Do litter arthropods respond to microhabitat gradients? A case study from Brazilian sand dunes in semiarid Caatinga

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Abstract. Many studies on terrestrial arthropod assemblages rely on low taxonomic resolution (organisms identified to above species level) to discriminate sites with different structural complexities. Whole assemblages are seldom used to evaluate arthropods relationships with microhabitats. We tested if/how microhabitat influences terrestrial arthropods great groups relative abundances. Our study site was a semiarid sand dune field in the Caatinga (Bahia, Brazil), which harbours an endemic biota and presents low microhabitat complexity. We used a General Linear Model to test the influence of microgeographic position, area covered by litter and by trees+shrubs on the most abundant arthropod groups. We used as response variable one NMDS axis representing the relative abundance of arthropod great groups (assemblage structure) for diurnal and nocturnal/crepuscular faunas in the beginning and the end of the rainy season. For both seasons, there is a negative association between Formicidae and Coleoptera during the night and a negative association between of Formicidae and Araneae during the day. Such changes were not explained by the microhabitat variables. Lack of association between microhabitat and assemblage structure could mean that arthropods do not respond to those variables or could derive from responses of individual species.

Keywords: Arthropod Assemblage; Taxonomic Resolution; Structural Complexity; Microhabitat Selection

Resumo. Muitos estudos sobre assembleias de artrópodes terrestres baseiam-se em baixas resoluções taxonômicas (organismos identificados acima do nível específico) para discriminar áreas com complexidades estruturais distintas. Assembleias completas raramente são utilizadas para avaliar as relações dos artrópodes com micro-hábitats. Nesse trabalho, testamos se (e como) o micro-hábitat influencia as abundâncias de grandes grupos de artrópodes terrestres. Nossa área de estudo foi um campo de dunas semiárido na Caatinga (Bahia, Brasil) que contém uma biota endêmica e apresenta baixa complexidade de micro-hábitats. Usamos um Modelo Lineal Geral para testar a influência das posições micrigeográficas, da área coberta por folhiço e da coberta por árvores+arbustos sobre os grupos de artrópodes mais abundantes. Usamos como variável resposta um eixo gerado por NMDS, representando a abundância relativa dos grandes grupos de artrópodes (estrutura da assembleia) para as faunas diurna e noturna/crepuscular no início e final do período de chuvas. Para ambas as estações, houve uma associação negativa entre Formicidae e Coleoptera durante a noite e uma associação negativa entre Formicidae e Araneae durante o dia. Tais gradientes não foram explicados por variáveis de micro-hábitat. A ausência de associação entre micro-hábitat e estrutura da assembleia poderia indicar que os artrópodes não respondem a essas variáveis ou poderia derivar das respostas das espécies.

Título em português: Artrópodes de folhiço respondem a gradientes de micro-hábitat? Um estudo de caso em dunas arenosas na Caatinga semi-árida do Brasil. (Artrópodes de folhiço e gradientes de micro-hábitat)

Palavras-chave: Assembleia de artrópodes; Resolução taxonômica; Complexidade estrutural; Seleção de micro-hábitat

INTRODUCTION

Arthropod assemblages are often studied to describe community succession and restoration (Pik *et al.*, 2002; Longcore, 2003; Schnell *et al.*, 2003), to evaluate conservation status (Ribeiro *et al.*, 1998; Barrow *et al.*, 2007), and to address the distribution of species along environmental (Bach, 1993; Antvogel & Bonn, 2001; Davis & Scholtz, 2004) and disturbance (Lawton *et al.*, 1998; Eggleton *et al.*, 2002) gradients. Terrestrial arthropod assemblages are also used as indicators of climate change (Fleishman *et al.*, 2000; Andrew & Hughes, 2004, 2005; Hodkinson, 2005).

Arthropod assemblages are normally very diverse and abundant. Addressing these issues at species level imposes difficulties that lead to the use of lower taxonomic resolutions. Such approach can save time and resources (Ward & Larivière, 2004), but only if individual species within each taxon present similar responses to environmental gradients. Furthermore, Olsgard & Sommerfield (2000) and Báldi (2003) suggest that lower taxonomic resolution should be applied to study diversity in highly diverse and unexplored sites.

In aquatic environments, family level approaches are statistically vigorous and time- and cost-saving in depicting changes in community (Olsgard & Sommerfield, 2000). In spite of that, the issue has not yet been addressed for terrestrial communities (Pik et al. 1999). Given the high environmental complexity, high diversity, taxonomical impediments and problems in sampling, most studies of terrestrial arthropod assemblages either apply low taxonomic resolution or focus on one feeding guild or one taxa (usually families or orders) with few species (Basset *et al.*, 2004). This approach is overly restrictive and leads to very limited generalizations, possibly ne-

glecting patterns of the whole arthropod community (Schowalter, 2000; Basset *et al.*, 2004).

Very little is known about how small spatial scale heterogeneity affects arthropod assemblages despite its importance to understanding the relationship between habitat loss and arthropod diversity (Noemí-Mazía *et al.*, 2006). Most studies of terrestrial arthropods assemblages focus on landscape or geographic scales. Few studies associate environmental features to their composition, or community structure. Some studies that do access arthropod assemblages use richness or abundance of taxa (with different taxonomic resolutions) to discriminate areas that either have undergone different management techniques or impacts or areas that are in the process of recovery (Pik et al, 1999; Cagnolo *et al.*, 2002; Pik *et al.*, 2002; Schnell & Dangerfield, 2003; Basset *et al.*, 2004).

Studies that report relationships between features of terrestrial arthropod assemblages and environmental conditions have found interesting associations with microhabitat and microclimate. Antvogel & Bonn (2001) and Lassau *et al.* (2005) have found a positive association of richness, composition and abundance of most species of beetles and vegetation structure complexity. Guido & Gianelle (2001) found that microhabitat features of grasslands and woodlands influence differently the occurrence and abundance of species in one orthopteran assemblage, with some species being associated with shorter herbs while others with tall grasses or shrubs. Longcore (2003), using data sets sorted to species and morphospecies for an entire arthropod assemblage of coastal shrub steppe, in southern California, found that species richness and diversity was negatively associated with vegetation height, but positively associated with structural microhabitat complexity in intermediate heights. Studying a

diurnal assemblage dominated by tenebrionid beetles in Namibian desert, Holm & Edney (1973) found that time activity of species is correlated to microclimate (temperature and humidity) and that the microclimate is strongly affected by desert topography, which is differently explored by beetle species. Noemí-Mazía *et al.* (2006), studying carabeid and tenebrionid beetles in a Patagonian shrub steppe, found that biomass, activity, and diversity of beetles is higher in shrub patches than in bare soil.

Arid and semiarid environments are challenging for any living organism and, for arthropods, the avoidance of extreme conditions of heat and moisture are achieved by regulating time of activity and through microhabitat selection (Crawford, 1981; Cloudsley-Thompson, 1991; Costa, 1995). Habitat selection should differ between day and night. It should be a way of thermal regulation for surface dwelling arthropods during the day, whereas it should be more associated to predator avoidance during the night (Crawford, 1981). If species within arthropod groups have similar responses to the environmental gradients, we expect to find changes in the structure of whole arthropod assemblage when analysed with low taxonomic resolution. We further expect that this association during daytime to be more related to thermal regulation, and more related to predator avoidance during the night. Since arthropods are the main food source for desert vertebrates, their response to microhabitat gradients can influence the use of space particularly for less active species.

In this study, we focused on a whole ground-dwelling arthropod community of a sand dune region in the semiarid Caatinga. This desert-like environment presents two main microhabitat gradients that potentially confer protection to small organisms (Rocha *et al.*, 2004). In short, trees and bushes are shorter and have a patchier distribution on the dunes than they do in the flooding plains of the São Francisco River. There is no herbaceous covering even in the rainy season; therefore, most of the sandy soil remains uncovered, except for patches of leaf litter, Bromeliads (Bromelia antiacantha Bertol.) and a small cacti (Tacinga inamoena (K. Schun) N. P. Taylor & Stuppy). Rocha *et al.* (2004) described three orthogonal axes of microhabitat variation in these dunes. The first is a gradient of increase of covering by woody species and of litter; the second represents a vegetational and topographic gradient of increase density of cacti and bromeliad towards valleys; and the third axis represents a topographic gradient from summits to slopes. In fact, the diurnal epigeous lizards respond to these gradients (Rocha & Rodrigues, 2005), but not the nocturnal anuran, as observed by one of us (Damasceno, unpublished data).

Here we (i) describe the local ground-dwelling terrestrial arthropod assemblage, in terms of great groups; (ii) describe microhabitat gradients; and (iii) test the hypothesis that the whole arthropod assemblage composition is correlated to environmental features such as shaded and moist microhabitats. We test this hypothesis separately for the diurnal and crepuscular/nocturnal assemblages and for the beginning and end of the rainy season, since differences are expected due to microclimate changes in both phases of the day and in both periods of the year.

Materials and Methods

Study Area

The study area, the sand dunes of the São Francisco River, is the most important area in terms of biodiversity in the Caatinga biome due to its high

endemicity of species (Rodrigues, 1996; Velloso, 2002). Among studied taxa, there is a profuse endemic herpetofauna (Rodrigues, 1996) and one endemic species of spiny rat (Rocha, 1995). Arthropods from the area are still poorly studied, and still one arthropod species, a Solifugae, *Mummucia mauryi* (Xavier & Rocha, 2001), has been described.

We developed the study in the dunes next to the village of Ibiraba (10º48'S 42º50'W), state of Bahia, Brazil, a region included in the Caatinga Morphoclimatic Domain. The study area was only 300m away from the village. This region presents the highest temperatures in the state of Bahia (exceeding 26.2ºC) and have a mean annual rainfall of 692mm (ranging from 400 to 800mm), with rains falling typically from October to March (Bahia-Seplantec, 1978). The sand dunes of Ibiraba have sharp morphology, with summits standing 40m above river level and 20m above the dunes valleys. Rocha *et al.* (2004) present a thorough description of the vegetation.

Fieldwork

We conducted two trips (of 15 sampling days each) to the site, one in the beginning of the rainy season (December 1996) and another towards its end (February/March 1997). We used 117 pitfall traps (1996) and 119 pitfall traps (in 1997) disposed in a sampling grid with lines and columns 7m apart. The first line was parallel to the first sampled summit and columns went down the slopes sampling a couple of sets of each microgeographic feature. A pitfall trap consisted of three radial 1.5 x 0.4m plastic drift fences converging on a 20L dry bucket. Such distance avoided that sampling points were restricted to dune summits, slopes or valleys. Microgeographic position may be important for arthropods because it modulates exposure to wind, valleys for example being less exposed to wind than summits. Grids of
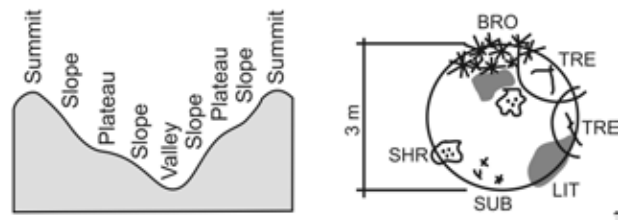

Figure 1. Measured microhabitat features. Left: Schematic profile of the dunes, showing summit, slope, plateau, and valleys (microgeographic positions). Right: Representation of the scale drawings used to quantify environmental variables: area covered by litter (LIT), bromeliad (BRO), subshrubs (SUB), shrubs (SHR) and area of projection of trees (TRE).

consecutive trips were plotted 250m apart from each other. We checked traps daily at dawn (0600 to 0900h) and dusk (1600 to 1800h) and collected all trapped arthropods larger than 1mm, preserving them immediately in 70% ethanol solution.

We produced drawings of a 3m diameter circle centred in each trap and measured the projected area of (1) litter, (2) bromeliad *B. antiacantha*, (3) subshrubs, and (4) shrubs+trees (Fig.1, right). The areas of shrubs and trees were computed summing projected area of each individual plant, allowing for superposition. We also recorded the microgeographic position of the trap (valley, slope, plateau and summit – Fig.1, left). We consider that these microhabitat descriptors influence most of the important changes that could affect activity of ground-dwelling arthropods in the area.

Sample processing

Given the great number of arthropods trapped, we randomly choose six days and six nights to perform analysis. We identified arthropods to major taxonomic groups (usually order or family), following identification keys by Borror & Delong (1998), Wheeler *et al.* (2001) and Brusca & Brusca (2002). Acari was extremely hard to identify below superorder and we considered adequate to separate Formici-

dae from other Hymenoptera due to its distinctive biology. We quantified the area (cm^2) of the environmental variables from our field drawings using the software SIGMA SCAN PRO 5.

Analysis

We tested the hypothesis that changes in relative abundance of arthropods in the assemblage (dependent variable) respond to changes in microhabitat (factor). A test was performed for each period of the year and for each phase of the day.

In order to represent the dependent variable, we created a synthetic axis using Non-Metric Multidimensional Scaling (NMDS), an iterative tool usually suited to retrieve patterns of ecological community data (McCune & Grace, 2002). In order to assess the most important patterns and to reduce noise we included in analysis only the most abundant arthropod groups: Acari, Araneae, Coleoptera, Formicidae, Orthoptera, and Thysanura. The synthetic axis for each analysis was built from an abundance matrix previously transformed dividing the value of each cell by the total of each line, in order to control for variations in counts. We removed from the analyses four traps (out of 117) considered as uninformative outliers. They consisted of traps with very large numbers of Formicidae or Acari. Occasional resources in a trap could attract hundreds of ant specimens, biasing their abundance estimation. Acari characteristically show aggregated spatial distribution that may not reflect effects of microhabitat features. We used Sorensen distance measure and random initial configurations (McCune & Grace, 2002) and performed 500 runs with real data in order to avoid local minima. We considered the final solution stable if the standard deviation in stress over the preceding 100 iterations was lower than 0.005. Monte Carlo test was performed with 999

runs to test the hypothesis that the stress in the reduction of the abundance matrix differs form those of randomized matrices (McCune & Grace, 2002), that is, to evaluate if structure in the data was stronger than expected by chance. We assessed the quality of the reduced axis by comparing plots distances in the original data with distances in the reduced dimension using a Mantel randomization test (Manly, 1997). This test was performed using Sorensen distance for the original matrix and Euclidean distance for NMDS scores in 1000 runs. We used PCORD (version 4) to run NMDS and Mantel analysis.

We created synthetic axis of environmental variables using Principal Component Analysis (PCA) based on correlation coefficient matrix (SPPS for Windows version 13). We only extracted axes with eigenvalues greater than one. Varimax rotation was applied to simplify the interpretation of axes (McCune & Grace, 2002). We transformed the variable "microgeographic position" into two dummy variables. To preclude the collinearity effect, the third level of the categorical variable (the most frequent one) was excluded of the analysis (Kachigan, 1986). PCA for 1996 had one trap excluded from the analysis due to an extremely high value of subshrub coverage, which generated a spurious gradient on PCA. We deemed the exclusion adequate because values for this variable were mostly very low but had an extremely high value in this trap (way above other variables values) which would stray the analysis from the most representative microhabitat variation. We then tested the effect of microhabitat principal components on NMDS synthetic axis of arthropod abundances, using a General Linear Model (GLM). We added the positions of the traps (X and Y coordinates) as covariates to the analysis to address spatial autocorrelation problems.

Table1. Frequency of arthropod groups in December 1996 and February/March 1997 by period of activity. Groups used in NMDS are shown in bold.

	Total	December 1996		February/March 1997	
		Night	Day	Night	Day
Acari	**4,448**	**140**	**74**	**3,864**	**370**
Formicidae	**3,510**	**1,145**	**708**	**1,145**	**512**
Coleoptera	**2,679**	**1,068**	**123**	**1,185**	**303**
Araneae	**2,459**	**863**	**946**	**249**	**401**
Thysanura	**477**	**127**	**160**	**85**	**105**
Orthoptera	**394**	**267**	**72**	**39**	**16**
Diplopoda	194	142	3	47	2
Collembola	173	40	10	57	66
Chilopoda	80	25	0	55	0
Pseudoscorpiones	74	13	3	14	44
Scorpiones	63	52	0	11	0
Other Hymenoptera	58	33	18	7	0
Blattodea	38	20	4	13	1
Hemiptera	36	24	4	4	4
Phasmida	33	23	3	7	0
Mantodea	27	14	7	3	3
Homoptera	20	13	2	4	1
Solpugida	20	6	10	1	3
Embioptera	19	8	4	0	7
Phthiraptera	9	9	0	0	0
Isopoda	1	0	0	1	0
Total	14,812	4,032	2,151	6,791	1,838

RESULTS

The arthropod assemblage recorded in this study comprised 14,812 individuals from 21 great groups, most of them belonging to Class Insecta (Tab.1). Arthropod fauna in the dunes proved to be mostly nocturnal/crepuscular (75% of individuals). High levels of diurnal activity were present in Araneae, Thysanura, and Solpugida in both field campaigns. Collembola, Pseudoscorpiones, Hemiptera, Mantodea, and Embioptera were more abundant in the end of the wet season (Feb/Mar-1997) than in its beginning.

In each trip, 20 of the 21 recorded groups were present. Isopoda was only present in 1997 and Phithiraptera was only sampled in 1996. We found a very high number of Acari (almost 2 000 individuals) active during the night in 1997, but as this was due to individuals captured by only two traps in a single night and those traps were removed from analysis. Disregarding Acari, Formicidae is the most abundant group, followed by Coleoptera and Araneae.

Most of the groups (over 75% of occurrence) were much more frequent in the beginning of the rainy season, while five of them (Acari, Collembola, Chilopoda, Isopoda and Pseudoscorpiones) were more frequent by the end of the rainy season, two of which (Acari and Isopoda) show a non reliable pattern. The other groups did not show many differences in abundance between trips, including Formicidae, Coleoptera and Thysanura, which were used in the analysis.

Most of the traps were located on slopes in both trips. Litter and shrubs+trees were the variables that presented the smaller number of zero values, also providing the largest areas. Other vegetation

features had a high number of zero values and did not add as much to coverage area. PCA extracted two microhabitat principal components with eigenvalues higher than one and the same pattern of association between variables was found for both trips. Together, both Principal Components (PC) explained only 51% of the environmental variation for 1996 (PC1 = 32% and PC2 = 19%) and 49% of 1997 (PC1 = 30% and PC2 = 19%).The first PC represented a positive association of litter (loadings: 1996 = 0.65 and 1997 = 0.54), bromeliad (1996 = 0.81 and 1997 = 0.55), valley (1996 = 0.66 and 1997 = 0.58) and negative association with summit (1996 = -0.31 and 1997 = -0.74). The second PC represented a negative association of subshrubs (1996 = -0.77 and 1997 = -0.76) and trees+shrubs (1996 = 0.67 and 1997 = 0.64).

Results for NMDS represented, for the 1996 trip, 62% and 78% of the matrices original variation for night and day, respectively. For 1997, the values were of 63% (night) and 56% (day). Final stress was of 36.3% (1996 night), 26.5% (1996 day), 34.5% (1997 night) and 38.9% (1997 day). NMDS axes mainly represented changes in relative abundances of Formicidae, Coleoptera, and Araneae (Fig.2-3). The association between Formicidae and Coleoptera changed from a negative association during the night period to a positive association during the day. Araneae showed a negative association with Formicidae during the night in 1996 and during night and day in 1997. Thysanura showed negative association with Formicidae and Coleoptera and positive association with Araneae.

We decided not to use the synthetic axes generated by PCA analysis to evaluate the association between microhabitat and arthropod composition as the first two PCA axes retained only half the
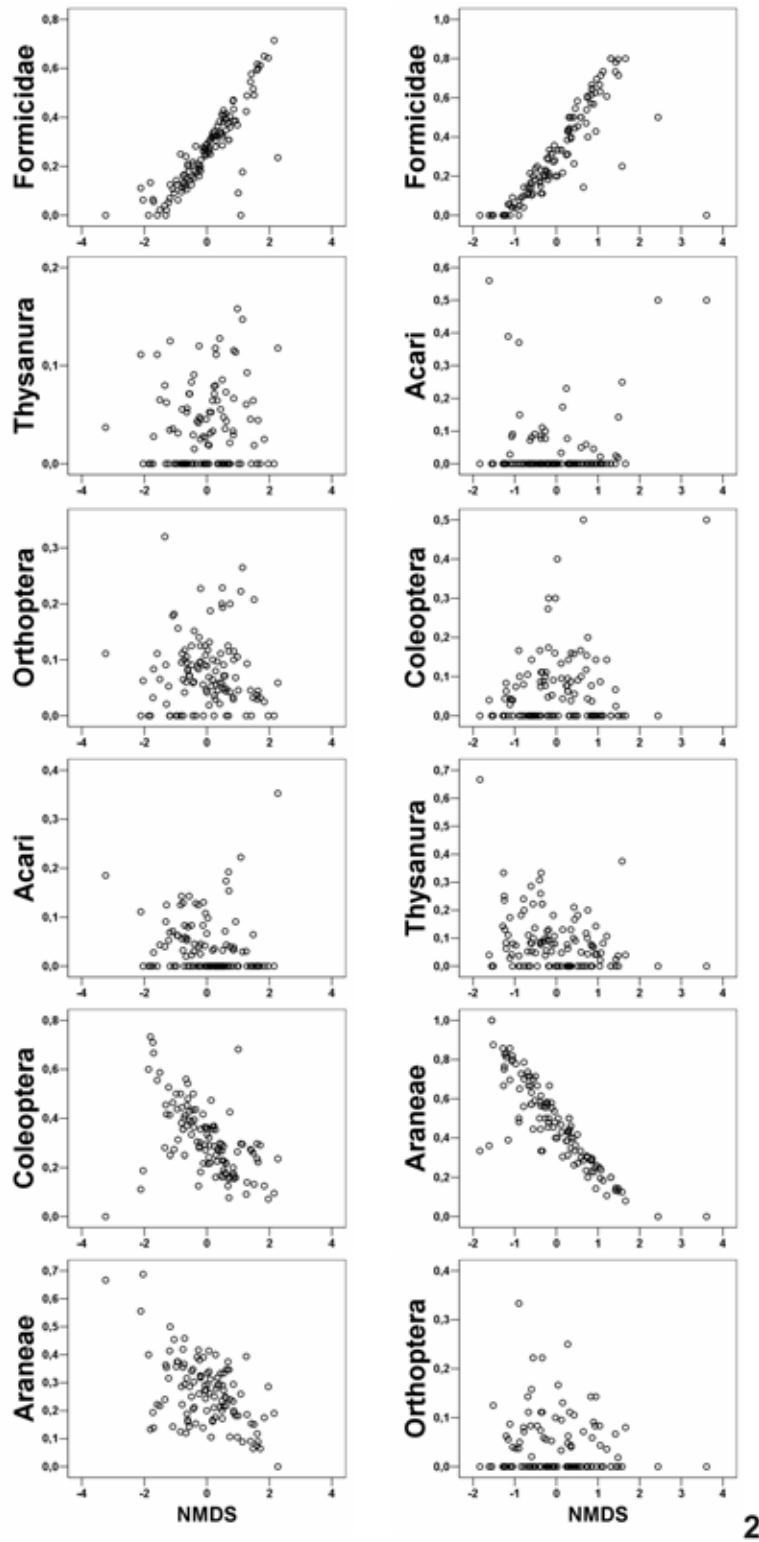
Figure 2. Relationship between arthropods abundances and NMDS scores in December 1996 (night = left, day = right). Arthropod groups are ordered by reciprocal averaging scores.
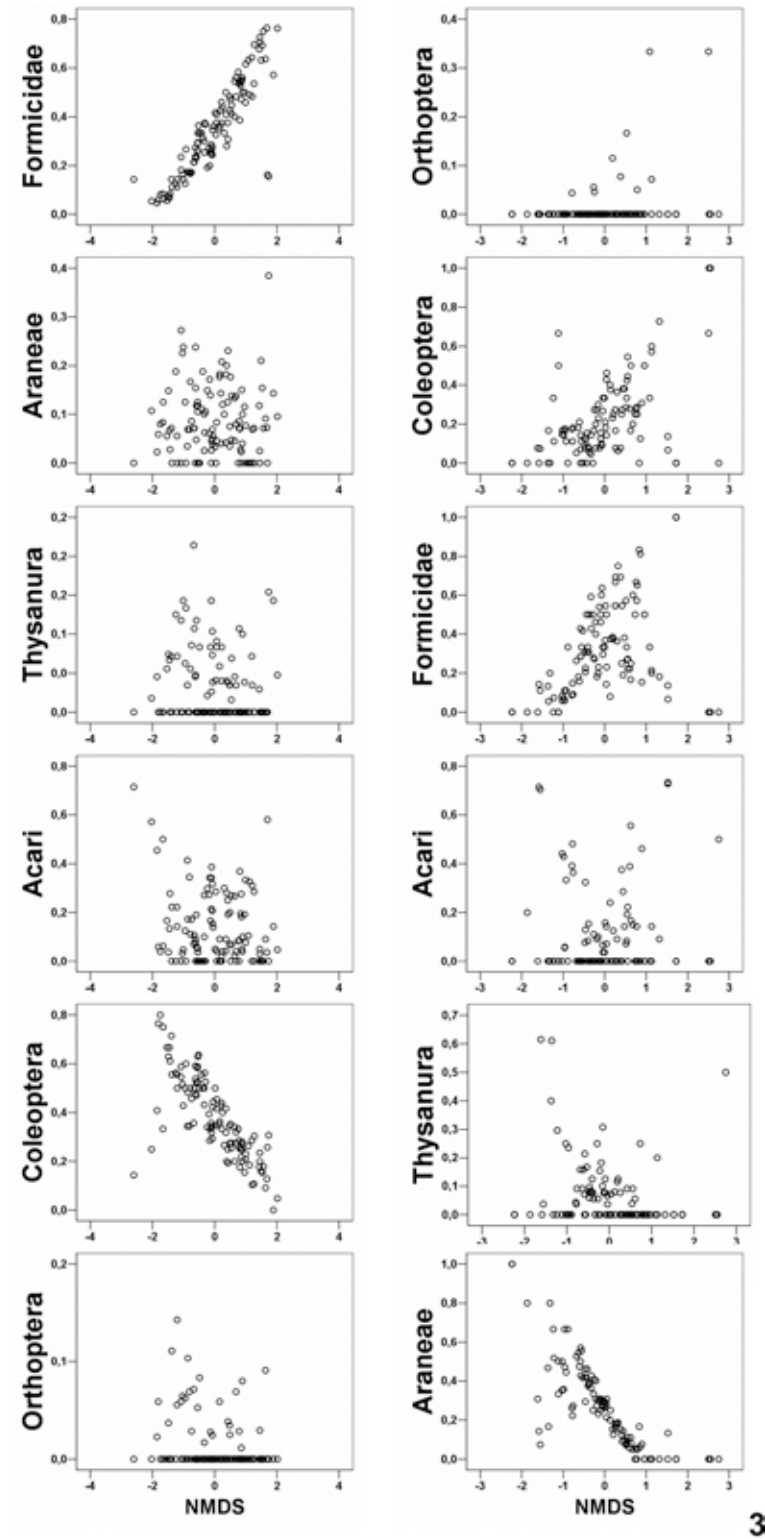
Figure 3. Relationship between arthropods abundances and NMDS scores in February/March 1997 (night = left, day = right). Arthropod groups are ordered by reciprocal averaging scores.

variation of microhabitat. Instead, we used a set of three relatively orthogonal primary variables that potentially have greater effect on arthropod composition as they may have critical effect on microclimate. Microgeographic position can be associated to wind exposure, a great factor for water loss. Valleys should be more protected from wind than summits. Trees and shrubs may provide shade and

consequently more suitable thermal condition for arthropods (HOLM & EDNEY, 1973; CRAWFORD, 1981; NOEMÍ-MAZÍA, 2006). Litter provides a mild and moist shelter for many arthropod species (CRAWFORD, 1981).

There was no relationship between arthropods assemblage composition (NMDS) and the environmental variables (litter, bromeliad, and microgeographic position) or trap distance. The GLM was not
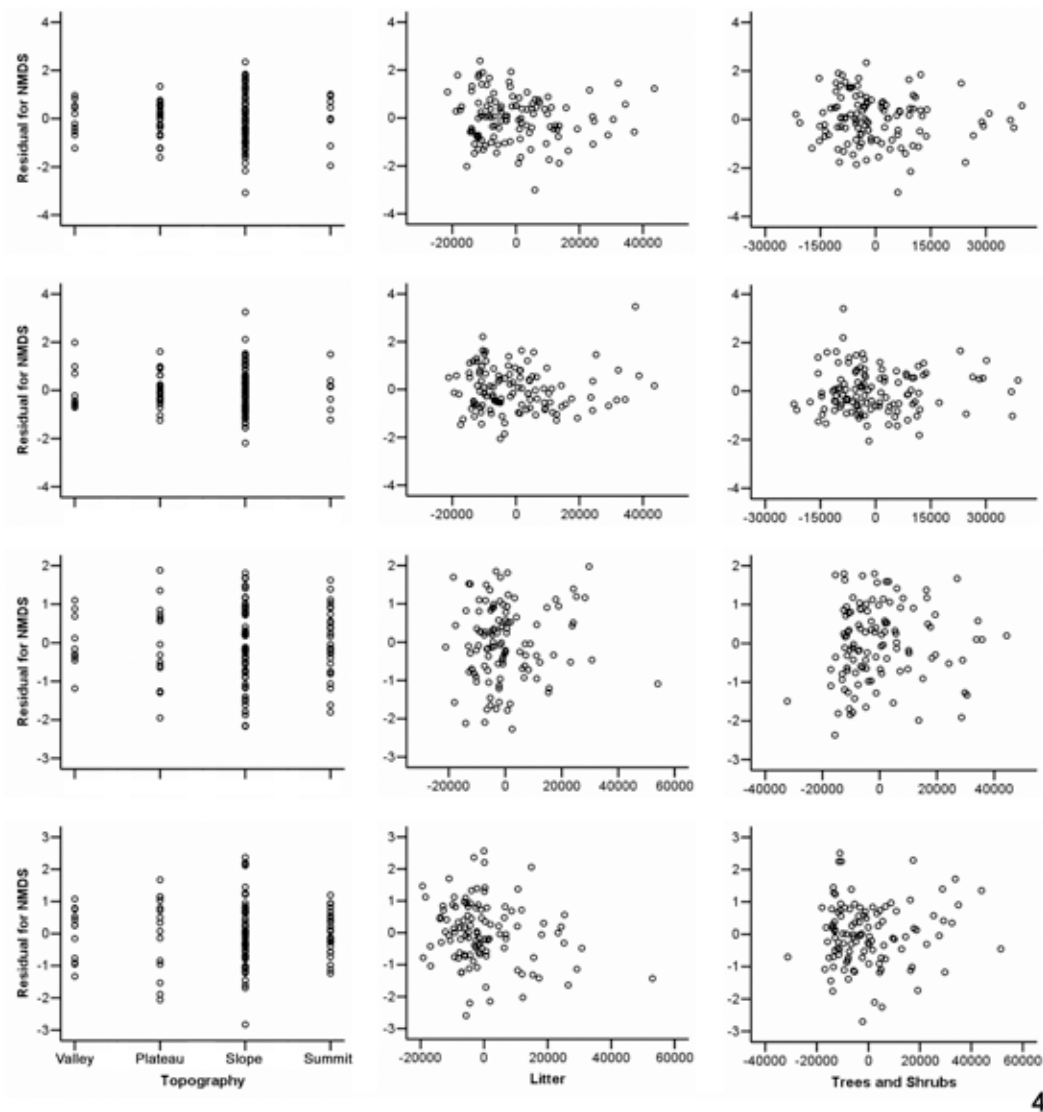

Figure 4. Partial plots for the General Linear Model. Rows, from top to bottom: December 1996 day, December 1996 night, February/March day and February March night.

significant for any period: 1996, night (F = 0.851, p = 0.548), day (F = 1.680, p = 0.121); 1997, night (F = 1.201, p = 0.309), day (F = 1.924, p = 0,073). Thus we cannot explain the variation of arthropod composition upon the variation of the primary environmental variables used in the test. Partial plots for the GLM are shown in Fig.4.

Discussion and Conclusion

Most of the great groups of arthropods found in the Brazilian sand dunes in semiarid Caatinga is considered as common to most arid environments (Crawford, 1981; Cloudsley-Thompson, 1991; Costa, 1995). Beetles (Coleoptera), spiders (Araneae), silverfish (Thysanura), mites (Acari), ants (Formicidae), scorpions (Scorpiones), solpugids (Solpugida), and grasshoppers and locusts (Orthoptera) are some of the most common groups of arthropods found in deserts. A higher level of activity at night (found in most groups) seems to be a common mechanism to avoid high temperatures during daytime, also described in the same literature.

At the beginning and the end of the rainy season, the abundance of Formicidae, Coleoptera and Thysanura showed no drastic changes, while Araneae and Orthoptera showed a decrease and only Acari an increase of abundance. If such differences represent a seasonal pattern (which our data is not able to formally evaluate), they might be due to reproductive activity. Many orthopterans finish their development by the end of the rainy season and while juveniles are associated to the soil, adult orthopterans are mainly associated to shrubs and trees (Crawford, 1981). Since pitfall sampling is biased to capture surface dwellers (Pik et al., 1999), this explains the high proportion of juveniles captures. Many species of spiders live for only one year (from

birth to reproduction) and therefore tend to have a periodic reproductive season followed by the death of the individual (Crawford, 1981). This may explain differences in abundance, but the literature on these matters are scarce for any group (except maybe for Tenebrionid beetles), making generalizations somewhat faulty. Similar abundance for Coleoptera, Thysanura and Formicidae could be explained by shifts in dominance of individual species between trips, absence of a defined reproductive season (with different species reproducing at different times along the year), or it could be derived from a certain environmental constancy. Rocha et al. (2004) found that in this particular area of the Caatinga most species keep their leaves along the dry season and that there is a continuous turnover of leaves all year long.

The PCA extracted two microhabitat components with same association between primary variables for both periods, showing a strong association (high loading values) among variables within each PC. The first PC was related to an increase of bromeliad and litter towards the valleys. This PC can be interpreted as being related to protection of small organisms within the bromeliads spiny leaves. The second PC had a negative association of subshrubs and trees+shrubs which can be interpreted as avoidance to extremes of heat and low moisture. Rocha et al. (2004), which conducted a study in the same site using a larger set of data and more environmental variables, found three components with different association of variables. The first PC represented a positive association between wooden plants and litter. The second PC was an association of increasing bromeliad and cacti towards the valleys. The third PC was a topographic gradient from summits to slopes. In comparison with the surrounding Caatinga, this sand field seems to rep-

resent a much more constant supply of resources, since plants species bud new leaves all year long and, even in the dry season, at least 50% of plant species keep their leaves (Rocha *et al.*, 2004).

The ordination of the arthropod community, despite the low taxonomic resolution used, retrieved a distinct pattern for days and nights for both trips. Despite such consistency, arthropod great groups' composition was not related to environmental variables in spite of studies that relate terrestrial arthropod species richness, abundance or composition to microhabitat features such as vegetation coverage, complexity and topography (Holm & Edney, 1973; Antvogel & Bonn, 2001; Guido & Gianelle, 2001; Longcore, 2003; Lassau *et al.*, 2005; Noemí-Mazía *et al.*, 2006). This suggests that either the great groups of arthropods from the area do not respond to habitat features related to shaded and moist microhabitats or that the taxonomic resolution used is not suitable to assess such associations.

Several authors state that the presence of microhabitats such as litter coverage, shading and vegetation complexity influences arthropods species distribution, composition and abundance (Holm & Edney, 1973; Crawford, 1981; Cloudsley-Thompson, 1991; Bach, 1993; Antvogel & Bonn, 2001; Guido & Gianelle, 2001; Longcore, 2003; Lassau *et al.*, 2005; Noemí-Mazía *et al.*, 2006). Most studies for terrestrial environments use differences in diversity or abundance to discriminate areas such as natural and impacted or undergoing restoration and still they tend not to include a great array of groups. Many use focal taxa under different resolutions to test their discriminatory power. Cagnolo *et al.* (2002) studying two areas in restoration after cattle exclusion (7 and 19 years) found differences in species composition of overall arthropod

assemblage. Studying coleopterans at species levels and sorted into feeding guilds, they also found that the areas had different species abundance and composition and that feeding guild structure was simpler in the area with more recent cattle exclusion. Pik *et al.* (2002) were able to discriminate between apparent similar sites comparing composition and abundance sets of data for an arthropod assemblage and for ants sorted to genus and morphospecies. Basset *et al.* (2004) also found high taxonomic level sets of multitaxa adequate for discriminating disturbances in tropical forests, but sets of focal taxa had the most discriminatory power.

These studies rely on the argument that arthropod community structure is greatly influenced by vegetation characteristics related to environmental complexity (Antvogel & Bonn, 2001; Lassau *et al.*, 2005). But studies that relate higher taxa and microhabitat structural complexity are scarce. Low taxonomic resolution is a common practice to discriminate sites, but its use to test association between arthropods and microhabitat features seems an unorthodox practice either for aquatic or terrestrial environments. Certainly, the use of low taxonomic resolution is much time and costs saving, but its use to discriminating sites is restrictive and neglects aspects of microhabitat selection. Few studies have related microhabitat features and arthropod composition, abundance and richness, and none of them approach them with a multitaxa set of data at low resolution.

Using high taxonomic levels to address terrestrial arthropods issues seems to be an unexplored approach though it is a proficuous tool. As far as we know, this work is the first one to address the effects of microhabitat gradients in the composition

of several arthropod taxa using low taxonomic resolution. The ordination of the assemblage revealed a constant and different pattern of shift in abundance of Formicidae, Coleoptera and Araneae for days and nights. Nevertheless we were not able to detect a relationship between arthropods composition and the microhabitat variables, even considering the drastic differences that should exist between different microhabitats, at least during the day. We encourage studies that make similar tests with distinct ecological systems, since our results may indicate that low taxonomic resolution is unsuitable to assessments of microhabitat effects in arthropods communities.

Acknowledgements

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