

A potential ant-hemiptera-plant mutualism on *Lorostemon coelhoi* (Clusiaceae) in the Brazilian Amazon

Silvia Larissa FERREIRA-SILVA^{1*}, Michael G. J. HOPKINS¹, Thiago M. MOUZINHO¹, Rosaly A. ROCHA¹, Lucas C. MARINHO²

¹ Instituto Nacional de Pesquisas da Amazônia – INPA, Laboratório de Taxonomia Vegetal, Av. André Araújo 2936, Petrópolis, 69060–001 Manaus, Amazonas, Brazil

² Universidade Federal do Maranhão, Centro de Ciências Biológicas e da Saúde, Departamento de Biologia, Av. dos Portugueses 1966, Bacanga, 65080-805 São Luís, Maranhão, Brazil

* Corresponding author: silvialarissa2013@gmail.com

ABSTRACT

Interactions among organisms are important in ecosystem functioning and relevant for the management and conservation of species. Here we report the first record of a potential ant-hemiptera-plant mutualism on *Lorostemon coelhoi* (Clusiaceae) in Manaus, Amazonas state, Brazil. Our observations on five trees indicated that the presence of hemiptera nymphs diverted ants from damaging flower buds while looking for nectar, because the nymphs secrete honeydew, which is collected by the ants instead. Trees without hemiptera nymphs produced less fruit due to damage to flower buds by ants. The observation suggests the occurrence of a tripartite mutualistic interaction among these organisms that represent three trophic levels. The absence of hemiptera nymphs could directly affect the reproductive success of the plant by increasing the predation of flower buds by ants. The interaction deserves further investigation.

KEYWORDS: animal-plant interaction, honeydew, mutualism, predation, tribe Symphonieae

Um potencial mutualismo formiga-hemíptera-planta em *Lorostemon coelhoi* (Clusiaceae) na Amazônia brasileira

RESUMO

As interações entre organismos são importantes no funcionamento do ecossistema e relevantes para o manejo e conservação de espécies. Aqui relatamos o primeiro registro de um potencial mutualismo formiga-hemíptera-planta em *Lorostemon coelhoi* (Clusiaceae) em Manaus, estado do Amazonas, Brasil. Nossas observações em cinco árvores indicaram que a presença de ninfas de hemípteros desviou as formigas de danificar os botões florais enquanto procuravam por néctar, porque as ninfas secretam um “melado”, que é coletado pelas formigas. Árvores sem ninfas de hemípteros produziram menos frutos devido aos danos aos botões florais por formigas. A observação sugere a ocorrência de uma interação mutualística entre esses organismos, que representam três níveis tróficos. A ausência de ninfas de hemípteros pode afetar diretamente o sucesso reprodutivo da planta, aumentando a predação de botões florais por formigas. A interação merece investigação mais aprofundada.

PALAVRAS-CHAVE: interação planta-animal, melado, mutualismo, predação, tribo Symphonieae

Mutualism is defined as an interspecific relationship among two or more species which obtain mutual benefits and improve their fitness relative to when they occur alone (Bronstein 1994). It is an important form of interaction, especially in tropical environments (Bronstein 2015). Ants, for example, have a high taxonomic and morphological diversity in the tropics (Brandão and Delabie 2012), which suggests a wide variety of behaviors and ecological functions, including an active involvement in mutualistic interactions (Rico-Gray and Oliveira 2007). There are many well-known examples of mutualism between ants and plants. In most cases, ants play a defensive role that can have direct effects on the fitness of a given plant species, since the

presence of ants is directly related to a decrease in herbivory and increased vegetative growth and reproduction of the plant host (e.g., Rico-Gray and Oliveira 2007; do Nascimento and Del-Claro 2010). However, the effects of ants on plants are not always positive (Rosumek *et al.* 2009), and can be neutral (Bronstein 1994) or negative (Jones *et al.* 2015).

Except for bees, reports of insect-plant interactions in Clusiaceae are few (e.g., Vlasáková *et al.* 2019), especially for arboreal and otherwise difficult-to-access genera, such as *Lorostemon* Ducke. *Lorostemon* is an Amazonian genus that comprises five species of trees: *L. bombaciflorus* Ducke, *L. coelhoi* Paula, *L. colombianus* Maguire, *L. roseoviridis* Ferr.-

CITE AS: Ferreira-Silva, S.L.; Hopkins, M.G.J.; Mouzinho, T.M.; Rocha, R.A.; Marinho, L.C. 2025. A potential ant-hemiptera-plant mutualism on *Lorostemon coelhoi* (Clusiaceae) in the Brazilian Amazon. *Acta Amazonica* 55: e55bc23250.

Silva & L. Marinho and *L. stipitatus* Maguire (Ferreira-Silva *et al.* 2023, 2024). The genus has solitary, apical or lateral inflorescences (rarely on the branches), and the flowers are large, glabrous, tubular, concave or straight, generally showy yellow-green to yellow-red, with very evident green to red bracts and sepals (Cabral and Marinho 2024). The flowers have a sweet aroma and nectaries that produce a large quantity of nectar. However, as trees of *Lorostemon* occur infrequently, and in very isolated populations, there is few information about ecological interactions or floral visitors (Ferreira-Silva 2023). Here we report the first observation of an insect-plant interaction in *Lorostemon*.

The reported observations were made in the context of a broader study on monitoring of floral visitors in *Lorostemon* species carried out every 1-2 weeks from December 2021 to June 2023 in the municipality of Manaus, Amazonas state, Brazil. Ants were identified through images taken in the field and hemipterans were collected and identified at Instituto Nacional de Pesquisas da Amazônia – INPA, and deposited in the entomological collection of the same institution. The observations were made on five individuals of *L. coelhoi* located at Ramal do Brasileirinho, km 5 (Sítio PANC, Sítio Karla and Sítio Santa Rita) in Manaus (3°01'21.0"S, 59°52'37.2"W). The trees were 3-4 m high and were located approximately 5 to 25 m apart from each other. On each monitoring occasion, the trees were observed by two people during 10 to 12 hours per day (during the day and during the night) on 15 days, with intervals of two to three days

between each visit. The observations were only qualitative, with no behavior quantification, and made from the ground. A ladder was used for flowers placed higher up.

We observed that the five *Lorostemon* trees were visited by ants of *Cephalotes* sp., *Camponotus atriceps* Smith, 1858 and *Dolichoderus* sp., including nest construction by *Camponotus atriceps* and *Dolichoderus* sp. (Figure 1a). On one of the trees, we observed *Corimelaena* nymphs (Hemiptera: Thyreocoridae) at the base of the buds, feeding on the sap of flowers, fruits and petioles (Figure 1c). None of the ants was seen carrying pollen grains, but *C. atriceps* and *Dolichoderus* sp. were observed near the nectaries at the moment of opening of the flowers, probably searching for nectar (Figure 1b). We also observed *C. atriceps* and *Dolichoderus* sp. collecting a sugary honeydew excreted by the *Corimelaena* nymphs. No *Cephalotes* ants were observed on this tree. On the trees without *Corimelaena* nymphs, that ants bit flower buds in search of nectar, making holes in the flower (Figure 1d). Damaged flowers stopped development (Figure 1e), reducing pollination and fruit formation in these trees. The tree with hemiptera formed approximately 70 flowers and 29 developing fruits, while the four trees without hemiptera had less than 20 flowers and five fruits.

Lorostemon does not bear extrafloral nectaries and, when floral nectar was unavailable (e.g., flowers were closed or absent), honeydew was an alternative food source for ants. Even not having observed ants carrying pollen grains, *Camponotus atriceps* and *Dolichoderus* sp., which were probably



Figure 1. Ants and Hemiptera on *Lorostemon coelhoi* Paula (Clusiaceae). **A** – Ant nests among the leaves; **B** – Ant visiting flowers in anthesis; **C** – Ant grazing hemipteran nymphs (black arrowheads); **D** – Flower bud of *L. coelhoi* with holes caused by ants (white arrows); **E** – Non-viable flower bud after predation by ants. Credit: S.L. Ferreira-Silva.

searching for nectar (Figure 1b), might be considered possible pollinators of *L. coelhoi*. *Camponotus* in particular do not have metapleural glands, which are responsible for secreting antibiotic substances, which could reduce pollen viability (Beattie et al. 1984).

Although the number of individuals monitored in this study was too small to be conclusive, we suggest that the presence of hemiptera and their interaction with various ant species contributed to the reproductive success of the trees through a reduction of damaging herbivory by the ants. The traditional theory highlights hemiptera as a resource for the plant to attract ants for plant defense (Campos and Camacho 2014), but our preliminary observations suggest a different hypothesis in that the hemipterans have a crucial role in preventing ants from attacking nectar producing flowers and being nectar-thieves. We understand that other parameters could influence plant reproductive success, such as abiotic factors and morphological characteristics of each individual, however, our observations suggest the occurrence of a tripartite mutualistic interaction among organisms of three trophic levels that possibly has a significant contribution to the reproductive success of *Lorostemon* and deserves further investigation.

ACKNOWLEDGMENTS

We thank Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) for the fellowship granted to the first author, and the graduate program in Botany at Instituto Nacional de Pesquisas da Amazônia (INPA/PPG-BOT) for logistical support.

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RECEIVED: 23/07/2023

ACCEPTED: 24/09/2024

ASSOCIATE EDITOR: Juliana Hipólito

DATA AVAILABILITY: The data that support the findings of this study are available, upon reasonable request, from the corresponding author [Silvia Larissa Ferreira-Silva].



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