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Polybia fastidiosuscula (Hymenoptera: Vespidae) foraging activity patterns

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Social insects forage food resources (proteins, carbohydrates), material for nest construction (plant fibers, clay), and water (Beggs 2001). Most social wasps (Vespidae) are generalist predators of agricultural pests; therefore, they are frequently found in agroecosystems (Auad et al. 2010; Brügger et al. 2011, 2017) controlling lepidopteran caterpillar populations (Saraiva et al. 2017).

The prey capture by social wasps consists of approaching the prey (generally by walking), antennation, attack, killing it by slicing pieces of flesh (Dejean et al. 2017), and transport of prey pieces to the nest (Brown et al. 2012).

Polybia fastidiosuscula Saussure (Hymenoptera: Vespidae) is a social wasp that is widely distributed in South America, and which constructs large nests (“fragmocitaro”) that are about 30 cm long (Saraiva et al. 2017). The foraging activity of these worker wasps covers a radius of approximately 81 m from their nest (Souza et al. 2010).

Behavioral aspects of social wasps, such as daily activity, diet, ecology, flight, and transport capacity (Moreyra et al. 2012; Brügger et al. 2017) should be studied to assess their potential for integrated pest management. The objective was to identify the prey captured and determine the foraging activity patterns of *P. fastidiosuscula* in an urban area.

A colony of *P. fastidiosuscula* (nest of 23 cm diam) in an experimental field of the Universidade Federal de Viçosa (UFV) in Viçosa, Minas Gerais, Brazil (20.764417°S, 42.868278°W) was evaluated. *Polybia fastidiosuscula* workers that were returning to the colony were intercepted in Jul 2015. Seven sampling sessions of 13 h each were conducted from 6:00 AM to 7:00 PM h, totaling 91 h of sampling effort. Wasps carrying prey, which were identified by their slow flight, were captured with an entomological net, and killed in a lethal chamber containing cotton moistened with ether. Dead wasps and preys were saved in 2 mL Eppendorf tubes with 70% alcohol. The gross sample weight was determined using a digital analytical scale (± 0.1 mg). The alcohol was dried by placing the samples on filter paper for 10 min at room temperature before weighing. Prey was identified under a stereomicroscope (DIGILAB, Piracicaba, São Paulo, Brazil).

Data on foraging activity and prey capture by *P. fastidiosuscula* throughout the d were subjected to ANOVA using Statistix, Version 9.0 (Analytical Software, Tallahassee, Florida, USA) with each 1 h sampling representing an experimental unit. Differences with $P < 0.05$ were sig-

nificant, and the means compared with the Tukey test at 95% probability level. The Spearman correlation coefficient (r) of wasp weight vs. prey/flesh-piece transported was obtained using the PAST program, Version 3.08 (Analytical Software, Oslo, Norway).

Foraging by *P. fastidiosuscula* typically varied throughout the d. The peak foraging period of this wasp occurred from 12:00 Noon to 2:00 PM (Fig. 1). A total of 322 departures of *P. fastidiosuscula* workers were counted during the observation period, with a return rate of 89.4% (288 arrivals). Of the 288 arrivals, 182 *P. fastidiosuscula* workers brought prey of Lepidoptera (caterpillars) (92.6%), Araneae (3.1%), Diptera (2.5%), or Orthoptera (1.8%) species. The other arrivals were wasps with material for nest building.

Mean (\pm SD) wasp weight and prey/flesh-pieces transported were 17.4 ± 3.3 mg ($n = 288$; ranging from 11.6 to 28.4 mg) and 5.2 ± 2.5 mg ($n = 182$; ranging from 1.1 to 13.1 mg), respectively. *Polybia fastidiosuscula* workers can carry a prey load up to 30% of their own body

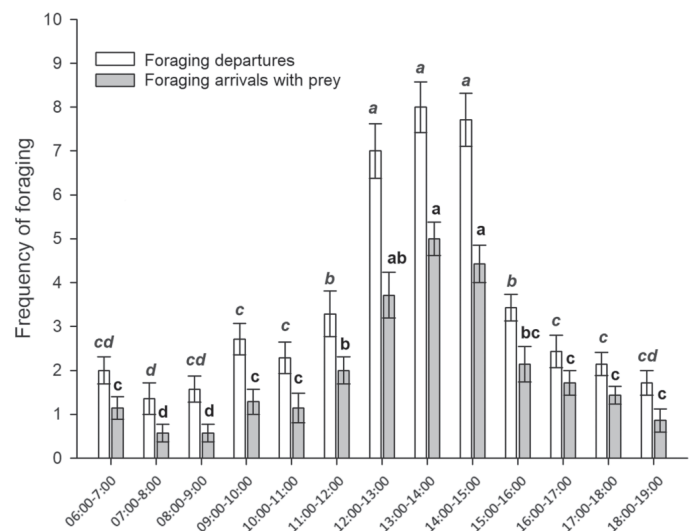


Fig. 1. Typical *Polybia fastidiosuscula* foraging patterns. Means with the same letter at each evaluation time do not differ at 95% probability by the Tukey's test. Vertical bars represent the standard error of the mean ($n = 7$).

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weight; however, the weights of wasp vs. prey/flesh-piece transported were not correlated ($r = 0.0424$; $P = 0.5692$). The wasps had different behaviors at certain periods of the d. Peak activity occurred during the hottest periods of the d (Hernández et al. 2009; Santos et al. 2009).

The high return rate of *P. fastidiosuscula* to the nest is due to their ability to locate themselves through visual signals during foraging up to a distance of 500 m from their colony (Souza et al. 2010). The Lepidoptera caterpillars were the principal prey of *P. fastidiosuscula* workers; this is similar to the report by Pereira et al. (2013) of caterpillars being a major protein source for social wasps.

The weight of the wasp and its prey was found to vary considerably for *P. fastidiosuscula* workers returning with a prey load. The prey weight was about 30% of their own body weight, which is lower than that of *Polybia occidentalis* (Olivier) (39%) (Hernández et al. 2009), but similar to *Polybia rejeata* (F.) (30.7%) (Dejean et al. 2017), and higher than that for *Polybia platycephala* Richards (all Hymenoptera: Eumenidae) (13.4%) (Prezoto et al. 2005). This weight variation of the prey captured and transported by *P. fastidiosuscula* may be related to the opportunistic and generalist behavior of social wasps, which capture the first prey regardless of size (Raveret-Richter 2000). In addition, wasps divide the large prey into small pieces of different weights (Raveret-Richter 2000; Dejean et al. 2017).

The *P. fastidiosuscula* preference for foraging caterpillars demonstrates the importance of this wasp to reduce Lepidopteran populations in agroecosystems. Chemical pest control, when necessary, should be conducted before 9:00 AM or after 4:00 PM, when the foraging activity of *P. fastidiosuscula* is reduced.

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Summary

Prey identification expands our knowledge on social wasps and their interactions as predators of herbivorous insects. The objective was to characterize the *Polybia fastidiosuscula* Saussure (Hymenoptera: Vespidae) foraging pattern in Jul 2015. *Polybia fastidiosuscula* workers returning to the nest were intercepted and captured with an entomological net at the Universidade Federal de Viçosa in Viçosa, Minas Gerais State, Brazil. Seven sampling sessions of 13 h each, from 6:00 AM to 7:00 PM, were carried out, totaling 91 sampling h. The prey collected (182 insects) were Lepidoptera (caterpillars, 92.6%), Araneae (3.1%), Diptera (2.5%), and Orthoptera (nymphs, 1.8%). Mean (\pm SD) wasp weight was 17.4 ± 3.3 mg, and mean weight of prey transported was 5.2 ± 2.5 mg. A *P. fastidiosuscula* worker can carry a load of about 30% of their own body weight. The foraging preference, principally of lepidopteran caterpillars, suggests that *P. fastidiosuscula* has potential as a natural enemy in integrated pest management programs.

Key Words: biological control; feeding behavior; natural enemy; social wasps

Sumario

A identificação de presas expande o conhecimento sobre vespas sociais e suas interações como predadores de insetos herbívoros. O objetivo foi caracterizar padrões de forrageamento de *Polybia fastidiosuscula* Saussure (Hymenoptera: Vespidae). Vespas operárias de *P. fastidiosuscula*, retornando ao ninho, foram interceptadas e capturadas com rede entomológica na Universidade Federal de Viçosa in Viçosa, Minas Gerais, Brasil em julho de 2015. Sete sessões de 13 h cada uma (06:00 às 19:00 h), totalizando 91 h de amostragem foram realizadas. As presas coletadas (182) são de Lepidoptera (92,6%), Araneae (3,1%), Diptera (2,5%), e Orthoptera (ninfas, 1,8%). O peso médio (\pm SD) da vespa foi de $17,4 \pm 3,3$ mg e o da presa transportada fixada de $5,2 \pm 2,5$ mg. Uma *P. fastidiosuscula* pode carregar uma carga de cerca de 30% do seu próprio peso corporal. A preferência pela alimentação em larvas, principalmente de lepidópteros, sugere que *P. fastidiosuscula* tem potencial como inimigo natural no manejo integrado de pragas.

Palavras Chave: controle biológico; comportamento alimentar; inimigo natural; vespa social

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