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Scientific Note

When the predator becomes the prey: record of *Mischocyttarus rotundicollis* (Cameron, 1912) (Hymenoptera: Vespidae) feeding on a spider in southeastern Brazil

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Abstract. Social wasps are commonly considered generalists in their feeding habits, but there are genera with little information regarding their diet, such as *Mischocyttarus* de Saussure, 1853 (Hymenoptera: Vespidae), the most species-rich wasp genus in the world. The objective of this study is to report *Mischocyttarus rotundicollis* (Cameron, 1912) (Hymenoptera: Vespidae) feeding on a spider in the southeastern region of Brazil, aiming to expand information about its feeding behavior. The record occurred occasionally on September 23, 2023, in the state of Minas Gerais, Brazil, in the ecotone region between the Atlantic Forest and the Cerrado. The feeding of a species from the Araneidae family occurred in its web, and the individual of *M. rotundicollis* used the tarsi of its legs to cling to the silk threads of the web, which could suggest a specialization for the exploitation of this food resource. Our record provides further information on the feeding behavior and diet of *M. rotundicollis* and presents the first information on spider feeding by this species. Further studies are suggested to evaluate this possible hypothesis of specialization of the genus for foraging in spider webs.

Keywords: Araneidae; Feeding; Mischocytarini; Social wasp; Trophic regulation.

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Social wasps (Hymenoptera: Vespidae) are generalists in terms of feeding habits; therefore, they explore a variety of food resources, whether of plant or animal origin. Regarding plant-based foods, wasps can feed on fruit pulp (Brügger *et al.* 2017), floral nectar (Clemente *et al.* 2012), and extrafloral nectar (Oliveira *et al.* 2023a). As for animal-based foods, wasps commonly feed on invertebrates, especially other insects such as Diptera (Gomes *et al.* 2007), Mantodea (Crispim *et al.* 2023), Orthoptera (Garcia *et al.* 2022), Hemiptera (Gobbi & Machado 1985), Blattodea, Dermaptera, Neuroptera (Oliveira *et al.* 2010), beetle larvae (Alves-Silva *et al.* 2013; Alves-Silva & Del-Claro 2016), and Lepidoptera (Prezoto *et al.* 2019; Oliveira *et al.* 2023b; Oliveira & Souza 2023), and even other social wasps (Silveira *et al.* 2016).

Due to this predatory behavior, vespids play an important role in the biological control of various agricultural pests (Southon *et al.* 2019), as well as in trophic regulation in natural ecosystems (McGruddy *et al.* 2021). However, for many species of social wasps, there is little information about their feeding behavior and ecology, such as for many species of the genus *Mischocyttarus* de Saussure, 1853 (O'Donnell 2021). There are few records of pollen consumption (Snelling 1953) and predation on some invertebrates (Snelling 1953; Jeanne 1972). Consequently, there is limited information available on arthropods, except insects, in the diet of these vespids.

Mischocyttarus constitutes the largest genus in the Vespidae family, with more than 250 known species, primarily found in neotropical regions (Silveira 2008; Pinheiro & Silveira 2023). In Brazil, *Mischocyttarus rotundicollis* (Cameron, 1912) (Hymenoptera: Vespidae) has a broad geographical distribution and occupies different biomes (Souza *et al.* 2020a, 2020b; Somavilla *et al.* 2021), being even considered synanthropic (Oliveira *et al.* 2017). However, the diet of *M. rotundicollis* remains unclear, with few reports such as feeding on pollen (Sühs *et al.* 2021). The aim of this study is to report *M. rotundicollis* feeding on a spider in the southeastern region of Brazil, aiming to expand information about its feeding behavior.

The record occurred occasionally in the late afternoon (5:25 pm) on September 23, 2023, in the vegetation at a small spring on the edge of a forest fragment in the urban area of São João del-Rei (-21.12942131935, -44.262760348621), Minas Gerais, Brazil. This area is located in an ecotone region between the Atlantic Forest and the Cerrado. The behavior was observed for about two minutes using the *ad libitum* method (Altmann 1974), and after photographic documentation of the interaction, the organisms were collected and later sent to the Biological Collection of Wasps at Instituto Federal de Educação, Ciência e Tecnologia, do Sul de Minas Gerais (IFSULDEMINAS), Campus Inconfidentes, for identification (CBVS 2023; Souza 2023). The social wasp was identified using dichotomous keys (Richards 1978), and by comparison with specimens deposited in the collection. As for the spider, due to

its conservation state, it was not possible to obtain a precise identification, but it is likely a species of the Araneidae family and its web was of the orbicular typ. Its cephalothorax measured approximately 5 mm in length and 4 mm in width and was missing all of its legs. At the time of observation, the social wasp was already perched on the spider in its web, manipulating and tearing apart part of the lateral and lower region of the cephalothorax of the arachnid with its mandibles, with the aid of its front legs (Figure 1).

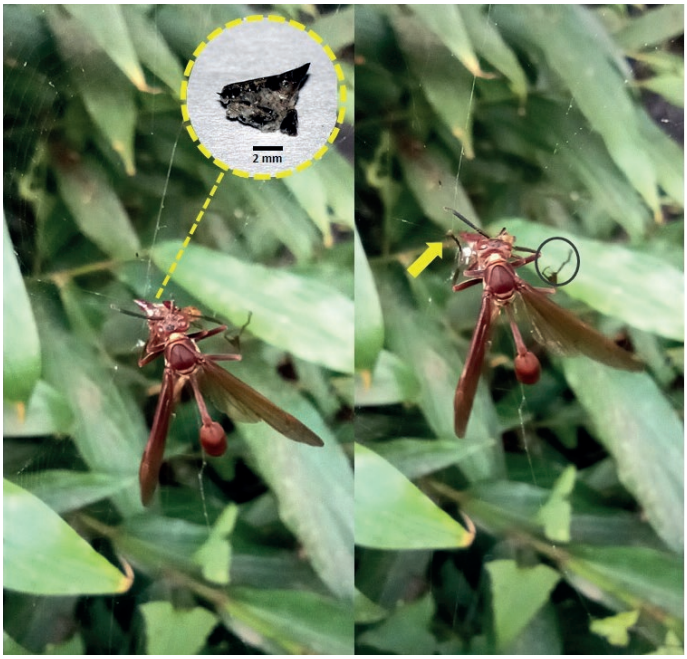

Figure 1. *Mischocyttarus rotundicollis* feeding on a spider in its web. Yellow circle: detail of the ventral surface of the spider's cephalothorax partially consumed by *M. rotundicollis*; Yellow arrow: detail of *M. rotundicollis* using a silk thread for anchoring; Black circle: detail of a spider leg caught in the web after being torn off by *M. rotundicollis*.

From this observation, we can pose four questions: first, did the social wasp actively prey on the spider? Second, is the use of spiders as a food resource frequent or occasional? Third, is the feeding behavior recorded similar to that of other species of wasps? Lastly, is there any morphological specialization for *M. rotundicolis* to obtain food from spider webs?

Regarding the first question, it is not possible to affirm whether the social wasp actively preyed on the spider or merely fed on the dead spider. However, we provide information that can help us better understand this situation. In your study conducted with *Mischocyttarus drewseni* de Saussure, 1857 (Hymenoptera: Vespidae), Jeanne (1972) demonstrated, through an experiment, that spiders are consumed by this species when offered mashed, but did not record predatory behavior towards spiders, as it was also not reported in other studies for different species of social wasps that use spiders as a food resource (*e.g.*, Machado *et al.* 1988; Clapperton 1999; Oliveira *et al.* 2010; López *et al.* 2013; Brügger *et al.* 2019). According to Jeanne (1972), there was a record of predation of a spider by *Mischocyttarus lecointei* (Ducke, 1918) (Hymenoptera: Vespidae), where the wasp captured the arachnid and transported it to a leaf where it consumed it. Therefore, it is possible to consider the possibility that *M. rotundicolis* preyed on the spider. The information presented above, combined with the fact that social wasps exhibit a generalist and opportunistic feeding behavior, allowing them to exploit different taxa as food (Brock *et al.* 2021), helps us with the second question, where we suggest that spiders are not a frequent food resource for *M. rotundicolis*, and that the recorded event is casual.

Regarding our third question about the observed feeding behavior, we can affirm that it is similar to what has been reported for other species. According to the literature, when attacking a relatively large prey, wasps macerate them into small portions and transport them to their colonies. It was also observed that the spider was missing the legs, as the wasp probably cut off and discarded them, as one of them can still be seen attached to the web (Figure 1). This behavior is similar to that observed in *Polistes cinerascens* de Saussure, 1854 (Hymenoptera: Vespidae) (Crispim *et al.* 2023), *Polistes dominula* (Christ, 1791) (Hymenoptera: Vespidae) (Brown *et al*. 2012), and *Polybia rejeita* (Fabricius, 1798) (Hymenoptera: Vespidae) (Dejean *et al*. 2017), which cut and discard hard parts of prey not used in feeding, consuming only parts composed of soft tissues.

As there are few records of spiders being used as food or preyed upon by social wasps, it is difficult to make assertions, particularly regarding our last question on whether there would be any morphological specialization for *M. rotundicolis* to obtain food in spider webs. This condition was suggested by Jeanne (1972) for *M. drewseni* in the Brazilian Amazon, as this species frequently forages spider webs to usurp small invertebrates trapped in the silk threads of these structures. This would be possible because *Mischocyttarus* species exhibit asymmetry in the tarsal lobes of the middle and hind legs, especially in the distal segments of the tarsus, which are exceptionally long (Jeanne 1972; O'Donnell 2021; Somavilla & Carpenter 2021). Such unique morphological modifications have been suggested as an adaptation of these organisms to forage in spider webs, as they function as hooks used to support wasps as they move and maintain stability on the silk threads of the webs (Jeanne 1972).

This possibility could explain the behavior of *M. rotundicolis*, which used the middle and hind tarsal lobes to anchor itself in the silk threads of the web and thus obtain stability and support for possible predation, enabling the manipulation of the spider as a food resource (Figure 1). Other social wasp species that do not have asymmetric tarsal lobes have also been reported to usurp prey in spider webs, such as *Polybia occidentalis* (Olivier, 1791) (Hymenoptera: Vespidae) (Jeanne 1972) and *Parischnogaster depressigaster* (Rohwer, 1919) (Hymenoptera: Vespidae) (Williams 1928). However, in these cases, the social wasps removed the insects without landing on the webs. Similarly, females of *Parischnogaster nigricans serrei* (Du Buysson, 1905) (Hymenoptera: Vespidae) feed almost exclusively on small arthropods, which they snatch during flight without touching the threads of the webs, a behavior that has been considered highly specialized (Turillazzi 1983). Based on this, our record does not allow us to affirm that the modifications in *Mischocyttarus* favor specialization in the exploitation of food resources in spider webs, so further studies are needed for a better understanding of this possible adaptation suggested by Jeanne (1972).

We also highlight that the behavior documented here differs in some aspects from that documented for *M. drewseni* by Jeanne (1972), on which the wasp manipulated its prey in the "upside-down" position with its mandibles and first pair of legs, and attached itself with the middle and hind legs to the silk threads of the web. In our report, the social wasp was manipulating the potential prey in its "natural position" (head up and dorsum down). Additionally, in Jeanne (1972), *M. drewseni* attacked only prey small enough to be transported after manipulation in a single trip to the colony, whereas in our record, the spider was relatively large, requiring manipulation to remove unused parts.

In conclusion, our record provides additional information about the feeding behavior and diet of *M. rotundicollis* along with the first information about the possibility of spider predation by this species. Further studies are suggested to evaluate the hypothesis of specialization of species in the

genus *Mischocyttarus* for obtaining food in webs and possibly their ability to prey on web-building spiders.

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AUTHORS CONTRIBUTION

GCSO, IHS, DSV and MMS: Conceptualization and writing the first draft; GCSO: Performed and photographed the record. All authors have read and agreed to the published version of this manuscript.

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CONFLICT OF INTEREST STATEMENT

The authors of this research declare that there is no conflict of interest.

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