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A taxonomic study on the Bornean and Philippines Sword-tailed Crickets in the genus *Rhicnogryllus* Chopard, 1925 (Orthoptera: Trgonidiidae; Trigonidiinae)

MING KAI TAN[1*], JESSICA B. BAROGA-BARBECHO[2], RAZY JAPIR[3], ARTHUR Y. C. CHUNG[3], RODZAY BIN HAJI ABDUL WAHAB[4] & SHERYL A. YAP[5, 6]

[1]*Institut de Systématique, Evolution et Biodiversité (ISYEB), Muséum national d'Histoire naturelle, CNRS, SU, EPHE, UA, 57 rue Cuvier, CP 50, 75231 Paris Cedex 05, France*
[2]*Office of the Vice Chancellor for Research and Extension, University of the Philippines Los Baños, College, Laguna, 4031 Philippines*
[3]*Forest Research Centre (Sepilok), Sabah Forestry Department, PO Box 1407, 90715 Sandakan, Sabah, Malaysia*
[4]*Institute for Biodiversity and Environmental Research, Universiti Brunei Darussalam, Jalan Universiti, BE1410, Brunei Darussalam*
[5]*Institute of Weed Science, Entomology, and Plant Pathology, College of Agriculture and Food Science, University of the Philippines Los Baños, College, Laguna, 4031 Philippines*
[6]*Museum of Natural History, University of the Philippines Los Baños, College, Laguna, 4031 Philippines*
[*]*Corresponding author. E-mail: orthoptera.mingkai@gmail.com*

Abstract

Rhicnogryllus Chopard, 1925 is a small and relatively unknown group of Sword-tailed Cricket of the subfamily Trigonidiinae. This genus currently comprises 12 species from Asia, Africa (including Madagascar), South America and the Pacific. Species have been recognised by the presence of parallel and elevated veins in both males (which lack stridulatory organs) and females. However, this approach to classifying Trigonidiinae may be outdated and examination of male genitalia can offer better insights into the generic status of these species and how they are related or unrelated. By comparing male genitalia of new materials and old specimens, we describe a new species from the Philippines: *Rhicnogryllus? paetensis* **n. sp.**, which is similar to the type species. Our hypothesis is that *Rhicnogryllus* is a non-monophyletic and artificial genus, and that the genus should comprise only Southeast Asian members (since the type species *Rhicnogryllus fascipes* Chopard, 1925 is known from the Philippines). We are cautiously against describing new genus to avoid adding more confusion until a comprehensive revision to the subfamily and *Rhicnogryllus* has been undertaken.

Key words: diagnosis, genitalia, new species, revision, Southeast Asia, taxonomy

Introduction

The taxonomic state of many genera from the Trigonidiinae is notoriously complicated (Tan *et al.*, 2019a), including the type genus *Trigonidium* Rambur, 1838. This is partly attributed to the different interpretation of characters used to delimit species and genera. Tegminal morphology (e.g., presence of stridulatory apparatus) and hearing apparatus (e.g., absence and presence of tympana) were used in the past, but this may no longer be reliable as Sword-tailed Crickets were postulated to lose acoustic communication numerous times in the phylogeny (Hugel, 2012). More recently, male genitalia and biogeography are being used to define Trigonidiinae (see Desutter-Grandcolas, 1987; Gorochov, 1987, 2015a). Genitalic morphology generally exhibits intraspecific stability and distinct interspecific differences in orthopterans, and this probably is also true for Trigonidiinae (Gorochov, 2015b, Gorochov *et al.*, 2018). This makes the characters, which are usually sclerotized and well-preserved in crickets, useful for differentiating species as well as providing evidence for mechanical reproductive isolation (Gorochov, 2015b). Nonetheless, it is no easy task to revise the taxonomy of Trigonidiinae owing to its species diversity and cosmopolitan distribution.

An example of a little-known genus of Sword-tailed Cricket in which the male genitalia are rarely used, if at all, to delimit species is the *Rhicnogryllus* Chopard, 1925. It was described by Chopard from the Philippines (Chopard,

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1925). Allied to *Trigonidium* and *Metioche* Stål, 1877, Chopard (1925) considered *Rhicnogryllus* to differ from *Trigonidium* in the absence of false veins in the tegmina, the two sexes having parallel veins "ribs", forming salient ribs, without transverse ribs; and to differ from *Metioche* by the stronger veins, entirely parallel and similar in both sexes. Subsequently, other species from all around the world previously placed under *Trigonidium* [i.e., *R. elegans* (Bolívar, 1910) from Africa and *R. tahitensis* (Saussure, 1878) from the Pacific oceanic islands] were transferred to this genus without examining the genitalic characters. More species were added, including a fossil species. Currently, 12 species are recognised, and the genus supposedly occurs throughout the world (Fig. 1).

FIGURE 1. Map of the distribution of *Rhicnogryllus* (A); and a closer look at Southeast Asian *Rhicnogryllus* (B).

Based on new specimens collected from Borneo and the Philippines, we re-examine species of *Rhicnogryllus* from this region, including the type species, while paying extra attention to the genitalia. This led to the discovery of a new species from the Philippines: *Rhicnogryllus? paetensis* **n. sp.**

Materials and methods

Material. *Rhicnogryllus* specimens were collected by MKT in the lowland forests of (1) Siargao Island, Philippines, (2) University of the Philippines (UP) Laguna Land Grant, Luzon, Philippines, (3) Andulau Forest Reserve, Belait District, Brunei Darussalam; and (4) Sepilok, Sandakan, Sabah, East Malaysia. Opportunistic collections were conducted during daytime and night-time. Whenever possible, in-situ images were taken using a Canon EOS 500D digital SLR camera with a compact-macro lens EF 100 mm f/2.8 Macro USM and Canon Macro Twin Lite MT-24EX was used for lighting and flash. The specimens were preserved in absolute analytical-grade ethanol and later pinned and dry-preserved. A single hind leg from each specimen was also preserved in absolute analytic-grade ethanol for future molecular work. The newly collected dry-pinned specimens were deposited in:

FRC	Forest Research Centre, Sepilok, Sabah, East Malaysia
UBDM	Universiti Brunei Darussalam Museum, Brunei Darussalam
UPLBMNH	University of the Philippines Los Baños, Museum of Natural History, Philippines
ZRC	Zoological Reference Collection, Lee Kong Chian Natural History Museum, Singapore

Examination. Close-up images of habitus and morphological features were done using a Canon EOS 6D digital SLR camera with a macro photo lens MP-E 65mm f/2.8 USM (1–5×) and imaging stacking was done using Helicon Remote version 9.3.1. W and Helicon Focus 6.8.0. Types were also examined using images from the Muséum national d'Histoire naturelle, Paris, France (MNHN) online collection (https://science.mnhn.fr/institution/mnhn/collection/eo/item/list?full_text=rhicnogryllus).

Male genitalia were dissected in relaxed specimens and observed after cleaning with cold KOH using a binocular microscope Leica MZ16 at magnifications up to 160×, and subsequently kept in glycerine in vials pinned under specimens. Photographs of male genitalia were done with a binocular microscope Leica MZ16 with AmScope Microscope Eyepiece Camera (MU1000, 10 MP Aptina Colour, CMO50) attached via an AmScope FMA050 fixed microscope adaptor and the montage software AMScope version ×64, 3.7. Image editing was accomplished using Adobe Photoshop CC2014.

Measurements were done based on the images using ImageJ 1.51j8. The abbreviations are used:

BL	body length (from fastigium to abdominal apex)
HW	head width (from lateral margin of one eye to that of another)
PL	pronotum length
PW	pronotum width
TL	tegmen length
HFL	hind femur length
HTL	hind tibia length
OL	ovipositor length

Terminologies. Terminology used to describe the male genitalia follows Tan & Robillard (2012) and Gorochov (2015a) (in square brackets). These abbreviations are used:

ps	pseudepiphallus [= epiphallus]
ps lb	lobule at the posterior edge of pseudepiphallic sclerite
ps lo	sclerotized lophus at the posterior apex of pseudepiphallus
ps p	pseudepiphallic parameres [=ectoparameres]
ra	ectophallic fold [= rachis]
v	virga
ec ap	ectophallic apodeme [= endoparamere apodeme]
r	ramus
en s	endophallic sclerite [= formula]

Systematic Parts

Subfamily Trigonidiinae Saussure, 1874

Tribe Trigonidiini Saussure, 1874

Genus *Rhicnogryllus* Chopard, 1925

Chopard, 1925: 310; Chopard, 1968: 338; Desutter-Grandcolas, 1987: 236

Type species: *Rhicnogryllus fascipes* Chopard

Distribution (Fig. 1). Southeast Asia: Philippines, Sarawak and Sabah (East Malaysia) and Brunei Darussalam (Chopard, 1925, 1968; Ingrisch, 1987)

East Asia: Ogasawara (Shiraki, 1930; Chopard, 1968; Ichikawa *et al.*, 2000; Gorochov, 2018)

Pacific oceanic islands: Caroline Islands (Federated State of Micronesia), Solomon Islands, Tahiti (French Polynesia) (Saussure, 1878; Kirby, 1906; Hebard, 1926, 1933; Chopard, 1930, 1938, 1957, 1968; Willemse, 1951; Chopard, 1968)

Africa: Republic of Congo, Equatorial Guinea, Tanzania, Madagascar, Reunion Island and Comoros Islands (Bolívar, 1910; Chopard, 1926, 1962, 1958, 1968; Desutter-Grandcolas, 1996)

South America: Peru (Chopard, 1956, 1968; Aguilar, 1973)

Holocene Africa (Chopard, 1936; Zeuner, 1939)

Description. Very small crickets, even among Trigonidiinae. Head, together with eyes, clearly wider than pronotum. Frontal rostrum flattened, only slightly wider than scapus; with a few long setae. Vertex flattened dorsally, with a few strong long setae. Antennal segments, including scapus, pubescent. Eye very large, protruding laterally, from dorsal view slightly elongated; in lateral view slightly hemispheric. Gena swollen, not pubescent. Maxillary palpi elongated; last three segments of about equal length; apical segment triangular, longer than wide, with apex truncated. Labial palpi with apical segment long and slightly swollen at the apex. Pronotum wider than long; with a few long setae but more pubescent along margins; sulci distinct or indistinct; anterior and posterior margins straight; dorsal disc flattened. Lateral lobe of pronotum longer than high, ventral margin straight or sinuous, anterior and posterior angles obtuse; anterior angle with numerous strong long setae, posterior margin lined with shorter setae. Without visible metanotal gland. Male and female tegmina in lateral view appears rounded, not pubescent; reaching abdominal apex, but not covering epiproct; without stridulatory apparatus in males; apex somewhat truncated. Tegminal dorsal field with 7 longitudinal, elevated and parallel veins, lateral field with 3 or 4 less-elevated and slightly sinuous veins; without cross-vein. Hind wing absent. Legs generally pubescent and with long setae. Fore tibia with both tympana absent. Tarsal middle segment with prominent adhesive pad. Hind tibia with three inner and three outer subapical spurs; two inner and two to three outer apical spurs, inner ones distinctly longer than outer ones.

Female: Not different morphologically as the males, including tegmina. Ovipositor short, barely reaching apex of cercus; basal half straight and apical half slightly curved dorsad; ventral and dorsal margins usually dentated; ventral valve surpassing usually dorsal valve, apex acute.

Colouration: Highly variable, but often with contrasting colour patterns. Exhibit sexual dimorphism in some species—typically with females having darker colouration (e.g., *Rhicnogryllus fascipes* Chopard, 1925)—but not others (e.g., *Rhicnogryllus bipunctatus* Ingrisch, 1987). Hind femur usually pale colour with two black bands, one in the middle, and another either before or after middle.

Comparison with similar genera. *Rhicnogryllus* (sensu *R. bipunctatus*) has similar genitalia morphology as *Trigonidium* and *Svistella* Gorochov, 1987 but differs from *Trigonidium* by virga long (usually shorter than rachis in *Trigonidium*). *Rhicnogryllus* also differs from *Trigonidium* (*Paratrigonidium* Brunner von Wattenwyl, 1893) and *Svistella* by absence of stridulatory organs in males (see Gorochov, 1987; Tan & Robillard, 2012; Lu *et al.*, 2018; Tan *et al.*, 2019a).

Discussion. Chopard (1925, 1930) specified that the main characteristics that define this genus from closely related ones, such as *Trigonidium* and *Metioche* is the strongly elevated veins on the tegmina, but species from different parts of the world can share such characters. However, the strongly elevated veins on the tegmina in *Rhicnogryllus* from different parts of the world are probably an outcome of convergence rather than relatedness. We have

already observed that the genitalia of *R. bipunctatus* and our new species *Rhicnogryllus? paetensis* **n. sp.** differ drastically from an African representative, *Rhicnogryllus lepidus* Chopard, 1962 (Desutter-Grandcolas, 1996).

The cosmopolitan distribution of this genus of small crickets that do not have apparent ability to fly and likely to have specialised niche, as well as vastly different genitalia morphology, strongly suggest that *Rhicnogryllus* is artificial and that species from different biogeographic regions may belong to different genera. Our hypothesis is that the current *Rhicnogryllus* is probably a genus endemic to Southeast Asia and/or Pacific oceanic islands and East Asia (since the type species is from the Philippines). Species from Africa and South America probably belong to different genera. Nonetheless, in the current state of Trigonidiinae taxonomy, introducing new genera may only add more confusion when the other taxa are not revised and examined.

Rhicnogryllus fascipes Chopard, 1925

Fig. 2

Rhicnogryllus fascipes—Chopard, 1925: 310 > original description of genus. Chopard, 1968: 338.
Rhicnogryllus nr. *bipunctatus*—Tan *et al.* (2019b): 12 > record in Siargao Island

Material examined. 1 female (UPLB.19.14), **Philippines**, Luzon Island, Paete, Barangay Ilaya Norte, UP Land Grant, N14.40015, E121.54217, 312.6±5.2 m.a.s.l., 0949 hours, 12 May 2019, coll. M. K. Tan, S. A. Yap, & J. B. Baroga-Barbecho. 1 female (Siargao18_60), **Philippines**, Siargao Island, Barangay Esperanza, Del Carmen, N9.86816, E126.02669. 61.2±7.9 m, 16 October 2018, 0922 hours, coll. M. K. Tan, S. A. Yap, & J. B. Baroga-Barbecho (UPLBMNH and ZRC).

Type details. One male and one female unspecific primary type (coll. C. Willemse) from Butuan City, Mindanao, Philippines.

Remarks. The primary types from Butuan City (Mindanao Island) are not present in MNHN (based on MNHN online collection). But we have collected morphologically identical females from Siargao Island (~193 km away from Butuan). The females from Siargao and Luzon Islands are indistinguishable from each other and from the original description of the types from Mindanao. It should be noted that morphologically cryptic species can exist and that we should be cautious that the species from Luzon and Siargao Islands may well represent different species from the primary types in Mindanao.

This species is closest to *R. bipunctatus* from Borneo by the colour patterns but differs by: tegmen without basal white spot but with a narrow transverse band at the base posterior of the apical margin of pronotum.

Distribution. Philippines Archipelago: Laguna in Luzon Island; Siargao Island; Butuan in Mindanao Island

Redescription. External morphology as described above.

Female: Habitus similar to males. Supra-anal plate with tenth abdominal tergite broad trapezoidal, with a longitudinal furrow in the middle, epiproct rounded and setose along apical margins. Subgenital plate broader than long, with apex truncated and narrowly excised in the middle. Ovipositor short, barely reaching apex of cercus; basal half straight and apical half slightly curved dorsad; ventral and dorsal margins dentated; ventral valve surpassing dorsal valve, apex acute.

Colouration: Males dark red, females black. Male with anterior of head (including scapus) black, with a white transverse stripe across the dorsum, including the eyes, dorsum posterior of the stripe red brown in male and black in female. Face black, with a transverse white spot between antennal scapus; with transverse pale band beneath eye and antennal cavity on each side. Palpus with segments red brown in male (probably discoloured) and white in female. Gena pale just beneath eyes, ventrally black. Pronotum dark red brown in male, black in female. Tegmen, with base white; when closed forms a white transverse stripe. Fore and middle femora and tibiae dark red to black; tarsi pale yellow. Hind femur generally white, with a thick black band just before middle and another thinner and in female, another less defined dark band at apical third; apex of hind femur, including knee brown. Hind tibia black, with brown spurs; hind tarsus brown. Thoracic and abdominal tergites and sternites black; cercus, in living specimens, pale or pale blue; tenth abdominal tergite black and epiproct white; subgenital plate pale with tint of red brown. Ovipositor pale basally, dark red brown thereafter.

FIGURE 2. Live habitus of *Rhicnogryllus fascipes* female from Luzon (A) and Siargao Island (B), Philippines.

Rhicnogryllus bipunctatus **Ingrisch, 1987**
Figs. 3, 6

Rhicnogryllus bipunctatus—Ingrisch, 1987: 176 > original description ; Tan et al., 2019c: 306 (record in Sandakan)
Rhicnogryllus eximius—Chopard, in litt.

Material examined. Male holotype (only images examined), **East Malaysia**, Sarawak, Batu Niah, 3/4 August

1984, coll. S. Ingrisch (SMFD). Paratype of *Rhicnogryllus eximius* (1 male, MNHN-EO-ENSIF6583, only images examined), **East Malaysia**, Sabah ("North Borneo"), Sandakan, 24 July 1927 (MNHN).

1 female (BRU.19.61), **Brunei Darussalam**, Belait District, Teraja, N4.28487, E114.41817, 28.7±74.9 m.a.s.l., 1906 hours, 2 March 2019, coll. M. K. Tan & H. Yeo; 1 male (BRU.19.68) and 1 female (BRU.19.69), same locality, Wasai Wong Kadir Recreational Park, N4.3421, E114.44655, 23.0±6.6 m.a.s.l., 1639 hours, 7 July 2019, coll. M. K. Tan & H. Yeo (ZRC and UBDM).

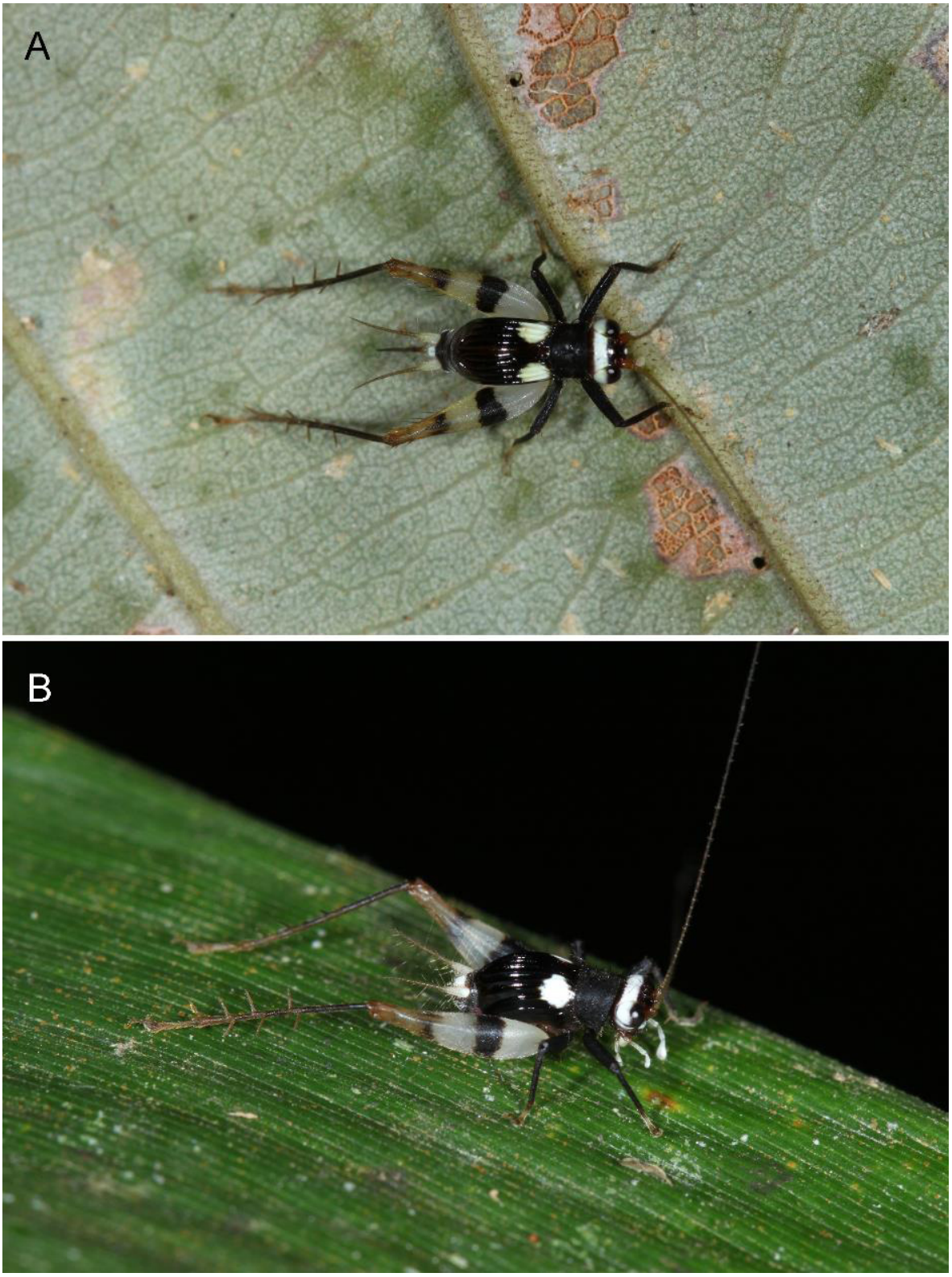

FIGURE 3. Live habitus of *Rhicnogryllus bipunctatus* female from Sandakan, Sabah (locality of *R. eximius* sensu Chopard) (A) and male from Brunei Darussalam (B).

4 males (SDK.19.42–45), **East Malaysia**, Sabah, Sandakan, Ulu Dusun, N5.78364–5.78379, E117.76051–117.76094, 38.3–41.6±5.1–6.7 m.a.s.l., 1008–1038 hours, 10 January 2019, coll. M. K. Tan, R. Japir, M. Binti & J. L. Yukang; 1 female (SDK.19.67), same locality, Sepilok, Rainforest Discovery Centre, N5.87575, E117.94059, 54.5±6.3 m.a.s.l., 0946 hours, 1 October 2019, coll. M. K. Tan & J. L. Yukang (ZRC and FRC).

Type details. Male holotype, Borneo: Sarawak: Batu Niah (SMFD)

Remarks. A male "paratype" of *Rhicnogryllus eximius* Chopard collected from Sandakan was found in MNHN and it resembles *R. bipunctatus* as described by Ingrisch (1987) as well as the recent specimens collected from Brunei and Sandakan. However, we could not find any publication of the description associated with *R. eximius* and concluded that Chopard may not have described this species despite specifying the type specimens until Ingrisch (1987) described the exact same species from Sarawak. Thus, we consider Chopard's *R. eximius* as a synonym of *R. bipunctatus*.

Ingrisch (1987) provided a comprehensive description of the male, but the female was not known at that time.

Diagnosis. This species differs from congeners by the combination of these characters: generally black colouration, with dorsum of head with a broad white line connecting the eyes; antennal scapus red brown; posterior femora white with two black bands, posterior tibia red brown; tarsal segments whitish; tegmen with a big, round, white spot at the base; supra-anal plate and base of cerci white; and male genitalia (Fig. 3). The male genitalia is also similar to that of *Trigonidium* but differs by virga as long as rachis (usually shorter than rachis in *Trigonidium*).

Distribution. Borneo: Sandakan (Sabah); Batu Niah (Sarawak); Brunei Darussalam

Male genitalia characteristics (Figs. 6A–C). Pseudepiphallus separated into two lateral parts joined by an anterior sclerotized bridge; bridge narrow and gently curved. Posterior apex of pseudepiphallus forming thin and long, sclerotized lophi; lophus feebly curved inwards, with inner margin with 4–5 tooth-like spines, with apex forming a tooth; posterior edges of pseudepiphallic sclerite with a stout, angular lobule in the middle, lobule with stout teeth along margin. Pseudepiphallic parameres elongated heart-shaped, not exceeding apex of pseudepiphallic lobules. Ectophallic fold large forming an elongated sclerotized virga with acute apex. Ectophallic apodeme weakly sclerotized but long. Ramus straight. Endophallic sclerite elongated along dorsal cavity, with a median crest, with lamella of apodemes appearing flat and broad.

Female description. Habitus similar to males, does not exhibit sexual dimorphism. Supra-anal plate with basal half black, with a longitudinal groove and angularly emarginated at the apex; epiproct with broad and stout, with obtuse apex, white. Subgenital plate stout, distinctly broader than wide, with anterior margin straight, apex narrowly excised in the middle; basal part black, thereafter white. Ovipositor not surpassing cerci; basal third with margins straight and smooth; apical third with dorsal margin distinctly denticulated, ventral margin also denticulated but less dense and only towards the apex. Ventral valves slightly longer than dorsal valves.

Natural history. This species tends to be found among foliage of shrubs or low-lying vegetation in the understory of relatively disturbed forest and/or forest edge (at least in Sandakan and Brunei). Ulu Dusun and Rainforest Discovery Centre (Sandakan) as well as Teraja and Wasai Wong Kadir Recreational Park (Brunei) typically are disturbed forest with the presence of human traffic. The species can be found active in both day and night.

Rhicnogryllus? paetensis Tan, Yap & Baroga-Barbecho, new species

Figs. 4–6

Material examined. Male holotype (UPLB.19.20), **Philippines**, Luzon Island, Paete, Brgy Ilaya Norte, UP Land Grant, N14.39968, E121.54356, 353.9±7.5 m.a.s.l., 1046 hours, 12 May 2019, coll. M. K. Tan, S. A. Yap, & J. B. Baroga-Barbecho, det. M. K. Tan (UPLBMNH).

Female allotype (UPLB.19.17), **Philippines**, same locality as holotype, N14.39994, E121.54324, 362.2±7.5 m.a.s.l., 1032 hours, 12 May 2019, coll. M. K. Tan, S. A. Yap, & J. B. Baroga-Barbecho, det. M. K. Tan (UPLBMNH).

Paratypes: 3 males and 1 female (UPLB.19.22–25), **Philippines**, same locality as holotype, N14.39963–14.39965, E121.54362–121.54385, 352.3–353.1±8.1–8.4 m.a.s.l., 1049–1058 hours, 12 May 2019, coll. M. K. Tan, S. A. Yap, & J. B. Baroga-Barbecho, det. M. K. Tan (UPLBMNH and ZRC).

Diagnosis. This species differs from all congeners by the unique shape of lophi at the posterior apex of pseudepiphallus.

FIGURE 4. Live habitus of *Rhicnogryllus paetensis* **n. sp.** males (A, B), and female (C) from Luzon, Philippines.

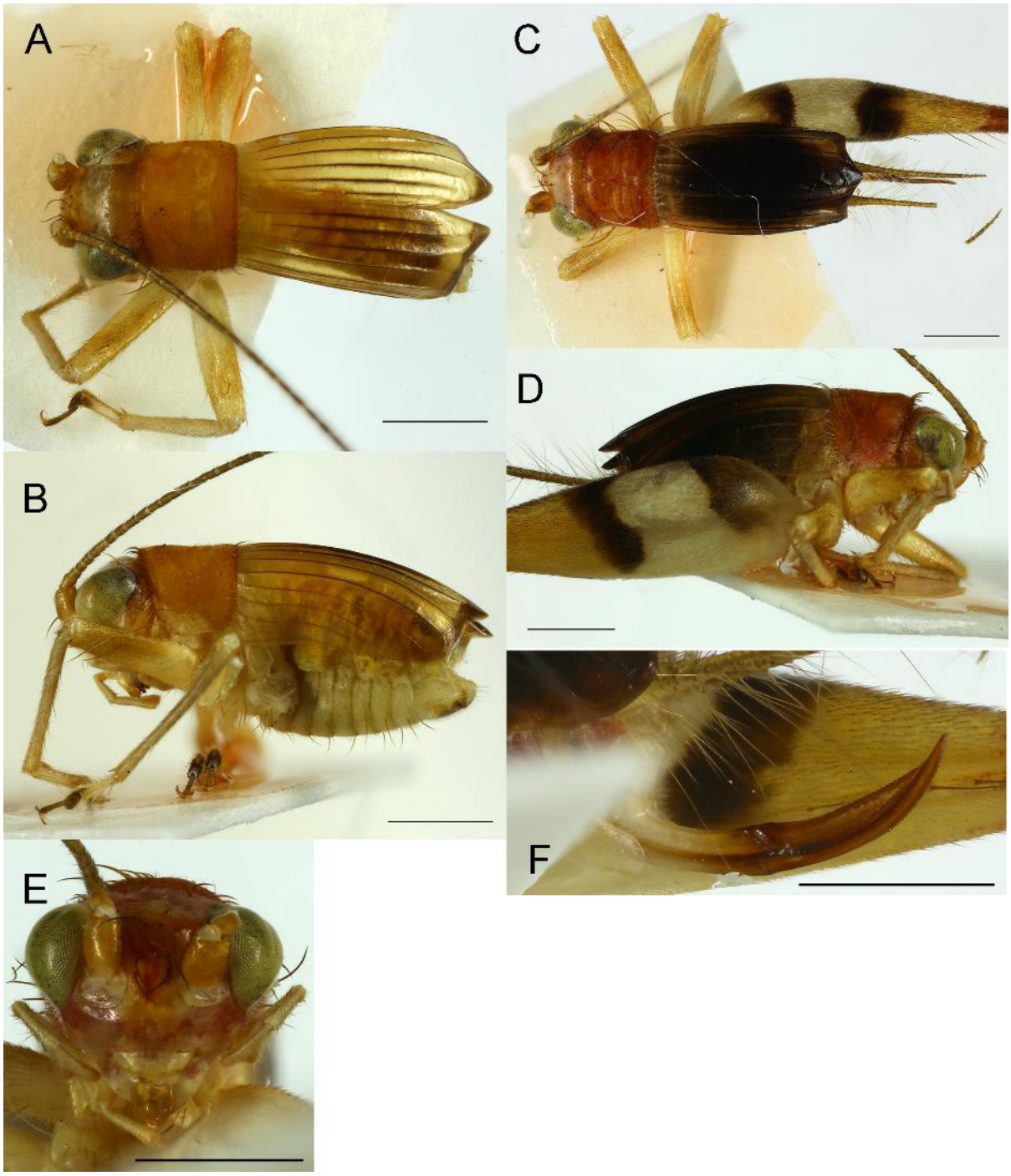

FIGURE 5. *Rhicnogryllus paetensis* **n. sp.** male (A, B) and female (C, D) in dorsal (A, C) and lateral (B, D) views; face in anterior view (E); female ovipositor in lateral view (F). Scale bars: 1 mm.

Remarks. This new species has an external morphology that is nearly indistinguishable from *Rhicnogryllus*. The male genitalia also has typical characteristics of *Rhicnogryllus*: pseudepiphallus separated into two lateral parts joined by an anterior sclerotized bridge; posterior apex of pseudepiphallus forming flattened lophi with inner margins dentated; pseudepiphallic parameres elongated rather than transverse, also variable in shape, but never exceeding posterior apex of pseudepiphallus; virga long with acute apex; ectophallic apodeme usually weakly sclerotized, but long. However, owing to the unique shape of lophi at the posterior apex of pseudepiphallus, it may be probable that this species belongs to another genus. We refrain from describing a new genus at the moment to avoid adding confusion to the generic taxonomy of Trigonidiinae and tentatively place this species under question in *Rhicnogryllus*.

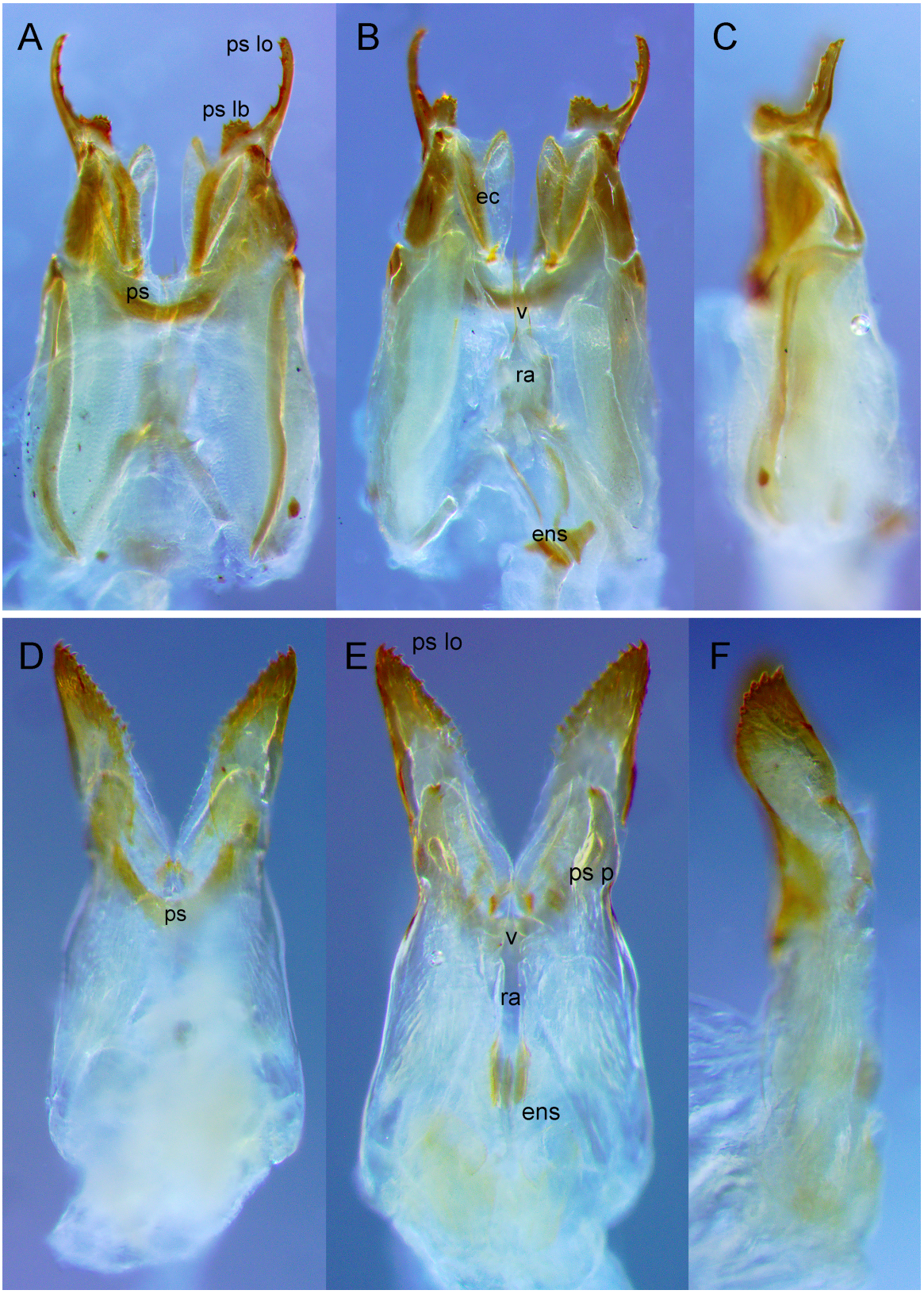

FIGURE 6. Male genitalia of *Rhicnogryllus bipunctatus* (A–C) and *Rhicnogryllus paetensis* **n. sp.** (D–F) in dorsal (A, D), ventral (B, E) and lateral (C, F) views.

Distribution. Philippines: Luzon Island: Laguna

Description. Habitus typical of *Rhicnogryllus* (Figs. 4, 5A–E). Tegminal dorsal field with seven elevated veins; first and second anal-most veins fused at the apex, which then fuse with the third (faintly) and fourth veins; without

cross-vein, not pubescent. Tegminal lateral field with four less-elevated and faintly sinuous veins. Hind wing absent. Without visible metanotal gland.

Male: Anal plate trapezoidal, apex narrow and truncated. Subgenital plate longer than broad, with apex roundly excised. Cerci simple, tapering and long surpassing hind femora. Male genitalia (Figs. 6D–E): Pseudepiphallus separated into two lateral parts joined by an anterior sclerotized bridge situated somewhere along the middle of the length of rami; sclerotized bridge narrow and strongly curved. Posterior edges of pseudepiphallic sclerite without lobule in the middle. Posterior apex of pseudepiphallus forming flattened lophi; lophus triangular, with inner margin dentated, with apex subacute, angularly emarginated (indented) at the inner margin at the base. Pseudepiphallic parameres elongated, not exceeding apex of pseudepiphallic lophus, falcate, posteriorly tapers into an obtuse apex with a small tooth. Ectophallic fold weakly sclerotized, elongated, with a short weakly sclerotized virga with acute apex. Ectophallic apodeme weakly sclerotized, but long. Ramus slender, surpassing anterior of ectophallic apodeme. Endophallic sclerite thin and relatively short, with lamella of apodemes also thing but longer.

Female: Habitus similar to males (Figs. 5C, 5D). Tegminal venation on dorsal field similar to males. Supra-anal plate with tenth abdominal tergite trapezoidal, apical end narrower and truncated, epiproct elongated with apex producing into two stout lobules. Subgenital plate about as long as wide, tapering, apex angularly concave and narrowly excised in the middle. Ovipositor not surpassing cerci; basal third with margins smooth, nearly straight; apical third with dorsal margin faintly denticulated (Fig. 5F). Ventral valves distinctly longer than dorsal valves (Fig. 5F).

Colouration: Males and females generally yellow but exhibit sexual dimorphism (Fig. 4). In living males, head (including scapus) yellow, with setae on dorsum brown. In living females, head and pronotum orange; dorsum of tergites dark brown. Face pale yellow, without any markings. Palpi with segments light yellow, apical segment sometimes slightly darker. Pronotum yellow, with brown setae. Tegmina in males nearly transparent, shiny yellow, with apical area on both dorsal and lateral field with tint of dark; longitudinal veins dark. In females, tegmen dark throughout (except basal area which is lighter). Legs yellow, without patterns; distal half of femora and tibiae darker. Hind femur with two black irregularly shaped bands, one near the base, another thicker one in the middle, delimiting the darker and lighter shades of yellow brown. In females, dark bands on hind femur are thicker and more with regular margin. Hind tibia yellow brown, spurs sometimes darker. Thoracic sternites in males and females pale yellow. In males, abdominal tergites and sternites pale yellow; supra-anal plate black; cerci with pale yellow brown, darkens apically. In females, abdominal tergites (except epiproct) dark. Male subgenital plate yellow with some black markings, yellow in females. Ovipositor pale basally, red brown thereafter.

Measurements (in mm). Male holotype: BL 4.0; HW 1.5; PL 1.0; PW 1.2; TL 2.4. Female allotype: BL 4.1; HW 1.6; PL 1.0; PW 1.3; TL 2.8; HFL 1.0; HTL 1.0; OL 1.7.

Etymology. The species is named after the type locality, Paete.

Natural history. This species, also tends to be found among foliage of shrubs or low-lying vegetation in the understory, seems to be most active in the morning, during which all the specimens were collected. We did not find individuals during survey in the afternoon and evening.

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