Insects in the diet of harvestmen (Arachnida, Opiliones) in the Atlantic Forest and Cerrado of Brazil

Insectos en la dieta de opiliones (Arachnida, Opiliones) en la Mata Atlántica y el Cerrado de Brasil

https://zoobank.org/References/AC4CC5AC-A130-4853-9885-140B4327F24A

Igor Rodrigues de Castro[1], Maria Luiza Simões-Silva[2], Luane Guapo Barcaro[2], Lucas Ramos Vieira[3], Gabriel de Castro Jacques[1,*] & Marcos Magalhães de Souza[2]

[1]Laboratório de Pesquisa em Biodiversidade, Instituto Federal de Educação, Ciência e Tecnologia de Minas Gerais, Campus Bambuí, Bambuí, Minas Gerais, Brasil.
[2]Laboratório de Zoologia, Instituto Federal de Educação, Ciência e Tecnologia do Sul de Minas, Campus Inconfidentes, Inconfidentes, Minas Gerais, Brasil.
[3]Universidade de São Paulo - Escola Superior de Agricultura Luiz de Queiroz. Departamento de Entomologia e Acarologia, ESALQ/USP – Piracicaba, São Paulo, Brasil.
*Correspondingt author: gabriel.jacques@ifmg.edu.br.

Abstract.- Harvestmen (Arachnida: Opiliones) are generalist omnivorous arachnids that exploit a wide variety of food resources, including fruits, fungi, decaying organic matter, and different groups of arthropods. Although they are abundant in various ecosystems, knowledge of their diet in Brazilian tropical biomes such as the Cerrado and the Atlantic Forest remains limited. This study reports three new records of insect consumption by harvestmen in Minas Gerais, southeastern Brazil. In the Atlantic Forest, one individual of the subfamily Gonyleptinae was observed feeding on the moth *Paratype univitta* (Lepidoptera: Erebidae), and another of *Munequita* sp. (Sclerosomatidae: Gagrellinae) was observed feeding on a winged ant of *Camponotus* sp. (Hymenoptera: Formicidae). In the Cerrado, one specimen of *Krateromaspis dilatata* (Gonyleptidae: Neopachylinae) was recorded feeding on a reproductive termite. The evidence suggests different feeding strategies, such as kleptoparasitism, necrophagy, and active predation. These new records contribute to understanding the feeding ecology of Neotropical harvestmen and reinforce their functional role in regulating insect populations and maintaining the balance of trophic networks in tropical ecosystems.

Key Words: *Kleptoparasitism, Gonyleptidae, necrophagy, predation, Sclerosomatidae, trophic interactions.*

Resumen.- Los opiliones (Arachnida: Opiliones) son arácnidos omnívoros generalistas que exploran una amplia variedad de recursos alimenticios, incluyendo frutos, hongos, materia orgánica en descomposición y diferentes grupos de artrópodos. Aunque son abundantes en diversos ecosistemas, el conocimiento sobre su dieta en biomas tropicales brasileños, como el Cerrado y la Mata Atlántica, aún es limitado. Este estudio presenta tres nuevos registros de consumo de insectos por opiliones en Minas Gerais, sureste de Brasil. En la Mata Atlántica, se observó un individuo de la subfamilia Gonyleptinae alimentándose de una polilla *Paratype univitta* (Lepidoptera: Erebidae) y un ejemplar de *Munequita* sp. (Sclerosomatidae: Gagrellinae) alimentándose de una hormiga alada de *Camponotus* sp. (Hymenoptera: Formicidae). En el Cerrado, se registró un ejemplar de *Krateromaspis dilatata* (Gonyleptidae: Neopachylinae) alimentándose de un reproductor de termita. Las evidencias sugieren diferentes estrategias alimentarias, como cleptoparasitismo, necrofagia y depredación activa. Estos nuevos registros contribuyen a la comprensión de la ecología alimentaria de los opiliones neotropicales y refuerzan su papel funcional en la regulación de las poblaciones de insectos y en el mantenimiento del equilibrio de las cadenas tróficas en ecosistemas tropicales.

Palabras clave: *Cleptoparasitismo, depredación, Gonyleptidae, interacciones tróficas, necrofagia, Sclerosomatidae.*

Editor responsable: Bolívar R. Garcete-Barrett*. / Recibido: 10.xi.2025 / Aceptado: 15.vi.2026 / Publicado online: 5.viii.2026
*Museo Nacional de Historia Natural del Paraguay, San Lorenzo, Paraguay.

Harvestmen (Arachnida: Opiliones) are predominantly nocturnal arachnids that exhibit different foraging strategies, including active prey searching and ambush behavior (Acosta *et al.*, 1995; Machado *et al*., 2000). As generalist omnivores, they consume a wide variety of food resources, such as fruits (Schaus *et al.*, 2013), decomposing organic matter (Curtis & Machado, 2007), fungi (Acosta & Machado, 2007), as well as arthropods and small vertebrates (Menegucci *et al*., 2020; Simões-Silva *et al.*, 2024). However, there is still little data on the feeding habits of harvestmen in Brazilian biomes, as well as the presence of insects in their diet (Rubim *et al*. 2022), considering the wide distribution of the taxon and the geographic area of the country.

From this perspective, understanding the feeding habits of harvestmen in Brazilian biomes is essential, particularly in the Atlantic Forest (Rubim *et al*., 2021) and the Cerrado (Simões-Silva *et al*., 2024a). Direct observations of trophic interactions provide valuable information on ecological relationships and the functional role of species in these ecosystems (Moore *et al*., 2004; Schmitz, 2008), contributing to the developing of conservation strategies in threatened biomes such as the Atlantic Forest and the Cerrado, both recognized as global biodiversity hotspots (Myers *et al*., 2000).

However, the ecological role of these arachnids within trophic networks in these biomes remains poorly understood, particularly in the Cerrado, a reflection of the scarcity of inventories and distributional studies of the species (Rubim *et al*., 2024; Simões-Silva *et al.*, 2024b). Therefore, this study aims to document and discuss new records of insect consumption by harvestmen in the Atlantic Forest and Cerrado, expanding the current knowledge of their trophic interactions.

Materials and methods

The first two records were made opportunistically in the Caparaó National Park (PNC), Minas Gerais, Brazil (20°26'6.125" S, 41°46'21.281" W). The park comprises formations of Dense Ombrophilous Forest and High-Altitude Grasslands, characterized by high relative humidity (ICMBio, 2015). Both records occurred in the Vale Verde region, an area of Ombrophilous Forest, an Atlantic Forest phytophysiognomy, associated with waterfalls, at an altitude of approximately 1,650 meters. The first record involved a harvestmen feeding on a moth, observed on May 10, 2025, around 8:00 p.m. The second record involved a harvestmen feeding on an ant, observed on September 30, 2025, around 7:30 p.m. Behavioral observations were conducted from a distance of approximately 20 cm using artificial light (flashlight) for about two minutes, after which the specimens were collected.

The third record involved a harvestmen feeding on a termite, observed opportunistically in a rural area of the municipality of Bambuí, located within the Cerrado biome, Minas Gerais, Brazil (20°1'42.279" S, 45°59'4.357" W), on October 13, 2025, during the rainy season, around 7:30 p.m. In this case, artificial light was also used, and photographic and video records were obtained; however, the specimens were not collected.

The arthropods from the first two records were collected, preserved in 70% ethanol, and sent for identification. Identification of the third record was based on photographs and videos. The moth was identified using wing venation and coloration patterns with the aid of specialized guides; the ant was identified by Ph.D. candidate Gabriel Magalhães Cardoso (Federal University of Minas Gerais – UFMG); the termite by Dr. Reginaldo Constantino (University of Brasília – UNB); and the harvestmen by Dr. Adriano B. Kury (National Museum of Rio de Janeiro – Federal University of Rio de Janeiro – UFRJ), where the harvestmen were incorporated into the collection.

Results and discussion

In the first record, a harvestmen gen. sp. (Gonyl-

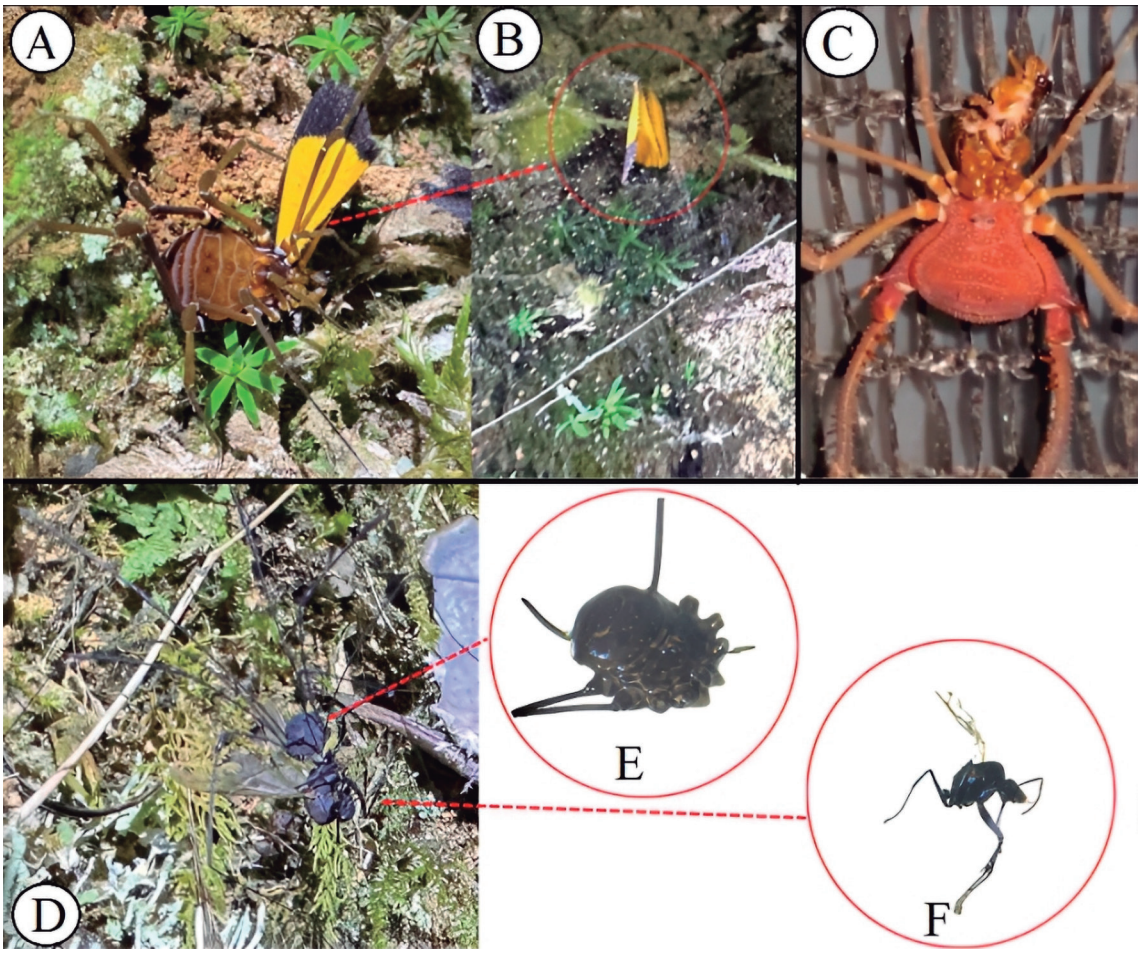

Figure 1. Harvestmen feeding on insects. **A)** Harvestman of the subfamily Gonyleptinae feeding on the moth *Paratype univitta* (Hampson, 1900). **B)** A wing of the same moth trapped in a spider web. **C)** *Krateromaspis dilatata* (Neopachylinae) feeding on a termite [Bambuí, Minas Gerais, Brazil]. **D)** *Munequita* sp. feeding on a *Camponotus* sp. ant which was partially dismembered [Caparaó National Park, Minas Gerais, Brazil]. **E)** Dismembered specimen of *Munequita* sp. **F)** Dismembered specimen of *Camponotus* sp.

eptidae: Gonyleptinae) was observed on a rock, approximately one meter above the ground, holding a moth *Paratype univitta* (Hampson, 1900) (Lepidoptera: Erebidae) between its chelicerae (Figure 1A). Near the location, one of the moth's wings was found entangled in a spider web, about 10 cm away from the harvestmen (Figure 1B).

In the second record, an individual of *Munequita* sp. (Sclerosomatidae: Gagrellinae) (Figure 1E) was found on a moss-covered slope, approximately 80 cm above the ground, manipulating with its chelicerae a winged male of *Camponotus* sp. (Hymenoptera: Formicidae) (Figure 1D). At the time of observation, the presumed prey was partially dismembered, with only the head, part of the thorax, wings, and a pair of legs remaining (Figure 1F).

In the third record, *Krateromaspis dilatata* (Gonyleptidae: Neopachylinae) was observed on a black shade net, about one meter above the ground, manipulating with its chelicerae a termite reproductive individual that had already shed its wings, grasping it by the abdomen (Figure 1C).

In none of the three records was the act of

predation itself observed, which allows for interpretative inferences regarding the observed behavior. Harvestmen may actively capture prey (Rubim *et al*., 2021), usurp prey from other predators (Sabino & Gnaspini, 1999), or feed on already dead organisms (Halaj & Cady, 2000).

In the first case, the presence of a moth wing trapped in a spider web suggests a possible instance of prey usurpation. This behavior, known as kleptoparasitism, was previously reported by Sabino & Gnaspini (1999), who observed *Goniosoma inscriptum* Mello-Leitão, 1922 (Opiliones: Gonyleptidae) feeding on a hemipteran wrapped in silk near the web of *Thwaitesia* sp. (Araneae: Theridiidae), and *G.* cf. *longipes* (Roewer, 1913) consuming a moth captured by *Enoploctenus cyclothorax* (Bertkau, 1880) (Araneae: Ctenidae). In addition, species of the genera *Cosmetus* and *Metavononoides* have been recorded seizing prey directly from the webs of *Blechroscelis* sp. These reports indicate that harvestmen may exploit prey immobilized by spiders, an energetically advantageous strategy. However, it is also plausible that the wing detached during manipulation by the harvestmen and accidentally fell onto the nearby web, a hypothesis that cannot be ruled out.

The second record, involving *Munequita* sp. and a winged male of *Camponotus* sp., may represent a case of opportunistic necrophagy, although there is no direct evidence available to determine whether the ant was already dead before being handled by the harvestman. However, some observations are consistent with the scavenging hypothesis. Males of this ant genus usually perform their nuptial flight at dusk or during the night (Stukalyuk *et al*., 2022) and die shortly thereafter, as reported for *Camponotus pennsylvanicus* (De Geer, 1773) (Miner, 2013). The fact that the individual was partially dismembered, and that the harvestmen belongs to a small-bodied subfamily (Gagrellinae), whose species range from 2 to 10 mm in body length (Pinto-da-Rocha & Giribet, 2007), supports the hypothesis that the specimen was exploiting a dead or weakened resource. Larger prey are generally avoided, as they pose a higher risk of injury and require greater energy expenditure (Acosta & Machado, 2007).

Nevertheless, the possibility of active predation cannot be ruled out, since the chelicerae perform alternating movements capable of cutting through the cuticle and internal tissues (Kästner, 1925; Immel, 1954), which could explain the dismembered state of the prey. Moreover, there are reports of Gagrellinae feeding on *Trigona* sp. (Apidae), Oligochaeta, and nymphs of other harvestmen, although without confirmation that these cases involved actual predation (Chelini & Machado, 2014; Rubim *et al*., 2021).

In the third record, involving *K. dilatata* and a termite reproductive, the observed environmental conditions strongly suggest active predation. At the time of observation, a termite nuptial flight was occurring (Pervez, 2018), an event that greatly increases prey availability for generalist predators (Dial & Vaughan, 1987). Harvestmen use chemoreception to locate prey during exploratory walks (Santos & Gnaspini, 2002), which may have facilitated the capture. The termite exhibited all body structures intact and was being vigorously manipulated, indicating predation rather than necrophagy. Unlike spiders and scorpions, harvestmen lack venom glands; thus, immobilization relies on the coordinated use of pedipalps, chelicerae, and legs, with prey generally consumed while still alive (Acosta & Machado, 2007). In Laniatores, particularly in Gonyleptidae, the pedipalps are robust and armed with ventrolateral spines on the tibia and tarsus, forming an efficient subchelate structure for prey capture (Weygoldt, 2000).

Although harvestmen are still rarely recognized as biological control agents (Acosta & Machado, 2007), some studies have already demonstrated their potential role in reducing populations of certain herbivorous insects (Ashby, 1974; Brust *et al*., 1986; Dixon & McKinlay, 1989; Drummond *et al*., 1990). It is well known that different termite species can

affect a wide range of crops (Costa-Leonardo, 2002; Rouland-Lefèvre, 2010), and although the termite species could not be identified in this case, this record reinforces the important ecosystem service provided by these arachnids.

The consumption of moths by harvestmen is relatively common (Acosta & Machado, 2007), given the overlap in nocturnal habits, as observed with *Pantherodes pardalaria* (Hübner, 1823) (Geometridae) and a moth of the family Erebidae, both preyed upon by *Acutisoma longipes* Roewer, 1913 (Gonyleptidae) (Rubim *et al*., 2021; Simões-Silva *et al*., 2024a). Similarly, ants are also found in the diet of these arachnids (Acosta & Machado, 2007), such as in *A. longipes* and *Mischonyx cuspidatus* (Roewer, 1913) (Gonyleptidae) (Rubim *et al*., 2021). In contrast, records of termite consumption are much scarcer, with reports of worker termites being preyed upon by *Erginulus clavotibialis* (Pickard-Cambridge, 1905) (Cosmetidae) under laboratory conditions (Schaus *et al*., 2013) and in the field, without identification of the harvestmen species (Timmermans *et al*., 2025).

Because harvestmen exhibit a generalist diet (Acosta & Machado, 2007) and occupy a variety of habitats, such as soil, slopes, rocks, tree trunks, and foliage (Curtis & Machado, 2007), they exploit a wide diversity of prey (Rubim *et al*., 2021; Simões-Silva *et al*., 2024a). This trophic breadth allows them to play an important role in regulating invertebrate populations, thereby contributing to the balance of food webs and the maintenance of community structure. Such ecological roles are better documented in temperate regions but remain poorly understood in tropical environments (Acosta & Machado, 2007).

Conclusions

In this context, the present study provides additional information on the diet of harvestmen in tropical Brazilian biomes, contributing to a better understanding of their role as key elements in the ecological dynamics of these ecosystems. However, future studies combining continuous behavioral observations, experimental assessments of feeding preferences, and standardized sampling across habitats with different structural complexities may contribute to a better understanding of the trophic ecology of harvestmen in Neotropical ecosystems.

Acknowledgements

We thank Dr. Adriano B. Kury (Museu Nacional, UFRJ) for the identification of the harvestmen; Dr. Reginaldo Constantino (Universidade de Brasília – UnB) for the identification of the termite; Ph.D. candidate Gabriel Magalhães Cardoso (Universidade Federal de Minas Gerais – UFMG) for the identification of the ant; the staff of Parque Nacional do Caparaó for logistical support; SISBIO for granting the research permits; and IFSULDEMINAS – Inconfidentes Campus and IFMG – Bambuí Campus for financial support.

Literature

Acosta, L.E., Pereyra, F.E. & Pizzi, R.A. (1995). Field observation on *Pachyloidellus goliath* (Opiliones, Gonyleptidae) in Pampa de Achala, province of Córdoba. *Bulletin of the British Arachnological Society*, 10(1): 23-28.

Acosta, L.E & Machado, G. (2007). Diet and foraging. P.p. 309- 338, *in* Pinto-Da-Rocha, R., Machado, G. & Giribet, G. (Eds.). *Harvestmen: The Biology of Opiliones*. Cambridge: Harvard University Press. 597 pp.

Ashby, J.W. (1974). A study of arthropod predation of *Pieris rapae* L. using serological and exclusion techniques. *Journal of Applied Ecology,* 11: 419–425.

Brust, G.E., Stinner, B.R. & McCartney, D.A. (1986). Predation by soil-inhabiting arthropods in intercropped and monoculture agroecosystems. *Agriculture, Ecosystems & Environment*, 18: 145–154.

Chelini, M.C. & Machado, G. (2014). Multiple

lines of egg defense in a Neotropical Arachnid with temporary brood desertion. *Ethology*, 120(12), 1147-1154.

Costa-Leonardo, A. M. (2002). *Cupins-praga: morfologia, biologia e controle*. Rio Claro: Divisa. 128pp.

Curtis, D.J. & Machado, G. (2007). Ecology. P.p. 280-308, *in* Pinto-Da-Rocha, R., Machado, G. & Giribet, G. (Eds.). *Harvestmen: The Biology of Opiliones*. Cambridge: Harvard University Press. 597 pp.

Dial, K.P. & Vaughan, T.A. (1987). Opportunistic Predation on Alate Termites in Kenya. *Biotropica*, 19(2), 185–187. <https://doi.org/10.2307/2388744>.

Dixon, P.L., & McKinlay, R.G. (1989). Aphid predation by harvestmen in potato fields in Scotland. *The Journal of Arachnology,* 17: 253– 255.

Drummond, F.,Y. Suhaya, Y & Groden, E. (1990). Predation on the Colorado potato beetle (Coleoptera: Chrysomelidae) by *Phalangium opilio* (Opiliones: Phalangidae). *Journal of Economic Entomology*, 83: 772–778.

Halaj, J. & Cady, A.B. (2000). Diet composition and significance of earthworms as food of harvestmen (Arachnida: Opiliones). *The American Midland Naturalist*, 143(2): 487-491.

ICMBio (Instituto Chico Mendes de Conservação da Biodiversidade). (2015). *Plano de Manejo do Parque Nacional do Caparaó*. ICMBio: 517p. [Consulted: 30.x.2025] . <https://www.gov.br/icmbio/pt-br/assuntos/biodiversidade/unidade-de-conservacao/unidades-de-biomas/mata-atlantica/lista-de-ucs/parna-de-caparao/arquivos/dcom_plano_de_manejo_parna_caparao.pdf>.

Immel, V. (1954). Zur Biologie und Physiologie von *Nemastoma quadripunctatum* (Opiliones, Dyspnoi). *Zoologische Jahrbücher*, 83: 129–184.

Kästner, A. (1925). Studien zur Ernährung der Arachniden. I. Die Nahrungsaufnahme einiger Phalangiden. *Zoologischer Anzeiger*, 62: 212–214.

Machado, G., Raimundo, R. L. G. & Oliveira, P.S. (2000). Daily activity schedule, gregariousness, and defensive behaviour in the neotropical harvestman *Goniosoma longipes* (Opiliones: Gonyleptidae). *Journal of Natural History*, 34(4): 587-596.

Martens, J. (1978). Spinnentiere, Arachnida: Weberknechte, Opiliones. Pp. 1–464 *in*: Senglaub, K., Hannemann, H.J. & Schumann, H. (Eds.). *Die Tierwelt Deutschlands*. Jena: Gustav Fischer.

Menegucci, R.C., Muscat, E., Tanaka, R.M. & Stuginski, D. (2020). Predation on *Hylodes phyllodes* (Anura: Hylodidae) by the harvestman *Heteromitobates discolor* (Arachnida: Opiliones). *Phyllomedusa: Journal of Herpetology,* 19(1): 121-124. <https://doi.org/10.11606/issn.2316-9079>.

Miner, A. (2013). *"Camponotus pennsylvanicus" (On-line), Animal Diversity Web*. [Consulted: 30.x.2025]. <https://animaldiversity.org/accounts/Camponotus_pennsylvanicus/>

Moore, J.C., Berlow, E.L., Coleman, D.C., Ruiter, P.C, Dong, Q., Hastings, A., Johnson, N.C., McCann, K.S., Melville, K., Morin, P.J., Nadelhoffer, K., Rosemond, A.D., Post, D.M., Sabo, J.L., Scow, K.M., Vanni, M.J. & Wall, D.H. (2004). Detritus, trophic dynamics and biodiversity. *Ecology Letters*, 7, 584–600. <https://doi.org/10.1111/j.1461-0248.2004.00606.x>.

Myers, N., Mittermeier, R.A., Mittermeier, C.G., Fonseca, G.A B. & Kent, J. (2000). Biodiversity hotspots for conservation priorities. *Nature,* 403: 853–858. <https://doi.org/10.1038/35002501>.

Pervez, A. (2018). Termite Biology and Social Behaviour. P.p. 199-143, *in*: Khan, M. & Ahmad, W. (Eds). *Termites and Sustainable Management. Sustainability in Plant*

and Crop Protection. Cham: Springer. <https://doi.org/10.1007/978-3-319-72110-1_6>.

Pinto-da-Rocha, R. & Giribet, G. (2007). Taxonomy. P.p. 280-308, *in* Pinto-Da-Rocha, R., Machado, G. & Giribet, G. (Eds.). *Harvestmen: The Biology of Opiliones*. Cambridge: Harvard University Press. 597 pp.

Rouland-Lefèvre, C. (2010). Termites as Pests of Agriculture. P.p. 499–517, *in:* Bignell, D., Roisin, Y. & Lo, N. (Eds.). *Biology of Termites: a Modern Synthesis*. Springer, Dordrecht. <https://doi.org/10.1007/978-90-481-3977-4_18>.

Rubim, L.G.T., Pádua, T.H.R., Costa, A.G. & Souza, M.M. (2021). Registro de dieta de opiliões na Mata Atlântica (Arachnida, Opiliones). *Biotemas*, 34(3): 1-4. <https://doi.org/10.5007/2175-7925.2021.e80428>.

Rubim, L.G.T., Pádua, T.H.R., Souza, A.S.B., Almeida, J.A.M., Shimamoto, C.Y., Barbado, N. & Souza, M.M. (2022). Registro de *Polistes simillimus* Zikán, 1951 (Hymenoptera, Vespidae) na dieta de *Gonyleptes atrus* Mello-Leitão, 1923 (Opiliones). *Entomological Communications*, 4: ec04041. <https://doi.org/10.37486/2675-1305.ec04041>.

Rubim, L.G.T., Renne, D.G.S., Padua, T.H.R., Gouvêa, T.P.G., Vilela, D.S., Jacques, G.C., Rocha, R.P. & Souza, M.M. (2024). Harvestmen Fauna (Arachnida: Opiliones) in a Conservation Unit in Cerrado, Parque Nacional Grande Sertãoo Veredas, Brazil. *Heringeriana,* 18: e918035. <https://doi.org/10.17648/heringeriana.v18i1.918035>.

Sabino, J. & Gnaspini, P. (1999). Harvestman (Opiliones, Gonyleptidae) Takes Prey from a Spider (Araneae, Ctenidae). *The Journal of Arachnology*, 27(3): 675-678.

Santos, F. H., & Gnaspini, P. (2002). Notes on the foraging behavior of the Brazilian cave harvestman *Goniosoma spelaeum* (Opiliones, Gonyleptidae). *The Journal of Arachnology*, 30: 177–180.

Schaus, M.H., Townsend, V.R., & Illinik, J.J. (2013). Food choice of the neotropical harvestman *Erginulus clavotibialis* (Opiliones: Laniatores: Cosmetidae). *Journal of Arachnology*, 4(2): 219-221. <https://doi.org/10.1636/P12-88.1>.

Schmitz, O. J. (2008). Effects of predator hunting mode on grassland ecosystem function. *Science*, 319(5865): 952–954. <https://doi.org/10.1126/science.1152355>.

Simões-Silva, M.L., Castro, I.R., Freitas, F.B.A., Vilela, D.S., Jacques, G.C. & Souza, M.M. (2024a). Record of Lepidoptera and Hemiptera as a food resource of *Acutisoma longipes* Roewer, 1913 (Arachnida; Opiliones) in the Cerrado, Brazil. *EntomoBrasilis*, 17: e1082. <https://doi.org/10.12741/ebrasilis.v17.e1082>.

Simões-Silva, M.L., Alvarenga, M.J.C., Rubim, L.G.T., Pádua, T.H.R., Castro, I.R., Vilela, D.S., Jacques, G.C. & Souza, M.M. (2024b). Harvestmen (Arachnida: Opiliones) from the Atlantic Forest-Cerrado transition zone of Luminárias, southern Minas Gerais state, Brazil. *EntomoBrasilis* 17: e1089. <https://doi.org/10.12741/ebrasilis.v17.e1089>.

Stukalyuk, S., Akhmedov, A., Stelia, V., Shymanskyi, A. & Netsvetov, M. (2022). Nuptial flight in ants (Hymenoptera: Formicidae). *Serangga*, 27(1): 152-179.

Timmermans, J., Tsishyn, M., Fontaine, N. & Roisin, Y. (2025), One nest, two niches? Distribution of alimentary resources between an inquiline termite and its host. *Insectes Sociaux*. <https://doi.org/10.1007/s00040-025-01045-x>.

Weygoldt, P. (2000). *Whip Spiders (Chelicerata: Amblypygi): Their Biology, Morphology, and Systematics*. Stenstrup: Apollo Books. 302 pp.