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(MINI REVIEW)

Mini Review by parasitoids collected Amazonia Biome

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Abstract

The Amazon is formed by different ecosystems such as dense upland forests, seasonal forests, igapó forests, flooded fields, floodplains, savannas, mountain refuges and pioneer formations. Even though our biome is more preserved, about 16% of its area has already been devastated, which is equivalent to two and a half times the area of the state of São Paulo. For the elaboration of this mini review, which consists of the construction of a bibliographic summary of the main groups of parasitoids of the Order Hymenoptera, with an emphasis on the hymenopterans parasitoids collected in the Amazon Biome (The Brazilian Amazon). A bibliographic search was carried out that contained papers published from 1995 to 2015 on the quantitative aspects of Families, Subfamilies, Genera and Species. The mini review was carried out from December 2019 to January 2020.

Keywords: Insect; Hymenoptera; Natural enemy; Biocontrol; Bibliographic summary

1. Introduction

The Brazilian Amazon passes through the territories of Acre, Amapá, Amazonas, Pará and Roraima, and part of the territory of Maranhão, Mato Grosso, Rondônia and Tocantins [1]. Forming (the regions) North, part of the Northeast and Midwest (Figure 1).

Source: https://diariodopoder.com.br/politica/moradores-da-amazonia-afirmam-que-as-queimadas-nesta-epoca-sao-comuns

Figure 1 General view of the Amazon

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The Amazon is formed by different ecosystems such as dense upland forests, seasonal forests, igapó forests, flooded fields, floodplains, savannas, mountain refuges and pioneer formations. Even though our biome is more preserved, about 16% of its area has already been devastated, which is equivalent to two and a half times the area of the state of São Paulo. Deforestation, fires, mining, agropastore and biopiracy represent the main environmental problems faced by the Amazon biome [1].

The group formed by these devastating actions is responsible for serious climate changes across the planet, such as global warming. The Amazon is considered a great atmospheric "cooler" and as the largest shelter for biodiversity in the world [1].

The citrus industry is growing in the Amazon and one of the pests that cause significant injuries are the scale insects. Knowing the scradoale insect species in citrus orchard and associate them with parasitoids is an important way to contribute with biological control, therefore reducing damage to the environment [2].

The objective of the mini review is to report some works related to parasitoids collected in the Amazon Biome.

2. Methods

For mini review, a bibliographic summary of parasitoids of the Order Hymenoptera (Hymenoptera Parasitica) collected in the Amazon Biome (The Brazilian Amazon) was used. Research was carried out in studies related to the theme with emphasis on the quantitative aspects of Families, Subfamilies, of Genera and Species. (Taxonomic Groups). The mini review was prepared in Goiânia, Goiás, Brazil (Figure 2) in the years 2007 to 2021, using the Online Electronic Scientific Library (Scielo).

Source: https://www.preparaenem.com/geografia/mapa-do-brasil.htm

Figure 2 Map of Brazil: Brazilian Amazon, located in the North Region (Purple color) and in the state of Amazonas

3. Studies carried out

3.1. Study 1

The present study aimed to contribute with ecological information about the parasitoid community in citrus orchards and the forests around it. Using (Malaise trap) [2].

In total, 8399 individuals were collected, distributed in 35 families of parasitoids in the two areas. The most abundant were Scelionidae (1621 individuals /19.3% of the total individuals), Mymaridae (1173/14%), Eulophidae (1058/12.6%) and Encyrtidae (1009/12%) and the most frequent were Scelionidae (91% of the total collections) (Figure 2), Eulophidae (84.2%), Braconidae (74.4%) and Encyrtidae (63%) [2]. In the two citrus groves, 3394 individuals were collected, distributed in 31 families.

The most abundant groups were Encyrtidae (907 / 26.7%), Eulophidae (496 / 14.6%), Scelionidae (436 / 12.8%), Ceraphronidae (302 / 8.9%) and Aphelinidae (250 / 7.3%) and the most frequent were Encyrtidae (89.6%) (Figure 3), Scelionidae (85.4%), Eulophidae (80.2%) (Figure 4) and Aphelinidae (63.6%).

Source: https://br.pinterest.com/pin/223561568980305086/

Figure 3 Representative Encyrtidae (Family)

In the two forest areas, 4634 specimens were collected, divided into 30 families, the most abundant and frequent being Scelionidae (1104 individuals / 23.8% of the total individuals and 96% of the total collections), Mymaridae (1039 / 22.4% and 94%), 23 Eulophidae (531 / 15.6% and 90%) and Braconidae (342 / 7.3% and 88%) [2].

Source: https://www.flickr.com/photos/69610519@N08/38145194696/

Figure 4 Representative Eulophidae (Family)

3.2. Study 2

The parasitoids were collected in four locations in the State of Amazonas, in the municipalities of Iranduba and Manaus. This work aimed to characterize four locations in the State of Amazonas, in relation to parasitoid braconids of fruit flies. Two hundred and five fruit samples from 35 botanical species were examined. Larvae/pupae parasitoids were obtained from flies in 11 fruit species, corresponding to 64 samples. Two thousand six hundred and thirty parasitoids belonging to the to five species of Braconidae: *Doryctobracon areolatus* (Szépligeti, 1911), *Opius bellus* Gahan, 1930, *Opius* sp*., Utetes anastrephae* (Viereck, 1913), *Asobara anastrephae* (Muesebeck, 1958) [3]. Most parasitoids were obtained from fly larvae / pupae on fruits of *Spondias mombin* L. (Anacardiaceae). Of the 2.630 parasitoids collected, 2,080 specimens of *Opius* sp. (79.08%) were obtained from the larvae / pupae of the flies that mainly infested taperebá, in Aleixo [3].

3.3. Study 3

This work aimed to carry out a rapid ecological assessment of the wasp fauna of the Serra do Divisor National Park (PNSD), to support the development of a management plan for that park. The insects were sampled in 12 sites located in eight forest types by Malaise traps that operated in each for 24 hours, totaling 288 hours of sampling. The results on the families Chalcididae, Eucharitidae, Evaniidae, Mutillidae, Pompilidae, Crabronidae and Vespidae (predator) are presented here [4].

Three hundred and sixty-six specimens from 40 genera and 84 species were collected at different PNSD sites. The most representative families in terms of individual abundance were Evaniidae (44%), Vespidae (21.6%) (predator) and Mutillidae (14.5%). The most representative in species were Crabronidae (25%), Vespidae (predator) (23.8%) and Mutillidae (17.9%). The species richest in species were *Ephuta* (Mutillidae) (15.5%), *Trypoxylon* (Crabronidae) (10.7%)

and *Conura* (Chalcididae) (7.1%). *Evaniella* sp. and *Semaeomyia* sp. (Evaniidae) were responsible for about 39% of the collected individuals. 20 or less individuals represented the vast majority (97.6%) of the species [4].

Of the total species, 57 (68%) were collected exclusively from a single sample site. However, some species were collected from most sites. *Evaniella* sp. and *Semaeomyia* sp. (Evaniidae) occurred in 92% and 83% of the sites, respectively; *Ephuta flavidens* Say (Mutillidae) and *Angiopolybia pallens* (Lepeletie) (Vespidae- predador) in 75% [4].

3.4. Study 4

Therefore, the present work aims to contribute with new data on the ecology and diversity of braconid in the Rondonia State, Brazil. Wasps were collected in the Parque Natural Municipal de Porto Velho (PNMPV), Rondonia (8°40' S; 63°52' W). The park is a conservation area that includes 200 ha of Amazon forest near the limits of the urban area of Porto Velho. Insect captures were performed with Malaise traps (from June/ 2008 to May/2009, comprising approximately 1,460 hours/ trap. Six traps were used and monitored monthly for removal of collected material [5]

A total of 377 wasps were collected, 17 subfamilies and 55 genera were identified in one-year period, and also including a not described genus of *Cardiochilinae*. The subfamilies collected in the present study comprises 50% of the 34 subfamilies of Braconidae registered [5].

Source: https://elp.tamu.edu/ipm/bugs/family-braconidae-braconid-wasps/hymenoptera-braconidae-subfamily-microgastrinae-braconid-wasps-g-4/

Figure 5 Representative Microgastrinae (Subfamily)

Source: https://en.wikipedia.org/wiki/Bracon_(wasp)

Figure 6 Genera *Bracon*

The subfamilies Microgastrinae (103) (Figure 5), Rogadinae (73), Braconinae (42) and Doryctinae (48) were the most abundant. Ten genera were the most abundant: *Aleiodes* Wesmael, 1838; *Bracon* Fabricius, 1804 (Figure 6); *Capitonius* Brullé, 1846, *Compsobracon* Ashmead, 1900; *Heterospilus* Haliday, 1836; *Hymenochaonia* Dalla Torre, 1898; *Opius* Wesmael, 1835; *Pedinotus* Szépligeti, 1902; *Rogas* Nees, 1818 and *Stantonia* Ashmead, 1904 [5].

3.5. Study 5

This study aimed to identify parasitoid species of frugivorous larvae and to describe the tritrophic interactions involving wild fruits, frugivorous insects and their natural enemies at Adolpho Ducke Forest Reserve (RFAD) (Manaus, AM, Brazil). Fruits were collected on the ground and/or still hanging from trees and placed in plastic containers to be transported to the laboratory, where the fruits were properly identified and recorded, placed in plastic containers containing a 3.0 cm layer of vermiculite, the containers covered by thin fabric and after one week, the vermiculite was sifted every five days to separate the puparia, which were maintained in plastic containers with a fine layer of vermiculite to obtain flies or parasitoids [6].

One hundred and eighty-five hymenopteran parasitoid specimens of frugivorous larvae were collected at Adolpho Ducke Forest Reserve (69% Braconidae and 31% Figitidae). The braconids belonged to three species of Opiinae (87%): *Doryctobracon areolatus* (Szépligeti), *Utetes anastrephae* (Viereck), and *Opius* sp., and four species of Alysiinae (13%): *Asobara anastrephae* (Muesebeck), *Phaenocarpa pericarpa* Wharton and Carrejo, 1999, *Idiasta delicata* Papp, 1969, and *Asobara* sp. [6].

Doryctobracon areolatus (Figure 7) had the highest parasitism percentage with 66.7% on larvae in *M. williamii* fruits, while in other opiines parasitism rates were: *Opius* sp. (1.63 to 3.10%) and *U. anastrephae* with 4.97% on *A. edentula*. Figitids was observed for *Aganaspis pelleranoi* (Brèthes) with 20% on *Osteophloeum platyspermum* (Spruce ex A. OC.) fruits (Myristicaceae) [6].

Source: https://www.researchgate.net/figure/The-proportions-of-Doryctobracon-areolatus-Diachasmimorpha-longicaudata-Opius-hirtus_fig6_51568995

Figure 7 Representative *Doryctobracon-areolatus* (Szépligeti) (Specie)

4. Conclusion

Brazil is one of the few countries in the world that hold the so-called biological megadiversity, that is, important ecosystems, still healthy. This biodiversity can offer unique opportunity for pest control in both Brazil and other countries, due to the identification of new organisms with potential to be used in biological control. For many agroecosystems in our country, little is known about the biodiversity and identity of species of natural enemies with the function of sustaining crop production.

Compliance with ethical standards

Acknowledgments

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