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Biology, ecology, and taxonomy of the parasitoids of the families Austroniidae, Peradeniidae, Proctorenyxidae, Roproniidae, and Vanhorniidae (Hymenoptera: Proctotrupoidea) and family Mymarommatidae (Hymenoptera: Proctotrupomorpha: Mymarommatoidea)

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Abstract

The Proctotrupoidea are koinobiont endoparasitoids of holometabolous insect larvae. Although Proctotrupidae can be common and readily collected by sweep netting or Malaise traps, the superfamily is poorly known biologically. Proctotrupidae is parasitoids of Coleoptera and, to a lesser extent, Diptera larvae, with one extraordinary host record from a centipede, whereas Heloridae has been reared from Neuroptera larvae. Extralimital families attacking Coleoptera and Neuroptera (Austroniidae, Peradeniidae, Proctorenyxidae) are biologically unknown. The hosts of the Mymarommatidae family are poorly known. One species was bred in "wood ear" fungi. Little is known about the biology of these wasps, but they are probably parasitoids of eggs of other insects in forests. *Mymaromma menehune* Honsberger & Huber, 2022 recorded as a solitary endoparasitoid of eggs of a *Lepidopsocus* sp. (Psocodea: Lepidopsocidae) on branches of *Ficus microcarpa* L.f. (Moraceae). This work studies the biology, ecology, and taxonomy of the parasitoids of the families of Austroniidae, Peradeniidae Proctorenyxidae, Roproniidae, and Vanhorniidae (Hymenoptera: Proctotrupoidea) and family Mymaromatidae (Hymenoptera: Proctotrupomorpha: Mymarommatoidea). In terms of the type of research source, we worked with scientific articles published in national and international journals. This modality of production, in addition to being commonly the most valued in the set of bibliographic production, is the most easily accessed. Access to articles was through virtual libraries such as SciELO, the University of São Paulo, Latin American Literature, and the University of Brasilia. This library has a specific section for Hymenoptera, with eight journals and texts of articles available in full. Considering only this section constitutes a limitation of the study since articles belonging to journals that integrate other sections of the fore mentioned electronic library could also contribute to the discussion of the production of knowledge about the relationship between hosts and parasitoids. However, in principle, within these articles, there could not necessarily be a discussion focused on biology, ecology, and taxonomy.

Keywords: Hosts; Insecta; Larva; Parasitoids; Superfamily

1 Introduction

Proctotrupoidea is a superfamily of Hymenoptera with 30 genera in seven living families if fossil families are known. The Proctotrupidae family is the most numerous, with 400 species. The other groups are very reduced groups. They are parasitoids since their larvae feed and develop inside or on the surface of the bodies of other insects. The majority are very small, black, and shiny.

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Objective

This work studies the biology, ecology, and taxonomy of the parasitoids of the Austroniidae, Peradeniidae Proctorenyxidae, Roproniidae, and Vanhorniidae (Hymenoptera: Proctotrupoidea) and family Mymaromatidae (Hymenoptera: Proctotrupomorpha: Mymarommatoidea).

2 Methods

This modality of production, in addition to being commonly the most valued in the set of bibliographic production, is the most easily accessed. Access to articles was through virtual libraries such as SciELO, the University of São Paulo, Latin American Literature, and the University of Brasilia. This library has a specific section for Hymenoptera, with eight journals and texts of articles available in full. Considering only this section constitutes a limitation of the study since articles belonging to journals that integrate other sections of the aforementioned electronic library could also contribute to the discussion of the production of knowledge about the relationship between hosts and parasitoids. However, in principle, within these articles, there could not necessarily be a discussion focused on biology, ecology, and taxonomy.

3 Family Roproniidae

Endoparasitoids of the beetle larva (Coleoptera) or less commonly fly larva (Mycetophilidae: Diptera) (Figure 1) [2-4].

Source: https://bugguide.net/node/view/15959

Figure 1 Wasp-parasitized larva Proctotrupoidea – *Exallonyx* Kieffer, 1904, Rockingham County, New Hampshire, USA, parasitizing Coleoptera

Metasoma with long 1st petiolate segment, as long as the rest of the segments; other segments strongly laterally compressed; antenna with 14 articles [5-7]. They measure from 5.0 to 10.0 mm. (Proctotrupoidea). Palearctic, Nearctic, Oriental region. Antennae 14-segmented (without annelus). The abdomen is strongly compressed from the sides with a long petiole [8-9].

Found *Ropronia garmani* Ashmead 1898. in the undergrowth beside streams in temperate deciduous forests. Florida specimens came from similar habitats in riparian hardwood forests along the Suwannee River (Figure 2) [10-11].

https://bugguide.net/node/view/1350071

Figure 2 *Ropronia garmani* Ashmead 1898

In the northeast, *R. garmani* flies from mid-June to August; whereas, Florida records are for May, suggesting that in Florida this species avoids the heat of summer, as do most ichneumonids and other parasitic Hymenoptera. hosts. *Ropronia* may parasitize Tenthredinidae saw-fly larvae (Hymenoptera), but the evidence is inconclusive [11-12].

Ropronia has five species in China, two in The Holarctic genus *Ropronia* Provancher has three species in North America: *Ropronia californica* Ashmead, 1899 (California, Oregon), *Ropronia pediculata* Provancher, 1886 (New York and Ontario), and *Ropronia garmani* Ashmead, 1898, known previously in the United States from New Hampshire to northern Georgia and west to Iowa [13-14].

Recently, as part of an ongoing survey of Hymenoptera in Florida State Parlrs, the following new record of *R. garrnani* was obtained: Recently, as part of one on-going survey of Hymenoptera in Florida State Parlrs, following new record of *R. garrnani* was obtained: Japan, one in Burma, and two in Turkey Roproniidae thus is a Holarctic group [15-16].

The world fauna includes 6 genera (including 4 fossils) and about 45 species, in the Palearctic - 1 genus and 7 species. The fauna of Russia includes 1 genus and 1 species of ichneumons of this family in the Far East (Sakhalin and Kuril Islands). They are found in the Nearctic, Palearctic, and Oriental regions [18-19].

- Superfamily Proctotrupoidea Latreille, 1802
- Family Roproniidae Viereck, 1916
- Genus *Paleoropronia* gen. nov.
- Type species *Paleoropronia salamonei* gen. et sp. nov.

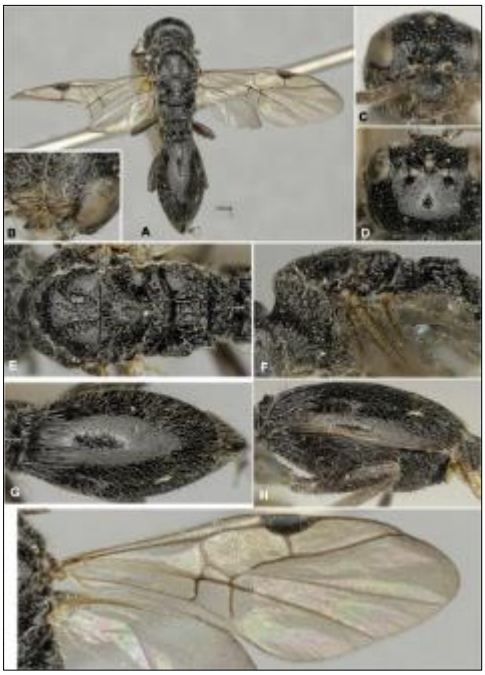
Paleoropronia salamonei gen. et sp. nov. Diagnosis Fore wing venation only. Cell 1M is very narrow, much narrower than cell 2Cu, only 0.2 times as wide as 2Cu; pterostigma is linear, not triangular; the base of pterostigma is well distal of 1M; cell 1R1 elongate. Type material Holotype France: MNHN.F.A57266, stored in the collection of Palaeontology (Paris). Type stratum and locality France: Paleocene, sponge-diatomite maar Palaeolake, Menat, Puy-de-Dôme. Source: Garrouste R, Pouillon JM. Nel A. European Journal of Taxonomy. 2016; 239: 1–9.

4 Family Vanhorniidae

4.1 Introduction

A monospecific family Vanhorniidae of the Hymenoptera in the superfamily Proctotrupoidea. Vanhorniidae is a small, uncommonly collected family of Hymenoptera (previously in the subfamily Serphidae or Proctotrupidae) [20-21].

4.2 Diagnostic characters



Source: https://jhr.pensoft.net/article/56481/zoom/fig/13/

Figure 3 *Vanhornia quizhouensis* (He & Chu, 1990) (female, holotype) A habitus, dorsal view B mandible, ventro-lateral view C head, front view D head, dorsal view E mesosoma, dorsal view F mesosoma, lateral view G metasoma, dorsal view H metasoma, lateral view I wings

Metasoma with most segments fused, forming a carapace; exodont jaws; antennae inserted just above the clypeus. They measure from 6.0 to 7.0 mm (Figure 3) [20-21].

4.3 Biology

Some species parasitoids on Coleoptera larvae. Oviposition appears to occur through cracks in decaying wood and the structure of the ovipositor suggests that the female is incapable of drilling through solid wood This author also suggested that oviposition might occur on or into earlier stages of the Eucnemidae host, which would imply that the larva behaves as a koinobiont [22-23].

4.4 Distribution

Europe, China, Japan, and North America. The family has only the genus *Vanhornia*, with 5 known species [20-22].

Vanhorniidae is a small, uncommonly collected family of Hymenoptera (previously in the subfamily Serphidae or Proctotrupidae) of 3 genera and 5 species: *Heloriserphusm castor* Masner and *Heloriserphus pollux* Masner, 1981 in Chile, *Sinicivanhormia quizhouensis* (He & Chu 1990) in China, *Vanhornia leileri* Hedqvist, 1976 in Sweden and far eastern Russia and *Vanhornia eucnemidarum* Crawford, 1909 east of North America [24-26].

This parasitoid species has been reared from the larval/pupal chambers of *Sorhipis ruficornis* (Say, 1823) (Coleoptera: Eucnemidae) in the wood of dead maple. A description of the unusual abdomen of *V. eucnemidarum*. This report provides the first evidence for the natural occurrence of *V. eucnemidarum* in Florida (Figure 4) [24-26].

Source: https://en.wikipedia.org/wiki/Eucnemidae

Figure 4 *Sorhipis ruficornis* (Say, 1823) (Coleoptera: Eucnemidae) larvae (Coleoptera)

There is also a recent record of the latter species from South Korea in eastern North America, *V. eucnemidarum* has been collected during the spring from mid-May to late Jul, with their peak flight period occurring from the end of May to the end of June. This parasitoid species has been reared from the larval/pupal chambers [24-26].

5 Family Austroniidae

This endemic Australian family of small (4–6 mm), very rarely collected wasps is known from wet forest habitats of southern Australia and Tasmania. Only three species in the genus *Austronia* are recorded and their biology is unknown (Figure 6) [27-28].

Source: https://twitter.com/ymilesz/status/1469031659005616129

Figure 5 *Austronia rubrithorax* Riek, 1955, Family Austroniidae

5.1 Diagnostic characters

Metasoma strongly compressed laterally, 1st segment petiolate; ovipositor relatively long, but retracted into the metasoma; pronotum with thin carina medially, partially covering the anterior part of the mesoscutum; metacoxa close to the insertion of the metasoma. They measure about 5.0 mm [29-30].

5.2 Taxonomy

The species live in moist forests. Like all related species and groups, they are parasitoids. Nothing else is known about their way of life and hosts.

Holotype: ANIC ♀, Australia. *Austronia nigricula* Riek, 1955, *Austronia nitida* Riek, E.F. 1955 and *Austronia rubrithorax* Riek, 1955.

6 Family Proctorenyxidae

6.1 Diagnostic characters

Antennae with 15 articles, including one ring-shaped (1st flagellomere); rather short scape; forewing with pterostigma; metasoma with petiole, 8th tergite with 2 spiracles (Figure 6) [31-32].

Source: https://zenodo.org/record/264959#.Y_yMEnbMLIU

Figure 6 Proctorenyxidae *incredibilis* Kozlov 1994, ♀. 1. Habitus, lateral view; 2. Head, frontal view; 3. Head, dorsal view; 4. Petiole, dorsal view; 5. Pronotum, dorsal view; 6. Mesosoma, dorso-posterial view; 7. Propodeum, dorso-posterial view

The family was described based on a single species from Russia, *Proctorenyxa incredibilis* Kozlov, 1994. There Is Still an undescribed species in The United States [33-34]

Proctorenyxa Lelej & Kozlov, 1999 (= *Renyxa* Kozlov, 1994).

7 Family Peradeniidae

7.1 Diagnostic characters

The eye is very large, occupying most of the head in lateral view, almost reaching the base of the jaw; 1st segment of the petiolate metasoma, as long as the rest of the segments. They measure from 6.0 to 10.0 mm and are black. The family comprises only the genus *Peradenia* with 2 species in Australia and Tasmania (Figure 7) [35-37].

Source: https://bie.ala.org.au/species/https://biodiversity.org.au/afd/taxa/34d2fe90-9921-4425-9d53- 65175bfd9b58

Figure 7 *Peradenia clavipes* Naumann & Masner, 1985

8 Family Mymarommatidae

Proctotrupomorpha is an important subgroup of the Apocrita within the Hymenoptera, containing mainly parasitic wasps. It contains the main groupings of Chalcidoidea, Diaprioidea, Proctotrupoidea, Cynipoidea, and Platygastroidea, as well as the small Mymarommatoidea, and extinct groups such as the Serphitoidea [38-42].

Mymarommatoidea only contains a single living family, Mymarommatidae, and three other extinct families known from aged amber. Less than half of all described species are living taxa (the others are fossils), but they are known from all parts of the world [38-42].

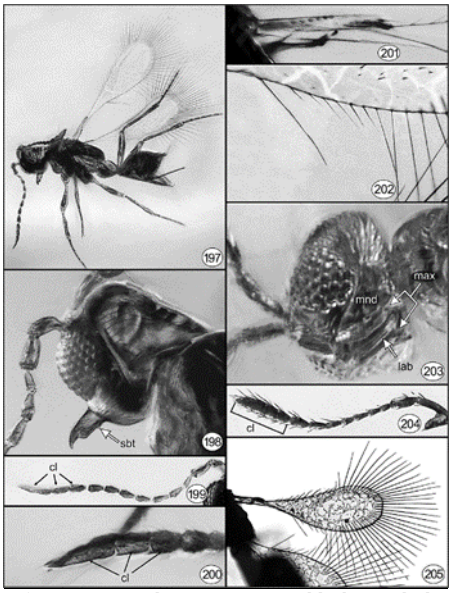
Mymarommatidae is a very small family of microscopic Hymenoptera. Only 14 living species in a single genus have been described at present but they are from all parts of the world (Figure 8) [38-42].

Source: Atlas of Living Australia (2019). What bug is that. Occurrence dataset https://doi.org/10.15468/wx7fit accessed via GBIF.org on 2023-10-14. https://www.gbif.org/occurrence/2419380097

Figure 8 *Palaeomymar* sp. (female)

8.1 Description

Diagnostic characters. Petiole with 2 segments; head with bellows-shaped structure at the back; geniculate antenna, with 9 to 11 articles in the female and 12 in the male; exodontic jaw; forewing, when present, spatula-shaped, reticulate alar venation; hindwing, when present, reduced to an apically bifurcated rod-like structure. They measure less than 1.0 mm and are yellow to brown (Figure 9) [38-46].

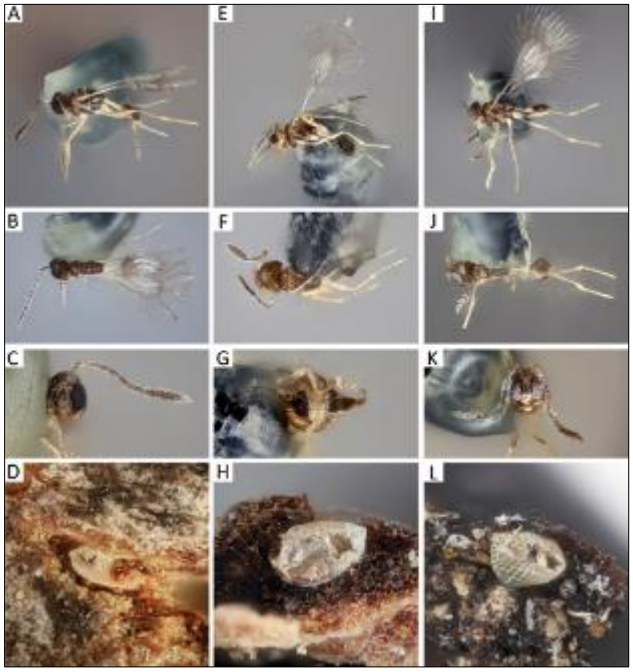


Source: https://www.researchgate.net/figure/205-197-202-Archaeromma-mandibulatum-holotype-R-197-habitus-198-head_fig10_281579951

Figure 9 figs.197–202, *Archaeromma mandibulatum* Kozlov and Rasnitsyn, 1979 (holotype R): 197, habitus; 198, head, dorsolateral; 199, antenna; 200, key; 201, proximal part of the anterior peduncle; 202, anterior posterobasal marginal setae. 203–205, *Archaeromma senonicum* (Kozlov & Rasnitsyn, 1979) (paratype R): 203, head, ventrolateral; 204, antenna; 205, previous

8.2 Biology

The hosts are unknown. One species was bred in "wood ear" fungi. Little is known about the biology of these wasps, but they are probably parasitoids of eggs of other insects in forests. *Mymaromma menehune* Honsberger & Huber, 2022 recorded as a solitary endoparasitoid of eggs of a *Lepidopsocus* sp. (Psocodea: Lepidopsocidae) on branches of *Ficus microcarpa* L.f (Moraceae) (Figure 10) [38-46].



Source: Honsberger DN, Huber JT, Wright MG. A new Mymaromma sp. (Mymarommatoidea, Mymarommatidae) in Hawaii and the first host record for the superfamily. Journal of Hymenoptera Research. 2022; 89: 73-87

Figure 10 *Mymaromma menehune* sp. nov., ex *Lepidopsocus* sp. eggs on *Ficus microcarpa* L.f. *branches*. A–C *M. menehune* ♂ (paratype) and D egg from which it emerged E–G *M. menehune* ♀ (paratype) and H egg from which it emerged I–K *M. menehune* ♂ (paratype) and L egg from which it emerged

The Mymarommatidae in the world, all belong to the genus *Palaeomymar* Meunier, 1901. Virtually nothing is known about the biology of these insects, but due to their size, and simple ovipositor, entomologists assume that they are parasitoids of the eggs of various insects [38-46].

8.3 Classification and Distribution Geography

Mymarommatidae wasps are considered rare in the world but the number of specimens collected in tropical forests indicates that this family may be common in Brazilian forests and with a wider distribution than that mentioned in the literature and in the labels of copies deposited in collections Entomology in the world.

The family has a cosmopolitan distribution, with only the genus *Paleomymar*, with 8 described species. In the Neotropical Region, there is only one species described for Argentina *Palaeomymar cyclopterus* Meunier, 1901 (Mymarommatidae). In Brazil, there are records of only 2 specimens of *Paleomymar,* one in Espírito Santo and another in São Paulo.

They were initially treated as an aberrant subfamily of the Chalcidoidea family Mymaridae but, due to morphological differences, they are now placed in a superfamily, Mymarommatoidea. Its similarity to Mymaridae is believed to be the result of convergent evolution. Mymarommatoidea contains two fossil families: Gallorommatidae and Lavarommatidae. Hymenoptera of the Mymarommatidae family in body length and which constitute an ancient Cretaceous group. The Mymarommatidae family belongs to a monotypic superfamily of unknown biology, considered the sister group of the Chalcidoidea.

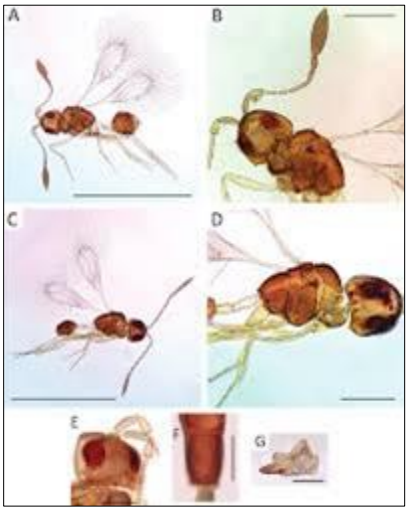
Genus: *Archaeromma* (extinta) Yoshimoto, 1975, *Mymaromella* (extinta) Girault, 1931, *Palaeomymar* (extinta) Meunier, 1901 and *Zealaromma* Gibson, Read and Huber, 2007 (Figures 4-7).

They are classified as a separate superfamily Mymarommatoidea, sometimes combined with Serphitoidea, which also has a 2-segmented stem. Previously considered as a subfamily of Mymarommatinae within the Serphitidae.

8.3.1 Proctotrupomorpha group

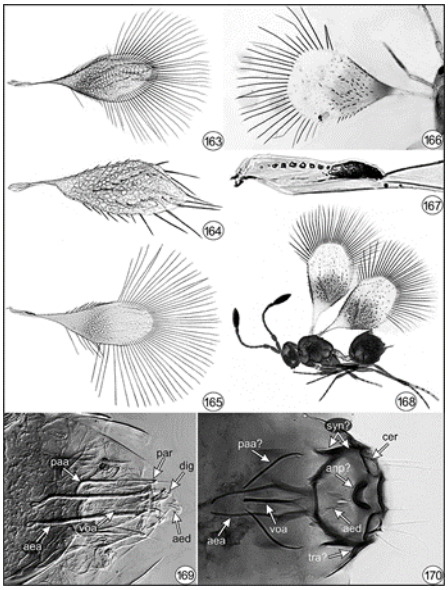
- Superfamily Mymarommatoidea
- Family Mymarommatidae

Some Species: *Archaeromma carnifex* Engel & Grimaldi, 2007, *Archaeromma gibsoni* Engel & Grimaldi, 2007, *Archaeromma mandibulatum* (Kozlov & Raznitsyn, 1979), *Archaeromma nearctica* Yoshimoto, 1975 and *Archaeromma senonicum* (Kozlov & Raznitsyn, 1979), *Mymaromma* Girault, 1920, *Mymaromma anomalum* (Blood & Kryger, 1922), *Mymaromma goethei* Girault, 1920, *Mymaromma mirissimum* (Girault, 1935), *Mymaromella chaoi* (L., 1758); *Mymaromella cyclo*pterus (Fidalgo & DeSantis, 1982), *Mymaromella mira* Girault, 193, *Zealaromma insulare* Valentine, 1971 (Figures 11- 12) [38-47].



Source: *Mymaromma menehune* sp. n A, B holotype ♀ C, D allotype ♂ E head showing mandible (non-type, ♀) F dorsal view of propodeum (non-type, ♀) G close up of mandible (non-type, ♀)

Figure 11 *Mymaromma menehune* sp. nov.



Source: https://www.researchgate.net/figure/170-163-166-forewing-163-Mymaromma-anomalum-Sweden-164-Zealaromma-insulare-165_fig13_277890596

Figure 12 figs. 163-166, forewing: 163, *Mymaromma anomalum* (Blood & Kryger, 1922); 164, *Zealaromma insulare* (Valentine, 1971); 165, *Zealaromma valentinei* Gibson, Read & Huber, 2007; 166, *Mymaromella cyclopterus* (Fidalgo & De Santis 1982) (holotype R). 167, *Mymaromella* sp. 14, forewing stalk. 168, *Mymaromella mira* Girault, 1931 (USNM type photograph). 169 and 170, " genitalia: 169, *Zealaromma insulare* (Valentine, 1971); 170, *Mymaromma anomalum* (Blood & Kryger, 1922) (Japan)

9 Studies conducted and selected

9.1 Study 10

In the present study, the microhymenopterans collected with Malaise traps were screened in the Atlantic Forest of the state of Espírito Santo in 1993 and in the Cerrado of the state of Tocantins for the separation of specimens of the genus *Palaeomymar*. Malaise traps were installed in four locations in these Brazilian states. At the Espírito Santo, the collections were made in a fragment of the Atlantic Forest. In Tocantins, the collections were natural forest fragments of the Araguaia River plain.

169 specimens of *Palaeomymar* sp. were found, half (84) in the Atlantic Forest fragment and the other (85) in the three localities in Cerrado. The abundance of Mymarommatidae between localities was not compared due to differences in sampling period and number of samples and sites sampled.

The Mymarommatidae wasps recorded in Brazil are represented by four specimens, collected in Cerrado in the state of São Paulo and in the Atlantic Forest of Espírito Santo. The large number of specimens of Mymarommatidae collected in the Brazilian forests of Espírito Santo and Tocantins corroborates data from the literature that show a relative abundance of these insects in tropical forests [48].

9.2 Study 2

This catalog is part of a series in which the critical analysis of the type materials of Hymenoptera that are conserved in the collections of the Entomología Division of the Museum of La Plata.

Until now, those belonging to them have been studied in families of Cynipoidea, Proctotrupoidea, Ceraphronoidea, Apoidea, and a large part of the families of Chalcidoidea: Encyrtidae, Eulophidae, Aphelinidae and Signiphoridae, Eupelmidae and Trichogrammatidae. In this opportunity, they studied belonging to the Chalcidoidea of the Mymaridae family and the Mymarommatoidea of the Mymarommatidae Family.

The Mymarommatidae family belongs to a monotypic superfamily of unknown biology, considered as the sister group of the Chalcidoidea; It counts with 17 described species grouped between three genera. In Argentina, it is represented by a single species, *Paleomymar cyclopterus*, described by Fidalgo & De Santis in 1982.

The 490 type specimens of Mymaridae (Chalcidoidea) and one of Mymarommatidae (Mymarommatoidea) housed at the collections of División Entomología Museo de La Plata were examined and listed, providing updated information on types, data of collection and hosts. The species treated here were described by the following authors: The holotype of a species of Mymarommatidae described by Fidalgo et De Santis [49].

10 Conclusion

The superfamily 'Proctotrupoidea has generally been a welcoming home to a variety of parasitoid groups and recognized as not being monophyletic the Platygastroidea and Diaprioidea were included in the Proctotrupoidea. The removal of the Diapriidae, Maamingidae, and Monomachidae to their own superfamily (Diaprioidea) has recently gained acceptance. The Proctotrupoidea now comprises the Heloridae and Proctotrupidae in Britain and the extralimital families Austroniidae, Pelecinidae, Peradeniidae, Proctorenyxidae, Roproniidae and Vanhorniidae. Proctotrupomorpha is an important subgroup of the Apocrita within the Hymenoptera, containing mainly parasitic wasps. It contains the main groupings of Chalcidoidea, Diaprioidea, Proctotrupoidea, Cynipoidea, and Platygastroidea, as well as the small Mymarommatoidea, and extinct groups such as the Serphitoidea.

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