



Nesting of social wasps (Hymenoptera: Vespidae) in a riparian forest of rio das Mortes in southeastern Brazil

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ABSTRACT. The survival of social wasp species depends on the success in founding new nests. These species can use plant species with different specific characteristics for nesting, with nest architecture varying according to the habits of those plant species. The nesting of social wasps in natural environments was studied in the period from October 2005 to September 2007 in the rio das Mortes riparian forest, municipal district of Barroso, Minas Gerais State, Brazil, with the objective of evaluating the different types of plant substrate used by social wasps for nesting, and to investigate whether there is a relationship between nest construction type and the habits of plant species. A total of 171 colonies of social wasps belonging to 29 species were recorded, which used 78 plant species as nesting substrate (76 Angiosperms and two Pteridophytes) of arbustive, herbaceous, arboreal, epiphyte and liana habits. Species with phragmocyttarus and gymnodomous nests were observed nesting, with higher incidence, in arboreal plants and their deciduousness did not affect the nesting. The preservation of natural areas is suggested in order to guarantee a higher availability of nesting places for the social wasp species, ensuring their higher efficiency in the environmental services and biological control of agricultural pests.

Keywords: colonies, angiosperms, phragmocyttarus nest, social insects, nest architecture.

Nidificação de vespas sociais (Hymenoptera: Vespidae) em floresta ripária do rio das Mortes no Sudeste do Brasil

RESUMO. A sobrevivência das espécies de vespas sociais depende do sucesso na fundação de novos ninhos. Essas espécies podem utilizar para nidificação de diferentes espécies vegetais com características específicas, com a arquitetura dos ninhos que variam em relação aos hábitos dessas espécies vegetais. A nidificação de vespas sociais em ambiente natural foi estudada no período de outubro de 2005 a setembro de 2007 em uma floresta ripária do rio das Mortes, município de Barroso, Estado de Minas Gerais, Brasil, com o objetivo de avaliar os diferentes tipos de substratos vegetais utilizados por vespas sociais para nidificação, e investigar se há relação entre o tipo de construção dos ninhos com os hábitos das espécies vegetais. Foram registradas 171 colônias de vespas sociais pertencentes a 29 espécies, que utilizaram como substrato de nidificação 78 espécies vegetais (76 Angiospermas e 2 Pteridófitas) de hábitos arbustivo, herbácea, arbóreo, epífita e liana. Espécies com ninhos fragmocítaros e giminódomos nidificaram, com maior incidência, em plantas arbóreas e a deciduidade das mesmas não afetou a nidificação. Sugere-se a preservação das áreas naturais de modo a garantir maior disponibilidade de locais de nidificação para as espécies de vespas sociais, assegurando maior eficiência nos serviços ambientais e no controle biológico de pragas na agricultura.

Palavras-chave: colônias, angiospermas, ninho fragmocítaro, insetos sociais, arquitetura de ninhos.

Introduction

The survival of social wasp species depends on their success in founding new colonies (DEJEAN et al., 1998; HUNT, 2007; JEANNE, 1975). The selection of nesting places, along with nest architecture, was developed under the influence of at least two types of selection pressure: climatic conditions and predation by ants and vertebrates

(JEANNE, 1970, 1975; CORBARA et al., 2009). To avoid those situations, the choice of nesting place in specific plant species depends on certain morphological or physiological characteristics (JEANNE, 1991; CORBARA et al., 2009), which provide the nest substrate (CORBARA et al., 2009), glucose resources (PEREIRA; SANTOS, 2006; SANTOS et al., 2006, 2010; SOUZA et al., 2010),

hunting area (PREZOTO et al., 2006) and material for nest construction (ANDENA et al., 2009).

The social wasps species build different types of nests, which vary in their architecture based on the types of substrate used (HUNT; CARPENTER, 2004; JEANNE, 1975; SMITH et al., 2001; WENZEL, 1991, 1998). These nests can be classified as: stelocytarus, gymnodomous, astelocytarus and phragmocytarus (RICHARDS; RICHARDS, 1951; ALVARENGA et al., 2010).

The first is formed by one or more combs attached to the substrate by a peduncle, with or without a protective envelope: gymnodomous nests do not possess an envelope (a plesiomorphic condition found of *Mischocyttarus* spp. Saussure, 1853, *Polistes* spp. Latreille, 1802, *Agelaia* spp. Lepeletier, 1836 and *Apoica* spp. Lepeletier 1836), and the *calyptodome* possess this envelope (*Pseudopolybia* spp. Saussure, 1863 and *Parachartergus* spp. R. von Ihering 1904) (ANDENA et al., 2009; SOUZA; ZANUNCIO, 2012; WENZEL, 1991, 1998).

Astelocytarus nests possess a single comb, with a protective envelope and the cells attached directly to the substrate (*Synoecca* spp. Saussure, 1852 and *Metapolybia* spp. Ducke, 1905) (ANDENA et al., 2009). In phragmocytarus nests, the initial comb is largely attached to the protective envelope and subsequent combs are built in contact with the sides of the previous comb (*Polybia* spp. Lepeletier, 1836 and *Brachygastra* spp. Perty, 1833) (ANDENA et al., 2009; WENZEL, 1991, 1998).

Riparian Forests are formations in the margins of rivers, ponds, streams and springs, comprised of the most varied plant formations (RODRIGUES; LEITÃO-FILHO, 2004). Those environments are of great importance as habitats and food sources for aquatic and terrestrial fauna, as they act as ecological corridors, thus being fundamental for biodiversity maintenance (CARVALHO et al., 2005; RODRIGUES; LEITÃO-FILHO, 2004). However, due to fragmentation and the introduction of monocultures, that environment is highly threatened, with various species of flora and fauna in danger of extinction (RODRIGUES; LEITÃO-FILHO, 2004; SOUZA et al., 2010). The riparian forests of the rio das Mortes located in the municipality of Barroso, south central Minas Gerais State, have suffered from numerous impacts starting in the 19th century with logging for lime production. This resulted in fragmentation of the native vegetation and led to several environmental problems, as also evidenced in many regions of Minas Gerais (PIRES et al., 2013; SOUZA, 2006).

In this regard, understanding the communities that exist in that environment is of utmost

importance, because the knowledge acquired of the species and their nesting places guarantee the maintenance of their environmental services. As such, the objective of the present study was to evaluate the types of plant substrate used by social wasps for nesting, and to investigate whether there is a relationship between nest construction type and the habits of plant species in riparian forests of the rio das Mortes in the municipality of Barroso.

Material and methods

Study Area

The present study was conducted in areas of riparian forest along the rio das Mortes in the municipality of Barroso, Minas Gerais (21°11'13"S, 43°58'33"W). That area is located in an vegetation types of seasonal semideciduous forest, riparian vegetation and Brazilian savanna, which are undergoing constant anthropic interventions related to the economic cycles of mining, agriculture, livestock, industrialization and, in the past, wood extraction to feed lime kilns (MENINI-NETO et al., 2004, PIRES et al., 2013; SOUZA, 2006). The climate of the area is classified as Cwb: mesothermic with well-defined seasons (OLIVEIRA-FILHO; MACHADO, 1993). The average annual temperature varies between 18 and 20°C, and annual average rainfall between 1,400 and 1,550 mm.

Data collection

A 30 m wide by 20 km long strip of vegetation was delimited starting from the margin of the river. A total of 48 collections were conducted from October 2005 to September 2007, using the active search method (ELPINO-CAMPOS et al., 2007; SOUZA; PREZOTO, 2006). Samples of the plant substrate types used for nesting by the social wasp species were also collected. Samples of the botanical materials were deposited in the herbarium of the Federal University of Lavras (UFLA).

The social wasp specimens were sent to the Entomology Department of the Federal University of Lavras, where they were identified using taxonomic keys or by comparing them to the collection present in that department. The unidentified specimens or with questionable identification were sent to Dr. Orlando Tobias da Silveira at Museu Emílio Goeldi, Pará State.

Statistical analysis

The characteristics of the plant species used in social wasp nesting, such as habit (arboreal, arbustive, herbaceous, epiphyte, liana or parasitic), deciduousness (evergreen, semi-deciduous and

deciduous), stem texture and consistency of the abaxial surface of the leaf were used to evaluate a possible relationship with the choice of nesting sites and nest architecture. The number of social wasp species, nest construction type and characteristics of the plant species were grouped and related with plant habit and deciduousness. The association between groups of wasps and the plant substratum was represented in biplot-type graphs (MELLO, 2009).

The interaction network graph was built using Pajek software, the thickness of the lines in the graphs expressing the number of interactions among the analyzed elements (MELLO, 2009). The graph, in itself, is a representation of the relationships among data elements and can be described in a Euclidean space of n dimensions as a group V of vertexes and a

group A of continuous curves (edges) (MELLO, 2009).

Whenever a possible relationship was evidenced among the data, we used Chi-squared tests to verify if the absolute nesting frequency differed from the expected absolute frequency distribution, thus making it possible to test the hypotheses about the factors that interfere in the choice for specific plant substrate by a social wasp species.

Results and discussion

A total of 171 colonies of social wasps belonging to 29 species were recorded, which used 78 plant species (76 Angiosperms and two Pteridophytes) of arboreal, arbustive, herbaceous, epiphyte or liana habits as nesting substrate (Tables 1, 2 and 3).

Table 1. Relationship between species of wasps of the Polistini tribe and plant species used as nesting substrate and their characteristics (Arbo.: arborious; Cor.: coriaceous; Dec.: deciduous; Eve.: evergreen; Fle.: Fleishy; Gla.: glabra; Hem.: hemiparasite; Her.:herbaceous; Mem.: membranous; Op.: open nest; Pub.: pubescent; Roug.: rough; Shr.: Shrub; Sem.: semideciduous; Smo.: smooth; Sub.: subcoriacea).

Specie	Plant	Family	Habit	Colonies	Nest	Leaf consistency	Ecological information	Stem's texture	Abaxial leaf surface
<i>Polistes actaeon</i> Haliday, 1836	<i>Aspidosperma cuspa</i> (Khunt)	Apocynaceae	Arbo.	1	Ope.	Mem.	Sem.	Rou.	Pub.
	<i>Machaerium</i> sp.	Fabaceae	Arbo.	1		Mem.	Dec.	Smo.	Gla.
	sp.	Loranthaceae	Hem.	1		Fle.	Eve.	Smo.	Gla.
	<i>Eugenia florida</i> DC.	Myrtaceae	Arbo.	1		Mem.	Eve	Rou.	Gla.
	<i>Celtis pubescens</i> (khunt)	Celtitaceae	Arbo.	1		Cor.	Eve	Smo.	Pub.
<i>Polistes cinerascens</i> de Saussure, 1854	<i>Baccharis dracunculifolia</i> DC.	Asteraceae	Shr.	1	Ope.	Mem.	Dec.	Smo.	Pub.
	<i>Salix humboldtiana</i> Willd.	Salicaceae	Arbo.	1		Mem.	Dec.	Rou.	Gla.
<i>Polistes billardieri</i>	<i>Lytraea moleoides</i> (Vell.)	Anacardiaceae	Arbo.	1	Ope.	Mem.	Eve	Rou.	Gla.
	<i>Vernonanthura divaricata</i> (Spreng.)	Asteraceae	Her.	1		Cor.	Eve	Smo.	Pub.
<i>Polistes pacificus</i> Fabricius, 1804	<i>Psidium guajava</i> L.	Myrtaceae	Arbo.	1	Ope.	Cor.	Sem.	Smo.	Gla.
	<i>Casearia sylvestris</i> Sw.	Salicaceae	Arbo.	2		Mem.	Eve	Rou..	Gla.
	<i>Vernonia</i> sp.	Asteraceae	Her.	1		Mem.	Eve	Smo.	Pub.
	<i>Vernonia</i> sp.	Asteraceae	Shr.	1		Sub.	Eve	Smo.	Pub.
<i>Polistes simillimus</i> Zikán, 1951	<i>Schynus terenbintifolia</i> Raddi	Anacardiaceae	Arbo.	1	Ope.	Mem.	Eve	Rou.	Gla.
	<i>Solanum</i> sp.	Solanaceae	Shr.	1		Mem.	Eve	Smo.	Pub.
	<i>Baccharis dracunculifolia</i> DC.	Asteraceae	Shr.	1		Mem.	Dec.	Smo.	Pub.
<i>Polistes versicolor</i> (Olivier, 1791)	<i>Mimosa bimucronata</i> (DC.)	Fabaceae	Arbo.	1	Ope.	Mem.	Dec.	Rou.	Pub.

sp. (unidentified species)

Table 2. Relationship between species of wasps of the Mischocyttarini tribe and plant species used as nesting substrate and its characteristics (Arbo.: arborious; Cor.: coriaceous; Dec.: deciduous; Epi.: epiphyte; Eve.: evergreen; Fle.: fleshy; Gla.: glabra; Hem.: hemiparasite; Her.: herbaceous; Lia.: liana; Mem.: membranous; Ope.: open nest; Pub.: pubescent; Roug.: rough; Shr.: Shrub; Sem.: semideciduous; Smo.: smooth; Sub.:subcoriacea).

Specie	Plant	Family	Habit	Colonies	Nest	Leaf consistency	Ecological information	Stem's texture	Abaxial leaf surface
<i>Mischocyttarus confusus</i>	<i>Piper propigua</i>	Piperaceae	Shr.	1	Ope.	Cor.	Eve.	Smo.	Pub.
	<i>Smilax</i> sp.	Smilacaceae	Lia.	1		Cor.	Eve.	Smo.	Gla.
	<i>Solanum paniculatum</i> L.	Solanaceae	Her.	1		Mem.	Eve.	Rou.	Pub.
	<i>Celtis pubescens</i> (khunt)	Celtitaceae	Arbo.	1		Cor.	Eve.	Smo.	Pub.
	<i>Inga vera</i> Willd.	Fabaceae	Arbo.	1		Mem.	Sem.	Smo.	Pub.
	<i>Chusquia</i> sp.	Poaceae	Shr.	1		Mem.	Eve.	Smo.	Pub.
	<i>Protium wuivereni</i>	Burseraceae	Arbo.	1		Mem.	Eve.	Rou.	Gla.
	<i>Pterocotenum</i> sp.	Bignoniaceae	Lia.	1		Mem.	Eve.	Smo.	Gla.
	<i>Casearia sylvestris</i> Sw.	Salicaceae	Arbo.	1		Mem.	Eve.	Rou.	Gla.
	<i>Ixora warmingii</i> Müll.Arg	Rubiaceae	Arbo.	1		Cor.	Eve.	Rou.	Gla.
	<i>Vochysia tucanarum</i> Mart.	Vochysiaceae	Arbo.	1		Cor.	Eve.	Rou.	Gla.
	<i>Roupala montana</i> Aubl.	Proteaceae	Shr.	1		Cor.	Dec.	Rou.	Gla.
	<i>Lafoensia pacari</i> A.St. – Hil.	Lytraceae	Arbo.	1		Cor.	Dec.	Rou.	Gla.
	<i>Rapanea umbellata</i> (Mart.)	Myrsinaceae	Arbo.	1		Cor.	Eve.	Rou.	Gla.

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Specie	Plant	Family	Habit	Colonies	Nest	Leaf consistency	Ecological information	Stem's texture	Abaxial leaf surface
	<i>Inga sessilis</i> (Vell.)	Fabaceae	Arbo.	1		Mem.	Sem.	Smo.	Pub.
	<i>Eugenia florida</i> DC.	Myrtaceae	Arbo.	2		Mem.	Eve.	Rou.	Gla.
	<i>Mimosa milefoliata</i>	Fabaceae	Shr.	1		Mem.	Dec.	Rou.	Pub.
<i>Mischocyttarus drewseni</i>	<i>Smilax</i> sp.	Smilacaceae	Lia.	1	Ope.	Cor.	Eve.	Smo.	Gla.
	<i>Tillandsia</i> sp.	Bromeliaceae	Epi.	1		Mem.	Eve.	NT	Pub.
<i>Mischocyttarus atramentarius</i>	<i>Pseudobombax grandiflorum</i> (Cav.)	Malvaceae	Arbo.	4	Ope.	Cor.	Dec.	Rou.	Gla.
<i>Mischocyttarus artifex</i>	<i>Pleurothallis niograndensis</i> Barb.Rodr	Orchidaceae	Epi.	1	Ope.	Cor.	Eve.	NT	Gla.
<i>Mischocyttarus araujo</i>	<i>Siparuna cujabana</i> (Mart.)	Siparunaceae	Arbo.	1	Ope.	Mem.	Eve.	Smo.	Gla.
<i>Mischocyttarus wagneri</i>	<i>Polypodium</i> sp.	Polypodiaceae	Epi.	1	Ope.	Mem.	Eve.	NT	Gla.
	<i>Pseudobombax grandiflorum</i> (Cav.)	Malvaceae	Arbo.	1		Cor.	Dec.	Rou.	Gla.
	<i>Psychotria</i> sp.	Rubiaceae	Shr.	1		Mem.	Eve.	Smo.	Gla.
	<i>Desmodium</i> sp.	Fabaceae	Her.	1		Mem.	Dec.	Smo.	Pub.
	<i>Lantana</i> sp.	Verbenaceae	Her.	1		Mem.	Dec.	Smo.	Pub.
<i>Mischocyttarus cassununga</i>	<i>Erythroxylum citrifolium</i> A.St.-Hil.	Erythroxyaceae	Arbo.	1	Ope.	Mem.	Dec.	Rou.	Gla.
	<i>Tillandsia gardneri</i> Lindley.	Bromeliaceae	Epi.	1		Mem.	Eve.	NT	Pub.
	<i>Campomanesia</i> sp.	Myrtaceae	Arbo.	1		Cor.	Dec.	Rou.	Pub.
	<i>Myrcia gomideria</i>	Myrtaceae	Shr.	1		Cor.	Dec.	Smo.	Gla.
	sp.	Pteridophyte	Epi.	1		Mem.	Eve.	NT	Lis.

sp. (unidentified species)

Table 3. Relationship between species of wasps of the Epiponini tribe and plant species used as nesting substrate and their characteristics (Arbo.: arborious; Ast.: astelocytarous; Cor.: coriaceous; Clo.: closed nest; Dec.: deciduous; Epi.: epiphyte; Eve.: evergreen; Fle.: fleshy; Gla.: glabra; Hem.: hemiparasita; Her.:herbaceous; Lia.: liana; Mem.: membranous; Ope.: open nest; Phra.: phragmocytarous; Pub.: pubescent; Roug.: rough; Shr.: shrub; Sem.: semideciduous; Smo.: smooth; Sub.: subcoriaceous).

Specie	Plant	Family	Habit	Colonies	Nest	Leaf consistency	Ecological information	Stem's texture	Abaxial leaf surface
<i>Agelaia multipicta</i>	<i>Inga vera</i> Willd.	Fabaceae	Arbo.	1	Ope.	Mem.	Sem.	Smo.	Pub.
	<i>Celtis pubescens</i> (khunt)	Celtidaceae	Arbo.	1		Cor.	Sem.	Rou.	Pub.
	<i>Nectandra nitidula</i> Nees.	Lauraceae	Arbo.	1		Cor.	Eve.	Smo.	Gla.
	<i>Croton urucurana</i> Baill.	Euphorbiaceae	Arbo.	1		Mem.	Dec.	Smo.	Pub.
<i>Apoica gelida</i>	<i>Schinus terebinthifolia</i> Raddi	Anacardiaceae	Arbo.	3	Ope.	Mem.	Eve.	Rou.	Gla.
	<i>Lytraea moleoides</i> (Vell.)	Anacardiaceae	Arbo.	1		Mem.	Eve.	Rou.	Gla.
	<i>Callisthene fasciculata</i> (Spr.)	Vochysiaceae	Arbo.	1		Cor.	Dec.	Rou.	Pub.
	<i>Luehea candicans</i> Mart. et Zucc.	Malvaceae	Arbo.	1		Cor.	Sem.	Rou.	Pub.
	<i>Vochysia tucanarum</i> Mart.	Vochysiaceae	Arbo.	1		Cor.	Eve.	Rou.	Gla.
<i>Brachygastra augusti</i>	<i>Myrcia tomentosa</i> (Aubl.)	Myrtaceae	Arbo.	1	Phra.	Mem.	Dec.	Smo.	Gla.
	<i>Croton floribundus</i> Spreng.	Euphorbiaceae	Arbo.	1		Mem.	Dec.	Smo.	Pub.
<i>Parachartegus fraternus</i>	<i>Aspidosperma cuspa</i> (khunt)	Apocynaceae	Arbo.	1		Mem.	Sem.	Rou.	Pub.
	<i>Trichilia pallida</i> Swartz	Meliaceae	Arbo.	1	Clo.	Cor.	Sem.	Smo.	Gla.
	<i>Machaerium hirtum</i> (Vell.)	Fabaceae	Arbo.	1		Cor.	Dec.	Rou.	Pub.
	<i>Salix humboldtiana</i> Willd.	Salicaceae	Arbo.	1		Mem.	Dec.	Rou.	Gla.
<i>Polybia bifasciata</i>	<i>Schinus terebinthifolia</i> Raddi	Anacardiaceae	Arbo.	1	Phra.	Mem.	Eve.	Rou.	Gla.
	sp.	Sapindaceae	Lia.	1		Cor.	?	Smo.	Pub.
	<i>Salix humboldtiana</i> Willd.	Salicaceae	Arbo.	1		Mem.	Dec.	Rou.	Gla.
<i>Polybia chrysothorax</i>	<i>Lytraea moleoides</i> (Vell.)	Anacardiaceae	Arbo.	1	Phra.	Mem.	Eve.	Rou.	Gla.
	<i>Celtis pubescens</i> (khunt)	Celtidaceae	Arbo.	1		Cor.	Eve.	Smo.	Pub.
<i>Polybia jurinei</i>	<i>Schinus terebinthifolia</i> Raddi	Anacardiaceae	Arbo.	1	Phra.	Mem.	Eve.	Rou.	Gla.
	<i>Salix humboldtiana</i> Willd.	Salicaceae	Arbo.	3		Mem.	Dec.	Rou.	Gla.
	<i>Schinus terebinthifolia</i> Raddi	Anacardiaceae	Arbo.	1		Mem.	Eve.	Rou.	Gla.
	<i>Inga vera</i> Willd.	Fabaceae	Arbo.	2		Mem.	Sem.	Smo.	Pub.
<i>Polybia paulista</i>	<i>Chusquia</i> sp.	Poaceae	1			Mem.	Eve.	Smo.	Pub.
	<i>Cedrela fissilis</i> Vell.	Meliaceae	Arbo.	1	Phra.	Cor.	Dec.	Rou.	Gla.
	<i>Mimosa bimucronata</i> (DC.)	Fabaceae	Arbo.	2		Mem.	Dec.	Rou.	Pub.
	<i>Lytraea moleoides</i> (Vell.)	Anacardiaceae	Arbo.	1		Mem.	Eve.	Rou.	Gla.
	<i>Nectandra nitidula</i> Nees.	Lauraceae	Arbo.	1		Cor.	Eve.	Smo.	Gla.
	<i>Machaerium hirtum</i> (Vell.)	Fabaceae	Arbo.	1		Cor.	Dec.	Rou.	Pub.
	<i>Chusquia</i> sp.	Poaceae	1			Mem.	Eve.	Rou.	Gla.
	<i>Siphoneugenia</i> sp.	Myrtaceae	Arbo.	1		Mem.	?	Smo.	Gla.
	<i>Terminalia</i> sp.	Combretaceae	Arbo.	1		Mem.	Dec.	Rou.	Gla.
	<i>Triumfetta bartramia</i> L.	Malvaceae	Shr.	1		Mem.	?	Smo.	Gla.
<i>Polybia platycephala</i>	<i>Baccharis</i> sp.	Asteraceae	Shr.	1	Phra.	N.T	Dec.	Ala.	N.T
	<i>Cedrela fissilis</i> Vell.	Meliaceae	Arbo.	1		Cor.	Dec.	Rou.	Gla.
	<i>Psychotria</i> sp.	Rubiaceae	Shr.	1		Mem.	?	Smo.	Gla.
	<i>Vernonia</i> sp.	Asteraceae	Shr.	1		Mem.	Eve.	Smo.	Pub.
	<i>Casearia slyvestris</i> Sw.	Salicaceae	Arbo.	1		Mem.	Eve.	Rou.	Gla.
	<i>Chusquia</i> sp.	Poaceae	1			Mem.	Eve.	Smo.	Pub.
<i>Polybia scutellaris</i>	<i>Copaifera langsdorffii</i> Desf.	Fabaceae	Arbo.	1	Phra.	Mem.	Dec.	Rou.	Gla.
	<i>Inga vera</i> willd.	Fabaceae	Arbo.	1		Mem.	Sem.	Smo.	Pub.
	<i>Schinus terebinthifolia</i> Raddi	Anacardiaceae	Arbo.	1		Mem.	Eve.	Rou.	Gla.
<i>Polybia sericea</i>	<i>Salix humboldtiana</i> Willd.	Salicaceae	Arbo.	1	Phra.	Mem.	Dec.	Rou.	Gla.

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Specie	Plant	Family	HabitColonies	Nest	Leaf consistency	Ecological information	Stem's texture	Abaxial leaf surface
<i>Protonectarina slyveirae</i>	<i>Machaerium hirtum</i> (Vell.)	Fabaceae	Arbo.	1	Cor.	Dec.	Rou.	Pub.
	<i>Platypodium elegans</i> Vog.	Fabaceae	Arbo.	1	Cor.	Sem.	Rou.	Gla.
	<i>Schinus terebinthifolius</i> Raddi	Anacardiaceae	Arbo.	1	Mem.	Eve.	Rou.	Gla.
<i>Protonectarina slyveirae</i>	<i>Machaerium hirtum</i> (Vell.)	Fabaceae	Arbo.	1	Cor.	Dec.	Rou.	Pub.
	<i>Platypodium elegans</i> Vog.	Fabaceae	Arbo.	1	Cor.	Sem.	Rou.	Gla.
	<i>Schinus terebinthifolius</i> Raddi	Anacardiaceae	Arbo.	1	Mem.	Eve.	Rou.	Gla.
<i>Protopolybia sedula</i>	<i>Lytriae moleoides</i> (Vell.)	Anacardiaceae	Arbo.	3	Mem.	Eve.	Rou.	Gla.
	<i>Schinus terebinthifolius</i> Raddi	Anacardiaceae	Arbo.	1	Mem.	Eve.	Rou.	Gla.
	<i>Tapirira guianensis</i> Aubl.	Anacardiaceae	Arbo.	1	Mem.	Eve.	Rou.	Gla.
	<i>Maclura tinctoria</i> (L.)	Moraceae	Arbo.	1	Mem.	Dec.	Smo.	Pub.
	<i>Nectandra nitidula</i> Nees.	Lauraceae	Arbo.	1	Cor.	Eve.	Smo.	Gla.
	<i>Aspidosperma cuspa</i> (khunt)	Apocynaceae	Arbo.	1	Mem.	Sem.	Rou.	Pub.
	<i>Tabebuia ochracea</i> (Cham.)	Bignoniaceae	Arbo.	1	Cor.	Dec.	Rou.	Pub.
	<i>Cedrela fissilis</i> Vell.	Meliaceae	Arbo.	1	Cor.	Dec.	Rou.	Gla.
	<i>Dendropanax cuneatum</i> (DC.)	Araliaceae	Arbo.	1	Mem.	Eve.	Smo.	Gla.
	<i>Myrcia tomentosa</i> (Aubl.)	Myrtaceae	Arbo.	1	Mem.	Dec.	Smo.	Gla.
	<i>Eugenia florida</i> DC.	Myrtaceae	Arbo.	1	Mem.	Eve.	Rou.	Gla.
	<i>Campomanesia</i> sp.	Myrtaceae	Arbo.	1	Mem.	?	Smo.	Gla.
	<i>Rollinia sylvatica</i> (A. St.- Hil)	Annonaceae	Arbo.	1	Cor.	Eve.	Smo.	Gla.
	<i>Siphoneugenia</i> sp.	Myrtaceae	Arbo.	1	Mem.	?	Smo.	Gla.
	<i>Ixora warmingii</i> Müll.Arg.		Arbo.	1	Cor.	Eve.	Rou.	Gla.
	<i>Casearia obliqua</i> Spreng.	Saliaceae	Arbo.	2	Mem.	Eve.	Rou.	Gla.
	<i>Xylosma</i> sp.	Saliaceae	Arbo.	1	Mem.	Dec.	Rou.	Gla.
	<i>Mimosa bimucronata</i> (DC.)	Fabaceae	Arbo.	1	Mem.	Dec.	Rou.	Pub.
	<i>Siparuna cujabama</i> (Mart.)	Siparunaceae	Arbo.	1	Mem.	Sem.	Smo.	Gla.
<i>Pseudopolybia vespiceps</i>	<i>Sebastiania commersoniana</i> (Baill.)	Euphorbiaceae	Arbo.	1	Cor.	Dec.	Smo.	Pub.
	<i>Mendoncia</i> sp.	Acanthaceae	Lia.	1	Mem.	?	Smo.	Pub.
	<i>Inga sessilis</i> (Vell.)	Fabaceae	Arbo.	1	Mem.	Sem.	Smo.	Pub.
<i>Synoecca cyanea</i>	<i>Inga vera</i> Willd.	Fabaceae	Arbo.	6	Mem.	Sem.	Smo.	Pub.
	<i>Croton urucurana</i> Baill.	Euphorbiaceae	Arbo.	1	Mem.	Dec.	Smo.	Pub.
	<i>Copaifera langsdorffii</i> Desf.	Fabaceae	Arbo.	1	Mem.	Dec.	Rou.	Gla.
	<i>Machaerium hirtum</i> (Vell.)	Fabaceae	Arbo.	1	Cor.	Dec.	Rou.	Pub.
	<i>Eucalyptus</i> sp.	Asteraceae	Arbo.	1	Cor.	Sem.	Smo.	Gla.
	<i>Anadenanthera</i> sp.	Fabaceae	Arbo.	11	Mem.	Dec.	Smo.	Gla.
	<i>Schinus terebinthifolius</i> Raddi.	Anacardiaceae	Arbo.	1	Mem.	Eve.	Rou.	Gla.

Individuals of species *Agelaia vicina* (Sausure, 1854); *Brachygastra lecheguana* (Latreille, 1824); *Polistes ferrerii* Saussure, 1853; *Polistes subsericus* Saussure, 1854; *Polybia ignobilis* (Haliday, 1836) and *Polybia minarum* Ducke, 1906 were collected in the study area, but without recording their colonies. This can be related to the fact that social wasp species have the habit of nesting in one place and foraging in another (DINIZ; KITAYAMA, 1994; PEREIRA; SANTOS, 2006), or even the difficulty in locating the nests (SOUZA et al., 2010).

Schinus terebinthifolius Raddi (Anacardiaceae) was the most used species for social wasp nesting, with 13 recorded colonies, belonging to 10 species. The area of the present study is under regeneration conditions, and the species *S. terebinthifolius* is abundant in regeneration areas (MORATO, 2001) providing nesting support and potential food resources for the social wasp species (BARBOLA et al., 2000; CESÁRIO; GAGLIANONE, 2008; MORATO, 2001; SOUZA et al., 2010).

The wasp species *Protopolybia sedula* (Saussure, 1854) nested in 20 angiosperm species (Table 1). This wide ecological plasticity demonstrates that those social wasps can be generalists with regard to nest substrate, which is characteristic of euryoecic species (DEJEAN et al., 1998; CRUZ et al., 2006).

Nests of wasp *Synoecca cyanea* (Fabricius, 1775) were found in arboreal species, mainly in *Anadenanthera* sp. Speg., a deciduous plant known as angico (Fabaceae). This occurrence can be related to climatic factors, because nesting in that plant could facilitate thermal regulation of the colony during winter, through greater exposure to sun rays (HOZUMI et al., 2010). That would also explain the recording of those Vespidae only in perennial trees in the Recôncavo Baiano region, where the hotter climate makes higher shading of the colony necessary during the year, which would be obtained by nesting in plants with that characteristic (MARQUES; CARVALHO, 1993).

Variations in social wasp nesting occurrence are seemingly not related to the deciduousness of the plant and its architectural patterns, with the exception of *Synoecca cyanea* (Fabricius, 1775), which possesses astelocytarus type nests. That species probably needs arboreal, perennial extract for its nesting, which suggests a stenoecic species (CRUZ et al., 2006). The nesting of that species in arboreal extract was also verified in other works (ALVARENGA et al., 2010; ELISEI et al., 2005; SANTOS et al., 2009).

The statistical test showed that the number of species of social wasps with phragmocytarus and gymnodomous-type nests showed preference for

arboreal plants for nesting ($\chi^2 = 4.09$, $P = 0.014$ and $\chi^2 = 3.42$, $P = 0.019$). That nesting pattern in arboreal plant species can be due to greater protection against bad weather, camouflage and mechanical support for the nests, results that corroborate those of Santos et al. (2009) who observed differences in the nesting of social wasp species in arboreal and shrub-sized plants in the Caatinga - Brazilian steppe, where drought is long-lasting and arboreal plants with longer life cycles seem to provide better nesting conditions for social wasps compared to shrubs, which have a shorter lifespan due the semi-arid climate.

When comparing the number of wasp nests according to construction type, it was verified that the arboreal species were more used by the wasp species regardless of nest construction type (Figure 1 and 2).

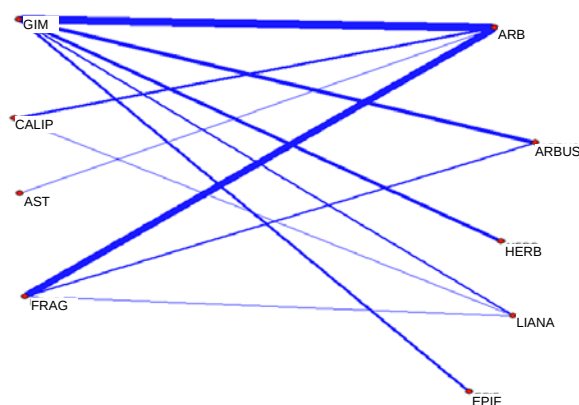


Figure 1. Number of species of social wasps and architectural patterns of nest building (GIM = gimnódomo, CALIP = caliptódomo, AST = astelocítaro and FRAG = fragmocítaro), related to the habit of the plants (trees, shrubs herbaceous liana and epiphyte) used as substrate for nesting.

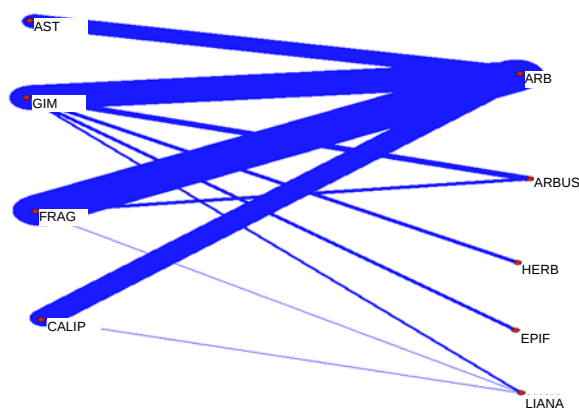


Figure 2. Number of colonies of social wasps and architectural patterns of nest building (GIM = gimnódomo, CALIP = caliptódomo, AST = astelocítaro and FRAG = fragmocítaro), related to the habit of the plants (trees, shrubs herbaceous liana and epiphyte) used as substrate for nesting.

The choice for that substrate type can be linked to the fact that those plant species feature specific

conditions (physical and/or biological) for the wasp species (DEJEAN et al., 1998; CRUZ et al., 2006; SANTOS et al., 2009).

The study shows that vegetation structure is more relevant in social wasp nesting than any given plant species, suggesting that recovery models for heterogeneous riparian forest using large numbers of plant species are favorable to social wasps, when compared to models that use few species (MARTINS, 2001; RODRIGUES; LEITÃO-FILHO, 2004).

The results evidenced the importance of Riparian Forest preservation for the maintenance of social wasp diversity. The effects of fragmentation and disordered land use can lead to the loss of the species. The preservation of natural areas guarantees a higher availability of nesting places for the social wasp species, ensuring the maintenance of their environmental services, greater agricultural pest biological control efficiency, in addition to that of other insect predators and parasitoids (LANDIS et al., 2000; PREZOTO et al., 2006).

Conclusion

The nesting of social wasps in plant substrate does not seem to be influenced by any particular plant species, but the complexity of the plant structure and environment were more relevant. In this sense, the use of models in heterogeneous recovery of riparian forest areas, which are based on planting a large number of species of different ecological groups, should positively influence the richness of social wasps.

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