Diversity and ecology of the Family Orussidae (Insecta: Hymenoptera)

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Abstract

The biology of the Siricoidea superfamily, a sister group of the Symphyta and the family Orussidae (Parasitica: Woodwasps), can be imagined as the evolution of parasitoids would have been. The larvae of the Siricoidea wasps generally feed on dead wood that has been previously digested by a fungal symbiont. For this reason, many species carry spores of the fungus that they leave on the wood during oviposition. Diversity and ecology of parasitoid insects of the Family Orussidae (Insecta: Hymenoptera). In summary, basically, the following steps of analysis were covered:

- Exhaustive reading of each national and international article aiming at a global understanding and discovery of the approach used by its authors;
- Identification of the central ideas of each article;
- Classification of ideas around nuclei of meaning;
- Comparison between the different nuclei of meaning present in the studied articles;
- Classification of the nuclei of meaning in broader axes (themes) around which the authors' discussions revolved and (e) writing of the interpretative syntheses of the theme.

Book scientific chapters, theses banks, university dissertations, national and international scientific articles, scientific journals book scientific chapters, theses banks, university dissertations, scientific journals and https://www.researchgate.net/post/How_to_increase_the_research_results_visibility were also used. HAL (https://hal.archives-ouvertes.fr/submit/index, SSRN (https://hq.ssrn.com/login/pubsiginjno.cfm) and ResearchGate (https://www.researchgate.net/signup.SignUp.html).

Keywords: Coleoptera; Ectoparasites; Hosts: Larvae; Wood

1 Introduction

The Orussidae family is a small group of Hymenoptera that includes some 85 species worldwide. Traditionally, included in the Symphyta suborder, their larvae deviate from the phytophagous regime of the group and are ectoparasites of xylophagous insect larvae. They are considered a rare group in which numerous species are known from few specimens from few localities, even in many species only the typical material is known. The phylogeny and the biogeography of the group have been analyzed in three excellent works by Vilhelmsen (Figures 1-3) [1,2,3].

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2 Description

The adults of this family are characterized by presenting cylindrical body, with very hard integuments, a head with two tubercles on the face, widely separated eyes located on both sides of jaws articulated, antennae short and stout inserted below the clypeus, under the eyes and at the level of the mouth, intermediate tibiae with two spurs, front tarsi with 5 knuckles in males and 3 knuckles in females, antennae divided into 11 segments in males and 10 in females and, in these last ones, a long and thin ovipositor; the forewings have a single mid-ulnar cell, the rest of the veins are greatly reduced and appear only lightly pigmented (Figure 4-12) [4,5,6].
Figure 4 Orussobaius nielspederi sp. nov. (A): Antenna and mouthparts, ventral. (B): Thorax, dorsal. (C): Thorax, lateral. (D): Hind femur and tibia. — Abbreviations and arrows: (md) = mandible; (n1) = pronotum; (n2) = mesoscutum; (n3) = metanotum; (pl1) = propleuron; (pl2) = mesopleuron; (pl3) = metapleuron; (pn2) = mesopostnotum; (sc2) = mesocutellum; (T1) = tergum (1); red arrow = maxillary palp; yellow arrow = labrum; green arrows = dorsal pegs on hind tibia; blue arrow = hind tibial apical spur.

Figure 5 Ophrella seagi sp. nov., female. (A) Habitus dorsal (B) Head, anterior (C) Head and antenna, lateral. Yellow arrow = cross vein cu-a; red arrow = longitudinal furrow on top of the head; blue arrow = pronotal transverse carina; green arrow = antennomere 10.
Figure 6 *Ophrella seagi* sp. n., female holotype. (A) Head and thorax, dorsal (B) Hind leg and abdomen, lateral. Yellow arrow = notch, pronotal transverse carina; red arrow = longitudinal furrow, top of the head; black arrow = projection, tergum 8; blue arrow = hind tibial apical spur; green arrow = triangular projection on hind femur. (c3) = hind coxa; (f3) = hind femur; (n1) = pronotum; (n2) = mesoscutum; (n3) = metanotum; (sc2) = mesoscutellum; (s7) = sternum 7; (t3) = hind tibia; T[x] = tergum [x]

Figure 7 *Orussus tessmanni* Enslin, 1913 Antennomeres (1–2) dark brown, the same color as remaining antennomeres (male unknown) (A, B)

Figure 8 *Orussus spinifer* (Benson, 1955). Mesoscutum with weakly developed longitudinal carina medially (a); mesoscutellum with hind margin not reaching anterior margin of metanotum, mesopostnotum continuous posteriorly (b); hind tibia with white spot proximally (male unknown) (c)
Figure 9 Ocellar corona narrow, distance between median ocellus and lateral most coronal tooth less than 2x the diameter of former (red bars) (A), dorsal most coronal tooth situated at level with lateral ocellus; mesoscutellum triangular, angled posteriorly (B).

Figure 10 Mesoscutellum sparsely punctured, with broad shining interspaces (A). Tibiae on all legs predominantly blackish-brown, sometimes with yellow patches (B).

Figure 11 Orussus taorminensis Trautmann, 1922. Female with pronotum, mesonotum, and anterodorsal part of mesopleuron reddish-brown, contrasting with the colour of other body parts (male unknown) (A, B). O. taorminensis
2.1 Biology

This is the only family in the Symphyta suborder whose larvae do not feed on plants. Habits are unknown for very few species and these have a parasitic or predatory association with various wood-boring insects, especially Coleoptera beetles such as Buprestidae, Cerambycidae and Hymenoptera such as Siricidae and Xiphydriidae. Adults have been seen emerging from various trees and shrubs. Some Nearctic species can be found scouring dead-standing trees, resembling ants. Orusids are parasitoids of wood larvae, especially. Adults are often found running rapidly along the trunks of dead trees (Figure 13) [7,8,9].

The biology of the Siricoidea superfamily can be imagined as the evolution of parasitoidism would have been. The larvae of the Siricoidea wasps generally feed on dead wood that has been previously digested by a fungal symbiont. For this reason, many species carry spores of the fungus that they leave on the wood during oviposition (Figure 14) [10,11,12].
2.2 Life cycle
Females vibrations with their antennae by rapidly tapping the wood (a form of ultrasound) to locate larvae hidden in the wood. They have vibration receptors in their feet. When the female locates a suitable host she pierces the wood with her long ovipositor and deposits an egg. The egg is elongated with a small enlargement at the anterior end and a larger one at the posterior end. The egg coils around the host. In some species, the egg may be deposited in a tunnel in the vicinity of the host and the orusid larva has to crawl to its host [13,14,15].

2.3 Taxonomy
Most species are black, sometimes with partially reddish legs. Around 100 species are known worldwide and are found on all continents. Five genera and 12 species are known from the Neotropics. Two species have been found in Costa Rica, *Kukulcania mexicana* Magalhaes & Ramírez, 2019 (Arachnida: Araneae: Filistatidae) and an unidentified species of the genus *Ophrynopus*. However, Orussidae is rarely collected and probably more species will be found in the future (Figure 15) [16,17].

![Figure 14: Horntail woodwasps active on a tree](https://bugspray.com/article/hornstail.html)

**Figure 14** Horntail woodwasps active on a tree

![Figure 15: Ophrynopus female, holotype](https://www.researchgate.net/figure/Ophrynopus-guarani-sp-nov-female-holotype-A-B-habitus-dorsal-and-lateral-C_fig10_256461381)

**Figure 15** *Ophrynopus* female, holotype: (A, B) habitus, dorsal and lateral; (C) antenna; (D) wings, cells and veins identified in the text; (E) abdominal terga 3-5
Orussidae used to be placed in a separate suborder, Idiogastra but is now placed in its own superfamily Orusoidea. Orussidae is decidedly monophyletic. The tribes and subfamilies of Orussidae have been abandoned as early subdivisions have not been corroborated by phylogenetic analyses (Figures 16-17) [18,19].

**Figure 16** Consensus tree of 9 trees of fit 41,51167 produced by implied weighting analysis with k = 10. Only crown group Orussidae shown; genera outside the Ophrynopine clade have been collapsed to single terminals.
Figure 17 The first Dominican amber fossil of the parasitoid family Orussidae (Euhymenoptera: Orussomorpha) is described and figured from a single individual preserved in Early Miocene (Burdigalian) amber from the Dominican Republic. *Ophrynopus peritus* Engel, 2008, new species, is the first orussid fossil described from Tertiary amber and the first species documented from the West Indies.

**Objective**

As seen previously, the objective of this manuscript is to study the biological and taxonomic characteristics of the Family Orussidae.

### 3 Methods

In summary, basically, the following steps of analysis were covered: (a) exhaustive reading of each national and international article aiming at a global understanding and discovery of the approach used by its authors; (b) identification of the central ideas of each article; (b) classification of ideas around nuclei of meaning; (c) comparison between the different nuclei of meaning present in the studied articles; (d) classification of the nuclei of meaning in broader axes (themes) around which the authors’ discussions revolved and (e) writing of the interpretative syntheses of the theme. Book scientific chapters, theses banks, university dissertations, national and international scientific articles, scientific journals book scientific chapters, theses banks, university dissertations, scientific journals and https://www.researchgate.net/post/How_to_increase_the_research_results_visibility were also used. https://goo.gl/gLTTTs, HAL (https://hal.archives-ouvertes.fr/submit/index), SSRN (https://hq.ssrn.com/login/pubsigninjoin.cfm) and ResearchGate (https://www.researchgate.net/signup.SignUp.html).

### 4 Selected searches

#### 4.1.1 Study 1

Hymenoptera of the Afrotropical region

**Subfamily:** Ophrynopinae and Orussinae

**Genus:** *Chalinus, Leptorussus, Orussus, Pedicrissa* and *Pseudoryssus* (Figures 18-19).
Source: http://www.waspweb.org/orussoidea/Orussidae/Chalinus/Chalinus_schultessi.htm

**Figure 18** Genus *Chalinus* Konow, 1897

Source: Photographs © Simon van Noort (Iziko Museums of South Africa) and © Stephen M. Blank (Senckenberg Deutsches Entomologisches Institut)

**Figure 19** Genus *Leptorussus* Benson, 1955

Source: Photographs © Simon van Noort (Iziko Museums of South Africa) and © Stephen M. Blank (Senckenberg Deutsches Entomologisches Institut)

**Figure 20** Genus *Orussus* Latreille, 1796

Source: Photographs © Simon van Noort (Iziko Museums of South Africa) and © Stephen M. Blank (Senckenberg Deutsches Entomologisches Institut)

**Figure 21** Genus *Pedicrissa* Benson, 1935
**Figure 22** Genus *Pseudoryssus*

**Distribution:** Angola, Benin, Botswana, Canary Islands, Central African Republic, Democratic Republic of Congo, Equatorial Guinea, Gabon, Ghana, Guinea, Ivory Coast, Kenya, Liberia, Madagascar, Malawi, Mali, Mozambique, Nigeria, Reunion, Senegal, Sierra Leone, Somalia, South Africa, Tanzania, Zimbabwe. Palaearctic region: Algeria, Bulgaria, France, Egypt, Greece, Iran, Iraq, Italy, Israel, Italy, Morocco, Spain, Tunisia, Turkey, Turkmenistan. Worldwide, with the greatest species richness in Africa. Species were usually rare.

**Biology:** Parasitoids of wood-boring Coleoptera and Hymenoptera larvae.

**Some species:** *Chalinus albitibialis* Vilhelmsen, 2005, *Chalinus berlandi* Guiglia, 1935 and *Chalinus oberthueri* (Saussure, 1890) (Figure 23).

**Figure 23** *Chalinus albitibialis* Vilhelmsen, 2005, male, Morocco (NHMD). (A), Habitus dorsal. (B), Hind leg and abdomen, lateral. (C), Head and antenna anterior. Blue arrow = discal cell; yellow arrow = hind tibial apical spur; red arrows = basal constrictions on antennomeres. a[x] = antennomere[x]

Biology: Parasitoids of wood-boring beetle larvae (Cerambycidae). *Chalinus somalicus* Guiglia, 1935, was reared from *Rinorea convallariiflora* Brandt (Violaceae) infested with Cerambycidae.

Some Species: *Leptorussus africanus* Benson, 1955, *Leptorussus kwazuluensis* Vilhelmsen, 2003 and *Leptorussus madagascarensis* Vilhelmsen, 2007 (Figure 24) [20,21,23].

![Figure 24 Leptorussus africanus Benson, 1955](image)

Sources: Photographs © Simon van Noort (Iziko Museums of South Africa) and © Robert Copeland (ICIPE)

Distribution: Kenya, Madagascar, Mozambique, South Africa and Zimbabwe.

Biology: Unknown.

Some Species: *Orussus abietinus* (Scopoli, 1763), *Orussus smithi* Blank, Kraus & Taeger, 2006 and *Orussus unicolor* Latreille, 1811 (Figure 25).

![Figure 25 Orussus abietinus (Scopoli, 1763)](image)

Sources: Photographs © Simon van Noort (Iziko Museums of South Africa) and © Robert Copeland (ICIPE)

Distribution: Afrotropical, Oriental and Palearctic regions.

Biology: Ectoparasites of woodboring insect larvae, usually Buprestidae (Coleoptera). Females make use of echolocation to locate hosts and hence oviposition is restricted to dry, bark-free wood.

Specie: *Pedicrjeta hyalina* Benson, 1935 (Figure 26).
Figure 26 Pedicrsta Hyalina Benson, 1935

**Distribution:** Malawi, South Africa and Zimbabwe.

**Biology:** Unknown, but probably a parasitoid of wood-boring beetle larvae.

**Species:** Pseudoryssus henschii (Mocsary, 1910) and Pseudoryssus niehuisorum Kraus, 1998 (Figure 27).

Figure 27 Pseudoryssus henschii (Mocsary, 1910)

**Distribution:** Algeria, Egypt, Israel, Morocco, Senegal. Also in central and southern Europe extending eastwards to Iran, Iraq, Turkey and Turkmenistan.

**Biology:** Host unknown [24,25].

4.1.2  Study 2

Iberian Orussidae (Hymenoptera: Symphyta, Orussoidea, Orussidae).

This paper provides new data on the Iberian distribution of the two species, new possible hosts of Orussus taorminensis and are provided habitus photographs of the two Iberian species [25,26,27].

Orussus abietinus (Scopoli, 1763) (Figure 28).
Figure 28 Orussus abietinus (Scopoli, 1763)

**Distribution:** Species widely distributed throughout the Palearctic region, reaching from North Africa and the Iberian Peninsula to Central Asia.

**Hosts:** *Orussus abietinus* have been cited: *Buprestis haemorrhoidalis* Herbst, 1780 (Coleoptera: Buprestidae), *Semanotus undatus* (Linnaeus, 1758), *Asemum* sp. and *Arhopalus* sp. (Coleoptera: Cerambycidae).

**Biology:** Once the female has located an occupied gallery for a larva, it deposits an egg inside it, as close as possible to the xylophagous larva. In this way, when she is born her own larva, she is going to parasitize the larva or pupa of the xylophagous insect, completing her cycle inside the wood.

Orussus taorminensis (Trautmann, 1922) (Figure 29).

Figure 29 Orussus taorminensis (Trautmann, 1922)

**Distribution:** Western Mediterranean species are initially known from the area initially know Nance, such as northwestern Italy and Sicily. Cited from southern Spain and Morocco recently has been collected very recently in Algeria.

**Biology:** The species is unknown, and they are not known with their hosts for sure. Point out two species of cerambycid beetles of the genus *Trichoferus* Wollaston, 1854 as possible hosts. The capture data from the specimens that we cite, which emerged from dry branches of various plant species, allow us to venture that the number of possible hosts must be much larger.

In the same trunks in which the individuals hatched from *O. taorminensis*, the following beetles did: *Opilo domesticus* (Sturm, 1837) (Family Cleridae), *Tillus ibericus* Bahillo de la Puebla, 2003, *Trichodes leucopsisdeus* (Olivier, 1795). Family Buprestidae: *Anthaxia hungarica* (Scopoli, 1772), *Anthaxia polychloros* Abeille de Perrin, 1894 and *Acmadura attuordecimpunctata* (Villers, 1789). Family Cerambycidae: *Chlorophorus ruficornis* (Olivier, 1790) [28,29].
4.1.3 Study 3

Orussus abietinus (Scopoli, 1763)

Dimensions: 14 mm.

Figure 30 Orussus abietinus (Scopoli, 1763): I am struck, in this species, by the eyes with a truly particular shape, as indeed those "ridges" on the vertex are particular, in the point where the ocelli are found

Head: The eyes have a ridge at the apex, at the point where the ocelli with denticulations around the eyes meet, they belong to the metanotum, they are the cencris. Likely used by the newly emerged adult to exit the forest by digging a passage by moving its head. Echolocation is for host detection and restricts female wasps to oviposit in dry environments such as wood bark.

Figure 31 Orussus abietinus (Scopoli, 1763): Here the same image at higher magnification

Biology: Orussus abietinus (Scopoli, 1763) are ectoparasites mainly of Buprestidae.

Oviposition: Pinus silvestris L. (Pineacea) and Picea abies Lindley (Pinaceae) killed by fire, usually in standing trees, and lasted an average of six minutes. Several times, females that laid eggs were attacked by other females. Eggs are deposited in excrement-filled tunnels, usually of Buprestis haemorrhoidalis Herbst, 1780 (Coleoptera: Buprestidae), but larvae have also sometimes been found in tunnels of Cerambicides (Asemum and Arhopalus) [30].
4.1.4 Study 4

Synoptic list of Symphyta (Hymenoptera) in Korea.

- Order Hymenoptera Linné, 1758
- Suborder Symphyta Gerstäcker, 1867
- Superfamily Cephoidea Newman, 1834
- Superfamily Orussoidea Newman, 1834
- Family Orussidae Newman, 1834
- Subfamily Ophrynopinae
- Genus Ophrynopus North, 1897

1- *Ophrynopus tosensis* (Tosawa and Suigihara, 1934) (Figure 32).

![Figure 32 Ophrynopus tosensis](https://www.researchgate.net/figure/Ophrynopus-tosensis-Tosawa-Suigihara-1934-female-A-head-in-frontal-view-B_fig4_270221658)

**Host plant**: *Quercus* sp.

**Distribution**: Korea (South), Japan.

2- *Orussus abietinus* (Scopoli, 1763) (Figure 33).

![Figure 33 Orussus abietinus](https://www.hgsc.bcm.edu/arthropods/parasitic-wood-wasp-genome-project)

**Figure 33 Orussus abietinus** (Scopoli, 1763)

Distribution. Korea (North), Albania, Algeria, Austria, Belarus, Belgium, Bosnia Herzegovina, Bulgaria, China, Croatia, Czech Republic, Estonia, Finland, France, Germany, Greece, Hungary, Iran, Italy, Kazakhstan, Latvia, Lithuania, Poland, Romania, Russia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Syria, Turkey and Ukraine.

Subfamily Orussinae Newman, 1834.

Genus *Orussus* Latreille, 1797.

3- *Orussus coreanus* Takeuchi, 1938.


**Distribution:** Korea (North), Albania, Algeria, Austria, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, China, Croatia, Czech Republic, Estonia, Finland, France, Germany, Greece, Hungary, Iran, Italy, Kazakhstan, Latvia, Lithuania, Poland, Romania, Russia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Syria and Turkey.

4- *Orussus melanosoma* Lee and Wei, 2014.

**Host plant:** Unknown.

**Distribution:** Korea (South) [31].

## 5 Conclusion

The Orussidae family is a small group of Hymenoptera that includes some 85 species worldwide. Traditionally included in the Symphyta suborder, their larvae deviate from the phytophagous regime of the group and are ectoparasites of xylophagous insect larvae. They are considered a rare group in which numerous species are known from few specimens from few localities, even in many species only the typical material is known. The phylogeny and the biogeography of the group have been analyzed in three excellent works by Vilhelmsen.

## References


