

# New species and records of the genus *Lipotactes* (Orthoptera: Tettigoniidae: Lipotactinae) from Vietnam, Cambodia, and Thailand

SIGFRID INGRISCH<sup>1</sup>

<sup>1</sup> Zoological Research Museum Alexander Koenig, Leibniz Institute for Animal Biodiversity, Adenauerallee 160, D-53113 Bonn, Germany.

Corresponding author: Sigfrid Ingrisch (S.Ingrisch@leibniz-zfmk.de)

Academic editor: Klaus-Gerhard Heller | Received 28 August 2020 | Accepted 14 September 2020 | Published 7 May 2021

<http://zoobank.org/23FFC085-3D20-43A0-A107-C142E085A659>

Citation: Ingrisch S (2021) New species and records of the genus *Lipotactes* (Orthoptera: Tettigoniidae: Lipotactinae) from Vietnam, Cambodia, and Thailand. Journal of Orthoptera Research 31(1): 51–65. <https://doi.org/10.3897/jor.30.58095>

## Abstract

Six new species of the genus *Lipotactes* Brunner, 1898 are described: three species from Vietnam – *L. serratus* sp. nov., *L. angulatus* sp. nov., *L. productus* sp. nov.; two species from Cambodia – *L. discus* sp. nov. and *L. samkos* sp. nov.; and one species from Thailand – *L. saengeri* sp. nov. The diagnostic characters are illustrated. Additional records are reported for *L. vietnamicus* Gorochoy, 1993 and *L. azureus* Gorochoy, 1996. The striking azure blue color of the alive male of *L. azureus* that contrasts with the green and white museum specimen is documented. An updated key to the species of *Lipotactes* from Vietnam, Cambodia, and Thailand is provided.

## Keywords

Cambodia, diagnostic key, South-East Asia, Taxonomy, Thailand, Vietnam

## Introduction

The genus *Lipotactes* comprises small- to medium-sized species that are known to occur in Asia from South China in the north-west to Sulawesi in the southeast. Thus far, 25 species are known, of which seven have been reported from Vietnam, one from Cambodia, and four from Thailand (Cigliano et al. 2020). The species occurrence in Vietnam and Cambodia has been mainly studied by Gorochoy (1993, 1996, 1998), with additional data by Ingrisch (1995) and Helfert and Sanger (2009). Species from China have recently been reviewed by Feng et al. (2017), while Wang and Shi (2020) estimated the effect of global warming on the potential distribution based on the present distribution information and climate data.

It has been shown that species related to *L. alienus* Brunner, 1898 and *L. virescens* Ingrisch, 1995 can be differentiated based on stridulation and the shape of the stridulatory area, especially the stridulatory file (Tan et al. 2020). However, such a study requires fresh and living specimens. The strongly reduced male wings are almost completely hidden under the pronotum, such that the file and mirror cannot be studied without cutting the wings off from the body. Also, the differences in stridulation and the stridulatory

apparatus correspond to distinct differences in the shape of the male cercus (Ingrisch 1995, Tan et al. 2020).

In the current study, species delimitation is based mainly on the shape and extensions of the male cerci. The variation of these organs allows differentiation between the species, as already shown in Ingrisch (1995) and Gorochoy (1996). Species with a similar basic structure of the cerci often replace each other geographically, while species that occur close to each other in the same locality or in nearby localities usually show more pronounced differences in the cerci and their extensions.

The male phallus of *Lipotactes* species is often fully membranous and thus not useful for identification. Phallus sclerites, which may act as titillators, have been reported only in species related to *L. azureus* Gorochoy, 1996 thus far (Gorochoy 1996).

A recent research project of the Institut Royal des Sciences Naturelles de Belgique in Brussels on the entomological diversity of Vietnam and Cambodia (Constant and Grootaert 2020) provided a reasonably high number of new specimens of the genus from localities distributed throughout Vietnam and Cambodia; this made it necessary for an updated overview of the species and their distribution in the area. During the study, it became necessary to re-examine the specimens reported by Helfert and Sanger (2009) as *L. khmericus* Gorochoy, 1998 from Southeast Thailand, as the collection in ISNB contained a new species from Cambodia with a similar basic cercus structure as *L. khmericus*. Thus, it was possible that the specimens from Southeast Thailand may also have similar male cerci that differ in detail.

A marked increase in the number of species in Vietnam and Cambodia added to the necessity for an updated key to the species. The key provided here is restricted to males, as the females of most species do not show enough characters to identify them on morphological characters without knowing the corresponding male. Also, females are only known for 12 of the 18 species considered for the present publication.

The type localities for the *Lipotactes* species described from Vietnam, Cambodia, or Thailand are presented in Fig. 1. *L. virescens* Ingrisch, 1995, described from Trang province in the very south of Thailand, is not presented as its type locality lies south of the area presented on the map.

## Materials and methods

The current study is mainly based on specimens from the research project "A step further in the Entomodiversity of Vietnam" managed by J. Constant (see Constant and Grootaert 2020).

A total of 34 specimens from 12 localities were available for the study. Of these, 28 specimens from eight localities could be sorted into seven distinct species according to the male abdominal appendages. From four other localities combined, only six females were available for study. Of these, five specimens from three localities were found to be similar to *L. azureus* Gorochoy, 1996, which belongs to a group of five species that mainly differ by details of the male abdominal appendages (Gorochoy 1996). In this paper, another species of this group is described. The females of these species are similar and described only for three of the five species, preventing a reliable identification to species level without a corresponding male. Another single female from central Cambodia has a subgenital plate similar to *L. silvestris* Ingrisch, 1990, although there are distinct differences. Its main characters are described below, but naming it is delayed until a corresponding male is found.

A selected number of the museum specimens were re-set to allow the study of the fine details of the male cerci and sclerotized genital structures if present.

Documentation of the specimens studied was done by photography using a Canon D500 mounted to a copy stand for habitus images and a Canon D6 mounted to the photo adapter of a Motic M5 for microscopic images. The images were processed by CaptureOne and stacked with Zerene Stacker.

To prepare the key to species, characters for species that I did not study were adapted from Gorochoy (1993, 1996, 1998).

Names of the localities, provinces, etc. for the specimens studied are given as printed on the labels, including the geographical coordinates. Additional information not on labels is mentioned within brackets. The names of the type localities of previously described species are given as in the original publication or in OSF (Cigliano et al. 2020). The spelling of some localities may differ in small details even though they refer to the same place.

## Depositories

ISNB	Institut royal des Sciences naturelles de Belgique, Brussels, Belgium
NMW	Naturhistorischen Museum Wien, Vienna, Austria
ZIN	Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia

## Results

### Taxonomy

Family Tettigoniidae Krauss, 1902

Subfamily Lipotactinae Ingrisch, 1995

### Genus *Lipotactes* Brunner von Wattenwyl, 1898

*Type species: Lipotactes alienus* Brunner von Wattenwyl, 1898

Species of the genus are characterized by their large head with big eyes compared to a rather small body. Many species are at least partly predators. They are able to follow flying insect with their large eyes and catch them out of the air.

### *Lipotactes azureus* Gorochoy, 1996

Figs 1, 2A–C, 3J–L

*Lipotactes azureus* Gorochoy, 1996: 32

*Type locality*.—Vietnam, Vinhu prov., Tamdao 800–900 m.

*Type material*.—VIETNAM • 3 males (including holotype), 1 female, 5 female nymphs; ZIN [not examined]

*Material examined*.—VIETNAM • 2 females, 6 males; Prov. Vinhfu, Tam Dao N.P. [= National Park]; 21°31'N, 105°33'E, 25–30 Jul. 2011; J. Constant and J. Bresseel leg.; I.G. 31.933; ISNB.

*Measurements*.—(2 males, 1 female; in mm) Body w/o wings: male 10.5–11.7, female 13.2; pronotum: male 3.9–4.0, female 4; tegmen: male 1.6–1.9, female 0; hind femur: male 11.0–11.5, female 13.4; ovipositor: female 8.6.

*Discussion*.—This species has been described in detail by Gorochoy (1996). It was named for the azure coloration of the alive male mixed with a black pattern. That azure color appears ivory white in museum specimens, while the legs are mostly green. I use this opportunity to illustrate the change of coloration between an alive male and a museum specimen (Fig. 2A, B). The females do not show the same striking coloration but display various shades of brown with black marks. A female from Tam Dao has fore- and mid-legs with remnants of green. Thus, one may suppose that at least some females of this species have green legs when alive.

*Remark*.—The female specimens from the type locality were clued to cardboard. Thus, a female from Ba Vi, Hanoi, Vietnam, was used to document the subgenital plate, although no male from that locality was available to verify the identification.

### *Lipotactes vietnamicus* Gorochoy, 1993

Figs 1, 2H–I, 3G–I

*Lipotactes vietnamicus* Gorochoy, 1993: 59

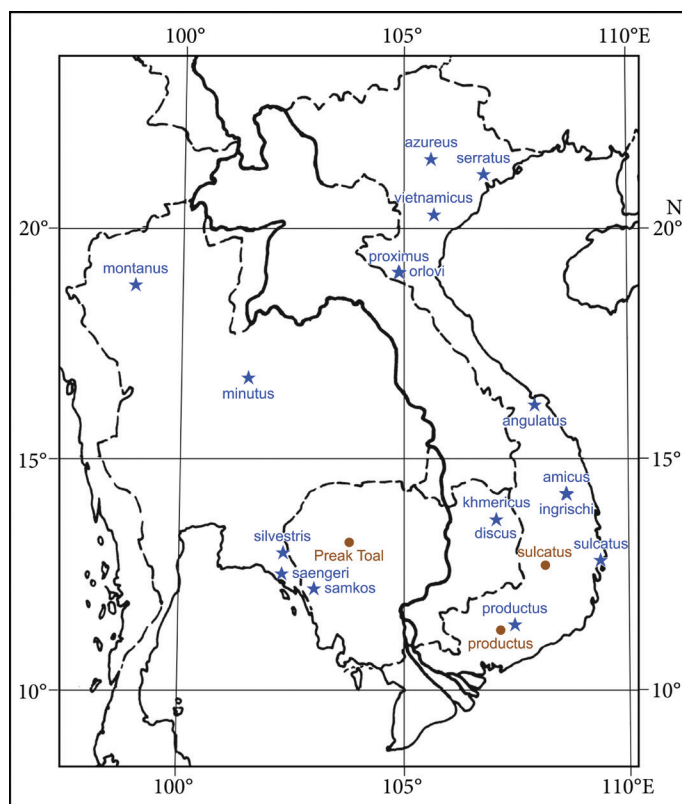
*Type locality*.—Vietnam, Prov. Hasonbinh, Cuc Phuong Nature Reserve.

*Type material*.—VIETNAM • 1 male (holotype), 2 females (paratypes); ZIN [not examined]

*Material examined*.—VIETNAM • 1 female, 1 male; Hoa Binh Prov., Cuc Phuong N.P. [= National Park]; 20°19'N, 105°36'30"E; 19–23 Jul. 2011, J. Constant and J. Bresseel leg.; I.G. 31.933; ISNB.

*Measurements*.—(1 male, 1 female; in mm) Body w/o wings: male 13.5, female 15; pronotum: male 4.2, female 4.7; tegmen: male 3, female 0; hind femur: male 13, female 14.5; anterior femur: male 4, female 4; ovipositor: female 8.

*Discussion*.—This species was described in detail by Gorochoy (1996) and was also reported from China by Feng et al. (2017). Some images are given for comparison with the new species described below.



**Fig. 1.** Type localities of *Lipotactes* species described from Vietnam, Cambodia, and Thailand; blue stars mark localities of holotypes, brown dots mark localities of a female paratype if not identical to locality of corresponding holotype; Preak Toal marks the locality of an unnamed female described in this publication. The species of the pairs *L. amicus* Gorocho, 1993 and *L. ingrischi* Gorocho, 1996; *L. discus* sp. nov. and *L. khmericus* Gorocho, 1998; and *L. orlovi* Gorocho, 1996 and *L. proximus* Gorocho, 1996 have been described from nearby localities. The type locality of *L. virescens* Ingrisch, 1995 lies south of the limits of this map.

***Lipotactes serratus* sp. nov.**

<http://zoobank.org/A93B534D-3059-4748-9006-F3BFAFE6D0CA>

Figs 1, 2D–G, 3A–F

**Material examined.**—**Holotype:** VIETNAM • male; Tay Yen Tu Nat. Res. [= Nature Reserve]; 21° 11' 10" N, 106° 43' 25" E; 7–11 Jul. 2013; J. Constant and J. Bresseel leg.; I.G. 32.454; ISNB. **Paratypes:** VIETNAM • 6 females, 1 male; same data as for holotype; ISNB.

**Diagnosis.**—In general appearance and coloration of males, the new species strongly resembles *L. azureus* Gorocho, 1996, although there are differences in details: the male pronotum is slightly prolonged and elevated posteriorly, almost completely covering the tegmen in dorsal view instead of leaving the apical area free, and the black band along the apical margin of the pronotum is broader than in *L. azureus*; in females, the black lateral bands of the pronotum are less distinct and gradually pass over into the brighter surrounding area, and the ovipositor is not as stout and less strongly curved as in *L. azureus*. The male cercus resembles that of *L. proximus* Gorocho, 1996, although the dorsal

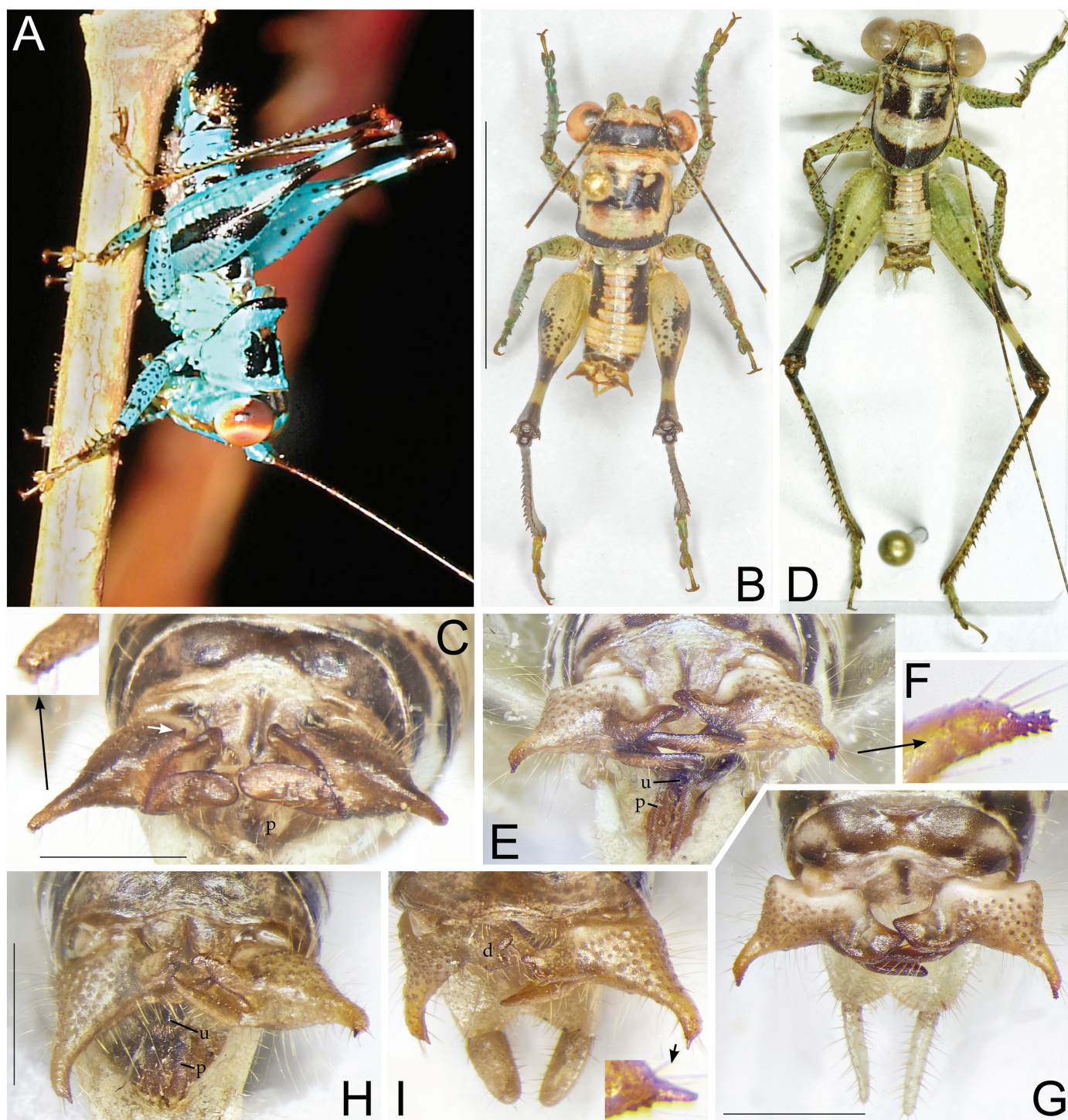
internal process has the internal margin straight, not concavely incised, and the process in apical view is more strongly upcurved; the ventral internal process has the dorsal surface concave as in *L. azureus* but is distinctly longer and resembles that of *L. orlovi* Gorocho, 1996, *L. proximus*, and *L. vietnamicus* Gorocho, 1993. The narrow apical area of the male cercus resembles, by its more pronounced bend, that of *L. orlovi* or *L. vietnamicus*. From all four mentioned species, it differs by the tip of the narrow apical area of the male cercus that is not acute nor slightly spinose but terminates into a serrate apical cone. The male phallus is provided with a parallel running pair of elongate granular sclerites that are triangularly widening at base; the apical areas of these sclerites are strictly parallel, neither deviating and narrowing as in *L. vietnamicus*, nor widened as in *L. orlovi*, nor curved outwards as in *L. azureus* or setose at tip as in *L. proximus*; the tips of these sclerites are acute rather than obtuse as in the other four species; the unpaired medial sclerite hardly reaches the end of the triangular widening of the elongate sclerites.

**Description.**—Medium-sized species. Males with white bodies and green legs, both with black ornaments (Fig. 2D); females brown with black ornaments (Fig. 3A).

**Male.** Pronotum with two transverse furrows, posterior area prolonged and almost fully covering tegmen. Tenth abdominal tergite at hind margin with a rather deep concave incision in middle. Epiproct with deep medial furrow. Cercus with stout basal area wider than long, at external angle prolonged into a narrow and little curved process that terminates into a strong spine that carries along margins acute teeth (Fig. 2F); at the internal apical angle of the wide basal area, prolonged into a dorsal and a ventral process; the dorsal process wide, compressed, and slightly upcurved with subtruncate apical margin and rounded distal but subangular proximal angle. The distal margin of the process is curved ventrad to meet the ventral process at base but narrows towards tip; the ventral process roughly elongate, triangular with rounded tip and concave dorsal surface, also somewhat upcurved (Fig. 2E, G). Phallus with two paired and one unpaired sclerites; paired sclerites triangular at base and prolonged into long, nearly straight, and parallel apical extensions with finely granular surface and only slightly narrowing towards obtuse tip; unpaired sclerite short with obtuse tip, not surpassing the triangular basal area of the lateral sclerites (Fig. 2E). Subgenital plate with roundly approaching lateral margins; apical margin sub-angularly incised; styli long and narrow (Fig. 2G).

**Coloration.** Face and vertex white with a medium to light brown medial band from end of vertex to clypeus and with a pair of slightly darker, medium brown subocular bands continued on mandibles; clypeus light green with brown rim; vertex with a wide black transverse band between compound eyes. Antennae annulated. Pronotum white with brown rim; in anterior area, with a pair of roughly rectangular black spots with projecting posterior angles and a triangular white spot; along hind margin and including part of paranota, with a wide black band that narrows from middle to lateral areas. Tegmen green. Abdominal tergites white; tergites 2–7 and 10 with black lateral bands. Cerci light brown with dark dots, internal processes getting darker towards tips. Subgenital plate in dorsal view white; styli brown. Legs green with numerous black dots at femora and tibiae; hind femur in widened basal area with a black oblique band followed by a black ring at beginning of narrow apical area; also black around hind knee on femur and tibia.





**Fig. 2.** *Lipotactes* males: A–C. *L. azureus* Gorochov, 1996; D–G. *L. serratus* sp. nov.; H–I. *L. vietnamicus* Gorochov, 1993. A. Alive male in habitat (photo credit Jérôme Constant); B, D. Male dorsal view; C, E, H. Abdominal apex in apical view; G, I. In dorsal view; F. Tip of cercus greatly enlarged (also insets in C and I). Abbreviations: d, dorso-medial projection of cercus; p, paired phallus sclerites; u, unpaired phallus sclerite. The white arrow in C indicates the spine at base of the upper process. Scales for habitus: 10 mm; for cerci: 1 mm.

**Female.** Subgenital plate with strongly convex lateral margins; more or less membranous and slightly projecting at subtruncate apical margin, with faint medial furrow (Fig. 3D). Ovipositor elongate, upcurved, regularly narrowed towards acute tip; ventral margin very finely serrulate before end (Fig. 3E, F).

**Coloration.** Face light or dark reddish brown, mouthparts of lighter color; vertex with complete or incomplete black transverse band between compound eyes (Fig. 3B, C). Antennae annulated. Pronotum brown with incomplete black lateral bands; transverse furrows very weak, but both furrows with a pair of short but deep impressions.



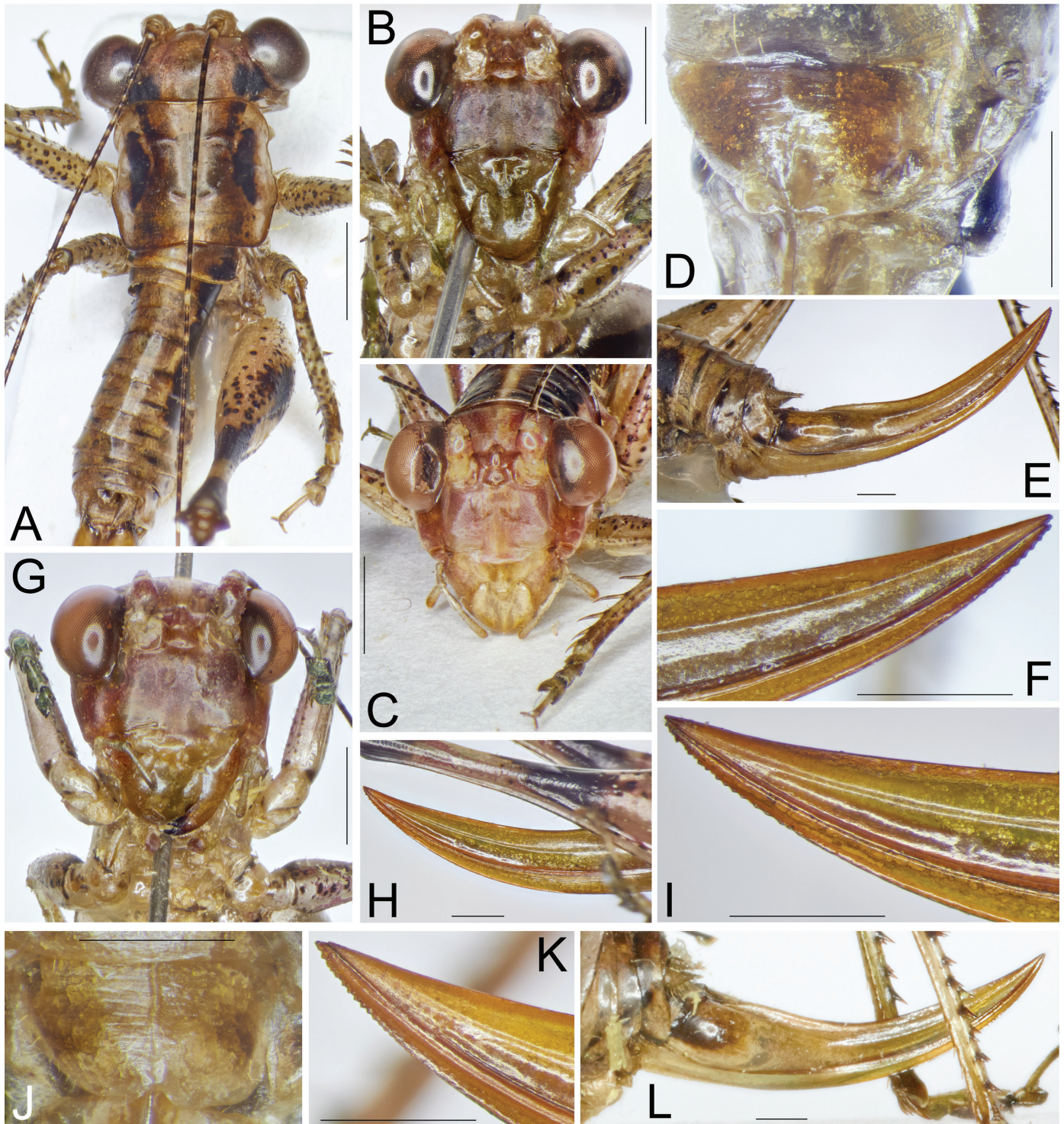


Fig. 3. *Lipotactes* females: A–F. *L. serratus* sp. nov.; G–I. *L. vietnamicus* Gorocho, 1993 from Cuc Phuong; J, K. *L. cf. azureus* Gorocho, 1996 from BaVi; L. *L. azureus* Gorocho, 1996 from Tam Dao. A. Habitus dorsal view; B, C, G. Face; D, J. Subgenital plate; E, H, L. ovipositor; F, I, K. End of ovipositor with serrate ventral margin. Scales for habitus and face: 5 mm; others: 1 mm.

Abdomen brown; segments 1–7 with black lateral bands. Legs as in male but of brown foundational color. Ovipositor medium brown.

**Measurements.**—(2 males, 6 females; in mm) Body w/o wings: male 10.0–10.5, female 11.5–15.0; pronotum: male 4.0–4.2, female 3.2–4.2; tegmen: male 2, female 0; hind femur: male 11–12,

female 12–14; anterior femur: male 3.5–4.0, female 3.7–5.0; antenna: female 70; ovipositor: female 7.0–9.5.

**Etymology.**—The name of the new species refers to the apical spine of the male cercus that carries acute teeth along margins; from Latin *serrare* meaning “to saw”.



*Lipotactes* sp.

**Material examined.** [females only]—VIETNAM • 2 females; Cat Ba N.P. [= National Park]; 20°48'N, 107°0'20"E; 12–16 Jul. 2013; J. Constant and J. Bresseel leg.; I.G. 32.454; ISNB. 1 female; Cham-Chu N. R. [= Nature Reserve]; 22°12'N, 105°6'0"E; 8–12 Jul. 2015, J. Constant and J. Bresseel leg.; I.G.: 33.092; – ISNB. 1 female, 1 nymph male; Hanoi prov., BaVi N.P.; 21°4'4"N, 105°21'30"E; 25–29 Jun. 2015; J. Constant and J. Bresseel leg.; I.G.: 33.092; ISNB.

**Discussion.**—Five species related to and including *L. azureus* were differentiated by Gorochov (1996), of which one species, *L. sinicus* (Bey-Bienko, 1959), is from China, and four species are from North Vietnam. These species were all based on the characteristic shapes of the male cerci and sclerites found on the male phallus. Both characters follow a common basic structure, which is markedly modified between species. For two of these five species, the females are still unknown. In the current paper, another species of this group from Northern Vietnam is described. Although females of these species can be differentiated as a group from other Vietnamese *Lipotactes* species by the absence of a weak concavity at the end of the dorsal margin of the ovipositor, no characters are reported so far to differentiate between the females of these species.

In the collection of specimens studied for this publication, there were four females and one nymph without corresponding adult males from three localities that are not one of the type localities of the described species. These specimens do not show any conspicuous diagnostic difference from the female of *L. azureus*, although they are missing the green color of the legs. I abstain from arranging these females to any of the named species.

*Lipotactes angulatus* sp. nov.

<http://zoobank.org/A36B713F-8A3D-4AFB-860D-71FAED728B0E>

Figs 1, 4A–H

**Material examined.**—**Holotype:** VIETNAM • male; Central Vietnam, Bach Ma N.P. [= National Park]; 16°12'N, 107°52'E; 15–16 Jul. 2011; J. Constant and J. Bresseel leg.; I.G. 31.933; ISNB. **Paratypes:** VIETNAM • 3 males; same data as for holotype; ISNB.

**Diagnosis.**—A predominantly green species that does not seem to be close to any other *Lipotactes* species reported so far from Vietnam. It is missing the striking black and pale color pattern and the complex internal process of the cercus found in the species reported from the more northern areas of Vietnam (e.g., *L. azureus* Gorochov, 1996 or *L. vietnamicus* Gorochov, 1993), but it also does not show the dull color pattern of species found in South Vietnam and Cambodia (e.g., *L. ingrischi* Gorochov, 1996), although it shares with both groups of species the possession of a narrow apical area of the male cercus that differs in shape from that of the other species. From coloration, the new species resembles *L. virescens* Ingrisch, 1995. It differs by the shape of the male cercus, which has a strongly widened base, incurved and narrow apical area, and a long and angularly curved internal process instead of a short and narrow internal process with a tubercle at base. Regarding the internal process of the male cercus, the new species resembles *L. hamatus* (Karny, 1931) described from Sulawesi. It differs by the strongly widened cercus base, the curved tip of the cercus, the larger and more strongly bent internal process, by the posteriorly widened and elevated disc of the pronotum, and by the strongly inflated tegmina.

**Description.**—Medium-sized species of predominantly green coloration with dark pattern (Figs 4A–B).

**Male.** Pronotum prolonged with diverging lateral margins to behind mid length, inflated in posterior half; anterior margin bend-up and rounded, appearing in dorsal view concave, posterior margin widely rounded; first transverse sulcus distinct and entire; second and third transverse sulcus hardly distinct except second sulcus on paranota. Tegmen strongly inflated (Fig. 4D). Tenth abdominal tergite in dorsal area somewhat prolonged, but apical margin widely concave in middle (Fig. 4F). Epiproct large with a deep medial furrow. Cerci rather short, extremely widened at base and, there, almost as wide as long; internal margin strongly narrowed towards narrow tip of cercus; tip slightly curved medially; from ventral side of base of cercus with a compressed elongate internal process that is rather narrow and bent before mid-length in an almost 90°-angle medially and slightly narrowed towards tip (Fig. 4E–G). The processes from both cerci almost touching each other in the middle. Subgenital plate wider than long with concave basal and convex lateral margins; apical margin subtruncate, very faintly concave between bases of styli; ventral surface convexly swollen in basal half, followed by a narrow conical swelling in middle (Fig. 4H).

**Coloration.** Head green; vertex with a pair of black bands that fuse to a single band at median ocellus and with a pair of short black lines from behind compound eyes to occiput. Frons green with three black vertical bands: two lateral bands from below compound eyes to tip of mandibles and one medial band from median ocellus to tip of labrum (Fig. 4C). Antennae with flagellum black with sparse white spots. Pronotum green with posterior area, anterior and posterior margins reddish brown, which may be partly due to discoloration in the set specimen. Tegmen brownish transparent; margin green. Abdomen discolored. Legs green, con-spense with black dots; hind femur with apical area black and with a black stroke in pre-apical area restricted to dorsal margin. Male cerci of general color but internal–ventral surface and internal process black; male subgenital plate of light color; styli darkened.

**Female.** Unknown.

**Measurements.**—(4 males; in mm) Body w/o wings: male 14–16; pronotum: male 6.2–6.8; tegmen: male 5.0–5.3; hind femur: male 11.8–12.5; anterior femur: male 4–5; antenna: male 60–65.

**Etymology.**—The name of the new species refers to the angular internal tooth of the male cercus; from Latin *angularis*: angular.

*Lipotactes productus* sp. nov.

<http://zoobank.org/136F5906-B869-4B88-B7BD-566AA323BFB4>

Figs 1, 5A–D, 6F–H

**Material examined.**—**Holotype:** VIETNAM • male; South Vietnam, Cat Tien NP [= National Park]; 11°26'N, 107°26'E; 6–16 Jul. 2012; J. Constant and J. Bresseel leg.; I.G.: 32.161; ISNB. **Paratypes:** VIETNAM • 1 female, 2 males; South Vietnam, Dong Nai Biosphere Res.; 11°18'N, 107°6'E; 25 Jun.–6 Jul. 2012; J. Constant and J. Bresseel leg.; I.G.: 32.161; ISNB.

**Diagnosis.**—The new species is very similar to *L. sulcatus* Ingrisch, 1995 and *L. ingrischi* Gorochov, 1996 in general appearance, size, and coloration. It differs from both by the shape of the male cerci that are conical with a vertically oriented, rounded process in basal area and terminating into a rather long styliform apical area that



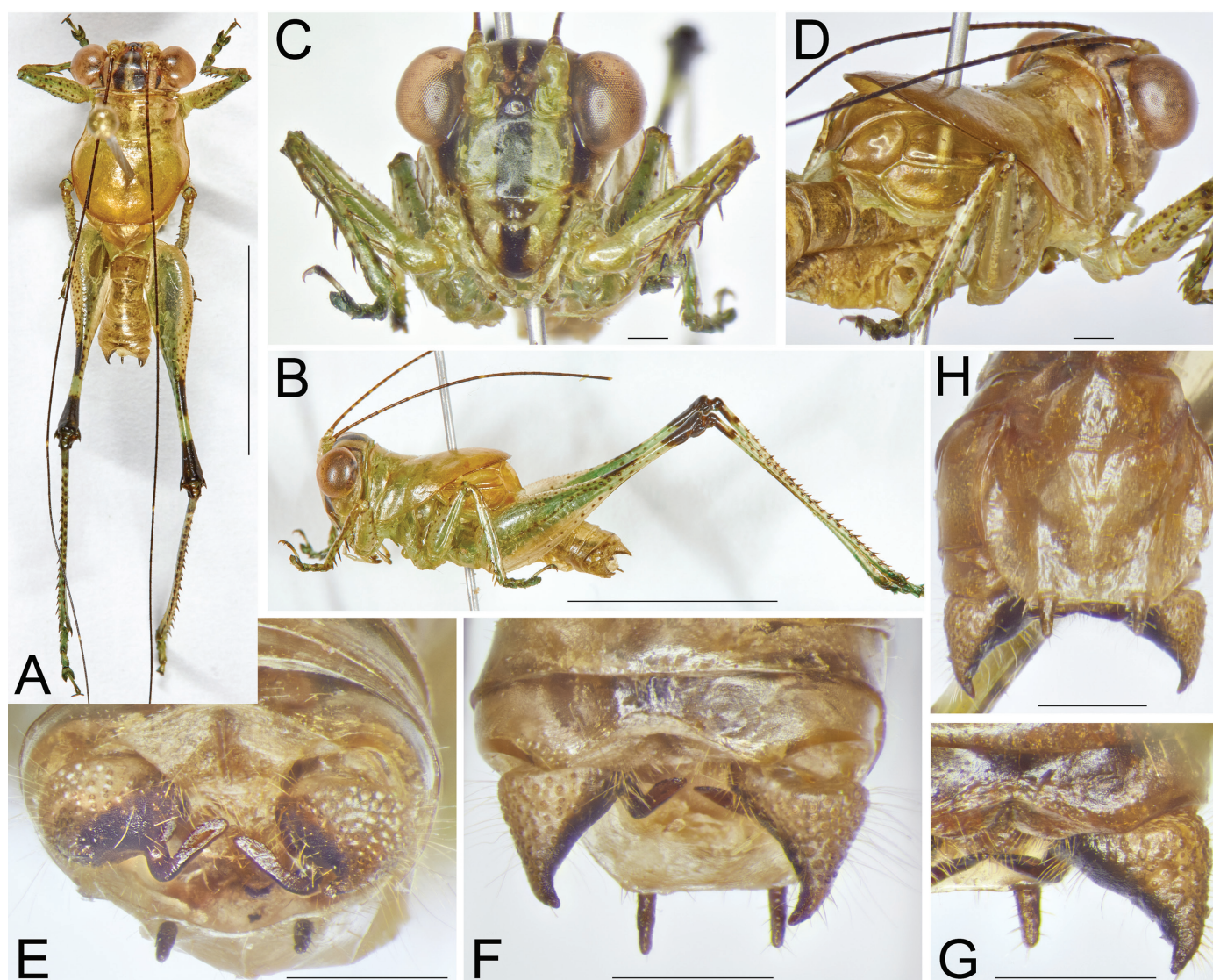


Fig. 4. *Lipotactes angulatus* sp. nov. males. A. Habitus dorsal view; B. Habitus lateral view; C. Frons; D. Anterior area of body with oblique apical view on tegmen; E–G. Abdominal apex in apical view (E) and in dorsal view of different males (F, G); H. Subgenital plate and cerci in ventral view. Scales for habitus (A–B): 5 mm; others (C–H): 1 mm.

is pointing straight behind, while in *L. sulcatus*, the cercus is rather narrow at base then widens to a process before mid-length and the styliform apical area appears attached and is pointing apico-lateral. In *L. ingrischi*, the male cercus has a short stout basal area with a horizontally oriented internal process that is distinctly wider at tip than at base, and the styliform apical area is pointing strongly laterad. More closely related to *L. productus* sp. nov. is *L. discus* sp. nov., described below. Both species have a vertically oriented, rounded process in the basal area of the male cercus to which, on the ventral side, a styliform process is appended. They differ in that the rounded internal process is somewhat spherical in *L. productus* with the styliform process flattened and arising from the proximo-ventral angle, while in *L. discus* the process is conical and the styliform process arises from the ventro-distal angle. In addition, the narrow apical area of the cercus is pointing straight behind in *L. productus* while oblique outwards in *L. discus*. Moreover, the tenth abdominal tergite has the apical margin slightly bilobate in the former while slightly concave in the latter species.

**Description.**—Small sized species of yellowish to grayish brown coloration with dark pattern.

**Male.** Pronotum convexly raised in posterior area. Tenth abdominal tergite slightly bilobate in middle. Cerci narrow conical with a long and narrow cylindrical apical area (Fig. 6H). In subbasal area of cercus, with a roughly circular internal process with strongly convex posterior surface and delimited from cercus stem by a weak furrow; at ventral side, a short, compressed, obtuse extension arises from the base of the process (Fig. 6F–G). Subgenital plate with strongly convex underside and with convex lateral margins that are at tip prolonged posteriorly into short, compressed, apical lobes that are separated by a wide concavity from each other and carry on the underside rather long styli (Fig. 6G).

**Female.** Subgenital plate wider than long, slightly curved from one side to the other; apical margin faintly concave (specimen glued on cardboard with subgenital plate only visible from behind). Ovipositor with ventral valves only faintly upcurved in



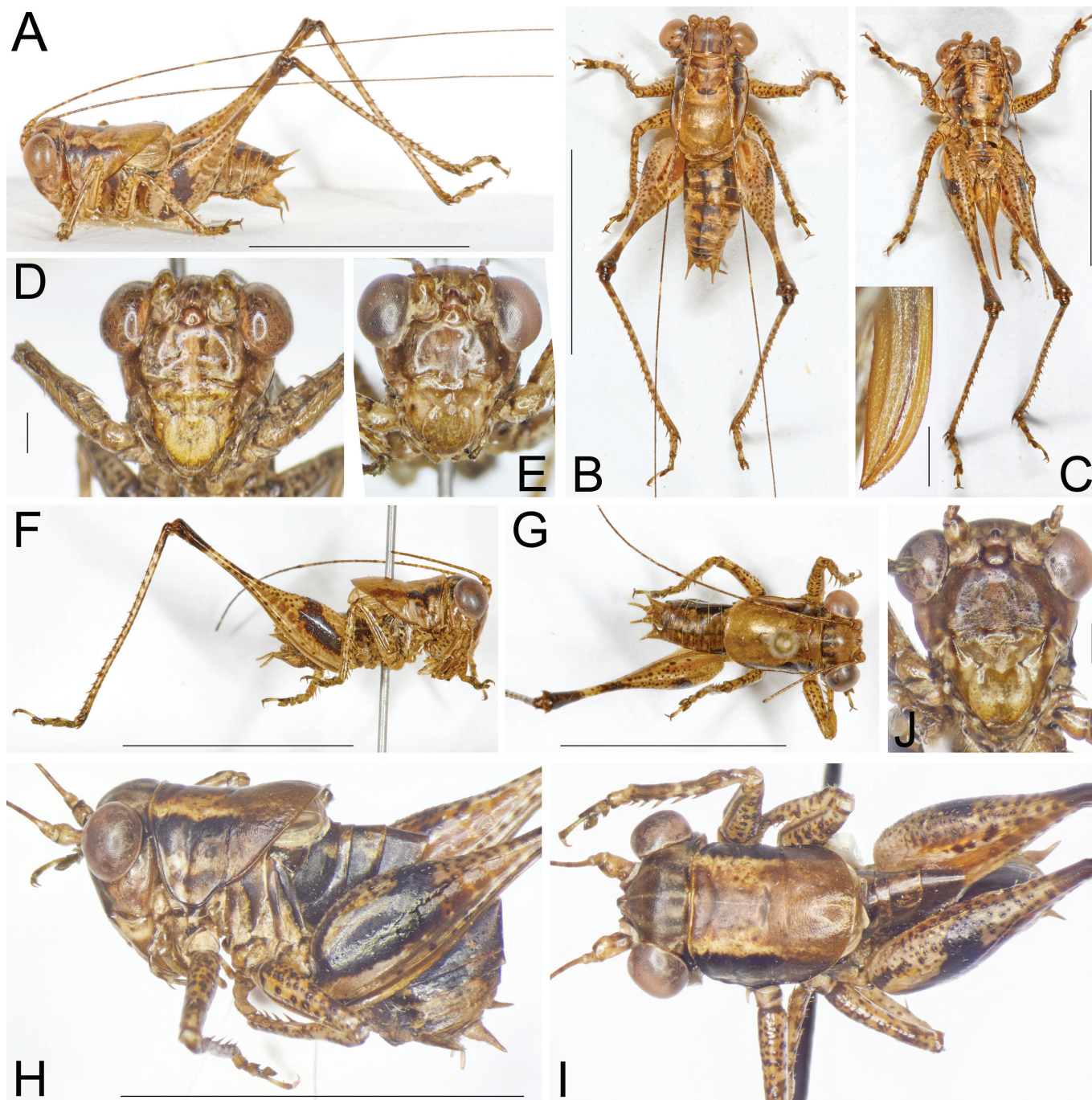


Fig. 5. *Lipotactes* sp. A, B, D. *L. productus* sp. nov. male; C. Female; E–G. *L. discus* sp. nov. male; H–J. *L. samkos* sp. nov. male. A, F, H. Habitus lateral view; B, C, G, I. Habitus dorsal view; D, E, J. Face. Inset in C. Apical half of ovipositor in lateral view. Scales for habitus: 10 mm; for face and ovipositor: 1 mm.

about apical half, more strongly upcurved towards tip; ventral margin in apical area provided with a few minute teeth: ten teeth in the specimen at hand; dorsal valves at base slightly depressed, then with dorsal margin nearly straight to almost mid-length; in subapical area, distinctly concave, then widened and convex, and in apical area, concave again to tip (Fig. 5C inset).

*Coloration (both sexes).* Grayish to ochre brown with black marks. Frons yellowish brown or ochre with little irregular, rather narrow, dark vertical bands. Vertex with two narrow black

bands along midline and irregular black spots behind eyes. Pronotum with black bands along lateral angles that do not reach the hind margin. Abdominal tergites with transverse black spots along midline to last tergite and with black lateral bands to about mid-length of abdomen. Legs with numerous dark brown to black dots. Hind femur with an upcurved black band from base and with black hind knees, the latter prolonged anteriorly into a medium to dark brown spot and another but rather indistinct dark brown spot at the beginning of the narrow apical area.



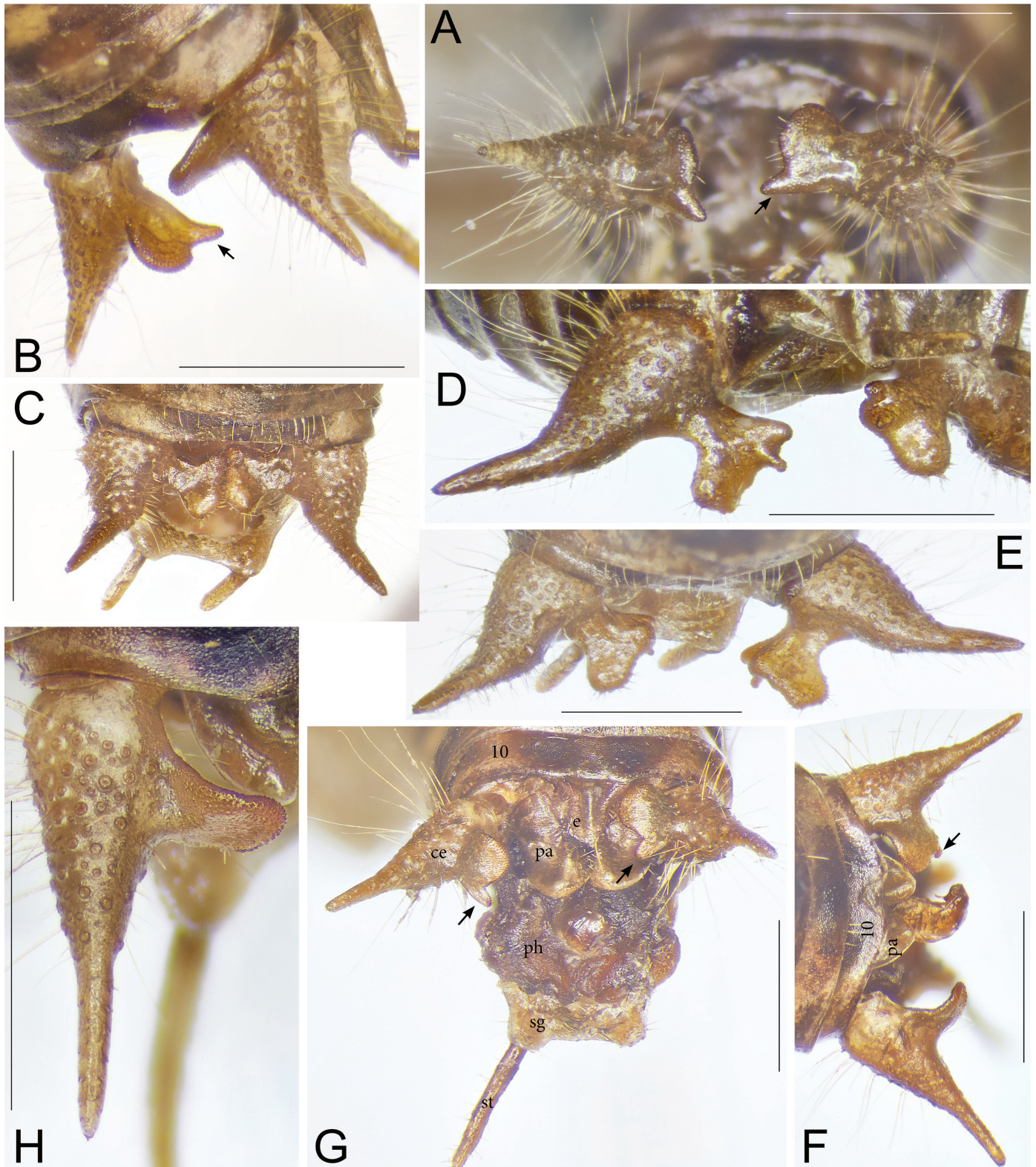


Fig. 6. *Lipotactes* sp. A, B. *L. discus* sp. nov.; C–E. *L. samkos* sp. nov.; F–H. *L. productus* sp. nov. A, G. Male abdominal apex with cerci in apical view; B. Oblique dorsal view; C. Dorsal view in situ; E, F. Dorsal view with cerci spread sideward; D. Oblique ventral view; H. Left cercus in dorsal view. Arrows point at ventral extension of internal process of the male cercus. Abbreviations: 10, tenth abdominal tergite; ce, cercus; e, epiproct; pa, paraproct; ph, phallus; sg, subgenital plate; st, stylus. All scales 1 mm.

**Measurements.**—(3 males, 1 female; in mm) Body w/o wings: male 11.5–12.0, female 11.0; pronotum: male 4.3–4.7, female 3.5; tegmen: male 2.5–3.3, female 0; hind femur: male 12.0–13.5, female 12.0; antenna: male 60; ovipositor: female 5.5.

**Etymology.**—The name of the new species refers to the prolonged narrow apical area of the male cercus; from Latin *productus*: prolonged, produced, elongated.

***Lipotactes discus* sp. nov.**

<http://zoobank.org/59C27D18-874F-4BA9-A41B-3AED24E6F588>

Figs 1, 5E–G, 6A–B

**Material examined.**—**Holotype:** CAMBODIA • male; Ratanakiri, Yeak Laom Lake env. [= environment]; 13°44'N, 107°1'E; 9–11 Oct. 2017; J. Constant and X. Vermeersch leg.; I.G. 33.551; ISNB.

**Diagnosis.**—In general appearance and shape of the male cerci, the new species is similar to *L. productus* sp. nov. It differs by the male cercus that has a more strongly conical basal area and the narrow apical area shorter and pointing outwards instead of straight behind, also by the internal process of the cercus that stands vertically to the cercus axis and is roughly disc-shaped in both species but has a conical tooth arising from the ventro-distal angle in *L. discus* sp. nov. while slightly shorter and arising from the proximo-ventral angle of the process in *L. productus* sp. nov. Moreover, the apical margin of the tenth abdominal tergite is slightly bilobate in *L. productus* sp. nov. but simply concave in *L. discus* sp. nov. From *L. khmericus* Gorochoy, 1998 that lives in the same larger area, the new species differs strikingly by the shape of the internal process of the male cercus that is vertically inserted in *L. discus* sp. nov. while horizontally inserted and terminating into three short lobes of different shapes in *L. khmericus*. Moreover, in the new species, the narrow apical area of the cercus is relatively shorter (about 0.65 times the length of the basal area) and gradually narrows from the wider and conical basal area, while in *L. khmericus*, it is relatively longer (about 0.85 times) and abruptly narrows from the basal area.

**Description.**—Small sized species of yellowish to grayish brown coloration with dark pattern.

**Male.** Pronotum with apical area prolonged and slightly elevated, with three transverse furrows; the first furrow distinct on disc and on paranota, the second furrow restricted to paranota, and the third furrow weak on disc, distinct on paranota (Fig. 5F, G). Cerci conical with little out-curved narrow apical area with subacute tip; cercus trunk in subbasal area with a vertical, compressed circular process that is prolonged in a ventro-distal angle into a cone; margin of process and cone finely granular; disc in upper basal area slightly swollen on distal side (Fig. 6A, B). Subgenital plate with lateral margins convex, in apical area straight; apical margin roundly excised; long styli inserted on underside at lateral tips of subgenital plate.

**Coloration.** Grayish to ochre brown with black marks. Frons yellowish brown to ochre with indistinctly delimited lighter and darker areas; clypeus and labrum of lighter color, mandibles yellowish white, darkened towards tip, with a rounded black spot in subbasal area. Vertex with six short longitudinal black bands from hind margin. Pronotum with black bands along lateral angles reaching the hind margin. Abdominal tergites brown with black lateral bands. Legs yellowish brown with numerous dark brown to black dots. Hind femur with an upcurved black band from base

and with black apical area that is preceded by a pale ring and by a black stroke restricted to dorsal margin.

**Female.** Unknown.

**Measurements.**—(1 male; in mm) Body w/o wings: 9; pronotum: 3.5; tegmen: 2.5; hind femur: 10; anterior femur: 2.8.

**Etymology.**—The name of the new species refers to the basic shape of the internal process of the male cercus, from Latin *discus*, noun in apposition.

***Lipotactes samkos* sp. nov.**

<http://zoobank.org/DB59CA99-92AB-4DB4-B003-72EA021418B8>

Figs 1, 5H–J, 6C–E, 7C

**Material examined.**—**Holotype:** CAMBODIA • male; Pursat, Phnom Samkos; 12°13'2"N, 102°55'7"E; 15–18 Oct. 2016; J. Constant and J. Bresseel leg.; I.G.: 33.345 GTI project; ISNB.

**Diagnosis.**—The basic shape of the internal process of the male cercus of the new species is similar to that in *L. khmericus* Gorochoy, 1998, as it is oriented horizontally and has the proximal marginal area down-bent. However, in *L. samkos* sp. nov., the internal margin is slightly wavy, while in *L. khmericus*, it has a distinct rounded incision; as a result, the straight posterior margin of the process appears as such in the new species, while it is part of the internal margin in *L. khmericus*. Additionally, a narrow ventral spine of the internal process arises from the underside of the process while from the ventro-internal margin in *L. khmericus*. The apical area of the cercus stem is slightly conical, distinctly bent outward, and with an obtuse tip in the new species, while that area is suddenly narrowed at base and subcylindrical with an acute spinose tip in *L. khmericus*. From *L. saengeri* sp. nov., the new species differs by the shape of the internal process of the male cercus, the shape and inserting position of a small ventro-medial spine at the internal margin of the process, and by the conical instead of cylindrical and more strongly outwards bent apical area of the cercus. *L. ingrischi* Gorochoy, 1996 also has a horizontal internal process of the male cercus, but the new species differs by the shape of the internal process and by the narrow apical part of the cercus that is much less curved laterad instead of strongly curved laterad.

**Description.**—Small sized species of yellowish to grayish brown coloration with dark pattern.

**Male.** Pronotum with three faint transverse furrows indistinct or absent on disc; apical area prolonged and slightly elevated (Fig. 5H, I). Tenth abdominal tergite short, apical margin very faintly concave in middle. Epiproct elongate-triangular, apex obtuse and slightly curved posteriorly. Paraproctes spoon-shaped with short stem and large bowl-shaped processes below internal processes of cerci. Cerci conical with slightly out-curved narrow apical area with subacute tip; cercus trunk in subbasal area provided with a horizontal internal process with rather long and flat proximal area that in dorsal view is strongly widening towards both sides into a rounded proximal lobe and a strongly swollen, subtruncate, or little convex distal lobe (Fig. 6E). In dorsal view and when at rest, the sub-straight internal margins of the processes of both cerci touching each other in the middle but deviating distally (Fig. 6C). On ventral side of the process, the anterior margin terminates into a conus; moreover, there is another short, but somewhat compressed conus from below the internal margin



of the process (Fig. 6D). Phallus membranous. Subgenital plate slightly wider than long with marked disc and up-bent lateral margins; apical margin wide and shallowly concave; styli inserted on underside at lateral angles of disc of subgenital plate (Fig. 6C).

**Coloration.** Yellowish to reddish brown with black pattern. Face with mixed flecks of yellowish and blackish brown; clypeus and mouthparts yellowish with brown flecks; vertex with six longitudinal dark brown bands. Pronotum with black band in upper area of paranota followed downwards by whitish, blackish, and again whitish bands; disc yellowish with darker staining in anterior half, red brown in posterior half. Tergites mostly black with few lighter spots, last three abdominal tergites and cerci mostly yellowish brown; subgenital plate medium brown. Legs yellowish brown with numerous rather large black dots; hind femur in about basal third with a wide black band that is bent to dorsal margin at end, narrow apical area with dorsal margin little darkened, followed by a long whitish ring and then shining black to tip; hind tibia rather pale with indistinct darker flecks, only apical area and lateral margin of tarsal segments partly black.

**Female.** Unknown.

**Measurements.**—(1 male; in mm) Body w/o wings: 11; pronotum: 4.2; tegmen: 2; hind femur: 11; anterior femur: 3.

*Lipotactes saengeri* sp. nov.

<http://zoobank.org/9F28BFD3-48A0-4CC9-90B4-ADB68BEF4293>

Figs 1, 7A, B

*Lipotactes khmericus* – Helfert & Sanger 2009

**Material examined.**—**Holotype:** THAILAND • male; Chanthaburi, Khao Sabap; 12°32'58.13"N, 102°11'55.32"E; 9 Sep. 2008; B. Helfert and K. Sanger leg.; NMW. **Paratype:** THAILAND • 1 male; same data as for holotype; NMW. **Other material:** THAILAND • 1 female; same data as for holotype; not re-examined; NMW.

**Diagnosis.**—The new species is similar to *L. khmericus* Gorochov, 1998 and *L. samkos* sp. nov. It differs from both by the shape of the internal process of the male cercus that has the anterior area flat and extended anteriorly, not down-bent as in both other species, but the central area of that process is slightly swollen instead of flat. The small ventral thorn of the process has an acute instead of obtuse tip and inserts nearly in the middle of the internal ventral margin instead of closer to the anterior margin in both other species; the internal margin of the process is slightly three-lobular instead of distinctly lobular in *L. khmericus* or sub-straight in *L. samkos*. The narrow apical area of the male cercus is cylindrical and moderately out-curved in *L. saengeri* sp. nov., conical and more strongly out-curved in *L. samkos*, while only faintly out-curved but suddenly narrowed at base and provided with an apical spine in *L. khmericus*.

**Description.**—Small sized species of yellowish to grayish brown coloration with dark pattern.

**Male.** Tenth abdominal tergite short, apical margin in central area slightly concave in strict dorsal view. Epiproct triangular with blunt tip and medial furrow. Cercus in more than basal half conical, following apical area slightly out-bent and sub-cylindrical with blunt tip; in basal area with a large, dorso-ventrally compressed, internal process that is behind basal incision widening slightly to three-lobate internal margin: basal lobe rounded, flat, medial lobe with slightly convex dorsal surface and also with rounded tip from which the ventro-internal margin gives rise to an acute, conical spine with

granular surface and pointing medio-ventrad; apical lobe of rectangular appearance with rounded angles, separated by only a shallow incision from medial lobe (Fig. 7A, B). Subgenital plate with shallowly concave apical margin; styli inserted at both sides of concavity.

**Female.** Described and figured in detail by Helfert and Sanger (2009) as *L. khmericus*. Subgenital plate with a simple, roughly oval outline without modification.

**Coloration (both sexes).** Museum specimens formerly conserved in alcohol; grayish pale to light ochre brown with dark blackish brown marks. Frons with indistinctly delimited lighter and darker areas; clypeus and labrum of lighter color, mandibles light gray, darkening towards tip. Pronotum with brownish disc and with black bands along lateral angles reaching the hind margin or the second transverse sulcus. Abdominal tergites light brown with black lateral bands. Legs light brownish with numerous dark brown to black dots. Hind femur on external side in more than basal quarter almost white with a blackish band in middle that is upcurved at end, afterwards with numerous large black dots; hind knees blackish brown. Hind tibiae at base and end also darkened. Photos of alive male and female are figured in Helfert and Sanger (2009).

**Measurements.**—(2 males; in mm) Body w/o wings: 12.7–13.1; pronotum: 4.5–4.6; tegmen: 2.3–2.4; hind femur: 10.9–11.8.

**Etymology.**—The new species is named after one of the collectors, Dr. Karl Peter Sanger (1939–2019), well known for his work on the ecology of European Orthoptera who, in his later years, became interested in the tropical fauna (see Waitzbauer 2019).

*Lipotactes* sp.

Figs 1, 8A–E

**Material examined.**—CAMBODIA • 1 female; Siem Reap, Preaek Toal; 13°14'32"N, 103°39'5"E; 6–14 Aug. 2005; Danny Jump leg.; ISNB.

**Discussion.**—Including the two new species described in this paper, three *Lipotactes* species are so far known from Cambodia based on marked differences of the male cerci, which is thought to be of isolating value between the species. Unfortunately, none of the females of these species have been collected at the type localities; thus, it is not possible to assign single females collected at other localities of the country to one of these species.

The type localities of both *L. khmericus* Gorochov, 1998 and *L. discus* sp. nov. lie in the Ratanakiri province of Cambodia. Both species were identified based on the male abdominalia. The female from Preaek Toal has a subgenital plate with widened base and semi-oval widening of central area resembling the shape in *L. silvestris* Ingrisch, 1990 from Khao Soi Dao in Southeastern Thailand, differing by the circular apical depression of the subgenital plate and the incised hind margin. The female from Preaek Toal also differs clearly from the female described in Helfert and Sanger (2009) that has a simple semi-oval shaped subgenital plate with apical margin convex without groove or basal widening. The closest locality from which a male of *Lipotactes* has been reported is that of *L. samkos* sp. nov., which is over 300 km away from Preaek Toal. It is uncertain if the female belongs to that species, although it cannot be excluded. Thus, it is best to avoid naming the female until more material from the area becomes available.

**Description.**—Small sized species of yellowish to grayish brown coloration with dark pattern.

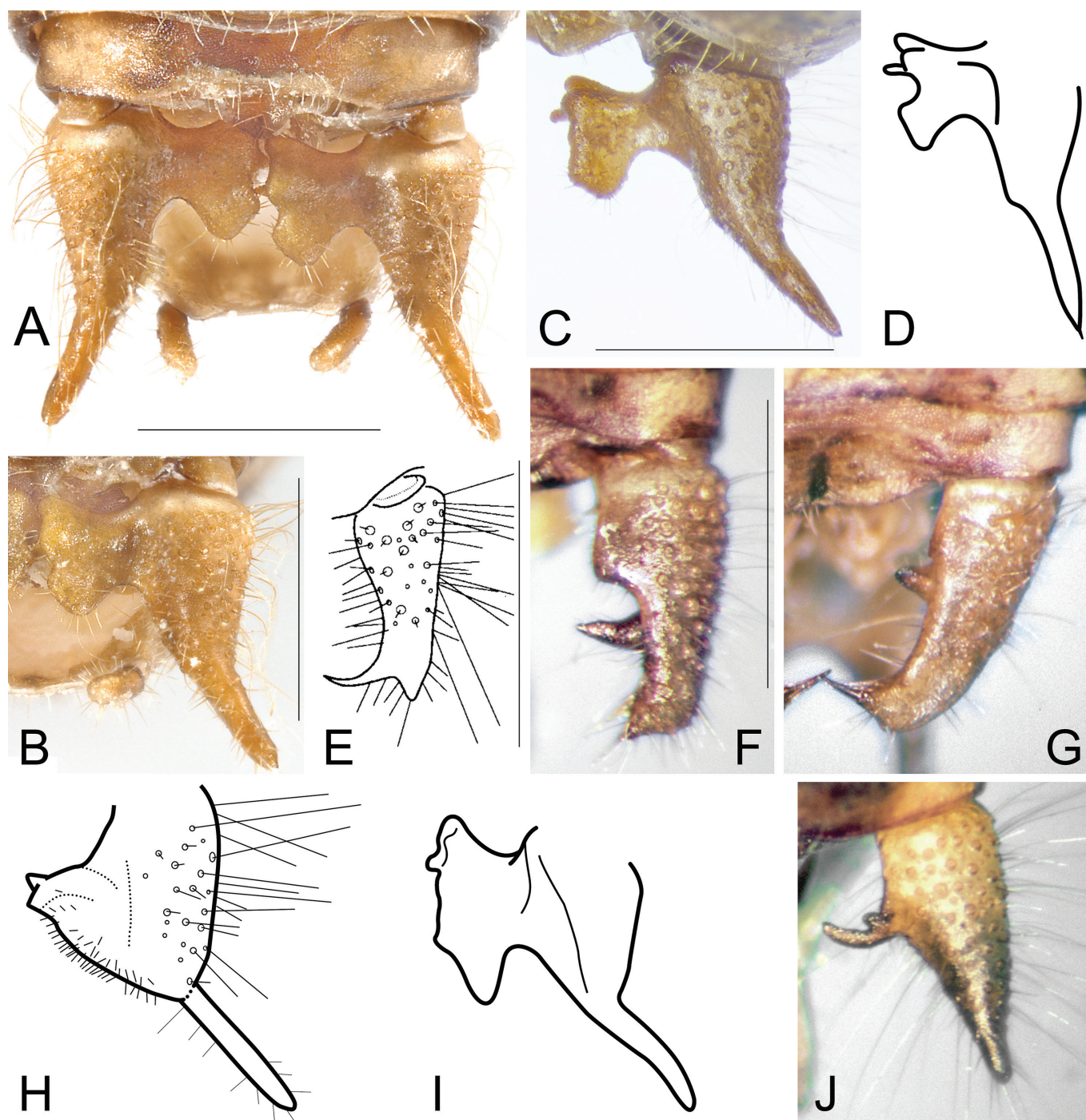


Fig. 7. *Lipotactes* sp. A–B. *L. saengeri* sp. nov.; C. *L. samkos* sp. nov.; D. *L. khmericus* Gorochov, 1998; E. *L. minutus* Ingrisch, 1995; F. *L. silvestris* Ingrisch, 1990; G. *L. montanus* Ingrisch, 1990; H. *L. sulcatus* Ingrisch, 1995; I. *L. ingrischi* Gorochov, 1996; J. *L. virescens* Ingrisch, 1995. A. Abdominal apex with cerci in dorsal view; B. Cercus in oblique dorsal view from behind; C–J. Cercus in dorsal view. Photos A–B from NMW NOaS Image Collection, photo credit H. Bruckner; figures D and I redrawn from Gorochov (1996 and 1998); figures E and H from Ingrisch (1995). All scales 1 mm; line drawings D and H–I not to scale.

**Female.** Subgenital plate wider than long; lateral areas very short; central area swollen and roundly projecting behind narrow lateral areas; the projecting part with a deep membranous groove in middle, at apex concave; laterally of the groove, the surface is swollen on both sides (Fig. 8C). Ovipositor slightly curved; dorsal margin in middle concave, then slightly convex and only very faintly concave before acute tip; ventral margin behind sub-

straight basal area concave to acute tip, in apical area provided with about six tiny teeth (Fig. 8D, E).

**Coloration.** Frons with irregular brownish–yellowish pattern; labrum and mandibles of lighter color; vertex with six slightly expressed dark longitudinal bands from hind margin (Fig. 8B). Pronotum with black bands along lateral angles that almost but not completely reach the hind margin. Abdominal tergites brown with black





Fig. 8. *Lipotactes* sp. female from Preak Toal, Cambodia: A. Habitus, lateral view; B. Face; C. Subgenital plate and base of ovipositor in ventral view; D. Ovipositor in lateral view; E. End of ovipositor in greater magnification. Scales 10 mm (A), 1 mm (B–E).

lateral bands. Legs yellowish brown with numerous dark brown to black dots. Hind femur with a black band from base that has the up-curved part largely reduced; the black apical spot becomes brownish anteriorly and the pre-apical dark spot is only indicated (Fig. 8A).

**Measurements.** — (1 female; in mm) Body w/o wings: 10.5; pronotum: 4; tegmen: 0; hind femur: 11; anterior femur: 2.8; ovipositor: 7.5.

#### Key to species of the genus *Lipotactes* from Vietnam, Cambodia, and Thailand

This key works only with males, as females are not known for all species concerned, and the morphology of related species is very similar. Data for species that were not studied or re-examined for the present publication are adapted from Gorochov (1993, 1996, 1998) and Ingrisch (1995).

- 1 Males of predominantly green general color mixed with light and with black pattern, or of whitish color that appears shiny blue in alive individuals of some species. Females are known to have a light brown or green general color with a black pattern. Male cercus with strongly widened basal area, either short conical or nearly quadrangular, in both cases with a short narrow conical or sub-cylindrical apical area from external-apical angle of wide basal area (Figs 2G–I, 4E, G) or male cercus simply conical with a forked internal tooth with rather short and simple branches behind end of basal third (Fig. 7J)..... 2
- Males of light brown general color with black pattern. Male cercus elongate, either with a subapical internal tooth (if the pronounced tip of cercus appears truncate) or conical with a distinct narrow apical area that is pointing straight behind or bent more or less outward; in basal area with internal process that varies between species (Figs 6A–H, 7A–I)..... 8
- 2 Male cercus with strongly widened basal area, either short conical or nearly quadrangular, in both cases with a short narrow conical or sub-cylindrical apical area from external-apical angle of wide basal area (Figs 2G, I, 4F). North and Central Vietnam ..... 3
- Male cercus simply conical with a forked internal tooth with rather short and simple branches behind end of basal third (Fig. 7J). Trang province of Thailand and Peninsular Malaysia.....  
..... *L. virescens* Ingrisch, 1995
- 3 Often head with distinct transverse dark cross-belt between posterior halves of eyes, in females often interrupted in middle or completely missing (Figs 2B, 3A). Pronotum in male with dark stripe along posterior margin of disk (Fig. 2A, B, D). Male cerci short, wider than long, from apical external angle with a narrow extension of about same length as wide basal area; wide basal area from internal margin with a huge process consisting of a dorsal and a ventral branch varying in shape between species (Fig. 2C, E, H). Male phallus with a pair of elongate sclerites and a shorter unpaired sclerite (Fig. 2E). Dorsal margin of ovipositor in all species with known females in subapical area without concavity but running straight into tip (Fig. 3E, F, H, I) ..... 4
- Green species with black dots. Pronotum prolonged behind and with widened posterior area (Fig. 4A). Head with a pair of longitudinal black bands along midline of vertex and a pair of narrow black lines behind eyes; face with three black vertical bands (Fig. 4C); hind femora green with hind knees black and a narrow black stroke on dorsal margin in apical area (Fig. 4B). Male cerci conical with wide base and narrow, slightly inwardly curved apical area; at base with a compressed, band-shaped but angularly bent internal process (Fig. 4E–G). Phallus membranous. Female unknown. Central Vietnam ...  
..... *L. angulatus* sp. nov.
- 4 Pronotum with large dark spots occupying the middle part of disk in male. Male cerci with rounded or truncate apex of upper inner process (Fig. 2C, 2G); narrow apical extension of cercus either ob-

- tuse with a minute spinule at inner angle or with a distinct, laterally serrate spine at tip (Fig. 2C, F). Male subgenital plate with long and narrow styli ..... 5
- Pronotum with small dark spots in the middle of disk or without spots. Male cerci with bifurcated apex of the upper inner process and more or less narrow lower inner process (Fig. 2H, I); narrow apical extension of cercus either narrowed into acute tip or with a distinct smooth spine at tip (Fig. 2I) ..... 6
- 5 Male cerci with a small spine at proximal base of concave upper inner process; upper inner process partly upcurved with rounded margin; lower inner process wide; narrow apical extension of cercus with a minute, hardly visible spinule at tip (Fig. 2C). Male genitals with narrow paired sclerites bearing no visible small setae at apex and unpaired sclerite approximately 1.5 times shorter than paired one. Northern Vietnam ..... *L. azureus* Gorochov, 1996
- Male cerci with upper inner process sinuate in apical view, in dorsal view nearly flat with truncate inner margin; lower inner process in apical view narrow, in dorsal view triangular; narrow apical extension of cercus with a strong spine at tip that carries along margins acute teeth (Fig. 2F). Male genitals with unpaired medial sclerite reaching only the end of the widened base of the narrow paired sclerites; the paired sclerites slightly narrowing towards tip (Fig. 2E). Northern Vietnam ..... *L. serratus* sp. nov.
- 6 Narrow apical extension of cercus with a distinct acute and smooth spine at tip (Fig. 2H, I). Elytra in male small, protruding in the rear only faintly from beneath the pronotum. Male genitals with narrow, paired sclerites with obtuse tip, approximately two times longer than unpaired sclerite. Male subgenital plate with rather short and wide styli (Fig. 2I). Northern Vietnam ..... *L. vietnamicus* Gorochov, 1993
- Narrow apical extension of cercus with acute tip or with a minute spinule at tip ..... 7
- 7 Pronotum in male with short posterior process of disk and narrow dark stripe along posterior margin of disk. Narrow apical extension of male cercus narrowed into acute tip. Male genitals with narrow paired sclerites bearing noticeable small setae at apex and with unpaired sclerite approximately 1.5 times shorter than the paired one. Northern Vietnam ..... *L. proximus* Gorochov, 1996
- Pronotum in male with more or less long posterior process of disk and wide dark stripe along posterior margin of disk. Male genitals without noticeable small bristles at apex of paired sclerites. Elytra in male large, protruding approximately 1 mm in the rear from beneath pronotum; male genitals with wide paired sclerites approximately 1.2 times longer than unpaired sclerites. Northern Vietnam ..... *L. orlovi* Gorochov, 1996
- 8 Male cercus in basal third to half with internal margin expanded with straight or little convex internal surface followed behind by a stout conical internal tooth or basal widening slightly expressed and cercus with a curved subapical internal tooth; apex of cercus obliquely truncate, rounded, or forming a short cone ..... 9
- Male cercus without basal widening but with an internal process of various shapes in basal half; apical area of cercus prolonged into a narrow conical or subcylindrical process pointing straight behind or bent outward ..... 11
- 9 Cercus conical with weak convex widening of basal area, with a subapical curved internal tooth with acute tip, cercus proper terminating into a short cone (Fig. 7E) ..... *L. minutus* Ingrisch, 1995
- Cercus with marked internal widening for basal third or half with straight internal margin that is gradually or abruptly narrowed at end; tip of cercus subtruncate with external angle rounded and internal angle extended into a minute cone or a distinct spine ..... 10
- 10 Cercus with internal expansion strongly expressed with straight internal margin for almost half of cercus length; at end suddenly narrowed, followed behind by a conical shape and at base faintly curved internal tooth; apex of cercus obliquely truncate with a minute cone at apical internal angle (Fig. 7F). Southeastern Thailand ..... *L. silvestris* Ingrisch, 1990
- Cercus with internal expansion less expressed and restricted to basal third; at end gradually narrowed, followed by a conical internal tooth; tip of cercus rounded and slightly curved mediad, with a long acute spine at apical internal angle (Fig. 7G). North and West Thailand ..... *L. montanus* Ingrisch, 1990
- 11 Male tenth abdominal tergite in middle of apical margin with a process that terminates on both sides into a short acute process. Male cercus nearly parallel-sided in basal half, finger-shaped in apical area, internal process arising at or slightly behind middle of cercus, in dorsal view narrow, running nearly parallel to cercus stem and terminating slightly before tip of cercus. Male subgenital plate with a pair of spine-like outgrowths at bases of styli. Southern Vietnam ..... *L. amicus* Gorochov, 1993
- Male tenth abdominal tergite in middle of apical margin slightly concave with a faint medial protuberance or apical margin with a pair of short conical processes. Male subgenital plate without spines at bases of styli ..... 12
- 12 Male cercus with basal area rather short, provided over most of the length of the cercus stem with a huge, dorso-ventrally compressed internal process of roughly triangular shape but with margins convex and at tip dividing into a pair of tubercles; styliform apical process rather long, pointing distinctly outwards (Fig. 7H). Southern Vietnam ..... *L. sulcatus* Ingrisch, 1995
- Male cercus of different shape ..... 13
- 13 Male cercus with internal process standing horizontally to the main cercus axis, slightly constricted after it arises from the cercus stem and then strongly widening towards inner margin ..... 14
- Male cercus with internal process standing vertically to the main cercus axis, of disc-shaped outline with ventral process ..... 17
- 14 Male tenth abdominal tergite faintly projecting in middle. The styliform apical area of the male cerci bent rather strongly sideward; the internal process of the male cerci widening towards inner margin at anterior and posterior sides; the inner margin roughly convex with small protuberances (Fig. 7I). Southern Vietnam ..... *L. ingrisci* Gorochov, 1996
- Male tenth abdominal tergite with apical margin simply concave or almost sub-straight in middle. The styliform apical area of the male cerci only moderately curved laterad or almost straight. Internal process of cercus of different shape ..... 15
- 15 Cerci with internal process roughly in one level, only in midline little convexly elevated and faintly sloping towards anterior and posterior margin, inner margin slightly trilobate, on underside of central lobe with an acute conical process pointing ventro-mediad; narrow apical area of cercus cylindrical, slightly bent outward, tip obtuse with or without a very minute spinule (Fig. 7A, B) ..... *L. saengeri* sp. nov.
- Cerci with internal process that has the anterior area of process bent ventrad with ventral margin obtuse or terminating into a cone; another process from ventral inner margin of the process appears to insert in the basal third of the process and ends in an obtuse tip ..... 16
- 16 Male cercus suddenly narrowed before styliform apical process that is pointing only slightly outward; cercus stem with a large, horizontally oriented internal process from base to about end of basal third, slightly widening medially, especially towards distal angle, and terminating into two lobes separated by a distinct incision and a conical process from ventral inner margin (Fig. 7D). Cambodia ..... *L. khmericus* Gorochov, 1998
- Male cercus gradually narrowed into a styliform apical area that is moderately but distinctly curved laterad; cercus stem with a large, horizontally oriented internal process that starts with a parallel-sided, dorso-ventrally compressed area that is widening towards both



sides and swollen along inner and hind margins, the processes of both sides touching each other along midline when at rest (Fig. 6C); on the ventral side, the anterior margin of the process is bent ventrad and prolonged into an obtuse cone; next to this cone, there is another short, little compressed process with an obtuse tip (Fig. 6D); in dorsal view, the internal process of the cercus is not divided into lobes but with faintly wavy internal and straight apical margin (Fig. 7C). Cambodia ..... *L. samkos* sp. nov.

- 17 Male tenth abdominal tergite with apical margin slightly bilobate in middle, interrupted by a narrow concavity. Male cercus elongate, with long styliform apical process pointing straight behind, in sub-basal area on internal side with a large rounded internal process with convex posterior surface, separated from cercus stem by a shallow furrow and provided at ventro-proximal angle with a short styliform process (Fig. 6F–H). Female ovipositor with a concave subapical widening of the dorsal margin followed by shallow concavity. Southern Vietnam ..... *L. productus* sp. nov.
- Male tenth abdominal tergite with apical margin simply concave in middle. Male cercus remarkably conical, in sub-basal area provided with a roughly circular internal process standing vertically to the main cercus axis; it has the proximal surface slightly concave, the distal surface slightly convex and is provided at ventro-distal angle with a conical process; styliform apical process of cercus acute-conical, not very long, pointing moderately outwards (Fig. 6A, B). Cambodia ..... *L. discus* sp. nov.

## Acknowledgements

Most of the specimens studied for this paper came from the project “A step further in the Entomodiversity of Vietnam” managed by Jérôme Constant (ISNB) and supported through a grant issued by the capacity building Programme of the Belgian Global Taxonomic Initiative National Focal Point that runs under the CEBioS programme with financial support from the Belgian Directorate-General for Development Cooperation (DGD). I am thankful to Jérôme Constant for providing the collection from that project for examination and for invitations to ISNB. One visit was supported by SYNTHESYS (BE-TAF-2608 in 2013). My special thanks go to Mag. Harald Bruckner (Naturhistorisches Museum Wien), who helped re-evaluate the status of the specimens reported by Helfert and Sängner (2009) as *L. khmericus* by repeatedly providing photographs of these specimens at my request until I was able to see all the characters necessary to differentiate the specimens. I am also grateful to Ming Kai Tan for editing the manuscript and offering useful tips for improvement.

## References

- Bey-Bienko GY (1959) On some orthopteroid insects from the preserve forest Tingushan in the province Kwantung, South China. *Zoologicheskii Zhurnal* 38: 1813–1820. [Russian, English summary]
- Cigliano MM, Braun H, Eades DC, Otte D (2020) Orthoptera Species File. Version 5.0/5.0. <http://Orthoptera.SpeciesFile.org> [Accessed 06.08.2020]
- Constant J, Grootaert P (2020) A step further in the Entomodiversity of Vietnam (continuation). [http://www.taxonomy.be/gti\\_calls/grants\\_awarded/grants-rbins-2014/constant-and-grootaert-vietnam](http://www.taxonomy.be/gti_calls/grants_awarded/grants-rbins-2014/constant-and-grootaert-vietnam) [Accessed 27.08.2020]
- Feng JY, Zhou ZJ, Cnang YL, Shi FM (2017) Remarks on the genus *Lipotactes* Brunner v. W., 1898 (Orthoptera: Tettigoniidae: Lipotactinae) from China. *Zootaxa* 4291: 183–191. <https://doi.org/10.11646/zootaxa.4291.1.11>
- Gorochov AV (1993) Two new species of the genus *Lipotactes* from Vietnam (Orthoptera: Tettigoniidae). *Zoosystematica Rossica* 2: 59–62.
- Gorochov AV (1996) New and little known species of the genus *Lipotactes* Br.-W. (Orthoptera, Tettigoniidae) from Vietnam. *Entomologicheskoe Obozrenie* 75: 32–38. [Russian; English translation in *Entomological Review* 76: 843–848]
- Gorochov AV (1998) A new species of the genus *Lipotactes* from Cambodia (Orthoptera: Tettigoniidae). *Zoosystematica Rossica* 7: e132.
- Helfert B, Sängner K (2009) The female of *Lipotactes khmericus* Gorochov 1998 (Lipotactinae: Tettigoniidae: Ensifera). *Zeitschrift der Arbeitsgemeinschaft Österreichischer Entomologen* 61: 119–122.
- Ingrisch S (1995) Revision of the Lipotactinae, a new subfamily of Tettigoniidea (Ensifera). *Entomologica Scandinavica* 26: 273–320. <https://doi.org/10.1163/187631295X00026>
- Karny HH (1931) Orthoptera Celebica Sarasiniana. I. Saltatoria, Fam. Tettigoniidae & Gryllacrididae. – *Treubia* 12, Bogor, supplement: 1–184. [1 map]
- Tan MK, Ingrisch S, Wahab RBHA, Japir R, Chung AYC (2020) Ultrasonic bioacoustics and stridulum morphology reveal cryptic species among *Lipotactes* big-eyed katydids (Orthoptera: Tettigoniidae: Lipotactinae) from Borneo. *Systematics and Biodiversity* 18: 510–524. <https://doi.org/10.1080/14772000.2020.1769223>
- Waitzbauer W (2019) Nachruf auf a.o. Univ.-Prof. Dr. Karl Peter Sängner (1939–2019). *AÖE News* 1: 73–78. [http://www.entomologie.at/uploads/www.entomologie.at/AOENEWS\\_2019\\_01\\_073-078.pdf](http://www.entomologie.at/uploads/www.entomologie.at/AOENEWS_2019_01_073-078.pdf) [Accessed 24.08.2020]
- Wang T, Shi FM (2020) Potential effect of the global warming to the subfamily Lipotactinae (Orthoptera: Tettigoniidae) in China and acoustics data of *Lipotactes truncatus* Shi & Li, 2009. *Journal of Asia-Pacific Entomology* 23: 146–151. <https://doi.org/10.1016/j.aspen.2019.12.007> [Accessed 10.09.2020]