ECOLOGY, BEHAVIOR AND BIONOMICS

Abundance and Species Richness of Coreoidea (Hemiptera: Heteroptera) from Parque Estadual do Turvo, Southern Brazil

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Abundância e Riqueza de Espécies de Coreoidea (Hemiptera: Heteroptera) do Parque Estadual do Turvo, Sul do Brasil

RESUMO - A fauna de coreóideos neotropicais é muito pouco conhecida quanto a estudos de comunidades. Visando preencher esta lacuna, um estudo de dois anos foi desenvolvido no Parque Estadual do Turvo, Derrubadas, RS, buscando avaliar a composição, abundância e riqueza de espécies de Coreoidea. As amostragens foram efetuadas com guarda-chuva entomológico nas primaveras de 2003 e 2004 (outubro) e nos outonos de 2004 e 2005 (maio), em duas trilhas do Parque. O esforço amostral (horas de coleta X número de coletores) totalizou 153h. Coletaram-se 282 indivíduos de 28 espécies/morfoespécies pertencentes a Alydidae, Coreidae e Rhopalidae. A espécie mais abundante foi o coreídeo *Cebrenis supina* Brailovsky, representando 16% dos indivíduos, seguida dos ropalídeos *Jadera aeola* (Dallas) e *Harmostes* sp., com 12,1% e 11,7%, respectivamente. As riquezas estimadas por Chao 1, Chao 2, Jackknife 1 e Jackknife 2 situaram a riqueza observada entre 70% e 80% da esperada para a área. A riqueza estimada de espécies por rarefação, na primavera de 2003 e outono de 2004, foi significativamente maior do que nos períodos amostrais seguintes. Não houve diferenças significativas entre a primavera de 2003 e o outono de 2004, e entre a primavera de 2004 e o outono de 2005, para o mesmo parâmetro. As trilhas não diferiram significativamente quanto à riqueza estimada de espécies. Espécies representadas por somente um ou dois indivíduos equivaleram a 32,1% do total. Adicionalmente, oito espécies de Coreoidea foram obtidas exclusivamente com amostragens qualitativas, incluindo guarda-chuva entomológico sem protocolo e coleta manual.

PALAVRAS-CHAVE: Alydidae, Coreidae, Rhopalidae, diversidade, inventário

ABSTRACT - The coreoid fauna from Neotropics is poorly known, especially in terms of community studies. Aiming at contributing to this knowledge, a two-year study was carried out at Parque Estadual do Turvo, Municipality of Derrubadas, state of Rio Grande do Sul, Brazil, to evaluate the composition, abundance and species richness of Coreoidea. Samplings were conducted in the springs of 2003 and 2004 (October), and autumns of 2004 and 2005 (May), using beating tray method, along two trails of the park. Sampling effort (hours X collectors) totaled 153h. A total of 282 individuals of Coreoidea were collected, distributed in 28 species of Alydidae, Coreidae and Rhopalidae. The most abundant species was the coreid *Cebrenis supina* Brailovsky, representing 16% of the collected individuals, followed by the rhopalids *Jadera aeola* (Dallas), and *Harmostes* sp., with 12.1% and 11.7%, respectively. The estimated richnesses by Chao 1, Chao 2, Jackknife 1 and Jackknife 2 indicated that the observed richness corresponds to 70% to 80% of the expected for the area. The estimated richness through rarefaction was significantly higher in spring 2003 and autumn 2004 than in the other periods. There was no significant difference, however, between spring of 2003 and autumn of 2004, and between spring of 2004 and autumn of 2005, for the same parameter. Yucumã and Garcia trails did not differ significantly for the estimated richness. Singletons and doubletons represented 32.1% of the recorded species. Additionally, eight other species were obtained qualitatively by using, besides beating tray without protocol, manual collection.

KEY WORDS: Alydidae, Coreidae, Rhopalidae, diversity, survey

Coreoidea includes three families in the Neotropical region: Coreidae, Rhopalidae, and Alydidae. Coreids, also called leaf-footed bugs, constitute the most speciose family within the group, with approximately 1800 species (Schuh & Slater 1995). Coreoids are, in a broad sense, essentially phytophagous, despite some data reporting coprophagy and carrion feeding within Coreidae (Mitchell 2000) and Alydidae (Panizzi *et al*. 2000). In most of the literature, they have been considered as minor pests. However, some species, as *Anasa* spp. (Coreidae), on Cucurbitaceae (Mitchell 2000), *Phthia picta* (Drury) (Coreidae), on Solanaceae (Mitchell 2000), and especially *Neomegalotomus parvus* (Westwood) (Alydidae), on soybean and other legumes, have been increasingly been pointed out as potentially important pests in Brazil (Panizzi *et al*. 2000).

Information on Coreoidea diversity is still scarce. Most of the literature on Coreoidea has focused on taxonomical (e.g., Brailovsky 1985, 1988, 1995; Brailovsky & Barrera 2004) or biological aspects of economically important species (Baldin & Boiça 1999, Caldas *et al*. 1998, 1999; Caetano & Boiça 2000).

Grazia-Vieira & Casini (1973) presented a list of Pentatomidae and Coreidae from northeastern Uruguay, based on material deposited in collections from that country. Mitchell (2000) provided a comprehensive revision of world economically important coreids, as did Schaefer & Kotulski (2000) and Panizzi *et al*. (2000), respectively for Rhopalidae and Alydidae of the World. Thum & Costa (1997) studied coreids from canopies of native forest plants in southern Brazil, including within Coreidae the rhopalids *Jadera sanguinolenta* (Fabricius) and *Jadera pectoralis* Stål, and the alydid *Megalotomus* sp. (= *Neomegalotomus*, see Schaefer & Panizzi 1998). Barcellos (2007), in a survey of heteropterans from the coastal plain of the state of Rio Grande do Sul, recorded 25 species of Coreoidea; that study area included patches of restinga-type forest, sandy dunes and wetlands.

This paper aimed at describing the composition and structure of the Coreoidea assemblage from Parque Estadual do Turvo, in the northwest of the state of Rio Grande do Sul. We compared the abundance and estimated species richness of Coreidae, Alydidae, and Rhopalidae in that conservation unity, both temporally (along four sampling periods) and spatially (along two trails). Doing so, we expect to provide basic biogeographical and ecological data that make possible to compare to further studies in other regions or ecosystems.

Material and Methods

The Parque Estadual do Turvo (PET) is located in the northwest of Rio Grande do Sul (27º00' - 27º20'S; 53º40' - 54º10'W), in the Municipality of Derrubadas. This 17,491.40 ha conservation unity is considered a relict of the pluvial subtropical forest from Upper Uruguay river region (Dias *et al*. 1992), which was extended over a large original area. This forest is currently restricted to the park and some minor fragments, predominating large soybean and wheat crops, besides some corn plantations. The climate, according to Köppen's classification, is Cfa, subtropical humid temperate, mean rain precipitation up to 1.900 mm/year and mean temperatures ranging from 6.6°C to 37.4°C (Vasconcellos *et al*. 1992).

Samplings were carried out in four 5-day expeditions to PET, respectively in October/2003, May/2004, October/2004 and May/2005. Two trails were sampled with beating trail, always by the same three collectors: the Garcia and the Yucumã trails. Although traffic of vehicles occurs in both trails, in Yucumã it is more intense due to access of visitors. The total sampling effort was 153h, distributed in 78h in the Yucumã trail and 75h in the Garcia. The effort in the four sampling periods totaled: spring of 2003, 41h; autumn of 2004, 28h; spring of 2004, 33h, and autumn of 2005, 51h. Additionally, qualitative, random collections were made, in order to complete the inventory, but these data were not included in the quantitative analyses. These collections included beating tray and manual collecting, totaling 39h.

The samplings included only adult specimens, as immatures are rarely identifiable to species level. The specimens were identified based on literature (*e.g*. Brailovsky 1988, Brailovsky & Cadena 1992, Schaefer 2004) and by comparison with identified specimens from collections. All the specimens were deposited in the collection of terrestrial Hemiptera, Museu de Ciências Naturais, Fundação Zoobotânica do Rio Grande do Sul.

As the total sampling effort with beating tray was not exactly the same in each sampling period and along each trail, we used rarefaction curves for comparisons of estimated richness among the four sampling periods and between trails (Moreno 2001), with the softwares Biodiversity Pro v. 2.0 (McAleece 2004) and Past 1.18 (Hammer & Harper 2004). We also compared the total observed with the expected richness by using the estimators Chao 1, Chao 2, first (Jack 1) and second order (Jack 2) Jackknife, randomized 500 times, with EstimateS ™ v. 7.5.2 (Colwell 2005). Chao 1 is based on proportion of singletons and doubletons (species represented respectively by one and two individuals in the sample); the remaining estimators use only ocurrence data (proportion of uniques and duplicates) (Magurran 2004). In all estimates, we considered only samples obtained with the same sampling effort (each sample unity representing the specimens collected with beating tray method, always by the same three collectors, during 1h). These samples represented 42, from a total of 45 unities. The structure of coreoids assemblage from PET was also evaluated for the relative abundance of each species by plotting a rank/abundance curve, with Microsoft Excel™.

Results

During the whole period, the quantitative samplings caught 282 specimens representing 28 species of Coreoidea, from which 20 belonging to Coreidae (Table 1). This family was also the most abundant, representing 63.8% of the captured specimens. Rhopalidae and Alydidae contributed with 28% and 8.2%, respectively, of the total abundance.

Cebrenis supina Brailovsky (Coreidae) was the most abundant species, with 16% of the individuals, followed by the rhopalids *Jadera aeola* (Dallas) and *Harmostes*

Table 1. Coreoids obtained in the quantitative samplings with beating tray method at Parque Estadual do Turvo, Derrubadas, RS, Brazil, 2003-2005 (G, Garcia trail; Y, Yucumã trail).

Family/species	Spring 2003		Autumn 2004		Spring 2004		Autumn 2005		Total	
	G	Y	G	Y	G	Y	G	Y	G	Y
Alydidae										
Cydamus picticeps (Stål)	1	1	2	1			1	8	4	10
Bactrodosoma parallela Stål		1			1	1			1	2
Cydamus femoralis (Stål)				1			2		2	1
Trachelium fulvipes Herrich-Schäffer				1		1				2
Hyalymenus puncticeps (Dallas)				1						1
Coreidae										
Cebrenis supina Brailovsky		5				40				45
Chariesterus cuspidatus Distant			2	21			4		6	21
Madura fuscoclavata Stål	1	4	1	7	1	2	3	6	6	19
Anasa varicornis (Westwood)	1	10	1	1	8		1		11	11
Zicca annulata (Burmeister)				9			2		2	9
Althos obscurator (Fabricius)	6					3			6	3
Acanthocephala sp.			3	1			3		6	1
Hypselonotus interruptus interruptus Hahn			2	2			1		3	2
Spartocera cinnamomea (Hahn)						5				5
Empedocles luridus Brailovsky & Barrera	2	1				1		1	2	3
Hypselonotus interruptus lineaticollis Stål				3		1	1		1	4
Sethenira testacea Spinola		1			1	1			1	2
Cebrenis cauta Brailovsky		2	1						1	2
Acidomeria sordida (Berg)							2		2	
Melucha phyllocnemis (Burmeister)		1								1
Zoreva sp.				1						1
Eubule rugulosa Brailovsky						1				1
Nyttum punctatum (Dallas)		1								1
Laminiceps fenestratus (Burmeister)			1						1	
Anasa apicalis (Westwood)						1				1
Rhopalidae										
Jadera aeola (Dallas)	1	1		1		1	21	9	22	12
Harmostes sp.	3	4		10	1	15			4	29
Liohryssus sp.	3	2		3	1	3			4	8
Total	18	34	13	63	13	76	41	24	85	197

sp., with 12.1% and 11.7% respectively (Table 1, Fig. 1). The high abundance of *C. supina* was due especially to data from spring 2004, when 88.9% of their individuals were collected; this species did not occur in autumn of 2004/2005. *J. aeola* occurred along all sampling periods; however, 88.2% of its individuals were collected during the autumn 2005. *Harmostes* sp. showed a more regular distribution along the periods, occurring in all but autumn of 2005. Singletons and doubletons were seven and two species, respectively, totaling 32.1% of species recorded in the quantitative samplings.

Besides *J. aeola*, the coreids *Madura fuscoclavata* Stål and *Anasa varicornis* (Westwood) were the most frequent species, occurring during the four sampling periods.

The observed richness, considering only samples with the same sampling effort, was 27 species. The estimators showed that this richness corresponds to 71.2, 74.6, 78.9 and 81.1 % of the medium estimated richness by, respectively, Jackknife 2 (S_{est} = 37.9; standard deviation = ±5.6), Jackknife 1 (S_{est} = 36.2, s.d. = ±2.7), Chao 2 (S_{est} = 34.2, s.d. = ±4.6), and Chao 1 (S_{est} = 33.3, s.d. = ±4.3). The accumulation curves obtained are non-asymptotic (Fig. 2), thus indicating that

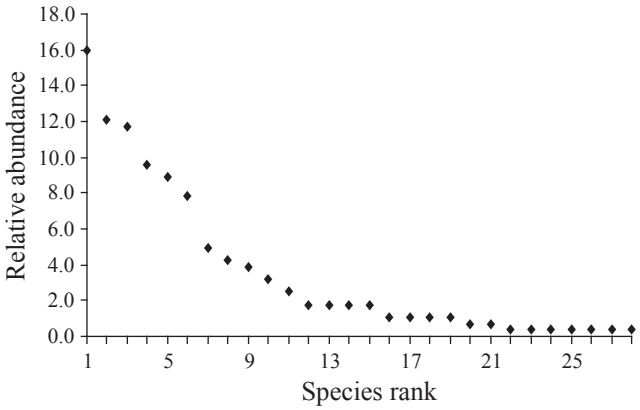

Fig. 1. Rank/abundance plot of coreoids obtained with beating tray method, Parque Estadual do Turvo, Derrubadas, RS, Brazil, 2003-2005.

total species richness would probably increase with additional sampling effort.

Comparing the estimated richness in the four sampling periods through rarefaction curves (Fig. 3), we verify that the spring of 2003 [estimated richness (S_{est}) = 13.9 species, standard deviation (s.d.) = ± 0.27] and the autumn of 2004 (S_{est} = 14.5; s.d. = ± 1.2) did not differ significantly from each other considering the same subsample size (51 individuals). Both seasons were significantly richer than spring of 2004 (S_{est} = 11.9; s.d. = ± 1.3) and autumn of 2005 (S_{est} =11, s.d. = ± 0.9). These last seasons did not differ significantly to each other for the same parameter.

There was no significant difference between the trails (Yucumã and Garcia) for the estimated richness, considering a subsample of 81 individuals (Garcia trail, S_{est} = 18.8 species; s.d. = ± 0.5; Yucumã trail, S_{est} = 18.9; s.d. = ± 1.8) (Fig. 4). However, considering species composition, Yucumã presented a higher number of exclusive species (nine), compared with only two present exclusively at Garcia. Thus, 17 Coreoidea species were common to both trails. Excepting for *C. supina* and *Spartocera cinamomea* (Hahn), all the other exclusive species were singletons or doubletons.

The qualitative samplings added 168 specimens and eight species of Coreidae not recorded in the quantitative samplings - *Anasa scorbutica* (Fabricius), *Catorhintha* sp., *Hypselonotus fulvus* (Hahn), *Leptoglossus gonagra* (Fabricius), *Hirilcus variolosus* (Burmeister), *Placoscelis limbata* (Berg), *Anasa lunicollis* (Stål), and *Ouranion crenulatus* (Stål). All of them constituted singletons. Additionally, the coreids *C. supina*, *S. cinnamomea*, and *Eubule rugulosa* Brailovsky, which had been recorded in the quantitative samplings exclusively at Yucumã, were also recorded at Garcia.

Discussion

The scarcity of information on diversity patterns of Coreoidea hampers the comparison with data here obtained. Grazia-Vieira & Casini (1973) listed 14 genera and 17 species of Coreoidea for northeastern Uruguay. Thum & Costa (1997) collected 339 individuals of 11 species of Coreoidea from canopies of ten native forest plants from Caibaté, northwestern Rio Grande do Sul, by using a funnel under crowns. In their paper, they mention *J. sanguinolenta* as the most abundant species, followed by *Hypselonotus interruptus* and *J. pectoralis*. The citation of *J. sanguinolenta* is possibly an error, as this species, according to Göllner-Scheiding (1983), has an exclusively Caribbean distribution. This author comments that most of citations for *J. sanguinolenta* for South America refer, probably, to *J. aeola* or *J. choprai* Göllner-Scheiding (Göllner-Scheiding 1983).

Barcellos (2007), in a 171h sampling effort employing beating tray method, found 25 species and 176 individuals

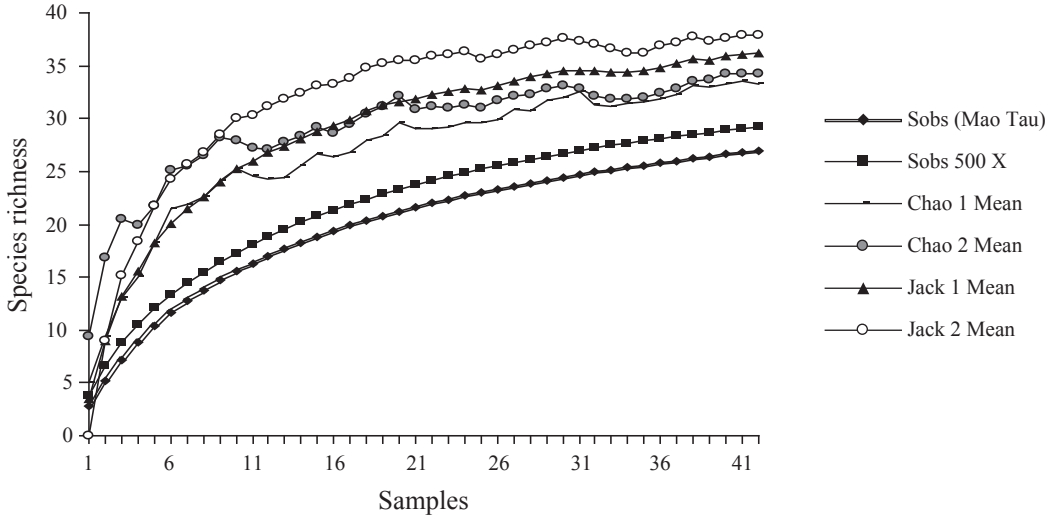

Fig. 2. Coreoids from Parque Estadual do Turvo, Derrubadas, RS, Brazil, obtained with beating tray method (each sample unity = 3 collectors X 1h): observed richness (Sobs), mean estimated richness by Chao 1, Chao 2, first (Jack 1) and second (Jack 2) order Jackknife estimators, and observed richness (Sobs 500X), randomized 500 x.

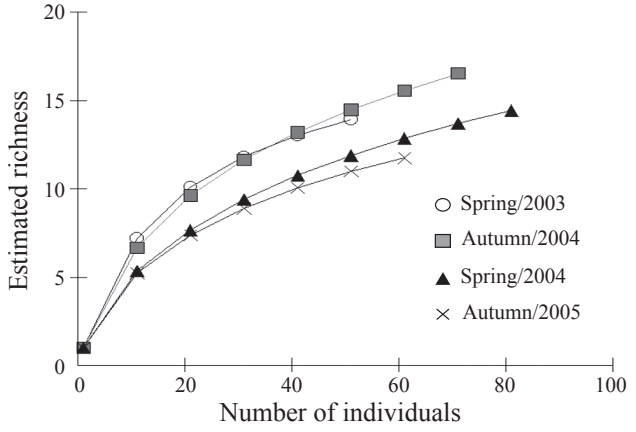

Fig. 3. Rarefaction curves for the estimated richness of Coreoidea species obtained with beating tray method in the four sampling periods, Parque Estadual do Turvo, Derrubadas, RS, Brazil: spring of 2003, autumn of 2004, spring of 2004, and autumn of 2005.

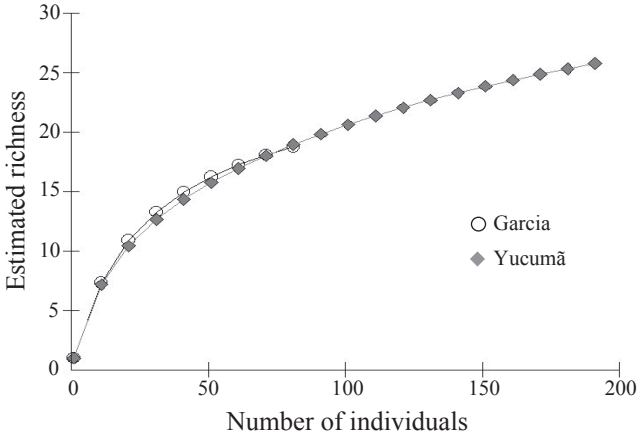

Fig. 4. Rarefaction curves for the estimated richness of Coreoidea species obtained with beating tray method along Garcia and Yucumã trails, Parque Estadual do Turvo, Derrubadas, RS, Brazil.

of Coreoidea in the coastal plain of Rio Grande do Sul. The most abundant species in that study was, by far, *J. aeola* (36.8% of the specimens), followed by *Sethenira testacea* Spinola, 1837 (Coreidae, Coreinae), with 8.5%, and three Alydidae species, with 6.8% each. Although the species richness of that study is very similar to the one found here, the composition of Coreoidea is quite distinct. The coastal plain and the Alto Uruguay region share only eight species – *J. aeola* and *Harmostes* sp. (Rhopalidae), *S. testacea*, *H. fulvus, H. interruptus*, *Acanthocephala* sp., *Althos obscurator* (Fabricius), and *Melucha phyllocnemis* (Berg) (Coreidae).

Unfortunately, the only information on the biology of *C. supina*, the most abundant species in this study, is about its host plants, which include Compositae as *Neurolaena lobata* (L.) R. B. R., *Mikania scandens* (L.) Willd, and *Verbesina* sp. (Brailovsky 1995).

The high abundance of *J. aeola* in different biomes of Rio Grande do Sul is noteworthy. In fact, this species has also been collected in several other localities of the state, frequently in high numbers and with strong aggregated distribution (unpublished data).

Singletons species are prevalent in insect assemblages, constituting generally the largest abundance class (Magurran 2004). Our results showed this pattern of species abundance. However, the proportion of singletons and doubletons in our study (32.1%) is lower than the one found for Coreoidea in the coastal plain of the same state (44%) (Barcellos 2007), and for Pentatomoidea of the PET (45%) (Schmidt & Barcellos 2007). Longino *et al*. (2002) pointed out that sampling method can have a large impact on the perception of rarity. By using different methods of collection, those authors found a proportion of 13% to 47% of unique species, when considered each method separately; however, considering all methods, that proportion dropped to 12%. In our study, it is possible that some of the singletons and doubletons represent species whose habitats are not accessible to beating tray method. Such might be the case of coreoids inhabitants of forest canopy, as pointed out for pentatomoids in a previous work (Schmidt & Barcellos 2007).

Comparing species richness among periods with the results for Pentatomoidea, in the same occasions (Schmidt & Barcellos 2007), the autumn of 2005 was significantly less species rich for both superfamilies. This fact reinforces the idea that the low rain precipitation observed in that period may have affected markedly the hemipteran assemblages from PET. According to Marengo (2006), the total rainfall from December 2004 to March 2005 in northwestern and eastern Rio Grande do Sul ranged from 100 mm to 500 mm below the historical mean. In February 2005, rainfall represented only 20% of the historical mean (Marengo 2006).

Otherwise, the similar richness results between trails differ from the pattern found for Pentatomoidea, in the same sampling occasions, in which Yucumã showed a significantly higher estimated richness than Garcia. Schmidt & Barcellos (2007) suggested that higher plant heterogeneity in Yucumã could be determinant in that result; the authors, however, pointed out that none of the trails had their vegetational composition determined. Despite of that, Yucumã presented a higher number of exclusive species than Garcia, for both Pentatomoidea and Coreoidea.

M. fuscoclavata represents a new record for Rio Grande do Sul. The occurrence of this species in the northwest of the state was somehow expected, as it has been recorded for the province of Misiones, Argentina, and the municipality of Nova Teutonia, in the west of the state of Santa Catarina, Brazil (Brailovsky 1988, Brailovsky & Cadena 1992), both regions very close to the study area. *M. fuscoclavata* has a wide distributional range, from southern Mexico to northern Argentine (Brailovsky 1988). Brailovsky (1988) justifies the large distribution of *M. fuscoclavata* by its food preferences; this species feeds on *Schaueria calycobratea* Hilsenbeck & Marshall and other Acanthaceae that grow in secondary vegetation from tropical regions (Brailovsky 1988). In our study, we did not record host plants of the coreoids. However, as the samplings were performed along trails with secondary

vegetation, it is probable that the presence of *M. fuscoclavata* in all samplings may be due to the availability of its host plants along all the sampling periods.

This paper represents a first step towards the knowledge on assemblage structure and diversity patterns of Coreoidea. More field studies on different biomes and regions are needed, preferably with data on seasonality and host plants, which will allow further comparisons in beta-diversity studies.

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