

## **DIVERSITY OF PONERINAE ANTS (HYMENOPTERA: FORMICIEDAE) USING URBAN AREAS FOR REPRODUCTION: THEIR POTENTIAL THREAT TO HUMAN HEALTH**

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**Abstract** Workers and mainly winged females of Ponerinae ants have been causing painful stings on people in the city of São Paulo, Brazil. The species live in small colonies, comprised from a few dozen to a few hundred individuals with monomorphic workers. Ponerinae ants are predators, although some species feed on plant nectaries, fruits and honeydew. In order to register which are the species that reproduce in the city, a survey was conducted for 13 months with light and Malaise traps that were placed in two different areas with the aim at collecting alate ants. The following Ponerinae ants were registered: *Odontomachus haematodus*, *O. bauri*, *Pachycondyla laevigata*, *P. striata*, *P. unidentata*, 10 morphospecies of *Hypoconera* and one species of *Anochetus*. Alate specimens were captured throughout the year. Peaks of alate capture are distinct among the species, from 1 to 655 specimens. With the exception of *P. striata* that reproduces in the dryer seasons, most Ponerinae species show reproductive flights in the warmer and rainy months.

**Key Words** Nuptial flights, alate, sting

### **INTRODUCTION**

Most ant species reproduce and disperse by nuptial flights, and reproductive period varies according to the species and place they occur (Holldobler and Wilson, 1990). Some ant species have their nuptial flights synchronized (Pfeiffer and Linsenmair, 1997). The importance of synchronization for reproduction is essential in nearby colonies of the same species, once both sexes suffer high losses due to predation (Wilson, 1975), in most species of ants the males live only a few days, due to low investment in single individuals during development, and to achieve exogamous pairing, male and female reproductives of different colonies have to be synchronously active to meet at the mating places.

Ants show at least two mating strategies: (i) male aggregation, males gather in large numbers in a certain place that are often reused annually, marking these places with pheromone; females join these flights aggregation and aggregation of males tend to be highly synchronized (Wilson, 1957), and (ii) female calling syndrome, females attract males through pheromones. In contrast with male aggregation, the female calling syndrome seems to be not well synchronized and do not take place in a fixed site. Some authors evaluate such strategy for those species that show nuptial flights for several months (Kaspari, 2001; Dunn, 2007).

Besides biological behaviors, abiotic factors may influence the reproductive time. In the neotropical region the daily photoperiodic alteration within the year is limited, thus giving hardly any guide to the season, which could serve as a proximate releaser for physiological activity. Since most other environmental clues, like temperature or rainfall, are either constant or unpredictable, exact *zeitgebers*

seem to be lacking near the equator. However, the more aseasonal the environmental conditions become, the lower is the need for close synchronization with them. (Pfeiffer and Linsenamair, 1997).

In urban areas ant nuptial flights are rarely observed by people, once most species are small and alate specimens do not sting. Some ant species even do not produce alate reproductives and mating occurs inside the colony (Passera, 1994). But many Poneromorph ants (Bolton, 2003) may cause serious nuisance due to the alate females' size and nuptial flights are promptly noticed by citizens, especially those who have already had the experience of being stung by them.

Accidents from alate ant stings are reported from the São Paulo citizens to Instituto Biológico, and most species belong to the Ponerinae subfamily. This is a primitive group of ants which is primarily tropical in distribution and shows a high diversity in the Atlantic rain forest (Feitosa and Ribeiro, 2005). It is unknown which are the Ponerinae species that reproduce in the city of São Paulo and their nuptial flight periods. This work surveys for reproductive Ponerinae forms in the city of São Paulo, to understand their diversity and flight periods.

## MATERIALS AND METHODS

A survey was conducted in the city of São Paulo. The city has a humid subtropical climate (Cfa/Cwa), according to the Köppen classification, characterized by a dry winter and a rainy summer. Light and Malaise traps were placed in two different areas to collect nocturnal and diurnal alate ants, respectively. Site 1 was located in a 3 ha park in the Southeast region of the city, surrounded by a residential urban area, 16 Km from an Atlantic Forest reservoir, and the Site 2 away 7 Km from it, in the Northern region of the city. Site 2 is surrounded by residential and commercial areas lacking green areas around it.

The Atlantic Forest reservoir, called Serra da Cantareira (Cantareira Hills), is comprised of 64,800 hectares, and is considered one of the biggest urban forests in the world. It is located in the Northern region of the city. Light and Malaise traps were left on each site for 13 months (October 2012 to October 2013). Light traps were attached to a photoelectric cell in order to turn them on at dusk and off at dawn. Specimens were weekly collected and identified to species, whenever possible. As most identification keys focus on the workers not all species could be identified to species. For analysis purposes, the occurrence of each captured species was registered in the month, independent if it was collected in only one week in a given month. Data from the two collecting sites were grouped and the number of captured alate specimens was registered.

Temperature and rain fall data were obtained at the National Institute of Meteorology located in the Northern region of the city of São Paulo.

## RESULTS AND DISCUSSION

Only light traps captured reproductive Ponerinae ants. It was registered sixteen species belonging to four genera, *Anochetus* (one species), *Hypoponera* (ten species) *Odontomachus* (two species), and *Pachycondyla* (three species) (Table 1). Feitosa and Ribeiro (2005) collected 14 Ponerinae species (workers) in Serra da Cantareira, in leaf litter samples. These authors collected the same genera that were collected in this work, except for *Odontomachus*.

The number of captured alate species is higher in site 1, in an urban park (Table 1). Urban green areas are known for the maintenance of biodiversity (Sandströma et al., 2006). Few studies have demonstrated in Brazil the biodiversity of ants in urban green areas (Pacheco and Vasconcelos, 2007; Munhae et al., 2009; Ribeiro et al., 2012) and no work surveyed for reproductive ants, only workers. The data show how rich is the Ponerinae biodiversity that uses urban areas for reproduction.

Alate specimens were captured throughout the year. Peaks of alate capture are distinct among the species (Table 2), from 1 to 655 specimens. *Anochetus* sp. and *Hypoponera* sp. 10 were captured in only one month, and only 1 and 2 specimens were recorded for each species, respectively, in contrast with *Pachycondyla striata* Fr. Smith that a huge number of alate ants were captured, in winter (August and September 2013). All other captured specimens concentrate their nuptial flights in spring, summer and autumn (Table 2), in the higher temperatures (Figure 1). This is a very large period, agreeing with Pfeiffer and Linsenmair (1997) statements that predicted that gain independence from seasons may develop shorter reproductive cycles, and thus benefit in the reproductive competition with their inter-specific seasonal rivals.

**Table 1.** Alate Ponerinae in light traps, in São Paulo, Brazil: October 2012 to October 2013.

Species	Site 1	Site 2
<i>Anochetus</i> sp.	X	
<i>Hypoponera</i> sp. 1	X	X
<i>Hypoponera</i> sp. 2	X	
<i>Hypoponera</i> sp. 3	X	
<i>Hypoponera</i> sp. 4	X	X
<i>Hypoponera</i> sp. 5	X	X
<i>Hypoponera</i> sp. 6	X	X
<i>Hypoponera</i> sp. 7	X	
<i>Hypoponera</i> sp. 8	X	X
<i>Hypoponera</i> sp. 9	X	
<i>Hypoponera</i> sp. 10	X	
<i>Odontomachus bauri</i>	X	X
<i>Odontomachus haematodus</i>	X	
<i>Pachycondyla laevigata</i>		X
<i>Pachycondyla striata</i>		X
<i>Pachycondyla unidentata</i>		X

From all captured Ponerinae species, some are known for promoting anaphylaxis in humans, especially those from the genus *Odontomachus* and *Pachycondyla*. Some ant species were captured along the months, even with few alate specimens. *Odontomachus bauri* Emery, for example was captured along 10 months, in all seasons, with peaks of reproductive specimens in spring and summer (Table 2).

*Odontomachus* species are often common and conspicuous insects. They are about 8 mm, with elongate mandibles (Deyrup and Cover, 2004). In spite of these formidable jaws, they have a sting strong enough to elicit a definitive reaction in humans. Urticaria was reported in Venezuela produced by a flying *O. bauri* (Rodríguez-Acosta and Reyez-Lugo, 2002).

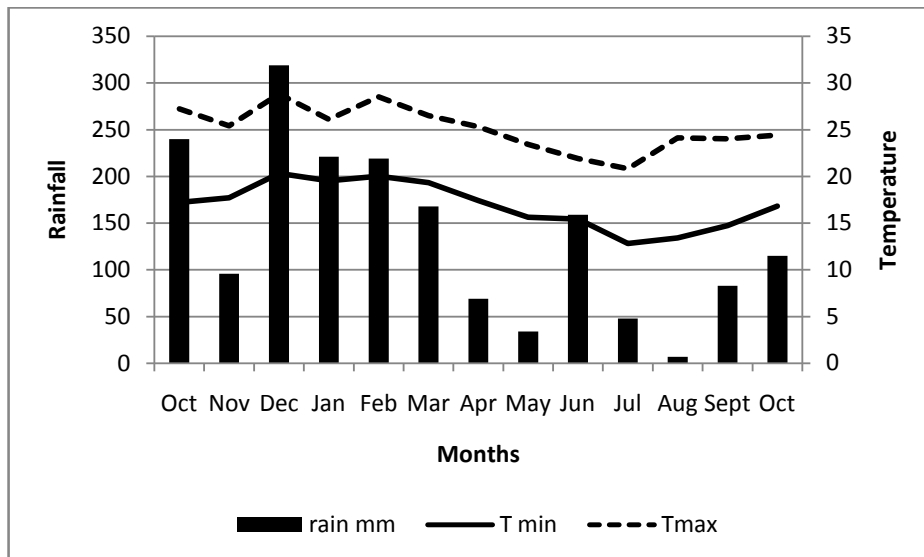
Alate specimens of *Pachycondyla* were not collected in site 1, but three *Pachycondyla* species were captured in site 2 (Table 1). The three species were collected in several months, but *P. striata* showed a peak of alate production in winter. *Pachycondyla laevigata* and *Pachycondyla unidentata* make nuptial flight in all seasons but alate specimens were collected throughout the year (Table 2). The light traps captured a high number of *P. striata* reproductive males and females (655 in August 2013 – Table 2). Silva-Melo and Gianotti (2010) excavated *P. striata* nests in Rio Claro, SP, 180 Km from the

**Table 2.** Number of alate specimens of Ponerinae ants collected with light traps, in two regions in São Paulo, Brazil, from October 2012 to October 2013.

Species	2012						2013						
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct
	Spring			Summer			Autumn			Winter			Spring
<i>Anochetus</i> sp.													
<i>Hypoponera</i> sp. 1													
<i>Hypoponera</i> sp. 2													
<i>Hypoponera</i> sp. 3													
<i>Hypoponera</i> sp. 4													
<i>Hypoponera</i> sp. 5													
<i>Hypoponera</i> sp. 6													
<i>Hypoponera</i> sp. 7													
<i>Hypoponera</i> sp. 8													
<i>Hypoponera</i> sp. 9													
<i>Hypoponera</i> sp. 10													
<i>Odontomachus bauri</i>													
<i>Odontomachus haematodus</i>													
<i>Pachycondyla laevigata</i>													
<i>Pachycondyla striata</i>						2		2		22	655	467	
<i>Pachycondyla unidentata</i>													
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct
	Spring			Summer			Autumn			Winter			Spring

city of São Paulo, and collected 80 males in one nest in April 2006. The high number of alate *P. striata* captured in the light traps indicate a synchronization of nuptial flights of several nests in São Paulo in the dry season (Figure 1). *P. striata* is one of the largest *Pachycondyla* species (Head Width > 2.8 mm), and known for their pugnacity with which they defend their nests, and their painful stings (Wild, 2002). The genus *Pachycondyla* is responsible for most cases of anaphylaxis (Klotz et al., 2005).

The species of *Hypoponera* varied their nuptial flights periods, from a few number of specimens captured for several months (*Hypoponera* sp. 1 and sp. 2), concentrating their flight activities in winter and summer (*Hypoponera* sp. 4) or in summer and autumn (*Hypoponera* sp. 5, sp. 6, sp. 7, sp. 8, and sp. 9) (Table 2). Members of the genus *Hypoponera* have a vast geographic range and are prevalent on a global scale (Wilson, 1976). Colonies are small (<100 individuals) and nest in soil or rotten wood (Wheeler and Wheeler, 1986). They are occasional pests because female winged reproductives may sting during their mating flights (Klotz et al. 2005). The captured *Hypoponera* alate specimens were 3.5 to 4.5 mm in length.



**Figure 1** – Temperature and rainfall in the city of São Paulo from October 2012 to October 2013.

## CONCLUSIONS

Data registered in this work help to comprehend the Ponerinae flight activities in the city of São Paulo and serve for the purpose of educating citizens for preventing Ponerinae stings. The most critical months are July to September, when the number of *P. striata* winged forms increases, and from October to February, in the peak of *O. bauri* alate production. Both species are known for their painful stings and for causing anaphylaxis in some humans.

The diversity of Ponerinae reproductive ants in the city is high and similar to surveys conducted in the Atlantic rain forest reservoir previously made by other authors. *Hypoponera* species were collected in the urban area, showing that even in a highly disturbed habitat like the city of São Paulo, such species can reproduce.

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