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# **MiniReview**

# Taxonomic and Biological Aspects of the Azotidae Family (Insecta: Hymenoptera)

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## Abstract

The Azotidae are hyperparasitoids linked to alleridae, mealybugs (Insecta: Hemiptera), and egg parasitoids. Azotidae Family Nikol'skaya & Yasnosh, 1966 was accepted by the authority of the name: In the taxonomic catalog of the fauna of Brazil and list of flora of Brazil 2020. The Azotidae were formerly included as a subfamily of the Aphelinidae. This manuscript aimed to establish the biological characteristics of the Azotidae. The bibliographic research was carried out from 1970 to July 2022, using manuscripts present in digital platforms such as Biological Abstract, Periodicals, and Scielo. Thus, the present study increases our knowledge to better understand the intricacies of the bioecology, geographic distribution, and taxonomy of the Azotidae.

Keywords: hyperparasitoids, Diaspididae, Aleyrodidae, parasitoid, taxonomy

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## **1 INTRODUCTION**

Azotidae Family Nikol'skaya & Yasnosh, 1966 was accepted by the Authority of the name: In the taxonomic catalog of fauna of Brazil and list of flora of Brazil 2020. The Azotidae were formerly included as a subfamily of the Aphelinidae (Figure 1)<sup>[1,2]</sup>.

## 1.1 Description

Pale lines or sutures on the head with the existence of a general groove. Female antennae include 7 knuckles, funicular with 4 knuckles, the 3rd reduced, apical nail entirely or weakly divided, antenna with some knuckles alternately yellow. Male antenna with a relatively short third flagellar segment (Figures 2 and 3)<sup>[3-7]</sup>.



Figure 1. Specimen of Azotidae Family. Source: http://www. waspweb.org/chalcidoidea/Azotidae/index.htm

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Figure 2. Female. 5: Antenna; 6: Forewing; 7: Mesosoma; 8: Ovipositor. Source: https://bioone.org/journals/floridaentomologist/volume-99/issue-3/024.099.0310/The-Speciesof-Genus-Ablerus-Howard-Hymenoptera--Chalcidoid ea/10.1653/024.099.0310.full



Figure 3 Female. 9: Body dorsal view; 10: Body ventral view; 11: Foreleg; 12: Mid-leg; 13: Hind leg. Source: https://bioone.org/ journals/florida-entomologist/volume-99/issue-3/024.099.0310/ The-Species-of-Genus-Ablerus-Howard-Hymenoptera--Chalcid oidea/10.1653/024.099.0310.full



Figure 4. Antenna-Ablerus-Female Azotidae Family. Source: Immokalee, Collier County, Florida, USA

## 1.2 Taxonomy

Anterior female wings are often spotted with smoky

patterns, wing without oblique bald line, stigma vein with large rounded stigma, a wing lacking oblique bald line, a stigma vein with large rounded stigma, and a lack of post marginal vein. Gaster female with a prominent ovipositor. Tarsus with 5 knuckles. Family with 1 genus and 7 species on the peninsula. Formerly traditionally included in Aphelinidae

Taxonomic Hierarchy: Animalia $\rightarrow$  Arthropoda von Siebold, 1848 $\rightarrow$  Hexapoda Latreille, 1825 $\rightarrow$  Insecta Linnaeus, 1758 $\rightarrow$  Hymenoptera Linnaeus, 1758 $\rightarrow$ Azotidae Nikol'skaya & Yasnosh, 1966. Genres *Ablerus* Howard. Lifeform and Substrate: Substrate terrestrial. Origin: Native. Endemism: Unknown. Environments: epicontinental. Geographic distribution: Southeast São Paulo) Brazil.

Synopsis for all Brazil; Species: 3 and Genus1 (Fernandes DRR, DalMolin A. Azotidae in taxonomic catalog of fauna of Brazil). Other countries are Argentina, Chile, Eritrea, Georgia, Mexico, and Uruguay Figures 4 and 5<sup>[8-12]</sup>.



Figure 5. IndoBioSys Chalcidoidea Species Diversity Per Family (Red Line) Compared to the Universal Chalcidoidea Database (UCDB) Species Diversity (Blue Line). The Number of Species Is Presented between Parenthesis Close to the Family Name. Source: IndoBioSys/UCDB.

#### 1.3 Objective

This manuscript aimed to establish the taxonomic and biological aspects of the Family Azotidae (Insecta: Hymenoptera).

#### **2 METHODS**

The method used to prepare this mini review was

Marchiori 2021 methodology<sup>[13]</sup>.

#### 3 STUDIES CONDUCTED AND SELECTED 3.1 Study 1

Biology and taxonomy

Biology and taxonomy of the genus *Ablerus* in Spain. Specie: *Ablerus* sp.

Transverse head, with pale lines or sutures, general groove present. Female antenna with 7 knuckles, funicular with 4 knuckles, the 3rd slightly reduced, apical nail entire or weakly divided, often with some knuckles alternately light and dark. Male antenna with funicular with 4 knuckles, F3 very small. 3-toothed jaws (Figure 6).



Figure 6. Ablerus Howard, 1894. Source: http://www.waspweb.org/chalcidoidea/Azotidae/Ablerus/Ablerus species.htm

Wings are long and slender, with smoky or hyaline patterns on the female, with thicker hairiness over dark areas, marginal long cilia, wing without oblique bald line, stigma vein with large rounded stigma, postmarginal vein absent. Constitutes short and oval shape chest. The Gaster is longer than the combined length of head and thorax together, female with prominent ovipositor. Tarsus with 5 knuckles<sup>[14-16]</sup>.

Biology: On diaspidids and aleirodids, often hyperparasitoids. Genus with 7 species on the peninsula, 11 on the mainland.

I counted 7 articles on the antennae, the 1st long white ringed with black or the reverse (not super visible on the photos) and the others alternately white and black. There is a laying organ, the abdomen is dark blue, and it seems to me that it has only one relatively thick and short rib on the forewings.

#### 3.2 Study 2

Ablerus chrysomphali (Ghesquière, 1960).

Description: Black and slightly blue body. Yellow head, with black vertex. Black antennae, with pedicel apex, white F2 and F4. Black legs, with trochanters, the apex of the thighs and the base of the light tibias. Anterior wings female with a longitudinal smoky band, extending from the basal smoky area to the apical margin. Antenna with slightly thickened escape, subequal flagellates except the 3rd smallest mace as long as the last 3 flagellomas (Figure 7).



### Figure 7. *Ablerus chrysomphali* (Ghesquière, 1960) (Azotidae). Source: http://ponent.atspace.org/fauna/ins/fam/azotidae/ ablerus azo.htm

Wing with rounded stigma, marginal vein with 4 long cilia on the margin, surface with thick arrows gathered in small groups below the marginal vein's apex, subapical on the anterior margin, longitudinal strip on the dark spot, long marginal cilia = 0.4x wide wing. Medium tibias with waiting as long as the basitars or almost.

Biology: Hyperparasitoid on diaspidids *Chrysomphalus*, *Diaspidiotus*, *Lepidosaphes*, *Parlatoria* and *Contigaspis*.

Distribution: Mediterranean: Palaearctic distribution (Figure 8).



Figure 8. Chrysomphalus (Hemiptera: Diaspididae). Source: https://www.biotaxa.org/Zootaxa/article/view/zootaxa.4759.4.9

Found in: Thymus vulgaris L. (Lamiaceae) (Figure 9).

Biology: Hyperparasitoids of different hymenopteran primary parasitoids, including chalcidoids. Some species are confirmed as oophagous.

Table 1. Number of Species for Each Chalcidoidea

Family Reported for the Maltese Islands



Figure 9. Adult of Gelechiidae (Lepidoptera). Source: https:// britishlepidoptera.weebly.com/35-gelechiidae.html

Number of taxa: World-1 genus and 94 species, Palaearctic-1/14, Russia-1/2.

Type: Especies: *Centrodora clisiocampae* Ashmead, 1894 (Hymenoptera: Aphelinidae). Cosmopolitan.

Number of species: World-94, Palaearctic-14, Russia-2.

Biology: *Encyrtus*, hemipterans from Diaspididae, Lasiocampidae and Aphelinidae.

Distribution: FE (PR). Azerbaijan and Australasia.

Biology: *Ablerus pulcherrimus* (Mercet, 1922) (Azotus). Diaspididae, Issidae. Russia: FE (PR). Europe (WE, SE, EE) (Figure 10).

Chalcidoidea Family	Total Number of Species Currently Known From Malta	Work
Agoanidae	03	00
Aphelinidae	20	03
Azotidae	01	01
Chalcididae	03	03
Encyrtidae	13	13
Eulophidae	35	19
Eupelmidae	07	02
Eurytomidae	05	4
Leucospidae	04	00
Mymaridae	02	00
Ormyridae	01	01
Pteromalidae	33	21
Signiphoridae	01	00
Tetracampidae	07	01
Torymidae	07	05
	147	73

Notes: Source: https://www.um.edu.mt/library/oar/ bitstream/123456789/12395/1/Chalcidoidea.pdf



Figure 11. Malaise Trap. Source: https://www.aimethods-lab. com/en/who-we-support/case-studies

1. Ablerus atomon (Walker, 1847) (Figure 12).

Hosts: *Chionaspis stantophris* Mercer, 1922, *Chionaspis, Diaspidiotus* and *Leucaspis ulmi* (L., 1758) and Aphelinidae (Figure 13).

2. *Ablerus pexus* (Huang, 1994). Host: Unknown. Distribution: China (Fujian)<sup>[17-20]</sup>.



Figure 10. *Ablerus pulcherrimus* (Mercet, 1922). Source: https://www.biodiversity4all.org/taxa/375478-Ablerus

Hosts: The whiteflies<sup>[14-16]</sup>. Azotidae Maltese Islands (Table 1) (Figure 11).

## 3.3 Study 3

Azotidae from China. Genus *Ablerus* Howard, 1894. Distribution: Cosmopolitan.

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Figure 12. *Ablerus atomon* (Walker, 1847). Source: Pekka Malinen.



**Figure 13.** *Leucaspis* **Diaspididae Family.** Source: http://v3.boldsystems.org/index.php/Taxbrowser\_Taxon-page?taxid=593683

#### 3.4 Study 4

Egg parasitoid.

Parasitoids develop in the host's egg. Egg parasitoids are found in the following Families: Ichneumonidae, Encyrtidae, Mymaridae, Trichogrammatidae, Aphelinidae, Scelionidae Azotidae, Braconidae, Eurytomidae, Evaniidae, Pteromalidae, Signiphoridae, Eupelmidae, Tetracampidae, Eulophidae, Torymidae and Encyrtidae (Figure 14).



Figure 14. The Egg Parasitoid Wasp. Source: https://pk-photography.blogspot.com/2012/04/egg-parasitoid-wasp-trissolcus-basalis.html

Species of egg parasitoids: *Telenomus edessae* Fabricius, 1916, *Telenomus podisi* Ashmead, 1893, *Telenomus* sp., *Ooencyrtus* sp. (Encyrtidae) *Trissolcus basalis* (Wollaston, 1858), *Trissolcus brochymenae* Ashmead, 1881, *Trissolcus* sp., *Trissolcus terettis* Johnson, 1987, *Trissolcus urichi* Crawford, 1913 (Scelionidae), *Anastatus auriceps* Ashmead, 1904, *Eupelmus* sp. (Eupelmidae) and *Ablerus* sp. (Azotidae) (Figure 15)<sup>[21,22]</sup>.



Figure 15. Life Cycle of an Egg Parastoid. Source: http://www. entomologa.ru/outline/263.htm

#### **4 CONCLUSION**

Little research has been conducted on the Azotidae Family, formerly considered a subfamily of the Aphelinidae Family. Therefore, this study was conducted to increase the knowledge of the bioecology, geographic distribution, and taxonomy of the Azotidae.

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Not applicable.

#### **Conflicts of Interest**

The author declared no conflict of interest.

#### **Author Contribution**

Marchiori CH wrote the manuscript, provided all figures, and approved the final version.

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