



Species of the Pelecinidae Family (Insecta: Hymenoptera) as Parasitoids of Melolonthinae (Coleoptera: Scarabaeidae) Larvae

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Abstract

The biology of this genus is poorly understood, despite its conspicuous size. Species of Pelecinidae have been reared on larvae of Melolonthinae (Coleoptera, Scarabaeidae), especially in species of Phyllophagous, and apparently *Pelecinus polyturator* (Drury, 1773) (Hymenoptera: Pelecinidae). It is a solitary koinobiont endoparasitoid of *Phyllophaga anxia* (LeConte, 1850), *P. polyturator*, *Podischnus rugosa* (Melsheimer, 1846) (Coleoptera: Scarabaeidae, Melolonthinae) and has been bred from *Podischnus agenor* (Olivier, 1789) (Coleoptera, Scarabaeidae, Dynastinae). The structure and movements of the metasoma in the female of *P. polyturator*. The genus *Pelecinus* and recognize three species. Females introduce the ovipositor into the soil to reach the beetle larva, flies, green lacewings, and sawflies. The objective is to describe the Pelecinidae Family (Insecta: Hymenoptera) as parasitoids of Melolonthinae (Coleoptera: Scarabaeidae) larvae. The bibliographic search used the following databases: Biological Abstract (<https://www.ebsco.com/products/research-databases/biological-abstracts>), Academia.edu (<https://www.academia.edu>), Researchgate (<https://www.researchgate.net/>) and Frontiers (<http://journal.frontiersin.org/article/<DOI>>). The articles were published from 2002 to 2022 in indexed scientific research, book scientific chapters, these banks, university dissertations, national and international scientific articles, scientific journals, documents and even in general journals when considered of interest..

Keywords: Beetle; Phyllophaga; *Pelecinus*; *Pelecinus polyturator*; Flies

Introduction

The family Pelecinidae belongs to a superfamily Proctotrupeoidea is a Hymenoptera superfamily containing seven extant families: Austroniidae (Australasian), Heloridae (Worldwide), Pelecinidae (Nearctic and Neotropical), Peradeniidae (Australasian), Proctorenyxidae (Eastern Oriental and Palaearctic), Proctotrupidae (Worldwide), Roproniidae (Nearctic and Palaearctic) Vanhorniidae (Nearctic, Oriental and Palaearctic). Though others have been recognized in the past, most of these have been removed to a recently erected superfamily Diaprioidea. Of the remaining families, only Proctotrupidae contains a substantial number of species, with over 400 described. The others are small, often relict groups. The superfamily is Proctotrupeoidea endoparasitoids of the

beetle larva (Coleoptera) or less commonly fly larva (Mycetophilidae: Diptera).

Description

The Pelecinidae is the largest proctotrochids; they measure between 20 to 70 mm long, and their body length varies a lot, maybe it depends on the size of the host. Body smooth, glabrous and black in color; in both sexes' antenna with 14 segments, filiform and with a short scape; forewing smoky, with closed costal cell, and a narrow pterostigma, open marginal cell, and distally bifurcated Rs vein; tibia thickened in female, in both sexes posterior tarsus with a segment I shorter than segment II; sexual dimorphism end in metasoma [1-3]. The female is greatly elongated, tubular and flexible, held in an arched position during flight, in the male is elongated and thickened at the back. The hind

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wings, compared to the forewings, are small, practically without ribs; the previous ones have the nervation system reduced to a few ribs and few closed cells (Figures 1-5) [4-6].

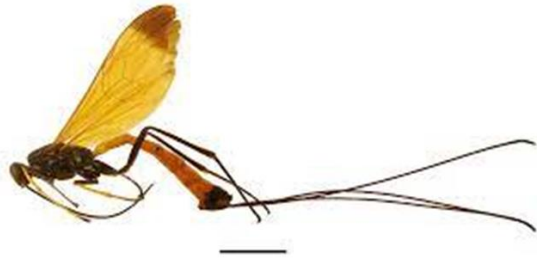


Figure 1: *Pelecinus* wasp these are females, as the smaller males are seldom seen. *Peleciniidae* parasitize of the grubs of June beetles, which are those white C-shaped grubs that you dig up in your garden. The female uses her long abdomen to probe into the soil and lay eggs on the grubs.

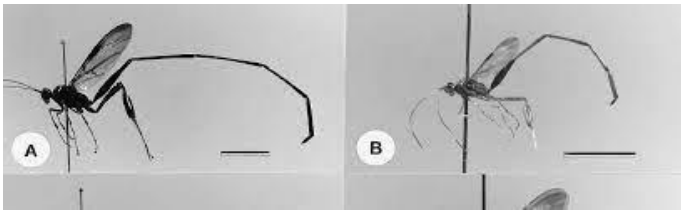


Figure 2: A: Adult females of this family are shiny black in colour and have an extremely long abdomen (4-5 times longer than the head and thorax combined). B: Males (which are rarely seen) resemble females but the abdomen is club-shaped and not nearly as long.

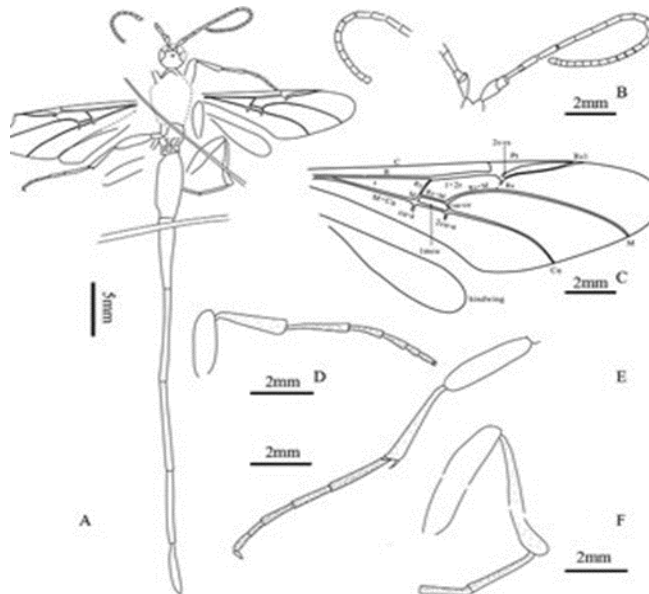


Figure 3: Holotype *Megapelecinus changi* gen. et. sp. nov. Part. (A) Entire insect. (B) Antennae. (C) Right wing showing key venation characters. (D) Foreleg showing two claws and hairs. (E) Mid leg showing hairs, two tibia spurs and one claw at the end of tarsi. (F) Hind leg.

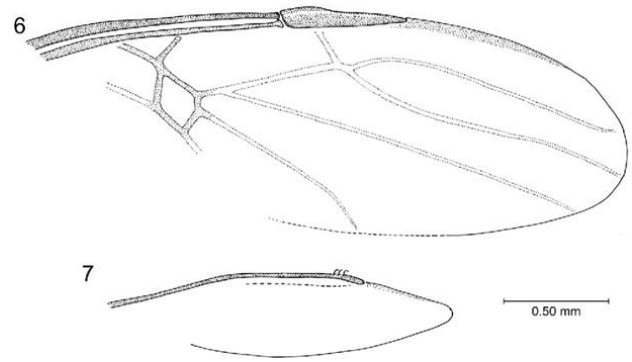


Figure 4: figs. 6–7. Figures 6–7. Wing venation of *Zoropelecinus zigrasi*, new genus and species; tubular veins indicated by solid lines, nebulous veins with a dashed outline, and pigmentation with stippling. 6. Forewing. 7. Hind wing.

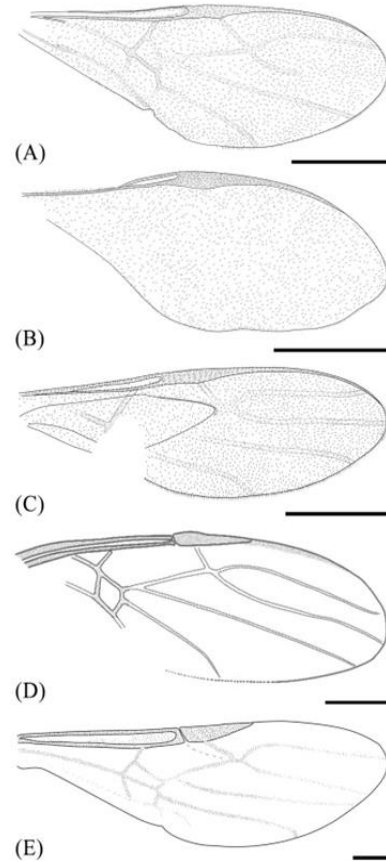


Figure 5: A new genus with a new species, (A) *Brachypelecinus euthyntus* gen. et sp. nov., and two new species, (B, C) *Abropelecinus tyththus* sp. nov. and (D and E) *Zoropelecinus periosus* sp. nov., are described and figured from three exquisitely preserved peleciniid wasps in the Upper Cretaceous Myanmar (Burma) amber. These taxa, owing to their well-preserved characters in amber, provide a better understanding of morphological changes and relationships among the constituent groups, while further highlighting the diversity of *Peleciniidae* in the Mesozoic.



Figure 6: Biological stages of *Aegopsis bolboecidus* (Thomson, 1860) (Coleoptera: Melolonthidae). Eggs (A); first instar larva (B); second instar larva (C); third instar larva (D); terminal portion of the third-instar larva (raster) (E); pre-pupa (F); pupae (G); adult (female) (H); and adult (male) (I). Insects commonly known as ghouls are beetle larvae belonging to the Melolonthidae family (Coleoptera: Scarabaeoideae).

The species *A. bolboecidus* has larvae that feed on roots and are capable of causing significant damage to several crops of economic interest.



Figure 8: The wasp then lays one egg on each host beetle larva, and when the egg hatches, the wasp larva burrows into the host as it feeds on it, thereby killing the June Bug beetle larva. Eventually, the wasp larva pupates and emerges above ground as an adult wasp the following summer. The Peleciniid wasp make looks like a small alien and evokes anxiety on sight, but it is actually a useful parasite that naturally controls beetle numbers.



Figure 9: Peleciniidae laying eggs on terrestrial beetles.



Figure 7: These female peleciniid wasps *Pelecinus polyturator* (Drury, 1773) (Hymenoptera: Peleciniidae) (males are much smaller and rarely seen) are actually beneficial, in that they greatly decrease the June Bug population. That long abdomen, or ovipositor, cannot sting you – it is strictly a mechanism for laying eggs. Its length is due to the fact that the wasp inserts its ovipositor deep into the ground in order to locate beetle larvae.

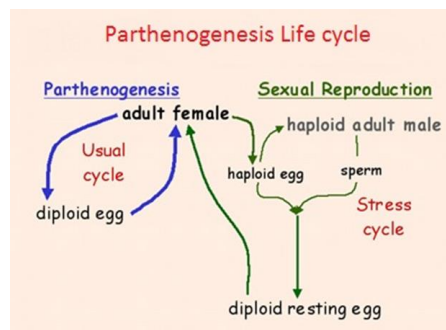


Figure 10: Reproduction in *P. polyturator* is handled primarily through Parthenogenesis. Parthenogenesis, when broken down into its Greek and Latin roots, means Virgin (partheno-) birth (-genesis) Parthenogenesis is basically a process where the female can lay eggs that don't require fertilization. Unfertilized eggs turn into females (see diagram). Given this fact, this particular wasp is a very female dominated species. In fact, in the wasps North American range, males are hardly ever found. Males are more common in the wasp's southern range, however.

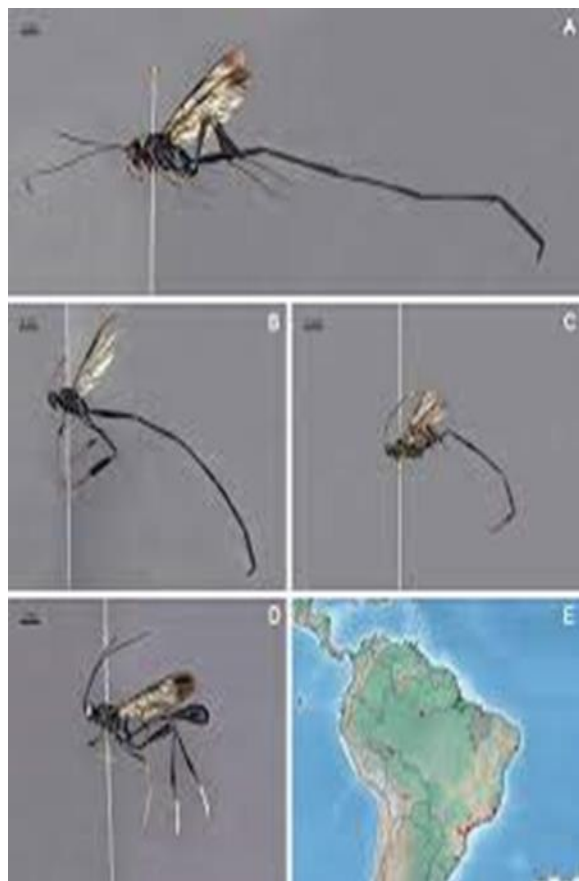


Figure 11: *Pelecinus polyturator* (Drury, 1773), habitus lateral. A. Female (State of Amazonas, Brazil). B. Female (State of Minas Gerais, Brazil). C. Female (State of Maranhão, Brazil). D. Male (State of Acre, Brazil). E. Distribution map (red dots = specimens studied; gray area = new state records).



Figure 13: Photomicrographs of holotype female of *Zoropelecinus zigراسي*, new genus and species. Right lateral aspect of holotype female. Right lateral aspect of head and mesosoma. Left lateral aspect of head. Apicalmost metasomal segment. Basal two metasomal segments and posterior of mesosoma.



Figure 14: A new genus with a new species, *Brachypelecinus euthyntus* gen. et sp. nov., and two new species, *Abropelecinus tyttus* sp. nov. and *Zoropelecinus periosus* sp. nov. Pelecinidae in the Mesozoic.

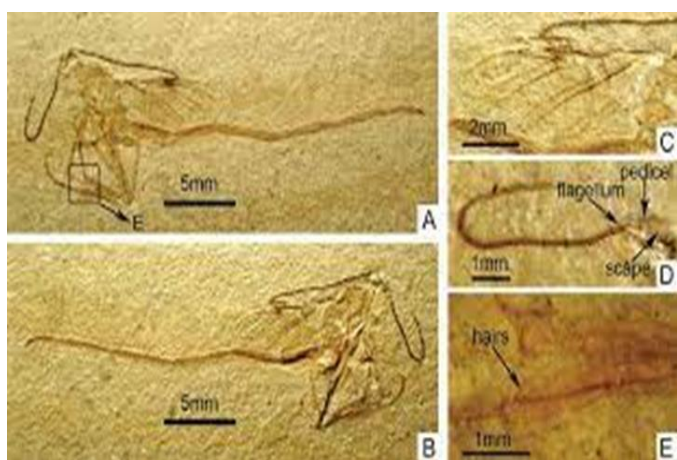


Figure 12: Holotype *M. nashi* sp. nov. CNU-HY-LB2006040. (A) Part. (B) Counterpart. (C) Forewings of counterpart. (D) Left antenna of part. (E) Legs of part, tibia and partial tarsi, showing hairs.

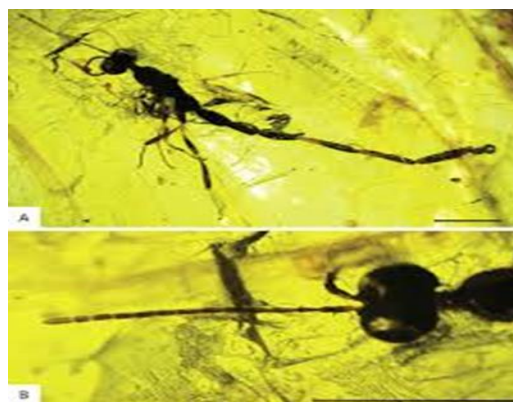


Figure 15: A and B A new species of pelecid wasp, *Eopelecinus inopinatus* sp. nov., is described and figured from Cenomanian Burmese amber based on a single female specimen. Additionally, the examination of a new, well-preserved specimen of *Zoropelecinus periosus* Guo, Shih & Ren 2016.

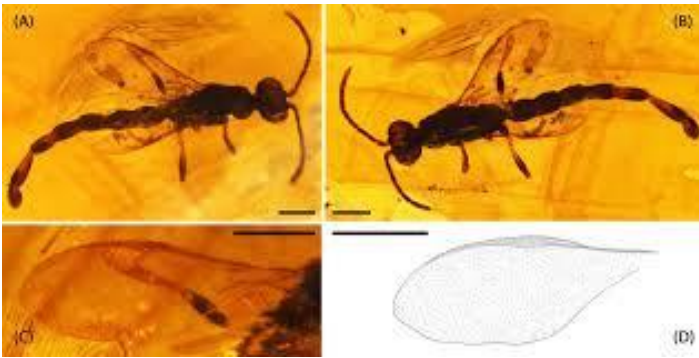


Figure 16: (A, B, C, and D) A new genus with a new species, *Brachypelecinus euthyntus* gen. et sp. nov., and two new species, *Abropelecinus tythtus* sp. nov. and *Zoropelecinus periosus* sp. nov., Peleciniidae in the Mesozoic.

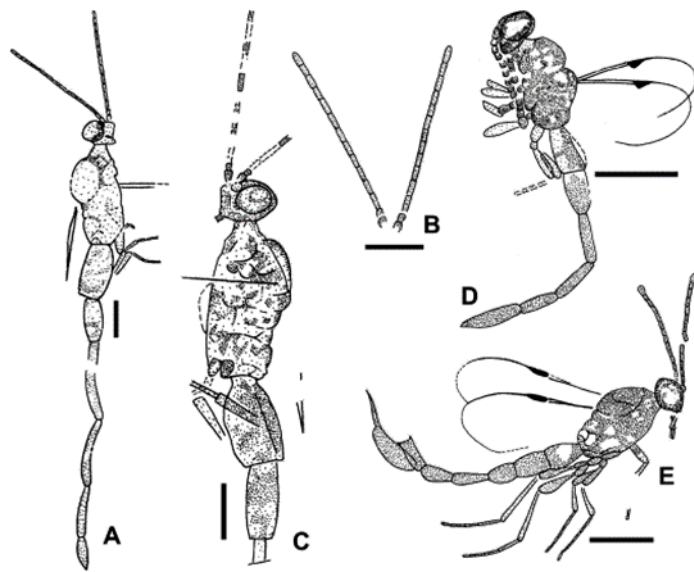


Figure 17A: Three new species and a new genus of peleciniid wasps from the Laiyang Formation in Laiyang, Shandong, China is described: *Sinopelecinus hierus* sp. nov., *S. daspletis* sp. nov. and *Allopelecinus terpnus* gen. et sp. nov.

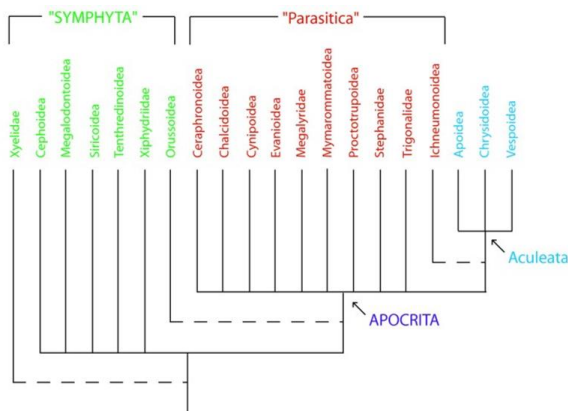


Figure 17B: A stylised summary of hymenopteran relationships. Traditional suborders represented in capital letters. Terminal taxa

indicate superfamilies, or those families not assigned to a superfamily. Dashed lines indicate hypothesised sister group relationships. Here we take available molecular, morphological and palaeontological information to construct a family-level super tree of the Hymenoptera including extinct taxa, presenting, in terms of the scope of its evidence base, the largest phylogenetic analysis of Hymenoptera to date.



Figure 18: Female *Pelecinus polyturator* (Drury, 1773) (Hymenoptera: Peleciniidae)



Figure 19: The Malaise trap is a large tent-like structure used to capture, kill and preserve flying insects, particularly Hymenoptera and Diptera. The trap is made of a material like PET mesh and can be in different colors.

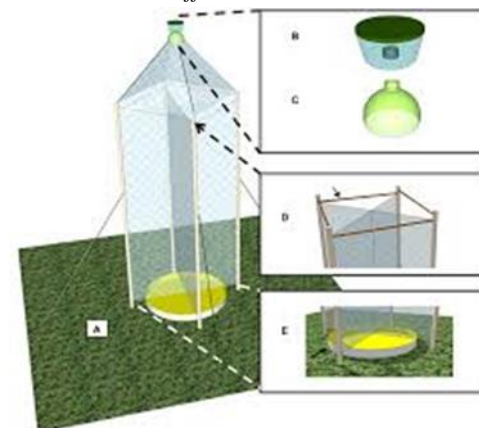


Figure 20: The Composite Insect Trap. A) The Composite Insect Trap is a passive trap designed to collect as broad a spectrum of insects as

possible, utilizing ideas from other, more specialized trap designs in a novel construction. The plastic components of the cone form the collection chamber (B and C). B) The modified plastic container with embedded bottle top will hold the alcohol for killing and storing insects. C) The top of the two-liter bottle will be attached to the mesh fabric of the cone. D) The bamboo rods stabilize the top part of the flight intercept trap. E) The yellow pan trap sits below the flight intercept trap and is filled with soapy water to act simultaneously as a killing and collecting dish.



Figure 21: Trap built in nylon with aluminum frame and a cable of aluminum tube with adjustable size at the discretion of the purchaser.

Geographic distribution

In Brazil, *Pelecinus polyturator* (Drury, 1773) is frequently found, a species with a wide geographic distribution, found from the United States to Argentina. It is interesting to point out that, if in the Neotropical. In regions, including Brazil, the males of this insect appear with a certain frequency, in the United States they are rare says the fact that suggests the idea of geographical parthenogenesis (Figure 11) [10,11].

Taxonomy

Subfamily: Pelecininae: Overview of genera (1 + 17†): Genus *Pelecinus*.

Pelecinidae is a family of parasitic wasps in the Proctotrupeoidea. It contains only one living genus, *Pelecinus*, with three species known from the Americas. The earliest fossil species are known from the Jurassic, and the group was highly diverse during the Cretaceous (Figures 12-17B) [13-15].

Species: *Pelecinus polyturator* (Drury, 1773), *Pelecinus clavator* Latreille, 1817, *Pelecinus tibiator* PERTY, 1833, *Pelecinus dichrous* Perty, 1833, *Pelecinus guerinii* R4, 1840, *Pelecinus annulatus* Klug, 1841, *Pelecinus rufus* Klug, 1841, *Pelecinus thora duponchelii* Romand, 1842, *Pelecinus spinolae* Romand, 1842, *Pelececinus brunneipes* Patton, 1894 [16,17].

Distribution: Canada, USA, Jamaica, Mexico, Belize, Guatemala, Nicaragua (Chontales), Costa Rica, Panama, Colombia, Brazil, and Argentina (Johnson NF, Musetti L. Geographic variation and sex ratio in *Pelecinus polyturator* (Drury) (Hymenoptera: Pelecinidae) [18-20].

Objective

The objective is to describe the Pelecinidae Family (Insecta: Hymenoptera) as parasitoids of Melolonthinae (Coleoptera: Scarabaeidae) larvae.

Methods

The bibliographic search used the following databases: Biological Abstract

(<https://www.ebsco.com/products/researchdatabases/biologicalabstracts>),

Academia.edu(<https://www.academia.edu/>), Researchgate(<https://www.researchgate.net/>)and

Frontiers (<http://journal.frontiersin.org/article/<DOI>>). The articles were published from 2002 to 2022 in indexed scientific research, book scientific chapters, theses banks, university dissertations, national and international scientific articles, scientific journals, documents and even in general journals when considered of interest (Marchiori, 2022) [21].

Studies Conducted and Selected

Study 1

Pelecinus polyturator (Drury, 1773) (Hymenoptera: Pelecinidae) is a parasitoid wasp with coloration metallic black in general. Females have a specialized metasoma and a medium to large body, measuring between 20 and 90 mm in length, while males have simple metasoma and usually do not exceed 15 mm (Shih et al. 2010). They occur in practically the entire American continent, from Canada to Argentina, females are usually more easily found, and males are much rarer (Figure 18). As far as the habit of these animals is concerned, they are koinobiont endoparasites. They are usually found parasitizing beetle larvae of the Phyllophaga Harris, 1827 genus (Scarabaeidae), using their huge and flexible specialized metasoma to penetrate the soil and encounter the larvae that females can reach larvae that are around 5 cm below the soil surface, inserting the entire metasoma into the soil and even a portion of the mesosoma (Figure 19). The collects were carried out from October 2018 to October 2019. Five traps of flight intercept (Malaise trap) were installed within the forest, 300 meters away from each other, two of which were installed at the base of the hill and three at the top. A total of 61 specimens were collected, being mostly females (n= 55) and only six males March was the month with the highest numbers of specimens. This paper reports

the first occurrence of *P. polyturator* for the state of Ceará, Brazil [22].

Study 2

The aim of this study was to contribute to the recognition of Hymenoptera parasitoid families in the Serra do Japi Forest Reserve. Samples were collected for five days, between February 5 and 9, 2011. Three sampling methods were used: Malaise trap, Moericke trap and vegetation sweep (Figure 20). The relative abundance of the eight superfamilies of parasitoid Hymenoptera collected in this study was as follows: Proctotrupoidea (48.77%), Ichneumonoidea (27.92%), Chalcidoidea (8.54%), Platygastridae (6.15%), Cynipoidea (4.08%), Evanioidea (2.62%), Crysidoidea (1.46%) and Ceraphronoidea (0.46%) (Figure 36). Of the 23 families found, nine had higher Relative abundance: Diapriidae (45.92%), Braconidae (15.00%), Ichneumonidae (12.92%), Platygastridae (6.15%), Figitidae (4.08%), Eulophidae (3.31%), Evaniidae (2.62%), Pteromalidae (2.62%) and Proctotrupidae (2.23%), which correspond to 94.85% of the hymenopterans captured. The presence of Perilampidae (0.62%) was recorded and Pelecinidae (0.15%), families that are not frequent in scientific collections and in samples of parasitoid fauna.

Study 3

Pelecinus polyturator (Drury, 1773) (Hymenoptera: Pelecinidae) is a large (up to 7 cm) shiny black wasp, the most common and familiar species of the Pelecinidae family. Adults drink nectar. They live in farm fields, forests, and suburban gardens throughout North, Central, and South America. Their antennae are long and females have an elongated, cylindrical, articulated metasoma. They are parasitoids that lay their eggs directly on June beetle larvae (genus *Phyllophaga*) buried in the soil. Adults can be found in late summer (Figure 38). Some populations of *P. polyturator* are parthenogenetic; Females do not require fertilization from males to reproduce and can produce males and females. Females are common throughout range, but males are rare in US and Canada, especially in some populations, and more common in the south [23].

Conclusion

The biology of this genus is poorly understood, despite its present conspicuous size. Species of Pelecinidae have been reared on larvae of Melolonthinae (Coleoptera, Scarabaeidae), especially in species of *Phyllophaga* (Hammond 1944; Lim et al. 1980), and apparently *Pelecinus polyturator* (Drury, 1773) (Hymenoptera: Pelecinidae). It is a solitary coenobiont endoparasitoid of *Phyllophaga anxia* (LeConte, 1850).

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