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(REVIEW ARTICLE)

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A systematic review of the Families Chrysolampidae, Cleonymidae, Diparidae, Cerocephalidae, Chalcedectidae, Ceidae and Herbertiidae

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Abstract

Despite their small size, the Chalcidoidea play a significant role in the ecosystem. Most species are parasitoids of other insects, attacking the egg or larval stage of their host, although many other life cycles are known. These hosts can be found in at least 12 different insect orders, including Lepidoptera (butterflies and moths), Diptera (true flies), Coleoptera (beetles), Hemiptera (true insects) and other Hymenoptera, as well as two orders of Arachnida and even a family of Nematoda. In addition to the parasitoids, there are some species with the phytophagous habit, the larvae feed inside seeds, stems and galls. This work aims to examine the parasitoids of Chrysolampidae, Cleonymidae, Diparidae, Cerocephalidae, Chalcedectidae, Ceidae and Herbertiidae (Hymenoptera: Chalcidoidea). The present work used the reference of bibliographical research, understood as the act of inquiring and seeking information on a given subject, through a survey carried out in national and foreign databases, with the objective of detecting what there is of consensus or controversy. in the state of the art. Digital platforms were examined. Google Scholar, CrossRef, CiteFactor, Scilit (Scientific Literature), Academic Resource Index (Research), Scientific Indexing Services, ResearchGate, World Cat, DRJI (Directory of Research Journals Indexing), Semantic Scholar. The articles were published from 1972 to 2022 in indexed scientific research, book scientific chapters, theses banks, university dissertations, national and international scientific articles and scientific journals.

Keywords: Mini review; Lepidoptera; Diptera; Arachnida; Control

1 Family Chrysolampidae

1.1 Introduction

Chalcidoidea is an old family belonging to the class Insecta, order Hymenoptera, and suborder Apocrita, which includes 24 families and nearly 22,500 described species. Its members are mostly insects of small stature, often with a metallic iridescent color and various body shapes. They are widespread worldwide, and most of them have a parasitoid lifestyle, they lay their eggs in the bodies of other insects, which their larvae devour from the inside. By destroying harmful insects, some of their species play an important role in biological control (Figures 1-5) [1].

1.1.1 Objective

This work aims to examine the parasitoids of Chrysolampidae, Cleonymidae, Diparidae, Cerocephalidae, Chalcedectidae, Ceidae and Herbertiidae (Hymenoptera: Chalcidoidea).

1.2 Methods

The present work used the reference of bibliographical research, understood as the act of inquiring and seeking information on a certain subject, through a survey carried out in national and foreign databases, with the objective of detecting what there is of consensus or controversy. in the state of the art. Digital platforms were examined. Google

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Sources: 20937PerilD12 and https://v3.boldsystems.org/index.php/Taxbrowser_Taxonpage?taxid=1139412

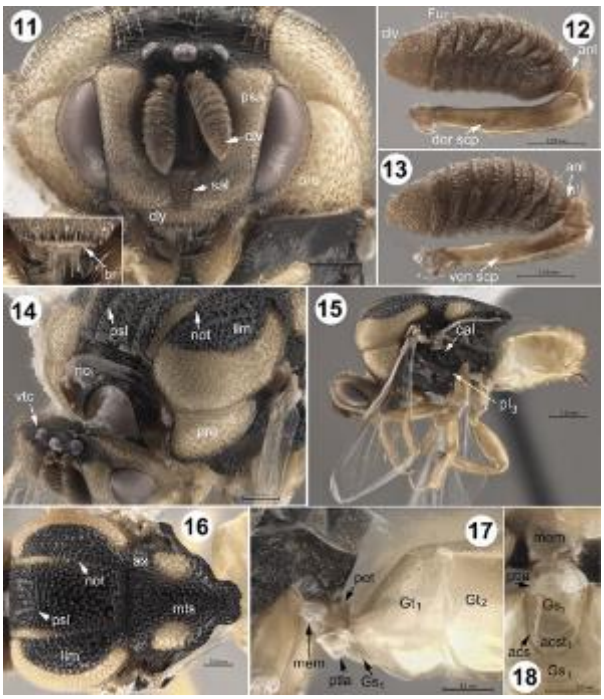
Figure 1 Specimen of Chrysolampidae family

Sources: Photo 75598240, (c) Pradyu, some rights reserved (CC BY-NC), uploaded by Pradyu and https://guatemala.inaturalist.org/photos/75598240

Figure 2 *Philomides indicus* Girish Kumar et al., 2008

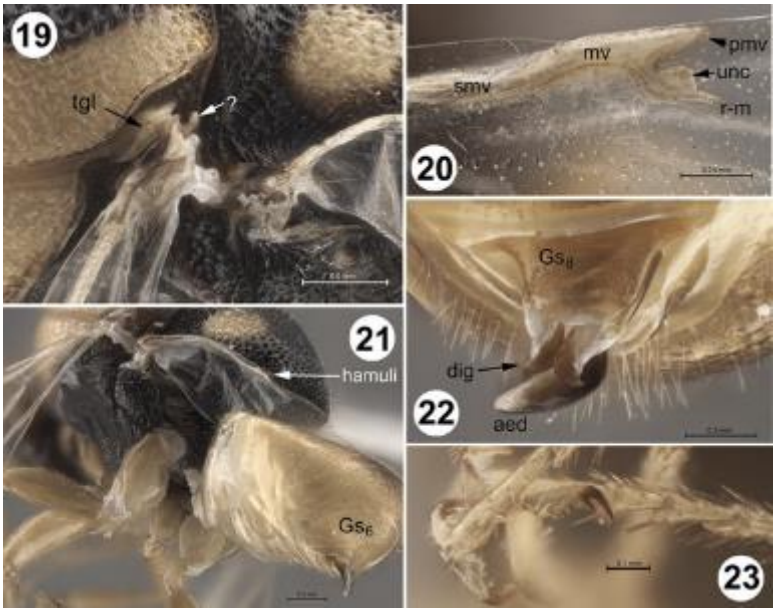
Source: https://www.researchgate.net/figure/10-Aperilampus-1-2-4-7-A-rabeharisoae-female-holotype-CASENT2212474-1_fig3_333207824

Figure 3 *Aperilampus* 1, 2, 4, 7: *Aperilampus rabeharisoae* Heraty, sp. nov., female (holotype): 1, habitus; 2, head, frontal view; 4, mesosoma, lateral view; 7, metasoma, ventral view. 6, *A. rabeharisoae*, female (paratype); posterior mesosoma and dorsal metasoma. 3, 5, 8, 10: *Aperilampus* sp., male: 3, head, frontal view; 5, mesosoma, dorsal view; 8, metasoma ventral view; 10, gastral tergum 1, lateral view. 9; male, genitalia. 10; ventral view



Source: https://www.researchgate.net/figure/18-Philomides-hamooniae-male-holotype-UCRCENT00491418-11-head-and-anterior_fig4_333207824

Figure 4 *Philomides hamooniae* sp. nov., male (holotype); 11, head and anterior mesosoma inset anteroventral view of clypeus and labrum); 12, right antenna, lateral view; 13, right antenna, medial view; 14, head and mesosoma, anterolateral view; 15, habitus, lateral view; 16, mesosoma, dorsal view; 17, mesosoma and gaster, lateral view; 18, petiole and anterior gaster ventral view



Source: https://www.researchgate.net/figure/23-Philomides-hamooniae-male-holotype-UCRCENT00491418-19-mesosoma-lateral-view_fig5_333207824

Figure 5 *Philomides hamooniae* sp. nov. male (holotype). 19, mesosoma, lateral view; 20, fore wing venation, dorsal view; 21, mesosoma and metasoma, posterolateral view; 22, apex of gaster and genitalia, subventral view; 23, tarsi

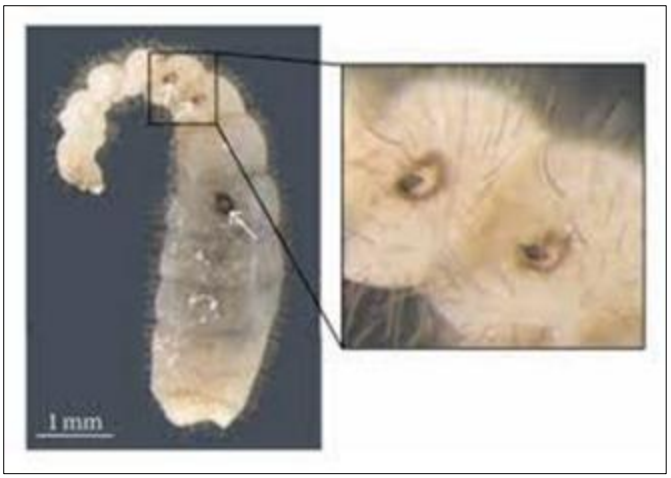
1.2.1 Biology

Either hyperparasitoids of Lepidoptera through Tachinidae (Diptera) or Ichneumonoidea, or primary parasitoids of wood-boring beetle larvae (Anobiidae and Platypodidae) (Insecta: Coleoptera), and less commonly Hymenoptera, Orthoptera or Neuroptera (Figure 6) [2,3,4].

Source: https://www.shutterstock.com/pt/search/wood-borer

Figure 6 Wood-boring beetle larvae (Anobiidae)

Planidia is free-living, first-instar motile larvae, notable for their ability to transit between different larval stages of their host and for completing their development in the host pre-pupae as ectoparasitoids, effectively acting as external larval-pupal koinobionts (Figure 7) [5,6].



Source: https://commons.wikimedia.org/wiki/File:Latina_rugosa_planidia.png

Figure 7 Planidia are free-living, first-instar motile larvae

1.3 Taxonomy

1.3.1 Chrysolampidae

Distribution: Worldwide.

Biology: Nitidulidae, Curculionidae and Cerambycidae (Insecta: Coleoptera) (Figure 8A) [5,6,7].

Source: https://pnwhandbooks.org/node/8012/pr

Figure 8A *Lyctus planicollis* LeConte, 1859 (Coleoptera: Platypodidae)

Subfamily: Chrysolampinae: Genus *Chrysolampus.*

Hosts: Parasitoids of the beetle larva Coleoptera.

Distribution: Worldwide (Figure 8B) [5,6,7].

Source: http://v3.boldsystems.org/index.php/Taxbrowser_Taxonpage?taxid=733949

Figure 8B Genus *Chrysolampus*

Subfamily Philomidinae

Distribution: Afrotropical, Oriental and Palaearctic regions.

Biology: Parasitoids of bees (Halictidae) [5,6,7].

Genus: *Aperilampus*, *Philomides* and *Vidlinus*.

Distribution: Afrotropical, Oriental and Palaearctic regions.

Biology: Parasitoids of bees (Halictidae) and *Vidlinus* Heraty, 2019: Parasitoids of bees (Halictidae) (Figure 9) [5,6,7].

Source: http://www.waspweb.org/Chalcidoidea/Chrysolampidae/Philomidinae/index.htm

Figure 9 Genus *Aperilampus*

- Species: *Aperilampus brevicornis* (Risbec, 1951) and *Aperilampus discolor* (Walker, 1862),

Aperilampus niayensis (Risbec, 1957), *Aperilampus rabeharisoae* Heraty, 2019 and *Aperilampus varians* Strand, 1911 (Figure 10).

http://www.waspweb.org/Chalcidoidea/Chrysolampidae/Philomidinae/Aperilampus/index.htm

Figure 10 *Aperilampus brevicornis* (Risbec, 1951)

Distribution: Madagascar, Malawi, Senegal, South Africa and Zimbabwe.

Biology: Host: unknown (Figure 11) [7,8].

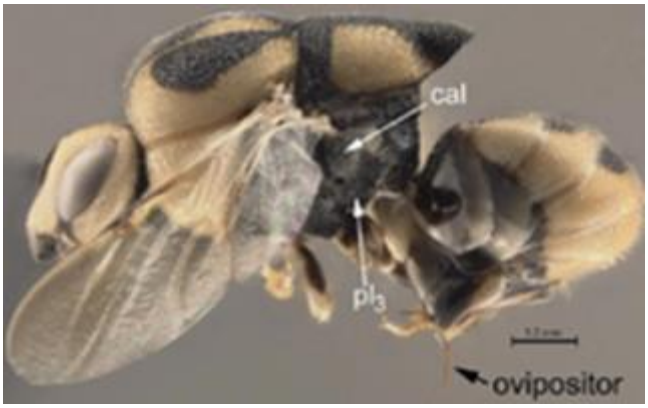
Source: http://www.waspweb.org/Chalcidoidea/Chrysolampidae/Philomidinae/Aperilampus/Aperilampus_rabeharisoae.htm

Figure 11 *Aperilampus rabeharisoae* Heraty, 2019

- Species: *Philomides aethiopicu*s Masi, 1939, *Philomides gigantea* (Risbec, 1951) and *Philomides lasallei* Heraty, 2019.

Distribution: Afrotropical, Oriental and Palaearctic regions.

Biology: Host: unknown (Figure 12A) [7,8].



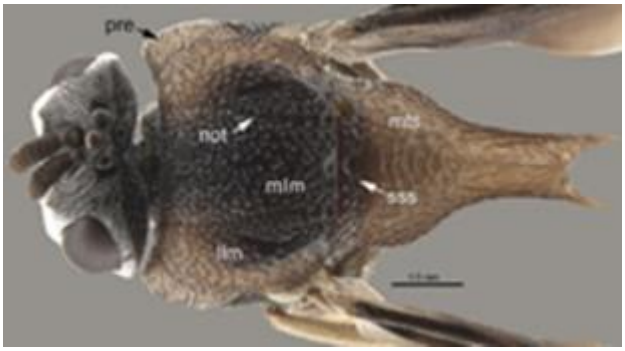
Source: http://www.waspweb.org/Chalcidoidea/Chrysolampidae/Philomidinae/Philomides/index.htm

Figure 12A *Philomides lasallei* Heraty, 2019

- Species: *Vidlinus abercornensis* (Risbec, 1958) and *Vidlinus metallicus* (Risbec, 1958).

Distribution: Mozambique, Niger, Nigeria, Yemen, Zambia, Zimbabwe. Also known by undescribed species from the Palaearctic region: Egypt and Tunisia [7,8].

Biology: Host: Unknown (Figures 12B-13).



Source: http://www.waspweb.org/Chalcidoidea/Chrysolampidae/Philomidinae/Vidlinus/index.htm

Figure 12B *Vidlinus abercornensis* (Risbec, 1958)

Source: http://www.waspweb.org/Chalcidoidea/Chrysolampidae/Philomidinae/Vidlinus/index.htm

Figure 13 *Vidlinus metallicus* (Risbec, 1958)

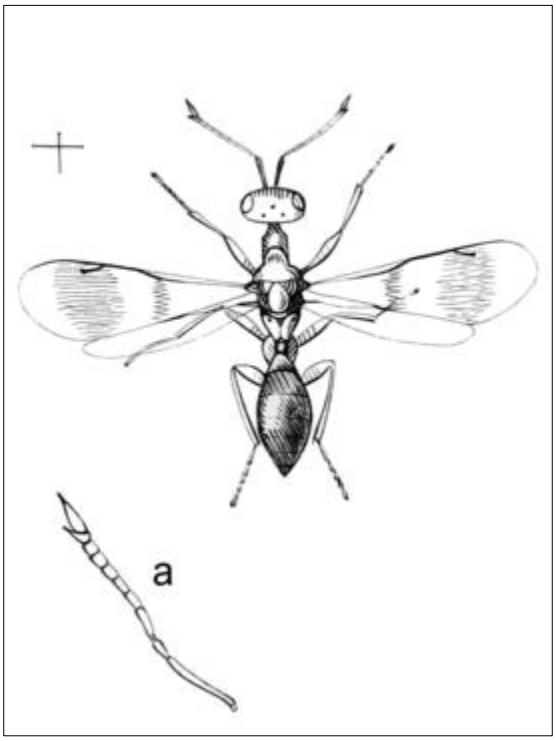
2 Family Cleonymidae

2.1 Introduction

Cleonymidae (Chalcidoidea) is worldwide in distribution currently known by 42 described species out of which six are known from the Oriental region and three are known from India. (Figures 14-15) [9,10].

Source: https://www.waspweb.org/Chalcidoidea/Cleonymidae/index.htm

Figure 14 Cleonymidae of the Afrotropical region



Sources: Monographia Chalciditum. Entomological Magazine 4: 352 and
https://ru.wikipedia.org/wiki/Cleonymidae#/media/%D0%A4%D0%B0%D0%B9%D0%BB:Notanisus_versicolor.png

Figure 15 Antenna *Notanisus versicolor* Walker, 1837 (Pteromalidae: Cleonyminae)

The subfamily Cleonyminae (Hymenoptera: Chalcidoidea, Pteromalidae) has an almost worldwide distribution, being found in nearly all regions. It contains over 260 nominal species within 39 genera and six tribes most species are parasitoids of woodboring beetles or other insects nesting or occurring in wood or under bark [11,12,13].

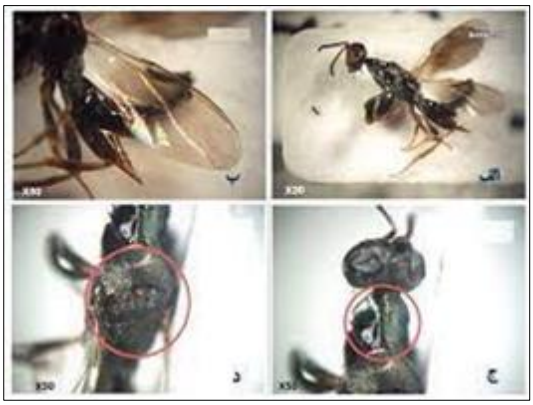
Until now, five species belonging to five genera Cleonyminae were reported from Iran: *Heydenia pretiosa* Förster, 1856 (Davatchi and Chodjai 1968), *Chalcedectus balachowskyi* Steffan, 1968, *Callocleonymus pulcher* Masi, 1940, *Oodera monstrum* Nikol'skaya, 1952 and *Cleonymus laticornis* Walker, 1837 (Figures 16-19) [11,12,13].

Source: https://www.biotaxa.org/jibs/article/view/74341

Figure 16 The subfamily Cleonyminae (Hymenoptera: Pteromalidae) from Iran

Source: https://www.flickr.com/photos/kahhihou/49008697067

Figure 17 *Heydenia pretiosa* Förster, 1856 (Davatchi and Chodjai, 1968)



Source: https://www.researchgate.net/figure/Body-view-of-Oodera-monstrum-Nikolskaya-1952-a-lateral-view-of-body-b-forewing_fig1_347376875

Figure 18 Body view of *Oodera monstrum* Nikol'skaya, 1952, (a) lateral view of body ♀ (b) forewing (c) view of long pronotum (d) groove of star-like on thorax dorsally

Source: https://artsandculture.google.com/asset/cleonymus-laticornis-walker-1837/JwEmT3TdD-DZVQ

Figure 19 *Cleonymus laticornis* Walker, 1837

2.2 Description

The British species of this family are mostly moderate to rather large-sized Chalcidoidea, generally long. As a representative*, Gastracanthus pulcherrimus* Westwood, 1833 is depicted in the present fascicle. So far as is known, the British species are parasites of Coleoptera attached directly or indirectly to wood, feeding in living or dead timber, under bark, or in large tree fungi; but the host relations of *Micradelus* and *Gea* are not known (Figure 20) [12,13].

Sources: https://www.naturbasen.dk/art/34091/gastracanthus-pulcherrimus and
https://twitter.com/sjthomasbotany/status/1450392733206601733

Figure 20 *Gastracanthus pulcherrimus* Westwood, 1833

2.3 Biology

Hosts: Order Coleoptera: *Amphicerus bicaudatus* (Say, 1823) (Bostrichidae), *Gracillaria minuta* Lewmanomont, 1994 (Gracillariinae), *Hoplitis product* sp. nov. (Osmiinae), *Hylesinus oleiperda* (Fabricius, 1792) (Scolytinae), *Molorchus minor* (Linnaeus, 1758) (Lamiinae), *Monochamus saltuarius* Gebler, 1830 (Lamiinae), *Ochina ptinoides* (Marsham, 1802) and *Scolytus scolytus* (Fabricius, 1775) (Scolytinae).

The family Cleonymidae parasitoids of wood-boring beetles or stem or mud-nesting Hymenoptera (Sphecidae, Megachilidae, Eumeninae) [13,14].

2.4 Taxonomy

Subfamilies: Cleongminae and Chalcedectidae.

Tribe: Cletngnini, Hegdenini, Oodetini, IlcAdenini, Leploloenini, Lyciscinii and Thoumosurini.

Genus: *Amotura, Callocleonymus, Cleonymus, Notanisus, Thaumasura* and *Zolotarewskya* [15,16,17].

2.4.1 Genus Amotura

Biology: Parasitoids of the wood-boring beetle larva.

Distribution: Central African Republic, South Africa, Indo-Australasian, Nearctic, Neotropical and Palaearctic regions [15,16,17].

Specie: *Amotura* spp.

Distribution: Central African Republic (Figures 21-22) [15,16,17].

Source: http://www.waspweb.org/Chalcidoidea/Cleonymidae/Amotura/index.htm

Figure 21 Genus *Amotura*

Source: http://www.waspweb.org/Chalcidoidea/Cleonymidae/Amotura/Amotura_species.htm

Figure 22 *Amotura* spp.

2.4.2 ***Genus****: Cleonymus*

Hosts: *Agrilus angelicus* Horn, 189 (Buprestidae) *Araecerus fasciculatus* (DeGeer, 1775) (Anthribidae), *Mecinus pyraster* (Herbst, 1795) (Curculioninae), *Myrmex carinicollis* (Horn, 1895) (Curculioninae), *Phoracantha semipunctata* (Fabricius, 1775) (Cerambycinae) (Insecta: Coleoptera).

Distribution: Madagascar, South Africa, Australasian, Oriental and Palaearctic regions (Figure 23) [15,16,17].

Source: https://en.wikipedia.org/wiki/Cleonymus_(wasp)

Figure 23 Genus: *Cleonymus*

Specie: *Callocleonymus pulcher* Masi, 1940

Distribution: Somalia, Australasian, Oriental and Palaearctic regions.

Biology: Hosts: *Agrilus occipitalis* (Eschscholtz, 1822) (Buprestidae), *Cryphalus exiguus* Blandford, 1894 (Scolytinae), *Ips aponicus* Niisima, 1909 (Scolytidae), *Phloeosinus aubei* (Perris, 1855) (Scolytinae), *Scolytus butovitschi* Stark, 1936 (=*S. butovitschi* Eggers, 1942) (Scolytinae), *Scolytus schevyrewi* Semenov 1902 (Scolytinae) and *Scotytus seulensis* Murayama, 1930 (Scolytinae) (Insecta: Coleoptera) [15,16,17].

2.4.3 ***Genus:*** *Notanisus*

Distribution: Madagascar, Mozambique, Tanzania, United Arab Emirates, Uganda, Yemen, Zambia, Zimbabwe, Australian, Nearctic and Palaearctic regions.

Biology: Hosts: Aphididae (aphid), *Tetramesa* (Eurytominae) and *Tetramesa calamagrostide* (Schlechtenda, 1891). (Eurytominae) (Hymenoptera: Eurytomidae) (Figure 24) [15,16,17].

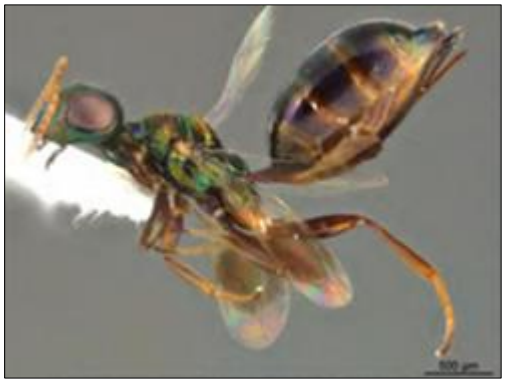
Source: http://www.waspweb.org/Chalcidoidea/Cleonymidae/Notanisus/index.htm

Figure 24 Genus *Notanisus*

Species: *Notanisus brevipetiolus* Gibson, 2015, *Notanisus cyaneus* (Risbec, 1952), *Notanisus longipetiolus* Gibson, 2015, *Notanisus sylvaticus* (Risbec, 1952*), Notanisus vanharteni* Gibson, 2015 and *Notanisus yemenensis* Gibson, 2015 (Figures 25-27) [15,16,17].

Source: http://www.waspweb.org/Chalcidoidea/Cleonymidae/Notanisus/index.htm

Figure 25 *Notanisus brevipetiolus* Gibson, 2015



Source: http://www.waspweb.org/Chalcidoidea/Cleonymidae/Notanisus/index.htm

Figure 26 *Notanisus longipetiolus* Gibson, 2015

Source: http://www.waspweb.org/Chalcidoidea/Cleonymidae/Notanisus/index.htm

Figure 27 *Notanisus vanharteni* Gibson, 2015

2.4.4 ***Genus:*** *Thaumasura*

Distribution: South Africa, Indo-Australian region: Australia, Indonesia, Papa New Guinea and Solomon Islands.

Biology: Hosts: Cerambycidae, *Euthyrhinus meditabundus* (Fabricius, 1775) (Curculionidae) (Insecta: Coleoptera) [15,16,17].

Specie*:* *Thaumasura australica* Westwood, 1872.

2.4.5 ***Genus:*** *Zolotarewskya*

Distribution: Madagascar, Australian, Oriental and Palaearctic regions.

Biology: Host: Unknown [15,16,17].

Specie: *Zolotarewskya seyrigi* Risbec, 1956.

Source: Photographs and map illustration © Simon van Noort (Iziko Museums of Cape Town) [15,16,17].

Distribution: Madagascar, Australian, Oriental and Palaearctic regions.

Biology: Host: unknown [15,16,17].

Specie: *Zolotarewskya seyrigi* Risbec, 1956

Source: Photographs and map illustration © Simon van Noort (Iziko Museums of Cape Town) [15,16,17].

2.4.6 Epicaudonia new genus

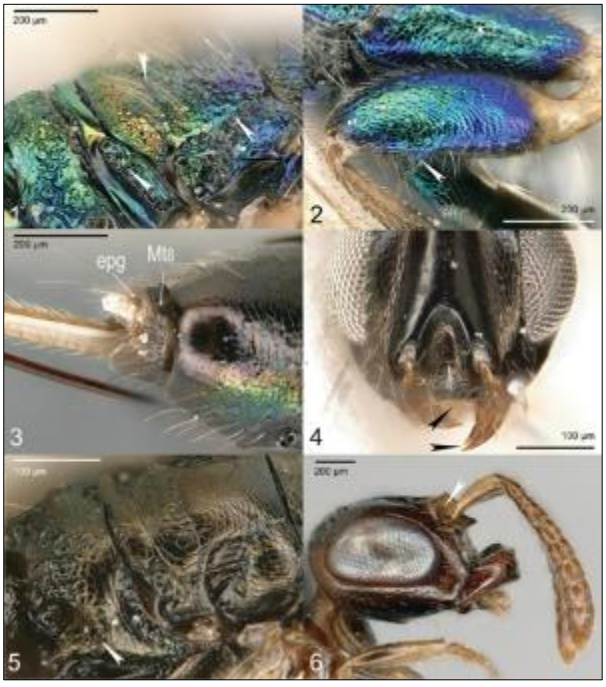
Epicaudonia scelestus sp. nov. (=*Epicaudonia scelestus* Girault, 1914).

Habitat: Meerawa (Cairns District) and Queensland -Australia

Distribution: Central African Republic, South Africa, Also in Indo-Australasian, Nearctic, Neotropical and Palaearctic regions [18].

3 Family Ceidae

3.1 Introduction



Source: https://jhr.pensoft.net/article/94263/

Figure 28 figs 1–6. *Boucekius* sp. (Boucekiidae) 1 metascutellum, axillula and propodeum 2 hind femur 3 epipygium (epg) and metasomal terga VIII (Mt8) 4, 5 *Spalangiopelta* sp. (Ceidae) 4 clypeus, labrum and mandible 5 metascutellum, axillula and propodeum, arrow shows the propodeal spiracle far separated from the anterior propodeal margin 6 *Muesebeckisia mandibularis* Hedqvist, 1969, (Cerocephalidae): head and antenna in lateral view, the arrow indicating intertorular prominence

Subforaminal bridge with postgena separated by lower tentorial bridge except for a small postgenal bridge dorsal to the hypostoma. Mesoscutellum with frenum indicated at least laterally, and with axillular sulcus. Mesopleural area without an expanded acropleuron. Propodeum with small and circular spiracle separated by more than its own length from the anterior propodeal margin All legs with 5 tarsomeres; protibial spur stout and curved; basitarsal comb longitudinal. Metasoma with syntergum, therefore without epipygium (Figure 28) [19,20,21].

3.2 Taxonomy

Bohpa Darling, 1991

Distribution: Worldwide.

Biology: Not known

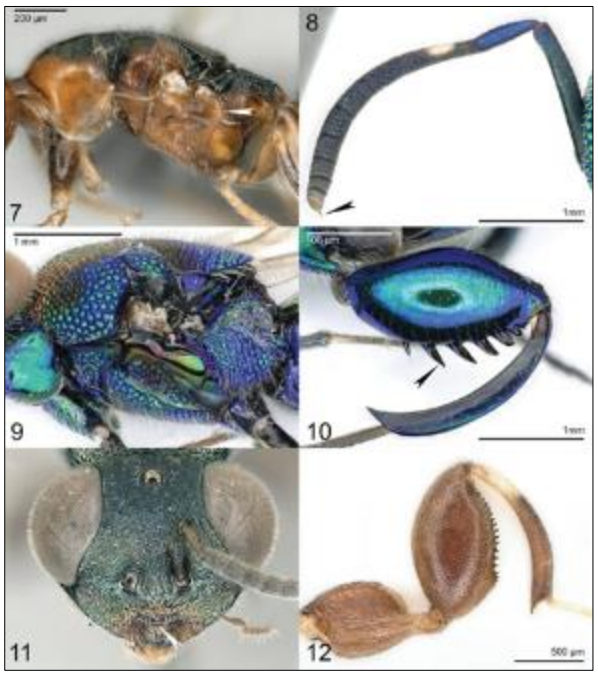
Bohra maculata Darling, 1991 (South Africa)

Distribution: South Africa [22,23,24].

4 Family Cerocephalidae

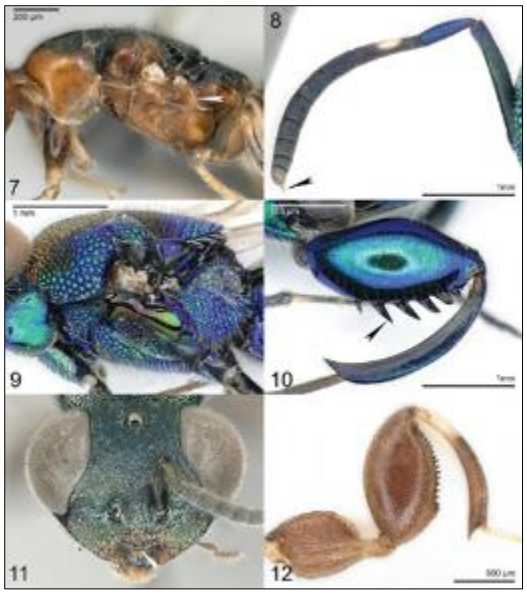
4.1 Introduction

Antenna with at most 10 flagellomeres. Subforaminal bridge with a postgenal bridge occurring dorsal to the hypostoma. Mesoscutellum with frenum indicated at least laterally, although this may be very subtle. Mesopleural area without an expanded acropleuron. All legs with 5 tarsomeres; protibial spur stout and curved; basitarsal comb longitudinal. Metasoma with syntergum, therefore without epipygium (Figures 29A-29B) [24,25,26].



Source: https://jhr.pensoft.net/article/94263/

Figure 29A fg. 7 *Neocalosoter* sp. (Cerocephalidae): mesosoma in lateral view 8–10 *Chalcedectus* sp. (Chalcedectidae) 8 antenna 9 mesosoma in lateral view 10 hind leg 11 *Cleonymus* sp. (Cleonymidae): head in frontal view 12 *Agrilocida ferrierei* Steffan, 1964 Steffan (Cleonymidae): hind leg



Source: https://jhr.pensoft.net/article/94263/

Figure 29B figs 7–12. 7 *Neocalosoter* sp. (Cerocephalidae): mesosoma in lateral view 8–10 *Chalcedectus* sp. (Chalcedectidae) 8 antenna 9 mesosoma in lateral view 10 hind leg 11 *Cleonymus* sp. (Cleonymidae): head in frontal view 12 *Agrilocida ferrieri* Steffan, 1964 (Cleonymidae); hind leg

4.2 Biology, Distribution Geographic and Taxonomy

Genus: *Acerocephala, Cerocephala, Neocalosoter, Neosciatheras, Paracerocephala, Sciatherellus* and *Theocolax*.

Distribution: Worldwide.

Biology: Parasitoids of wood-boring beetles Coleoptera: Anobiidae, Bostrychidae, Curculionidae, Lyctidae, and Scolytidae (Figures 30-31) [27,28,29].

Sources: Photographs © Simon van Noort (Iziko Museums of South Africa) and http://www.waspweb.org/Chalcidoidea/Cerocephalidae/index.htm

Figure 30 Genus *Acerocephala* (Cerocephalidae)

Sources: Photographs © Simon van Noort (Iziko Museums of South Africa) and http://www.waspweb.org/Chalcidoidea/Cerocephalidae/index.htm

Figure 31 Genus *Cerocephala* (Cerocephalidae)

4.2.1 Genus: Acerocephala

Species*: Acerocephala* species (Kenya)

Distribution: Worldwide.

Biology: Parasitoids of wood-boring beetles (Coleoptera: Curculionidae, Scolytidae) [27,28,29].

4.2.2 Genus: Cerocephala

Species: *Cerocephala eccoptogastri* Masi, 1921 (Congo, Israel and Italy and Libya*), Cerocephala oblonga* Delucchi, 1956 (Democratic Republic of Congo), *Cerocephala petiolata* Hedqvist, 1969 (Democratic Republic of Congo), *Cerocephala rotunda* Delucchi, 1956 (Congo and Democratic Republic of Congo) and *Cerocephala* species (South Africa) (Figure 32) [27,28,29].

Sources: Photographs © Simon van Noort (Iziko Museums of South Africa and http://www.waspweb.org/Chalcidoidea/Cerocephalidae/Cerocephala/index.htm

Figure 32 *Cerocephala* species

5 Family Chalcedectidae

5.1 Introduction

The family was Chalcedectidae. This is separated from North American Chalcididae by the flattened dorsal surface of the abdomen and the metallic highlights [30,31].

5.1.1 Family Chalcedectidae

Chalcedectus Walker, 1852

Distribution: Afrotropical, Australasian, Nearctic and Neotropical.

Chalcedectus maculicornis Walker 1852

5.1.2 Chalcedectus species

Distribution: South Africa.

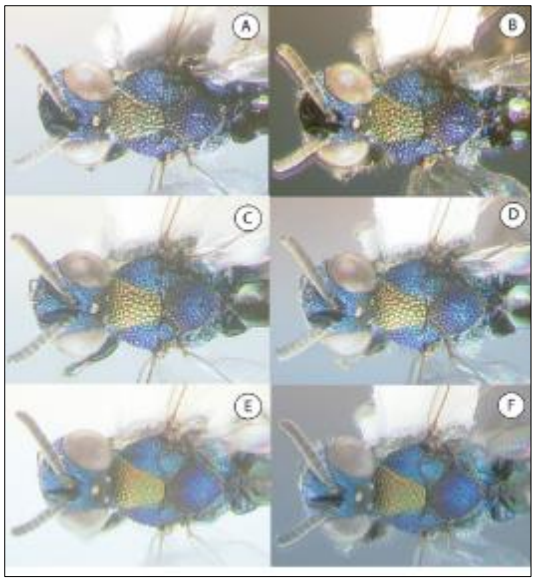
Biology: Parasitoid of Cerambycidae larva boring in Rosaceae (Figures 33-38) [32,33,34].

Source: http://v3.boldsystems.org/index.php/Taxbrowser_Taxonpage?taxid=483942

Figure 33 *Chalcedectus* Walker, 1852 (Chalcedectidae)

Source: https://eol.org/pages/848113

Figure 34 *Chalcedectus maculicornis* Walker 1852



Source: https://www.researchgate.net/figure/Chalcedectus-sp-Pteromalidae-A-direct-light-white-background-B-direct-light-gray_fig2_233612559

Figure 35 *Chalcedectus* sp. (Family Chalcedectidae). A, direct light, white background; B, direct light, gray background; C, Mylar filtered light, white background; D, Mylar filtered light, gray background; E, chambered light, white background; F, chambered light, gray background

Source|: https://bugguide.net/node/view/856138

Figure 36 *Chalcedectus caelata* Grissell 1991 – Female

Source: https://bugguide.net/node/view/856094/bgimagehttps://bugguide.net/node/view/856094/bgimage

Figure 37 *Chalcedectus hyalinipennis* (Ashmead, 1896) - ♀

Source: https://bugguide.net/node/view/160704/bgpage

Figure 38 *Chalcedectus hyalinipennis* (Ashmead, 1896) ♀

6 Family Diparidae

6.1 Introduction

The following former subfamilies and tribes of Pteromalidae are elevated to family rank: Boucekiidae, Ceidae, Cerocephalidae, Chalcedectidae, Cleonymidae, Coelocybidae, Diparidae, Epichrysomallidae, Eunotidae, Herbertiidae, Hetreulophidae, Heydeniidae, Idioporidae, Lyciscidae, Macromesidae, Melanosomellidae, Moranilidae, Neodiparidae, Ooderidae, Pelecinellidae (senior synonym of Leptofoeninae), Pirenidae, Spalangiidae, and Systasidae. The following subfamilies are transferred from Pteromalidae: Chromeurytominae and Keiraninae to Megastigmidae, Elatoidinae to Neodiparidae, Nefoeninae to Pelecinellidae, and Erotolepsiinae to Spalangiidae family (Figure 39) [34].



Sources: Photo 20647350, (c) Bioexploradores Farallones, some rights reserved (CC BY-NC) and https://www.inaturalist.org/photos/20647350; Sources: Photo 65891375, (c) Stephen WV and https://www.inaturalist.org/taxa/466970-Diparinae Sources: Photo 1212798, (c) Stephen Thorpe and https://www.inaturalist.org/photos/1212798

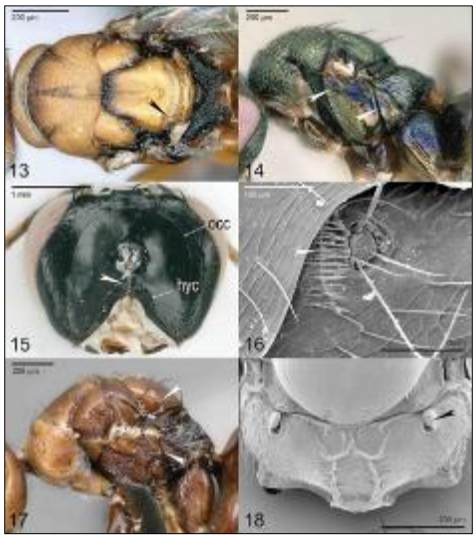
Figure 39 Genre *Lelaps* and Subfamily, Diparinae Inactive species or group and Genus *Pseudoceraphron*

6.1. Description

Sources: Photo 40342326, (c) Sergio Zapata Martinez and https://www.inaturalist.org/photos/40342326

Figure 40A Family Diparinae: Subfamily Diparinae

Diparines are often noted for their marked sexual dimorphism. The majority of known males are macropterous, have filiform antennae, and show little to moderate variation between genera. Females may be macropterous, brachypterous, or even apterous, often have clavate antennae, and display great morphological variation across genera (Figures 40A-40B) [35,36].



Source: https://jhr.pensoft.net/article/94263/

Figure 40B figs. 13–18. 13 *Coelocyboides* sp. (Coelocybidae): mesosoma in dorsal view, arrow indicating setae on or adjacent to frenal groove 14 *Ormyromorpha trifasciata* Girault, 1913 (Coelocybidae): mesosoma in lateral view 15, 16 *Lelaps* sp. (Diparidae) 15 head posterior view 16 cercal brush 17 *Eufroggattisca polita* (Ashmead, 1904) (Epichrysomallidae): mesosoma lateral view 18 *Odontofroggattia* sp. (Epichrysomallidae): propodeum female dorsal view

1.1 Biology

Parasitoids of curculionid beetles (Coleoptera); mantid egg cases (Mantodea); or *Glossina* tsetse fly puparia (Diptera: Glossinidae) [37].

1.2 Distribution geographic and Habitat

Overall, the Diparinae have a cosmopolitan distribution and are generally most common in lowland and montane rainforests. In Australia, most Diparine diversity is restricted to Queensland and the surrounding islands. To a lesser extent, they are distributed throughout Western Australia, southeastern Australia, and Tasmania, particularly Netomocera and *Liepara* which are generally found in drier forests and arid regions [38,39,40].

In Africa, most genera are known only from South Africa, although this may be an artifact of intensive sampling small collections from Namibia, Botswana, Zimbabwe, Tanzania, and Kenya suggest that this diversity extends farther north, particularly through the East Rift Valley [38,39,40].

Oddly, while the diversity of Diparine in most regions seems to be highest in the rainforest, this is exactly the opposite in southern and eastern Africa, where the distribution of the rainforest coincides with a dramatic drop in Diparine generic diversity. The majority of southern and eastern African genera exist in drier areas, including the fynbos, savannah and montane grasslands [38,39,40].

1.3 Taxonomy

This study approaches the problem of Pteromalidae phylogeny from two directions, coupling a detailed morphological revision of one of the most divergent and poorly-known subfamilies of Pteromalidae (Diparinae) with a broad, exemplar-based molecular study that seeks to place this subfamily in the broader context of pteromalid and chalcidoid phylogeny [41,42].

First, a morphological phylogenetic analysis of the world genera of Diparinae is provided based on 76 characters. Diparinae is supported as monophyletic based on the presence of a cercal brush in all analyses. The cercal brush, in

combination with the absence of a smooth, convex dorsellum, is diagnostic for Diparinae *Liepara* Boucek (Pteromalidae) [43,44].

Genus: *Boeria*, *Cerodipara, Desjardins, Conodipara, Conophorisca, Dipara, Dozodipara, Lelaps, Myrmicolelaps, Netomocera* and *Pyramidophoriella* (Source: van Noort, S. 2023. WaspWeb: Hymenoptera of the Afrotropical region) (Figures 41-42) [44,45].

Source: Photographs © Simon van Noort (Iziko Museums of Cape Town). van Noort, S. 2023. WaspWeb: Hymenoptera of the Afrotropical region

Figure 41 Genus *Cerodipara*

Source: Photographs © Simon van Noort (Iziko Museums of Cape Town). van Noort, S. 2023. WaspWeb: Hymenoptera of the Afrotropical region

Figure 42 *Genus Conophorisca*

6.1.1 ***Specie****: Cerodipara sabensis Desjardins, 2007*

Distribution: South Africa [44,45].

6.1.2 ***Species****: Conophorisca annulata Hedqvist, 1969, Conophorisca grisselli Desjardins, 2007 and Conophorisca littoriticus Desjardins, 2007.*

Distribution: South Africa (Figure 43) [44,45].

Source: Photographs © Simon van Noort (Iziko Museums of Cape Town). van Noort, S. 2023. WaspWeb: Hymenoptera of the Afrotropical region

Figure 43 *Conophorisca littoriticus* Desjardins, 2007

Species*: Pyramidophoriella albiclava* Hedqvist, 1969 and *Pyramidophoriella brunnea* Hedqvist, 1969.

Distribution: South Africa (Figure 44) [44,45].

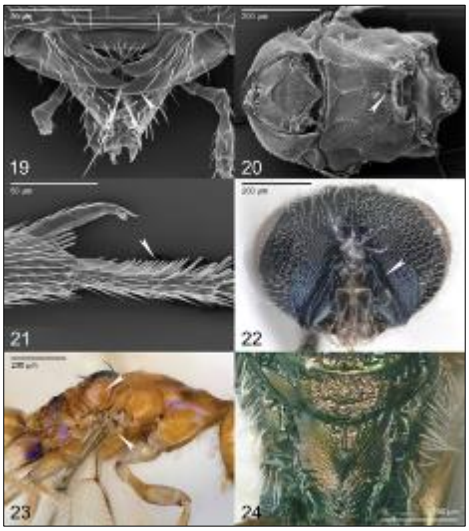
Source: Photographs © Simon van Noort (Iziko Museums of Cape Town). van Noort, S. 2023. WaspWeb: Hymenoptera of the Afrotropical region

Figure 44 *Pyramidophoriella albiclava* Hedqvist, 1969

7 Family Herbertiidae

7.1 Introduction

The Herbertiidae in body shape differs in having an elongate uncus and much shorter marginal vein relative to the stigmal vein on the fore wing, an indicated axillular sulcus, and only one mesofurcal pit, and in lacking a postgenal lamina and postgenal groove. Antenna with 10 flagellomeres, including 3 clavomeres. Clypeus with transverse subapical groove (Figure 45) [46,47].



Source: https://jhr.pensoft.net/article/94263/element/7/0/Eunotinae/

Figure 45 figs.19–24. *Eunotus* sp. (Eunotidae) 19 mandible and labrum in frontal view 20 mesosoma ventral view 21 protibial spur and basitarsal comb 22 *Herbertia brasiliensis* Ashmead, 1904 (Herbertiidae) head posterior view 23 *Hetreulophus* sp. (Hetreulophidae), mesosoma lateral view 24 Zeala walkerae Bouček, 1988 (Hetreulophidae): propodeum

Mesoscutellum with frenum indicated only laterally by the frenal arm, without axillular sulcus. Mesopleural area without an expanded acropleuron, with or without pits. All legs with 5 tarsomeres; protibial spur stout and curved; basitarsal comb oblique. Metasoma with syntergum, therefore without epipygium (Figure 46) [47,48,49].

Source: http://www.waspweb.org/Chalcidoidea/Herbertiidae/Exolabrum/Exolabrum_vannoorti.htm

Figure 46 figs 5–10. *Exolabrum vannoorti* gen. nov. and sp. nov. figs 5–6, female holotype. 5. Habitus, with close-up of prepectus on top right. 6. Head, anterior. Fig. 7, male paratype. Head, posterior, occ = occipital carina, pgl = postgenal lamella, sfb = subforaminal bridge. Figs 8–10, female holotype. 8. Antenna. 9. Head and mesosoma, dorsal. 10. Metanotum and propodeum

7.1.1 Genus: Exolabrum and Herbertia (Figure 47).

Sources: Photo 246310763, (c) Chalon Boesel and https://ecuador.inaturalist.org/photos/246310763

Figure 47 Genus *Herbertia*

Distribution: Worldwide.

Biology: Parasitoids of leaf-mining flies (Diptera: Anthomyiidae).

7.1.2 Herbertia species (Nigeria, South Africa).

Distribution: Worldwide

Biology: Parasitoids of leaf-mining flies (Diptera: Anthomyiidae) (Figure 48).

Sources: Photographs © Roger Burks and http://www.waspweb.org/Chalcidoidea/Herbertiidae/Exolabrum/index.htm

Figure 48 *Exolabrum vannoorti* Burks, 2018

Herbertiinae previously contained only the extant genus *Herbertia* Howard, which contains only eight described species but is geographically widespread. This genus was transferred from Pireninae to its own subfamily and is reliably recorded as a parasitoid of Agromyzidae [50].

Herbertiinae was likely given subfamily status because of numerous morphological peculiarities of Herbertia, including a modified burr-like seta on the mesopleuron near the mesocoxal insertion, and a strong tuft of setae on the posterior surface of each axill [50].

7.1.3 Herbertiinae Bouček, 1988

- **1-Type genus**: *Herbertia* Howard, 1894.

Type species: *Exolabrum vannoorti* Burks sp. nov. [50].

- **2-Genus:** *Versolabrum* gen. nov

Type species: *Versolabrum coriaceum* Burks & Krogmann sp. nov.

- **Genus:** *Versolabrum* nov. [50].

8 Conclusion

The family Pteromalidae (Hymenoptera: Chalcidoidea) is reviewed with the goal of providing nomenclatural changes and morphological diagnoses in preparation for a new molecular phylogeny and a book on world fauna that will contain keys to identification. Most subfamilies and some tribes of Pteromalidae are elevated to family level or transferred elsewhere in the superfamily. The resulting classification is a compromise, with the aim of preserving the validity and diagnosability of other, well-established families of Chalcidoidea. The following former subfamilies and tribes of Pteromalidae are elevated to family rank. The following former subfamilies and tribes of Pteromalidae are elevated to family rank, Cleonymidae, Diparidae, Cerocephalidae, Chalcidectidae, Ceidae and Herbertiidae. The following subfamilies are transferred from Pteromalidae:

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