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### Ecological and Forensic Implications of Social Wasps on Pig Carcass Degradation in Brazilian Savannah

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**Abstract.** Herein are recorded the composition and richness of 188 specimens of social wasps collected processing pig carcasses (*Sus scrofa* L.) in a Brazilian Savannah. Among the species collected *Polybia* (*Myrapetra*) *fastidiosuscula* de Saussure, 1854 (n = 178), *Polybia* (*Trichotorax*) *ignobilis* (Haliday, 1836) (n = 6), *Apoica* (*Apoica*) *gelida* Van der Vecht, 1972 (n = 3) and *Polybia* (*Trichotorax*) *sericea* (Olivier, 1791) (n = 1) were founded using fresh, bloated, decayed and skeletonized pig carcass. *P. fastidiosuscula* showed significant differences among decomposition stages, with preference for the bloated stage. The high abundance of social wasps in animal carcasses under decomposition, mainly those considered necrophagous, reveals the ecological importance of these wasps in carcass fragmentation by directly influencing the duration of the decomposition process. Moreover, the preference of *P. fastidiosuscula* for the bloated stage may be used as subsidy for forensic implications.

**Keywords.** Social wasps; Decomposition; Necrophagous; Forensic entomology.

#### 1. Introduction

The order Diptera is considered the most important for forensic entomology<sup>1</sup> by having, in most cases, a well-known life cycle. Although most forensic studies are based on flies, in recent decades a growing number of studies with other insects that may have implications for forensic investigations have being realized. Beetles<sup>2</sup> and

hymenopterans<sup>3</sup> are some of the groups that have been reported as to forensic importance due to their necrophagous habits.

The hymenopterans associated to animal carcass decomposition process depending on their abundance and frequency, can delay, acting as a predator of the necrophagous species<sup>4</sup>, or accelerate this process acting as necrophagous<sup>5</sup>.

Within the Hymenoptera, the social wasps, especially the genera *Agelaia* Lepeletier and *Angiopolybia* Araujo, have been recognized as having several necrophagous species, which may have implications for forensic investigations<sup>3,6,7,8,6</sup>.

In the present study were evaluated the composition, richness and abundance of social wasps on pig carcasses in Brazilian Savannah. Furthermore, was attempted to analyze the ecological habits of the different species collected in function of their mouth structure and forage behavior, in order to indicate their possible forensic implications.

## 2. Material and Methods

### 2.1 Study area

The study was conducted in an area with a total of 159.9 ha in the Unilavras Boqueirão biological reserve (21°20'47"S, 44°59'27"W) located in the municipal district of Ingaí, in the south of Minas Gerais, Brazil, from June 12 to July 25, 2009, dry season. The area can be characterized by topography of hills and ridges disposed in intermediate quotas varying between 1,100 and 1,250 meters of altitude. The average annual temperature is 19.3°C and the average annual precipitation is 1,411 mm, presenting rainy summers and dry winters<sup>9</sup>.

### 2.2 Methods

Two domestic pigs, *Sus scrofa* L., with approximately 10 kg each, were selected as model animal for this study. The animals were killed at the site where the experiments were conducted with a deep and direct cut in the heart, to guarantee a quick death. Anesthetic substances were not used because they could interfere in the attraction and consequently in the composition of the necrophagous fauna<sup>10</sup>.

To impede the attack of large-sized necrophagous, each of the two carcasses, approximately 100 m distant from each other, were placed inside an iron cage on the soil, in which was mounted an inverted funnel-shaped iron frame with the sides covered by a fine mesh fabric, and with an opening of 20 cm at the bottom to allow the collection of the insects attracted to the resource<sup>11</sup>. At the top, a plastic flask was

coupled to a 28 cm diameter circular exit, to facilitate the capture of the winged insects trapped inside the funnel. The collection of the specimens and observations on the decomposition stage durations were carried out daily, in field, between 9 a.m and 3 p.m.

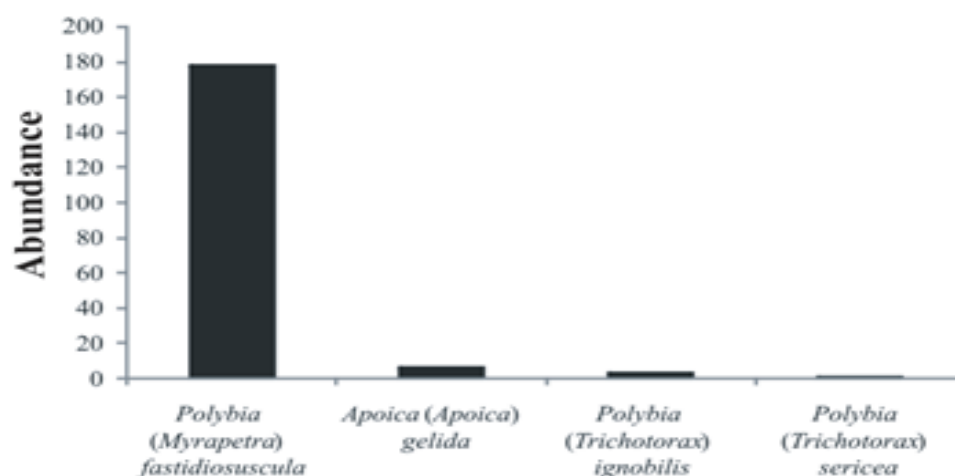
After the collection, the collected specimens were taken to the laboratory for screening and identification of the material. Vespidae of interest for this study were identified until the species level using dichotomous keys<sup>12</sup> and with the help of the researchers Dr. Marcos Magalhães de Souza and Dr. Orlando Tobias Silveira.

The non-parametric Kruskal-Wallis test was performed to test if there were significant differences between the decomposition stages, in other words, if there was preference for any of the stages.

### 3. Results

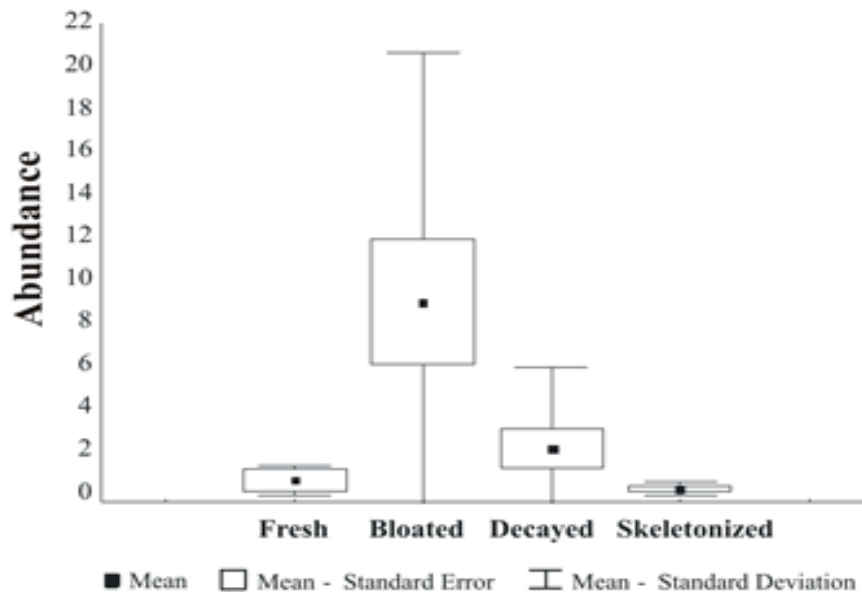
The total decomposition of the animals lasted 43 days and the four stages<sup>13</sup> recognized that composed this process were denominated as fresh (2 days), bloated (approximately 15 days), decayed (14 days) and skeletonized (12 days).

A total of 188 specimens of social wasps (Hymenoptera, Vespidae) were collected: *Polybia (Myrapetra) fastidiosuscula* de Saussure, 1854 (n = 178 or 95% of the total specimens), *Polybia (Trichotorax) ignobilis* (Haliday, 1836) (n = 6), *Apoica (Apoica) gelida* Van der Vecht, 1972 (n = 3), and *Polybia (Trichotorax) sericea* (Olivier, 1791) (n = 1) (Figure 1). The highest abundances were observed in the bloated (n = 148) and decayed stages (n = 38).



**Figure 1.** Abundance of social wasp species collected on pig carcasses exposed in a Brazilian Savannah in southern Minas Gerais state.

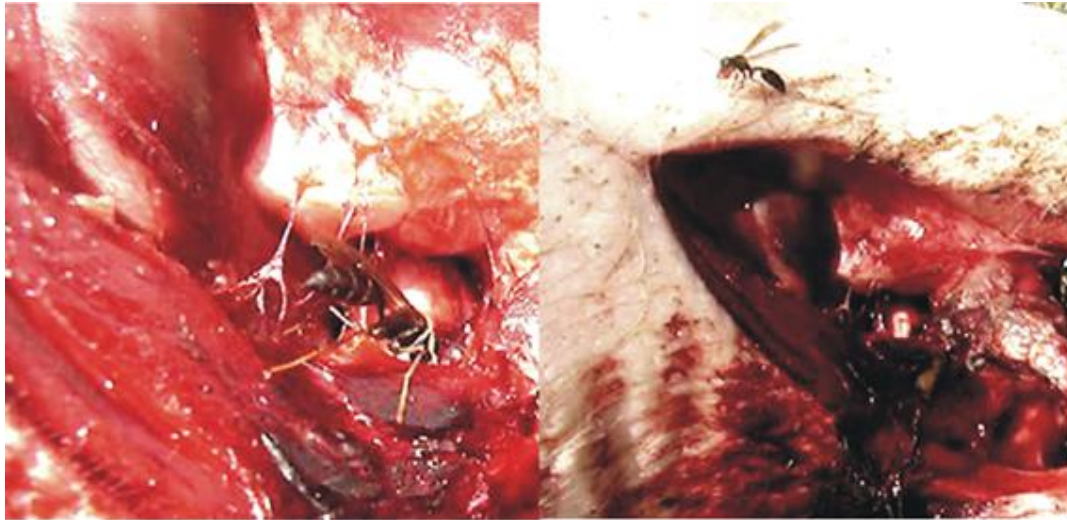
The Kruskal-Wallis test was performed only for *Polybia fastidiosuscula* due to its high abundance. The test between bloated and decay stages showed that there was significant difference, identifying the preference of this species for the bloated stage (KW-H(1;33) = 5.0667;  $p = 0.0244$ ) (Figure 2).



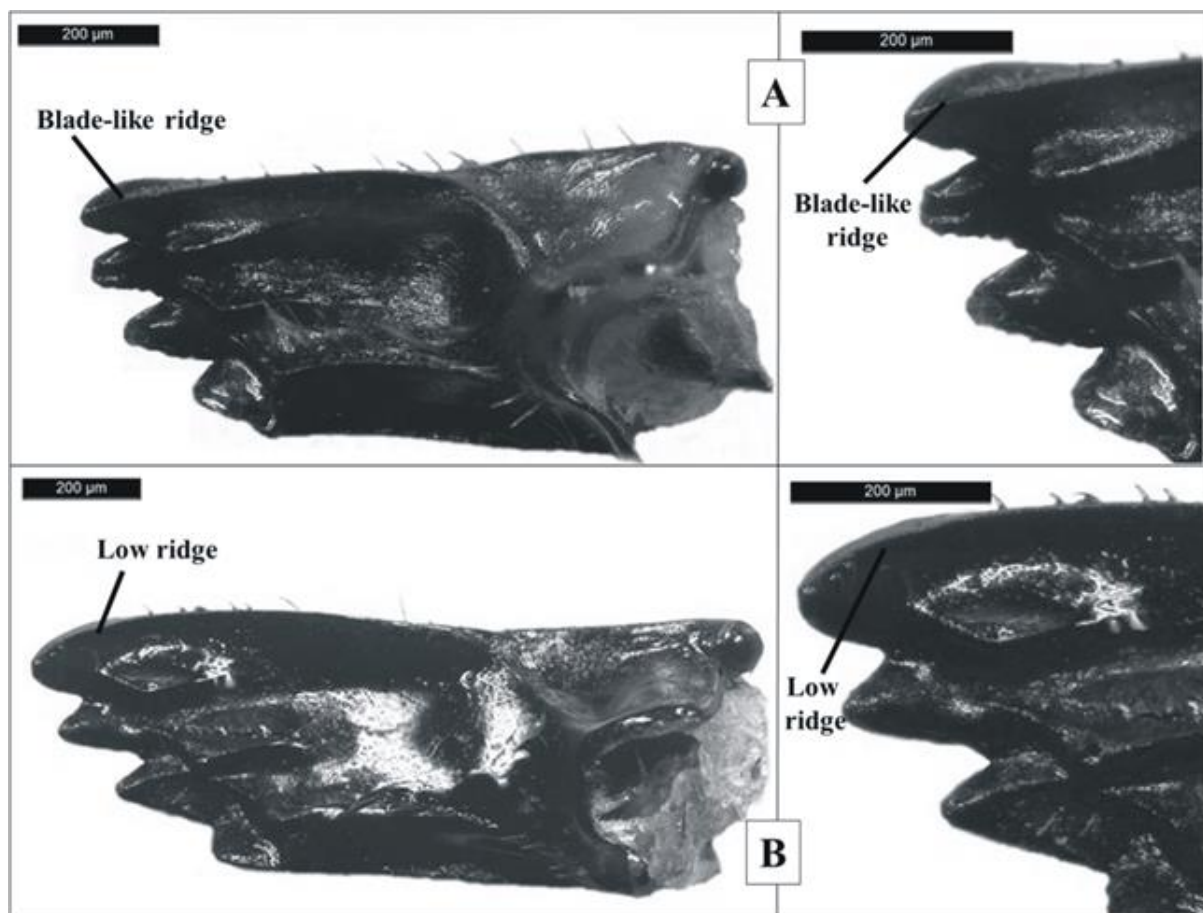
**Figure 2.** Box-plot for the different stages of decomposition showing the significant difference to abundance of *Polybia (M.) fastidiosuscula* (KW-H(1;33) = 5.0667;  $p = 0.0244$ ) among stages with greater abundance of social wasps, bloated and decay.

Other *taxa* abundantly found in the carcasses were Diptera and Coleoptera, both in immature and adult stages, which served as prey for the wasps, though this behavior was not verified as dominant.

It was observed that *Polybia fastidiosuscula* cuts and transports pellets originating from the exposed animal tissue (Figure 3). Furthermore, the analysis of mandible structure showed that this species has structures adapted to necrophagous habits (Figure 4).



**Figure 3.** *Polybia (M.) fastidiosuscula* cutting and carrying pellets from pig carcasses exposed in a Brazilian Savannah in southern Minas Gerais state, Brazil.



**Figure 4.** A: Left mandible of a *Polybia (M.) fastidiosuscula* worker showing the inner surface of dorsal tooth with a blade-like ridge, possibly associated with the necrophagy, and B: Left mandible of a *Polybia (T.) ignobilis* worker showing the inner surface of dorsal tooth with the low ridge.

#### 4. Discussion

The highest abundances of specimens observed in the bloated and decayed stages indicate that the attractiveness is more associated to the exploration of the resource at a more advanced degree of decomposition, which would characterize and establish the necrophagous role. Furthermore, at these decomposition stages, the odor is stronger, which would probably facilitate the location of the carcass by the wasps<sup>14</sup>.

In relation to *Polybia (T.) ignobilis*, apparently it cannot be considered necrophagous because of the low number of collected specimens. A study with pig carcass registered that this species arrives to the substrate looking for other insects, mainly dipterans of the families Muscidae and Calliphoridae, thus classifying it as predatory<sup>15</sup>, which was not observed in this study.

*Apoica (A.) gelida* has the habit of foraging during the night<sup>12</sup>, which at first hinders observation on the diet and behavior of these wasps, thus making its position in relation to the exposed animals uncertain.

However *Polybia (T.) sericea*, whose registrations in the literature point to a feeding preference for Lepidoptera larvae<sup>16</sup>, may have credited its presence in the carcass at random, especially if taking into account the non-presence of such organisms in this type of substrata.

There are no reports of the occurrence of *Polybia fastidiosuscula* in carcasses, however its great representativeness in the present study shows that the association with necrophagous habits is significant. Besides the fact that this species “cuts and transports pellets” (Figure 3), originating from the exposed animal tissue, probably to the nest to be distributed among larvae and adults, workers of this species have a structural modification of the mandibles<sup>3</sup>, as a possible characteristic of necrophagous wasps (Figure 4). These facts are sufficient to corroborate this habit. But the predator role, though with lower prevalence when compared to the necrophagy, should also be investigated more deeply in future research, having in mind the concomitant observation of the removal of eggs of dipterans of the suborder Brachycera from the resource. The importance of new studies to determine the relationship between social wasps as predator of necrophagous insect in order to know more about the their role in the process of animals carcasses decomposition<sup>5</sup>.





The high abundance of social wasps in animal carcasses under decomposition, mainly those considered necrophagous, reveals the importance of these wasps in carcass fragmentation by directly influencing the duration of the

decomposition process. Moreover, the preference of *Polybia fastidiosuscula* for the bloated stage may be used as subsidy for forensic implications. Furthermore, the present study enhances the importance of decomposing carcasses in the feeding of social wasps, which might enrich their protein diet, and with that, lead to a change of behavioral habit, under favorable conditions, from optional necrophagy to obligatory necrophagy.




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