Flight Distance and Return Capacity of Polistes lanio lanio (Hymenoptera: Vespidae) Workers

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Flight distance and return capacity of *Polistes lanio lanio* (Hymenoptera: Vespidae) workers

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Abstract

Social wasps find prey mainly using olfactory cues when foraging. Flight area and the ability to return to the nest after this activity was studied for the predatory wasp *Polistes lanio lanio* (Fabricius) (Hymenoptera: Vespidae) using mark-recapture techniques. One hundred workers of this wasp were removed from 20 nests (5 per nest), marked on the mesothorax, and released after 2 d. Wasps were released at different times and distances to reduce memorization of the flight path. We determined that *P. lanio lanio* workers' hypothetical foraging area was 13.2 km^2 based on their greatest return capacity to nests.

Key Words: foraging; nests; social wasps; workers

Resumo

Vespas sociais localizam lagartas usando principalmente pistas olfativas quando forrageando. A área de voo e a capacidade de retornar ao ninho após esta atividade foram estudadas para a vespa predadora *Polistes lanio lanio* (Fabricius) (Hymenoptera: Vespidae) usando técnicas de marcação e recaptura. Cem operárias desta vespa foram removidas de 20 ninhos (5 por ninho) marcadas no mesotórax e liberadas após dois dias. As vespas foram liberadas em diferentes momentos e distâncias para reduzir a memorização do trajeto do voo. Nós determinamos que a área hipotética de forrageamento das operárias de *P. lanio lanio* foi de 13.2 km^2 com base em sua maior capacidade de retorno aos ninhos.

Palavras Chave: forrageamento; ninhos; operárias; vespas sociais

Polistinae are primitive eusocial insects forming colonies with dominant, reproductive, active, and subordinate foraging individuals (De Souza & Prezoto 2012). *Polistes lanio lanio* (Fabricius) (Hymenoptera: Vespidae) occurs from Guyana to Argentina (Richards 1978) with independent nest formation, and is active throughout the yr, principally in urban areas (Braun et al. 2008). All social insects must search for food resources (proteins, carbohydrates), water, and material for building nests (e.g., plant fibers and clay) (Richter 2000; Nascimento et al. 2015; Brügger et al. 2017, 2019a, b). Therefore, environmental factors such as humidity, sunlight, and temperature regulate these activities (Kovac et al. 2018). Foraging is the most complex behavior of social wasps (Richter 2000) with a behavioral sequence of travel, searching, preying, loading, return, and discharging the load in the nest (Brügger et al. 2019a). However, we believe that flight capacity of social wasps should be studied to define their foraging area (Mandal et al. 2017; Masciocchi et al. 2018) and to determine the predatory potential of these insects (Dejean 2017). Here we report on investigations of the flight area and return capacity of *P. lanio lanio* workers in Seropédica, Rio de Janeiro State, Brazil.

Materials and Methods

This study was carried out from Jan 2004 to Jun 2005 at the Centro Integrado de Manejo de Pragas (CIMP) in the Universidade Federal Rural do Rio de Janeiro in Seropédica, Rio de Janeiro State, Brazil. Five post-emergent workers from 20 field colonies of *P. lanio lanio* (100 individuals) were collected with an aerial net. Wasps were anesthetized for 25 s, marked on the mesothorax with 3 different colors using a Ceramic Twin Marker (water-based) (Marvy Uchida, Tokyo, Japan) (Fig. 1) to identify colony and individual wasp. Wasps were then placed in 500 mL clear polyethylene pots for 2 d with a 6.0 cm opening covered with cotton. Pots containing wasps were transported in black bags to release sites located at 450, 800, 1,000, 1,300, 1,400, 1,500, and 2,050 m from

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Fig. 1. *Polistes lanio lanio* (Hymenoptera: Vespidae) in a nest after being marked and released at predetermined points at the Universidade Federal Rural do Rio de Janeiro campus in Seropédica, Rio de Janeiro, Brazil.

their colonies and released at different times to reduce memorization of flight path. Colonies were monitored for 72 h after wasp release.

STATISTICAL ANALYSIS

The return speed of the wasps was obtained by dividing return time by distance of the initial release point. The hypothetical flight area of *P. lanio lanio* was calculated with the equation: $A = \pi \times r^2$, where π is the constant and *r* the longest return distance, or theoretical flight range in relation to the central point of the respective nests (Prezoto & Gobbi 2005). Return speed data were obtained by dividing return time by release point distance of foraging workers. These data were transformed into cosine arc (x/100) 0.5 and subjected to analysis of variance; means were compared using the Scott-Knott test ($P \leq 0.05$) (Scott and Knott 1974).

Results

Polistes lanio lanio workers from 19 colonies returned to their nest and performed trophallaxis with the queen as the first behavior after arrival. Mean return time ranged from 0.6 to 24.3 h, with a travel speed of 4.8 to 62.4 m per s at the release distances of 450 to 1,400 m (Table 1). Foraging areas increased with increasing release distance; the largest forage area was 13.2 km^2 and the largest release distance was 2.050 km^2.

Discussion

The return distance of *P. lanio lanio* from foraging confirms the capacity of Vespidae to travel great distances. Indeed, other authors have reported similar behavior for *Polistes versicolor* Olivier (Hymenoptera: Vespidae), with a maximum distance of 850 m and effective range of 200 m (Gobbi 1978). Ugolini (1986) reported that *Polistes gallicus* (Linnaeus) (Hymenoptera: Vespidae) had return distances of 300 to 400 m and > 600 m. Santos et al. (1994) found that *Polistes canadensis canadensis* (Linnaeus) (Hymenoptera: Vespidae) exhibited foraging distances from 50 to 250 m with 80% return of workers.

The foraging area of *P. lanio lanio* workers and the increase of return time with distance from the release point was expected. A similar observation also was reported for *Vespula germanica* (Fab.) (Hymenoptera: Vespidae) by Moreyra et al. (2016). Wasps with resources such as prey, nectar, wood, and water reduce return time (Prezoto & Gobbi 2005). We also noted in our area that buildings and the Atlantic Forest may reduce return speed of *P. lanio lanio*, because the absence of these 2 obstacles increased the speed of return to its respective colony. Golding et al. (2005) found that return speed of *Vespula vulgaris* (Linnaeus) (Hymenoptera: Vespidae) was lower, because they move back and forth in front of flowers before landing for feeding. In our study, *P. lanio lanio* workers returning from the 2,050 m release point reinforced the notion that wasps use visual cues for reference points when returning to the colony. Indeed, Mandal et al. (2017) reported that foraging *Ropalidia marginata* (Lepeletier) (Hymenoptera: Vespidae) may travel 1,500 m to accomplish the same task. The foraging area of 13.2 km² for *P. lanio lanio* may be directly related to its larger body size. This was similarly observed by Prezoto and Gobbi (2005) where forage areas for *Polistes simillimus* Zikán (Hymenoptera: Vespidae) and *Angipolybia pallens* (Lepeletier) (Hymenoptera: Vespidae) were reported to be 7.6 and 1.8 km^2, respectively.

Obstacles between *P. lanio lanio* workers and their colony may reduce return speed, because this behavior depends on factors such as environmental preferences as it relates to nesting requirements and resource availability (Kasper et al. 2008; Moreyra et al. 2017). We found that *P. lanio lanio* workers may return to their nests from long distances, although with greater speed up to 450 m. The return time of this wasp did not vary directly with nest distance due to the absence of obstacles along the flight path. However, the individual needs of each colony also influence this behavior.

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Table 1. Mean ± SE of the distance (m), forage area (km^2), mean return period (h), return speed in m pers of *Polistes lanio lanio* (Hymenoptera: Vespidae) in an area with or without physical barriers between release points and their nests.

Distance	Forage area	Return period[a]	Return speed	Physical barriers
450	0.64	0.6 ± 0.06 e	4.8 ± 0.002 b	Without
800	2.01	12.5 ± 0.10 c	56.2 ± 0.003 a	Buildings
1,000	3.14	24.3 ± 0.12 a	87.4 ± 0.003 a	Buildings and Atlantic Forest
1,300	5.31	15.0 ± 0.07 b	41.5 ± 0.002 a	Buildings
1,400	6.16	24.3 ± 0.07 b	62.4 ± 0.001 a	Buildings and Atlantic Forest
1,500	7.07	3.0 ± 0.06 d	7.2 ± 0.001 b	Atlantic Forest
2,050	13.2	3.8 ±0.07 d	6.6 ± 0.001 b	Buildings

[a]Means followed by a different letter per column are significantly different by the Scott-Knott test ($P < 0.05$).

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