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On a poorly known Amazonian ant-plant association: *Myrcia madida* McVaugh (Myrtaceae) and *Myrcidris epicharis* Ward (Hymenoptera: Formicidae: Pseudomyrmecinae)

Uma associação mirmecófila amazônica pouco conhecida: *Myrcia madida* McVaugh (Myrtaceae) e *Myrcidris epicharis* Ward (Hymenoptera: Formicidae: Pseudomyrmecinae)

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Abstract: Ecological data are provided for the first time on the myrmecophilious relationship between the ant *Myrcidris epicharis* Ward (Hymenoptera: Formicidae: Pseudomyrmecinae) and the Amazonian tree *Myrcia madida* McVaugh (Myrtaceae), the only Neotropical species of its family to produce domatia in hollow branches. Ants were collected from 30 plants of various sizes (0.9 to 18 m in height) and all plants were inhabited by *Myrcidris epicharis* Ward. On average, there were 13.3 adult ant workers, 3.8 larvae, 1.5 pupae, and 2.3 eggs per domatium. Ants tend scale insects that live inside the hollow stems. New colonies of *M. epicharis* are founded by a single queen, and in none of the plants examined more than one queen was found, suggesting that secondary adoption of queens may not take place in this ant species. *Myrcidris epicharis* Ward appears to provide protection to its host-plant against both vertebrate and invertebrate herbivores.

Keywords: Amazon. Myrmecophily. Ant.

Resumo: São apresentados, pela primeira vez, dados ecológicos sobre a relação entre a formiga *Myrcidris epicharis* Ward (Hymenoptera: Formicidae: Pseudomyrmecinae) e a árvore amazônica *Myrcia madida* McVaugh (Myrtaceae), a única espécie Neotropical da sua família a produzir domáceas em ramos ocos. Foram coletadas 30 plantas de diversos tamanhos (de 0,9 a 18 m de altura) e todas estavam colonizadas pela formiga *Myrcidris epicharis* Ward. Em cada domácea, foram encontradas, em média, 13,3 formigas operárias adultas, 3,8 larvas, 1,5 pupas e 2,3 ovos. As formigas cuidam de cochinilhas dentro dos galhos ocos. Novas colônias de *M. epicharis* são fundadas por uma rainha desacompanhada de operárias e nenhuma das plantas examinadas abrigou mais de uma rainha, indicando que a adoção de rainhas secundárias não ocorre. *Myrcidris epicharis* Ward aparentemente protege a planta-hospedeira contra herbivoria de vertebrados e invertebrados.

Palavras-chave: Amazônia. Mirmecofilia. Formiga.

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INTRODUCTION

Myrmecophytes or ant-plants often produce specialized structures known as domatia to house ants that, in turn, often provide protection against herbivores or competing plants, or supply nutrients to their host-plants (Davidson & McKey, 1993). The domatia consist of hollow stems (e.g., *Cecropia* Loefl., *Leonardoxa* Aubrév., *Macaranga* Thouars, *Tachigali* Aubl., hollow thorns (*Acacia* Mill.), petioles (*Piper* L.), or leaf pouches (e.g., *Hirtella* L., *Maieta* Aubl., *Scaphopetalum* Mast., *Tococa* Aubl.) (Martin & McKey, 2003), and therefore can be of primary (in the case of hollow stems or thorns) or secondary origin (leaf pouches) (Benson, 1985). Myrmecophytes are typically tropical forest plants whose associated ants have been noted to vary at both regional and local scales (Fonseca & Ganade, 1996).

In his review of Amazonian ant-plants, Benson (1985) recorded more than 200 species of myrmecophytes from 27 genera in the Amazon region. He listed *Siparuna* Aubl. (Monimiaceae) that was later found to be *Myrcia* DC. Ex Guill. (Myrtaceae) (Ward, 1990). To date, only one of the 300 described species of *Myrcia* (*M. madida* McVaugh) has been recorded as producing domatia (Benson, 1985), but the myrmecophytic relationship of *Myrcia* remains poorly understood. This note provides basic information on the ant-*Myrcia* relationship.

METHODS

The study was conducted in central Amazonian rainforest, 70 km north of Manaus, Amazonas, Brazil (2° 30' S and 60° 00' W). Forests in the study area are lowland (100-150 m elevation) but not seasonally flooded (locally termed 'terra firme'). Annual rainfall ranges from 1.900-2.500 mm with a pronounced dry season from June through October (Ferreira & Laurance, 1997). The forest canopy is 30-37 m tall, with emergent trees to 55 m. The flora of the study area is remarkably diverse in tree species (Ferreira & Rankin-de-Mérona, 1997).

Detailed measurements were made on 50 domatia collected randomly from *M. madida* individuals located along human trails in Biological Dynamics of Forest Fragments Project (BDFFP). A total of 30 plants were also examined with regard to ant occupancy (i.e. ant species, and number of ants per domatium).

Examining voucher specimens deposited in the herbarium of the National Institute of Amazonian Research (INPA-Manaus) and in the reference collection of the BDFFP, one of us identified *Myrcia* sp. as *Myrcia madida* McVaugh. *Myrcia madida* McVaugh is a small- to medium- sized tree of up to 20 m in height, whose distribution ranges from the Napo River, in Peru, to the Negro River, in Brazil.

RESULTS AND DISCUSSION

Myrcia madida McVaugh has domatia in hollow stems (Figure 1), i.e. the domatia produced by this plant species is of primary origin (*sensu* Benson, 1985).

In the studied area, *M. madida* occurs at low densities, averaging 0.15 trees (diameter at breast height >10 cm) per hectare (N = 66 plots of 1 hectare). Bruna *et al.* (2005) found a density of 1.38 plants per hectare, including both trees and saplings (> 0.5 m in height).

The length of each stem internode (domatium) of *M. madida* varied from 2.54 to 8.35 cm (Mean ± SD = 6.71 ± 1.43, N = 50). The maximum width varied from 0.19 to 0.41 cm (0.28 ± 0.05, N = 50), while the minimum width from 0.10 to 0.13 cm (0.12 ± 0.01, N = 50). Stems are filled with soft pith that ants remove to form a hollow cavity. An entrance hole is cut in each stem internode, just below the insertion of the opposite leaves (Figure 1). The diameter of these holes varied from 0.19 to 0.45 cm (0.25 ± 0.07, N = 50), with one or two holes being found per domatium.

Ants were collected from 30 plants of various sizes (0.9 to 18 m in height), and all plants were inhabited by the same pseudomyrmecine ant, *Myrcidris epicharis* Ward, 1990, which is the only known species of the genus *Myrcidris* (Ward, 1990). A total of 81 domatia were dissected from ten trees. On average there were 13.3 adult ant workers (SD = 3.8), 3.8 larvae (SD =

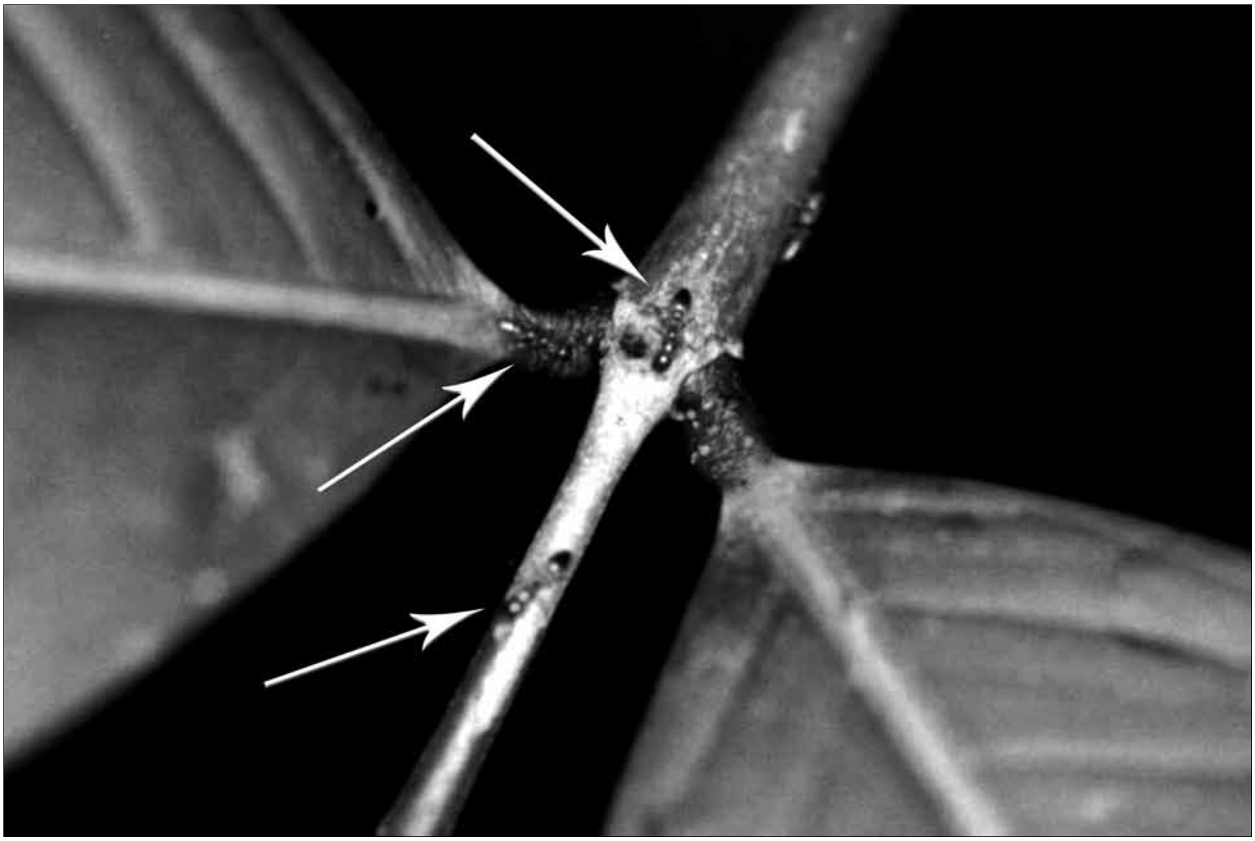

Figure 1. General view of a stem domatium of *Myrcia madida*. Arrous indicate the presence of *Myrcidris epicharis* workers on the stem and leaves. Photo: L. V. Ferreira.

3.7), 1.5 pupae (SD = 1.1), and 2.3 eggs (SD = 2.8) per domatium. One plant housed larvae and pupae with adult male ants. Scale insects were found in the interior of most domatia (Mean = 0.97 scale insects per domatium, SD = 0.67), and these are probably an important source of food (honeydew) for *M. epicharis*. In one incipient colony (defined as incipient because it was the only colony present in a small, young tree sapling), composed of a single queen, three workers, two larvae and one pupa, all in the same domatium, two scale insects were found. The presence of scale insects in incipient ant colonies suggests that either plant colonization by these herbivorous insects occurs almost concomitantly with ant colonization or that these are transported by founding queens when they leave their maternal nests (Trager & Bruna, 2006).

New colonies of *M. epicharis* are founded by a single queen (haplometrosis; Figure 2), and none of the examined plants harbored more than one queen, suggesting that secondary adoption of queens (secondary polygyny) may not take place in this species. It is not clear how long a colony of *M. epicharis* lives, but it seems unlikely that a given host-plant will host the same colony throughout its life. Ants colonize *M. madida* at an early stage (saplings as small as 50 cm in height often harbor ants), and several decades may be required for this plant to reach maturity. In some other species of myrmecophytic trees, such as *Tachigali myrmecophylla* Ducke an ontogenetic succession of ant species occurs throughout the life of the tree, from the sapling stage until the plant reaches the forest canopy

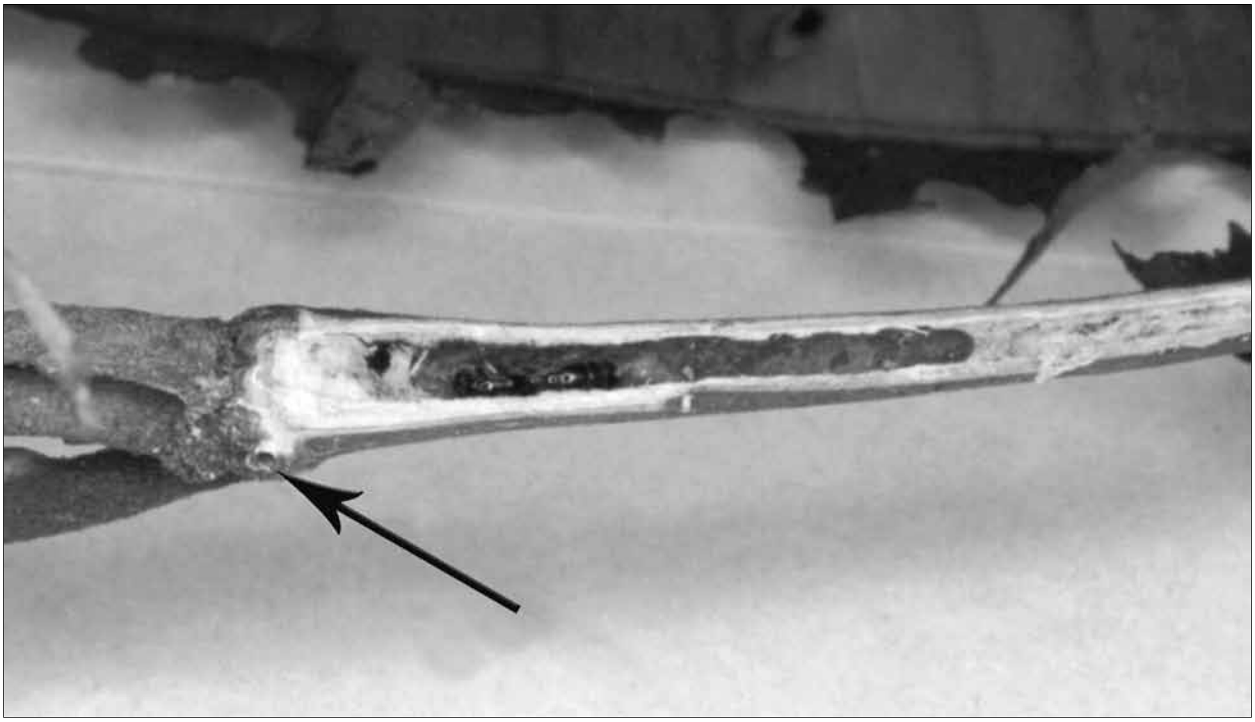

Figure 2. Longitudinal section of the hollow stem of *Myrcia madida* showing a founding *Myrcidris epicharis* queen. The arrow indicates the entrance hole that gives ants access to the interior of the stem domatium. Photo: L. V. Ferreira.

and eventually dies (Fonseca & Benson, 2003). Such succession of ant species does not appear to take place in *M. madida*, since all plants examined were inhabited by *M. epicharis*. Similarly, all ant-inhabited individuals of *M. madida* found by Bruna *et al.* (2005) were associated with *M. epicharis*.

Protective ant-plant interactions, important in both temperate and tropical communities, are increasingly used to study a wide range of phenomena of general interest (Martin & McKey, 2003). In contrast, to other pseudomymecine ants associated with myrmecophytes (Janzen, 1966), *M. epicharis* is not very aggressive against human intruders. In collecting ants from cut and branches from several trees, the authors were bitten and stung by the ants only occasionally during the first day. However, on the following day the ant's stings caused a strong allergic reaction, which made the collectors more reluctant to manipulate ant-protected branches. This suggests that *M. epicharis* may be efficient in deterring vertebrate attacks on its host-plant, but this possibility remains to be evaluated with proper field experiments. The ants also appear to be efficient in deterring herbivorous insects, resulting in the observed low level of damage on its leaves. Herbivore damage was quantified in 19 randomly collected leaves from four plants and most (68.4%) of these leaves were found to have less than 2% of the leaf area damaged by insects (most commonly by leaf miners).

Overall, our observations suggest that the association between *M. epicharis* and *M. madida* is a mutually benificial one; the plants provide shelter and indirectly food (scale insects), while ants provide defense against herbivores. However, experimental studies are needed to confirm this hypothesis. These observations will hopefully stimulate further work on this poorly-known ant-plant association.

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