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STUDY ON THE DIET AND FEEDING PREFERENCES OF *Calomys venustus* (RODENTIA, MURIDAE)

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ABSTRACT: The aim of this work was to determine the diet and feeding preferences of *Calomys venustus*. Relative food availability was determined through seasonal vegetation censuses and the species present were recorded. Microhistological analysis of the stomach contents was used for the determination of the seasonal diet. A cafeteria test was used to study laboratory feeding preferences. It was determined that *C. venustus* is omnivorous, showing a tendency to folivory in spring and autumn and to granivory in summer. Furthermore, significant differences between the relative composition of leaves, seeds and arthropods in each season were observed. *C. venustus* did not consume those leaves that were abundant in the habitat, or they consumed them in low proportions and showed a high preference for seed consumption under conditions of equal food availability.

RESUMEN: Estudio de la dieta y preferencias alimentarias de *Calomys venustus* (Rodentia, Muridae). El objetivo de este estudio fue determinar la dieta y preferencias alimentarias de *Calomys venustus*. La disponibilidad alimentaria relativa, se determinó a través de censos estacionales de vegetación, registrándose la cobertura de las especies presentes. La dieta se determinó estacionalmente por el método microhistológico sobre contenido estomacal, y para el estudio de preferencias alimentarias en laboratorio se utilizó el test de cafetería. *C. venusutus* tuvo un comportamiento alimentario omnívoro, tendiendo hacia la folivoría en primavera y otoño y hacia la granivoría en verano. Además, hubo diferencias significativas entre la composición relativa de hojas, semillas y artrópodos en cada estación. *C. venustus* no consumió aquellas hojas que fueron abundantes en el hábitat, o sólo las consumió en bajas proporciones, y presentó una alta preferencia por semillas en el experimento de consumo bajo condiciones de igual disponibilidad alimentaria.

Key words: rodents, *Calomys venustus*, diet, feeding preferences.

Palabras clave: roedores, *Calomys venustus*, dieta, preferencias alimentarias.

INTRODUCTION

Studies on the diet of small mammals are of fundamental importance to understanding energy budgets of species (Butet, 1985a). They have been conducted to explain demographic aspects (Hubert et al., 1981; Butet, 1985b, Anderson and Jonasson, 1986, Montenegro-Díaz et al., 1991) as well as to establish the relationships on which the communities of small-mammals structure themselves (Pizzimenti and De Salle, 1980; Meserve, 1981a and 1981b). Among the rodent communities of the province of Córdoba, Argentina, *Calomys venustus* appears to be a numerically important species (Kravetz and Polop, 1983). Even though some studies leading to the taxonomic definition of *C. venustus* (Forcone et al., 1980; Reig, 1984; Vitullo et al, 1990), its spatial distribution (Polop et al., 1985), its demography (Polop, 1996), and its use of the niche temporal dimension (Priotto and Polop,

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1997), have been carried out during the last 20 years, aspects related to feeding in this species have not been studied previously. Thus, the purpose of this work was to determine the diet and feeding preferences of *C. venustus.* The results of this study should help us understand some aspects of populations dynamics of the species and allow us to compare and establish some trophic relationships with sympatric species whose feeding habits have already been characterized. (Martínez et al., 1990; Bilenca et al., 1992; Dellafiore and Polop, 1994).

MATERIAL AND METHODS

Samples for this study were collected on a railway bank where *C. venustus* exists at high population numbers (Kravetz and Polop, 1983; Polop, 1996). This site is in the rural area of the district of Chucul (33º S lat; 64º10'41" W long), province of Córdoba, Argentina. Phytogeographycally, the area is placed within the borders of Espinal (Cabrera, 1953) but its characteristic woody vegetation (*Prosopis alba, P. nigra, Celtis tala*) is only observed in small relicts as a consequence of intense human activity.

On the railway bank, vegetation availability was recorded seasonally by taking into account both the species present and the relative percentage of cover according to Braun Blanquet's (1979) square method. Tissue of identified plants collected on the study area was prepared and mounted on microscope slides using the diaphanization technique (Strittmater, 1973). Seeds patterns were framed by using Jeffrey's technique (Johansen, 1940).

Animals were trapped monthly using two snap-traps at 5-meter intervals arranged in two lines of 150 m each. Forty-eight animals were captured including 8 in autumn, 27 in winter, 8 in spring and 5 in summer.

Stomachs were kept in 95º alcohol and processed through the Strittmater's technique (1973) as modified by Scaglia et al. (1981). Safranine was used for coloring and a modified gelatine-glycerine medium was used as an assembly medium. Stomach contents were identified by comparison with reference tissues patterns. To quantify the diet sampling, two slides per animal were analyzed. Twenty random microscopic fields per slide under 100 X magnification were considered (Martínez et al., 1990). From those observations, only the frequencies with recognizable fragments were considered. Neither blank fields nor unidentified fragments were considered. Relative percentage frequency of each feeding item was calculated, and then converted into relative density (Fracker and Brischle's, 1944). Seasonal percentage of total composition was calculated for leaves, seeds and arthropods material eaten. The Kruskal-Wallis nonparametric one-way analysis of variance (ANOVA) was used for seasonal comparisons of diet composition. A multiple comparisons procedure (Holander and Wolfe, 1972) was performed following significant results of Kruskal-Wallis test to identify variant seasons. Friedman nonparametric two-way analysis of variance (ANOVA) was used for leaves, seeds and arthropods comparison within the season.

To study the feeding preferences in the laboratory, 27 feeding items were collected (**Table 3**); these items included seeds and leaves of some species consumed by *C. venustus,* as well as other species that were present in the area under study. The cafeteria test (Drodz, 1975) was used in this experiment by using a cage with eight feeders, similar to the one described by Murúa et al. (1980) and Murúa and González (1981). To establish a preference ranking, each feeder was provided 3 g of each item. This weight was equivalent to half the daily consumption per animal. Groups of three and four items were combined at random and placed in each feeder. Ten animals were captured in the field and maintained without food while water was provided ad-libitum for 24 hours before the experiment. Each animal was placed in the feeding cage for 24 hours then sacrificed for analysis of stomach contents. The analysis of feeding preferences was done through a relative preference index (Krueger, 1972).

RESULTS

The annual diet of *C. venustus* consisted of 24 feeding items: 16 corresponded to leaves, 7 to seeds, and 1 to arthropods (**Table 1**). Food items found most frequently for all months combined, in order of decreasing importance were leaves (50,9%), seeds (42,9%), and arthropods (6,2%). Results of the Kruskal-Wallis analysis across the four seasons showed seasonal differences in consumption of leaves ($p= 0.0021$) and seeds ($p= 0.0002$). Using the multiple comparison procedure, significant differences of leaves and seeds consumption were found between the summer and the winter, and between the summer and the spring. Thus, it was necessary to consider each season separately when analyzing dietary composition. Significant differences between the relative

Table 1. Seasonal diet of *C. venustus* on the railway bank expressed as relative percentages.

Seasons	**Autumn**	**Winter**	**Spring**	**Summer**
Number of stomachs	8	27	8	5
Seeds				
Chenopodium sp.	11.94	1.32	-	7.27
Melilotus sp.	9.42	0.82	-	-
Eleusine sp.	6.07	-	-	-
Descurainia sp.	-	-	4.84	-
Bromus unioloides	-	-	-	12.78
Sorghum halepense	-	0.57	-	-
Gramineae	21.70	14.43	-	73.67
Unidentified	0.84	4.78	-	-
Leaves				
Clematis montevidensis	8.50	22.27	18.26	0.50
Parietaria debilis	-	9.47	-	-
Descurainia argentina	-	3.24	0.24	-
Oxalis cordobensis	-	7.00	18.90	-
Melilotus albus	-	4.35	1.50	-
Salpichroa origanifolia	0.84	0.41	0.74	-
Lippia turbinata	-	-	5.36	-
Convolvulus sp.	9.11	-	-	-
Conyza sp.	-	4.09	5.10	-
Gomphrena sp.	-	-	4.83	-
Diplotaxis sp.	5.17	-	-	-
Cruciferae	13.55	15.20	5.89	-
Solanaceae	-	1.56	1.00	-
Gramineae	2.26	1.48	2.00	0.25
Unidentified	0.56	8.03	22.74	0.25
Arthropods	10.04	0.98	8.60	5.28

composition of leaves, seeds and arthropods in each season were observed (winter: $p<0.0001$; spring: $p<0.003$, and summer: $p<0.01$). Leaves were the most consumed food in winter followed by seeds and arthropods; in spring the rank order was leaves, arthropods, and seeds; in summer seeds consumption exceeded that of arthropods, which exceeded leaves (**Fig. 1**).

Consumption of leaves during autumn, winter, and spring (**Table 1**) was compared in relation to relative availability of leaves (**Table 2**). During autumn and winter gramineous species (*Setaria geniculata, Stipa sp.* and *Cynodon sp.*) provided the highest cover values, whereas in spring *Conyza bonariensis* was the dominant species. Cruciferae and *Clematis montevidensis* were the most consumed leaves during autumn and winter whit *Oxalis cordobensis* being most consumed during spring. All of these species were found in at least 50% of the stomach contents studied during the corresponding season.

Results of the preferences studies showed that *C. venustus* consumed only 12 of the 27 items offered (**Table 3**). Seeds from six species and leaves from another six species were selected. However, relative preference index values shown in **Table 3** indicate that *C. venustus* had a high preference for seed consumption with *Chenopodium album* being most preferred.

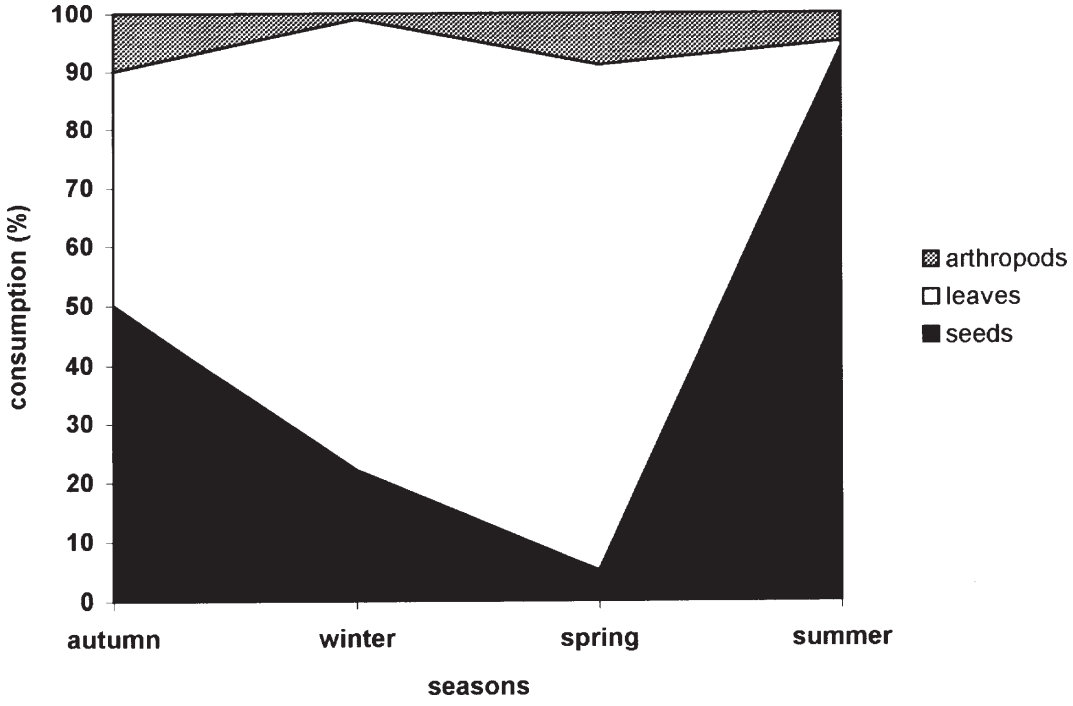

Fig. 1. Seasonal variation of diet of *C. venustus* on the railway bank at Chucul, Córdoba.

Table 2. Relative percentual compositionn of the vegetal species present on the railway bank at Chucul, Córdoba.

Species	Autumn	Winter	Spring	Summer
Diplotaxis tenuifolia	6.80	-	10.80	6.80
Sorghum halepense	12.20	-	5.30	3.60
Salsola kali	3.40	-	-	-
Oxalis cordobensis	-	5.90	-	-
Clematis montevidensis	4.70	-	9.70	-
Sphaeralcea bonariensis	7.70	-	-	
Bowlesia incana	-	3.10	-	-
Salpichroa origanifolia	-	-	8.00	-
Talinum paniculatum	-	-	-	6.10
Conyza bonariensis	-	-	16.00	30.30
Cynodon sp.	19.60	13.00	10.10	-
Setaria geniculata	16.70	27.90	3.40	8.10
Chloris sp.	9.20	-	-	-
Schyzachirium sp.	-	9.70	-	-
Stipa sp.	9.50	17.70	3.30	5.30
Setaria leiantha	-	-	-	10.10
Cenchrus pauciflorus	-	-	-	3.70
Solanaceae	-	-	6.41	-

Table 3. Items used in the *C. venustus* feeding preference in the laboratory and their relative preference index.

Feeding items offered	Consumption (%)	Relative preference index
Seeds		
Chenopodium album	51.13	296.92
Amaranthus sp.	13.28	32.74
Melilotus albus	12.92	31.14
Sorghum sp.	10.04	19.61
Lycium australe	4.12	3.60
Salsola kali	3.04	1.99
Setaria leiantha	-	-
Conium maculatum	-	-
Sorghum halepense	-	-
Leaves		
Clematis montevidensis	2.08	0.95
Foeniculum vulgare	1.74	0.66
Salpichroa origanifolia	0.57	0.07
Diplotaxis tenuifolia	0.49	0.05
Relbunium richardianum	0.41	0.04
Hirschfeldia incana	0.16	0.005
Bowlesia incana	-	-
Schyzachirium sp.	-	-
Lippia turbinata	-	-
Sphaeralcea bonariensis	-	-
Melilotus albus	-	-
Sorghum halepense	-	-
Cenchrus pauciflorus	-	-
Parietaria debilis	-	-
Chenopodium albus	-	-
Gamochaeta sp	-	-
Veronica dydima	-	-
Lycium australe	-	-

DISCUSSION

Although the annual diet of *C. venustus* is best characterized as omnivory, differences in the relative proportions of the seasonal consumption of leaves, seeds, and arthropods indicate a tendency toward folivory during winter and spring and granivory during summer (**Table 1** and **Fig. 1**). These results agree with those of Landry (1970) who characterized small mammals as omnivorous, and also with the studies of Myers and Vaughan (1964), Hubert et al. (1981) and Butet (1985a) that also found seasonal differences on rodent diets. Plant material was more important than reported in most earlier studies in *Calomys* from Argentina. Bilenca et al. (1992) in *C. laucha* and Dellafiore and Polop (1994) in *C. musculinus* reported that leaves accounted for less than 10% of the rodent diet. Nevertheless, differences between our study and these previous studies could be attributed to specific differences or, at least in part, to varying resources and resource level in the different habitats in which the studies were conducted.

The relationship between consumption and availability of leaves was not clear for *C. venustus*. When comparing the data of relative leaves consumption (**Table 1**) and relative food availability (**Table 2**) no relationship was observed between the most consumed leaves and those most available. This means

that *C. venustus* consumed leaves of species having relatively low availability in the habitat or species not recorded on the covering census. It also demonstrates that *C. venustus* did not consume those leaves that were abundant in the habitat, or they consumed them in low proportions. Thus, according to Norbury and Sanson (1992), for whom the diet selection requires a comparison of the relative abundance of food items available with the relative abundance of food items utilized, *C. venustus* would be classified as highly selective. In this case, selectivity varied seasonally and a high relative consumption of Cruciferace sp. leaves and *C. montevidensis* was observed during autumn and winter, whereas *O. cordobensis* was most consumed in spring.

Seasonal data in this study showed that leaves were replaced by seeds as the principal item consumed in the summer. It is not known whether high seed consumption is performed due to the high availability of the resource in the field or, as it is suggested by Butet (1985a) for other rodents, there would be energetic demands related to the reproductive activity during these seasons that lead to increased seed consumption. However, a preference for seeds was recorded in laboratory preferences studies where seeds and leaves were offered in equal proportions to non-reproductive animals. Although this observation might not be conclusive enough to disregard energetic demands related to reproductive activity, it demonstrates that accessibility and availability play a very important interactive role on the relative proportions of food items consumed. *C. venustus* did not consume seeds in an aleatory way, but instead it showed a remarkable preference for seeds of *Chenopodium album* which supports the selectivity characterization of its feeding habits.

Food availability does not fully explain the variations observed in the diet of *C. venustus*. In this sense, trophic interactions within the community should be considered. It has been observed that those species sympatric with *C. venustus* consume during winter some items that are consumed by *C.venustus* only during summer and autum (Martínez et al., 1990; Dellafiore and Polop, 1994). This might suggest that feeding resources are shared and might be related to the mechanism of coexistence of the species within the community. However, further studies should be carried out to demonstrate these relationships.

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