New genus and new species of spittlebugs (Hemiptera: Cercopidae) from the Philippines

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Abstract. The following new taxa are described from the Philippines: *Mioscarta nubisa* Crispolon & Soulier-Perkins sp. nov., *M. translucida* Crispolon & Yap sp. nov. and *Trigonoschema* Crispolon & Soulier-Perkins gen. nov. with three new species: *T. manoborum* Crispolon & Soulier-Perkins sp. nov. (as type species), *T. negrosensis* Crispolon & Yap sp. nov and *T. rubercella* Crispolon & Guilbert sp. nov. *Trigonoschema pallida* (Lallemand, 1927) comb. nov. is transferred from *Mioscarta* Breddin, 1901. Descriptions of male genitalia are illustrated and keys to species of Philippine *Mioscarta* and *Trigonoschema gen. nov.* are provided. Although phylogenetic results confirm the monophyly of all genera and *Trigonoschema* being a distinct genus from *Mioscarta*, relationships between genera remain uncertain. A checklist of the genera and species of Cercopidae found in the Philippines is included.

Key words. Auchenorrhyncha, Rhinaulacini, froghopper, Cicadomorpha, molecular phylogeny.
Introduction

Currently 18 genera of Cercopidae are known from the Philippines with 65 species and 9 subspecies (Table 1). Three genera and most of these species are endemic to the Philippines and are generally recorded throughout its three main geographical regions: Luzon, Visayas and Mindanao. Thirteen species cannot be precisely located on the archipelago since no exact locations were provided in the original descriptions (Soulier-Perkins 2020). Luzon constitutes a distinct centre of endemism (Vallejo 2014), which could explain the high number of Cercopidae found on the island. The Visayas is composed of many islands and is located in the central part of the archipelago. Out of the 65 species known, only six are recorded from the Visayan Islands, three in Samar, two in Negros and one in Panay. Of the three main islands, Mindanao is said to be the least explored (Crispolon et al. 2019), this is most likely why so few cercopids are recorded from it. With a more extensive exploration especially in the central and south geographical parts of the archipelago, we expect to discover more species. Some recent explorations on the main island Luzon, Negros and Mindanao, led us to find two new species for *Mioscarta* Breddin, 1901 and a new genus *Trigonoschema* Crispolon & Soulier-Perkins gen. nov. for which three species are described here. This brings to a total of four genera endemic to the Philippines and 70 for the number of cercopid species known for this archipelago (Table 1) with 87% endemicity (Soulier-Perkins 2020).

In order to ease the identification of *Mioscarta* and *Trigonoschema* gen. nov. species present in the Philippines, keys are provided and if possible the male terminalia are described and illustrated. Since we hypothesized that *Trigonoschema* gen. nov is sufficiently morphologically distinct from *Mioscarta*, to be described as a new genus, we tested the species for which we had molecular samples using molecular characters in Bayesian inference and Maximum likelihood reconstruction analyses. Lallemand (1949) and Lallemand & Synave (1961) provided a generic key for the family, which remains the only complete key available. Interactive keys, for the Cercopidae genera found in the Philippines and for the *Poeciloterpa* Stål, 1870 species can be accessed throughout the web page dedicated to keys (https://hemiptera-databases.org/cool/id_keys.php) in the database Cercopoidea Organized On Line (COOL). A key to the species of *Poeciloterpa* is also available in Crispolon et al. (2019).

Cercopids are generally not confined to one host and not bound to oligophagy (Soulier-Perkins & Le Cesne 2016). They feed on diverse host-plants such as pastures crops, sugarcane, eucalyptus, rice and maize in Africa, America (Mello et al. 1996; Holmam & Peck 2002; Thompson 2004; Carvalho & Webb 2005; Paladini et al. 2008; Bartlett et al. 2018; Thompson et al. 2020), China and Southeast Asia (Chen & Liang 2015, Su et al. 2018) and they are also associated with nitrogen-fixing angiosperm (Thompson 2004; Deitz et al. 2008). In the Philippines, Crispolon et al. (2019) have recorded new host-plants associated to species of *Poeciloterpa*. However, collectors often used light traps so, very little information on the natural history is available for the species of *Mioscarta* and *Trigonoschema* gen. nov. and their host plants, biology and other ecological data remain very limited.

Material and Methods

**Taxonomic study**

**Preparation of specimen for morphological observation**

For type and other material examined, when label citations cannot be reliably interpreted and formatted they are cited verbatim in double quotation marks: “ ”. When the label is interpreted the data is placed in square brackets: [ ] e.g., coordinates interpreted from a locality, or translations of foreign text.

The abdomen of each specimen examined was cut off and cleared for 20 minutes in hot (85°C) 10% KOH. Dissections and cleaning of genital structures were performed in distilled water. If needed, a few drops of blue paragon for dyeing the ectodermic genital ducts were added for a few minutes. Observations were done in glycerol using a Leica MZ16 stereo microscope on which a camera lucida is attached in
Table 1. Checklist of genera, species and subspecies found in the Philippines.

<table>
<thead>
<tr>
<th>Genera</th>
<th>Species and subspecies</th>
<th>Philippine Islands</th>
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</thead>
<tbody>
<tr>
<td>Cosmoscarta</td>
<td>C. consociata Distant, 1900</td>
<td>Main Island Luzon</td>
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<td></td>
<td>C. lateralis Jacobi, 1927</td>
<td>Samar Island</td>
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<td></td>
<td>C. nigroguttata Stål, 1870</td>
<td>Philippine Islands</td>
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<td></td>
<td>C. semimaculata Stål, 1870</td>
<td>Philippine Islands</td>
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<td></td>
<td>C. sexmaculata Stål, 1870</td>
<td>Philippine Islands</td>
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<td></td>
<td>C. sulakensis Distant, 1900</td>
<td>Sulu Islands</td>
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<td></td>
<td>C. whiteheadi Distant, 1900</td>
<td>Main Island Luzon</td>
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<tr>
<td>Ectemnonotum</td>
<td>E. luzonensis (Lallemand, 1931)</td>
<td>Luzon Islands</td>
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<tr>
<td>Eoscarta</td>
<td>E. borealis (Distant, 1878)</td>
<td>Main Island Mindanao</td>
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<td></td>
<td>E. philippinica Lallemand, 1949</td>
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<td>Euglobiceps</td>
<td>E. elongata Lallemand, 1923</td>
<td>Main Island Mindanao</td>
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<tr>
<td>Gynopygoplax</td>
<td>G. bicolor Lallemand, 1956</td>
<td>Mindoro Island</td>
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<td></td>
<td>G. daphne (Stål, 1865)</td>
<td>Luzon Islands</td>
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<td></td>
<td>G. inclusa Lallemand, 1922</td>
<td>Balabac Island</td>
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<td></td>
<td>G. inclusiformis Schmidt, 1911</td>
<td>Palawan Island</td>
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<td></td>
<td>G. luzonensis Schmidt, 1909</td>
<td>Luzon Islands</td>
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<td>G. meyeri Schmidt, 1909</td>
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<td></td>
<td>G. mounseyi Lallemand, 1927</td>
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<td></td>
<td>G. proserpina (White, 1845)</td>
<td>Luzon Islands</td>
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<td></td>
<td>G. proserpinella Schmidt, 1909</td>
<td>Luzon Islands</td>
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<td></td>
<td>G. theora (White, 1845)</td>
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<td>G. walkeri Metcalf, 1961</td>
<td>Luzon Islands</td>
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<tr>
<td>Homalostethus</td>
<td>H. dirce (Breddin, 1901)</td>
<td>Sulu Islands</td>
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<td></td>
<td>H. sangaris (Jacobi, 1905)</td>
<td>Luzon Islands</td>
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<td></td>
<td>H. spectabilis (Burmeister, 1834)</td>
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<tr>
<td>Jacobsoniella</td>
<td>J. bakeri Schmidt 1920</td>
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<tr>
<td>Leptataspis</td>
<td>L. bukidnona Lallemand 1923</td>
<td>Main Island Mindanao</td>
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<td>L. butuanensis Lallemand 1923</td>
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<td>L. insularis Lallemand 1927</td>
<td>Philippine Islands</td>
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<td></td>
<td>L. palawana Schmidt, 1911</td>
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<td></td>
<td>L. philippinensis Schmidt, 1920</td>
<td>Luzon Islands</td>
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<td></td>
<td>L. proserpinopsis Schmidt, 1911</td>
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<td></td>
<td>L. rotundata (Walker, 1858)</td>
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<td>L. rufipes Stål, 1870</td>
<td>Philippine Islands</td>
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<tr>
<td>Mioscarta</td>
<td>M. basilana Jacobi, 1927</td>
<td>Basilan Island</td>
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<tr>
<td></td>
<td>M. ferruginea (Walker, 1851)</td>
<td>Samar Island</td>
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<td></td>
<td>M. flavosalis Jacobi, 1927</td>
<td>Samar Island</td>
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<td></td>
<td>M. lutea Schmidt, 1925</td>
<td>Luzon Islands</td>
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<tr>
<td></td>
<td>M. nabisa Crispolon &amp; Soulier-Perkins sp. nov.</td>
<td>Main Island Luzon</td>
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<td></td>
<td>M. obscuripennis Schmidt, 1920</td>
<td>Main Island Luzon, Negros Island</td>
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<td></td>
<td>M. semperi Jacobi, 1905</td>
<td>Luzon Islands, Mindanao Islands</td>
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<td></td>
<td>M. translucida Crispolon &amp; Yap sp. nov.</td>
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<tr>
<td>Opistharsostethus</td>
<td>O. calypso Lallemand, 1923</td>
<td>Polillo Island</td>
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<tr>
<td>Oxymegaspis</td>
<td>O. izzardi Lallemand, 1954</td>
<td>Luzon Islands</td>
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<td></td>
<td>O. schultzei (Schmidt, 1931)</td>
<td>Luzon Islands</td>
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</table>
order to draw the terminalia. The photos of the habitus were taken using a stereo microscope Leica MZ16 with IC3D digital camera; final images were produced using Helicon 5.0 software. Schematic illustration of the head in frontal view (Fig. 1) for ocelli size and distance comparison and lateral view of the insect body for the pronotum angle (Fig. 2) were also done. Posterior wings of *Mioscarta* and *Poeciloterpa* were also illustrated (Fig. 3). Terminalia terminologies follow Soulier-Perkins & Kunz (2012) and Le Cesne *et al.* (2021). Specifically, the sterno-lateral plate often referred as the lateral plate for each newly described species, two authors are selected for the authorship: the first author followed alternatively by one of the three other authors.

<table>
<thead>
<tr>
<th>Paratrichoscarta Lallemand &amp; <em>P. carinata</em> (Stål, 1870)</th>
<th>Philippine Islands</th>
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<tr>
<td><em>P. cincta</em> Lallemand, 1923</td>
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<td><em>P. perspicillaris</em> (White, 1845)</td>
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<tr>
<td>– <em>P. p. dapitana</em> Lallemand 1923</td>
<td>Mindanao</td>
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<td>– <em>P. p. extensa</em> Lallemand, 1951</td>
<td>Mindanao Islands</td>
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<tr>
<td>– <em>P. p. flavopicta</em> Distant, 1900</td>
<td>Luzon Islands</td>
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<tr>
<td>– <em>P. p. iligana</em> Lallemand, 1923</td>
<td>Main Island Mindanao</td>
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<tr>
<td>– <em>P. p. montana</em> Schmidt, 1920</td>
<td>Luzon Islands</td>
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<tr>
<td>– <em>P. p. rubens</em> Lallemand, 1923</td>
<td>Main Island Luzon</td>
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<tr>
<td>– <em>P. p. sibuyana</em> Lallemand, 1951</td>
<td>Sibuyan Island</td>
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<td>– <em>P. p. variegata</em> Lallemand, 1951</td>
<td>Mindanao Islands</td>
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<tr>
<th>Poeciloterpa Stål 1870</th>
<th>Main Island Mindanao</th>
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<tr>
<td><em>P. alissima</em> Crispolon &amp; Soulier-Perkins, 2019</td>
<td>Negros Island</td>
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<td><em>P. atra</em> Jacobi, 1927</td>
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<tr>
<td><em>P. conica</em> Crispolon &amp; Soulier-Perkins, 2019</td>
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<tr>
<td><em>P. fusca</em> Lallemand 1927</td>
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<tr>
<td><em>P. gapudi</em> Crispolon &amp; Yap, 2019</td>
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<tr>
<td><em>P. latipennis</em> Schmidt, 1920</td>
<td>Main Island Mindanao</td>
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<tr>
<td><em>P. mangkas</em> Crispolon &amp; Yap, 2019</td>
<td>Main Island Luzon</td>
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<tr>
<td><em>P. minuta</em> Lallemand, 1922</td>
<td>Siargao Island</td>
</tr>
<tr>
<td><em>P. montana</em> Schmidt, 1927</td>
<td>Main Island Luzon</td>
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<tr>
<td><em>P. nigrolimbata</em> Stål 1870</td>
<td>Main Island Mindanao</td>
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<tr>
<td><em>P. obscura</em> Schmidt, 1927</td>
<td>Main Island Luzon</td>
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<tr>
<td><em>P. rufolimbata</em> Schmidt, 1927</td>
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<tr>
<td><em>P. unicolor</em> Lallemand, 1922</td>
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<tr>
<th>Radioscarta Lallemand, 1923</th>
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<tr>
<td><em>R. surigaona</em> Lallemand, 1923</td>
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<tr>
<td><em>S. charon</em> (White,1845)</td>
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<tr>
<td><em>S. philippinensis</em> Lallemand,1922</td>
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<tr>
<td><em>S. torquata</em> (Jacobi 1905)</td>
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<tr>
<td>Suracarta Schmidt, 1909</td>
<td>Main Island Mindanao</td>
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<tr>
<td><em>T. lutemaculata</em> Lallemand 1922</td>
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<tr>
<td>Trichoscarta Breddin, 1902</td>
<td>Philippine Islands</td>
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<tr>
<td><em>T. manoborum</em> Crispolon &amp; Soulier-Perkins sp. nov.</td>
<td>Negros Island</td>
</tr>
<tr>
<td><em>T. mangkas</em> Crispolon &amp; Yap sp. nov.</td>
<td>Main Island Mindanao</td>
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<tr>
<td><em>T. pallida</em> (Lallemand, 1927) comb. nov.</td>
<td>Negros Island</td>
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<tr>
<td><em>T. rubercella</em> Crispolon &amp; Guilbert sp. nov.</td>
<td>Negros Island</td>
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<tr>
<th>Trigonoschema Crispolon &amp; Soulier-Perkins gen. nov.</th>
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<tbody>
<tr>
<td><em>T. negrosensis</em> Crispolon &amp; Yap sp. nov.</td>
<td>Negros Island, Main Island Luzon</td>
</tr>
<tr>
<td><em>T. pallida</em> (Lallemand, 1927) comb. nov.</td>
<td>Philippine Islands</td>
</tr>
<tr>
<td><em>T. rubercella</em> Crispolon &amp; Guilbert sp. nov.</td>
<td>Negros Island</td>
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</table>
**Molecular study**

**Taxon and data sampling**

A phylogenetic analysis based on molecular characters is performed in order to check if its results support our decision to describe *Trigonoschema* gen. nov. as a new genus distinct from *Mioscarta*. This study includes 16 exemplars of Cercopidae as ingroup representing genera *Eoscarta* Breddin, 1902 (3), *Mioscarta* (3), *Trigonoschema* (3), *Poeciloterpa* (5), *Jacobsoniella* Melichar, 1914(1) and *Wawi* Soulier-Perkins & Le Cesne, 2016 (1) and 14 terminals as outgroup selected from Aphrophoridae, Clastopteridae and Machaerotidae. Genera included in the ingroup are supposed to be phylogenetically as close as possible to *Mioscarta* and *Trigonoschema* gen. nov. in order to test our hypothesis. We have selected genera that belong to the same tribe, Rhinaulacini: *Poeciloterpa*, *Eoscarta* from the Philippines and *Wawi* from Papua New Guinea. *Jacobsoniella* is found in the Philippines but in the actual classification it is incertae sedis concerning its tribe placement. However, the male terminalia for this genus present the same characteristic sterno-lateral plates observed in most Rhinaulacini genera. For this reason, we used it in our analysis, included in the ingroup.

Most specimens sampled were stored into 95–100% ethanol otherwise dry. DNA extractions were conducted using standard protocols for QIAamp DNA microkit (Qiagen) from disarticulated legs. Intact voucher specimens from which the disarticulated legs were extracted were mounted on pins and are deposited in the MNHN. PCR reactions, with negative controls included to detect contamination, were conducted in 25 μl volume using Taq DNA Polymerase, from Taq Core kit (Qiagen) under standard thermocycler protocols (for Histone 3, 18S and 28S: initial denaturation for 3 minutes at 94°C, then 35 cycles of 94°C for 30 seconds, 49–56°C for 40 seconds and 72°C for 1 minute, then a final extension step at 72°C for 10 minutes, and finally held at 10°C before being removed from the cycler. For CO1, the thermal cycling protocol are the following: initial denaturation for 3 minutes at 94°C; five cycles of 30 seconds at 94°C, 40 seconds at 47°C, and 1 minute at 72°C; 30 cycles of 30 seconds at 94°C, 40 seconds at 52°C, and 1 minute at 72°C; 10 minutes at 72°C; and finally held at 10°C) and using Oligonucleotide primers (Table 3) targeting four loci: CO1, Histone 3, 18S, and 28S.

Amplified DNA was visualized using 1–2% agarose gel electrophoresis with midori green staining. Sequence fragments were imported into codoncode aligner V.5.1.4. (CodonCode Corporation, Dedham, Massachusetts, USA) and trimmed to remove primer sequence. After sequence inspection, contiguous sequences were assembled and edited based on chromatograms to ensure the accuracy of base calls. In addition, insertions/deletions and checking of contaminations were confirmed for accuracy by using a reference sequence for comparison in BLAST ([https://blast.ncbi.nlm.nih.gov/Blast.cgi](https://blast.ncbi.nlm.nih.gov/Blast.cgi)). All sequence data are accessioned into GenBank (Table 4).

**Sequence alignment and Phylogenetic reconstruction**

Consensus sequences were imported to Phylosuite v1.2.2 ([Zhang et al. 2020](#)) and aligned using MAFFT (Katoh & Standley 2013) and MACSE ([Ranwez et al. 2011, 2018](#)). Nuclear protein coding genes (H3) were aligned with MAFFT program, using the FFT-NS-i algorithm. Ribosomal genes (18S and 28S) were aligned using MAFFT with algorithm E-INS-I (suitable for sequences with long unalignable regions). Mitochondrial protein coding genes (CO1) were aligned using MACSE.

For the combined analyses all sequence alignments were concatenated into a single data set using Phylosuite v1.2.2 ([Zhang et al. 2020](#)). The resulting data matrix consisted of 3575 bp of DNA nucleotide sequence data for 30 Cercopioidea specimens used as terminals. Phylogenetic reconstructions were conducted using maximum likelihood (ML) criteria ([Guindon et al. 2010](#)) and Bayesian inference (BI). Under all reconstructions method, gaps were treated as missing data. Partitioned analyses were conducted with Partition Finder ([Lanfear et al. 2012, 2016](#)). Best fitting model was searched using partition finder with following configuration: branchlengths = linked, models = all, model_selection
AICc and the search = greedy. Codon code mode was activated for CO1 before running the analysis. Results obtained with the corrected Akaike Information Criterion (AICc) (Guindon et al. 2010; Lanfear et al. 2012, 2016) indicated that GTR+G was best fitting model for Histone 3; TRNEF+I+G for 18S; GTR+I+G, TRN+I and HKY+I+G for each codon base for CO1 and GTR+I+G for 28S.

For ML analysis the results were then imported to IQ tree (Guindon et al. 2010; Minh et al. 2013; Nguyen et al. 2015; Hoang et al. 2018) for fast and effective stochastic algorithm to reconstruct phylogenetic trees. Partition mode was selected, “Models” argument will be ignored and models and thread were automatically set to auto. Maximum likelihood phylogeny were inferred under edge-linked partition model for 1000 standard bootstraps, as well as the Shimodaira-Hasegawa-like approximate likelihood-ratio test (SH_aLRT branch test) with 1000 replicates (Guindon et al. 2010; Minh et al. 2013; Nguyen et al. 2015; Hoang et al. 2018).

BI analysis was conducted with MrBayes version 3.1.2 (Huelsenbeck & Ronquist 2001; Ronquist & Huelsenbeck 2003) as implemented in CIPRES (Miller et al. 2010). Because MrBayes only allows a relatively small collection of models, models in the analyses were approximated using GTR+I+G (nst = 6) for DNA, or ‘wag’ for Protein (Guindon et al. 2010; Lanfear et al. 2012, 2016). The analysis coupled with Metropolis Coupled Markov Chain Monte Carlo (MCMCMC) was implemented. These analyses were conducted with six-gene partition implemented across two independent runs each with four chains run (one cold and three heated) for 20 million generations with 1000 sampling frequency. Burn in fraction value was set to 0.25 in which the initial 25% of sampled data were discarded as burn-in. The final posterior probability tree was calculated as a 50% majority-rule consensus tree (Huelsenbeck & Imennov 2002; Huelsenbeck et al. 2002). Clade support was evaluated by their posterior probabilities (BPP). The IQ Tree analysis tree and the Bayesian inference analysis tree were visualized with FIGTREE v1.1.3 (Rambaut 2016).

**Abbreviations used in text**

- ae = apical extension
- Cua = cubital anterior vein
- Cup = cubital posterior vein
- IP = intermediate plate
- m-cu = cross vein between Median and Cubital veins
- PCR = polymerase Chain Reaction
- pdp = postero-dorsal protrusion
- pp = posterior protrusion
- R = radial vein
- Ra = radial anterior vein
- Rp = Radial posterior vein
- SLP = sterno-lateral plate
- Sc = sub-costal vein

**Acronyms**

- ECpc = Elorde Crispolon personal collection
- MIZ = Museum and Institute of Zoology, Warszawa, Poland
- MNHN = Muséum national d’Histoire naturelle, Paris, France
- NHM = Natural History Museum, London, UK
- SMTD = Staatliches Museum für Tierkunde, Dresden, Germany
- UPLBMNH = University of the Philippines Los Baños Museum of Natural History, Philippines
Fig. 1. Head schematic representation with diameter of ocelli compared to distance between them and between ocellus and compound eye. 

A. *Mioscarta* Breddin, 1901.  
B. *Trigonoschema* Crispolon & Soulier-Perkins gen. nov.  
C. *Poeciloterpa* Stål, 1870.
Fig. 2. Schematic representation of the pronotum angle. A. *Mioscarta* Breddin, 1901. B. *Trigonoschema* Crispolon & Soulier-Perkins gen. nov. C. *Poeciloterpa* Stål, 1870.
Results

Taxonomy

Class Insecta Linnaeus, 1758
Order Hemiptera Linnaeus, 1758
Suborder Auchenorrhyncha Duméril, 1806
Infraorder Cicadomorpha Evans, 1946
Family Cercopidae Leach, 1815
Subfamily Cercopinae Oshanin, 1916
Tribe Rhinaulacini Kirkaldy 1906
Subtribe Poeciloterpina Schmidt, 1920

Genus Mioscarta Breddin, 1901

Mioscarta Breddin, 1901: 123 (new genus), 183 (Zoogeography).

Type species
Mioscarta forcipata Breddin, 1901.

Diagnosis

The genus can be identified by the following combination of characters:

Habitus general shape dorso-ventrally flattened, in lateral view total length nearly 4 times height (Figs 2, 4–11A). Pronotum angle not more than 25° (Figs 2, 4–11A). Distance between ocellus and compound eye 2 times ocellus diameter (Fig. 1A). Ocelli large, distance between eyes less than 8 times ocellus diameter (Fig. 1A). Apical reticulation of the tegmen generally developed and reduced in few cases (Figs 4–11A–C). Widest part of postclypeus in frontal view is at midheight (Fig. 1A). Apical curve of tegmen visible in dorsal view (Figs 4–11C). Widest part of habitus in dorsal view at midlength of tegmen (Figs 4–11C). Male subgenital plates is at least 1.5 times longer than pygofer height. Male subgenital plates appendage always present, longer than main plate (Figs 5, 7–8, 10–11F).

Among the Rhinaulacini, Mioscarta closely resembles Trigonoschema Crispolon & Soulier-Perkins gen. nov. with respect to the distance between ocelli, postclypeus shape in frontal view, postclypeus

![Fig. 3. Posterior wings. A. Mioscarta sp. B. Poeciloterpa sp.](image-url)
longitudinal groove, apical cells of the tegmen, Rp posterior wing, absence of r-m crossvein, and presence of sterno-lateral plate between subgenital plate and pygofer while Peociloterpa with respect to postclypeus longitudinal groove, absence of r-m crossvein, presence of sterno-lateral plate between subgenital plate and pygofer and paramere general shape, but they differ by the following characters presented in Table 2 below.

Distribution
India, Indonesia (Borneo, Flores and Sulawesi), Malaysia (Borneo), and Philippines.

Key to the species of Philippine Mioscarta Breddin, 1901

1. Tegmen containing red coloration (Figs 4–6, 10) ................................................................. 2
   – Tegmen without red coloration (Figs 7–9, 11) ........................................................................ 5
2. Basal third of tegmen yellowish (Figs 4, 10) ........................................................................... 3
   – Basal third of tegmen brown or reddish (Figs 5–6) .................................................................. 4
3. Narrow brown transverse band following basal third then tegmen getting darker and redder toward apex (Fig. 10) .................................................................................. M. semperi Jacobi, 1905
   – No narrow transverse band but a brown patch within basal area, a large reddish band underlines costal and apical margins (Fig. 4) .......................................................... M. basilana Jacobi, 1927
4. Basal third of tegmen reddish, rest of the tegmen darker brown with red underlining veins (Fig. 5) ........................................................................................................ M. ferruginea (Walker, 1851)
   – Tegmen with basal third brown getting lighter in second third and slightly darker in last apical third with red underlining veins (Fig. 6) ............................................................. M. lutea Schmidt, 1925
5. Tegmen coloration containing some black (Figs 8–9) ............................................................. 6
   – Tegmen coloration from yellowish to brown only (Figs 7, 11) ................................................. 7
6. Tegmen entirely black except for the very orange base (Figs 8–9) M. obscuripennis Schmidt, 1920
   – Tegmen basally yellowish brown and apically black ......................................................... M. flavobasalis Jacobi, 1927
7. Tegmen brownish and opaque, darker toward apex, pronotum brownish (Fig. 7) .................
   – Tegmen yellow with some brown and translucent parts, pronotum yellowish with darker irregular patch in middle (Fig. 11) .......................................................... M. translucida Crispolon & Yap sp. nov.

Mioscarta basilana Jacobi, 1927
Fig. 4


Material examined
PHILIPPINES • 3α ♀; “Island of Basilan Baker”; “1926”; “Typus”; “coll. A. Jacobi”, “basilana Jac.”, “Museum für Tierkunde Dresden (MTD)”; SMTD.

Distribution
Philippines: Mindanao: Basilan.

Remarks
The description provided by Jacobi (1927) was based on four females. Here we provide photographs of a female syntype and its labels. Male remains unknown.
Mioscarta ferruginea (Walker, 1851)

Fig. 5

Triecphora ferruginea Walker, 1851: 672.

Cercopis ferruginea – Stål 1870: 721.

Eoscarta ferruginea – Distant 1908: 132.

Mioscarta ferruginea – Lallemand 1912: 299.

Material examined


Fig. 4. Mioscarta basilana Jacobi, 1927 ♀ syntype habitus. A. Lateral view. B. Frontal view. C. Dorsal view. D. Labels.
CRISPOLON E. Jr. S. et al., New genus and new species of spittlebugs from the Philippines

Table 2. Character diagnosis for the three closely related genera from the Philippines.

<table>
<thead>
<tr>
<th>No.</th>
<th>Characters</th>
<th>Mioscarta</th>
<th>Poeciloterpa</th>
<th>Trigonoschema gen. nov.</th>
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<tr>
<td>1</td>
<td>Habitus general shape in lateral view</td>
<td>dorso-ventrally flattened, total length nearly 4 times height (Figs 2, 4–11A)</td>
<td>globulous, total length around 2.5 times height (Fig. 2C)</td>
<td>not dorso-ventrally flattened, in lateral view total length around 3 times height (Figs 2, 12–16B)</td>
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<td>2</td>
<td>Total length of the specimen</td>
<td>8 mm – 11 mm</td>
<td>not exceeding 8 mm</td>
<td>9.5 mm – 12.5 mm</td>
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<td>3</td>
<td>Pronotum angle</td>
<td>not more than 25° (Figs 2, 4–11A).</td>
<td>42° (Fig. 2C)</td>
<td>around 45° (Figs 2B, 12–16A)</td>
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<td>4</td>
<td>Distance between ocellus and compound eye</td>
<td>2 times ocellus diameter (Fig. 1A)</td>
<td>6 times ocellus diameter (Fig. 1C)</td>
<td>less than 4 times ocellus diameter (Fig. 1B)</td>
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<tr>
<td>5</td>
<td>Distance between ocelli</td>
<td>1.5 ocellus diameter (Fig. 1A)</td>
<td>at least 2 times ocellus diameter (Fig. 1C)</td>
<td>1.5 ocellus diameter (Fig. 1B)</td>
</tr>
<tr>
<td>6</td>
<td>Size of ocelli evaluated according to the distance</td>
<td>large, distance between eyes less than 8 times ocellus diameter (Fig. 1A)</td>
<td>very small, distance between eyes 16 times ocellus diameter (Fig. 1C)</td>
<td>small, distance between eyes 9-10.5 times ocellus diameter (Fig. 1B)</td>
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<td>7</td>
<td>Postclypeus shape in frontal view</td>
<td>ovoid (Fig. 1A)</td>
<td>compressed laterally with lateral sides almost straight (Fig. 1C)</td>
<td>ovoid (Fig. 1B)</td>
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<tr>
<td>8</td>
<td>Widest part of postclypeus in frontal view</td>
<td>mid height (Fig. 1A)</td>
<td>close to frons (Fig. 1C)</td>
<td>close to frons (Fig. 1B)</td>
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<tr>
<td>9</td>
<td>Apical reticulation of the tegmen</td>
<td>generally developed and reduced in few cases (Figs 4–11A, C)</td>
<td>reduced</td>
<td>reduced (Figs 12–16A, C)</td>
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<td>10</td>
<td>Apical curve of tegmen in dorsal view</td>
<td>visible (Figs 4–11C)</td>
<td>rarely visible</td>
<td>rarely visible (Figs 12–16C)</td>
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<tr>
<td>11</td>
<td>Widest part of habitus</td>
<td>midlength of tegmen (Figs 4–11C)</td>
<td>before midlength of tegmen (Figs 12–16C)</td>
<td>before midlength of tegmen (Figs 12–16C)</td>
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<td>12</td>
<td>Apical cells of the tegmen</td>
<td>not concave (Figs 4–11A, C)</td>
<td>not concave</td>
<td>not concave (Figs 12–16 A, C)</td>
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<td>13</td>
<td>Rp posterior wing</td>
<td>Rp separating from SC+Ra nearly at midlength (Fig. 3A)</td>
<td>Rp separating from SC+Ra after midlength and making a strong bend after separating from SC+ Ra (Fig. 3B)</td>
<td>Rp separating from SC+Ra nearly at midlength, (Fig. 3A (Fig. 13E))</td>
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<td>14</td>
<td>Subgenital plates length</td>
<td>at least 1.5 times longer than pygofer height (Figs 5, 7–8, 10–11F).</td>
<td>slightly longer than pygofer height</td>
<td>clearly shorter than 1.5 times longer than pygofer height (Figs 12, 14, 16F)</td>
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<tr>
<td>15</td>
<td>Subgenital plates fine appendage</td>
<td>always present, longer than the main plate (Figs 5, 7–8, 10–11F).</td>
<td>generally absent, if present shorter than the main plate</td>
<td>generally present but shorter than the main plate (Figs 12, 14 &amp; 16F)</td>
</tr>
<tr>
<td>16</td>
<td>Paramere general shape</td>
<td>not globose and without protrusion on lateral side (Figs 5, 7–8, 10–11G).</td>
<td>not globose and without protrusion on lateral side</td>
<td>globose with protrusion on lateral side (Figs 12, 14, 16G).</td>
</tr>
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</table>

Description

Male Terminalia
In lateral view, posterior margin of pygofer slightly undulating (Fig. 5E). Subgenital plate (Fig. 5F) very long relative to height of pygofer with fine tapering appendage slightly longer than main plate, dorsal margin of plate largely rounded, sterno-lateral plate present, largely concave subapically on dorsal and ventral margins. Intermediate plate present, rectangular, linking internal side of lateral and subgenital plates. Paramere (Fig. 5G) not globose, dorsal margin rounded and regularly curving, apex with a sharp spine pointing dorsally, ventral margin regularly rounded with subapical part bearing a spiniform process pointing ventrally. Aedeagus (Fig. 5H) with basal third of dorsal margin angled and sharply bent in acute angle and last 2/3 vertical and roughly C-shaped, slightly humped in apical part of dorsal margin before apical extension, apical extension pointing postero-dorsally, posterior protrusion thin and hook-shaped, postero-dorsal protrusion absent.

Type Locality
Philippines: Visayas: Samar.

Distribution
Philippines: Luzon Island, Visayas: Samar and Leyte, Mindanao Island.

Remarks
Walker (1851) based his description on two male specimens “a” and “b” from the “Philippine Islands” coming from the collections of Mr Cuming and Mr Wood. Both specimens are currently kept in the NHM. According to Walker’ description and Lallemand’ key (1949), we identified specimens, for which we provide photographs and male terminalia description and drawings.

Mioscarta lutea Schmidt, 1925

Fig. 6

Mioscarta lutea Schmidt, 1925: 36.


Type Locality
Philippines: Luzon: Baguio, Benguet province.

Distribution
Philippines: Luzon Island.

Remarks
Schmidt (1925) described this species based on a single female specimen. Therefore, the description does not contain any information on the male terminalia. Here, we provide photographs of the female holotype and labels. Male remains unknown.
**Mioscarta nubisa** Crispolon & Soulier-Perkins sp. nov.

urn:lsid:zoobank.org:act:17979C2C-D071-44EA-9D16-974A742808A1

Fig. 7

**Diagnosis**

General shape of *M. nubisa* is similar to *M. obscuripennis* but are distinctly different in color. *M. nubisa* in dorsal view presents a brownish and opaque tegmen, darker toward apex, pronotum brownish and yellowish or brown legs while *M. obscuripennis* has a dark brown or black tegmen, brown or orange pronotum and orange legs.

**Etymology**

Species name refers to the light to darker coloration forming a cloudy pattern on the tegmen and is the female superlative of the latin word “nubis” which means cloudy.

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**Fig. 6.** *Mioscarta lutea* Schmidt, 1925, ♀ holotype habitus. A. Lateral view. B. Frontal view. C. Dorsal view. D. Labels.
Material examined

Holotype

Paratypes

Description

Body. Length 10 mm (tegmina included), width 5 mm.

Head (Figs 1A, 7B). In dorsal view, large ocelli, distance between eyes less than 8 times ocellus diameter, distance between ocelli equals one ocellus diameter, distance between ocellus and compound eye 2 times ocellus diameter, ocelli closer to each other than from compound eyes. Eyes not prominent, length 1.44 times than wide. Vertex and frons longitudinal median carina absent. Vertex slightly longer than wide with 3 times ocellus diameter in between two vertex grooves outside ocelli and 3.5 times ocellus diameter between anterior and posterior vertex margins. Postclypeus with longitudinal furrow, slightly swollen and ovoid shape in frontal view, widest part at mid height (Figs 1A, 7B), not receding and prior to anteclypeus where it bends forming obtuse angle in lateral view (Fig. 7A). Rostrum long, reaching but not surpassing mesocoxae. Thorax (Figs 2A, 7A–C). In dorsal view, pronotum with anterior concavities on each side, anterior margin of pronotum as wide as posterior margin of head including eyes, anterolateral margin curved, posterior margin grooved, postero-lateral margin slightly concave, longer than anterior margin, humeral angle rounded. In lateral view, pronotum curving not more than 25º (Figs 2, 7A). Scutellum as long as wide with large median dimple (Fig. 7C). Tegmen (Fig. 7A–C). R bifurcates on apical half, M bifurcate on basal third, apical reticulation well developed without concave apical cells. Posterior wing (Fig. 3A), Rp separating from SC+Ra nearly at midlength, M reaches ambient vein, Cua and Cup fused at base and m-cu links M to Cua before Cua bifurcation, common base for Cup and Cua originate at base of wing, posterior wing with 7 longitudinal veins and 5 apical cells between SC+Ra and Cup, angular protrusion of costal margin near its base present. Metafemur with apical spine in inner margin, metatibiae bearing 1 lateral spine.

Male terminalia. In lateral view, posterior margin of pygofer largely convex in middle with slight curved on last third (Fig. 7E). Subgenital plates (Fig. 7F) very long relative to height of pygofer with fine tapering appendage longer than main plate, dorsal and ventral margin of main plate straight, sterno-lateral plate present, slightly elongated. Intermediate plate present, elongated, roughly oblong shaped, linking internal sides of lateral and subgenital plates. Paramere (Fig. 7G) not globose, dorsal margin convex and regularly curving finishing by a sharp process pointing dorsally, ventral margin convex and largely angled subapically, apex with spiniform process pointing postero-ventrally. Aedeagus (Fig. 7H) with basal third of dorsal margin regularly bent without angle before the bent part, last 2/3 vertical and S-shaped, ventral margin regularly curved, apical extension pointing posteriorly, posterior protrusion axe-shaped with edge prolonged ventrally by a straight, long and thin extension, postero-dorsal protrusion absent.
Fig. 7. *Mioscarta nubisa* Crispolon & Soulier-Perkins sp. nov. holotype, habitus and ♂ terminalia in lateral view. **A.** Lateral view. **B.** Frontal view. **C.** Dorsal view. **D.** Labels. **E.** Terminalia. **F.** Sterno-lateral, intermediate and subgenital plates. **G.** Paramere. **H.** Aedeagus.
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Table 3. Primers used for amplifying and sequencing the molecular markers.

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**Histone 3**

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<td>HexAR (R)</td>
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</table>

**COLOR.** Head, antennae, pronotum, abdomen, legs scutellum light brown, rostrum brownish highlighted with white. Tegmen opaque light brown to brown.

**Type locality**

Philippines: Camarines Sur, Luzon isl. Mt Isarog Natural Park, Panicuason Naga.

**Distribution**

Philippines: Luzon Island.

*Mioscarta obscuripennis* Schmidt, 1920

Figs 8–9

*Mioscarta obscuripennis* Schmidt, 1920: 47.


**Material examined**


Fig. 9. Mioscarta obscuripennis Schmidt, 1920, ♂ holotype habitus. A. Lateral view. B. Frontal view. C. Dorsal view. D. Labels E.
Table 4. Taxa included in the phylogeny with their voucher code, geographical origin and GenBank accession number for each marker used. *Isolates; †From GenBank; – Indicating absence of sequence.

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</table>

Description

Male terminalia. In lateral view, posterior margin of pygofer hump shaped in middle, last third abruptly truncated (Fig. 8E). Subgenital plates (Fig. 8F) very long relative to height of pygofer with fine tapering appendage longer than main plate, dorsal margin regularly convex and slightly curving on basal part, ventral margin roughly straight. Sterno-lateral plate present and roughly bean-shaped. Intermediate plate present, square shaped with a corner truncated, linking internal sides of lateral plate and subgenital plate. Paramere (Fig. 8G) dorsal margin rounded then regularly curving up to apex. Lateral margin with spine located subapically pointing dorsally, ventral margin rounded then sharply angled subapically pointing ventrally, apex without any spines. Aedeagus (Fig. 8H) with basal third of dorsal margin regularly bent, basal half enlarged then largely narrowed in the middle and gradually enlarging up to apex, roughly C-shaped, ventral margin regularly curved, apical extension pointing posteriorly, posterior protrusion axe-shaped with long thin extension prolonging the edge ventrally and slightly curving, postero-dorsal protrusion absent.

Type Locality

Philippines: Luzon: Mount Banahao, Quezon Province.

Distribution

Philippines: Luzon Island, Baguio, Quezon province, Mountain province; Visayas, Negros Island.

Remarks

Schmidt (1920) described this species from a single male specimen with few details on the male terminalia. Here, we provide, a detailed illustration and description of male terminalia from identified specimens using Schmidt description (Fig. 8), along with photographs of the male holotype and its labels (Fig. 9). The coloration of the specimen we identified and the holotype are different but the specimen from which we illustrated the male terminalia (Fig. 8) has a brighter coloration and is the closest to the description given by Schmidt while the holotype has a faded coloration.

Mioscarta semperi Jacobi, 1905

Fig. 10


Material examined

PHILIPPINES • ♂; “Samar Calbayog Elev. – Sea level; 8 May 1950; R. Araneta Jr.”, “Eoscarta sp. Bal ’53” “UPLBMNH HEM-04054” • ♂; “Calambog Ala Valley Elev.; 8 June 1950 S. Mendaña”

Description

MALE TERMINALIA. In lateral view, posterior margin of pygofer regularly convex last third slightly curved (Fig. 10E). Subgenital plates (Fig. 10F) very long relative to height of pygofer with fine tapering appendage slightly longer than main plate, dorsal margin of plate regularly rounded, ventral margin straight. Sterno-lateral plate present, slightly elongated. Intermediate plate present, cylindrical, linking internal side of lateral and subgenital plates. Paramere (Fig. 10G) not globose, dorsal margin rounded and regularly curving, apex with a sharp spine pointing antero-dorsally, ventral margin regularly rounded then subapical part largely rounded, protruding and finishing with a sharp spine pointing ventrally. Aedeagus (Fig. 10H) with basal third of dorsal margin angled and sharply bent in acute angle and last 2/3 vertical and roughly C-shaped, slightly humped in apical part of dorsal margin before apical extension, apical extension pointing posteriorly, posterior protrusion thin very short and spine-shaped, postero-dorsal protrusion absent.

Type Locality

Philippines: Philippine Islands.

Distribution

Philippines: Luzon, Visayas and Mindanao Islands.

Remarks

According to what Jacobi (1905) mentioned at the end of the description “Mus. Berol. Nr. 9107: Semper coll., 2 Ex.”. He examined two specimens and described this species from at least one female without a description of the male terminalia. We illustrate and describe them here based on a specimen identified using Lallemand’s (1949) key.

*Mioscarta translucida* Crispolon & Yap sp. nov.

urn:lsid:zoobank.org:act:7D16117A-699D-4C7E-B037-E290B274EA8C

Fig. 11

Diagnosis

*M. translucida* is the only species with tegmen translucid without any other coloration.

Etymology

The species name refers to the translucid tegmen and is based on the latin word “translucidus” which means allowing light to pass through.
Material examined

Holotype

Description

Body. Length 10 mm (tegmina included), width 4 mm.

Head (Figs 1A, 11B). In dorsal view, large ocelli, distance between eyes less than 8 times ocellus diameter, distance between ocelli equals one ocellus diameter, distance between ocellus and the compound eye 2 times ocellus diameter, ocelli closer to each other than from compound eyes. Eyes not prominent, length 1.44 times than wide. Vertex and frons longitudinal median carina absent. Vertex as long as wide with 3 times ocellus diameter in between two vertex grooves outside ocelli and 3 times ocellus diameter between anterior and posterior vertex margins. Postclypeus with longitudinal furrow, slightly swollen and ovoid shape in frontal view, widest part at mid height (Figs 1A, 11B), not receding and prior to anteclypeus where it bends forming right angle in lateral view (Fig. 11A). Rostrum long, surpassing mesocoxae. Thorax (Figs 2A, 11A-C). In dorsal view, pronotum with anterior concavities on each side, anterior margin as wide as posterior margin of head including eyes, anterolateral margins curved, posterior margin grooved, postero-lateral margins slightly concave, longer than anterolateral margins, humeral angle rounded. In lateral view, pronotum curving not more than 25º (Figs 2, 11A) Scutellum as long as wide with large median dimple (Fig. 11C). Tegmen (Fig. 11A–C). R bifurcates on apical half, M bifurcate on basal third, apical reticulation not well developed without concave apical cells. Posterior wing (Fig. 3A). Rp separating from SC+Ra nearly at midlength, M reaches ambient vein, Cua and Cup fused at base and m-cu links M to Cua before Cua bifurcation, common base for Cup and Cua originate at base of wing, 7 longitudinal veins and 5 apical cells between SC+Ra and Cup, angular protrusion of costal margin near its base. Metafemur with apical spine in inner margin, metatibiae bearing 1 lateral spine.

Male terminalia. In lateral view, posterior margin of pygofer slightly undulating in the middle with slight curved on the last third (Fig. 11E). Subgenital plates (Fig. 11F) dorsal and ventral margin of main plate roughly straight, sterno-lateral plate present, slightly elongated, intermediate plate present, elongated slightly triangular shaped, linking internal sides of lateral and subgenital plates. Paramere (Fig. 11G) not globose, dorsal margin convex and regularly curving finishing with rounded apex with very minute groove, ventral margin convex, apex with spiniform process pointing antero-ventrally. Dorsal and ventral margins of aedeagus undulating. Aedeagus (Fig. 11H) with basal third of dorsal margin regularly bent without angle before the bent part and last 2/3 vertical and S-shaped, ventral margin regularly curved then slightly concaved before the base, apical extension sharp pointing postero-ventrally, posterior protrusion sharp at the apex hook-shaped, postero-dorsal protrusion absent.

Color. Head and pronotum brown with yellow patches, rostrum yellowish white, pedicel of antenna brown, legs yellowish and abdomen light brown. Tegmen partially translucid, opaque parts being yellowish with darker patches.

Type Locality
Philippines: Luzon, Camarines Sur, Mount Isarog Natural Park.

Distribution
Philippines: Luzon Island.
CRISPOLON E. Jr. S. et al., New genus and new species of spittlebugs from the Philippines

Remarks
The exact length of subgenital plate relative to height of pygofer is not provided because part of the appendage is damaged.

Trigonoschema Crispolon & Soulier-Perkins gen. nov.
urn:lsid:zoobank.org:act:C8299091-60D3-49B4-852F-2145956D7FE9
Figs 12–16

Type species
Trigonoschema manoborum sp. nov. here designated.

Diagnosis
In dorsal view, teardrop shaped and apex of tegmen not visible due to folding. In lateral view, very steeply declivous pronotum and crown of the head, nearly form a right angle with the rest of the dorsum in profile.

Etymology
When observed in dorsal view, the general shape of the habitus fits in a triangle even if a closer observation would lead to describe it as teardrop shaped. The name is built using two Greek words “trigonos” for triangular and “schema” for shape. It is neutral.

Description
Body. Length 9.5–12.5 mm (tegmen included), width 4–5 mm.

General shape. Not dorso-ventrally flattened, in lateral view total length around 3 times height (Figs 2B, 12–16A). Ocelli small, distance between eyes 9–10.5 times ocellus diameter (Figs 1, 12–16B). Distance between ocellus and compound eye less than 4 times ocellus diameter (Figs 1, 12–16B). Distance between ocelli 1.5 ocellus diameter (Figs 1, 12–16B). Postclypeus with longitudinal furrow, swollen laterally and slightly ovoid shape in frontal view, widest part close to frons, not receding and prior to anteclypeus where it bends rounded in lateral view, with wide longitudinal furrow (Figs 1, 12–16B). Pronotum curving around 45° angle (Figs 2B, 12–16A). Tegmen translucid without concave apical cells. Apical curve of tegmen rarely visible in dorsal view, tegmen folded in such a way that widest part of habitus is before midlength of tegmen (Figs 12–16C).

Male terminalia. Subgenital plates without fine appendage (Fig. 12F), if present shorter than main plate, not forming an acute angle shape with the main plate (Figs 14, 16F). Paramere globose, lateral margin of paramere with protrusion, on the ventral margin on the sub apex with angular protrusion ornamented with set of setae (Figs 12, 14, 16G). Pp of aedeagus thick and beak-like shape (Figs 12, 14, 16H).

Distribution
Philippines.

Key to the species of Philippine Trigonoschema gen. nov.
1. Most of vertex and frons bright yellow and postclypeus orange (Figs 12–13)..........................
   ................................................................................................................Trigonoschema manoborum Crispolon & Soulier-Perkins sp. nov.
   - Vertex, frons and postclypeus of the same color that can be brown, orange or red (Figs 14–16).... 2
2. Red band running across base of tegmen and scutellum (Fig. 16)...........................
   ................................................................................................................Trigonoschema rubercella Crispolon & Guilbert sp. nov.
No red band visible in dorsal view (Figs 12–13)................................................................. 3
3. Scutellum yellow (Fig. 14)...............................................................................................T. negrosensis Crispolon & Yap sp. nov.
   – Scutellum brown (Fig. 15).......................................................................................... T. pallida (Lallemand, 1927) comb. nov.

**Trigonoschema manoborum** Crispolon & Soulier-Perkins gen. et sp. nov.
Figs 12–13

**Diagnosis**
Tegmen, white in basal $\frac{1}{4}$ with orange marking on the basal half of the margin of the clavus. Scutellum orange with yellowish white coloration in middle. Most of vertex and frons bright yellow and postclypeus dull orange for male and bright orange for female.

**Etymology**
Manoborum, genitive plural made from Manobos. The Manobo tribe is found in Bongolanon, Magpet, North Cotabato.

**Material examined**

**Holotype**
PHILIPPINES • ♂; “Philippines, Mt. Apo, Bongolanon, Magpet N. Cotabato”; “5 May 2018; Daniela Alcalde”; “holotype”, “séquençage par Elorde Crispolon C-00148”, “Muséum Paris, MNHN (EH) 24871”; MNHN.

**Paratype**
PHILIPPINES • ♀; “PH. MT. APO, Bongolanon, Magpet, Cot, Mindanao, 17 Dec. 2015, ES Crispolon” “séquençage par Elorde Crispolon C-00078” “UPLBMNH HEM-05054”; UPLBMNH.

**Description**

**Body length.** 10.5 mm (tegmina included), width 4 mm.

**Head** (Figs 1, 12–13B). In dorsal view, ocelli small, distance between eyes 10.5 times ocellus diameter (Figs 1, 12–13B). Distance between ocellus and compound eye less than 3.5 times ocellus diameter ((Figs 1, 12–13B). Distance between ocelli 1.5 ocellus diameter (Figs 1, 12–13B). Eyes not prominent, length 1.15 times than wide. Vertex with longitudinal short median carina, slightly longer than wide. Frons without any carina. Postclypeus with dimple below margin of frons and a longitudinal furrow clearly marked in male, swollen laterally and slightly ovoid shape in frontal view, widest part close to frons, not receding and prior to anteclypeus where it bends rounded in lateral view (Figs 1B, 12–13A). Rostrum long, reaching but not surpassing mesocoxae. Thorax (Figs 2B, 12–13A–C). In dorsal view, pronotum with anterior deep concavities on each side, much clearly marked in female, longitudinal median carina absent. Anterior margin of pronotum as wide as posterior margin of head including eyes, anterolateral margins curved, posterior margin grooved, postero-lateral margins slightly concave, slightly longer than anterolateral margins, humeral angle rounded. In lateral view, pronotum angle around 45º (Figs 2B, 12–13A), scutellum as long as wide with large median dimple (Figs 12–13C). Tegmen (Figs 12–13A–C). R bifurcates on apical half, M bifurcate on basal third, apical reticulation not well developed without concave apical cells. Posterior wing (Fig. 13E). $\frac{3}{4}$ of M length alone then fuses with Rp before reaching ambient vein, 6 longitudinal veins on posterior wing reaching apex, four apical cells between SC+Ra and Cup, angular projection near base of costal margin present. Legs. Metafemur with apical spine in inner margin, metatibiae bearing 1 lateral spine.

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MALE TERMINALIA. In lateral view, posterior margin of pygofer (Fig. 12E) largely convex in middle getting concave in last third and presenting a bump in first third. Subgenital plates (Fig. 12F) with equal length relative to height of pygofer without any appendage, regularly tapering towards apex, dorsal margin straight then curving up towards apex, ventral margin straight half its length then regularly curving dorsally, minute denticuli covering last quarter toward apex. Sterno-lateral plate present,

slightly elongated. Intermediate plates present, elongated and linked with internal sides of lateral plate and subgenital plate. Paramere (Fig. 12G) globose, dorsal margin convex then curving regularly and finishing with a sharp spine pointed antero dorsally, lateral margin with process in middle part pointing postero-dorsally, ventral margin regularly rounded with subapical part largely protruding posteriorly then finishing with a sharp spine pointing ventrally. Aedeagus (Fig. 12H) with dorsal margin slightly humped at base then concave most its length, curving regularly half its length vertically and finishing ¼ its length convex in a C-shaped, apical extension pointing posteriorly, posterior protrusion thick, duck head shaped with minute denticuli along posterior margin, in posterior view basal half lobular (Fig. 12I), postero-dorsal protrusion absent.

**Color.** Head, and pronotum white-yellowish with orange markings, postclypeus, rostrum, abdomen and legs orange, pedicel of antennae yellowish brown, scutellum orange with yellowish white markings medially. Tegmen, translucid yellowish white, white in basal ¼ with orange marking in between white and on the basal half of the margin of the clavus, last ¼ yellowish getting yellowish brown in apical fourth.

**Type Locality**
Philippines, Mt. Apo, Bongolanon, Magpet North Cotabato.

**Distribution**
Philippines: Mindanao Island.

*Trigonoschema negrosensis* Crispolon & Yap gen. et sp. nov.
urn:lsid:zoobank.org:act:BFF10DEF-C172-4861-A9AE-81AA8B88657B

**Diagnosis**
In general shape, *T. negrosensis* is similar to *T. rubercella* but their coloration is distinctly different. *T. negrosensis* in dorsal view presents a dirty yellow pronotum followed by a light orange scutellum framed by yellow irregular patches on clavus of tegmen while *T. rubercella* presents a bright yellow pronotum followed by a red band running on basal parts of tegmen and across scutellum.

**Etymology**
The species is named after the island where it was found: Negros.

**Material examined**

**Holotype**
PHILIPPINES • ♂; “Philippines, Negros volcán Canlaon, champ de coqs; 10º25'29" N, 123º05.23" E”; “Muséum Paris, Piège lumineux, 932 m; 28 Oct. 2010; A. Soulier-Perkins rec.”, “UPLBMNH HEM-05055”; UPLBMNH.

**Paratypes**
Fig. 14. Trigonoschema negrosensis Crispolon & Yap sp. nov., holotype, habitus and ♂ terminalia in lateral view. 

Description

**Body.** Length 11–12.5 mm ( tegmina included), width 4–5 mm.

**Head** (Figs 1, 14B). In dorsal view, ocelli small, distance between eyes 9.5 times ocellus diameter (Figs 1, 14B). Distance between ocellus and compound eye less than 3 times ocellus diameter (Figs 1, 14B). Distance between ocelli 1.5 ocellus diameter (Figs 1, 14B). Eyes not prominent, length 1.33 times than wide. Vertex with longitudinal median carina, as long as wide. Frons without median carina. Postclypeus with dimple below margin of frons and a longitudinal furrow clearly marked in males, swollen laterally and slightly ovoid shape in frontal view, widest part close to frons, not receding and prior to anteclypeus where it bends rounded in lateral view (Figs 1B, 14A). Rostrum long, reaching but not surpassing mesocoxae. Thorax (Figs 2B, 14A–C). In dorsal view, pronotum with anterior deep concavities on each side, much clearly marked in female, longitudinal median carina absent. Anterior margin of pronotum as wide as posterior margin of head including eyes, anterolateral margins curved, posterior margin grooved, postero-lateral margins slightly concave, slightly longer than anterolateral margins, humeral angle rounded. In lateral view, pronotum angle around 45º (Figs 2B, 14A). Scutellum as long as wide with large median dimple (Fig. 14C). Tegmen (Fig. 14A, C). R bifurcates on apical half, M bifurcate in inner margin, metatibiae bearing 1 lateral spine.

**Male terminalia.** In lateral view, posterior margin of pygofer (Fig. 14E) convex in middle and clearly concave on last third. Subgenital plates (Fig. 14F) slightly longer relative to height of pygofer with fine appendage smaller forming acute angle with main plate, dorsal and ventral margin of main plate roughly straight. Stero-lateral plate present and slightly elongated. Intermediate plates present, boomerang-shaped, linking internal sides of lateral plate and subgenital plate. Paramere (Fig. 14G) globose, dorsal margin convex then curving regularly and finishing with a sharp spine pointed antero-dorsally, lateral margin with process in middle part pointing dorsally, ventral margin regularly rounded with subapical part largely protruding posteriorly then finishing with two sharp spines pointing postero-ventrally. Aedeagus (Fig. 14H) with basal fourth almost straight then bending vertically and slightly wave-shape up to postero-dorsal protrusion, apical extension pointing dorsally, posterior protrusion thick, beak-shaped, in posterior view, very slim at the top and petal shaped and foliaceous toward the base (Fig. 14I), postero-dorsal protrusion present.

**Color.** Head including postclypeus and rostrum, legs and abdomen orange, pronotum orange white anterior half, greenish on apical part, scutellum greenish white with orange coloration, antennal scape and pedicel
orange, flagellum with brown coloration. Tegmen translucid yellow, basal third with white coloration in costal margin and clavus and with orange coloration in between white coloration, last $\frac{2}{3}$ yellowish brown.

**Type Locality**
Philippines: Visayas, Negros Occidental, Mount Kanlaon.

**Distribution**
Philippines, Visayas, Negros Island; Luzon Island.

*Trigonoschema pallida* (Lallemand, 1927) comb. nov.

*Fig. 15*


**Distribution**
Philippines: Philippine Islands.

**Remarks**
Lallemand in 1927 described this species based on the pattern of coloration and placed it in *Mioscarta*. He mentioned only a single male specimen (holotype), however, in the collection it is labelled as female (Fig. 15D). This species does not conform to Breddin's definition of *Mioscarta* but possesses characters of *Trigonoschema* gen. nov. For this reason we transfer it to this new genus. We could not borrow the holotype, however some photographs of the habitus and labels were kindly provided by Mick Webb (NHM). They are integrated here (Fig. 15) and are sufficient to see the most obvious characters of *Trigonoschema* gen. nov.

*Trigonoschema rubercella* Crispolon & Guilbert gen. et sp. nov.

urn:lsid:zoobank.org:act:02DFAF48-FC8F-45CE-BE52-FB1DD05626DF

**Fig. 16**

**Diagnosis**
In general shape, *T. rubercella* is similar to *T. negrosensis* but is distinctly different in color. *T. rubercella* presents a bright yellow pronotum followed by red band running on the basal parts of the tegmen and scutellum when *T. negrosensis* in dorsal view presents a dirty yellow pronotum followed by a light orange scutellum framed by yellow patches sprawling on the clavus of the tegmen.

**Etymology**
This species has a distinct red coloration in the network of cells at the apex of tegmen. The species name is a combination of two latin words “ruber” and “cella” respectively meaning red and cell. The name is placed in apposition.

**Material examined**

**Holotype**
PHILIPPINES •♂; “Philippines, Negros volcano Canlaon, forêt, 10°25'29" N, 123°05.36" E”; “Muséum Paris, 1050 m; 28 Oct. 2010; D. Ouvrard Rec”, “Muséum Paris, MNHN (EH) 23638”, “séquençage par Elorde Crispolon C-00074”; MNHN.
Paratypes

Fig. 15. Trigonoschema pallida (Lallemand, 1927) comb. nov., holotype (NHMUK 013588933), habitus. A. Lateral view. B. Frontal view. C. Dorsal view. D. Labels.
CRISPOLON E. Jr. S. et al., New genus and new species of spittlebugs from the Philippines


Description

Body length. 9.5–10.5 mm ( tegmina included), width 4.5 mm.

Head (Figs 1, 16B). In dorsal view, ocelli small, distance between eyes 9 times ocellus diameter (Figs 1, 16B). Distance between ocellus and compound eye less than 4 times ocellus diameter (Figs 1, 16B). Distance between ocelli 1.5 ocellus diameter (Figs 1, 16B). Eyes not prominent, length 1.33 times than wide. Vertex slightly longer than wide. bearing a median longitudinal carina. Frons without carina. Postclypeus with dimple below margin of frons and a longitudinal furrow, swollen laterally and slightly ovoid shape in frontal view, widest part close to frons, not receding, prior to anteclypeus where it bends forming obtuse angle in lateral view (Figs 1B, 16A). Rostrum long, reaching but not surpassing mesocoxae.

Thorax (Figs 2B, 16A–C). In dorsal view, pronotum with anterior deep concavities on each side, much clearly marked in female, longitudinal median carina absent. Anterior margin of pronotum as wide as posterior margin of head including eyes, anterolateral margins curved, posterior margin grooved, postero-lateral margins slightly concave, slightly longer than anterolateral margins, humeral angle rounded. In lateral view, pronotum angle around 45° (Figs 2B, 16A). Scutellum as long as wide with large median dimple (Fig. 16C).

Tegmen (Fig. 16A–C). R bifurcates on apical half, M bifurcate on basal third, apical reticulation not well developed without concave apical cells. Posterior wing (Fig. 3A). Rp separating from SC+Ra nearly at midlength, M reaches ambient vein, Cua and Cup fused at base and m-cu links M to Cua before Cua bifurcation, 7 longitudinal veins and 5 apical cells between SC+Ra and Cup, angular protrusion of costal margin near its base present. Metafemur with apical spine in inner margin and metatibiae bearing 1 lateral spine.

Male terminalia. In lateral view, posterior margin of pygofer (Fig. 16E) convex in middle with slight concavity toward ventral margin. Subgenital plates (Fig. 16F) with equal length relative to height of pygofer with fine appendage shorter than main plate directed posteriorly not forming acute angle with main plate, dorsal and ventral margin of main plate regularly curved. Sterno-lateral plates present, triangular shaped. Intermediate plates present, roughly boomerang-shaped linking internal sides of lateral plate and subgenital plate. Paramere (Fig. 16G) globose, dorsal margin convex than curving regularly and finishing with a sharp spine pointed dorsally, lateral margin with slightly and rounded, ventral margin roughly straight with subapical part angled largely protruding posteriorly then finishing with two sharp spines pointing postero-ventrally. Aedeagus (Fig. 16H) with dorsal margin making a right angle at its base, straight on a small portion before curving up regularly, apical part bending posteriorly and straight, apical extension pointing dorsally, posterior protrusion thick and beak-shaped, postero-dorsal protrusion absent.

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COLOR. Head, legs, abdomen, scutellum and anterior part of pronotum red, rest of pronotum yellow, rostrum red, antennal scape and pedicel reddish orange, flagellum yellowish. Tegmen translucid yellow, basal and apical third including network of cells red.

Type Locality
Philippines: Visayas, Negros Occidental, Mount Kanlaon.

Distribution
Philippines: Visayas, Negros Island.

Molecular Phylogeny
Results of the Bayesian 50% consensus tree and ML analyses with likelihood score of −13870.493 are shown in Figures 17 and 18 respectively. The resulting topologies are not similar with respect to the placement of Jacobsoniella and Wawi. In the Bayesian topology (Fig. 17), Jacobsoniella is recovered within a clade containing Eoscarta, Mioscarta, Poeciloterpa and Trigonoschema gen. nov. clades, each

Fig. 17. Bayesian 50% consensus tree based on partitioned analysis of combined sequences Histone 3 + CO1 + 18S + 28S for Eoscarta Breddin, 1902, Jacobsoniella Melichar, 1914, Mioscarta Breddin, 1901, Poeciloterpa Stål, 1870, Trigonoschema Crispolon & Soulier-Perkins, gen. nov. and Wawi Soulier-Perkins & Le Cesne, 2016 species with Clastopteridae, Machaerotidae and Aphrophoridae as outgroup. Numbers indicated at each resolved nodes are posterior probability values presented in %. Branches are colored according to genus.
supported by a probability value (PPv) of 100%. This clade (Eoscarta + Mioscarta + Poeciloterpa + Trigonoschema + Jacobsoniella) is supported PPv of 82.61% and Wawi appears as sister group to it. However, the clade containing Wawi plus the five other genera is supported with a high PPv of 100%. In the ML analysis (Fig. 18), Poeciloterpa and Trigonoschema gen. nov. are sister groups with a ML bootstrap value (MLBv) of 85.2/21% (SH-aLRT support/ standard bootstrap support). Then Mioscarta appears as sister group of (Eoscarta + Wawi + (Poeciloterpa + Trigonoschema)). Jacobsoniella is recovered basally as sister of the other ingroup taxa and all together the ingroup clade is supported with a MLBv of 100/100% branch support.

Several key aspects of both topologies are similar. Regardless of the relationships of Eoscarta, Mioscarta, Poeciloterpa, Trigonoschema, Jacobsoniella and Wawi in both topologies the monophyly of each genus is well supported with a PPv of 100% and MLBv of 98.40/91%, 97.3/96%, 99.7/99% and 98.8/77% respectively. In both trees the ingroups are well supported with a PPv of 100% and MLBv of 100/100%.

Fig. 18. Maximum likelihood topology (likelihood score of −13870.493) for Eoscarta Breddin, 1902, Jacobsoniella Melichar, 1914, Mioscarta Breddin, 1901, Poeciloterpa Stål, 1870, Trigonoschema Crispolon & Soulier-Perkins, gen. nov. and Wawi Soulier-Perkins & Le Cesne, 2016 species with Clastopteridae, Machaerotidae and Aphrophoridae as outgroup based on analyses of combined sequences (CO1, Histone 3, 18S, and 28S). Support statistics from a ML bootstrap value (SH-aLRT support % / standard bootstrap support %) are indicated at each resolved node. Branches are colored according to genus.
Discussion

Distribution, Biology and Ecology

Eight species currently belonging to the genus *Mioscarta* (Fig. 19) and four species of the new genus *Trigonoschema* (Fig. 20) are known from the Philippines. Of the four species of *Trigonoschema* gen. nov., only *T. pallida* cannot be placed precisely since the locality provided by Lallemand (1927) was “Philippine Islands”.

**Fig. 19.** Philippines *Mioscarta* Breddin, 1901 distribution map.
Some specimens were collected using a light trap, thus very little information on their natural history is available to date. Such positive phototaxy was also reported by Soulier-Perkins & Kunz (2012). Their host-plants remain unknown, even if, some species of both genera were observed alighting on the leaves of different plants of secondary and primary forests. This observation is not enough to conclude the insect’s hostplant. Direct observations therefore remain difficult. With the development of next generation sequencing it is possible now to identify plants using their barcoding even when in small

Fig. 20. *Trigonoschema* Crispolon & Soulier-Perkins gen. nov. distribution map.
quantity. It is most likely that in a near future, when analysing the content of the insect guts we should find enough genetic material belonging to the ingested host plants that would allow their identification.

**Placement of *Trigonoschema* gen. nov. in the classification**

According to Liang & Webb (2002) the tribe Rhinaulacini is characterized by a relatively broad head with non-globose eyes and a concave posterior margin of pronotum. It is also usually mentioned that a central longitudinal concave postclypeus and a hind tibia bearing a single strong lateral spine (Lallemand 1949, Liang & Webb 2002). However, the most obvious character that can separate Rhinaulacini from other Cercopidae is the presence of a sterno-lateral plate between the pygofer and subgenital plate (Liang & Webb 2002). This sterno-lateral plate is observed in all new described taxa belonging to *Eoscarta* (Liang & Webb 2002), *Amberana* and *Bourgoinrana* (Soulier-Perkins & Kunz, 2012), *Euryaulax* (Liang et al. 2012), *Wawi* (Soulier-Perkins & Le Cesne 2016), *Poeciloterpa* (Crispolon et al. 2019), and *Jacobsoniella* (based on a specimen we identified), and here in all new *Mioscarta* and *Trigonoschema* gen. nov. We are therefore certain in our placement of the new genus *Trigonoschema* in Rhinaulacini.

Liang & Webb (2002) formally placed the Eoscartini as a junior synonym of Rhinaulacini without placing the genera in any of the existing subtribes due to the need of further studies on their male terminalia. They emphasized the difficulties in identifying genera and species in this group, separations mainly based on small differences in male genitalia. *Trigonoschema* gen. nov. possesses characters that allow its clear identification from the other Rhinaulacini genera found in the Philippines, specifically *Mioscarta* and *Poeciloterpa*. It appears as well close to those genera, which belong to the Poeciloterpina subtribe. But we have decided for now to follow Liang and Webb’s example and leave *Trigonoschema* gen. nov. as *incertae sedis* in the Rhinaulacini. The phylogeny shows that *Trigonoschema* gen. nov. is a distinct clade from *Mioscarta*. Although the sample is reduced to only six genera with a partial representation for each of them, both resulting topologies (ML and BI) show a well-supported monophyly of *Eoscarta*, *Mioscarta*, *Poeciloterpa*, and *Trigonoschema* gen. nov., revealing *Mioscarta* and *Trigonoschema* gen. nov. as two distinct genera. This justifies the description of the new genus *Trigonoschema* gen. nov. It is also clear from the differences in topologies between ML and BI, it would be unwise to make assumptions on genera relationships here. All the ingroup genera selected, except *Jacobsoniella*, belong to the Rhinaulacini and the ingroup support in both analyses is strong but no hasty conclusion should be made on placing *Jacobsoniella* in the Rhinaulacini or even believing this tribe to be monophyletic. Such hypotheses could only be tested with a larger sampling of Cercopinae genera.

Using the 50% majority rule topology highlighted the need of a wider analysis including the rest of Cercopidae to reconsider the family’s relationships and to build up more robust phylogenetic hypotheses for the family. It is also congruent with the ML analysis, as the relationships between the targeted genera are not well established.

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