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An Improved Bait Method for Collecting Hymenoptera, especially Social Wasps (Vespidae: Polistinae)

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Método de Armadilha Melhorado para a Coleta de Hymenoptera, especialmente de Vespas Sociais (Vespidae: Polistinae)

RESUMO - Neste trabalho é proposto método para a captura de vespas sociais neotropicais nos mais diferentes habitats e que pode substituir os métodos comumente utilizados em levantamentos faunísticos de curto prazo. O método foi inicialmente testado em um fragmento de floresta estacional semidecidual no Noroeste do estado de São Paulo, obtendo sucesso na coleta de vespas sociais e também de outros grupos de Hymenoptera. Coletou um número maior de espécies e também maior abundância do que outros métodos utilizados na mesma área, como armadilhas Malaise, garrafas-armadilha e iscas de carne. O método desenvolvido baseou-se na proposta de Wille (1962), que utilizou uma solução atrativa, composta por água e mel, para a coleta de abelhas. Neste trabalho, substituiu-se o mel por açúcar e adicionou-se sal, obtendo sucesso na atração não apenas de vespas sociais, mas também de abelhas e vespas solitárias.

PALAVRAS-CHAVE: Diversidade, Epiponini, levantamento, floresta estacional semidecidual

ABSTRACT - In this work, an alternative method for the capture of neotropical social wasps is described, which may supplement or replace the procedures commonly used in wasp surveys. The method was tested in a seasonal semideciduous forest in the northwest of São Paulo State, collecting a larger number of species and a greater abundance of social wasps and of other Hymenoptera than other methods also used in the same area, namely Malaise traps, bottle traps and meat baits. The proposed method was adapted from Wille (1962) who used an attractive solution based on water and honey for bee attraction. In here, the attractive solution was based on water, salt and crystal sugar, and was effective in attracting bees and solitary wasps, but mainly social wasps, which is the group of interest for this report.

KEY WORDS: Diversity, Epiponini, survey, semidecidual seasonal forest

Neotropical social wasps belong to subfamily Polistinae, a group that includes 25 genera and more than 900 species, most numerous and diverse in tropical and subtropical regions (Richards 1971, 1978, Carpenter *et al* 1996). Several methods are commonly used to collect these wasps: Malaise traps (Silveira 2002) are flight-intercept traps; light traps (Neto 1995), which are useful in the collection of nocturnal wasps like the genus *Apoica*, the only Polistinae with nocturnal habits (Pickett & Wenzel 2007); carrion traps (O'Donnell 1995, Silveira *et al* 2005), which attract wasps through baits (pieces of meat beginning to putrefy), a method restricted in catching wasps with necrophagous habits, especially *Agelaiia* Lepelletier and *Angiopolybia* Araujo; active collecting on

flowers (Hermes & Köhler 2006, Silva-Pereira & Santos 2006); active search in a delimited area (Aguilar & Santos 2007, Elpino-Campos *et al* 2007, Santos *et al* 2007), which may be a transect or quadrant; bottle-traps, which contain attractive substances varying from alcohol to juices and fruit extracts; active search for nests (Lima *et al* 2000, Silveira 2002), although experience is necessary for finding nests or the help of local people who know the area, which may still exclude nests in localities difficult to access, such as high trees, or species with high camouflage ability (Wenzel 1998).

Wille (1962) introduced a method for the collection of bees in the jungles of the Pacific lowland in Costa Rica, by using an attractive honey water based solution at a 1:1

proportion. Other studies have also used this method for surveying bees in a variety of habitats (Salmah *et al* 1990, Roubik 1996, Liow *et al* 2001, Singapore & Eltz 2004). In here, we proposed a new bait-based method adapted from Wille (1962) for collecting social wasps.

Material and Methods

General description of the alternative method. The proposed method uses a 10 L dorsal spray bag, which contains the attractive solution composed of a water based solution of crystal sugar (sucrose – 200 g/l) and salt (sodium chloride – 25 g/l). Different proportions of salt and sugar were also preliminary tested as attractive solutions, but no differences were obtained in the diversity and abundance of attracted wasps. Therefore, the chosen proportion further used is an average of all tested proportions.

The attractive solution was sprayed in a transect of 200 m, using the spray bag at 10 points every 20 m. At each point, an average of 500 ml of solution was applied. The application was done following a zigzag pattern from left to right, generally applied on green vegetation, with solar incidence in an area of 3 m². It is important to note that after each day of collection, the spray bag must be cleaned

using water and sodium hypochlorite to prevent fungi proliferation, which may compromise performance and efficiency in later collections.

After the application of the attractive solution, each point was individually observed for five minutes and wasps which visited these points were collected with an entomological net. After collecting at the 10 points, the solution was applied again at every point. Four applications were made during the day, usually between the periods from 10:00h to 16:00h. To check the efficiency of this method, monthly collections were made in the period of September 2005 to December 2006.

Studied area and comparisons among methods. We used a fragment of semideciduous seasonal forest in northwestern State of São Paulo, in the Paulo de Faria city 19°58' S 49°31' O / 19°55' S 49°30' O (Fig 1). The new proposed method was compared to other methods for insect collection, such as i) Malaise trap (Silveira 2002), installed inside the forest, 100 m in parallel with the transect in which the attractive solution was sprayed on. The trap remained fixed until the end of the experiments; ii) a meat-based bait using pieces of fresh meat, usually a 15 cm bovine muscle beef deposited in a single point near the transect. The meat-based bait was observed for five minutes at the intervals between the

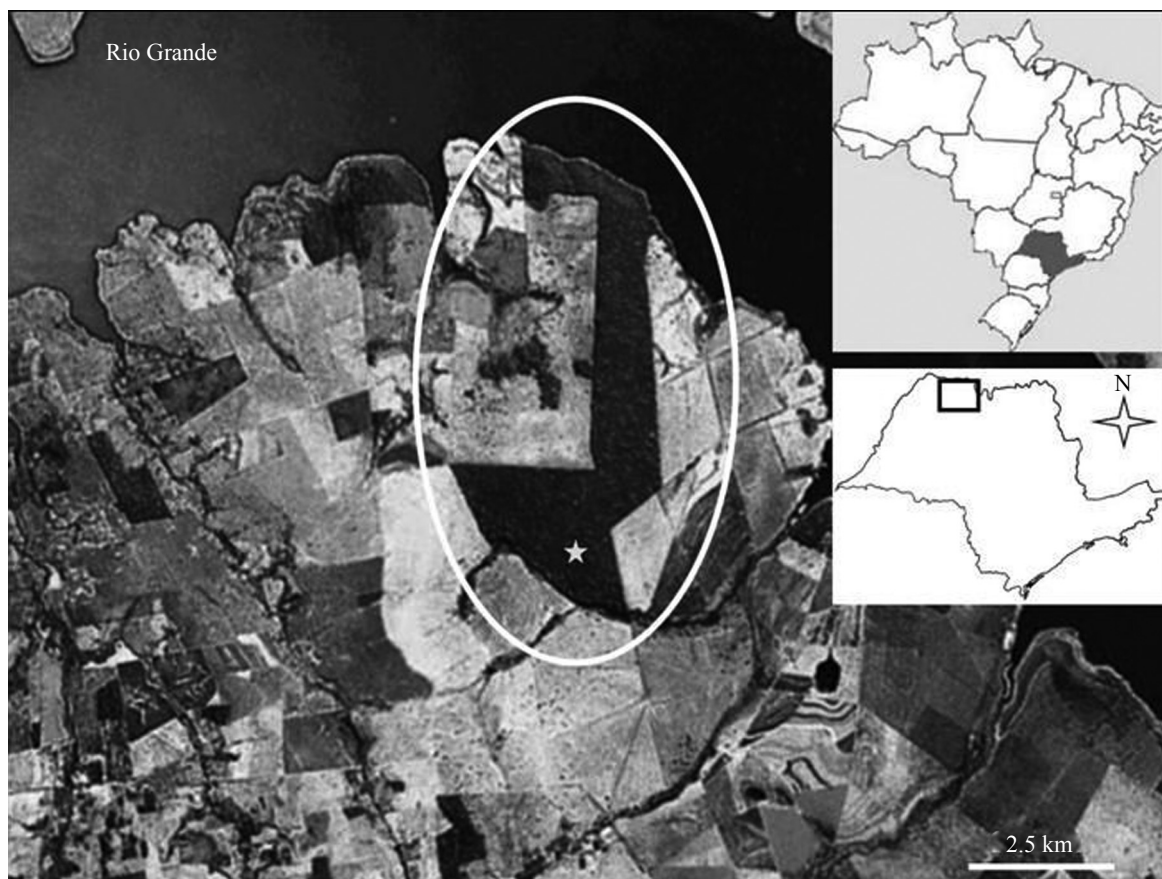


Fig 1 Satellite image (adapted from GoogleEarth 2006) indicating the studied area. The ellipse indicates the forest fragment and the star corresponds to the collecting area.

applications of the attractive solution. The wasps visiting the bait were collected with an entomological net; iii) bottle traps. The method was based on twelve bottles hung by a 3 m long steel thread. Each bottle had a 13 x 12 cm hole at the middle and was yellow colored on the inside and black on the outside with oil based paints. After the bottles were installed, they were filled with a 70% ethanol solution containing detergent.

All methods for comparison were performed in the interior of the fragment, and the passive methods were monthly collected from September 2005 to December 2006.

The species richness was estimated using the EstimateS 7 software (Colwell, 2004) by the ICE estimator (Incidence-based Coverage Estimator), which calculates the correction factor using the incidence of rare species (those found in up to 10 samples, Lee & Chao 1994), and the ACE estimator (Abundance-based Coverage Estimator), a correction factor using the abundance of species up to 10 individuals in the samples (Chao *et al.* 1993).

Results and Discussion

We collected seven species of social wasps with the attractive solution, two species with the meat bait and Malaise trap and three with bottle traps (Table 1). The new method collected not only social wasps, but also other groups of Hymenoptera, as solitary wasps and bees. It collected the greatest number of species and also in greater abundance, except in relation to solitary wasps that had the greater number of species and abundance in the Malaise trap (Fig 2). Eight species of bees were collected with the attractive liquid: *Apis mellifera* L. (6), *Ephantidium* sp. (2), *Euglossa* sp. (5), *Pseudaugochlora* sp. (13), *Tetragona clavipes* F. (8), *Tetragonisca angustula* L. (2), *Trigona spinipes* (F.) (5)

Table 1 Abundance of social wasps collected by using different sampling methods.

Species	Attractive solution	Meat bait	Bottle traps	Malaise
<i>Agelaia vicina</i> (de Saussure)	446	337	11	4
<i>A. pallipes</i> (Olivier)	80	12	1	1
<i>Polybia jurinei</i> (de Saussure)	46	0	1	0
<i>Polistes versicolor</i> (Olivier)	12	0	0	0
<i>Polybia ignobilis</i> (Haliday)	6	0	0	0
<i>Mischocyttarus rotundicollis</i> (Cameron)	6	0	0	0
<i>M. cerberus</i> (Richards)	4	0	0	0

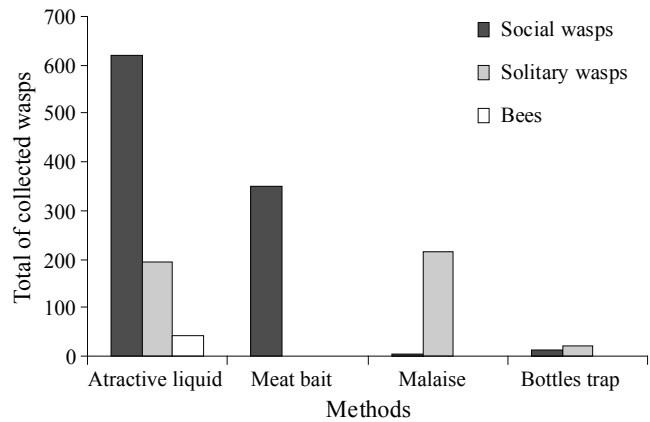


Fig 2 Efficiency of each method employed in relation to the abundance of social wasps, solitary wasps and bees collected.

and *Xylocopa* sp. (2). The bottle traps and the meat-based baits collected none, while the Malaise trap collected only *A. mellifera* (2). Other nine families of solitary wasps were attracted by the attractive solution (Table 2).

The period between 11:00h and 16:00h represented a suitable period for the employment of the attractive solution (Fig 3), collecting the largest number of wasps. If tested in other biomes, this method could presumably attract other groups of insects, as during the sampling period of this study we also observed a reasonable number of Diptera at the collection points (data not shown).

According to the diversity estimators, the collections with this method were suitable to estimate the species of the area, as the observed number of species overlapped with the calculated values of the incidence-based coverage estimator and the abundance-based coverage estimator starting from the eleventh sample (Fig 4). This method is probably more advantageous in surveying wasps because it has a lower cost if compared with methods using honey as an attractant (Wille 1962, Salmah *et al* 1990, Liow *et al* 2001, Eltz 2004).

Even though other methods may use comparable baits to collect social wasps (Santos 1996), polyethylene terephthalate

Table 2 Abundance of solitary wasp families collected using different sampling methods.

Families	Attractive liquid	Meat bait	Malaise	Bottle traps
Ichneumonidae	93	0	168	9
Braconidae	5	0	35	0
Eumeninae	61	0	6	12
Sphecidae	11	0	0	0
Chalcididae	4	0	0	0
Scoliidae	12	0	7	0
Mutillidae	2	0	0	0
Pompilidae	5	0	0	0
Tenthredinidae	2	0	0	0

(PET) bottles were used instead of active collections. The proposed method is advantageous in comparison with other methods as the spray of the attractant solution will increase the area of collection, and as a consequence it will decrease the time wasps take to find the baits. Another advantage is that different areas can be surveyed at the same time without the need of extra traps.

As a conclusion, the proposed alternative method proved to be effective in surveying social wasps in a semideciduous seasonal forest, compared to other methods simultaneously used in the same area. The alternative method collected the greatest number of species and also in greater abundance (Table 1) if compared with others methods, despite the low number of species collected. The reduced diversity of species presented in here is probably due to the fact that the studied area is located in one of the most degraded areas of the São Paulo State.

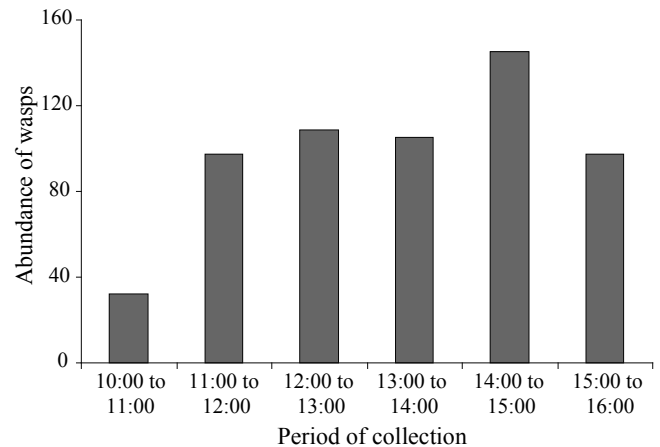


Fig 3 Daily periodicity of wasp collection with the attractive solution.

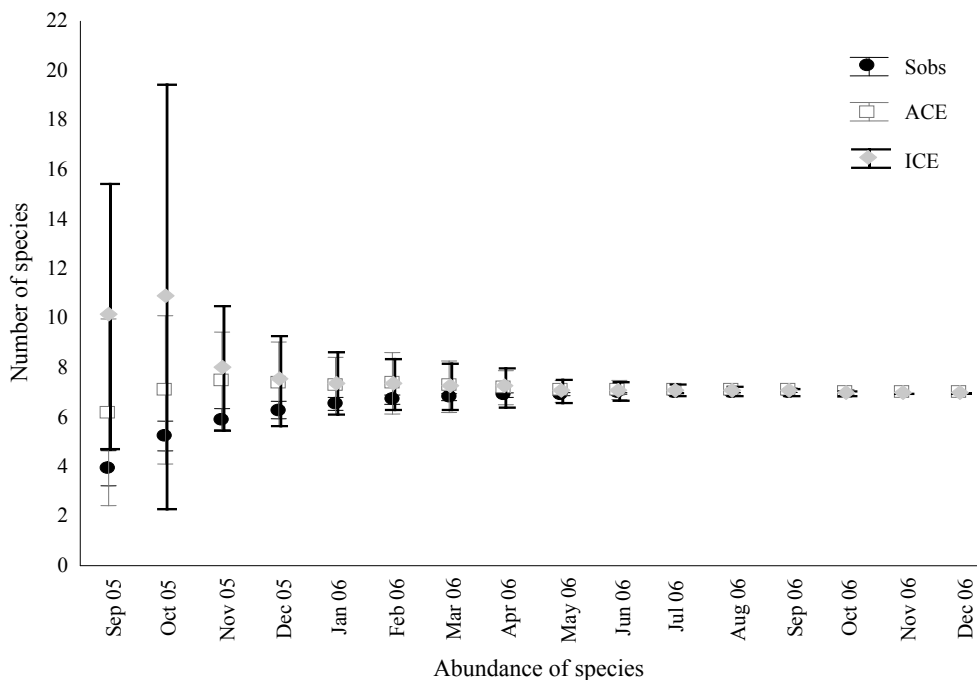


Fig 4 Richness of wasps observed (Sobs) and estimated by the “Abundance-Based Coverage Estimator” (ACE) and “Incidence-Based Coverage Estimator” (ICE) for 16 samples obtained at Paulo de Faria.

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