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Structure and composition of a dung beetle community (Coleoptera, Scarabaeinae) in a small forest patch from Brazilian Pantanal

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Abstract. Here, we present and discuss data on the composition and structure of a dung beetles community attracted to human-dung baited traps, in an forest patch located in South Pantanal, Mato Grosso do Sul State, Brazil. We found 20 Scarabaeinae species, 13 of which are species with large geographical distribution. The species richness observated is simillar to others Scarabaeinae communities from Brazilian tropical rainforests. On the other hand, the relative abundance of the species is very atypical for tropical environments and followed a log-series model (χ^2=1.822, df=19, P>0.999). *Canthidium barbacenicum* was the most abundant species, had 46% of the 3950 sampled individuals.

Key words: dung beetles, pantanal, insect community, Scarabaeidae.

Resumo: Estrutura e composição de uma comunidade de besouros (Coleoptera, Scarabeinae) em um pequeno fragmento florestal do Pantanal brasileiro. Apresentamos e discutimos dados sobre a composição e estrutura de uma comunidade de besouros rola-bostas atraída a armadilhas iscadas com fezes humanas, em um fragmento florestal no sul do Pantanal, estado de Mato Grosso do Sul, Brasil. Encontramos 20 espécies de Scarabaeinae, pelo menos 14 das quais com ampla distribuição geográfica. A riqueza de espécies observada é similar a outras comunidades de Scarabaeinae de florestas tropicais do Brasil. Por outro lado, a abundância relativa das espécies é muito atípica para ambientes tropicais e tem uma distribuição que segue o modelo da série logarítmica (χ^2=1.822, df=19, P>0.999). *Canthidium barbacenicum* foi a espécie mais abundante, correspondendo a 46% dos 3950 indivíduos amostrados.

Palavras-chave: rola-bostas; comunidade de insetos; pantanal, Scarabaeidae.

Introduction

The Pantanal is a 139.700 km^2 sedimentary floodplain in the Paraguay river basin, located in the South America central region (Ponce, 1995). Its altitudes vary from 100 to 200 meters above the sea level (Tricart, 1982). The characteristics of the regional fauna and flora are most influenced by the flooding cycles of the Paraguay River than by the strong seasonal rainfall (Tricart, 1982; Novaes-Pinto, 1989). On the flooding period, large part of the Pantanal landscape is submerged by a approximately 4 m deeping water layer. During this period terrestrial animals take refuge in the few non-flooded areas.

Studies focusing on the zoogeography of the Pantanal are rare. Brown Jr. (1986) argued that the great climatic variability, and the unpredictability of resource availability in the Pantanal floodplain would be unfavourable conditions for the great majority of animal species. However, he hypothesise that those conditions would be very favorable to generalist predators, homeoterms, migratory and opportunists, in general, that inhabits wide geographical regions. Analysing the available data for lepidopterans, birds and mammals, Brown Jr. (1986) concluded that Pantanal floodplain shows a low rate of endemisms,

and that it should be seen more as a reproduction site for broad-distributed species than a source of evolutionary novelties.

The Scarabaeinae dung beetles are fundamental components of the organic matter cycling in terrestrial ecosystems, because these beetles are detritus-feeding insects, whose adults and larvae feed on dung, carrion and rotting fruits (HALFFTER & MATTHEWS, 1966). This group of insects is very diversified in tropical regions, and forms well-defined communities from both a taxonomic and functional point of view (HANSKI & CAMBEFORT, 1991).

Knowledge about the South American Scarabaeinae communities is still precarious. A lot of vegetation physiognomies are still without any information at the community level. The knowledge is restricted to some sites of the Amazon Basin (HOWDEN & NEALIS, 1975; PECK & FORSYTH, 1982; KLEIN, 1989), Atlantic Forest (LOUZADA, 1995; LOUZADA & LOPES, 1997) and sandbank beach forests ("restingas") (LOUZADA *et al.*, 1996).

This paper is a preliminary look at the dung beetle community of the Pantanal of Miranda and Abobral Rivers, Mato Grosso do Sul state, Brazil. Specifically in relation to the Pantanal region, this is the first study at community level involving dung beetles.

MATERIAL AND METHODS

The study was carried out from 9 to 11 February 1996, during the rainy season, before the peak of the flood season, in the Miranda/Abobral sub-region of the part of the Pantanal located at the state of Mato Grosso do Sul, Brazil. That subregion presents the most unpredictable hydrological regimen in all Pantanal (HAMILTON et al., 1996).

Data was collected inside a forest patch, called locally "Capão", with approximately 15 ha (19°34'36'' S; 57°01'06"W), near the Base de Estudos do Pantanal, a field station belonging to Universidade Federal de Mato Grosso do Sul. This capão is 3-4 m height elongated hill, rarely flooded, covered with forest, and surrounded by grassland.

We sampled dung beetles during 48 h, using six pitfall traps baited with human dung, placed along the forest patch. Each trap was a 15 cm diameter by 9 cm depth plastic jar, covered for protection against the rain, with 300 ml of detergent solution (1-2% in water). The bait was placed inside a small cup suspended by wires in the opening of the jar.

We compared the observed distribution of individuals by species with that expected for the logarithmic series model. The choice of this model was made because of the aspect of the Whittaker plot pattern generated by the program LOGSERIES (KREBS, 1989). The goodness of fit of the data to the model was tested by a Chi-square test, in agreement with MAGURRAN (1988).

RESULTS

We sampled 3,950 dung beetle specimnens, belonging to 20 species (Tab.1). At least 14 species, all those that were fully or almost identified present wide geographical distribution (Tab.1). Species collected belong to the tribes Coprini, Ateuchini, Canthonini, Eurysternini and Onthophagini No Phanaeini species was sampled, although some species from this tribe are known to occur in the Pantanal region.

The most abundant species were *Canthidium barbacenicum* Preudhommme de Borre, 1886 (46% of the individuals), *Onthophagus* aff. *hirculus* Mannerheim, 1829 (17%), *Uroxys* sp. (9,32%), *Ontherus sulcator* (Fabricius, 1775) (8,58%), and *Ontherus appendiculatus* (Mannerheim, 1829) (7,1%). Individuals of these five species represented 88% of all sampled dung beetles. The species abundance-rank distribution agrees with the log-series model (χ^2=1,822, df=19, P>0,999) (Fig.1).

DISCUSSION

Despite 14 species with wide geographical distribution, it is possible that some of those six species not identified have a distribution restricted to the central region of South America, a region whose fauna is notoriously not well known.

Table 1. List of species of dung beetles found in the study site in the "Pantanal do Miranda/Abobral". Total number of colected specimens and known geographical distribution for each species.

Species	Total	Geographical Distribution
Ateuchus sp	1	Brazil: 1
Canthidium barbacenicum	1817	Brazil: 1, 3, 4, 7; Argentina, Paraguay
Canthidium breve	110	Brazil: 4, 7, 8, 10, 14, 16; Argentina, Paraguay, Uruguay
Canthidium sp3	3	Brazil: 1
Canthidium sp4	1	Brazil: 1
Dichotomius bos	2	Brazil: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 17, 18; Bolivia, Argentina, Paraguay
Dichotomius nisus	1	Brazil: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 17, 18; Bolivia, Argentina, Paraguay, Colombia
Ontherus appendiculatus	280	Brazil: 1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 12, 13, 14, 15, 16, 17, 19; Bolivia, Argentina, Paraguay, Colombia
Ontherus sulcator	339	Brazil: 1, 2, 4, 8, 10, 11, 12, 14, 16; Bolivia, Argentina, Paraguay, Uruguay, Ecuador, Guyana, Peru, Venezuela
Pedaridium quadridens	16	Brazil: 1; Bolivia, Paraguay, Argentina
Trichillum externepunctatum	87	Brazil: 1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 12, 14, 15, 17; Bolivia, Argentina, Paraguay, Colombia, Uruguay
Uroxys sp	368	Brazil: 1
Canthon quinquemaculatum	48	Whole Brazil; Argentina, Bolivia, Paraguay, Peru, Colombia, Venezuela, Guyana, Panama, Trinidad
Canthon septemmaculatum	11	South America, except Chile; Panama
Canthon sp1	2	Brazil: 1
Canthon sp2	2	Brazil: 1
Pseudocanthon xanthurum	1	Brazil: 1, 2, 3, 4, 7, 9, 11, 12, 14, 15, 17,18, 19, 20, 21, Colombia, Argentina
Eurysternus caribaeus	116	South America, except Chile; Central America and south of Mexico
Eurysternus hirtellus	70	Brazil: 1, 2, 4, 7, 9, 10, 11, 14, 15; Argentina, Paraguay, Bolivia, Peru, Ecuador, Guyana
Onthophagus sp	675	Brazil: 1

Brazilian States: (1) Mato Grosso do Sul; (2) Mato Grosso; (3) Goiás; (4) São Paulo; (5) Distrito Federal; (6) Tocantins; (7) Minas Gerais; (8) Paraná; (9) Bahia; (10) Santa Catarina; (11) Amazonas; (12) Pará; (13) Maranhão; (14) Rio de Janeiro; (15) Espírito Santo; (16) Rio Grande do Sul; (17) Rondônia, (18) Pernambuco; (19) Ceará; (20) Rio Grande do Norte; (21) Acre.

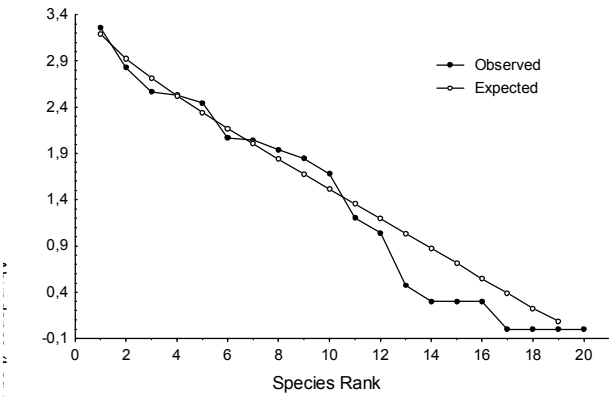

Figure 1. Comparison between the observed distribution patterns of abundance in the community of Scarabaeidae attracted by human dung in the South Pantanal (Brazil, Mato Grosso do Sul, Corumbá) and that one expected by a log-series model pattern. Statistically the two curves are identical (χ^2=1,822, df=19, P>0,999).

The species *Dichotomius bos* (Blanchard, 1845), *D. nisus* (Olivier, 1789), *Ontherus sulcator, O. appendiculatus* and *Trichillum externepunctatum*, are very common in pastures and, except for *O. sulcator*, also in the South American savanas (*cerrado*). *Pseudocanthon xanthurus* (Blanchard, 1845), *Canthon quinquemaculatus* Castelnau, 1840, and *C. septemmaculatus histrio* Serville, 1828, are found in practically the whole of Brazil and neighbouring countries.

Pedaridium quadridens Arrow, 1911, is a typical species from Chaco, and it is cited only for Bolivia, Argentina and Paraguay (Ferreira & Galileo, 1993; Martínez, 1988). Therefore, this is the first record for the Brazilian fauna.

Eurysternus caribaeus (Herbst, 1789) and *E. aff. hirtellus* Dalman, 1824 belong to species complexes, with several geographical variations not yet satisfactorily studied (Martínez, 1988). *Canthidium barbacenicum* and *C. breve* occur in the Cerrado and Chaco. Additionally, *C. breve* also occurs in Serra do Mar (Brazilian Highlands) and in the Pampas (South Brazil, Argentina and Uruguay).

The composition pattern of the community agrees with that proposed by Brown Jr. (1986). This author considered that a significant part of the Pantanal fauna would be composed by species of wide distribution. However, the relatively high number of species, similar to Atlantic Forest fragments (Louzada & Lopes, 1997) and tropical forests in Mexico (Halffter et al., 1992), that we found at the site (S = 20) seems not to confirm suppositions of Brown Jr. (1986) about the low species richness in the Pantanal.

This result is especially noticeable when we consider the small area of this and the others *capões* in the region. Three hypotheses can be proposed to explain the relatively high richness of species observed in the study site: 1) This environment presents pulses of food productivity as a consequence of the flooding regimen, allowing in this way the coexistence of a great number of opportunistic species; 2) The alpha diversity may be high because the beta diversity for all *capões* is also high; and 3) The dung beetle communities of the *capões* and that of the surrounding grassland may not differ and the

beetles would not differentiate the two environment. Assuming that passive sampling (Coleman et al., 1982) is not the process by which species accumulate with increasing area, and that the local species richness increases with the size of the populations, diversity in the *capão* would be reflecting that of an area several orders of magnitude greater.

The first hypothesis is based on the seasonal increase of the resource availability to the Scarabaeinae in the "capões". It occurs because in the flooding season mammals (including the domestic cattle), reptiles and birds stay on the "capões" to escape rising water (personal observation). This concentration of vertebrates in a small area represents a great production and concentration of dung and carcasses on the "capões" during flooding season. At least, theoretically, an increase in the availability of resources would permit the coexistence of several species as a consequence of reduced competition (May, 1975). The limited time of resource abundance may also benefit some opportunistic species and generate a pattern of great dominance by a few species. The community that we studied seems to show this pattern: its abundance distribution fits very well to a log-series model (Figure 1). This distribution pattern is expected in communities where resource partitioning is very heterogeneous (Magurran, 1988).

The second hypothesis is based on the fact that floristic composition of the "capões" is very variable. Some areas are dominated by amazon elements, other by Cerrado species, others by a flora originated from the Bodoquena plateau forest, to the east, and finally, the most common situation, the floristic composition is a mixture of all these influences (Allen & Valls, 1987). The major causes of this floristic diversity are local differences in soil fertility, drainage and water availability during dry season (Eiten, 1974). That environmental heterogeneity may increase the dung beetle beta diversity causing an increase in alpha diversity because of the increase in the persistence of rare species (Holt, 1993).

The third suggested hypothesis is that the dung beetle communities of the "capões" are composed most by species that are not restricted to forest environments. In this case, if local species richness increases with the pool of individuals, thus diversity in the "capão" would mirror the diversity of a area greater than the forest patch. In this way, it would be possible to maintain a high species richness of habitat generalist species whose populations are not subject to isolation and other factors related to island biogeography, which are known to act upon Scarabaeinae communities (Howden & Nealis, 1975; Klein, 1989; Louzada, 1995).

Independent of the causes for the observed pattern, a better knowledge about them has implications for the establishment of conservation plans to the Pantanal and new studies will be developed for test the proposed hyphotesis.

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