

Systematic revision of the genus *Graphelmis* (Coleoptera: Elmidae) II. *Graphelmis bandukanensis* species group

Fedor ČIAMPOR Jr.

Institute of Zoology, Slovak Academy of Sciences, Dúbravská cesta 9, SK 842 06, Bratislava, Slovakia. E-mail: uzaeciam@savba.sk

ČIAMPOR Jr., F. 2002. Systematic revision of the genus *Graphelmis* (Coleoptera: Elmidae) II. *Graphelmis bandukanensis* species group. *Entomol. Probl.* 32(2): 149–161. – The new species group *Graphelmis bandukanensis* is designated within the genus *Graphelmis* DELÈVE, 1968, comprising six new species: *G. bandukanensis* sp.nov., *G. punggulensis* sp.nov., *G. minuta* sp.nov., *G. berbulu* sp.nov. from Malaysia, *G. dembickyi* sp.nov. from Philippines and *G. sulawesiensis* sp.nov. from Indonesia. The habitus and detail drawings of characteristic structures of genitalia and pregenital segments are given.

Introduction

The family Elmidae comprises approximately 140 genera distributed worldwide. These genera are either small, with only a few species, e.g. *Ancyronyx* (JÄCH 1994) or *Roraima* (KODADA & JÄCH 1999), or large ones like *Stenelmis* or *Austrolimnius* (BOUKAL 1997), whose representatives are quite uniform and thus hardly separable into smaller distinct groups. The genus *Graphelmis*, supposed to have more than 80 species, makes an exception in this point of view.

Diagnostic characters proposed by DELÈVE (1968) and amended by ČIAMPOR (2001) enable simple identification of the *Graphelmis* species within the family but, on the other side, a huge variability among species provides an opportunity to divide the genus into several distinct species groups.

Supporting the above statement, the *G. bandukanensis* species group designated in this paper encompasses six new species, which undoubtedly belong to the genus *Graphelmis* but, even at first sight, they distinctly differ from the remaining representatives of the genus. These species are up to now known from three southeast Asian islands: Borneo, Luzon and Sulawesi. All specimens were collected in small, at least partly shaded streams or rivers, flowing through primary or degraded forest. It is no doubt that this kind of habitat is typical for the majority of *Graphelmis* species (ČIAMPOR 2001).

Material and methods, as well as the acronyms and symbols used, follow ČIAMPOR (2001).

Graphelmis bandukanensis species group

Members: *G. bandukanensis* sp.nov., *G. punggulensis* sp.nov., *G. minuta* sp.nov., *G. berbulu* sp.nov., *G. dembickyi* sp.nov., *G. sulawesiensis* sp.nov.

Diagnosis. The *G. bandukanensis* species group is characterized by the following features: 1) small size; 2) narrow body form; 3) phallobasis almost as long as penis

or even longer; 4) males usually with distinct setae on disc of metasternum; 5) metatibiae simple; 6) eyes small, not surrounded by raised margin, only finely convex in dorsal view; 7) median protuberance of prosternal process absent; 8) male sternite 9 with deeply emarginated posterior margin; 9) spiculum gastrale slender, with median strut short.

Graphelmis bandukanensis sp.nov.

(Figs 1, 7–12)

Type locality. Malaysia, Sabah, Crocker Range, Bingkor env., Taman Bandukan, small and shallow river, ca 10m wide, flowing through degraded primary forest with stones, gravel and submerged wood.

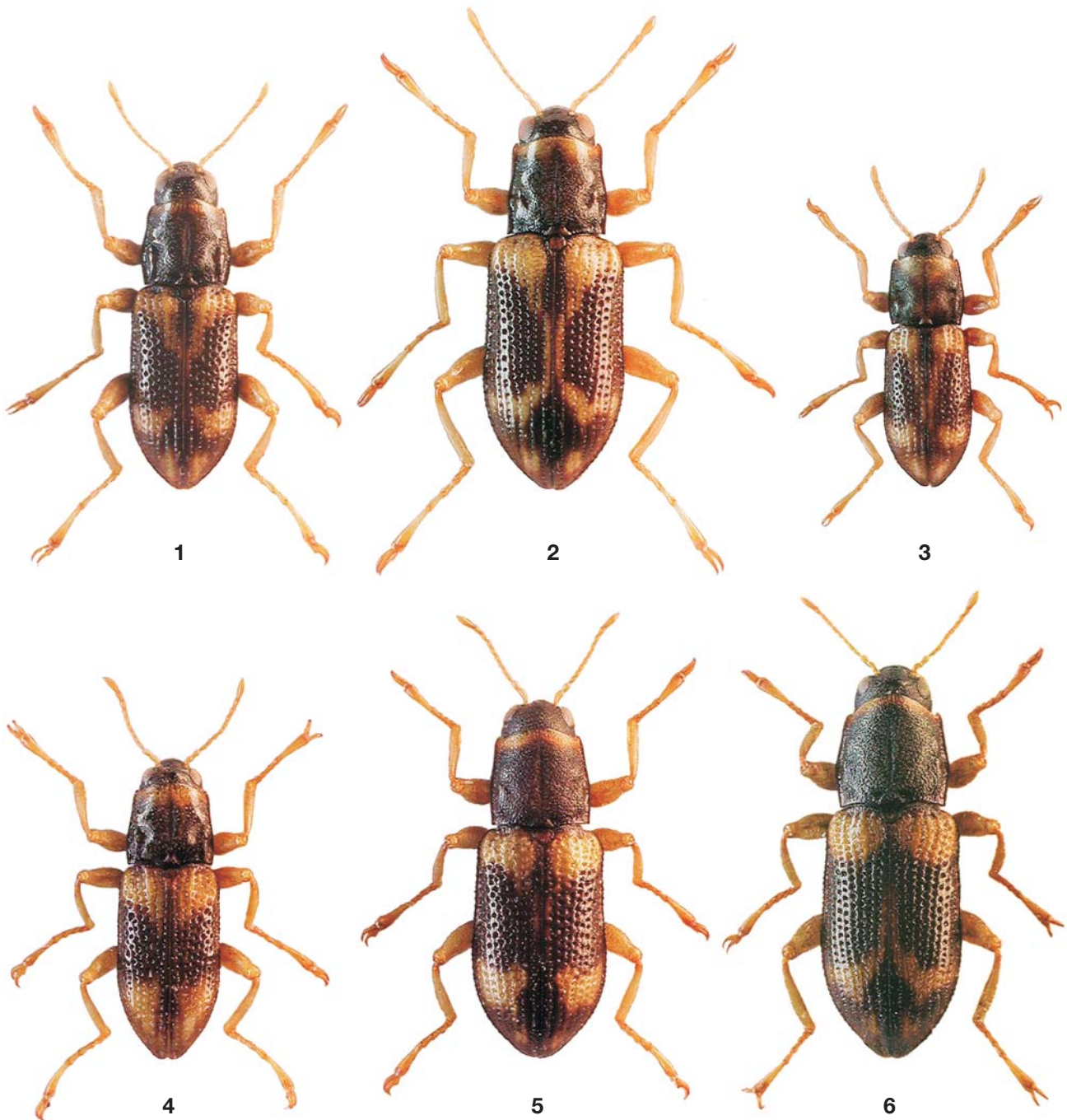
Material examined. Holotype ♂ (NMW): “Malaysia, SABAH, Crocker Range, Bingkor env., Taman Bandukan, 3.VI.1998, river ca 10m wide flowing through degraded primary forest”; **Paratypes** (NMW, CKB): 15♂♂, 22♀♀ with the same label as holotype; 3♂♂, 3♀♀, 1ex. (sex not examined): “Malaysia, SABAH, Crocker Range, Bingkor env., Taman Bandukan, 6.-7.VII. 1996, 10a, river ca 10m wide, flowing through degraded primary forest”; 4♂♂, 15♀♀, 5ex. (sex not examined): “Malaysia, SABAH, Crocker Range, Keningau env., Taman Bandukan, 13.-14.6.1998 J. Kodada ♂ F. Čiampor lgt.”; 1ex. (sex not examined): “Malaysia, Sabah, Crocker Range, Taman Bandukan, small stream in primary forest, 24.05.1998, J. Kodada ♂ F. Čiampor lgt.”; 5♂♂, 8♀♀, 18ex. (sex not examined): “Malaysia, SABAH, Ranau env., Liwagu river, 1.6.1998 J. Kodada ♂ F. Čiampor leg.”; 2♀♀, 3ex. (sex not examined): “Malaysia, Sabah, Ranau env., Liwagu river, 1.06.1998, J. Kodada ♂ F. Čiampor lgt.”; 1♂, 1ex. (sex not examined): “Malaysia, Sabah, Sabalangan river in primary forest ca. 25km SE Sapulut, 26.06.1998, J. Kodada ♂ F. Čiampor lgt.”; 1♂, 1ex. (sex not examined): “SARAWAK (Borneo) ca 40km SE Kapit 03. 1994, J. Kodada leg.”

Diagnosis. Within the *G. bandukanensis* species group, *G. bandukanensis* sp.nov. is characterized by the following features: 1) prebasal and subapical parts of elytral yellowish pattern usually not connected by mesal yellowish stripe; 2) males with only very fine, indistinct

setae on metasternum; 3) prebasal sublateral tubercles on pronotum distinct; 4) distal portion of prosternal disc and prosternal process microreticulate; 5) penis distinctly constricted before middle.

Description. Body form elongate (Fig. 1); CL in ♂♂ (1.74–2.15 mm, $\bar{S} = 1.93 \pm 0.11$), in ♀♀ (1.95–2.15 mm, $\bar{S} = 2.05 \pm 0.07$); EW in ♂♂ (0.67–0.82 mm, $\bar{S} = 0.77 \pm 0.05$), in ♀♀ (0.72–0.87 mm, $\bar{S} = 0.82 \pm 0.06$), CL/EW in ♂♂ (2.38–2.64, $\bar{S} = 2.51 \pm 0.10$), in ♀♀ (2.35–2.71, $\bar{S} = 2.53 \pm 0.12$). Colour dark brown; yellowish elytral pattern consists of: V-shaped marking in anterior half, paired transverse patches in ca. 0.6 and apical spots.

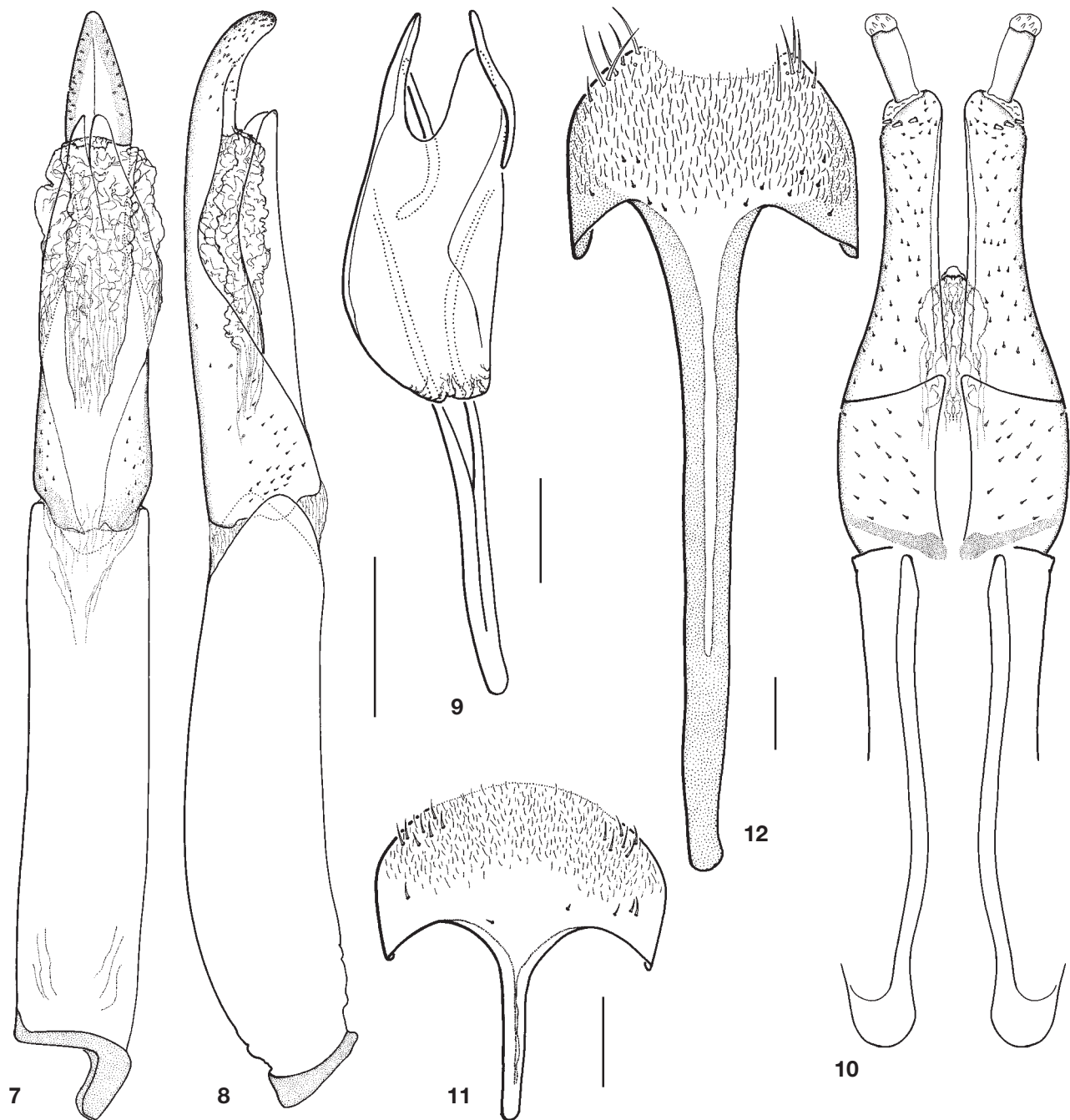
Head. HW in ♂♂ (0.38–1.047 mm, $\bar{S} = 0.44 \pm 0.03$), in ♀♀ (0.44–0.50 mm, $\bar{S} = 0.46 \pm 0.02$); ID in ♂♂ (0.22–0.29 mm, $\bar{S} = 0.25 \pm 0.02$), in ♀♀ (0.26–0.28 mm, $\bar{S} = 0.27 \pm 0.01$); ED in ♂♂ (0.16–0.24 mm, $\bar{S} = 0.20 \pm 0.02$), in ♀♀ (0.19–0.24 mm, $\bar{S} = 0.21 \pm 0.01$); HW/ID in ♂♂ (1.60–1.88, $\bar{S} = 1.73 \pm 0.09$), in ♀♀ (1.63–1.79, $\bar{S} = 1.74 \pm 0.06$). Labrum almost glabrous, anterior half setose; anterior margin paler; clypeus as long as labrum, finely longitudinally grooved; frons slightly depressed behind fronto-clypeal suture; surface of frons and vertex micropunctured at least around eyes; eyes oval in lateral view, convex in dorsal view.



Figs 1–6 Habitus of: 1) *Graphelmis bandukanensis* sp.nov.; 2) *Graphelmis punggulensis* sp.nov.; 3) *Graphelmis minuta* sp.nov.; 4) *Graphelmis berbulu* sp.nov.; 5) *Graphelmis dembickyi* sp.nov.; 6) *Graphelmis sulawesiensis* sp.nov.

Thorax. Pronotum as long as wide, widest about in the middle; PL in ♂♂ (0.56–0.67 mm, $\bar{S} = 0.60 \pm 0.03$), in ♀♀ (0.59–0.67 mm, $\bar{S} = 0.65 \pm 0.03$); PW in ♂♂ (0.51–0.62 mm, $\bar{S} = 0.56 \pm 0.04$), in ♀♀ (0.56–0.62 mm, $\bar{S} = 0.59 \pm 0.02$); AP in ♂♂ (0.46–0.54 mm, $\bar{S} = 0.48 \pm 0.03$), in ♀♀ (0.49–0.56 mm, $\bar{S} = 0.52 \pm 0.02$); lateral margins finely explanate; anterior margin glabrous, paler; anterior angles finely produced; sublateral tubercles visible, prebasal tubercles larger, usually distally extended into fine carinae reaching posterior pronotal margin; median groove about in the middle third of pronotum, thin, micropunctured; prebasal admedian pits fine; surface of pronotal sides micropunctured, mesal portion along

groove glabrous and shiny. Prosternum: prosternal process longer than wide; lateral margins raised around coxae, microreticulate; apical margin acuminate; median protuberance absent; surface plicate. Scutellum almost rounded, surface shiny. Mesosternum with well developed oblique, microreticulate carinae. Metasternum about twice as long as mesosternum; disc more or less depressed medially; surface of disc shiny, except lateral portions covered by plastron structures; in males with sparse, longer pale setae; longitudinal suture thin; admedian prebasal punctures absent; sublateral carinae absent. Elytra with sides parallel or slightly diverging in about proximal two thirds, then continuously converging toward



Figs 7–12 *Graphelmis bandukanensis* sp.nov.: 7) aedeagus ventral view; 8) aedeagus lateral view; 9) spiculum gastrale and sternite 9; 10) ovipositor; 11) male sternite 8; 12) female sternite 8. Scale bars: 0.1 mm.

apices; EL in ♂♂ (1.18–1.49 mm, $\bar{S} = 1.33 \pm 0.09$), in ♀♀ (1.33–1.49 mm, $\bar{S} = 1.41 \pm 0.05$); lateral margins finely serrate; apices rounded; stria punctures well depressed, especially in the middle third; interval 3 with small, prebasal tuft of setae in some specimens. Legs glabrous; FT in ♂♂ (0.56–0.65 mm, $\bar{S} = 0.61 \pm 0.03$), in ♀♀ (0.56–0.65 mm, $\bar{S} = 0.61 \pm 0.03$); MT in ♂♂ (0.53–0.65 mm, $\bar{S} = 0.61 \pm 0.03$), in ♀♀ (0.56–0.65 mm, $\bar{S} = 0.60 \pm 0.03$); HT in ♂♂ (0.59–0.71 mm, $\bar{S} = 0.66 \pm 0.03$), in ♀♀ (0.62–0.71 mm, $\bar{S} = 0.67 \pm 0.03$); length of tarsomere 5 equal to combined length of tarsomeres 1–4.

Abdomen. Admedian keels of ventrite 1 straight, reaching middle of ventrite; abdominal intercoxal process and mesal portion of remaining ventrites shiny; lateral portions of ventrites covered by plastron structures; apex of ventrite 5 with sides only finely produced. Sternites 8 (Figs 11, 12). Spiculum gastrale and sternite 9 as in Fig. 9.

Aedeagus (Figs 7, 8). Penis elongate, apically and prebasally with numerous small spines; apex curved, ventral side narrow in apical ca. 0.5, then widened toward base (lateral view); in ventral view distinctly constricted about in the middle. Ventral lobe with apex rounded; membranous endophallus without any special more sclerotized structures; phallobasis as long as penis or slightly longer.

Ovipositor (Fig. 10) with terminal segment straight; preterminal segment ca. 3.3× as long as terminal, outer side slightly concave; distal sclerite about half as long as terminal; basal segment as long as preterminal and distal sclerites combined; ventral fulcrum slightly sinuate.

Sexual dimorphism. Males are recognized by longer, thin setae on the disc of metasternum and are generally of smaller size.

Distribution. So far known only from Sabah and Sarawak, Malaysia.

Etymology. Named for type locality, Taman Bandukan.

Graphelmis punggulensis sp.nov.

(Figs 2, 13–16)

Type locality. Malaysia, Sabah, Batu Punggul Resort env., river, ca 10m wide flowing in primary forest, partly shaded, with boulders, gravel and submerged wood.

Material examined. Holotype ♂ (NMW): “Malaysia, Sabah, Batu Punggul Resort env. 24.VI.-1.VII.1996, 11a, river about 10m wide flowing in primary forest, partly shaded”;

Paratypes: (NMW, CKB): 4♀♀ with the same label as holotype; 13♂♂, 4♀♀: “Malaysia, Sabah, ca. 5km S Sapulut, Saliku river, 16.V.2001, J.F. Kočiam lgt.”; 23♂♂, 22♀♀, 10ex. (sex not examined): “Malaysia, Sabah, Kuamut river env. near Kampung Pisang Pisang, 3.-4.VII.1996, 14a, shaded stream in primary forest with submerged wood”; 4♂♂, 5♀♀, 2ex. (sex not examined): “Malaysia, SABAH, Kuamut river env. near Kampung Pisang Pisang, 3.-4.VII.1996, 14b: ca 10m wide tributary of Kuamut river in primary forest”; 1♀, 1ex. (sex not examined): “Malaysia, Sabah, Kampung Pisang Pisang env., tributary of Kuamut river .29.6.1998, J. Kodada ♂ F. Ćiampor lgt.”; 1♂: “Malaysia, Sabah, Kampung Pisang Pisang env., tributary of Kuamut river, 29.06.1998, J. Kodada ♂ F. Ćiampor Lgt.”; 2♂♂,

2ex. (sex not examined): “Malaysia, SABAH, Crocker Range, Keningau env., Taman Bandukan, 13.-14.6.1998 J. Kodada ♂ F. Ćiampor lgt.”; 2♂♂: “Malaysia, SABAH, Crocker Range, Bingkor env., Taman Bandukan, 6.-7.VII. 1996, 10a, river ca 10m wide, flowing through degraded primary forest”; 1♂: “Malaysia, SABAH, Crocker Range, Bingkor env., Taman Bandukan, 3.VI.1998, river ca 10m wide flowing through degraded primary forest”; 1♂: “Malaysia, Sabah, Crocker Range National Park, Longkogungan env., ca 750-850m a.s.l., 19.-21.VI.1996, 7d”; 1♂, 2ex. (sex not examined): “MAL., Sarawak, 1993 E Bandar Sri Amman Batang Ai NP, 19./20.2., M. Jäch (7)”; 1♀: “MALAYSIA, Sarawak, Mulu NP, Long Iman 4.3.1993 M. Jäch (20)”; 4♂♂, 8ex. (sex not examined): “SARAWAK (Borneo), ca 40km SE KAPIT 03.1994, J. Kodada leg.”; 1♀, 2ex. (sex not examined): “SARAWAK (Borneo), ca 40km SE Kapit 3.1994, leg. J. Kodada”; 46 ex. (sex not examined): “BRUNEI: Temburong, July 2000 Belalong Forest S. Temburong, nr. S. Apan 500m, on logs, lg. A. Foggo”.

Diagnosis. Within the *G. bandukanensis* species group, *G. punggulensis* sp.nov. differs as follows: 1) prebasal and apical parts of elytral yellowish pattern connected mesally by yellowish stripe along sutural interval; 2) males with dense yellow flat setae on metasternum; 3) margins of prosternal process distinctly raised; 4) metasternum behind mesocoxae with short curved carinae; 5) penis not constricted before midlength in ventral view.

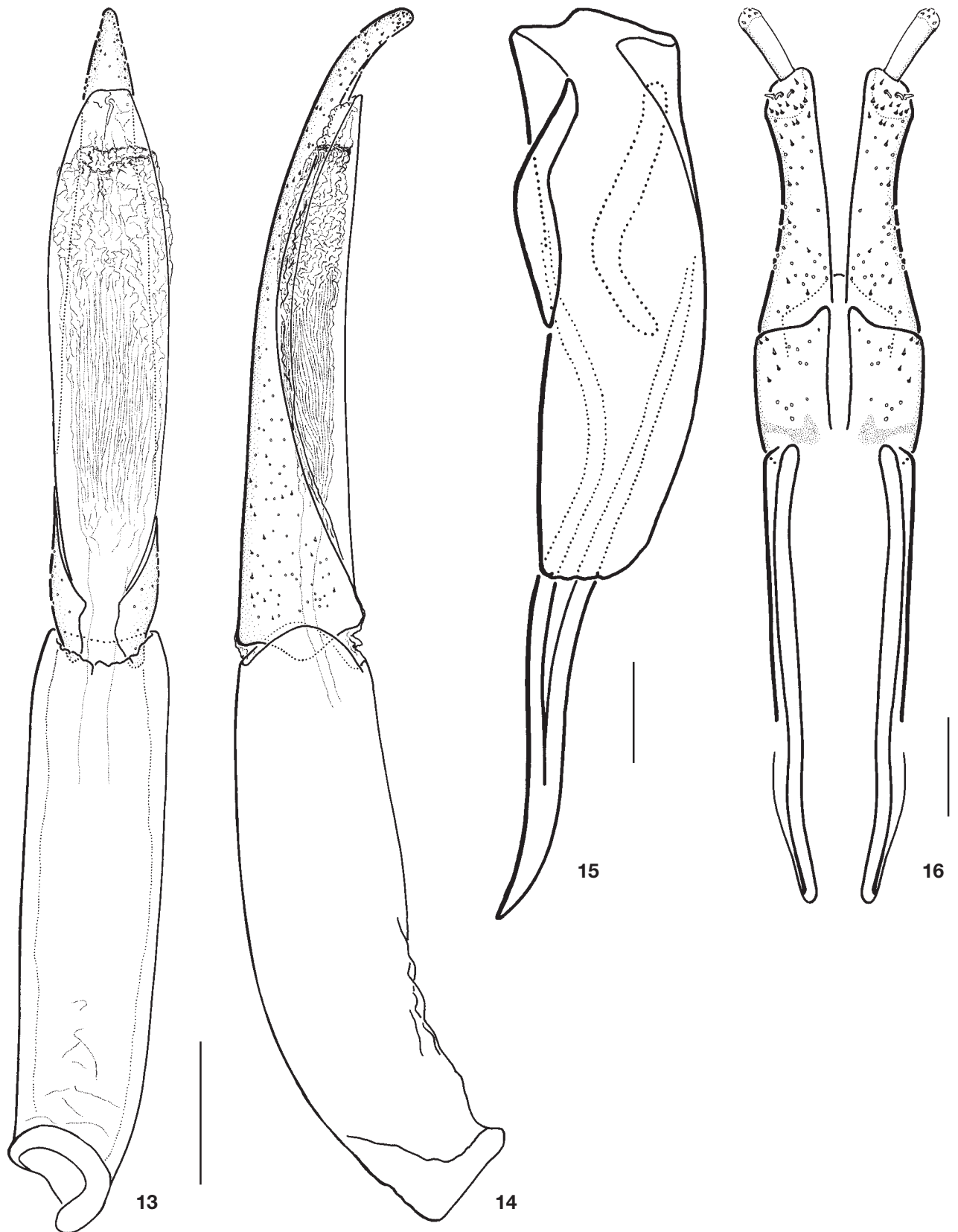
Description. Body form elongate (Fig. 2); CL in ♂♂ (2.18–2.59 mm, $\bar{S} = 2.34 \pm 0.13$), in ♀♀ (2.26–2.74 mm, $\bar{S} = 2.44 \pm 0.14$); EW in ♂♂ (0.82–1.03 mm, $\bar{S} = 0.91 \pm 0.06$), in ♀♀ (0.87–1.05 mm, $\bar{S} = 0.92 \pm 0.06$), CL/EW in ♂♂ (2.50–2.71, $\bar{S} = 2.57 \pm 0.07$), in ♀♀ (2.58–2.75, $\bar{S} = 2.65 \pm 0.06$). Colour dark brown; yellowish elytral pattern consists of: V-shaped marking in anterior half connected by longitudinal median stripe in middle third with paired transverse stripes in ca. 0.6 and apical spots.

Head. HW in ♂♂ (0.41–0.56 mm, $\bar{S} = 0.48 \pm 0.04$), in ♀♀ (0.47–0.56 mm, $\bar{S} = 0.50 \pm 0.03$); ID in ♂♂ (0.26–0.29 mm, $\bar{S} = 0.29 \pm 0.01$), in ♀♀ (0.26–0.32 mm, $\bar{S} = 0.30 \pm 0.02$); ED in ♂♂ (0.18–0.26 mm, $\bar{S} = 0.21 \pm 0.02$), in ♀♀ (0.19–0.26 mm, $\bar{S} = 0.22 \pm 0.02$); HW/ID in ♂♂ (1.56–1.90, $\bar{S} = 1.67 \pm 0.10$), in ♀♀ (1.62–1.79, $\bar{S} = 1.70 \pm 0.05$). Labrum almost glabrous, apical half setose; anterior margin paler; basal half finely longitudinally grooved; clypeus as long as labrum, especially in apical half finely longitudinally grooved; frons slightly depressed behind fronto-clypeal suture; surface of frons and vertex micropunctured at least around eyes; eyes oval in lateral view and convex in dorsal view.

Thorax. Pronotum slightly longer than wide, widest about in the middle; PL in ♂♂ (0.62–0.79 mm, $\bar{S} = 0.71 \pm 0.05$), in ♀♀ (0.72–0.85 mm, $\bar{S} = 0.75 \pm 0.04$); PW in ♂♂ (0.59–0.72 mm, $\bar{S} = 0.64 \pm 0.04$), in ♀♀ (0.62–0.77 mm, $\bar{S} = 0.67 \pm 0.04$); AP in ♂♂ (0.51–0.59 mm, $\bar{S} = 0.55 \pm 0.02$), in ♀♀ (0.54–0.64 mm, $\bar{S} = 0.58 \pm 0.03$); lateral margins finely explanate; anterior margin glabrous, paler; anterior angles finely produced; sublateral tubercles indistinct, prebasal tubercles larger, flat and usually glabrous; median groove about in middle third of pronotum,

finely demarcate, thin, micropunctured; prebasal admedian pits fine; surface of pronotum irregularly, more or less densely micropunctured. Prosternum: prosternal process longer than wide; lateral margins raised around

coxae, microreticulate; apical margin acuminate; median protuberance absent; surface plicate. Scutellum almost rounded, surface shiny. Mesosternum glabrous with well developed microreticulate carinae. Metasternum about



Figs 13–16 *Graphelmis punggulensis* sp. nov.: 13) aedeagus ventral view; 14) aedeagus lateral view; 15) spiculum gastrale and sternite 9; 16) ovipositor. Scale bars: 0.1 mm.

twice as long as mesosternum; disc depressed along longitudinal suture at least in basal half; surface of disc shiny, except lateral portions covered by plastron structures; in males with admedian clusters of flat yellow setae in basal half; admedian prebasal punctures small; sublateral carinae very short, curved behind mesocoxae. Elytra with sides slightly diverging in about proximal two thirds, then continuously converging toward apices; EL in ♂♂ (1.56–1.79 mm, $\bar{S} = 1.63 \pm 0.08$), in ♀♀ (1.54–1.90 mm, $\bar{S} = 1.69 \pm 0.10$); lateral margins finely serrate; apices rounded; striae punctures except base and apex well depressed; 3rd interval with small, prebasal tuft of setae in some specimens. Legs glabrous; FT in ♂♂ (0.62–0.74 mm, $\bar{S} = 0.69 \pm 0.03$), in ♀♀ (0.62–0.76 mm, $\bar{S} = 0.69 \pm 0.04$); MT in ♂♂ (0.59–0.74 mm, $\bar{S} = 0.67 \pm 0.04$), in ♀♀ (0.59–0.71 mm, $\bar{S} = 0.66 \pm 0.04$); HT in ♂♂ (0.68–0.79 mm, $\bar{S} = 0.75 \pm 0.04$), in ♀♀ (0.68–0.79 mm, $\bar{S} = 0.74 \pm 0.03$); length of tarsomere 5 subequal to combined length of tarsomeres 1–4.

Abdomen. Admedian keels of ventrite 1 straight, short, not reaching middle of the ventrite; abdominal intercoxal process sparsely shallowly punctured; mesal portion of remaining ventrites shiny; lateral portions of ventrites covered by plastron structures; apex of ventrite 5 with sides very finely produced. Spiculum gastrale and sternite 9 as in Fig. 15.

Aedeagus (Figs 13, 14). Penis elongate, with numerous small spines along whole length; in lateral view slightly curved and widened toward base; in ventral view almost continuously widened toward base; apex more slender than in previous species. Ventral lobe with apex bluntly rounded; membranous endophallus without any special, more sclerotized structures; phallobasis as long as penis or slightly shorter.

Ovipositor (Fig. 16) with terminal segment straight; preterminal segment ca. 3.3× as long as terminal, outer side slightly concave; distal sclerite about half as long as terminal, with antero-medial angle produced; basal segment slightly longer than preterminal and distal sclerites combined; ventral fulcrum straight.

Sexual dimorphism. Males are recognized by clusters of flat yellow setae on the disc of metasternum.

Distribution. Sabah and Sarawak (Malaysia), Brunei.

Etymology. Named after an exciting limestone rock Batu Punggul which also gave its name to the primary forest resort where the type specimen were collected.

Graphelmis minuta sp.nov.

(Figs 3, 17–20)

Type locality. Malaysia, Sarawak, ca. 40km Southeast Kapit, Sut river.

Material examined. **Holotype** ♂ (NMW) "SARAWAK (Borneo), ca. 40 km SE KAPIT 03. 1994, J. Kodada leg."; **Paratypes** (NMW, CKB): 2 ♀♀ with the same data as holotype.

Diagnosis. Within the *G. bandukanensis* species group, *G. minuta* sp.nov. differs in having: 1) smallest size; 2) median pronotal groove distinct, widened in middle, microreticulate, with yellowish border; 3) sublateral

pronotal tubercles distinct, shiny; 4) anterior pronotal angles very slightly produced; 5) males without distinct yellow setae on metasternum; 6) raised lateral margins of prosternal process narrow; 7) metatrochanter posteriorly with small projection (projection less distinct in females); 8) ventral lobe of penis distinctly widened basally; 9) phallobasis widened in lateral view.

Description. Body form elongate (Fig. 3); CL in ♂ 1.56 mm, in ♀♀ (1.82, 1.88 mm); EW in ♂ 0.59 mm, in ♀♀ (0.68, 0.71 mm), CL/EW in ♂ 2.64, in ♀♀ 2.67, 2.70. Colour dark brown; yellowish elytral pattern consists of: anterior V-shaped marking, extending middle of elytra, paired transverse stripes in ca. 0.6 and apical spots.

Head. HW in ♂ 0.38 mm, in ♀♀ (0.41, 0.43 mm); ID in ♂ 0.24 mm, in ♀♀ 0.26 mm; ED in ♂ 0.16 mm, in ♀♀ (0.16, 0.18 mm); HW/ID in ♂ 1.63, in ♀♀ 1.56, 1.61. Labrum glabrous, sparsely setose; anterior margin paler. Clypeus as long as labrum, very finely longitudinally grooved; frons slightly depressed behind fronto-clypeal suture; surface of frons and vertex densely micropunctured; eyes oval in lateral view, convex in dorsal view.

Thorax. Pronotum about as long as wide, widest near middle; PL in ♂ 0.50 mm, in ♀♀ 0.59 mm; PW in ♂ 0.47 mm, in ♀♀ (0.50, 0.53 mm); AP in ♂ 0.41 mm, in ♀♀ (0.49, 0.50 mm); lateral margins finely explanate; anterior margin glabrous, as well as mesal portion of pronotum along groove paler; anterior angles very finely produced; sublateral tubercles distinct, prebasal tubercles larger, projected basally; median groove distinct, microreticulate, about half as long as PL, widened in middle; prebasal admedian pits visible; surface of pronotum irregularly, densely micropunctured; punctures more dense on sides. Prosternum: prosternal process flat, longer than wide; lateral margins microreticulate, slightly raised around coxae; apical margin acuminate; median protuberance absent; surface shallowly plicate. Scutellum almost rounded, surface shiny. Mesosternum with medio-apical portion raised; carinae microreticulate, short. Metasternum about twice as long as mesosternum; disc almost flat; surface of disc shiny, except lateral portions covered by plastron structures; in males with sparse thin setae; admedian prebasal punctures absent; sublateral carinae absent. Elytra with sides parallel in proximal two thirds, then continuously converging toward apices; EL in ♂ 1.06 mm, in ♀♀ (1.24, 1.29 mm); lateral margins finely and sparsely serrate; apices rounded; striae punctures shallowly depressed; 3rd interval with a few clustered setae behind the elytral base. Legs glabrous; tibiae finely longitudinally grooved; FT in ♂ 0.47 mm, in ♀♀ (0.44, 0.47 mm); MT in ♂ 0.43 mm, in ♀♀ (0.41, 0.44 mm); HT in ♂ 0.50 mm, in ♀♀ (0.47, 0.50 mm); length of tarsomere 5 subequal to combined length of tarsomeres 1–4.

Abdomen. Admedian keels of ventrite 1 indistinct; abdominal intercoxal process sparsely shallowly punctured; mesal portion of remaining ventrites shiny; lateral portions of ventrites covered by plastron structures; apex of ventrite 5 with sides produced. Spiculum gastrale slender; anterior median strut shorter than posterior bifurcate part (Fig. 19).

Aedeagus (Figs 17, 18). Penis elongate, slender, with numerous small spines along whole length; in lateral view straight, with apex arched; main lobe widest in about apical 0.3 then narrowed toward base; ventral lobe abruptly widened before base; penis in ventral view continuously widened toward base; ventral lobe with apex rounded; membranous endophallus with very fine small spines; phallobasis subequal in length with penis, widened in lateral view.

Ovipositor (Fig. 20) with terminal segment straight, widened apically; preterminal segment ca. 2.7× as long as terminal, outer side slightly curved; distal sclerite almost as long as terminal, subquadrat; basal segment slightly longer than preterminal and distal sclerites combined; ventral fulcrum finely sinuate.

Sexual dimorphism. Males are very similar to females and are recognized only by thin setae on the disc of metasternum.

Distribution. So far known only from the type locality Sarawak, Malaysia.

Etymology. Named *minuta* because of the smallest size within the genus.

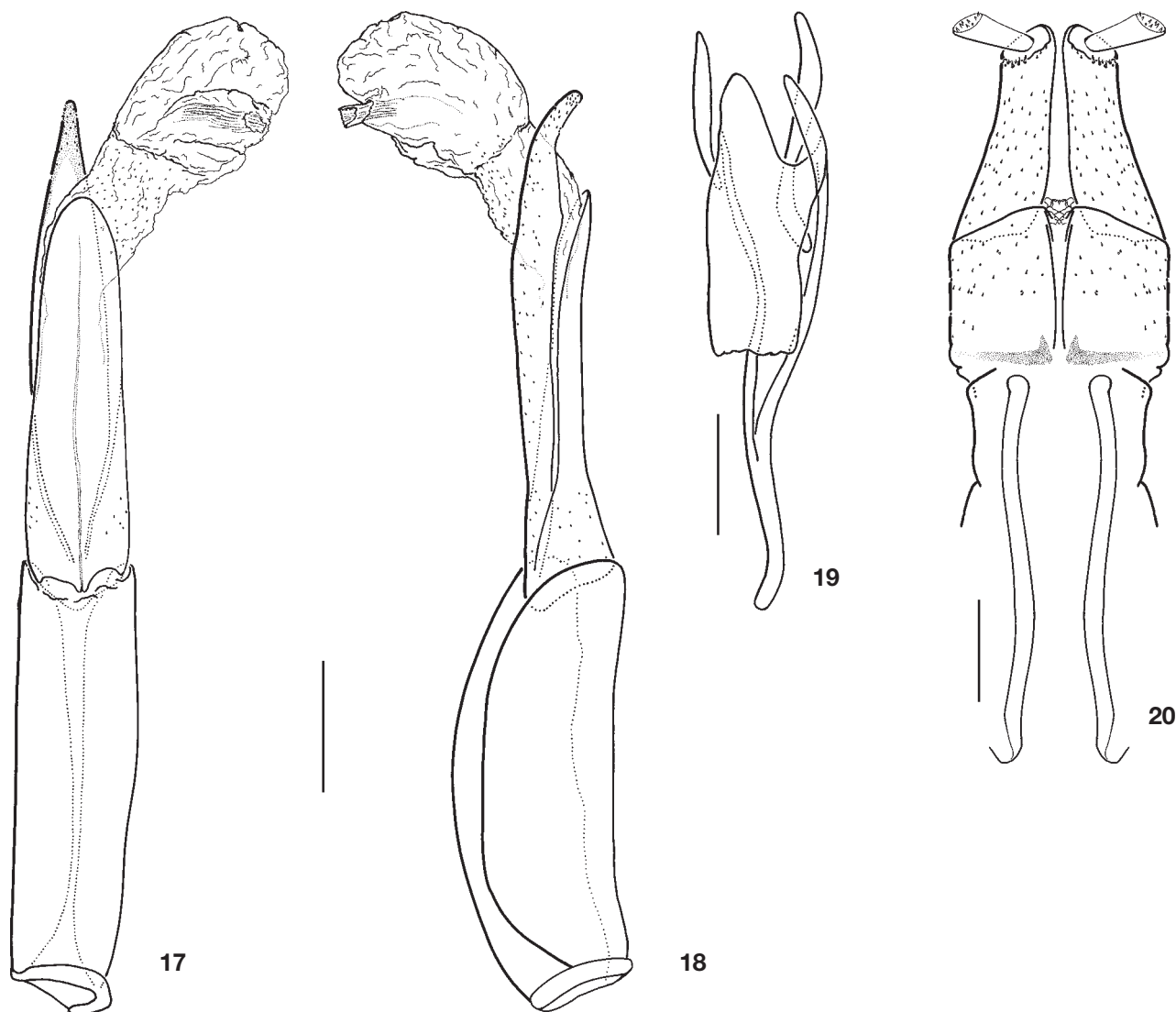
***Graphelmis berbulu* sp.nov.**

(Figs 4, 21–24)

Type locality. Malaysia, Sarawak, Kelabit Highlands

Material examined. **Holotype** ♂ (NMW): “MAL., Sarawak, 1993 Kelabit HL, Umg. Bario 28.2., 1000-1200m leg. M. Jäch (16)”; **Paratypes** (NMW, CKB): 1 ♀: “MAL., Sarawak, 1993 Kelabit HL, Bareo Pa Ukat, 27.2., 1000m leg. H. Zettel (12)”; 4 ♀ ♀: “MAL., Sarawak, 1993 Kelabit HL, Umg. Bario 26.2., ca. 1000m leg. M. Jäch (14)”; 2 ♀ ♀: “MAL., Sarawak, 1993 Kelabit HL, 5km E Bario Pa Ukat, 27.2., 1000m leg. M. Jäch (16)”; 6 ♀ ♀: “MAL., Sarawak, 1993 Kelabit HL, 5km E Bario Pa Ukat, 1.3., 1000m leg. M. Jäch (17)”.

Diagnosis. Within the *G. bandukanensis* species group, *G. berbulu* sp.nov. differs in having: 1) pronotum shiny and setose; 2) median pronotal groove wide and short, micropunctured; 3) pronotum except of paler ante-



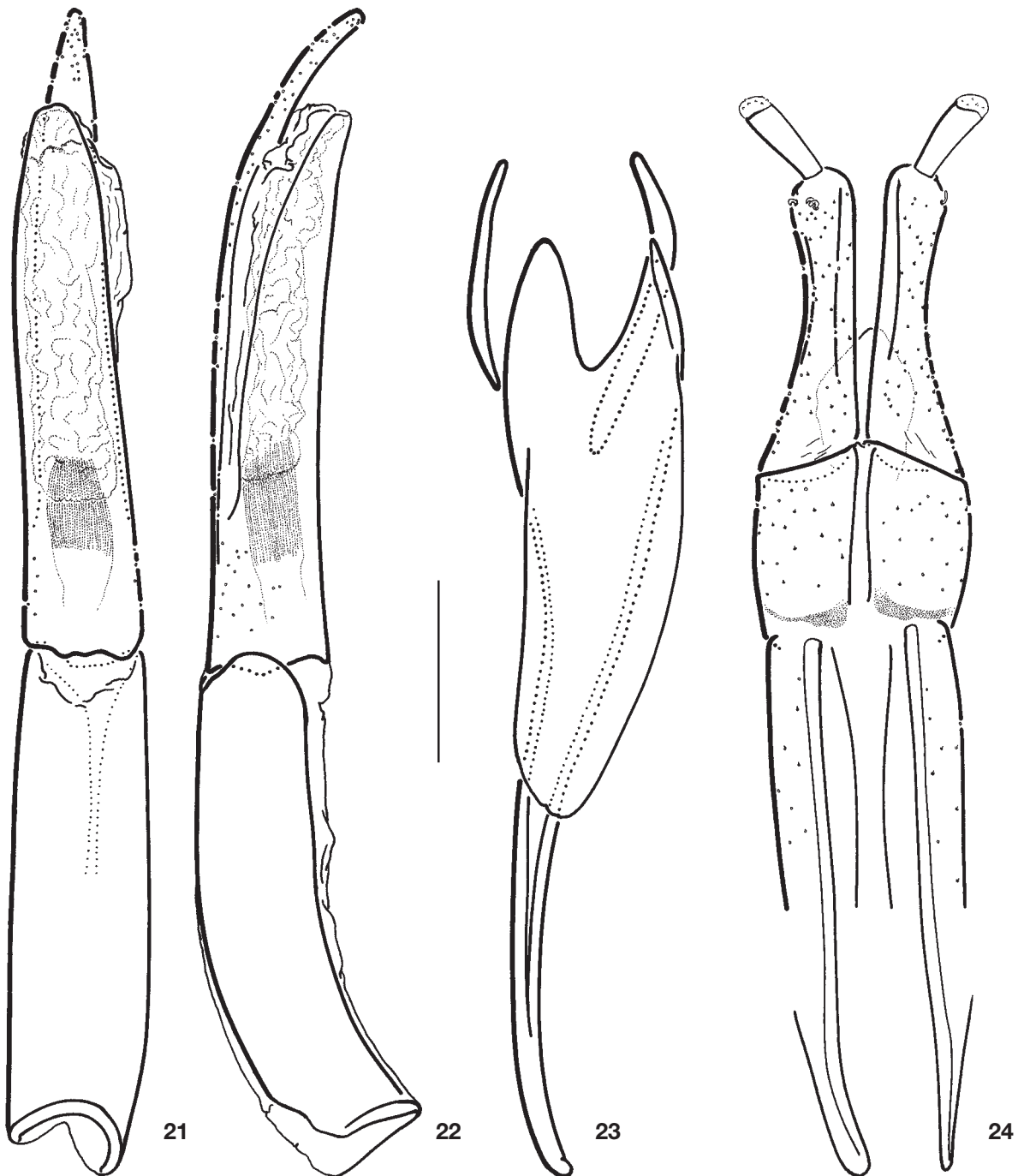
Figs 17–20 *Graphelmis minuta* sp.nov.: 17) aedeagus ventral view; 18) aedeagus lateral view; 19) spiculum gastrale and sternite 9; 20) ovipositor. Scale bars: 0.1 mm.

rior margin black; 4) sublateral pronotal tubercles distinct, shiny; 5) males with long, thin, yellow setae on metasternum; 6) main lobe of penis narrow in lateral view; 7) phallobasis shorter than penis.

Description. Body form elongate (Fig. 4); CL in ♂ 1.87 mm, in ♀♀ (2.26–2.54 mm, $\bar{S} = 2.42 \pm 0.09$); EW in ♂ 0.72 mm, in ♀♀ (0.82–0.95 mm, $\bar{S} = 0.90 \pm 0.05$), CL/EW in ♂ 2.61, in ♀♀ (2.59–2.79, $\bar{S} = 2.70 \pm 0.05$). Colour dark brown; yellowish elytral pattern consists of: paired basal patches in anterior third fused mesally and paired wide transverse stripes in ca. 0.6.

Head. HW in ♂ 0.43 mm, in ♀♀ (0.47–0.53 mm, $\bar{S} = 0.50 \pm 0.02$); ID in ♂ 0.24 mm, in ♀♀ (0.26–0.29 mm, $\bar{S} = 0.27 \pm 0.01$); ED in ♂ 0.19 mm, in ♀♀ (0.21–0.24 mm, $\bar{S} = 0.22 \pm 0.02$); HW/ID in ♂ 1.81, in ♀♀ (1.75–1.94, $\bar{S} = 1.85 \pm 0.07$). Labrum glabrous, sparsely setose; anterior margin paler. Clypeus as long as labrum, glabrous except finely microreticulate anterior portion; frons and vertex irregularly micropunctured, mesally glabrous; eyes small, oval in lateral view and feebly protruding in dorsal view.

Thorax. Pronotum about as long as wide, widest



Figs 21–24 *Graphelmis berbulu* sp.nov.: 21) aedeagus ventral view; 22) aedeagus lateral view; 23) spiculum gastrale and sternite 9; 24) ovipositor. Scale bars: 0.1 mm.

about in basal third; PL in ♂ 0.56 mm, in ♀♀ (0.67–0.74 mm, $\bar{S} = 0.72 \pm 0.03$); PW in ♂ 0.62 mm, in ♀♀ (0.69–0.79 mm, $\bar{S} = 0.74 \pm 0.04$); AP in ♂ 0.47 mm, in ♀♀ (0.54–0.60 mm, $\bar{S} = 0.57 \pm 0.02$); lateral margins finely explanate; anterior margin glabrous, paler; anterior angles finely produced; sublateral tubercles irregularly shaped; median groove micropunctured in middle third, with edges rounded; prebasal admedian pits distinct; surface of pronotum irregularly, very sparsely micropunctured; punctures coarser around tubercles. Prosternum: prosternal process about as long as wide; lateral margins microreticulate, slightly raised around coxae; apical margin acuminate; median protuberance absent; surface shallowly plicate. Scutellum almost rounded, surface shiny; lateral tubercles blunt and indistinct or absent. Mesosternum with oblique microreticulate carinae. Metasternum about twice as long as mesosternum; disc flat in anterior half; posterior half shallowly depressed mesally, finely transversally plicate along median longitudinal suture; surface shiny, except lateral portions covered by plastron structures; in males with sparse thin and long setae; admedian prebasal punctures transverse, shallow; sublateral carinae very short behind mesocoxae. Elytra with sides parallel in basal two thirds, then continuously converging toward apices; EL in ♂ 1.31 mm, in ♀♀ (1.59–1.79 mm, $\bar{S} = 1.70 \pm 0.07$); lateral margins feebly serrate; apices almost rounded; striae punctures well depressed; 3rd interval with a few clustered setae behind elytral base. Legs glabrous; FT in ♂ 0.59 mm, in ♀♀ (0.56–0.71 mm, $\bar{S} = 0.64 \pm 0.05$); MT in ♂ 0.56 mm, in ♀♀ (0.56–0.68 mm, $\bar{S} = 0.61 \pm 0.05$); HT in ♂ 0.65 mm, in ♀♀ (0.62–0.76 mm, $\bar{S} = 0.69 \pm 0.05$); length of tarsomere 5 subequal to combined length of tarsomeres 1–4.

Abdomen. Admedian keels of ventrite 1 short and indistinct, not reaching middle of ventrite; abdominal intercoxal process in males equally setose as metasternum; surface as well as mesal portion of remaining ventrites shiny; lateral portions of ventrites covered by plastron structures; apex of ventrite 5 with sides produced. Spiculum gastrale and sternite 9 as in Fig. 23.

Aedeagus (Figs 21, 22). Penis elongate, slender, with small spines along whole length; in lateral view arched behind apex, then almost straight; main lobe thin; ventral lobe distinctly wide; in ventral view penis continuously widened toward base; ventral lobe with apex almost rounded; membranous endophallus basally with ring of small spines formed in thin rows; phallobasis about 0.8× as long as penis.

Ovipositor (Fig. 24) with terminal segment straight, slightly widened apically; preterminal segment ca. 3.4× as long as terminal, outer side slightly concave; distal sclerite about half as long as terminal; basal segment subequal in length with terminal, preterminal and distal sclerites combined; ventral fulcrum almost straight.

Sexual dimorphism. Males are easily recognized by thin long setae on the disc of metasternum and intercoxal process of ventrite 1.

Distribution. So far known only from Sarawak, Malaysia.

Etymology. From Malay *berbulu*: hairy, in reference to setose pronotum.

***Graphelmis dembickyi* sp.nov.**

(Figs 5, 25–28)

Type locality. Philippines, North Luzon, Ilcos Norte province, Patapas Mountains.

Material examined. **Holotype** ♂ (NMW): “PHILIPPINES, N LUZON, 300m; ILOCOS NORTE pr. Patapas Mts.; L. Dembický lgt; 3.IV.2000”; **Paratypes** (NMW, CKB): 110 ♂♂, 59 ♀♀ with the same label as holotype; 10 ♂♂, 10 ♀♀, 11 ex. (sex not examined): “Philippines, Mindoro Hidden Paradise, Baco, 1. 12. 1992, leg. Jäch”; 116ex. (sex not examined): “PHILIPPINEN – Mindoro 20km W Calapan 1992 Hidden Paradise (10) leg. Jäch 20.-21.11.”; 39ex. (sex not examined): “PHILIPPINEN – Mindoro 20km W Calapan 1992 Hidden Paradise (10a) leg. Preuler 20.-21.11.”; 46ex. (sex not examined): “PHILIPPINEN – Mindoro 20km W Calapan 1992 Hidden Paradise (21) leg. Jäch 1.12.”; 5ex. (sex not examined) “PHIL.: Mindoro or. Baco, Hidden Paradise 19.-21.11.1993 leg. Zettel (27)”; 1ex. (sex not examined): “leg. Preuler (5a) PHILLIPINEN – Mindoro 10km W Puerto Galera 17.11.1992”.

Diagnosis. Within the *G. bandukanensis* species group, *G. dembickyi* sp.nov. differs as follows: 1) entire pronotal surface densely micropunctured; 2) males with dense yellow, flat setae on metasternum; 3) disc of prosternum and prosternal process rough or plicate; 4) apical margin of prosternal process almost rounded; 5) admedian keels of ventrite 1 absent; 6) penis slightly constricted subapically.

Description. Body form elongate (Fig. 5); CL in ♂♂ (2.05–2.46 mm, $\bar{S} = 2.22 \pm 0.13$), in ♀♀ (2.21–2.51 mm, $\bar{S} = 2.36 \pm 0.10$); EW in ♂♂ (0.82–0.92 mm, $\bar{S} = 0.87 \pm 0.04$), in ♀♀ (0.87–0.95 mm, $\bar{S} = 0.90 \pm 0.03$), CL/EW in ♂♂ (2.44–2.67, $\bar{S} = 2.55 \pm 0.06$), in ♀♀ (2.53–2.69, $\bar{S} = 2.60 \pm 0.05$). Colour dark brown; yellowish elytral pattern consists of: paired basal patches, paired wide transverse patches in ca. 0.6 and usually also of indistinct apical spots.

Head. HW in ♂♂ (0.44–0.50 mm, $\bar{S} = 0.47 \pm 0.02$), in ♀♀ (0.46–0.53 mm, $\bar{S} = 0.50 \pm 0.03$); ID in ♂♂ (0.26–0.31 mm, $\bar{S} = 0.28 \pm 0.02$), in ♀♀ (0.28–0.34 mm, $\bar{S} = 0.30 \pm 0.02$); ED in ♂♂ (0.19–0.24 mm, $\bar{S} = 0.21 \pm 0.02$), in ♀♀ (0.19–0.21 mm, $\bar{S} = 0.20 \pm 0.01$); HW/ID in ♂♂ (1.58–1.78, $\bar{S} = 1.66 \pm 0.06$), in ♀♀ (2.57–2.70, $\bar{S} = 2.63 \pm 0.05$). Labrum with apical half glabrous and setose; posterior half finely longitudinally grooved. Clypeus as long as labrum, finely longitudinally grooved in apical half, distal half almost glabrous; frons slightly depressed behind fronto-clypeal suture; surface of frons and vertex densely micropunctured; eyes oval in lateral view and convex in dorsal view.

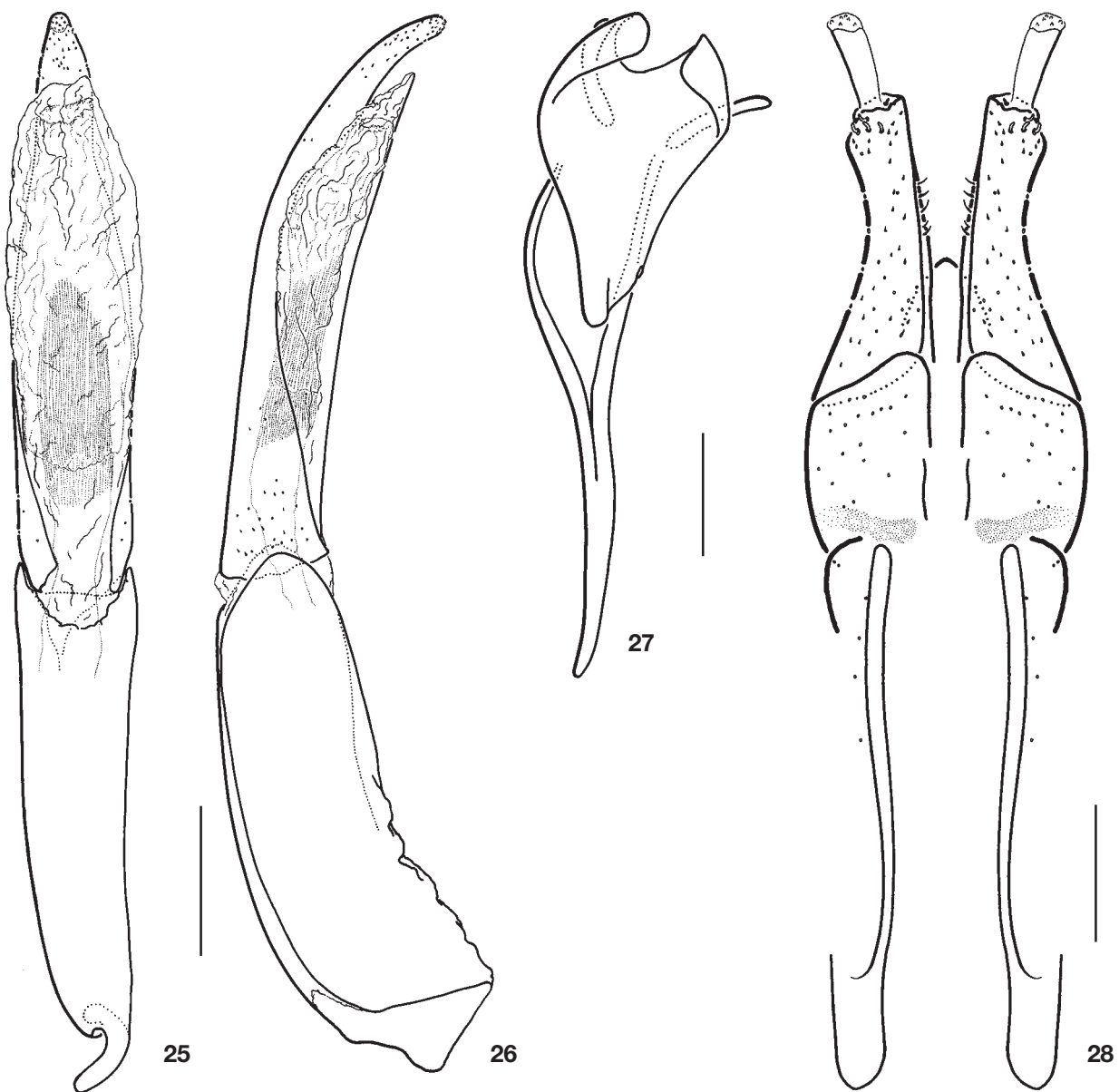
Thorax. Pronotum about as long as wide, widest about in basal half; PL in ♂♂ (0.62–0.77 mm, $\bar{S} = 0.68 \pm 0.04$), in ♀♀ (0.67–0.82 mm, $\bar{S} = 0.73 \pm 0.05$); PW in ♂♂ (0.62–0.72 mm, $\bar{S} = 0.66 \pm 0.03$), in ♀♀ (0.62–0.74 mm, $\bar{S} = 0.68 \pm 0.05$); AP in ♂♂ (0.51–0.62 mm, $\bar{S} = 0.55 \pm 0.03$), in ♀♀ (0.54–0.62 mm, $\bar{S} = 0.58 \pm 0.03$); lateral margins finely explanate; anterior margin paler,

micropunctured; anterior angles finely produced; sublateral tubercles flat, more sparsely punctured than rest of pronotum; median groove weak, micropunctured; prebasal admedian pits fine; surface of pronotum densely micropunctured. Prosternum: prosternal process longer than wide; lateral margins raised around coxae, microreticulate; apical margin almost rounded; median protuberance absent; surface rough or plicate. Scutellum subtriangular, surface rough. Mesosternum glabrous with microreticulate carinae. Metasternum about twice as long as mesosternum; disc almost flat; surface of disc shiny, except lateral portions covered by plastron structures; in males with admedian clusters of flat yellow setae; admedian prebasal punctures absent; sublateral carinae absent. Elytra with sides slightly parallel in about anterior two thirds, then continuously converging toward apices; EL in ♂♂ (1.44–1.69 mm, $\bar{S} = 1.54 \pm 0.09$), in ♀♀ (1.54–1.74 mm, $\bar{S} = 1.63 \pm 0.07$);

lateral margins finely serrate; apices rounded; strial punctures more depressed on disc; interval 3 with small, prebasal tuft of setae in some specimens. Legs glabrous; FT in ♂♂ (0.53–0.62 mm, $\bar{S} = 0.58 \pm 0.02$), in ♀♀ (0.56–0.62 mm, $\bar{S} = 0.58 \pm 0.03$); MT in ♂♂ (0.50–0.59 mm, $\bar{S} = 0.55 \pm 0.02$), in ♀♀ (0.53–0.59 mm, $\bar{S} = 0.55 \pm 0.03$); HT in ♂♂ (0.56–0.65 mm, $\bar{S} = 0.61 \pm 0.03$), in ♀♀ (0.59–0.65 mm, $\bar{S} = 0.62 \pm 0.03$); length of tarsomere 5 subequal to combined length of tarsomeres 1–4.

Abdomen. Admedian keels of ventrite 1 absent; abdominal intercoxal process sparsely shallowly punctured; mesal portion of remaining ventrites densely micropunctured; lateral portions of ventrites covered by plastron structures; apex of ventrite 5 with sides finely produced. Spiculum gastrale and sternite 9 as in Fig. 27.

Aedeagus (Figs 25, 26). Penis elongate, with numerous small spines especially in apical and basal parts; in



Figs 25–28 *Graphelmis dembickyi* sp.nov.: 25) aedeagus ventral view; 26) aedeagus lateral view; 27) spiculum gastrale and sternite 9; 28) ovipositor. Scale bars: 0.1 mm.

lateral view apical half curved, basal part straight; in ventral view penis slightly constricted in apical 0.25, then widened to middle and parallel-sided in basal half; ventral lobe with indistinct, membranous apex; phallobasis about as long as penis or slightly shorter.

Ovipositor (Fig. 28) with terminal segment straight; preterminal segment ca. 3.3× as long as terminal, outer side concave; distal sclerite about half as long as terminal; basal segment as long as terminal, preterminal and distal sclerites combined; ventral fulcrum finely sinuate.

Sexual dimorphism. Males are recognized by clusters of flat yellow setae on the disc of metasternum.

Distribution. So far known only from Philippines.

Etymology. Dedicated to our friend, entomologist Luboš Dembický.

Graphelmis sulawesiensis sp.nov.

(Figs 6, 29–32)

Type locality. Indonesia, Central Sulawesi, ca 45km Southeast Palu, 01°11'S, 120°08'E.

Material examined. **Holotype** ♂ (NMW): "INDON.: C-Sulawesi ca. 45km SE Palu 01°11'S, 120°08'E leg. Haft (7) 1994, Lore Lindu NP Umg. Kamarora 700-900m 19.-29.12. 1994";

Paratypes (NMW, CKB): 3 ♀ ♀ with the same label as holotype; 1 ♂, 2 ♀ ♀: "INDON.: C-Sulawesi ca. 45km SE Palu 01°11'S, 120°08'E leg. J. Haft (5) 1994"; 9 ♂ ♂: "INDONESIA: C-Sulawesi ca. 20km SW Tentena Umg. Poso See Saluopa Wasserfälle, 18.-20.2.1998, 700m 01°45'S, 120°32'E leg. J. Haft (PO 3)"; 1 ♂, 2 ♀ ♀: "INDON.: C-Sulawesi Umg. Pendolo 53,9km SSE Tentena 1340m 02°14'S, 120°46'E 17.1.1995 leg. Haft (17)"; 1 ex. (sex not examined): "S-SULAWESI 1992 Malino, Takapala Wasserfall (29) leg. Jäch 30.IV."; 1 ♂: "N-SULAWESI 1992 Gunung Ambang NSG (13) leg. Jäch 20.IV."; 1 ♂, 1 ♀: "S-SULAWESI Malino-Manipi 700m (31) leg. Jäch 1.V. ".

Diagnosis. *G. sulawesiensis* sp.nov. differs from *G. dembickyi* sp.nov. in having: 1) anterior pronotal margin almost glabrous; 2) pronotal surface more sparsely micropunctured; 3) disc of prosternum and prosternal process distinctly plicate; 4) intercoxal process of ventrite 1 and mesal portion of remaining ventrites shiny, with very few, shallow punctures only; 5) apex of penis arched; 6) endophallus with rows of small spines.

Description. Body form elongate (Fig. 6); CL in ♂ ♂ (2.33–2.69 mm, $\bar{S} = 2.46 \pm 0.12$), in ♀ ♀ (2.54–2.82 mm, $\bar{S} = 2.70 \pm 0.09$); EW in ♂ ♂ (0.87–1.03 mm, $\bar{S} = 0.93 \pm 0.05$), in ♀ ♀ (0.97–1.13 mm, $\bar{S} = 1.06 \pm 0.06$), CL/EW in ♂ ♂ ♂ ♂ (2.57–2.68, $\bar{S} = 2.64 \pm 0.04$), in ♀ ♀ (2.47–2.65, $\bar{S} = 2.56 \pm 0.09$). Colour dark brown to black; yellowish elytral pattern consists of: paired rounded basal patches, paired posterior transverse patches extending anteriorly; apical spots very feebly coloured or absent.

Head. HW in ♂ ♂ (0.47–0.51 mm, $\bar{S} = 0.49 \pm 0.02$), in ♀ ♀ (0.50–0.54 mm, $\bar{S} = 0.52 \pm 0.02$); ID in ♂ ♂ (0.26–0.31 mm, $\bar{S} = 0.29 \pm 0.02$), in ♀ ♀ (0.29–0.32 mm, $\bar{S} = 0.31 \pm 0.01$); ED in ♂ ♂ (0.21–0.24 mm, $\bar{S} = 0.21 \pm 0.01$), in ♀ ♀ (0.21–0.24 mm, $\bar{S} = 0.22 \pm 0.02$); HW/ID in ♂ ♂ (1.65–1.83, $\bar{S} = 1.72 \pm 0.07$), in ♀ ♀ (1.64–1.71, $\bar{S} = 1.67 \pm 0.03$). Labrum glabrous and setose; basal half

finely microreticulate, grooved. Clypeus as long as labrum, surface especially in apical half and on lateral portions finely microreticulate, medio-distal part glabrous; frons and vertex densely micropunctured with mesal portions glabrous; eyes oval in lateral view and slightly convex in dorsal view.

Thorax. Pronotum as long as wide, widest about in basal half; PL in ♂ ♂ (0.69–0.79 mm, $\bar{S} = 0.73 \pm 0.04$), in ♀ ♀ (0.79–0.87 mm, $\bar{S} = 0.84 \pm 0.03$); PW in ♂ ♂ (0.69–0.79 mm, $\bar{S} = 0.73 \pm 0.03$), in ♀ ♀ (0.77–0.87 mm, $\bar{S} = 0.82 \pm 0.04$); AP in ♂ ♂ (0.54–0.60 mm, $\bar{S} = 0.58 \pm 0.02$), in ♀ ♀ (0.62–0.65 mm, $\bar{S} = 0.64 \pm 0.01$); lateral margins finely explanate; anterior margin glabrous, paler; anterior angles finely produced; sublateral tubercles flat, indistinct; median groove fine and thin, micropunctured; prebasal admedian pits small; surface of pronotum densely micropunctured, punctures coarser on disc. Prosternum: prosternal process slightly longer than wide; lateral margins raised around coxae, microreticulate; apical margin almost rounded; median protuberance absent; surface plicate. Scutellum subtriangular, surface rough. Mesosternum glabrous, with microreticulate carinae. Metasternum about twice as long as mesosternum; disc almost flat in anterior third; basal two thirds depressed along median longitudinal suture; mesal portion of disc shiny; portion behind anterior margin rough; lateral portions of disc covered by plastron structures; males with admedian clusters of flat yellow setae; admedian prebasal punctures visible; sublateral carinae almost absent. Elytra with sides parallel in about anterior two thirds, then continuously converging toward apices; EL in ♂ ♂ (1.64–1.90 mm, $\bar{S} = 1.74 \pm 0.09$), in ♀ ♀ (1.74–1.95 mm, $\bar{S} = 1.85 \pm 0.07$); lateral margins finely serrate; apices rounded; strial punctures more depressed on disc; interval 3 widened prebasally, with small tuft of setae in some specimens. Legs glabrous; FT in ♂ ♂ (0.57–0.68 mm, $\bar{S} = 0.64 \pm 0.03$), in ♀ ♀ (0.59–0.68 mm, $\bar{S} = 0.63 \pm 0.04$); MT in ♂ ♂ (0.54–0.62 mm, $\bar{S} = 0.60 \pm 0.03$), in ♀ ♀ (0.56–0.63 mm, $\bar{S} = 0.59 \pm 0.03$); HT in ♂ ♂ (0.62–0.74 mm, $\bar{S} = 0.68 \pm 0.04$), in ♀ ♀ (0.65–0.74 mm, $\bar{S} = 0.69 \pm 0.03$); length of tarsomere 5 subequal to combined length of tarsomeres 1–4.

Abdomen. Admedian keels of ventrite 1 very short; abdominal intercoxal process and mesal portion of remaining ventrites sparsely, shallowly punctured or glabrous; lateral portions of ventrites covered by plastron structures; apex of ventrite 5 with sides finely produced. Spiculum gastrale and sternite 9 as in Fig. 31.

Aedeagus (Figs 29, 30). Penis elongate, with small spines especially in apical and basal parts; in lateral view with apex moderately arched; main lobe constricted before middle, then distinctly widened toward base; in ventral view penis widened in anterior half and subparallel in posterior half; ventral lobe with apex rounded; membranous endophallus with long rows of small spines; phallobasis slightly longer than penis.

Ovipositor (Fig. 32) with terminal segment straight; preterminal segment ca. 3.6× as long as terminal, outer side finely concave; distal sclerite about half as long as

terminal, with antero-medial angle sharp; basal segment longer than terminal, preterminal and distal sclerites combined; ventral fulcrum slightly sinuate.

Sexual dimorphism. Males are recognized by clusters of flat yellow setae on disc of metasternum.

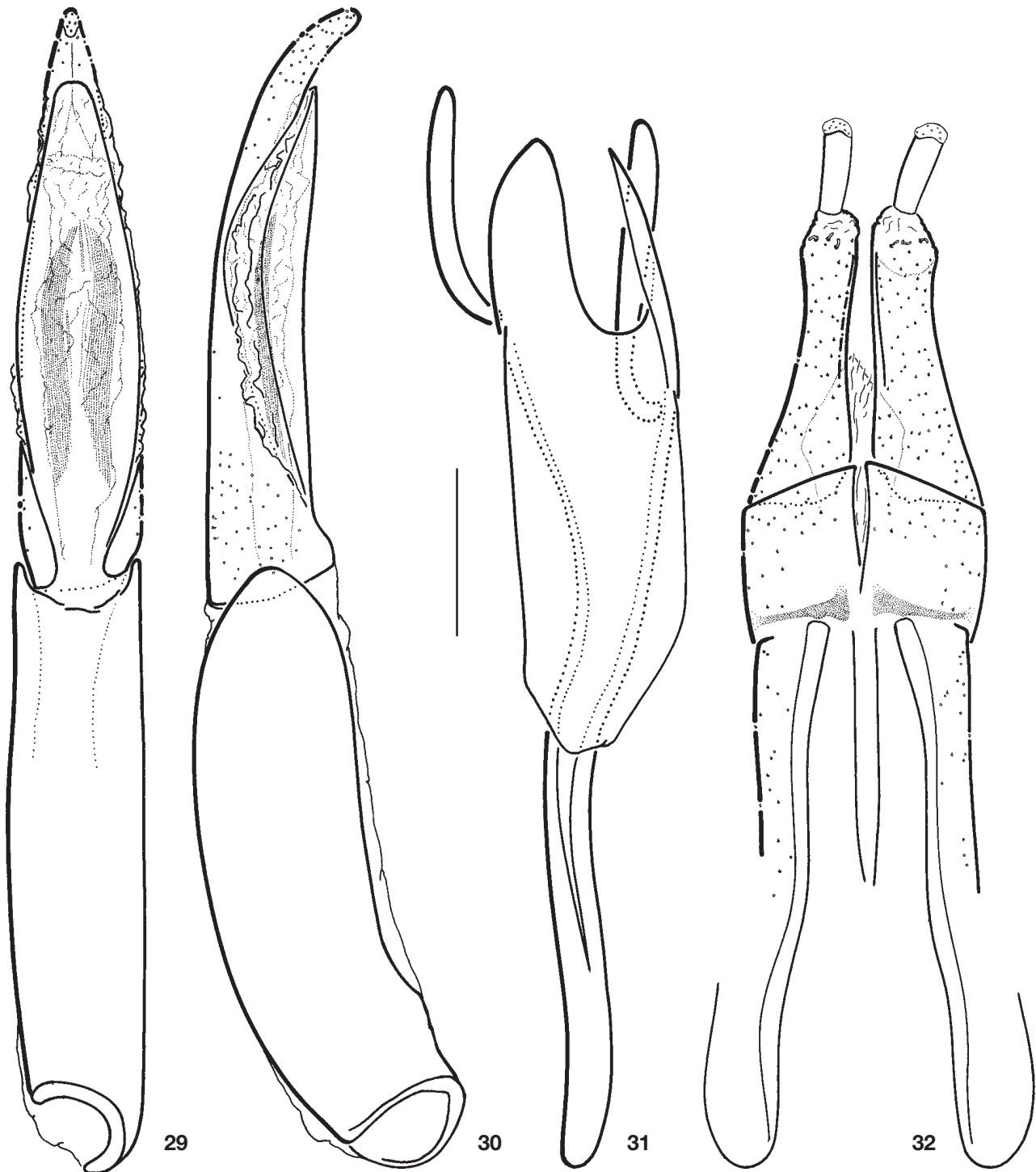
Distribution. So far known only from Sulawesi, Indonesia.

Etymology. Named for the type locality, Indonesian island Sulawesi.

Acknowledgements

I wish to thank J. Kodada (Bratislava) and M. A. Jäch (Vienna) for their useful comments on the manuscript. My thanks are also due to D. Žitňan (Bratislava) for his kind loan of a digital camera used for habitus photography.

This study was partly supported by the Slovak Scientific Grant Agency, Projects No. 1/7196/20 and 2/7167/20.



Figs 29–32 *Graphelmis sulawesiensis* sp.nov.: 29) aedeagus ventral view; 30) aedeagus lateral view; 31) spiculum gastrale and sternite 9; 32) ovipositor. Scale bars: 0.1 mm.

References

- DELÈVE, J. 1968. Dryopidae et Elminthidae (Coleoptera) du Vietnam. *Annales Historico-Naturales Musei Nationalis Hungarici*, tomus 60, pars zoologica, pp.149–181.
- JÄCH, M.A. 1994. A taxonomic review of the Oriental species of the genus *Ancyronyx* ERICHSON, 1847 (Coleoptera, Elmidae). *Revue Suisse de Zoologie*, 101, 3: 601–622.
- KODADA, J. & JÄCH, M.A. 1999. *Roraima carinata* gen. et sp.nov. and *Neblinagena doylei* sp.nov., two new Larinae from Mount Roraima, Venezuela (Coleoptera: Elmidae). *Entomological Problems*, 30(1): 13–29.
- BOUKAL, D.S. 1997. A revision of the genus *Austrolimnius* CARTER & ZECK, 1929 (Insecta: Coleoptera: Elmidae) from New Guinea and Moluccas. *Annalen des Naturhistorischen Museums in Wien*, 99B: 155–215.
- ČIAMPOR Jr., F. 2001. Systematic revision of the genus *Graphelmis* (Coleoptera: Elmidae) I. Redescription of the genus and description of four new species. *Entomological Problems*, 32(1): 17–32.

Manuscript received: 20. 9. 2001