Oribatid mites and springtails from a coffee plantation in Sierra Sur, Oaxaca, Mexico

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Abstract – The objective of this work was to compare the oribatid mite and springtail communities in three plots with different soil use – Coffee (CP), secondary vegetation or fallow fields (acahual, A) and a cloud mountain forest (CMF) – within a coffee plantation located in Santa Maria Huatulco, Oaxaca State, Mexico. In each plot 20 samples (10 of soil, 10 of litter) were taken and processed in Berlese funnels. The extracted fauna was preserved in 70% ethanol. A total of 3,031 oribatid mites belonging to 33 species, and 1,177 specimens of springtails belonging to 43 species, were collected. The number of species recorded was: 27 at CP (14 oribatids; 13 springtails), 44 at A (19 oribatids; 25 springtails) and 62 at CMF (32 for each group). A total of 26 oribatid and 27 springtail species was found in the soil, and 25 oribatid and 32 springtail species were found in the litter. The most abundant species were the oribatids *Rostroztes foveolatus* (Haplozetidae), *Tectocepheus* sp. (Tecocepheidae), *Karenella* sp. (Oppidae), *Atropacarus* (*Hoplophorella)* cf. *fonseciai* (Phthiracaridae), *Epilohmannia pallida americana* (Epilohmannidae), and the springtails *Ceratophysella* cf. *gibbosa* (Hypogastruridae), *Mesaphorura* sp. (Tullbergidae) and *Proisotoma* cf. *minuta* (Isotomidae). Fourteen families and 18 species of Oribatida species and 5 families and 34 species of Collembola were recorded for the first time for the State.

Index terms: *Coffea arabica*, biodiversity, cloud mountain forest, Collembola, litter, microarthropods, secondary vegetation.

Ácaros oribatídeos e colêmbolos de uma plantação de café em Sierra Sur, Oaxaca, México

Resumo – O objetivo deste trabalho foi comparar as comunidades de ácaros oribatídeos e de colêmbolos em três parcelas com uso diferente do solo – plantação de café (CP), a vegetação secundária ou pousio (acahual, A) e a floresta nublada de montanha (CMF) – em uma plantação de café situada na municipalidade de Santa María Huatulco, estado de Oaxaca, México. Vinte amostras foram tomadas em cada lote (dez do solo, dez de serapilheira) e processadas em funis de Berlese. A fauna extraída foi preservada em álcool 70%. Um total de 3.031 ácaros oribatídeos pertencentes a 33 espécies e de 1.177 espécimes de colêmbolos de 43 espécies foram coletados. Os números de espécies encontradas foram: 27 no CP (14 oribatídeos e 13 colêmbolos); 44 em A (19 oribatídeos e 25 colêmbolos); e 62 no CMF (32 para cada grupo). Foram encontradas 26 espécies de ácaros oribatídeos e 27 de colêmbolos no solo e 25 espécies de ácaros e 32 de colêmbolos na serapilheira. As espécies mais abundantes foram os oribatídeos *Rostroztes foveolatus* (Haplozetidae), *Tectocepheus* sp. (Tecocepheidae), *Karenella* sp. (Oppidae), *Atropacarus* (*Hoplophorella)* cf. *fonseciai* (Phthiracaridae), *Epilohmannia pallida americana* (Epilohmannidae); e os colêmbolos *Ceratophysella* cf. *gibbosa* (Hypogastruridae), *Mesaphorura* sp. (Tullbergidae) and *Proisotoma* cf. *minuta* (Isotomidae). Foram registradas 18 espécies e 14 famílias de Oribatida e 34 espécies e 5 famílias de Collembola como novos registros para o estado.

Termos para indexação: *Coffea arabica*, biodiversidade, floresta nublada de montanha, Collembola, serapilheira, microartrópodos, vegetação secundária.

Introduction

The production of coffee situates Mexico in the fifth place at the worldwide level, with more than 700,000 hectares in 12 states, 400 municipalities and more than 3,500 communities dedicated to this crop, numbers surpassed only by maize, beans, wheat and sorghum (Bartra, 2002). The 40% of the areas with coffee plantations corresponds to high and median forests (humid zone tropical), 23% to pine and oak forests, 21% to tropical dry forest, and 15% to mesophilous or mountain forest, which means that, from the biological point of view, the coffee regions in Mexico are richest and diverse in flora and fauna (Perfecto et al., 2003). Oaxaca, along with Veracruz and Chiapas, are the main producers of coffee in the country (Bartra, 2002).

With the development of sustainable agriculture, the interest in the study of soil biodiversity has increased to conserve and to maintain the operation of the ecosystems (González et al., 2003). The main representatives of edaphic microarthropods are the mites and springtails, since they can represent up to 98% of the soil fauna (Palacios-Vargas, 1983). Its importance is mainly due to its ecological function, emphasizing its direct participation in the control of populations of fungi and bacteria (Seastedt, 1984), in the soluble mineral leaching, and in the contribution to the maintenance of physical and chemical characteristics of soils (Díaz, 1988; Sjurse & Holmstrup, 2004). However, few studies on the role of microarthropods in coffee soils (Ibarra-Núñez, 1990; Marín Castro, 2006) exist in Mexico. The aim of the present study was to compare the oribatid mites and springtails communities in three plots with different soil use – coffee plot (CP), secondary vegetation or fallow (acahual; A) and cloud mountain forest (CMF) – in one coffee farm located in the Santa María Huatulco municipality, Oaxaca State, Mexico.

Materials and Methods

The coffee farm “El Nueve” (15°56'04"N, 96°17'07"W) is situated at 1,330 m a.s.l., located within the municipality of Santa Maria Huatulco, Oaxaca, Mexico (Instituto Nacional de Ecología, Geografía e Informática, 1996). The climate there is subhumid warm with rains in summer (Aw1); the annual average precipitation is 800 mm; the annual average temperature is between 24 and 26°C (García, 1981).

Within the coffee farm, besides *Coffea arabica* var. *typica* (L.), vegetation surrounding consist of semi-deciduous tropical forest together with cloud mountain forest (Rzedowski, 1978). The characteristic soil in the zone are Acrisols, Luvisols and Cambisols (García-Caderón et al., 2000), with basic pH values (CP, 6.3; A, 4.3; CMF, 6.6). The distribution of sand, calculated on a clay-free basis, is irregular, with differences between the A and Bo horizons (Krasilnikov et al., 2007). The carbon content (g kg^{-1}) for each plot was: CP, 58.6; A, 55.6; CMF, 68.5.

Three sites of 100 m^2 each were chosen for sampling: one secondary vegetation or fallow (acahual), one real coffee plantation, and one cloud mountain forest site. Within the sites, ten points were randomly located, and at each point one soil and one litter sample of 10x10 cm and a depth of 5 cm were taken, totalling 60 samples. The distance between samples was of at least 1 m. The soil samples were taken from the sampled litter layer. The sampling was done in May 2002. The temperature recorded at the ground level in each plot was of 21.5°C for coffee, 20°C for fallow, and 19°C for the forest. The distance from the fallow to the coffee plot was of approximately 200 m, whereas the forest was located 700–900 m from the coffee plot. The forest site was never used for agriculture before. The coffee plot was planted seven years before sampling. Fallow treatment had the same age.

The samples were transported to the Laboratorio de Ecología y Sistemática de Microartrópodos at Facultad de Ciencias of Universidad Nacional Autónoma de México (UNAM), to be processed. They were treated in a Berlese-Tullgren apparatus during six days, three at room temperature and three with a light source (60 watts) to extract the fauna. For the identification of specimens, the keys of Balogh & Balogh (1988, 1990, 1992a, 1992b) were used for the mites, and the keys of Palacios-Vargas (1990), Jordana et al. (1997), Christiansen & Bellinger (1998) and Janssens (2004) for the Collembola. In both cases, the animals were identified to the species level, if possible.

The relative and absolute abundances were determined, and the Shannon's (H') index of diversity (heterogeneity) and the Pielou's (J') evenness and Simpson's dominance (λ) indexes (Ludwig & Reynolds, 1988) were calculated using Biodiversity Pro version 2 software (McAleece, 1997). For statistic tests, abundance data were transformed to root $(x + 0.5)^{0.5}$ (Zar, 1999). In order to evaluate the effect of the plot on the mite and springtail abundance, an ANOVA test was performed, and the Tukey's test was used post hoc to prove significant differences. The analyses were performed using STATISTICA version 6.0 software (StatSoft, 1995).

Results and Discussion

A total of 6,777 specimens (11,295 individuals m^{-2}) belonging to 22 Arthropoda groups (including Aranea, Schizomida, Palpigradi, Pseudoscorpionida, Mesostigmata, Prostigmata, Astigmata, Metastigmata, Isopoda, Diplopoda, Chilopoda, Pauropoda, Symphyla, Protura, Diplura, Coleoptera, Blattodea, Hemiptera, Homoptera) were collected. Oribatid mites were the most abundant, with 3,031 specimens (5,052 individuals m^{-2}), followed by Collembola, with 1,177 specimens (1,962 individuals m^{-2}).

The greatest density of specimens was found in the soil samples of the fallow (10,240 individuals m^{-2}), followed by soil samples of the forest (7,250 individuals m^{-2}), litter samples from the forest (5,140 individuals m^{-2}), litter from the fallow (4,400 individuals m^{-2}), soil samples of the coffee plot (2,610 individuals m^{-2}) and finally, litter from the coffee plot (670 individuals m^{-2}) (Figure 1 A). The main differences in densities were found between the coffee plot and the other two types of vegetation.

Thirty-three recognizable taxonomic units (UTR) were obtained with a total of 3,031 organisms, from 30 families with 28 genera and 33 species (Table 1). The fallow displayed the largest abundance, with 1,464 specimens in both layers, soil and litter (average±SE: 73±22; n = 20), followed by the forest, with 1,239 specimens (62±9), and by the coffee plot, with only 328 specimens (16±4). The most abundant families were Haplozetidae (743 specimens, 24.5%), followed by Tectocepheidae (311 specimens, 10.3%) and Oppiidae (290 specimens, 9.38%). In relation to the biotope, the soil displayed greater abundance of organisms, with 2,010 (66.3%), whereas 1,021 specimens (33.7%) were collected in litter.

The greater species richness was observed in the forest, with 31 taxa belonging to a total of 28 families, followed by the fallow, with 19 species and 19 families, whereas the coffee plot had only 14 species and the same number of families (Table 1). In the forest, the *Arcoppia serrulata*, *Sternoppia* sp. and *Samoabates* sp. species were found only in the soil; in the litter, the species found were *Nothrus* sp., *Microtegeus* sp., *Heterobelba* sp., *Xenillus* sp. and *Cubabodes* sp. besides *Nanhermannia* sp., *Neoliodes* sp. and *Charassobates* sp. For the fallow, only *Sphaerochthonius* sp. was found in the soil, whereas for the coffee plot zone no particular records appeared.

The most abundant species were: *Epilohmannia pallida*, followed by *Rostrozetes foveolatus* and *Hoplophorella* cf. *fonseciai* in the coffee plot; *Rostrozetes foveolatus*, followed by *Tectocepheus* sp. and *Hoplophorella* cf. *fonseciai* in the acahual; and *Rostrozetes foveolatus*, followed by *Karenella* sp. and *Hoplophorella* cf. *fonseciai* in the forest.

The zone that displayed the smallest value of diversity was the litter of acahual, while the greatest value was displayed at the forest litter, what is reflected by the smaller value of the index of Simpson (Table 1, Figure 1). The most abundant orders was Entomobryomorpha (713 organisms, 60,6%), followed by Poduromorpha (402 organisms, 34,2%), Symphypleona (60 organisms, 5,1%) and Neelipleona (only two organisms, 0,2%). The forest presented a greater number of Collembola with 656 individuals (average±EE: 33±10), whereas the fallow and the coffee plot presented 409 (21±6) and 112 (6±3) specimens respectively. Litter presented

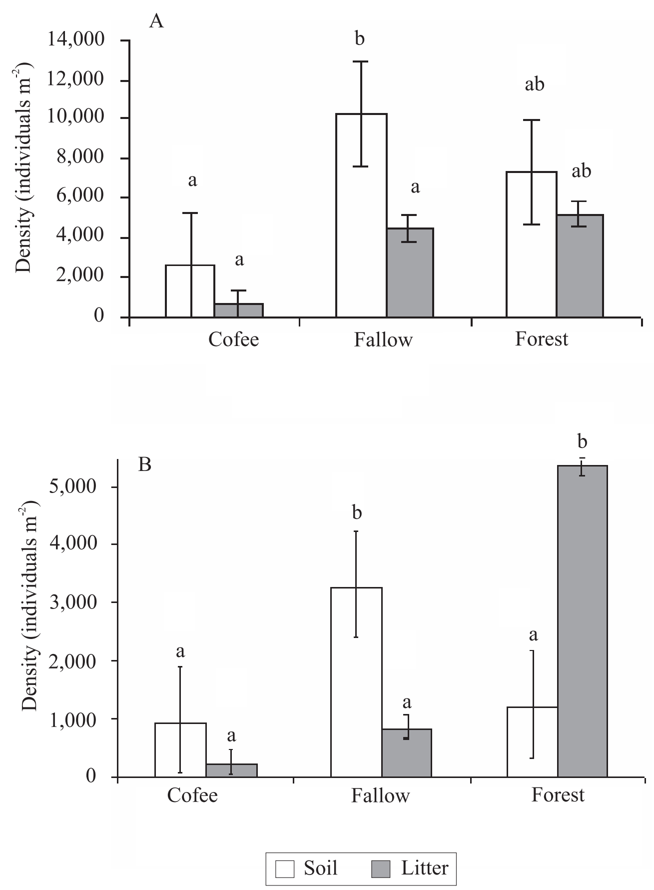

Figure 1. Density of (A) oribatid mites and (B) Collembola by area and biotope with standard error (vertical bars) at "El Nueve" coffee farm. Different letters indicate significant (p<0.05) differences by Tukey's test.

641 (54,5%), whereas the soil had 536 (45,5%) organisms. A total of 43 UTR among 13 families were identified (in order of abundance): Isotomidae with 503 (42,7%) specimens, Entomobryidae with 209 (17,8%) specimens, Hypogastruridae with 163 (13,8%) specimens, and Onychiuridae with 138 (11,7%) specimens. The greatest species richness was found in the forest, with 31 species from 9 families, followed by the fallow, with 25 species grouped in 9 families, and by the coffee plot, which presented only 13 species in 6 families, in a total of 43 species (Table 2).

The Odontellidae family was found exclusively at the coffee plot, and Sminthuridae and Neelidae were found in the forest. Sminthurididae specimens were collected only in the forest litter, while Katiannidae were found in the soil at the same zone. Isotomidae was the family with greatest diversity of genera (nine).

Table 1. Community structure of Cryptostigmata mites for May 2002 at "El Nueve" farm at Santa María Huatulco, Oaxaca. Density (no. of individuals m^{-2}); S, species richness; H', Shannon diversity index; J', Pielou's evenness index; λ, Simpson's index**.**

Species/vegetation biotope	Coffe plantation		Fallow		Cloud montain forest		Total litter	Total soil	Total
	Litter	Soil	Litter	Soil	Litter	Soil			
Mesoplophoridae[1]									
Mesoplophora sp.	0	0	18	15	10	21	28	36	64 (107)
Sphaerochtoniidae[1]									
Sphaerochthonius sp.	0	0	0	29	0	0	0	29	29 (48)
Phthiracaridae[1]									
Atropacarus (*Hoplophorella*)cf. *fonseciai*	29	18	67	49	71	43	167	110	277 (462)
Euphthiracaridae									
Rhysotritia cf. *comtae*	8	3	41	32	14	23	63	58	121 (202)
Epilohmanniidae									
Epilohmannia pallida americana[1]	2	61	0	116	14	55	16	232	248 (413)
Nothridae									
Nothrus sp.	0	0	0	0	5	0	5	0	5 (8)
Nanhermanniidae[1]									
Nanhermannia sp.	0	0	0	0	5	0	5	0	5 (8)
Hermanniellidae[1]									
Sacculobates cf. *horologiorum*	9	8	3	3	3	2	15	13	28 (47)
Plasmobatidae									
Plasmobates sp.	5	11	0	6	0	1	5	18	23 (38)
Neoliodidae[1]									
Neoliodes sp.	0	0	0	0	3	0	3	0	3 (5)
Gymnodamaeidae									
Plesiodamaeus tuberculatus	0	0	0	0	2	39	2	39	41 (68)
Microtegeidae[1]									
Microtegeus similis	0	0	0	0	3	0	3	0	3 (5)
Charassobatidae[1]									
Charassobates sp.	0	0	0	0	6	0	6	0	6 (10)
Microzetidae									
Acaroceras sp.	0	20	3	41	39	27	42	88	132 (220)
Eremobelbidae									
Eremobelba piffli[1]	0	5	0	0	39	49	39	54	93 (155)
Heterobelbidae									
Heterobelba sp.	0	0	0	0	1	0	1	0	1 (2)
Basilobelbidae[1]									
Basilobelba cf. *werneri*	0	8	0	12	0	0	0	20	20 (33)
Liacaridae[1]									
Liacarus (*Rhaphidosus*) sp.	0	0	3	0	0	14	3	14	17 (28)
Xenillidae[1]									
Xenillus sp.	0	0	0	0	3	0	3	0	3 (5)
Carabodidae[1]									
Cubabodes sp.	0	0	0	0	12	0	12	0	12 (20)
Tectocepheidae									
Tectocepheus sp.	2	22	0	181	31	75	33	278	311 (518)
Dampfiellidae									
Beckiella arcta[1]	0	0	0	7	5	0	5	7	12 (20)

Continue...

Table 1. Continuation...

Oppiidae									291 (485)
Karenella sp.(1)	1	26	11	100	32	120	44	246	290 (483)
Arcoppia serrulata(1)	0	0	0	0	0	1	0	1	1 (2)
Sternoppiidae(1)									
Sternoppia sp.	0	0	0	0	0	15	0	15	15 (25)
Protoribatidae									
Protoribates sp.	0	24	12	57	29	37	41	118	159 (265)
Haplozetidae									743 (1,238)
Rostrozetes foveolatus	8	45	233	240	105	112	346	397	742 (1,237)
Rostrozetes sp.	0	0	0	0	0	1	0	1	1 (2)
Scheloribatidae									187 (312)
Samoabates sp.(1)	0	0	0	0	0	1	0	1	1 (2)
Scheloribates cf. *elegans*	0	7	5	96	18	60	23	163	186 (310)
Ceratozetidae(1)									
Ceratozetes sp.	0	0	0	3	0	9	0	12	12 (20)
Epactozetidae(1)									
Truncozetes cf. *sturmi*	0	0	0	5	7	0	7	5	12 (20)
Galumnidae									
Acrogalumna sp.(1)	3	3	44	32	56	21	103	56	159 (265)
Total by biotope	67	261	440	1024	514	725	1021	2010	3031 (5,052)
	(670)	(2,610)	(4,400)	(10,240	(5,140)	(7,250)	(3,403)	(6,700)	
Species richness	9	14	11	18	24	21	26	25	33
Shannon diversity	1.75	2.30	1.55	2.33	2.62	2.58	2.32	2.54	2.58
Pielou's evenness	0.79	0.87	0.65	0.81	0.82	0.85	0.55	0.73	0.67
Simpson's determinance	0.23	0.12	0.29	0.13	0.09	0.09	0.16	0.10	0.11

(1)First record for the State.

Six families were found in the coffee plot, the most abundant of them being Onychiuridae (fallow) and Isotomidae (forest). The most abundant species were: in the coffee plot – *Xenyllodes* sp., followed by *Mesaphorura* sp., *Ceratophysella gibbosa* and *Protaphorura* sp.; in acahual – *Pseudosinella* cf. *octopunctata*, followed by *Isotomiella* sp., *Proisotoma minuta*, *Mesaphorura* sp., *Protaphorura* sp., *Folsomina onychiurina*, *Ceratophysella gibbosa* and *Xenylla* cf. *grisea*; in the forest – *Proisotoma* cf. *minuta*, followed by *Folsomides parvulus*, *Pseudosinella* cf. *octopunctata*, *Neosminthurus* cf. *bakeri*, *Pseudosinella* sp., *Micranurida* sp., *Ceratophysella gibbosa* and *Folsomina onychiurina*.

With regard to the values of equitativity, the litter of the fallow had the highest value, whereas the litter of the coffee plot displayed the smallest value. For the Simpson's results, the soil forest was the one that recorded the smallest dominance (0,08), but with the greatest amount of very abundant species; however, the litter of the coffee plot presented the greatest dominance with the smallest number of abundant species (Table 2).

Variations shown in richness and diversity of mites and springtails in the three types of vegetation usually appear when soils with different types of use are compared. In the forest, as it was expected, there was greater diversity and particular species records for both groups, promoted by the little human intervention, which maintains the biotopes in more natural conditions. Clear examples are the *Nothrus* sp. species (Cryptostigmata), and the species pertaining to the Sminthuridae family, which are characteristic in zones with low alteration (Cutz-Pool, 2003).

On the other hand, in the CP, the richness, diversity and abundance of Cryptostigmata and Collembola were lower because it is an active zone of crops, which generates substantial changes in both biotopes (Mendoza, 1995). Species as *Rostrozetes foveolatus* (Cryptostigmata) and *Mesaphorura* sp. (Collembola) are characteristic in soils that have undergone substantial changes in the composition of litter, which indicates that the abundance and diversity of these species are usually sensible to these changes (Loranger, et al. 1998; Mendoza, 1995).

In the fallow plot (A), abundances and species similar to those of the other zones appeared. This is agreement with Mendoza (1995) findings, which mention that the secondary vegetation (fallows) are transition sites where the sequence of changes in the composition of species of the community is associated with a series of modifications in the functional and structural properties of the soil. This becomes stronger with the

Table 2. Community structure of Collembola for May 2002 at "El Nueve" property at Santa María Huatulco, Oaxaca. Density (no. of individuals m^{-2}); S, species richness; H', Shannon diversity index; J', Pielou's evenness index; λ, Simpson's index**.**

Species/vegetation biotope	Coffe plantation		Fallow		Cloud montain forest		Total litter	Total soil	Total
	Litter	Soil	Litter	Soil	Litter	Soil			
Hypogastruridae									163 (272)
Hypogastrura sp.[1]	0	0	0	7	7	0	7	7	14 (23)
Ceratophysella gibbosa	3	17	10	20	15	11	28	48	76 (127)
Schottella sp.[1]	0	0	0	0	1	0	1	0	1 (2)
Xenylla cf. *grisea*[1]	0	5	0	24	7	6	7	35	42 (70)
X. humicola[1]	0	0	0	0	11	0	11	0	11 (18)
X. cf. *tullbergi*[1]	0	0	0	1	0	0	0	1	1 (2)
X. cf. *welchi*	0	0	0	0	16	0	16	0	16 (27)
X. cf. *uniseta*[1]	0	0	0	0	1	0	1	0	1 (2)
X. cf. *fernandesi*[1]	0	0	0	1	0	0	0	1	1 (2)
Odontellidae[1]									33 (55)
Superodontella sp.	0	3	0	0	0	0	0	3	3 (5)
Xenyllodes sp.	14	16	0	0	0	0	14	16	30 (50)
Neanuridae									58 (97)
Friesea sp.[1]	0	0	0	2	0	1	0	3	3 (5)
Neanura sp.[1]	0	0	0	5	0	2	0	7	7 (12)
Palmanura sp.	0	0	0	0	0	5	0	5	5 (8)
Pseudachorutes sp.	0	0	4	3	4	3	8	6	14 (23)
Micranurida sp.[1]	0	0	0	0	29	0	29	0	29 (48)
Brachystomellidae									
Brachystomella sp.	3	0	3	4	0	0	6	4	10 (17)
Onychiuridae									138 ()
Onychiurus sp.[1]	0	1	0	4	0	1	0	6	6 (10)
Protaphorura sp.[1]	0	13	19	16	4	0	23	29	52 (87)
Mesaphorura sp.[1]	0	21	10	26	11	12	21	59	80 (133)
Isotomidae									503 (838)
Folsomides parvulus	1	0	0	0	85	9	86	9	95 (158)
Dagamaea sp.[1]	0	1	0	0	0	0	0	1	1 (2)
Proisotoma cf. minuta[1]	0	4	9	34	154	17	163	55	218 (363)
Cryptopygus termophilus[1]	0	6	0	10	0	0	0	16	16 (27)
Folsomia sp.[1]	0	0	12	0	0	0	12	0	12 (20)
Folsomina onychiurina	0	0	3	29	18	6	21	35	56 (93)
Isotomurus sp.	0	0	2	0	16	0	18	0	18 (30)
Isotoma sp.[1]	0	0	3	0	0	5	3	5	8 (13)
Isotomiella sp.[1]	0	0	6	52	17	4	23	56	79 (132)
Entomobryidae									209 (348)
Entomobrya sp.[1]	0	0	0	0	0	1	0	1	1 (2)
Seira cf. bipunctata[1]	0	0	0	1	0	0	0	1	1 (2)
Lepidocyrtus sp.[1]	0	0	0	0	1	0	1	0	1 (2)
Pseudosinella cf. sexoculata[1]	0	0	0	0	15	0	15	0	15 (25)
P. cf. alba[1]	0	0	0	0	0	1	0	1	1 (2)
P. cf. collina[1]	0	0	0	1	0	0	0	1	1 (2)
P. cf. *octopunctata*[1]	0	4	2	81	52	16	54	101	155 (258)
P. sp.	0	0	0	0	34	0	34	0	34 (57)
Paronellidae									
Salina cf. beta[1]	0	0	0	1	0	0	0	1	1 (2)
Sminthurididae[1]									
Sphaeridia cf. pumilis	0	0	0	0	10	0	10	0	10 (17)
Katiannidae[1]									
Sminthurinus sp.	0	0	0	0	0	4	0	4	4 (7)
Dicyrtomidae[1]									
Calvatomina sp.	0	0	0	1	0	0	0	1	1 (2)
Sminthuridae									
Neosminthurus cf. bakeri[1]	0	0	0	3	28	14	28	17	45 (75)
Neelidae[1]									
Megalothorax sp.	0	0	0	0	1	1	1	1	2 (3)
Total by biotope	21 (210)	91 (910)	83 (830)	326 (3,260)	537 (5,370)	119 (1,190)	641 (2,137)	536 (1,787)	1,177 (1,962)
Species richness	4	11	12	22	23	19	27	32	43
Shannon diversity index	0.97	2.06	2.24	2.39	2.46	2.60	2.69	2.69	2.90
Pielou's evenness index	0.70	0.86	0.90	0.77	0.78	0.88	0.61	0.72	0.77
Simpson's index	0.46	0.14	0.12	0.12	0.131	0.08	0.11	0.09	0.08

[1]First record for the State.

high presence of species like *Rostrozetes foveolatus* and *Tectocepheus* sp. (Cryptostigmata) and of *Pseudosinella* cf. *octopunctata* (Collembola), which are characteristic for being pioneer species in the recolonization of altered grounds (Palacios-Vargas, 1997; Iglesias, 2006). These can work like indicators of certain stages of natural recovery. In general, the high diversity in both groups was recorded in the forest plot. The microclimatic conditions in this plot are probably better for mite and Collembola communities, as they offer more resources and niches for the organisms to exploit. The forest plot recorded nearly neutral pH values (6.6), and it presented the highest values of carbon content (68.5). In the fallow, the pH was very acid (4.3), and some acidophilous species can be found only in this environment.

Conclusions

1. Out of a total of 76 species, 33 belong to the Oribatida and 43 to the Collembola orders, and a total of 18 species and 14 families of the oribatid mites recorded are new for the state, whereas for Collembola a total of 34 species and 5 families are new records.
2. The abundance and distribution of oribatid mites found in the three sampling areas, in decreasing sequence, is *Rostrozetes foveolatus*, *Tectocepheus* sp., *Karenella* sp., *Hoplophorella* cf. *fonseciai* and *Epilohmannia pallida*.
3. The Collembola species found in the three zones with greatest abundance and distribution are *Proisotoma minuta*, *Pseudosinella* cf. *octopunctata*, *Mesaphorura* sp. and *Ceratophysella gibbosa*, as well as *Folsomides parvulus* and *Isotomiella* sp.
4. The greater oribatid mites abundance and richness are in the fallow and forest areas respectively; whereas for Collembola, both characteristics appear in greater magnitude in the forest.
5. The fallow presents similarities with the other zones in density and richness of species of oribatid mites and Collembola.

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