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Platybinthus, a new genus of Lebinthina crickets (Orthoptera, Gryllidae, Eneopterinae) from Maluka, Indonesia

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Abstract. A new genus of Lebinthina (Orthoptera: Gryllidae: Eneopterinae) is erected based on species from Maluka Islands near northern Sulawesi (Indonesia): *Platybinthus* gen. nov. This new genus currently consists of three species. *Platybinthus punctatus* (Brunner von Wattenwyl, 1898) gen. et comb. nov. from Halmahera Island is assigned as the type species. *Platybinthus striolatus* gen. et comb. nov., also from Halmahera Island, is redescribed. We also describe a new species: *Platybinthus sandyi* gen. et sp. nov. from Morotai Island.

Keywords. Indonesia, Lebinthini, new combination, Morotai, taxonomy.

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Introduction

The Lebinthini Robillard, 2004 is the most diverse tribe of crickets within the subfamily Eneopterinae Saussure, 1874 (Tan *et al.* 2021; Cigliano *et al.* 2022). These crickets are highly disparate in terms of wing morphology, ranging from brachypterous to fully winged species, and acoustic signals (Robillard & Desutter-Grandcolas 2004a, 2004b; Tan *et al.* 2021). They have been subject of multidisciplinary evolutionary studies because they use an alternative communication system to other crickets (ter Hofstede *et al.* 2015), which involves high-frequency calls (10–28 kHz) (Robillard & Desutter-Grandcolas 2004b), females lacking phonotaxis, and vibrational signals produced by females in response to male calls (ter Hofstede *et al.* 2015).

A recent systematic revision and phylogeny of the tribe led a clarification of its classification and the erection of three monophyletic subtribes with clear morphological features and distribution areas: Cardiodactylina Robillard & Tan, 2021, Lebinthina Robillard, 2004, and Ligypterina Robillard & Tan, 2021 (Tan *et al.* 2021). Within Lebinthina, the species are characterised by brachypterous forewings (FWs) and absent hind wings (HWs), and the males having functional stridulatory structures with a vestigial mirror area. This subtribe is distributed in Southeast Asia and the Western Pacific archipelagos (Tan *et al.* 2021). Since the genera within Lebinthina are well defined (Tan *et al.* 2021), studies on taxa with unclear generic statuses could proceed. Indeed, a new genus of Lebinthina, *Rugabinthus* Tan & Robillard, 2022 from New Guinea, was erected comprising 13 species (of which 12 were new to science) (Tan & Robillard 2022). New species of *Gnominthus* Robillard & Vicente, 2015, *Microbinthus* Robillard & Dong, 2016 and *Macrobinthus* Robillard & Dong, 2016 were also recently described (Tan & Robillard 2021).

The Maluka Islands are an archipelago between Sulawesi and New Guinea. In southern Maluka, two genera and two species can be found: *Fadinthus buruensis* (Robillard, 2010) and *Macrobinthus kei* Tan & Robillard, 2021 (Robillard 2010; Tan & Robillard 2021; Tan *et al.* 2021). In this study, we examined two other species from Halmahera Island (North Maluka), *Lebinthus punctatus* (Brunner von Wattenwyl, 1898) (Fig. 1) and *Lebinthus striolatus* (Brunner von Wattenwyl, 1898) (Fig. 2), and found that these species exhibit a unique combination of characters in the male genitalia among the Lebinthina. These characters are also shared with an undescribed species from Morotai Island. Consequently, we erect a new genus, *Platybinthus* gen. nov., and assigned *Platybinthus punctatus* (Brunner von Wattenwyl gen. et comb. nov., 1898) as the type species. We redescribe the two previous species and describe the species from Morotai Island: *Platybinthus sandyi* gen. et sp. nov.

Material and methods

Material

Specimens were studied from MNHN collections and additional materials loaned from MZB and ZIN.

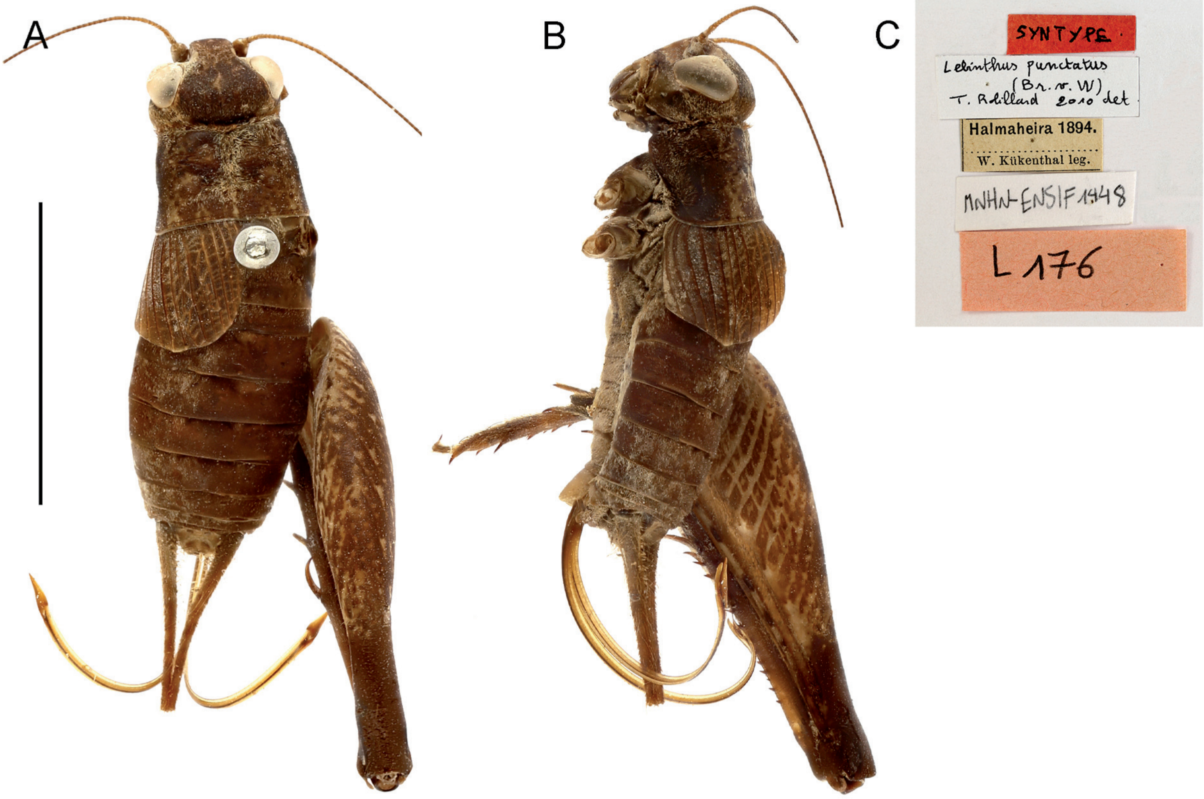

Fig. 1. *Platybinthus punctatus* (Brunner von Wattenwyl, 1898) gen. et comb. nov., syntype, ♀ (MNHN-EO-ENSIF1448). **A**. Dorsal view. **B**. Lateral view. **C**. Specimen label. Scale bar = 10 mm.

Male and female genitalia dissection as well as imaging of habitus, morphological features and genitalia follow procedures by Tan & Robillard (2021, 2022). Male tegminal veins and cells follow terminology by Desutter-Grandcolas (2003) and Robillard & Desutter-Grandcolas (2004a). Male genitalia are named according to Desutter (1987), modified in Desutter-Grandcolas (2003) and Robillard & Desutter-Grandcolas (2004a).

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 65 mm f/2.8 USM (1–5 ×). Imaging stacking was done using Helicon Remote ver. 9.3.1. and Helicon Focus ver. 6.8.0. Photographs of male and female 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 software ToupView (ToupView, Hangzhou ToupTek Photonics, China). Image editing was accomplished using CombineZP ver. 1.0 and Adobe Photoshop CC2014. To highlight the structural components of genitalia, water solution containing a drop of JBL Punktol was used. To fix orientations and stabilisation of genitalia for photography, a clear and viscous Hand Sanitiser was used following Su (2016).

Repositories

MNHN = Muséum national d'histoire naturelle, Paris, France
MZB = Museum Zoologicum Bogoriense, Bogor, Java, Indonesia
SMFD = Senckenberg Naturmuseum Frankfurt, Germany
ZIN = Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia

Abbreviations

General morphology

I, II, III = front, median, hind respectively (femora, legs, tibiae)
F = femora
FW = forewing
T = tibiae
Tarsomere III-1 = basal segment of hind leg tarsomere

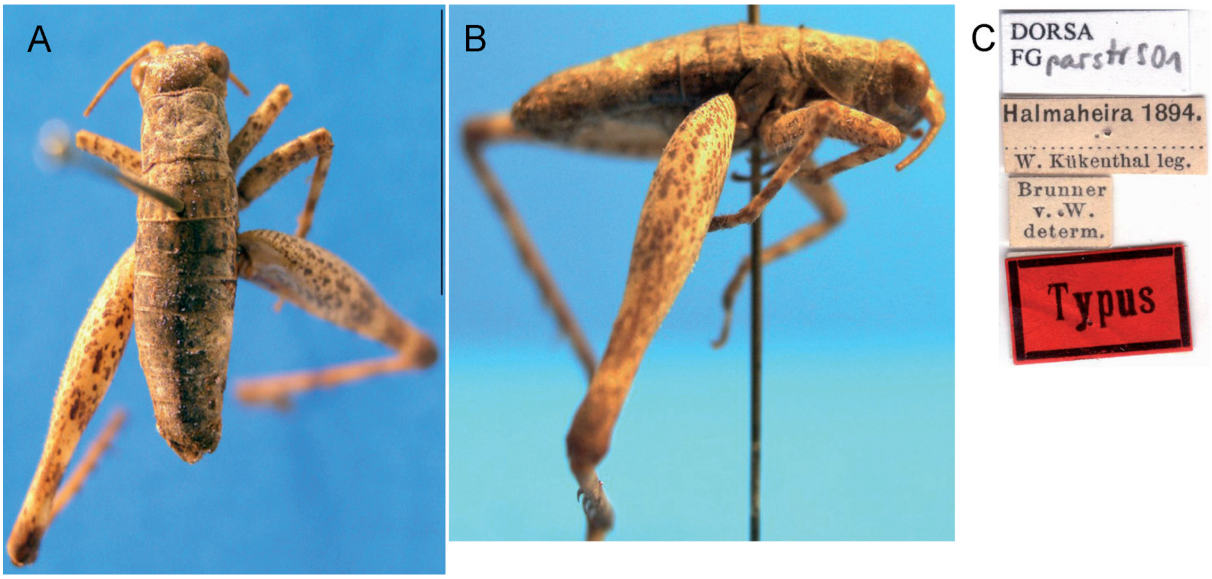

Fig. 2. *Platybinthus striolatus* (Brunner von Wattenwyl, 1898) gen. et comb. nov., holotype, ♂ juvenile (SMFD). **A**. Dorsal view. **B**. Lateral view. **C**. Specimen label. Scale bar = 10 mm. Images obtained from Orthoptera Species File online (Cigliano *et al.* 2022).

Tegminal venation

1A–4A = first to fourth anal veins
c1–3 = first to third cells of C alignment
CuA = anterior cubital vein
CuA1, CuA2 = first, second, … bifurcations of CuA
CuP = posterior cubital vein
d1 cell (mirror) = first cell(s) of D alignment
d2 = second cell of D alignment
e1 = first cell of E alignment
ha = harp area
M = median vein
R = radial vein
Sc = subcostal vein

Measurements

FIIIL = length of hind femora
FIIIW = width of hind femora
FWL = forewing length
FWW = forewing width (at the level of maximal width)
Ias = inner spines on TIII dorsal side, above the spurs
Ibs = inner spines on TIII dorsal side, between the spurs
Oas = outer spines on TIII dorsal side, above the spurs
Obs = outer spines on TIII dorsal side, between the spurs
OL = ovipositor length
PronL = pronotum length
PronW = pronotum width
TIIIL = length of hind tibiae
TaIIIs = spines on outer edge of third hind tarsomere, not including the apical spine

Phylogenetic study

DNA sampling and sequence assembly

New sequence data were obtained from one historical dry insect specimen of each of the three species recognised in the new genus *Platybinthus* gen. nov.: lectotype of *P. punctatus* gen. et comb. nov, (MNHN), a paratype of *P. sandyi* gen. et sp. nov. (MZB), and a male attributed to *P. striolatus* gen. et comb. nov. (ZIN). DNA extractions and bank preparations were carried out at Service de Systématique Moléculaire and at the BOEM lab of the MNHN. Total genomic DNA of the three species were extracted from a median leg, using a DNeasy Blood and Tissue Kit (Qiagen Inc.) following the manufacturer's instructions. We used this relatively non-destructive method because it avoided damaging the legs of type specimens, which were dried after DNA extraction and replaced on the specimens. The extracts were then used for library preparation in a Genome Skimming approach (Straub *et al.* 2012) as presented in Salazar *et al.* (2020). We assessed total DNA with a QubitTM dsDNA High-Sensitivity Assay Kit (Life Technologies, Paisley, UK) with a Fluorescence Microplate Reader in 1.0 µL of sample. The molecular weight of the fragmented DNA sample was analysed in agarose gel electrophoreses (3.0 µL DNA sample plus BG 1.0 µL; gel agarose 1% in TAE buffer (Tris-acetate-EDTA) 1.0 ×; migration buffer TAE 0.5 ×; migration time 20 min) before and after the sonication of the DNA. We then used the NEBNext_UltraTM II DNA Library Prep Kit for Illumina (New England BioLabs, Ipswich, MA, USA; dsDNA protocol) with a modified version of the protocol based on Meyer & Kircher (2010). After library preparation, total genomic DNA was quantified with a QubitTM dsDNA (HS) Assay Kit using QubitTM Fluorometer (Life Technologies, Carlsbad, CA, USA) in 1.0 µL of sample. Libraries were then analysed with a Bioanalyzer 2100 DNA 1000 series II chip (Agilent Technologies, Santa Clara, CA, USA) (High Sensitivity DNA Assay). Pooled libraries were sequenced as paired-end reads (150 bp) on an Illumina Novaseq SP-PE150 at the Plateforme MGX - Montpellier GenomiX (France).

Sequencing reads from both paired-end libraries were imported in Geneious ver. 9.0.2 (Biomatter Ltd., New Zealand, www.geneious.com), then filtered and trimmed by quality using the BBDuk plugin (minimum quality score of 30 and minimum length of reads of 30 bp). We then extracted sequences of interest from the total read using the *Map to reference* option in Geneious [Custom sensibility, fine tuning: iterate up to 10 times; Maximum Mismatches Per Read 30]. Available sequences of the mitochondrial markers *12S rRNA* gene (*12S*, amplicon ~400 bp), and the *cytochrome c oxidase subunit 1* (*CO1*, ~750 bp) used in previous molecular phylogenetic studies of the Eneopterinae crickets were used

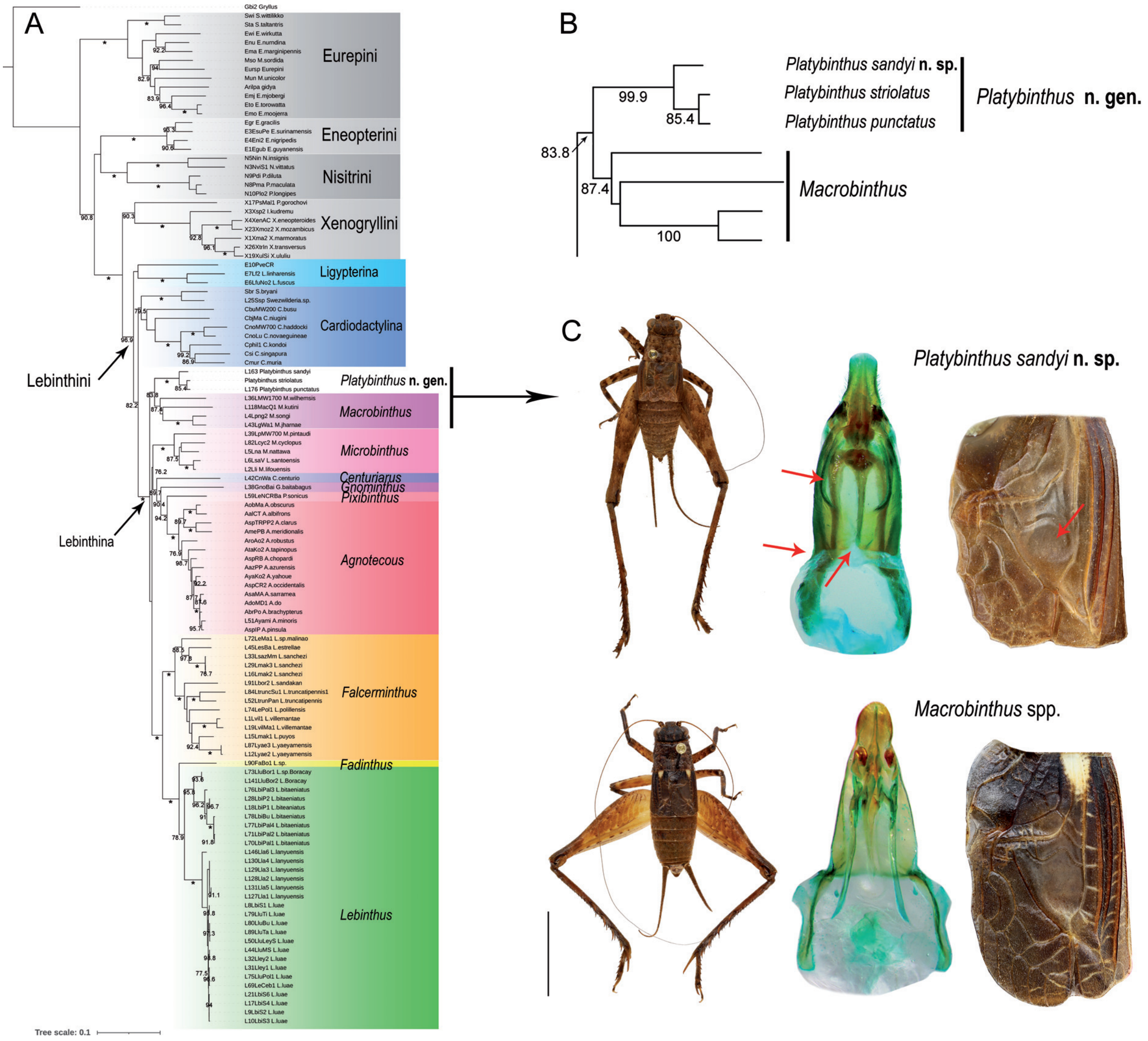

Fig. 3. A. Maximum likelihood phylogenetic tree based on concatenated sequences of eight molecular markers. Values under branches indicate bootstrap values; bootstrap value > 99 is indicated with an asterisk (*). **B**. Close-up view of the maximum likelihood phylogenetic tree showing the relationships among species of *Platybinthus* gen. nov. and with *Macrobinthus* Robillard & Dong, 2016. **C**. Morphological comparison of the males (habitus, genitalia and FW) between *Platybinthus* and *Macrobinthus*. The red arrows indicate diagnostic characters for *Platybinthus*. Scale bar (for habitus) = 10 mm.

as reference for the *Map to reference* option of Geneious. New sequences obtained from the specimens of *Platybinthus* gen. nov. as described above, were cleaned and checked for sequencing errors in Geneious ver. 9.0.2 and Bioedit ver. 7.0.5.3 (Hall 1999). The sequences generated for this study were deposited in GenBank with accession numbers OP684787–OP684789 (*CO1*) and OP686540–OP686542 (*12S*).

Phylogenetic analysis

The phylogenetic relationships of *Platybinthus* gen. nov. and the position of the genus within Lebithini were estimated by combining the new sequence data with molecular data sets from the species-level analyses in Tan *et al*. (2021), representing DNA markers from eight genes, five from the mitochondrial and three from the nuclear genomes for 80 eneopterine species and one more distant species belonging to the subfamily Gryllinae Saussure, 1893 (*Gryllus bimaculatus* De Geer, 1773 used as most external outgroup). The sequences were aligned with Mafft ver. 7 online (Kuraku *et al.* 2013; Katoh *et al.* 2017), and were concatenated in SequenceMatrix ver. 1.7.8 (Vaidya *et al.* 2011). The concatenated dataset (eight markers) was then analysed using Maximum Likelihood (ML), with data partitioned by gene marker and the best model for each marker found using IQ-TREE modelfinder (Kalyaanamoorthy *et al.* 2017). ML analyses were run using the IQ-TREE ver. 1.6.2 web portal (Nguyen *et al.* 2015) (http://iqtree.cibiv.univie.ac.at/; Trifinopoulos *et al.* 2016) using the option 'Edge-unlinked partitions'. Clade support was assessed using non-parametric bootstrap; for each analysis 1000 bootstrap replicates were conducted. Nodes supported by bootstrap support values (BS) ≥75% were considered well supported.

Results

Our study results in the following taxonomic treatments and nomenclatural acts: the new genus *Platybinthus* gen. nov. from Halmahera Island and nearby islands is described. Two species previously classified in *Lebinthus* are redescribed and transferred to *Platybinthus* as new combinations, and one new species, *Platybinthus sandyi* gen. et sp. nov. is described.

The maximum likelihood tree resulting from the phylogenetic analysis yielded a largely robust topology with the three species of *Platybinthus* forming a robust clade (BS of 99.9%) corresponding to the sister group of the genus *Macrobinthus* Robillard & Dong, 2016 from New Guinea and Northern Australia with a good support (BS of 83.8%) (Fig. 3). Within *Platybinthus* gen. nov., the new species *P. sandyi* gen. et sp. nov. from Morotai Island is found as the sister group of the two other species, both from Halmahera (Fig. 3).

Systematic part

Class Insecta Linnaeus, 1758
Order Orthoptera Latreille, 1793
Suborder Ensifera Chopard, 1920
Superfamily Grylloidea Laicharting, 1781
Family Gryllidae Laicharting, 1781
Subfamily Eneopterinae Saussure, 1874
Tribe Lebinthini Robillard, 2004
Subtribe Lebinthina Robillard, 2004

Genus ***Platybinthus*** gen. nov.
urn:lsid:zoobank.org:act:31113AC2-ED96-4949-95A5-E8F0879B351B

Type species

Piestodactylus punctatus Brunner von Wattenwyl, 1898.

Diagnosis

Among the genera of Lebinthina, species of *Platybinthus* are average to large sized with a dark brown colouration. *Platybinthus* is mainly characterised by male genitalia with pseudepiphallus middle part forming a dorsal ovular disk.

General shape close to that of *Macrobinthus* and *Rugabinthus*, both mostly from New Guinea. Eyes prominent and large as in *Macrobinthus* and *Rugabinthus*. Microptery in both sexes, FWs not reaching mid-length of abdomen. Female FWs shorter than in males, very slightly overlapping, rounded posteriorly as in *Macrobinthus* and *Rugabinthus*. Ovipositor nearly as long as FIII; apex faintly denticulate dorsally. Copulatory papilla conical, with a wide basal sclerite and a well-developed apex slightly sclerotized and indented. Male FWs more resemble that of *Macrobinthus*, from which it slightly differs by main oblique vein partly differentiating a false mirror in harp posterior angle. Likewise, mirror only slightly differentiated, as in *Macrobinthus*. CuA clearly curved inwards posteriorly, as in *Macrobinthus* (almost straight in *Rugabinthus*). Some characters of male genitalia more resemble some species of *Rugabinthus* in that it is elongated and slender, its basal margin distinctly indented in the middle and the posterior apex spoon-like, without paired lophi.

In contrast, *Platybinthus* differs from *Rugabinthus* by the male FWs with a shield-shaped harp (triangle-shaped in *Rugabinthus*) and absence of strong diagonal fold carrying diagonal vein and cell c1, and separating FWs in two distinct areas (characteristic feature of *Rugabinthus*). The new genus also differs by hind legs distinctly longer (twice as long as body size).

Etymology

Genus named after the old genus name ‘*Platydactylus*’ to which several early described eneopterine species belonged, including the type species, before the name was recognised as an homonym of a genus of Squamata Oppel, 1811. Therefore we use the prefix ‘*Platy*’ (referring to *Platydactylus*) with the suffix ‘*binthus*’ referring to Lebinthina.

Description

Size medium for the subtribe (Figs 1–2, 4). Dorsum of head rounded, prolonged by rectangular fastigium distinctly wider than long (Fig. 4A–C). Head dorsum uniformly black (Fig. 5A–C). Eyes large and prominent. Head roundly triangular in facial view, almost as wide as high (Fig. 5D–F). Face finely rugulose, colouration usually cream-coloured and with lateral parts dark (Fig. 5D–F). Maxillary palpi with apical and subapical segments cream-coloured (slightly darkened apically), other segments black. Ocelli large, pale-coloured, forming a rather wide triangle; median ocellus rounded, lateral ocelli similar sized and rounded. Scapes small. Antenna with basal segments cream-coloured with tint of black, otherwise dark. Lateral part of head black with a narrow yellow band behind eyes (Fig. 6). Pronotum dorsal disk trapezoidal, on average 1.6 times as wide as long, its anterior margin distinctly emarginated in the middle, posterior margin straight, mostly black. Lateral lobes longer than wide, uniformly black (Fig. 6). Legs (Figs 1–2, 4): TI with two tympana; inner tympanum covered by a flat sclerotized expansion, its membrane visible along a small longitudinal slit only; outer tympanum ellipsoidal, its membrane transversally plicate in dorsal half. TI with two inner and two outer apical spurs. TII with two inner and two outer spurs. Hind legs very long (twice as long as body size); FIII muscular; TIII serrulated on their whole length, with four pairs of subapical spurs and three pairs of apical spurs; inner spurs long and curved, outer spurs shorter and straight. Legs I and II light brown to yellow brown, femora with brown spots and longitudinal patterns, tibiae with rings. TaIII-1 with 4–5 spines on dorsal outer edge and without any on dorsal inner edge. TIIIs and tarsomeres brown with spines and spurs with dark apices. FWs short, barely reaching abdomen mid-length; hind wings absent. Cerci well developed. Abdomen: tergites dark brown, with faint pale spots along posterior margins.

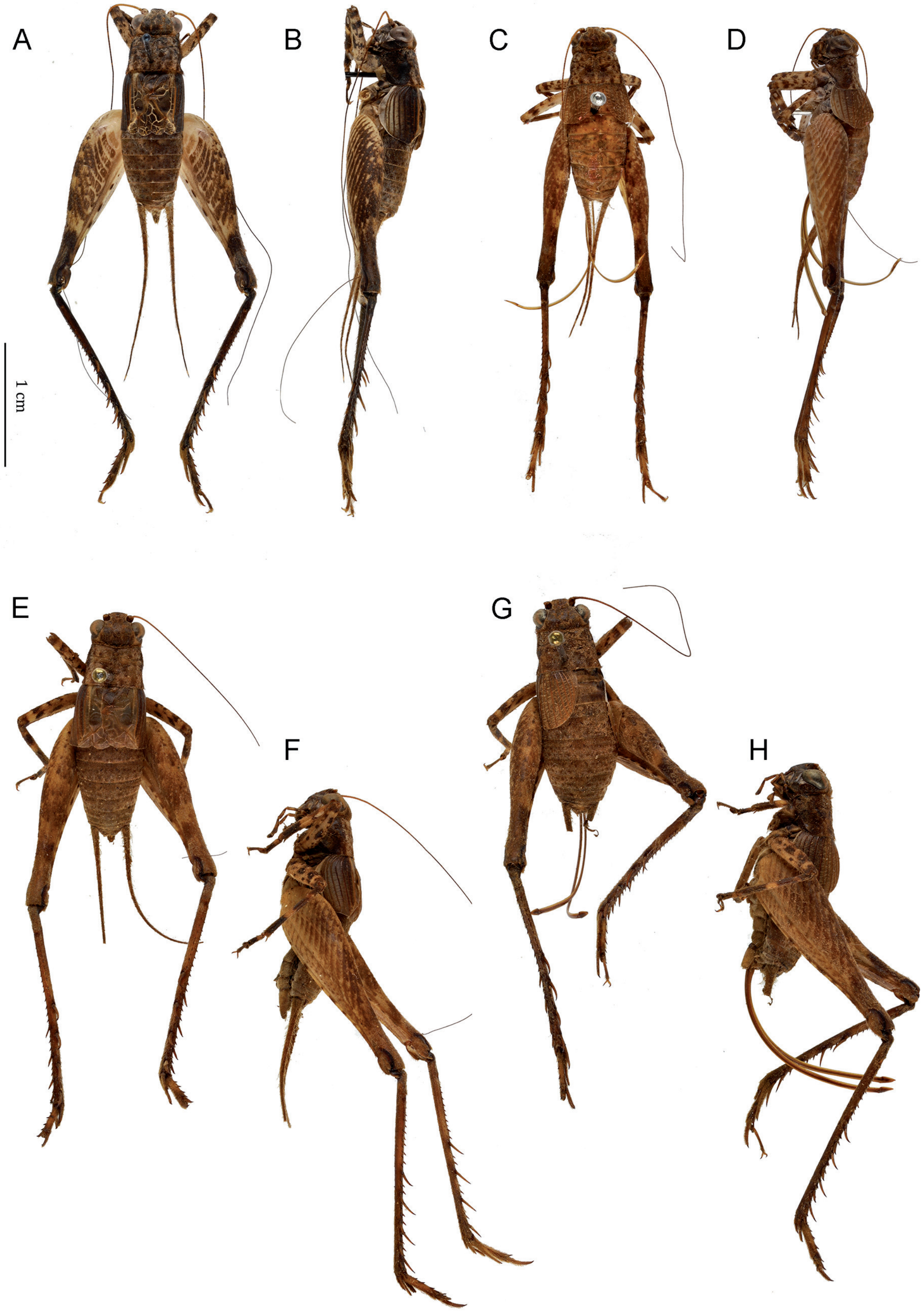

Fig. 4. Habitus. **A–D**. *Platybinthus striolatus* (Brunner von Wattenwyl, 1898) gen. et comb. nov. (♂ ZIN; ♀ MNHN-ENSIF1449). **E–H**. *Platybinthus sandyi* gen. et sp. nov. (♂ holotype MZB.ORTH.1786; ♀ paratype MZB.ORTH.1787). **A–B, E–F**. ♂♂. **C–D, G–H**. ♀♀. Scale bar = 1 cm.

Male

Metanotal glands absent. Dorsal field of FWs slightly shorter than lateral field. FWs 1.4–1.6 times as long as wide, on average 1.7 times as long as pronotum dorsal disk. FW venation (Fig. 7A–B): 1A vein (file) transverse part straight, bisinuate anteriorly to angle, forming a notch in most species. Diagonal vein strong. Harp shield-shaped, with a characteristic fold, longer than wide, occupying approximately half of dorsal field surface, with a strong transverse, bisinuate harp vein, and a secondary one in anterior corner of harp. Cell c1 widened posteriorly. CuA anterior part strong throughout, slightly curved inward near apex. Mirror (d1) little differentiated from other cells of D alignment. Apical field very short, including one cell alignment posterior to mirror. Lateral field with four strong longitudinal veins ventral to Sc; Sc without projection. Subgenital plate elongated, clog-shaped. Epiproct and subgenital plate brown.

Genitalia (Fig. 8A–F). Pseudepiphallus elongate and slender, its basal margin distinctly indented in the middle; median part of pseudepiphallus forming a dorsal ovular disk dorsally; posterior apex elongated, without paired lophi, forming a median spoon-like expansion shorter than rest of pseudepiphallus. Rami short, shorter than half of pseudepiphallus length. Pseudepiphallic parameres average sized, ventral lobe strongly sclerotized. Ectophallic apodemes parallel and long, usually reaching beyond anterior margin of pseudepiphallic sclerite. Ectophallic arc well sclerotized, curved. Ectophallic fold with two ventral

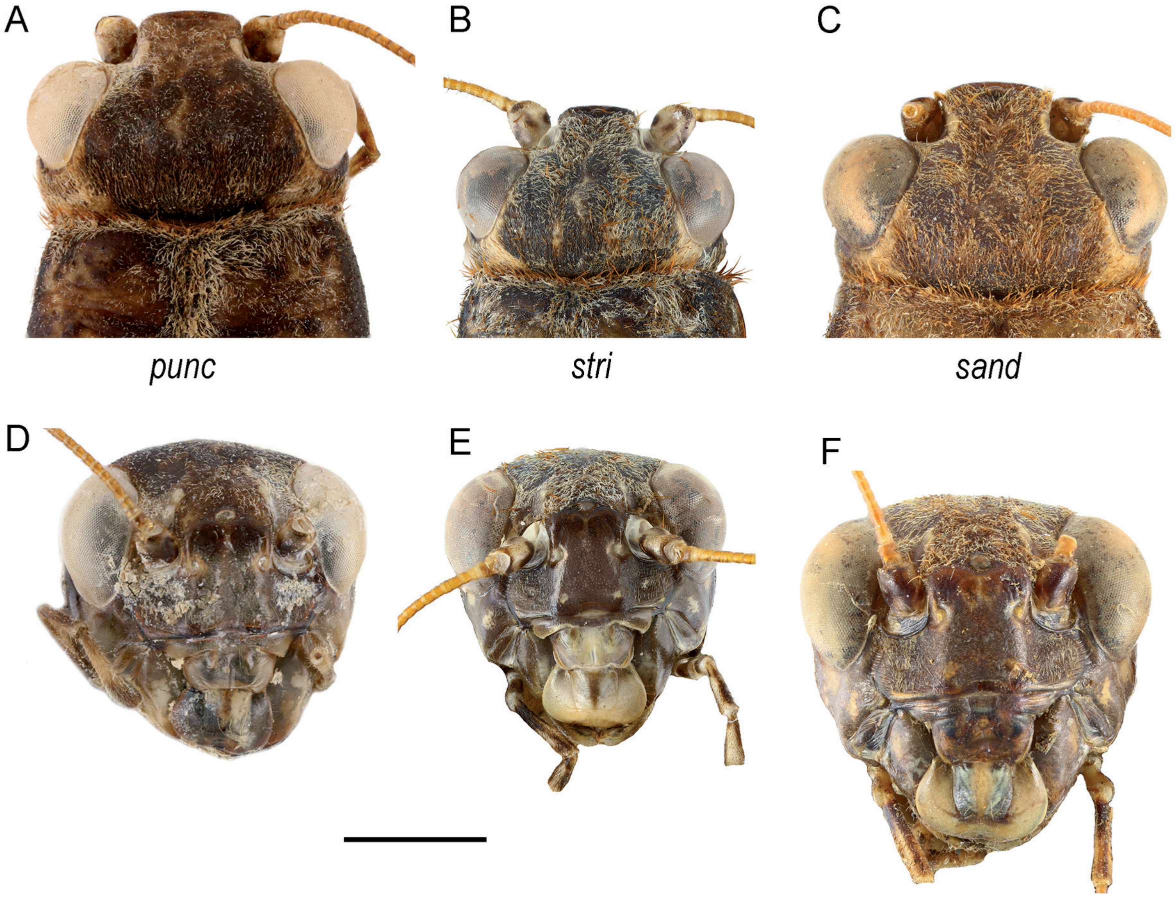

Fig. 5. Head in dorsal view (A–C) and face in anterior view (D–F). **A, D**. *Platybinthus punctatus* (Brunner von Wattenwyl, 1898) gen. et comb. nov., syntype, ♀ (MNHN-EO-ENSIF1448). **B, E**. *Platybinthus striolatus* (Brunner von Wattenwyl, 1898) gen. et comb. nov., ♂ (ZIN). **C, F**. *Platybinthus sandyi* gen. et sp. nov., holotype, ♂ (MZB.ORTH.1786). Scale bar = 2 mm.

sclerites of variable shapes, extending posteriorly but not reaching posterior apex of pseudepiphallus. Endophallic sclerite comprising a long and straight anterior region, a short median expansion and short lateral arms posteriorly. Endophallic apodeme with well-developed lateral lamellae and a triangular dorsal median crest.

Female

FWs very short, not reaching base of first tergite, very slightly overlapping. Cells of dorsal field brown, dorsal field with strong orange longitudinal veins and very weak yellow transverse ones; lateral field with four longitudinal veins (Fig. 7C–D). Posterior corner between dorsal and lateral fields forming an acute angle. Dorsal field apex oblique.

Genitalia (Fig. 8G–H). Ovipositor rather short, apex faintly denticulate dorsally. Copulatory papilla conical, with a wide basal sclerite and a well-developed apex slightly sclerotized and indented.

Distribution

INDONESIA: Halmahera Island of Maluka and nearby island of Morotai.

Included species

Platybinthus punctatus (Brunner von Wattenwyl, 1898) gen. et comb. nov. from Halmahera Island, Indonesia.

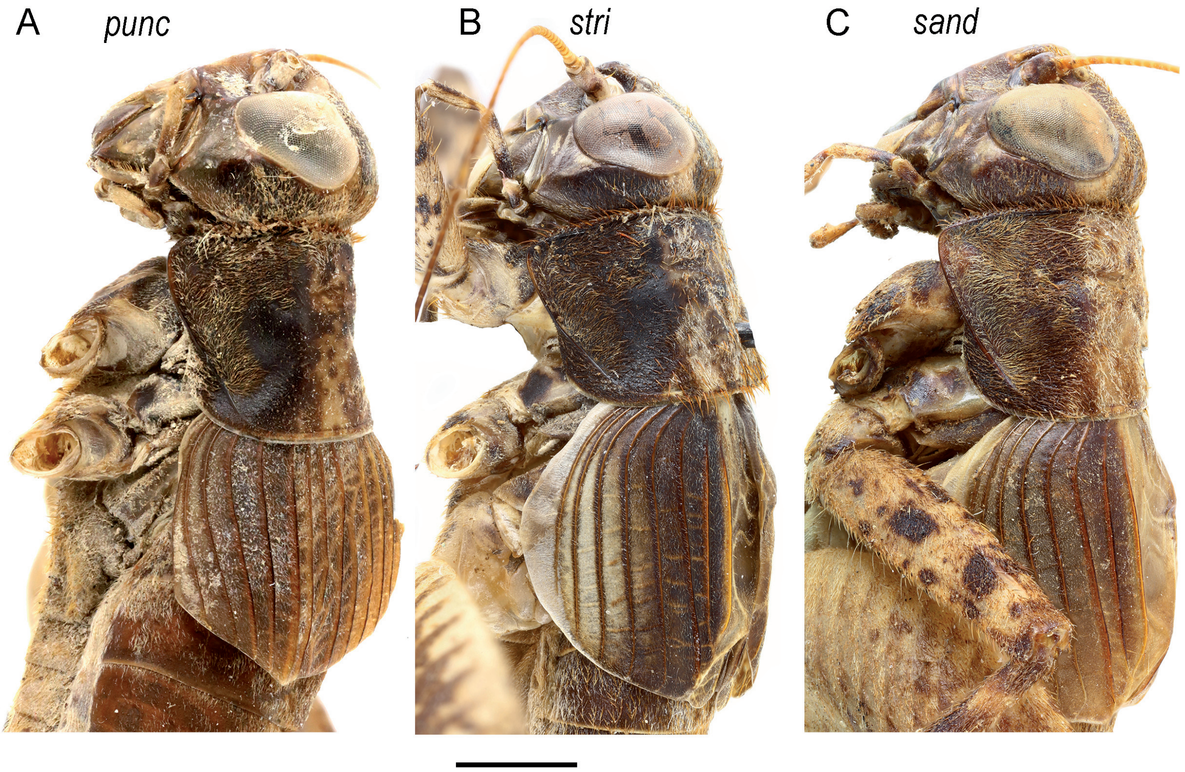

Fig. 6. Body in lateral view. **A**. *Platybinthus punctatus* (Brunner von Wattenwyl, 1898) gen. et comb. nov., syntype, ♀ (MNHN-EO-ENSIF1448). **B**. *Platybinthus striolatus* (Brunner von Wattenwyl, 1898) gen. et comb. nov., ♂ (ZIN). **C**. *Platybinthus sandyi* gen. et sp. nov., holotype, ♂ (MZB.ORTH.1786). Scale bar = 2 mm.

Platybinthus striolatus (Brunner von Wattenwyl, 1898) gen. et comb. nov. from Halmahera Island, Indonesia.

Platybinthus sandyi gen. et sp. nov. from Morotai Island, Indonesia.

Platybinthus punctatus (Brunner von Wattenwyl, 1898) gen. et comb. nov.

Figs 1, 3, 5A, D, 6A, 8G

Piestodactylus punctatus Brunner von Wattenwyl, 1898: 278.

Eurepa punctata – Kirby 1906: 89. — Chopard 1968: 355.
Lebinthus punctatus – Robillard 2011: 58.

Diagnosis

Platybinthus punctatus gen. et comb. nov. differs from *Platybinthus striolatus* gen. et comb. nov. by larger size, and female copulatory papilla with apex narrowed and bilobed (instead of narrowed and obtusely rounded). Only faint differences of female FW venation and colouration with *Platybinthus sandyi* gen. et sp. nov.

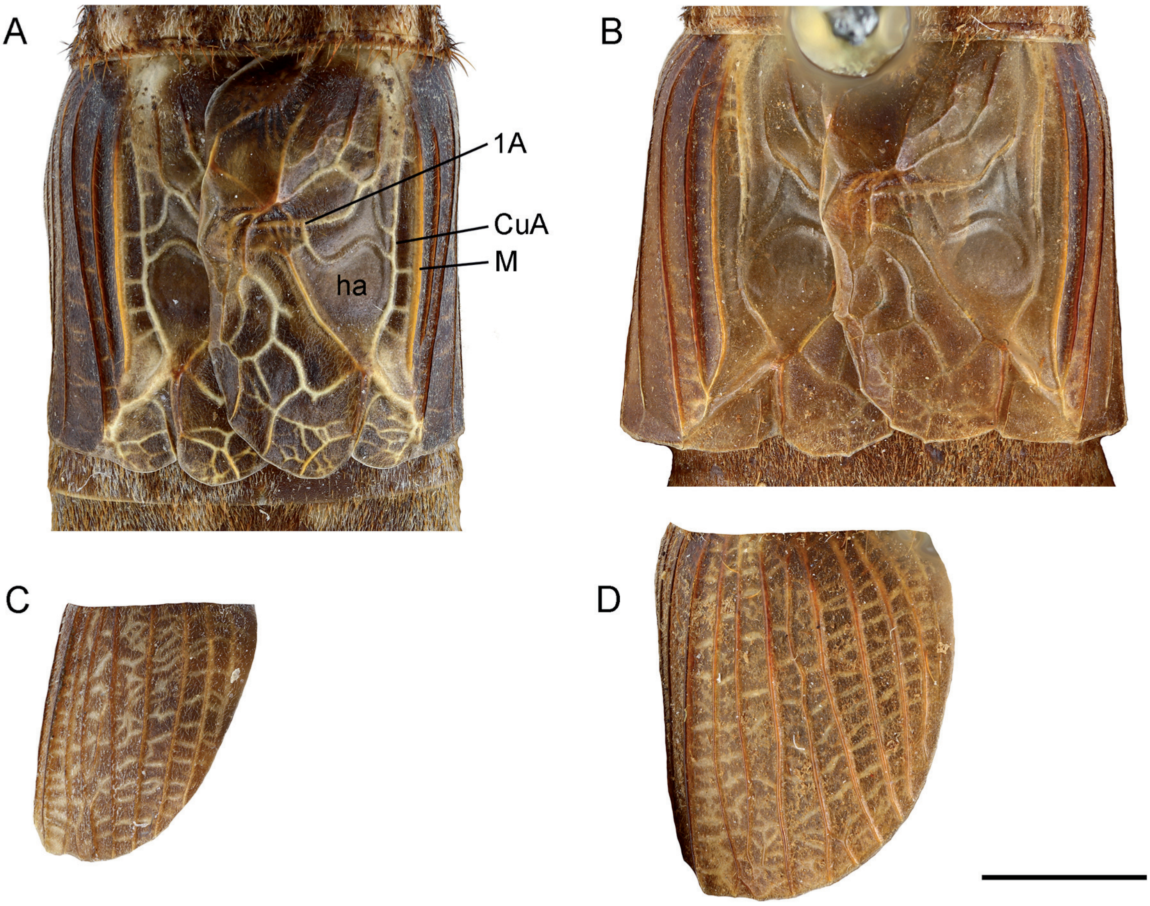

Fig. 7. FWs. **A–B**. ♂♂. **C–D**. ♀♀. **A, C**. *Platybinthus striolatus* (Brunner von Wattenwyl, 1898) gen. et comb. nov. (♂ ZIN; ♀ MNHN-ENSIF1449). **B, D**. *Platybinthus sandyi* gen. et sp. nov. (♂ holotype MZB.ORTH.1786; ♀ paratype MZB.ORTH.1787) Scale bar = 2 mm.

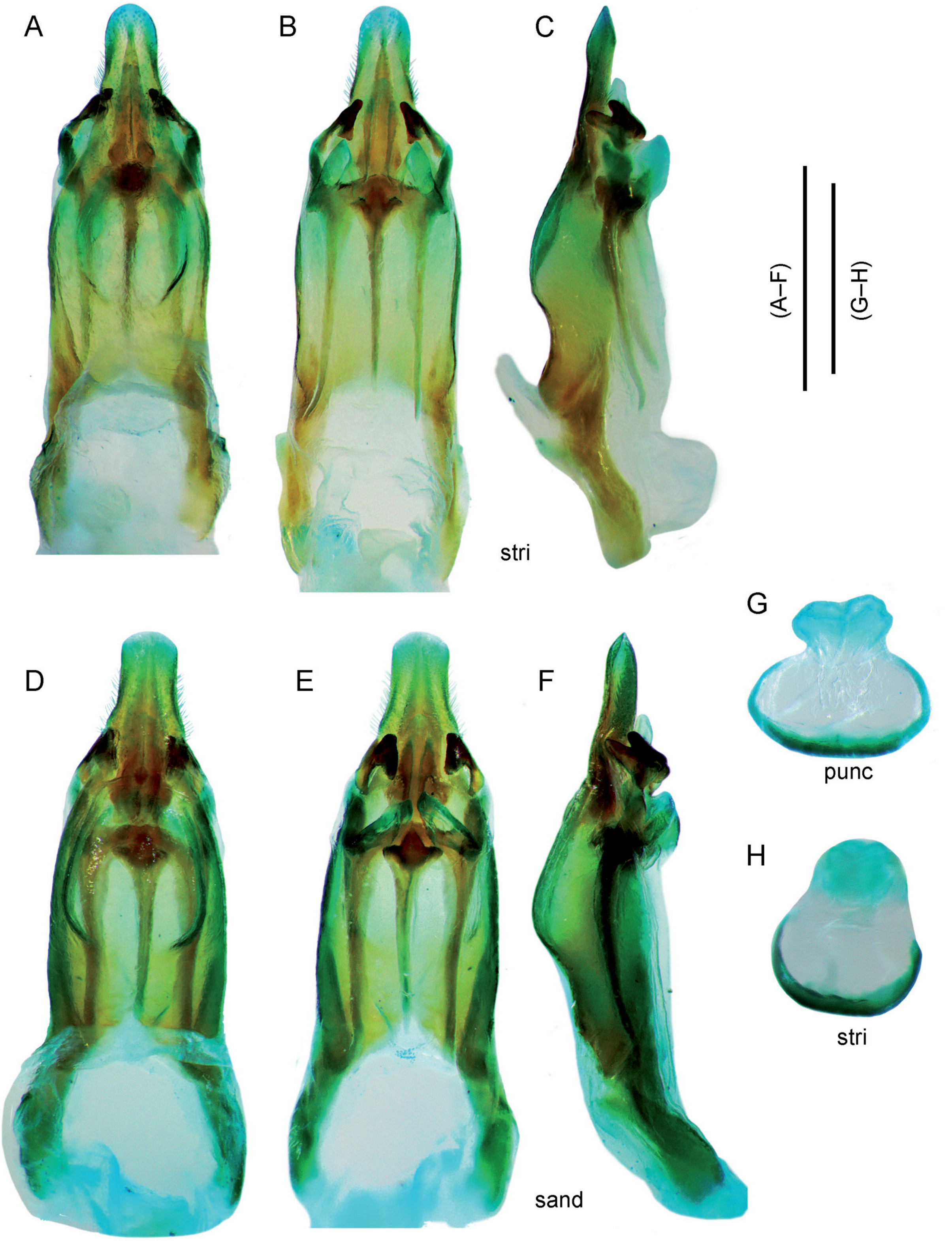

Fig. 8. Genitalia. **A–F**. ♂♂. **G–H**. ♀♀. **A–C, H**. *Platybinthus striolatus* (Brunner von Wattenwyl, 1898) gen. et comb. nov. (ZIN). **D–F**. *Platybinthus sandyi* gen. et sp. nov., holotype (MZB.ORTH.1786) **G**. *Platybinthus punctatus* (Brunner von Wattenwyl, 1898) gen. et comb. nov., syntype (MNHN-EO-ENSIF1448). Scale bars: A–F = 1 mm; G–H = 0.5 mm.

Material examined

Syntype

INDONESIA – **Maluka** • 1 ♀; Halmaheira [= Halmahera Island]; 1894; W. Kükenthal leg.; molecular sample L176; GenBank accession: OP684789 and OP686541; MNHN-EO-ENSIF1448.

Additional specimens

INDONESIA – **Maluka** • 1 ♀; Halmahera [Island], Gamkonora; 4 May 1931; G. Heinrich leg.; MNHN-EO-ENSIF1430.

Remark

The only type specimen examined from the original type series is a female from MNHN, but male syntypes exist according to the male measurements and the drawing of male FW venation presented in Brunner von Wattenwyl (1898). Due to the lack of male characters, the comparison with other species of the genus remains limited. Molecular data obtained for the three species of the genus support the fact that they should be considered as different taxa, despite the lack of detailed information on *P. punctatus* gen. et comb. nov. Further information will have to be provided by future studies.

Redescription

Female

FWs reaching middle of fourth tergite, faintly overlapping. Cells of dorsal field dark brown, not translucent, with orange strong longitudinal veins and white weak transverse ones; with 9 veins on dorsal field, 4 on lateral field. Dorsal field apex truncated, lateral field posterior margin oblique.

GENITALIA. Ovipositor as long as FIII, apex not denticulate dorsally. Copulatory papilla rounded; basal sclerite forming a semi-circular ring with a small basal plate; bent at apical third in lateral view; apex narrowed and bilobed (Fig. 8G).

Measurements

See Table 1.

Ecology

Unknown.

Distribution

INDONESIA: Maluka: Halmahera Island.

Type locality

INDONESIA: Maluka: Halmahera Island.

Calling song

Unknown.

Platybinthus striolatus (Brunner von Wattenwyl, 1898) gen. et comb. nov.

Figs 2–3, 4A–D, 5B, E, 6B, 7A, C, 8A–C, H

Paraeneopterus striolatus Brunner von Wattenwyl, 1898: 279.

Lebinthus striolatus – Kirby 1906: 88. — Karny 1915: 68. — Shiraki 1930: 233. — Chopard 1968: 354. — Hsiung 1993: 26. — Ichikawa *et al*. 2000: 275.

Table 1. Measurements of *Platybinthus* gen. nov. (in mm).

	PL	PW	FWL	FWW	FIIIL	FIIIW	TIIIL	OL
Platybinthus punctatus gen. et comb. nov.								
♀ syntype (MNHN-EO-ENSIF1448)	3.2	5.2	4.2	3.0	16.4	4.3	15.0	15.5
♀ (MNHN-EO-ENSIF1430)	3.6	5.1	4.2	3.1	16.5	4.8	14.0	16.9
Platybinthus striolatus gen. et comb. nov.								
♂ (ZIN)	2.8	4.6	5.2	3.5	15.1	4.3	14.1	–
♀ (MNHN-ENSIF1449)	2.7	4.7	3.4	2.3	14.5	3.7	12.8	14.5
Platybinthus sandyi gen. et sp. nov.								
♂ holotype (MZB.ORTH.1786)	3.4	5.1	5.1	3.7	17.1	4.3	16.8	–
♂ paratype (MNHN-EO-ENSIF11342)	3.8	5.3	7	4.3	19.2	5.5	17.4	–
♀ paratype (MZB.ORTH.1787)	3.4	5.3	4.7	3.4	17.8	4.8	16.8	16.5
♀ paratype (MZB.ORTH.1788)	2.9	4.9	4.1	3.0	11.9	3.4	11.1	9.4

Diagnosis

Platybinthus striolatus gen. et comb. nov. differs from *P. punctatus* gen. et comb. nov. by smaller size and by female copulatory papilla with apex narrowed and obtusely rounded. It also differs from *Platybinthus sandyi* gen. et sp. nov. by male genitalia with pseudepiphallus dorsal disk smaller, margins at the apex tapering (instead of straight) and by pseudepiphallic parameres with ventral lobe cylindrical (instead of appearing triangular and flattened).

Material examined

Holotype

INDONESIA – **Maluka** • ♂ (juvenile); Halmaheira [Halmahera Island]; W. Kükenthal leg.; Brunner v. W. det.; DORSA FG; #Orth.57; SMFD.

Additional specimens

INDONESIA – **Maluka** • 1 ♀; Halmaheira [= Halmahera Island]; 1894; W. Kükenthal leg.; 21.852; MNHN-ENSIF1449 • 1 ♂; prov. Maluka Utara [northern Maluka], Halmahera Island, env. of vill. Subaim to S from vill. Lolobata (not far of it) near coast of Wasile Bay; 27 Jan.–1 Feb. 2011; A. Gorochov leg.; molecular sample L81-Lpc1; GenBank accession: OP684788 and OP686542; ZIN.

Remarks

The type (holotype) specimen in SMFD is a male juvenile. It is the only known specimen of the species, and probably the only specimen examined by Brunner von Wattenwyl (1898), according to the measurements that he provided. Given the general shape and colouration pattern on the legs, we hypothesise here that this juvenile belongs to the same species as the adult specimens from Halmahera found in MNHN and ZIN, and differing from the type of the species *P. punctatus* gen. et comb. nov. Although the evidence is weak, and not being able to sequence the old type juvenile, we refrained from describing a new species from these adult specimens; instead we propose to stabilise the name *P. striolatus* gen. et comb. nov. by redescribing the species based on them.

As a consequence of the very brief original description and limited characters available on the type specimen, the name *Lebinthus striolatus* has been mentioned multiple times in databases, books and publications based on erroneous identifications of specimens of other species of *Lebinthus* from Taiwan (e.g., Shiraki 1930; Ichikawa *et al.* 2000). Those specimens and records probably correspond to one of the two species of Lebinthina documented in Taiwan, *Lebinthus lanyuensis* Oshiro, 1996 or *Falcerminthus yaeyamensis* (Oshiro, 1996), which were wrongly identified as *Lebinthus striolatus* based on their colouration matching the evocative 'striolated' name.

Redescription

Size small for the genus (Fig. 4A–D). Vertex and fastigium very dark brown; dorsum of head at posterior end with three longitudinal pale bands (Fig. 5B); back of eyes with a cream-coloured band. Scapes white, with some dark patterns (more in the ventral). Antennae orange brown. Fastigium verticis and frons dark grey-brown (Fig. 5E). Mouthparts whitish, mandibles grey-brown mottled with white; clypeus and labrum white; maxillary palpi with segments white with some dark stripes (more prominent on external surface) (Fig. 5E). Gena grey with a triangular white spot beneath eyes and two small white spots nearer to mouthparts. Lateral parts of head dark brown behind eyes (Fig. 6B). Pronotum dorsal disk yellow mottled with dark brown, anterior and posterior margins straight; lateral lobes very dark brown (Fig. 6B). Legs: FI–II pale with numerous dark brown spots and incomplete ring near apices, knee area dark brown; TI–II pale with three broad dark brown rings; tarsomeres 1 and 3 of each leg yellow basally then brown; FIII brown finely mottled with yellow and dark brown, knees dark brown; TIII homogeneously dark brown, spurs lighter brown with dark tips. Abdominal tergites dark brown with faint dark and light spots. Cerci brown with faint apical rings.

Male

FW reaching apex of third tergite. FW colouration (Fig. 7A): dorsal field cells mostly brown, plectrum area and basal area darker, with two faint pale spots at the basal and apical end of Cu and M; veins whitish or cream-coloured; M yellow brown, R orange brown. Lateral field cells dark brown in dorsal half and whitish in ventral half; longitudinal veins red brown with cross-veins cream-coloured. FW venation: harp vein bordering false mirror strongly sinuous. Anal area of dorsal field extending beyond apex lateral field, apex of dorsal field obliquely rounded.

GENITALIA (Fig. 8A–C). Pseudepiphallus elongate and slender, its basal margin distinctly indented in the middle, posterior apex rounded, slightly swollen at the apex. Rami short, shorter than half the pseudepiphallus length. Pseudepiphallic parameres with ventral lobe cylindrical. Ectophallic apodemes parallel and long, slightly reaching beyond anterior margin of pseudepiphallic sclerite. Endophallic sclerite with long anterior region not reaching anterior margin of pseudepiphallic sclerite and a short median expansion and small lateral arms posteriorly. Endophallic apodeme with lateral lamellae curved and pointing anteriorly.

Female

FWs reaching middle of fourth tergite, faintly overlapping. Cells of dorsal field dark brown, not translucent, with strong orange longitudinal veins and weak yellow transverse ones; with 9 longitudinal veins on dorsal field, 4 on lateral field (Fig. 7C). Dorsal field apex truncated, lateral field posterior margin oblique.

GENITALIA. Ovipositor as long as FIII, apex slightly denticulate dorsally. Copulatory papilla rounded; basal sclerite forming a semi-circular ring with a small basal plate; apex narrowed and obtusely rounded (Fig. 8H).

Measurements

See Table 1.

Ecology

Unknown.

Distribution

INDONESIA: Maluka: Halmahera Island.

Type locality

INDONESIA: Maluka: Halmahera Island.

Calling song

Unknown.

Platybinthus sandyi gen. et sp. nov.

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Figs 3, 4E–H, 5C, F, 6C, 7B, D, 8D–F

Diagnosis

This new species differs from *Platybinthus striolatus* gen. et comb. nov. by its larger size and by male genitalia with pseudepiphallus with dorsal disk larger, apical margins straight and parallel and by pseudepiphallic parameres with ventral lobe appearing triangular and flattened.

Etymology

This species is dedicated to Sandy Robillard, the late brother of the first author.

Material examined

Holotype

INDONESIA • ♂; [Maluku] Sangi en Talaud, Goegoeti [Indonesia: Maluku, Morotai, Pilowo, Guguti (2°6′3.63″ N, 128°15′36.83″ E)]; Jun. 1926; Erie leg.; molecular sample L163; GenBank accession: OP684787 and OP686540; MZB.ORTH.1786.

Paratypes

INDONESIA • 1 ♀; same collection data as for holotype; MZB.ORTH.1787 • 1 ♀; same collection data as for holotype; MZB.ORTH.1788 • 1 ♂; Morotai, Goegoeti [Maluku, Morotai, Pilowo, Guguti (2°6′3.63″ N, 128°15′36.83″ E)]; 1926; Erie leg. (ex MZB.ORTH.1839); MNHN-EO-ENSIF11342.

Remark

The labels of all the type specimens mention "Sangi en Talaud", seemingly referring to the archipelago of Sangi and Talaud, near northern Sulawesi. However, the manuscript addition of the term Goegoeti on the labels of all the specimens of the type series, completed with the term "Morotai" on the label of one male specimen, suggests that the type locality may rather correspond to the locality of Pilowo, Goegoeti (Guguti) (2°6′3.63″ N, 128°15′36.83″ E), in the island of Morotai, Maluku.

Description

Size relatively large for the genus (Fig. 4E–H). Vertex and fastigium brown, lighter in colouration than *P. punctatus* gen. et comb. nov. (Fig. 5C); back of eyes with a cream-coloured band. Scapes brown.

Antennae orange brown. Fastigium verticis and frons brown to dark brown (Fig. 5F). Mandibles mostly brown; clypeus brown with some dark patterns, labrum pale yellow with two dark longitudinal stripes in the middle; maxillary palpi with segments white with some dark stripes (more prominent on external surface) (Fig. 5F). Gena dark brown with a triangular white spot beneath eyes and two small white spots nearer to mouthparts. Lateral parts of head dark brown behind eyes (Fig. 6C). Pronotum dorsal disk yellow mottled with dark brown, anterior and posterior margins straight; lateral lobes very dark brown (Fig. 6C). Legs: FI–II pale with numerous dark brown spots and incomplete ring near apices, knee area dark brown; TI–II pale with three broad dark brown rings; tarsomeres 1 and 3 of each leg yellow basally then dark brown; FIII brown finely mottled with yellow and dark brown, knees dark brown; TIII brown to dark brown, spurs lighter brown with dark tips. Abdominal tergites dark brown with faint dark and light spots. Cerci brown with faint apical rings.

Male

FW surpassing base of third tergite. FW colouration (Fig. 7B): dorsal field cells mostly yellow brown, with two faint pale spots at the basal and apical end of Cu and M; veins pale brown; M yellow brown, R red brown. Lateral field cells dark brown and whitish near ventral margin; longitudinal veins red brown. FW venation: harp vein bordering false mirror strongly sinuous, slightly angular. Anal area of dorsal field not extending beyond apex of lateral field, apex of dorsal field truncated.

GENITALIA (Fig. 8D–F). Pseudepiphallus typical of genus, except dorsal disk larger, posterior apex truncated, lateral margins at the apex straight and parallel. Rami shorter. Pseudepiphallic parameres with ventral lobe appearing triangular and flattened. Endophallic sclerite with long anterior region reaching anterior margin of pseudepiphallic sclerite and a short median expansion and small lateral arms posteriorly. Endophallic apodeme with lateral lamellae pointing laterally.

Female

FWs reaching middle of fourth tergite, faintly overlapping. Cells of dorsal field dark brown, not translucent, with strong orange longitudinal veins and weak yellow transverse ones; with 9 veins on dorsal field, 4 on lateral field (Fig. 7D). Dorsal field apex truncated, lateral field posterior margin oblique.

GENITALIA. Ovipositor as long as FIII, apex very slightly denticulate dorsally. Copulatory papilla not observed (lost in female specimen).

Measurements

See Table 1.

Ecology

Unknown.

Distribution

INDONESIA: Morotai Island near northern Halmahera.

Type locality

INDONESIA: Morotai Island, near northern Halmahera (see remarks).

Calling song

Unknown.

Discussion

The new genus *Platybinthus* presented in this study includes three species, all from Maluka Islands (Halmahera Island and Morotai Island). The three species studied here are unique among Lebinthina by the male genitalia forming a dorsal ovular disk in the middle of the pseudepiphallus and by the harp vein and diagonal tending to define a false mirror in the posterior corner of the harp. Along with the phylogenetic tree supporting a monophyletic clade for these species, we erected the new genus. The species of *Platybinthus* are most similar to *Macrobinthus* and *Rugabinthus* in terms of general shape and morphology, although they appear to share more similar characters with *Macrobinthus* than with *Rugabinthus*. This is also supported by the molecular data, in which our phylogenetic tree suggests that *Macrobinthus* is sister group to *Platybinthus*. While the phylogenetic relationship with *Macrobinthus* seems supported by the phylogenetic results, the relationship can afford further confirmation with more data in terms of more specimens, species and molecular markers. In particular, the relationship with the genus *Rugabinthus*, although less supported by morphological evidence, will have to be tested by including taxa representative of this genus in forthcoming phylogenetic studies.

Within *Platybinthus* gen. nov., the new species *P. sandyi* gen. et sp. nov. is the sister group of the other two species of the genus in the phylogenetic tree. However, more data is also necessary to make more comprehensive comparisons between the three species. Indeed, *P. punctatus* gen. nov. is known only from females and hence male genitalia and FW venation cannot be compared with that of *P. sandyi* and *P. striolatus* gen. nov. Furthermore, although the female copulatory papilla differs distinctly from that of *P. striolatus*, we could not compare the female genitalia with *P. sandyi* (female genitalia was missing in the only available female specimen).

Names and type status attributed here to the specimens of *P. punctatus* gen. et comb. nov. and *P. striolatus* gen. et comb. nov. are also tentative. We could not find and examine presumably-present male syntypes of *P. punctatus* to make morphological comparison with other congeners. Fortunately, the genetic data of the examined female syntype of *P. punctatus*, together with those of *P. striolatus* and *P. sandyi* gen. et sp. nov., allowed us to establish that they can be considered as three different taxa. However, this cannot confirm that the male syntypes and the examined female syntype are of the same species. They may belong to *P. striolatus* (also found in Halmahera Island) or to a completely different and undescribed species of *Platybinthus* gen. nov. (or similar-looking genus). In the case of *P. striolatus*, the holotype is a male juvenile lacking DNA sequence and male genitalia. We can only redescribe the species based on two adult specimens from Halmahera found in MNHN and ZIN hypothesised to be *P. striolatus* based on the general shape and colouration pattern on the legs. Nevertheless, this current work represents only a first step in the study of these species. The species will have to be revised with more details by using more material, molecular data, male of each species and calling signals.

Given the large size and complex geological history of the island of Halmahera and the Maluka Islands, it is likely that several additional species of the genus are awaiting discovery. A diversity comparable to *Agnotecous* Saussure, 1878 (Saussure 1878) in New Caledonia (Desutter-Grandcolas & Robillard 2006; Robillard *et al.* 2010), or to *Macrobinthus* or *Rugabinthus* in the nearby island of New Guinea (Robillard & Su 2018; Tan & Robillard 2022) are thus expected. Further expeditions to discover and describe these species will be crucial to improve the description and knowledge about the species and genus, and how species of *Platybinthus* relate with one another and with other closely-related genera, respectively.

Finally, acoustic data of *Platybinthus* gen. nov. is currently unknown because there were no recent encounters of the species in the field to allow for acoustic recording. The new data not only can assist in species delimitation, but can also reveal new insights into the acoustic signalling and communication behaviours of this subtribe known to present a large diversity of spectral features (Robillard & Desutter-

Grandcolas 2004a; Tan *et al.* 2021). Owing to the presence of false mirror in species of *Platybinthus*, we postulate that their calling songs could be a different spectrum than that of *Macrobinthus*. In conclusion, it is clear that our understanding of *Platybinthus* remains in its infancy.

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