

## *Krakatauia recta* (Wiedemann, 1830) in coastal habitats in Singapore with a re-description and notes on its Oriental and Australasian distribution, and the description of a new related *Krakatauia* species from the Philippines (Diptera: Dolichopodidae)

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**Abstract.** *Krakatauia recta* (Wiedemann, 1830) was recorded in Singapore in mangrove and on vegetation in the supralittoral zone of a sandy beach on Coney Island Park (Pulau Serangoon), and is re-described here. It forms a species complex with *Krakatauia philippinensis*, new species, described here from Mt. Makiling (Luzon) in the Philippines.

**Key words.** mangrove, Sciapodinae, *Krakatauia* species complex

### INTRODUCTION

During a survey of the mangroves of Singapore, the authors found *Krakatauia recta* (Wiedemann, 1830) in a marine habitat in Singapore. Among Singaporean Sciapodinae, it superficially resembles the genus *Amblypsilopus* Bigot, 1888 in having a rather short arista barely longer than the height of the head and inserted apicodorsally on a somewhat rounded third antennal segment. A full genus diagnosis is given by Bickel (1994).

Although *Krakatauia* is difficult to distinguish from *Amblypsilopus*, the males of *Krakatauia recta* are easily recognisable based on the round black spot at the tip of the wing and straight  $M_1$  vein. Females of *K. recta* do not have such a wing spot and the  $M_1$  vein is bent as in other sciapodine flies. This renders the association of females with males very difficult unless observed during display or mating or if DNA barcodes are available.

*Krakatauia recta* is thought to have a wide Oriental and Australasian distribution (Bickel, 1994) since it is reported from Taiwan, Borneo, the Philippines, Sumatra, India, and New Guinea. Bickel (1994) reports it also from Sri Lanka.

We re-examined the material that Becker (1922) and Bickel (1994) studied, paying attention to the structure of the male terminalia. We consider that *Krakatauia recta* is a species complex with at least two species: the nominative species *K. recta*, originally described from Sumatra (Indonesia), is confirmed to be present in Taiwan and in Singapore. The specimens from Mount Makiling in the Philippines and New Guinea both have similar male terminalia that are however, different from *K. recta*. Hence, this species is described here as a new species.

### MATERIAL AND METHODS

A survey to assess the habitat quality of the small mangrove on Coney Island (Pulau Serangoon), Singapore was done from 8 March 2019 till 21 June 2019. Five Malaise traps were installed in the intertidal zone of this mangrove and some occasional sampling was made with yellow pan traps and by sweep netting. The *Krakatauia* specimens were not collected in the Malaise traps but in the supplementary sampling only.

#### Abbreviations in text.

ZRC: Zoological Research Collection, Lee Kong Chian Natural History Museum, National University Singapore

MfN: Museum für Naturkunde, Berlin

RBINS: Royal Belgian Institute of Natural Sciences (Brussels)

MSSC: Male Secondary Sexual Character.

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Fig. 1. *Krakatauia recta* (Wiedemann, 1830) male habitus (photograph by Rene Ong).

## TAXONOMY

### Family Dolichopodidae Latreille, 1809

#### Subfamily Sciapodinae Becker, 1917

#### Genus *Krakatauia* Enderlein, 1912

*Krakatauia* Enderlein, 1912: 408.

Type species. *Psilopus rectus* Wiedemann, 1830, orig. des.

Bickel, 1994: diagnosis: 142.

Bickel & Martin, 2020: extended diagnosis: 398.

A recent key to the Australasian Sciapodine genera can be found in Bickel & Martin (2020, p. 381) as well as a key to the species groups of *Krakatauia* (p. 399).

*Krakatauia* is not strongly defined by synapomorphies, but forms a probable monophyletic group whose species share the following features in a mosaic of combinations (Bickel & Martin, 2020): usually abundant setae on the male frons (MSSC), but absent in the female; male face bulging (MSSC; not in female), eyes often with pale hairs between facets, pedicel usually with rather short dorsal and ventral setae, fore tibia usually bare of major setae, wing often infuscate, venation sometimes modified, haltere sometimes black in both

sexes, male cercus with large ventral clavate arm and short distal digitiform projection, large subtriangular projection present between cercal bases.

Since *Krakatauia recta* (Wiedemann, 1830) is the type species of its genus, we can include the species with confidence in that genus. Bickel (1994: 144) attributes *K. recta* (Wiedemann, 1830) to the *Krakatauia evulgata* species group. *Krakatauia recta* was until now the only species of the group with a wide distribution in the Oriental region.

#### ***Krakatauia recta* (Wiedemann, 1830)**

(Figs. 1, 2)

*Psilopus rectus* Wiedemann, 1830: 225. Male. Type locality: Sumatra.

*Krakatauia recta* (Wiedemann, 1830): Enderlein, 1912: 408. Description genus *Krakatauia*.

*Sciopus rectus* (Wiedemann, 1830) in Becker, 1922: 206 (male, female), fig. 185 (wing). Taiwan.

*Sciopus unitus* Parent, 1928: 193 (male only) figs 73 (male terminalia), 74 (hind tarsus), 75 (wing) Type locality: Malaysia: Borneo, Labang.

*Krakatauia recta* (Wiedemann, 1830) in Bickel, 1994: 145 (comments, no description).

*Krakatauia recta* (Wiedemann, 1830) in Yang et al., 2011: 254, diagnosis (in Chinese) fig. 144 (wing).

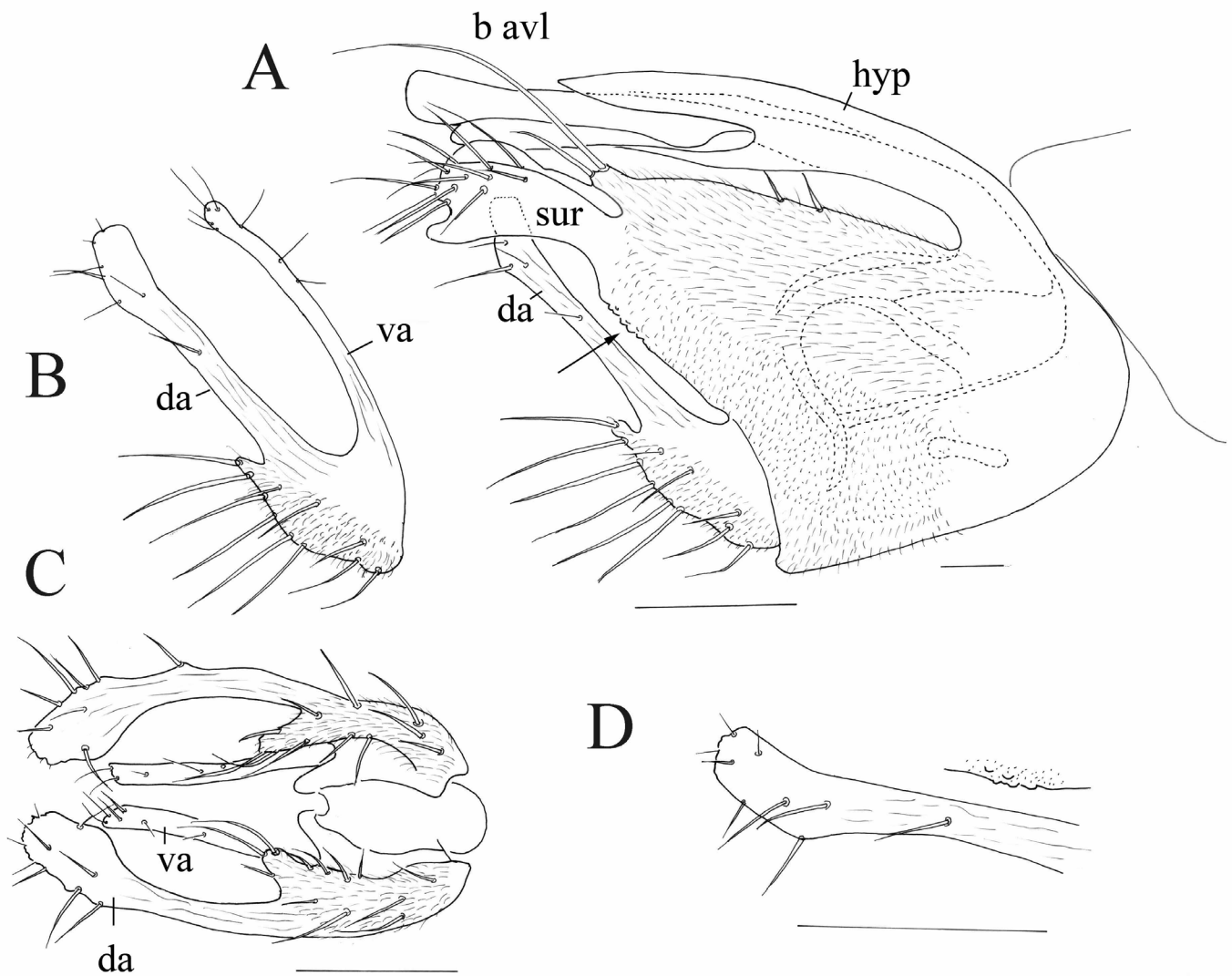


Fig. 2. *Krakatauia recta* (Wiedemann, 1830) male terminalia, A, lateral view; B, Cercus lateral; C, Cerci dorsal view; D, Tip of dorsal arm of cercus with detail of rugged border of base of surstylus. Scale bars = 0.1 mm. Abbreviations: b avl: bristles apicoventral epandrial lobe; da: dorsal arm cercus; hyp: hypandrium; va: ventral arm cercus; sur: surstylus (drawings by Patrick Grootaert).

**Material examined.** SINGAPORE, 1 male, Coney Island (Pulau Serangoon), 5 April 2019 (col. P. Grootaert) in yellow pan trap set along the border of the mangrove (1°24'35.45"N, 103°55'23.61"E), ZRCBDP0243034, Genbank Accession Code (COI): PP887786; 1 male, Coney Island (Pulau Serangoon), 21 June 2019 (col. P. Grootaert, by net sweeping over beach morning glory growing at the mouth of the creek leading to the mangrove, 1°24'37.98"N 103°55'25.54"E) in RBINS; TAIWAN: 1 male, labelled: Formosa Sauter, Kankau 1912 VIII, MfN; not dissected, male terminalia identical to those of Singaporean specimens; 1 female labelled: South Formosa, Takao 24.VI.1907; H. Sauter S.V. labelled *Sciopus rectus* Wied female sign O. Parent MfN; 1 female labelled: Formosa Sauter Tainan 1912 IV MfN (head lost).

**Re-description.** Since the original description is incomplete, a more detailed re-description of *K. recta* is given so that the new species from the Philippines can be compared.

**Male.** Body: 4.5 mm; Wing length: 4.3 mm; Wing width: 1.3 mm.

**Head.** Vertical bristles as long as anterior ocellar bristles, black. Median and posterior ocellars shorter, pale, also diverging. Frons metallic green, the slope to the eye set with multiple rows of long white bristles. Face shiny metallic green with reddish coppery reflections. Clypeus distinctly separated, not bulging. Postoculars short and uniserial above, very long white and multiserial below. Antenna entirely black, postpedicel subtriangular as long as high with as dorsoapical arista. Arista 4 to 5 (4.8) × as long as antenna. Basal part of arista thickened. Pedicel with a black dorsal bristle, 2× as long as pedicel. Tip of clypeus silvery dusted. Palpus yellow, hidden below tip of clypeus, set with long white bristles.

**Thorax.** Mesoscutum shiny metallic green, pleura black. All bristles black. 3 pairs of long acrostichals. 5 dorsocentrals, anterior 3 short, the prescutellar very long. A pair of very long lateral scutellars with a hair at each side. 1 long posthumeral 2 notopleurals, a very long postalar.

**Legs.** Colour: black coxae, trochanters and femora. Tip of fore and mid femur anteroventrally yellow; tip of hind femur





Fig. 3. Habitat of *K. recta*, a leaf-dweller observed on leaves of Beach morning-glory on a sandy beach in front of a mangrove on Coney Island (Pulau Serangoon), Singapore (photograph by Patrick Grootaert).

entirely black. All tibiae yellowish, though tip of hind tibia brown. Fore tarsus with basal  $\frac{3}{4}$  of fore tarsomere 1 yellow, tip brown; following tarsomeres entirely brown. Tarsomere 1 of mid leg entirely yellow except for tip; following tarsomeres brown. Hind tarsus brown to black.

**Chaetotaxy.** Fore leg: coxa anteriorly set with multiple rows of long woolly white bristles (a few thicker bristles at side). Femur in basal half ventrally and posteriorly over the entire length with long fine, white bristles at least 1.5 x as long as femur is wide. Tibia lacking distinct bristles. Tarsomere 1 long, with a ventral row of crocheted hairs over entire length. Size of femur, tibia, tarsomeres 1–5 in mm: 0.7 ; 0.8 ; 0.58 ; 0.34 ; 0.18 ; 0.1 ; 0.06.

Mid leg: coxa anteriorly with long white woolly bristles. A long white exterior bristle near tip.

Trochanter with a long black bristle, 2x as long as trochanter. Femur club-shaped thickened in basal half, there set with a row of long fine white bristles 2x as long as femur width. Tibia with 4 short anteroventral bristles (including the preapical) about as long as tibia is wide and a small inconspicuous dorsal bristle beyond middle.

Size of femur, tibia, tarsomeres 1–5 in mm: 0.84; 1.2; 0.9; 0.22; 0.18; 0.08; 0.06.

Hind leg: coxa with 2 white exterior bristles next to each other on basal third; the anterior positioned bristle short,  $\frac{1}{2}$  as long as the posterior one that is as long as coxa is long. Femur about as wide as mid femur ventrally with a row of long interspaced fine white bristles 2x as long as femur is wide and a short black preapical anteroventral bristle. Tibia lacking distinct bristles except of a short preapical anterodorsal. Tarsomere 1 with a short black ventral bristle at base. Tarsomeres 4 and 5 widened. Size of femur, tibia, tarsomeres 1–5 in mm: 1.2 ; 1.6 ; 0.7 ; 0.3 ; 0.18 ; 0.1 ; 0.08.

**Wing.** Brownish tinged but apical half of the 2 anterior cells clear (Fig. 1). Veins black. A round black or dark brown spot on tip of wing, touching tip of  $R_{2+3}$  and covering tips of  $R_{4+5}$  and  $M_1$ . Tips of  $R_{4+5}$  and  $M_1$  joining just before wing tip and ending with a short stump into the costa. Vein M-Cu undulating. Only basal half of vein  $M_2$  sclerotised.

**Abdomen.** Tergites shining metallic green, but base of tergites 2–5 black. Apical marginal bristles black, longer than each tergite; central part of each tergite with shorter black bristles, at sides a few longer fine white bristles. Male terminalia brownish black (Fig. 2). The cercus bears a forked appendage (Fig. 2 B, C). In dorsal view this dorsal oriented appendage (da) has a club-shaped tip while the ventral appendage is slender (Fig. 2B). In a dorsal view of the cercus it can be seen that the club-shaped tip of the dorsal appendage is quite flattened (Fig. 2C) while the ventral appendage is slender over the entire length. Fig. 2D shows the tip of the dorsal appendage in lateral view with the serrated border of the hypopygium (indicated by an arrow on Fig. 2A).

**Female.** Females lack the black apical spot on the wing tip and have a bent vein  $M_1$  that does not join the tip of vein  $R_{4+5}$  (Bickel, 1994).

**Habitat.** Like most of the other members of the Sciapodinae, *Krakatauia* species are leaf dwellers. Males of *K. recta* were observed on beach morning glory (goat's foot) *Ipomoea pes-caprae* (L.) on a sandy beach in front of a mangrove at Coney Island (Serangoon Island) in Singapore. Beach morning glory is a common pantropical creeping vine belonging to the family Convolvulaceae (Fig. 3). Some *K. recta* males were also collected in yellow pan traps placed along a path along the mangrove on Coney Island.

**Comments.** The specimens from Taiwan, collected by Sauter (MfN) are very similar to those in Singapore and although there are some differences in colouration of the legs and setation, the male terminalia are identical. The tarsi in the specimens from Taiwan are yellowish but quite darkened in the Singapore specimens. There are only 12 white bristles on each side of the frons in male from Taiwan, while there are up to 30 bristles in the specimens from Singapore and in the new species *K. philippinensis*. At the moment, we consider the morphology of the male terminalia important to delimit species. Nonetheless, we suppose that although colour variation in legs and bristling may be important in



Fig. 4. *Krakatauia philippinensis*, new species, Holotype male habitus (photograph by Patrick Grootaert).

species recognition and successful mating, we do not have genetic support to support this.

***Krakatauia philippinensis*, new species**  
(Figs. 4, 5)

**Type material.** Holotype male, Philippines, Mt. Makiling Luzon, Baker. Label: rectus Wied. MfN (male terminalia dissected and figured).

Paratype male: Indonesia, West Papua, Saonek, Raja Ampat, 0°28'20.08"S, 130°47'26.39"E [Label: Saonek 11.1.10; Mevr. de Beaufor. leg.; *Sciopus rectus* Wiedem. Det. Becker, MfN, Berlin (male terminalia dissected)].

**Differential diagnosis**

The male terminalia are similar to those of *K. recta* but have the dorsal appendage of the cercus slenderer while the tip of the dorsal appendage is club-shaped in *K. recta*, as can be seen in both lateral as ventral view even without dissecting the specimen. The palpus is black in *K. philippinensis*, new species while yellow in *K. recta*. Apical part of  $M_1$  strongly bent in *K. philippinensis*, new species, while almost straight in *K. recta*.

**Male.** Body: 4 mm; Wing length: 3.5 mm.

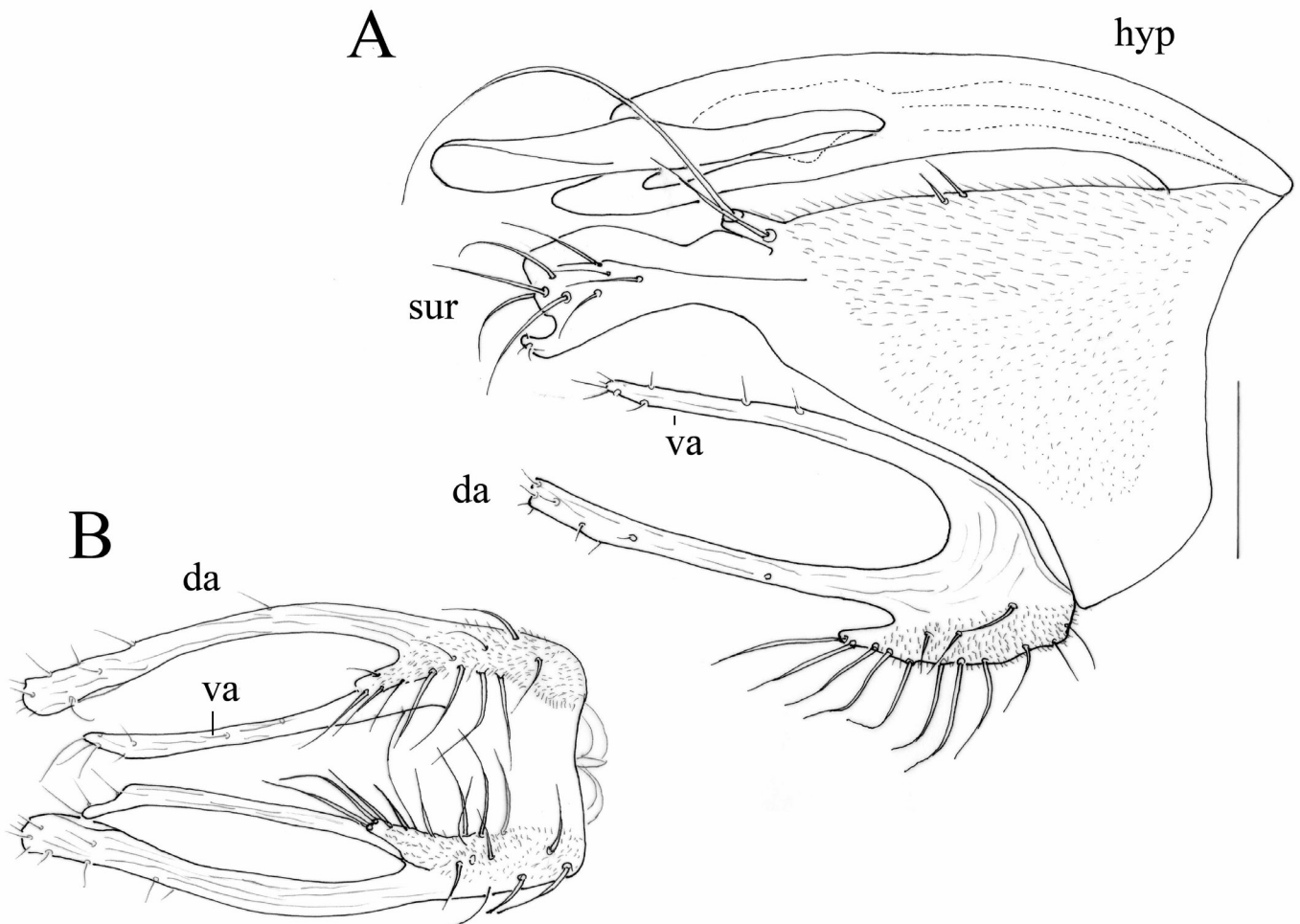


Fig. 4. *Krakatauia philippinensis*, new species. Holotype male habitus (photograph by Patrick Grootaert).



**Head.** Vertical bristles as long as anterior ocellar bristles, black. Median and posterior ocellars shorter, white, also diverging. Frons metallic green, the slope to the eye set with multiple rows of at least 30 long white bristles at each side. Face shiny metallic green with reddish coppery reflections. Clypeus distinctly separated, not bulging, at tip silvery grey dusted. Postoculars short, black and uniserial above, very long white and multiserial below, longest and densest along mouth. Antenna entirely black, postpedicel subtriangular as long as high with as dorso-apical arista. Arista 5× as long as antennal segments together. Basal part of arista thickened. Pedicel with a black dorsal bristle, nearly 2× as long as pedicel. Palpus black, hidden below tip of clypeus, set with long white bristles.

**Thorax.** Mesoscutum shiny metallic green, pleura black. All bristles black. 3 pairs of long acrostichals. 5 dorsocentrals, anterior 3 short, the prescutellar very long. 1 long posthumeral 2 notopleurals, a very long postalar. A pair of very long lateral scutellars with a fine bristle half as long at each side.

**Legs.** Colour: coxae, trochanters and femora black except for tip of fore and mid femur which are yellow. All tibiae yellowish, except hind tibia brownish. Fore tarsus with fore tarsomere 1 yellow, tip brown; following tarsomeres entirely brownish. Tarsomere 1 of mid leg entirely yellow except for tip; following tarsomeres brown. Hind tarsus brown.

**Chaetotaxy.** Fore leg. Coxa anteriorly set with multiple rows of long white woolly bristles. Femur in basal half ventrally and posteroventrally with long fine, white bristles at least 1.5× as long as femur is wide. Posterodorsally in basal 2/3 with long fine bristles. Tibia lacking distinct bristles. Tarsomere 1 long, with a ventral row of crocheted hairs over entire length.

**Mid leg.** Coxa anteriorly with long white woolly bristles. A long exterior bristle with basal half white and apical half black. Femur club-shaped thickened in basal half, there set with a row of long fine white bristles 2× as long as femur width. Tibia with 3 short anterior bristles about as long as tibia is wide and a small inconspicuous dorsal bristle beyond middle.

**Hind leg.** Coxa with 2 white exterior bristles next to each other on basal third and a long white bristle near middle. Femur about as wide as mid femur ventrally with a row of long interspaced fine white bristles a little longer than femur is wide and a short black preapical anteroventral bristle. Tibia lacking distinct bristles except of a short preapical anterodorsal and 2 short anterior bristles near middle. Tarsomere 1 with a short black ventral bristle at base. Tarsomeres 4 and 5 widened.

**Abdomen** (see Fig. 4). Male terminalia brownish black (Fig. 5).

**Female.** Unrecognised.

**Comments.** Both *K. philippinensis*, new species and *K. recta* are closely related and seem to form a species complex with clines over the Oriental and Australasian region as discussed under *K. recta*.

#### Key to the male Oriental *Krakatauia recta* complex

1. Palpus yellow. Apical part of M<sub>1</sub> almost straight. Dorsal appendage of the cercus club-shaped (Fig. 2, B–D); apical part of M1 almost straight.....*K. recta*
- Palpus black. Apical part of M<sub>1</sub> strongly bent. Dorsal appendage of cercus slender, not club-shaped (Fig. 5); apical part of M1 strongly bent.....*K. philippinensis*, new species

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