

Soil oribatid mite in four typical vegetation communities of Misiones forest in the Iguazú area, Argentina

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Abstract – The objective of this work was to assess the soil oribatid mite communities in four sites of the Upper Paraná Bosque Atlántico, in the Iguazú National Park, Argentina and in surrounding areas: bamboo forest, palm forest and two mixed forests. A comparison between each pair of sites, based on the presence-absence of oribatid species, was performed using Jaccard's index. This is the first systematic sampling of oribatid mites in this area. A total of 56 genera and 96 oribatid species were found, 25 and 49 of them, respectively, are new citation for Argentina. The highest similarity was found between mixed forests. Almost 68% and 34% of the genera were cited for similar biotopes in Brazil and Paraguay, respectively.

Index terms: bamboo, biogeography, bioprospection mixed forest, palm, soil mites.

Ácaros oribatídeos do solo em quatro comunidades vegetais da floresta de Misiones, na região de Iguazú, Argentina

Resumo – O objetivo deste trabalho foi avaliar as comunidades de oribatídeos em quatro sítios da Mata Atlântica do Alto Paraná, na área do Parque Nacional Iguazú, Argentina, e em áreas adjacentes: floresta de bambu, floresta de palmito e duas florestas mistas. Foi feita uma comparação de cada par de sítios, com base na presença/ausência de oribatídeos, por meio do índice de Jaccard. Esta é a primeira amostragem sistemática dos oribatídeos dessa região. Cinquenta e seis gêneros e 96 espécies de oribatídeos foram encontrados, dos quais 25 e 49, respectivamente, são citados pela primeira vez para a Argentina. A maior similaridade foi encontrada entre as duas florestas mistas. Quase 68% e 34% dos gêneros já foram coletados em biótopos similares no Brasil e no Paraguai, respectivamente.

Termos para indexação: bambu, biogeografia, bioprospecção, floresta mista, palmito, ácaros do solo.

Introduction

The Atlantic Forest ecoregion is the most threatened tropical ecosystem on the planet (Galindo-Leal & Gusmão Câmara, 2003). However, the remnants still hold high biological diversity and endemism (Myers, 2000) that are scarcely legally under protected areas (Tabarelli et al., 2005). The Atlantic Region is extremely heterogeneous in structure and species composition as a result of different climatic and edaphic conditions across its distributional range. Accordingly, major different forest ecosystem types have been recognized: the Atlantic Rainforest and the

inland semideciduous Atlantic Forest (Oliveira Filho & Fontes, 2000). The semideciduous Atlantic Forest occupies areas of southern Brazil, east of Paraguay and north of Argentina. This biome suffered a hard exploitation during the last century (Holz & Placci, 2003; Campanello et al., 2009), with less than 10% of its original surface being preserved at present. In the Argentinian portion, the best preserved continuous remnants occur, representing 44% of the original covering in this country (Campanello et al., 2007), whose largest preserved area is located in the Iguazú National Park (65,000 ha) and surrounding

areas in the north of Misiones province (DiBitetti et al., 2003).

The complexity and diversity of oribatid mites in tropical areas and the lack of specialists in the region make oribatids a poorly known group in these areas. Despite the Argentina holding of the best preserved areas of the Semidecidual Atlantic Forest and the importance of Oribatid communities as ecological indicators, no bio-prospecting for mites have been performed there.

The objective of this work was to assess the soil oribatid mites communities composition in four vegetation sites in this region, the relations between mite community composition and vegetation cover, and also to compare the mite communities among sites, and among areas of Brazil and Paraguay belonging to the same biogeographical region.

Materials and Methods

The climate in the Atlantic Forest of Argentina is subtropical with monthly average temperature variations of about 10°C between the warmest and the coldest months, with certain probability of freezing temperatures from middle June to middle September. Annual precipitation ranges from 1,900 to 2,100 mm (Ligier, 2000). Rainfall is evenly distributed along the year, but short dry spells can occur. The topography of this region in northeastern Argentina is undulated, as a result of a dense network of rivers eroding a basalt formation (Tujchneider et al., 2007). The soils are derived from basaltic rocks with a high concentration of Fe, Al and Si, and are well drained (Ligier, 2000).

Two sites were sampled inside the Iguazú National Park: palm forest or “Palmital” (PA) and bamboo forest or “Bambusal” (BA), separated 20 km one from another (Figure 1). The first is a forest dominated by

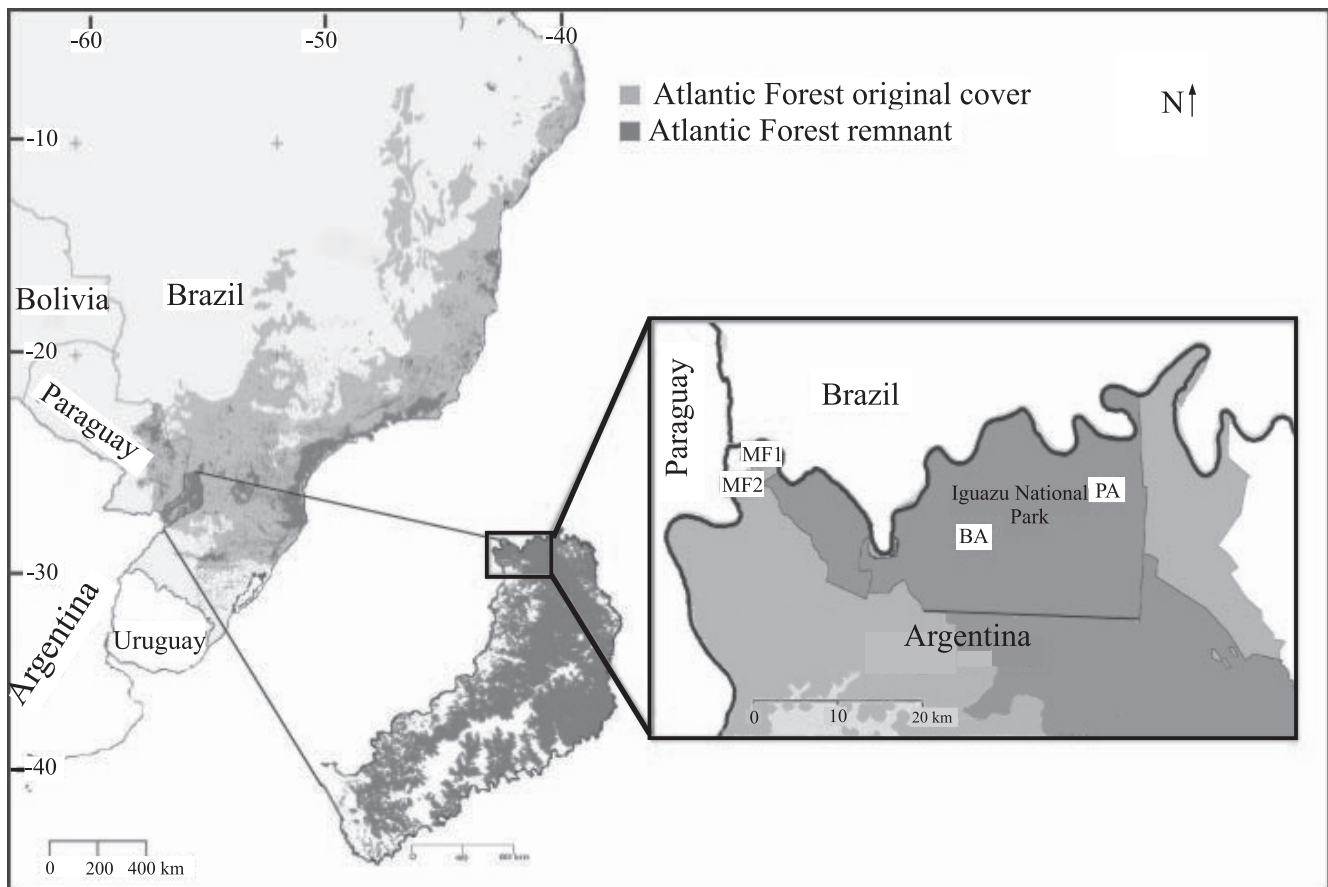


Figure 1. Map of the sample sites. MF1 and MF2, mixed forests 1 and 2, respectively; BA, bamboo forest, PA, palm forest. Map modified from Di Bitetti et al. (2003).

heart-of-palm trees (*Euterpe edulis*), in a density near 728 individuals per hectare, and with the sporadic presence of other trees like rosewood (*Aspidosperma polyneuron*), Lauraceae (specially *Nectandra megapotamica*), and *Chrysophyllum gonocarpum* (Srur et al., 2007). This palm constitutes a dense cover between 4 and 18 m height. The understorey of palm forest is shadowed, wet and open with fern, shrubs and tree saplings (Gatti, 2005). Bamboo forest includes big forest gaps dominated by woody bamboos (*Chusquea ramosissima* and *Merostachys* spp.) that form impenetrable thickets in the understorey. Big gaps and open canopy areas with isolated trees and scarce diversity constitute the forests. There are sites associated to natural or anthropogenic disturbs. The organic soils were deep with high content of bamboo leaf.

Other two sample sites were located outside the National Park, and were constituted by native and exotic tree species (mixed forests 1 and 2 – MF1 and MF2, respectively) (Figure 1). They were located 24 km away from the closest site in the National Park, and were separated one from another by 3 km. These forests presented a mixed tall and open canopy. Some of the dominant canopy trees were: *Balfourodendron riedelianum* (Engl.) Engl., *Nectandra megapotamica* (Spreng.) Mez, *Bastardiopsis densiflora* (Hook. & Arn.) Hassler and *Lonchocarpus leucanthus* Burkart. Common subdominant tree species are *Sorocea bonplandii* (Baill.) W.C. Burger, Lanj. & Boer *Actinostemon concolor* (Spreng.) Muell. Arg., *Trichilia catigua* A. Juss. and *Trichilia elegans* A. Juss. The understorey is dense, wet, shadowed, and presents some Piperaceae, Bambusaceae, lianas and different native and exotic herbs.

Ten samples with 8-cm diameter and 5-cm deep were taken from each site in November 2006. They were distributed along a transect, with a distance of 5 m between samples. Microarthropods were extracted by Berlese funnels and preserved in ethanol 70%. Oribatid mites were identified to species level using identification keys (Balogh & Balogh, 1988, 1990, 1992a, 1992b). Specific taxonomical bibliography was used, in order to check some determinations. The classification system adopted was based on that of Subías (2004). The term “cf.” (in some of the listed species) refers to an uncertainty in the identification. A comparison among sites, based on presence-absence of oribatid species, was made

using Jaccard's similarity index, recommended to work with qualitative data (Moreno, 2001). Species composition was compared with those found in nearby areas of Brazil and Paraguay, based on bibliography (Pérez-Iñigo & Baggio, 1980, 1985, 1986, 1988, 1989, 1991, 1993, 1994; Mahunka, 1984; Oliveira et al., 2005;).

Results and Discussion

No systematic studies on oribatid fauna were made in the Iguazú area before this study. Only eight phthiracarid species were cited by Mahunka (2004) from Iguazú National Park and Iguazú Falls. In the present work, a total of 56 genera and 96 species of oribatid mites were found (Table 1). Twenty-five genera and 49 species constitute new citations for Argentina. The number of species was similar among sites: PA = 35, BA = 41, MF1 = 45, MF2 = 51. Many species were recorded in only one site in this study: 6 species in MF1, 14 in MF2, 12 in BA and 15 in PA. Some genera were represented by different species in different sites (e.g. *Schelorbitates*, *Lamellobates*). Some phylogenetically associated species groups showed a clear distribution, and were present in bamboo forest and in palm forest, but not in the mixed forests, or vice-versa. All of Plateremaeoids (species 22 to 26, numbered in Table 1) were present only in BA and PA, whereas all Suctobelbids (species 59 to 64) were present only in mixed forests. Some haplozetid-protoribatid species (two *Protoribates*, two *Indoribates* and one *Lauritzenia* (species 83 to 87), but no other haplozetid species, as *Rostrozetes* or *Pelorbitates*, showed the later distribution too.

The highest similarity value among sites (Jaccard's index) was found for MF1 and MF2 (Table 2). The sampled area in this study shared almost 68% of the genera collected with similar biotopes of south of Brazil (Pérez-Iñigo & Baggio, 1980, 1985, 1986, 1988, 1989, 1991, 1993, 1994; Oliveira et al., 2005), and 34% with those of Paraguay (Mahunka, 1984). As expected, the number of shared species was higher than the number of shared genera in both cases (Table 3). However, these results are not definitive, because a stronger sampling effort in our work certainly could result in a higher number of collected species, whereas the data taken from bibliography are not exhaustive. Oliveira et al. (2005) reported that the species mentioned in their paper represented about 20% of the species

Table 1. Oribatid mite species collected in mixed forests (MF1, MF2), in forest dominated by bamboo (BA), and in forest dominated by palm trees (PA).

Nº	Species ⁽¹⁾	MF1	MF2	BA	PA
1	<i>Eohypochthonius becki</i> ⁽¹⁾	X	X	X	-
2	<i>Malacoangelia remigera</i> ⁽²⁾	-	X	-	-
3	<i>Epilohmannia lenko</i> ? ⁽¹⁾	X	-	-	X
4	<i>Epilohmannia pallida americana</i>	X	X	-	X
5	<i>Torpacarus omittens paraguayensis</i> ⁽¹⁾	X	X	-	-
6	<i>Rhysotritia peruensis</i>	X	X	X	X
7	<i>Rhysotritia</i> cf. <i>monodactyla</i>	-	-	-	X
8	<i>Atropacarus (Hoplophorella) cucullatus</i> ⁽²⁾	X	X	X	X
9	<i>Atropacarus (Hoplophorella) vitrinus</i> ⁽²⁾	X	-	-	-
10	<i>Atropacarus (Hoplophorella) cochlearis</i> ? ⁽²⁾	-	-	-	X
11	<i>Notophthiracarus (Protophthiracarus) grandjeani</i> ⁽¹⁾	-	-	X	-
12	<i>Notophthiracarus (Protophthiracarus)</i> sp.	-	-	-	X
13	<i>Steganacarus</i> ? sp.	-	-	-	X
14	<i>Malaconothrus</i> cf. <i>sylvaticus</i>	X	-	X	X
15	<i>Malaconothrus</i> cf. <i>hauseri</i>	-	X	-	-
16	<i>Nothrus macedi</i> ⁽¹⁾	X	-	X	-
17	<i>Masthermannia</i> cf. <i>mamillaris</i> ⁽²⁾	X	-	-	-
18	<i>Baloghacarus australis</i> ⁽²⁾	X	X	X	X
19	<i>Hermannobates</i> n. sp. ⁽²⁾	-	-	X	-
20	<i>Hermannobates flagelliset</i> ⁽²⁾	-	-	-	X
21	<i>Plasmobates</i> n. sp. ⁽¹⁾	X	X	X	X
22	<i>Teleioliodes</i> n. sp. ⁽²⁾	-	-	X	-
23	<i>Teleioliodes zikani</i> ⁽²⁾	-	-	X	X
24	<i>Plateremaeus</i> cf. <i>ornatissimus</i> ⁽²⁾	-	-	X	X
25	<i>Pheroliodes</i> sp.	-	-	X	X
26	<i>Pheroliodes</i> cf. <i>intermedius</i>	-	-	X	-
27	<i>Austrodamaeus elegantulus</i>	X	X	-	X
28	<i>Microtegeus</i> cf. <i>borhidii</i> ⁽²⁾	-	-	X	-
29	<i>Microtegeus cardosensis</i> ⁽²⁾	X	X	-	X
30	<i>Charassobates tuberosus</i> ⁽²⁾	X	-	X	X
31	<i>Acaroceras</i> aff. <i>furcatus</i> ⁽²⁾	-	-	-	X
32	<i>Berlesezetes brasilozetoides</i>	X	X	X	-
33	<i>Phylacozetes</i> sp. ⁽²⁾	X	X	-	-
34	<i>Rophalozetes</i> sp. ⁽²⁾	-	-	-	X
35	<i>Cultroribula zicsii</i>	X	-	X	-
36	<i>Ceratorchestes</i> n. sp. ⁽²⁾	-	X	X	-
37	<i>Eremulus rigidisetosus</i> ⁽¹⁾	X	X	X	-
38	<i>Fosseremus laciniatus</i>	X	-	X	-
39	<i>Eremobelba zicsii</i> ⁽¹⁾	X	X	X	-
40	<i>Eremobelba</i> sp.	-	X	-	-
41	<i>Stauroma</i> n. sp. ⁽²⁾	-	X	-	-
42	<i>Pletzenoppia</i> ? sp.	X	-	-	-
43	<i>Brachioppia</i> sp.	X	X	X	-
44	<i>Brachioppia tropicalis</i> ⁽¹⁾	-	-	-	X
45	<i>Brachioppia</i> aff. <i>pseudocostulata</i>	X	X	-	-
46	<i>Micropopia minus</i>	-	X	-	-
47	<i>Oxyoppia (Oxyoppiella) suramericana</i>	X	X	-	X
48	<i>Ramusella (Inscultoppia) merimna?</i>	X	X	-	-
49	<i>Globoppia</i> o <i>Lanceoppia</i> sp.	-	-	-	X
50	<i>Trapezoppia longipectinata</i> ⁽²⁾	-	-	-	X
51	<i>Corynoppia</i> sp. ⁽²⁾	-	X	-	-
52	<i>Amerioppia barrancensis paraguayensis</i> ⁽¹⁾	-	-	X	-
53	<i>Pseudoamerioppia paraguayensis</i> ⁽²⁾	-	X	X	-
54	<i>Striatoppia opuntiset</i> ⁽²⁾	-	X	-	-
55	<i>Teratoppia</i> sp.	-	X	X	-
56	<i>Teratoppia</i> sp. 2	X	-	-	-
57	<i>Teratoppia</i> n. sp.	-	X	-	-
58	<i>Teratoppia</i> cf. <i>pluripectinata</i>	-	X	-	-
59	<i>Neosuctobelba transitoria</i> ⁽²⁾	X	X	-	-
60	<i>Novosuctobelba (Coartobelba) transversalis</i> ⁽²⁾	X	X	-	-
61	<i>Suctobelbella (Ussuribata) longiclava</i>	X	-	-	-
62	<i>Suctobelbella (Flagrosuctobelba) peracuta</i> ⁽¹⁾	X	X	-	-
63	<i>Suctobelbella (Suctobelbella) ornatissima</i>	X	X	-	-

Continue...

Table 1. Continuation...

64	<i>Suctobelbella subcomplexa</i>	-	x	-	-
65	<i>Carabodes (Austrocarabodes ?) n. sp.</i> ⁽¹⁾	x	x	x	x
66	<i>Carabodidae</i> sp.	-	-	-	x
67	<i>Tectocepheus velatus</i>	x	x	x	x
68	<i>Tectocepheus americanus?</i>	-	-	-	x
69	<i>Tegeozetes n. sp.</i> ⁽²⁾	-	-	-	x
70	<i>Scapheremaeus</i> sp.	x	-	-	-
71	<i>Allozetes n. sp.</i>	-	x	-	-
72	<i>Lamellobates quadricornis</i> ⁽¹⁾	-	-	x	x
73	<i>Lamellobates molecula</i> ⁽²⁾	x	x	-	-
74	<i>Ceratobates spatulatus</i> ⁽²⁾	x	x	x	-
75	<i>Ceratobates fornerisae</i> ⁽²⁾	-	-	-	x
76	<i>Hemileius suramericanus</i>	x	x	x	-
77	<i>Scheloribates praencisus sandvicensis</i> ⁽¹⁾	x	-	-	-
78	<i>Scheloribates praencisus acutivclava</i> ⁽¹⁾	-	x	x	x
79	<i>Scheloribates</i> sp.	-	x	-	-
80	<i>Scheloribates pauliensis</i> ⁽¹⁾	-	-	-	x
81	<i>Scheloribates</i> cf. <i>parvialatus</i>	-	-	x	-
82	<i>Scheloribates elegans</i> ⁽¹⁾	x	x	-	-
83	<i>Protoribates (Protoribates) capucinus capucinus</i>	x	x	-	-
84	<i>Protoribates (Triaungius) praeoccupatus</i>	x	-	-	-
85	<i>Indoribates (Mancoribates ?) sp.</i>	-	x	-	-
86	<i>Indoribates (Haplozetes) nudus</i>	-	x	-	-
87	<i>Lauritzenia longipluma</i>	-	x	-	-
88	<i>Peloribates</i> sp.	-	x	x	-
89	<i>Trachyoribates (Rostrozetes) ovulum ovulum</i>	x	x	x	x
90	<i>Trachyoribates (Rostrozetes) heterotrichus</i> ⁽¹⁾	-	-	x	-
91	<i>Galumna (Galumna) flabellifera</i>	x	x	x	x
92	<i>Carinogalumna clericata</i>	x	x	-	-
93	<i>Pergalumna decoratissima</i> ⁽¹⁾	-	-	x	-
94	<i>Pergalumna</i> aff. <i>nasica</i>	-	-	x	-
95	<i>Pergalumna</i> sp.	-	-	x	-
96	<i>Allogalumna alpha</i> ⁽²⁾	-	-	x	-
Number of species		45	51	41	35
Percentage of total observed species		46.9%	53.1%	42.7%	36.5%

⁽¹⁾The sign “?” (in some of the listed species) refers to an uncertainty in the identification, and the term “cf.” indicates “to be compared with”. ⁽²⁾Species cited for the first time for Argentina. ⁽³⁾Species and genus cited for the first time for Argentina.

Table 2. Similarity (Jaccard's index) of oribatid communities among sample sites.

Site	Palm forest	Mixed forest 1	Mixed forest 2
Bamboo forest	0.25	0.30	0.28
Palm forest	-	0.23	0.18
Mixed forest 1	-	-	0.48

Table 3. Comparison of oribatid composition among geographic areas.

Oribatid	This study	South of Brasil ⁽¹⁾	Paraguay ⁽²⁾
Genera/species cited	56/96	97/167	37/43
Genera shared	-	38 (67.8%)	19 (33.9%)
Species shared	-	19 (19.8%)	6 (6.25%)

⁽¹⁾Reference: Pérez-Iñigo & Baggio (1980, 1985, 1986, 1988, 1989, 1991, 1993, 1994); Oliveira et al. (2005). ⁽²⁾Reference: Mahunka (1984).

actually collected by them; and that the great number of morphological species found in their study indicates the great diversity of Oribatida in the areas where the study was conducted. The main objective of the cited works of Mahunka and Pérez-Iñigo & Baggio is

species description, but they do not include detailed lists of species.

From the oribatid species from Paraguay, cited by Mahunka (1984), 55% are presumptively endemic; the same is reported for those species collected by Pérez-Iñigo & Baggio (1980) from many sites of São Paulo state. In our study, we collected nine species (9.4%), probably new to science, whereas 30 (31.2%) need revision for a final identification. The remaining 57 species (approximately 60%) are known from other areas.

Conclusions

1. The high number of taxa found in this study indicates great diversity of oribatid mites in tropical areas, and the great number of new citations for Argentina reveals the pertinence of this kind of work for such areas.

2. The phylogenetic pattern of association among oribatid taxa and vegetation type can be an indication of habitat dependence of this group.

Acknowledgements

To biologists Vanesa Lucero and Matías Maggi, for collecting soil samples in the mixed forests out of Iguazú National Park.

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Received on September 29, 2008 and accepted on July 21, 2009