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Evaluating the efficiency of different sampling methods to survey social wasps (Vespidae: Polistinae) in an anthropized environment

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Abstract

Social wasps play important ecological roles, such as the natural biological control of other arthropods as well as major components of the flower-visiting insect guild. Despite many studies focusing on the survey of these organisms in Brazil, information on the community structure of polistines in anthropized environmets is still rare. The goals of the present study were: i) to survey the social wasp fauna in an anthropized area in the transition of Cerrado and Atlantic Forest; ii) to investigate the efficiency of two sampling methods, namely active search for wasps and the use of attractive traps; iii) to investigate the performance of different attractive baits in the capture success of social wasps in the study area. Sampling of social wasps was conducted by actively searching for individuals and by using attractive traps. A total of 40 species was recorded, with *Agelaia multipicta* and *Agelaia vicina* species being the most frequently collected with attractive traps and *Mischocyttarus cassununga* by actively searching for wasps. In all analyses performed (except when comparing abundance of social wasps considering the molasses bait and the active search), actively searching for wasps was the best method. This is also highlighted by the fact that the time spent actively capturing polistines was considerably lower than the time (and costs) that the traps were left in the field. Active search, as demonstrated by previous studies, remains as the best capturing methodology when surveying Neotropical social wasps, either in natural or anthropized environments.

Introduction

Social wasps occurring in Brazil belong to the cosmopolitan Polistinae, which are particularly speciose in the Neotropics (Silveira, 2002). Three polistine tribes are found in Brazil, with totals for the subfamily counting to as much as 21 genera and 343 species (Hermes et al., 2017), corresponding to approximately 35% of the world fauna (Prezoto et al., 2007).

Environmental structure directly affects the social wasp fauna (Santos et al., 2007), since some species will only nest under specific vegetational conditions, such as shape and size of the leaves, trunk diameter and presence of thorns (Cruz et al., 2006). However, several species are highly sinantropic, nesting preferably in urban environments (Michelutti et al., 2013; Oliveira et al., 2017) due to higher prey and protected nesting site availability (Prezoto et al., 2007).

Human disturbance, such as direct colony destruction, excessive use of insecticides (Souza et al., 2012), and forest fragmentation strongly decrease nesting possibilities (Souza et al., 2010; Souza et al., 2014b). Also, some species are sensitive to changes in abiotic factors (luminosity, temperature and humidity) that may be related to environmental degradation, making them good indicators of environmental quality (Souza et al., 2010). In this context, biological surveys are essential to support conservation actions and programs (Elpino-Campos et al., 2007). Since polistines are easily surveyed in tropical

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systems and are active during all seasons, and may be sampled in a short period of time (Kumar et al., 2009), their study in a conservationist perspective is strongly recommended.

There are a large number of studies on the diversity of social wasps in the last ten years (Barbosa et al., 2016; Souza et al., 2017), although there is still no standard in the duration of the study and methodology of data collection. The date of studies ranges from a few days to 144 months, with 12 months being the most usual (Barbosa et al., 2016). For the collection methodology, there are several forms of capture such as the active search and the attractive traps, Malaise, Möerick and light traps (Silva & Silveira, 2009; Jacques et al., 2015; Gradinete & Noll, 2013; Locher et al., 2014; Souza et al., 2015), but most studies use active search and attractive traps together (Barbosa et al., 2016). This wide variety of methodologies and study time hampers the comparative analyzes between the different studies.

In relation to the attractive traps, there is a great diversity of baits used as juices of mango, guava, passion fruit and orange, sardine stock and honey. This diversity of baits occurs mainly due to the lack of a study that tests the efficiency of the best bait for this method. In addition, there is a wide variation in the amount, arrangement and duration of the traps (Souza & Prezoto, 2006; Elpino-Campos et al., 2007; Jacques et al., 2015; Locher et al., 2014). The standardization of this methodology would optimize the time and monetary costs to establish these traps in the field.

Most of studies dealing with community structure of social wasps carried out in Brazil are focused in natural environments (Silveira, 2002; Silva-Pereira & Santos, 2006; Souza & Prezoto, 2006; Elpino-Campos et al., 2007; Santos et al., 2007; Silveira et al., 2008; Gomes & Noll, 2009; Silva & Silveira, 2009; Santos et al., 2009; Arab et al., 2010; Prezoto & Clemente, 2010; Souza et al., 2010; Bonfim & Antonialli Junior, 2012; Simões et al., 2012; Souza et al., 2012; Gradinete & Noll, 2013; Locher et al., 2014; Souza et al., 2014a, 2014b; Togni et al., 2014; Somavilla et al., 2014, 2015; Souza et al., 2015; Brunismann et al., 2016; Elisei et al., 2017). The polistine fauna of anthropized areas, however, is still poorly investigated (Jacques et al., 2012, 2015; Oliveira et al., 2017). With that in mind, the goals of the present study are: i) to survey the social wasp fauna in an anthropized area in the transition of Cerrado and Atlantic Forest in Southern Minas Gerais, Brazil; ii) to investigate the efficiency of two sampling methods, namely active search for wasps and the use of attractive traps; and iii) to investigate the performance of different attractive baits in the capture success of social wasps in the study area.

Material and Methods

The study was conducted in the Federal University of Lavras (UFLA), Lavras, Minas Gerais, Brazil, which is located at 21º 14' 30" S and 45º 00' 10" W. The altitude is approximately 918 m above sea level and the climate is characterized as Cwa Köppen, with rainy summers and dry winters. The mean annual pluviosity is 1,411 mm and the mean annual temperature is 19.3 ºC.

The university´s campus has a total area of 508 ha, which is highly anthropized, with 117 ha of urban settlements and 207 ha of crops. From the remaining 184 ha, only 33.23 ha comprehend Atlantic Forest and Cerrado fragments. Collecting of social wasps in the study area was conducted from April 2014 to June 2015, by actively searching for individuals and with the aid of attractive traps.

Active searches for wasps were conducted in the entire area of the campus, totaling 14 field incursions of five hours each, totaling 70 hours of sampling effort (two collectors = 140 hours). Flowering plants, logs, vegetation close to lakes, and buildings were inspected and the wasps collected with entomological nets (Souza & Prezoto, 2006; Elpino-Campos et al., 2007).

Attractive traps were made using plastic bottles with three triangular openings (2 x 2 x 2 cm) at approximately 10 cm from the base (Souza & Prezoto, 2006). Four types of attractive baits were used: a) natural passion fruit juice (*Passiflora edulis* f. *flavicarpa* Deg.) prepared with 1 kg of fruit blended with 250g granulated sugar plus two liters of water; b) sardine stock, using two sardine cans mixed with two litters of water (Souza & Prezoto, 2006); c) pure honey; and d) 50% diluted sugar cane molasses (Jacques et al., 2015).

The traps were installed in seven different fragments of the forest remnants inside the campus, with 150 ml attractive substance placed in eight bottles each, totaling 32 traps per fragment. The traps were placed at 1.5 m from the ground and at 10 m apart from each other (Fig 1). The traps stayed in the field for seven days, when the wasps were removed and preserved in 70% alcohol. Social wasps were identified to species level using keys (Richards, 1978; Carpenter, 2004) and by specialists (Dr. James M. Carpenter, AMNH, and MGH and MMS coauthors of the study).

The diversity of wasps was calculated with the Shannon-Wiener (H') index and the dominance with the Berger-Parker (D_{pb}) index, using the software Past (Hammer et al., 2005). To evaluate sampling effort success we constructed species accumulation curves using the observed richness with a 95% confidence interval, under the Bootstrap 1 estimator in the software EstimateS 9.1.0 (Cowell, 2013). This estimator uses information from all collected species instead of restricting the analysis to rare species (Santos, 2003).

To test which bait was more successful regarding species richness and abundance, generalized linear mixed models (GLMM) were performed assuming sampling date as the random variable, reducing the effects of sampling and repeated measures, and the different baits and active search as explicative variables. Lastly, Tukey contrast analyses with Bonferroni correction (i.e., multiple comparisons of means) were employed as pairwise comparisons. Poisson errors distribution was assumed for both models and statistical analyses were performed using the software R (R Development CoreTeam, 2017).

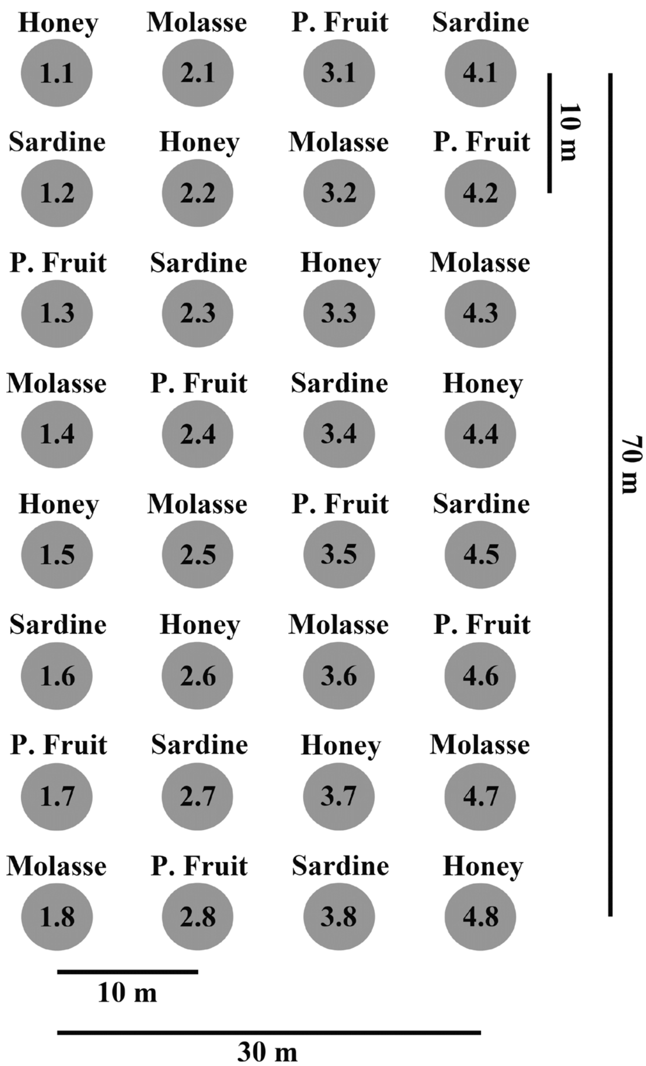

Fig 1. Distributional scheme of the attractive bait-traps used in the present study.

Results and Discussion

A total of 11 genera and 40 species of social wasps was collected during the study, with a total diversity index of 2.495 (Table 1). The present collecting effort resulted in the fifth highest Polistine richness considering similar studies in Brazil (Table 2) (Barbosa et al., 2016), only behind those conducted in the Amazon (Silveira, 2002; Silva & Silveira, 2009; Somavilla et al., 2014; Somavilla et al., 2015). The high richness found herein may be a result of the high sinantropic affinity presented by several social wasp species (Michelutti et al., 2013; Oliveira et al., 2017), despite colony development and productivity being negatively affected by the urban environment (Michelutti et al., 2013; Torres et al., 2014). However, nesting in buildings reduces interspecific competition, predation by vertebrates, and offers better protection against climatic adversities (McGlynn, 2012; Michelutti et al., 2013).

Another factor that may contribute to a higher richness of social wasps in urban areas is likely a methodological one, because dense vegetation and nest camouflage will certainly difficult sampling when actively searching for these insects inside forests (Souza et al., 2010). Also, the environmental structure of the study area is highly complex and heterogeneous, with human constructions, crops, and Atlantic Forest and Cerrado fragments, which may favor coexistence of a higher number of species due to a greater offering of microhabitats and resources, as well as nesting materials and substrates (Santos et al., 2007; Souza et al., 2012).

A high dominance of only few species was observed. *Agelaia vicina* de Sausurre and *Agelaia multipicta* (Haliday) were the most frequent species when considering only the attractive traps (40.16% and 23.0%, respectively). Some species of *Agelaia* are necrophagous, and were captured with the sardine stock in the present study, which may be used as an additional proteic resource offered to the larvae (Souza & Prezoto, 2006). Also, they may establish colonies with up to one million adults (Zucchi et al., 1995), which provides an enhanced foraging capacity and, consequently, better chances for one to capture specimens of *Agelaia* (Hunt et al., 2001). A high abundance of this taxon have already been reported in several studies in Brazil (Gomes & Noll, 2009; Arab et al., 2010; Jacques et al., 2012; Gradinete & Noll, 2013; Locher et al., 2014; Togni et al., 2014; Jacques et al., 2015).

Another species that was frequently trapped was *Polybia fastidiosuscula* Saussure, with 10.53% of relative frequency. Since the traps were placed inside Atlantic Forest fragments, the occurrence of this taxon may indicate a good conservation status of this area (Souza et al., 2010). Despite occurring in different biomas and altitudes (Souza et al., 2010, Albuquerque et al., 2015), *P. fastidiosuscula* is particularly dominant above 1,500 meters high (Souza et al., 2015).

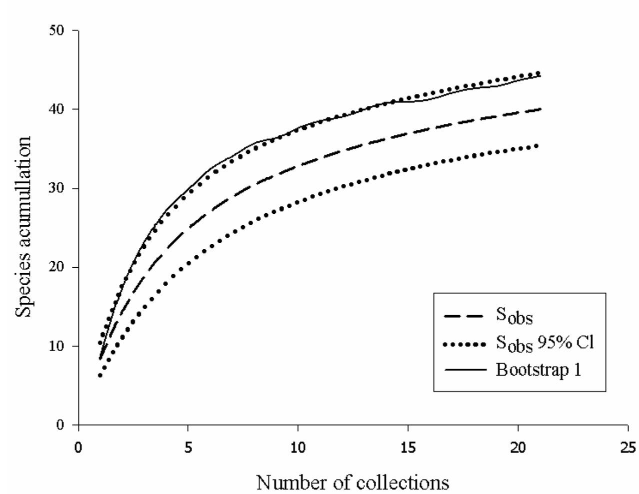

Fig 2. Species accumulation curve for social wasps collected at anthropized environment using the observed species richness within a 95% confidence interval and the estimated species richness (Bootstrap 1).

Table 1. Richness, diversity and dominance of social wasp species collected at anthropized environment.

Taxon	Active Search		Attractive Traps		Totals	
	Nº of individuals	Frequency (%)	Nº of individuals	Frequency (%)	Nº of individuals	Frequency (%)
Agelaia centralis (Cameron)	2	0.85	0	0.00	2	0.18
Agelaia multipicta (Haliday)	1	0.42	201	23.00	202	18.20
Agelaia vicina de Saussure	1	0.42	351	40.16	352	31.71
Apoica pallens (Fabricius)	5	2.12	9	1.03	14	1.26
Brachygastra lecheguana (Latreille)	3	1.27	3	0.34	6	0.54
Clypearia augustior (Ducke)	2	0.85	0	0.00	2	0.18
Mischocyttarus ignotus Zikán	9	3.81	4	0.46	13	1.17
Mischocyttarus cassununga (R. Von. Ihering)	68	28.81	3	0.34	71	6.40
Mischocyttarus drewseni de Sausurre	3	1.27	5	0.57	8	0.72
Mischocyttarus paraguayensis de WillinK	3	1.27	0	0.00	3	0.27
Mischocyttarus labiatus Fabricius	5	2.12	6	0.69	11	0.99
Mischocyttarus rotundicolis (Cameron)	1	0.42	0	0.00	1	0.09
Mischocyttarus socialis (de Saussure)	1	0.42	3	0.34	4	0.36
Mischocyttarus sp.	2	0.85	0	0.00	2	0.18
Parachartergus fraternus (Griboldo)	1	0.42	0	0.00	1	0.09
Polistes actaeon Haliday	1	0.42	0	0.00	1	0.09
Polistes billardieri (Fabricius)	3	1.27	0	0.00	3	0.27
Polistes cinerascens (de Saussure)	1	0.42	0	0.00	1	0.09
Polistes ferreri (de Saussure)	1	0.42	4	0.46	5	0.45
Polistes pacificus Fabricius	1	0.42	0	0.00	1	0.09
Polistes simillimus Zikán	19	8.05	0	0.00	19	1.71
Polistes subsericius (de Saussure)	3	1.27	0	0.00	3	0.27
Polistes versicolor (Olivier)	8	3.39	3	0.34	11	0.99
Polybia bifasciata de Saussure	5	2.12	46	5.26	51	4.59
Polybia bistriata (Fabricius)	5	2.12	32	3.66	37	3.33
Polybia chrysothorax (Lichtenstein)	2	0.85	7	0.80	9	0.81
Polybia fastidiosuscula (de Saussure)	8	3.39	92	10.53	100	9.01
Polybia ignobilis (Haliday)	5	2.12	3	0.34	8	0.72
Polybia jurinei de Saussure	1	0.42	3	0.34	4	0.36
Polybia minarum (Ducke)	1	0.42	25	2.86	26	2.34
Polybia occidentalis (Olivier)	12	5.08	19	2.17	31	2.79
Polybia paulista (R. Von. Ihering)	1	0.42	0	0.00	1	0.09
Polybia platycephala (Richards)	1	0.42	11	1.26	12	1.08
Polybia punctata du Buysson	2	0.85	35	4.00	37	3.33
Polybia quadrincicta de Saussure	2	0.85	0	0.00	2	0.18
Polybia scutellaris (White)	14	5.93	0	0.00	14	1.26
Polybia sericea (Olivier)	1	0.42	0	0.00	1	0.09
Protonectarina sylveirae (de Saussure)	6	2.54	5	0.57	11	0.99
Protopobybia sedula (de Saussure)	22	9.32	0	0.00	22	1.98
Synoeca cyanea (Fabricius)	4	1.69	4	0.46	8	0.72
Individual totals	236		874		1110	
Species richness (S`)	40		23		40	
Shannon-Wiener Index (H`)	2.871		1.956		2.495	
Berger-Parker Index (D_{pb})	0.288		0.4016		0.3171	

Mischocyttarus cassununga (R. Von. Ihering) was the most sampled species by actively searching for these insects. It is a highly sinathropic taxon easily found nesting in human buildings (Jacques et al., 2012; Oliveira et al., 2017). This nesting behavior may have been adopted to avoid competition for resources with other social wasps, for an anthropized environment that harbor various crops may offer a considerable amount of prey itens (Prezoto et al., 2007).

The species accumulation discovery depicted in Fig 2 (S_{obs} = 40) shows that the species curve tends to an asymptote. Also, the estimated number of species (Bootstrap 1 – 44.21) lies inside the confidence interval of 95%, showing that our sampling effort was sufficient. Despite the fact that the monthly active collecting effort may be considered low (ten hours per month), sampling throughout an entire year yelded results that may be considered a good approximation of the real biotic diversity within the study area (Barbosa et al., 2016).

Table 2. Polistinae richness comparison among studies carried out in different ecological systems in Brazil.

Authors	Ecological systems	Species richness
Silveira, 2002	Amazon	79
Silva & Silveira, 2009	Amazon	65
Somavilla et al., 2014	Amazon	58
Somavilla et al., 2015	Amazon	49
Present Study	Anthropized Environment	40
Souza et al., 2014a	Cerrado	38
Souza & Prezoto, 2006	Cerrado and Semidecidual Forest	38
Souza et al., 2010	Riparian Forest	36
Brunismann et al., 2016	Semidecidual Forest	35
Souza et al., 2015	Semidecidual Forest	34
Simões et al., 2012	Cerrado	32
Locher et al., 2014	Riparian Forest	31
Jacques et al., 2015	Agroecosystem	29
Elpino-Campos et al., 2007	Cerrado	29
Souza et al., 2014b	Riparian Forest	28
Jacques et al., 2012	Anthropized Environment	26
Prezoto & Clemente, 2010	Rock Field	23
Gradinete & Noll, 2013	Cerrado	22
Togni et al., 2014	Atlantic Forest	21
Santos et al., 2009	Cerrado	19
Bonfim & Antonialli Junior, 2012	Riparian Forest	18
Santos et al., 2007	Atlantic Forest	18
Oliveira et al., 2017	Anthropized Environment	18
Santos et al., 2007	Restinga	16
Auad et al., 2010	Grazing System	13
Silva-Pereira & Santos, 2006	Rock Field	11
Elisei et al., 2017	Caatinga	10
Arab et al., 2010	Atlantic Forest	10
Santos et al., 2007	Mangrove	8
Gomes & Noll, 2009	Semidecidual Forest	7

All species captured by attractive traps were also sampled through active search (compare Table 1 and Table 3), highlighting the efficiency of this method. It is by far the most widely used sampling method to survey social wasps and the one with the higher sampling success regarding exclusive species (a species recorded by only one method) (Barbosa et al., 2016; Maciel et al., 2016), with a total of 17 exclusive species sampled herein. Although, the use of other methodologies may reveal sampling success of exclusive species as well, for some have been exclusively recorded by other methods such as attractive traps (e.g. Souza & Prezoto, 2006; Elpino-Campos et al., 2007; Jacques et al., 2012; Loucher et al., 2014; Souza et al., 2014b; Jacques et al., 2015). Also, important ecological and phenological information may be gathered by using different approaches to access community structure.

Several kinds of attractive baits have been used to access social wasp species richness, such as natural and industrialized fruit juices (passion fruit, orange, guava, mango, pineapple), honey and sardine stock (Barbosa et al., 2016; Maciel et al., 2016). This bait diversity may be a result of the lack of studies testing the efficiency of each of these attractions, which may vary depending on the environmental conditions as well (Souza et al., 2012; Souza et al., 2015). In the present study, species abundance recovered by the four baits and by active search were consistently different, demonstrating that active search was the most effective collecting method, followed by molasses, honey, sardine and passion fruit juice (Table 4, Fig 3). Species richness also presented similar outcomes as ascribed for abundance (Table 5, Fig 4). Finally, Table 6 depicts contrast analyses comparing each collecting method in a pairwise way, revealing that only abundance retrieved by active search versus the use of molasses bait have not shown statistical differences. In all other cases (species abundance and richness), actively searching for social wasps was the most effective collecting methodology.

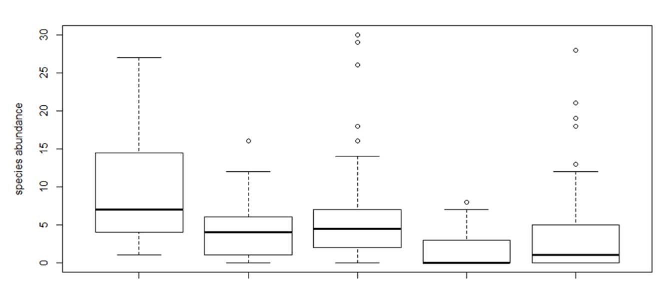

Fig 3. Abundance of individuals of social wasps attracted by different baits and active search.

Table 3. Richness, diversity and dominance of social wasp species collected with different attractive baits at anthropized environment.

Taxon	Honey		Molasses		Sardine		Passion Fruit Juice	
	Nº of individuals	Frequency (%)	Nº of individuals	Frequency (%)	Nº of individuals	Frequency (%)	Nº of individuals	Frequency (%)
Agelaia multipicta (Haliday)	43	18.30	57	16.86	85	42.08	16	16.16
Agelaia vicina de Saussure	73	31.06	130	38.46	109	53.96	39	39.39
Apoica pallens (Fabricius)	4	1.70	5	1.48	0	0.00	0	0.00
Brachygastra lecheguana (Latreille)	0	0.00	3	0.89	0	0.00	0	0.00
Mischocyttarus ignotus Zikán	1	0.43	3	0.89	0	0.00	0	0.00
Mischocyttarus cassununga (R. Von. Ihering)	1	0.43	2	0.59	0	0.00	0	0.00
Mischocyttarus drewseni de Sausurre	2	0.85	3	0.89	0	0.00	0	0.00
Mischocyttarus labiatus Fabricius	0	0.00	6	1.78	0	0.00	0	0.00
Mischocyttarus socialis (de Saussure)	1	0.43	1	0.30	0	0.00	1	1.01
Polistes ferreri (de Saussure)	2	0.85	2	0.59	0	0.00	0	0.00
Polistes versicolor (Olivier)	1	0.43	2	0.59	0	0.00	0	0.00
Polybia bifasciata de Saussure	22	9.36	18	5.33	0	0.00	6	6.06
Polybia bistriata (Fabricius)	12	5.11	12	3.55	2	0.99	6	6.06
Polybia chrysothorax (Lichtenstein)	5	2.13	2	0.59	0	0.00	0	0.00
Polybia fastidiosuscula (de Saussure)	27	11.49	48	14.20	2	0.99	15	15.15
Polybia ignobilis (Haliday)	1	0.43	1	0.30	0	0.00	1	1.01
Polybia jurinei de Saussure	0	0.00	0	0.00	0	0.00	3	3.03
Polybia minarum (Ducke)	10	4.26	10	2.96	3	1.49	2	2.02
Polybia occidentalis (Olivier)	8	3.40	9	2.66	0	0.00	2	2.02
Polybia platycephala (Richards)	4	1.70	5	1.48	0	0.00	2	2.02
Polybia punctata du Buysson	16	6.81	16	4.73	1	0.50	2	2.02
Protonectarina sylveirae (de Saussure)	1	0.43	0	0.00	0	0.00	4	4.04
Synoeca cyanea (Fabricius)	1	0.43	3	0.89	0	0.00	0	0.00
Individual totals	235		338		202		99	
Species richness (S`)	20		21		6		13	
Shannon-Wiener Index (H`)	2.193		2.084		0.8773		1.931	
Berger-Parker Index (D_{pb})	0.3106		0.3846		0.5396		0.3939	

Sugar cane molasses is still a poorly explored attractive bait in studies surveying polistine wasps (Jacques et al., 2015), but as shown above, was the most effective regarding species composition with 21 out of 23 taxa collected by traps. On the other hand, passion fruit juice traps captured only 13 species, with only one being exclusive to this attractive. Sardine stock is a widely used attractive, with 71% os the studies conducted in the state of Minas Gerais making use of this product (Maciel et al., 2016). However, almost all abundance and species richness captured by this attractive belong to only two species, *A. multipicta* and *A. vicina*, since these exhibit necrophagous habits (Souza & Prezoto, 2006). Finally, when monetary values are compared, sugar cane molasses is a cheaper product when compared to honey, for example, which allied to its efficiency in the capture of social wasps makes it an ideal attractive bait for studies of this nature.

Table 4. General linear mixed models on social wasps species abundance and different attractive baits and active search.

Fixed effect	*Species abundance*			
Coefficients	***Estimate***	***Std. Error***	***z-value***	***Pr(>|z|)***
(Intercept)	2.2878	0.1464	15.628	<0.001
Passionfruit	-1.8556	0.2594	-7.152	<0.001
Honey	-0.9793	0.2476	-3.955	<0.001
Molasses	-0.6162	0.2450	-2.515	<0.05
Sardine	-1.0880	0.2486	-4.376	<0.001
Random effects				
Group			***Variance***	***Std. Dev.***
Sampling date	(intercept)		0.2475	0.4975

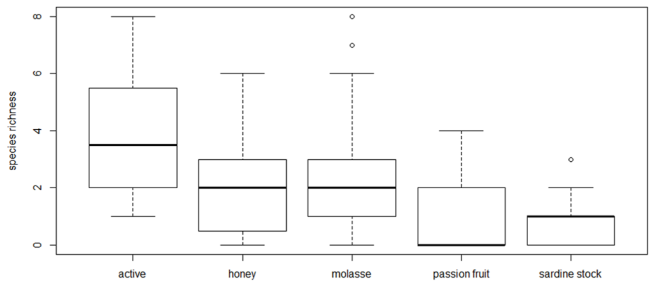

Fig 4. Social wasps species richness attracted by different baits and active search.

Surveying organisms that may be influenced by anthropogenic activity provides the most valuable information when indicating priority areas for conservation. Furthermore, when these organisms are easily accessible and sampled in a fast and efficient way, studies may be conducted within a reasonable amount of time. This is the case of Neotropical social wasps. It is clear by our results that actively searching for polistines is far superior than using attractive baits: two collectors spent a total of 140 hours in the field, while traps remained in the field for a total of 1,176 hours (summing up all trap hours individually). All our analyses recovered active searching for wasps as the best method regarding species richness and abundance, despite using a somewhat more efficient and affordable attractive bait (sugar cane molasses).

Table 5. General linear mixed models on social wasps species richness and different attractive baits and active search.

Fixed effect		*Species richness*		
Coefficients	***Estimate***	***Std. Error***	***z-value***	***Pr(>|z|)***
(Intercept)	1.3443	0.1188	11.313	<0.001
Passionfruit	-1.6397	0.2187	-7.496	<0.001
Honey	-0.7325	0.1854	-3.951	<0.001
Molasses	-0.5640	0.1816	-3.106	<0.01
Sardine	-1.6397	0.2187	-7.496	<0.001
Random effects				
Group		***Variance***		***Std. Dev.***
Sampling date	(intercept)	0.07649		0.2766

Another factor that may affect our understanding of the real efficiency of attractive traps is that most studies conducted in Brazil make use of different kinds of baits (Maciel et al., 2016). Also, field hours differ abruptly among analyzed studies. Since no real statistical comparison among baits and field hours used in different studies may be accomplished, active searching for Neotropical social wasps remains as the best surveying method for this group of organisms, as indicated by Silveira (2002).

Table 6. Abundance and species richness contrast analyses (Tukey test) among active search and baits.

	Contrast analyses (Tukey test)		
Abundance	***p-value***	**Richness**	***p-value***
Active X Honey	<0.05	Active X Honey	<0.001
Active X Molasses	=0.58	Active X Molasses	<0.05
Active X Passion Fruit	<0.001	Active X Passion Fruit	<0.001
Active X Sardine	<0.01	Active X Sardine	<0.001
Honey X Molasses	=1.00	Honey X Molasses	=1.00
Honey X Passion Fruit	<0.01	Honey X Passion Fruit	<0.001
Honey X Sardine	=1.00	Honey X Sardine	<0.001
Molasses X Passion Fruit	<0.001	Molasses X Passion Fruit	<0.001
Molasses X Sardine	=0.183	Molasses X Sardine	<0.001
Passion Fruit X Sardine	<0.05	Passion Fruit X Sardine	=1.00

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