ACTA BIOLÓGICA COLOMBIANA
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Facultad de Ciencias
Departamento de Biología
Sede Bogotá

UNIVERSIDAD NACIONAL DE COLOMBIA

NOTA BREVE / SHORT NOTE

NEW GEOGRAPHIC RANGE AND FIRST RECORD OF *Seira tinguira* (COLLEMBOLA: ENTOMOBRYIDAE) IN A COLONY OF *Polistes ferreri* (HYMENOPTERA, VESPIDAE)

NUEVO ALCANCE GEOGRÁFICO Y PRIMER REGISTRO DE *Seira tinguira* EN UNA COLONIA DE *Polistes ferreri* (HYMENOPTERA, VESPIDAE)

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Received: 16th August 2023. **Revised:** 08th February 2024. **Accepted:** 27th February 2024.
Associate editor: Héctor Jaime Gasca Álvarez

Citation/ citar este artículo como: Maciel, T.T.; Barbosa, B.C., Cipola, N.G., Prezoto, F. (2024). New Geographic Range and First Record of *Seira tinguira* (Collembola: Entomobryidae) in a Colony of *Polistes ferreri* (Hymenoptera, Vespidae). *Acta Biol Colomb*, *29*(2), 182-186. https://doi.org/10.15446/abc.v29n2.110078

ABSTRACT

The springtail *Seira tinguira* was observed for the first time in the state of Minas Gerais in a colony of the social wasp *Polistes ferreri*. The colony was collected in the Botanical Garden of the Federal University of Juiz de Fora, a fragment of Montane Seasonal Semideciduous Tropical Forest, located in the urban perimeter of the municipality of Juiz de Fora, southeast of the state of Minas Gerais, Brazil. These springtails were recorded walking on the inner base of the cells of the nest close to the meconium, which served as the substrate for the *Aspergillus* sp. hyphomycete fungus. There was no removal or defense behavior against the springtail, however, the wasps occasionally showed alarm behavior, characterized by opening the wings, contracting the abdomen, and actively patrolling the nest.

Keywords: Atlantic Forest, Ecological interaction, Springtail, Polistinae.

RESUMEN

El colémbolo *Seira tinguira* fue observado por primera vez en el estado de Minas Gerais, en una colonia de la avispa social *Polistes ferreri*. La colonia fue colectada en el Jardín Botánico de la Universidad Federal de Juiz de Fora, localizada en un fragmento de Bosque Tropical Semideciduo Estacional Montano ubicado en el perímetro urbano del municipio de Juiz de Fora, al sureste de la Estado de Minas Gerais, Brasil. Los colémbolos fueron observados caminando sobre la base interna de las celdas del nido cerca del meconio, el cual sirve como sustrato para el hongo hifomiceto *Aspergillus* sp. Las avispas no demostraron comportamiento de remoción o defensa contra los colémbolos, sin embargo, ocasionalmente mostraron un comportamiento de alarma, caracterizado por abrir las alas, contraer el abdomen y patrullar activamente el nido.

Palabras clave: Bosque Atlántico, Colémbolo, Interacción ecológica, Polistinae.

Social insect nests are attractive habitats for a variety of organisms that can use the structure after it has been abandoned or still associate with the active colony, this includes many symbionts, detritivores, and parasites (Rafael et al., 2012). Within an active colony, the associates benefit not only from shelter but also from resources such as meconium, fungi, larvae, pupae, and even adult individuals (Barbosa et al., 2021), among them Collembola (Hexapoda), a group most often thought of as related to soil (Chahartaghi et al., 2005; Hopkin, 1997).

Springtails are usually recorded in colonies of several species of eusocial insects, such as bees, ants and termites (Salt, 1929; Delamare-Deboutteville, 1948; Snider and Husband, 1966; Husband and Brown, 1976; Dekoninck et al., 2007; Castaño-Meneses et al., 2014; Janion-Scheepers et al., 2015; Mota-Filho et al., 2021). Members of Cyphoderinae (Paronellidae), are the springtails most found in these colonies but at least two species of *Seira* Lubbock (Entomobryidae) have been reported as putative commensals, *S. munroi* (Paclt, 1959) in ant colonies from South Africa, and *S. pulcher* (Handschin, 1924) in a colony of termite *Nasutitermes arenarius* (Hagen, 1858) in Santa Catarina, Brazil (Handschin, 1924; Janion-Scheepers et al., 2015).

However, there are few records of Entomobryidae in wasp nests and colonies. *Entomobrya unostrigata* Stach, 1930 was reported in an unidentified solitary wasp nest in Michigan, United States (Snider, 1967), unidentified springtails were recorded as food sources for larvae in colonies of different species of *Microstigmus* (Crabronidae), as well as by adults in a colony of *Polybia sericea* (Olivier, 1791) (Vespidae) (Bohart and Menke, 1976; Machado et al., 1988). Still regarding social wasps, the only record in which springtail species are identified is that of Womersley (1930) who found *Pseudosinella cavernarum* (Moniez, 1893) and *Lepidocyrtus vespensis* in a nest of *Vespula germanica* (Fabricius, 1793) (Vespidae) in Slough, United Kingdom.

Considering that the identity of the springtail species, as well as the interactions in colonies of many species of social wasps, are unknown, this study aims to report for the first time the species *Seira tinguira* Cipola and Bellini, 2014 in a colony of *Polistes ferreri* Saussure, 1853 (Hymenoptera, Vespidae).

The record took place in February 2016 at the Botanical Garden of the Federal University of Juiz de Fora (21°43'28" S–43°16'47" O, 750 m a.s.l.), a fragment of Montane Seasonal Semideciduous Tropical Forest, located in the urban perimeter of the municipality of Juiz de Fora, southeast of the state of Minas Gerais, Brazil. At the time, a colony of *P. ferreri* in the post-emergence phase (Figs. 1a-1b), nesting in a ravine, was collected for a laboratory study in which two live springtails were observed (Figs. 1c-1d), which were sacrificed and preserved in 92 % ethanol. Specimens in ethanol gel were photographed using a stereomicroscope (M165C) attached to a DFC420 digital camera with a dome (Kawada and Buffington 2016) and the images digitized (in grayscale) using Application Suite V3.4.1. After, the specimens were cleared with Nesbitt's solution and then mounted on glass slides in Hoyer's medium (following Jordana et al., 1997), whose method is necessary to visualize the internal morphology and chaetotaxy elements used in identifications (Figs. 1d–1f). Photographs of specimens on slides were taken using a microscope (Leica-DM 5000B) attached to a digital camera (DFC295), and then digitally joined using Application Suite V.4.1.0. From these procedures, the specimens were identified as *Seira tinguira*, being an adult female and a juvenile (Cipola et al., 2014), both deposited at the Invertebrate Collection of the Instituto Nacional de Pesquisas da Amazônia (INPA), Manaus, Brazil. The wasps were identified using the key proposed by Somavilla et al. (2021b) and some individuals were fixed in 70 % alcohol and deposited at the Laboratório de Ecologia Comportamental e Bioacústica (LABEC) at the Universidade Federal de Juiz de Fora.

Individuals of *S. tinguira* were recorded walking on the inner base of cells in the nest of *P. ferreri* close to the meconium, which also harbored the fungus *Aspergillus* sp. (Ascomycota: Trichocomaceae). The meconium is deposited at the bottom of the cell by larva moments before they pupate (Giannotti and Rocha, 2021). Neotropical social wasps reuse their cells several times and do not remove the meconium, which favors fungal growth (Mayorga-Ch et al., 2021). For wasps, fungi are not useful, but do not pose risks either, however, they serve as a resource for associated organisms, especially springtails, that act in the control and dispersion of fungi, by feeding on hyphae and spores (Hopkin, 1997, 2002).

However, *Aspergillus* sp. does not seem to be associated with springtails, as only spores of Hyphomycetes were detected in their digestive tract (Ascomycota) (Fig. 1e). Rosello et al. (1986) detected at least 11 morphotypes (none of them *Aspergillus*) of ascomycete fungi in the digestive tract of *Seira brasiliana* (Arlé, 1939) [reported as *Seira subannulata* (Denis, 1933) in Rosello et al. (1986), see Mari Mutt and Bellinger, 1990: 103], four of these fungi were the main diet of the other nine springtail species identified in the studied, showing that there is no specificity, at least not for *S. brasiliana* and *S. tinguira*. Furthermore, Rosello et al. (1986) did not provide identification for numerous circular spores (see Rosello et al., 1986: 119, Fig. 2) like the present study (Fig. 1f).

Despite the absence of evidence of the expected fungal spores or hyphy, other types of materials present in abundance in the colonies of social wasps, such as meconium and decomposing plant material, may have attracted these small arthropods (Chahartaghi et al., 2005). Certainly, the nesting site chosen by *P. ferreri* (a ravine) allowed springtails access to the colony since *S. tinguira*, as well as most other species of the genus in the Neotropics, are known to inhabit the edaphic environment (Christiansen and Bellinger, 2000; Cipola et al., 2014).

Although Machado et al. (1988) observed the presence of springtails among the prey captured by adults of *Polybia*

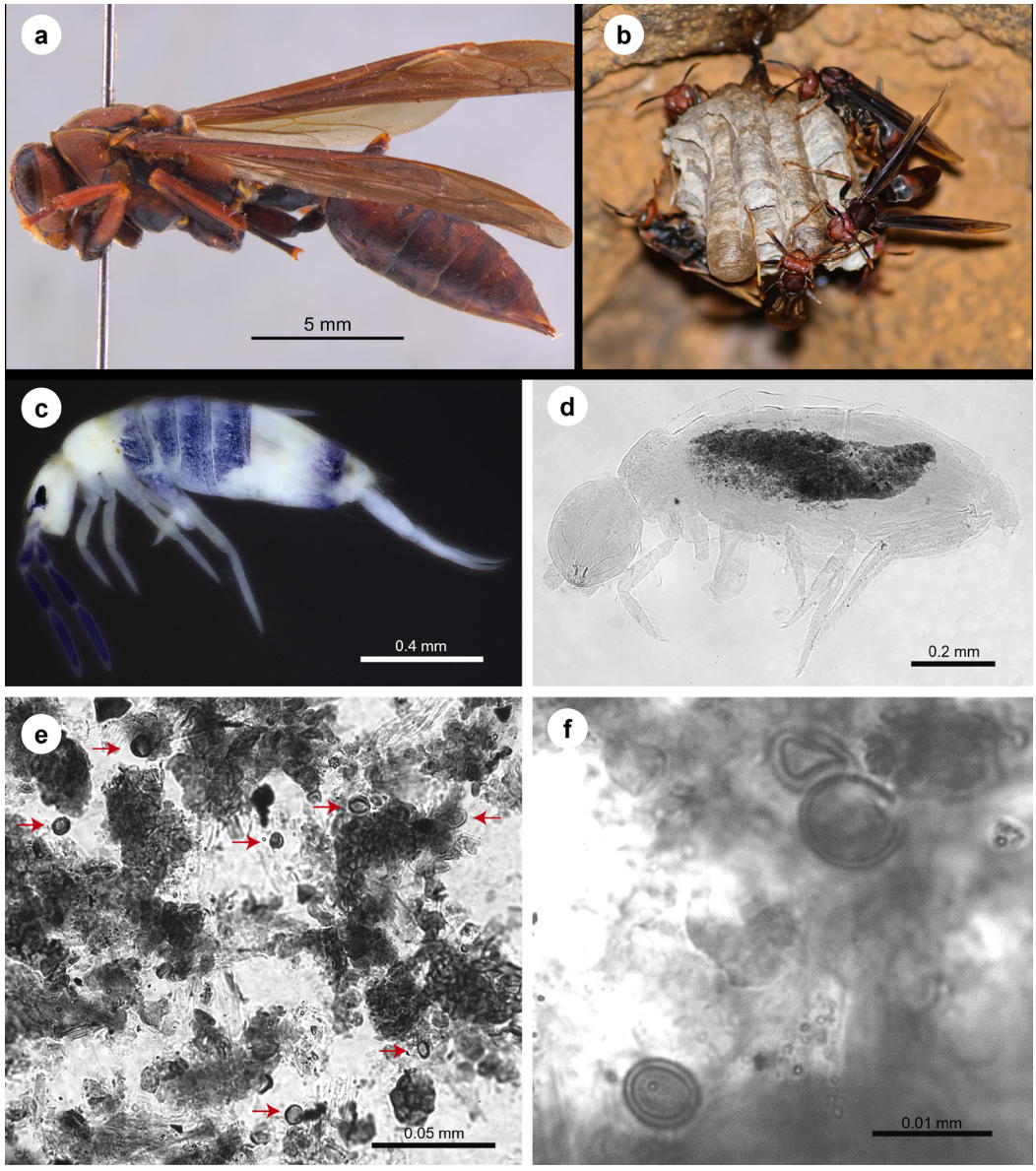

Figure 1. a–*Polistes ferreri*, habitus of specimen (lateral view); b – Colony of *Polistes ferreri* nesting in a ravine; c – *Seira tinguira*, habitus of specimen fixed in alcohol (lateral view); d – *Seira tinguira*, habitus of specimen clarified and preserved on slide (lateral view); e – Part of the digestive tract of *S. tinguira* containing hyphomycetes fungus spores (red arrows); f- *Hyphomycetes fungus* spores.

sericea (Olivier, 1791) and some species of *Microstigmus* have also been recorded providing entomobryids to their offspring (Bohart and Menke, 1976; Akre, 1982), we can rule out the possibility that the individuals of *S. tinguira* observed were taken as prey because they were alive.

However, we still cannot rule out the possibility that this is a phoretic association, considering that springtails (at least *Symphypleona*) use different groups of flying insects for their dispersion, since the Miocene (Penney et al., 2012), *S. tinguira* may use individuals of *P. ferreri* to move around.

Unlike what was recorded by Mota-Filho et al. (2021) in ant colonies, the wasps did not display defense behavior or attempt to remove the springtails. However, the wasps occasionally showed alarm behavior, characterized by opening the wings, contracting the abdomen and active patrolling through the nest (Jeanne and Taylor, 2021). Nothing is known about the behavior of springtails within colonies of social wasps, but we hypothesize that *S. tinguira* use chemical masks that inhibit the complex mechanism of cuticular hydrocarbons used for recognition between individuals in the colony, making them imperceptible (Dani, 2006; Blomquist and Bagnères, 2010).

Regardless of their relationships, the geographic coexistence of *P. ferreri* and *S. tinguira* in the Seasonal Semideciduous Forest of Paraná and Minas Gerais (and probably in the state of São Paulo) reported here, is the first record of *S. tinguira* for the Minas Gerais state (Somavilla et al., 2021a; Cipola et al., 2014; Zeppelini et al., 2024), and the first record of

an identified species of Collembola in a *Polistes* nest. Thus, this work expands the geographic distribution for *S. tinguira*, and increases the list of interactions between springtails and social wasps, as well as related fungi. Such data are fundamental for future research on multispecies interactions.

AUTHORS PARTICIPATION

All authors contributed to the writing of the manuscript. Data collection and analysis were performed by TTM, BCB and NGC. The first version of the manuscript was written by TTM and BCB and all authors commented and revised the previous versions. All authors read and approved the final manuscript.

ACKNOWLEDGMENT

We thank Dr. Patrícia Oliveira Fiuza (UFRN) for the fungus identification in the digestive tract of the springtail. This work was supported by the Universidade Federal de Juiz de Fora (UFJF), the Instituto Nacional de Pesquisas da Amazônia (INPA), the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES), the Conselho de Desenvolvimento Científico e Tecnológico (CNPq) and the Fundação de Amparo à Pesquisa do Estado do Amazonas (FAPEAM). The first and third authors are granted by CNPq (PCI-DB, Process 301762/2024-4 and 300925/2019-0).

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

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