COMMUNITY STRUCTURE AND DIVERSITY OF SIGMODONTINE RODENTS (MURIDAE: SIGMODONTINAE) INHABITING MAIZE AND SOYBEAN FIELDS IN PAMPEAN AGROECOSYSTEMS, ARGENTINA

Paula Courtalon and María Busch

SUMMARY

The aim of this work was to characterize and compare the communities of small sigmodontine rodents present in soybean and maize plots according to specific composition, richness, diversity and equitativity. The study was performed over two consecutive years (periods); a follow up was made in crop plots from sowing (early crop stage) to post-harvest (stubble). For both crop types, analysis was conducted considering the entire plot and each of its habitats (field and border). The results indicate that although rodent communities were composed in both types of plots of the same species: Akodon azarae, Calomys laucha, Calomys musculinus *and* Oligoryzomys flavescens, *these were absent in some sampling months.* A. azarae *and* C. laucha *were the most abundant species, the former being captured in the borders and the latter in the fields, regardless the type of crop. Diversity was higher in maize than soybean plots when crops were mature, or after harvest. Differences in diversity were due to both changes in richness (generally by absence of* C. musculinus *or* O. flavescens*) and changes in equitativity (due to a high similarity between the densities of* C. laucha *and* A. azarae*). Species diversity varied according to the developmental stage of the crop cycle and differences resulted from changes in species richness (generally by absence of* C. musculinus *or* O. flavescens*) and equitativity (by high similarity in the densities of* C. laucha *and* A. azarae*).*

Introduction

Agricultural activities result in the replacement of natural ecosystems by a matrix composed of croplands and their fencerows, livestock and pastures, pests and plagues, machinery and facilities, and associated processes. An agroecosystem is an ecosystem subjected by humans to frequent changes in its biotic and abiotic components in order to produce fibers and food (Soriano and Aguiar, 1998). Its complexity derives not only from ecological interactions but also from socioeconomic aspects.

The agricultural labors produce a disturbance, giving place to new kinds of habitats (crop fields). This disturbance generates the fragmentation of the natural landscape (grasslands) into crop fields, the weeded borders (corridors) and patches of remnant grass-lands. The partitioning process is known as landscape fragmentation (Wilcove *et al.*, 1986). In this way, the croplands of the Pampean agroecosystems are the main landscape element present nowadays.

Agricultural practices lead to changes in the complexity and heterogeneity of the environment at different scales. Human disturbances may produce more uniform landscapes at a regional scale, and more heterogeneous landscapes at a local scale, due to the inclusion of fields for agriculture and cattle raising. The expansion of agriculture that took place during the last years in Latin America caused a decrease in the number of available habitats, which in turn resulted in loss of diversity by species extinction (Altieri, 1999; Solbrig, 1999). In some systems, however, there has been an increase in species diversity due to increased environmental heterogeneity, changes in the relationships among the different landscape components, hunting on dominant competitors, or introduction of new species.

Although the role played by small rodents as community structuring elements has been well documented for different types of natural environments (Dueser and Shugart, 1978; Dueser and Brown, 1980; August, 1983; Iriarte *et al.*, 1989; Ojeda, 1989; Mares and Ernest, 1995; Kelt and Brown, 1996; Shanker and Sukumar, 1998). In contrast, little is known of their structuring role in agroecosystems. (Ouin *et al.*, 2000).

In Pampean agroecosystems, the most abundant sigmodontine rodent species are *Calomys laucha, C. musculinus, Akodon azarae* and *Oligoryzomys flavescens.* Studies performed in the region indicated the presence of two main types of habitats available for wild rodent species, namely the crop fields and their weedy edges, the fencerows. The latter show less variability in vegetal cover because they are less affected by agricultural activities (Busch and Kravetz., 1992a, b, Busch *et al.*, 1997; 2000; 2001; Hodara, 1997; Hodara, *et al.*, 2000).

The grasslands, pastures and cultivated fields in Central Europe exhibit a trend towards a reduced number of species, with one of them dominating over the others (Jacobs, 2003). In Pampean agroecosystems, Kravetz (1986) proposed a model of rodent community dynamics as a function of land use; this model describes an increase in the equitativity of the rodent community in cultivated fields, since the appearance of the field habitat

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ESTRUCTURA COMUNITARIA Y DIVERSIDAD DE ROEDORES SIGMODONTINOS (MURIDAE: SIGMODONTINAE) DE PARCELAS DE CULTIVO DE MAÍZ Y SOJA EN AGROECOSISTEMAS PAMPEANOS DE ARGENTINA

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RESUMEN

El objetivo de este trabajo fue caracterizar y comparar las comunidades de roedores sigmodontinos en parcelas de soja y maíz en cuanto a composición específica, riqueza, diversidad (H) y equitatividad (E). El estudio fue llevado a cabo en dos años consecutivos (períodos) en que se siguió parcelas de cultivo desde su siembra (precosecha) hasta la post cosecha (rastrojos). Para cada tipo de cultivo, se consideró la parcela completa y cada uno de los hábitats que la forman (campo y bordes). Los resultados muestran que las comunidades de roedores estuvieron compuestas en ambos tipos de cultivo por las mismas especies: Akodon azarae, Calomys laucha, Calomys musculinus *y* Oligoryzomys flavescens, *todas no estuvieron siempre presentes en todos los meses de muestreo.* A. azarae *y* C. laucha *fueron las más abundantes, la primera más capturada en los bordes y la segunda en los campos, independiente del tipo de cultivo. H fue mayor en las parcelas de maíz que en las de soja en postcosecha. Las diferencias en H se debieron tanto a cambios en la riqueza (por ausencia de* C. musculinus *u* O. flavescens*) como a cambios en E (por mayor similitud en las abundancias entre* C. laucha *y* A. azarae*). Estos resultados permiten proponer que la diversidad de roedores varió según el momento del ciclo del cultivo considerado y los cambios en la riqueza (por ausencia de* C. musculinus *o* O. flavescens*) y en E (por alta similitud en la abundancia de* C. laucha *and* A. azarae*).*

ESTRUTURA COMUNITÁRIA E DIVERSIDADE DE ROEDORES SIGMODONTINOS (MURIDAE: SIGMODONTINAE) DE PARCELAS DE CULTIVO DE MILHO E SOJA EM AGROECOSSISTEMAS PAMPEANOS DE ARGENTINA

Paula Courtalon e María Busch

RESUMO

O objetivo de este trabalho foi caracterizar e comparar as comunidades de roedores sigmodontinos em parcelas de soja e milho quanto a composição específica, riqueza, diversidade (H) e equitatividade (E). O estudo foi realizado em dois anos consecutivos (períodos) em que foram acompanhados lotes de cultivo desde sua plantação (precolheita) até a pós colheita (restos). Para cada tipo de cultivo, se considerou o lote completo e cada um dos hábitats que o formam (campo e bordas). Os resultados mostram que as comunidades de roedores estiveram compostas em ambos tipos de cultivo pelas mesmas espécies: Akodon azarae, Calomys laucha, Calomys musculinus *e* Oligoryzomys flavescens, *todas não estiveram sempre presentes em todos os meses de amostragem.* A. azarae *e* C. laucha *foram as mais abundantes, a primeira mais capturada nas bordas e a segunda nos campos, independente do tipo de cultivo. H foi maior nos lotes de milho que nos de soja em pós colheita. As diferenças em H se deveram tanto a mudanças na riqueza (por ausência de* C. musculinus *u* O. flavescens*) como a mudanças em E (por maior similitude nas abundâncias entre* C. laucha *e* A. azarae*). Estes resultados permitem propor que a diversidade de roedores variou segundo o momento do ciclo do cultivo considerado e as mudanças na riqueza (por ausência de* C. musculinus *o* O. flavescens *) e em E (por alta similitude na abundância de* C. laucha *and* A. azarae*).*

leads to habitat segregation and decreases the competition effect of *A. azarae* on *Calomys* sp. However, the type of crop may affect the features of rodent communities because of differences in resource availability. In particular, the temporal distribution of the rodent community may vary according to the different agriculture schedules. In this respect, Busch *et al.* (1984) observed differences in rodent density and proportion of rodent species between winter and summer crops; these differences were attributed to a differential effect of agricultural practices on distinct rodent species, e.g. the reproductive cycle of *Calomys* sp. is synchronized with the developmental cycle of maize.

Sigmodontine rodents have been historically studied due to their epidemiological importance, since they act as reservoirs of viruses such as the Junin virus, which is the etiological agent of the argentine hemorrhagic fever (AHF), and the Hantaviruses, causing the hantavirus pulmonary syndrome (HPS). In the Pampean region, *C. musculinus* has been incriminated as the main reservoir of the Junin virus. The Hantavirus circulating in Argentina, Chile and Uruguay is the Andes virus (AND). The latter has been associated with species of the genus *Oligorizomys*. In the central region of Argentina (including the Pampean region), *O. flavescens* has been associated with cases of HPS by the

AND Cent Lec lineage that occurred in the provinces of Entre Ríos and Buenos Aires, but the rodents associated with the lineages AND Cent Buenos Aires and AND Cent Plata are still to be determined. On the other hand, there are no records of human cases of the Pergamino virus and the Maciel virus, associated to *A. azarae* and *Necromys benefactus* (formerly *Bolomys benefactus*), respectively.

In a previous study conducted in endemic areas of hemorrhagic fever in Argentina, Busch *et al.* (1984) found lower densities of *Calomys* rodents in soybean than in maize fields, and suggested to replace soybean fields by mayze fields. Up to now, however, no studies

have been made involving a simultaneous follow-up from sowing to postharvest of maize and soybean fields, or taking into account the different types of habitats in a crop field.

The goal of this study is to characterize and compare the communities of sigmodontine rodents present in soybean and maize croplands, in terms of species composition, richness, diversity and equitativity.

Material and Methods

Study area

This study was performed in the locality of Diego Gaynor (34°08'S-59°14'W), Buenos Aires Province, Argentina. The study area is

located in the Undulating Pampa subregion within the Pampean phytogeographical region (Cabrera, 1953). The area is under a temperate climate with mean temperatures of 22.5 and 9.8°C in summer and winter, respectively. The original vegetation consisted of 1m high native grasses reduced to small relict grasslands along field borders and roads, and several introduced species: *Avena* spp., *Brassica campestris, Cynodon dactylon, Medicago* spp., and *Stellaria medial* (Bonaventura and Cagnoni, 1995). Winter crops are mainly wheat and linen, and summer crops are maize, soybean and sunflower.

In the study area maize and soybean crops, which are summer grain crops, have different agricultural schedules. In maize crop fields, sowing takes place between late September and early October. During spring, maize seedlings start to develop, providing the greatest amount of green cover. As summer progresses, maize matures and dries progressively until senescence at the end of March, when harvest takes place; in autumn, stubble maize crop fields are characterized by scarce vegetal cover and a high percentage of bare ground. Soybean has two periods of sowing, the first one (first soybean crop) in November, and the second soybean crop in December; harvest also takes place earlier in the first than in the second period. The crop matures in summer, dries progressively until the beginning of autumn, and is senescent in mid-April (first soybean crop) or at the beginning of May (second crop), when it is harvested. Then, crop fields are in stubble, with less vegetal cover and a higher proportion of bare soil than maize stubble fields.
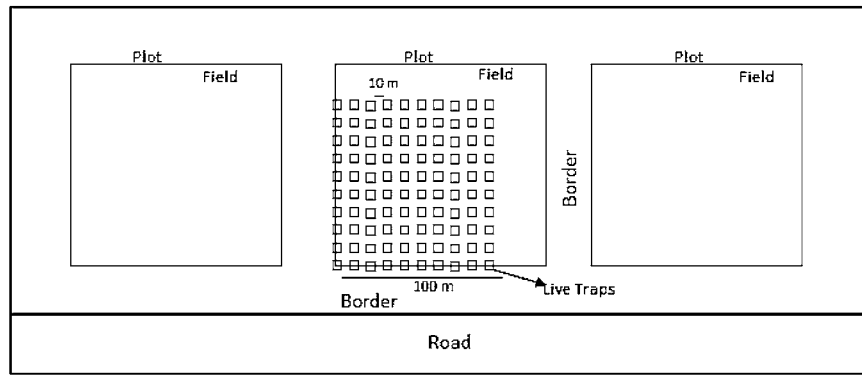

Figure 1. Scheme of the experimental plot showing the grid of live traps set on the crop field and adjacent borders. A total of 100 traps were used in each grid, with 81 traps in the field habitat and 19 traps in the border habitat.

Rodent sampling

In the present study, the plot is taken as the habitat composed of the field and the border habitats (Figure 1). Samplings were performed between January 1999 and July 2000 in maize and soybean plots. The capture-mark-recapture method was used to follow rodent populations over the developmental cycles of both types of crops. The study was divided into two consecutive periods: a) Period 1, from January to July 1999, when samplings were performed in January (both types of crops before harvest), March (maize crops after harvest, soybean crops before harvest) and May (both crops after harvest); b) Period 2, from October 1999 to July 2000, when samplings were made in October (recently sown maize and soybeam crops), December (maize and soybean crops in growth phase), February (senescent maize crops, soybean crops in growth phase), and May (both crops in stubble). Three maize plots and three soybean plots were sampled simultaneously per period, and different plots were studied in the first and second periods.

Sherman live traps were set in the six plots studied per period (Figure 1). In each plot traps were placed 10m apart from one another in a 10×10 grid, thus

resulting in 100 traps per plot. One side of the grid will be referred to as the internal border and another one as the external border. Eighty one traps were set in the field habitat and 19 along the border habitat. Traps were baited with peanut butter and, in order to protect rodents against low temperatures, they were provided with cotton wool and wrapped in paper and nylon bags. In each sampling, traps operated for three consecutive nights and were monitored every morning. The following information was recorded from each caught animal: species, spatial location on the grid, sex, weight, total and tail lengths, and reproductive stage. Animals were handled according to the national laws of animal care (www.sarem.org.ar).

The abundance of each rodent species in each habitat was estimated based on its trap success (trapped individuals/trap-nights)×100 (Mills *et al.*, 1991)

Species diversity (H), richness (S), and equitativity (E) were obtained for each plot and each habitat (field and border), over each sampling month and each period. According to Magurran, (1988) diversity was estimated with the Shannon-Wiener index,

$$H= -\Sigma pi \ln pi, \text{ and}$$

$$E= H / \ln S$$

Results

First period

A total of 253 individuals were captured between January and July 1999. Of these, 100 were found in the soybean plots (76 *A. azarae*, 15 *C. laucha,* 8 *C. musculinus* and 1 *O. flavescens*) and 153 in maize plots (104 *A. azarae*, 32 *C. laucha*, 10 *C. musculinus* and 7 *O. flavescens*), with a trapping effort of 2700 captures trap-night in soybean plots and 2400 trap-night in the maize plot.

In the plots, when all samplings of the first period were considered, maize and soybean crops showed a richness of 4 species (*A. azarae, C. laucha, C. musculinus* and *O. flavescens*; Figure 2a). There were variations in the values of diversity and equitativity throughout the first period (Table I). In January (prior to harvest in both crops) there were no significant differences in the diversity (H) and equitativity (E) between maize and soybean plots (p>0.05 for both indices; Table I). The relative abundance showed a similar pattern (Figure 2a), but *O. flavescens,* which was in low abundance in maize plots, was not captured in soybean plots. Likewise, in March (after maize harvest,
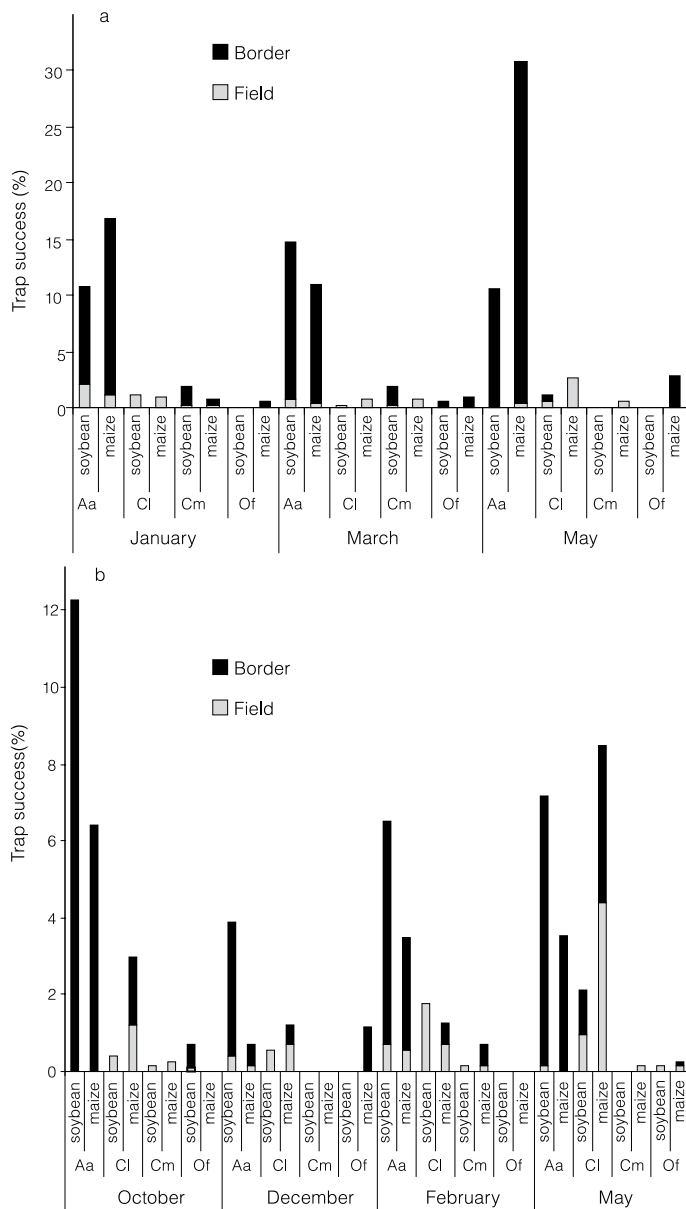
Figure 2. Relative abundance pattern of each rodent species in field and border habitats of maize and soybean plots for the different sampling months. a. first period, b: second period. Data are expressed as trap success of each species in each habitat type and sampling month. Aa: *Akodon azarae*, Cl: *Calomys laucha*, Cm: *Calomys musculinus*, Of: *Oligoryzomys flavescens*.

before soybean harvest), no significant differences were found in H and E between maize and soybean plots (p>0.05 for both indices). Although the most abundant species in both types of crops was *A. azarae*, *C. laucha* and *C. musculinus* were the second most abundant species in crop and soybean plots, respectively. *O. flavescens* showed the least relative abundance in both types of crops (Figure 2a). In May (both crops after

harvest), *C. musculinus* and *O. flavescens* were not found in soybean plots, whereas the dominance of *A. azarae* over *C. laucha* was more pronounced in maize plots. Species diversity was significantly higher in maize than in soybean plots (U= 0, P= 0.0463), and no significant difference in equitativity was found between soybean and maize crops (U= 2, P= 0.26).

The comparison between field habitats indicated that

maize fields had a richness of three species in each of the three sampling months, whereas only *C. laucha* was present in soybean fields in May (Figure 2a), resulting in a significantly higher species diversity in maize than in soybean fields for this month (U= 0, P= 0.0495; Table I). A similar trend was observed for equitativity, but no significant differences were found for any month (p>0.05 for both indices). *O. flavescens* was not captured in any of the two crop fields during this period.

When the maize and soybean border habitats were compared, differences in species richness among the three sampling months were observed (Figure 2a). *A. azarae* was present in maize and soybean border habitats in all sampling months; *C. laucha* was not found in the border habitats of any of the two crops during January and March, and appeared in both crop types in May; *C. musculinus* was not captured neither in the border habitat of maize in March, nor in the border habitats of the two crop types in May. Finally, *O. flavescens* was always present in the maize border habitat, whereas it was only captured in March in the soybean border habitat. In May, diversity was significantly higher in the maize than in the soybean border habitats (U= 0, P= 0.0495; Table I) whereas no significant differences were found in the two other months. The equitativity showed no significant differences between border habitats of the two crops for any of the months (p>0.05).

Second period

A total of 190 individuals were captured between October 1999 and July 2000, of which 91 were found in soybean plots (58 *A. azarae*, 29 *C. laucha*, 2 *C. musculinus* and 2 *O. flavescens*) and 99 in maize plots (28 *A. azarae*, 63 *C. laucha*, 5 *C.*

musculinus and 3 *O. flavescens*). The trapping effort was 3600 captures trap-night in soybean plots and 3300 trap-night in maize plots. During this period, richness was 4 species for both crop types (Figure 2b).

In the plots, when all samplings of the second period were considered, maize and soybean crops showed a richness of 4 species (*A. azarae*, *C. laucha*, *C. musculinus* and *O. flavescens*; Figure 2b). There were variations in the values of H and E throughout the second period (Table I). In October (recently sown maize crops, not-sown soybean crops) all 4 species were present in the soybean plots, whereas *O. flavescens* was not captured in maize plots (Figure 2b). H and E values did not differ between crop types (p>0.05 for both indices, Table I). In December (well-developed maize crops and recently sown soybean crops), *A. azarae* was the dominant species in soybean plots and *C. laucha* in maize plots. *C. musculinus* was not captured in any of the two crop types. No significant differences were found in H and E between types of crop (p>0.05 for both indices), and *O. flavescens* was not captured in soybean plots. In February (both crops in senescence), diversity was higher in maize than in soybean plots (U= 0, P= 0.0495). Differences in equitativity between the two crop types was non-significant (p>0.05). The two showed a similar pattern of relative abundance or rodents, with *A. azarae* as the dominant species, followed by *C. laucha*, although the abundance of these species was more similar in soybean than in maize plots. In May (both crop types after harvest), when maize plots remained in stubble for a longer period than soybean plots, all 4 species were captured in maize plots, but *C. musculinus* was not found in soybean plots. In maize

TABLE I
MEAN H (DIVERSITY) AND E (EQUITABILITY) INDICES ACCORDING TO TYPE
OF PLOT (M: MAIZE; S: SOYBEAN) TIME PERIOD AND TYPE OF HABITAT.
(FIELD AND BORDER) OVER EACH SAMPLING MONTH

		First period						Second period							
		January		March		May		October		December		February		May	
		M	S	M	S	M	S	M	S	M	S	M	S	M	S
Plots	H	0.47	0.54	0.65	0.65	0.91	0.15*	0.33	0.38	0.36	0.16	0.60	0.3*	0.50	0.36
	E	0.38	0.49	0.78	0.67	0.65	0.21	0.54	0.46	0.56	0.24	0.90	0.48	0.61	0.40
Fields	H	0.53	0.29	0.35	0.39	0.47	0*	0.36	0.10	0	0.16	0.54	0.33	0.20	0.36
	E	0.60	0.42	0.25	0.24	0.46	0	0.52	0.15	0	0.24	0.55	0.48	0.18	0.53
Borders	H	0.16	0.22	0.17	0.33	0.4	0.05*	0.19	0.09	0.36	0	0.28	0	0.751	0.21*
	E	0.14	0.23	0.25	0.477	0.29	0.073	0.28	0.13	0.33	0	0.26	0	0.8	0.3

*: differences between type of plots.

plots, *C. laucha* dominated over the remaining species, whereas *A. azarae* was the most abundant species in soybean plots. No significant differences in H and E values were found for this month between crop types (p>0.05 for both indices).

Differences in diversity and equitativity between the two types of field habitats were not significant for any of the sampling months (p>0.05 for both indices; Table I). In October, *A. azarae* was not captured in any of the two types of field habitats. *C. laucha* was the dominant species in maize and soybean field habitats but showed a higher abundance in maize. In December, *C. laucha* retained its dominance over *A. azarae*, while *C. musculinus* and *O. flavescens* were not captured in any field habitat type. In February, the abundance pattern was similar to that observed for December, but *C. musculinus* was detected in low abundance in both field habitat types. In May, *C. laucha* dominated in the two types of field habitats, with the rest of the species being in low abundance (Figure 2b).There were no significant differences in diversity between the two types of border habitats for October, December and February (p>0.05 for both variables; Table I). In May, the diversity in maize border habitats was higher than in soybean border habitats (U= 0, P=0.0495; Table I). There

were no significant differences in the equitativity between the two types of border habitats for any of the sampling months (p>0.05). In October *C. musculinus* was not captured in any of the border habitat types; *A. azarae* was the most abundant species in both types of border habitats, and *C. laucha* was exclusively captured in maize border habitats. The pattern of relative abundance for December was similar to that for October: *O. flavescens* was captured in maize border habitats, *A. azarae* was only present in soybean border habitats, and *C. musculinus* was not found in both types of border habitats (Figure 2b).

Discussion

The characterization and comparison of the communities of small sigmodontine rodents present in soybean and maize plots is essential to generate management guidelines, given their public health relevance as reservoirs of the Junin virus and Hantaviruses.

The sigmodontine communities present in the studied soybean and maize plots shared the same species, namely *A. azarae*, *C. laucha*, *C. musculinus* and *O. flavescens*, but there were differences in the relative abundance pattern of these species depending on the type of crop, habitat, sampling month and period considered.

Species diversity showed no differences between maize and soybean plots, but varied with the different developmental stages of both crops. During the first study period, species diversity was higher in maize than in soybean plots after harvest, when both plots were in stubble (May). During the second study period, species diversity was higher in maize than in soybean plots when both crops were mature and standing upright (February). Mills *et al.* (1991) suggested the occurrence of a gradient of increasing diversity from soybean, maize or wheat fields to "linear" habitats represented by fence lines, field borders and railroads. In the present study, however, the fact that species diversity differed between maize and soybean plots in some months only, may indicate that this variable depends on the developmental stages of the crop. In addition, variations might have been due to particular features of each crop type and different climatic conditions among years.

Species diversity was higher in the maize field habitat than in the soybean field habitat when data from all samplings performed in the first period were pooled together. In maize fields, *C. laucha* was the most abundant species, followed by *A. azarae* and *C. musculinus*, whereas in soybean fields, *A. azarae* dominated, followed

by *C. laucha* and *C. musculinus*; *O. flavescens* was not found in any of the two crop fields. These differences in the pattern of relative abundance would be related to the fact that the population cycle of *C. laucha* was more synchronized with the maize cycle than with the soybean cycle (Kravetz, 1978). Differences in species diversity between fields were likely to be due to the response of species in May, on the basis that it was the only month when differences were statistically significant. During this month, in maize fields the most abundant species was *C. laucha*, followed by *C. musculinus* and *A. azarae*, whereas *C. laucha* was the only rodent found in the soybean fields. The difference in species diversity between the maize and soybean fields would be related to the response of species to agricultural activities undertaken for each type of crop. At the time of sampling, after harvest, maize fields remained in stubble for a longer period than did soybeans fields, since the former were harvested at the end of May and the latter between late April and early May. This determined that rodent populations in maize fields had more time for recovery after the disturbance caused by harvest than those in soybean fields, and that *C. laucha* individuals had enough time to re-colonize fields from the borders.

In the second period, the lack of significant differences between maize and soybean fields reinforces the idea that the differences in rodent populations strongly depend on the period analyzed. Diversity and equitativity were significantly higher in borders of maize than in borders of soybean crops during the second period. In the borders of the two crop fields, *A. azarae* was the most abundant species in both the first and second periods. The differences in diversity between the borders of the two crops would be

due to the absence of *C. musculinus* in the borders of soybean, and to variations in the abundance of *C. laucha*. This species was always less abundant than *A. azarae*, but it was more abundant in maize borders than in soybean borders, which determined a higher diversity in maize than in soybean borders. Similarly to that observed for field habitats, differences in diversity in border habitats might be due to the developmental stage of the crops. In this study, these differences occurred when the two crop types were in stubble (May), because species diversity after harvest was higher in maize than in soybean borders for both study periods.

The data provided by this study support the recommendation of Busch *et al.* (1984) to plant soybean in areas endemic to argentine hemorrhagic fever (AHF); *C. musculinus* was more abundant in the field habitat of the maize plots than in that of the soybean plots in May, when both crops were in stubble, rodent abundance was high, and there is a peak in the number of AHF cases (Mills *et al.*, 1992). With regard to the epidemiology of the Hantavirus pulmonary syndrome (HPS), *O. flavescens* was also more abundant in the maize plots, reinforcing the advantage of planting soybean. For example, in the locality of Diego Gaynor, where this study was carried out, 90% of the fields were planted with soybean and no cases of HPS were detected in humans. However, this observation should be interpreted with caution, considering the absolute number of individuals captured of *C. musculinus* and *O. flavescens*. Further comparisons must be made among years and/or regions where these species are more abundant to clarify this issue.

In brief, it is concluded that 1) species diversity was higher in maize than in soybean plots when crops were mature or after harvest; 2) species diversity in maize field habitats was higher than in soybean field habitats, depending on the period analyzed and the developmental stage of the crop; 3) when there were significant differences in species diversity between borders of maize and soybean borders, values were higher in maize borders; 4) species diversity varied according to the developmental stage of the crop and differences resulted from changes in species richness (generally by the absence of *C. musculinus* or *O. flavescens*) and equitativity (by a high similarity in the densities of *C. laucha* and *A. azarae*). These differences were mainly observed after the harvest, in May.

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