Foraging by *Polybia (Trichothorax) ignobilis* (Hymenoptera, Vespidae) on flies at animal carcasses

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ABSTRACT. Foraging by *Polybia (Trichothorax) ignobilis* (Hymenoptera, Vespidae) on flies at animal carcasses. Proteins for brood nutrition of social wasps are obtained from many prey, including insects (even bees and other wasps), spiders and bits of decaying meat. After being captured and killed, prey are reduced to a shapeless mass and distributed to the brood. Little is known about the foraging activity, especially on this group. Herein we describe the sequence of foraging behaviours of the social wasp *Polybia (Trichothorax) ignobilis* for hunting flies (Diptera: Calliphoridae and Muscidae) over pig carcasses. To our knowledge, there are few scientific descriptions of prey foraging behaviour on this species.

KEYWORDS. Calliphoridae; hunting behavior; Muscidae; prey and wasps.

RESUMO. Forrageamento de *Polybia (Trichothorax) ignobilis* sobre moscas visitantes de carcaças animais. Proteínas para nutrição da prole de vespas sociais são obtidas de várias presas, incluindo insetos (mesmo abelhas e outras vespas), aranhas e pedaços de carne em decomposição. Após serem capturadas e mortas, as presas são reduzidas a massas amorfas e distribuídas para a prole. Pouco é sabido sobre a atividade de forrageamento, especialmente nesse grupo. Assim nós descrevemos a seqüência de comportamento de forrageamento da vespa social *Polybia (Trichothorax) ignobilis* capturando moscas (Díptera: Calliphoridae e Muscidae) em carcaças de porcos. Para nosso conhecimento, há poucas descrições científicas do comportamento de forrageamento nessa espécie.

PALAVRAS-CHAVE. Calliphoridae; comportamento de caça; Muscidae; presas e vespas.

Foraging activity is considered one of the most relevant and complex behaviours of social wasps (Lima & Prezoto 2003), being dependent on their skill at interacting with the environment and collecting essential resources for the colony maintenance. Social wasps generally gather materials like water, carbohydrates (mainly nectar), plant materials for building nests and animal proteins (Wilson 1971; Hunt *et al.* 1987). Among these collected items, capturing prey demands a particularly complex behavioural flexibility, including recognition of prey, being able of capturing specific prey types and the capacity of returning it to the nest (Wilson 1971, Ugonili & Cannicci 1998).

The proteins for brood nutrition of social wasps (Hymenoptera, Vespidae) are obtained from a vast range of different prey, such as insects (including bees and other wasps), spiders (Sakagami & Fukushima 1957 a e b; Jeanne 1972) and even decaying bovine and fish meat (Snelling 1953). After being captured and killed, prey are cut down into pieces, thoroughly chewed and distributed to the brood. But little is known about wasp hunting behaviour, especially about this group of insects, mainly because these behaviours occur at unpredictable places (Rabb & Lawson 1957).

Previous studies about prey foraging activity with social wasps were mainly quantitative and qualitative analyses of collected materials. Some Vespinae, especially those belonging to the genus *Vespa*, seem to prefer capturing insects of the order Diptera, particularly from the families Tabanidae, Syrphidae, Muscidae and Anthomyiidae (Matsuura 1984). Jeanne (1972) observed *Mischocyttarus drewseni* capturing small spiders, ants, nymphs of hemipterans and other wasps as prey, while Prezoto *et al.* (1994) and Gianotti *et al.* (1995) noticed that *Polistes simillimus* and *Polistes lanio* more frequently capture larvae from Lepidoptera.

Between 90% and 95% of the prey captured by *Polybia occidentallis* (Olivier) (Gobbi *et al.* 1984), *Polybia paulista* (Ihering) (Gobbi & Machado 1985), *Polybia ignobilis* (Haliday) (Gobbi & Machado 1986), *Agelaia pallipes* (Olivier) (Machado *et al.* 1987), *Polistes simillimus* Zikán (Prezoto *et al.* 1994) and *Polistes lanio* (Fabricius) (Giannotti *et al.* 1995) are Lepidoptera larvae (Prezoto *et al.* 2006).

Gobbi *el al.* (1984) analysed the protein diet of the Epiponinae wasp *Polybia occidentalis* and verified that it was constituted mainly by prey from the orders Lepidoptera, Hemiptera, Hymenoptera and Diptera. The same was verified to *Polybia (Myrapetra) paulista* (Gobbi & Machado 1985), *Polybia (Trychothorax) ignobilis* (Höfling 1982, Gobbi & Machado 1986 and Höfling & Miranda 1987), *Pobybia (Trychothorax) sericea* (Machado *et al.* 1988), *Agelaia pallipes* (Machado *et al.* 1986) and *Polybia dimidiata* (Campos-Farinha & Pinto 1996), in which, although no marked specificity for prey was observed, there was a preference for caterpillars, including many agriculture pest species. Prezoto

et al. 2005 noticed that *Polybia platycephala* displays a preference for capturing Diptera, especially of the family Culicidae.

However, descriptions on behaviours of prey foraging activity of Vespidae are exceedingly rare. There are only those made by Jeanne (1972) and Richter & Jeanne (1991), on which were described the patterns of sequences of hunting behaviours of *Mischocyttarus drewseni* and *Polybia (T.) sericea*, respectively. The latter displayed the following pattern when hunting: the wasp flies at high heights (2-6m), but searches for prey circling at lower heights (0,5m above ground) until it finds a substrate. Then it surveys the substrate with the antennae, forelegs and hind legs, lands on it and starts vibrating its wings. Then the wasp repeatedly rubs its forelegs against the antennae, locates a prey, bites it and chews it down into an amorphous mass. The prey seems to be located during the flight mainly by visual cues and recognized from the substrate by odoriferous cues (Raveret Ritcher and Jeanne 1985).

Generally, the foraging wasps return to areas where they have been well-succeeded in foraging (Rabb & Lawson 1957; Suzuki 1978; Takagi *et al.* 1980; Raveret Richter & Jeanne 1985).

Polybia (Trychothorax) ignobilis (Haliday, 1836) is a common wasp in South America, occurring from Panama to Paraguay and Argentina (Höfling 1982, Carpenter 1993; Carpenter & Marques 2001) and a very aggressive species (Richards 1978). Nests from this species are protected by envelopes and are generally built in cavities. The present study aims at describing the sequence of prey foraging behaviours of this social wasp while hunting flies (Diptera, Calliphoridae e Muscidae), for there is few available scientific description of the sequence of hunting behaviours of this species (Höfling 1982, Gobbi & Machado 1986 and Höfling & Miranda 1987).

The observation area was an open field area with "latosoil" covered with semi-deciduous vegetation, inside the *campus* of UNESP University, Rio Claro, São Paulo, Brazil (22° 23' 5'' S; 47° 32' 32.28'' W). The area is 608 m above sea level; temperatures vary between 15.4 and 30°C during the year and annual relative humidity is over 65% (CEAPLA).

During the winter of 2006 during 76 days (July - August), two pig carcasses weighting 13.34 kg and 13.65 kg were killed by head concussion just prior to the setting of each experiment. The same was made during 54 days with a 15.44 kg and 11.44 kg pig carcasses during the summer (September - November 2006). They were kept in hermetic plastic bags to avoid any insect infestation until being placed in the experimental area, where they were placed in a metal cage (100 cm x 50 cm x 50 cm) lined with wire mesh (2 cm x 2 cm of frame) for avoiding interference from vertebrate scavengers, while offering open access to insects (Wolff *et al.* 2001).

The pig carcasses were observed for 6 h immediately after being placed at the field. There after, everyday at 6:00-8:00 am, 12:00-14:00 and 18:00-20:00, the behaviour of the wasps was observed. We gathered temperature and humidity data from the local university meteorological station (CEAPLA) (Table I).

Any wasp flying over or landing on the carcass was collected with an entomological net after behaviour observation. The nest wasps were situated from about 100m of the carcass. The insects were killed with ethyl-acetate, mounted on entomological pins and identified using dichotomous keys from Johnson (2005) and (Richards 1978). Voucher specimens are deposited at the UNESP entomological collection.

Thirty-five *P. ignobilis* wasps were observed at different occasions during 8 hours by day. Each wasp approached the pig carcass flying some 2 m above it, which was covered with flies. Then the wasp seemed to descend in circles down to the place where the flies (spotted as prey) were, landing at the most 2 m away, on some place on the surrounding vegetation. Then, it flied to a particular place containing a great number of flies and lands there, vibrating wings and touching the carcass with the antennae. The wasp started approaching the flies on foot walking, trying to grab them with the mandibles, preferentially by biting on the thorax or, less often, on the head. Such behaviour was repeated until the wasp was well-succeeded in capturing a fly, after which the wasp flied away from the carcass and landed under some nearby leaf at a maximum distance of 10 m from the capturing place (Fig.1). Then, it decapitates the fly (Fig 2), removes its wings (Fig 3) and finally malaxate the abdomen during about 3 minutes, with the prey becoming visibly drier during chewing (Fig 4). After about 5 min, the wasp holds the fly remains by the thorax with its mandibles and returns to a closely located nest.

It must be mentioned that once the behaviour sequence was complete, more wasps came the carcass. Curiously, these newly arrived wasps displayed greater ability in capturing the flies than did the first one observed. First-attempting wasps performed an average number of 10 tries before catching a fly, while the following wasps needed a maximum of 4 attempts for succeeding (Fig. 5).

Adults of *Musca domestica* (Diptera: Muscidae), *Chrysomya megacephala* and *C. albiceps* (Diptera: Calliphoridae) were captured by the wasps, although it is not possible to discern species from the pictures (Fig. 1, 2, 3 e 4).

This is the first study to describe field hunting behaviours from *Polybia ignobilis*, here illustrating the capture of flies over pig carcasses.

The figure 5 presents a descriptive model that we suggested for describing the sequence of hunting behaviours

Table 1. Local temperature, relative humidity and precipitation during the study (24 hours) (obtained from the CEAPLA meteorological station).

Season	Temperature[1] (°C)	Relative humidity[2] (%)	Precipitation[3] (mm)
Winter	21.1	35.7	35
Spring	29.4	61.3	180

1 - Mean Standard Deviation: 28.94
2 - Mean Standard Deviation: 32.71
3 - Mean Standard Deviation: 15.73

Fig. 1. *Polybia ignobilis* holding a captured *Chysomya albiceps* fly on the vegetation around the carcass.

Fig. 2. *Polybia ignobilis* wasp decapitating a *Chrysomya albiceps* fly.

Fig. 3. *Polybia ignobilis* wasp removing wings from *Chrysomya albiceps.*

Fig. 4. *Polybia ignobilis* wasp chewing (malaxation) the abdomen of a *Chrysomya albiceps* fly (notice the withered abdomen during to the process).

of *P. ignobilis* over the animal carcass. The patterns of hunting behaviour of *P. ignobilis* are very similar to those observed with other social wasps, including *Polistes candensis* in Brazil (Richter 2000), *Polistes major* in Costa Rica (Raveret 1981) and *P. sericea* (Richter and Jeanne 1991). Knowledge about how wasps act when hunting and how the environment affects their behaviour is needed for being able of predicting and understanding their foraging behaviour.

Holding prey above the ground has been observed in some Neotropical wasps (Richter and Jeanne 1991) and the foraging in flies was similar with *Dolichovespula maculate* (Stein and Fell 1992), while hunting close to the ground may be a widespread practice in wasps. This practice of carrying parts or remains of large prey above ground, rather than close to it (where the captures usually take place) must reduce the odds that the prey will be stolen. This results with the finding that

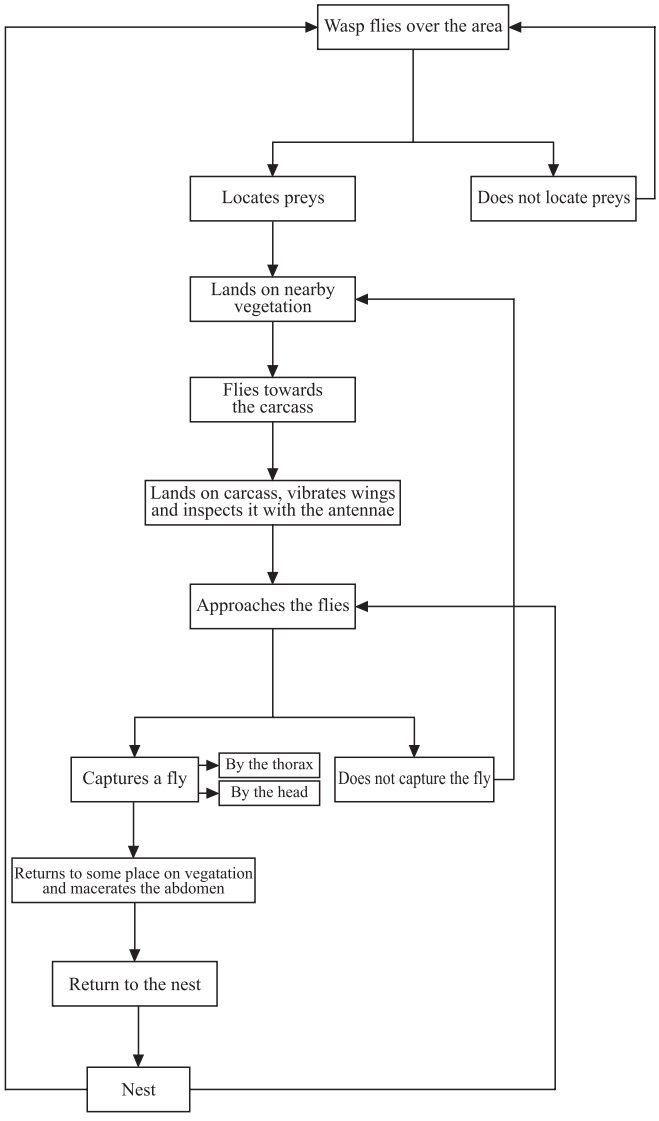

Fig 5. Sequence of hunting behaviours of *Polybia ignobilis* over an animal carcass.

ant predation pressure at each of 5 latitudes is higher on the ground than on the vegetation (Jeanne 1979).

The figures 5 illustrates that some wasps may fly to the carcass and capture flies directly. The greater efficiency when capturing flies displayed by later coming wasps may perhaps be due to the recruitment made by the first wasp, informing the localization of the prey, or sometimes could have been the same wasp returning to the carcass to capture more prey (Wilson 1971, Ugolini & Cannicci Richter 2000). Foraging on natural prey often takes place infrequently at unpredictable locations, making it difficult to document how social wasps locate and choose prey in the field (Richter 2000).

This hypothesis can only be confirmed with further studies by marking some wasps not only in their hunting areas, but also in their nest. Finally, further studies about the collection and utilization of food resources by *P. ignobilis* wasps are warranted to obtain a comprehensive picture of the species role in exploiting resources from animal carcasses.

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