Springtails (Collembola) Associated with Nests of Fungus-Growing Ants (Formicidae: Myrmicinae: Attini) in Southern Bahia, Brazil

Authors: Castaño-Meneses, Gabriela, Palacios-Vargas, José G., Delabie, Jacques H.C., Zeppelini, Douglas, and Mariano, Cléa S.F.

Source: Florida Entomologist, 100(4) : 740-742

Published By: Florida Entomological Society

URL: https://doi.org/10.1653/024.100.0421

Springtails (Collembola) associated with nests of fungus-growing ants (Formicidae: Myrmicinae: Attini) in southern Bahia, Brazil

Gabriela Castaño-Meneses[1,2], José G. Palacios-Vargas[2], Jacques H.C. Delabie[3,4], Douglas Zeppelini[5], and Cléa S.F. Mariano[3,4]*

Abstract

Four species of Collembola were found in nests of the ant genera *Myrmicocrypta*, *Trachymyrmex* and *Sericomyrmex* of the tribe Attini (Formicidae: Myrmicinae). The panmyrmecophilic collembolan *Cyphoderus* (Lepidocyrtidae: Cyphoderinae) was the most abundant and was associated with all the ants. The collembolan genus *Mucrosomia* (Isotomidae: Anurophorinae) was found for the first time in ant nests. This is the first list of springtails found in nests of fungus-growing ants other than those belonging to the genera *Atta* and *Acromyrmex* (Formicidae: Myrmicinae).

Key Words: *Cyphoderus*, *Mucrosomia*, lower Attini, synecomorphs

Resumen

Se encontraron cuatro especies de Collembola en nidos de hormigas de los géneros *Myrmicocrypta*, *Trachymyrmex* y *Sericomyrmex* de la tribu Attini (Formicidae: Myrmicinae). El colémbolo panmirmecófilo *Cyphoderus* (Lepidocyrtidae: Cyphoderinae) fue el más abundante y se registró asociado a todas las hormigas. El género de colémbolos *Mucrosomia* (Isotomidae: Anurophorinae) se registra por primera vez en nidos de hormigas. Este es el primer listado de colémbolos encontrados en nidos de hormigas cultivadoras de hongos de géneros diferentes a *Atta* y *Acromyrmex* (Formicidae: Myrmicinae).

Palabras Clave: *Cyphoderus*, *Mucrosomia*, Attini inferiores, sinecomorfos

Fungus-growing ants (Formicidae: Myrmicinae: Attini) are distributed exclusively in the New World, with more than 230 species described. They are obligately dependent on the fungi they grow, though displaying great variation in their ecology (Mehdiabadi & Schultz 2010). Conditions in the nests of fungus-growing ants are extremely stable in time and space, and nests possess considerable resources that are available for the diverse fauna associated with such ants (Kistner 1982; Waller & Moser 1990; Hughes et al. 2008). Most genera, previously considered to be the "lower" attines in an earlier system of classification (before Ward et al. 2015), form small colonies with fewer than 3,000 workers. In contrast, the species of the related genus *Atta* form very large colonies that can include several million workers (Hölldobler & Wilson 1990). Most research on the fauna associated with fungus-growing ant nests has been focused on the genera *Atta* and *Acromyrmex*, particularly on some groups of inquilines such as Coleoptera and Araneae (Cushing 1997; Vaz-de-Mello et al. 1998; Navarrete-Heredia 2001).

Springtails are common inhabitants of fungus-growing ant nests, and in some cases they can be considered to be pests of the fungal gardens maintained by the ants. Even the peculiar behavior known as "jigging", described as rhythmic rocking behavior displayed by *Cyphomyrmex* and *Myrmicocrypta* ants (Formicidae: Myrmicinae), has been attributed to driving away the collembolans from fungus gardens (Kweskin 2004). Nevertheless, until now only 3 species of collembolans have been reported to be associated with fungus-growing ants, all in the genera *Atta* and *Acromyrmex* (Formicidae: Myrmicinae): *Cyphoderus inaequalis* Folsom (Lepidocyrtidae: Cyphoderinae) with *Acromyrmex octospinosus* (Reich) (Weber 1958), *Pseudosinella violenta* (Folsom) (Lepidocyrtidae) with *Atta texana* (Buckley) (Waller & Moser 1990), and *Seira edmanni* (Stach) (Seiridae) with *A. sexdens* (L) (Eidmann 1937). The occurrence of springtails of the family Sminthuridae have been reported in laboratory colonies of *Cyphomyrmex costatus* Mann (Formicidae: Myrmiciane) (Kweskin 2004), but there are no records of this group of microarthropods in any other fungus-growing ant nests. Here we report information on springtails living in the nests of fungus-growing ants in different localities of southern Bahia, Brazil.

[1]Ecología de Artrópodos en Ambientes Extremos, Unidad Multidisciplinaria de Docencia e Investigación, Facultad de Ciencias, Universidad Nacional Autónoma de México, Campus Juriquilla, Boulevard Juriquilla 3001, 76230, Querétaro, México. E-mail: gabycast99@hotmail.com (G. C. M.)
[2]Ecología y Sistemática de Microartrópodos, Departamento de Ecología y Recursos Naturales, Facultad de Ciencias, Universidad Nacional Autónoma de México, 04510, México, Distrito Federal, México. E-mail: troglolaphysa@hotmail.com (J. G. P. V.)
[3]Departamentos de Ciências Biológicas e de Ciências Agrárias e Ambientais, Universidade Estadual de Santa Cruz, 45650-000 Ilhéus, Bahia, Brazil. E-mail: jacques.delebie@gmail.com (J. H. C. D.)
[4]Laboratôrio de Mirmecologia, Centro de Pesquisas do Cacau, , Caixa Postal 7, 45600-970, Itabuna, Bahia, Brazil. E-mail: camponotu@hotmail.com (C. S. F. M.)
[5]Universidade Estadual da Paraíba Campus V, Centro de Ciências Biológicas e Socias Aplicadas, Depto. Biologia. Programa de Pós Graduação en Ecologia e Conservação. 58070-450, João Pessoa, Paraíba, Brazil. E-mail: zeppelini@daad-alumni.de (D. Z.)
*Corresponding author; E-mail: gabycast99@hotmail.com

Table 1. Collecting sites in the southeast of Bahia State, Brazil, 2012-2013.

Locality	Geographical coordinates (Latitude, Longitude)	Environment	Nests
Aurelino Leal-Boa Vista Farm	14.3500°S, 39.4000°W	Cacao field	5
Canavieiras	15.6500°S, 38.9500°W	*Arboretum*	3
Ilhéus-Cocoa Research Center-Reserva Zoobotânica	14.7500°S, 39.2162°W	*Arboretum* Cacao field Secondary growth forest	50
Itajuípe-Estação Experimental	14.7000°S, 39.4830°W	Cacao field	6
Santa Luzia	15.4000°S, 39.3330°W	Cacao field	2
Ubaitaba-Fazenda Fortaleza	14.3000°S, 39.3160°W	Cacao field	4
Ubatã-Fazenda Providência	14.1830°S, 39.5000°W	Cacao field	2
Una-Estação Experimental ESMAI	15.2660°S, 39.0660°W	Cacao field	2

Materials and Methods

Entire nests of fungus-growing ants, including ants of the genera *Apterostigma*, *Cyphomyrmex*, *Mycocepurus*, *Myrmicocrypta*, *Sericomyrmex*, and *Trachymyrmex* (Formicidae: Myrmicinae) were collected in the localities of Ubatã, Ubaitaba, Itajuípe, and Ilhéus, in the southeast of the state of Bahia, Brazil, during different periods of 2012 and 2013, during the project "Biology of fungus-growing ants in Southern Bahia, Brazil: associated fauna and nesting strategy". They were obtained from cocoa plantations and areas of secondary growth of tropical rain forest. These nests were examined for associated fauna. Springtails were obtained directly using a paint brush or entomological forceps. The springtails were sorted and mounted in Hoyer's solution for identification. Table 1 shows the main characteristics of the nests examined.

Results

A total of 74 nests of the different ant species were examined for associated fauna. Springtails were found in only 17 nests, which belonged to the ants *Sericomyrmex saussurei* Emery (Formicidae: Myrmicinae) (5 nests), *S. bondari* Borgmeier (Formicidae: Myrmicinae) (4 nests), *S. parvulus* Forel (Formicidae: Myrmicinae) 2 nests), *Myrmicocrypta* sp. (5 nests), and *Trachymyrmex cornetzi* (Forel) (Formicidae: Myrmicinae) (1 nest). No collembolans were found in the nests of *Apterostigma*, *Cyphomyrmex* and *Mycocepurus*. A total of 106 springtails representing 4 species were recorded, the most common being *Cyphoderus agnotus* Börner (Cyphoderidae: Cyphoderus) (Table 2).

Table 2. Springtails associated with the nests of fungus-growing ants in southeastern Bahia State, Brazil.

Collembola	Host ants
Entomobryomorpha	
Lepidocyrtidae	
Cyphoderinae	
Cyphoderus agnotus Börner	*Myrmicocrypt*a sp. *Sericomyrmex bondari* Borgmeier *Sericomyrmex parvulus* Forel *Sericomyrmex saussurei* Emery
Cyphoderus similis Folsom	*Myrmicocrypt*a sp. *Sericomyrmex parvulus* Forel *Sericomyrmex saussurei* Emery *Trachymyrmex cornetzi* (Forel)
Isotomidae	
Proisotominae	
Proisotoma minima (Absolon)	*Sericomyrmex saussurei* Emery
Anurophorinae	
Mucrosomia sp.	*Sericomyrmex saussurei* Emery

Discussion

Springtails were found in only 24% of the nests, and were associated with 3 genera of fungus-growing ants among the 6 we studied. *Cyphoderus* was present in all the ant species nests, confirming its panmyrmecophily (Wasmann 1894). Nevertheless, we found that *C. agnotus* was associated with *S. bondari* (Hymentopera: Formicidae), whereas *C. similis* was associated with *T. cornetzi*. *Mucrosomia* (Iso tomidae: Anurophorinae) was recorded for the first time in ant nests; until now this genus has been found in Brazil only by Mendonça and Queiroz (2013) in mountains of the southeast of the country, whereas the other 3 known species occur in Europe (Potapov 2001). The species *Proisotoma minima* (Collembola: Isotomidae) has been recorded once previously associated with Ponerinae (Hymenoptera: Formicidae) ant nests found in cacao pods (Castaño-Meneses et al. 2014).

Within attine "agricultural systems," *Myrmicocrypta* display a "lower agriculture" system, whereas *Trachymyrmex* and *Sericomyrmex* show a "generalized higher agriculture" system (Mehdiabadi & Schultz 2010). All of these ants cultivate their symbiotic fungus with plant detritus, flower fragments, seeds, and arthropod feces as substrates, which are suitable for growth of the leucocoprineous fungi grown by the ants (Brandão & Mayhé-Nunes 2007; Mehdiabadi & Schultz 2010). These fungi are common decomposers of the leaf litter, and also are consumed by the Collembola (Vellinga 2004; Takahashi et al. 2005). The availability of this food source can explain the abundance of springtails such as *Cyphoderus* in the nests of these ants. Collembola were already recorded as commensals in nests of different fungus growing ants, but without discrimination of the host ant species (Mehdiabadi & Schultz 2010). This is the first record of springtails associated with known species of the genera *Myrmicocrypta*, *Trachymyrmex* and *Sericomyrmex*. The occurrence of collembolans in the nests of fungus-growing ants is possibly beneficial to the growth of the symbiotic fungus. It has been observed that grazing activity of collembolans is able to increase the growth and respiration rate of fungal hyphae (Hedlund et al. 1991), and for this reason, the host ants tolerate them in their nests.

Acknowledgments

The authors would like to thank the Programa de Apoyos para la Superación del Personal Académico, DGAPA, UNAM that gave support to sabbatical leave to GCM and research visit of DZ. CNPq is acknowledged for the grant concession to CSFM and JHCD. We are deeply

thankful to José Raimundo Maia Santos's support in the field work, and to Karina Alves (In Memoriam) and Evelyn Fróes for ant nest collection and sorting of the associated fauna. Luis Parra (ENAP-UNAM) corrected the English composition of the final manuscript.

References Cited

Brandão CRF, Mayhé-Nunes AJ. 2007. A phylogenetic hypothesis for the *Trachymyrmex* species groups, and the transition from fungus-growing to leaf-cutting in the Attini, pp. 72–88 *In* Snelling RR, Fisher BL, Ward PS [Eds.], Advances in Ant Systematics (Hymenoptera: Formicidae): Homage to E. O. Wilson – 50 Years of Contributions. Memoirs of the American Entomological Institute 80. 690 pp.

Castaño-Meneses G, Palacios-Vargas JG, Delabie JHC, de Jesus Santos R, Mariano CSF. 2014. Springtails (Collembola) from nests of Ponerinae (Hymenoptera: Formicidae) ants in Brazilian cacao plantations. Florida Entomologist 97: 1862–1864.

Cushing PE. 1997. Myrmecomorphy and myrmecophily in spiders: a review. Florida Entomologist 80: 165–193.

Eidmann H. 1937. Gäste und Gasterverhältsnisse der Blattschneidersameise *Atta sexdens* L. Zeitschrft für Morphologie und Ökologie der Tiere 32: 391–462.

Hedlund K, Boddy L, Preston CM. 1991. Mycelial response of the soil fungus, *Mortierella isabellina*, to grazing by *Onychiurus armatus* (Collembola). Soil Biology and Biochemistry 23: 361–366.

Hölldobler B, Wilson EO. 1990. The Ants. Harvard University, Cambridge, Massachusetts.

Hughes DF, Pierce NE, Boomsma JJ. 2008. Social insect symbionts: evolution in homeostatic fortresses. Trends in Ecology and Evolution 23: 672–677.

Kistner DH. 1982. The social insects' bestiary, pp. 1–244 *In* Hermann HR [Ed.], The social insects, vol. 3. Academic Press, New York, USA.

Kweskin MP. 2004. Jigging in the fungus-growing ant *Cyphomyrmex costatus*: a response to collembolan garden invaders? Insectes Sociaux 51: 158–162.

Mehdiabadi NJ, Schultz TR. 2010. Natural history and phylogeny of the fungus-farming ants (Hymenoptera: Formicidae: Myrmicinae: Attini). Myrmecological News 13: 37–55.

Mendonça MC, Queiroz GC. 2013. A new species of *Mucrosomia* (Collembola: Isotomidae) from Brazil. Zoologia 30: 217–220.

Navarrete-Heredia JL. 2001. Beetles associated with *Atta* and *Acromyrmex* ants (Hymenoptera: Fomicidade: Attini). Transactions of the American Entomological Society 127: 381–429.

Potapov M. 2001. Isotomidae, pp. 1–603 *In* Dunger W [Ed.], Synopses on Palearctic Collembola. Abhandlungen und Berichte des Naturkundemuseums 73.

Takahashi KH, Tuno N, Kagaya F. 2005. Abundance of mycophagous arthropods present on different species of fungi in relation to resource abundance at different spatial scales. European Journal of Entomology 102: 39–46.

Vaz-de-Mello FZ, Louzada JNC, Schoereder JH. 1998. New data and comments on Sacarabaeidae (Coleoptera: Scarabaeoidea) associated with Attini (Hymenoptera: Formicidae). The Coleopterists Bulletin 52: 209–2016.

Vellinga EC. 2004. Ecology and distribution of *Leiotaceous* fungi (Agaricaceae). A review. Nova Hedwigia 78: 273–299.

Waller DA, Moser JC. 1990. Invertebrate enemies and nest associates of the leaf-cutting ant *Atta texana* (Buckley) (Formicidade, Attini), pp. 255–273 *In* Vander Meer RK, Jaffe K, Cedeno A [Eds.], Applied Myrmecology: a World Perspective. Westview Press, Boulder, Colorado, USA.

Ward PS, Brady SG, Fisher BL, Schultz TR. 2015. The evolution of myrmicine ants: phylogeny and biogeography of a hyperdiverse ant clade (Hymenoptera: Formicidae). Systematic Entomology 40: 61–81.

Wasmann ESJ. 1894. Kritisches Verzeichniss der Myrmekophilen und Termitophilen Arthoopoden it Angabe der Lebensweise und mit Beschreibung neur Arten. Verlag Von Felix L. Dame, Berlin, Germany. 231 pp.

Weber NA. 1958. Evolution in fungus-growing ants. Proceedings of the 10th International Congress of Entomology 2: 459–473.