New records of the association between *Polybia rejecta* (Fabricius, 1798) (Hymenoptera: Vespidae) and *Azteca chartifex* Emery, 1896 (Hymenoptera: Formicidae) for the Caatinga and Amazon forest

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Edited by: Ana Dal Molin

Received: February 03, 2020. Accepted: July 13, 2020. Published: August 25, 2020.

**Abstract.** Some neotropical social wasps are associated with certain vertebrates and other insects, like ants. These interactions have been reported for decades, but little is known about these associations in the caatinga biome. This study describes the first association record between the nests of *Polybia rejecta* wasps and *Azteca chartifex* ants in the caatinga of Piauí state and presents new records for Amazonas. This study supports the hypothesis that the association between the social wasps *P. rejecta* and *A. chartifex* ants is more common than previously documented. This new finding reinforces this association between different species not only for the Amazon and atlantic forest, but also for the caatinga biome.

**Keywords:** species interactions, interspecific relationship, tolerance, wasp nest, ant nest.

Wasps have evolved noticeably different means of defense against predatory ants such as (1) the selection of a safe nest site and using long thorns to anchor their nest (Jeanne 1975; Dejean et al. 1998a), (2) the architectural properties of their nests which can be protected by an envelope or connected to the substrate through a long, thin, easy-to-defend petiole (Jeanne 1975), and (3) adaptive behavior such as constant vigilance, instantaneous escape, rapid movements, repellent chemicals smeared onto the nest petiole, the active guarding of the nest entrance, and agonistic defense with the use of venom or by ejecting the ants (Jeanne 1970, 1975, 1978; Post & Jeanne 1981; Kojima 1993; Dejean et al. 1998b; Togni & Giannotti 2010; Grangier & Lester 2011).

Predation by ants, particularly army ants (Dorylineae) has been known to have a significant impact on the ecology and evolution of neotropical social wasps (Jeanne 1970, 1975, 1978; Young 1979; Chadab-Crépet & Rettenmeyer 1982; Corbara et al. 2009; Le Guen et al. 2015). However, several social wasp species protect themselves from army ants by, paradoxically, forming associations with arboreal ants, which implies appropriate nest site selection by foudresses or swarms. Indeed, by constantly patrolling their host tree, arboreal ants “control” their branches and leaves and may be able to exclude other ants, including army ants (Chadab-Crépet & Rettenmeyer 1982; Dejean et al. 1998b; Corbara et al. 2009). For instance, workers of the territorially dominant arboreal ant *Azteca chartifex* Emery, 1896 defend access to their host tree by attacking army ants at its base, causing the columns to deviate (Chadab-Crépet & Rettenmeyer 1982).

Although they probably represent a limited number of wasp species, examples of ant associations are easily found in the Neotropics. Because they are frequently associated with arboreal ants, mostly *A. chartifex*, the nests of the polistine social wasp *Polybia rejecta* (Fabricius, 1798) are protected from army ant raids (Richards 1978b; Chadab-Crépet & Rettenmeyer 1982; Corbara et al. 2009; Somavilla et al. 2013; Souza et al. 2013); in turn, the wasps protect the ant nests from bird predation (Le Guen et al. 2015).

In 2013, we presented a report (Somavilla et al. 2013) on the associations between wasps, ants, and birds in central Brazilian Amazon, with information about behavior, nest locations and photographs of active and abandoned colonies. The same association between *P. rejecta* nests and ant colonies of an unidentified species of the genus *Azteca* was reported for southern Brazilian Amazon (Richards 1978) and the Mamirauá Sustainable Development Reserve, in central Brazilian Amazon (Silveira et al. 2008). Jeanne (1978) found 47 *P. rejecta* nests in Santarém, eastern Brazilian Amazon, mostly near other wasp nests and, in some cases, associated with *Azteca* ants.

In the active colonies of *P. rejecta*, any disturbance caused by the collector when approaching the colony, usually resulted in aggressive behavior by the wasps (Somavilla et al. 2013). On the other hand, the ants are usually aggressive after direct disturbances in the colony, resulting in rapid recruitment of a large number of ants.

Most occurrence records of the association between *P. rejecta* and *A. chartifex* are in the Amazon biome (Jeane 1978; Corbara et al. 2009; Somavilla et al. 2013; Servigne et al. 2018), but this seems to be changing. This association has been previously recorded in areas of transition between cerrado and amazon (Richards 1978), atlantic forest (Souza et al. 2013) and in areas of transition between atlantic forest and caatinga (Virginio et al. 2015) (Tab. 1). Here we provide more records for the Brazilian Amazon (Fig. 1A), for an area of transition between atlantic forest and caatinga, and record the association between *P. rejecta* and *A. chartifex* for the first time in the caatinga (Fig. 1B) (Tab. 1).

In conclusion, the *P. rejecta* and *A. chartifex* nesting association appears to be more common than previously documented. Our findings support that this association between different species occurs not only in the Amazon but also in the other biomes like atlantic forest, caatinga, and cerrado. The association requires a significant level of tolerance by the associated ants, although they can be aggressive when disturbed by an external source. However, further experimentation or analysis has not yet been conducted to formally document the benefits of this interspecific relationship. Thus, further studies in ethology and ecology should be undertaken to assess whether this relationship is merely a case of tolerance between the two hymenopteran species or there is some kind of symbiosis between them.
Acknowledgments

We sincerely thank the Fundação de Amparo à Pesquisa do Estado do Amazonas (FAPEAM, FIXAM - 062.01427/2018) for the financial support to A.S. I.O.F. was supported by a PNPD/CAPES scholarship. Thanks are due to INPA for providing the facilities for the sorting and identification of the species. Please, include this sentence: This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) - Finance Code 001

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Table 1. Records of associations between Polybia rejecta (Hymenoptera: Vespidae) and Azteca chartifex (Hymenoptera: Formicidae) with localities and references.

| Number of colonies | Locality  | Biome                  | Coord.                  | Reference     |
|--------------------|-----------|------------------------|-------------------------|---------------|
| 01                 | Sete Cidades National Park, Piripiri, Piauí | Caatinga               | 04°05'57"S; 41°42'34"W | New record    |
| 02                 | Bosque da Ciência, INPA, Manaus, Amazonas | Amazon Forest          | 03°05'49"S; 59°59'11"W | New record    |
| 01                 | Campus II, INPA, Manaus, Amazonas         | Amazon Forest          | 03°05'42"S; 59°27'23"W | New record    |
| 01                 | Balbina, Presidente Figueiredo, Amazonas  | Amazon Forest          | 01°51'18"S; 59°59'06"W | New record    |
| 01                 | Canutama National Forest, Canutama, Amazonas | Amazon Forest        | 06°31'58"S; 64°23'27"W | New record    |
| 01                 | Paudalho, Pernambuco                      | Transition Caatinga and Atlantic Forest | 07°53'31"S; 35°10'37"W | New record    |
| 05                 | Ducke Reserve, Manaus, Amazonas           | Amazon Forest          | 02°55'10"S; 59°58'48"W | Somavilla et al. (2013) |
| 01                 | Mamirauá Sustainable Development Reserve, Tefé, Amazônia | Amazon Forest | 02°59'38.07"S; 64°56'08.37"W | Silveira et al. (2008) |
| 01                 | Santarém, Pará                            | Amazon Forest          | -                       | Jean (1978)   |
| 02                 | Base Camp, Nova Xavantina, Mato Grosso     | Transition Cerrado and Amazon Forest | 12°50'S; 51'47"W | Richards (1978) |
| 12                 | Parque Estadual do Rio Doce, Mariléria, Timóteo and Dionísio, Minas Gerais | Atlantic Forest       | 19°45' to 19°30' and 42°38' to 48°28"W | Souza et al. (2013) |
| 04                 | Timbaúba, Monte Alegre, Rio Grande do Norte | Transition Caatinga and Atlantic Forest | 06°05'14"S; 35°21'44"W | Virginio et al. (2015) |
| 18                 | Petit Saut, French Guiana                 | Amazon Forest          | 05°03'39"N; 53°02'36"W | Corbara et al. (2009) |
| 05                 | Petit-Saut, Sinnamary and Kourou, French Guiana | Amazon Forest | 05°03'39'N, 53°02'36"W | Servigne et al. (2018) |

Figure 1. A) and B) Polybia rejecta nest associated with a colony of Azteca chartifex ants. A) At Bosque da Ciência, INPA, Amazon Forest, B) At Sete Cidades National Park, Caatinga biome.
ant-repellent substance to the nest petiole in paper wasps (Hymenoptera: Vespidae). *Insectes Sociaux*, 40: 403-421. doi: 10.1007/BF01253903

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