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Annotated keys to the species of Megaspilidae (Hymenoptera: Ceraphronoidea) of the Neotropical Region

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Abstract. A key to the species of Megaspilidae occurring in Neotropical Region is given, and information on the 20 species in four genera is provided, including data on their distribution and host associations. The Megaspilidae fauna is still poorly known in the Neotropical region and more studies are necessary.

Keywords: Biodiversity; Insect; Megaspilid; Parasitoid wasps; Taxonomy.

Chaves de identificação para as espécies de Megaspilidae (Hymenoptera: Ceraphronoidea) na Região Neotropical

Resumo. É fornecida chave de identificação para os quatro gêneros e 20 espécies de Megaspilidae que ocorrem na Região Neotropical assim como dados sobre as suas distribuições e associações. A fauna de Megaspilidae da Região Neotropical é pouco conhecida e mais estudos são necessários.

Palavras-Chave: Biodiversidade; Inseto; Megaspilídeos; Taxonomia; Vespas parasitoides.

Approximately 800 species of Ceraphronoidea are described worldwide, although it is estimated that there are about 2,000 (Masner 2006). Regarding the Neotropics, there are no precise numbers because of the absence of revisions. The superfamily is composed of two extant families, Ceraphronidae and Megaspilidae (Dessart 2006).

The main characteristics of Megaspilidae are: body usually 2-3mm in length (exceptionally up to 4 mm); antenna in both sexes with 11 segments, in some females the antenna is clavate and in some males with filiform, serrated or branched shape. Some species are apterous, but the most are winged; forewing with submarginal, marginal and radial veins, the latter curved and with enlarged stigma (pterostigma). Foretibia with two apical spurs, the longest one forked at the apex; middle and posterior tibia each with two spurs (Dessart 1995a; Masner 1993, 2006).

According to Masner (2006); Dessart (2006) Megaspilidae is divided into two subfamilies: Lagynodinae and Megaspilinae and comprehends nine genera and about 450 species described in the world.

Lagynodinae contains six genera: *Aetholagynodes* Dessart, 1994, restricted to Australia; *Archisynarsis* Szabó, 1973 and *Typhlolagynodes* Dessart, 1981, restricted to Europe; *Holophleps* Kozlov, 1966, to North America and Europe; *Lagynodes* Förster, 1840, with a worldwide distribution and *Prolagynodes* Alekseev & Rasnitsyn, 1981, fossil (Johnson & Musetti 2004).

Megaspilinae is the largest subfamily, with seven genera: *Platyceraphron* Kieffer, 1906 and *Megaspilus* Westwood, 1829, restricted to North America and Europe; *Trichosteresis* Förster, 1856, from South America, North America, Africa and Europe; *Creator* Alekseev, 1980 and *Trassedia* Cancemi, 1996, restricted to Europe and Africa, respectively, and *Dendrocerus* Ratzeburg, 1852 and *Conostigmus* Dahlbom, 1858, with a worldwide distribution (Dessart & Cancemi, 1986; Dessart 1995a; Johnson & Musetti 2004).

Dessart & Cancemi (1986) provided a key to the world genera and Johnson & Musetti (2004) cataloged the species described from each region. Therefore the aim of this study was to develop identification keys for the species of Megaspilidae occurring in the Neotropical Region.

MATERIAL AND METHODS

For the development of the keys, deposited specimens were examined in the following collections: Invertebrate collection

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of INPA (Instituto Nacional de Pesquisas da Amazônia) and the Entomological Collection of Santa Cruz do Sul (CESC) of UNISC (Universidade de Santa Cruz do Sul). For the Neotropical species not deposited in these collections, we used the works of Paul Dessart (Table 1). A key for all species was elaborated based on these data. The keys were separated for males and females, based on reproductive system (genitalia).

Morphological terminology follows Dessart (1987b, 1997, 1999, 2006); Fergusson (1980); Miko & Deans (2009). The figures have been redesigned from the original illustrations of each species.

RESULTS

A revised key to the Neotropical species of Megaspilidae is presented, since there is no key that includes all species of this region yet.

In the Neotropical Region, 20 species are recognized and classified into four genera (Table 1): *Dendrocerus* (12 species), *Lagynodes* (five), *Conostigmus* (two) and *Trichosteresis* (one).

Family Megaspilidae

Key to subfamilies of the family Megaspilidae

1 Females always apterous; mesosoma with mesoscutum and scutellum greatly reduced and large pronotum and propodeum (Figure 1A); second metasomal tergum large with three longitudinal carinae. Males apterous or winged, without pterostigma; other characteristics similar to females .... **(Lagynodinae)** ***Lagynodes***

- Females and males winged, with a conspicuous pterostigma; if females apterous, then mesonotum less reduced; second metasomal tergum with more than three longitudinal carinae .. .. **(Megaspilinae)**

Subfamily Lagynodinae

Key to the species of *Lagynodes* Förster, 1840 (Males) (Adapted from Dessart 1987b)

1 Wings present **2**

Table 1. Known genera and species of Megaspilidae present of the Neotropical region and their hosts (known gender: ♂ ♀).

Taxon	Distribution	Reference(s)	Hosts
LAGYNODINAE			
Lagynodes Förster			
L. acuticornis (Kieffer, 1906) ♂ ♀	cosmopolitan	Dessart (1987b); Alekseev & Radchenko (2001)	Unknown, live in soil and can be associated with ant nests.
L. botulifer Dessart, 1987 ♂ ♀	Chile	Dessart (1987b)	
L. obscuriceps Dessart, 1981♀	Chile	Dessart (1987b); Dessart (1990)	
L. ocellifer Dessart, 1977 ♀	Chile	Dessart (1977); Dessart (1987b)	
L. pallidus (Boheman, 1832) ♂ ♀	cosmopolitan	Dessart (1987b); Alekseev & Radchenko (2001)	
MEGASPILINAE			
Conostigmus Dahlbom			
C. binasutus Dessart and Cancemi, 1987 ♂	Ecuador	Dessart & Cancemi (1986)	-
C. yunquensis Ogloblin, 1957 ♂ ♀	Chile	Dessart (1995b)	-
Dendrocerus Ratzeburg			
D. aphidum (Rondani, 1877) ♂ ♀	cosmopolitan	Dessart (2001)	Hyperparasitoids of Aphidiidae (Braconidae)
D. araucanus Dessart, 1999 ♂	Chile	Dessart (1999)	-
D. carpenteri (Curtis, 1829) ♂ ♀	cosmopolitan	Dessart (2001)	Lachnidae, Chaitophoridae, Callaphididae, Aphididae, Thelaxidae, Pemphigidae, Adelgidae; hyperparasitoids of Aphidiidae (Braconidae)
D. ciuthan Dessart, 1994 ♀	Mexico	Dessart (1994)	Diptera or hyperparasitoids
D. hadrophthalmus Dessart, 1994♀	Costa Rica	Dessart (1994)	*Paratheresia claripalpis* Wulp, 1896 (Diptera: Tachinidae)
D. henkvlugi Dessart, 1975 ♂	Chile	Dessart (1975)	-
D. mexicali Dessart, 1999 ♂	Mexico	Dessart (1999)	-
D. phallocrates Dessart, 1987♂ ♀	Peru and Brazil	Dessart (1987a)	*Paratheresia claripalpis* (Diptera: Tachinidae)
D. ranquel Martinez, 2003 ♂	Argentina	Martinez (2003)	-
D. riograndensis Pezzini and Köhler, 2014 ♂	Brazil	Pezzini *et al.* (2014)	-
D. sylvia Dessart & Cancemi, 1987 ♀	Brazil	Dessart & Cancemi (1986)	-
D. zoticus Dessart, 1995 ♂	Mexico	Dessart (1995a)	-
Trichosteresis Förster			
T. glabra (Boheman, 1832) ♂ ♀	cosmopolitan	Alekseev & Dessart (1980)	Diptera: Syrphidae

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- Wingless **3**

2 Poststigmal vein twice longer than the stigma (Figure 1B) ..... ***L. pallidus***

- Poststigmal vein less than twice the length of the stigma (Figure 1C) ..... ***L. acuticornis***

3 Last segment of antenna very long, at least 5 times longer than wide and longer than the scape (Figure 1F) ..... ***L. botulifer***

- Last segment of antenna with approximately the same length as the others segments ..... ***L. acuticornis***

Key to the species of *Lagynodes* Förster, 1840 (Females)

(Adapted from Dessart 1987b)

1 Pronotum very developed; mesoscutum and scutellum greatly reduced, with combined length less than half of pronotal length (Figure 1G)..... ***L. acuticornis***

- Pronotum not developed; mesoscutum and scutellum not greatly reduced (Figures 1H, I) **2**

2 Front edge of pronotum marked by a complete or interrupted medially carina **3**

- Front edge of pronotum without carina **4**

3 Mesoscutum without notaulus (Figure 1H); propodeum slightly wider than the pronotum ..... ***L. obscuriceps***

- Mesoscutum with notaulus (Figure 1I); propodeum slightly narrower than pronotum ..... ***L. botulifer***

4 Ocelli present, eyes large (Figure 1D) ..... ***L. ocellifer***

- Ocelli not present (Figure 1E) ..... ***L. pallidus***

Subfamily Megaspilidae

Key to the Neotropical genera

1 Ocelli forming an isosceles triangle with a narrow base, or an equilateral triangle (Figure 2A) ..... ***Conostigmus***

- Ocelli forming an isosceles triangle, always with wider base (Figure 2B) **2**

2 Forewings fuscous or smoky, usually with marginal bristles. Post-pterostigmal vein longer than pterostigma (Figure 2E) ..... ***Dendrocerus***

- Forewings hyaline without marginal bristles. Post-pterostigmal vein shorter than pterostigma (Figure 2F) ..... ***Trichosteresis***

Key to the species of *Conostigmus*

1 Notaulices angulated anteriorly and converging posteriorly, deeply foveolate; scutellum with a prominent concave spur posteriorly (Figure 2K)..... ***C. binasutus*** ♂

- Notaulices angulated anteriorly and slightly convergent posteriorly, not favoleate (Figure 2L) ..... ***C. yunquensis*** ♂ ♀

Key to the groups of *Dendrocerus* (Males)

1 Antenna cylindrical; scape short, massive and significantly larger than flagellomeres (Figure 2M) ..... (***Penmaricus* group**) . **3**

- Not having that combination of characters **2**

2 Antenna with long lateral flagella, some of which can be longer than the length of flagellomeres (Figures 2O, 2P, 2Q and 2R) ... . (***Halidayi* group**) . **4**

- Antenna serrated, with flagellomeres, longer than wide, triangular in profile (Figure 2N) . ..... (***Carpenteri* group**) . **7**

3 Facial groove present from the occiput until just before the insertion of antenna (Figure 2C) ..... ***D. phallocrates***

- Facial groove not present . ..... ***D. zoticus***

4 Antenna with five unarticulated branches; T_{III} smooth, without punctures **5**

- Antenna with five articulated branches basally (Figure 2O); T_{III} with punctures ..... ***D. mexicali***

5 A_8 same length as A_7 and approximately same length as A_{11} ... **6**

- A_8 twice length of A_7 and longer than A_{11} (Figure 2P) ..... ***D. araucanus***

6 Antennal branches relatively thin; A_7 and A_8 of similar width; R_1 smaller than R_2; R_5 length approximately similar to A_7 (Figure 2Q) ..... ***D. ranquel***

- Antennal branches relatively thick; A_7 thinner than A_8; R_1 and R_2 of same length; R_5 much longer than A_7 (Figure 2R) ..... ***D. riograndensis***

7 Propodeum mostly smooth and bright ..... ***D. henkvlugi***

- Propodeum not smooth **8**

8 Intertorular carina present; stigma almost oval (Figure 2G) .. .. ***D. aphidum***

- Intertorular carina absent; stigma almost circular (Figure 2H) ..... ***D. carpenteri***

Key to the species of *Dendrocerus* (Females)

1 T_{III} with longitudinal grooves (Figure 2J) ..... ***D. sylviae***

- T_{III} without longitudinal grooves **2**

2 Occipital region with salient facial groove (Figures 2C, D) **3**

- Occipital region without salient facial groove (Figures 2A, B) **4**

3 Occipital region with facial groove reaching the antenna insertion (Figure 2C) ..... ***D. phallocrates***

- Occipital region with facial groove reaching the median ocellus (Figure 2D) ..... ***D. hadrophthalmus***

4 Poststigmal vein with the same length as stigma (Figure 2I) .. .. ***D. ciuthan***

- Poststigmal vein longer than the stigma length **5**

5 Intertorular carina present; stigma almost oval (Figure 2G) .. .. ***D. aphidum***

- Intertorular carina absent; stigma almost circular (Figure 2H) ..... ***D. carpenteri***

Key to the species of *Trichosteresis*

1 Forewing without marginal fringes, stigmal vein shorter than pterostigma and wing disc with much reduced hairs (Figure 2F) ..... ***T. glabra*** ♂ ♀

Examined material

***Conostigmus binasutus* Dessart & Cancemi, 1987: BRASIL, Amazonas, Manaus:** ♀, 02.vii.1986.

***Conostigmus yunquensis* Ogloblin, 1957: BRASIL, Rio Grande do Sul, Santa Cruz do Sul:** ♂, 06.i.2009, (CESC 19968/04); ♂, 28.i.2009, (CESC 23048/17); ♂, 25.xii.2009, (CESC 31936/17).

***Dendrocerus aphidum* (Rondani, 1877): BRASIL, Rio Grande do Sul, Santa Cruz do Sul:** ♀, 16.xii.2011, (CESC 43364/20); ♀, 27.xii.2011, (CESC 45553/14); ♀, 17.i.2012, (CESC 46916/16); ♀, 24.i.2012, (CESC 47815/15), ♀, 03.xii.2010, (CESC 38528/22).

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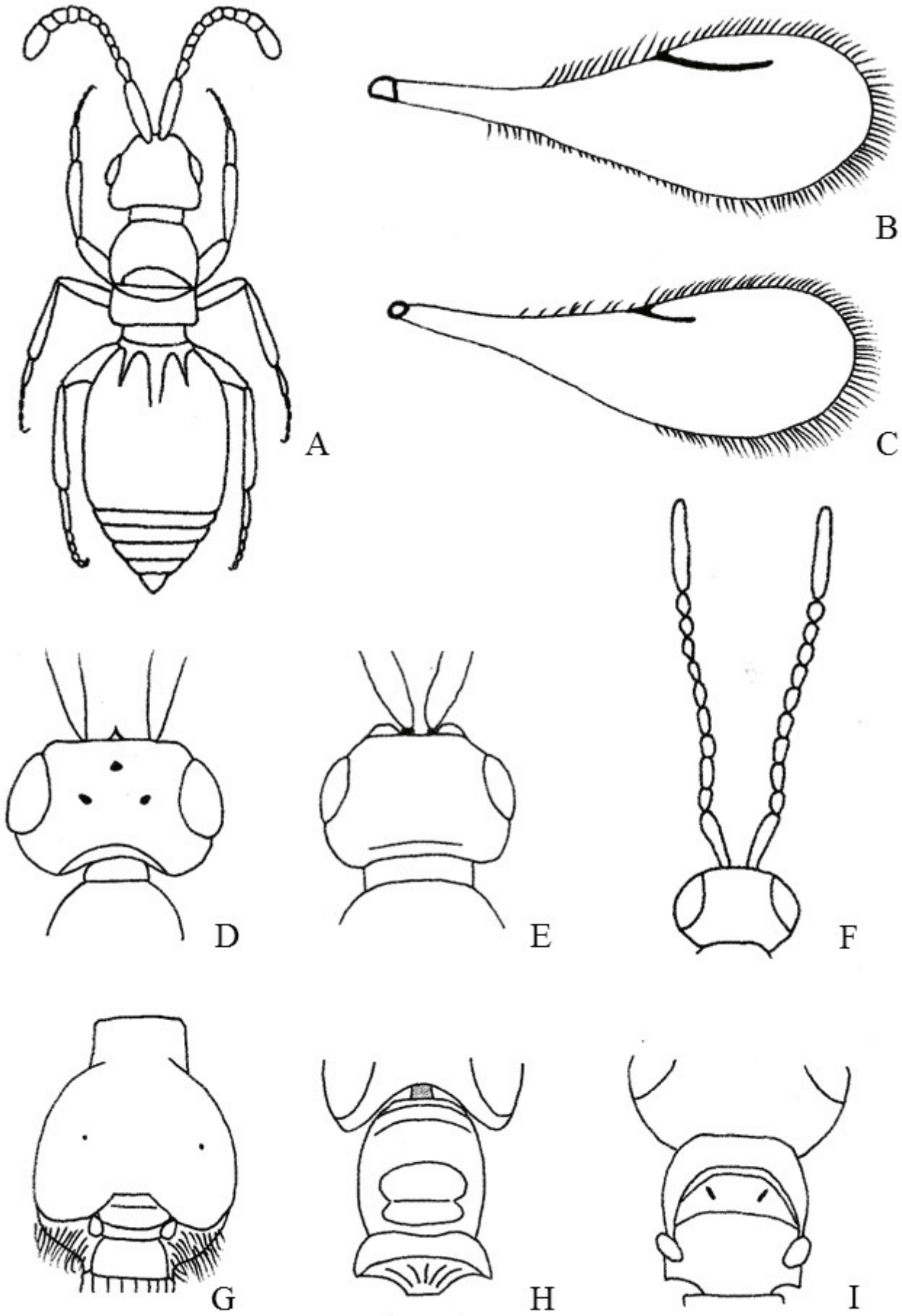

Figure 1. Details of structure of the members of the subfamily Lagynodinae: **A** Dorsal view of a female *Lagynodes* sp. **B** *L. pallidus* ♂ **C** *L. acuticornis* ♂ **D** *L. ocellifer* ♀ **E** *L. pallidus* ♀ **F** *L. botulifer* ♂ **G** *L. acuticornis* ♀ **H** *L. obscuriceps* ♀ **I** *L. botulifer* ♀. (Adapted from Dessart 1987b).

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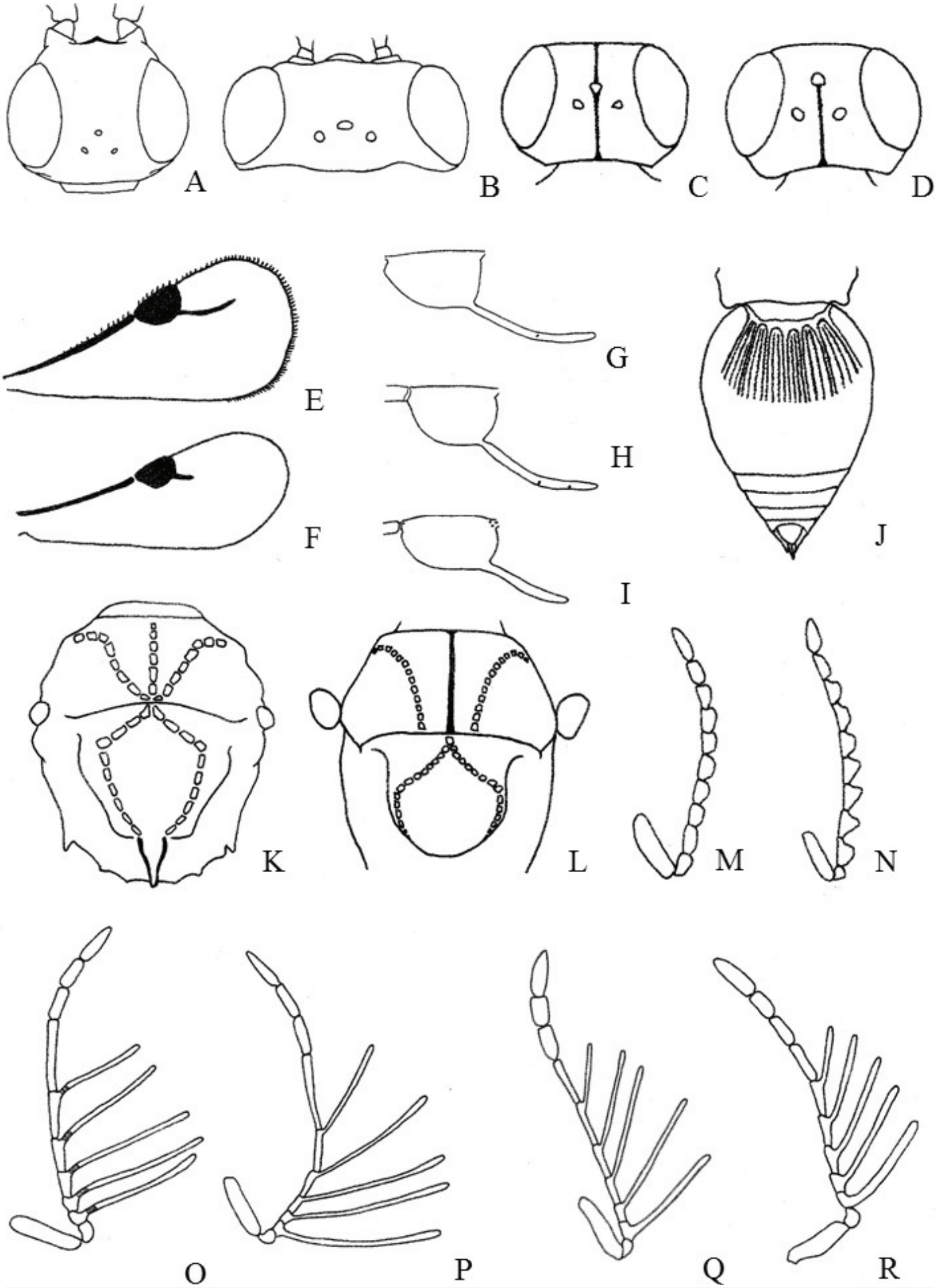

Figure 2. Details of structure of the members of Megaspilinae: **A** *Conostigmus* sp. **B** *Dendrocerus* sp. **C** *D. phallocrates* ♂ ♀ **D** *D. zoticus* ♂ **E** *Conostigmus* sp. or *Dendrocerus* sp. **F** *Trichosteresis glabra* ♂ ♀ **G** *D. aphidum* ♂ ♀ **H** *D. carpenteri* ♂ ♀ **I** *D. ciuthan* ♀ **J** *D. sylviae* ♀ **K** *C. binasutus* ♂ **L** *C. yunquensis* ♂ ♀ **M** *Penmaricus* group **N** *Carpenteri* group **O-P-Q-R** *Halidayi* group **O** *D. mexicali* ♂ **P** *D. araucanus* ♂ **Q** *D. ranquel* ♂ **R** *D. riograndensis* ♂. (Adapted from Dessart 1987a, 1994, 1995a, 1995b, 1999, 2001, 2006; Dessart & Cancemi 1986; Martinez 2003; Masner 2006; Pezzini *et al.* 2014)

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***Dendrocerus carpenteri* (Curtis, 1829): BRASIL, Amazonas, Manaus:** ♂, 23.i.1985; **Rio Grande do Sul: Passa Sete:** ♀, 04.ii.2010, (CESC 31228/10); ♂, 04.ii.2010, (CESC 31212/07); **Rio Grande do Sul, Santa Cruz do Sul:** ♂, 20.xi.2008, (CESC 15814/08); ♂, 20.xi.2008, (CESC 16718/13); ♂, 28.xi.2008, (CESC 17565/24); ♀, 28.xi.2008, (CESC 17617/04); 2♀, 05.xii.2008, (CESC 17488/06); ♀, 16.xii.2008, (CESC 18472/12); ♀, 29.xii.2008, (CESC 18614/14); ♀, 20.xi.2008, (CESC 16951/11); ♀, 20.xi.2008, (CESC 15825/11); ♀, 28.xi.2008, (CESC 15915/16); ♀, 05.xii.2008, (CESC 17030/06); 2♀, 05.xii.2008, (CESC 17537/20); ♂, 23.xii.2008, (CESC 18528/03); ♂, 20.xi.2008, (CESC 15667/08); ♀, 20.xi.2008, (CESC 15656/03); ♀, 28.xi.2008, (CESC 16626/07); 2♀, 20.xi.2009, (CESC 26417/05); 2♀, 20.xi.2009, (CESC 26431/16); ♀, 27.xi.2009, (CESC 26680/16); ♀, 27.xi.2009, (CESC 26618/09); ♂, 20.xi.2009, (CESC 26369/09); ♀, 20.xi.2009, (CESC 26395/10); ♀, 20.xi.2009, (CESC 26301/07); ♀, 27.xi.2009, (CESC 26662/06); ♀, 27.xi.2009, (CESC 26503/15); 2♀, 27.xi.2009, (CESC 26548/17); ♀,1♂, 04.xii.2009, (CESC 29231/11); ♀, 08.i.2010, (CESC 32684/17); 2♀, 23.xi.2009, (CESC 26288/18); 2♀, 23.xi.2009, (CESC 26207/09); ♀, 23.xi.2009, (CESC 26218/06); 4♀, 23.xi.2009, (CESC 26228/04); ♀, 16.xii.2011, (CESC 43445/20); ♂, 03.xi.2010, (CESC 36280/08); ♂, 11.xi.2010, (CESC 37402/08); 3♀, 03.xi.2010, (CESC 36333/20); 6♀, 11.xi.2010, (CESC 37486/13); ♀, 11.xi.2010, (CESC 37546/03); 2♀, 2♂, 11.xi.2010, (CESC 37501/12); 2♀, 19.xi.2010, (CESC 37703/26); ♀, 26.xi.2010, (CESC 38162/16); ♀, 07.i.2011, (CESC 39963/16); ♀, 03.xi.2010, (CESC 36443/14); 2♀, 03.xi.2010, (CESC 36456/01); ♀, 03.xi.2010, (CESC 36468/10); 5♀, 11.xi.2010, (CESC 37605/11); ♂, 11.xi.2010, (CESC 37573/06); ♀, 11.xi.2010, (CESC 37597/13); ♀, 11.xi.2010, (CESC 37586/10); 2♀, 19.xi.2010, (CESC 39639/09); 2♀, 19.xi.2010, (CESC 37659/09); ♀, 26.xi.2010, (CESC 38261/07); ♀, 03.xii.2010, (CESC 38483/08); ♀, ♂, 03.xi.2010, (CESC 36179/07); 2♀, 11.xi.2010, (CESC 37305/06); 3♀, 19.xi.2010, (CESC 37866/07); ♀, 26.xi.2010, (CESC 37947/03); ♂, 10.xii.2010, (CESC 38311/09); ♀, 11.xi.2010, (CESC 37317/12); 2♀, 19.xi.2010, (CESC 37876/07); ♀, 26.xi.2010, (CESC 37960/05); ♀, 17.xii.2010, (CESC 38388/04); ♀, 03.xi.2010, (CESC 36198/14); ♀, 19.xi.2010, (CESC 37889/09); 2♀, 11.xi.2010, (CESC 37341/04); ♀, 03.xi.2010, (CESC 36232/09); 3♀, 11.xi.2010, (CESC 37350/05); ♀, 19.xi.2010, (CESC 37910/10); 2♀, 2♂, 11.xi.2010, (CESC 37366/06); 4♀, 19.xi.2010, (CESC 37923/10); ♀, 03.xii.2010, (CESC 38078/07); ♀, ♂, 03.xi.2010, (CESC 36245/09); 6♀, 11.xi.2010, (CESC 37380/16).

***Dendrocerus phallocrates* Dessart, 1987: BRASIL, Rio Grande do Sul, Passa Sete:** ♀, 18.ii.2010, (CESC 31337/10); ♀, 23.xii.2010, (CESC 30883/11); **Rio Grande do Sul, Santa Cruz do Sul:** ♀, 28.i.2009, (CESC 23048/17); ♀, 28.xii.2009, (CESC 31849/12); ♀, 03.i.2012, (CESC 50411/16); ♀, 06.iii.2012, (CESC 50411/16); ♀, 19.xi.2010, (CESC 37900/07).

***Dendrocerus riograndensis* Pezzini & Köhler, 2014: BRASIL, Rio Grande do Sul: Santa Cruz do Sul:** ♂, 16.xii.2011, (CESC 43364/20); ♂, 16.xii.2011, (CESC 43389/17); 2♂, 27.xii.2011, (CESC 45553/14); ♂, 03.i.2012, (CESC 46152/13); ♂, 10.i.2012, (CESC 46511/10); 2♂, 17.i.2012, (CESC 46916/16); ♂, 20.xii.2011, (CESC 44067/11).

The Megaspilidae fauna is still poorly known in the Neotropical region and more studies are necessary. Many species have information only from its description, with no subsequent reports. Aspects of biology are very restricted, only on cosmopolitan species information are published.

Although several species are reported in the literature only in one country location, it is probable they also occur in similar habitats in frontier countries. This work will help to study easier this family by providing information shared on the Neotropical species.

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