

## Notes on Tettigoniids (Orthoptera, Ensifera) from Sulawesi

by Karl SÄNGER and Brigitte HELFERT

### Abstract

A list of eleven tettigoniid species recently collected in Sulawesi Utara and Sulawesi Tengah, Indonesia, is presented. Two new species, *Conocephalus sojolensis*, *C. melaenoides* and a female specimen of the genus *Lipotactes*, which is probably the hitherto unknown female of *L. digitatus* are described. Observations on the biology of several conocephalid and tympanophorid species are provided.

### Zusammenfassung

In der vorliegenden Arbeit werden elf Tettigoniiden-Arten aufgelistet, die in den Jahren 1993 und 1994 in Sulawesi Utara und Sulawesi Tengah, Indonesien, gesammelt wurden. Zwei neue Arten, *Conocephalus sojolensis* und *C. melaenoides* werden beschrieben, sowie ein adultes Weibchen der Gattung *Lipotactes*. Bei diesem Tier handelt es sich wahrscheinlich um das bisher unbekannte Weibchen von *L. digitatus*. Beobachtungen zur Biologie der neuen Arten ergänzen die Beschreibungen.

Keywords: New species, *Conocephalus*, *Lipotactes*, Tettigoniidae, Sulawesi, Indonesia

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### Introduction

The tettigoniids from Sulawesi (formerly Celebes) are very incompletely documented. The main source for Orthoptera of this island is still SARASIN'S collection dating back about 100 years. CHOPARD, WILLEMSE and KARNY studied the Saltatoria part of this collection. KARNY (1931) listed 56 species of Tettigoniidae. Later publications on orthopterans of the Indo-Pacific area (HEBARD 1922, WILLEMSE 1942, PITKIN 1980) treat tettigoniids of Sulawesi only occasionally. The present paper provides further records and descriptions of new species.

The studied specimens are deposited in the Natural History Museum, Vienna.

### List of the species (systematics according to BEIER, 1972):

#### Phaneropterinae

*Euanerota celebica* DE HAAN 1842

Material: 1 ♂, 2 ♀♀

Locality: Perikari, Palolo-Valley, Sulawesi Tengah, 21. 2. 1993. Secondary growth.

*Holochlora mapanensis* KARNY 1931

Material: 1 ♂

Locality: Bumaken, Sulawesi Utara, 30. 3. 1994. Orchard.

## Conocephalinae

### Conocephalini

*Conocephalus longipennis* DE HAAN 1842

Material: 2 ♀ ♀

Locality: Gunung Sojol, Ogoamas, Sulawesi Tengah; 18. 2. 1993. Secondary growth in a primary wet mountain rain forest.

### *Conocephalus sojolensis* sp. n.

Type material: Holotype ♀, Paratypes 1 ♀, 1 ♂. The male specimen is damaged: the hind legs are missing and the genital segments heavily injured. The relevance of the description is therefore limited. These injuries do not stem from our handling but must have happened to the living animal, because a distinct callus can be observed.

Type locality: Gunung Sojol, Ogoamas, Sulawesi Tengah; 18. 2. 1993. Secondary growth in a primary wet mountain rain forest.

Etymology: Named in reference to type locality.

#### Description:

Measures (in mm):.

	♂	♀ ♀
Total length	19,0	21,0/22,0
Median pronotum length	4,3	3,8/4,2
Head length	2,5	3,1/3,0
(fastigium verticis to clypeal suture)		
Postfemur length	-	17,5/19,9
Ovipositor length	-	19,0/22,0

Fastigium verticis width less than half of scapus, length about half of scapus, in front view with parallel margins. Antennae very long, the flagellomeres relatively thick, short, with regularly scattered setae. Posterior and anterior margin of the pronotum slightly convex, discus more or less flat. Paranota triangular, rounded at the tip, humeral sinus very weak. Prosternum with 2 short, sharp spines. Meso- and metasternum terminate in 2 apically rounded lobi. Parapter, the elytra reach more or less the posterior knees; the alae extend somewhat beyond the elytra. Tympana covered, with narrow, slit-shaped openings. Procoxae with one strong, downwardly bent lateral spine, the other coxae unarmed. Pro- and mesofemora unarmed, metafemora with 1 - 2 short spines. Lobi of the middle and posterior knees with 2 (1) terminal spines. Pro- and mesotibiae with 5 - 6 externo- and internoventral spines, metatibiae with 5 interno- and 6 - 7 externoventral spines, 25 - 34 externo- and 24 - 33 internodorsal spines and with 6 apical spurs (2 dorsal, 4 ventral spurs).

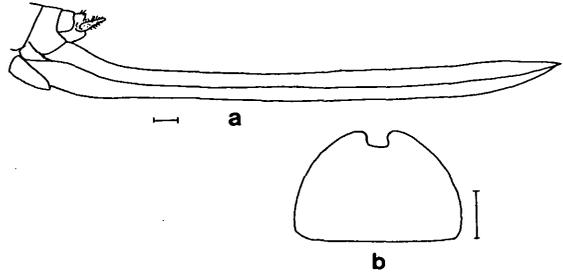
Genital segments: male cerci with 1 internal, downwardly bent spine in the middle. Subgenital plate slightly concave apically, styli slightly conical, short. Female cerci unarmed, apically pointed. Subgenital plate concave medially. Ovipositor long, straight (Fig. 1 a, b).

Colouration ex alcohol: primary colour yellowish. Occiput and dorsal side of the pronotum brown. Scapus and pedicellus with brown spots, flagellomeres each distally darker brown than proximally. Elytra grey, the anterior margin colourless. Alae smoked, the colouration intensifying toward the apex; costa and subcosta light-grey, all other veins dark-grey. Posterior knees blackish brown. Ovipositor brown.

Colouration in vivo: primary colour green. Occiput and dorsal side of the pronotum dark-brown. A small brown stripe extends from the posterior margin of the eye to the posterior margin of the pronotum. Scapus and pedicellus light-brown, flagellum dark-brown. Elytra greyish brown, the anterior margin colourless. Alae smoked, darker toward the apex, the anterior margin colourless.

Posterior knees black, all tibiae and tarsus greyish brown. Abdomen yellowish, the tergites of the abdomen yellowish to red yellow. Ovipositor light-brown.

Fig. 1: Genital segments of *C. sojolensis* ♀ (Scale = 1 mm). a = ovipositor, b = subgenital plate.



Differential diagnosis:

*C. sojolensis* occurs syntopically with *C. longipennis*. In comparison, *C. sojolensis* is considerably larger and bulkier, the ovipositor is significantly longer (19.0 - 22.0 mm versus only 13.0 -13.5 mm in *C. longipennis* from the same locality). The length of the ovipositor in specimens from the West Pacific area ranges between 12.6 and 15.9 mm (PITKIN 1980).

***Cococephalus melaenoides* sp. n.**

Type material: Holotype ♂. Paratypes: 6 ♂♂, 8 ♀♀, ex cult., F1.

Type locality: Gunung Sojol, Ogoamas, Sulawesi Tengah; 18. 2. 1993. Secondary growth in a primary wet mountain rain forest.

Etymology: Named in reference to the closely related *C. melaenus*.

Description:

Measures (in mm):

	♂♂	♀♀
Total length	17,2-18,9 (18,0 ±0,6)	17,0-20,2 (19,0 ±1,1)
Median pronotum length	3,2-3,6 (3,3 ±0,2)	3,2-3,8 (3,3 ±0,2)
Head length (fastigium verticis to clypeal suture)	2,6-3,2 (2,9 ±0,2)	2,9-3,1(3,0 ±0,1)
Postfemur length	12,9-14,9 (13,7 ±0,8)	13,8-15,8 (14,2 ±0,7)
Ovipositor length	-	7,3-8,3 (7,8 ±0,4)

Fastigium verticis width and length about half of scapus. Pronotum with a very weak, median carina, anterior margin straight, posterior margin slightly convex, discus flat, somewhat expanded posteriorly. Paranota triangular, lower margins rounded, humeral sinus weak. Parapter, alae slightly longer than elytra, which extend beyond the posterior knees. Stridulatory field set off with a distinct step. Prosternum with 2 short, weak spines, meso- and metasternum with narrow, apically rounded lobes. Protibiae broadened in the region of the tympana. Tympana covered with slit-shaped openings. Procoxae with 1 lateral spine, all femora unarmed. Knee lobes with 0 - 1 weak spine. Pro- and mesotibiae with 5 - 6 externo- and internoventral spines, metatibiae with 5 - 6 externo- and internoventral spines and 28 - 32 externo- and internodorsal spines and 6 apical spurs (2 dorsal, 4 ventral spurs).

Genital segments: male cerci with 1 internal, downwardly bent spine in the middle. Subgenital plate apically concave. Styli short, bent downwards. Titillators bent, apically not expanded,

distinctly toothed (Fig. 2a, b, c). Female cerci simple, pointed. Subgenital plate simple, apically rounded, with a V-shaped median incision. Ovipositor nearly straight (Fig. 2d, e).

Colouration ex alcohol: primary colour yellowish. Occiput and dorsal side of the pronotum dark-brown. Two light-brown stripes extend from fastigium to the proximal parts of the pronotum and fade away in the metazona. Fastigium verticis, scapus and pedicellus with dark-brown spots, flagellum blackish brown. Elytra dark-brown, only precostal and costal field colourless. Alae colourless, only anterior margin and apex dark-brown. Femora distally dark-brown. Knees dark-brown, tibiae and tarsus light-brown. Ovipositor light-brown.

Colouration in vivo: primary colour green. Markings of occiput and pronotum brown. The stripes between fastigium and metazona greenish white. Paranota verdigris. Abdominal tergites red with yellow-green stripes along each side. Basis of antennae light-brown, flagellum distally blackish brown. Elytra dark-brown, only precostal and costal field colourless. Alae colourless, only anterior margin and apex dark-brown. Basal parts of leg including proximal parts of the femora green, the postfemora proximally with fine dark markings, distally brown. Knees blackish brown. Tibiae and tarsus chestnut. Ovipositor chestnut, darker toward the apex.

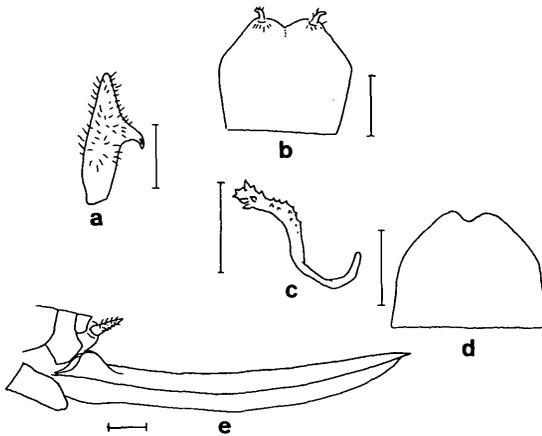


Fig. 2: Genital segments of *C. melaenoides*. (Scale = 1 mm). a = left cercus ♂ in ventral view; b = subgenital plate ♂; c = left titillator ♂ in ventral view; d = subgenital plate ♀; e = ovipositor.

#### Differential diagnosis:

*C. melaenoides* is very closely related to *C. melaenus* (DE HAAN 1842), which is also recorded for Sulawesi by KARNY 1931 (sub *Xiphidion melan*). It can be distinguished from the latter by the distinctly longer and less curved ovipositor. All femora are unarmed. The titillators are wider and more distinctly toothed. The length of the ovipositor ranges between 7,6 and 8,3mm ( $\bar{X} = 7,8 \pm 0,4$  mm; n = 6) in *C. melaenoides* and 6,0 - 7,6mm ( $\bar{X} = 6,7 \pm 0,4$ mm; n = 20) in *C. melaenus*. The differentiation between the species was carried out with material from Thailand only (localities of *C. melaenus*: Khao Sabap, Province Chanthaburi, n = 9; Tung Salaeng Luang, Province Phitsanulok, n = 2; Huay Kha Kaeng, Province Uthai Thani, n = 5; Khao Sok, Province Surat Thani, n = 4).

The larvae of both species are easy to distinguish, at least in the early stages. Hatchlings of *C. melaenoides* are slim, the primary colour is yellow red. In contrast, early larvae of *C. melaenus* are comparatively stout with a conspicuous red and black colouration: head and pronotum are intense bright red, the abdomen and the distal parts of the postfemora black. In both species the primary colour gradually changes to green with dark-brown markings, but the dynamics of these features are very different with respect to stages as well as individuals: the appearance of different individuals of one stage is much more uniform in *C. melaenus* than in *C. melaenoides*. Toward the end of ontogenesis all larvae look quite similar.

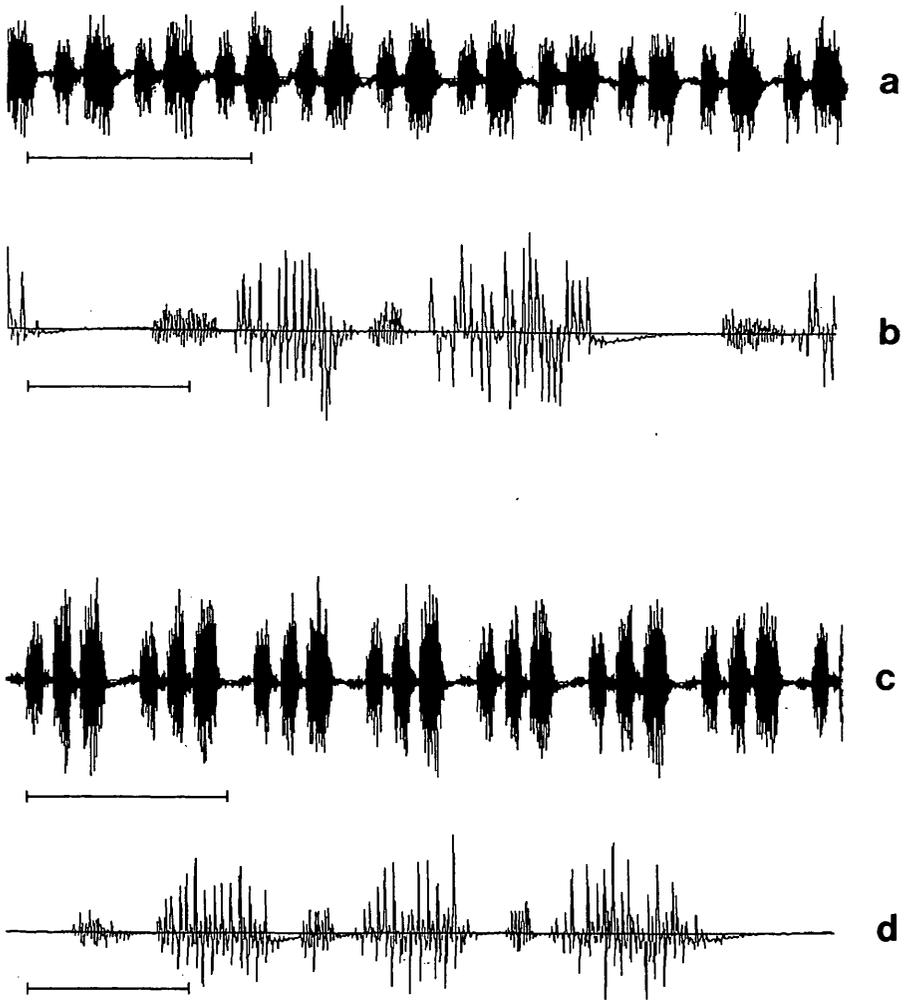


Fig. 3a: Verses of the calling song in *C. melaenoides* without ultrasonic frequency range (Scale = 100 msec); b = Syllable pattern of a verse including ultrasonic frequency range (Scale = 10 msec); c = Verses of the calling song in *C. melaenus* without ultrasonic frequency range (Scale = 100 msec); d = Syllable pattern of a verse including ultrasonic frequency range (Scale = 10 msec).

**Sound production:**

The feature best suited for a species discrimination, especially in the field, is the stridulation. Although both species produce sound in the same frequency range, their chirping is different. In *C. melaenoides* the calling song of isolated males consists of regularly repeated verses, each with 2 isolated syllables. The first macrosyllable (sensu HELLER 1988) lasts 8,9 msec, the second 14,9 msec. One verse takes 25 msec (mean of 5 males at 25° C). In *C. melaenus* a single verse lasts 39,4 msec and is formed by 3 separated macrosyllables. The first two syllables are of nearly equal duration (9,3 msec), the third macrosyllable being slightly longer and taking 11,6 msec (mean of 5 males at 25° C.). The inter-verse intervals are shorter in *C. melaenoides* (11,5 msec)

than in *C. melaenus* (18,5 msec). In the ultrasonic frequency range, one short additional syllable (2,8 msec) could be detected in both species (Fig. 3a, b, c, d).

Only males of the same age (3 weeks after the final moulting) were studied to avoid a possible geriatric effect on the syllable pattern (STIEDL et al. 1991). Recording took place during the day, because calling activity in both conocephalids is not restricted to photo- or scotophasis. The records were made in a sound - proof chamber with an UHER 4000 tape recorder and an ultrasonic-detector PETERSON 940. Sound analysis was carried out with S-Tools, Integrated Work Station for Acoustics, Speech and Signal Processing, Austrian Academy of Sciences, Research Laboratory of Acoustics.

#### Cross-breeding experiments:

The degree of compatibility between the species was investigated by cross-breeding experiments with 10 ♂♂ and ♀♀ of each species. All animals were selected at random as larvae from bisexually reared stock cultures and kept as singles until adulthood. Rearing and maintenance is described in HELFERT and SÄNGER (1975). After the final moulting, female *C. melaenoides* were paired with male *C. melaenus* and vice versa. In both cases fecundity as well as fertility of the females were extremely low compared with females from stock cultures. In the cross-breeding experiments the average egg production of *C. melaenoides* was 6 eggs during the life span (3 - 9 eggs), compared with 16 eggs for *C. melaenus* (11 - 20 eggs). *C. melaenoides* produced no larvae, whereas in *C. melaenus* 41% of the eggs completed embryogenesis and hatched. Further investigations revealed that egg viability in *C. melaenus* is not the result of a certain restricted compatibility between the species, but the ability to reproduce parthenogenetically (HELFERT and SÄNGER in prep.).

#### Copiphorini

*Euconocephalus mucro* DE HAAN 1842

Material: 1 ♀

Locality: Manado, Sulawesi Utara; 31. 3. 1994. Orchard.

#### Agraeciini

*Anthraxes disco-lateralis* KARNY 1931

Material: 1 ♂

Locality: Toraut/Dumoga-Bone, Sulawesi Utara; 11. 2. 1993. Primary moist mountain rain forest.

*Nicsara sarasini* KARNY 1931

Material: 1 ♀

Locality: Toraut/Dumoga-Bone, Sulawesi Utara; 11. 2. 1993. Primary moist mountain rain forest.

#### ListrosceIIDinae

*Hexacentrus unicolor* SERV. 1831

Material: 1 ♂, 1 ♀

Locality: (♂) Gunung Ambang, Sulawesi Utara; 8.2. 1993. Primary wet mountain rain forest. (♀) Perikari/Gunung Nokilakaki, Sulawesi Tengah; 20. 2. 1993. Primary moist mountain rain forest.

#### Tympanophorinae

Among the Tympanophorinae 2 species of the genus *Lipotactes* were collected. HEBARD (1922) regarded the genus *Mortoniellus* (GRIFFINI 1909), to which all the species recorded for Celebes had been assigned, as a synonym of *Lipotactes* BRUNNER v. W. 1898. We follow the argumentation of HEBARD and INGRISCH (1989) regarding the assignment of the genus *Lipotactes* to the family Tympanophorinae.

*Lipotactes hamatus* KARNY 1931:

Material: 1 ♂

Locality: Gunung Nokilakaki, Lore Lindu, Sulawesi Tengah, 21. 2. 1993. Primary moist mountain rain forest.

*Lipotactes* sp.

Type material: 1 ♀

Type locality: Gunung Nokilakaki, Lore Lindu, Sulawesi Tengah, 21. 2. 1993. Primary moist mountain rain forest.

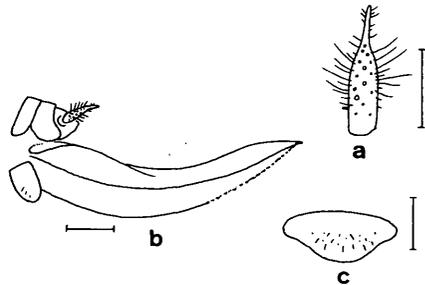
The present specimen is probably *Lipotactes digitatus* KARNY 1931. The general features are concordant with the holotype, but the type material of this species (collection SARASIN) consists in 1 adult male and 1 medium-sized, larval female only. The holotypes of *L. hamatus* and *L. digitatus* are deposited in the Natural History Museum, Basel. Since this is the first adult female of *L. digitatus* to emerge, the specimen will be described in detail. A definite assignment to *L. digitatus* should not be carried out without further investigations of living animals, especially because members of the discussed species occur syntopically with *L. hamatus*. The specimen was collected as a larva and reared in captivity until adulthood.

Description:

Measures (in mm): total length: 19,0; head width (including eyes): 6,6; head length (fastigium verticis to clypeal suture): 3,6; median pronotum length: 3,7; ovipositor length: 6,5; metafemur length: 13,4; metatibia length: 13,2. Head features corresponding with *L. digitatus*, head wider than body, eyes very large. Fastigium frontis trapezoid, separated from frons by a convex sulcus, median ocellus just above the sulcus. Frons smooth, subocular sulci not continuous, clypeofrontal suture interrupted in the middle. Scapus distally expanded, pedicellus short, width about half of scapus. Flagellum very long, thinly haired, hair short. Pronotum not saddle-shaped, transverse sulcus in the prozona very distinct. Apter. Prosternum with 2 slender humps, meso- and metasternum each with 2 broad rounded humps. Abdominal sternites with a median, unpaired buldge, being most prominent on the 1<sup>st</sup> abdominal sternite. Coxae with 1 hump; hump is slender and conical on the metacoxae. Tympana covered, openings slit-shaped. Pro- and mesotibia with 5 extero- and internoventral spines, mesotibia with 1 additional dorsal spine. Metatibiae with 2 extero- and internoventral spines, 18 - 19 extero- and internodorsal spines and 6 apical spurs. Metafemora extremely thick in the proximal third.

Genital segments: supra-anal plate triangular, cerci conical, extremely pointed, with long, thin setae. Subgenital plate short, apically rounded. Ovipositor slightly curved, considerably expanded proximally, distally compressed, ventral valves minutely serrated (Fig. 4a, b, c).

Fig. 4: Genital segments of *Lipotactes* sp. ♀ (Scale = 1 mm). a = left cercus in ventral view, b = ovipositor, c = subgenital plate.



Colouration ex alcohol: primary colour yellow. Head brownish, antennae dark-brown, only scapus light-brown. Occiput with light median line, dark-brown stripes along each side side turning ventrad behind the eyes. Pronotum with narrow, dark-brown margin, prozona with 2 symmetric, dark-brown spots. Posterior knees dark-brown, posterior femora dorsally dark-brown in the distal third.

Colouration in vivo: primary colour dark-green. Head darker than body, antennae dark-brown, only scapus green. Occiput blackish green, the markings only faintly visible. Eyes conspicuously yellow-ocher. Pronotum light-brown, margin and spots in the prozona chestnut-coloured. Abdominal tergites green with brown margins. Coxae light-green. Pro- and mesofemora proximally light-green, distally dark-green. Metafemora proximally light-green with distinct, dark, transversal stripes, distally black. Ovipositor proximally light-green, distally brown, darker toward the apex.

Notes on the biology of *L. hamatus* and *L. sp.*:

Both species are silvicolous. The female of *L. sp.* is predacious and pursues the prey actively. The prey-catching behaviour is similar to *Lipotactes montanus* (INGRISCH 1989). The head is very mobile; prey movement can be followed without the whole animal moving. The large eyes enable it to judge its distance from the prey accurately. *L. sp.* makes a rapid jump onto the prey when it is in range (up to 15 cm) and grabs it with the mouthparts. In the

laboratory it was observed that the female, while feeding on a tettigoniid larva, successfully grasped a further prey. In contrast, the male *L. hamatus* fed on grass and TetraMin (protein diet for aquarium fish) only, although it was provided with living food.

### Mecopodinae

*Mecopoda elongata* (LINNAEUS 1758)

Material: 1 ♂, 1 ♀

Locality: Toraut/Dumoga-Bone, Sulawesi Utara, 12. 2. 1993. Primary moist mountain rain forest.

This widely distributed species ranges from India to Japan and Australia. It varies to a very great extent in colouration and wing venation. KARNY (1926, 1931) has already pointed out the high degree of variability in Indonesian populations. A revision of the existent material seems highly necessary.

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