



Short Commentary

Family Tetracampidae (Insecta: Hymenoptera) as Parasitoids of the Orders Diptera, Coleoptera and Lepidoptera as Agricultural Pests

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Abstract

Many species of Tetracampidae are hosts that have been identified are plant-mining insects. The European species of the genus *Dipriocampe* are endoparasitoids of the eggs of flies or saw wasps. Species of the genus *Foersterella* from England are endoparasitoids of the eggs of *Cassida* spp. One species, *Dipriocampe diprioni* (Ferrière, 1935), has been introduced to Canada from Europe as a biological control of saw wasps but has failed to become established. The aim of this mini review is to consider the importance of the Tetracampidae family (Insecta: Hymenoptera) as parasitoids of the Diptera, Coleoptera and Lepidoptera orders as agricultural pests. The short commentary research was carried out based on studies related to the quantitative and conceptual aspects of Tetracampidae. A bibliographic search was carried out containing national and international articles from 1973 to 2022. The short commentary used digital platforms.

Keywords: endoparasitoids, eggs, dipterans, damage, coleopterans, lepidopterans

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1 INTRODUCTION

The Tetracampidae are a small family of parasitic wasps in the superfamily Chalcidoidea. They are parasitoids of phytophagous insects, primarily flies. The 44 species in 15 genera are almost entirely absent from the new world. The biology of most species of Tetracampidae is little studied. Most of those whose hosts are known are associated with insects that mine in plants (Figure 1)^[1].

1.1 Description

Head usually with occipital carina; antenna with 7

to 12 articles, usually with 3 flagellomeres club (rarely fused); mesoscutum with linear notaulice; forewing with vein long marginal, stigmal vein extended beyond the apex of the short stigmal vein; protibia with short, apically bifurcated spur; tarsus with 4 or 5 tarsomeres; petiolate metasome. They measure from 0.8 to 3.5mm and are mostly metallic green (Figures 2-8)^[2-4].

1.2 Biology

Parasitoids of miner and galling dipterans, as well as eggs of Chrysomelidae (Coleoptera) and Diprionidae (Hymenoptera) and larval parasitoids of the biology

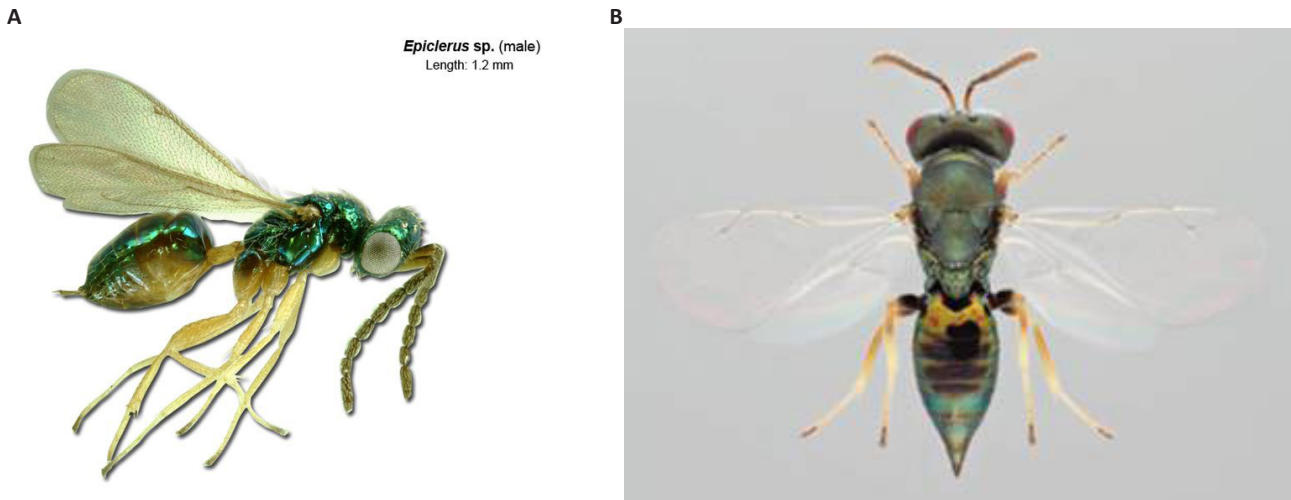


Figure 1. Specimens of Tetracampidae family. A: *Epiclerus* sp. male; B: *Pteromalus hieracii* Thomson 1878. Sources: <https://alchetron.com/Tetracampidae> and <https://www.discoverlife.org/mp/20q?search=Tetracampidae>

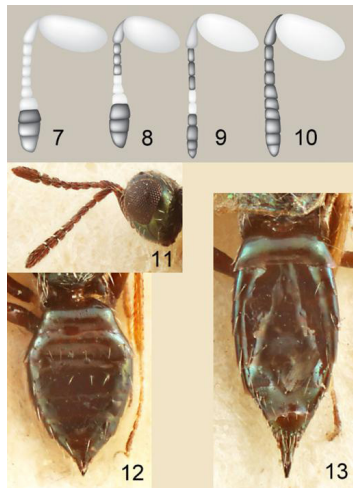


Figure 2. *Foersterella* spp., antenna, lateral view, male. 7: *Foersterella erdoesi* Boucek 1958; 8: *Foersterella reptans* (Nees) sp. nov.; 9: *Foersterella angusticornis* sp. nov.; 10: *Foersterella fuscicornis* sp. nov.; 11: *Foersterella* sp., female, head and antennae, lateral view; 12: *Foersterella* sp.; 13: *F. erdoesi*. Source: <https://zenodo.org/record/255285#.YxJLX3bMLIU>

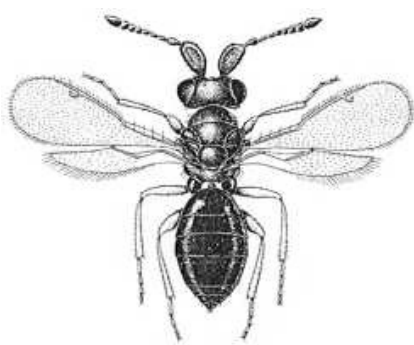


Figure 3. *Foersterella erdoesi* Boucek 1958. Source: <https://www.nhm.ac.uk/our-science/data/chalcidoids/tetracampidae.html>

flies (Agromyzidae) and Orthoptera. Very little is known

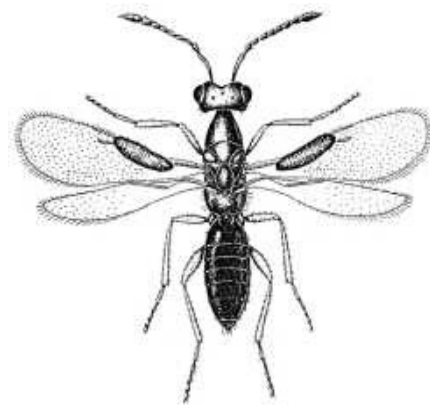


Figure 4. *Platynocheilus cuprifrons* (Nees, 1834). The majority of those whose hosts are known are associated with insects that mine in plants. European species of one genus, *Dipriocampe*, are endoparasitoids of the eggs of diprionid sawflies and the British species are endoparasitoids of the eggs of *Cassida* spp. (Coleoptera, Cassididae). Source: <https://www.nhm.ac.uk/our-science/data/chalcidoids/tetracampidae.html>

of most Tetracampidae species. Most of the host species that have been identified are plant-mining insects. The European species of the genus *Dipriocampe* are endoparasitoids of the eggs of flies or saw wasps. Species of the genus *Foersterella* from England are endoparasitoids of the eggs of *Cassida* spp. One species, *Dipriocampe diprioni* (Ferrière, 1935), has been introduced to Canada from Europe as a biological control of saw wasps, but has failed to become established (Figure 9)^[5-7].

The way of life of tetracampids is still not well known, however, host selection seems to be limited to mining larvae. Some species are of economic importance because they are among the pests of forest and arable crops parasitizing^[7-9].

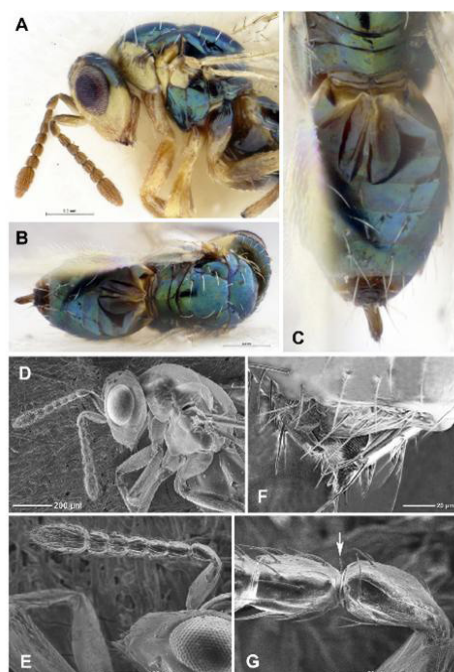


Figure 5. *Afrocampe prinslooii* gen. et sp. nov., holotype, ♀. A: Head and mesosoma in lateral view; B: Body in dorsal view; C: Metasoma and posterior part of mesosoma; D: Head and mesosoma in lateral view; E: Antenna; F: Mouth opening and clypeus; G: Pedicel, anellus and F1 (seta on anellus is arrowed). A-C: color imaging; D-G: SEM. Source: [https://www.semanticscholar.org/paper/A-new-genus-of-Tetracampidae-\(Hymenoptera\)-from-Gumovsky/6b7ba0e8058cfb9c0e5e6a4177d884750cbad565/figure/2](https://www.semanticscholar.org/paper/A-new-genus-of-Tetracampidae-(Hymenoptera)-from-Gumovsky/6b7ba0e8058cfb9c0e5e6a4177d884750cbad565/figure/2)

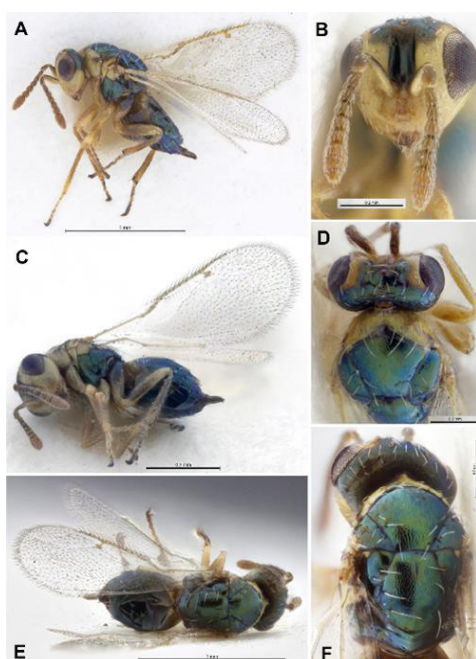


Figure 6. *Afrocampe prinslooii* gen. sp. nov., holotype (color imaging), ♀. A: Habitus in lateral view; B: Face; C: Habitus in ventro-lateral view; D: Head and anterior part of mesosoma; E: Habitus in dorsal view; F: Head and mesosoma in dorsal view. Source: [https://www.semanticscholar.org/paper/A-new-genus-of-Tetracampidae-\(Hymenoptera\)-from-Gumovsky/6b7ba0e8058cfb9c0e5e6a4177d884750cbad565/figure/1](https://www.semanticscholar.org/paper/A-new-genus-of-Tetracampidae-(Hymenoptera)-from-Gumovsky/6b7ba0e8058cfb9c0e5e6a4177d884750cbad565/figure/1)

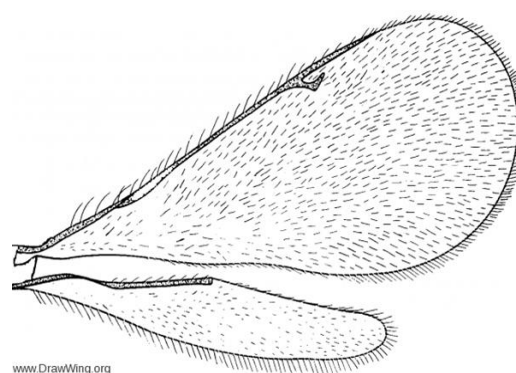


Figure 7. Wing of Tetracampidae from Goulet and Huber, 1993. Source: <http://drawwing.org/insect/tetracampidae-wings>

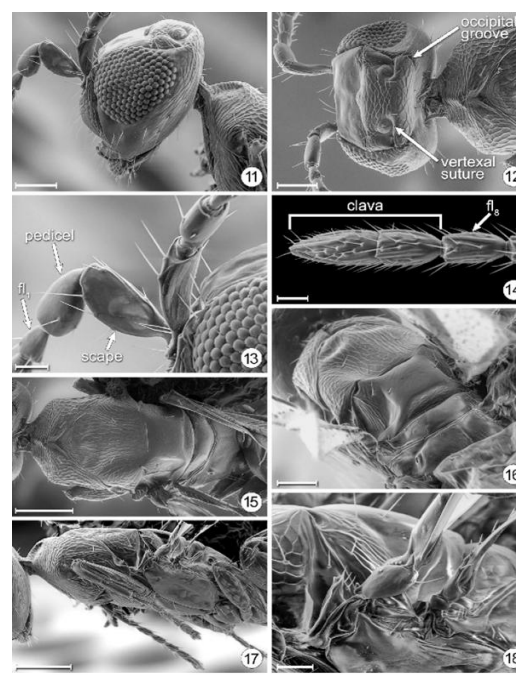


Figure 8. *Eustochomorpha haeckeli* Girault, 1915, female. 11: Head + prothorax, lateral; B: 12 Head + prothorax, dorsal; 13: Base of antenna, lateral (right antenna) and ventral (left antenna); 14: Apex of antenna; 15: Mesosoma, dorsal; 16: Mesosoma, posterolatero dorsal; 17: Mesosoma, lateral; 18: Base of wings + mesosoma, lateral (medial portion). Source: <https://www.semanticscholar.org/topic/Tetracampidae/8532679>



Figure 9. Egg mass of *Aspidomorpha sanctaecrucis* (Fabricius, 1792) (Coleoptera: Chrysomelidae) parasitized by Tetracampidae wasps. Source: <https://en.wikipedia.org/wiki/Tetracampidae>

1.3 Distribution Geographic

Bosnia, Herzegovina, Denmark, Germany, France, Great Britain, Ireland, Italy, Yugoslavia, Croatia, Latvia, Macedonia, Moldova, Netherlands, Austria, Poland, Romania, Russia, Sweden, Switzerland, Slovakia, Slovenia, Spain, Czech Republic, Hungary and Belarus. In addition to Europe, this family is also found in the Middle East, the Nearctic, North Africa and the eastern Palearctic^[8-10].

1.4 Taxonomy

The family has a cosmopolitan distribution, with about 44 species in 12 genera. In the Neotropical Region, there is only the record of the genus *Epiclerus* in Costa Rica and Cuba.

Subfamilies: Tetracampinae, Platynocheilinae, Mongolocampinae and Distylopinae (Figure 10).

Genus: *Afrocampe* Gumovsky, 2018 (South Africa), *Diplesiostigma* Girault, 1920, Undescribed species (Bouček, 1988), *Epiclerus* Haliday, 1844, (Senegal), *Foersterella* Dalla Torre, 1897, *Kilomotoia* Gumovsky, 2016 (Figures 11 and 12).

Some Species include *Afrocampe prinsloo* Gumovsky, 2018, *Dipriocampe diprioni* (Ferrière, 1935), *Epiclerus agromyzae* (Risbec, 1951), *Epiclerus plectroniae* (Risbec, 1952) (Madagascar), *Foersterella africana* (Ferrière, 1938) (Senegal, Uganda), *Kilomotoia kitoko* Gumovsky, 2016 (Democratic Republic of Congo, Uganda), *Foersterella reptans* (Nees, 1834), *Platynocheilus cuprifrons* (Nees, 1834) (Figures 13-15).

There are many fossil taxa in this group but their relationship to other chalcidoid families is not clear (Figures 16 and 17)^[11-15].

1.5 Objective

The aim of this mini review is to consider the importance of the Tetracampidae family (Insecta: Hymenoptera as parasitoids of the Agromyzidae (Diptera), Chrysomelidae (Coleoptera) and Elachistidae (Lepidoptera) families as agricultural pests.

2 METHODS

The short commentary research from September to October 2021, using digital platforms such as: Abstract, Science Research.com, CAPES Periodicals, Google Academic, Bioline International, Scopus, Web of Science and Portal of Scientific Journals in Health Sciences^[16].

3 STUDIES CONDUCTED AND SELECTED

3.1 Study 1

3.1.1 Tetracampidae Family and Subfamily Tetracampinae

Genus: *Epiclerus*

Identification: The genus *Epiclerus* includes wasps with 11 antennal segments, including 6 at the funicle. The pedicel is smaller than the first article of the funicle. The pronotum is bell-shaped, the mesoscutum short, has notauli complete. The scutellum is glabrous with 4 bristles. The marginal vein is large, 4 times larger than the radial. The female has 5 tarsal segments. The male has 4 segments at the tarsi (Figure 18).

Biology: Parasitoid of Diptera Agromyzidae.

Similar species: The genus *Platynocheilus* has 7 funicular segments. In the other genera of the family, the pedicel is equal to or larger than the first segment of the funicle. I first took it for a Pteromalidae, but i was corrected on insecticide.org (Figures 19 and 20)^[17].

3.2 Study 2

3.2.1 Subfamily Tetracampinae

3.2.1.1 Genus *Afrocampe* Gumovsky, 2018

Afrocampe prinsloo Gumovsky, 2018 (South Africa) (Figure 21).

Biology: Parasitoids of dipteran leaf miners (Agromyzidae). Recorded host species: *Chromatomyia syngenesiae* Hardy 1849, *Liriomyza trifolii* (Burgess, 1880), *Ophiomyia beckeri* (Hendel, 1923), *Perittia weberella* Whitebread 1984, *Phytomyza phillyreae* Hering 1930, *Phytomyza rostrata* Hering 1934 and *Tropicomyia atomella* Malloch, 1914.

3.2.1.2 Genus *Diplesiostigma* Girault, 1920

Biology: Unknown.

3.2.1.3 Undescribed Species (Bouček, 1988)

Biology: Unknown.

3.2.1.4 Genus: *Epiclerus* Haliday, 1844

Epiclerus agromyzae (Risbec, 1951) (Senegal) (Figure 22).

3.2.1.5 *Epiclerus Plectroniae* (Risbec, 1952) (Madagascar) (Figure 23)

Biology: Parasitoid of leaf-mining Diptera on *Plectronia umbellata* Kuntze, 1891 (Penaeaceae) and an Asteraceae species (Risbec, 1952) (Figure 24).

3.2.1.6 Genus *Foersterella* Dalla Torre, 1897

Foersterella africana (Ferrière, 1938) (Senegal, Uganda) (Figure 25).

Biology: Egg parasitoid of *Aspidomorpha* spp. (Chrysomelidae, Cassidinae), most commonly *Aspidomorpha tecta* Boheman, 1854: and *Aspidomorpha quinquefasciata* (Fabricius, 1801) (Figure 26).



Figure 10. Subfamily Tetracampinae. Source: https://www.discoverlife.org/mp/20p?see=L_MWS137397&res=640

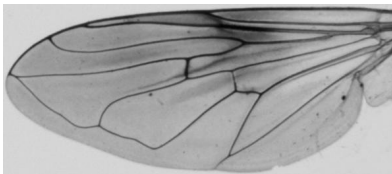


Figure 11. Wings of Tetracampidae *Myolepta nigritarsis* Coe, 1957. Source: <http://drawwing.org/insect/myolepta-nigritarsis-wing>



Figure 12. *Epiclerus* species. Source: http://www.waspweb.org/Chalcidoidea/Tetracampidae/Epiclerus/Epiclerus_species.htm

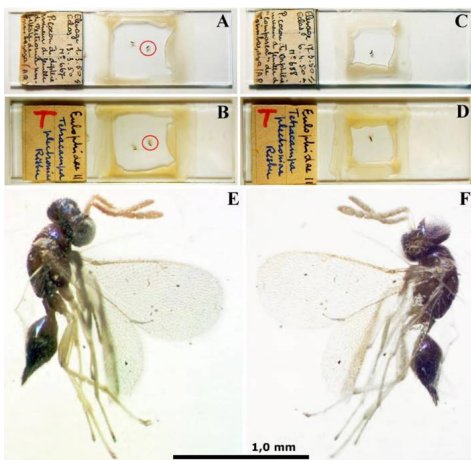


Figure 13. *Epiclerus plectroniae* (Risbec, 1952) Syntypes. A: Upper side; B: Underside; C: Upper side; D: Underside; E and F: The female indicated by a red circle in A and B. Source: http://www.waspweb.org/Chalcidoidea/Tetracampidae/Epiclerus/Epiclerus_plectroniae.htm

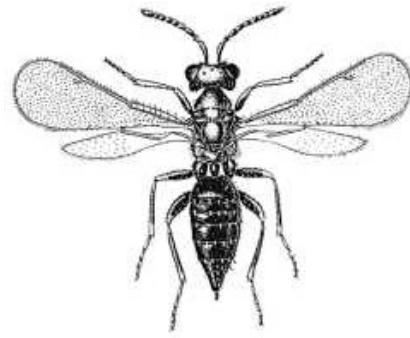


Figure 14. Platynochelilinae: *Platynochelilus cuprifrons* (Nees, 1834) Female. The family currently includes 15 genera and 50 species placed in 6 subfamilies as follows: Baeomorphinae (1/4, fossil), Bouceklytinae (1/1, fossil), Distylopinae (1/1, fossil), Mongolocampinae (4/10), Platynochelilinae (1/4), Tetracampinae (7/30). Source: <https://www.nhm.ac.uk/our-science/data/chalcidoidea/tetracampidae.html>

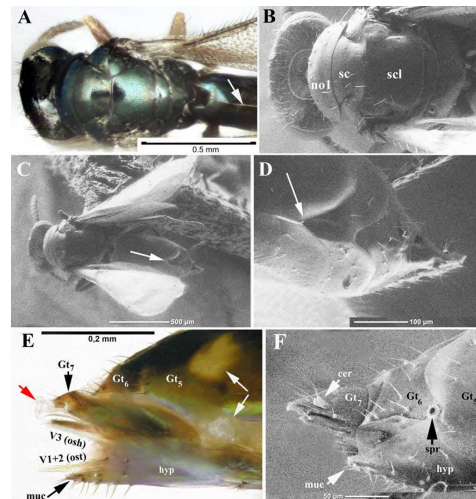


Figure 15. *Kilomotoia kitoko* Gumovsky, 2016. A and B: Head, mesosoma and anterior part of metasoma, dorsal view; C: Entire habitus; D: Dorsal view; E and F: Lateral views. (White arrows in A, C and D points to dorsal submedian ridge stretching to deep emargination of posterior margins of gastral tergites; white arrows in E point to lightly sculptured areas). Source: http://www.waspweb.org/Chalcidoidea/Tetracampidae/Kilomotoia/Kilomotoia_kitoko.htm



Figure 16. Fossil of Tetracampidae. Source: <https://eol.org/pages/8149/media>

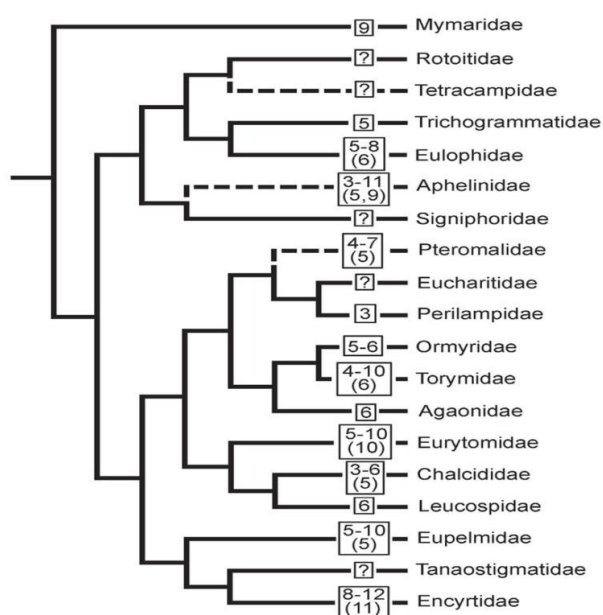


Figure 17. Phylogenetic tree of chalcid families. Based on Noyes, 1990; see the text for further explanations) with ranges of haploid chromosome numbers superimposed onto it (based on data from Gokhman, 2009 and recent updates by the first author. Most frequent "n" values are given in brackets. Source: https://www.researchgate.net/figure/Phylogenetic-tree-of-chalcid-families-based-on-Noyes-1990-see-the-text-for-further_fig2_247905145

3.2.1.7 Genus *Kilomotoia* Gumovsky, 2016

Kilomotoia kitoko Gumovsky, 2016 (Democratic Republic of Congo, Uganda) (Figure 27).

Biology: Unknown^[18,19].

3.3 Study 3

3.3.1 *Foersterella Angusticornis* Hansson, 2016 (Figure 28)

Host: Unknown, but based on records for other species in *Foersterella* it probably is an egg parasitoid of some species of *Cassida* (Coleoptera: Chrysomelidae) (Figure 29).

Distribution: Sweden (Figure 30).

3.3.2 *Foersterella Erdoesi* Bouček, 1958

Host: Endoparasitoid in eggs of *Cassida viridis* L., 1758 (Coleoptera: Chrysomelidae) (record checked).

Distribution: Hungary (Bouček 1958), Romania, Sweden, United Kingdom (all records checked).

3.3.3 *Foersterella Fuscicornis* Hansson, 2016

Host: Unknown, but based on records for other species in *Foersterella* it probably is an egg parasitoid of some species of *Cassida* (Coleoptera: Chrysomelidae).

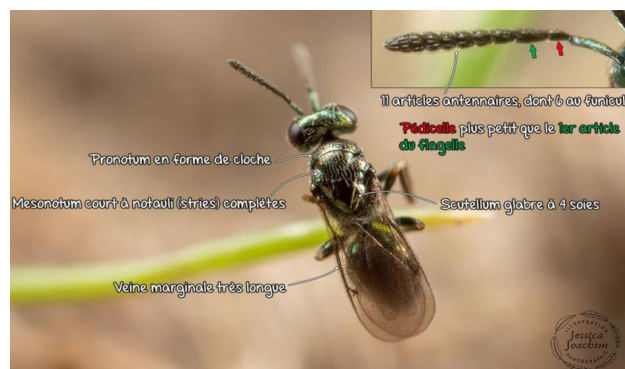


Figure 18. Genre: *Epiclerus*. Source: <https://jessica-joachim.com/insectes/hymenopteres/tetracampidae/epiclerus-sp>

Distribution: France and Sweden.

3.3.4 *Pteromalus Reptans* Nees, 1834

Hosts: Endoparasitoid in eggs of *Cassida deflorata* Suffrian (Labeyrie, 1961), *Cassida murraea* L., 1758 (Bouček & Askew 1968), *Cassida rubiginosa* (Bouček, 1958), and *Cassida viridis* L. (Bouček 1958) (Coleoptera: Chrysomelidae). I have not seen any reared specimens of this species, and in view of the confusion with species identification, host records in literature must be regarded with caution (Figure 31).

Distribution: Austria, Czechoslovakia, Denmark, Germany, Hungary, Sweden, Yugoslavia (all seven records in Bouček 1958), France, Italy, Romania and United Kingdom)^[20-24].

3.4 Study 4

Eight species of Tetracampidae are recorded in Britain and Ireland, but only three species are recorded as parasitoids of British and Irish miners.

3.4.1 *Epiclerus Nomocerus* (Masi, 1934)

Distribution: Croatia Czechoslovakia, Europe rance, Germany, Hungary Moldova, Morocco, North Africa, Romania, Serbia, Slovakia, Sweden, Turkmenistan, United Kingdom and England (Figure 32).

Plant associates: Family: Fabaceae: *Pisum* sp. and *Pisum sativum* L. Family: Solanaceae: *Lycopersicon esculentum* Mill.

3.4.2 *Epiclerus Panyas* (Walker, 1839)

Distribution: Canary Islands, Czech Republic, Czechoslovakia, Europe, Germany, Hungary, Italy, Macedonia, Slovenia, Spain, Sweden, Turkey, United Kingdom, England and Wales.

Associates: Family: Asteraceae: *Centaurea scabiosa* L., *Cirsium arvense* L., *Cirsium palustre* L., *Eupatorium cannabinum* L., *Inula conyza* (Griess.), *Senecio* sp.,

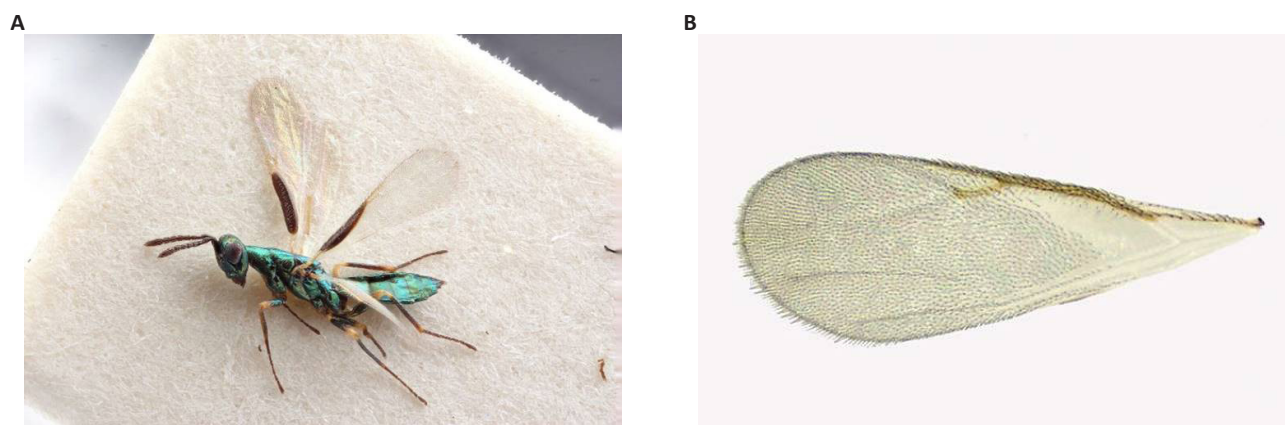


Figure 19. Genus *Platynocheilus*. A: Hymenoptera; B: Chalcid wasp. Sources: <https://eol.org/pages/75470> and <https://bugguide.net/node/view/1670044/bgimage>



Figure 20. *Liriomyza trifolii*, Burgess, 1880. A: Egg inside a puncture on the leaf; B: Larvae inside a leaf, behind is a trail of mines, while the dark areas are the waste products; C: Pupa attached to the upper surface of a leaf; D: Adult dorsal view. Source: <https://cipotato.org/riskatlasforafrica/liriomyza-trifolii>

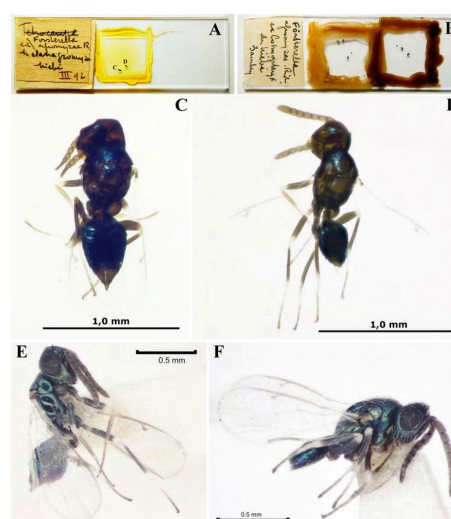


Figure 22. *Epiclerus agromyzae* (Risbec, 1951) (Senegal). **Syntypes.** A and B: General view of the MNHN slides from Risbec's collection; C: Female; D: Male (both are indicated in A); E and F: Female (E) male (F) of the series of pinned specimens in BMNH. Source: http://www.waspweb.org/chalcidoidea/Tetracampidae/Epiclerus/Epiclerus_agromyzae.htm

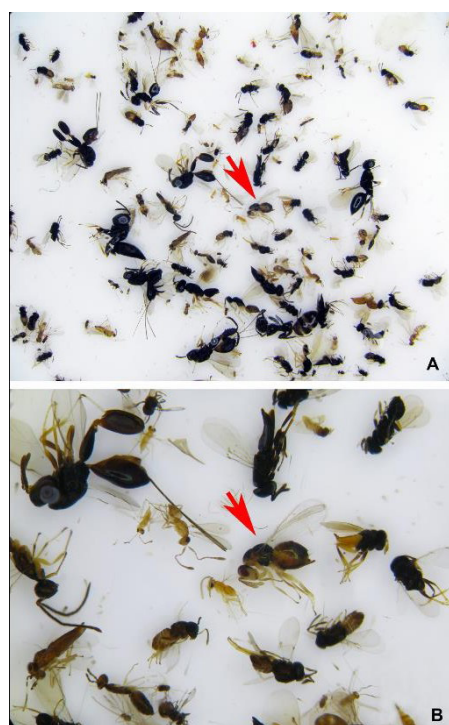


Figure 21. *Afrocampe prinsloo* gen. et sp. nov., paratype (arrows), ♀, in a sample from the Grootvadersbosch Nature Reserve (Western Cape, South Africa) among other chalcidoid wasps. A–B: General view. Source: <https://www.mindat.org/paleoim.php?id=11051>



Figure 23. *Epiclerus plectroniae*, Risbec, 1952. Source: <http://www.waspweb.org/chalcidoidea/Tetracampidae/Epiclerus/index.htm>



Figure 24. *Plectronia umbellate* Kuntze, 1891, Penaeaceae. Source: <https://efloraofindia.com/2013/01/30/psyrax-umbellatus>



Figure 25. *Foersterella africana* (Ferrière, 1938). Source: http://www.waspweb.org/Chalcidoidea/Tetracampidae/Kilomotoia/Kilomotoia_kitoko.htm



Figure 26. *Aspidomorpha quinquefasciata* (Fabricius, 1801) (Coleoptera: Chrysomelidae). Source: https://www.kaefer-der-welt.de/aspidomorpha_quinquefasciata.htm

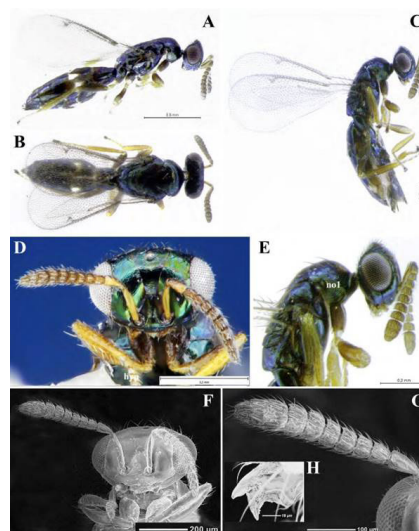


Figure 27. *Kilomotoia kitoko* Gumovsky, 2016. A and B: Holotype (from D.R. Congo); A and B: Habitus in lateral and dorsal views; C: Habitus in lateral view; D: Head in frontal view; E: Head and mesosoma enlarged; F: Head in frontal view; G: Antenna; H: Mandible. Source: http://www.waspweb.org/Chalcidoidea/Tetracampidae/Kilomotoia/Kilomotoia_kitoko.htm



Figure 28. *Foersterella* spp., habitus in lateral view. 1: *Foersterella angusticornis* Hansson, 2016, male holotype, specimen length 1.1mm; 2: *Foersterella erdoesi* Bouček, 1958, male non-type from Sweden (Skåne); 3: *Foersterella reptans* (Nees, 1834), male; 4: *Foersterella fuscicornis* Hansson, 2016, male Head, frontal view, males: 5: *F. angusticornis*, holotype; 6: *F. erdoesi*. Source: <https://www.mindat.org/paleoimg.php?id=12161>



Figure 29. Genus *Foersterella*. Source: <https://treatment.plazi.org/id/E56F87C43E2CFF80FF550389FE1F49AD>

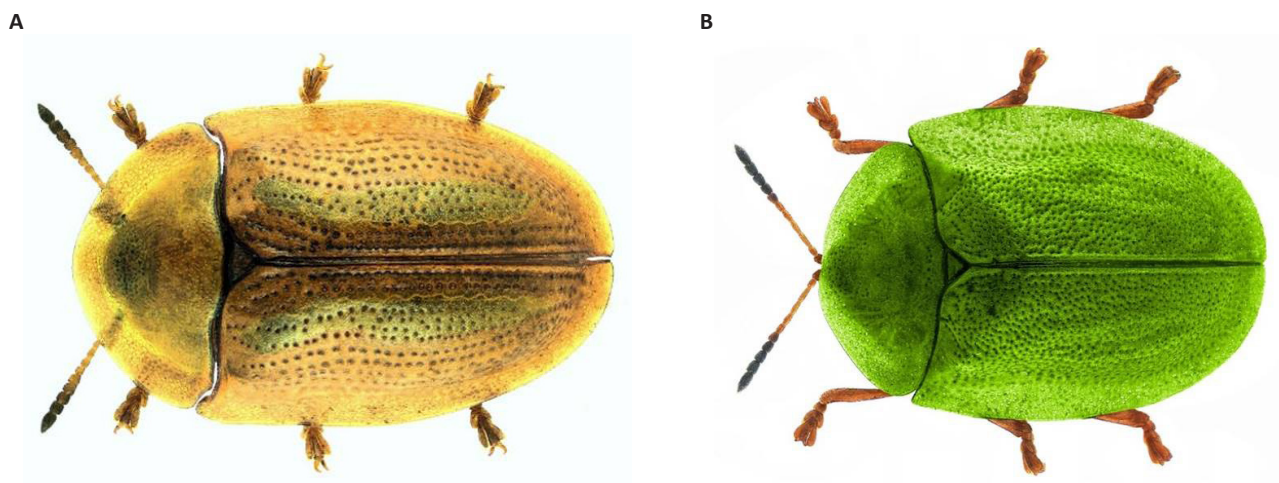


Figure 30. *Cassida*. A: *Cassida* (Coleoptera: Chrysomelidae); B: *Cassida viridis* L., 1758 (Coleoptera: Chrysomelidae). Sources: <https://www.flickr.com/photos/coleoptera-us/51306979961> and <https://www.flickr.com/photos/coleoptera-us/51331318562>



Figure 31. *Cassida deflorata* Suffrian (Labeyrie, 1961). Source: <https://www.insecte.org/forum/viewtopic.php?t=193830>

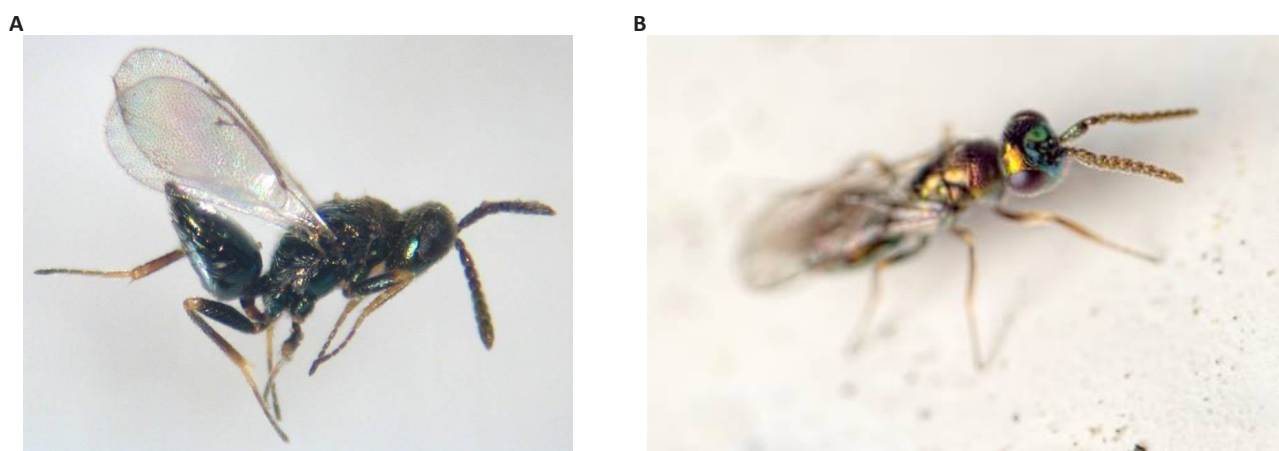


Figure 32. *Epiclerus*. A: *Epiclerus nomocerus* (Masi, 1934); B: *Epiclerus panyas* (Walker, 1839). Sources: http://ponent.atspace.org/fauna/ins/fam/tetracampidae/epiclerus_tet.htm and http://v3.boldsystems.org/index.php/TaxBrowser_Taxonpage?taxid=968813



Figure 33. *Perittia weberella* Whitebread, 1984. Source: https://lepiforum.org/wiki/page/Perittia_weberella

Sonchus sp., *Sonchus asper* L., *Tanacetum* sp., and *Taraxacum* sp., Family: Chenopodiaceae: *Atriplex halimus* L., Family: Cucurbitaceae: *Cucumis sativus* L., Family: Plantaginaceae: *Plantago lanceolata* L., Family: Poaceae: *Holcus* sp., *Holcus lanatus* L., *Holcus mollis* L., *Poa* sp. Family: Tamaricaceae: *Tamarix canariensis* Willd.

3.4.3 *Epiclerus Temenus* (Walker, 1839)

Distribution: Czech Republic, Czechoslovakia, Europe, France, Germany, Hungary, Italy, Netherlands, Slovakia, Sweden, Switzerland, United Kingdom, England and Scotland.

Associates: Family: Agromyzidae: *Phytomyza rostrata* Hering 1934.

Order: Lepidoptera: Family: Elachistidae: *Perittia weberella* Whitebread, 1984 (Figure 33)^[25-28].

4 CONCLUSION

Tetracampidae parasitoids of miner and galling dipterans, as well as eggs of Chrysomelidae (Coleoptera) and Diprionidae (Hymenoptera) and larval parasitoids of flies (Agromyzidae) and Orthoptera. Very little is known of the biology of most Tetracampidae species. Most of the host species that have been identified are plant-mining insects.

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Conflict of Interest

The author declared no conflict of interest.

Author Contribution

Marchiori CH contributed to the manuscript and approved the final version.

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