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Scientific Note

Foraging Activity in *Polybia striata* (Fabricius, 1787) (Hymenoptera: Vespidae)

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Abstract. Foraging ensures resource acquisition for feeding, nest construction, and colony maintenance in social wasps. This study examined the foraging activity and dripping behavior of *Polybia striata* (Fabricius, 1787) (Hymenoptera: Vespidae) in an urban environment, analyzing their correlation with temperature and humidity. Observations took place on the campus of the Federal University of Juiz de Fora, totaling 50 hours between January and February 2018. Every 30 minutes, departures and returns to the nest were recorded, along with climatic variables. Foraging activity peaked between 9:00 and 13:30, the hottest period of the day. The number of departures increased with temperature and decreased with humidity, suggesting that hottest conditions favor foraging while high humidity inhibits it. Always after rainfall, wasps engaged in dripping behavior, regurgitating small water droplets from the nest structure. This behavior occurred more frequently in the morning and was linked to nest maintenance. In addition to advancing knowledge of the species' ecology, this study may inform management strategies in urban areas.

Keywords: Eusocial insects, Humidity, Nest maintenance, Temperature effects, Social wasp.

Foraging behavior is one of the most essential activities for the survival of social wasps, as it involves the search for and collection of critical resources necessary for nutrition, nest construction, and colony maintenance. These resources – including nectar, plant fibers, animal proteins, and water – play vital roles in sustaining colonies. Nectar and animal proteins contribute to adult and larval nutrition, while plant fibers are essential for nest construction. Water, in turn, serves multiple functions: it can aid in thermoregulation, assist in nest building, and may also be involved in behaviors related to nest maintenance, particularly following rainfall (Elisei et al. 2005; Detoni & Prezoto 2021; Stabentheiner et al. 2022; Maciel et al. 2024). Understanding these behavioral strategies enhances knowledge about the ecology of social wasps and provides insights for managing these species in urban and agricultural environments (Prezoto et al. 2019; Barbosa & Maciel 2023).

Among social wasps, the genus *Polybia* Lepeletier, 1836 (Hymenoptera: Vespidae) stands out due to its broad geographic distribution and remarkable adaptability to diverse habitats, including human-modified environments. Despite their ecological, economic, and behavioral significance, many aspects of foraging behavior–particularly in *Polybia* species-remain understudied. In the case of *Polybia striata* (Fabricius, 1787), this challenge is further amplified by its aggressive behavior and highly populous colonies. Similar to other species of the genus that form large nests, studying their foraging behavior poses logistical and safety risks, which may explain the scarcity of detailed investigations on this topic (Richards 1978; Jeanne & Taylor 2021).

This study aimed to document the foraging activity and water-dripping behavior of *P. striata*, with a focus on the temporal patterns this species uses to exploit available resources in urban and semi-urban environments. By addressing this knowledge gap, we aim to establish a foundation for future research on the behavioral ecology of social wasps and their ecological roles in modified habitats, while also informing species-specific management strategies.

The study was conducted on the campus of the "Universidade Feeral de Juiz de Fora", located in the municipality of Juiz de Fora (21°48'21"S, 43°22'09"W, 781 m altitude), in the state of Minas Gerais, southeastern Brazil. Direct observations were carried out on a colony of *P. striata* approximately 40x30 cm in size (Fig. 1) from 07:00 to 17:00 hours over six randomly selected days between January and February 2018, totaling 60 hours of data. Observers remained close to the nest and used manual counters to record the behavioral data, following the methodology proposed by Prezoto et al. (1994).

Data were recorded every 30 minutes on the number of wasps leaving and returning to the colony for foraging. Air temperature (°C) and relative humidity (%) were also measured at these intervals using a digital thermo-hygrometer placed near the colony. To assess the relationship between climatic variables and foraging activity, air temperature and relative humidity data were correlated with the number of foragers departing the colony using Spearman's rank correlation coefficient. Analyses were performed with the free software BioEstat 5.3 (Ayres et al. 2017).

Data on the foraging activity of *P. striata* reveal a pattern consistent with the existing literature on the influence of abiotic factors–particularly temperature and humidity–on the daily activities of social wasp colonies. Similar patterns have been reported for other species, such as *Mischocyttarus cassununga* R. von Ihering, 1903 (Castro et al. 2011), *Parachartergus fraternus* Gribodo, 1892 (Santos et al. 2009), *Polybia paulista* H. von Ihering, 1896 (Cavenazzi & Noll 2011), *Protopolybia exigua* de Saussure, 1854 (Ribeiro-Júnior et al. 2006) and *Protopolybia sedula* de Saussure, 1854 (Detoni et al. 2015).

During the daytime period, 12,208 departures and 11,244 returns were recorded, highlighting the colony's intense foraging dynamics, with peak activity between 9:00 and 13:30 hours, coinciding with the hottest hours of the day (Fig. 2). This increase in foraging activity may be explained by the wasps' need to maximize food acquisition, as resource availability, such as prey and nectar, tends to be higher under elevated temperatures (Wallace & Szarek 1981; Deutsch et al. 2008; Dillon et al. 2010).

When correlating abiotic factors, temperature was found to stimulate both departures and returns, whereas humidity inhibited colony activity. The correlation between temperature and departures

was moderately positive (rs = 0.6170, p = 0.01), indicating that as temperature rises, more individuals tend to leave the colony. The correlation between temperature and returns was also positive but weaker (rs = 0.4394, p = 0.08), suggesting a less pronounced association, though this correlation was not statistically significant.

Thus, higher temperatures appear to stimulate individuals to leave the nest. This response aligns with expectations, as elevated temperatures may enhance insect locomotion and metabolic activity (Chown & Nicolson 2004). These observations support the hypothesis that energy efficiency and resource acquisition are critical for larval survival and colony development, reinforcing the adaptive nature of foraging behavior (Dejean et al. 2017).

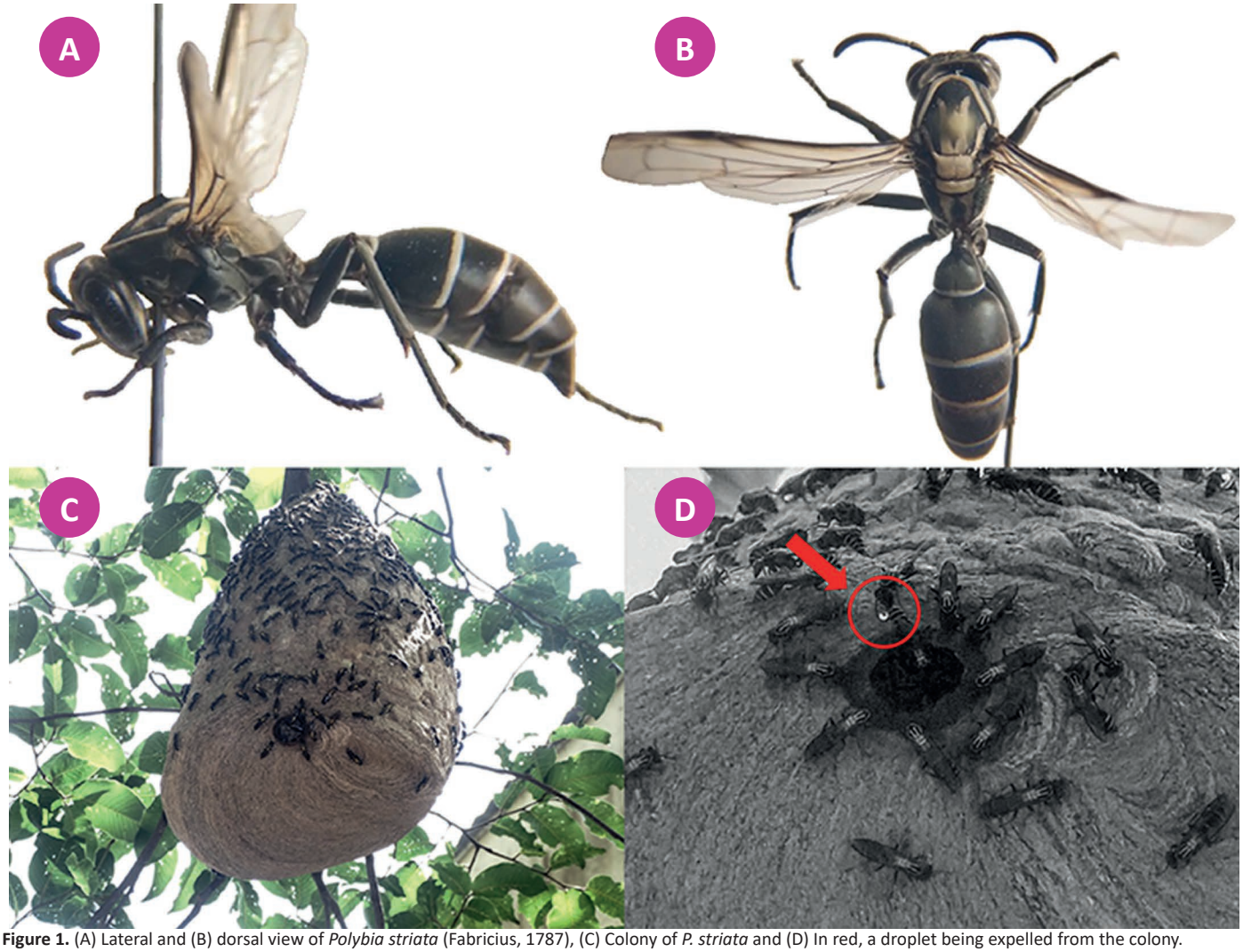

Figure 1. (A) Lateral and (B) dorsal view of *Polybia striata* (Fabricius, 1787), (C) Colony of *P. striata* and (D) In red, a droplet being expelled from the colony.

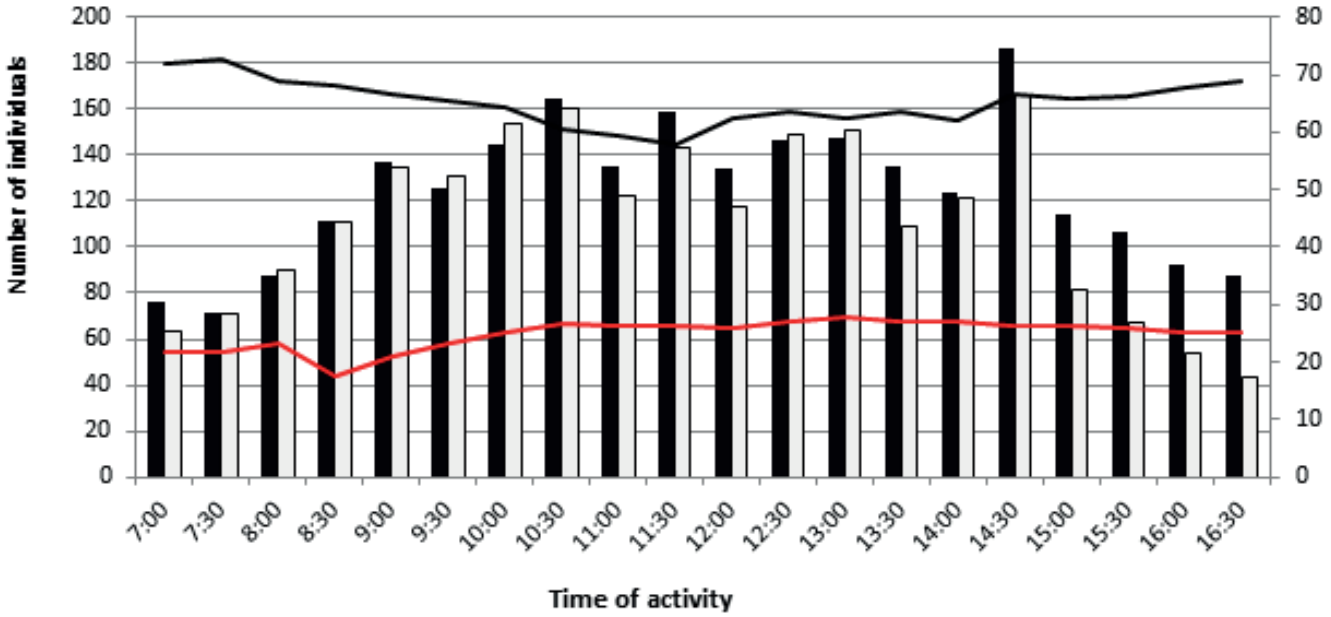

Figure 2. Mean number of worker departures (black bars) and returns (white bars) of *Polybia striata* (Fabricius, 1787) throughout the day in Juiz de Fora, Minas Gerais, Brazil. Red line – Temperature (°C); Black line – Humidity (%).

Conversely, the correlation between humidity and departures was moderately negative (rs = -0.7188, p = 0.01), indicating that higher humidity reduces departures. A similar pattern was observed for returns, though the relationship was weaker (rs = -0.5932, p = 0.08), suggesting a tendency for fewer individuals to return under humid conditions. This reinforces the understanding that high humidity inhibits foraging activity. The reduction in departures may be linked to the impact of excessive moisture on insect locomotion and prey availability. Additionally, although not investigated in the present study, the literature indicates that strong air currents and adverse conditions associated with high humidity may hinder wasp flight (Elisei et al. 2005; 2013), reducing their efficiency in resource acquisition.

During the study period, several rainfall events–typical of the season–were recorded. Immediately after these events, a water-dripping behavior was observed (Fig. 1D and Supplementary Information), in which individuals moved from the nest interior to the entrance and regurgitated droplets of water absorbed from the nest structure. This behavior was also exhibited by wasps on the outer surface of the nest's protective envelope. Dripping occurred most frequently in the morning [14 ±24.6 (1-84) droplets/30 min.

We hypothesize that this behavior plays a critical role in maintaining the nest's structural integrity. As nests are primarily composed of paper, they become highly fragile when saturated, risking collapse (Wenzel 2020; Barbosa et al. 2021). Furthermore, high internal humidity may compromise brood development, underscoring the importance of this behavior in maintaining homeostasis for a species whose nests are established on tree branches and thus exposed to weather extremes (Archer 2012; Mayorga-Ch et al. 2021).

These findings emphasize the role of environmental factors in modulating foraging activity in social wasps. Future studies could explore how these interactions vary across ecological contexts and investigate the impacts of climate change on wasp populations and their ecosystem services, such as pollination and pest control.

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Authors' Contributions

IS: Investigation, Validation, Writing - review & editing; WM: Investigation, Validation, Writing - review & editing; LRO: Investigation, Validation, Writing - review & editing; BCB: Investigation, Validation, Writing - review & editing; FB: Investigation, Validation, Writing - review & editing.

Conflict of Interest Statement

The authors declare that they have no conflicts of interest.

Supplementary Material

Supplementary data for this article be accessed at doi: https://doi.org/10.5281/zenodo.14821371

References

Archer, M. E. (2012) *Vespine Wasps of the World: Behaviour, Ecology & Taxonomy of the Vespinae* Manchester, UK: Siri Sci. Press.

Ayres, M.; Ayres Jr, M. D.; Ayres, D. L.; Santos, A. A. S. (2007). BioEstat 5.3: Aplicações estatísticas nas áreas das Ciências Biomédicas. Sociedade Civil Mamirauá. https://www.mamiraua.org.br/pt-br/downloads/programas/bioestat-versao-53/

Barbosa, B. C.; Maciel, T. T.; Somavilla, A.; Prezoto, F. (2021) Interactions between wasps and other animals: associations and natural enemies. In: Prezoto, F.; Nascimento, F. S.; Barbosa, B. C.; Somavilla, A. (Eds.), *Neotropical Social Wasps: Basic and Applied Aspects*. pp. 395-403. Springer. doi: 10.1007/978-3-030-53510-0_21

Barbosa, B. C.; Maciel, T. T. (2023) Vespas sociais no Controle. *Cultivar Hortaliças e Frutas*, XXI(140): 14-17. doi: 10.5281/zenodo.8364261

Castro, M. M.; Guimarães, D. L.; Prezoto, F. (2011) Influence of environmental factors on the foraging activity of *Mischocyttarus cassununga* (Hymenoptera, Vespidae). *Sociobiology*, 58(1): 133-141.

Cavenazzi, N. C. S.; Noll, F. B. (2011) Environmental factors influencing foraging activity in the social wasp *Polybia paulista* (Hymenoptera: Vespidae: Epiponini). *Pysche*, 2011: 542487. doi: 10.1155/2011/542487

Chown, S. L.; Nicolson, S. (2004) *Insect Physiological Ecology: Mechanisms and Patterns*, Oxford. doi: 10.1093/acprof:oso/9780198515494.001.0001

Dejean, A.; Rodriguez-Perez, H.; Carpenter, J. M.; Azémar, F.; Corbara, B. (2017) The predatory behavior of the Neotropical social wasp *Polybia rejecta*. *Behavioural Processes*, 140: 161-168.

Detoni, M.; Mattos M. C.; Castro M. M.; Barbosa, B. C.; Prezoto, F. (2015) Activity schedule and foraging in *Protopolybia sedula* (Hymenoptera, Vespidae). *Revista Colombiana de Entomología*, 41(2): 245-248.

Detoni, M.; Prezoto, F. (2021) The Foraging Behaviour of Neotropical Social Wasps. In: Prezoto, F.; Nascimento, F. S.; Barbosa, B. C.; Somavilla, A. (Eds.), *Neotropical Social Wasps: Basic and Applied Aspects*. Springer. doi: 10.1007/978-3-030-53510-0_3

Deutsch, C. A.; Tewksbury J. J.; Huey, R. B.; Sheldon, K. S.; Ghalambor, C. K.; Haak, D. C.; Martin, P. R. (2008) Impacts of climate warming on terrestrial ectotherms across latitude. *Proceedings of the National Academy of Sciences*, 105(18): 6668-6672. doi: 10.1073/pnas.0709472105

Dillon, M. E.; Wang, G.; Huey, R. B. (2010) Global metabolic impacts of recent climate warming. *Nature*, 467(7316): 704-706. doi: 10.1038/nature09407

Elisei, T.; Guimarães, D. L.; Ribeiro C.; Prezoto, F. (2005) Foraging activity and nesting of swarm-founding wasp *Synoeca cyanea* (Hymenoptera: Vespidae, Polistinae). *Sociobiology*, 46(2), 317-327.

Elisei, T.; Nunes J. V.; Ribeiro C.; Fernandes, A. J.; Prezoto, F. (2013) What is the ideal weather for social wasp *Polistes versicolor* (Olivier) go to forage? *EntomoBrasilis*, 6(3): 214-216. doi: 10.12741/ebrasilis.v6i3.342

Jeanne, R. L.; Taylor, B. J. (2021) Research Techniques Used in the Study of Social Wasps. In: Prezoto, F.; Nascimento, F. S.; Barbosa, B. C.; Somavilla, A. (Eds.), *Neotropical Social Wasps: Basic and Applied Aspects*, pp. 337-372. Springer. doi: 10.1007/978-3-030-53510-0_19

Maciel, T. T.; Barbosa, B. C.; Oliveira, M. L.; Prezoto, F. (2024) If you can't stand the heat, get out of the kitchen! Notes on the influence of temperature on the nesting of social wasps. *Revista Chilena de Entomología*, 50(2).

Mayorga-Ch, D.; Rodríguez-C, C.; Ortíz-Reyes, A.; Romero-Tabarez, M.; Sarmiento, C. E. (2021) Interactions of Social Wasps with Microorganisms. In: Prezoto, F.; Nascimento, F. S.; Barbosa, B. C.; Somavilla, A. (Eds). *Neotropical Social Wasps: Basic and Applied Aspects*. Springer. doi: 10.1007/978-3-030-53510-0_22

Prezoto, F.; Giannotti, E.; Machado, V. L. L. (1994) Atividade forrageadora e material coletado pela vespa social *Polistes simillimus* Zikán, 1951 (Hymenoptera, Vespidae). *Insecta*, 3(1): 11-19.

Prezoto, F.; Maciel, T. T.; Detoni, M.; Mayorquin, A. Z.; Barbosa, B. C. (2019) Pest control potential of social wasps in small farms and urban gardens. *Insects*, 10(7): 192.

Ribeiro-Júnior, C.; Guimarães, D. L.; Elisei, T.; Prezoto, F. (2006) Foraging activity rhythm of the Neotropical swarm-founding wasp *Protopolybia exigua* (Hymenoptera, Vespidae, Epiponini) in different seasons of the year. *Sociobiology* 47(1): 115-123

Richards, O. W. (1978) The social wasps of the Americas excluding the Vespinae. British Museum (Natural History), London.

Santos, G. M. M.; Zanuncio, J. C.; Pires, E. M.; Prezoto F.; Pereira, J.

M. M.; Serrão, J. E. (2009) Foraging of *Parachartergus fraternus* (Hymenoptera: Vespidae: Epiponini) on cloudy and sunny days. *Sociobiology*, 53(2B): 431-441.

Stabentheiner, A.; Nagy, J. M.; Kovac, H.; Petrocelli, I.; Turillazzi, S. (2022) Effect of climate on strategies of nest and body temperature regulation in paper wasps, *Polistes biglumis* and *Polistes gallicus*. *Scientific Reports*, 12: 3372. doi: 10.1038/s41598-022-07279-0

Wallace, C. S.; Szarek, S. R. (1981) Ecophysiological studies of Sonoran Desert plants. VII. Photosynthetic gas exchange of winter ephemerals from sun and shade environments. *Oecologia*, 51: 57-61. doi: 10.1007/BF00344653

Wenzel, J. W. (2020) Nest Structure: Social Wasps. In: Starr, C. (Ed), *Encyclopedia of Social Insects*, pp. 1-14. Springer. doi: 10.1007/978-3-319-90306-4_146-1