

New species and descriptions of Lepidostomatidae (Trichoptera) from Sulawesi

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Four new species of *Lepidostoma* from Sulawesi of the caddisfly family Lepidostomatidae are described. The three lepidostomatid species previously known from Sulawesi (Neboiss 1991) are removed from *Goerodes* and transferred to *Lepidostoma*. Also, the female of *Lepidostoma xylochos* (Neboiss) is described for the first time.

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Introduction

Examination of caddisflies from Sulawesi in the collections of the Nationaal Natuurhistorisch Museum, Leiden, the Instituut voor Taxonomische Zoologie of the Universiteit van Amsterdam, and the Bernice P. Bishop Museum, Honolulu, has revealed four new species of *Lepidostoma*, bringing the total number of lepidostomatid species from Sulawesi to seven. Most of the specimens examined were collected recently by the second author in Sulawesi Tenggara. The finding of these new species also makes a substantial addition to the lepidostomatid fauna of the Australasian Region, where only six species were previously known. Three of these species, described by Neboiss (1991), are from Sulawesi: *Goerodes anorhopes* Neboiss, *G. tectoris* Neboiss, and *G. xylochos* Neboiss; new records of these species and the first description of the female of the latter species are provided herein. The three other species known from the Australasian Region are *Goerodes japonensis* Kimmins, 1962, from New Guinea (Irian Jaya), *Dinarthropsis picea* (Ulmer, 1913) from Java and Irian Jaya, and one dubious species, *Neolepidostoma daabanum* Ulmer, 1951, from New Guinea; the latter species was poorly described and is known only from the female type. Figures of these three species are provided by Neboiss (1986) and redescrptions of *Dinarthropsis picea* were made by Weaver (1985, 1989). Several of the lepidostomatids of Sulawesi and Borneo appear to be closely related; these relationships will be discussed by Weaver and Huisman (in press) in a review of the Lepidostomatidae of Borneo.

Abbreviations used herein for collections where the specimens examined have been deposited are as follows: BPBM — Bernice P. Bishop Museum, Honolulu; RMNH — Nationaal Natuurhistorisch Museum (formerly Rijksmuseum van Natuurlijke Historie), Leiden; ZMA — Instituut voor Taxonomische Zoologie, Zoologisch Museum, Universiteit van Amsterdam; MVMA — Museum of Victoria, Abbotsford;

JSW — the first author; JH — the second author. Collectors' names are abbreviated herein as follows: JH — Jolanda Huisman; RdJ — Rienk de Jong; RS — R. Straatman. Abbreviations in the locality data herein of Indonesian words are as follows: Gn. — *gunung*, mountain; ; P. — *pulau*, island; Sg. — *sungai*, river, stream.

Collection sites

Habitat descriptions are provided for the following localities in Sulawesi Tenggara where much of the material examined herein was collected:

Bat Camp: 1050 m, P. Kabaena, inside forest near tiny well; water clear, water temperature 21°C; vegetation, low pole trees, 5°19'S 121°57'E.

Hornbill Camp: 800-900 m, P. Kabaena, sparse trickle over boulders with much leaf litter, on a 30° slope, water clear, water temperature 21°C, pH 7.1; vegetation, undisturbed, low forest (15 m), providing ca. 80% shade, 3°48'30"S 121°39'30"E.

Sungai Lakambula: 300-350 m, P. Kabaena, Cave Camp, 5-10 m wide, fast-flowing river, some places 1.5 m deep, rock bottom with boulders and pebbles; water clear, water temperature 25°C, pH 8.8, high riverine forest, with bamboo and tree ferns on steep slopes, 5°18'S 121°57'E

Sungai Lalonduwasi: 1100 m, P. Kabaena, shallow, 3 m wide river, with huge boulders, steep slopes. Water clear, water temperature 20°C, pH 7.0; vegetation, dense undisturbed, wet forest on a ridge, c. 3°49'S 121°40'E.

Sungai Lampepoporea: 350 m, P. Kabaena small braided stream, comprising 1-2 m wide brooklets, small amounts of clear water flowing quietly over pebbles and leaf litter, water temperature 24°C, pH 8.5; vegetation on gentle slopes, riverine forest and bamboo, 5°18'S 121°57'E.

Sungai Lantinoli: 550 m, P. Kabaena 3 m wide, clear water flowing quietly over big boulders; water temperature 24°C, pH 8.8; steep slopes, with riverine forest surrounded by pastures, 5°17'S 121°57'E.

Sungai Mokowu: 200-250 m, fast-flowing river of clear water, 5-10 m wide, with many boulders, water temperature 23°C, pH 7.3, vegetation dry, evergreen tropical forest, in sandy soil, 3°48'S 121°39'E.

Sungai Moramo: 175-200 m. fast-flowing, silty turbid water, 15-50 m wide, shallow; water temperature 24°C, pH 8.5; vegetation undisturbed mixed evergreen forest with rattan (*Calamus*), 4°09'S 122°38'E.

Sungai Sena: 50 m, fast-flowing river with turbid water, 5 m wide, riverbed composed of sand, silt and leaf litter; water temperature 24°C, pH 8.5, vegetation, riverine forest and ladangs.

Systematics

Lepidostoma Rambur, 1842

All of the lepidostomatids known from Sulawesi have male genitalia without parameres, and hence all have been placed in the genus *Lepidostoma* (Weaver & Huisman, in press). Thus, the three lepidostomatid species from Sulawesi described

by Neboiss (1991) were removed from the genus *Goerodes* and transferred to *Lepidostoma*, now *Lepidostoma anorhepes* (Neboiss), *L. tectore* (Neboiss), and *L. xylochos* (Neboiss).

Lepidostoma anorhepes (Neboiss) comb. nov.

Goerodes anorhepes Neboiss, 1991: 91-92, ♂, ♀, figs. 22-30.

Material.— Sulawesi Tengah: 1 ♂, (JSW), 72 km SE Palu, Kulawi, 18-28.xii.1965, RS; 1 ♂, 1 ♀, (BPBM), *ibid.*, 19-28.xii.1965, RS. Sulawesi Tenggara: 2 ♂♂, (RMNH), N slope Gn. Watuwila, Hornbill Camp, 900 m, 18.x.1989, RdJ & JH; 10 ♂♂, 8 ♀♀, (JSW), N slope Gn. Watuwila, Sg. Mokowu, 250 m, 19.x.1989, RdJ & JH; 22 ♂♂, 20 ♀♀, (RMNH [10 ♂♂, 10 ♀♀, JH]), *ibid.*, 11.x.1989, RdJ & JH; 11 ♀♀, (RMNH), *ibid.*, 20.x.1989, RdJ & JH; 2 ♂♂, 2 ♀♀, (ZMA), Mokowu Camp, Mokowu River, 3°49'S 121°40'E, 200 m, 29.x.1989, J.P. Duffels.

Lepidostoma gigitarang spec. nov.

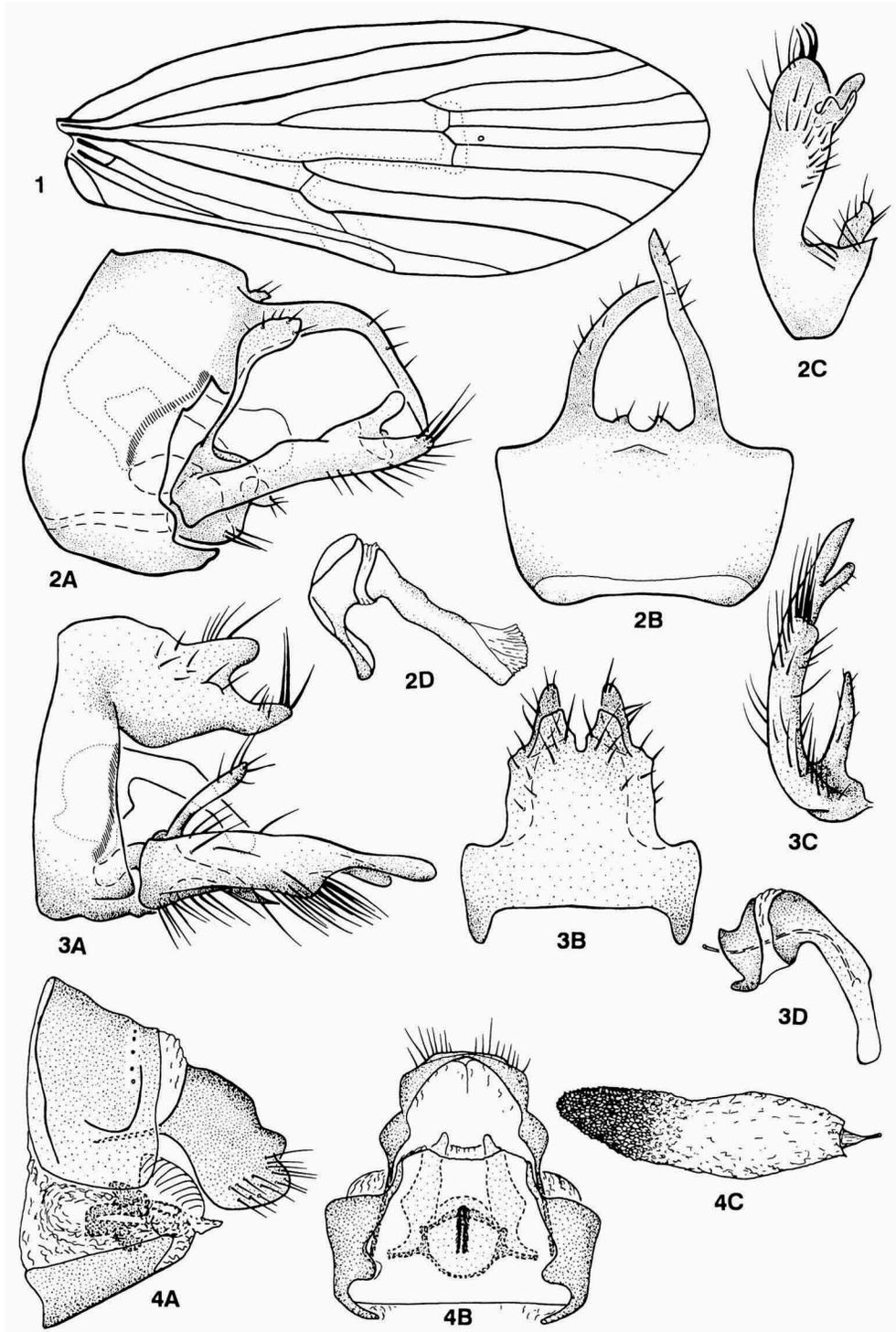
(figs. 1-2)

Material.— Sulawesi Selatan: holotype: ♂, (BPBM), 12 km E Rantepao Toradja, Pedamaran 1200 m, 17-25.iv.1966, RS.

Male.— Head dorsum with two pairs of setaceous warts, large posterior pair and smaller anterior pair; frons with two pairs of setaceous areas, long narrow lateral setal area adjacent to eye, small round setal area below scape; vertex with minute bump, frons slightly concave. Scape 1.2 mm, cylindrical with striated mesal concavity. Maxillary palp 0.6 mm, first segment 0.4 mm, apical segment flexible, 0.2 mm. Fore wing (fig. 1) 8.3 mm, having minute setose anterior basal pocket, venation similar to that of *L. pedang* Weaver & Huisman, but Cu_1 not running halfway between R_{3+4} and Cu_2 , anal veins terminating in posterior margin closer to the arculus and farther away from apex of Cu , anal groove absent, longitudinal veins bearing dark scales, faint lighter stripes extending from arculus to base of discal cell and short stripe encompassing crossveins r-m and m-cu. Genitalia (fig. 2): Segment IX rather broad sclerotized ring. Segment X comprising a long pair of curved asymmetrical lateral rods and a minute pair of short mesal triangular bumps; in dorsal view left rod nearly straight, inclined mesad and extended posteriad as far as inferior appendages, right rod gradually curved mesad. Phallus without parameres, phallicata nearly straight. Inferior appendages each, in lateral view, main article having square base, comprising dorsomesal and ventromesal ridges with ventral and dorsal sides horizontal and slightly shorter than anterior and posterior sides; posterior extension of main article slender and fingerlike inclined upward about 30° from horizontal sides of base; basodorsal process long and capitate, in lateral view extended upward with apical knob curved posteriad and concealing part of ventral base of lateral rod of X; basoventral mesal process in lateral view, a short tooth extended just below ventral margin, in ventral view short with a square rectangular base inclined mesad and a curved apical tooth directed posteriad; subapical mesal process in lateral view having thumblike dorsal process inclined upward with irregular ventromesal shelf.

Female.— Unknown.

Remarks.— This species is similar to *L. pedang*, but differs by having male lateral



Figs. 1-2. *Lepidostoma gigitarium* spec. nov., male: 1. fore wing; 2. genitalia: 2A. lateral; 2B. IX and X, dorsal; 2C. left inferior appendage, ventral; 2D. phallus, lateral. Figs. 3-4. *Lepidostoma memotong* spec. nov.: 3. male genitalia: 3A. lateral; 3B. IX and X, dorsal; 3C. left inferior appendage, ventral; 3D. phallus, lateral. 4. female genitalia, VIII and IX: 4A. lateral; 4B. ventral; 4C. spermatheca, lateral.

side of segment IX long, about half as long as its height. Other lepidostomatids from Sulawesi have segment IX narrow (except *L. anorhepes* which has segment IX long, but with pleuron noticeably shorter than venter). Both *L. pedang* and *L. gigitaring* have male segment X asymmetrical; *L. gigitaring* differs by having X with minute dorsomesal processes, and *L. pedang* differs by having the dorsomesal processes about $\frac{2}{3}$ as long as the lateral processes.

Etymology.— Indonesian, *gigi taring*, fang, for the dorsolateral processes of the male segment X.

***Lepidostoma memotong* spec. nov.**
(figs. 3-4)

Material.— Sulawesi Tengah: holotype: ♂, (ZMA), SW of Luwuk, Totop Camp, Batui River, 01°09'S 122°31'E, alt. 120 m, wet, lowland rainforest, 20.x.1989, J.P. Duffels. Paratypes: 1 ♀, (ZMA), *ibid*; 1 ♀, (ZMA), SW of Luwuk, Sinsing Camp, Batui River, 01°09'S 122°31'E, alt. 90 m, 17.x.1989, J.P. Duffels.

Male.— Head dorsum with large posterior setaceous warts and smaller anterior warts, frons with long slender lateral setal area, vertex with short rounded anterior bump. Scape cylindrical, 0.6 mm. Maxillary palp fingerlike, 1st segment clavate, 0.35 mm; 2nd segment lobiform 0.2 mm. Fore wing 5.7 mm, anal groove extending to arcus, venation similar to that of *L. gigitaring*, but without basoanterior setose pocket. Genitalia (fig. 3): IX slender sclerotized ring. X with dorsomesal and lateral pair of short lobes; in lateral view dorsomesal lobe extended posteriad about as long as basal height, lateral lobe extended posteriad from ventral margin, about twice as long as dorsomesal lobe, and separated from dorsal lobe by wide rounded notch; in dorsal view, dorsomesal lobes trapezoid and separated by irregular V-shaped notch. Phallus without parameres, phallicata bent downward at base, remainder nearly straight. Inferior appendages each, in lateral view, having main article with basal $\frac{2}{3}$ rectangular, long and slender, about 3 times as long as height, extended posteriad well beyond apex of subapical mesal lobe, apicoventral margin incised, bearing fingerlike apical process, its dorsal margin almost continuous with dorsum of main article; basodorsal process slender in lateral view, slightly narrower at its base and with apex bluntly pointed, inclined at about 45° from main article; subapical mesal process short slender lobe extended posteriad and slightly inward; in ventral view apical lobe with pointed apex; basoventral process in ventral view slender and acuminate about half as long as main article; and ventromesal ridge absent.

Female.— Head with vertex normal, scape 0.65 mm. Fore wing 6.6 mm. Genitalia (fig. 4): VIII pleuron with recessed membranous pocket. IX in lateral view dorsal margin with anterior portion curved downward, but posterior half interrupted by large dorsal bump; anterolateral arm long and slender. Spermathecal sclerite nearly circular, with long slender lateral processes. Spermatheca, anterior portion with conspicuous reticulate pattern.

Remarks.— This species is similar to *L. tectore* and *L. xylochos*, but differs by having male inferior appendages in ventral view, each with long slender acuminate basoventral process, and segment X in dorsal view with short truncate dorsomesal process.

Etymology.— Indonesian, *memotong*, truncate, for the dorsomesal processes in male Xth segment.

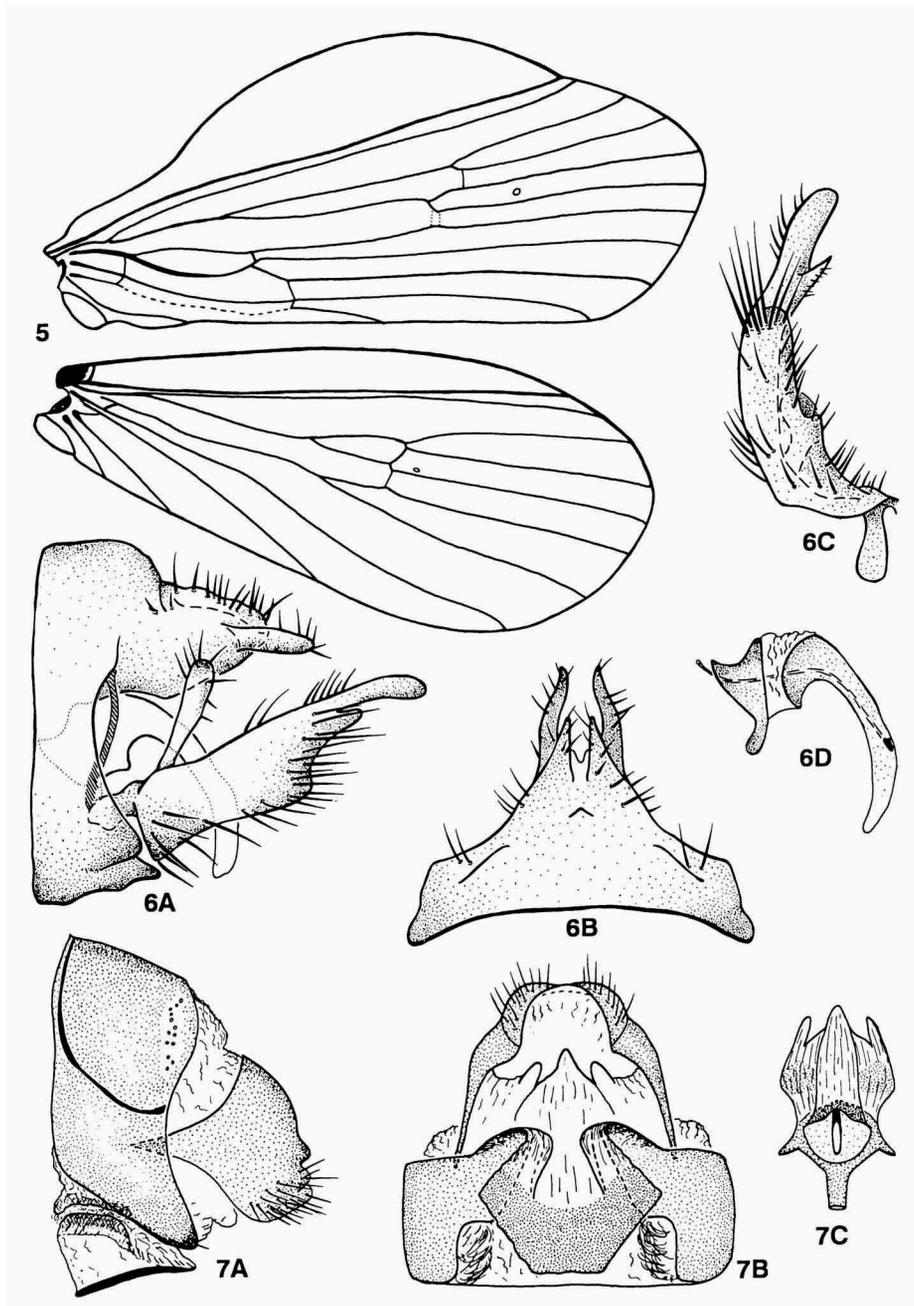
Lepidostoma neboissi spec. nov.
(figs. 5-7)

Material.— Sulawesi Tenggara: holotype: ♂, (RMNH), Moramo, Sg. Moramo, 175 m, 17.xi.1989, glade in lowland evergreen forest near waterfall, RdJ & JH. Paratypes: 4 ♂♂, 2 ♀♀, (RMNH), *ibid.*; 1 ♂, 4 ♀♀, (RMNH), Moramo, Sg. Sena, 50 m, 15.xi.1989, RdJ & JH; 23 ♂♂, 71 ♀♀, (RMNH [7 ♂♂, 10 ♀♀, JSW; 7 ♂♂, 10 ♀♀, JH]), Moramo, Sg. Moramo, 200 m, 16.xi.1989, RdJ & JH; 3 ♂♂, 6 ♀♀, (JSW), N slope Gn. Watuwila, Sg. Mokowu, 200 m, 21.x.1989, RdJ & JH; 1 ♂, 1 ♀, (RMNH), *ibid.*, 250 m, 19.x.1989, RdJ & JH; 2 ♂♂, 2 ♀♀, (MVMA), *ibid.*, 20.x.1989, RdJ & JH; 1 ♂, (ZMA), Mokowu Camp, Mokowu River, 03°49'S 121°40'E, 200 m, 29.x.1989, J.P. Duffels.

Male.— Head, dorsum with posterior setaceous warts oval but pointed mesad, anterior warts smaller and more nearly round, vertex with small truncate flange projecting forward, frons concave with raised central ridge, and with large pair of dorso-lateral circular setal warts. Scape 1.6 mm, cylindrical with flattened basomesal concavity. Maxillary palp having 1st segment 1.1 mm, fingerlike and with mesal concavity bearing dense brush of short scales; 2nd segment 0.1 mm, minute lobiform. Wings (fig. 5); fore wing 9.0 mm, with broad postcostal cell extended nearly to apex of Sc, and when folded, concealing discal cell and base of fork I, discal cell long slender, over twice as long as petiole of Rs, with short anal groove slightly longer than thyridial cell. Genitalia (fig. 6): IX slender ring. X having dorsomesal and lateral pair of processes; dorsomesal processes, in dorsal view with bases fused, apical portions free and triangular, each in shape of 30-60-90° triangle, broadly attached to dorsum of IX and tapering posteriad to acute apex, with mesal sides parallel and lateral margins slanted inward, in lateral view broad lobiform with basal height subequal to length; lateral processes in dorsal view slender acuminate processes, about 4 times basal width, directed posteriad, slightly sinuate, originating from subapical lateral sides of X, each in lateral view fingerlike, directed posteriad and about 3 times basal width, with apical $\frac{2}{3}$ extended beyond dorsomesal process. Phallus without parameres, with phallicata slender and curved downward. Inferior appendages each, in lateral view, main article with basal $\frac{2}{3}$ long and rectangular, ventroapical margin incised, bearing fingerlike lobe directed posteriad, continuous with dorsal margin of main article; basodorsal process clavate, inclined slightly posteriad; in ventral view having subapical mesal process short and toothlike, ventromesal ridge shallow, without basoventral process.

Female.— Head with vertex normal, scape 1.4 mm. Fore wing 9.5 mm. Genitalia (fig. 7): VIII pleuron with deeply recessed pockets, recessed inward beyond lateral margins of sternite, sternite nearly hexagonal but posterior side opening into vaginal canal. IX short and broad in lateral view, anterolateral arm slender and triangular, dorsal margin short curved downward with two subapical bumps. Spermathecal sclerite somewhat circular with anterolateral pair of slender triangular points. Spermatheca with inconspicuous pattern.

Remarks.— This species is similar to *Lepidostoma xylochos*, but differs by having male fore wing with broader postcostal cell, extending almost to apex of Sc; remainder of fore wing is more slender with apical margin shorter and slightly truncate, veins in apical half are nearly parallel, in contrast the fore wing of *L. xylochos* is more oval. This type of wing is similarly modified in *Goerodes dulitense* (Mosely, 1951) from Borneo and *Goerodes vipera* Weaver, 1989, from Sumatra. This difference in shape is especially noticeable if postcostal cell is folded over top of the wing, as in its natural



Figs. 5-7. *Lepidostoma nevoissi* spec. nov.: 5. male wings. 6. male genitalia: 6A. lateral; 6B. IX and X, dorsal; 6C. left inferior appendage, ventral; 6D. phallus, lateral. 7. female genitalia, VIII and IX: 7A. lateral; 7B. ventral; 7C. spermathecal sclerite, ventral.

state. Also, *L. neboissi* can be distinguished from *L. xylochos* by its male inferior appendages, each having a minute subapical mesal process and hence, its apex is not bilobed in lateral view.

Etymology.— This species is named for Arturs Neboiss, in honor of his contributions to the caddisflies of the Australian Region.

***Lepidostoma pedang* spec. nov.**
(figs. 8-9)

Material.— Sulawesi Selatan: holotype: ♂, (BPBM), Pulu-Pulu, 25 km NNW Rantepao, Toradja, 1700-1900 m, 13.v.1966, RS.

Male.— Head dorsum with rounded triangular posterior setaceous warts and smaller anterior pair of warts; vertex with minute point with a pair of minute warts; frons with lateral setose area. Scape cylindrical, 0.7 mm. Maxillary palp having 1st segment cylindrical, 0.30 mm; 2nd segment short lobiform, 0.13 mm. Fore wing (fig. 8) 6.5 mm, 1A, 2A and Cu₂ coalesce along anal groove, Cu₁ adjacent to Cu₂ and parallel to posterior margin, 3A short and terminates just beyond base of posterior margin, venation similar to *Goerodes medius* (Banks, 1934) (cf. Weaver & Huisman, in press). Genitalia (fig. 9): IX broad in lateral view, about half as long as high. X having dorsomesal and lateral pair of processes; dorsomesal processes about $\frac{2}{3}$ as long as lateral processes, straight in both dorsal and lateral views, in dorsal view fused at base, apical $\frac{2}{3}$ separated by long narrow gap; lateral processes asymmetrical, heavily sclerotized and saber-shaped; in lateral view sinuate, left process curving downward and apex recurved upward, in dorsal view lanceolate with lateral margins curved and mesal margins nearly straight, both directed posteriad, left process shorter than right. Phallus without parameres, base of phallicata nearly straight and directed posteriad. Inferior appendages each in lateral view, having main article with base trapezoidal, but dorsum curved; apex attenuated into short fingerlike extension, bearing three or more spinelike setae apically; basodorsal process capitate, extended upward to base of X, apical knob oval and expanded ventroposteriad and dorsoanteriad; subapical mesal process short slender lobe extending above dorsal margin of main process and with rounded ventral shelf; in ventral view, basoventral mesal process short, triangular with mesal margin curved outward and lateral margin straight and parallel to base of ventromesal ridge, separated from it by narrow gap.

Female.— Unknown.

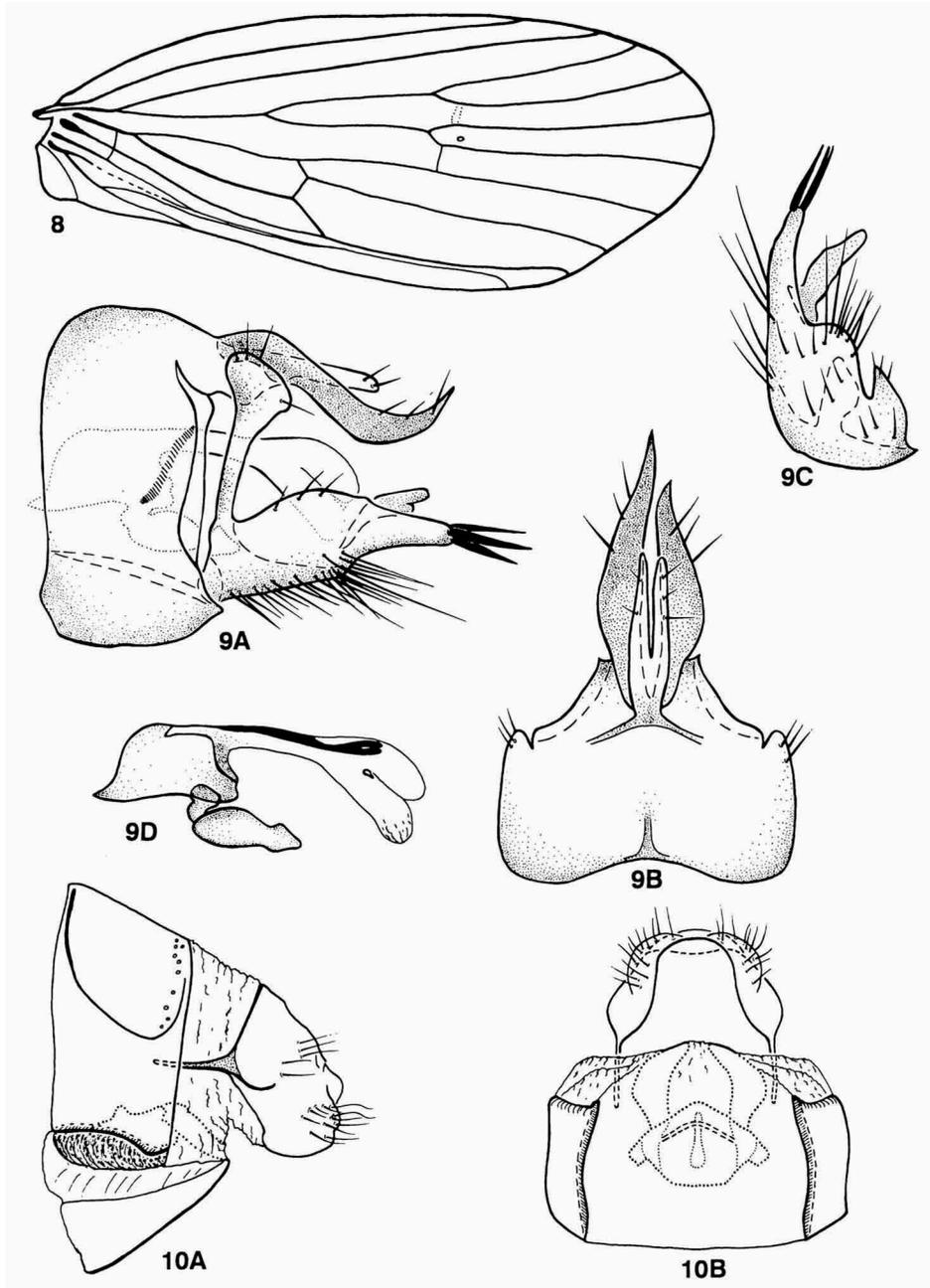
Remarks.— In this species the male genitalia is similar to the aforementioned *L. gigitaring*, however the male wing venation is more similar to *Goerodes medius* (Banks, 1934) from Sabah (Weaver & Huisman, in press).

Etymology.— Indonesian, *pedang*, saber, referring to the lateral processes on the male segment X.

***Lepidostoma tectore* (Neboiss) comb. nov.**

Goerodes tectoris Neboiss, 1991: 89, ♂, ♀, figs. 8-16.

Material.— Sulawesi Selatan: 2 ♂♂, (BPBM), 72 km SE Palu, Kulawi, 18-28.xii.1966, RS; 1 ♂, (JSW), 100



Figs. 8-9. *Lepidostoma pedang* spec. nov., male: 8. fore wing. 9. genitalia: 9A. lateral; 9B. IX and X, dorsal; 9C. left inferior appendage, ventral; 9D. phallus, lateral. Fig. 10. *Lepidostoma xylochos* (Neboiss): 10. female genitalia, VIII and IX: 10A. lateral; 10B. ventral.

km N Palopo, Lamasie, 22.vi-10 vii.1966, RS. Sulawesi Tenggara: 2 ♂♂, (RMNH), N slope Gn. Watuwila, Hornbill Camp, 900 m, 18.x.1989, RdJ & JH; 1 ♂, (JSW), N slope Gn. Watuwila, Sg. Lalonduwasi, 1100 m, 15.x.1989, RdJ & JH.

Lepidostoma xylochos (Neboiss) comb. nov.

(fig. 10)

Goerodes xylochos Neboiss, 1991: 89-91, ♂, figs. 17-21.

Material.— Sulawesi Selatan: 1 ♂, (BPBM), 12 km E Rantepao, Toradja Pedamaran, 1200 m, 17-25.iv.1966, RS. Sulawesi Tenggara: 2 ♂♂, 3 ♀♀, (MVMA), N slope Gn. Watuwila, Hornbill Camp, 900 m, 18.x.1989, RdJ & JH; 6 ♂♂, 3 ♀♀, (JSW), P. Kabaena, S of Tangkeno, 1050 m, 1.xi.1989, RdJ & JH; 6 ♂♂, 1 ♀, (RMNH), P. Kabaena, 4 km S Tangkeno, Sg. Lakambula, 300 m, 4.xi.1989, RdJ & JH; 10 ♂♂, 7 ♀♀, (JSW), *ibid.*, 5.xi.1989, RdJ & JH; 4 ♂♂, 4 ♀♀, (JH), P. Kabaena, 3 km S Tangkeno, Sg. Lampepoporea, 350 m, 7.xi.1989, RdJ & JH; 5 ♂♂, 8 ♀♀, (RMNH), *ibid.*, 6-7.xi.1989, RdJ & JH.; 10 ♂♂, 26 ♀♀, (RMNH), P. Kabaena, 1 km S Tangkeno, Sg. Lantinoli, 550 m, 8.xi.1989, RdJ & JH; 10 ♂♂, 14 ♀♀, (RMNH), *ibid.*, 8-9.xi.1989, RdJ & JH; 5 ♂♂, 16 ♀♀, (RMNH), *ibid.*, 9.xi.1989, RdJ & JH; 1 ♂, 2 ♀♀, (RMNH), Moramo, Sg. Moramo, 200 m, 16.xi.1989, RdJ & JH; 1♀, (RMNH), *ibid.*, 175 m, 17.xi.1989, RdJ & JH.

Female.— Head with vertex normal, scape 0.65 mm. Fore wing 6.0 mm. Genitalia (fig. 10): VIII pleuron with long recessed pocket. IX short, in lateral view ventral margin subequal to anterior margin, anterolateral arms long and slender. Spermathecal sclerite short and wide, posterior margin forming obtuse angle, bearing a pair of short truncate anterolateral processes. Spermatheca inconspicuous, but anterior portion with very faint reticulate pattern.

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