Relationships among vegetation, flora, litter and litter-dwelling microarthropods in an urban forest stand of São José Do Rio Preto, State of São Paulo, Brazil.

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ABSTRACT
Little is relatively known about the abundance of microarthropds in relation to the litter composition and structure. Litter samples were taken on seven occasions from each of two subplots (A,B) of a seasonal semideciduous forest located at Bosque Municipal São José do Rio Preto, State of São Paulo, Brazil. The litter was sorted in leaves, fruits, bark and climber fragments, the biological type were determinated wherever possible. The microarthopods were extracted by means of Berlese-Tullgren funnels. A total of 37 plant species was identified, and it was found some structural and floristic differences between subplots, due to the complexity of vegetation and flora of subplot B. In the litter were collected 27 species and the proportion of biological types corresponds to the composition of the forest. Microarthopods densities were significantly lower in subplot A than in subplot B, this result may reflects the differences in the vegetation structure and flora in both subplots.

Key words: microarthropods, litter, seasonal semideciduous forest

RESUMEN
Existe poca información sobre la abundancia de mircoartrópodos edáficos en relación con la composición y estrucura de la hojarasca. Se llevaron a cabo 7 muestreos con periodicidad quincenal desde enero a abril de 1999 en dos subparcelas (A y B) de un bosque semideciduo estacional localizado en el Bosque Municipl de São José de Rio Preto, Estado de São Paulo, Brasil, La hojarasca se clasificó en hojas, frutos, fragmentos de corteza y lianas. Los microartrópodos se extrajeron mediante embudos Berlese-Tullgen. Se identificaron 37 especies de plantas asi como sus tipos biológicos. Las diferencias entre las dos subaparcelas se deben a la complejidad estructural y a la flora presente en la subparcela B. En la hojarasca se colectaron e identificaron 27 especies, la proporción de sus tipos biológicos se corresponde con la composición estrucutral del bosque. Las densidades de microartrópodos fueron significativamente mas bajas en la subparcela A, lo que refleja las diferencias en la estructura de la vegetación y la flora entre las dos subaprcelas.

Palabras clave: microartrópodos, hojarasca, bosque semideciduo estacional

INTRODUCTION

Litter microarthopod abundance exhibits spatial variation between local sites (Wauthy *et al.*, 1989). These intrahabitat differences are associated with the structural complexity of the vegetation among other factors, but there have been only a relatively few researches which attempt to study this aspect (Vallejo & Vallejo, 1981; Sharma *et al.*, 1984; Klironomos & Kendrick, 1995; Santos *et al.*, 1998).

The aim of this paper was to investigate the type of litter in terms of floristic composition and vegetation structure in relation to the abundance of Acari and Collembola, the most important groups of litter microarthropods.

MATERIALS AND METHODS

This study was carried out at Bosque Municipal located in São José do Rio Preto, State of São Paulo, Brazil (20°, 48', 56" S - 49°, 23', 9" W; 475 m a.s.l.). The climate has a dry season from April to September and a rain season from October to March (Taroda Ranga *et al.*, 1999). The soil is a red-yellow podzol with a pH of 5,5; the organic (LFH) horizon ranges from 1 to 3 cm depth. The L layer is clearly separate, but the layers F and H are not distinctly stratified.

The vegetation is a seasonal semideciduous forest, as a remaining area of the primary forest of the region, now in a secondary succession due to anthropogenic changes (Taroda Ranga *et al.*, 1999). The sampled area has an emergent layer with high trees, until 20 m height as *Copaifera langsdorffii* Desf., *Ficus guaranitica* Chod. ex Chod. et Veisn., *Coccoloba latifolia* Lam., *Mabea fistulifera* Mart., *Xylopia aromatica* (Lam.) Mart., *Luehea speciosa* Willd., *Didymopanax* sp. and *Inga* sp.; the understory is dominated by *Siparuna guianensis* Aubl. and *Alibertia edulis* (L.L.Rich.) A.C . Rich., both in some cases as high shrubs, also *Actinostemun communis* (Muell. Arg.) Pax. In the herb layer there are saplings of the tree species and grasses , the most common grass is *Brachiaria* sp.

In the «Bosque Municipal» an area pártially conserved was chosen and was divided into subplots A and B each about 6 x 6 m.

Sampling of microarthropods was carried out at intervals of

about two weeks during the period from late January 1999 to late April 1999 (seven times). Four litter samples of 400 cm^2 were taken from each of the two subplots (total of 56 samples) and microarthropods were extracted by means of Berlese-Tullgren funnels over seven days.

The density of Acari and Collembola in both subplots were compared using a non-parametric Wilcoxon-Mann-Whitney U-test.

The L layer of the litter was sorted in leaves, fruits, bark and climber fragments; the biological type was determinated wherever possible.

Two profiles of the vegetation were made each one in each subplot. Plant diversity was measured with the Shannon-Wiener index (H').

RESULTS AND DISCUSSION

It was recorded 37 plant species in the forest stand and their biological type were determinated (Table I).

TABLE I

List of species of an urban forest stand located at Bosque Municipal, São José do Rio Preto, State of São Paulo, Brazil.

Family and species	Subplot A	Subplot B	Both subplots	Biological Type
Annonaceae				
Xylopia aromatica (Lam.) Mart.		X		tree
Apocynaceae				
Forsteronia glabrescens Muell. Arg.	X	X	X	climber
Araliaceae				
Didymopanax sp.		X		tree
Bignoniaceae				
Arrabidaea florida DC	X	X	X	climber
Arrabidaea triplinervia (DC) Baill. ex Bur.	X	X	X	climber
Pyrostegia venusta (Kev. Gawl) Miers	X	X	X	climber
Tabebuia roseo-alba (Ridley) Sandwith	X			tree
Burseraceae				
Protium heptaphyllum (Aubl.) March.		X		tree
Cecropiaceae				
Cecropia pachystachya Trec.		X		tree
Erythoxylaceae				
Erythroxylon pelleterianum A. St-Hill.		X		shrub
Euphorbiaceae				
Actinostemon communis (Muell.Arg.)Pax		X		shrub
Mabea fistulifera Mart.	X	X	X	tree
Lacistemaceae				
Lacistema floribundum Mez.		X		tree
Lauraceae				
Nectandra megapotamica (Spreng.) Mez	X	X	X	tree
Nectandra rigida Ness	X	X	X	tree
Leguminosae-Caesalpinoideae				
Copaifera langsdorffii Desf.	X	X	X	tree
Pterogyne nitens Tul.	X	X	X	tree
Leguminosae-Mimosoideae				
Anadenanthera falcata (Benth.) Spreng.		X		tree
Inga sp.	X			tree

TABLE I

List of species of an urban forest stand located at Bosque Municipal, São José do Rio Preto, State of São Paulo, Brazil (continuation).

Family and species	Subplot A	Subplot B	Both subplots	Biological Type
Leguminosae-Papilionideae				
Machaerium aculeatum Raddi		X		tree
Machaerium paraguariense Hassler		X		tree
Myroxylon peruiferum L.f.		X		tree
Platypodium elegans Vog.	X	X		tree
Meliaceae				
Trichilia pallida Sw.		X		tree
Menispermacae				
Cissampelos glaberima A. St-Hill.		X		climber
Monimiaceae				
Siparuna guianensis Aubl.	X	X	X	shrub
Moraceae				
Ficus guaranitica Chod. ex Chod. & Veisn.		X		tree
Myristicaceae				
Virola sebifera Aubl.		X		tree
Piperaceae				
Piper aduncum L.	X			shrub
Poaceae				
Brachiaria sp.		X		grass
Polygonacae				
Coccoloba latifolia Lam.	X	X	X	tree
Proteaceae				
Roupala sp.	X			shrub
Rubiaceae				
Alibertia edulis (L.L.Rich.) A.C. Rich.	X	X	X	shrub
Rudgea viburnoides Benth.		X		shrub
Sapindaceae				
Cupania vernalis Cambess.		X		tree
Serjania lethalis A. St-Hill.	X	X	X	climber
Tiliaceae				
Luehea speciosa Willd.		X		tree

It was founded some structural and floristic differences between the two subplots:

—Sub-plot A: is relatively open, the emergent trees are scattered, jointed by the climbers, there is an open place, made by fallen tree, with some grasses. The flora is composed by 18 species, the 49 % of the total species of the area (Figs. 1 y 2). The diversity expressed by H' is 2,43.

—Sub-plot B: is more closer, the branches of the emergent trees are jointed and the understory is more or less dark, and dominated by a high *Ficus guaranitica* embracing a *Copaifera langsdorffii*, the grass layer composed by saplings and grasses.The flora comprises 32 species, 86 % of the total species of the area. (Figs. 3 y 4). The diversity expressed by H' is 2,67.

The subplots have 13 species in common (35 %), but there is a difference between the number of species in the subplots due to the more complex structure and flora of the subplot B; nevertheless the values of H' are similar for both but lower then the value recorded for the forest: 2,82 (Taroda Ranga *et al.*, 1999).

In the litter, were identified 19 species, and unidentified 8 taxa, with their biological type (Table II).
The results of the biological types are:

—trees: 11 species, 57,89% from A: 7 (63 %) and B: 11 (100 %).
—climbers: 5 species 26,31 %, from A: 5 (100 %) and B: 5 (100 %).
—shrubs: 3 species, 15,78 % from A: 3 (100 %) and B: 3 (100 %).

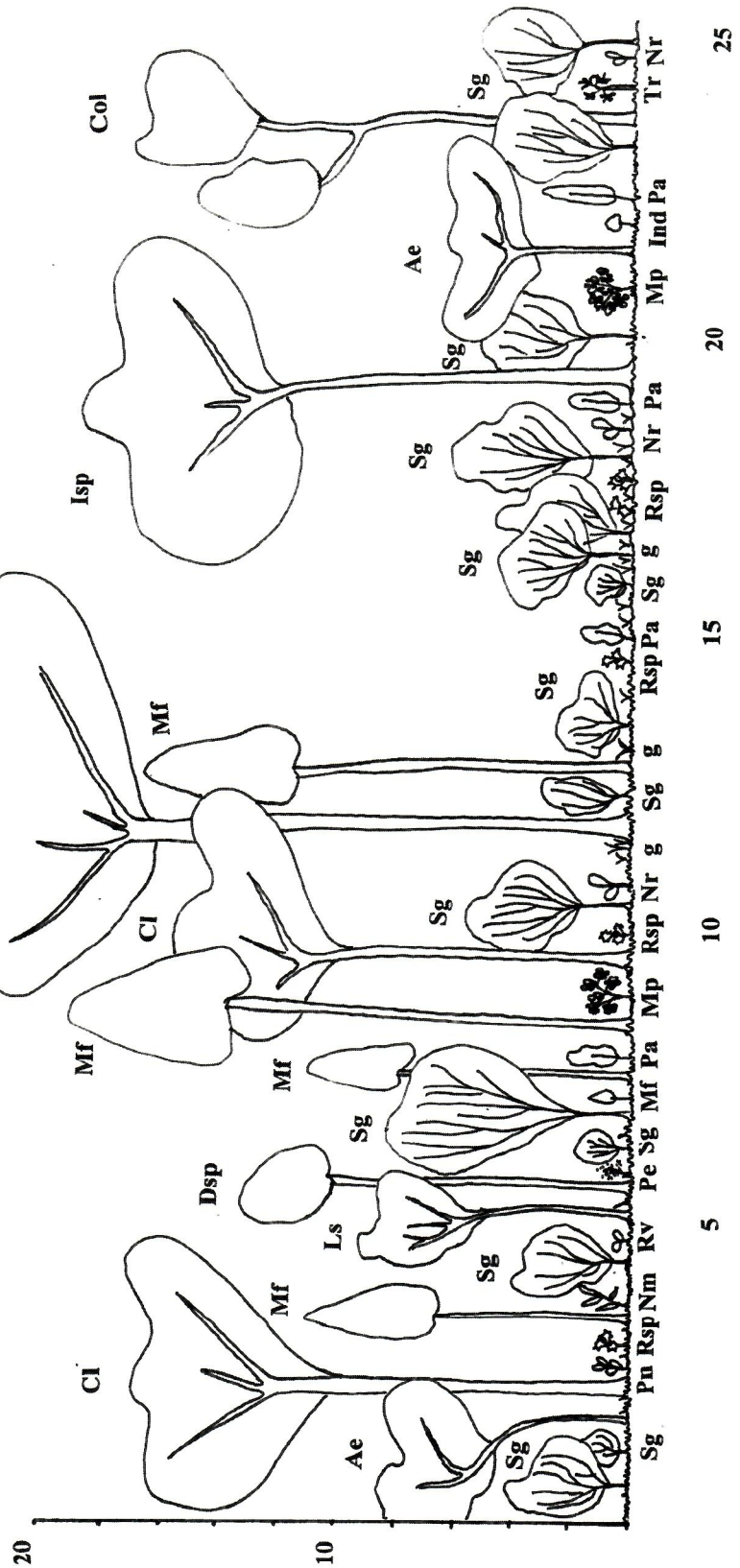

Fig. 1. Profile of the vegetation in the sub-plot A.: **Ae**: *Alibertia edulis*, **Cl**: *Copaifera langsdorffii*, **Col**: *Coccoloba latifolia*, **Dsp**: *Didymopanax* sp., **g**: grass, **Ind**: *Indeterminate*, **Isp**: *Inga* sp., **Ls**: *Luehea speciosa*, **Mf**: *Mabea fistulifera*, **Mp**: *Myroxylon peruiferum*, **Nm**: *Nectandra megapotamica*, **Nr**: *Nectandra rigida*, **Pa**: *Piper aduncum*, **Pe**: *Platypodium elegans*, **Pn**: *Pterogyne nitens*, **Rsp**: *Roupala* sp., **Rv**: *Rudgea vibumoides*, **Sg**: *Siparuna guianensis*, **Tr**: *Tabebuia roseo-alba*. (Scale in meters, climbers are not representated).

Fig. 2. Subplot A: climbers in the open area.

Fig. 3. Subplot B: a high tree of Figueira, *Ficus guaranitica* embracing the Copaiba, *Copaifera langsdorffii*.

The proportion of trees, climbers and shrubs is the same reported Taroda Ranga *et al.* (1999) for the structure of the forest, thus the contribution of these individuals to the litter corresponds to the same proportion of the forest structure.

The subplot A has slightly more climber fragments, but the bark fragments are more common in the subplot B due to the abundance of trees which form a dense strata.

The density of Collembola in the subplot A was 1651 (± S.E. 221) individuals m^{-2} whereas that of subplot B was 7276 (± S.E. 1298) individuals m^{-2}. The difference was statistically significant (U-test, $p < 0.001$); Similarly, mean Acari density was significantly lower (U-test, $p < 0.01$) in subplot A than in subplot B, 3426 (± S.E. 372) individuals m^{-2} and 6421 (± S.E. 798) individuals m^{-2} respectively.

It has been established that the abundance of litter microarthropods may be determined by different abiotic and biotic factors, as well as their combined effect. Thus, macroflora may affect the faunal populations by indirectly modifying the micro-climate, soil structure or the populations of microorganisms (Sharma *et al.*, 1984). According to the results of the present study of microarthropods associated with plant litter species, these authors emphasize that the litter layer under broadleaf trees has large interstitial spaces and also the amount of lignin is low. These factors may determine the abundance of microarthropods in such sites.

The lower abundance in subplot A may reflect the less compacted canopy and therefore in some places no deeply litter layer is developed.

In contrast, certain characteristics of the plot B, i.e., a more closed vegetation strata, tree abundance and the presence of species with large leaves as *Coccoloba latifolia* and *Luehea speciosa* contribute to the maintenance of the organic soil horizon and as a consequence providing a wider spectrum of food resources for the litter microarthropod community.

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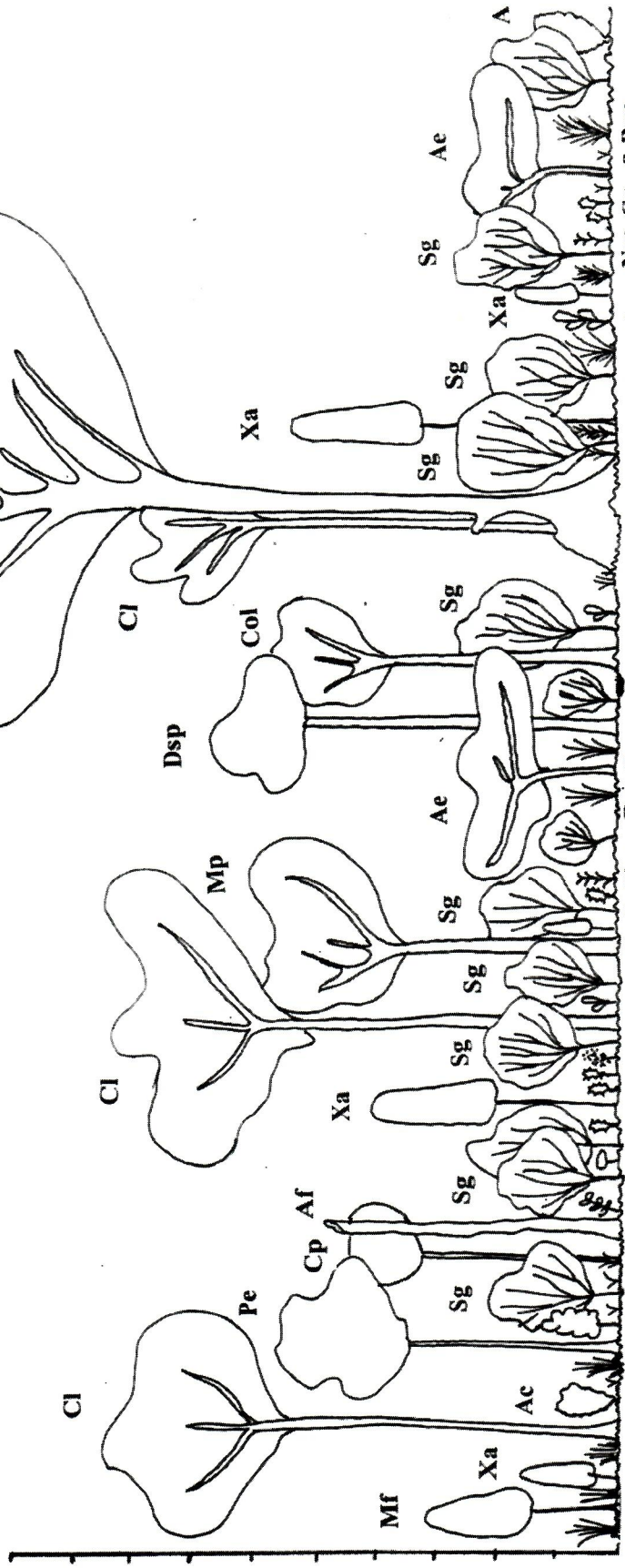

Fig. 4. Profile of the vegetation in the sub-plot B: **Ac**: *Actinostemom comunis*, **Ae**: *Alibertia edulis*, **Af**: *Anadenanthera falcata*, **Bsp**. *Bracharia* sp., **Cl**: *Copaifera langsdorffii*, **Col**: *Coccoloba latifolia*, **Cp**: *Cecropia pachystachya*, **Cv**: *Cupania vernalis*, **Dsp**. *Didymopanax* sp., **Fg**: *Ficus guaranitica*, **g**: grass, **Ls**: *Luehea speciosa*, **Ma**: *Machaerium aculeatum*, **Mf**: *Mabea fistulifera*, **Mp**: *Myroxylon peruiferum*, **Nm**: *Nectandra megapotamica*, **Nr**: *Nectandra rigida*, **Pe**: *Platypodium elegans*, **Ph**: *Protium heptaphyllum*, **Sg**: *Siparuna guianensis*, **Xa**: *Xylopia aromatica*. (Scale in meters, climbers are not representated).

TABLE II

Species founded in the litter samples and their characters 5: A n: number of samples in sub-plot A; A %: % of presence in samples of sub-plot A; B n: number of samples in sub-plot B; B %: % of presence in samples of sub-plot B; T n: total number of samples; T %: % of presence in total samples; B;T: biological type (tree, shrub or climber: clim).

Species/Family	A n	A %	B n	B %	T n	T %	BT
Annonaceae							
Xylopia aromatica (Lam.) Mart.	9	16	26	48	35	64	tree
Apocynaceae							
Forsteronia glabrescens Muell. Arg.	19	8	35	15	27	50	clim
Bignoniaceae							
Arrabidaea florida DC.	22	40	26	48	48	88	clim
Arrabidaea triplinervia (DC) Baill. ex Bur.	12	15	22	27	27	49	clim
Pyrostegia venusta (Kev. Gawl) Miers	6	11	14	26	20	37	clim
Lacistemaceae							
Lacistema floribundum Mez.			2	3	2	3	tree
Lauraceae							
Nectandra megapotamica (Spreng.) Mez.	22	40	11	20	353	60	tree
Nectandra rigida Nees	1	1	1	1	2	2	tree
Leguminosae-Caesalpinoideae							
Copaifera langdorffii Desf.	23	42	24	44	47	86	tree
Leguminosae-Papilioideae							
Machaerium aculeatum Raddi			1	2	1	2	tree
Machaerium paraguariense Hassler	3	5	4	7	7	12	tree
Platypodium elegans Vog.	1	2	4	7	5	9	tree
Monimiaceae							
Siparuna guianensis Aubl.	23	42	20	37	43	77	shrub
Myristicaceae							
Virola sebifera Aubl.	1	2	4	7	5	9	tree
Poligonaceae							
Coccoloba latifolia Lam.			1	2	1	2	tree
Rubiaceae							
Alibertia edulis (L.L.Rich.) A.C.Rich.	1	2	9	16	10	18	shrub
Sapindaceae							
Cupania vernalis Cambess.	1	2	5	9	6	11	shrub
Serjania lethalis A. St-Hill	16	30	26	48	42	78	clim
Tiliaceae							
Luehea speciosa Willd.			1	2	1	2	tree
Undeterminated							
Species 1			2	3	2	3	
Species 2	3	5	2	3	5	8	
Species 3	2	3	5	9	7	12	
Species 4	3	5	2	3	5	8	
Species 5	2	3			2	3	
Species 6			1	2	1	2	
Species 7			1	2	1	2	
Species 8	5	9			5	9	
Total of species present	20	74	25	92	27	100	
Branches	21	39	19	35	40	74	
Bark fragments	3	5	8	15	11	20	
Climber fragments	12	22	9	17	21	39	
Fruits							
Arrabidaea florida DC	26	48	23	42	49	90	
Arrabiadea triplinervia (DC) Baill. ex Bur.	14	26	9	16	23	42	
Others fruits			1	2	1	2	

BIBLIOGRAPHY

Klironomos J, Kendrick B. 1995. Relationships among microarthropods, fungi, and their environment. *Plant and Soil*, v. 170. 183 – 197.

Santos HC, Rocha CFD, Bergallo HG.1998. A produtividade, diversidade e abundância da mesofauna do litter em dois segmentos de mata atlântica (mata de planície e mata de encosta) na ilha do Cardoso, Cananéia, São Paulo. *Anais do VIII Seminário Regional de Ecologia*, v. 8, 823 – 836.

Sharma AP, Bisht JS, Singh JS. 1984. Microarthropods associated with certain litter species in Kumaun Himalaya. *Pedobiologia*, v. 27, 229 – 236.

Taroda Ranga N *et al*. 1999. Florística e Fitossociologia de uma mata nativa do Bosque Municipal de São José do Rio Preto – SP. In: 50° Congresso Nacional de Botanica, Blumenau, SC, *RESUMOS*, 274.

Vallejo LR, Vallejo MS. 1981.Contribuição ao estudo ecológico dos microartrópodos do "litter" na restinga de Maricá, RJ. Revta. brasil. Biol., v. 41, 535 – 543.

Wauthy G, Noti MI, Dufrene M. 1989. Geographic ecology of soil oribatid mites in deciduous forest. *Pedobiologia*, v. 33, 399 – 416.

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