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Preliminary Results of Biomass Partitioning in Three Chihuahuan Desert Rodent Communities

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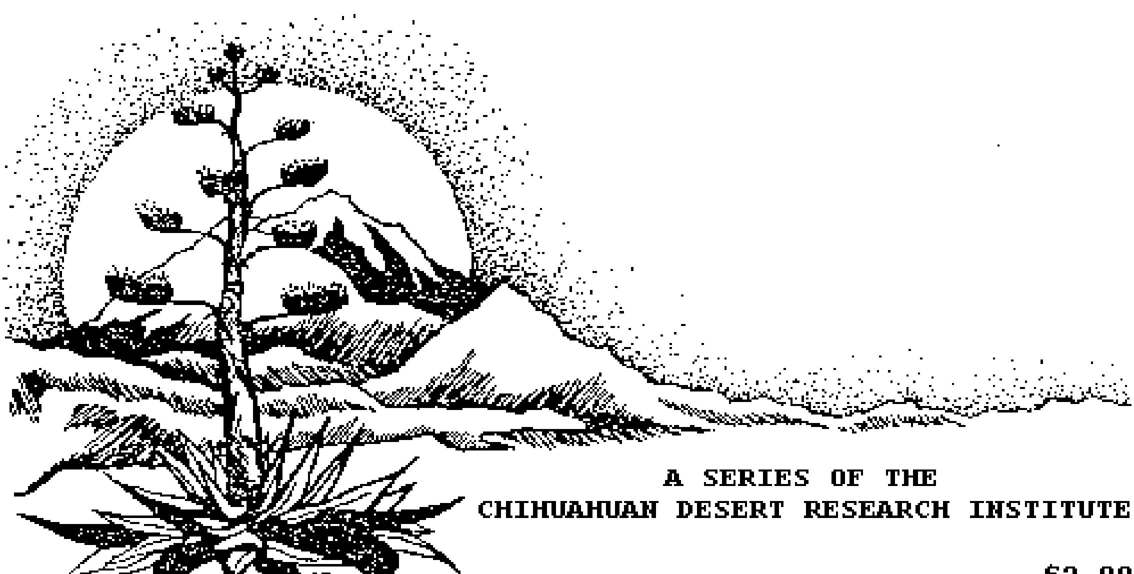

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PRELIMINARY RESULTS OF BIOMASS PARTITIONING IN THREE CHIHUAHUAN DESERT RODENT COMMUNITIES

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ABSTRACT.--Rodent communities in sand dune, river valley, and low-elevation mountain habitats in the northern Chihuahuan Desert were studied during spring 1983 as part of a longer study to determine biomass partitioning. Fecal pellet analysis for the spring season revealed that herbivory was most common and supported 85.1, 95.7, and 92.1% of the rodent biomass in the dune, valley, and mountain sites, respectively. Granivory was greatest on the dune site at 17.4%. Insectivory was less than 1% on each site. Cluster and factor analyses, including both plant and rodent community parameters, showed that each site was distinct, but that the valley and mountain sites were more closely related than either was to the dune site.

The purpose of this study was to analyze the proportions of rodent biomass supported by herbivory, granivory, and insectivory in three Chihuahuan Desert communities. To my knowledge, a study emphasizing the biomass supported by different trophic levels has not been done, although in recent years much attention has been given to the coexistence of competing rodent species in relation, to resource allocation.

Several researchers, including O'Connel (1979), Wondolleck (1978) and Brown and Lieberman (1973) attributed the ability to coexist to differences in habitat selection. Smartt (1978) suggested that the subdivision of resources is accomplished by differences in morphology, microhabitat selection, and foraging behavior of the various species. Price (1976) concluded that different species exploit different seed densities. Other studies have reached similar conclusions.

In a study of the food requirements of four species of coexisting heteromyids in the Mojave Desert of Nevada, French et al. (1974) found no significant difference in the dietary composition between sexes, genera, or species. Apparently the rodents were either opportunistic or had similar preferences. Seeds and vegetable material were approximately equal contributors to the diet, and arthropods made up only a small portion, but the biomass supported by these foods was not calculated.

French et al. (1976) studied rodent biomass in a desert grassland in southern New Mexico composed of heteromyid, sciurid, and cricetid rodents.

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The diet, in terms of herbage, seeds, and arthropods, of each species was determined by fecal pellet analysis. The pellets were air–dried, ground, and permanently mounted on labeled slides. Four fields on each slide were analyzed at a power of 40x with a 100–square grid used to count the proportions of the different food groups.

Apparently the manner in which desert rodent communities divide the available resources varies with the location. Here I attempt to show the trophic distribution of the rodent biomass in three Chihuahuan Desert communities during the spring.

METHODS

Field studies were conducted at three sites in the northern Chihuahuan Desert of south–central New Mexico and western Trans–Pecos Texas. One site is located 4.2 km N Santa Teresa Golf Course, Santa Teresa, Dona Ana Co., New Mexico (T28S, R2E, SE1/4, SE1/4 Sec 24). This sandy dune area has an elevation 1245 m and is characterized chiefly by honey mesquite (*Prosopis glandulosa*), four–winged saltbush (*Atriplex canescens*), broom pea (*Dalea scoparia*), creosote bush (*Larrea tridentata*), and soaptree yucca (*Yucca elata*).

The second or Rio Grande Valley site is situated 1.3 km W junction Farm Road 257 and Bosque Road, Canutillo, El Paso Co., Texas, at 1148 m. Parts of the area are seasonally marshy and are dominated by salt grass (*Distichlis spicata*), salt cedar (*Tamarix* sp.), muhly (*Muhlenbergia* sp.), bluestem (*Andropogon* sp.), screwbean mesquite (*Prosopis pubescens*), and seepwillow (*Baccharis glutinosa*).

The third study area is located on the western slopes of the arid Franklin Mountains, 31.2 km E junction Interstate-lO and Trans Mountain Road (East Loop 375), El Paso Co., Texas, at an elevation of 1521 m. The dominant flora consists of lechguilla (*Agave lechequilla*), sotol (*Dasylirion wheeleri*), black grama (*Bouteloua eriopoda*), Spanish dagger (*Yucca torreyi*), prickly pear (*Opuntia* spp.), and creosote bush.

Each of the three sites was trapped for two night at 6- to 8-week intervals during spring (April through June) 1983. Grids consisted of 81 (9 by 9) Sherman live–traps placed at 20-m intervals on a 3.24-ha plot. The traps were baited with rolled oats, and cotton was added for insulation during cold weather. Each morning the traps were checked and the location, weight, sex, and species of each capture was recorded. Animals captured the first morning were marked by clipping fur from the top of the head, and recapture data were collected on the following morning. Fecal pellets were collected from each trap.

Species density was estimated for each trap session using the Modified Lincoln–Peterson Index (Pielou, 1974), and converted to density per hectare. Biomass was calculated by multiplying the average weight of the individuals by the estimated population density to give estimates of the biomasses for each species and the entire population. Species diversity for each site was calculated using Simpson’s Index of Diversity (Poole, 1974).

The diet, in terms of herbage, seeds, and arthropods, of each species was determined by fecal pellet analysis. The pellets were air–dried, ground, and permanently mounted on labeled slides. Four fields on each slide were analyzed at a power of 40x with a 100–square grid used to count the proportions of the different food groups.

Vegetational data at each site were obtained using the line-intercept method. Two 100-m transects along the fifth row and fifth column of the grid were used to determine diversity, total coverage, and the relative dominance and relative frequency of annuals and perennial forbs, grasses, succulents, shrubs, and trees.

Seasons were divided according to a climatogram based on data from the U.S. Dept. of Commerce (1981). The spring season, which is typically hot and dry, was designated as April through June. Precipitation based on elevation was extrapolated using data from Tuan et al. (1973).

Cluster and factor analyses, using the NT-SYS computer package (Rohlf and Kishpaugh, 1972), were used to determine relationships and the most important distinguishing parameters measured. Each trapping session at each site was considered an operational taxonomic unit (OTU). Community parameters included in the cluster and factor analyses were rodent diversity and biomass; percentage of herbivory, granivory, and insectivory; precipitation; plant diversity and coverage; the relative frequency and dominance of annuals, perennial forbs, grasses, succulents, shrubs, and trees.

RESULTS AND DISCUSSION

On the dune site, Dipodomys merriami (6.6 animals/ha; average weight = 43.3 g), D. ordi (4.5 animals/ha; 49.1 g), Perognathus penicillatus (2.8 animals/ha; 16.0 g), Neotoma albigula (2.0 animals/ha; 153.9 g), Spermophilus spilosoma (0.9 animals/ha; 109.1 g), and Onychomys leucogaster (0.6 animals/ha; 24.6 g) were captured. Reithrodontomys megalotis (3.2 animals/ha; 10.1 g) and D. merriami (0.2 animals/ha; 42.0 g) were found at the valley site, and the mountain site had N. albigula (1.3 animals/ha; 173.1 g), Perognathus intermedius (0.8 animals/ha; 15.3 g), and Peromyscus eremicus (0.5 animals/ha; 20.0 g).

All three sites were fairly similar in plant diversity and coverage (Table 1), but dominants differed with shrubs, grasses, and succulents being dominant at the dune, valley, and mountain sites, respectively. The dune and mountain sites had similar rodent diversities and the valley site had a much lower diversity. Rodent biomass was 3.5 times as great at the dune site as at the mountain site and 25 times greater than at the valley site. The dune site also had a larger percentage (17.4%) of granivory than the mountain (6.8%) or valley (3.7%) sites. Herbivory was 81.5, 92.1, and 95.7% at the dune, mountain, and valley site, respectively. Insectivory was less than 1% on each of the sites.

Although Dipodomys merriami was the most abundant species at the dune site, Neotoma albigula was the major biomass contributor (308 g/ha). D. merriami and D. ordi also were significant contributors, with averages of 286 g/ha and 219 g/ha, respective1y. Other species were only minor contributors to the high total community biomass (963 g/ha) at the dune site. N. albigula (226 g/ha) and Reithrodontomys megalotis (32 g/ha) were the only significant biomass contributors at the mountain and valley sites, respectively.

TABLE I. Plant and rodent community parameters of three Chihuahuan Desert communities in spring, 1984.

Parameters	Dunes	Valley	Mountain
Rodent diversity	0.77	0.17	0.67
Rodent biomass (g/ha)	963.00	38.00	249.00
Granivory (7.)	17.40	3.70	6.80
Herbivory (%)	81.50	95.70	92.10
Insectivory (%)	0.90	0.60	0.30
Plant diversity	0.69	0.71	0.79
Plant coverage (%)	35.50	34.70	45.30
Dominant plants	Shrubs	Grasses	Succulents

French et al. (1976) suggested that a large rodent biomass in an area could be due to the high energy content of seeds and arthropods. Arthropods were not an important food source during this study, but seeds were. Larrea tridentata and Prosopis glandulosa are both common at the dune site, and the latter has large, energy—rich seed pods. Granivory was greatest at the dune site (17.4%) and D. ordi, a relatively large biomass contributor, consumed 41.6% seeds during the spring season. Thus, seed consumption may have allowed more rodents to live at the dune site. The mountain site, although rich in plant diversity and coverage, supported relatively little biomass compared to the dune site. The ample plant community at this site may have supported less total rodent biomass because granivory was not common (7.9%) and arthropods were not utilized. Human intervention and vegetation type at the valley site may have inhibited rodent populations. Roads and trails through the site were traveled by off-the-road vehicles and dumping was common. Tamarix sp. was the most abundant tree and the second most important plant group. No understory plant growth was evident beneath the Tamarix. Salts were evident on the ground surface at irregular intervals throughout the site.

Rodent biomass was 963 g/ha, 249 g/ha, and 38 g/ha at the dune, mountain, and valley sites, respectively (Table 1). On the average, 695 g/ha were supported by herbaceous consumption, 263 g/ha by seed consumption, and

8 g/ha by arthropod consumption at the dune site. Proportionally more bio— mass was supported by herbivory (228 g/ha as compared to 20 g/ha maintained by granivory) at the mountain site. At the valley site, 43 g/ha and 2 g/ha were supported by herbivory and granivory, respectively. One reason such large amounts of biomass were supported by herbaceous material was that the diet of the largest biomass contributor at the dune and mountain sites, N. albigula, consisted of about 95% herbage at each site.

The percentage of herbivory was greater than expected at each site. French et al. (1974, 1976) found approximately 40 to 50% herbaceous consumption in their studies, whereas herbivory ranged from 85 to 96% in this study. One possible reason for the greater herbivory is that green vegetation often is necessary to initiate reproduction (Negus and Pinter, 1966); hence, the animals may have had a high intake of herbaceous material during the spring.

Trapping sessions at all sites were compared and expressed in a phenogram based on a distance matrix from the cluster analysis which contained both plant and rodent community parameters. Each distance for the matrix was computed as the square root of the average squared difference between the variables (Sokal and Sneath, 1963). The analysis revealed that trapping sessions within a site were more similar to each other than to any other site (Fig. 1). The valley and mountain sites were more closely related to each other than to the dune site. Unique characteristics at each site caused trapping sessions within, rather than between, sites to group. The valley site was unique because of the depauperate rodent community and because it was the only site containing trees. The dunes could be distinguished by the relatively rich rodent community and as the only site containing many shrub. Granivory at the dune site increased from 8.5% in April to 26.2% in June, and this may have caused the relatively large separation between the two trapping sessions. The mountain site had the richest plant community and was the only site with many succulents.

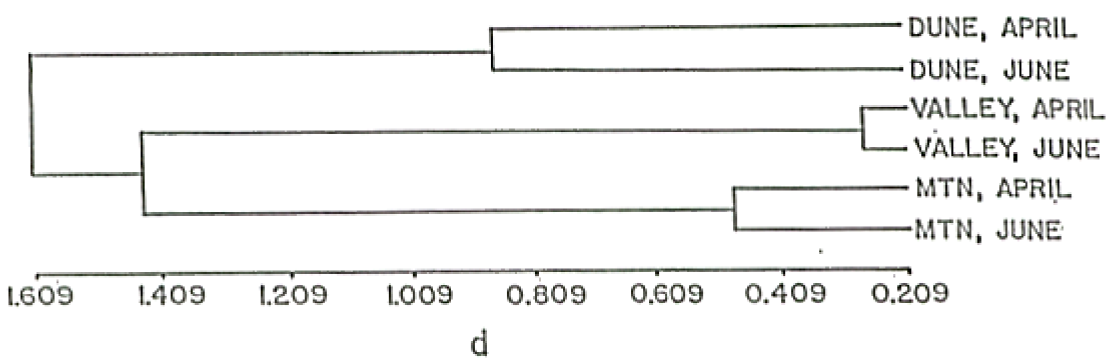

FIGURE 1. Phenogram based on cluster analysis of community parameters in three Chihuahuan Desert communities in spring, 1984. D = distance coefficient (Sokal and Sneath, 1963).

 The factor analysis, based on the same rodent and plant community parameters, revealed the most important distinguishing parameters. The prominent parameters in factor I were plant diversity, dominance of annuals and forbs, and frequency of forbs. Those in factor II were dominance and frequency of trees, and the only important parameters in factor III was the proportion of insectivory. These three factors accounted for 97.6% of the total variance.

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