Open Access Research Journal of
Science and Technology
Journals home page: https://oarjst.com/
ISSN: 2782-9960 (Online)

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Description of the biogeography of the Mymaridae Family (Insecta: Hymenoptera)

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Open Access Research Journal of Science and Technology, 2021, 03(01), 070–086

Publication history: Received on 08 November 2021; revised on 13 December 2021; accepted on 15 December 2021

Article DOI: https://doi.org/10.53022/oarjst.2021.3.1.0069

Abstract

The objective of this manuscript is to research the management, biology, habitat, ecology, geographic distribution, taxonomy, life cycle, phenology, parasitoidism (parasitism) of the Mymaridae Family (Insecta: Hymenoptera). The research was carried out in studies related to quantitative aspects taxonomic and conceptual aspects. A literature search was carried out containing articles published from 1984 to 2021. The mini review was prepared in Goiânia, Goiás, from September to October 2021. The mini-review was prepared in Goiânia, Goiás, from September to October 2021, through the Online Scientific Library (Scielo), internet, ResearchGate, Academia.edu, Frontiers, Biological Abstract, Publons, Qeios, Pubmed, Dialnet, World, Wide Science, Springer, RefSeek, Microsoft Academic, Science, ERIC, Science Research.com, SEEK education, Periodicals CAPES, Google Academic, Bioline International, VADLO, Scopus, Web of Science, LILACS, Medline, LIS and Portal of Scientific Journals in Health Sciences.

Keywords: Management; Taxonomy; Ecology; Habitat; Insecta

1. Introduction

Chalcidoidea is a superfamily of wasps that belongs to the insect order Hymenoptera. It is one of the most numerous groups within Hymenoptera, with around 22,000 known species. It is estimated that there are between 60,000 to 100,000 species, extrapolating up to 500,000 or 10% of insect species (Figure 1) [1,2,3].

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Figure 1 Specimens of Chalcidoidea Superfamily; (Source: https://pt.wikipedia.org/wiki/Chalcidoidea)

Chalcidoid wasps are tiny; most are less than 3 mm long. Adult males of the smallest known species (Mymaridae) are just 0.11 mm long. Most are dark colored wasps, often with complex metallic blue or green body details. They are also recognized by the characteristic of reduced wing nerves, like what is seen in other parasitic wasp superfamilies. They are important both as agents for the biological control of agricultural pests and as the pests themselves (Figure 2) [4,5].

Figure 2 Specimens of Mymaridae Family; (https://pt.wikipedia.org/wiki/Mymaridae)

Mymaridae is a family of small wasps belonging to the superfamily Chalcidoidea whose most species have natural distribution in subtropical and tropical regions around the world. The family groups about 1,400 species divided into 100 genera [6,7].

They are tiny insects like most calcidoids (Chalcidoidea), usually less than 0.5 mm in length. This family includes the species *Dicopomorpha echmepterygis* Mockford, 1997, the smallest known insect, just 0.139 mm in average length, and the smallest flying insect, with 0.15 mm in wingspan. Females' antennae end in a hammer-shaped flare, while males have threadlike antennae. The wings are generally slender, with long arrows that give them a feathery appearance. Some species have very small or completely absent wings. They are distinguished from other Chalcidoidea by the H-shape of the sutures they have on the front of the head (Figure 3 and 4). [7,8].

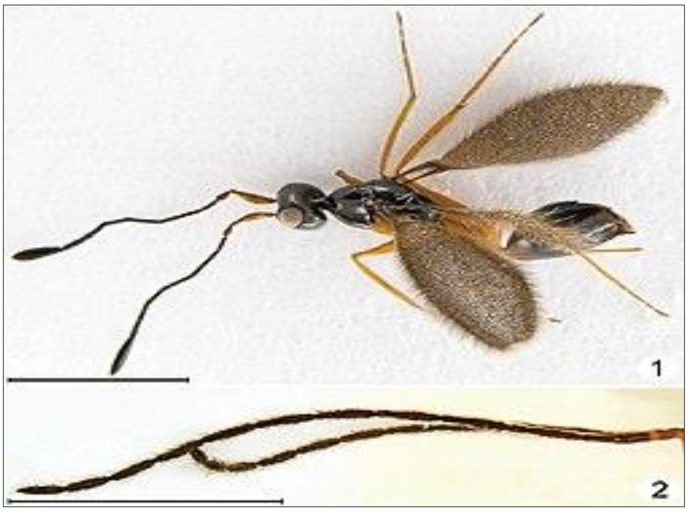


Figure 3 *Mymarilla wollastoni* Westwood, 1879: (1) Female with extremely fleecy wings. (2) Detail of the male's filiform antennae. *Mymarilla wollastoni* is endemic to the island of Saint Helena in the South Atlantic (scale = 1000 μm); (Source: https://pt.wikipedia.org/wiki/Mymaridae)

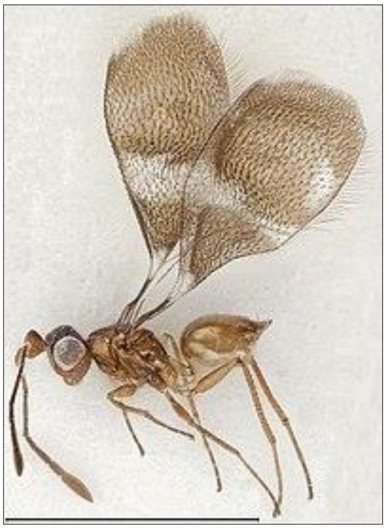


Figure 4 *Richteria ara* (Girault, 1920) (female) with the characteristic wing type of the family (scale = 1000 μm); (Source: https://pt.wikipedia.org/wiki/Mymaridae)

The insects that make up the Mymaridae family are small, measuring between 0.13 and 5.4 mm in length, with the majority being between 0.5 to 1.0 mm in maximum length. They usually have a non-metallic body, in shades of black, brown, or yellow. The main distinguishing feature of the group in relation to other calcidoids is the presence of sutures forming an H-shaped design under the ocelli and between the compound eyes. In rare cases the sutures extend to the ocelli (Figure 5A, 5B, 6 and 7) [9,10].

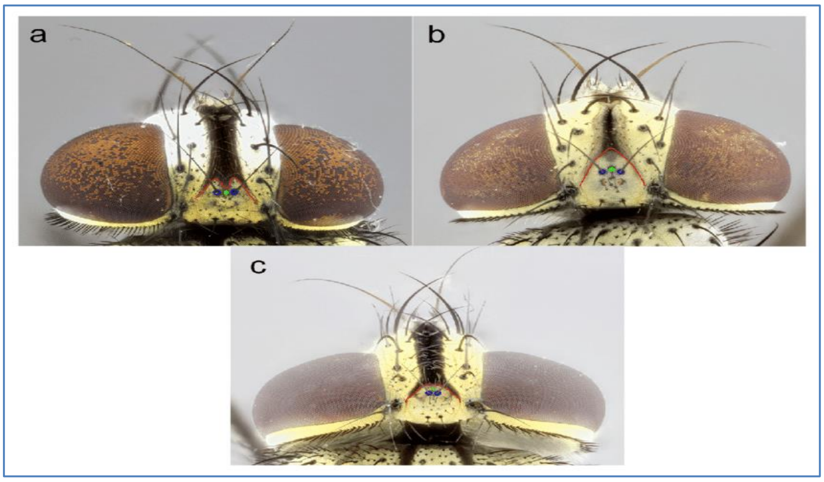


Figure 5A Dorsal view of head. Red lines indicate the shape of the ocellar triangle as described, and placement of anterior ocellus (green circle) relative to the base(s) of ocellar setae (blue circles). a. *Houghia marini* Fleming & Wood, 2014 b. *Houghia graciloides* Fleming & Wood, 2014. c. *Houghia griseifrons* Fleming & Wood, 2014. d. H-shaped design under the ocelli and between the compound eyes; (Source: https://www.researchgate.net/figure/Dorsal-view-of-head-Red-lines-indicate-the-shape-of-the-ocellar-triangle-as-described_fig5_266626968)

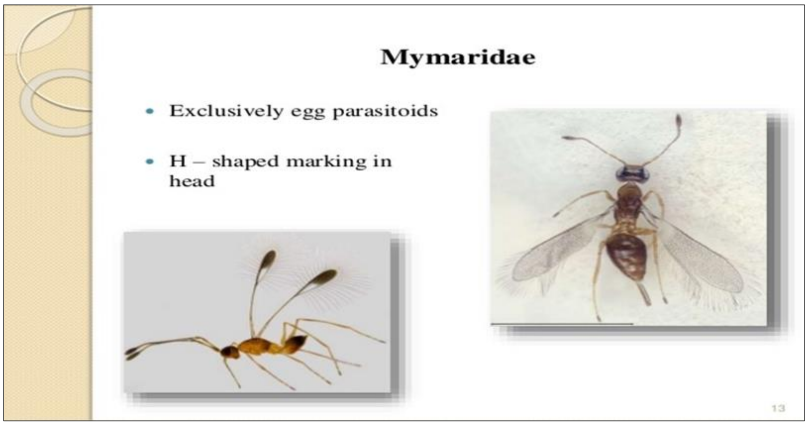


Figure 5B Egg parasitoids of H-shaped design under the ocelli and between the compound eyes; (Source: https://pt.slideshare.net/NishaNepoleon/identification-of-parasitoids-ppt-entomology)

Figure 6 *Kalopolynema ema* (Schauff & Grissell, 1982) (Hymenoptera: Mymaridae) adults that emerged from eggs of *Megamelus scutellaris* Berg, 1883 (Hemiptera: Delphacidae), a biological control agent of water hyacinth, *Eichhornia crassipes* Mart. (Solms), 1883 (Pontederiaceae). Female (left) and male (right); (Source: Photos taken by Jeremiah Foley, USDA-ARS Invasive Plant Research Laboratory)

Figure 7 *Eichhornia crassipes* Mart. (Solms), 1883 (Pontederiaceae); (Source: https://www.ufrgs.br/floracampestre/eichhornia-crassipes-aguape/)

Almost all species have long antennae, at least if the metasome. The antennas are inserted close to the edges of the eyes. In females, the antennae end in a hammer shape, usually with long sensory hairs (arrows) that give them a feathery appearance. In males, they are threadlike. Some species have wings of reduced size or even completely absent (they are apterous). Generally, females are those with reduced wings. This reduction in wings is more common among species that seek out the eggs of the host species in limited and confined spaces, such as in the ground, under dead leaves or in the tubules of certain fungi (Figures 8, 9, 10, 11, 12, 13, 14, 15 and 16) [11,12].

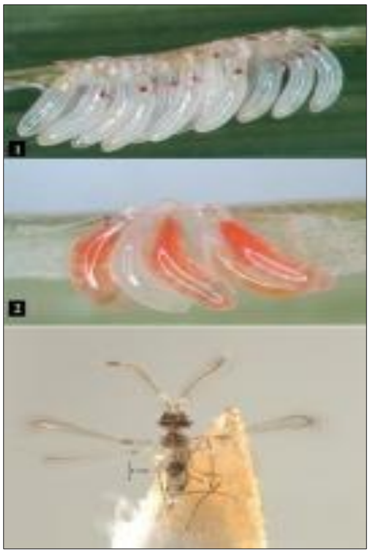


Figure 8 Unparasitized (1) and parasitized (2) eggs of brown planthopper, *Nilaparvata lugens* (Stal, 1854), by *Anagrus incarnatus* Haiday 1833 (Hymnoptera: Mymaridae), the predominant egg parasitoid of rice planthoppers in Taiwan; adult female (3) of *A. incarnates;* (Source: Photos by Shou-Horng Huang and Serguei Vladimirovich Triapitsyn)

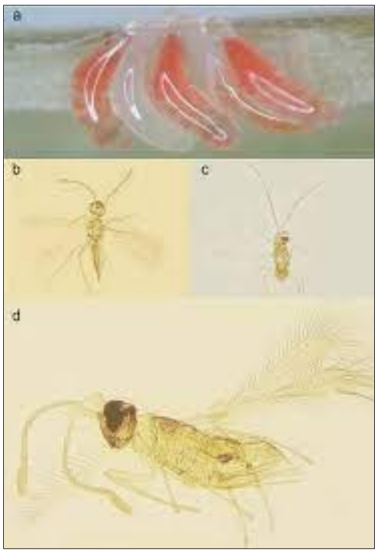


Figure 9 *Anagrus nilaparvartae* Pang and Wang, 1883 (Mymaridae) has been recorded frequently as an egg parasitoid of rice planthoppers in SE Asia, especially of brown planthopper *Nilaparvata lugens* (Stal, 1854). The brown leafhopper is a species of leafhopper that feeds on rice plants. These insects are among the most important pests of rice, which is the main staple crop for about half of the world's population; (Source: https://www.tandfonline.com/doi/full/10.1080/00222933.2018.1552333?needAccess=true)

Figure 10 Emergence holes and females of *Platystethynium triclavatum* (Donev & Huber, 2002) (Hymenoptera, Mymaridae). (A) Eggs of *Barbitistes vicetinus* Galvagni & Fontana, 1993 (Insecta Orthoptera Tettigoniidae) with numerous emergence holes of *P. triclavatum*; (B) newly emerged females of *P. triclavatum* preserved in ethanol; (Source: https://peerj.com/articles/9667/)

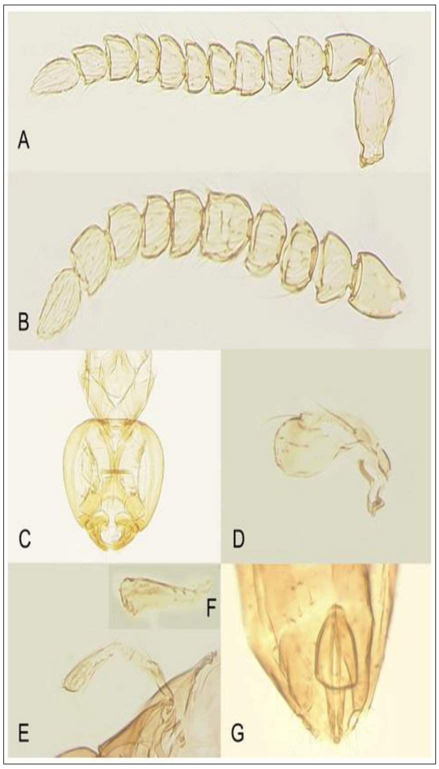


Figure 11 Male of *Platystethynium triclavatum* (Donev & Huber, 2002) (Hymenoptera, Mymaridae). (A) Antenna (10-segmented flagellum); (B) antenna (flagellum nine-segmented); (C) head; (D) fore wing; (E and F) hind wings; (G) genitalia

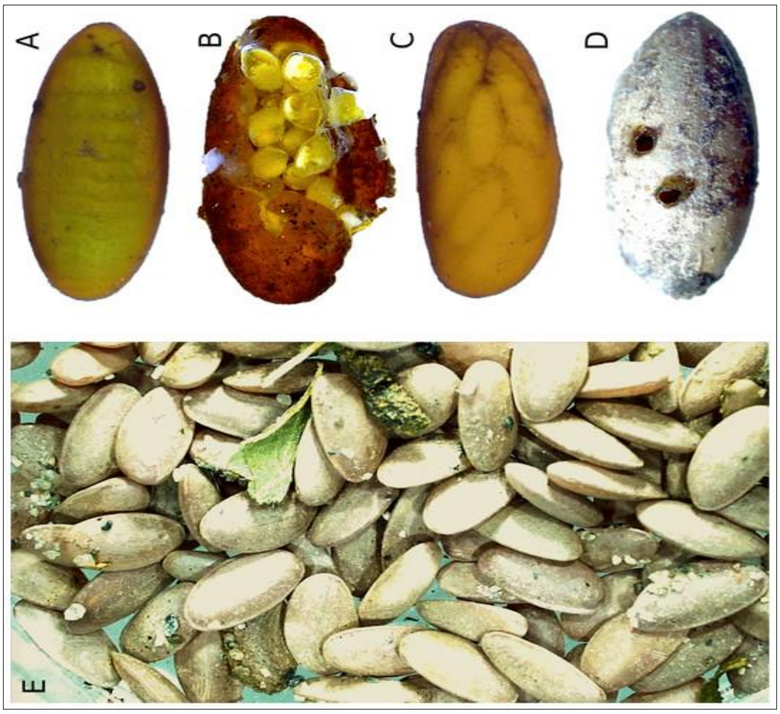


Figure 12 Eggs of *Barbitistes vicetinus* Galvagni & Fontana, 1993. (A) Fertile egg treated with xylene to enhance the transparency of the chorion; (B) dissected egg with embryos of the parasitoid; (C) larval stages of the parasitoids visible in transparency in an egg treated with xylene; (D) emergence holes of *Platystethynium triclavatum* (Donev & Huber, 2002) (Hymenoptera, Mymaridae); (E) eggs of *B. vicetinus; (*Source: Ortis G, Triapitsyn SV, Cavaletto G, Martinez-Sañudo I, Mazzon L. 2020. Taxonomic identification and biological traits of *P. triclavatum*), comb. n. (Hymenoptera, Mymaridae), a newly recorded egg parasitoid of the Italian endemic pest Barbitistes vicetinus (Orthoptera, Tettigoniidae) PeerJ 8: e9667)

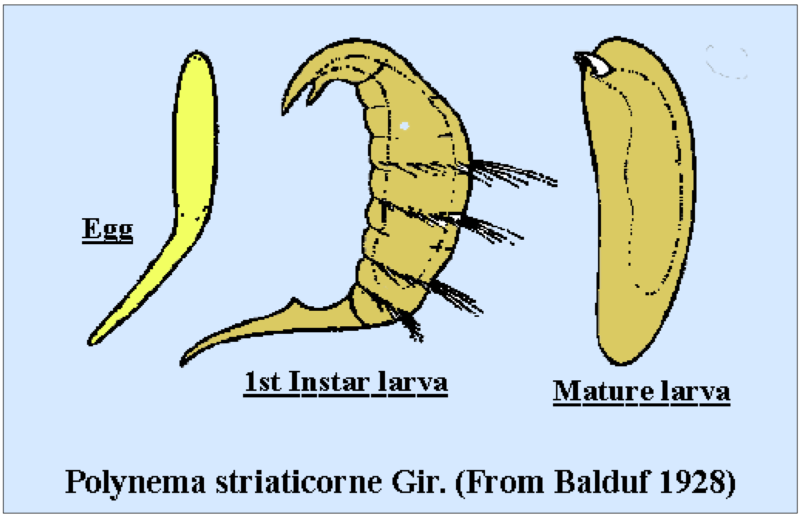
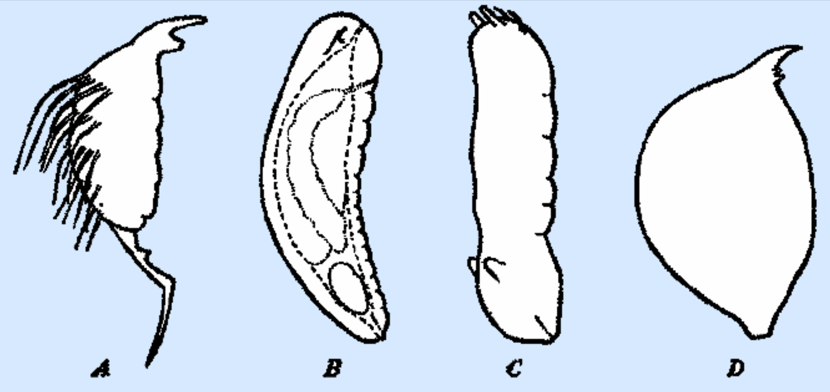


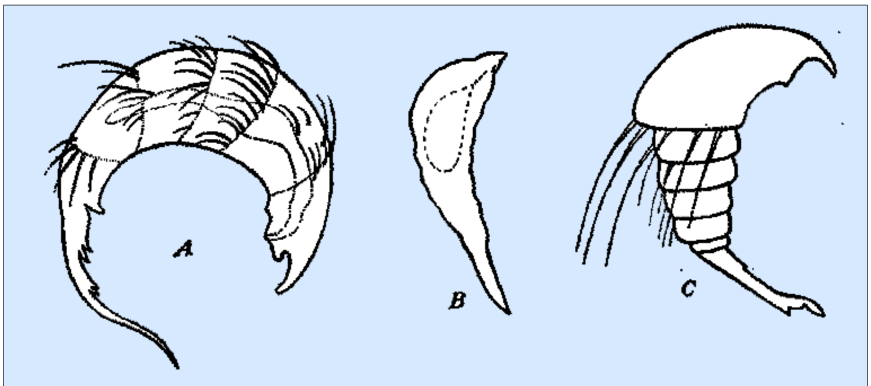
Figure 13 There is little variation in egg shape within the family. The main body of the egg is ellipsoidal, ovoid, or fusiform, with a narrow, tapered stalk at the anterior end varying in length to one-tenth of the egg's body. These eggs

are extremely small, ranging from 0.06 mm. of length in Anagrus atomus at 0.25 mm. In *Polynema striaticorne* (Balduf, 1928; (Source: http://www.faculty.ucr.edu/~legneref/immature/gif/mymar1.ima.htm)



Immature stages of the Mymaridae. *A*, first-instar larva of *Polynema euchariformis* Hal.; *B*, second-instar larva *P. ovulorum* Hal.; *C*, "histriobdellid" second-instar larva of *Anagrus incarnatus* Hal.; *D*, second-instar larva of *Polynema pusillus* Hal. (*From Bakkendorf*, 1933–1934.)

Figure 14 There is a lot of confusion regarding the larval forms of Mymaridae. This is mainly due to the excessively small size of the early stages combined with the lack, in the following instars, of strongly sclerotized or fixedly hardened structures. Often, several species were involved in instar descriptions of what was supposedly a single species; (Source: http://www.faculty.ucr.edu/~legneref/immature/gif/mymar1.ima.htm)



Larvae of the Mymaridae. *A*, first-instar larva of *Polynema bifasciatipenne* Gir. (*from Ayers*, 1884); *B*, first-instar larva of *Lymnaenon affusi* Bakk. (*from Bakkendorf*, 1933–34)· *C*, presumed second-instar larva of *Anaphoidea nitens* Gir. (*from Clark*, 1931).

Figure 15 The second and most common form of the first instar larva is called mmariform. In size, Mymaridae first instar larvae are small and range from 0.1 to .3 mm. The number of larval instars following the first is very uncertain. Several authors asserted that there are only the first and the mature forms, though in most species there are said to be three. The indication of mature larvae with an internal tracheal system or with spiracles in any of the larval instars; (Source: http://www.faculty.ucr.edu/~legneref/immature/gif/mymar1.ima.htm)

A new fairyfly species from the Neotropics, *Anagrus (Anagrus) amazonensis* Triapitsyn, Querino & Feitosa sp, n., is described and illustrated. *Anagrus* Haliday is a large genus of Mymaridae (Hymenoptera), which now includes eight species recorded from Brazil. This new species attacks eggs of damselflies (Odonata: Zygoptera) [11].

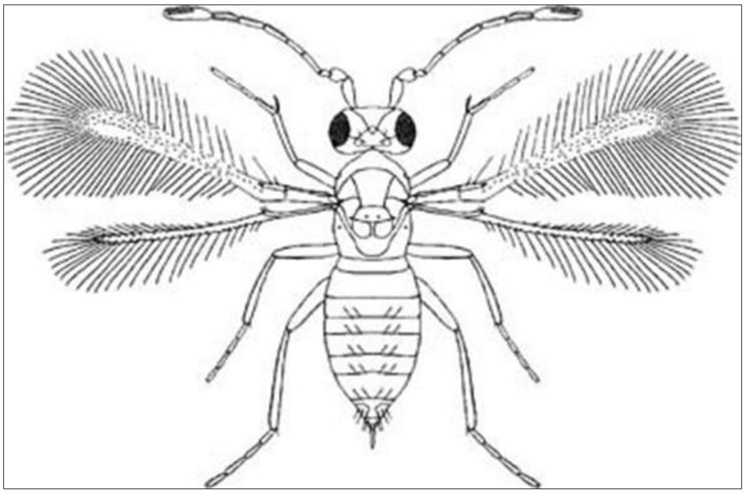


Figure 16 *Anagrus* species (Mymaridae), among the smallest insects known, are endoparasitoids of eggs of Odonata and Hemiptera. The genus is worldwide and about 60 species is now recognized; (Source: https://link.springer.com/referenceworkentry/10.1007%2F0-306-48380-7_175)

Family, Mymaridae, small parasitic wasps (Hymenoptera) with an average length of 0.21mm, which are effective parasites of eggs of scales, cycads, beetles, and others (Figures 17A and 17B) [12].

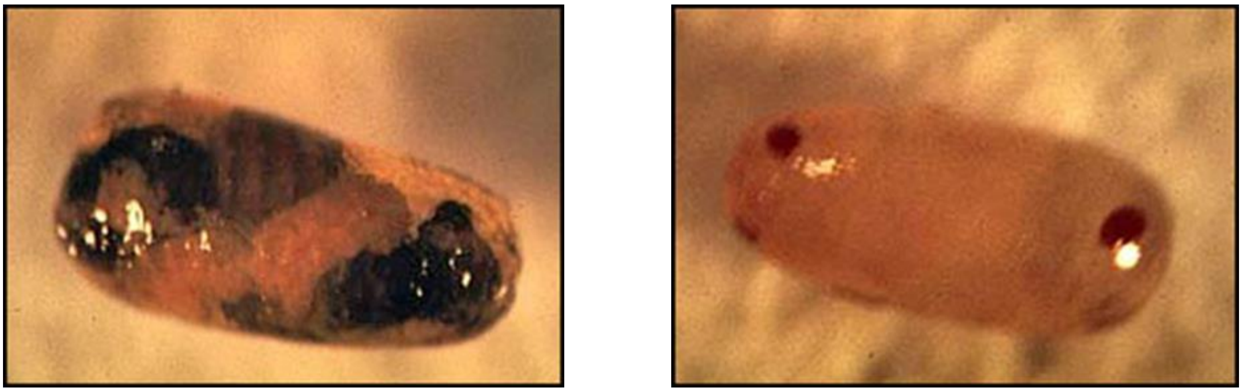


Figure 17 A and B *Anaphes flavipes* (Förster, 1841) early pupal stage within host. Red compound eyes are the first visible feature. *Anaphes flavipes* late pupal stage within host. Note the darkened body ; (Source: PHOTO: USDA, APHIS, PPQ, Niles Plant Protection Center https://biocontrol.entomology.cornell.edu/parasitoids/anaphes.php)

1.1. Life Cycle

Its life cycle consists of the egg, larva, prepupa, pupa and adult stages. The egg stage consists of the internal cleavage of the parasitoid and its growth into the larva. The larval stage consists of the consumption of the host's egg yolk. As a prepupa, the parasitoid is completely immobile; the excretion of fecal matter means the end of this stage. In the early stage of pupae, red compound eyes are the first visible feature. The body begins to darken and faint adult features become visible [12].

In the late larval stage, the body is dark, and the ovipositor is visible in the female. Just before emergence, the head and legs show movement as the parasitoid chews its way through the egg's chorion. Under ideal conditions (21-25°C), adults emerge from the host's egg in 10 to 11 days. A minimum of 174 hours (at 32.2°C) and a maximum of 1089 hours (2.7°C) was determined for the development of *Anaphes* from egg to adult [12].

Within an hour of emergence, the adult female Anaphes will attack suitable hosts and begin laying eggs. On average, females lay 20 eggs over an average period of 2-3 days after emergence. Females will lay fertilized (resulting in female offspring) and unfertilized (resulting in male offspring) eggs (Figure 18) [12].

Figure 18 Oviposition; (Source: Host Shelton A. Família Mymaridae. 1st ed. Annapolis: Copyright is held by Cornell University. 1976 and Li Q Hu H, Triapitsyn S, Yi L, Lu J. *Anagrus dmitrievi* sp. n. (Hymenoptera, Mymaridae), an egg parasitoid of *Zyginidia eremita* Zachvatkin, 1953 (Hemiptera, Cicadellidae), a pest of maize in Xinjiang, China. ZooKeys. 2018; 736: 43-57)

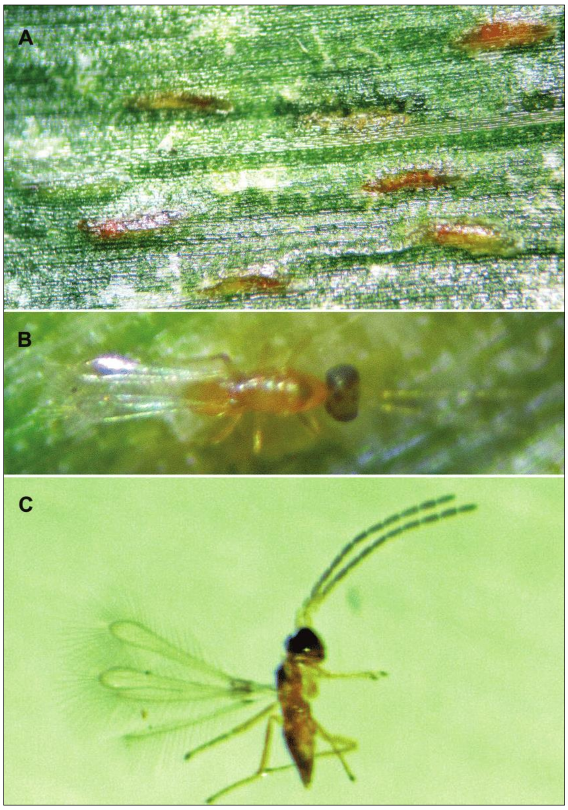


Figure 19 A parasitized eggs of *Zyginidia eremita* Zachvatkin, 1953 (Hemiptera, Cicadellidae) by *Anagrus dmitrievi* sp. n. (Hymenoptera, Mymaridae) in a maize leaf B an adult female of *A. dmitrievi* right after emergence C an adult male of *A. dmitrievi*

Oulema melanopsis (Schaeffer, 1919) (Coleoptera: Chrysomelidae) (cereal leaf beetle) is the main host; however, *Anaphes* is also known to parasitize *Oulema gallaeciana* (Heyden, 1870) (Coleoptera, Chrysomelidae), *Lema collaris* Say, 1824 (Coleoptera: Chrysomelidae), and *Lema trilineata* Kogan & Goeden, 1970 (Coleoptera: Chrysomelidae) (three lined potato beetle) if the primary host is not available. Techniques have been developed using *L. trilineata* eggs for laboratory rearing of *Anaphes flavipes* (Foerster, 1841) (Hymenoptera: Mymaridae). Except for the four species listed previously, *Anaphes* will oviposit in eggs of other Chrysomelidae, but development does not proceed much beyond embryogenesis (Figures 19 and 20) [12].

Figure 20 Family, Mymaridae, small parasitic wasps (Hymenoptera) with an average length of 0.21mm, which are effective parasites of eggs of scales, cycads, beetles, and others

The presence of reduced wings or apter species also occurs in windy weather conditions, such as on oceanic islands or in high altitude places. In these habitats, the wings would be disadvantageous and therefore they are subjected to strong negative natural selection [12].

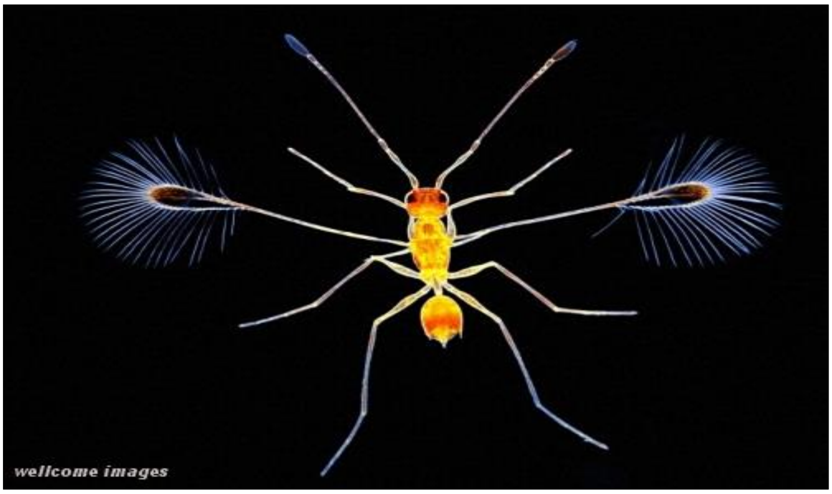


Figure 21 Also called fairy wasps or fairyflies, Mymaridae includes the tiniest insects known to man, their wings don't so much sustain their flight as simply steering them as they float through the air like dust motes. Many species are even partially or fully aquatic, using their wings as swimming paddles. The small size of these "fairies" allows them to parasitize other insects during the egg stage, laying several of their own within a single host egg. Young will mature and even mate (with their own siblings) before breaking free of the host's eggshell, and target such as a diverse range of insects as beetles, grasshoppers, true bugs, flies and even lice; (Source: https://bogleech.com/bio-parasitoids.htm)

Members of the Mymaridae family are among the most common calcidoids but are rarely seen due to their sparse size. The group has a natural distribution in tropical and subtropical regions around the world, also occurring in temperate regions. Most occur in tropical forests, with the greatest diversity in the southern hemisphere, South America, New Zealand, and Australia. In the Nearctic (North America) only about 28 genera and 120 species occur, out of the 100 genera and 1,424 known species [13,14].

Members of this family can survive in all types of terrestrial habitats, from deserts to rainforests. Five aquatic species are known, which live in lagoons or rivers. Among aquatic species is the species *Caraphractus cinctus* Walker, 1846, which uses its wings as oars and can remain underwater for up to 15 days. Due to their small size, these insects need to climb the stem of a plant to come to the surface because they cannot break the imposed barrier by the surface tension of the water [13,14].

1.2. Ecology

All known members of this family are parasitoids on the eggs of other insects. These eggs are usually deposited in hidden places, such as in plant tissue or under a layer of soil, so these species are forced to have complex search behaviors. Members of this family do not appear to be very specific in their host selection. Some species parasitize insects from several families belonging to a single order [14].

The most common hosts are members of the order Hemiptera, especially *Auchenorrhyncha* cicadas and the like and Coccoidea (scale insects), but these conclusions are perhaps since these groups are better studied. Other important hosts are beetles, flies, dragonflies, Psocoptera and Thysanoptera. The hosts of only a quarter of the described species are known [14,15].

The definition of aquatic Hymenoptera, which includes all Hymenoptera species that parasitize any life stage of aquatic insects. Most of these species belong to the families Eulophidae, Mymaridae, Trichogrammatidae and Scelionidae.

1.3. Economic importance

Some species of Mymaridae have been used as biological pest control agents in crops and are highly appreciated for their ability to find the hidden eggs of their hosts. The genus *Anagrus* parasitizes a wide variety of hosts, so it has been introduced in several countries for biological control purposes. In Hawaii the species *Anagrus optabilis* (Perkins, 1905) was introduced to control *Perkinsiella saccharicida* Kirkaldy, 1903, an important sugarcane pest [14,15].

1.4. Taxonomy

Allanagrus magniclava Noyes & Valentine 1989 (female). *Richteria ara* (Girault, 1920) (female) with the characteristic wing type of the family *Camptopteroides verrucosa* (Noyes & Valentine, 1989) (female). *Enneagmus pristinus* Noyes & Valentine, 1989) (female in amber). *Myanmymar aresconoides* Huber, 2011 (female) the oldest known fossil attributed to this family. *Gonatocerus triguttatus* Girault, 1916 laying its eggs on *Homalodisca vitripennis* (Germar, 1821) eggs inside a leaf. In its present taxonomic circumscription, the Mymaridae family groups around 100 genera with more than 1400 validly described species [15,16].

The genera *Allomymar* and *Metanthemus* were transferred to the Aphelinidae family. The fossil genus *Protooctonus* was transferred to the family Mymarommatidae and is now considered a taxonomic synonym of *Archaeromma.* The genera *Nesopolynema*, *Oncomymar* and *Scolopsopteron* are considered synonymous with *Cremnomymar* [15,16].

1.5. Management

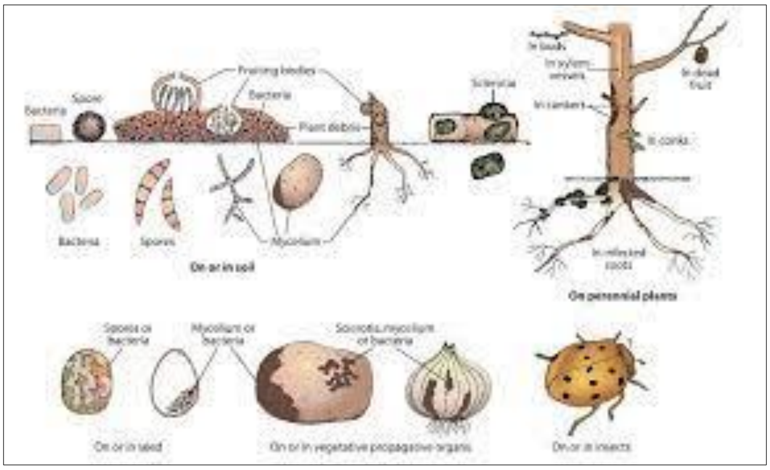


Figure 22 Cycle of pathogen - host relations - *Homalodysca coagulata* virus-1 (HoCV-1, Dicistroviridae); (Source: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/viewer.html?pdfurl=https%3A%2F%2Fwww.fcav.unesp.br%2FHome%2Fdepartamentos%2Ffitossanidade%2FMARGARETECAMARGO%2Fciclo2015a.pdf&clen=1731782&chunk=true)

Successful efforts using integrated pest management (IPM) of the glassy-winged sharpshooter include the use of insecticides, parasitoids (especially wasps in the family Mymaridae), and the impact of naturally occurring pathogens like viruses, bacteria, and fungi [17,18].

One of the newly discovered pathogens is a virus specific. The leafhopper-infecting virus, *Homalodysca coagulata* virus-1 (HoCV-1, Dicistroviridae), has been shown to increase leafhopper mortality. The virus occurs in nature and is spread most readily at high population densities through contact among infected individuals, contact with virus-contaminated surfaces, and/or as an aerosol in leafhopper excretes (Figure 22 and 23) [18,19].

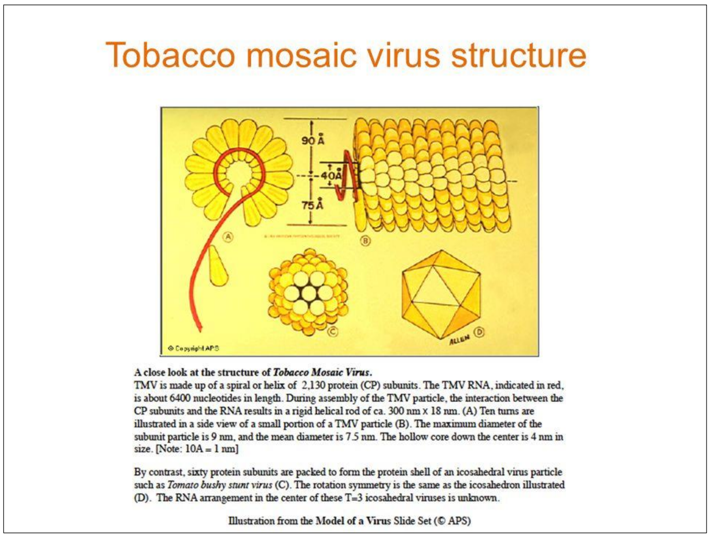


Figure 23 Cycle of pathogen-host: virus and viroid relationships. Virus Tobacco mosaic virus (TMV) of plants provides a good model to learn about the relationship; (Source: https://slideplayer.com/slide/9467449/)

One of the most successful biocontrol efforts has been the mass rearing and release of four different leafhopper parasitoids (in the mymarid genus *Gonatocerus)*, which have been very successful in reducing the number of eggs that survive. The traditional means of insect management, such as scouting and landowner reports of leafhopper presence, followed by highly focused insecticide treatments, have also been of great value in reducing leafhopper numbers; all of these impacts have produced a system wherein reasonable, environmentally sound management of this insect pest is being maintained [19,20].

Objective

The objective of this manuscript is to research the management, biology, habitat, ecology, geographic distribution, taxonomy, life cycle, phenology, parasitoidism (parasitism) of the Mymaridae Family (Insecta: Hymenoptera).

2. Methods

A literature search was carried out containing articles published from 1984 to 2021. The mini review was prepared in Goiânia, Goiás, from September to October 2021.

The mini-review was prepared in Goiânia, Goiás, from September to October 2021, through the ResearchGate, Academia.edu, Frontiers, Online Scientific Library (Scielo), internet, Academia.edu, Frontiers, Biological Abstract, Publons, Qeios, Pubmed, Dialnet, World, Wide Science, Springer, RefSeek, Microsoft Academic, Science, ERIC, Science Research.com, SEEK education, Periodicals CAPES, Google Academic, Bioline International, VADLO, Scopus, Web of Science, LILACS, Medline, LIS and Portal of Scientific Journals in Health Sciences.

3. Study conducted and selected

3.1. Study 1

The aim of the present study is to document the aquatic insect hosts of *Anagrus amazonensis* Triapitsyn, Querino & Feitosa, sp. a new and the plants on which host eggs are laid in Central Amazonia. Eggs were randomly collected in 2004, 2005, and 2006 in three floodplain lakes (lentic environments) and eight upland (*terra firme*) forest streams (lotic environments) in four municipalities (Iranduba, Manaus, Presidente Figueiredo, and Rio Preto da Eva) in Amazonas State, Brazil.

Figure 24 Moericke trap; (Source: https://simonleather.wordpress.com/2015/01/12/entomological-classics-the-moericke-yellow-pan-trap/)

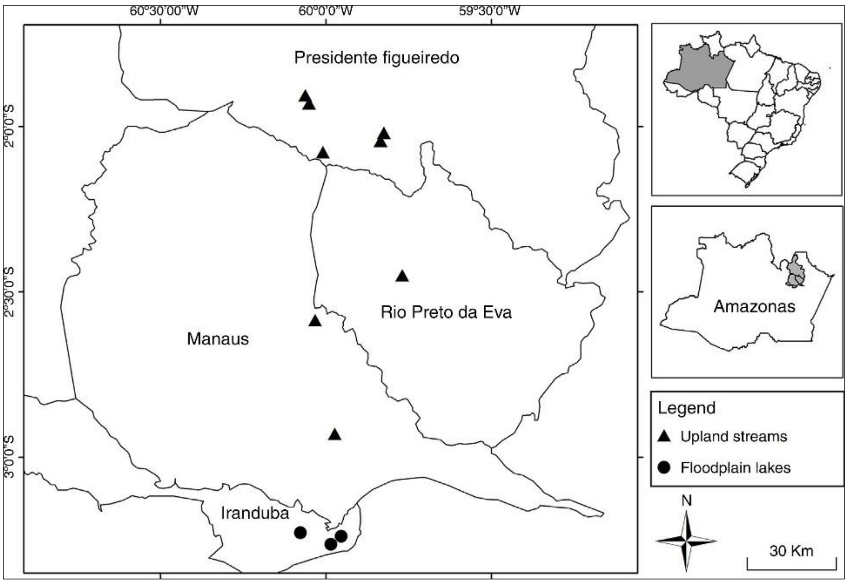


Figure 25 Sites where *Anagrus amazonensis* (Hymenoptera, Mymaridae), its hosts, and their associated plants were collected in Amazonas State, Brazil

A total of 1223 individuals of *A. amazonensis* Triapitsyn, Querino & Feitosa, sp. a new fairyfly species from the Neotropics. Were obtained, of which 1128 were female and 95 were male. *Anagrus amazonensis* emerged from eggs of Hemiptera, Lepidoptera, and Odonata. *A. amazonensis* parasitized eggs placed on the underside of the macrophyte's leaves, except for lepidopteran eggs, which were placed on the upper surfaces of the leaves. The higher rate of parasitism in Odonata eggs is most likely since they are more easily found in the sampled locations. The host range of *A. amazonensis* appears to be exceptionally wide (encompassing three insect orders) even for a taxon (Mymaridae) where there seems to be a tendency for species not to be host-species specific; many mymarid species present host specificity at the genus level, while others are known to parasitize hosts of a wide range of families in a single insect order (Figure 25).

Anagrus amazonensis emerged from aquatic insect eggs laid on 12 species of aquatic plants. Of these, only *Eichhornia crassipes* (Mart.) Solms. (Pontederiaceae) *Salvinia* sp. (Salviniaceae), *Pistia stratiotes* L., (Araceae). *Tonina fluviatilis* Aublet (Eriocaulaceae), *Thurnia* sp. (Ciperaceae) have been previously associated with oviposition of aquatic insect eggs in the Amazon region Thumbnail [21].

3.2. Study 2

This study aimed to know the parasitoid Hymenoptera families in a cotton crop and their relative frequencies (Figure 26).

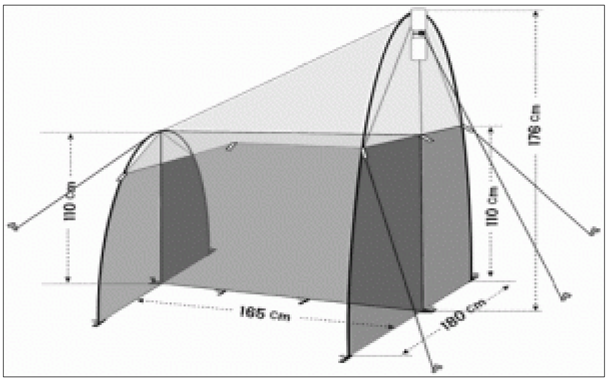


Figure 26 Malaise trap; (Source: https://malaiseprogram.com/discover/what-is-a-malaise-trap/)

We collected 16,166 parasitoid hymenoptera belonging to 22 families, distributed in eight superfamilies: Chalcidoidea, Platygastroidea, Ichneumonoidea, Cynipoidea, Ceraphronoidea, Chrysidoidea, Proctotrupoidea and Evanioidea. The most abundant families were Encyrtidae, Trichogrammatidae, Mymaridae and Scelionidae, which represented 45.14%, 19.11%, 14.33% and 6.57% of the total number of collected parasitoid Hymenoptera, respectively.

In the superfamily Chalcidoidea, the Encyrtidae, Trichogrammatidae and Mymaridae families stood out. In the Encyrtidae family, it was observed that a single unidentified species of the genus *Copidosoma* Ratzeburg, 1844, represented 94.18% of the total of 7,297-captured Encyrtidae. Trichogrammatidae and Mymaridae are parasitoids of eggs of other insects and together represent 33.44% of the total parasitoid hymenoptera collected. In the superfamily Platygastroidea, the Scelionidae family 6.57% of the collected parasitoid hymenoptera) stood out.

Of the total parasitoid Hymenoptera collected, 53.79% were captured in Moericke traps installed at 1 m from the ground (hereinafter written as AS), while 46.21% were captured in traps installed at 0.5 m from the ground (hereinafter spelled as AI). The pattern observed for the total of parasitoid Hymenoptera was maintained in Chalcidoidea (54.74% in AS and 45.26% in AI), Cynipoidea (65.12% and 34.88%), Ceraphronoidea (50.33% and 49 .67%), Proctotrupoidea (53.21% and 46.79%) and Evanioidea (63.64% and 36.36%). Chrysidoidea, Platygastroidea and Ichneumonoidea had the highest number of specimens collected in the AI with 44.44% and 55.56; 48.64% and 51.36%; and 32.29% and 67.71%, respectively. Except for Ichneumonoidea, Cynipoidea and Evanioidea, which together accounted for 4.77% of the total parasitoid hymenoptera collected [22].

3.3. Study 3

This work aims to estimate and compare diversity of the Hymenoptera families, evaluating the presence, abundance over time and evaluating the diversity of insects in two distinct types of restinga forest (Figure 27).

A total of 5,518 hymenoptera were collected. The RA area was the most abundant and rich, featuring 5,176 individuals, divided into 30 families, 13 of which are exclusive to the area. In contrast, the Antropizada Restinga Area (RP) had 342 individuals comprising 17 families, all present in the Preserved Restinga Area RA.

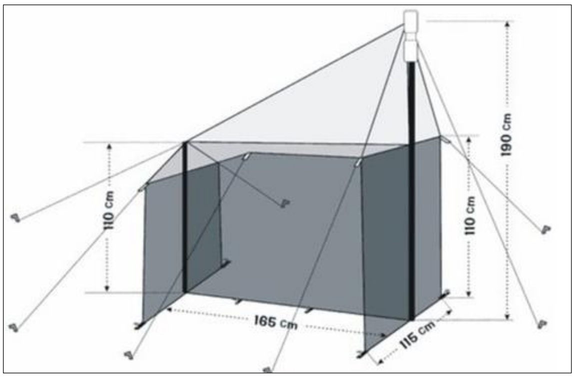


Figure 27 Malaise trap; (Source: https://www.scientificinstrumentmanufacturers.com/malaise-trap-3203935.html)

The composition of the five most abundant families in each area was specific. In the RA area, the most abundant families were Formicidae, Halictidae, Sphecidae, Ichneumonidae and Tiphiidae, representing about 80% of the captured individuals. In the RP area, Formicidae, Ichneumonidae, Braconidae, Pompilidae and Pteromalidae were the most abundant families, comprising 67% of the specimens collected. Total abundance of Hymenoptera families captured by Malaise traps from August 2004 to July 2005 in two restinga areas of Ilha dos Marinheiros, Rio Grande, RS. GE: Ecological Groups (A: *Antophiles*. P: Parasitoids. G: Generalists.). R.A.: Anthropized Restinga. R.P.: Preserved Restinga. FR: Relative Frequency for the Family was Mymaridae: GE: Parasitoid, R.A: 20, FR: 0,39%, R.P 15, FR: 4,39%, Total 35 and Total FR: 0,65% [23].

4. Conclusion

All known members of this family are parasitoids on the eggs of other insects. These eggs are usually deposited in hidden places, such as in plant tissue or under a layer of soil, so these species are forced to have complex search behaviors. Members of this family do not appear to be very specific in their host selection.

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