BioOne COMPLETE

The Pink Katydids of Sabah (Orthoptera: Tettigoniidae: Phaneropterinae: Eulophophyllum) with Description of Two New Species

Authors: Ingrisch, Sigfrid, Riede, Klaus, and Beccaloni, George

Source: Journal of Orthoptera Research, 25(2) : 67-74

Published By: Orthopterists' Society

URL: https://doi.org/10.1665/034.025.0205

BioOne Complete (complete.BioOne.org) is a full-text database of 200 subscribed and open-access titles in the biological, ecological, and environmental sciences published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Complete website, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at www.bioone.org/terms-of-use.

Usage of BioOne Complete content is strictly limited to personal, educational, and non - commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

BioOne sees sustainable scholarly publishing as an inherently collaborative enterprise connecting authors, nonprofit publishers, academic institutions, research libraries, and research funders in the common goal of maximizing access to critical research.

Downloaded From: https://complete.bioone.org/journals/Journal-of-Orthoptera-Research on 28 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

The pink katydids of Sabah (Orthoptera: Tettigoniidae: Phaneropterinae: *Eulophophyllum*) with description of two new species

Sigfrid Ingrisch, Klaus Riede, George Beccaloni

(SI, KR) Zoologisches Forschungsmuseum Alexander Koenig, Adenauerallee 160, D- 53113 Bonn, Germany. Email: s.ingrisch@zfmk.de, k.riede@zfmk.de
(GB) The Natural History Museum, Cromwell Road, London, SW7 5BD, UK

Abstract

Two new species of the previously monotypic genus *Eulophophyllum* Hebard, 1922 are described. All species of the genus known up until now occur in forested areas in Sabah, Borneo. The genus is unique for the strongly widened media field of the tegmen, in which all branches of the media anterior plus radius sector are strongly curved and run anteriorally. There is also a striking color difference between the sexes, with males uniformly green and females pink. The two new species *E. lobulatum* Ingrisch & Riede sp. n. and *E. kirki* Ingrisch & Riede sp. n. have large leaf-like expansions of the hind tibiae that are absent in *E. thaumasium* Hebard, 1922. They differ from each other in the number of main vein branches in the media field of the tegmen. Stridulation of *E. lobulatum* sp. n. consists of short double-clicks ranging from 6.5 to 8.5 kHz, repeated at longer intervals.

Key words

crypsis, tegminal venation, stridulation

Introduction

The genus *Eulophophyllum* Hebard, 1922 was previously known from a single species, *Eulophophyllum thaumasium* Hebard, 1922, described from one female collected in "Labuan, North Borneo" (Federal Territory of Labuan, Malaysia: an island 8 km off the coast of Sabah state). No additional specimens of either sex have been collected since.

The genus is unique within Phaneropterinae in that the tegminal venation with all main branches in the strongly widened medial field are curved dorso-anteriorally, *i.e.*, their ends are pointing towards the head, while the normal case in Phaneropterinae is that those veins run more or less oblique posteriorally. These unique features were probably the reason for Hebard's epithet *thaumasium* (θαυμάζειν [thaumazein] – amazed).

During more recent investigations by KR in 1991 (Riede 1997) and Peter Kirk in 2013, more specimens of the genus differing from *E. thaumasium* by conspicuous lobes of the hind tibia and showing a spectacular color polymorphism have been collected, photographed, or sound recorded. We have also noticed a photograph of a juvenile *Eulophophyllum* from montane forest on Mount Kinabalu, Sabah on a website (Lee 2016). Since this forest type is different from the forest types in which the known species of *Eulophophyllum* were collected it is possible that it represents an undescribed species.

In the present paper the strange tegminal venation will be discussed and the relation of *Eulophophyllum* to other Phaneropterinae genera considered. Two new species from Sabah are described and differentiated. Stridulation of one of the species is documented.

Material and methods

Recording of stridulation was done in the field (Silau Silau) with a Sony Digital Audio Tape-corder TCD-D100, microphone Telinga EM-3, frequency range up to 24 kHz (sampling frequency 48 kHz) in darkness (starting 20:24 h, temperature 20 °C). The singing male sat more than 2.5 m above ground. Recordings were digitised using a Sony Linear PCM recorder PCM-M10, using a sampling rate of 96 kHz, and stored in wav format.

Sound analysis was done using Amadeus Pro Version 2.2.2 on a Mac Mini. In order to get a clear overview of the stridulation pattern over time, noise and sounds of crickets and another tettigoniid singing in the background were suppressed using an Audio Unit bandpass filter: 20 Hz to 6 kHz -20 db, 6.3 kHz +20 db, 8 to 10 kHz -20 db, 12 to 16 kHz +20 db, 20 kHz -20 db. For detailed analysis of the song, the unfiltered sound was used. For spectral analysis a Blackman window with 1024 dots was used.

Images of the stridulatory apparatus were produced using a Canon A6 camera mounted to a Motic M3 microscope. The images were processed with CaptureOne and stacked using ZereneStacker.

Images and a copy of the sound file will be available via OSF (Cigliano *et al.* 2016).

Abbreviation of veins: Cu Cubitus, MA Media anterior, MP Media posterior, R Radius, Sc Subcosta.

Morphology of tegminal venation

The venation of the strongly widened tegmina of *Eulophophyllum* is unique. The genus does not seem to be closely related to any other Phaneropterinae, although one might speculate that its peculiar tegminal venation may have evolved from an ancestor which had similar tegmina to *Dysmorpha* Brunner, 1878 or *Leptoderes* Serville, 1838. The widened dorsal margins of the hind tibiae possessed by the species of *Eulophophyllum* described below are superficially similar to those of *Xantia* Brunner, 1878, but this is probably due to convergence as that genus has a quite different appearance in all other respects. In his description of *Eulophophyllum* Hebard (1922) noted that it keys out (in Brunner's 1891 key) to the Holochlorae (now Holochlorini) close to the genus *Liotrachela* Brunner, 1878 [which mainly occurs on the Philippines (OSF 2016)]. However he also pointed out that there are big differences in the shape of vertex, pronotum, tegmina, legs and ovipositor.

The shape and venation of the tegmen in *Eulophophyllum* resembles *Dysmorpha obesa* Brunner, 1878, in having a widened media

Downloaded From: https://complete.bioone.org/journals/Journal-of-Orthoptera-Research on 28 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

field with dorso-anteriorally curved cross veins within it. But in *Dysmorpha* the subcosta and radius are fused to a single broad vein, only at their base and tip are they free (Fig. 1A). Moreover, there is a distinct radius sector, the media anterior does not run parallel to radius, and the cross veins in the media field are connected by secondary veins, which is not the case in *Eulophophyllum*. In contrast, in both *Leptoderes* and *Eulophophyllum* the subcosta and radius run parallel for the greater part of the wing, but in *Leptoderes* they are sinuate (Fig. 1B) while in *Eulophophyllum* they are simply curved (Fig. 1C-F).

With regard to the widening of the tegmen and the course of its veins, *Eulophophyllum* seems to be most closely related to the genus *Leptoderes* Serville, 1838 [distributed in tropical SE Asia; see OSF (2016)] although in the latter genus the tegmina are widening towards the apex, and the head and pronotum are different. Indeed the course of the radius, radius sector and media anterior veins in *Leptoderes* show an intermediate position between that found in *Eulophophyllum* and other genera of Phaneropterinae with rather broad wings *e.g.*, *Holochlora*, in which the branches of radius and media anterior run dorso-posteriorally into the dorsal (hind) margin. In *Leptoderes*, both branches of radius sector and also the end of the radius stem are strongly curved while the media anterior and its branches run vertically into the dorsal margin (the posterior margin in spread wings) (Fig. 1B). In *Eulophophyllum* all branches of the radius and media anterior are strongly curved and run oblique-anteriorally into the dorsal margin (hind margin in spread wings, Fig. 1C-D), but there are differences in details between the species.

The line drawings in Hebard's (1922) description of *E. thaumasium*, show a distinct radius sector and a second branch of the radius [images also available in OSF (2016)]. The anterior branch of the media runs close to and parallel to the radius over almost the whole length, while the media posterior is fused with the cubitus anterior after a short distance from base, and that vein reaches the dorsal margin of the tegmen in lateral view (when the wings are spread the hind margin) (Fig. 1C-F). On photographs of *Eulophophyllum* from the Danum Valley and Kinabalu, and also on the photograph of the holotype of *E. thaumasium* made by Piotr Naskrecki and available in OSF (2016), it seems as though the media anterior is fused with radius sector shortly after it gives rise to the last curved cross vein. This is striking as the meshwork of veinlets of the tegmina of *Eulophophyllum* is indistinct. Thus the main part of the tegmen is formed by the greatly widened media field. All branches of the media anterior and radius are strongly curved and run dorso-anteriorally. The number of branches of the media anterior plus radius differs between species, however.

Taxonomy

***Eulophophyllum* Hebard, 1922**
Hebard. 1922. Proc. Acad. Nat. Sci. Philad. 74:160

urn:lsid:Orthoptera.speciesfile.org:TaxonName:12499

Diagnosis.—The genus has a unique tegminal venation as discussed above. Apart from this it differs from *Leptoderes* by a more robust and in frontal view shorter head and by a rather short and stout pronotum, instead of an elongate pronotum with a laterally concave disc. The tibial tympana are conchate internally and are open on the external side.

Apart from the tegminal venation and the modified hind tibiae, the two new species are notable for their color polymorphism comprising two color variants, (1) a variant with striking pink and red-brown body color, with wings and legs contrasting with the pastel green tegminal veins and other marks of the same color and (2) a uniform green variant so far only observed in males. Color pattern of *E. thaumasium* have been described as ochreous buff with yellowish pattern (Hebard 1922), but this description was based on a dead female specimen whose color would have altered after death.

Key to species

1. Hind tibia simple. Female tegmen with six dorsal branches of MA plus R. Labuan Island . . . . . *E. thaumasium* Hebard, 1922
– Dorsal angles of hind tibia forming widened lobes . . . . . 2.
2. Tegmen with five dorsal branches of MA plus R. Dorsal area of tegmen behind R in female semi-oval, in male strongly raised, almost semi-circular with concave anterior area along stridulatory area of dorsal field in lateral view (Fig. 1C-D). Male cercus thick at base, narrowing towards and gradually transforming into apical third; moderately curved with spinule at tip Fig. 1G). Mt. Kinabalu . . . . . *E. lobulatum* sp. n.
– Tegmen with seven to eight dorsal branches of MA plus R. Dorsal area of female tegmen behind R nearly semi-oval in shape, in male slightly higher (Fig. 1E-F). Male cercus moderately thickened at base, narrowing towards apical third; apical third markedly thinner, slightly curved Fig. 1H). Danum Valley. . . . . *E. kirki* sp. n.

***Eulophophyllum lobulatum* Ingrisch & Riede sp. n.**

urn:lsid:Orthoptera.speciesfile.org:TaxonName:493860

Holotype (male): East Malaysia: Sabah, Mt. Kinabalu NP, headquarters, Silau-Silau trail near Bukit Tupei trail (N 6° 0′ 40″, E 116° 32′ 29″, 1600 m a.s.l.), 25.v.1993, leg. Hoffmann (Fig. 2). Depository: Zoological Research Museum Koenig (ZFMK), Bonn, Germany.

Other material (photograph of a female, Fig. 3G): East Malaysia: Sabah, Mt. Kinabalu, viii.2011, photographed by Mark Eller (http://www.whatsthatbug.com/2012/02/05/unknown-katydid-from-borneo/).

Diagnosis.—The new species differs in both sexes from *E. thaumasium* by its tegminal venation having only five instead of six dorsal branches of MA plus R and more strikingly by the dorsal margins of the hind tibia being expanded into a pair of lateral lobes that are absent in the female holotype of *E. thaumasium*, which has the hind tibia of normal shape. From *E. kirki* sp. n., *E. lobulatum* sp. n. differs by the more rounded instead of oval, shape of the tegmen, which has only five instead of seven to eight dorsal branches of MA plus R. The apical area of the male cercus is wider than in *E. kirki*.

Description (male holotype).—Head with vertex sloping between ocelli; fastigium verticis with a medial furrow bordered by a parallel-sided rectangular carina opened behind, separated from fastigium frontis by a deep transverse furrow; lateral ocelli situated on both sides at base of that carina. Frons distinctly higher than wide, with shallow and wide subocular grooves, bulging in middle; antennae inserted between lower half of compound eyes (Fig. 2C). Pronotum slightly widening from anterior to posterior margin; anterior margin subtruncate, very slightly concave in middle, posterior margin broadly rounded; disc flat with a faint medial carina in posterior area, lateral margins straight and subangular (Fig. 2B); paranota

Downloaded From: https://complete.bioone.org/journals/Journal-of-Orthoptera-Research on 28 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

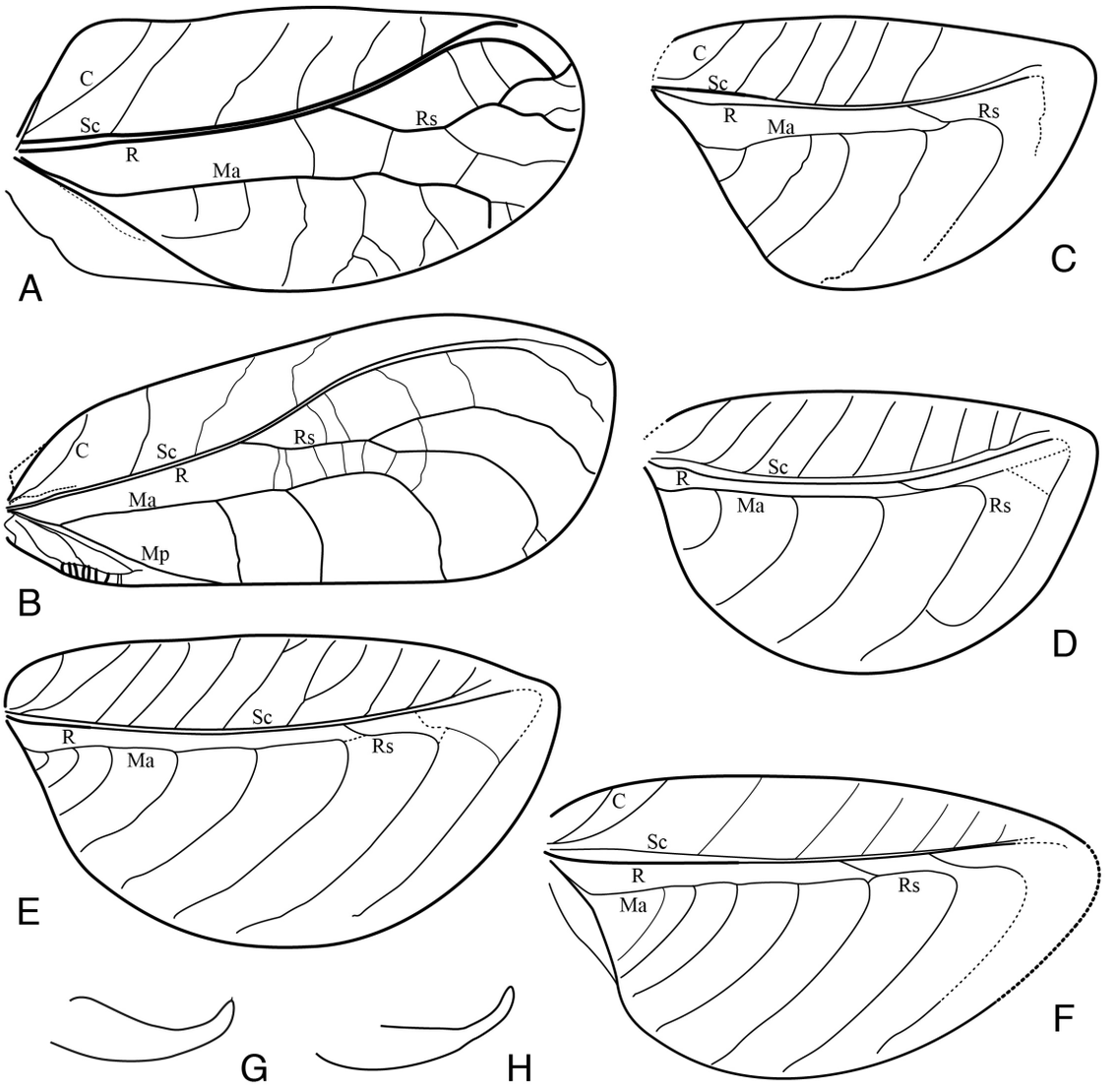


Fig. 1. A-F, Comparison of venation of left (A, F) or right tegmina (B-E) between *Dysmorpha*, *Leptoderes* and *Eulophophyllum* species (only main veins and stronger cross veins, most drawings without dorsal field): A, male of *Dysmorpha* sp. (Myanmar, Tenasserim); B, female of *Leptoderes* sp. (Thailand, Tak, Mae Salid); C, male (holotype) and D, female of *E. lobulatum* sp. n. (Sabah, Kinabalu); E, female (holotype) and F, male of *E. kirki* sp. n. – G-H, Left male cercus of *E. lobulatum* sp. n. (G, latero-dorsal view) and *E. kirki* sp. n. (H, dorso-lateral view). Left tegmina (A, F) mirror inverted to ease comparison. Abbreviations for veins: C Costa, Ma Media anterior, Mp Media posterior, R Radius, Rs Radius sector, Sc Subcosta. Not to scale. All after photographs. Stippled line in F indicates part of tegmen hidden by hind tibia.

slightly longer than high, posterior area in situ covered by a projecting flap of tegmen. Tegmina leaf-like, strongly widened; anterior margin moderately convex near both ends, almost straight in middle; posterior margin strongly convex, nearly semi-circular (Fig. 2A).

Tegminal venation: Costa normal, costal field moderately widened with oblique cross veins; subcosta and radius parallel and closely approaching each other, little diverging before apex of tegmen; radius without distinct branches but connected by numerous weak veinlets to media anterior, two slightly stronger veinlets in posterior half of tegmen running more oblique than the other veinlets in this area might be regarded as remains of radius branches that are fused with media anterior; media forked shortly behind base; media anterior running parallel and closely approached to radius, both veins connected by numerous faint cross veinlets; media posterior fused with cubitus and the fused veins forming the hind margin of tegmen; media field (area between media anterior and media posterior) extremely widened with all cross veins within this field curved dorso-craniad, the last two of those cross veins seem to have a twofold base where the more distad might be a branch of radius; dorsal area of tegmen narrow, triangular and short (Figs 1C, 2A-B).

Legs: Fore tibia normal, in cross-section quadrangular, tibial tympana with conchate cover on anterior (internal) side, open on posterior (external) side; mid tibia with dorsal margins little widened in basal half; hind femur widened in basal half, narrow in apical half. Hind femur on ventral margins with four internal and seven external spinules in apical area; hind knees bi-spinose. Hind tibia with both dorsal margins strongly expanded conferring a leaf-like appearance (Fig. 2A-B); with numerous distinct spines on lateral margins of expanded area, on internal side nearly from

Downloaded From: https://complete.bioone.org/journals/Journal-of-Orthoptera-Research on 28 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use



Fig. 2. *Eulophophyllum lobulatum* sp. n. male (holotype): A, lateral view original setting; B, dorsal view after spreading wings of both sides; C, frontal view of head, pronotum and fore legs; D, stridulatory file on underside of left tegmen; E, stridulatory area of right tegmen; F, abdominal apex dorso-apical view; G, subgenital plate and cerci ventral view. Scales 10 mm (A-B), 1 mm (C-D, F-G), 5 mm (E). For color version, see Plate II.

Downloaded From: https://complete.bioone.org/journals/Journal-of-Orthoptera-Research on 28 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

base, on external side behind basal quarter; ventral area of hind tibia compressed with a single, rounded medial margin carrying three minute spinules; only in apical area a little widened with two angular margins carrying three external and two internal spines; at tip with one dorsal and three ventral apical spurs on both sides.

Stridulatory file curved, 3.93 mm (diagonally measured and disregarding basal tubercles) with 61 teeth and four minute tubercles at very base; stridulatory teeth in about basal third dense and narrow (37 teeth per 1.535 mm), afterwards wide and spaced (24 teeth per 2.51 mm; Fig. 2D). Behind stridulatory vein with a triangular semi-transparent window. Mirror in stridulatory field of right tegmen also triangular (Fig. 2E). Tenth abdominal tergite with apical margin wide and shallowly concave in middle, very faintly convexly projecting on both sides of concavity. Epiproct tongue-shaped, flattened, tip broadly rounded. Cerci rather stout at base but gradually narrowed and little curved towards subparallel-sided, nearly cylindrical posterior area, towards apex more strongly curved, in apical area strongly setose and at tip provided with a small acute spinule (Figs 1G, 2F). Subgenital plate with lateral margins slightly approaching from base to hind margin; ventral surface with a pair of longitudinal furrows separating a medial carina from lateral bulges; hind margin subtruncate or very faintly concave in middle, on both sides forming a roundish groove from which the small styli arise (Fig. 2G). Phallus membranous.

Coloration (male holotype): Tegmen and hind leg (especially lobes of hind tibia) yellowish brown in the dried specimen, probably green when alive; hind wings transparent. Body, fore and mid legs discolored dirty brown. Face including bases of antennae light yellowish brown; compound eyes reddish brown; lateral margins of clypeus black. Disc of pronotum along fore and lateral margins light yellowish brown, centre of disc until hind margin and paranota dark brown.

Female. The female on the photograph agrees with the male holotype in general characters but its coloration resembles that of the pink variant of *E. kirki* sp. n. Subgenital plate not clearly visible on the photographs. Ovipositor sickle-shaped.

Coloration (based on photograph of the pink color variant of female, Fig. 3G). Head, pronotum, thorax, abdomen, and ovipositor light pink. Antennal flagellum dark brown with spaced white and black annulation. Head and pronotum pink with lighter ornaments. Pronotum with light green lateral angles. Tegmen pink to medium red in general color with anterior margin, veins and main cross veins and area between radius and media anterior pastel green; dorsal margin of tegmen in more than anterior half reddish, then light green. Fore and mid legs pink; fore tibia at base, mid tibia in basal half green; tarsi green. Hind femur pink in basal half, apical half green; posterior tibia green at base and very tip, the larger expanded central area pinkish red on ventral, dark red on dorsal side; posterior tarsus green.

Measurements (male holotype).— (In mm.) Body w/ wings: 33; body w/o wings: 20; pronotum: 5.8; tegmen: 28; tegmen width: 17.5; anterior femur: 7; hind femur: 23; hind tibia: 23.

Etymology.—Named for the strongly widened dorsal margins of the hind tibiae.

Stridulation.—The calling song of the male of *E. lobulatum* consists of short double-clicks ("zic-zic") of together about 280 - 352 ms (mean 308.65 ms ± 22.63 ms (s.d.), median 309 ms, n = 26). The time from the beginning of the first to the beginning of the second click was rather constant, between 160 - 169 ms (mean 163.96 ms ± 2.07 ms, median 164 ms (s.d.), n = 26). The song is rather loud even to the human ear, with a peak frequency between 6.5 and 8.5 kHz and a second quieter maximum between 13.5 and 14.5 kHz (Fig. 4A-D).

Eulophophyllum kirki Ingrisch & Riede sp. n.

urn:lsid:Orthoptera.speciesfile.org:TaxonName:493861

Holotype (female): East Malaysia: Sabah, Danum Valley (N 4° 57′ 55″; E 117° 41′ 25″, ca 170 m), 6.vi.2013, photographed by Peter Kirk (Fig. 3B-F).

Other material (photograph of a male, Fig. 3A): East Malaysia: Sabah, Danum Valley field centre, night walk, 24.i.2009, photographed by Paul Bertner (https://www.flickr.com/photos/rainforests/3430798861).

Diagnosis.—This species is very similar to *E. lobulatum* sp. n. with regard to the strongly widened tegmina, lobate hind tibiae and green and pink color polymorphism. It differs by the more semi-oval and relatively longer tegmina with seven or eight instead of five transverse veins in the medial field. The apical area of the male cerci is narrower than in *E. lobulatum*.

Description (female holotype).—Pronotum with concave anterior and convex posterior margin; disc flat, lateral margins straight and subangular; paranota a little longer than high, posterior area covered by a projecting flap of tegmen. Tegmen strongly widened; anterior margin moderately convex near both ends, nearly substraight in middle; posterior margin strongly convex, nearly semi-circular (Fig. 3C-F).

Tegminal venation: costa normal, costal field widened with oblique cross veins; subcosta and radius parallel and closely approaching each other, little diverging before apex of tegmen; radius without distinct branches but connected by numerous weak veinlets to media anterior, two of those veinlets in posterior half of tegmen that are slightly stronger and run more obliquely than the other veinlets in this area, can be regarded as branches of radius that are fused with media anterior; media forked shortly behind base; media anterior running parallel with and close to radius, both veins connected by numerous faint cross veinlets; media posterior fused with cubitus and the fused veins forming the hind margin of tegmen; media field (area between media anterior and media posterior) extremely widened with all cross veins within this field curved (in situ) dorso-craniad, the last of those cross veins with a twofold base; dorsal area of tegmen narrow, triangular and short (Fig. 1E).

Legs: Fore tibia normal (quadrangular), tibial tympana conchate on anterior (internal), open on posterior (external) side; mid tibia with dorsal margins little widened in basal half; hind femur widened in basal half, narrow in apical half; hind tibia with both dorsal margins strongly expanded conferring a leaf-like appearance (Fig. 3B).

Coloration (living female, pink color variant, Fig. 3B-F). Head, pronotum, thorax, abdomen, and ovipositor light pink. Antennae pink at base, otherwise dark brown with white and black spaced annulation. Head with a white band from base of mandibles to compound eyes, running along and continued behind eyes; compound eyes light green, ocelli white; tips of mandibles and maxillary palpi black. Pronotum with pale green lateral angles. Tegmen pink at very base, later red with anterior margin, veins and main cross veins and area between radius and media anterior pastel green;

Downloaded From: https://complete.bioone.org/journals/Journal-of-Orthoptera-Research on 28 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use



Fig. 3. *Eulophophyllum* species in habitat (A, D, G) and sitting on red leaves (B-C, E-F): A, *E. kirki* sp. n. male (Danum); B-F, *E. kirki* sp. n. female (Danum); G, *E. lobulatum* sp. n. female (Kinabalu). – A, C, F, G, lateral view; B, apical view of hind legs and ovipositor; D, oblique lateral view. Photographs: A, Paul Bertner; B-E, Peter Kirk; F, Mark Eller. For color version, see Plate III.

Downloaded From: https://complete.bioone.org/journals/Journal-of-Orthoptera-Research on 28 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

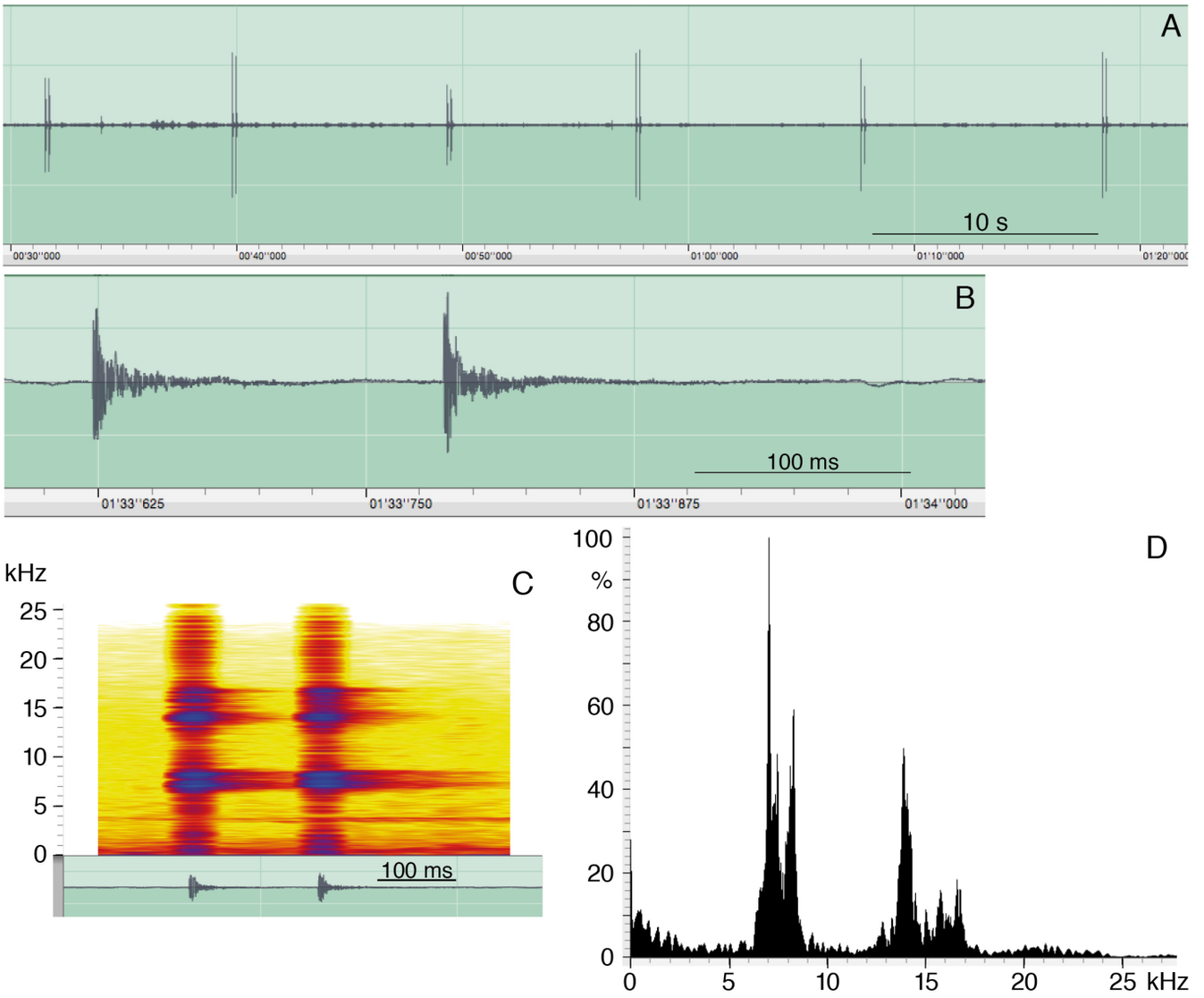


Fig. 4. Stridulation of *Eulophophyllum lobulatum* sp. n. (holotype) in field: A, oscillogram showing time pattern of double-click echemes of undisturbed male; B, single double-click in greater time resolution; C, sonogram of a single double-click; D, spectrum analysis of sound. A, after applying a bandpass filter 6-16 kHz; B-D, from unfiltered recordings. Recordings by P. Hoffmann.

subcosta, radius and fused media - cubitus posterior for the greatest part pink or red. Fore and mid legs pink; fore tibia at base and mid tibia in basal half green, both with a black subapical mark; tarsi dirty green. Hind femur pink at base, getting darker posteriorally, apical half and ventral margin except at base green; posterior tibia green at base and apex, the larger expanded central area dark red on ventral, brown on dorsal side, margins green; posterior tarsus green.

Coloration (living male, green color variant, Fig. 3A). Rather uniformly green; thorax, fore and mid legs pale green; abdomen for the greater part yellowish green. Head green with a white band bordering compound eyes on posterior side and running down to clypeus; antennal flagellum blackish, narrowly annulated and with spaced white rings; maxillary palpi with black tips. Pronotum green; disc with white lateral bands. Tegmen green; anterior margin, most veins and main cross-veins are a little lighter yellowish green; along radius in the area between radius and media there is a dark greyish green band. Fore tibiae with a black spot near ventral end.

The male cerci have the apical area distinctly narrowed setose before tip.

Etymology.— Named after the photographer of the holotype, Peter Kirk.

Discussion

Up until now, the remarkable Phaneropterinae genus *Eulophophyllum* was based on the description of only one specimen of one species, a female from the island Labuan off the west coast of Sabah, Malaysia, Borneo (Hebard 1922). The male of this species is still unknown. Here we describe two additional species, *E. lobulatum* sp. n. and *E. kirki* sp. n., based on collections and photographs of males and females. Unfortunately *E. kirki* sp. n. could not be collected due to strict conservation rules in the Danum Valley Conservation Area (SEARRP 2016).

At present, the IZCN lacks clear rules and formally does not

Downloaded From: https://complete.bioone.org/journals/Journal-of-Orthoptera-Research on 28 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

exclude a photograph as a holotype. There are some instances of description of species based on photographs alone (Marshall & Evenhuis 2015), but this approach has been discussed critically by Cianferoni & Bartolozzi (2016). These authors fear that "this [photographs as holotypes] will lead ...to severe problems....", which is particularly true for insects, in which genitalia or other hidden structures are used for species differentiation. This is not the case for the katydids described here. Therefore, we decided to include and name *E. kirki* sp. n., because (1) wing venation is the main diagnostic feature and is clearly visible on photographs, (2) to stimulate the search for and capture of a few individuals of *E. kirki* sp. n. that may also occur outside protected areas, and (3) to stimulate the search for the male of *E. thaumasium* at Labuan, at least using photography. However, for all species mentioned here we recommend collection, designation and institutional deposition of more material. This includes the unknown male of *E. thaumasium*. Since we found no major dimorphism between sexes apart from sex specific differences, we predict that the general aspect of the unknown male of *E. thaumasium* is similar to that of the female.

The recent discovery and collection of the tetrigid *Arulenus miae* Skejo & Caballero, 2016 from a mountain forest in Mindanao was triggered by an amateur Facebook photograph. In this case, the authors organised a dedicated search for specimens. In contrast, rainforest habitats of the species described here are either under severe pressure (Labuan Island), or protected by strict law prohibiting collection of any organisms (Danum Valley). Therefore, we opted for a timely description of both species, hoping that our publication will lead to further photographic and/or acoustic detections, that it will convince authorities to grant permits for collection of type material, and that it may stimulate habitat protection measures for these enigmatic species.

We hypothesize that *Eulophophyllum* consists of an allopatric species complex of at least three species: *E. lobulatum* from montane rainforest, *E. kirki* from lowland forest, and *E. thaumasium* from an island. Additional species probably exist on other islands (*e.g.*, Bangi) and the genus might even occur in Palawan (Philippines). On mainland Borneo, distinct species will probably be found along the major mountain ranges (Crocker range) and micro-geographic regions. Hybridisation could occur along contact zones between montane and lowland forests. Detection of these highly cryptic species will be facilitated by their conspicuous song, which might be similar between the species, but with distinct diagnostic differences. Besides photographs, song recordings are another valuable contribution which can be easily made. Many Phaneropterinae species have a communication system between male and female where both sexes stridulate, whilst in others only the males sing (Heller *et al.* 2015). Up to now we only have information about the acoustic behaviour of the male of *E. lobulatum* sp. n. described here.

Pink coloration.— The pink color variant in *Eulophophyllum* has so far only been documented for females of *E. lobulatum* sp. n. and *E. kirki* sp. n. The photographer of *E. kirki* sp. n. placed the pink female on leaves of a plant with young red leaves to demonstrate the cryptic appearance of the pink individual when sitting on such leaves (Fig. 3B-C, F). However, when discovered in the field, neither this female nor the pink female of *E. lobulatum* sp. n. were resting on red leaves (Fig. 3D, G). In fact, the pink female of *E. kirki* sp. n. was resting on a branch with green leaves when discovered (Fig. 3D) and was very conspicuous to a human observer.

Possible reasons for the pink coloration of the females are as follows: (1) Against a background of variable vegetation a pink female with green veins might merge optically with the background when seen from a distance (Fig. 3G); (2) It is possible that the pink individuals which have so far been found may have simply been resting on an atypical background - making them more obvious to human observers. Their 'usual' resting site may be reddish first-flush leaves, common in many rainforest plants; (3) the pink coloration might serve as warning coloration, although we consider this to be unlikely. Further field observations will be necessary to shed light on the function of the pink coloration of these species and it may reveal something unexpected.

Acknowledgements

Field work of Klaus Riede and Peter Hoffmann was supported by the German Research Foundation (DFG). Peter Hoffmann recorded and captured the male holotype specimen of *E. lobulatum*. We wish to express our gratitude to the photographers for their permission to publish their specimen photographs in this publication and in OSF: Peter Kirk recorded the female holotype of *E. kirki* sp. n., Paul Bertner photographed the male of *E. kirki* sp. n. (previously published in www.flickr.com), and Mark Eller photographed the female of *E. lobulatum* sp. n. (previously published in www.whatsthatbug.com).

References

Bertner P. 2016. https://www.flickr.com/photos/rainforests/3430798861 (accessed 2016-08-16).

Cianferoni F., Bartolozzi L. 2016. Warning: potential problems for taxonomy on the horizon? Zootaxa 4139: 128-130. http://doi.org/10.11646/zootaxa.4139.1.8.

Cigliano M.M., Braun H., Eades D.C., Otte D. 2016. Orthoptera Species File. Version 5.0/5.0 http://Orthoptera.SpeciesFile.org [accessed 2016-10-17].

Eller M. 2016. http://www.whatsthatbug.com/2012/02/05/unknown-katydid-from-borneo/ 3430798861 (accessed 2016-08-16).

Hebard M. 1922. Studies in Malayan, Melanesian and Australian Tettigoniidae (Orthoptera). Proceedings of the Academy of Natural Sciences of Philadelphia 74: 121-299, pls 11-22.

Heller K.-G., Hemp, C. Ingrisch S., Liu C. 2015. Acoustic communication in Phaneropterinae (Tettigonioidea) - a global review with some new data. Journal of Orthoptera Research 24: 7-18.

Lee C.C. 2016. www.wildborneo.com.my/photo.php?f=cld1303478.jpg (accessed 2016-08-16).

Riede K. 1997. Bioacoustic monitoring of insect communities in a Bornean rain-forest canopy, pp. 442-452. In: Stork N.E., Adis J., Didham R.K. (Eds) Canopy Arthropods. Chapman & Hall, London.

Marshall S.A., Evenhuis N.L. 2015. New species without dead bodies: a case for photo-based descriptions, illustrated by a striking new species of *Marleyimyia* Hesse (Diptera, Bombyliidae) from South Africa. ZooKeys, 525: 117-127. http://dx.doi.org/10.3897/zookeys.525.6143

OSF. 2016. = Cigliano *et al.* 2016

Santos C.M.D., Amorim D.S., Klassa B., Fachin D.A., Nihei S.S., De Carvalho C.J.B., Falaschi R.L., Mello-Patiu C.A., Couri M.S., Oliveira S.S., Silva V.C., Ribeiro G.C., Capellari R.S., Lamas C.J.E. 2016. On typeless species and the perils of fast taxonomy. Systematic Entomology 41: 511-515. doi:10.1111/syen.12180

SEARRP 2016. The South East Asia Rainforest Research Partnership http://www.searrp.org/danum-valley/ (accessed 2016-09-03).

Skejo J., Caballero J.H.S. 2016, A hidden pygmy devil from the Philippines: *Arulenus miae* sp. nov. — a new species serendipitously discovered in an amateur Facebook post (Tetrigidae: Discotettiginae). Zootaxa 4067: 383-393.

Downloaded From: https://complete.bioone.org/journals/Journal-of-Orthoptera-Research on 28 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use