively. Also, the ecotonal area between grasslands and desert habitats (Factor V) is shown.

Species indicative of the Desert Faunal Area, include: *Pappogeomys castanops*, *Dipodomys nelsoni*, *Perognathus penicillatus*, *Peromyscus eremicus*, and *Neotoma goldmani*.

Grassland Faunal Area. -- This Faunal Area corresponds to the Grassland vegetation and in part to the Crassicaulescent Scrub and Subtropical Scrub Vegetations (Figure 4). Under the vegetation types considered by Leopold (1950), the Grassland Faunal Area would include almost the entire extent of Mesquite-grassland in Zacatecas.

Species indicative of the Grassland Faunal Area, include: *Dipodomys phillipsii*, *Peromyscus truei* (by Factor I, see Results section and Species Accounts), *Perognathus hispidus*, *Thomomys umbrinus* (but also associated with the Montane Faunal Area by Factor II), *Liomys irroratus* (by Factor I). In addition, *Sigmodon fulviventer* might best be considered associated with this Faunal Area (see discussion above).

Montane Faunal Area. -- This Faunal Area occurs as disjunct areas in western and southern portions of Zacatecas (Figure 17). This is so because of the disjunct nature of the Sierra Madre Occidental at its southern extent (see section on Physiography and Topography). The Montane Faunal Area is associated entirely with the Montane Forests of the western part of Zacatecas (Figure 4), and usually restricted to elevations above 2,300 m (Figure 1).

Species indicative of the Montane Faunal area, include: *Eutamias bulleri*, *Sciurus nayaritensis*, *Peromyscus melanotis*, *P. boylii*, *P. difficilus*, *Sigmodon leucotis*, *Neotoma mexicana*, and *Nelsonia neotomodon*.

Tropical Faunal Area. -- In Zacatecas, the Tropical Faunal Area is restricted to the canyon bottoms and adjacent slopes of the river valleys of the west and south (Figure 17). It coincides with the Subtropical Scrub and Tropical Deciduous Forest vegetation (Figure 4), mostly at elevations below 2,000 m (Figure 1).

Species indicative of the Tropical Faunal Area, include: Spermophilus mexicanus mexicanus, Sciurus aureogaster, Peromyscus spicilegus, Sigmodon mascotensis, and Neotoma palatina.

Human Impact

The rapidly changing landscape in Mexico due to increased cultivation mentioned in the introductory paragraphs and the centuries-old results of overgrazing by cattle and goats (Johnston, 1978), can drastically affect distribution patterns of mammals. A personal experience will emphasize this much better. In Octoer of 1973, on my first trip to Zacatecas, Bob Hannum and I made camp and set out trap lines at a locality two miles east of Bañon. This area was in the desert-grassland ecotone dominated by nopal cactus, creosote bush, tree yuccas, shrub acacias, and a good undergrowth of grasses. Although we did not collect any bannertail kangaroo rats (Dipodomys spectabilis), we did observe their mounds and specimens in the LACM taken by Percy Clifton were from this approximate locality. The area at that time was being grazed by a few donkeys, horses, and goats. We collected 10 species of rodents in two nights of trapping. In July of 1976, I returned to this same locality but it had been converted to corn fields with no "natural" vegetation over many hectares. Except along the shoulder of the gravel road leading to Bañon, I observed no sign of kangaroo rats. The conspicuous mounds of bannertail kangaroo rats had vanished completely. Because of other priorities at that time, we decided not to collect in the area. It would have been interesting to compare collections from the two different years. Although this illustration of the changes in habitat that can occur in a relatively short time is a single case, it is indicative of much of Zacatecas and in general Mexico (Wellhausen, 1976).

Much of the grassland and desert-grassland ecotone in Zacatecas is being turned to agriculture (personal observation and R. H. Baker, personal communication). Johnston (1978) described the western edge of the Chihuahuan Desert and eastern edge of the grasslands to be in a state of flux due to centuries of land abuse. In fact, Johnston (1978) suggests that much of what is now the western portion of the Chihuahuan Desert in Zacatecas may have been grasslands in the past.

The same is true for many of the fertile river valleys in tropical habitats. They are rapidly being converted to croplands. Especially, this is true of the valley of the Río Juchipila and Río Jérez.

In addition to the cultivation of land, much of the forested regions of the west are now being exploited for their timber resources.

Road building in Zacatecas, especially paving, could also affect the distributional patterns of small mammals. The roads themselves are built high above the surrounding terrain. Vegetation is cleared for some 30-50 m on either side of the road with a depression or gulley adjacent to the road. These gulleys tend to collect and hold rain water for longer periods than the surrounding land. The result is a change in vegetation with grasses and herbaceous plants more common than in the adjacent more xeric areas. The effects of this habitat disturbance has not been studied. Presumably, species such as cotton rats (*Sigmodon hispidus*), spiny pocket mice (*Liomys irroratus*), and pocket gophers (*Thomomys umbrinus*) could use such habitat avenues to invade the desert areas. These three species are already known to occur in desert riparian situations (see discussion above and Species Accounts). The uses of roadways as dispersal routes for small mammals has been documented by Getz *et al*. (1978) and for desert situations by Huey (1941).

Some rodents are used as food items by local inhabitants. These include most all species of squirrels, woodrats (*Neotoma* spp.), cotton rats (*Sigmodon* spp.) and the plateau mouse (*Peromyscus melanophrys*). Though these are taken with regularity in some areas (personal observations), the main threat to rodent populations remains with habitat perturbations.

The ultimate effect of habitat modification by man on the distribution of rodents cannot at this time be objectively evaluated. In any event, it is obvious that man is actively and potentially affecting the habitats of many mammals in general and rodents in particular. What the outcome will be depends upon the actions taken in future years by the Mexican people and authorities. It is hoped that this report will aid wise management decisions by the Mexican people.

In past years, most concern for Mexican mammals has centered around the game species (Leopold, 1959; Tinker, 1978). Recently, Baker (1978), Findley and Caire (1978), and Packard (1978) have discussed the status of various mammals in the Chihuahuan Desert Region. Their concern was not simply with the game animals but included non-game species, including rodents, as well. Findley and Caire (1978) and Baker (1978) list species of rodents that occur in Zacatecas (mostly in the desert areas) which they consider to be rare, endangered, or threatened. These include: Mexican prairie dog (Cynomys mexicanus), Mexican ground squirrel (Spermophilus mexicanus), Nelson kangaroo rat (Dipodomys nelsoni), and Pigmy woodrat (Neotoma goldmani). Other species that occur in Zacatecas which I believe should also be considered threatened due to habitat restriction or lack of knowledge about their status, include: Buller chipmunk (Eutamias bulleri), Nayarit tree squirrel (Sciurus nayaritensis), Mexican gray squirrel (S. aureogaster), bannertail kangaroo rat (Dipodomys spectabilis cratodon), southern bannertail kangaroo rat (D. phillipsii), and Bolaños wood rat (Neotoma palatina).

Gazetteer

The following list of place-names are used in recording localities from which rodents have been taken or observed in Zacatecas. Each place-name is followed by its approximate location in degrees and minutes of latitude and longitude. All place-names were located on and coordinates determined from 20' x 15' topographic maps with the exception of the locality called Sierra Madre. The geographic position of Sierra Madre was taken from Goldman (1951) and is approximate. Place-names are listed alphabetically followed by a parenthetical number identifying each on the map (Figure 18). On the map, place-names are numbered north to south and west to east.

Apizolaya. -- 24° 47' N, 102° 15' W (3)

Apozol. -- 21° 27' N, 103° 08' W (70)

Atolinga. -- 21° 47' N, 103° 28' W (65)

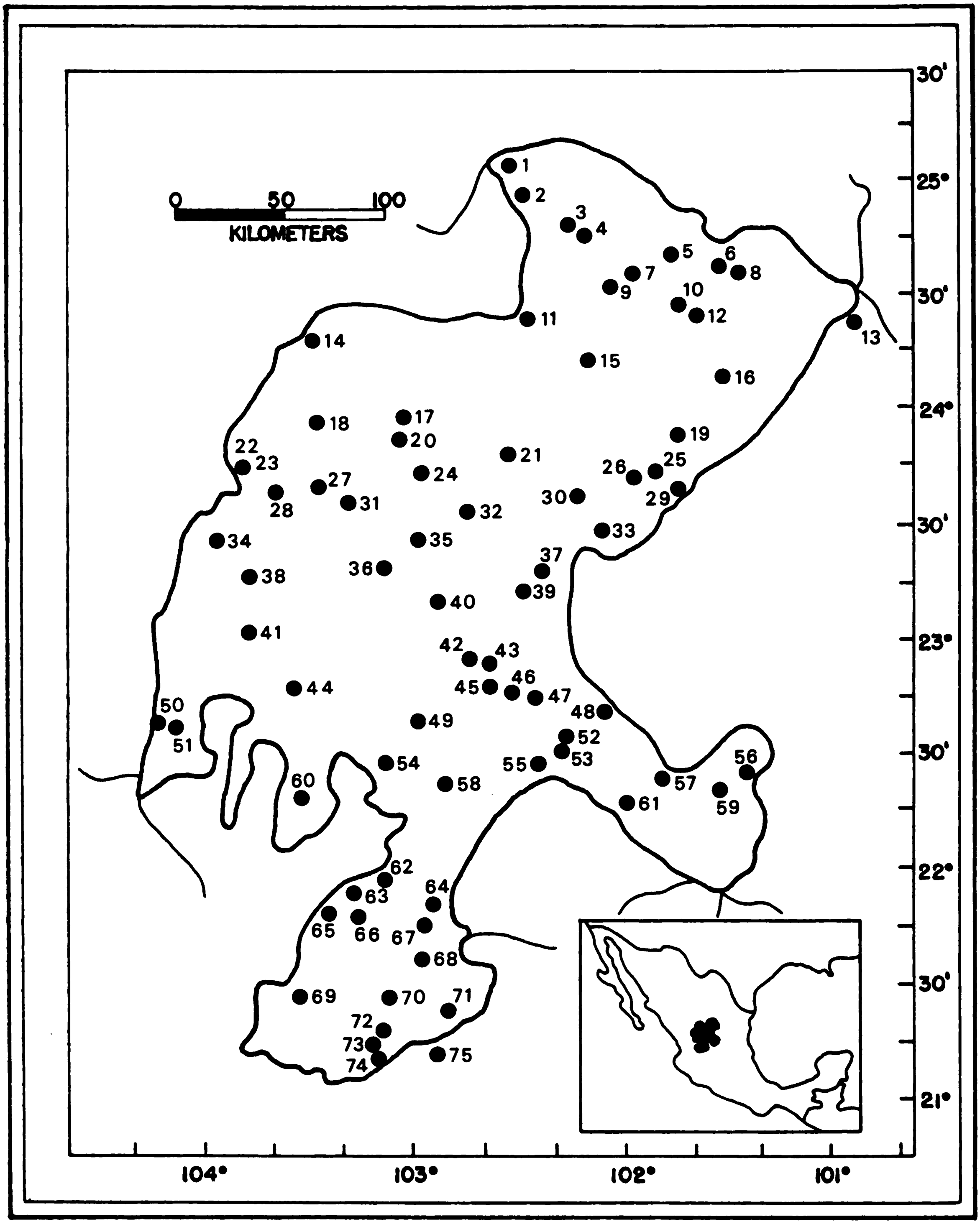

Figure 18. Place-names used to identify collecting localities in Zacatecas. Numbers correspond to the locality in the gazetteer.

Bañón. -- 23° 13' N, 102°, 27' W (39)

Berriozábal. -- 22° 32' N, 102° 18' W (53)

Calera. -- 22° 55' N, 102° 42' W (42)

Camacho. -- 24° 26' N, 102° 28' W (11)

Cañitas. -- 23° 33' N, 102° 42' W (32)

Caopas. -- 24° 46' N, 102° 15' W (4)

Capriote. -- 23° 38' N, 102° 15' W (30)

Cedros. -- 24° 38' N, 101° 43' W (5)

Chalchihuites. -- 23° 28' N, 103° 56' W (34)

Concepción del Oro. -- 24° 37' N, 101° 23' W (8)

Cuauhtémoc. -- 22° 27' N, 102° 21' W (55)

El Arenal. -- 23° 41' N, 103° 25' W (27)

El Calabazal. -- 23° 45' N, 103° 50' W (23)

El Rosario. -- 24° 26' N, 101° 39' W (12)

Fresnillo. -- 23° 12' N, 102° 52' W (40)

Gonzáles Ortega. -- 23° 56' N, 103° 24' W (18)

Guadalupe. -- 22° 45' N, 102° 31' W (46)

Huanasco. -- 21° 50' N, 102° 55' W (64)

Jalpa. -- 21° 37' N, 102° 58' W (68)

Jérez. -- 22° 39' N, 102° 58' W (49)

Jiménez del Téul. -- 23° 16' N, 103° 49' W (38)

Juan Aldama. -- 24° 19' N, 103° 23' W (14)

La Blanca. -- 22° 43' N, 102° 05' W (48)

La Colorada. -- 23° 46' N, 102° 31' W (21)

La Pendencia. -- 24° 55' N, 102° 29' W (2)

Loreto. -- 22° 16' N, 101° 58' W (61)

Lulú (in San Luis Potosí). -- 24° 26' N, 100° 52' W (13)

Majoma. -- 23° 48' N, 101° 41' W (19)

Mazapil. -- 24° 38' N, 101° 26' W (6)

Mesquituta. -- 21° 14' N, 103° 10' W (73)

Milpillas de la Sierra. -- 23° 03' N, 103° 43' W (41)

Momax. -- 21° 55' N, 103° 19' W (63)

Monte Escobedo. -- 22° 17' N, 103° 51' W (60)

Monte Mariana. -- 23° 18' N, 103° 03' W (36)

Morelos. -- 22° 52' N, 102° 38' W (43)

Moyahua. -- 21° 16' N, 103° 09' W (72)

Nieves. -- 23° 59' N, 103° 01' W (17)

Nochistlán. -- 21° 21' N, 102° 48' W (71)

Noria de Angeles. -- 22° 22' N, 101° 46' W (57)

Ojo Caliente. -- 22° 34' N, 102° 16' W (52)

Pinos. -- 22° 18' N, 101° 32' W (59)

Plateado. -- 21° 56' N, 103° 08' W (62)

Rancho Grande. -- 23° 27' N, 102° 58' W (35)

Río Grande. -- 23° 47' N, 103° 02' W (20)

Sabana Grande. -- 24° 28' N, 101° 42' W (10)

Sain Alto. -- 23° 34' N, 103° 18' W (31)

Saldaña. -- 22° 24' N, 101° 22' W (56)

San Andrés. -- 23° 42' N, 101° 55' W (26)

San Felipe de Nuevo Mercurio. -- 24° 13' N, 102° 09' W (15)

San Juan Capistrano. -- 22° 37' N, 104° 10' W (51)

San Juan de los Charcos. -- 25° 05' N, 102° 33' W (1)

San Rafael. -- 24° 36' N, 102° 03' W (9)

San Tiburcio. -- 24° 08' N, 101° 29' W (16)

Santa Efigenia. -- 23° 43' N, 101° 52' W (25)

Santa Rosa. -- 21° 12' N, 103° 09' W (74)

Sarteneja. -- 23° 38' N, 101° 42' W (29)

Sierra Madre. -- 22° 37' N, 104° 18' W (50)

Sierra Vieja. -- 23° 29' N, 102° 04' W (33)

Sombrerete. -- 23° 38' N, 103° 38' W (28)

Tabasco. -- 21° 46' N, 102° 57' W (67)

Tecolotes. -- 24° 37' N, 101° 59' W (7)

Tepetongo. -- 22° 27' N, 103° 07' W (54)

Tetillas. -- 23° 43' N, 102° 58' W (24)

Téul de Gonzáles Ortega. -- 21° 28' N, 103° 29' W (69)

Tlatenango. -- 21° 47' N, 103° 18' W (66)

Trancoso. -- 22° 44' N, 102° 23' W (47)

Valparaíso. -- 22° 47' N, 103° 33' W (44)

Villa de Cos. -- 23° 18' N, 102° 22' W (37)

Villa Insurgentes. -- 23° 45' N, 103° 50' W (22)

Villanueva. -- 22° 19' N, 102° 51' W (58)

Yahualica (in Jalisco). -- 21° 12' N, 102° 56' W (75)

Zacatecas. -- 22° 46' N, 102° 36' W (45)

SPECIES ACCOUNTS

The arrangement of genera in this report follows that of Hall and Kelson (1959). Species are arranged alphabetically under their respective genera. When more than one subspecies is considered to be present in Zacatecas these are listed alphabetically under the species. Specimens examined are listed north to south (west to east at the same latitude). Localities are given as recorded on the specimen label (but see section on Materials and Methods). Other records of occurrence for species are noted. Species records for quadrats in adjacent states and their references are included.

Collections from which specimens have been examined, other than The Museum, Michigan State University, are listed with the following abbreviations: AMNH, American Museum of Natural History; CAS, California Academy of Sciences; KU, Museum of Natural History, University of Kansas; LACM, Los Angeles County Museum; LSU, Louisiana State University; MVZ, Museum of Vertebrate Zoology, University of California; MZ, Museum of Zoology, University of Michigan; OU, Stoval Museum of Science and History, University of Oklahoma; RHG, private collection of Robert G. Hannum; TCWC, Texas Cooperative Wildlife Collections, Texas A & M University; TTU, Texas Tech University; UI, Museum of Natural History, University of Illinois; US, United States National Museum and Biological Survey Collections. Specimens of rodents from Zacatecas housed in the Instituto de Biología, Universidad Nacional Autonoma de México and under the charge of Bernardo Villa-Ramirez, have not been examined. For the most part, they are specimens returned to the Mexican authorities under the terms of the collecting permits issued to universities and museums in the United States (Cornelio Sánchez, personal communication). These specimens, then, duplicate the records given in the accounts below.

EUTAMIAS BULLERI BULLERI (J. A. ALLEN)

Buller's Chipmunk

Distribution. -- Pine-oak forests of the Sierra Madre Occidental in western Zacatecas.

Remarks. -- Buller's chipmunk seems to be most common in those parts of the pine-oak forests where rock outcrops are abundant. Pregnant and lactating individuals were taken in July and August.

This is the only species of chipmunk that reaches as far south in México as Zacatecas. Its southernmost distribution is approximately 22° 30' N latitude.

Specimens Examined. -- Total 47, from: 10 mi SW Chalchihuites, 7200 ft, 5 (LACM); 25 km WSW Milpillas de la Sierra, 2580 m, 3; 9 mi NW Valparaíso, 8350 ft, 7; Valparaíso Mountains, 8700 ft, 17 (US); 8.7 mi W Valparaíso, 8400 ft, 2 (OU); 7.2 mi W Valparaíso, 7900 ft, 2 (OU); Sierra Madre, 9 (US); 10 km W San Juan Capistrano, 2900 m, 2. Other records: 8 mi S Chalchihuites (Jones and Webster, 1977); 8 mi W Milpillas (de la Sierra), (CAS); in Jalisco, Quadrat 48 (Genoways and Jones, 1973).

SPERMOPHILUS MEXICANUS (ERXLEBEN)

Mexican Ground Squirrel

Distribution. -- Disjunct populations; one in the extreme north in desert scrub; one in the southwest in grasslands.

Remarks. -- The few records of this species in Zacatecas do not allow for any generalizations to be made concerning its ecological distribution. The two females taken in the desert scrub of northern Zacatecas were lactating in July. One female taken in the southwestern grassland on 3 July contained six embryos.

These records document the occurrence of both the northern and southern subspecies of S. mexicanus in Zacatecas for the first time. The localities given below narrow the hiatus between the two subspecies to about 200 km. Howell (1938) distinguished the two subspecies on the basis of size and color: A northern subspecies, S. m. parvidens, small in size and light in color; and, a southern subspecies, S. m. mexicanus, large in size and dark in color. Two adult females here assigned to parvidens and one adult female assigned to mexicanus have external measurements, respectively, as follows: total length, 38, 36, 44; ear length, 11, 11, 14. Because of the distance between the two populations and their relatively large size differences, I treated these as separate "species" in the analysis of distribution patterns.

Specimens Examined. -- Spermophilus mexicanus mexicanus (Erxleben), total 2, from: 16 km SSE Monte Escobedo, 2010 m, 2. Other records: E Monte Escobedo, (sight); N Téul de Gonzáles Ortega, (sight); in Jalisco, Quadrat 55 (genoways and Jones, 1973).

Spermophilus mexicanus parvidens Mearns, total 2, from: 10 km ESE San Juan de los Charcos, 1500 m, 1; 3 km SE Apizolaya, 1920 m, 1.

SPERMOPHILUS SPILOSOMA BENNETT

Spotted Ground Squirrel

Distribution. -- Deserts and grasslands east of the Sierra Madre Occidental in Zacatecas.

Remarks. -- Spotted ground squirrels were taken in a variety of open habitats in Zacatecas. A female captured on 8 July contained six embryos. Lactating individuals were obtained in July and August.

Two subspecies of *S. spilosoma* occur in Zacatecas (Howell, 1938). Specimens assigned to *S. s. pallescens* from the arid northeastern part of the state are lighter in color than *S. s. spilosoma* from the western and southern parts of the state. Although Howell (1938) also records *pallescens* as being smaller in size than *spilosoma*, I can find no obvious size differences between these two subspecies.

Specimens Examined. -- *Spermophilus spilosoma pallescens* (A. H. Howell), total 40, from: 3 km SE Apizolaya, 1920 m, 3; 7 km SE Caopas, 1940 m, 1; 11 mi E Concepción del Oro, 5300 ft, 2 (LACM); 5 km SW Concepción del Oro, 2400 m, 1; 10 mi SW Concepción del Oro, 7600 ft, 2 (LACM); 13 km SE Concepción del Oro, 1; 35 km SSE Concepción del Oro, 1980 m, 1; 13 mi SW Camacho, 5900 ft, 2 (LACM); 2 km W San Felipe de Nuevo Mercurio, 1740 m, 2; 6 km W San Felipe de Nuevo Mercurio, 1790 m, 1; 20 km NE Río Grande, 1770 m, 4; 15 mi NE San Andrés, 6200 ft, 3 (LACM); 6.5 km S La Colorada, 1970 m, 2; 43 mi NE Villa de Cos, 7400 ft, 1; 13 km WNW Capriote, 2100 m, 1; Cañitas, 1 (US); 1 mi W Sierra Vieja, 6100 ft, 2 (OU); 12 km SW Villa de Cos, 1950 m, 1; 45 km NE

Morelos Jct, 1 (TTU); Bañon, 6400 ft, 6 (LACM); 2 mi E Bañon, 6400 ft, 1 (LACM), 1 (RGH). Other records: 10 km ESE San Juan de los Charcos, (sight); near Cedros, (sight); 3 km E San Tiburcio, (sight); 15 km NNW Nieves, (sight); in San Luis Potosí, Quadrat 13 (Dalquest, 1953).

Spermophilus spilosoma spilosoma Bennett, total 56, from: 7 mi SW Sombrerete, 6800 ft, 2 (LACM), 2 (RGH); 5.6 mi ESE Sain Alto, 7700 ft, 1 (OU); Chalchihuites, 7500 ft, 1 (LACM); 2 km S Monte Mariana, 2180 m, 1; 4.5 mi E Fresnillo, 8 (MVZ); 10 mi NW Zacatecas, 1, 1 (KU); 5 mi NW Zacatecas, 7600 ft, 1 (KU); 3 mi SE Guadalupe, 1 (UI); 2 mi ESE Trancoso, 7000 ft, 4 (KU); 7 mi SE Trancoso, 1 (KU); 9 mi SE Zacatecas, 7900 ft, 1 (KU); Berriozábal, 10 (US); 3 mi N Cuauhtémoc, 6600 ft, 8 (LACM); 2 mi NNW Cuauhtémoc, 6600 ft, 1 (OU); 5 mi S Ojo Caliente, 1 (UI); 8 mi N Villanueva, 6800 ft, 1 (KU); 7 mi S Pinos, 6800 ft, 10 (LACM). Other records: 3 mi SW Sombrerete (Jones and Webster, 1977); 10 mi SW Sombrerete (CAS); 14 km N Fresnillo, (CAS); 40-41 mi W Fresnillo, (Jones and Webster, 1977); 17 mi SW Fresnillo, (CAS); 45 km SW Fresnillo, (sight); 13 km E Jérez, (sight); 10 mi S Pinos, (CAS); 45 km S Pinos, (sight).

SPERMOPHILUS VARIEGATUS (ERXLEBEN)

Rock Squirrel

Distribution. -- Widely distributed in Zacatecas, except for the most arid desert areas.

Remarks. -- Rock squirrels are abundant in the mountainous regions of the state usually in arroyos or along rock cliffs. In the grasslands and tropical areas they are often associated with rock outcroppings or rock fences. A female taken on 25 July contained four embryos. Another female captured on 10 July was lactating.

Range maps in Howell (1938:137) and Hall and Kelson (1949:353) indicate the possibility of three subspecies occurring in Zacatecas. Specimens assigned to S. v. couchii from northeastern Zacatecas have a dark brown dorsum with a more distinctly blackened head than specimens from southern Zacatecas assigned to S. v. variegatus and which have a more gray dorsum. Specimens from northwestern Zacatecas assigned to S. v. rupestris differ from variegatus in the same way that couchii does. From couchii, rupestris has a lighter brown dorsum. I was not able to distinguish differences in size between any of the populations examined. A reevaluation of the subspecies of Spermophilus variegatus is much warranted.

Specimens Examined. -- Spermophilus variegatus couchii Baird, total 14, from: 12 km W San Rafael, 2590 m, 3; 10 mi SW Concepción del Oro, 7600 ft, 3 (LACM); 5 km SW Concepción del Oro, 2400 m, 8. Other records: 40 km ESE Concepción del Oro, 2320 m, (sight).

Spermophilus variegatus rupestris (J. A. Allen), total 7, from: 15 km NNW Nieves, 1910 m, 1; 9 mi N Nieves, 6000 ft, 1 (LACM); 7 mi SW Sombrerete, 6800 ft, 1 (LACM); 14.5 mi WSW Sombrerete, 7100 ft, 2 (OU); 14.2 mi N Jiménez del Téul, 7300 ft, 1 (OU); 32 km SE Valparaíso, 2040 m, 1. Other records: 3 mi SW Sombrerete (Jones and Webster, 1977); 2 km S Monte Mariana, (sight); 53 km WSW Fresnillo, (sight); 32 km SW Fresnillo, (sight); Valparaíso, (sight); 13 km E Jérez, (sight); 8 km SW Jérez, (sight); Zacatecas, (sight).

Spermophilus variegatus variegatus (Erxleben), total 23, from: Berriozábal, 1 (US); Monte Escobedo, 7300 ft, 3 (LACM); 10 km ENE

Loreto, 7350 ft, 1 (OU); 7 mi S Pinos, 6800 ft, 1 (LACM); 30 km NE Jalpa, 1740 m, 3; 10 mi W Jalpa, 6100 ft, 1 (LACM); 24 km ESE Jalpa, 2590 m, 1; 4 mi S Jalpa, 4300 ft, 1 (LACM); 8 mi NW Nochistlán, 6600 ft, 4 (LACM); 6 km S Téul de Gonzáles Ortega, 2010 m, 1; 16 km SSW Jalpa, 1; 10 mi NW Yahualica, 7100 ft, 1 (LACM); .5 mi ENE Mesquituta, 3450 ft, 2 (OU); Santa Rosa, 4000 ft, 2 (LACM). Other records: 18 km N San Juan Capistrano, 1100 m, (sight); San Juan Capistrano, (sight); 3 mi N Cuauhtémoc, (sight); Pinos, (sight); 20 km S Monte Escobedo, (sight); 8 mi S Moyahua, (Jones and Webster, 1977); in Jalisco, Quadrats 48 and 55 (Genoways and Jones, 1973).

CYNOMYS MEXICANUS MERRIAM

Mexican Prairie Dog

Distribution. -- Known from only one intermontane basin in extreme northeastern Zacatecas.

Remarks. -- Mexican prairie dogs are known from a few localities in Coahuila, Nuevo Leon, and San Luis Potosi (Hall and Kelson, 1959; Baker, 1956; Dalquest, 1953; Pizzimenti, 1975). The specimens reported upon here represent the first records of this species in Zacatecas. The six specimens were taken in an "island" of mesquite-grassland in the intermontane basin east of Concepción del Oro. Extensive searching in this same valley to the south did not reveal any other colonies.

Specimens Examined. -- Total 6, from: 11 mi E Concepción del Oro, 5300 ft, 6 (LACM). Other records: in San Luis Potosí, Quadrat 13 (Dalquest, 1953).

SCIURUS AUREOGASTER SOCIALIS WAGNER

Mexican Gray Squirrel

Distribution. -- Tropical to lower montane forests in extreme southern Zacatecas.

Remarks. Three specimens from two localities represent the first records of the species from Zacatecas. *Sciurus aureogaster* has an extensive distribution south of Zacatecas in tropical to lower montane forests (Musser, 1968).

Specimens Examined. -- Total 3, from: 10 mi NW Yahualica, 7100 ft, 1 (LACM); Santa Rosa, 4000 ft, 2 (LACM).

SCIURUS NAYARITENSIS NAYARITENSIS J. A. ALLEN

Nayarit Squirrel

Distribution. -- Pine-oak forests of the Sierra Madre Occidental in Zacatecas.

Remarks. -- This tree squirrel seems to be most abundant in forests dominated by oaks. Two females taken on 24 and 30 July were lactating.

The Nayarit squirrel was taken in one locality in association with *S. aureogaster*. It would be interesting to study the ecology of these two species in areas where they occur together. Musser (1968) also records areas where the two species occur in sympatry.

Specimens Examined. -- Total 49, from: Sierra Valparaíso, 8200 ft, (type locality), 4 (AMNH); Valparaíso Mountains, 8700 ft, 19 (US); 9 mi NW Valparaíso, 8350 ft, 2; 9.5 mi WSW Valparaíso, 8650 ft, 2; Sierra Madre, 1 (US); 36 km SSE Valparaíso, 2330 m, 1; Monte Escobedo, 7300 ft, 5 (LACM); Plateado, 12 (US); 9 mi WNW Jalpa, 8250 ft, 2; 10 mi

NW Yahualica, 7100 ft, 1 (LACM). Other records: 8 mi S Chalchihuites (Jones and Webster, 1977); 41 mi W Fresnillo (Jones and Webster, 1977); 17 and 18 mi W Milpillas (de la Sierra), (CAS); 25 km WSW Milpillas de la Sierra, (sight); 4-5 mi W Monte Escobedo, (CAS); in Aguascaliente, Quadrat 57 (Lee and Hoffmeister, 1963).

PAPPOGEOMYS CASTANOPS (BAIRD)

Yellow-Faced Pocket Gopher

Distribution. -- Arid to semi-arid areas east of the grasslands in Zacatecas.

Remarks. -- This species is most abundant in the interior desert basins of eastern Zacatecas where soils are silty or sandy and deep. Mounds of this species were numerous at Rancho San Marcos 7 km W of San Felipe de Nuevo Mercurio. They occurred over an area of several hectares in extent. Two females taken on 5 and 21 August contained one and two embryos, respectively.

Russel (1968) recognized four subspecies in Zacatecas based on size differences and geographic locality. I follow his arrangement of subspecies.

Specimens Examined. -- *Pappogeomys castanops goldmani* (Merriam), total 15, from: 4 km N Nieves, 1980 m, 3; 6 km SE Tetillas, 2040 m, 1; Cañitas, 5 (US); 1 mi S Cañitas, 2 (TTU); 11 mi SW Cañitas, 4 (TTU).

Pappogeomys castanops rubellus (Nelson and Goldman), total 23, from: Villa de Cos, 6700 ft, 8 (KU); 1 mi SW Villa de Cos, 4 (TTU); 20 mi NE Morelos jct, 3 (TTU); 45 km NE Morelos jct, 8 (TTU).

Pappogeomys castanops subnubilus (Nelson and Goldman), total 30, from: 16.4 mi ENE Concepción del Oro, 2 (OU); 10 mi E Concepción del

Oro, 5390 ft, 1 (LACM); 11 mi E Concepción del Oro, 5300 ft, 4 (LACM), 4 (RGH); 15 mi S Concepción del Oro, 6900 ft, 3 (KU); 35 km SSE Concepción del Oro, 1980 m, 2; 3 mi N Lulú, 13 (MVZ); 1 mi N Lulú, 1830 m, 1.

Pappogeomys castanops surculus Russell, total 39, from: 10 km ESE San Juan de los Charcos, 1500 m, 2; 3 km SE Apizolaya, 1920 m, 1; 7 km SE Caopas, 1940 m, 1; 1 mi S Cedros, 6050 ft, 1; Concepción del Oro, 7680 ft, 8 (KU); 3.5 mi E Mazapil, 1 (TTU); 2 km SE Sabana Grande, 1945 m, 1; 13 mi SW Camacho, 5800 ft, 8 (LACM), 1 (RGH); 7 km SW San Felipe de Nuevo Mercurio, 1790 m, 2; 3 km E San Tiburcio, 1880 m, 1; 25 km SW San Tiburcio, 2030 m, 2; 5 km S La Colorada, 1960 m, 1; 8 mi S Majoma, 7700 ft, 9 (KU). Other records: 22 mi SW Concepción del Oro, (CAS).

THOMOMYS BOTTAE ANALOGUS GOLDMAN

Botta Pocket Gopher

Distribution. -- Desert mountain ranges of northeastern Zacatecas.

Remarks. -- Fresh mounds of Botta pocket gophers were numerous in soils covered with pinyon pine forests in the mountains west of Concepción del Oro during the summer of 1976. They were taken in rocky but deep soils of an arroyo. Old mounds were found in pinyon-oak forests in the Sierra Astillero (SE of Concepción del Oro) in the summer of 1978. These specimens are clearly assignable to the subspecies T. b. analogus based upon the characters given by Baker (1953).

Specimens Examined. -- Total 14, from: 5 km E Mazapil, 2270 m, 1; 3.5 mi E Mazapil, 2 (TTU); 10 mi SW Concepción del Oro, 7600 ft, 4 (LACM); 5 km SW Concepción del Oro, 2400 m, 5; 40 km ESE Concepción del Oro, 2320 m, 2. Comparative material from Coahuila, total 15, from:

10 mi S, 8 mi W General Cepeda, 7000 ft, 3 (KU); 10 mi S, 7 mi W General Cepeda, 8200 ft, 2 (KU); 11 mi S, 4 mi W General Cepeda, 6700 ft, 9 (KU); 11 mi S, 6 mi W General Cepeda, 1 (KU).

THOMOMYS UMBRINUS (RICHARDSON)

Southern Pocket Gopher

Distribution. -- Widely distributed, except for the most arid parts of Zacatecas.

Remarks. -- This species is usually locally abundant but populations are spotty in their distributions. They seem rare in deserts of northeastern Zacatecas being recorded from only two localities. The Pocket gophers become more abundant in the western parts of the state. In the deep soils of the montane regions of the west, they appear to be most abundant. Two females taken on 27 and 30 July contained five and one embryos, respectively. Two females taken on 1 and 6 August were lactating.

The spotty distribution, dependence on particular soil types, and fossorial habits of pocket gophers has produced considerable geographic variation in this species (Hall and Kelson, 1959; Baker and Greer, 1962; Anderson, 1966, 1972). Four subspecies from a total of five localities were recorded to occur in Zacatecas (Hall and Kelson, 1959). Recently, Berry and Baker (1971) and Jones and Webster (1977) reported upon additional specimens from Zacatecas. Additional material from many localities is now available. Because of small sample sizes from most localities, high degree of sexual dimorphism, and high degree of individual variation (Hoffmeister, 1969 and others) assignment of individuals to subspecies is difficult. The original descriptions of the known subspecies from Zacatecas included but a few individuals; thus, the extent of individual variation was not known. I have defined adults as specimens with the basioccipital-basisphenoid suture and supraoccipital-exoccipital suture closed (Patton, 1973). A number of the type specimens that I have examined did not meet these criteria.

In the comparisons given below I have considered only females, for the most part, since they exhibit less individual variation than males (Hoffmeister, 1969 and unpubl. data) and they are more numerous in collections. In a few instances, I have used males in comparisons when they are the only representative adults from a locality. In most comparisons only mean values of basilar length of skull (BL) are given. Five other cranial measurements were recorded which, in most cases, substantiate the trends seen in BL. External measurements proved to be too variable within populations to be of any value. Notes on general color within populations are also noted. Subspecies from contiguous states were examined for comparative purposes.

Specimens from two localities in the deserts of northeastern Zacatecas were easily assigned to T. u. goldmani. These are the lightest colored and smallest (BL = 29.6) of all populations in Zacatecas. Comparative material from Coahuila and the original description (Merriam, 1901) indicate goldmani to be the smallest and lightest colored subspecies on the Mexican Plateau.

Specimens assigned to T. u. durangae from several localities in grassland and intermontane valleys of northwestern Zacatecas are small (BL = 30.6) although not so small as goldmani. These are also darker colored than goldmani. In color and size they correspond to comparative material from near the type locality and with a topotype from

Durango. In the original description Nelson and Goldman (1934) remarked upon the similarity of durangae to goldmani except in color.

In the mountains of west-central Zacatecas, specimens are assigned to T. u. crassidens with the type locality in the Valparaíso mountains. In color, they are only slightly darker than durangae but with considerable variation. They are larger than durangae (BL = 31.5 and 31.2 from populations south of Chalchihuites and Sierra Valparaíso, respectively).

Specimens from Sierra Madre were assigned to T. sheldoni in the original description by Bailey (1915). Later, Nelson and Goldman (1934) demonstrated that this was only a subspecies of T. umbrinus. It is a large subspecies (BL = 32.00) and somewhat darker colored than crassidens. In addition, specimens from Monte Escobedo agree in size (BL = 31.97) and color with specimens from Sierra Madre and comparative material from the type locality in Nayarit. The Monte Escobedo specimens seem best referred to this subspecies, although a direct route of interbreeding between these populations would not seem likely. The Monte Escobedo populations may represent an unnamed subspecies; however, until more specimens become available for study, I do not believe it wise to proliferate the already voluminous nomenclature of pocket gophers.

Specimens from near Plateado (in the Sierra Moroni) were described by Nelson and Goldman (1934:112) as T. u. enixus based upon four specimens. Later, Hall and Kelson (1959) added a second locality in Jalisco. Nelson and Goldman (1934:112) remarked that the skull was very similar to that of T. u. zacatecae which they also described, differing only in ". . . color darker and richer." The type specimen of enixus (US #90834) was a subadult male by my aging criterion. Two other topotypes had broken skulls and I did not see the fourth specimen. For comparative purposes, I used specimens from the Sierra Moroni northwest of Jalpa. These specimens do not differ appreciably in color from specimens of zacatecae from Berriozábal, the type locality. In size, pocket gophers from the Sierra Moroni do not differ from topotypes or near topotypes (Table 9). Because of this it seems best to refer all specimens from the Sierra Moroni to T. u. zacatecae (Nelson and Goldman, 1934:112) since this name takes precedence by page position over enixus. In addition, specimens from near Nochistlán (Sierra Nochistlán) and Sierra Fria (in Aguascalientes) are also assigned to zacatecae. Specimens from south of Pinos agree in size (BL = 30.10) with zacatecae and are so assigned. Specimens from north of Ojo Caliente are larger (BL = 31.50) but do not differ in color. These are assigned to zacatecae for convenience until more specimens become available. Dalquest (1951:361) described T. u. newmani from Palma in San Luis Potosí which is near the Zacatecas border. I have examined his series of topotypes which were all subadult by my criteria. Since Dalquest (1951) remarked upon the similarity in color between newmani and zacatecae, the small size he reported for newmani may be due to his using a different aging criteria. In any event, none of the material from Zacatecas is referable to newmani.

A single adult male from 25 km ESE of Pinos is, in color, similar to specimens of T. u. arriagensis (Dalquest, 1951:361) that I have examined. Dalquest (1951) considered this subspecies to be one of the largest on the Central Plateau and in this I agree (BL = 32.20 for topotypes and near topotypes). In size, the single male from Zacatecas

TABLE 9

COMPARATIVE MEASUREMENTS OF FEMALE *THOMOMYS UMBRINUS* FROM THREE LOCALITIES IN ZACATECAS[1, 2]

	Berriozábal (n=2)	Cuauhtémoc (n=8)	NW of Jalpa (n=6)
Basilar Length	30.05 (30.0-30.1)	30.45 (28.8-31.1)	30.42 (29.9-30.2)
Nasal Length	11.35 (11.3-11.4)	11.41[7] (11.1-11.9)	11.67 (11.0-12.4)
Zygomatic Breadth	22.30 (22.1-22.5)	22.84 (22.0-23.7)	22.78 (22.2-23.6)
Mastoid Breadth	18.40 (18.0-18.8)	18.29 (17.9-19.2)	17.97 (17.6-18.4)
Rostral Length	13.15 (13.0-13.3)	13.54[7] (13.1-14.0)	13.55 (12.8-14.4)
Rostral Width	6.45 (6.4-6.5)	6.70 (6.3-6.9)	6.93 (6.5-7.5)
Maxillary Toothrow	7.25 (7.1-7.4)	8.10 (7.6-8.4)	7.67 (7.2-7.8)

[1]Means with range in parentheses are given in millimeters.

[2]Superscript indicates sample size different from that associated with the locality.

does not differ from males taken 7 mi S of Pinos (here referred to zacatecae). But then, males from the type locality of arriagensis do not differ to any appreciable extent from males of zacatecae. Since this specimen was taken only a few kilometers from the type locality and it agrees in color with arriagensis, I have assigned it to that subspecies.

Two subadult specimens taken in the tropical valley of the Río Juchipila north of Moyahua are similar in color and the coarse texture of their pelage to T. u. musculus (Nelson and Goldman, 1934:119). In addition, four specimens from 9 mi W of Yahualica, Jalisco can also be referred to this subspecies. Nelson and Goldman (1934) and Baker and Greer (1962) considered musculus to be restricted to the deep tropical canyons of the western slopes of the Sierra Madre Occidental. I have assigned these specimens to musculus but note that more extensive material, when available, may display characters which will prove them to be different.

Specimens Examined. -- Thomomys umbrinus arriagensis Dalquest, total 1, from: 25 km ESE Pinos, 2425 m, 1. Comparative material, total 12, from: 1 km S Arriaga, (type locality) San Luis Potosí, 7 (LSU), 1 (US); 4 mi E Villa Arriaga, San Luis Potosí, 4 (MVZ).

Thomomys umbrinus crassidens Nelson and Goldman, total 50, from: 10 mi SW Chalchihuites, 7200 ft, 15 (LACM); 8 mi S Chalchihuites, 8600 ft, 5 (CAS); 8 mi W Milpillas (de la Sierra), 8300 ft, 2 (CAS); 25 km WSW Milpillas de la Sierra, 2580 m, 5; 9 mi NW Valparaíso, 8350 ft, 13; Valparaíso Mountains, (type locality), 10 (US).

Thomomys umbrinus durangae Nelson and Goldman, total 50, from: 5 km S Gonzales Ortega, 2450 m, 1; 18 km S Gonzales Ortega, 2150 m, 3;

3 mi SW Sombrerete, 5 (CAS); 5 mi SW Sombrerete, 6800 ft, 1 (LACM), 2 (RGH); 7 mi SW Sombrerete, 6900 ft, 2 (LACM), 2 (RGH); 14.5 km WSW Sombrerete, 7100 ft, 3 (OU); 10 km S, 2 km W Sombrerete, 17 (MVZ); 14.2 mi N Jiménez de Téul, 7300 ft, 2 (OU); 40 mi W Fresnillo, 7700 ft, 12 (CAS). Comparative material from Durango, total 8, from: Nombre de Dios, 1; 6 mi NW La Pila, 6100 ft, 2; 4 mi SW La Pila, 1; 5 mi S Durango, 6200 ft, 1; 4 mi E, 7 mi S Durango, 6200 ft, 1; Durango, (type locality), 2 (US).

Thomomys umbrinus goldmani Merriam, total 27, from: 22 mi S Concepción del Oro, 1 (CAS); 15 mi NE San Andrés, 6200 ft, 26 (LACM). Comparative material, total 7, from: Mapimi, Durango (type locality), 2 (US); 2 mi S El Palmito, Durango, 1; 3 mi NE Sierra Mojada, Coahuila, 4100 ft, 1 (KU); Sierra Mojada, 4150 ft, Coahuila, 1 (KU); 3 mi SE Torreon, 3800 ft, Coahuila, 2 (KU).

Thomomys umbrinus musculus Nelson and Goldman, total 2, from: 2.5 mi N. Moyahua, 4400 ft, 2 (CAS). Comparative material: 9 mi W Yahualica, Jalisco, 4 (KU).

Thomomys umbrinus sheldoni Bailey, total 42, from: Sierra Madre, 5 (US); 36 km SSE Valparaíso, 2330 m, 3; 3 mi NW Monte Escobedo, 13 (KU); Monte Escobedo, 7300 ft, 21 (LACM). Comparative material, total 11, from: Santa Teresa, 6800 ft, (type locality), Nayarit, 11 (US).

Thomomys umbrinus zacatecae Nelson and Goldman, total 145, from: 10 mi SE Fresnillo, 1 (TTU); 5 mi NW Zacatecas, 7600 ft, 1 (KU); 9 mi W Zacatecas, 1 (CAS); 4 mi W Trancoso, 2 (TTU); .5 mi NW Trancoso, 1 (UI); 2 mi S, 5 mi E Zacatecas, 7700 ft, 1; 3 km N Ojo Caliente, 25 (MVZ); Berriozábal (type locality), 10 (US); 3 mi N Cuauhtémoc, 6600 ft, 21 (LACM); .5 mi SE Cuauhtémoc, 6600 ft, 5 (OU); 2 km N Noria de

Angeles, 2200 m, 1; 6 mi NNW Pinos, 7900 ft, 1; 10 km ENE Loreto, 7350 ft, 2 (OU); 7 mi S Pinos, 6800 ft, 9 (LACM); Plateado, 3 (US); 11 mi NW Jalpa, 8000 ft, 15 (KU); 9 mi WNW Jalpa, 8250 ft, 3; 25 km ESE Jalpa, 2590 m, 16; 8 km NW Téul de Gonzáles Ortega, 2200 m, 1; 8 mi NW Nochistlán, 6600 ft, 26 (LACM). Comparative material, total 2, from: 3 mi N Cerro de Jaguey, 8200 ft, 2 (MVZ).

PEROGNATHUS FLAVUS BAIRD

Silky Pocket Mouse

Distribution. -- Widely distributed, except for forested regions, throughout Zacatecas.

Remarks. -- Silky pocket mice seemed to be most abundant in the grasslands of western Zacatecas. Burrows of these mice, found in summer in a plowed field, were about 5 to 10 cm deep with a greatest length of about 100 cm. No seed caches were present in any of five burrows excavated. Two females taken on 22 July and 21 August contained three embryos each.

Baker (1954), in reviewing the subspecies of *Perognathus flavus* in Mexico, reported one subspecies from Zacatecas and indicated that two others may also be present. These three subspecies were separated on the basis of size and color. Specimens from the extreme north are assigned to *P. f. pallescens* based upon their pale color and small size. Specimens assigned to *P. f. medius* occur throughout the major portion of the state. They are darker and larger than *pallescens*. In localities east of Concepción del Oro specimens appear to be intermediate between *pallescens* and *medius*. Since the Sierra Astillero and narrow intermontane valleys may act as a partial barrier to interbreeding with populations to the north, these intermediate specimens are assigned to medius. Specimens from the extreme southern part of Zacatecas are assigned to P. f. parviceps on the basis of small size and light color.

Specimens Examined. -- Perognathus flavus medius Baker, total 95, from: 6 km E Mazapil, 2645 m, 1; 12 km ENE Concepción del Oro, 1850 m, 2; 35 km SSE Concepción del Oro, 1980 m, 6; 3 km NW San Felipe de Nuevo Mercurio, 1770 m, 4; 2 km W San Felipe de Nuevo Mercurio, 1740 m, 2; 1 mi S San Tiburcio, 7000 ft, 2 (KU); 15 km NNW Nieves, 1910 m, 7; 4 km N Nieves, 1980 m, 2; 23 km NE Río Grande, 1800 m, 5; 12 mi NW Río Grande, 6800 ft, 1; 18 km S Gonzales Ortega, 2450 m, 1; 5 km S La Colorada, 1960 m, 1; 6.5 km S La Colorada, 1970 m, 1; 13 km WNW Capriote, 2100 m, 1; 5 mi SW Sombrerete, 6900 ft, 1 (LACM), 1 (RGH); 5 km NE Chalchihuites, 2360 m, 1; 3 km SE Rancho Grande, 2190 m, 1; Bañon, 6400 ft, 2 (LACM); 4.5 mi E Fresnillo, 5 (MVZ); 10 km SE Fresnillo, 2250 m, 1; 53 km SW Fresnillo, 2250 m, 5; Valparaíso, 6200 ft, 1 (US); 3 mi SE Guadalupe, 1 (UI); 2 mi S, 5 mi E Zacatecas, 7700 ft, 1; 5 mi SW Zacatecas, 1 (MVZ); 15 km SW Valparaíso, 2250 m, 1; 6 mi W Jérez, 6700 ft, 1; 6 mi E Jérez, 7000 ft, 2 (KU); 8 km SW Jérez, 2030 m, 18; Berriozábal, 1 (US); 5 mi S Ojo Caliente, 7 (UI); 2 km N Noria de Angeles, 2200 m, 5; 10 km S Tepetongo, 1950 m, 1; 7 mi S Pinos, 6800 ft, 2 (LACM); 25 km ESE Pinos, 2425 m, 1; 45 km S Pinos, 2350 m, 1. Other records: 40 mi W Fresnillo (Jones and Webster, 1977); 10 mi S Pinos, (CAS).

Perognathus flavus pallescens Baker, total 4, from: 10 km ESE San Juan de los Charcos, 1500 m, 2; 3 km SE Apizolaya, 1920 m, 1; 7 km SE Caopas, 1940 m, 1.

Perognathus flavus parviceps Baker, total 5, from: 16 km SSE Monte Escobedo, 2010 m, 2; 2.5 mi S Momax, 5800 ft, 1; 25 km ESE Jalpa, 2590 m, 1; 8 mi NW Nochistlán, 6600 ft, 1 (LACM). Other records: in Jalisco, Quadrat 73 (Baker, 1954).

PEROGNATHUS HISPIDUS ZACATECAE OSGOOD

Hispid Pocket Mouse

Distribution. -- Lower montane, grassland and tropical regions of western Zacatecas.

Remarks. -- Hispid pocket mice seem to be most abundant in open grassland habitats or in riparian areas. An adult female taken on 24 July was lactating.

Specimens Examined. -- Total 36, from: 5.5 mi NW Juan Aldama, 6200 ft, 1 (OU); 5 km S Gonzales Ortega, 2150 m, 1; 23 km NE Río Grande, 1800 m, 1; 10 km SE Fresnillo, 2250 m, 1; 11 mi NE Valparaíso, 7100 ft, 2; Valparaíso, 6200 ft, (type locality), 9 (US); 2 mi S, 5 mi E Zacatecas, 7700 ft, 1; 3 mi SE Guadalupe, 1 (UI); 8 mi SE Zacatecas, 7225 ft, 6 (KU); 13 km E Jérez, 2200 m, 1; 8 km SW Jérez, 2030 m, 3; 2 km N Noria de Angeles, 2200 m, 1; 25 km ESE Pinos, 2425 m, 1; 45 km S Pinos, 2350 m, 3; 30 km NE Jalpa, 1740 m, 3; 6 mi SW Jalpa, 4900 ft, 1 (LACM). Other records: 10 mi NW Sombrerete (Jones and Webster, 1977).

PEROGNATHUS LINEATUS DALQUEST

Lined Pocket Mouse

Distribution. -- Known from only one locality in southeastern Zacatecas.

Remarks. -- Very little is known about this species of pocket mouse. Some natural history observations were reported by Dalquest (1953).

In the original description, Dalquest (1951) commented upon the similarity between _P. lineatus_ and _P. nelsoni_. Apparently, the major distinction is that _P. lineatus_ lacks the distinct stiff pelage spines that are present on _P. nelsoni_. Compared to _P. penicillatus_, which also lacks spines, _P. lineatus_ has a longer broader skull. In a numerical taxonomic analysis in which the species of the subgenus _Chaetodipus_ were considered, _P. lineatus_ was found to be distinct from either _nelsoni_ or _penicillatus_ (Caire, 1976). I compared the two specimens from Zacatecas with topotypes from San Luis Potosí and believe they are best referred to the species _P. lineatus_.

Specimens Examined. -- Total 2, from: 1 mi NE Noria de Angeles, 2 (CAS). Comparative material: 1 km S Arriaga, (type locality), San Luis Potosí, 2 (LSU), these specimens also represent the record from Quadrat 67 used in the analysis of distribution patterns.

PEROGNATHUS NELSONI NELSONI OSGOOD

Nelson's Pocket Mouse

Distribution. -- Widely distributed in open lands throughout the state.

Remarks. -- This species is the most widely distributed and abundant pocket mouse in Zacatecas. Apparently, it is absent only from montane forests in western Zacatecas. Ten females taken between 5 July and 8 August contained an average of 2.9 (range 1 to 4) embryos. Six females captured between 13 July and 18 August were lactating. Of

32 adult females obtained in June, none showed any evidence of breeding activity.

Prior to the present study, there were relatively few records of P. nelsoni reported from Zacatecas (Osgood, 1900; Jones and Webster, 1977). The large series now available considerably increases our knowlede of the distribution of this species. No appreciable amount of geographic variation was found to occur in Zacatecas.

Specimens Examined. -- Total 511, from: 10 km ESE San Juan de los Charcos, 1500 m, 5; 6 km W Apizolaya, 1800 m, 39; 3 km SE Apizolaya, 1920 m, 11; 7 km SE Caopas, 1940 m, 3; 8 mi W Cedros, 5650 ft, 1 (LACM), 2 (RGH); 18.6 mi ENE Concepción del Oro, 1 (OU); 12 km ENE Concepción del Oro, 1850 m, 57; 4 km W San Rafael, 2140 m, 3; 13 km NE Concepción del Oro, 1700 m, 1; 40 km ESE Concepción del Oro, 2320 m, 11; 13 km SW Concepción del Oro, 1900 m, 1; 5 km SW Concepción del Oro, 2400 m, 2; 5 km SE Concepción del Oro, 1935 m, 4; 18 km SSW Concepción del Oro, 2130 m, 5; 2 km SE Sabana Grande, 1945 m, 13; 7 km SE El Rosario, 2100 m, 1; 35 km SSE Concepción del Oro, 1980 m, 10; 13 km SW Camacho, 5800 ft, 2 (LACM); 3 km NW San Felipe de Nuevo Mercurio, 1770 m, 21; 2 km W San Felipe de Nuevo Mercurio, 1740 m, 2; 10 mi SE Juan Aldama, 2210 m, 4; 15 km WSW San Tiburcio, 1980 m, 1; 15 km NNW Nieves, 1910 m, 8; 9 mi NE Nieves, 2010 m, 2; 23 km NE Río Grande, 1800 m, 2; 25 km SW San Tiburcio, 2030 m, 2; 15 mi NE San Andrés, 6200 ft, 2 (LACM); 5 mi SE Río Grande, 1940 m, 14; 5 km S La Colorada, 1960 m, 3; 6.5 km S La Colorada, 1970 m, 14; 6 km SE Tetillas, 2040 m, 4; 2 mi S Santa Efigenia, 7400 ft, 2 (KU); 9.5 mi W Sombrerete, 1 (OU); 13 km WNW Capriote, 2100 m, 20; 3 km E El Arenal, 2450 m, 2; 9 km NW Sarteneja, 2200 m, 2; 10 mi N Rancho Grande, 6700 ft, 1; 15.5 mi WSW Sombrerete, 6400 ft, 1 (OU); Cañitas, 1 (US); 5 km NE Chalchihuites, 2360 m, 1; 1 mi W Sierra Vieja, 6100 ft, 1 (OU); 40 km NE Villa de Cos, 2000 m, 1 (OU); 3 km SE Rancho Grande, 2190 m, 2; 18 km NE Villa de Cos, 2040 m, 8; 3 mi E, 4.6 mi N Villa de Cos, 2 (OU); 2 km S Monte Mariana, 2180 m, 3; 2 mi SE Villa de Cos, 6200 ft, 2; 3 mi NW Fresnillo, 7760 ft, 2; Bañon, 6400 ft, 12 (LACM); 2 mi E Bañon, 6400 ft, 1 (LACM), 2 (RGH); 6 km N Fresnillo, 2250 m, 2; 1.8 mi N Fresnillo, 1 (MVZ); 2.5 km WNW Fresnillo, 7400 ft, 2 (OU); 18 km N San Juan Capistrano, 1100 m, 9; Valparaíso, 6200 ft, 1 (US); 5 mi SW Zacatecas, 4 (MVZ); 2 mi S, 5 mi E Zacatecas, 7700 ft, 1; 8 mi SE Zacatecas, 7225 ft, 14 (KU); San Juan Capistrano, 1 (US); 5 km NE San Juan Capistrano, 1330 m, 4; 3 km N San Juan Capistrano, 1500 m, 7; 5 km E San Juan Capistrano, 1 (OU); 13 km E Jérez, 2200 m, 5; 8 km SW Jérez, 2030 m, 6; Berriozábal, 11 (US); 3 mi N Cuauhtémoc, 6600 ft, 5 (LACM); 3 mi WNW Saldaña, 6850 ft, 1; 5 mi S Ojo Caliente, 13 (UI); 2 km N Noria de Angeles, 2200 m, 2; 10 km ENE Loreto, 7350 ft, 7 (OU); 6 km ENE Loreto, 6850 ft, 1 (OU); 7 mi S Pinos, 6800 ft, 17 (LACM); 20 km S Villanueva, 1810 m, 1; 25 km ESE Pinos, 2425 m, 26; 30 km ENE Jalpa, 1740 m, 10; 2 mi S Tabasco, 2 (UI); 10 mi W Jalpa, 6100 ft, 7 (LACM); r mi S Jalpa, 4300 ft, 5 (LACM); 13 mi WSW Jalpa, 1 (OU). Other records: 20 mi SW Concepción del Oro, (Jones and Webster, 1977); 20 mi S Villanueva (CAS); between Huanasco and Tabasco, (CAS); 7 mi N Jalpa, (Jones and Webster, 1977); in Jalisco, Quadrat 55 (Genoways and Jones, 1973); in San Luis Potosí, Quadrat 67 (Dalquest, 1953).

PEROGNATHUS PENICILLATUS EREMICUS MEARNS

Desert Pocket Mouse

Distribution. -- Arid to semi-arid regions east of the grasslands in Zacatecas.

Remarks. -- This species seems most abundant in the interior drainage basins where fine soils are deep. The western limit of this species distribution in Zacatecas coincides with the beginning of the grassland vegetation. Two females taken on 10 July and 5 August contained four and five embryos, respectively. Two females taken on 7 and 9 July were lactating.

Previous to this report, no specimens of the desert pocket mouse had been reported from Zacatecas, although they were known from both north and south of the state (Hoffmeister and Lee, 1967). The specimens are assigned to the subspecies *P. p. eremicus* based on the characters given in Hoffmeister and Lee (1967).

Specimens Examined. -- Total 140, from: 10 km ESE San Juan de los Charcos, 1500 m, 3; 6 km W Apizolaya, 1800 m, 1; 3 km SE Apizolaya, 1920 m, 23; 8 mi W Cedros, 5650 ft, 1 (LACM); 1 mi S Cedros, 6500 ft, 3; 15 mi NE Concepción del Oro, 8 (OU); 14.5 mi NE Concepción del Oro, 3 (OU); 12 km ENE Concepción del Oro, 1850 m, 9; 13 km NE Concepción del Oro, 1700 m, 2; 11 mi E Concepción del Oro, 5300 ft, 3 (LACM); 2 km SE Sabana Grande, 1940 m, 6; 3 mi N Lulú, 7 (MVZ); 35 km SSE Concepción del Oro, 1980 m, 1; 13 mi SW Camacho, 5800 ft, 8 (LACM), 1 (RGH); 3 km NW San Felipe de Nuevo Mercurio, 1770 m, 37; 2 km W San Felipe de Nuevo Mercurio, 1740 m, 9; 3 km E San Tiburcio, 1880 m, 3; 15 km WSW San Tiburcio, 1980 m, 4; 6.5 km S La Colorada, 1970 m, 7; 3 mi E, 4.6 mi N Villa de Cos, 1 (OU).

DIPODOMYS MERRIAMI ATRONASUS MERRIAM

Merriam's Kangaroo Rat

Distribution. -- Arid to semi-arid regions mostly east of the grasslands in Zacatecas.

Remarks. -- This species seems most abundant in level desert situations of northeastern Zacatecas. The distribution of D. merriami includes the eastern margin of the grasslands. The presence of D. merriami marginally in grassland habitats may be the result of deterioration of the grasslands due to overgrazing. Eighteen females taken on 6 July, 1978, in the very arid region near San Tiburcio, did not show any sign of reproductive activity. Of 20 females taken on 8 July, 1978, in an area near Capriote with more luxuriant vegetation, seven contained an average of 3.0 (range, 2 to 4) embryos. Of 12 females taken on 14 July, 1978, in the area near Monte Mariana also in green vegetation, four contained an average of 2.75 (range, 2 to 3) embryos. These data may be suggestive of different timing of reproduction in different habitats.

Lidicker (1960), in his review of D. merriami, recognized only one subspecies, D. m. atronasus, in Zacatecas but indicated that another, D. m. ambiguus, might occur in the extreme northern part of the state. Specimens from the extreme north, now available, show some characteristics of ambiguus (lighter color) but in size all are referable to atronasus.

Specimens Examined. -- Total 557, from: 10 km ESE San Juan de los Charcos, 1500 m, 1; 2.5 mi N La Pendencia, 5400 ft, 3 (OU); 6 km W Apizolaya, 1800 m, 51; 3 km SE Apizolaya, 1920 m, 26; 7 km SE Caopas, 1940 m, 5; 8 mi W Cedros, 5650 ft, 2 (LACM), 1 (RGH); 1 mi S Cedros, 5600 ft, 1; 4 km W San Rafael, 2140 m, 1; 15 mi NE Concepción del Oro, 3 (OU); 14.5 mi ENE Concepción del Oro, 6 (OU); 16.4 mi ENE Concepción del Oro, 5 (OU); 12 km ENE Concepción del Oro, 1850 m, 22; 13 km NE Concepción del Oro, 1700 m, 2; 11 mi E Concepción del Oro, 5300 ft, 3 (LACM); 5 km SE Concepción del Oro, 1940 m, 4; 18 km SSW Concepción del Oro, 2130 m, 3; 2 km SE Sabana Grande, 1945 m, 9; 3 mi N Lulú, 4 (MVZ); 15 mi S Concepción del Oro, 6900 ft, 8 (KU); 7 km SE El Rosario, 2100 m, 8; 35 km SSE Concepción del Oro, 1980 m, 8; 5.5 mi NW Juan Aldama, 6200 ft, 3 (OU); 13 mi SW Camacho, 5800 ft, 1 (LACM), 2 (RGH); 3 km NW San Felipe de Nuevo Mercurio, 1770 m, 14; 10 mi SE Juan Aldama, 2210 m, 2; 1 mi SW San Tiburcio, 9 (KU); 3 km E San Tiburcio, 1880 m, 6; 15 km WSW San Tiburcio, 1980 m, 33; 15 km NNW Nieves, 1910 m, 1; 9 mi NE Nieves, 6050 ft, 1; 4 km N Nieves, 1980 m, 5; 23 km NE Río Grande, 1800 m, 9; 25 km WSW San Tiburcio, 2030 m, 4; 12 mi NW Río Grande, 6900 ft, 2; 15 mi NE San Andrés, 1 (LACM); 5 mi SE Río Grande, 6350 ft, 5; 5 km S La Colorada, 1960 m, 3; 6.5 km S La Colorada, 1970 m, 15; 8 mi S Majoma, 7700 ft, 17 (KU); 6 km SE Tetillas, 2040 m, 4; 13 km WNW Capriote, 2100 m, 39; 9 km NW Sarteneja, 2200 m, 2; 10 mi N Rancho Grande, 6700 ft, 6; Cañitas, 6; 1 mi N Rancho Grande, 1 (KU); 1 mi W Sierra Vieja, 6100 ft, 14 (OU); 18 km NE Villa de Cos, 4; 23 km N Fresnillo, 2140 m, 2; 3 mi E, 4.6 mi N Villa de Cos, 3 (OU); 13 mi NNW Fresnillo, 2 (LACM); Villa de Cos, 6700 ft, 9 (KU); 2 km S Monte Mariana, 2180 m, 34; 2 mi SE Villa de Cos, 6200 ft, 1; 45 km NE Morelos Jct, 3 (TTU); Bañon, 6400 ft, 33 (LACM); 2 mi E Bañon, 6400 ft, 2 (LACM), 4 (RGH); 4 km ESE Bañon, 6200 ft, 6 (OU); 4.5 mi E Fresnillo, 12 (MVZ); 10 km SE Fresnillo, 2250 m, 4; 24 mi NE Zacatecas, 6700 ft, 2 (LACM), 2 (RGH); 8 mi SE Zacatecas, 7225 ft, 16 (KU); 2 mi ESE

Trancoso, 7000 ft, 6 (KU); 3 mi N Cuauhtémoc, 6600 ft, 13 (LACM); 5 mi S Ojo Caliente, 5 (UI); 3 mi WNW Saldaña, 6850 ft, 2; 2 km N Noria de Angeles, 2200 m, 2; 7 mi S Pinos, 6800 ft, 1 (LACM); 10 mi S Pinos, 7100 ft, 1 (LACM); 25 km ESE Pinos, 2425 m, 1. Other records: 22 mi SW Concepción del Oro, (Jones and Webster, 1977); 14 mi S Concepción del Oro, (CAS); 20 mi S Concepción del Oro, (CAS); 17 mi NW Fresnillo, (CAS); 16 mi NW Fresnillo, (CAS); 8 mi W Fresnillo, (Jones and Webster, 1977).

DIPODOMYS NELSONI MERRIAM

Nelson's Kangaroo Rat

Distribution. -- Arid regions of northern and northeastern Zacatecas.

Remarks. -- Scattered mounds of this species are conspicuous in desert flatlands and the interior basins where soils are sandy. Its western and southern limits coincide with the desert-grassland ecotone. A female taken on 22 July contained 2 embryos.

Alvarez (1960) listed a specimen from 3 mi N Lulú as *D. spectabilis cratodon*. According to Cornelio Sánchez (personal communication), this specimen is, in fact, *D. nelsoni*. It was part of a collection made by the MVZ in 1940. Other specimens from that locality were examined and all are referable to *D. nelsoni*.

Specimens Examined. -- Total 76, from: 10 km ESE San Juan de los Charcos, 1500 m, 2; 6 km W Apizolaya, 1800 m, 2; 3 km SE Apizolaya, 1920 m, 4; 7 km SE Caopas, 1940 m, 6; 8 mi W Cedros, 5650 ft, 1 (RGH); 15 mi NE Concepción del Oro, 12 (OU); 14.5 mi ENE Concepción del Oro, 1 (OU); 16.4 mi ENE Concepción del Oro, 2 (OU); 10 mi E Concepción del

Oro, 5300 ft, 1 (LACM); 11 mi E Concepción del Oro, 5300 ft, 1 (LACM); 16 km SW Concepción del Oro, 1900 m, 1; 3 mi N Lulú, 4 (MVZ); 7 km SE El Rosario, 2100 m, 1; 35 km SSE Concepción del Oro, 1980 m, 2; 20 mi SSW Concepción del Oro, 5 (KU); 22 mi SSW Concepción del Oro, 6000 ft, 3 (KU); 13 mi SW Camacho, 5800 ft, 5 (LACM); 3 km NW San Felipe de Nuevo Mercurio, 1770 m, 1; 2 km W San Felipe de Nuevo Mercurio, 1740 m, 2; 6 mi NE San Tiburcio, 6100 ft, 1 (KU); 3 km E San Tiburcio, 1880 m, 1; 1.5 mi SW San Tiburcio, 6100 ft, 2 (KU); 3.5 mi SW San Tiburcio, 6100 ft, 3 (KU); 4 mi SW San Tiburcio, 6100 ft, 3 (KU); 7 mi SW San Tiburcio, 6100 ft, 1 (KU); 7.5 mi SW San Tiburcio, 6000 ft, 3 (KU); 8 mi SW San Tiburcio, 1 (KU); 9 mi NE Nieves, 6050 ft, 1; 4 km N Nieves, 1980 m, 3; 23 km NE Río Grande, 1880 m, 1. Other records: 14 mi S Concepción del Oro, (CAS).

DIPODOMYS ORDII WOODHOUSE

Ord's Kangaroo Rat

Distribution. -- Arid to semi-arid grasslands and deserts east of the Sierra Madre Occidental in Zacatecas.

Remarks. -- This species is widely distributed throughout the grasslands and desert of Zacatecas but is less abundant in any given locality than in *D. merriami*. It occurs further west into the grasslands than does *D. merriami*. Of forty females taken in June, July, and August, for which data are available, none showed any evidence of reproductive activity.

Based upon characters given in Setzer (1949), I recognize three subspecies in Zacatecas. In the extreme north specimens are assigned to *D. o. idoneus* based on their small size and pale color. In northeastern Zacatecas specimens assigned to D. o. fuscus are large and pale colored. In central and southeastern Zacatecas, specimens assigned to D. o. palmeri are medium sized and dark colored.

Specimens Examined. -- Dipodomys ordii fuscus Setzer, total 43, from: 14.5 mi ENE Concepción del Oro, 1 (OU); 12 km ENE Concepción del Oro, 1850 m, 17; Concepción del Oro, 7600 ft, 1 (KU); 10 mi E Concepción del Oro, 5300 ft, 1 (LACM); 11 mi E Concepción del Oro, 5300 ft, 2 (LACM), 1 (RGH); 16 km SW Concepción del Oro, 1900 m, 2; 3 mi N Lulú, 5 (MVZ); 35 km SSE Concepción del Oro, 1980 m, 11; 3 mi E San Tiburcio, 1880 m, 2.

Dipodomys ordii idoneus Setzer, total 17, from: 3 km SE Apizolaya, 1920 m, 5; 7 km SE Caopas, 1940 m, 10; 13 mi SW Camacho, 5800 ft, 1 (LACM); 3 km NW San Felipe de Nuevo Mercurio, 1770 m, 1.

Dipodomys ordii palmeri (J. A. Allen), total 223, from: 15 km NNW Nieves, 1910 m, 3; 23 km NE Río Grande, 1800 m, 4; 15 mi NE San Andrés, 6200 ft, 2 (LACM); 13 km WNW Río Grande, 2050 m, 1; 6.5 km S La Colorada, 1970 m, 9; Santa Efigenia, 7400 ft, 1 (KU); 5.5 mi SW Sombrerete, 6850 ft, 2 (LACM); 15.5 mi WSW Sombrerete, 6400 ft, 1 (OU); 10 mi N Rancho Grande, 6700 ft, 1; Cañitas, 5 (US); 1 mi S Cañitas, 2 (TTU); 3 km SE Rancho Grande, 2190 m, 1; Villa de Cos, 6700 ft, 3 (KU); 13 mi NNW Fresnillo, 3 (LACM); 2 km S Monte Mariana, 2180 m, 2; Bañon, 6400 ft, 22 (LACM); 2 mi E Bañon, 6400 ft, 1 (RGH); 4 km ESE Bañon, 6200 ft, 5 (OU); 4.5 mi E Fresnillo, 1 (MVZ); 10 mi N Zacatecas, 6200 ft, 1 (KU); 2 mi SE Calera, 7300 ft, 3 (KU); 2 mi S, 5 mi E Zacatecas, 7700 ft, 27; 9 mi SE Zacatecas, 7900 ft, 1 (KU); 8 mi SE Zacatecas, 7225 ft, 65 (KU); 3 mi SE Guadalupe, 7 (UI); 7 mi SE Trancoso, 1 (KU); 13 km E Jérez, 2200 m, 1; 8 mi N Villanueva, 6800 ft, 1 (KU); 5 mi S

Ojo Caliente, 2 (UI); 6 mi NNW Pinos, 7900 ft, 2; 7 mi S Pinos, 6800 ft, 12 (LACM); 10 mi S Pinos, 7100 ft, 1 (RGH); 25 km ESE Pinos, 2425 m, 1.

DIPODOMYS PHILLIPSII ORNATUS MERRIAM

Phillip's Kangaroo Rat

Distribution. -- Grasslands of western and southern Zacatecas.

Remarks. -- This species seems to be most abundant in short grass habitats. In Zacatecas, this kangaroo rat is recorded from open areas in the tropical scrub vegetation of the deep canyons (1100 m) to the highest grassland plains (2400 m). Three females taken on 19 and 20 July and 3 August contained three embryos each. Other natural history notes on this species can be found in Genoways and Jones (1971).

All specimens from Zacatecas are assigned to the subspecies *D. p. ornatus* following the review by Genoways and Jones (1971). They found specimens from low elevations to be lighter colored than those from higher elevations. I see the same trend in samples which I have examined. Specimens from near San Juan Capistrano (1100 m) are the lightest colored of all populations in Zacatecas.

Specimens Examined. -- Total 99, from: 5 km S Gonzales Ortega, 2150 m and 2320 m, 7; 3 km E El Arenal, 1; 5.5 mi SW Sombrerete, 6850 ft, 1 (LACM); 5 km NE Chalchihuites, 2360 m, 2; 2 km S Monte Mariana, 2180 m, 2; 45 km SW Fresnillo, 2165 m, 1; 53 km SW Fresnillo, 2250 m, 2; 11 mi NE Valparaíso, 7100 ft, 1; Valparaíso, 6200 ft, 11 (US); 18 km N San Juan Capistrano, 11 m, 7; Zacatecas, 4 (US); 5 mi SW Zacatecas, 4 (MVZ); 2 mi S, 5 mi E Zacatecas, 1; 8 mi SE Zacatecas, 7225 ft, 4 (KU); 5 km NE San Juan Capistrano, 1330 m, 2; San Juan Capistrano, 3 (US); 6

mi W Jérez, 6700 ft, 1; 13 km E Jérez, 2200 m, 2; 8 km SW Jérez, 2030 m, 4; Berriozábal, 2 (US); 3 mi N Cuauhtémoc, 6600 ft, 15 (LACM); 5 mi S Ojo Caliente, 2 (UI); 2 mi N Villanueva, 1 (KU); 6 mi NNW Pinos, 7900 ft, 1; 7 mi S Pinos, 6800 ft, 1 (LACM); 25 km ESE Pinos, 2425 m, 2; 45 km S Pinos, 2350 m, 1; Plateado, 5 (US); 30 km NE Jalpa, 1740 m, 1; 5.5 mi SW Jalpa, 4400 ft, 3 (OU). Other records: 40 mi W Fresnillo, (Jones and Webster, 1977); 12 mi N, 7 mi E Fresnillo, (Genoways and Jones, 1971); 1 mi S Momax, (CAS); in Jalisco, Quadrat 55 (Genoways and Jones, 1971).

DIPODOMYS SPECTABILIS CRATODON MERRIAM

Banner-tailed Kangaroo Rat

Distribution. -- Grassland and desert-grassland ecotone of central and southeastern Zacatecas.

Remarks. -- This species seems to be most abundant in the desert-grassland ecotone habitats. They do not enter traps readily, most specimens being secured either by digging them from their burrows or shooting them at night. Little is known about the natural history of this southernmost, disjunct population of D. spectabilis.

Specimens Examined. -- Total 113, from: 28 mi NE San Andrés, 6700 ft, 5 (KU); 6.5 km S La Colorada, 1970 m, 1; 13 km WNW Capriote, 2100 m, 2; 12 mi SW San Andrés, 6000 ft, 3 (KU); Cañitas, 3 (US); 40 km NE Villa de Cos, 2000 m, 1; 3 mi E, 4.6 mi N Villa de Cos, 38 (OU); Villa de Cos, 6700 ft, 3 (KU); 13 mi NNW Fresnillo, 1 (LACM); Bañon, 6400 ft, 17 (LACM); 4.5 mi E Fresnillo, 1 (MVZ); 5 mi SW Bañon, 3 (KU); 10 mi N Zacatecas, 6200 ft, 3 (KU); 8 mi W Zacatecas, 1 (KU); 8 mi SE Zacatecas, 7225 ft, 3 (KU); 1.5 mi E Jérez, 7000 ft, 2 (KU);

Berriozábal, 4 (US); 3 mi N Cuauhtémoc, 6600 ft, 4 (LACM); 8 mi N Villanueva, 6800 ft, 2 (KU); 6 mi N Villanueva, 6500 ft, 3 (KU); 4 mi N Villanueva, 6400 ft, 4 (KU); 2 mi N Villanueva, 6500 ft, 4 (KU); 5 mi S Ojo Caliente, 2 (UI); Pinos, 4 (AMNH).

LIOMYS IRRORATUS (GRAY)

Mexican Spiny Pocket Mouse

Distribution. -- Grasslands to tropical canyons in Zacatecas.

Remarks. -- On the Mexican Plateau, this species seems most abundant in brushy areas where nopal (*Opuntia* sp) is a dominant plant. In tropical canyons it is also found in heavy brush habitats. In the desert regions of the northeast, it occurred in islands of mesquite-grassland. Five females taken between 27 July and 18 August contained an average of 4.2 (range, 3 to 5) embryos. One female taken on 5 July contained five embryos and was lactating.

Two subspecies were recognized as occurring in Zacatecas by Genoways (1973). A large sized *L. i. alleni* occurs on the Plateau and western slopes of the tropical canyons. A smaller *L. i. jaliscensis* lives in the southernmost tropical canyon near Santa Rosa. Genoways (1973:102) noted that specimens from Zacatecas that he assigned to *jaliscensis* ". . . evince intergradation between *jaliscensis* and *alleni*." I have followed Genoways (1973) in the assignment of subspecies, noting that the specimens from near Santa Rosa in the valley of the Río Juchipila are difficult to identify to one or the other subspecies. Specimens here assigned to *alleni* from near La Colorada, San Felipe de Nuevo Mercurio, and Apizolaya, all in desert islands of mesquite-grassland, extend the known range of L. i. alleni some 100 km east of that given in Genoways (1973).

Specimens Examined. -- Liomys irroratus alleni (Coues), total 249, from: 3 km SE Apizolaya, 1920 m, 1; 2 km W San Felipe de Nuevo Mercurio, 1740 m, 5; 9 mi NE Nieves, 6050 ft, 1; 23 km NE Río Grande, 1800 m, 1; 5 km S Gonzales Ortega, 2320 m, 2; 13 km WNW Río Grande, 2050 m, 1; 5 mi SE Río Grande, 1940 m, 2; 5 km S La Colorada, 1960 m, 2; 6.5 km S La Colorada, 1970 m, 1; 6 km SE Tetillas, 2040 m, 2; 15.8 mi W Sombrerete, 7050 ft, 2 (OU); 10.4 mi WSW Sombrerete, 7250 ft, 2 (OU); 14.5 mi WSW Sombrerete, 7100 ft, 7 (OU); 15.5 mi WSW Sombrerete, 6400 ft, 1 (OU); 10 mi N Rancho Grande, 6700 ft, 11; 14.2 mi N Jiménez del Téul, 7300 ft, 1 (OU); 13 mi NNW Fresnillo, 1 (LACM); 6 km N Fresnillo, 2250 m, 5; 2.5 km WNW Fresnillo, 7400 ft, 1 (OU); Bañon, 6400 ft, 15 (LACM); 2 mi E Bañon, 6400 ft, 1 (LACM); 4 km ESE Bañon, 6200 ft, 2 (OU); 11 mi NE Valparaíso, 7100 ft, 5; San Juan Capistrano, 2 (US); 6 mi W Jérez, 6700 ft, 3; 13 km E Jérez, 2200 m, 13; 3.5 km W La Blanca, 6650 ft, 13 (OU); 11.7 mi NW Cuauhtémoc, 7100 ft, 2 (OU); 9.7 mi NW Cuauhtémoc, 7100 ft, 5 (OU); 3 mi N Cuauchtémoc, 6600 ft, 27 (LACM); 3 mi WNW Saldeña, 6850 ft, 11; 13 km N Villanueva (Ruinas Chicomoztoc), 1 (LACM); 10 km ENE Loreto, 7350 ft, 4 (OU); 7 mi S Pinos, 6800 ft, 2 (LACM); 10 mi S Pinos, 7100 ft, 4 (LACM), 1 (RGH); 25 km ESE Pinos, 2425 m, 1; 16 km SSE Monte Escobedo, 2010 m, 2; 20 km S Villanueva, 1810 m, 2; 45 km S Pinos, 2350 m, 1; 2.5 mi S Momax, 5; 30 km NE Jalpa, 1740 m, 18; 3 mi NE Jalpa, 5400 ft, 2; 10 mi W Jalpa, 6100 ft, 7 (LACM); 5.5 mi SW Jalpa, 4400 ft, 22 (OU); 25 km ESE Jalpa, 2590 m, 1; 13 mi WSW Jalpa, 6000 ft, 3 (OU); 4 mi S Jalpa, 4300 ft, 6 (LACM); 8 mi NW Nochistlán, 6600 ft, 15 (LACM); 6 km S Apozol, 1170 m,

14. Other records: Genoways (1973) unless otherwise noted; 2 mi W Sain Alto, 4 mi NNW Chalchihuites; 1 mi N Rancho Grande; 5 mi NW Zacatecas; 9 mi W Zacatecas; 2 mi ESE Trancoso; 7 mi SE Trancoso; 8 mi SE Zacatecas; Berriozábal; 1 mi NE Noria de Angeles; 13 mi N Jalpa; 3 mi SW Jalpa; in Durango, Quadrat 8 (MSU); in Jalisco, Quadrats 48 and 55.

Liomys irroratus jaliscensis (J. A. Allen), total 60, from: .5 mi ENE Mesquituta, 3450 ft, 11 (OU); 2.5 mi N Santa Rosa, 3700 ft, 8 (OU); 2 mi N Santa Rosa, 3850 ft, 11; 1.5 mi N Santa Rosa, 3900 ft, 3 (OU); 1.1 mi N Santa Rosa, 3500 ft, 1 (OU); 1 mi N Santa Rosa, 3600 ft, 11; Santa Rosa, 4000 ft, 14 (LACM); 7 km SE Santa Rosa, 1500 m, 1.

LIOMYS PICTUS HISPIDUS (J. A. ALLEN)

Painted Spiny Pocket Mouse

Distribution. -- Known from only one locality in the tropical canyons in Zacatecas.

Remarks. -- A single specimen of this species, from near San Juan Capistrano, was reported upon by Matson et al. (1978). At a slightly different locality, L. irroratus has also been recorded (see above account). Genoways (1973) suggested that in the few areas where the two species have been reported in sympatry, L. pictus seemed to be associated with more mesic lowland situations than L. irroratus. The specimen of L. pictus was taken from a sugar cane field adjacent to the Río Atengo while the exact conditions from which the specimens of L. irroratus were taken are unknown.

This specimen of L. pictus is assigned to the subspecies hispidus on geographic grounds (Genoways, 1973).

Specimens Examined. -- Total 1, from: 5 km NE San Juan Capistrano, 1330 m, 1.

REITHRODONTOMYS FULVESCENS J. A. ALLEN

Fulvous Harvest Mouse

Distribution. -- Widely distributed throughout non-forested parts of Zacatecas.

Remarks. -- In desert areas of northeastern Zacatecas, this species seems most abundant in grassy or brushy, as opposed to open, habitats. In the western parts of the state there was no apparent habitat preference. Six females taken between 15 July and 2 August contained an average of 4.5 (range, 4 to 6) embryos. Two females taken on 22 July and 6 August were lactating. The fulvous harvest mouse was reported to use old bird nests by Jones and Webster (1977).

Hooper (1952) recorded one subspecies as occurring in Zacatecas with the indication that a second may also occur there. Following the characters given by Hooper (1952) which differentiate the two possible subspecies, I recognize R. f. canus in northern Zacatecas based upon its pale color, small auditory bullae, and narrow frontal region of the skull. Specimens assigned to R. f. griseoflavus are darker (redder), with a more or less "distinct dorsal stripe," larger bullae, and broader frontal region.

Specimens Examined. -- Reithrodontomys fulvescens canus Benson, total 26, from: 6 km W Apizolaya, 1800 m, 1; 3 km SE Apizolaya, 1920 m, 2; 12 km ENE Concepción del Oro, 1850 m, 8; 6 km E Mazapil, 2645 m, 1; 18 km SSW Concepción del Oro, 2130 m, 1; 3 km SW San Felipe de Nuevo Mercurio, 1770 m, 6; 2 km W San Felipe de Nuevo Mercurio, 1740 m, 7.

Reithrodontomys fulvescens griseoflavus Merriam, total 116, from: 5 km S Gonzales Ortega, 2150 m, 2; 23 km NE Río Grande, 1800 m, 1; 15 mi NE San Andrés, 6200 ft, 1 (LACM); 13 km WNW Río Grande, 2050 m, 1; 5 mi SE Río Grande, 1940 m, 1; 3 mi E El Calabazal, 8000 ft, 3; 15.8 mi W Sombrerete, 7050 ft, 1 (OU); 9 mi W Sombrerete, 7900 ft, 1 (OU); 3 km E El Arenal, 2460 m, 2; 13 km WNW Capriote, 2100 m, 1; 15.5 mi WSW Sombrerete, 6400 ft, 1 (OU); 1 mi W Sierra Vieja, 6100 ft, 1 (OU); 2 km S Monte Mariana, 2180 m, 1; 6 km N Fresnillo, 2250 m, 5; 3 mi NW Fresnillo, 7760 ft, 1; 4 km ESE Bañon, 6200 ft, 2 (OU); 10 km SE Fresnillo, 2250 m, 2; 53 km SW Fresnillo, 2250 m, 1; Valparaíso, 6200 ft, 6 (US); 3.5 km W La Blanca, 6650 ft, 3 (OU); 6 mi W Jérez, 6700 ft, 1; 13 km E Jérez, 2200 m, 4; 8 km SW Jérez, 2030 m, 7; 32 km SE Valparaíso, 2040 m, 6; 36 km SSE Valparaíso, 2330 m, 3; Berriozabal, 1 (US); 5 mi S Ojo Caliente, 5 (UI); 3 mi WNW Saldaña, 6850 ft, 1; 10 km S Tepetongo, 1950 m, 1; 10 km ENE Loreto, 7350 ft, 2 (OU); 16 km SSE Monte Escobedo, 2010 m, 4; 20 km S Villanueva, 1810 m, 4; 25 km ESE Pinos, 2425 m, 10; 45 km S Pinos, 2350 m, 8; 30 km NE Jalpa, 1740 m, 5; 10 mi W Jalpa, 6100 ft, 5 (LACM); 4 mi S Jalpa, 4300 ft, 3 (LACM); 8 mi NW Nochistlán, 6600 ft, 3 (LACM); .5 mi ENE Mesquituta, 3450 ft, 1 (OU); Santa Rosa, 4000 ft, 2 (LACM); 7 km SE Santa Rosa, 1500 m, 3. Other records: 9 mi W Zacatecas, (CAS); 8 mi S Moyahua, (Jones and Webster, 1977).

REITHRODONTOMYS MEGALOTIS (BAIRD)

Western Harvest Mouse

Distribution. -- Widely distributed throughout Zacatecas except for the tropical canyons.

Remarks. -- This species seems most abundant in brushy to grassy habitats in the desert. However, unlike *R. fulvescens*, it was also captured in more open areas. The western harvest mouse was taken most regularly in the grasslands and desert-grassland ecotone habitats of Central Zacatecas. Five females taken between 16 and 24 July contained an average of 3.8 (range, 2 to 5) embryos. A female taken on 18 July was lactating.

Hooper (1952) recorded two subspecies occurring in Zacatecas: *R. m. megalotis*, a light colored subspecies of the Plateau; and, *R. m. zacatecae*, a dark colored subspecies in the Sierra Madre Occidental.

Specimens Examined. -- *Reithrodontomys megalotis megalotis* (Baird), total 89, from: 7 km SE Caopas, 1940 m, 4; 6 km E Mazapil, 2645 m, 3; 2 km SE Sabana Grande, 1945 m, 2; 3 mi N Lulú, 1 (MVZ); 5.5 mi NW Juan Aldama, 1890 m, 1 (OU); 5 km NW Juan Aldama, 1980 m, 1; 3 km NW San Felipe de Nuevo Mercurio, 1770 m, 3; 2 km W San Felipe de Nuevo Mercurio, 1740 m, 13; 5 km S Gonzales Ortega, 2150 m, 1; 23 km NE Río Grande, 1800 m, 1; 13 km WNW Río Grande, 2050 m, 1; 5 km S La Colorada, 1960 m, 1; 2 mi S Santa Efigenia, 7400 ft, 2 (KU); 13 km WNW Capriote, 2100 m, 3; 8 mi W, 1 mi N Sombrerete, 7800 ft, 1; 9 mi W Sombrerete, 7900 ft, 7 (OU); 3 km E El Arenal, 2460 m, 1; 5 km NE Chalchihuites, 2360 m, 2; 1 mi N Rancho Grande, 4 (KU); 3 km SE Rancho Grande, 2190 m, 1; 5 mi WSW Sierra Vieja, 6200 ft, 1 (OU); 2 km S Monte Mariana, 2180 m, 4; 6 km N Fresnillo, 2250 m, 3; 3 mi NW Fresnillo, 7760 ft, 2; 2.5 km WNW Fresnillo, 7400 ft, 1 (OU); Bañon, 6400 ft, 2 (LACM); 4 km ESE Bañon, 6200 ft, 1 (OU); 10 km SE Fresnillo, 2250 m, 2; Zacatecas, 2 (US); 2 mi S, 5 mi E Zacatecas, 7700 ft, 1; 9 mi SE Zacatecas, 7900 ft, 3 (KU); 13 km E Jérez, 2200 m, 3; 5 mi S Ojo Caliente, 1 (UI); 2 km N

Noria de Angeles, 2200 m, 1; 6 mi NNW Pinos, 7900 ft, 1; 25 km ESE Pinos, 2425 m, 5; 45 km S Pinos, 2350 m, 3. Other records: Jones and Webster (1977); 22 mi SW Concepción del Oro; 40 mi W. Fresnillo.

Reithrodontomys megalotis zacatecae Merriam, total 24, from: 25 km WSW Milpillas de la Sierra, 2580 m, 2; 9 mi NW Valparaíso, 8350 ft, 1; Valparaíso mountains, 8700 ft, (type locality), 14 (US); 36 km SSE Valparaíso, 2330 m, 1; 25 km ESE Jalpa, 2590 m, 6. Other records: 8 mi S Chalchihuites, (Jones and Webster, 1977); in Aguascalientes, Quadrat 57 (Hooper, 1955).

PEROMYSCUS BOYLII ROWLEYI (J. A. ALLEN)

Brush Mouse

Distribution. -- Montane regions of western Zacatecas.

Remarks. -- The brush mouse seems most abundant at high elevations in pine-oak forests. However, it also occurs at lower elevations in brushy or rocky habitats. Nine females taken between 23 July and 7 August contained an average of 2.67 (range, 1 to 4) embryos. Six females obtained between 23 July and 7 August were lactating.

Carleton (1977) demonstrated that P. spicilegus (see below) was specifically distinct from P. boylii. He also indicated the need for more taxonomic work to be done on various populations of P. boylii. I have assigned all Zacatecas specimens of P. boylii to the subspecies P. b. rowleyi on the basis of geography (Hall and Kelson, 1959). However, some specimens from localities in the extreme west and south appear to be larger than specimens from localities further east and north.

<u>Specimens Examined</u>. -- Total 292, from: 2 mi E Villa Insurgentes, 8050 ft, 4; 2 mi E El Calabazal, 8000 ft, 2; 14.8 mi W Sombrerete, 7250 ft, 3 (OU); 13.6 mi W Sombrerete, 7450 ft, 1 (OU); 9.5 mi W Sombrerete, 7900 ft, 11 (OU); 9 mi W Sombrerete, 7900 ft, 5 (OU); 10.4 mi WSW Sombrerete, 7250 ft, 12 (OU); 10.7 mi WSW Sombrerete, 7250 ft, 2 (OU); 15.5 mi WSW Sombrerete, 6400 ft, 1 (OU); 3 km E El Arenal, 2460 m, 2; 21 mi SW Sombrerete, 7800 ft, 2 (LACM), 2 (RGH); 10 mi SW Chalchihuites, 7200 ft, 12 (LACM); 14.2 mi N Jiménez del Téul, 7300 ft, 18 (OU); 4 km E Jiménez del Téul, 2375 m, 1; 25 km WSW Milpillas de la Sierra, 2580 m, 7; 9 mi NW Valparaíso, 8350 ft, 11; Valparaíso mountains, 8700 ft, 1 (US); 8.2 mi W Valparaíso, 7900 ft, 14 (OU); 6.2 mi W Valparaíso, 7500 ft, 4 (OU); 6 mi W Valparaíso, 7400 ft, 1 (OU); Valparaíso, 13 (US); 15 km SW Valparaíso, 2250 m, 18; Sierra Madre, 10 (US); 10 km W San Juan Capistrano, 2900 m, 7; 8 km W San Juan Capistrano, 2110 m, 6; 32 km SE Valparaíso, 2040 m, 13; 36 km SSE Valparaíso, 2330 m, 4; 11.7 mi NW Cuauhtémoc, 7100 ft, 7 (OU); Monte Escobedo, 1 (US), 7300 ft, 13 (LACM); 16 km SSE Monte Escobedo, 2010 m, 1; 20 km S Monte Escobedo, 1920 m, 6; Plateado, 4 (US); 3.5 mi W Tlatenango, 6500 ft, 3; 11 mi NW Jalpa, 8000 ft, 7 (KU); 9 mi WNW Jalpa, 8250 ft, 13; 25 km ESE Jalpa, 2590 m, 2; 8 mi NW Nochistlán, 6600 ft, 16 (LACM); 6 km SW Téul de Gonzáles Ortega, 1; 6 km S Téul de Gonzáles Ortega, 2010 m, 30; 10 mi NW Yahualica, 7100 ft, 1 (LACM). Other records: Jones and Webster (1977) unless otherwise noted; 4 mi NW Chalchihuites; 8 mi S Chalchihuites, 40 mi W Fresnillo; 16 mi W Fresnillo, (CAS); 18 mi W Milpillas (de la Sierra), (CAS); 3 mi NW Téul de Gonzáles Ortega, (CAS).

PEROMYSCUS DIFFICILIS (J. A. ALLEN)

Rock Mouse

Distribution. -- Montane regions of western and northeastern Zacatecas.

Remarks. -- The rock mouse seems most abundant in or around rock outcrops or fences in the montane regions of the state. Five females taken between 29 and 31 July, 1970, from northwest of Valparaíso contained an average of 3.0 (range, 2 to 4) embryos, Two females taken during the same time at the same place were lactating. Six females taken on 27 and 28 July, 1977, from southeast of Jalpa contained an average of 3.2 (range, 2 to 4) embryos. One of these females was lactating as well. Of 31 females taken in June from the Sierra Madre Occidental, for which data were recorded, none showed any sign of reproductive activity. Four females taken on 30 June and 1 July, 1978, in the Sierra Astillero, contained three embryos each. It is not possible to determine whether this difference in reproductive timing is due to a geographic phenomenon, climatic variations in differene years, or to small sample size.

In reviewing the subspecies of *P. difficilis*, Hoffmeister and de la Torre (1961) recognized one subspecies, *P. d. difficilis*, as occurring in Zacatecas. They also indicated that a second subspecies, *P. d. petricola*, may live in the northeastern part of the state. Later, Diersing (1976) documented the occurrence of *P. d. petricola* from near Concepción del Oro. As reported by Hoffmeister and de la Torre (1961), *petricola* is larger in most measurements (smaller hind foot length) and its color more gray than *difficilis*.

Specimens Examined. -- Peromyscus difficilis difficilis (J. A. Allen), total 207, from: 2 mi E Villa Insurgentes, 8050 ft, 2; 3 mi E El Calabazal, 8000 ft, 1; 9.5 mi W Sombrerete, 6 (OU); 10 mi SW Chalchihuites, 7200 ft, 16 (LACM); 4 km E Jiménez del Téul, 2375 m, 2; 25 km WSW Milpillas de la Sierra, 2580 m, 4; 45 km SW Fresnillo, 2165 m, 2; 9 mi NW Valparaíso, 8350 ft, 28; Valparaíso mountains, 8700 ft, (type locality), 24 (US); Zacatecas, 14 (US); Sierra Madre, 1 (US); 10 km W San Juan Capistrano, 2900 m, 2; 36 km SSE Valparaíso, 2330 m, 1; 11.7 mi NW Cuauhtémoc, 7100 ft, 4 (OU); Monte Escobedo, 7300 ft, 5 (LACM); 10 km ENE Loreto, 7350 ft, 12 (OU); 25 km ESE Pinos, 2425 m, 6; Plateado, 19 (US); 11 mi NW Jalpa, 8000 ft, 8 (KU); 9 mi WNW Jalpa, 8250 ft, 12; 25 km ESE Jalpa, 2590 m, 37; 8 mi NW Nochistlán, 6600 ft, 1 (LACM). Other records: 8 mi S Chalchihuites, (Jones and Webster, 1977); 1 mi NE Noria de Angeles, (CAS); in Aguascalientes, Quadrat 57 (Hooper, 1955); in Jalisco, Quadrat 55 (Genoways and Jones, 1973).

Peromyscus difficilis petricola Hoffmeister and de la Torre, total 76, from: 5 km E Mazapil, 2270 m, 2; 6 km E Mazapil, 2645 m, 8; 7 mi E Mazapil, 1 (UI), 1 (TTU); 4 mi SE Mazapil, 8425 ft, 21 (OU); 6 mi W Concepción del Oro, 8 (UI); 4 mi W Concepción del Oro, 10 (UI); 3 mi W Concepción del Oro, 1 (UI); 10 mi SW Concepción del Oro, 7600 ft, 5 (LACM); 40 km ESE Concepción del Oro, 2320 m, 19.

PEROMYSCUS EREMICUS PHAEURUS OSGOOD

Cactus Mouse

Distribution. -- Arid to semi-arid regions east of the grasslands in Zacatecas.

Remarks. -- The cactus mouse seems most abundant in brushy habitats in the deserts. Its western limit coincides with the western edge of the desert-grassland ecotone in Zacatecas. Ten females taken between 9 July and 17 August contained an average of 3.1 (range, 2 to 4) embryos. Six females taken between 4 July and 17 August were lactating.

The subspecies of *P. eremicus* are in need of a revisionary study. Baker and Greer (1962) considered all specimens of *P. eremicus* from south of the Río Nasas, in Durango, to belong to the subspecies *P. e. phaeurus*. On geographic grounds, then, all Zacatecas specimens are so assigned.

Specimens Examined. -- Total 229, from: 10 km ESE San Juan de los Charcos, 1500 m, 1; 6 km W Apizolaya, 1800 m, 2; 3 km SE Apizolaya, 1920 m, 13; 8 mi W Cedros, 5650 ft, 1 (LACM); 20 km NE Concepción del Oro, 1910 m, 1; 15 mi NE Concepción del Oro, 1 (OU); 18.6 mi ENE Concepción del Oro, 2 (OU); 12 km ENE Concepción del Oro, 1850 m, 11; 13 km NE Concepción del Oro, 1700 m, 1; Concepción del Oro, 7600 ft, 1 (KU); 10 mi E Concepción del Oro, 5300 ft, 1 (LACM); 11 mi E Concepción del Oro, 5300 ft, 8 (LACM); 2 (RGH); 1 mi W Tecolotes, 6150 ft, 1; 5 km SE Concepción del Ori, 1935 m, 1; 12 mi SE Concepción del Oro, 7450 ft, 1; 25 km NE Camacho, 1975 m, 3; 2 km SE Sabana Grande, 1945 m, 6; 3 mi N Lulú, 2 (MVZ); 1 mi N Lulú, 1; 5 km NW Juan Aldama, 1980 m, 1; 13 mi SW Camacho, 5900 ft, 1 (LACM); 3 km NW San Felipe de Nuevo Mercurio, 1770 m, 3; 2 km W San Felipe de Nuevo Mercurio, 1740 m, 6; 10 mi SE Juan Aldama, 2210 m, 2; 3 km E San Tiburcio, 1880 m, 2; 1 mi SW San Tiburcio, 7000 ft, 13 (KU); 15 km WSW San Tiburcio, 1980 m, 2; 15 km NNW Nieves, 1910 m, 3; 23 km NE Río Grande, 1800 m, 6; 15 mi NE San

Andrés, 6200 ft, 1 (LACM); 25 km SW San Tiburcio, 2030 m, 16; 13 km WNW Río Grande, 2050, 2; 5 mi SE Río Grande, 1940 m, 2; 50 km SW San Tiburcio, 2125 m, 1; 8 mi S Majoma, 7700 ft, 10 (KU); 6 km SE Tetillas, 2040 m, 2; 2 mi S Santa Efigenia, 7400 ft, 1 (KU); 13 km WNW Capriote, 2100 m, 7; 9 km NW Sarteneja, 2200 m, 3; Cañitas, 7 (US); 1 mi S Cañitas, 2 (TTU); 1 mi W Sierra Vieja, 6100 ft, 1 (OU); 3 km SE Rancho Grande, 2190 m, 2; 18 km NE Villa de Cos, 2040 m, 4; Villa de Cos, 6700 ft, 18 (KU); 13 mi NNW Fresnillo, 1 (LACM); 2 km S Monte Mariana, 2180 m, 14; 6 km N Fresnillo, 2250 m, 2; 3 mi NW Fresnillo, 7760 ft, 1; Bañon, 6400 ft, 11 (LACM); 2 mi E Bañon, 6400 ft, 1 (LACM), 1 (RGH); 4 km ESE Bañon, 6200 ft, 20 (OU). Other records: 22 mi SW Concepción del Oro, (Jones and Webster, 1977); 20 mi S Concepción del Oro, (CAS); 8 mi W Fresnillo, (Jones and Webster, 1977).

PEROMYSCUS HOOPERI LEE AND SCHMIDLY

Hooper's Mouse

Distribution. -- Known from only one locality in northeastern Zacatecas.

Remarks. -- Very little is known about the natural history of this recently described species. Lee and Schmidly (1977) and Schmidly (personal communication) suggested that *P. hooperi* may be restricted in its distribution to tree yucca and sotol habitats.

This species is very similar in external characters to *P. eremicus* but can be distinguished by cranial and phallic characters (Lee and Schmidly, 1977). The specimens listed below were identified by David Schmidly.

Specimens Examined. -- Total 7, from: .5 mi S Coahuila-Zacatecas border (Mexican Highway 54), 7 (TCWC).

PEROMYSCUS MANICULATUS (WAGNER)

Deer Mouse

Distribution. -- Widely distributed throughout Zacatecas.

Remarks. -- This species might be expected to occur anywhere in Zacatecas. It is usually less abundant in any given area than most other species of Peromyscus. Eight females taken between 3 and 30 July contained an average of 3.0 (range, 2 to 4) embryos. Three females taken on 18 July, 3 and 5 August were lactating.

The subspecific status of populations in Zacatecas are difficult to determine. In general, specimens from the arid central and northeast parts of the state are light colored and correspond to P. m. blandus as defined by Osgood (1909). Specimens from the southwestern mountainous regions are, in general, more darkly colored and correspond to P. m. labecula. However, intergradation, at least in color, seems apparent in specimens from near Chalchihuites, Zacatecas, and in the mountains east of Jalpa. Specimens from the valley of the Río Juchipila are clearly assignable to the light colored blandus while specimens from the mesa above the Río Bolaños south of Monte Escobedo seem to be intermediate in color. In assigning specimens from Zacatecas to subspecies, I have used color and geographic locality as best as possible in conjunction with Osgood's (1909) revision. Specimens from near Zacatecas are here considered to be blandus.

Specimens Examined. -- Peromyscus maniculatus blandus Osgood, total 404, from: 2.5 mi N La Pendencia, 5400 ft, 1 (OU); 3 km SE

Apizolaya, 1920 m, 2; 7 km SE Caopas, 1940 m, 9; 12 km ENE Concepción del Oro, 1850 m, 8; 4 mi SE Mazapil, 8425 ft, 5; Concepción del Oro, 7600 ft, 1 (KU); 11 mi E Concepción del Oro, 5300 ft, 5 (LACM); 2 km SE Sabana Grande, 1945 m, 2; 3 mi N Lulú, 2 (MVZ); 1 mi N Lulú, 1830 m, 1; 35 km SSE Concepción del Oro, 1980 m, 2; 5.5 mi NW Juan Aldama, 6200 ft, 4 (OU); 3 km NW San Felipe de Nuevo Mercurio, 1770 m, 7; 2 km W San Felipe de Nuevo Mercurio, 1740 m, 4; 3 km E San Tiburcio, 1880 m, 1; 1 mi SW San Tiburcio, 7000 ft, 18; 15 km WSW San Tiburcio, 1980 m, 4; 15 km NNW Nieves, 3; 5 km S Gonzáles Ortega, 2150 m, 1; 23 km NE Río Grande, 1800 m, 3; 15 mi NE San Andrés, 6200 ft, 1 (LACM); 13 km WNW Río Grande, 2050 m, 1; 45 km SW San Tiburcio, 1940 m, 1; 5 mi SE Río Grande, 1940 m, 4; 5 km S La Colorada, 1960 m, 3; 6.5 km S La Colorada, 1970 m, 2; 8 mi S Majoma, 7700 ft, 38; 2 mi E Villa Insurgentes, 8050 ft, 1; 6 km SE Tetillas, 2040 m, 2; 2 mi S Santa Efigenia, 7400 ft, 9 (KU); 13 km WNW Capriote, 2100 m, 15; 13.6 mi W Sombrerete, 7450 ft, 2 (OU); 5 mi SW Sombrerete, 6900 ft, 3 (LACM), 2 (RGH); 7 mi SW Sombrerete, 6800 ft, 4 (LACM), 1 (RGH); Cañitas, 3 (US); 5 km NE Chalchihuites, 2360 m, 2; 6 mi WSW Sierra Vieja, 6200 ft, 1 (OU); 23 km N Fresnillo, 2140 m, 2; Villa de Cos, 6700 ft, 6 (KU); 4 km E Jiménez del Téul, 2375 m, 1; 2 km S Monte Mariana, 2180 m, 14; Bañon, 6400 ft, 21 (LACM); 2 mi E Bañon, 6400 ft, 1 (RGH); 4 km ESE Bañon, 6200 ft, 10 (OU); 4.5 mi E Fresnillo, 3 (MVZ); 24 mi NE Zacatecas, 6700 ft, 1 (LACM), 1 (RGH); Zacatecas, 4 (US); 2 mi S, 5 mi E Zacatecas, 7700 ft, 9; 8 mi SE Zacatecas, 7225 ft, 45 (KU); 9 mi SE Zacatecas, 7900 ft, 1 (KU); 3 mi SE Guadalupe, 10 (UI); 7 mi SE Trancoso, 2 (KU); 13 km E Jérez, 2200 m, 8; Berriozábal, 6 (US); 6 mi NNW Pinos, 7900 ft, 2; 25 km ESE Pinos, 2425 m, 11; 10 mi S Pinos, 7100 ft, 2 (RGH); 45 km

S Pinos, 2350 m, 3; 30 km NE Jalpa, 1740 m, 21; 25 km ESE Jalpa, 2590 m, 20; 4 mi S Jalpa, 4300 ft, 2 (LACM); 6 km S Apozol, 1170 m, 19. Other records: Jones and Webster (1977) unless otherwise noted; 22 mi SW Concepción del Oro; 10 mi NW Sombrerete; 4 mi NW Chalchihuites; 16 mi NW Fresnillo, (CAS); 40 mi W Fresnillo; 9 mi W Zacatecas, (CAS).

Peromyscus maniculatus labecula Elliot, total 63, from: 11 mi NE Valparaíso, 7100 ft, 1; Valparaíso mountains, 8700 ft, 1 (US); Valparaíso, 17 (US); 32 km SE Valparaíso, 2040 m, 9; 8 km SW Jérez, 2030 m, 19; 16 km SSE Monte Escobedo, 2010 m, 6; 20 km S Monte Escobedo, 1920 m, 8; Plateado, 1 (US); 1 mi S Atolinga, 7300 ft, 1. Other records: 8 mi W Milpillas (de la Sierra), (CAS); 1 mi S Momax, (CAS); in Jalisco, Quadrat 55 (Genoways and Jones, 1973).

PEROMYSCUS MELANOPHRYS (COUES)

Plateau Mouse

Distribution. -- Widely distributed, except for forested montane areas, in Zacatecas.

Remarks. -- This species can be expected to occur anywhere on the Plateau and tropical canyons of Zacatecas. It seems to be most abundant in dense brush habitats. Dalquest (1953) and Baker and Greer (1962) reported this species being taken in tree yuccas. I have collected them in tree yuccas in Zacatecas but have been most successful in collecting them using museum special and Sherman live traps placed in dense brush under nopal or in tree yuccas. Fourteen females taken between 10 July and 8 August contained an average of 3.1 (range, 2 to 5) embryos. Four females taken between 6 and 19 October contained an average of 3.75 (range, 3 to 4) embryos. Lactating individuals have been taken as early as 10 July and as late as 10 October. Live individuals, kept in the animal colony at The Museum, MSU, are easy to handle and breed readily.

Baker (1952) recorded only one subspecies from Zacatecas but indicated that three others might also be present. Specimens assigned to P. m. consobrinus from the Plateau are larger and darker colored than populations from the north and northeast. Specimens from the valley of the Río Juchipila are somewhat smaller than those from the Plateau, approaching P. m. micropus in size. These same specimens also seem to be intermediate in color. They are here assigned to consobrinus. Specimens from the valley of the Río Atengo are darker, reddish on the dorsum compared to consobrinus. They also tend to be smaller in external characters. These are assigned to the subspecies micropus. Specimens assigned to P. m. coahuiliensis from the northeast are lighter colored than consobrinus. Specimens assigned to P. m. xenurus from the northern part of Zacatecas are also light colored. These differ from coahuiliensis by having relatively smaller auditory bullae. Since Baker's (1952) review of the subspecies of P. melanophrys, many more specimens have become available. It would be interesting to reevaluate the geographic variation in this species.

Specimens Examined. -- Peromyscus melanophrys coahuiliensis Baker, total 42, from: 18.6 mi ENE Concepción del Oro, 1(OU); 16.4 mi ENE Concepción del Oro, 1 (OU); 12 km ENE Concepción del Oro, 1850 m, 7; 7 mi E Mazapil, 1 (UI); 6 km E Mazapil, 2645 m, 6; Concepción del Oro, 7 (KU); 2 mi SE Concepción del Oro, 1860 m, 1; 5 km SW Concepción del Oro, 2400 m, 1; 10 mi SW Concepción del Oro, 7600 ft, 3 (LACM); 18 km SSW Concepción del Oro, 2130 m, 4; 40 km ESE Concepción del Oro, 2320 m, 3; 12 mi SE Concepción del Oro, 2270 m, 1; 2 km SE Sabana Grande, 1945 m, 3; 7 km SE El Rosario, 2100 m, 4; 35 km SSE Concepción del Oro, 1980 m, 1; 3 mi N Lulú, 5 (MVZ). Other records: 22 mi SW Concepción del Oro, (Jones and Webster, 1977).

Peromyscus melanophrys consobrinus Osgood, total 290, from: 15 km SW San Tiburcio, 1980 m, 2; 15 mi NE San Andrés, 6200 ft, 3 (LACM); 25 km SW San Tiburcio, 2030 m, 3; 45 km SW San Tiburcio, 1940 m, 1; 8 mi S Majoma, 7700 ft, 19 (KU); 5 mi SE Río Grande, 1940 m, 8; 6.5 mi S La Colorada, 1970 m, 1; 6 km SE Tetillas, 2040 m, 2; 2 mi S Santa Efigenia, 7400 ft, 3 (KU); 13 km WNW Capriote, 2100 m, 7; 12 mi W Sombrerete, 2 (KU); 4 mi SW Sombrerete, 7000 ft, 1 (RGH); 10 m N Rancho Grande, 6700 ft, 4; 15.5 mi WSW Sombrerete, 6400 ft, 2 (OU); 14.2 mi N Jiménez del Téul, 7300 ft, 6 (OU); 1 mi N Rancho Grande, 8 (KU); 6 mi WSW Sierra Vieja, 4 (OU); 23 km N Fresnillo, 2140 m, 2; 13 mi NNW Fresnillo, 3 (LACM); Villa de Cos, 6700 ft, 1 (KU); 2 km S Monte Mariana, 2180 m, 1; 3 mi NW Fresnillo, 7760 ft, 1; 6 km N Fresnillo, 2250 m, 28; 5 km N Fresnillo, 2250 m, 16; Bañon, 6400 ft, 1 (LACM); 2 mi E Bañon, 6400 ft, 19 (LACM), 2 (RGH); 4 km ESE Bañon, 6200 ft, 12 (OU); 2.5 km WNW Fresnillo, 7400 ft, 9 (OU); 10 km SE Fresnillo, 2250 m, 1; 24 mi NE Zacatecas, 6700 ft, 1 (LACM); 45 km SW Fresnillo, 2200 m, 1; 46 km SW Fresnillo, 2150 m, 1; 2 mi SE Calera, 7300 ft, 1 (KU); 2 mi S, 5 mi E Zacatecas, 7700 ft, 2; 8 mi SE Zacatecas, 7225 ft, 8 (KU); 9 mi SE Zacatecas, 7900 ft, 1 (KU); 2 mi ESE Trancoso, 7000 ft, 1 (KU); 3.5 km W La Blanca, 6650 ft, 4 (OU); 13 km E Jérez, 2200 m, 2; 8 km SW Jérez, 2030 m, 1; 11.7 mi NW Cuauhtémoc, 7100 ft, 2 (OU); Berriozábal, (type locality), 12 (US); 3 mi N Cuauhtémoc, 6600 ft, 7 (LACM); 5 mi S Ojo Caliente, 4 (UI); 3 mi WNW Saldaña, 6850 ft, 2; 13 mi NE Villanueva

(Ruinas Chicomoztoc), 2040 m, 2 (LACM), 1 (RGH); 10 km S Tepetongo, 1950 m, 1; 6 mi NNW Pinos, 7900 ft, 5; 10 km ENE Loreto, 7350 ft, 14 (OU); 6 km ENE Loreto, 6850 ft, 2 (OU); Monte Escobedo, 1 (US); 10 mi S Pinos, 7100 ft, 2 (LACM); 25 km ESE Pinos, 2425 m, 9; 20 km S Villanueva, 1810 m, 1; 3.5 mi W Tlatenango, 6500 ft, 2; 13 mi N Jalpa, 5000 ft, 1 (KU); 10 mi W Jalpa, 6100 ft, 5 (LACM); 3 mi SW Jalpa, 4600 ft, 1 (KU); 6 mi SW Jalpa, 4900 ft, 4 (LACM); 4 mi S Jalpa, 4300 ft, 5 (LACM); 13 mi WSW Jalpa, 6000 ft, 4 (OU); .5 mi ENE Mesquituta, 3450 ft, 1 (OU); 1 mi N Santa Rosa, 3600 ft, 4; Santa Rosa, 4000 ft, 3 (LACM). Other records: 8 mi W Fresnillo, (Jones and Webster, 1977); 9 mi W Zacatecas, (CAS); 1 mi NE Noria de Angeles, (CAS); 20 mi S Villanueva, (CAS); 8 mi S Moyahua, (Jones and Webster, 1977); in San Luis Potosi, Quadrat 67 (Dalquest, 1953).

Peromyscus melanophrys micropus Baker, total 16, from: 18 km N San Juan Capistrano, 1100 m, 6; 3 km N San Juan Capistrano, 1500 m, 1; 5 km NE San Juan Capistrano, 1330 m, 4; 5 km E San Juan Capistrano, 3350 ft, 3; 6 km E San Juan Capistrano, 3300 ft, 1 (OU); San Juan Capistrano, 1 (US).

Peromyscus melanophrys xenurus Osgood, total 35, from: 10 km ESE San Juan de los Charcos, 1500 m, 5; 3 km SE Apizolaya, 1920 m, 1; 7 km SE Caopas, 1940 m, 1; 8 mi W Cedros, 5650 ft, 1 (LACM); 4 km W San Rafael, 2140 m, 3; 25 km NE Camacho, 1975 m, 9; 10 km NW Juan Aldama, 1860 m, 1; 3 km NW San Felipe de Nuevo Mercurio, 1770 m, 1; 10 mi SE Juan Aldama, 7250 ft, 1; 9 mi NE Nieves, 6600 ft, 1.

PEROMYSCUS MELANOTIS J. A. ALLEN AND CHAPMAN

Black-Eared Mouse

Distribution. -- Known from only two localities in montane forests of the Sierra Madre Occidental of western Zacatecas.

Remarks. -- Very little is known about this mouse in Zacatecas. Baker and Greer (1962) restricted its distribution in Durango to high mesic forests of the Sierra Madre Occidental.

Specimens Examined. -- Total 7, from: 25 km WSW Milpillas de la Sierra, 2580 m, 1; Valparaíso mountains, 8700 ft, 6 (US).

PEROMYSCUS PECTORALIS OSGOOD

White-Ankled Mouse

Distribution. -- Grasslands, lower montane forests, and tropical canyons of Zacatecas.

Remarks. -- This species seemed to be most abundant in rocky habitats. The only records of *P. pectoralis* in the desert region of Zacatecas is in the desert mountain ranges. However, Baker and Greer (1962) reported it from desert habitats in Durango. Twelve females obtained between 1 July and 7 August contained an average of 3.5 (range, 2 to 4) embryos. Three females taken on 29 and 30 July were lactating.

Schmidly (1972) recognized two subspecies in Zacatecas. Specimens assigned to *P. p. pectoralis* have longer tails, shorter skulls, and smaller auditory bullae compared to *P. p. laceianus*. The former occurs in western and southern Zacatecas. Schmidly (1972) noted that specimens from northeastern Zacatecas are somewhat intermediate between typical *pectoralis* and *laceianus* but assigned them to the latter because they were more similar to laceianus. I follow Schmidly's (1972) designations for those populations in the northeast. In addition, specimens from near San Rafael (Cerro de Teyra) seem better considered as laceianus than pectoralis.

Specimens Examined. -- Peromyscus pectoralis pectoralis Osgood, total 137, from: 5.5 mi NW Juan Aldama, 1890 m, 4 (OU); 5 km NW Juan Aldama, 1980 m, 1; 10 mi SE Juan Aldama, 7250 ft, 7; 13 km WNW Río Grande, 2050 m, 1; 6 km SE Tetillas, 2040 m, 3; 12 mi W Sombrerete, 4 (KU); 10 mi N Rancho Grande, 6700 ft, 1; 2.5 mi WNW Fresnillo, 7400 ft, 1 (OU); 18 km N San Juan Capistrano, 1100 m, 26; 3 km N San Juan Capistrano, 1500 m, 2; 5 km NE San Juan Capistrano, 1330 m, 2; San Juan Capistrano, 2 (US); 5 km E San Juan Capistrano, 3350 ft, 4 (OU); 36 km SSE Valparaíso, 2330 m, 2; 13 km NE Villanueva, 2040 m, 5; 2 km N Noria de Angeles, 2200 m, 1; 3 mi WNW Saldaña, 6850 ft, 1; Monte Escobedo, 7300 ft, 2 (LACM), 1 (US); 20 km S Monte Escobedo, 1920 m, 22; 10 mi W Jalpa, 6100 ft, 17 (LACM); 6 mi SW Jalpa, 4900 ft, 2 (LACM); 4 mi S Jalpa, 4300 ft, 7 (LACM); 13 mi WSW Jalpa, 6000 ft, 10 (OU); 6 km S Téul de Gonzáles Ortega, 2010 m, 5; .5 km ENE Mesquituta, 3450 ft, 1 (OU); 1 mi N Santa Rosa, 3600 ft, 3. Other records: 3 mi SW Sombrerete, (Jones and Webster, 1977); 2 mi S Villanueva, (CAS); in Jalisco, Quadrat 55 (Schmidly, 1972).

Peromyscus pectoralis laceianus Bailey, total 66, from: 4 mi W Concepción del Oro, 14 (UI); 3 mi W Concepción del Oro, 2 (UI); 1 mi W Concepción del Oro, 1 (UI); Concepción del Oro, 14 (KU); 5 km SW Concepción del Oro, 2400 m, 5; 10 mi SW Concepción del Oro, 7600 ft, 21 (LACM); 4 km W San Rafael, 2140 m, 2; 1 mi W Tecolotes, 6150 ft, 1; 40

km ESE Concepción del Oro, 2320 m, 5; 18 km SW Concepción del Oro, 2130 m, 1.

PEROMYSCUS SPICILEGUS J. A. ALLEN

Gleaning Mouse

Distribution. -- Known from only three localities in the canyon region of southwest Zacatecas.

Remarks. -- Little is known about the natural history of this mouse. Baker and Greer (1962) and Carleton (1977) suggested that it is restricted to subtropical habitats directly below the pine-oak forests. The localities listed below include tropical deciduous forests and, at most, the lower portion of pine-oak forests. Specimens from Monte Escobedo and northwest of Yahualica were taken with *P. boylii*; however, it was not possible to determine if they were taken in the same or different microhabitats. Carleton (1977) suggests that where these two species are taken in close proximity to one another, *P. spicilegus* occurs in more mesic situations.

Specimens Examined. -- Total 5, from: Monte Escobedo, 1 (US); 10 mi NW Yahualica, 7100 ft, 2 (LACM); 8 mi S Moyahua, 5600 ft, 2 (CAS).

PEROMYSCUS TRUEI GENTILIS OSGOOD

Piñon Mouse

Distribution. -- Grasslands to montane forests in Zacatecas.

Remarks. -- The piñon mouse is usually associated with low montane forests, as the common name implies. In Zacatecas, however, they seem most common in grassland and brush habitats, usually in rocky situations. Baker and Greer (1962) reported similar conditions for the piñon mouse in Durango. Seven females taken between 9 July and 5

August contained an average of 3.0 (range, 2 to 4) embryos. Seven females captured between 30 June and 5 August were lactating. One of the females taken on 5 August was lactating and contained four embryos.

Hoffmeister (1951) recognized one subspecies P. t. gentilis in Zacatecas. He indicated that a second subspecies, P. t. gratus, may also occur in the extreme southern part of the state. All specimens from southern Zacatecas seem best referred to gentilis based on the characters given in Hoffmeister (1951).

Specimens Examined. -- Total 177, from: 40 km ESE Concepción del Oro, 2320 m, 18; 5 km S Gonzáles Ortega, 2150 m, 1; 2 mi E Villa Insurgentes, 8050 ft, 3; 4 mi E El Calabazal, 1 (MZ); 8 mi W, 1 mi N Sombrerete, 7800 ft, 8 (KU); 12 mi W Sombrerete, 5 (KU); 10.7 mi WSW Sombrerete, 7250 ft, 10 (OU); 4 mi SW Sombrerete, 7000 ft, 1 (LACM); 15.5 mi WSW Sombrerete, 6400 ft, 2 (OU); 3 km E El Arenal, 2460 m, 1; 2 mi W Sain Alto, 6900 ft, 6 (KU); 5 km NE Chalchihuites, 2360 m, 2; 4 km E. Jiménez del Téul, 2375 m, 2; 25 km WSW Milpillas de la Sierra, 2580 m, 16; 45 km SW Fresnillo, 2165 m, 5; 46 km SW Fresnillo, 2200 m, 1; 53 km SW Fresnillo, 2250 m, 2; 11 mi NE Valparaíso, 7100 ft, 1; Valparaíso, 5 (US); Zacatecas, 1 (US); 15 km SW Valparaíso, 2250 m, 7; 13 km E Jérez, 2200 m, 8; 8 km SW Jérez, 2030 m, 5; 32 km SE Valparaíso, 2040 m, 11; 35 km SSE Valparaíso, 2330 m, 1; 3 mi N Cuauhtémoc, 6600 ft, 4 (LACM); 2 (RGH); 5 mi S Ojo Caliente, 7 (UI); 13 km NE Villanueva (Ruinas Chicomoztoc), 2040 m, 3, 1 (LACM); 6 km ENE Loreto, 6850 ft, 1 (OU); 6 mi NNW Pinos, 7900 ft, 5; 25 km ESE Pinos, 2425 m, 12; 45 km S Pinos, 2350 m, 1; 8 mi NW Nochistlán, 6600 ft, 18 (LACM). Other records: Jones and Webster (1977) unless otherwise noted; 3 mi SW Sombrerete; 4 mi NW Chalchihuites, (CAS); 8 mi S Chalchihuites; 40 mi W Fresnillo.

BAIOMYS TAYLORI PAULUS (J. A. ALLEN)

Northern Pygmy Mouse

Distribution. -- Grasslands to tropical canyons in Zacatecas.

Remarks. -- The northern pygmy mouse does not seem abundant anywhere in Zacatecas. As noted in Baker and Greer (1962), it prefers areas of grass or brush habitats that are relatively free of heavy grazing by livestock. Packard (1960) indicated that this species is only locally abundant. Petersen (1978) noted that this mouse was the most abundant small rodent at Atotonilco, Durango, only a few kilometers from the Zacatecas border. Four females taken between 12 and 24 July contained an average of 1.5 (range, 1 to 2) embryos. However, Packard (1960) recorded an average of 2.48 embryos from 41 females.

All specimens from Zacatecas are referable to *B. t. paulus* by the characters given in Packard (1960).

Specimens Examined. -- Total 67, from: 15 km NNW Nieves, 1910 m, 1; 5 km S Gonzáles Ortega, 2150 m, 1; 16 mi NW Río Grande, 6750 ft, 1; 13 km WNW Río Grande, 2050 m, 1; 3 mi E El Calabazal, 8000 ft, 3; Valparaíso, 6200 ft, 10 (US); 15 km SW Valparaíso, 2250 m, 1; 6 mi W Jérez, 6700 ft, 2; 13 km E Jérez, 2200 m, 3; 8 km SW Jérez, 2030 m, 3; 32 km SE Valparaíso, 2040 m, 9; 36 km SSE Valparaíso, 2330 m, 3; 16 km SSE Monte Escobedo, 2010 m, 5; 20 km S Monte Escobedo, 1920 m, 1; 20 km S Villanueva, 1810 m, 2; 2.5 mi S Momax, 5800 ft, 1; 3.5 mi W Tlatenango, 6500 ft, 1; 30 km NE Jalpa, 1740 m, 2; 10 mi W Jalpa, 6100 ft, 8 (LACM); 5.5 mi SW Jalpa, 4400 ft, 1 (OU); 25 km ESE Jalpa, 2590 m, 1; 8 mi NW Nochistlán, 6600 ft, 2 (LACM); 6 km S Téul de Gonzáles Ortega, 2010 m, 2; 7 km SE Santa Rosa, 1500 m, 3. Other records: Jones and Webster (1977) unless otherwise noted; 4 mi NW Chalchihuites; 40 km W Fresnillo; 8 mi S Moyahua; in Durango, Quadrat 8 (MSU).

ONYCHOMYS TORRIDUS CANUS MERRIAM

Southern Grasshopper Mouse

Distribution. -- Widely distributed, except for montane regions, in Zacatecas.

Remarks. -- This species seems most abundant in the desert-grassland ecotone of central Zacatecas. Usually, only one or two individuals are taken in any given locality. However, a field party from the University of Oklahoma was able to collect 10 and 15 specimens from near Sierra Vieja and Bañon, respectively. Both localities are in the desert-grassland ecotone. A female taken on 31 July contained four embryos and was lactating. Two females taken on 26 July and 21 August were lactating.

All specimens from Zacatecas are referable to the subspecies *O. t. canus* based upon color and size characters given in Hollister (1914). Specimens from extreme northeastern Zacatecas approach *O. t. surrufus* in having slightly longer anterior palatine foramina but do not possess the spine on the posterior border of the palate. Van Cura and Hoffmesiter (1966) and Matson and Friesen (1979) demonstrated that color, length of anterior palatine foramina, and the development of a spine on the palate were of questionable utility in separating northern subspecies of *O. torridus*.

Specimens Examined. -- Total 83, from: 15 mi NE Concepción del Oro, 2 (OU); 12 km ENE Concepción del Oro, 1850 m, 1; 35 km SSE Concepción del Oro, 1980 m, 1; 13.5 mi SW Camacho, 5800 ft, 1 (RGH); 3 km NW San Felipe de Nuevo Mercurio, 1770 m, 4; 4 km N Nieves, 1980 m, 1; 15 mi NE San Andrés, 6200 ft, 3 (LACM); 6.5 km S La Colorada, 1970 m, 1; 8 mi S Majoma, 7700 ft, 5 (KU); 10 mi N Rancho Grande, 6700 ft, 1; 1 mi S Cañitas, 1 (TTU); 1 mi W Sierra Vieja, 6100 ft, 10 (OU); 40 km NE Villa de Cos, 2000 m, 1; 18 km NE Villa de Cos, 2040 m, 1; 3 mi E, 4.6 mi N Villa de Cos, 1 (OU); Villa de Cos, 6700 ft, 2 (KU); 2 km S Monte Mariana, 2180 m, 3; 45 km NE Morelos jct, 1 (TTU); Bañon, 6400 ft, 2 (LACM); 2 mi E Bañon, 6400 ft, 3 (LACM), 2 (RGH); 4 km ESE Bañon, 6200 ft, 15 (OU); 10 km SE Fresnillo, 2250 m, 1; 24 mi NE Zacatecas, 6700 ft, 1 (LACM), 1 (RGH); Calera, 7300 ft, 3 (KU); 3 mi SE Guadalupe, 2 (UI); 8 mi SE Zacatecas, 7225 ft, 1 (KU); 9 mi SE Zacatecas, 7900 ft, 2 (KU); 2 mi ESE Trancoso, 7000 ft, 1 (KU); 7 mi SE Trancoso, 1 (KU); 13 km E Jérez, 2200 m, 1; San Juan Capistrano, (type locality), 5 (US); 5 mi S Ojo Caliente, 1 (UI); 3 mi WNW Saldaña, 6850 ft, 1. Other records: Jones and Webster (1977) unless otherwise noted; 22 mi SW Concepción del Oro, (CAS); 20 mi S Concepción del Oro; 40 mi W Fresnillo; 8 mi W Fresnillo.

SIGMODOAN FULVIVENTER FULVIVENTER J. A. ALLEN

Tawny-Bellied Cotton Rat

Distribution. -- Grasslands of western and southern Zacatecas.

Remarks. -- This species does not seem very abundant anywhere in Zacatecas. Baker (1969) considered this cotton rat to be extremely sensitive to overgrazing. Its spotty distribution and low numbers in

Zacatecas may be a reflection of this sensitivity. One female taken on 16 July was lactating. Other natural history data for a nearby locality in Durango were given by Petersen (1978). Baker (1969) reviewed the fulviventer group of cotton rats and referred all specimens from Zacatecas to S. f. fulviventer.

Specimens Examined. -- Total 22, from: 5 km S Gonzáles Orgega, 2150 m, 1; 16 mi NW Río Grande, 6750 ft, 1; 3 mi E El Calabazal, 8000 ft, 1; 9 mi W Sombrerete, 7900 ft, 1 (OU); 5 km NE Chalchihuites, 2360 m, 1; 12 mi SE Fresnillo, 7000 ft, 1; 45 km SW Fresnillo, 2165 m, 2; Zacatecas, (type locality), 3 (AMNH); 10.9 mi NW Cuauhtémoc, 7100 ft, 1 (OU); Monte Escobedo, 7300 ft, 8 (LACM); 25 km ESE Jalpa, 2590 m, 1; 8 km NW Téul de Gonzáles Ortega, 2200 m, 1. Other records: 67 km W Fresnillo, (Baker, 1969); 13 km S Villanueva, (Dalby and Lillevik, 1969); in Durango, Quadrat 8 (MSU).

SIGMODON HISPIDUS BERLANDIERI BAIRD

Hispid Cotton Rat

Distribution. -- Widely distributed, except for the montane forests, in Zacatecas.

Remarks. -- In the desert regions of Zacatecas, this species occurs in islands of grassland or near cultivated fields. It seems to be most abundant in brushy habitats in the grasslands. Three females taken on 10, 15 July and 3 August contained 5, 6, and 11 embryos respectively. One female taken on 15 July was lactating.

The status of various subspecies of S. hispidus are in need of review. All specimens from Zacatecas are assigned to S. h. berlandieri on the basis of geography (Hall and Kelson, 1959).

Specimens Examined. -- Total 90, from: 10 km ESE San Juan de los Charcos, 1500 m, 1; 3 km SE Apizolaya, 1920 m, 1; 12 km ENE Concepción del Oro, 1850 m, 1; 5 km NW Juan Aldama, 1980 m, 1; 13 mi SW Camacho, 5900 ft, 1 (LACM); 35 km SSE Concepción del Oro, 1980 m, 1; 1 mi N Lulú, 1830 m, 1; 2 km W San Felipe de Nuevo Mercurio, 1740 m, 14; 5 km S Gonzáles Ortega, 2320 m, 2; 23 km NE Río Grande, 1800 m, 1; 13 km WNW Río Grande, 2050 m, 1; 2 mi W Sain Alto, 6900 ft, 7 (KU); 6 km N Fresnillo, 2250 m, 8; 5 km N Fresnillo, 2250 m, 1; 2.5 km WNW Fresnillo, 7400 ft, 2 (OU); 2 mi S Fresnillo, 7420 ft, 1; 5 mi NW Zacatecas, 7600 ft, 1 (KU); Valparaíso, 6200 ft, 3 (US); 8 mi SE Zacatecas, 7225 ft, 3 (KU); 20 km S Villanueva, 1810 m, 1; 25 km ESE Pinos, 2425 m, 1; 2.5 mi S Momax, 5800 ft, 1; 30 km NE Jalpa, 1740 m, 1; 10 mi W Jalpa, 6100 ft, 8 (LACM); 5.5 mi SW Jalpa, 4400 ft, 6 (OU); 6 mi SW Jalpa, 5100 ft, 1 (LACM); 4 mi S Jalpa, 4300 ft, 10 (LACM); 8 mi NW Nochistlán, 6600 ft, 2 (LACM); Santa Rosa, 4000 ft, 8 (LACM). Other records: 9 mi W Zacatecas, (CAS); in Jalisco, Quadrat 55 (Genoways and Jones, 1973).

SIGMODON LEUCOTIS LEUCOTIS BAILEY

White-Eared Cotton Rat

Distribution. -- Montane regions of western and southern Zacatecas.

Remarks. -- The white-eared cotton rat is fround only in montane areas usually associated with grassy meadows and adjacent brushy areas in pine-oak forests. Baker (1939:213) reported that they were most common in ". . . mixed grass and shrub cover on shallow, rocky soils,

. . ." Three females taken on 5 and 6 August contained 3, 4, and 6 embryos. One female taken on 5 August was lactating.

The subspecies of S. leucotis were reviewed by Baker (1969). He assigned all specimens from Zacatecas to S. l. leucotis.

Specimens Examined. -- Total 19, from: 25 km WSW Milpillas de la Sierra, 2580 m, 14; 9 mi NW Valparaíso, 8350 ft, 2; 9 mi WNW Jalpa, 8250 ft, 3. Other records: Baker (1969); 13 km S Chalchihuites; 13 km W Milpillas (de la Sierra); 27 km W Milpillas (de la Sierra); Valparaíso mountains; 15 km W Zacatecas; 17 km S Pinos; in Aguascalientes, Quadrat 57.

SIGMODON MASCOTENSIS J. A. ALLEN

Mascota Cotton Rat

Disbrituion. -- Tropical canyons of southwestern Zacatecas.

Remarks. -- Very little is known about S. mascotensis. It seems common along cultivated fields and grassy areas. Two females taken on 21 and 30 July contained six and eight embryos, respectively. Two females taken on 21 July were lactating.

Until recently (Zimmerman, 1970), S. mascotensis was considered to be a subspecies of S. hispidus. These two are difficult to identify on external characters. However, Zimmerman (1970) listed some cranial characters that are useful in separating the two. In addition, The Museum, Michigan State University, has a large series of known-age specimens of both species which aided in their identification. In a previous report (Matson et al., 1978), a subadult specimen from near San Juan Capistrano was incorrectly identified as S. arizonae. Now with a larger series from a nearby locality, I believe that specimen is better referred to S. mascotensis.

Specimens Examined. -- Total 18, from: 18 km N San Juan Capistrano, 1100 m, 6; 5 km NE San Juan Capistrano, 1330 m, 1; 16 km SSE Monte Escobedo, 2010 m, 7; 6 km S Apozol, 1170 m, 1; 2 mi N Santa Rosa, 3850 ft, 2; Santa Rosa, 4000 ft, 1 (LACM).

NEOTOMA ALBIGULA LEUCODON MERRIAM

White-Throated Wood Rat

Distribution. -- Widely distributed throughout the Plateau region in Zacatecas.

Remarks. -- White-throated wood rats seem to be most abundant in brushy and rocky habitats of central Zacatecas. Apparently, they are absent from the valleys of the Río Atengo and other tributaries of the Río Bolaños where N. palantina occurs. Hall and Genoways (1970) suggested that in areas where the ranges of these two species approach one another, N. albigula occurs in upland situations. Five females taken between 16 and 31 July contained an average of 1.6 (range, 1 to 2) embryos. Five females taken between 6 and 16 July were lactating.

All Zacatecan specimens are assigned to the subspecies N. a. leucodon following the recent review of the species by Hall and Genoways (1970). Previously, populations in western Zacatecas were considered to be a distinct subspecies N. a. zacatecae with the type locality at Plateado (Goldman, 1910). As shown by Hall and Genoways (1970), the characters of zacatecae do not hold when compared to the large series of specimens now available of leucodon. Specimens from northeastern Zacatecas approach N. a. subsolana (Alvarez, 1962) in size and color but are still referable to leucodon.

Specimens Examined. -- Total 262, from: 6 km W Apizolaya, 1800 m, 3; 3 km SE Apizolaya, 1920 m, 1; 7 km SE Caopas, 1940 m, 1; 8 mi W Cedros, 5650 ft, 1 (LACM); 12 km W San Rafael, 2590 m, 1; 13 km NE Concepción del Oro, 1700 m, 2; Concepción del Oro, 7600 ft, 1 (KU); 11 mi E Concepción del Oro, 5300 ft, 5 (LACM); 40 km ESE Concepción del Oro, 2320 m, 2; 25 km NE Camacho, 1975 m, 5; 12 mi SE Concepción del Oro, 7450 ft, 3; 3 mi N Lulú, 2 (MVZ); 1 mi N Lulú, 6000 ft, 1; 7 km SE El Rosario, 2100 m, 1; 15 mi S Concepción del Oro, 1 (KU); 13 mi SW Camacho, 5800 ft, 2 (LACM); 10 mi SE Juan Aldama, 7250 ft, 3; 2 km W San Felipe de Nuevo Mercurio, 1740 m, 16; 3 km E San Tiburcio, 1880 m, 1; 1 mi SW San Tiburcio, 7000 ft, 6 (KU); 15 km WSW San Tiburcio, 1980 m, 3; 9 mi NE Nieves, 6600 ft, 2; 4 km N Nieves, 1980 m, 3; 5 km S Gonzáles Ortega, 2320 m, 1; 23 km NE Río Grande, 1800 m, 1; 25 km SW San Tiburcio, 2030 m, 1; 15 mi NE San Andrés, 6200 ft, 1 (LACM); 13 km WNW Río Grande, 2050 m, 1; 45 km SW San Tiburcio, 1940 m, 2; 5 mi SE Río Grande, 1940 m, 11; 50 km SW San Tiburcio, 2125 m, 1; 6.5 km S La Colorada, 1970 m, 1; 8 mi S Majoma, 7700 ft, 6 (KU); 4 mi E El Calabazal, 1 (MZ); 13 km WNW Capriote, 2100 m, 10; 9 km NW Sarteneja, 2200 m, 1; 10 mi N Rancho Grande, 6700 ft, 6; 7 km N Rancho Grande, 2190 m, 1; 1 mi W Sierra Vieja, 6100 ft, 13 (OU); 40 km NE Villa de Cos, 2000 m, 2; 6 mi WSW Sierra Vieja, 6200 ft, 1 (OU); 10 mi SW Chalchihuites, 7200 ft, 1 (LACM); 3 mi E, 4.6 mi N Villa de Cos, 3 (OU); 23 km N Fresnillo, 2140 m, 1; Villa de Cos, 6700 ft, 6 (KU); 2 km S Monte Mariana, 2180 m, 1; 2 mi SE Villa de Cos, 6200 ft, 1; 6 km N Fresnillo, 2250 m, 1; 3 mi NW Fresnillo, 7760 ft, 1; 2.5 km WNW

Fresnillo, 7400 ft, 2 (OU); 20 mi NE Morelos jct, 2 (OU); Bañon, 6400 ft, 18 (LACM); 2 mi E Bañon, 6400 ft, 3 (LACM); 4 km ESE Bañon, 6200 ft, 19 (OU); 45 km SW Fresnillo, 2165 m, 1; 7.2 mi W Valparaíso, 7900 ft, 3 (OU); 6 mi W Valparaíso, 7400 ft, 1 (OU); Valparaíso, 6200 ft, 5 (US); 10 mi N Valparaíso, 6200 ft, 1 (KU); Zacatecas, 1 (US); 8 mi SE Zacatecas, 7225 ft, 2 (KU); 2 mi ESE Trancoso, 7000 ft, 7 (KU); 8 mi SW Jérez, 2030 m, 1; 11.7 mi NW Cuauhtémoc, 7100 ft, 2 (OU); Berriozábal, 9 (US); 3 mi N Cuauhtémoc, 6600 ft, 13 (LACM); 1 (RGH); 13 km NE Villanueva, 2040 m, 2; 3 mi WNW Saldaña, 6850 ft, 1; 6 mi NNW Pinos, 7900 ft, 1; Pinos, 1 (AMNH); Monte Escobedo, 7300 ft, 4 (LACM); 8 mi S Villanueva, 6850 ft, 1; 25 km ESE Pinos, 2425 m, 4; Plateado, 1 (US); 13 mi N Jalpa, 5000 ft, 6 (KU); 10 mi W Jalpa, 6100 ft, 1 (LACM); 3 mi SW Jalpa, 4600 ft, 1 (KU); 5.5 mi SW Jalpa, 4400 ft, 2 (OU); 6 mi SW Jalpa, 4900 ft, 1 (RGH); 4 mi S Jalpa, 4300 ft, 3 (LACM). Other records: 22 mi SW Concepción del Oro, (Jones and Webster, 1977); 16 mi NW Fresnill0, (CAS); 6 mi W Fresnillo, (Jones and Webster, 1977); in Durango, Quadrat 8 (MSU); in Jalisco, Quadrat 55 (Hall and Genoways, 1970); in San Luis Potosí, Quadrat 67 (Dalquest, 1953).

NEOTOMA GOLDMANI MERRIAM

Pigmy Wood Rat

Distribution. -- Arid regions of northeastern and southeastern Zacatecas.

Remarks. -- In Zacatecas, this species seems to be associated with rocky habitats. Three females taken on 9, 21 July and 8 August contained one, two, and one embryos, respectively. A female taken on 29 July was lactating.

The geographic distribution of the species was reviewed by Rainey and Baker (1955). Specimens reported here represent western and southern marginal records for the species.

Specimens Examined. -- Total 15, from: 20 km NE Concepción del Oro, 1910 m, 2; 4 km W San Rafael, 2140 m, 1; 6 mi W Concepción del Oro, 1(UI); Concepción del Oro, 7600 ft, 1 (KU); 25 km SW San Tiburcio, 2030 m, 2; 50 km SW San Tiburcio, 2125 m, 3; 5 mi S Ojo Caliente, 1 (UI); 3 mi WNW Saldaña, 6850 ft, 2; 6 mi NNW Pinos, 7900 ft, 1; 25 km ESE Pinos, 2425 m, 1.

NEOTOMA MEXICANA BAIRD

Mexian Wood Rat

Distribution. -- Montane regions of western and southern Zacatecas.

Remarks. -- In the montane forests of Zacatecas, the Mexican wood rat seems to be associated with rock outcrops. In the tropical vegetation along the Río Juchipila, it was taken in association with rock ledges or fences. Two females taken on 30 July were lactating.

Hall (1955) recorded two subspecies from western and southern Zacatecas. Although he also indicated that a third subspecies may be present in the northeastern part of the state, I failed to find them. Specimens assigned to N. m. madrensis from the western part of Zacatecas are larger and have a more reddish colored dorsum than specimens from the south assigned to N. m. tenuicauda.

Specimens Examined. -- Neotoma mexicana madrensis Goldman, total 15, from: 4 mi E El Calabazal, 3 (MZ); 12 mi W Sombrerete, 2 (KU); 14.2 mi N Jiménez del Téul, 7300 ft, 1 (OU); 25 km WSW Milpillas de la

Sierra, 2580 m, 4; 9 mi NW Valparaíso, 8350 ft, 5. Other records: 8 mi W Milpillas (de la Sierra), (CAS); Sierra de Valparaíso, (Hall, 1955); in Jalisco, Quadrat 48 (Genoways and Jones, 1973).

Neotoma mexicana tenuicauda Merriam, total 14, from: Pinos, 3 (AMNH); Plateado, 6 (US); 10 mi W Jalpa, 6100 ft, 1 (LACM); 8 mi NW Nochistlan, 6600 ft, 1 (LACM); .5 mi ENE Mesquituta, 3450 ft, 2 (OU); Santa Rosa, 4000 ft, 1 (LACM). Other records: In Aguascalientes, Quadrat 57 (Hooper, 1955).

NEOTOMA PALATINA GOLDMAN

Bolaños Wood Rat

Distribution. -- Known only from the valley of the Río Atengo in Zacatecas.

Remarks. -- This species was collected only in the canyon bottom of the Río Atengo in Zacatecas. Matson et al. (1978) reported two specimens taken in rocky habitats. Two additional specimens from north of San Juan Capistrano were also taken along rock fences in canyon bottom. A female taken on 3 August contained one embryo.

Specimens Examined. -- Total 5, from: 18 km N San Juan Capistrano, 1100 m, 2; 5 km NE San Juan Capistrano, 1330 m, 2; 5 km E San Juan Capistrano, 3350 ft, 1 (OU). Other records: in Jalisco, Quadrat 48 and 61 (Hall and Genoways, 1970).

NELSONIA NEOTOMODON NEOTOMODON MERRIAM

Diminutive Wood Rat

Distribution. -- Montane regions of western and southern Zacatecas.

Remarks. -- This is a rare species of rodent for which very little is known. Apparently, it is restricted to rocky situations in mesic montane forests of the Sierra Madre Occidental (Hooper, 1954).

All Zacatecan specimens are assigned to _N_. _n_. _neotomodon_ following Hooper (1954).

Specimens Examined. -- Total 11, from: 9 mi NW Valparaíso, 8350 ft, 1; Valparaíso mountains, 8700 ft, 2 (US); Sierra Madre, 4 (US); Plateado, 4 (US). Other records: in Aguascalientes, Quadrat 57 (Hooper, 1954).

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