ÁLVAREZ-CASTAÑEDA SERGIO TICUL, CORTÉS-CALVA PATRICIA AND VÁZQUEZ MARÍA DEL ROSARIO. STRUCTURE AND CONTENTS OF BURROWS OF THE POCKET MOUSE (*CHAETODIPUS RUDINORIS*) NEAR LA PAZ, BAJA CALIFORNIA SUR, MÉXICO, CAP. 1: 1-14. *En:* SÁNCHEZ-CORDERO V. y MEDELLÍN R.A. (Eds.) *CONTRIBUCIONES MASTOZOOLÓGICAS EN HOMENAJE A BERNARDO VILLA*, 706 p. Instituto de Biología, UNAM; Instituto de Ecología, UNAM; CONABIO. México, 2005. ISBN 970-32-2603-5.

1. STRUCTURE AND CONTENTS OF BURROWS OF THE POCKET MOUSE (*CHAETODIPUS RUDINORIS*) NEAR LA PAZ, BAJA CALIFORNIA SUR, MEXICO

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Abstract

Twenty-four mouse burrows were excavated and mapped in a protected area of tropical desert scrub northwest of La Paz, Baja California Sur, Mexico. For each burrow, we recorded measurements and features, collected seeds and insects, and described the surroundings. Each burrow complex was mapped in three-dimensions (x, y, z), with the entrance hole as origin. We recorded total length and the length of main tunnel, and computed two complexity indices. Sand, silt, or clay texture was determined from soil samples. We studied 13 burrows of males and 11 of females; four were simple, and 20 were complex. Burrows of males and females did not differ in total length, length of main tunnel, number of side passages, diameter, volume, or depth ($P > 0.05$). The complexity indices for burrows of females were significantly higher than for those of males. There was no significant difference ($P > 0.05$) between sexes in burrow food content. Correlation between burrow complexity and content biomass was significant only for the burrows of females. The correlation between burrow volume and content biomass was not significant.

Key words: *Chaetodipus rudinoris*, burrows, desert ecology, Heteromyidae, Mexico.

Resumen

Se excavaron y realizaron mapas de veinticuatro madrigueras (13 de machos y 11 de hembras) de *Chaetodipus rudinoris* en el área protegida de El Comitán, al noroeste de La Paz, Baja California Sur, México, con vegetación de matorral desértico tropical (sarcocaule). Para cada madriguera se tomaron sus dimensiones, caracterización del ambiente y se colectó el contenido de semillas e insectos que se encontraron dentro de ellas. Cada sistema de madrigueras se trazó en función del sistema de coordenadas (x, y y z), considerando al agujero de entrada como origen de los ejes. Se obtuvo la longitud total y longitud de túnel principal para determinar el índice de complejidad. Se realizaron pozos edafológicos para la determinación de la textura del suelo (porcentaje de arena, limo y arcilla). Cuatro madrigueras se clasificaron como simples y 20 como complejas. Las madrigueras de machos y hembras no difirieron significativamente ($P > 0.05$) en la longitud total, longitud de túnel principal, túneles laterales, diámetros, volumen, y profundidad. El índice de complejidad fue significativamente ($P > 0.05$) más alto para las madrigueras de hembras que para machos. No hubo diferencia significativa ($P > 0.05$) entre el contenido de alimento (biomasa de semillas e insectos) y la longitud de las madrigueras entre ambos sexos. La correlación entre los volúmenes de biomasa encontrada dentro de la madriguera y la complejidad sólo fue significativa ($P > 0.05$)

para las madrigueras de las hembras. La correlación entre el volumen de las madrigueras no fue significativa.

Palabras claves: *Chaetodipus rudinoris*, madrigueras, ecología de desiertos, Heteromyidae, México.

Introduction

Rodents differ greatly in habitat, soil type (Best 1982; Laundré and Reynolds 1993; Price and Podolsky, 1989; Vogel *et al.* 1973), and geographical locality (Soholt 1974) of burrows, and in species body size and activity (Kenagy 1973). The information available about burrow structure in desert environments is limited (Kay 1978; Laundre 1993).

For many desert rodents, the burrow is the keystone of survey. Mouse burrows are complex, and provide humidity and temperature homeostasis, protection from wind, rain, and predators, and space for rearing young (Reichman and Smith 1993). Burrows are commonly located near the bases of shrubs, and they can have more than one entrance (Jameson and Pettersen 1988).

Heteromyids are one of the most abundant families of rodents in arid and semi-arid areas of North America (Brown and Lieberman 1973; Genoways and Brown 1993; Mares 1993). In the literature available on burrow construction of the family in desert areas of North America, burrows of pocket mice (*Chaetodipus* and *Perognathus*) are relatively simple (Reichman 1983). Burrows of kangaroo rats (*Dipodomys*) are extensive (Best 1982; Schroder 1979). *Dipodomys venustus,* constructs two types of burrows: one is simple, used to avoid predators, and the other is complex, with many tunnels and chambers for living and food storage (Hawbecker 1940). The amount of food stored in burrows changes over days and months (Smith and Reichman 1984).

Heteromyids are important small mammals constituents of desert ecology and have a recognized impact on their environment (Hull-Sieg 1987). This field study of pocket mouse (*Chaetodipus rudinoris*) burrows was conducted in 1997 near La Paz, Baja California Sur, Mexico, with the objective of examining their structure and contents to enrich our understanding of the life story of the mammals and to describe the structure and complexity of burrows and to identify their contents. Many natural objects reveal a certain degree of self-similarity over different length scales. This approximate self-similarity is statistical for natural objects because smaller parts look the same as the whole only on average (Peak and Frame 1994). Pocket mouse burrows appear to display statistical self-similarity, so we considered that the burrows could be analyzed as fractals to determine differences in complexity among burrows.

We hypothesized that the burrows of females and males are different in complexity, mainly because of the females' need for a nest to rear young. In general, the species of temperate areas have burrows more complex than those of tropical areas. The species that we are studying is from a transition zone: a warm desert.

Study Area and Methods

The study area was a natural preserve area of the Centro de Investigaciones Biológicas del Noroeste (CIBNOR), 20 km northwest of La Paz, Baja California Sur, Mexico (24°05' N, 110°21' W). The region has an arid tropical climate, which was described by Wiggins (1980). The soil is hapic yermosol (aridosol) (Instituto Nacional de Estadística Geografía e Informática, 1985), with a light-colored upper stratum and little organic material. The flora has arid and subtropical elements, with an abundance of cacti and shrubs. The most representative families are Euphorbiacea, Cactaceae, and Leguminosae (León de la Luz *et al.* 1996). Zoogeographically, the locality is an arid subregion of the Llanos de Magdalena biotic province (Álvarez-Castañeda *et al.* 1995). Rodents at the site (Cortés-Calva and Álvarez-Castañeda 1997) include four heteromyid species: *Chaetodipus arenarius, C. rudinoris, C. spinatus*, and *Dipodomys merriami.* We located active burrows from March to May 1997 during the reproductive season, and set traps near those selected for possible study.

Rodent sampling-Forty Sherman live traps (7.9 by 8.9 by 23 cm) per night, totaling 520, were located on two line transects. Traps were baited with oats and checked three hours after sunset. Only specimens of *C. rudinoris* that weighed more than 20 grams were used. Location, date, number, weights, sexes, ages, and reproductive conditions were recorded for all captured rodents, which were marked by toe clipping and released.

Sampling burrow characteristics -A spool of nylon thread (average weight 2.0 g, less than 10% rodent weight) was glued to the back of each *C. rudinoris* specimen. The thread was attached to a stick that replaced the trap, and the mouse was released. This technique determined distances traveled by marked rodents, and provided information about movement in the burrows. By following a thread on the day after capture, we discovered that an individual might go into many different holes during a night, so we chose the hole that a specimen used most frequently as "the burrow." The burrow was marked, and on the following day traps were set to confirm that the specimen was a resident of the area. Then the burrow was excavated. Twenty-four burrow systems were excavated using a three-dimensional coordinate system, with the entrance hole as origin. The x-axis was aligned north positive, the y-axis was aligned east positive, and the z-axis began at the surface, down positive. Using a small shovel for excavation, positions of burrow features on the three axes were recorded every 2 cm. Major (generally horizontal) and minor (generally vertical) tunnel diameters were recorded, and notes on microhabitat were taken. A plan view of each burrow system was mapped on graph paper at 10:1 scale (Figs. 1 and 2). Measurements of total length, main tunnel length, and complexity (R. Vázquez, personal observations) were recorded. Total length of a burrow was obtained by adding the lengths of the main and side tunnels (Laundré and Reynolds 1993). The main tunnel was classified into three types: a) closed, or those that did not end in an open hole, b) open, or those that ended in a hole, and c) those that ended in a chamber. Complexity of a burrow was calculated as the length of a straight line between the two extremes of the main tunnel divided by total length of the burrow. This index is 1.0 for linear burrows and progressively less with increased complexity (Laundré and Reynolds 1993). Burrow depth, and major and minor tunnel diameters were obtained by excavation. Burrow volume was calculated with the mathematical formula for a cylinder, using the average of major and minor diameters, and total length. Soil texture (% sand, silt, and clay) was determined from core samples obtained near each burrow to a depth of 105 cm. Texture was determined by the hygrometer technique (Bouyoucos 1951). From each burrow system, we collected and identified insects and seeds. Each category of material was air-dried and then weighed in the laboratory. Seeds, soil, and other material in the tunnel were sieved in 1 mm screens. Organic material was separated for identification by species in the CIB herbarium and entomological collection.

The average time spent digging and recording field data for each burrow system, which included collection of seeds and insects, measurement of the burrow, and description of the surroundings, was 12 hours. We used 10 main burrows per sex, excluding simple burrows, for analysis of differences between sexes. The Student's t-test was used at 95%. For other analyses, regression and multiple regressions were used (*Statistica* 1995).

For evaluation of burrow complexity, the fractal dimension was calculated. The fractal dimension varied between 1.0 (that of a straight line) and 2.0 (that of an area). Burrow fractal dimensions were calculated using the squared graph paper drawings and the formula $D = \text{Log } N/\text{Log } 1/S$, where D is the fractal dimension, N is the number of small squares occupied by a burrow, and $1/S$ is the number of small squares on the side of a large square enclosing the entire burrow (S can be interpreted as Scaling factor). The typical value of $1/S$ was 20. The fractal dimensions were used as complexity indices to analyze the structure of burrows. To make the self-similarity analysis we take other small square of ¼ of the original with the $1/S$ was 100.

We compared the fractal dimension with the conventional index of complexity (Laundré and Reynolds 1993) used in burrow analysis, to evaluate differences between the two indices. If the two indices were strongly correlated, the fractal index could be used in preference to the conventional index, which is applicable only to burrows, because the fractal index is a measure of complexity that can be applied to any natural shape with self-similarity.

Results

From 36 specimens total of *Chaetodipus rudinoris* weighing more than 20 g, 13 males and 11 females were fitted with a spool. Based on our capture and tracking technique, we had found the main burrows of each

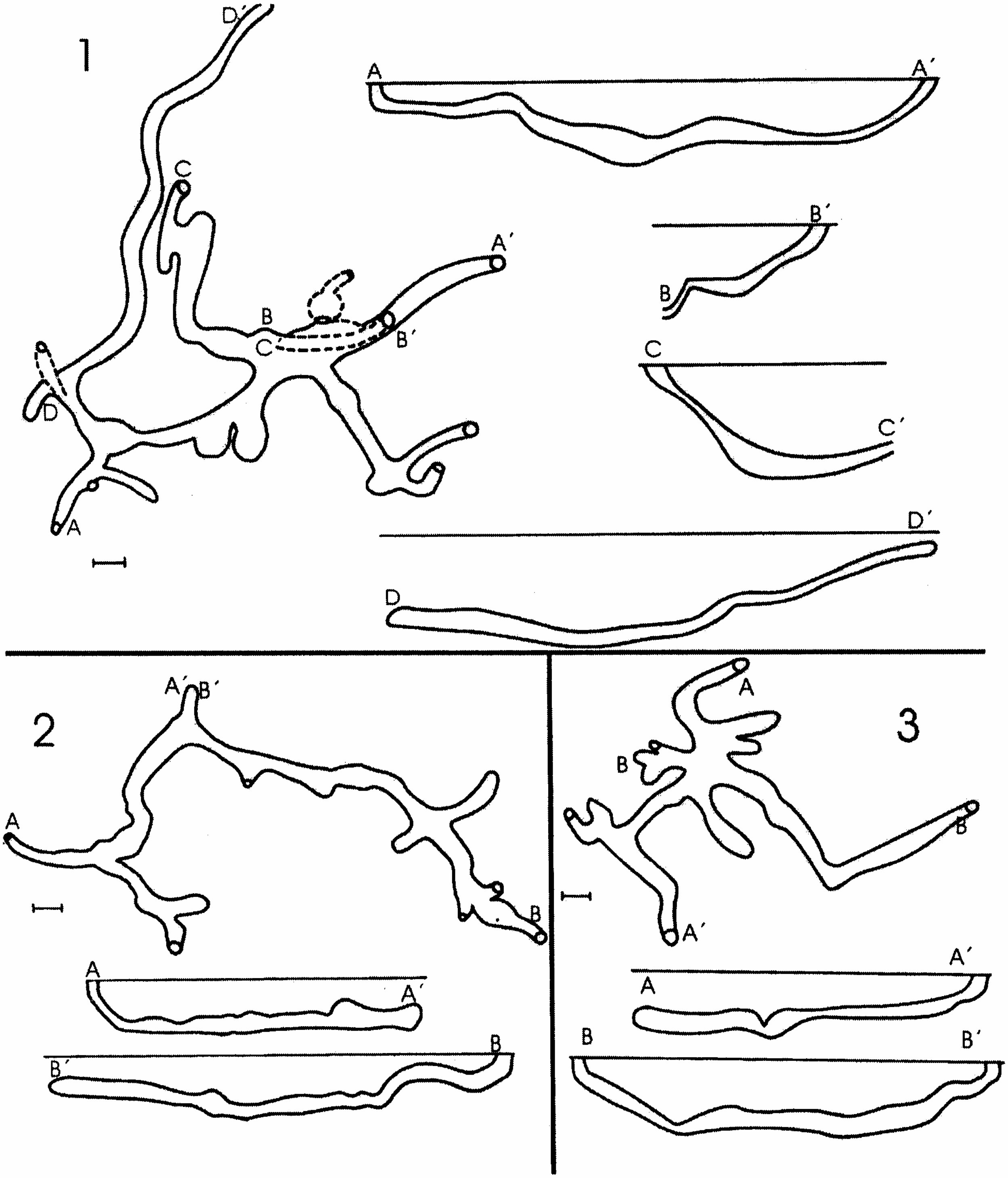

Fig. 1. Maps of three selected complex longitudinal profiles of female burrows of *Chaetodipus rudinoris*.

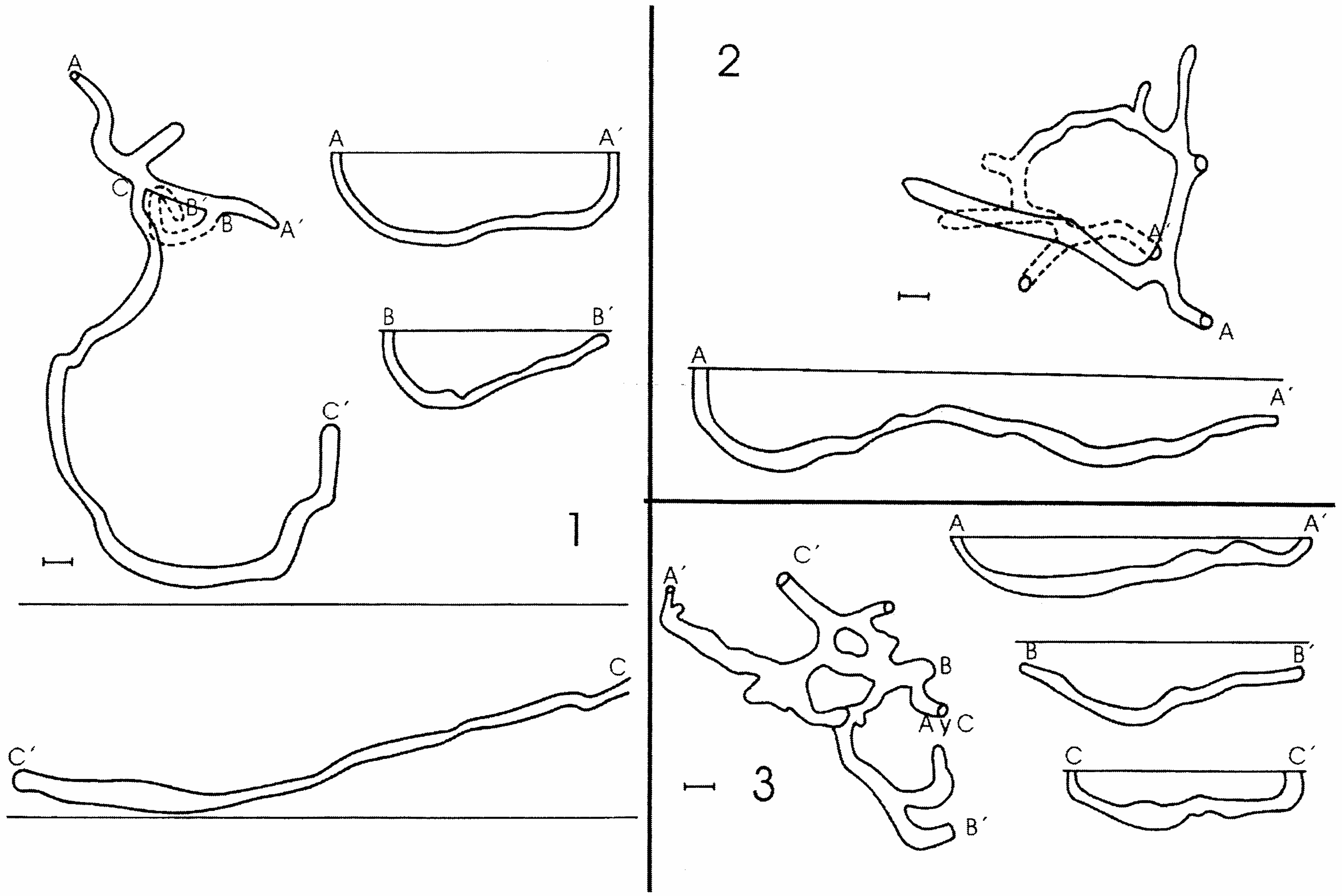

Fig. 2. Maps of three selected complex longitudinal profiles of male burrows of *Chaetodipus rudinoris*.

specimen. Of the 24 burrow systems excavated, four burrows were simple tunnels and not analyzed. The remainder were centered under small mounds 10-20 cm higher than the surrounding soil surface.

The total lengths of main tunnels and open-ended side tunnels of burrows of *C. rudinoris* males were greater than those of females, but side tunnels with no exit were longer in the burrow systems of females. Significant differences between burrow structures of males and females include the major diameter of side tunnels with no exit, which was greater for male burrows (Table 1). Also, female burrows had fewer side tunnels (3 ± 1.82) and fewer holes (3 ± 0.66) than males (4 ± 2.75 and 4 ± 2.34, respectively), but male burrows were significantly less complex ($P < 0.05$) (Table 2).

We found the major diameter usually horizontal and the minor diameter usually vertical. Major tunnel diameter of male burrows was larger, but female tunnels were deeper. Student's *t*-test showed no significant difference in total length, main tunnel length, side tunnel length, major or minor diameter, volume, or depth (Table 2) between male and female burrows.

We discovered many dead-end side tunnels. We found no chambers of large volume, but main tun-

Table 1. Mean and standard deviation by type of tunnel of the length, diameter, and depth (measurements in centimeters) of 10 main burrows per sex of *Chaetodipus rudinoris*. (n.s.) no significant different and (*) significant difference ($p < 0.05$).

Type of tunnel		Length	Major diameter	Minor diameter	Depth
Main tunnel	Female	103 ± 56	5.0 ± 0.5	4.2 ± 0.7	14.9 ± 5.0
	Male	121 ± 71	5.1 ± 1.1	4.2 ± 1.0	13.3 ± 4.4
		n.s.	n.s.	n.s.	n.s.
Side tunnel with exit	Female	16.9 ± 4.8	4.3 ± 0.9	3.8 ± 0.6	11.2 ± 3.6
	Male	24.5 ± 3.80	4.5 ± 1.2	3.9 ± 1.1	11.9 ± 6.1
		n.s.	n.s.	n.s.	n.s.
Side tunnel without exit	Female	33.7 ± 32.2	4.5 ± 0.5	4.0 ± 0.9	19.2 ± 9.5
	Male	28.1 ± 34.3	5.2 ± 0.6	4.1 ± 1.1	15.1 ± 6.9
		n.s.	*	n.s.	n.s.

Table 2. Mean, standard deviation, and range of the total length, diameter, depth (cm), volume (cm^3), and complexity of burrow (calculated as the length of a straight line between the two extremes of the main tunnel of a burrow divided by total burrow length) of 10 main burrows per sex of *Chaetodipus rudinoris*.

Variables	Sex	X ± SD	Minimum-Maximum	*P*
Total length	Female	223 ± 128	100 — 435	n.s
	Male	232 ± 216	143 — 718	
Major diameter	Female	4.8 ± 0.4	3.8 — 5.4	n.s
	Male	4.9 ± 0.9	3.1 — 6.0	
Minor diameter	Female	4.1 ± 0.5	3.2 — 5.1	n.s
	Male	4.1 ± 0.9	3.0 — 5.3	
Volume	Female	4409 ± 2915	1241 — 8352	n.s
	Male	5714 ± 5456	2710 — 20300	
Depth	Female	16.5 ± 7.9	9.7 — 35.8	n.s
	Male	12.8 ± 4.4	6.3 — 19.5	
Complexity	Female	0.4 ± 0.1	0.3 — 0.6	*
	Male	0.5 ± 0.2	0.2 — 0.9	

nels, and sometimes side tunnels, had slightly larger dimensions that a typical tunnel. In these areas, we found more seeds, fruit, and other plant parts (table 3). Frequently, this vegetable matter was mixed with floor soil. The biomass in burrows of females was related significantly to total length of the burrow tunnels ($r = 0.630, P < 0.05$), but not to complexity ($r = 0.062, P > 0.05$). For males, neither relation was significant ($r = 0.14, P > 0.05; r = 0.15, P > 0.05$). Correlation between biomass and total length of all burrows was significant ($r^2 = 0.55, P < 0.01$), but not between biomass and complexity ($r^2 = 0.099, P > 0.05$). Females had significantly ($P < 0.05$) greater biomass (10.78 g) stored in burrows than males (6.71 g). No significant correlation was found between lengths of seeds and fruits and total burrow biomass.

The fractal dimension analysis for burrows of males resulted in a very high variance coefficient (0.10), while that of burrows of females was smaller (0.05), but the difference between the sexes was not significant ($P < 0.05$). However, the fractal dimension of female burrows ($\bar{x} = 1.26 \pm 0.07$) was high in relation to that of male burrows ($\bar{x} = 1.17 \pm 0.12$). The fractal and conventional complexity indices for all burrows were significantly correlated ($F_{(1,\,18)} = 63, r = 0.88, r^2 = 0.77, P < 0.01$). The indices were not correlated for male burrows ($F_{(1,\,8)} = 3.88$, $r = 0.57, r^2 = 0.32, P < 0.08$) but were significantly correlated for female burrows ($F_{(1,8)} = 56.87, r = 93$, $r^2 = 0.87, P < 0.001$). However, we found outlying data for two male burrows that were closer to those of female burrows. Based on a hypothesis explained in the discussion, when we considered these two with the females ($n = 12$), we observed no change in variance coefficient of females (*c.v.* = 0.05), but the male coefficient changed ($n = 8$, *c.v.* = 0.08). *t*-student tests of the fractal dimension ($t_{18,05}\, P < 0.01$) and complexity index ($t_{18,05}\, P < 0.01$) showed significant difference between sexes, and the correlation between fractal dimension and complexity index for male burrows ($F_{(1,6)} = 26.09, r = 0.90, r^2 = 0.81, P < 0.01$) was then significant. The self-similarity of the burrow made with fractal analysis, using the $1/S = 20$ and two squares of $1/S = 100$, do not show significant differences ($p < 0.05$) for males and females burrows.

Soil stratigraphy using a core sampler showed that two layers were present. From 0 to 26 cm, we found loamy fine sands of fine porosity and from 27 to 56 cm there was a similar layer of finer porosity (Naranjo 1994). Usually, burrows were in the less compact upper layer. The average composition of upper layer core samples was sand 72.5 ± 8.3%, silt 16.0 ± 6.7%, and clay 11.3 ± 4.9%. No stones were present. No significant correlation was found between texture variables and length of burrows ($r^2 = 0.035, P > 0.05$), complexity ($r^2 = 0.13, P > 0.05$), or volume ($r^2 = 0.04, P > 0.05$). Burrow soil textures of males (sand 74.6 ± 7.9%, silt 13.9 ± 6.0%, clay 11.1 ± 5.5%) and females (70.0 ± 8.3%, 18.4 ± 7.1%, 11.5 ± 4.3%) were not significantly different. Only one tunnel of the burrow of a female went in to the second layer.

Seeds and fruits of torote (*Bursera microphylla*), grassbur (*Cenchrus ciliaris*), grassbur (*Cenchrus palmeri*), brittlebush (*Encelia farinosa*), coyote melon (*Ibervillea sonorae*), krameria (*Krameria paucifolia*), creosote bush (*Larrea divaricata*) desert thorn (*Lycium brevipes*), cholla (*Opuntia cholla*),

Table 3. Weight (g) of seeds and other plant parts in the burrows of *Chaetodipus rudinoris*.

Species	Female	Male	Total	Other material
Bursera microphylla	7.5	0.0	7.5	
Prosopis articulata	13.0	12.0	25.0	pod
Larrea divaricata	7.0	11.0	18.0	
Krameria paucifolia	33.5	8.0	41.5	
Lycium brevipes	3.2	1.5	4.7	
Ruellia peninsularis	3.6	4.9	8.5	
Opuntia cholla	149	198	347	branch and fruit
Pachycereus pringlei	82	152	234	fruit
Cenchrus palmeri	9.3	1.1	10.4	
Ibervillea sonorae	0.0	1.5	1.5	
Cenchrus ciliaris	2.0	3.0	5.0	
Total	310	392	703	

Table 4. Insects found in burrows of *Chaetodipus rudinoris*.

Class	Order	Family	Genera	Number of Individuals
Arachnida	Solifugae			5
		Scorpionidae	*Centruroides*	5
Hexápoda	Coleoptera	Scarabeidae	*Ataenius*	10
		Tenebrionidae	*Cryptoglossa*	45
		Anobiidae		5
		Cleridae		5
	Blattaria	Polyphagidae	Arenivaga	35
	Hymenoptera	Formicidae	*Pogonomyrmex*	30
	Thysanura	Lepismatidae		5

cardon (*Pachycereus pringlei*), mesquite (*Prosopis articulata*), and rama parda (*Ruellia peninsularis*) were found in burrows. These are the xerophytic trees, shrubs, and grasses common to this area. Few insects were found (Table 4). Only two species were identified: *Arenivaga bolliana* (Dictyoptera: Polyphagidae) and *Pogonomyrmex californicus* (Hymenoptera: Formicidae). Most common insect families found in the burrows were Tenebrionidae (45%), Polyphagidae (35%), and Formicidae (30%).

Discussion

The majority of studies about heteromyid burrow system structure speak of the importance of the tunnel system to activities. Hawbecker (1940) commented that *C. baileyi* had two types of burrow: "simple", of one tunnel and used mainly for escape, and "more elaborate systems" containing a main and side tunnels, and chambers. Hawbecker believed the second type was used for living quarters, food storage, and rearing of young. Best (1972) reported that *Dipodomys* began construction of the burrow with a simple tunnel, and increased the complexity of the tunnel system with chambers and side tunnels over time. The lengths of main tunnels changed at different stages of construction because the burrows had many adjacent tunnels, probably for storing food; Reichman and Smith (1993) reported that this is common in rodents. Best (1982) mentions that in places with dense vegetation, *Dipodomys agilis* built burrows with more side tunnels. Soil stratification and texture might influence the structure of heteromyid burrows. Where the soil texture is sandy clay, digging is more active (Best 1982). The presence of clay allows soil particles to aggregate and support the construction of tunnels. Denyes (1954) found that rodents dig bigger burrows, store food, and make nests in this texture more than others. Another important characteristic of burrows is homogeneous distribution of particle classes (Laundré 1989; Laundré and Reynolds 1993; Price and Podolsky 1989). Burrows in these soils can be bigger than those of the same species in other places. The texture of the majority of soils around La Paz is sandy clay, and might influence construction of complex burrow systems of this species. The texture of tunnel soils was loamy sand, which probably influenced construction of burrows of *C. rudinoris*. In the study area, they were found mainly under trees or scrub such as sour leatherplant (*Jatropha cuneata*), cholla (*Opuntia cholla*), rama parda (*Ruellia peninsularis*), and pitaya (*Stenocereus gummosus*). These species give protection and shade. Burrows had several exits, some of which could be closed or opened for air circulation. In many burrows, we found pieces of cacti, particularly cholla (*O. cholla*) and cardon (*Pachycereus pringlei*), that can be used as a source of water and to increase burrow humidity. Another soil characteristic, which supports long tunnels, is small roots that hold the soil of the tunnel roof and walls together. Burrow placement can influence total length, and might be the reason for choosing the soil mound surrounding a plant.

Female burrows are more complex than male. This species has a medium body size and males are slightly larger (Cortés-Calva, personal observation). Male burrows averaged 12.8 cm depth, and female 16.5 cm. We believe burrows are built in the more workable upper layer because there is no strong negative effect of cold or moisture.

There was no significant correlation between burrow depth and presence of seeds. Jones (1993) reported that female *Dipodomys spectabilis* and *D.*

heermanni need long burrows for storing seeds and accommodating the nest. This probably applies also to *C. rudinoris*. We found seeds and plant pieces of various species. *C. rudinoris* stores fruit that have a large number of seeds, such as those of cardon and cholla, and eat the seeds in the burrow. Fruit was found in burrows of females more frequently than in those of males.

In the La Paz area, the phenology of vegetation is independent of the rainy season, with flower and seed production throughout the year. During the rainy season and after rains from hurricanes, annuals increase production (León de la Luz *et al.* 1996). Seed production is generally steady throughout the year and readily supports the rodent populations. This could account for the relatively small total quantity of seeds in a burrow (96 g maximum), compared to other rodents of the same size (Reichman and Smith 1993). We believe this is significant because excavation of burrows occurred in March through May, which is the reproductive season, and the time when females require more food and water. León de la Luz *et al.* (1992) observed that rodents in this region consume the fruit of the desert thorn. We also found seeds of this plant in the burrows. We observed seeds of *Burcera, Jatropha, Euphorbia,* and Leguminosae in cheek pouches of some species of *Chaetodipus* (Cortés-Calva personal observation). The most frequently found fruit in burrows of *C. rudinoris* was cholla, probably because of the high water content. There were few cardon seeds, but we found many fruit. We assume that the rodents ate all the seeds or they were lost in the soil of the tunnel because they are very small.

In El Comitán, an area immediately adjacent to the research facility, grassbur is the most common annual after the July-October rainy season (Cruz-Estrada 1992), and was abundant in the burrows. We found small numbers of mesquite seeds in 45% of the burrows. In laboratory analyses, Gutiérrez-Ramos (personal comment) found that *C. rudinoris* use mesquite seed more than any other native seed of the region. We think that mesquite seed is taken to the burrows and eaten, and not stored, since mesquite seeds are rare in burrows, but are very abundant in this season.

The fractal dimension analysis of female burrows showed that they are more complex than those of males, and that the variance for female burrows was smaller than that for males. However, when the outlying data for the two atypical male burrows were included with those of the female burrows, we observed low variance for male and female burrows, and significant difference between the burrows of each sex. The self-similarity has been demonstrated for the burrow in each one of the sex.

Long-term study of rodent species in the La Paz region, including *Chaetodipus*, shows that males have greater mobility than females, and do not maintain their presence in an area as long as females. This might be correlated to the data showing that males burrows are significantly smaller than those of females, which are normally resident, so probably the males dig a burrow to be used only a short time, or reinhabit old burrows of other males. Because *Chaetodipus* species are considered intraspecific and aggressive (Jones 1993), we believe that the two atypical male burrows could have been abandoned female burrows, or that the males took them from females, and used them during the time that they were in the area.

The fractal dimension and conventional complexity indices were close for both sexes, and were highly correlated, so either can be used with similar results.

Conclusions

Females of *C. rudinoris* store more food than males. Our findings agree with fieldwork that showed higher food storage in female burrows of Nearctic *Dipodomys spectabilis* and *D. hermanni* (Jones 1993) and Neotropical species *Liomys salvini* and *Heteromys desmarestianus* (Fleming and Brown 1975). We studied a Nearctic species in a tropical area; the burrows of males had longer tunnels than those of females, and there were more places for seed storage. This study established that the architecture of *C. rudinoris* burrows is similar in complexity to those of cold areas species. We believe the life cycle of this species is similar to that of a Nearctic species, in not making simple burrows, as we expected for this warm area, and in not digging burrows in relation to soil texture. To determine how tunnel structure and complexity effectively support storage, nesting, and nursing functions, we would have to investigate tunnel systems in more situations, topographically and seasonally. We found the complexities of female and male burrows varied little, and that they were significantly different. We hypothesize that male burrows are simple because males are more mobile and stay in a particular place less time than females. Males probably are more opportunistic, and use abandoned burrows or displace females from their burrows, but this hypothesis needs to be tested.

During this study, adult females did not present external evidence of reproductive condition. No pups and little food, rakes or structures necessary for nests were found in the burrows. Cortés-Calva (per. obs.) found reproduction began in the season of our research, later than in average years.

For a more complete understanding of burrow function, structure, and content, a survey across a wide latitude range needs to be done. The data to date on burrows of this *Chaetodipus* species are limited for answering many questions of their life story. We do not have the information needed to reach significant conclusions about issues that we had in mind.

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