Fundación Miguel Lillo
Tucumán
Argentina

NOTE

Fungus For Fungus: *Acromyrmex rugosus* (Hymenoptera: Formicidae) collecting on *Gymnopilus* cf. *peliolepis* (Agaricales: Hymenogastraceae) in a Brazilian dry forest

Fungo para fungo: *Acromyrmex rugosus* (Hymenoptera: Formicidae) coletando em *Gymnopilus* cf. *peliolepis* (Agaricales: Hymenogastraceae) em uma floresta seca brasileira

Edna K. do N. Santos[1], Rony P. S. Almeida[2], Felipe Wartchow[3], Mário H. de Oliveira[4*]

[1] Departamento de Biologia, Universidade Estadual da Paraíba, Paraíba, Brazil.
[2] Departamento de Biociências, Universidade Federal de Sergipe, Sergipe, Brazil.
[3] Universidade Federal da Paraíba, Departamento de Sistemática e Ecologia, Paraíba, Brazil.
[4] Programa de Pós-Graduação em Ecologia e Conservação, Universidade Estadual da Paraíba, 58429-500, Campina Grande, Paraíba, Brazil.
* Corresponding author: <mariohecules@hotmail.com>

Abstract

This short note is a report of *Acromyrmex rugosus* collecting a slice of mushroom during its foraging. This behavior was already described for other *Acromyrmex* species, but our register of *A. rugosus* collecting *Gymnopilus* cf. *peliolepis* is unprecedented and present insights about this behavior. The ants collected were close to a nest of *Atta sexdens*. This is the first register of this behavior in these farming-ants from areas of Caatinga, with previous records only from the South and Southeastern regions of Brazil. Thus, future studies are needed to understand the benefits of ants belonging to *A. rugosus* to transport fungal species different from those cultivated by them, and we suspect that this foraging mode probably increase the dispersal of *G.* cf. *peliolepis*.

Keywords: Attini, ants, foraging, Basidiomycota fungi.

➤ Ref. bibliográfica: do N. Santos, E. K.; Almeida, R. P. S.; Wartchow, F.; de Oliveira, M. H. 2025. "Fungus For Fungus: *Acromyrmex rugosus* (Hymenoptera: Formicidae) collecting on *Gymnopilus* cf. *peliolepis* (Agaricales: Hymenogastraceae) in a Brazilian dry forest". *Acta Zoológica Lilloana 69* (1): 227-233. DOI: https://doi.org/10.30550/j.azl/2087
➤ Recibido: 12 de diciembre 2024 – Aceptado: 1 de febrero 2025.
➤ URL de la revista: http://actazoologica.lillo.org.ar

Resumo

Esta nota é um registro de *Acromyrmex rugosus* coletando um pedaço de cogumelo durante o forrageio. Este comportamento foi descrito para outras espécies de *Acromyrmex*. No entanto, o presente registro de *A. rugosus* coletando *Gymnopilus* cf. *peliolepis* é inédito e apresenta insights sobre esse comportamento. As formigas coletadas estavam próximas de um ninho de *Atta sexdens*. Este é o primeiro registro desse comportamento para estas formigas cultivadoras de fungos para áreas de Caatinga, com registros anteriores apenas para as regiões Sul e Sudeste do Brasil. Estudos futuros são necessários para entender os benefícios que o transporte de partes de fungos diferentes das cultivadas pelas formigas provém para *A. rugosus*. É possível que este comportamento de forrageio aumente a dispersão de *G*. cf. *peliolepis*, gerando benefícios para o fungo.

Palavras-chave: Attini, formigas, forrageio, fungos Basidiomycota.

The leaf-cutting ants *Acromyrmex rugosus* (Smith, 1858) (Hymenoptera: Formicidae) in general use insect carcasses and excrement or pieces of dry plant material as substrate for their fungus gardens (Weber, 1966; Wetterer Hilmer, Yospin., 2000). This species is widely distributed, with colonies found in Brazil (Amazonas, Pará, Maranhão, Piauí, Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Sergipe, Bahia, Mato Grosso, Goiás, Minas Gerais, São Paulo, and Rio Grande do Sul), Argentina, Uruguay, Paraguay, Bolivia, Peru, and Colombia, including a wide range in the Atlantic Forest, Cerrado and Caatinga biomes of Brazil (Kempf, 1972; Della Lucia Gandra, Guedes, 2014; Bezděčka, Machar, 2015). These ants have a huge economic importance due frequently causing problems in cultivated plants such as cotton, beans, orange, and wild plants such as *Libidibia ferrea* (Gonçalves, 1961). In *A. rugosus*, the average depth of their nests is 81±56 cm, with 2.3±1.68 fungus chambers per nest (Soares, Della-Lucia, Santos, 2006). Regarding the mycophagy, members of this genus consume the fungus cultivated in their gardens inside the nest (Weber, 1966). However, recent reports showed *A. subterraneus* (Forel, 1893), *A. versicolor* (Pergrande, 1893), and *A. niger* (Smith, 1858) foraging mushrooms outside their nests in areas from South and Southeast Brazil (Lechner and Josens, 2012; Calheiros, Ronque, Soares, Oliveira,., 2019; Costa, Furlan-Lopes, Bertazzo-Silva, Klotz-Neves, 2022). Little is known about the inclusion of these additional mushrooms in ant diet (l'Allemand Brückner, Hashim, Witte, von Beeren., 2019), nor about the types of mycophagy habit involving them (Epps and Penick, 2018). Thus, the present short note includes a new register of external mushroom being collected by an individual of *A. rugosus*, presenting for the first time this behavior in the Brazilian Caatinga semiarid region.

The register was made in a field observation in July/2023, in the private conservation unit (RPPN) Fazenda Almas, located in the municipality of São José dos Cordeiros (36º52'W; 7º28'S). The ant was collected and identified as *Acromyrmex rugosus* (Figure 1) according to specialized literature (Forti et al., 2006), and deposited in the Entomological Collection of the Federal University of Paraíba with register number DSEC0011377HY.

A worker of *A. rugosus* was observed collecting a piece of a Basidiomycota fungus (Figure 2a-c), identified according specialized literature as *Gymnopilus* cf. *peliolepis* (Speg.) Singer (Figure 2d). The ant was seen removing a piece of the fungus and headed to the foraging trail, carrying the collected material. The specimen had other cut marks similar to the one where the ant removed the piece (Figure 2). The deadwood bark with the fungus *Gymnopilus* cf. *peliolepis* was seen near to a nest of *Atta sexdens* (Figure 3). This species is characterized by its yellowish basidiomata, with ferruginous or purple pileal scales, and yellow to ferruginous lamellae in

Figure 1. *Acromyrmex rugosus* (Hymenoptera: Formicidae) worker (Register code: DSEC0011377HY) observed collecting the fungi. Scale bar = 1 mm.

mature specimens (Campi et al., 2021). Species of this genus have a lignocolous habit, being able to grow on woods with different degrees of decomposition (Hesler, 1969; Guzmán-Dávalos, 2003; Holec, 2005). We also observed many other mushrooms growing on the bark close to the nest and in deadwood pieces in the surrounding.

The genera *Atta* and *Acromyrmex* are known as fungus-farming ants or leaf-cutting ants because they mostly take to the nest leaves and small twigs (Weber, 1966; Hölldobler and Wilson, 1990). The reason why the ant observed here took slices of *G.* cf. *peliolepis* to the nest instead of only leaves or twigs is not yet fully understood. However, further studies are needed to understand the benefits to carry other fungi different from those cultivated by them to the nest. Ecological and natural history data about *Acromyrmex* species also need a better understanding of the ecological success of leaf-cutting ants and their role in Neotropical habitats (Calheiros, et al. 2019). Actually, this behavior, although not spread over all leaf-cutting ants, was already observed in three *Acromyrmex* species in Brazil, viz., *A subterraneus*, *A. versicolor*, and *A. niger* (Calheiros et al., 2019; Costa et al., 2022). In addition to these three species, Lechner and Josens (2012) and Masiulionis, Weber, Pagnocca. (2013) found *A. lundii* and *A. lobicornis* also foraging some mushrooms.

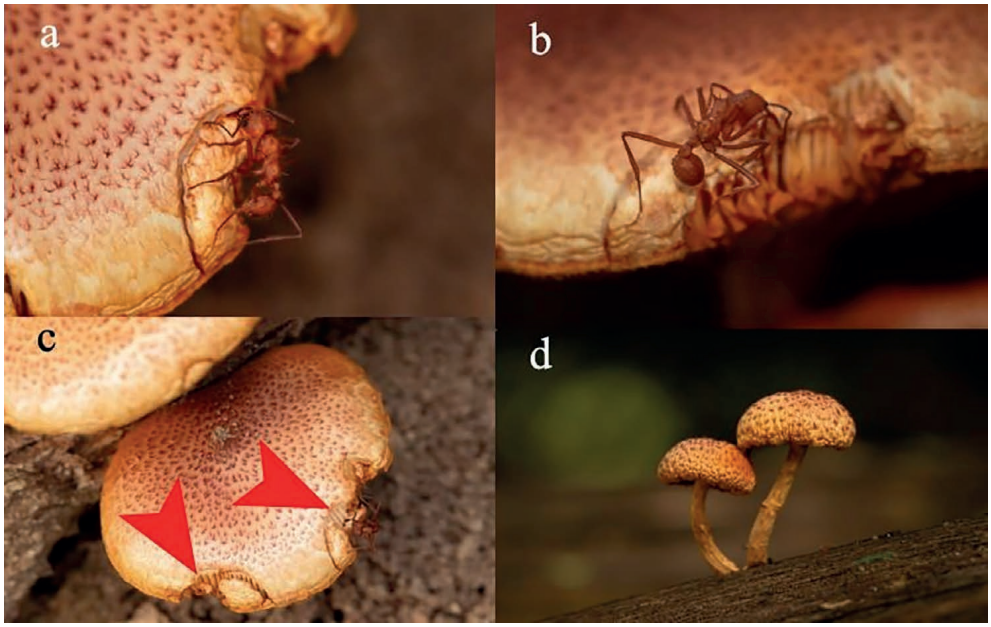

Figure 2. (a-b) *Acromyrmex rugosus* (Hymenoptera: Formicidae) worker collecting a portion of the pileus marging of *Gymnopilus* cf. *peliolepis*. (c) red arrows point to marks of pieces of mushrooms removed by ants. (d) Basidiomata of *Gymnopilus* cf. *peliolepis* in situ.

Figure 3. Nest of *Atta sexdens*. The red arrow shows the point where *A. rugosus* was observed collecting fungi.

In general mushrooms are primarily dispersed by airborne spores (Ingold, 1965), but recent study reported fungal spores also in body parts of some foraging ants (e.g., Costa et al., 2022). When the ants collect the reproductive parts of a mushroom, the spores apparently are carried by them, making possible an expansion of the area during the dispersal. Only more accuracy studies will elucidate if the mushrooms dispersal is increased by foraging ants carrying the spores or not, and if the abundance of basidiomata is higher in whiting or outside the ratio of the foraging areas of leaf-cutting ants. If the dispersal is efficient, it could be observed, in similar conditions, higher density of fungi within the foraging radius of the ants than outside the foraging area.

ACKNOWLEDGEMENTS

The authors wish to thank for funding and scholarship received for Oliveira MH from the Brazilian Coordination for the Improvement of Higher Education Personnel (CAPES) - (FAPESQ/PELD/23/2020). We are also thankful to Bruno Martins for the help in the field observations, and thanks to I. Nascimento and A. Pereira-Colavite for the support in receiving and depositing the specimens in the Entomological Collection of the UFPB.

CONFLICT OF INTEREST

The authors declare that there are no conflicting interests and emphasize that all contributed to the writing of this study.

REFERENCES

Bezděčková, K., Bezděčka, P., Machar, I. (2015). A checklist of the ants (Hymenoptera: Formicidae) of Peru. Zootaxa, 4020, 101–133.

Calheiros, A.C., Ronque, M.U.V., Soares, H., Oliveira, P.S. (2019). Foraging Ecology of the Leaf-Cutter Ant, *Acromyrmex subterraneus* (Hymenoptera: Formicidae), in a Neotropical Cerrado Savanna. Environmental Entomology, 48, 1434–1441. https://doi.org/10.1093/ee/nvz120

Campi, M., Maubet, Y., Grassi, E., Niveiro N., Guzmán-Dávalos, L. (2021). First contribution to the genus *Gymnopilus* (Agaricales, Strophariaceae) in Paraguay. Rodriguesia, 72: e00752019. https://doi.org/10.1590/2175-7860202172013

Costa, A.L., Furlan-Lopes, C., Bertazzo-Silva, F.A., Klotz-Neves, A.L., Ferraz, K.R., Köhler, A., Putzke, J. (2022). Mycophagy of Attini Ants (Hymenoptera, Formicidae, Myrmicinae) with Agaricales Mushrooms (Basidiomycota, Agaricomycetes) at Riparian Zone in Southern Brazil. Brazilian Journal of Animal and Environmental Research, 5, 3935–3960. https://doi.org/10.34188/bjaerv5n4-039

Della Lucia, T.M.C., Gandra, L.C., Guedes, R.N.C. (2014). Managing leaf-cutting ants: peculiarities, trends and challenges. Pest Management Science, 70, 14–23. https://doi.org/https://doi.org/10.1002/ps.3660

Epps, M.J., Penick, C.A. (2018). Facultative mushroom feeding by common woodland ants (Formicidae, *Aphaenogaster* spp.). Food Webs, 14, 9–13. https://doi.org/https://doi.org/10.1016/j.fooweb.2017.12.001

Forti, L.C., Andrade, M.L. de, Andrade, A.P.P., Lopes, J.F.S. (2006). Bionomics and Identification of *Acromyrmex* (Hymenoptera: Formicidae) Through an Illustrated Key. Sociobiology, 48, 1–17.

Gonçalves, C.R. (1961). O Genero *Acromyrmex* no Brasil (Hym. Formicidae). Hassel Street Press, 70 p.

Guzmán-Dávalos, L. (2003). Type studies of *Gymnopilus* (Agaricales) I. Mycotaxon, 86, 395–423.

Hesler, L.R. (1969). North American species of *Gymnopilus*. Mycologia Memoirs, 3, 1–117.

Holec, J. (2005). The genus *Gymnopilus* (Fungi, Agaricales) in the Czech Republic with respect to collections from other European countries. Acta Musei Nationalis Pragae Series B, 61, 1–52.

Hölldobler, B., Wilson, E.O. (1990). The Ants. Harvard University Press, 732 p.

Ingold, C.T. (1965). Spore Liberation. Oxford University Press, London, 210 p.

Kempf, W.W. (1972). Catálogo abreviado das formigas da região Neotropical. Studia Entomologica, 15, 3–344.

l'Allemand, S.L., Brückner, A., Hashim, R., Witte, V., von Beeren, C. (2019). Competition as possible driver of dietary specialisation in the mushroom harvesting ant *Euprenolepis procera* (Hymenoptera: Formicidae). Myrmecological News, 29, 79–91.

Lechner, B.E., Josens, R. (2012). Observation of leaf-cutting ants foraging on wild mushrooms. Insectes Sociaux, 59, 285–288. https://doi.org/10.1007/s00040-012-0219-9

Masiulionis, V.E., Weber, R.W.S., Pagnocca, F.C. (2013). Foraging of Psilocybe basidiocarps by the leaf-cutting ant *Acromyrmex lobicornis* in Santa Fé, Argentina. Springerplus, 2, 1–4

Soares, I.M.F., Della-Lucia, T.M.C., Santos, A.A. dos, et al. (2006). Caracterização de ninhos e tamanho de colônia de *Acromyrmex rugosus* (F. Smith) (Hymenoptera, Formicidae, Attini) em restingas de Ilhéus, BA, Brasil. Revista Brasileira de Entomologia, 50, 128–130.

Weber, N.A. (1966). Fungus-Growing Ants: A symbiotic relationship exists between an insect and a plant, involving an effective culturing technique. Science, 153, 587–604. https://doi.org/10.1126/science.153.3736.587

Wetterer, J.K., Hilmer, A.G., Yospin, M.M. (2000). Foraging ecology of the desert leaf-cutting ant, *Acromyrmex versicolor*, in Arizona (Hymenoptera: Formicidae). Sociobiology, 36, 1–17.