Studies and surveys of parasitoids collected from oceanic islands

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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. For the preparation of this study, which consists of building a bibliographic summary of the main groups of parasitoids of the Order Hymenoptera (Parasitica Hymenoptera) collected in the Amazon Biome, a bibliographic search was carried out that contained published works on the following aspects: Definition Caatinga, Characteristics Hymenoptera, Characteristics Parasitica Hymenoptera, Main Superfamilies, and Families and Studies carried out and Main genera or species, during the period from December 2019 to January 2020.

Keywords: Insect, Hymenoptera, natural enemy, biocontrol, bibliographic summary

Introduction

This biome occupies an area of 4,196,943 km², which corresponds to more than 40% of the national territory and consists mainly of a tropical forest. The Amazon passes through the territories of Acre, Amapá, Amazonas, Pará and Roraima, and part of the territory of Maranhão, Mato Grosso, Rondônia and Tocantins (Linhares & Gewandsznajder 1998). 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, agropasture and biopiracy represent the main environmental problems faced by the Amazon biome (Linhares & Gewandsznajder 1998).

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 (Linhares & Gewandsznajder 1998).

The citrus industry is growing in the Amazon and one of the pests that cause significant injuries are the scale insects.
Knowing the scathed 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 (Oliveira, 2015).

2-Methods
For the preparation of this study, which consists of building a bibliographic summary of the main groups of parasitoids of the Order Hymenoptera (Parasitica Hymenoptera) collected in the Amazon Biome, a bibliographic search was carried out that contained published works on the following aspects: Definition Caatinga, Characteristics Hymenoptera, Characteristics Parasitica Hymenoptera, Main superfamilies, and Families and Studies carried out and Main genera or species, during the period from December 2019 to January 2020.

3- Parasitic Hymenoptera characteristics, main superfamilies and families and studies carried out and main genera or species
The parasitoids were collected in a gradient comprising 80 meters inside the forest until 80 meters inside the orchard. The scale insects were collected in a gradient comprising the forest edge until 80 meters inside the orchard and than carried to laboratory to quantify the emergence of parasitoids. We tested the influence of edge distance and spontaneous vegetation on abundance, richness, diversity and composition of parasitoid families. For the parasitoids species correlated with de scales reared in laboratory we tested the influence of edge distance, spontaneous vegetation and citrus scale abundance over the abundance and richness of scale parasitoids (Oliveira, 2015).

Overall, the composition of families was different between forest, edge and orchard and abundance, richness and diversity of parasitoid families were both influenced by edge distance and spontaneous vegetation on orchard, we also found that the spontaneous vegetation reduced the edge effect and influenced the abundance, diversity and richness of some families of parasitoids. In the rearing of scales, were found nine species belonging to four families, Diaspididae, Coccidae, Pseudococcidae and Ortheziidae (Oliveira, 2015).

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), Eulophidae (84.2%), Braconidae (74.4%) and Encyrtidae (63%). 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%), Scelionidae (85.4%), Eulophidae (80.2%) and Aphelinidae (63.6%). 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%), B 23 Eulophidae (531 / 15.6% and 90%) and Braconidae (342 / 7.3% and 88%) (Oliveira, 2015).

In the traps of the interior of the plantation and edge, 5098 individuals were collected, distributed in 40 families of Hymenoptera. Of these, 1083 were mealybug parasitoids and seven species were identified: Arrenophagus chionaspidus,
Encarsia lounsburyi, Aphytis diaspidis, Cheiloneurus javensis, Anagyrus pseudococci, Encyrtus infelix and Metaphycus flavus Howard, belonging to two families, Encyrtidae. The most abundant species were A. chionaspidus and E. lounsburyi, corresponding to 90% of the total parasitoids collected. Although specimens of Encyrtidae and Aphelinidae were collected in the traps in the interior of the forest, the species collected were different from those that emerged from scale insects in the laboratory (Oliveira, 2015).

In total, 8624 scale insects belonging to nine species were collected: Pinnaspis aspidistrae, Selenaspis articulatus, Chrysomphalus aonidum, Lepidosaphes gloverii, Lepidosaphes beckii, Coccus viridis, Ceroplastes floridens, Protopulvinaria pyriformis, Pseudocidiidae, Pseudocidiidae, and Ortheziidae. The most abundant species were P. aspidistrae with 8082 specimens and S. articulatus with 187 specimens, these two species accounted for 95% of the total number of individuals. The spontaneous vegetation did not affect the abundance and diversity of parasitoids of scales but as the abundance of scales increase, abundance of parasitoids increased too. The vegetation plays an important role over Hymenoptera community and the use of some techniques such as intercropping attractive plants, ecological corridors and maintenance of adjacent edges contribute to increase the parasitoid diversity because it provides alternative hosts and food (Oliveira, 2015).

A total of 2,630 braconids from Anastrepha spp. were recovered in four locations of two counties (Manaus and Iranduba) in Amazonas State, Brazil. The parasitoids belong to five species. Opius sp. was the predominant species, showing the highest frequency in the downtown region of Manaus. On the other hand, Doryctobracon areolatus (Szépligeti, 1911) was the predominant species in the countryside. For the faunistic analysis, each collecting site was considered a community. The coefficient of similarity between communities varied from 82 to 100% (Canal et al., 1995).

The Serra do Divisor National Park (PNSD), located at the northwest of Acre State, Amazonia, is considered an area of great biodiversity. The question of considering insects in conservation programs. Solitary and social wasps are important components of the terrestrial ecosystems due to their position in trophic webs. The present study aimed at making a rapid ecological assessment of the wasps from the PNSD in order to support the elaboration of a conservation and 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 are presented here (Morato, et. al., 2008).

On the whole, 366 wasps were collected representing 40 genera and 85 species. The genera Ephuta (Mutillidae), Trypoxylon (Crabronidae) and Conura (Chalcididae) were the most specious. The sites situated at the northern region of the PNSD, the intangible and primitive zones, were the most species rich. Some collected species were considered rare and about 65% of species were exclusive to only one site. This means that the samples have little faunal similarity (Morato, et. al., 2008).

Braconidae is a highly diversified family of Hymenoptera and usually known by their role in biological control both in
agricultural and natural ecosystems. Despite of that, little is known about its diversity in the Amazon region. The present work inventoried the braconid fauna of an Open Ombrophylous Forest with Palm Trees of the Parque Natural Municipal de Porto Velho, RO. Insects were collected from June/2008 to May/2009 using six Malaise traps in different parts of the reserve (Gadelha, et al., 2012).

A total of 377 wasps were captured, 17 subfamilies and 56 genera identified. Braconinae, Microgastrinae, Doryctinae and Rogadinae subfamilies were very abundant, and also the genera *Aleiodes, Bracon, Capitonius, Compsobracon, Heterospilus, Hymenochaonia, Opius, Pedinotus, Rogas* and *Stantonia*. The calculated Shannon diversity index was 2.15 and 3.3 for subfamily and genera, respectively, which were, generally, higher than the values found for other regions in Brazil. Generally, parasitoids were more abundant during the rainy season. The present work contributes with new genera records and faunistic data of Braconidae in Rondonia State, western Amazon (Gadelha, et al., 2012).

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). Collections were performed in four 1 km² quadrants in the corners of the RFAD. The wild fruits were collected inside the forest in access trails leading to each collection area and in trails that surrounded the quadrants, up to five metres from the trail on each side. The fruits were placed in plastic containers covered with thin fabric, with a vermiculite layer on the base to allow the emergence of flies or parasitoids (Costa, 2009).

Seven Braconidae species were collected, distributed among Opiinae: *Doryctobracon areolatus* (Szépligeti, 1911), *Utetes anastrephae* (Viereck, 1913), and *Opius* sp., and Alysiinae: *Asobara anastrephae* (Muesebeck, 1958), *Phaenocarpa pericarpa* Wharton and Carrejo, 1999, *Idiasta delicata* Papp, 1969, and *Asobara* sp. Parasitism rates by braconids and figitids are presented. *Doryctobracon areolatus* was the most frequent, parasitizing the highest number of fly species, and showing the highest parasitism percentage in larvae feeding on *Micropholis williamii* fruits. The collected figitids belong to *Aganaspis nordlanderi* Wharton, 1998 and *A. pelleranoi* (Brethes, 1924). All 15 tritrophic associations are new records for the Brazilian Amazon region. The RFAD is an important natural reservoir of frugivorous larvae parasitoids (Costa, 2009).

Fruit production is an important agricultural activity in Brazil, fruit flies (Diptera: Tephritidae) being the main phytosanitary problem for the chain. In the Amazon region, the cultivation of different native and exotic fruit trees is extensive, usually inserted in diversified systems of family farmers, where it plays an important role in the food security of these families as well as complementing their income. This research characterized the fruit production systems of family farming communities, through the collection of fruits in these areas, to determine the diversity of fruit fly species, their hosts and natural enemies in two municipalities of the northeast of Pará (Façanha, 2017).

The studies were carried out in the municipalities of Igarapé-Açú (S 1° 07'33" - W 47° 37'27") and Marapanim (S 00° 43'03" - W 47° 41'59"). Selected farmers were interviewed according to their availability, in order to characterize the fruit
production systems found (and collection of fruit samples to identify fruit flies, their hosts and natural enemies. The
taking was carried out on diversified systems and the surrounding areas. Fruits were collected randomly from plants
and recently fallen from the ground. The samples were conditioned and taken to the entomology laboratory of Embrapa
Amazônia Oriental, where they were arranged in plastic trays wrapped in organza fabric and evaluated every 48 hours to
verify the emergence of pupae. The pupae were deposited in transparent plastic flasks (8 cm in diameter x 6 cm in height)
on a thin layer of vermiculite and wrapped in organza fabric, conditioned in B.O.D until adults were obtained. The adults
that emerged were killed and deposited in other flasks containing 70% ethanol and labeled for further identification
(Façanha, 2017).

In this research, 1287 fruits were collected, divided into 57 composite samples and 77 individualized samples, belonging
to 17 fruit tree species of 10 botanical families. Only 303 fruits were infested by fruit fly larvae of which 504 pupae were
counted, that originated 197 specimens of tephritids, all from the genus Anastrepha. Four species were identified,
including A. bahiensis, the first record of this species associated with fruits of carambola (Averrhoa carambola) at the State
of Pará. Fruits of five hosts were infested, all previously described in Pará. From the samples 48 parasitoids from the
Braconidae family of three different species were obtained: Doryctobracon areolatus (Szépligeti), Opius bellus (Gahan)
and Asobara Anastrephae (Muesebeck) (Façanha, 2017).

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