Acta Scientiarum

http://www.uem.br/acta
ISSN printed: 1679-9283
ISSN on-line: 1807-863X
Doi: 10.4025/actascibiolsci.v36i2.21460

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

Marcos Magalhães de Souza[1], Epifânio Porfiro Pires[2*], Abner Elpino-Campos[3] and Júlio Neil Cassa Louzada[4]

*[1]Instituto Federal de Educação, Ciência e Tecnologia do Sul de Minas, Campus Inconfidentes, Inconfidentes, Minas Gerais, Brazil. [2]Departamento de Entomologia, Universidade Federal de Lavras, Cx Postal 3037, 37200-000, Lavras, Minas Gerais, Brazil. [3]Departamento de Zoologia, Instituto de Biociências, Universidade Federal do Rio Grande do Sul, Porto Alegre, Rio Grande do Sul, Brazil. [4]Setor de Ecologia, Universidade Federal de Lavras, Lavras, Minas Gerais, Brazil. *Author for correspondence. E-mail: epifaniopires@yahoo.com.br*

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: stelocyttarus, gymnodomous, astelocyttarus and phragmocyttarus (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).

Astelocyttarus nests possess a single comb, with a protective envelope and the cells attached directly to the substrate (*Synoeca* spp. Saussure, 1852 and *Metapolybia* spp. Ducke, 1905) (ANDENA et al., 2009). In phragmocyttarus 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 semidecidual 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 20ºC, 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..: Fleshy; 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
Polistes actaeon Haliday, 1836	*Aspidosperma cuspa* (Khunt)	Apocynaceae	Arbo.	1	Ope.	Mem.	Sem.	Rou.	Pub.
	Machaerium sp.	Fabaceae	Arbo.	1		Mem.	Dec.	Smo.	Gla.
	sp.	Loranthaceae	Hem.	1		Fle.	Eve.	Smo.	Gla.
	Eugenia florida DC.	Myrtaceae	Arbo.	1		Mem.	Eve	Rou.	Gla.
	Celtis pubenses (khunt)	Celtitaceae	Arbo.	1		Cor.	Eve	Smo.	Pub.
	Baccharis dracunculifolia DC.	Asteraceae	Shr.	1		Mem.	Dec.	Smo.	Pub.
Polistes cinerascens de Saussure, 1854	*Salix humboldtiana* Willd.	Salicaceae	Arbo.	1	Ope.	Mem.	Dec.	Rou.	Gla.
	Lytraea moleoides (Vell.)	Anacardiaceae	Arbo.	1		Mem.	Eve	Rou.	Gla.
Polistes billardieri	*Vernonanthura divaricata* (Spreng.)	*Asteraceae*	Her.	1	Ope.	Cor.	Eve	Smo.	Pub.
Polistes pacificus Fabricius, 1804	*Psidium guajava* L.	Myrtaceae	Arbo.	1	Ope.	Cor.	Sem.	Smo.	Gla.
	Casearia slyvestris Sw.	Salicaceae	Arbo.	2		Mem.	Eve	Rou..	Gla.
	Vernonia sp.	Asteraceae	Her.	1		Mem.	Eve	Smo.	Pub.
Polistes simillimus Zikán, 1951	*Vernonia* sp.	Asteraceae	Shr.	1	Ope.	Sub.	Eve	Smo.	Pub.
	Schynus terenbintifolia Raddi	Anacardiaceae	Arbo.	1		Mem.	Eve	Rou.	Gla.
	Solanum sp.	Solanaceae	Shr.	1		Mem.	Eve	Smo.	Pub.
	Baccharis dracunculifolia DC.	Asteraceae	Shr.	1		Mem.	Dec.	Smo.	Pub.
Polistes versicolor (Olivier, 1791)	*Mimosa bimucronata* (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
Mischocyttarus confusus	*Piper propigua*	Piperaceae	Shr.	1	Ope.	Cor.	Eve.	Smo.	Pub.
	Smilax sp.	Smilacaceae	Lia.	1		Cor.	Eve.	Smo.	Gla.
	Solanum paniculatum L.	Solanaceae	Her.	1		Mem.	Eve.	Rou.	Pub.
	Celtis pubencens (khunt)	Celtitaceae	Arbo.	1		Cor.	Eve.	Smo.	Pub.
	Inga vera Willd.	Fabaceae	Arbo.	1		Mem.	Sem.	Smo.	Pub.
	Chusquia sp.	Poaceae	Shr.	1		Mem.	Eve.	Smo.	Pub.
	Protium wiwereni	Burseraceae	Arbo.	1		Mem.	Eve.	Rou.	Gla.
	Ptecoctenium sp.	Bignoniaceae	Lia.	1		Mem.	Eve.	Smo.	Gla.
	Casearia sylvestris Sw.	Salicaceae	Arbo.	1		Mem.	Eve.	Rou.	Gla.
	Ixora warmingii Müll.Arg	Rubiaceae	Arbo.	1		Cor.	Eve.	Rou.	Gla.
	Vochysia tucanarum Mart.	Vochysiaceae	Arbo.	1		Cor.	Eve.	Rou.	Gla.
	Roupala montana Aubl.	Proteaceae	Shr.	1		Cor.	Dec.	Rou.	Gla.
	Lafoensia pacari A.St. – Hil.	Lytraceae	Arbo.	1		Cor.	Dec.	Rou.	Gla.
	Rapanea umbellata (Mart.)	Myrsinaceae	Arbo.	1		Cor.	Eve.	Rou.	Gla.

Continue...

...continuation.

Specie	Plant	Family	Habit	Colonies	Nest	Leaf consistency	Ecological information	Stem's texture	Abaxial leaf surface
	Inga sessilis (Vell.)	Fabaceae	Arbo.	1		Mem.	Sem.	Smo.	Pub.
	Eugenia florida DC.	Myrtaceae	Arbo.	2		Mem.	Eve.	Rou.	Gla.
	Mimosa milefoliata	Fabaceae	Shr.	1		Mem.	Dec.	Rou.	Pub.
Mischocyttarus drewseni	*Smilax* sp.	Smilacaceae	Lia.	1	Ope.	Cor.	Eve.	Smo.	Gla.
	Tillandsia sp.	Bromeliaceae	Epi.	1		Mem.	Eve.	NT	Pub.
Mischocyttarus atramentarius	*Pseudobombax grandiflorum* (Cav.)	Malvaceae	Arbo.	4	Ope.	Cor.	Dec.	Rou.	Gla.
Mischocyttarus artifex	*Pleurothalis riograndensis* Barb.Rodr	Orchidaceae	Epi.	1	Ope.	Cor.	Eve.	NT	Gla.
Mischocyttarus araujoi	*Siparuma cujabana* (Mart.)	Siparunaceae	Arbo.	1	Ope.	Mem.	Eve.	Smo.	Gla.
Michocyttarus wagneri	*Polypodium* sp.	Polypodiaceae	Epi.	1	Ope.	Mem.	Eve.	NT	Gla.
	Pseudobombax grandiflorum (Cav.)	Malvaceae	Arbo.	1		Cor.	Dec.	Rou.	Gla.
	Psychotria sp.	Rubiaceae	Shr.	1		Mem.	Eve.	Smo.	Gla.
	Desmodium sp.	Fabaceae	Her.	1		Mem.	Dec.	Smo.	Pub.
	Lantana sp.	Verbenaceae	Her.	1		Mem.	Dec.	Smo.	Pub.
Mischocyttarus cassununga	*Erytroxylum citrifolium* A.St.-Hil.	Erytroxylaceae	Arbo.	1	Ope.	Mem.	Dec.	Rou.	Gla.
	Tillandsia gardnerri Lindley.	Bromeliaceae	Epi.	1		Mem.	Eve.	NT	Pub.
	Campomanesia sp.	Myrtaceae	Arbo.	1		Cor.	Dec.	Rou.	Pub.
	Myrcia gomideria	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.: astelocyttarous; 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.: phragmocyttarous; 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
Agelaia multipicta	*Inga vera* Willd.	Fabaceae	Arbo.	1	Ope.	Mem.	Sem.	Smo.	Pub.
	Celtis pubencens (khunt)	Celtidaceae	Arbo.	1		Cor.	Sem.	Rou.	Pub.
	Nectandra nitidula Nees.	Lauraceae	Arbo.	1		Cor.	Eve.	Smo.	Gla.
	Croton urucurana Baill.	Euphorbiaceae	Arbo.	1		Mem.	Dec.	Smo.	Pub.
Apoica gelida	*Schynus terenbentifolia* Raddi	Anacardiaceae	Arbo.	3	Ope.	Mem.	Eve.	Rou.	Gla.
	Lytrae moleoides (Vell.)	Anacardiaceae	Arbo.	1		Mem.	Eve.	Rou.	Gla.
	Callisthene fasciculata (Spr.)	Vochysiaceae	Arbo.	1		Cor.	Dec.	Rou.	Pub.
	Luehea candicans Mart. et Zucc.	Malvaceae	Arbo.	1		Cor.	Sem.	Rou.	Pub.
	Vochysia tucanarun Mart.	Vochysiaceae	Arbo.	1		Cor.	Eve.	Rou.	Gla.
Brachygastra augusti	*Myrcia tomentosa* (Aubl.)	Myrtaceae	Arbo.	1	Phra.	Mem.	Dec.	Smo.	Gla.
	Croton floribundus Spreng.	Euphorbiaceae	Arbo.	1		Mem.	Dec.	Smo.	Pub.
	Aspidosperma cuspa (khunt)	Apocynaceae	Arbo.	1		Mem.	Sem.	Rou.	Pub.
Parachartegus fraternus	*Trichilia pallida* Swartz	Meliaceae	Arbo.	1	Clo.	Cor.	Sem.	Smo.	Gla.
	Machaerium hirtum (Vell.)	Fabaceae	Arbo.	1		Cor.	Dec.	Rou.	Pub.
	Salix humboldtiana Willd.	Salicaceae	Arbo.	1		Mem.	Dec.	Rou.	Gla.
Polybia bifasciata	*Schynus terebinthifolia* Raddi	Anacardiaceae	Arbo.	1	Phra.	Mem.	Eve.	Rou.	Gla.
	sp.	Sapindaceae	Lia.	1		Cor.	?	Smo.	Pub.
	Salix humboldtiana Willd.	Salicaceae	Arbo.	1		Mem.	Dec.	Rou.	Gla.
Polybia chrysothorax	*Lytraea moleoides* (Vell.)	Anacardiaceae	Arbo.	1	Phra.	Mem.	Eve.	Rou.	Gla.
	Celtis pubensces (khunt)	Celtidaceae	Arbo.	1		Cor.	Eve.	Smo.	Pub.
Polybia jurinei	*Schynus terebinthifolia* Raddi	Anacardiaceae	Arbo.	1	Phra.	Mem.	Eve.	Rou.	Gla.
	Salix humboldtiana Willd.	Salicaceae	Arbo.	3		Mem.	Dec.	Rou.	Gla.
	Schynus terebinthifolia Raddi	Anacardiaceae	Arbo.	1		Mem.	Eve.	Rou.	Gla.
	Inga vera Willd.	Fabaceae	Arbo.	2		Mem.	Sem.	Smo.	Pub.
	Chusquia sp.	Poaceae		1		Mem.	Eve.	Smo.	Pub.
Polybia paulista	*Cedrela fissilis* Vell.	Meliaceae	Arbo.	1	Phra.	Cor.	Dec.	Rou.	Gla.
	Mimosa bimucronata (DC.)	Fabaceae	Arbo.	2		Mem.	Dec.	Rou.	Pub.
	Lytraea moleoides (Vell.)	Anacardiaceae	Arbo.	1		Mem.	Eve.	Rou.	Gla.
	Nectandra nitidula Nees.	Lauraceae	Arbo.	1		Cor.	Eve.	Smo.	Gla.
	Machaerium hirtum (Vell.)	Fabaceae	Arbo.	1		Cor.	Dec.	Rou.	Pub.
	Chusquia sp.	Poaceae		1		Mem.	Eve.	Rou.	Gla.
	Siphoneugenia sp.	Myrtaceae	Arbo.	1		Mem.	?	Smo.	Gla.
	Terminalia sp.	Combretaceae	Arbo.	1		Mem.	Dec.	Rou.	Gla.
	Triumffeta bartramia L.	Malvaceae	Shr.	1		Mem.	?	Smo.	Gla.
Polybia platycephala	*Baccharis* sp.	Asteraceae	Shr.	1	Phra.	N.T	Dec.	Ala.	N.T
	Cedrela fissilis Vell.	Meliaceae	Arbo.	1		Cor.	Dec.	Rou.	Gla.
	Psychotria sp.	Rubiaceae	Shr.	1		Mem.	?	Smo.	Gla.
	Vernonia sp.	Asteraceae	Shr.	1		Mem.	Eve.	Smo.	Pub.
	Casearia slyvestris Sw.	Saliacaceae	Arbo.	1		Mem.	Eve.	Rou.	Gla.
	Chusquia sp.	Poaceae		1		Mem.	Eve.	Smo.	Pub.
Polybia scutelaris	*Copaifera langsdorfii* Desf.	Fabaceae	Arbo.	1	Phra.	Mem.	Dec.	Rou.	Gla.
	Inga vera willd.	Fabaceae	Arbo.	1		Mem.	Sem.	Smo.	Pub.
	Schynus terebinthifolia Raddi	Anacardiaceae	Arbo.	1		Mem.	Eve.	Rou.	Gla.
Polybia sericea	*Salix humboldtiana* Willd.	Salicaceae	Arbo.	1	Phra.	Mem.	Dec.	Rou.	Gla.

Continue...

...continuation.

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

Individuals of species *Agelaia vicina* (Sausure, 1854); *Brachygastra lecheguana* (Latreille, 1824); *Polistes ferreri* Saussure, 1853; *Polistes subsericius* 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 *Synoeca 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 *Synoeca cyanea* (Fabricius, 1775), which possesses astelocyttarus 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 phragmocyttarus and gymnodomous-type nests showed preference for

arboreal plants for nesting (χ^2 = 4.09, P = 0.014 and χ^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).

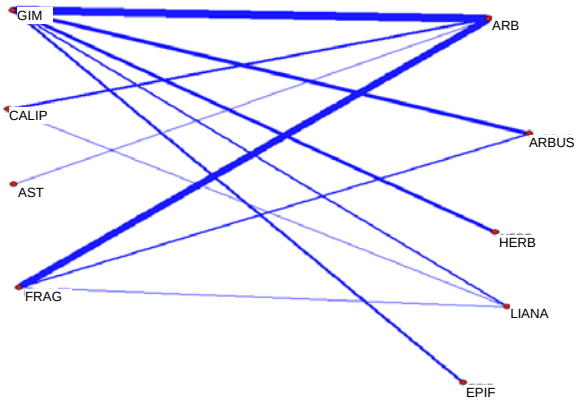

Figure 1. Number of species of social wasps and architectural patterns of nest building (GIM = gimnódomo, CALIP = caliptódomo, AST = astelocítaro and FRAG = fragmocítaro), related to the habit of the plants (trees, shrubs herbaceous liana and epiphyte) used as substrate for nesting.

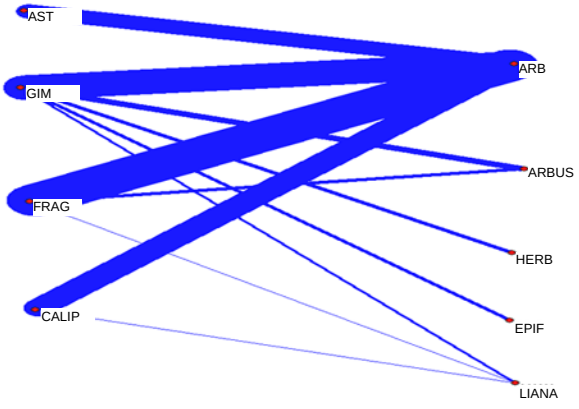

Figure 2. Number of colonies of social wasps and architectural patterns of nest building (GIM = gimnódomo, CALIP = caliptódomo, AST = astelocítaro and FRAG = fragmocítaro), related to the habit of the plants (trees, shrubs herbaceous liana and epiphyte) used as substrate for nesting.

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.

References

ALVARENGA, R. B.; CASTRO, M. M.; SANTOS-PREZOTO, H. H.; PREZOTO, F. Nesting of social wasps (Hymenoptera, Vespidae) in urban gardens in Southeastern Brazil. **Sociobiology**, v. 55, n. 2, p. 445-452, 2010.

ANDENA, S. R.; CARPENTER, J. M.; PICKETT, K. M. Phylogenetic analysis of species of the neotropical social wasp *Epipona* Latreille, 1802 (Hymenoptera, Vespidae, Polistinae, Epiponini). **ZooKeys**, v. 20, p. 385-398, 2009.

BARBOLA, I. F.; LAROCA, S.; ALMEIDA, M. C. Utilização de recursos florais por abelhas silvestres (Hymenoptera, Apoidea) da floresta estadual Passa Dois (Lapa, Paraná, Brasil). **Revista Brasileira de Entomologia**, v. 44, n. 1, p. 9-19, 2000.

CARVALHO, D. A.; OLIVEIRA FILHO, A. T.; VILELA, E. A.; CURI, N.; VAN DEN BERG, E.; FONTES, M. A. L.; BOTEZELLI, L. Distribuição de espécies arbóreo-arbustivas ao longo de um gradiente de solos e topografia em um trecho de floresta ripária do Rio São Francisco em Três Marias, MG, Brasil. **Revista Brasileira de Botanica**, v. 28, n. 2, p. 329-345, 2005.

CESÁRIO, L. F.; GAGLIANONE, M. C. Biologia floral e fenologia reprodutiva de *Schinus terebinthifolius* Raddi

(Anacardiaceae) em Restinga do Norte Fluminense. **Acta Botánica Brasileira**, v. 22, n. 3, p. 828-833, 2008.

CORBARA, B.; CARPENTER, J. M.; CÉRÉGHINO, R.; LEPONCE, M.; GIBERNAU, M.; DEJEAN, A. Diversity and nest site selection of social wasps along Guianese forest edges: assessing the influence of arboreal ants. **Comptes Rendus Biologies**, v. 332, n. 5, p. 470-479, 2009.

CRUZ, J. D.; GIANNOTTI, E.; SANTOS, G. M.; BICHARA-FILHO, C. C.; ROCHA, A. A. Nest site selection and flying capacity of the Neotropical wasp *Angiopolybia pallens* (Lepeletier, 1836) (Hymenoptera-Vespidae) in the Atlantic Rain Forest, Bahia State, Brazil. **Sociobiology**, v. 47, n. 3, p. 739-750, 2006.

DINIZ, I. R.; KITAYAMA, K. Colony densities and preferences for nest habitats of some social wasps in Mato Grosso State, Brazil (Hymenoptera, Vespidae). **Journal of Hymenoptera Research**, v. 3, p. 133-143, 1994.

DEJEAN, A.; CORBARA, B.; CARPENTER, J. M. Nesting site selection by wasps in the Guianese rain forest. **Insectes Sociaux**, v. 45, n. 1, p. 33-41, 1998.

ELISEI, T.; RIBEIRO-JÚNIOR, C.; GUIMARÃES, D. L.; PREZOTO, F. Foraging activity and nesting of swarm-founding wasp *Synoeca cyanea* (Fabricius, 1775) (Hymenoptera, Vespidae, Epiponini). **Sociobiology**, v. 46, n. 1, p. 317-327, 2005.

ELPINO-CAMPOS, A.; DEL-CLARO, K.; PREZOTO, F. Diversity of social wasps (Hymenoptera: Vespidae) in Cerrado fragments of Uberlândia, Minas Gerais State, Brazil. **Neotropical Entomology**, v. 36, n. 5, p. 685-692, 2007.

HOZUMI, S.; MATEUS, S.; KUDO, K.; KUWARARA, T.; YAMANI, S.; ZUCCHI, R. Nest Thermoregulation in *Polybia scutellaris* (White) (Hymenoptera: Vespidae). **Neotropical Entomology**, v. 39, n. 5, p. 826-828, 2010.

HUNT, J. H. **The evolution of social wasps**. Oxford University Press, 2007.

HUNT, J. H.; CARPENTER, J. M. Intra-specific nest form variation in some Neotropical swarm-founding wasps of the genus *Parachartergus* (Hymenoptera: Vespidae: Epiponini). **Journal Kansas Entomology Socience**, v. 77, n. 4, p. 448-456, 2004.

JEANNE, R. L. Chamical defense of broad by a social wasp. **Science**, v. 168, p. 1465-1466, 1970.

JEANNE, R. L. The adaptivness of social wasps nest architecture. **Quarterly Review of Biology**, v. 50, p. 267-287, 1975.

JEANNE, R. L. The swarm-founding Polistinae, In: ROSS, K. G.; MATTHEWS, R. W. (Ed.). The Social Biology of Wasps. **Cornell University Press**. New York: Ithaca, 1991. p. 191-231.

LANDIS, D. A.; WRATTEN, S. D.; GURR, G. M. Habitat management to conserve natural enemies of arthropod pest in agriculture. **Annual Review of Entomology**, v. 79, p. 1697-1702, 2000.

MARQUES, O. M.; CARVALHO, C. A. L. Hábitos de nidificação de vespas sociais (Hymenoptera: Vespidae) o município de Cruz das Almas, Estado da Bahia. **Insecta**, v. 2, n. 2, p. 23-40, 1993.

MARTINS, S. V. **Recuperação de matas ciliares**. Viçosa: Aprenda Fácil, 2001.

MELLO, R. M. A. Temporal variation in the organization of a Neotropical assemblage of leaf-nosed bats (Chiroptera: Phyllostomidae). **Acta Oecologica**, v. 35, n. 2, p. 280-286, 2009.

MENINI-NETO, L.; ASSIS, L. C. S.; FORZZA, R. C. A família Orchidaceae em um fragmento de floresta estacional semidecidual no município de Barroso, Minas Gerais, Brasil. **Lundiana**, v. 4, n. 1, p. 9-27, 2004.

MORATO, E. F. Efeitos da fragmentação florestal sobre vespas e abelhas solitárias na Amazônia Central. **Revista Brasileira de Zoologia**, v. 18, n. 3, p. 101-118, 2001.

OLIVEIRA-FILHO, A. T.; MACHADO, J. M. N. Composição florística de uma floresta semidecídua montana na Serra de São José, Tiradentes, Minas Gerais. **Acta Botanica Brasilica**, v. 7, n. 2, p. 71-88, 1993.

PIRES, E. P.; MORGADO, L. N.; SOUZA, B.; CARVALHO, C. F.; NEMÉSIO, A. Community of orchid bees (Hymenoptera: Apidae) in transitional vegetation between Cerrado and Atlantic Forestin southeastern Brazil. **Brazilian Journal of Biology**, v. 73, n. 3, p. 507-513, 2013.

PEREIRA, V. S.; SANTOS, G. M. M. Diversity in bee (Hymenoptera, Apoidea) and social wasps (Hymenoptera, Vespidae) comumnity in Campos Rupestres, Bahia, Brazil. **Neotropical Entomology**, v. 35, n. 2, p. 165-174, 2006.

PREZOTO, F.; PREZOTO, H. H. S.; MACHADO, V. L.; ZANUNCIO, J. C. Prey captured and used in *Polistes versicolor* (Olivier) (Hymenoptera: Vespidae) nourishment. **Neotropical Entomology**, v. 35, n. 5, p. 707-709, 2006.

RICHARDS, O. W.; RICHARDS, M. J. Observations on the social wasps of South America (Hymenoptera; Vespidae). **Transactions of the Royal Entomological Society of London**, v. 102, p. 1-170, 1951.

RODRIGUES, R. R.; LEITÃO-FILHO, H. F. **Matas ciliares, conservação e recuperação**. São Paulo: USP, 2004.

SANTOS, G. M. M.; AGUIAR, C. M. L.; GOBBI, N. Characterization of the wasps guild (Hymenoptera, Vespidae) visiting flowers in the caatinga (Itatim, Bahia, Brazil). **Sociobiology**, v. 47, n. 2, p. 483-494, 2006.

SANTOS, G. M. M.; BISPO, P. C.; AGUIAR, C. M. L. A. Fluctuations in richness and abundance of social wasps during the dry and wet seasons in three phyto-physiognomies at the Tropical Dry Forest of Brazil. **Environmental Entomology**, v. 38, n. 6, p. 1613-617, 2009.

SANTOS, G. M. M.; AGUIAR, C. M. L.; MELLO, M. A. R. Flower-visiting guild associated with the Caatinga flora: trophic interaction networks formed by social bees and social wasps with plants. **Apidologie**, v. 41, n. 4, p. 466-475, 2010.

SMITH, A. R.; O'DONNELL, S.; JEANNE, R. L. Correlated evolutionary of colony defence and social structure: a comparative analysis in eusocial wasps (Hymenoptera: Vespidae). **Evolutionary Ecology Research**, v. 3, p. 331-344, 2001.

SOUZA, M. M. Barroso, uma história de desmatamentos e de esforços atuais para conservação. **Vertentes**, v. 27, n. 1, p. 16-26, 2006.

SOUZA, M. M.; PREZOTO, F. Diversity of social wasps (Hymenoptera, Vespidae) in Semideciduous forest and cerrado (savanna) regions in Brazil. **Sociobiology**, v. 47, n. 1, p. 135-147, 2006.

SOUZA, M. M.; ZANUNCIO, J. C. **Marimbondos-Vespas sociais (Hymenoptera: Vespidae)**. Viçosa: UFV, 2012.

SOUZA, M. M.; LOUZADA, J.; SERRÃO, J. E.; ZANUNCIO, J. C. Social wasps (Hymenoptera: Vespidae) as indicators of conservation degree of riparian forests in southeast Brazil. **Sociobiology**, v. 56, n. 1, p. 1-10, 2010a.

WENZEL, J. W. Evolution of nest architecture in social vespids. In: ROSS, K. G.; MATTHEWS R. W. (Ed.). **The social biology of wasps**. Ithaca: Cornell University Press, 1991. p. 480-519.

WENZEL, J. W. A generic key to the nests of hornets, yellowjackets and paper wasps world-wide (Vespidae: Vespinae, Polistinae). **American Museum Novitates**, n. 3224, p. 1-39. 1998.

Received on July 24, 2013.
Accepted on January 28, 2014.