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Botanical composition of cattle and vizcacha diets in central Argentina

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Abstract

Cattle (*Bos taurus*) and vizcacha (*Lagostomus maximus*) diets were examined monthly in the semiarid Caldenal in central Argentina. Cow-calf operations are the most important economic activities within the region. In spite of a widespread distribution of the vizcacha in Argentina, comparative studies of the diet of cattle and vizcacha are scarce. The objective of this work was to analyze the botanical composition, seasonal trends, and possible dietary overlap between cattle and vizcacha. Diets were determined by microscopic analysis of cattle and vizcacha feces collected from November 1994 through December 1995 in a shrubland community of the southern Caldenal. Grasses were the bulk of the diet for both herbivores. *Piptochaetium napostaense* (Speg.) Hack. was the most abundant grass in vizcacha (53%) and cattle (40%) diets. *Prosopis Caldenia* Burk. pods partially (34%) replaced this grass in cattle diets during late summer and fall. Consumption of *P. napostaense* was generally higher (13%) in vizcachas than in cattle, especially during the dry period of the study (21%). During the drier months, cattle consumed more of the less preferred grasses (48%). Forbs were poorly represented in the diets perhaps because of scarce rains and low availability. Classification and ordination techniques revealed seasonal trends and overlapping diets. A greater overlap (75%) was found during the wet period due to simultaneous consumption of *P. napostaense* by both herbivores. Trends in diet diversity were similar with indices generally higher for cattle than for vizcachas, especially during the dry period.

Key Words: free ranging cattle, diet composition, semiarid area, microhistology.

Resumen

Las dietas de vacunos (*Bos taurus*) y vizcachas (*Lagostomus maximus*) fueron examinadas mensualmente en el Caldenal semiárido del centro de Argentina. La ganadería es la principal actividad en la región. A pesar que la vizcacha se encuentra ampliamente distribuida en la Argentina, existen pocos estudios comparativos de la dieta de vacunos y vizcachas. El objetivo de este trabajo fue analizar la composición botánica, tendencias estacionales y posible superposición dietaria entre vacunos y vizcachas. Las dietas se determinaron por análisis microhistológico de heces de vacunos y vizcachas recogidas desde noviembre de 1994 hasta diciembre de 1995 en una comunidad arbustiva del sur del Caldenal. Las gramíneas fueron el principal componente de la dieta de ambos herbívoros. *Piptochaetium napostaense* (Speg.) Hack fue la gramínea más abundante en las dietas de vizcachas (53 %) y vacunos (40 %). Los frutos de *Prosopis caldenia* Burk. reemplazaron parcialmente (34%) a esta gramínea en la dieta de vacunos durante el verano tardío y otoño. Las vizcachas generalmente consumieron más *Piptochaetium napostaense* (13 %) que los vacunos, especialmente durante el período seco del estudio (21%). Durante los meses más secos los vacunos consumieron gramíneas menos preferidas (48 %). Las dicotiledóneas herbáceas fueron escasas en la dieta de ambos herbívoros, quizás por la baja disponibilidad debida a las escasas lluvias. Las técnicas de clasificación y ordenamiento revelaron las tendencias estacionales y la superposición de dietas. Una gran superposición de dietas (75%) se encontró durante el período húmedo del estudio debido a que ambos herbívoros consumieron principalmente *Piptochaetium napostaense*. Las tendencias en la diversidad dietaria fueron similares con índices generalmente más altos para el ganado que para las vizcachas, especialmente durante el período seco.

Wild and domestic herbivores directly influence plant communities with their selective grazing. Floristic changes are highly variable and depend on many factors such as preferences of herbivores, the relative abundance and availability of forages, season of the year, and temporal and spatial overlap when more than one species grazes the same area.

The Southern Espinal (Fernández et al. 1989) or District of the Caldén (Cabrera 1976), commonly referred to as the Caldenal, is a temperate semiarid region in central Argentina characterized by the presence of *Prosopis caldenia* Burk. The landscape in the southern Caldenal is dominated by shrub-

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lands with a very rich grass layer. Poor range management is common throughout the region, and soil erosion and plant community deterioration are incipient but generalized (Fernández et al. 1989, Bóo and Peláez 1991).

The plains vizcacha (*Lagostomus maximus*, Chinchillidae) is a native rodent of Paraguay, Bolivia, and Argentina that inhabits grasslands and scrub (Branch and Sosa 1994). It is abundant in the Southern Caldenal and has been considered a plague in Argentina since 1907 because of its burrowing and foraging habits. Adult females (2.9–3.3 kg), adult males (4.5–5.6 kg) and young individuals live in groups of 9 to 14 individuals per colony (Branch et al. 1993). Daily intake by adults is 1.7–4.7% of body weight (Jackson 1985), and areas around the vizcacha colonies are characterized by bare soil with scarce, low-growing forbs and grasses.

Studies of the diet of cattle and vizcacha in semiarid Argentina are very scarce. Giulietti and Jackson (1986) studied food habits of vizcacha and cattle and found little similarity in their diets. They concluded that potential competition was low between both herbivores, but knowledge of the botanical composition of vizcacha and cattle diets where both herbivores graze a common area is much needed. The objective of this work was to analyze the botanical composition, seasonal variation, and dietary overlap of cattle and vizcacha diets in a plant community typical of the southern Caldenal.

Study Area and Methods

Cano et al. (1980) have described the vegetation of La Pampa where most of the Caldenal occurs. The study was conducted in a 600 ha pasture located in southeast La Pampa (Argentina) at 38°45'S, 63°45'W with mean elevation of 80 m. Mean annual rainfall is 448 mm with about 60% occurring in spring and fall. Mean annual potential evapotranspiration is 800 mm (Peláez 1986), and the mean annual temperature is 15.3°C with a minimum mean of 7°C (July) and a maximum mean of 23.6°C (January). Recorded maximum and minimum temperatures are 42.5°C and –12.8°C respectively. Soil at the study site is a Calciustoll with a petrocalcic horizon at an average depth of 0.60 m (Fernández et al. 1989).

The research area supports a plant community defined as "Unidad C" by Bóo and Peláez (1991). This community is characterized by a woody species cover of 50–70 % with *Prosopis caldenia* Burk., *P. flexuosa* D. C. and *Condalia microphylla* Cav. as the most abundant. The herbaceous cover is about 40–50% with *Piptochaetium napostaense* (Speg.) Hack. and *Stipa tenuis* Phil. as the major grasses. *Stipa speciosa* Trin. et Rupr. and *S. gynerioides* Phil. are frequent, and *S. clarazii* Phil., *Poa ligularis* Nees and *Pappophorum mucronulatum* Nees are scarce. *P. napostaense* and *S. tenuis* are good forage species that replace *Stipa clarazii* Phil and *Poa ligularis* Nees under moderate continuous grazing (Distel and Bóo 1995). Bare ground (30–40 %) is colonized during wet years by annual forbs, mostly *Medicago minima* (L.) Grufberg and *Erodium cicutarium* L'Herit. Annual above ground net primary production in this plant community for S. tenuis was 862 kg ha^{-1}, and 684 kg ha^{-1} for *P. napostaense* in a year with 532 mm of rainfall (Distel and Fernández 1986, Distel 1987).

Fifteen independent fecal samples from different mature cows were collected monthly from November 1994 to December 1995. These samples were analyzed following Bóo et al. (1991) to obtain 20% (P<0.05) precision in the estimation of the mean for species exceeding 6% of the total sample. On each sampling date, fresh fecal pellets from 10 vizcacha colonies were collected and analyzed in the same way. This sampling intensity gave a 20% (P<0.05) precision for species making up at least 4% of the sample (Bontti et al. 1995). Composition of cattle and vizcacha diets was determined by microscopic analysis of fecal samples (Sparks and Malechek 1968). Five slides were prepared from each sample and 40 microscope fields per slide were systematically viewed using 100X magnification. Fragments were identified by comparing fecal material with a reference collection that included most of the forages present in the area (Lindström 1994). Epidermal fragments were identified to species level except for *Ephedra* spp. and a few grasses and forbs. Differences between cattle and vizcacha diet components were analyzed using Student's t test (Ho: the relative composition of dietary components were equal in vizcacha and cattle feces; n = 10 for vizcacha and n = 15 for cattle).

Vegetation cover was visually estimated with the Braun-Blanquet (1979) abundance-cover scale in March 1995 (late summer), August 1995 (winter), and December 1995 (late spring), and we compared diet composition and forage abundance for those months. Cover estimation permits a rapid and non-destructive measure of food abundance, and estimates were made in and out of vizcacha colonies to detect possible differences in community composition. Plant taxa were grouped in 4 classes: woody species, forbs, preferred grasses and non-preferred grasses. This grouping was made because of the difficulty of identifying some taxa to species level especially during the winter when vegetative forms of grasses are similar. However, it was important to differentiate preferred and non-preferred grasses because diets may be correlated with forage availability. The woody species group included *Prosopis caldenia*, *Prosopis flexuosa*, *Condalia microphylla* and *Ephedra* spp. The forb group included *Erodium cicutarium* and *Medicago minima*. The preferred grasses included *Piptochaetium napostaense*, *Stipa tenuis*, *Pappophorum mucronulatum*, *Poa ligularis* and *Stipa clarazii*. The non-preferred grasses included *Stipa speciosa*, *Stipa gynerioides*, *Stipa trichotoma* and *Stipa tenuissima*. Student's t test was used to detect possible differences in botanical composition of the pasture in and out of vizcacha colonies (Ho: plant community composition was identical in and outside of vizcacha colonies; n = 10 on each site).

A matrix of the Bray and Curtis (1957) similarity index (BC_{jk}) between all possible pairs of average monthly diets was classified using complete linkage (Sneath and Sokal 1973, McInnis et al. 1990, Bóo et al. 1993). A possible distortion produced by the classification procedure was evaluated by the calculation of the cophenetic correlation coefficient (r_{xy}) following McInnis et al. (1990), and by ordination of the data matrix (DECORANA, Hill 1979).

Rainfall and temperature data were obtained locally with an automatic Zeeman station. Monthly diversity of cattle and vizcacha diets (N_2) were calculated as the reciprocal of Simpson's index (Hill 1973). Regression analyses using monthly rainfall and mean temperatures on monthly diet diversity for both herbivores were performed.

Results

Cattle diets.

During the study, rains were scarce (388 mm) and erratic, with a relatively wet period during the first 6 months followed by a pronounced drought and rain near the end of the study in November 1995 (Fig.1). Grasses dominated the diets of both herbivores throughout the study. However, diets varied among months and between herbivores within the same month.

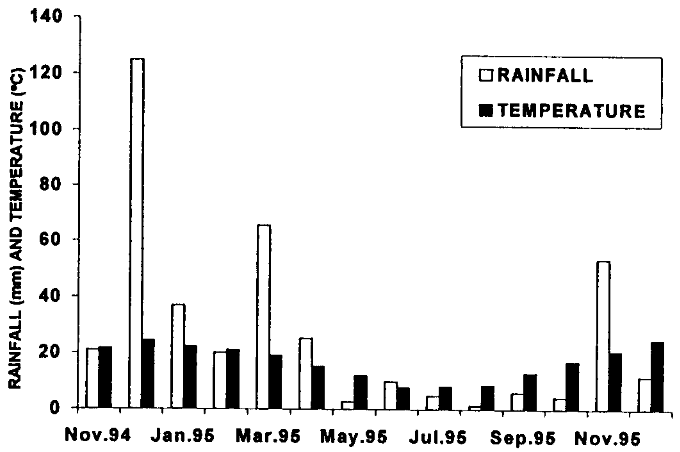

Fig. 1. Monthly rainfall and monthly averages of daily temperatures from November 1994 through December 1995 in a 600 ha. pasture in southeast La Pampa, Argentina.

Cattle relied heavily on *Piptochaetium napostaense*, one of the dominant perennial cool-season grasses on the study site, throughout the study (Fig. 2A). Monthly diet composition of this grass exceeded 65% during the first 3 months of the study. From February to July diet composition still exceeded 35%, but *P. napostaense* was partially replaced by *Prosopis caldenia* pods (Fig. 2G). For the rest of the study, *P. napostaense* made up less than 15% of the cattle diets, and it was basically replaced by 3 other grasses: *Stipa speciosa* (Fig. 2C), *S. gynerioides* (Fig. 2E) and *S. trichotoma* (Fig. 2D). These 3 grasses have been given low palatability rankings for cattle by Cano (1988), Bóo and Peláez (1991), and Distel and Bóo (1995). *Stipa tenuis* (Fig. 2B), a high yielding cool season grass (Distel and Fernández 1986), was present in low proportions in the diets with a maximum of 16% in July 1995. Forbs were scarce in cattle diets, and they reached a maximum of 7% in September. *Medicago minima* was the only forb in cattle diets in appreciable amounts (Fig. 2F). *Prosopis caldenia* pods consistently appeared in cattle diets (Fig. 2G). They were abundant from February through May (>30%) with a maximum of 40.5% in February. Other woody plants such as *Condalia microphylla* (Fig. 2H) and *Prosopis flexuosa* were very scarce in the cattle diets.

Vizcacha diets.

Grasses made up the majority of vizcacha diets throughout the study. *P. napostaense* contributed more than 64% of the vizcacha diets from November 1994 through May 1995. From June to August vizcacha consumption of *P. napostaense* declined and vizcacha consumed more *S. speciosa*, *C. microphylla* and *M. minima*. Vizcacha consumption of *S. tenuis* showed the lowest seasonal variation of all dietary components, and it was second to *P. napostaense* as the most important component of the vizcacha's diet. Vizcacha consumption of *S. tenuis* peaked at 26% in November 1995 but still ranked below *P. napostaense*. Other grasses such as *Stipa tenuissima* contributed less than 1% to vizcacha diets.

Forbs made a maximum contribution (16%) to vizcacha diets in August 1995. *M. minima* was the most abundant forb in their diet. Because *M. minima* was not detected growing in the field during our study, we assumed the fruit fragments detected in their feces were produced in a previous growing season.

Woody plants were generally scarce in vizcacha diets. The most prominent was *C. microphylla* (23% in August 1995), and it was detected from June to December 1995. *P. caldenia* was not detected in vizcacha diets, and *P. flexuosa* contributed only trace amounts.

Table 1. Mean (n = 10) botanical composition ($\overline{X} \pm SE$) of the pasture by selected plant groups and mean (n = 10 for vizcacha; n = 15 for cattle) botanical composition ($\overline{X} \pm SE$) of cattle and vizcacha diet in March, August and December 1995 in Southeast La Pampa, Argentina.

Month	Pasture and diet composition				
	Preferred grasses	Non preferred grasses	Forbs	Woody species	Bare soil
	(%)				
March					
Pasture composition	32.6 ± 3.0	19.9 ± 3.5	2.9 ± 0.7	27.6 ± 3.8	15.7 ± 2.6
Cattle diet	64.1 ± 3.3	0.7 ± 0.2	0.7 ± 0.2	33.9 ± 3.2	—
Vizcacha diet	91.6 ± 1.7	0.7 ± 0.4	5.0 ± 1.5	0.3 ± 0.2	—
August					—
Pasture composition	27.4 ± 2.6	25.3 ± 2.9	1.1 ± 0.3	34.7 ± 5.5	16.5 ± 2.7
Cattle diet	20.4 ± 2.1	54.9 ± 1.7	6.5 ± 0.9	8.3 ± 1.1	—
Vizcacha diet	30.9 ± 2.7	23.4 ± 2.1	9.9 ± 2.6	24.1 ± 2.3	—
December					—
Pasture composition	24.0 ± 2.5	22.9 ± 2.3	1.1 ± 0.2	29.2 ± 3.3	17.7 ± 1.6
Cattle diet	19.6 ± 3.5	56.8 ± 2.9	4.0 ± 0.7	1.9 ± 0.4	—
Vizcacha diet	62.3 ± 2.7	13.4 ± 1.2	6.3 ± 1.1	2.2 ± 0.5	—

Comparisons of cattle and vizcacha diets.

There were marked similarities and differences among the principal dietary components of both herbivores (Fig. 2). In December 1994 cattle consumed more ($p<0.05$) *P. napostaense* than vizcachas. Equal proportions of *P. napostaense* occurred in the diets of both species in November 1994, and January and August 1995. For the rest of the study, vizcachas consistently consumed more *P. napostaense* than cattle. Vizcachas consumed more ($p<0.05$) *S.*

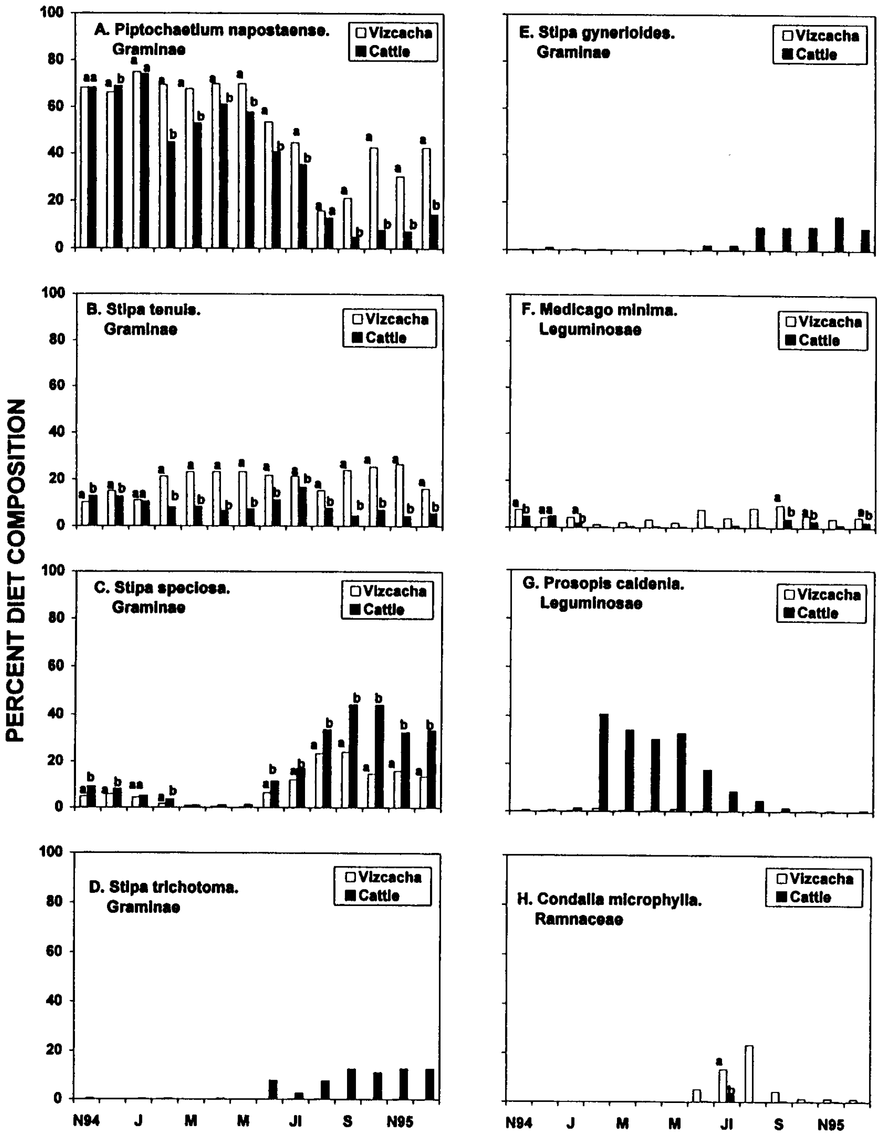

Fig. 2. Mean monthly contribution (percent) of forages contributing at least 8% to the total diet of vizcacha and cattle in central Argentina from November 1994 to December 1995. Paired bars sharing a common letter are not significantly different. (p>0.05).

tenuis than cattle during most of the study. Exceptions were November 1994, when cattle consumed more *S. tenuis* than vizcachas, and January 1995 when dietary proportions were equal. In most months when *Stipa speciosa* was found in cattle and vizcacha diets, its contribution was higher for cattle than vizcachas. During March, April, and May, *Stipa speciosa* was a trace component of both herbivore diets. Other grasses such as *S. Gynerioides* and *S. trichotoma* were detected in moderate (14%) to low (2%) amounts in the diets of cattle from June to December 1995.

Fruits of *M. minima*, the only appreciable forb in the diets, were generally more abundant in vizcacha than in cattle diets. Among the woody plants, *P. caldenia* pods were found only in cattle diets. Leaves of *C. microphylla* were found from June to December 1995 in vizcacha diets and in cattle diets only in July 1995.

Plant community composition.

Although we suspected there were differences in plant community composition within and adjacent to vizcachas colonies, our analyses did not support that hypothesis and the data were pooled. Table 1 summarizes those data and includes cattle and vizcachas diet composition data for the same periods.

Cluster analysis.

Seventeen of 19 taxa were present in both herbivore diets, indicating in qualitative terms, a high degree of dietary overlap. However, there were significant differences ($p<0.05$) in the proportions of components that appeared in the diet of each herbivore. Seasonal differences also occurred. These differences are evident from the groupings generated by the cluster analyses (Fig. 3). By cutting the tree in the range $62<BC_{jk}<63$ six groups were formed.

Cluster A included vizcacha diets from August, September, and November 1995. This 3-month period coincided with the minimum use of *P. napostaense* (Fig. 2A) and high use of *S. speciosa* (Fig. 2C) by vizcachas. This group is rather heterogeneous which is evidenced by its height. If we chose 74 instead of 63 as the upper limit of the BC_{jk} interval, the August 1995 vizcachas diet would be segregated as an "outlier" (sensu Gauch 1982). August 1995 was the month with the highest consumption of *C. microphylla* by vizcachas (Fig. 2H).

Cluster B groups cattle diets from August through December 1995 (mid winter and spring). During this period cattle consumed the lowest proportion of *P. napostaense* and *S. tenuis* (Fig. 2A,B) and relied more heavily on non-preferred grasses (*S. speciosa, S. trichotoma*, and *S. gynerioides*, Fig. 2C, D, E).

Cluster C was the largest and exhibited 2 well-defined subclusters. The first subcluster, contains the greatest overlap between the diets of both herbivores, and it encompasses the mid spring to mid summer (November and December 1994 and January 1995) diets of cattle and vizcachas. This period contained the greatest consumption of *P. napostaense*, moderate intake of *S. tenuis*, and low intakes of *S. speciosa* and *M. minima* (Fig. 2F). The second subcluster contains the mid summer to mid fall (February, March, April, and May 1995) diets of vizcachas which consisted almost entirely of *P. napostaense* and *S. tenuis*. Cattle diets were segregated from this subcluster into cluster F probably because of the high intake of *Prosopis*

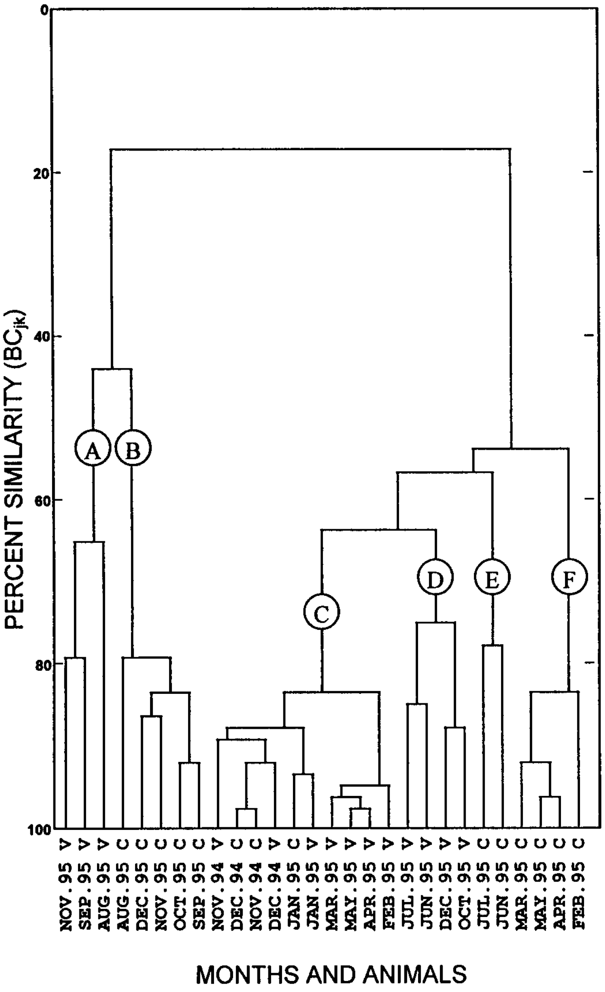

Fig. 3. Dendrogram of cluster analyses of monthly diets of vizcacha (VIZ) and cattle (CAT). A, B, C, D, E and F indicate defined clusters.

caldenia pods.

Cluster D contains the diets of vizcacha from June, July, October and December 1995. The main difference between cluster D and cluster A is a higher proportion of *P. napostaense* and a lower proportion of *S. speciosa* in D.

Cluster E, which is the smallest group, includes only the June and July diets of cattle. Based on the main diet components (Fig. 2) it is similar to cluster B but had a greater proportion of *P. napostaense* and *S. tenuis*, and a lower proportion of non-preferred grasses.

The cophenetic correlation coefficient, an index of possible distortion between the resemblance matrix and the classification procedure, was found to be $r_{x,y}$ = 0.86 which is considered acceptable. Values of $r_{x,y} \geq 0.80$ indicate that distortion is not great (McInnis et al. 1990).

Ordination output

Ordination output is shown in Figure 4. The first 2 axes (DC1 and DC2) had eigenvalues of 0.48 and 0.05 respectively. The different clusters generated by the classification are also depicted in Figure 4. The samples span a range of 250 units on the first axis indicating a high degree of homogeneity in the data. Two samples separated by 400 would have no species in common. This analysis suggested considerable overlap occurred for the entire study period.

Cluster B, C, and F were homogeneous and well separated on the first axis, whereas Clusters A, D and E were less homogeneous and did not show clear separation. The diets of cattle had a wider distribution on the axes than vizcacha diets. Cluster F, characterized by high proportion of *P. caldenia* pods in cattle diets, was located near the origin of the first axis, whereas cluster B with a high proportion of non-preferred grasses in cattle diets was at the other extreme. All clusters indexing vizcacha diets occupied intermediate positions on the first axis. Diets of cattle, with the exception of those included in cluster C, were found on the lower half of the second axis. The diets of vizcacha were concentrated on the upper half of the second axis. The ordination confirmed our interpretation of the cluster analyses and also revealed higher level of homogeneity in the diets of vizcacha than in cattle.

Diversity indices.

Diversity indices (Fig. 5) exhibited some similar patterns between the 2 herbivores. Cattle indices showed more variability and reached higher values than vizcacha. During the first 7 months of the study, diversity remained low and fairly constant, especially in the case of vizcachas. There was a sharp increase from May to August, more pronounced in cattle than in vizcacha diets. A decrease occurred between August and October, another increase occurred in November, and a final decline in December. Low but significant ($P<0.05$) negative correlations between monthly rainfall and diversity of vizcacha diets ($r = -0.53$) and cattle diets ($r = -0.53$) were found. There was also a negative correlation ($P<0.05$) between monthly mean daily temperature and diversity of vizcacha ($r = -0.65$) and cattle diets ($r = -0.55$). Although rains during the study were lower than average and erratic, there was a general association between months with relatively high rainfall and high temperatures, with low diversity indices.

Discussion

The main components of cattle and vizcacha diets were grasses during most of the study. Cattle preference for grasses has been reported in many regions (Johnson 1979, Migongo-Bake and Hansen 1987, Bóo et al. 1993), and Giulietti and Jackson (1986) have also reported vizcachas preferences for grasses. Although cattle predominantly consumed grasses, *P. Caldenia* pods were an important food source from late summer through the fall. Bóo et al. (1993) reported similar use of *P. Caldenia* pods during a year with well above average rainfall, but they detected a lower level of use (23%) than our study (40%). Menvielle and Hernández (1985) suggest that *P. caldenia* may have special significance as a food resource for cattle during dry years. By consuming pods cattle may expedite seed dispersal and shrub encroachment in the Caldenal (Peláez et al. 1992, Bóo et al. 1993). Pods were not found in vizcacha diets, so these rodents are probably not a dispersal agent of *P. caldenia*.

P. napostaense and *S. tenuis* were present in cattle diets throughout the study, with a very high consumption made of *P. napostaense*. Cattle made a shift to less preferred grasses in November and December 1995. A less pronounced but similar trend was observed for *P. napostaense* in vizcachas. Vizcachas con-

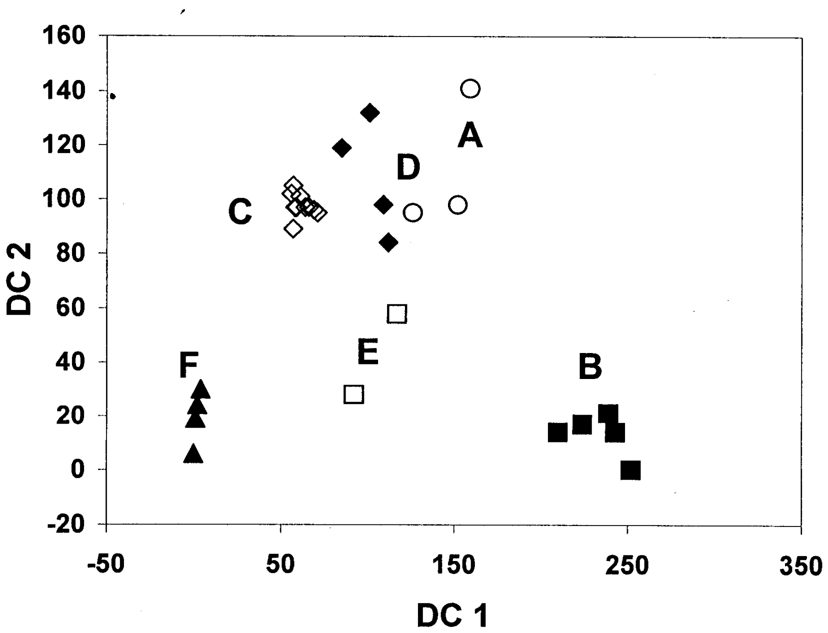

Fig. 4. Spatial distribution of monthly diets defined by the first 2 axes of ordination (DC1 and DC2). Monthly diet of different clusters produced in the classification are: Cluster A: O, Cluster B: g , Cluster C:◊ , Cluster D: u , Cluster E: r and Cluster F: ▲.

sumed more *S. tenuis* in 1995 than in 1994, and they exhibited a less substantial shift to the less palatable *S. speciosa*. This was reflected in the classification and ordination analyses, where vizcacha and cattle diets of November and December 1994 clustered together, but their diets were well separated in these same months in 1995. This was probably due to variations in forage availability, since plant growth was lower in 1995. The drought period that began in April, and continuous heavy grazing, probably caused a decline in available forage and brought about a greater reliance on less preferred forages.

Branch et al. (1994) reported that vizcachas relied heavily on *P. napostaense* throughout the year. We had similar findings for both vizcacha and cattle. The more stable vizcacha diets, compared to cattle, may be related to differences in mouth size and morphology. Cattle may be constrained by bite size and their demands as bulk grazers (Schwartz and Ellis 1981). Size, morphology and grazing behavior may also explain the rapid shift to preferred grasses in vizcachas that was detected in December (Fig. 2) after abundant rains in November 1995 stimulated forage growth.

Cattle grazed less preferred grasses during the dry period of the study, and these species are consumed only when better quality forage becomes scarce (Cano 1975). It is important, in terms of management and planning, to take into account the combined effects of heavy grazing by cattle and vizcachas. Under severe grazing conditions some species (*P. napostaense* and *S. tenuis*) are more tolerant of defoliation than others (*Stipa Clarazii* and *Poa ligularis*). Less tolerant forages may be replaced by undesirables like *S. gynerioides* and *S. tenuissima* (Distel and Bóo 1995).

Forbs were found in low proportions in the diets of both herbivores. Annuals like *M. minima* and *Erodium cicutarium* may provide good seasonal forage during spring (Fresnillo-Fedorenko 1990) in the southern Caldenal. Being annuals, they produce numerous seeds (Mayor 1996), and growth is quite variable between dry and wet years. During a wet year, *M. minima* contributed heavily to cattle diets (Bóo et al. 1993). In our study forb production was low. *M. minima* pods contributed more heavily to vizcacha than cattle diets, possibly because the pods are difficult for cattle to pick up.

Although high diet overlap (90%) occurred between both herbivores in November 1994 through January 1995, exploitative competition cannot be assessed (Begon et al. 1986). During this period rains occurred and stimulated the growth of preferred grasses. During the dry period of the study, cattle and vizcacha diets diverged (Figs. 3 and 4) in qualitative and quantitative terms (Fig. 2). We assume then that the greatest competition for preferred grasses (i.e. *P. Napostaense* and *S. Tenuis*) coincided with the lower levels (38–48%) of dietary overlap. At that time vizcachas, and especially cattle, were forced to rely on the less preferred grasses (i.e. *S. Speciosa, S. Gynerioides*, and *S. Tricotoma*) that have low nutritive value (Cano 1988). This would probably

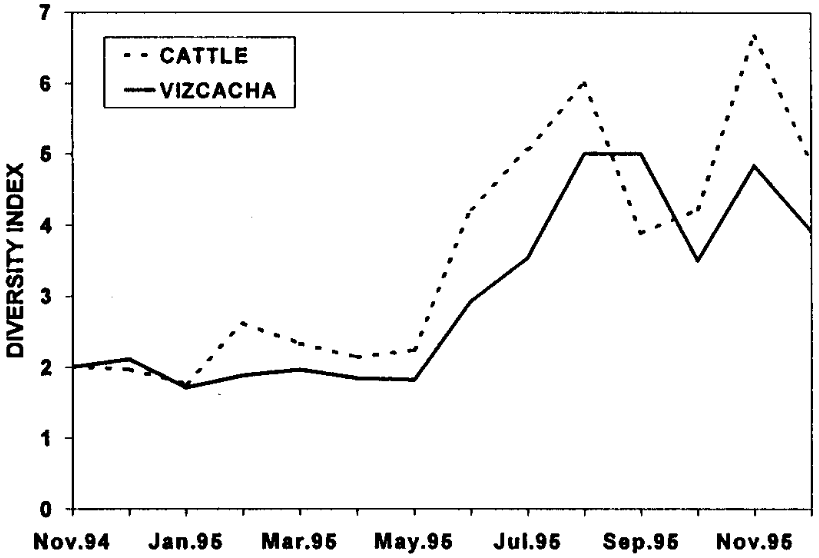

Fig. 5. Monthly diversity indices of cattle and vizcacha's diets sampled in a 600 ha pasture in southeast La Pampa from November 1994 through December 1995.

affect cattle performance more than vizcachas, because the cattle relied more heavily on the lower quality herbage

Holechek et al. (1982) reported an increase in the diversity of cattle diets as forage availability increased in late spring. Because forage biomass depends on rainfall (Sala et al. 1988), one would expect a positive correlation between diversity of the diets and rainfall. Bóo et al. (1993) found no correlation between diversity and rainfall. Kufner and Pellizza de Sbriller (1987) found a higher trophic diversity in cattle and mara (*Dolichotis patagonum*) diets in the arid plains of eastern Mendoza during summer, which was considered the lean season. In our study the warmest months coincided with the highest rainfall. Consequently, there was more forage available than in the coldest and driest months. The negative correlation found among mean monthly daily temperatures, monthly rainfall and botanical diversity of the diets indicated that diversity increased as available forage decreased. When favorable conditions for plant growth occurred, vizcachas and cattle consumed mainly preferred grasses. Under unfavorable conditions their diets diverged because cattle shifted to other resources.

In a study on vizcacha diets Branch et al. (1994) found a decrease in diet breadth concomitant with scarce resources in the field. A decrease in selectivity occurred when annual forbs were abundant. In our study, higher diversity indices occurred during the drier months. This may have been due to a less diverse plant community on our study site than on the natural reserve where Branch's research was conducted.

Cattle and vizcachas have overgrazed our study site for years, and highly preferred grasses like *S. clarazii* and *P. ligularis* are scarce. Monthly diversity was generally lower for vizcacha than for cattle diets, especially during most of the driest months. Vizcachas also consistently consumed more of the preferred grasses and *M. minima* fruits than cattle. We speculate that vizcacha require a higher quality diet than cattle.

Conclusions

This study indicates that both herbivores relied heavily on grasses, with high intake of the available, good quality species during wet and warm months. During the dry months, when the best grasses were scarce, both herbivores grazed on less preferred and lower quality grasses. Managing stocking rate and rodents density should prevent an extreme situation of forage depletion. A low density of vizcachas would also increase availability of desirable grasses for cattle during the wet season.

Prosopis caldenia pods were the only contribution by woody species to cattle diets, and they were not detected in vizcacha feces. While pods could potentially be a good source of food for cattle during the fall, the possibility of seed dispersal and *P. caldenia* encroachment represents a serious risk.

Dietary overlap was highest during wet months when *Piptochaetium napostaense* was consumed in high proportions by both herbivores. Dietary overlap was lower during the fall than during summer because cattle relied on *Prosopis caldenia* pods. The lowest overlap was observed during the driest months when cattle consumed more of the less preferred grasses than vizcacha.

In this study, diversity indices were higher in cattle than in vizcacha diets. During the drier months, diversity of both herbivore diets was higher, because they consumed more of the less preferred species. The combined effect of heavy grazing by cattle and vizcachas should be prevented to avoid displacing high quality forages with undesirable grasses or woody vegetation. These shifts in community composition would be difficult to reverse.

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