Diversity of Braconidae (Insecta, Hymenoptera) of the Parque Natural Municipal de Porto Velho, Rondonia, Brazil

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ABSTRACT. Diversity of Braconidae (Insecta, Hymenoptera) of the Parque Natural Municipal de Porto Velho, Rondonia, Brazil. 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 ombrophilous 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. 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, Opisus, 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 Rondônia State, western Amazon.

KEYWORDS. Ichneumonoidea; parasitoid wasps; richness; Western Amazon.


PALAVRAS-CHAVE. Amazônia Ocidental; Ichneumonoidea; riqueza; vespas parasitoides.

Braconidae, the second most diverse family of Hymenoptera, includes more than 15,000 species, but species richness is estimated in 100,000 (Hanson & Gauld 2006). The insect size varies from 1 to 30 mm, excluding ovipositor and antennae. Braconidae are cosmopolitan (Gauld & Bolton 1988; Hanson & Gauld 2006) parasitoids of other insects such as Coleoptera and Lepidoptera (Gillot 2005). These wasps have an important role in the population dynamics of phytophagous insects, with emphasis on biological control of agricultural pests (Gauld & Bolton 1988; Gillot 2005).

Diego & Campos (2001) reviewed the distribution of Braconidae genera recorded for the Neotropical region, particularly to Colombia and in general for South America or Central America, without the exact notation of the records. In general, there are few systematic inventories describing the Amazon fauna of parasitoids (Ichneumonoidea). Feitosa et al. (2007) collected parasitic wasps in reserves 1112, 1208 and 1301 included in the BDFFP, and reported that the Braconidae comprised 93% of the wasps collected, therefore the most abundant family. Most studies focused on parasitoids of frugivo-rous insect larvae, e.g., Costa et al. (2009) found seven species of Braconidae of the subfamily Alysiinae and three Opininae in the Adolfo Ducke forest reserve in Manaus. In a similar study, Thomazini & Albuquerque (2009) also reported three species of Opininae parasitizing the larvae of fruit flies in Acre State. Pereira et al. (2010) related the first record of Doryctobracon areolatus (Szépligeti) and Opisus bellus Gahan (Opininae) in the larvae of fruit flies collected in Rondônia.

In this sense, more studies on the diversity of insect parasitoids in the Neotropical region, especially those that combining biology, distribution, behavior and related subjects are needed. Therefore, the present work aims to contribute with new data on the ecology and diversity of braconid in the Rondonia State, Brazil.
MATERIAL AND METHODS

Area of study. 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.

The predominant vegetation at PNMPV is the Open Ombrophylous Forest with Palm Trees of dry land lower areas, i.e., altitude not exceeding 100 meters.

The climate in the region is typically hot and humid tropical during the whole year, with very narrow annual temperature range and remarkable amplitude during daytime, especially in the winter. There are markedly dry (Spring and Summer) and rainy (Autumn and Winter) seasons, and under the influence of Aw climate, the average annual rainfall varies between 1400 and 2500 mm/year, and annual average air temperature between 24°C and 26°C.

Sampling design and data collection. Insect captures were performed with Malaise traps (Townes 1972) from June/2008 to May/2009, comprising approximately 1,460 hours/trap. Six traps were used, and installed in several parts of the park to cover potential vegetation variation in the sampled area. Traps were monitored monthly for removal of collected material and replenishment of lethal liquid (70 % Ethyl Alcohol).

Set of two traps, placed 30 to 45 meters from each other, were distributed in three different areas of PNMPV. The different areas were 100 meters apart from each other, and included a border area, near the limits of the visitation area of the park, characterized by intense human activity and the predominance of small trees and presence of many palm trees; a dryland area with conserved Open Ombrophylous Forest that comprises most of the park area, characterized by the large trees and denser understory; and seasonal flooded area, with Open Lowland Ombrophylous Forest, near the Belmont stream, characterized by regular-sized trees with discontinuous canopy and open understory.

The collected material was identified based on taxonomic keys (Wharton et al. 1997; Marsh 2002) and with the help of INCT Hympar Sudeste staff, from Universidade Federal de São Carlos, São Carlos, São Paulo. The specimens are deposited in the collection of entomology at the Universidade de São Carlos, São Carlos, São Paulo. The program calculates the richness of subfamilies, genera and species, i.e., S_{cha02} = S_{obs} + Q_1 - 2Q_2, meaning: S_{obs} = number of genera observed; Q_1 = number of genera that occurs in only one sample; Q_2 = number of genera that occurs in two samples.

The Shannon diversity index (H) in this study was 2.15 ± 0.08. The Shannon diversity index (H) was based on the results from the statistical calculations of the program ANAFAU, developed by the Departamento de Entomologia, Fitopatologia e Zoologia Agrícola, ESALQ/USP.

The program uses the following formula for the calculation of diversity: 

\[ H = - \sum_{i=1}^{k} \frac{p_i}{n} \log \frac{p_i}{n} \]  

where \( k \) = total number of subfamilies/genera, \( p_i \) = proportion of subfamilies/genera, \( f_i \) = frequency of subfamilies/genera and \( n = total number of individuals of all subfamilies/genera. Males Microgastrinae subfamily were not included in the analysis of genera diversity, because the identification keys are based on morphological characters of females.

Two Way Anova tests analyzed parasitoid abundance and richness variation during the sampling period. The variables included were period of sampling (months) and trap. All tests were performed using SigmaStat 2.0.

RESULTS AND DISCUSSION

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 (Table I).

The subfamilies collected in the present study comprises 50% of the 34 subfamilies of Braconidae registered for the New World by Wharton et al. (1997) and 68% of the estimated value for the richness of subfamilies (S_{cha02} = 25). The 56 genera of Braconidae collected in this study comprised 60.87% of the estimated richness of genera (S_{cha02} = 92).

The subfamilies Microgastrinae (103), Rogadinae (73), Braconinae (42) and Doryctinae (48) were the most abundant. The other subfamilies had lower numbers, mostly below ten individuals. Nevertheless, the most abundant subfamilies found in the present work are similar to the pattern found in other areas (Cirelli & Penteado-Dias 2003; Scatolini & Penteado-Dias 2003; Restello & Penteado-Dias 2006) (Table I).

Ten genera were the most abundant: Aleiodes Wesmael, 1838; Bracon Fabricius, 1804; Capitonius Brullé, 1846; Compsbracon Ashmead, 1900; Heterospilus Haliday, 1836; Hymenochaonia Dalla Torre, 1898; Opius Wesmael, 1835; Pedinotus Szépligeti, 1902; Rogas Nees, 1818 and Stantonia Ashmead, 1904 (Table I). Only two genera, Aleiodes and Heterospilus, were related by Scatolini & Penteado-Dias (2003) as the most abundant, while Whitfield & Lewis (2001) also found Aleiodes, Bracon, Heterospilus and Opius among the most abundant genera collected in their work.

The Shannon diversity index (H) in this study was 2.15 and 3.3 for subfamilies and genera, respectively, much higher than observed in other regions of Brazil. Restello & Penteado-Dias (2006) found HH = 1.32 for subfamily in Rio Grande do Sul State; Scatolini & Penteado-Dias (2003) in different areas of Paraná State found HH = 1.30 for braconid genera. On the other hand, Pereira (2009) related higher values for a reforestation area (H = 2.26), a mesophilous semideciduous forest area (H = 3.05), and an agrosilvopastoral system area (H = 2.97) in São Carlos, São Paulo arising from a higher equitability index, as found in the present work.

The number of genera collected in November/2008 was significantly (F = 2.58; P = 0.01) higher than May/2009 and June/2008 (Fig 1).
Similarly to genera richness, the abundance of braconid along the sampling period was also higher in November/2008 compared to the months of lowest abundance (June/2008 and May, 2009) (F = 2.34; P = 0.019) (Fig 2). Parasitoid abundance tended to increase during the rainy season (November/2008-February/2009) but no significant (P > 0.05) correlations were found between precipitation and insect abundance.
Coley & Barone (1996) observed that the populations of insects in general decline in the dry season and increasing during the rainy season. This pattern may be related to high leaf production during the rainy season, increasing the abundance of several herbivores (Wolda 1978), and, thus, host availability for parasitoids during this season.

Besides, other complex relations between trap location and vegetation characteristics might also have affected wasp collection in the present study. Irvine and Woods (2007) concluded that Hymenoptera appeared to be sensitive to factors that interact to sun/shade conditions, since it was the group with the most variable results in captures using different sun/shade scenarios to evaluate the efficiency of different Malaise traps, including traditional Malaise traps.

The number of subfamilies, genera, and also the wasp abundance, collected is lower than the average found in the literature in other Brazilian regions, mostly in the South and Southeast (Scatolini & Penteado-Dias 2003, Cirelli & Penteado-Dias 2003, Restello & Penteado-Dias 2006). Moreover, only 38% of the genera in the present work are common within those collected by Cirelli & Penteado-Dias (2003) and Sigalphinae was the only subfamily not collected by Penteado-Dias in previous studies mentioned above.

Despite of that, comparisons are difficult due to differences in sampling effort and methodologies, e.g. Restello & Penteado-Dias (2006) collected wasps in 15 days intervals, using three malaise traps during one year in the border areas of different natural landscapes and Scatolini & Penteado-Dias (2003) used one light trap in three different locations.

The use of “old” traps in the present work may also have affected trap efficiency, because Duarte et al. (2010) related that new Malaise traps caught a higher number of individuals and also species of Muscidae than 12 and 18 months old traps, probably due to darkening of the mesh after long time exposure in field. Moreover, Lewis & Whitfield (1999) argued that two factors might also be related to the quantitative differences wasp collections. First one is related to increased primary production in disturbed related to climax associations in the short term. Second, undisturbed areas probably offer more vertically stratified habitat options compared to disturbed areas. Pucci (2008) results highlights that sampling only at the ground level resulted in biased representation of the composition of parasitic wasps and data from other insect groups support the importance of stratified collection, e.g., Stireman III et al. (2012) related that community structure of tachinid parasitoid fauna in understory and canopy are distinct and diverse and must be considered in studies related to diversity, community structure, and the population dynamics of herbivorous insects. Therefore, the use of suspended Malaise traps to access canopy insect community could improve sampling data for parasitoid wasps.

Concluding, despite of the lower wasp abundance and genera richness, population dynamics and diversity value found in the PNMPV is comparable to other Brazilian regions, but presents different genera, thus providing new data and records for Braconidae genera in the Amazon region.

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REFERENCES


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