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New Braconidae (Hymenoptera: Ichneumonoidea) records from Cuniã Ecological Station, Porto Velho, Rondônia, Brazilian Western Amazon

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Abstract

The ecological station of Cuniã (ESEC Cuniã) was created in order to avoid the loss of biodiversity at the Purús-Madeira interfluvium, where the re-asphalting of BR-319 facilitated access to the region causing an excessive exploitation of its natural resources. To contribute with the purpose of legal biological reserves, it is now necessary to explore the biodiversity within this area, such as parasitoid hymenopterans of the Braconidae family, which can be used as indicators of the arthropod diversity. Therefore, the present work aimed to carry out a survey of the Braconidae genera in the ESEC of Cuniã. Sampling were carried out in the PPBio grid, an area of 25 km², using Malaise traps, in the years of 2011 and 2012, totaling 4 collection events. A total of 360 specimens were collected, identified in 18 subfamilies and 69 genera. Six subfamilies and 36 genera are new records for Rondônia. The subfamilies with the greatest genus richness were Microgastrinae (17) and Doryctinae (12), while the most abundant genera were *Heterospilus* Haliday (39), *Bracon* Fabricius (22), *Rogas* Nees (16) and *Chelonus* Panzer (15). General diversity of subfamilies and genera was similar to other Brazilian regions, suggesting a rich diversity of Braconidae at ESEC of Cuniã. Moreover, some genera found has potential use for future biological control programs.

Key words: Parasitoids, Microgastrinae, Doryctinae, Diversity.

Resumo

A estação ecológica de Cuniã foi criada no intuito de evitar a perda da biodiversidade no interflúvio Purús-Madeira, onde o reasfaltamento da BR-319 facilitou o acesso a região causando uma exploração excessiva de seus recursos naturais. Para contribuir com o propósito das reservas biológicas legais, se faz necessário agora explorar a biodiversidade desta área, como os himenópteros parasitóides da família Braconidae, que podem ser utilizados como indicadores da diversidade de artrópodes. Assim, o presente trabalho teve como objetivo realizar um inventário dos gêneros de Braconidae da ESEC de Cuniã. As coletas foram realizadas na grade do PPBio, uma área de 25 km², utilizando armadilhas do tipo Malaise, nos anos de 2011 e 2012, totalizando 4 coletas. Ao todo foram coletados 360 espécimes, identificados em 18 subfamílias e 69 gêneros. Seis subfamílias e 36 gêneros são novos registros para Rondônia. As subfamílias com maior riqueza de gêneros foram Microgastrinae (17) e Doryctinae (12), enquanto os gêneros mais abundantes foram *Heterospilus* Haliday (39), *Bracon* Fabricius (22), *Rogas* Nees (16) e *Chelonus* Panzer (15). A diversidade geral de subfamílias e gêneros foi similar a outras regiões brasileiras, sugerindo uma rica diversidade de Braconidae na ESEC de Cuniã. Além disso, alguns gêneros encontrados possuem uso potencial para futuros programas de controle biológico.

Palavras-chave: Parasitoides, Microgastrinae, Doryctinae, Diversidade.

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Introduction

The loss of biological diversity due to the environment degradation is a worldwide problem, therefore it necessary to identify and register the organisms present in these areas, as soon as possible (Landau *et al*., 1999). In this context, the Estação Ecologica (ESEC) de Cuniã was created in the Purús-Madeira interfluvium as a way of trying to contain the impacts caused in the region due to the excessive exploitation of its natural resources, occurring mainly after the access that was provide to the region due to the re-asphalting of highway BR-319 (Brasil, 2018).

One way to access the biodiversity is through parasitoid Hymenoptra, since these can be used as indicators of arthropod diversity or even as bioindicators of anthropogenic disturbances in natural areas (Basset *et al*., 2004; Stevens *et al*., 2013).

Braconidae is the second largest family of Hymenoptera, with approximately 19,500 valid species (Yu *et al*., 2011) and an estimated 100,000 (Hanson & Gauld, 2006). It differs from Ichneumonidae, the largest one, due to the absence of the recurrent vein (2m-cu) in anterior wings and the rigid junction of the second and third metasomal tergites (Triplehorn & Johnson, 2005). Braconidae has a wide distribution in all terrestrial habitats, except the poles (Hanson & Gauld, 2006). Most of the braconids are parasitoids of larvae and pupae of all orders of insects, except for Megaloptera and Siphonaptera (Gillot, 2005). However, a number of studies have shown that some groups are phytophagous, parasitizing both galls (Wharton & Hanson, 2005; Penteado-Dias & Carvalho, 2008; Zaldívar-Riverón *et al.*, 2014) and fruits, where they occur mainly in seeds (Macedo & Monteiro, 1989; Infante *et al.*, 1995; Wharton & Hanson, 2005; Chavarría *et al.*, 2009).

Some species of Braconidae are economically important as potential pest control (González & Ruiz, 2000). In addition, they are also important regulators of natural insect populations (Lasalle & Gauld, 1993), and due to their host-parasitoid specificity, they can be used to infer the presence or absence of their hosts in a given environment (Matthews, 1974; LaSalle & Gauld, 1993).

Few works have studied general Braconidae diversity in the Amazon region, e.g., Gadelha *et al.* (2012) in the Porto Velho Municipal Natural Reserve, Rondônia, and Oliveira *et al.* (2017) in *Citrus* plantations surrounded by Amazon rainforest. The other studies focus on a specific group of braconids that are parasitoids of frugivorous larvae, e.g., Costa *et al.* (2009) which found seven species of Braconidae in the Adolpho Ducke Forest Reserve in Manaus. Despite the lack of studies on the group's diversity in the Amazon Region, braconids comprise a large part of the parasitoid hymenopteran fauna in the region as observed by Feitosa *et al.* (2007) and Querino *et al.* (2011).

Therefore, the present work aimed to inventory the Braconidae of the Estação Ecológica de Cuniã and thus contribute with new information about the group's distribution in the State of Rondônia, Brazilian Western Amazon region.

Material and Methods

Study area

The Estação Ecológica de Cuniã (ESEC Cuniã) has a total area of 189,661.23 hectares and is located in the Purus-Madeira rivers interflow. Vegetation is highly influenced by the local hydrological cycle in fluviolacustre plains with predominance of floodplains. In higher areas, Dryland forests and Savana (Cerrado) predominate, in addition to their ecotones. The main climate is the Tropical Monsoon and the rainfall averages exceed 1,500mm per year with about 55 to 74 dry days per year (Brasil, 2018)

This study was carried out in a 25Km² grid of the Biodiversity Research Program (PPBio), installed at ESEC Cuniã, including 12 tracks of 5 km in length, 6 in the north-south direction and 6 in the east-west direction, divided into 30 permanent 250 m^2 plots with variable width adjacent to the tracks (PPBio, 2012).

Sampling design and data collection.

Sampling was performed using Malaise traps, as proposed in the collection protocol number 4 of PPBio (Magnusson & Martins, 2005).

Four field trips were carried out in the period between April / 2011 to August / 2012 to alternately sample 15 plots, of the 30 existing at the Cuniã grid (Figure 1). In each plot, a Malaise was set up, so that in the first two campaigns eight parcels were sampled (four in each), in the third six parcels were sampled and in the last campaign one parcel was sampled. Each field trip lasted 14 days and each plot was sampled for 240 hours (10 days) of active trap. The specimens collected in each Malaise were removed every 48 hours and placed in plastic bottles with 70% alcohol until sorting.

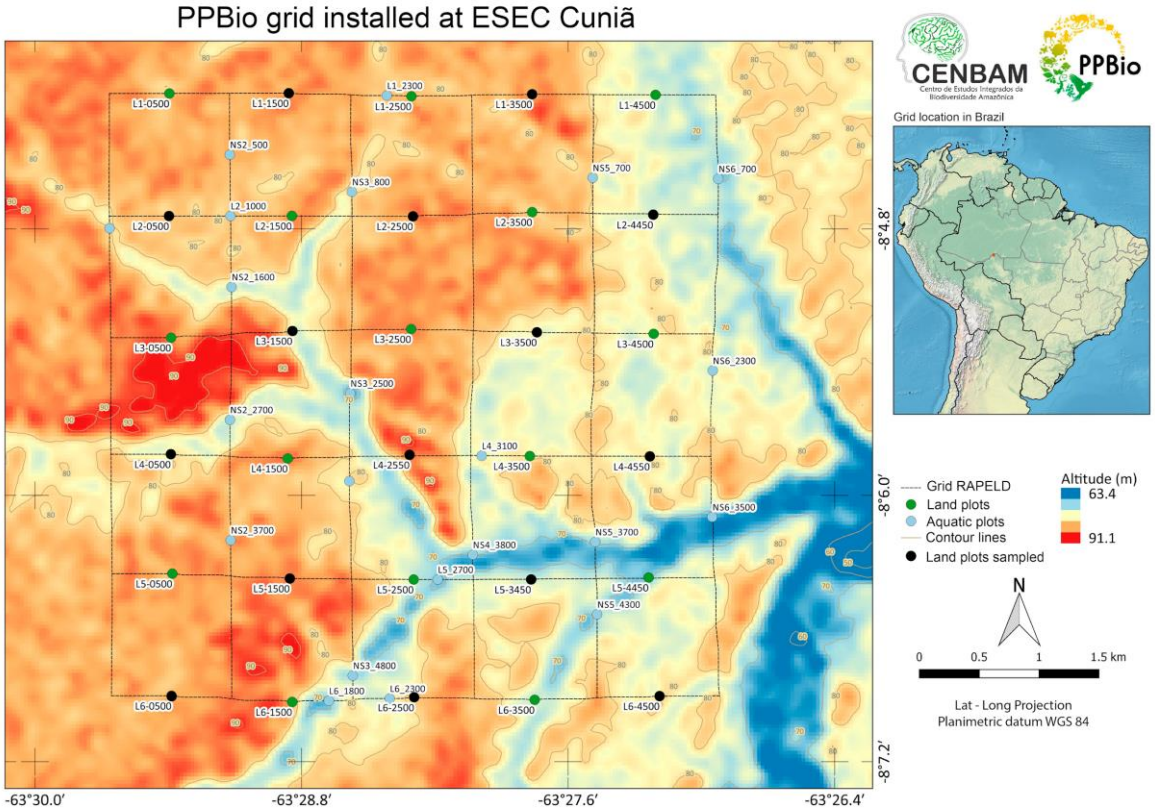

Figure 1: PPBio grid installed at the Ecological Station of Cuniã, Porto Velho, RO. Plots sampled in the present study are represented with black dots. Source: Modified from Programa de Pesquisa em Biodiversidade, ESEC Cuniã (available at http://ppbio.inpa.gov.br/sitios/cunia).

Specimen identification

After the field trips, the collected material was taken to the Laboratório de Bioecologia de Insetos (LABEIN) at Federal University of Rondônia (UNIR), Brazil, where the specimens of Braconidae were separated from the other groups captured using a stereomicroscope with a 350x magnification. Subfamilies were identified using the identification keys of Hanson e Gauld (2006)

and Wharton *et al.* (1997), and genera were identified using the identification keys of Wharton *et al.* (1997) and Marsh (2002) and also confirmed with the help of the staff of Instituto Nacional de Ciência e Tecnologia dos Hymenoptera Parasitoides da Região Sudeste Brasileira. Only Microgastrinae males could not be identified at a generic level, since the key used is based on female morphological characters. Furthermore, due to the high number of undescribed species of Braconidae and the lack of identification keys for Amazonian species of many groups of the family we were not able to identify species already.

After identification, specimens were individualized in 1.5 ml plastic microtubules with 70% alcohol and tagged with identification and field data (location, date and plot). Subsequently, the material was deposited in the entomological collection of the Universidade Federal de Rondônia, except for the Doryctinae specimens that were deposited in the invertebrate collection of the Instituto Nacional de Pesquisas da Amazônia (INPA).

Results and discussion

A total of 360 specimens of Braconidae were collected and identified in 18 subfamilies and 69 genera (Table 1).

The number of subfamilies collected represents about 42% of the 43 subfamilies of Braconidae in the world (Quicke, 2015) and about 64% of the number of subfamilies of Braconidae already described for Brazil (28) according to the taxonomic catalog of the Brazilian fauna (Shimbori *et al.*, 2020). In addition, six of them (Blacinae, Euphorinae, Pambolinae, Rhysipolinae, Ichneutinae and Miracinae) are registered for the first time for the state of Rondônia.

Microgastrinae was the most frequent sampled subfamily with 144 individuals, followed by the subfamilies Doryctinae (61), Rogadinae (30) and Braconinae (29), four of the largest and most diverse subfamilies of Braconidae (Wharton *et al.*, 1997).

Microgastrinae constitutes the largest subfamily of Braconidae with almost 3,000 valid species and worldwide distribution in all the main terrestrial ecosystems (Fernandez-Triana et al., 2020), and also in Brazil (Restello & Penteado-Dias, 2006; Gadelha *et al.*, 2012; Oliveira *et al*., 2017). Its high abundance and diversity of species is possible related to its gregarious habit, *i.e.* several larvae can complete their development on the same host (Hanson & Gauld, 2006), and to preserved environments presenting high number of niches available for the development of defoliating insects, such as lepidoptera, which constitute the hosts of this subfamily (Whitfield, 1997; Fernandez-Triana *et al*., 2020).

Doryctinae is among the most diverse subfamilies of Braconidae (Wharton, 1997) and it is the second most abundant in this work. This group is composed mostly of idiobiont ectoparasitoids of Coleoptera wood boring larvae (Marsh, 2002), however, it also has a small group of phytophagous individuals associated with galls (Marsh, 2002; Zaldívar-Riverón *et al.*, 2007; 2014).

As expected, Microgastrinae (17) and Doryctinae (12) had the highest genera richness. However, only the last one was represented among the most abundant genera, which were *Heterospilus* Haliday (Doryctinae) with 39 individuals, *Bracon* Fabricius (Braconinae) with 22, *Rogas* Nees (Rogadinae) with 16 and *Chelonus* Panzer (Cheloninae) with 15 individuals. Among the 69 genera identified, more than half (36) are new records for the state of Rondônia.

Table 1. Subfamilies, genera and abundance of Braconidae collected from April 2011 to August 2012, at ESEC Cuniã (* New records for the state of Rondônia).

SUBFAMILY/*Genus*	Number of individuals
AGATHIDINAE	**8**
Bassus Fabricius	1
Coccygidium Saussure,	1
Earinus Wesmael	2
Zamicrodus Viereck	4
ALYSIINAE	**6**
Asobara Foerster*	1
Aspilota Foerster*	2
Dinotrema Foerster*	1
Phaenocarpa Foerster*	2
BLACINAE*	**6**
Blacus Nees*	6
BRACONINAE	**29**
Bracon Fabricius	22
Compsobracon Ashmead	2
Cyclaulacidea Quicke & Delobel*	1
Digonogastra Viereck*	4
CHELONINAE	**19**
Ascogaster Wesmael*	1
Chelonus Panzer	15
Phanerotoma Wesmael	2
Pseudophanerotoma Zettel	1
DORYCTINAE	**61**
Acanthorrogas Szégligeti*	1
Allorhogas Gahan, 1912*	1
Amazondoryctes Barbalho & Penteado-Dias*	5
Ecphilus Foerster*	1
Hansonorum Marsh	1
Heterospathius Barabalho & Penteado-Dias*	2
Heterospilus Haliday	39
Johnsonius Marsh	1
Liobracon Ashmead*	1
Notiospathius Mattews & Marsh	5
Pedinotus Szépligeti	2
Semirhytus Szépligeti	2
EUPHORINAE*	**2**
Centistes Haliday*	1
Euphoriella Ashmead*	1
GNAMPTODONTINAE	**2**
Gnaptodon Haliday	1
Pseudognaptodon Fisher*	1
HELCONINAE	**9**
Eubazus Nees	3
Nealiolus Mason*	4
Topaldios Papp*	1

Urosigalphus Ashmead	1
HORMIINAE	**10**
Hormius Nees	9
Parahormius Nixon*	1
PAMBOLINAE*	**5**
Pambolos Haliday*	5
RHYSIPOLINAE*	**2**
Rhysipolis Foerster*	2
ICHNEUTINAE*	**8**
Muesonia Sharquey & Wharton*	1
Oligoneurus Szégligeti*	5
Paroligoneurus Muesebeck*	1
Proterops Wesmael*	1
MICROGASTRINAE	**144 (60 ♀ + 84 ♂)**
Alphomelon Mason	4
Apanteles Foerster	12
Choeras Mason*	2
Cotesia Cameron*	6
Diolcogaster Ashmead	9
Distatrix Mason*	1
Fornicia Brullé	1
Glyptapanteles Ashmead	11
Hypomicrogaster Ashmead	4
Microplitis Foerster*	3
Parapanteles Ashmead*	1
Promicrogaster Brues & Richardson*	3
Pseudapanteles Ashmead	1
Wilkinsonellus Mason*	1
Xanthomicrogaster Cameron	1
MIRACINAE*	**2**
Centistes Haliday*	1
Mirax Haliday*	1
OPIINAE	**11**
Opius Wesmael	11
ORGILINAE	**6**
Orgilus Haliday	4
Stantonia Ashmead	2
ROGADINAE	**30**
Aleiodes Wesmael	11
Clinocentrus Haliday*	1
Rogas Nees	16
Stiropius Cameron	2

Heterospilus, the genus most collected in this work is also one of the most diverse within Doryctinae with about 400 species described (Yu *et al.*, 2011; Marsh *et al.*, 2013) and estimates of at least 50 to 100 more species not described in Costa Rica only (Marsh *et al.*, 2013). This genus has already been registered among the most abundant of the family in other surveys of Braconidae carried out in Brazil (Cirelle & Penteado-Dias, 2003; Gadelha *et al.*, 2012) and this abundance and diversity

may be related to the parasitic habits of this genus, which has a wide range of hosts including several families of Coleoptera, Lepidoptera and even Hymenoptera (Symphyta) (Marsh, 2002).

Bracon, a generalist parasitoid that like *Heterospilus*, is idiobiont ectoparasitoids of last-instar wood boring larvae and pupae of Coleoptera, Lepidoptera and Diptera, (Shaw & Huddleston, 1991). Some species of *Bracon* are used in biological control programs for root-eating caterpillars and stored product pests (Wharton *et al.*, 1997). Brower and Press (1990) argued that the use of natural enemies, including the species *Bracon hebetor* (Say, 1836), provided good results in stored peanut pests. *Bracon celer* Szepligeti, 1913 has been reported as the most effective parasitoid to attack olive flies in South Africa (Neuenschwander, 1982) and Kenya (Silvestri, 1914), in South African olive groves *B. celer* had a level of parasitism of 87% (Annecke & Moran, 1982).

Rogas, despite being a common genus in surveys of Braconidae, is seldom used in biological control in the Neotropical region (Shaw, 1997), despite of parasitizing a wide range of hosts from the Lepidoptera Noctuoidea, Geometroidea and Sphingoidea superfamilies (Wharton *et al*., 1997).

Chelonus has species reported as natural enemies of Lepidoptera. *Chelonus texanus* Cresson, 1872, e.g., as a natural enemy of *Spodoptera frugiperda* (Smith), *Spodoptera exigua* (Hubner), *Heliothis zea* Walker *e Elasmopalpus lignosellus* (Zeller), that are corn pests (Wall & Berberet, 1975). The parasitic potential of the genus *Chelonus* has been studied in different pests, e.g., *Chelonus blackburni* Cameron, 1886, in eggs of *Corcyra cephalonica* (Stainton) (Lepidoptera, Galleriidae) and *Earias viuella* Wiltshire (Lepidoptera, Noctuidae), both cotton pests. In *Pectinophora gossypiella* (Saunders) (Lepidoptera, Gelechiidae) the female of *C. blackburni* laid 909 eggs, indicating a high reproductive capacity when compared to other species of microhimopterans (Jackson *et al.*, 1978; Swamiappan & Balasubramanian, 1979). Thus, due to its high abundance in the region and proven efficiency in biological control, this genus can be considered in future biological pest control programs, and more specific studies regarding its use need to be carried out.

Conclusion

The diversity and abundance of specimens, subfamilies and genera of Braconidae collected is similar to that found in other studies with this family. Despite that, greatly contributes to the knowledge of the Braconidae fauna of Rondônia reporting new records of six subfamilies and 36 genera for the state. Some of the observed genera have the potential to be evaluated as possible candidates for future biological control programs that may be implemented in the state of Rondônia or in the Amazon region.

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