

The Genus *Trichadenotecnum* (Insecta: Psocoptera: Psocidae) in Sumatra, Indonesia, With Description of Thirteen New Species

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ABSTRACT. Records of 20 species of *Trichadenotecnum* Enderlein (Psocidae) from Sumatra, including 13 species described here as new, are provided. Keys are given to the 33 species of the genus now known from Indonesia, and their relationships and distribution discussed. Most species are known from few individuals and appear to be scarce. Several new species are referable to species groups designated by Yoshizawa for Japanese taxa, but others are anomalous.

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Endang *et al.* (2002) summarized information on the Psocoptera of Indonesia, and emphasized that some major parts of this complex archipelago have scarcely been investigated for these small insects. Their summary implied that the family Psocidae may be especially well represented in the region, with a few genera particularly complex and therefore important to clarify as tools to appraise the diversity and geographical relationships of the fauna. This paper is a further contribution to knowledge of the family Psocidae in Indonesia and deals with a regionally complex and diverse genus of the family, *Trichadenotecnum* Enderlein, in the large western island of Sumatra, which has hitherto been poorly surveyed. In this paper, we supplement information on the genus from more eastern parts of Indonesia (Endang *et al.*, 2002) to provide a more complete appraisal of *Trichadenotecnum* in Indonesia.

Sumatra is geographically important in indicating possible transitional faunal relationships with both West Malaysia and eastern Indonesia: indeed, it has been described as “the gateway to Indonesia” from Asia, and was

last connected to the Asian mainland only some 10 000 years ago. The second largest island in the archipelago (after Borneo), Sumatra has an area of about 475 000 km², and the Bukit Barisan Mountain Range extends for much of the length of the island. Psocoptera were collected by beating vegetation in the four most important National Parks in Sumatra (Fig. 1) (Way Kambas National Park [WKNP], Bukit Barisan Selatan National Park [BBSNP], Kerinci Seblat National Park [KSNP], Gunung Leuser National Park [GLNP or LRNP]), and from numerous areas outside the national parks. Latitude/longitude data for all localities are given to the nearest minute. Way Kambas is in the southeast lowlands, much of the area in and around the park being cultivated land, and the other three parks are founded on montane forest in the major range. Extensive areas of kebun cultivation (involving perennial crops in areas recently cleared of forest for cultivation) occur within and around these parks, so that varying levels of disturbance have occurred. Considerable information on these changes is provided by Laumonier (1997).

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Collections of Psocoptera were made (by ESK) on 66 days at intervals from December 1995–July 1997, and on all visits efforts were made to collect from a variety of different vegetation types up to altitudes of around 1500 m. During this survey, 72 species of Psocidae were collected, including 20 of *Trichadenotecnum*. The collections include 13 new species of this genus, which are described below, and collection records of all species are summarised. Of the previously described species, two are recorded in Indonesia for the first time, one of them described from Malaysia and the other from Nepal. The others were known previously from other parts of Indonesia. No *Trichadenotecnum* have been recorded previously from Sumatra.

Methods

Measurements of body length (B) and IO:D (by Badonnel's method, following Ball, 1943) were made from entire specimens in alcohol, and all other measurements (in mm) were from permanent slide-mounted material. Abbreviations are: FW, fore wing length; HW, hind wing length; F, length of hind femur; T, length of hind tibia; t_1 , t_2 , lengths of basal and distal hind tarsal segments; f_1 , f_2 , lengths of first and second antennal flagellar segments; Ct, number of ctenidiobothria on hind tarsal segments. Figures were made using a camera lucida, and scale lines on figures of terminalia represent 0.1 mm.

Holotypes and some paratype material will be deposited in the Zoological Museum, Bogor, Indonesia (ZMB) and, where possible, paratype and other voucher material also in the Australian Museum, Sydney (AMS), or in our collections.

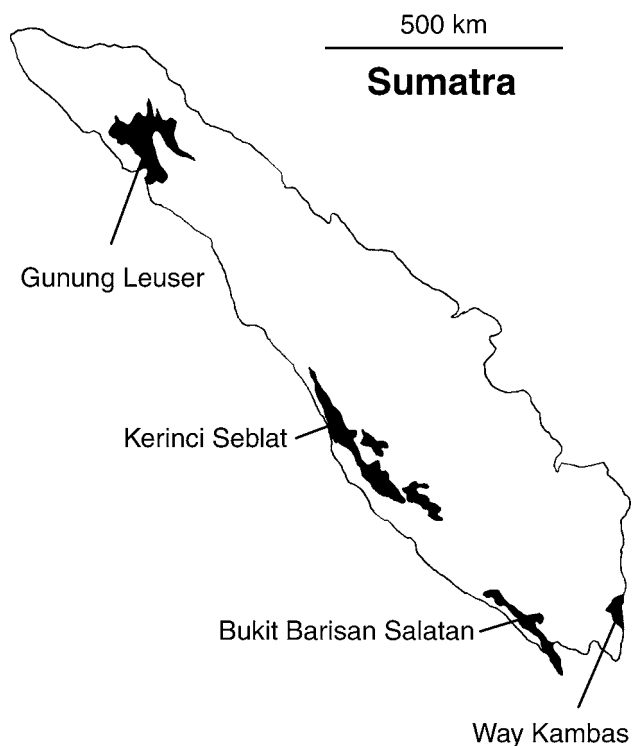


Fig. 1. Map of Sumatra, to show positions of national parks.

Checklist of species from Indonesia

This checklist and the following key exclude three Javan species *T. minutum*, *T. (Loensia) glabridorsum*, *T. (L.) fuscimacula*, described by Enderlein (1926) without genitalic descriptions or any figures. None of those types are available for study and their generic placement remains unconfirmed. An asterisk (*) denotes species recorded from Sumatra.

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- * *Trichadenotecnum adika* Endang *et al.*, 2002
 - T. alinguum* Endang *et al.*, 2002
 - * *T. alobum* n.sp.
 - T. bidens* Thornton, 1961
 - T. bidentatum* Thornton, 1984
 - T. bromoense* Endang *et al.*, 2002
 - T. cheahae* Endang *et al.*, 2002
 - * *T. cinnamomum* n.sp.
 - * *T. cornutum* n.sp.
 - T. galihi* Endang *et al.*, 2002
 - * *T. godavarensense* New, 1971
 - * *T. gombakensense* New & Lee, 1992
 - T. hammani* Endang *et al.*, 2002
 - * *T. jambiense* n.sp.
 - * *T. kalibiruense* n.sp.
 - * *T. kerinciense* n.sp.
 - * *T. krucilense* Endang *et al.*, 2002
 - * *T. laticornutum* Endang *et al.*, 2002
 - * *T. malayense* New, 1975
 - * *T. muaraense* n.sp.
 - * *T. paradika* n.sp.
 - * *T. pardus* Badonnel, 1955
 - * *T. proctum* n.sp.
 - T. quadrispinosum* Endang *et al.*, 2002
 - T. rachimi* Endang & Thornton, 1992
 - T. santosai* Endang & Thornton, 1992
 - * *T. sibolangitense* n.sp.
 - T. soekarmanni* Endang *et al.*, 2002
 - T. soenarti* Endang *et al.*, 2002
 - * *T. sumatrense* n.sp.
 - T. vaghani* Endang *et al.*, 2002
 - * *T. waykambasense* n.sp.
 - * *T. waykananense* n.sp.
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Genus *Trichadenotecnum* Enderlein

Trichadenotecnum Enderlein, 1909: 329. Type species: *Hemerobius sexpunctatus* Linnaeus.

Trichadenopsocus Roesler, 1943: 4. Type species: *Psocus desolatus* Chapman.

Historically, the scope of *Trichadenotecnum* has been confused, and ambiguities in its definition persist, with a number of included species difficult to assign convincingly and, in Yoshizawa's (2001) example, retained *pro tem.* in this genus simply because no other suitable genus has been raised to contain them. Lienhard & Smithers (2002) listed 78 described species of this widely distributed genus, including *Trichadenopsocus* as a synonym, following Mockford (1993). Mockford's generic scope was adopted also by Yoshizawa (2001), who confirmed *Trichadenotecnum* in that sense to be a monophyletic entity and described 15 further Japanese species. Endang *et al.* (2002) also followed this arrangement, and described 12 species from eastern Indonesia. However, Li (2002) reinstated *Trichadenopsocus* as a full genus, based on fore wing pattern (Li, 2002: 1902, English abstract: "The genus differs from the *Trichadenotecnum* in forewing without submarginal belt and noly [sic] spots"), and allocated 16 new Chinese species to this genus, in addition to a further 14 to his restricted sense *Trichadenotecnum*. Li had earlier (Li, 1997) erected another genus within the tribe Ptyctini (sensu Lienhard & Smithers, 2002), *Conothoracalis*, to contain several heavily-marked species with *Trichadenotecnum*-like venation, and also acknowledged the presence of *Loensia* Enderlein in China. Li (2002) included 9 and 22 Chinese species respectively in these genera. Although not included in his new tribe Trichadenotecnini, Li (2002) also raised *Cryptopsocus* as, in part, "related to *Trichadenotecnum*". Ambiguities of recognising species of *Trichadenopsocus*

are illustrated further by Li's transfer of species such as *Trichadenotecnum spiniserrulum* Datta to this genus; *T. spiniserrulum* is the foundation species for one of Yoshizawa's species groups in *Trichadenotecnum*, and there seems little practical advantage, or need, in shifting species uncritically at this stage. We suggest that Yoshizawa's appraisal, based on detection of testable apomorphies, forms a better basis for consideration (so that *Trichadenopsocus* should remain a synonym), and that his progressive removal of non-conforming species be advanced as evidence accumulates. Essential to such advance is the diagnosis of as many representative species as possible within the complex, a step to which the present paper is a contribution.

Trichadenotecnum sensu Yoshizawa (2001) as followed here thus contains around 135 described species, including the diverse Chinese fauna discussed by Li (2002). It is especially diverse in the eastern Palaearctic and Oriental regions, where its structural variety and possible taxonomic complexity have long been acknowledged (New, 1978). Yoshizawa erected five species groups from the Japanese fauna. However, several of the species described here, as with some eastern Indonesian taxa, have a wing pattern more resembling *Loensia*, in that the submarginal row of fore wing spots regarded as diagnostic by Yoshizawa is absent or entirely obscured by more intensive wing markings. These would correspond to the appearance of species placed in *Loensia* by Li (2002) but, because of ambiguities over their correct placement, are considered here as belonging to *Trichadenotecnum* s.l. In the following account, records and augmented descriptions of described species precede descriptions of new taxa.

Including the Sumatran taxa treated here, 33 species have now been reported from Indonesia, most of them known from singletons or few specimens. Although some species are geographically widespread, these may still be rather rare psocids.

Key to Indonesian species of *Trichadenotecnum*

Male

- | | | |
|---|--|--------------------------|
| 1 | Fore wing pattern consisting of many (over 100) small pigment spots, with or without larger pigment patches | 11 |
| — | Fore wing pattern consisting of less than 30 pigment patches, at least three apical cells with an isolated submarginal patch | 2 |
| 2 | Lateral extension of clunium as a long narrow blunt projection with a heavily spinous bulb at its base | <i>T. arciforme</i> |
| — | Lateral extension not as above, or absent | 3 |
| 3 | Phallosome a closed frame | 4 |
| — | Phallosome open | 7 |
| 4 | Phallosome with apical tine | 5 |
| — | Phallosome without apical tine | 6 |
| 5 | Hypandrium asymmetrical, with median rounded spinose lobe, a sharp spine to one side and two pairs of lateral spines | <i>T. soenarti</i> |
| — | Hypandrium symmetrical, two pairs of sharp spines | <i>T. quadrispinosum</i> |
| 6 | Hypandrium symmetrical* (Fig. 13), with two pairs of large spines; epiproct with pair of rounded lobes | <i>T. krucilense</i> |

* The male holotype (from Java) has three hypandrial spines (fig. 333 of Endang *et al.* [2002])

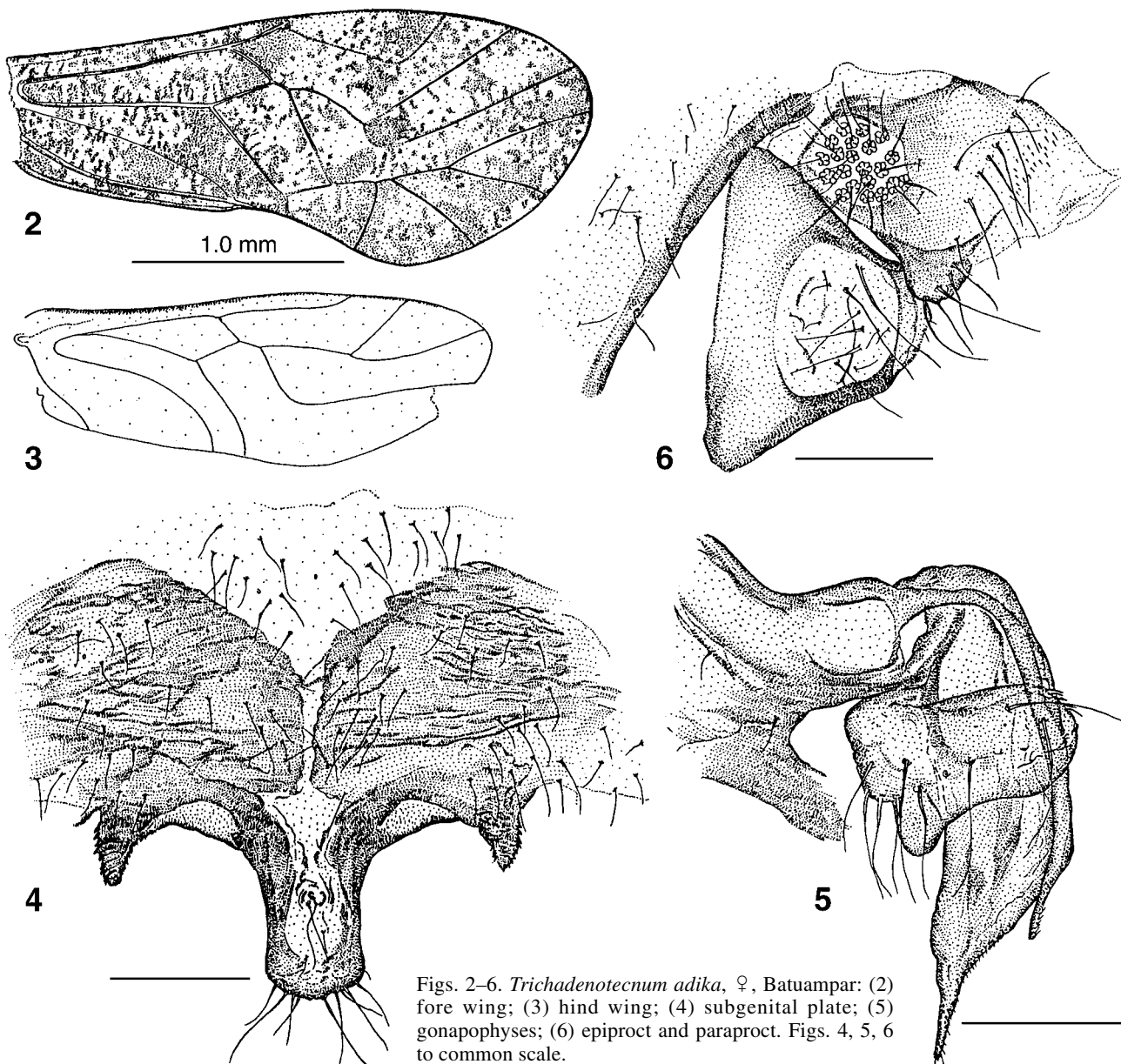
- Hypandrium asymmetrical, with single broad pointed spine and broad rounded lobe; epiproct with pair of trianguloid lobes *T. santosai*
- 7 Hypandrium with truncate median spiculate lobe between a small narrow and a large broad spine *T. vaughani*
- Hypandrium without truncate median lobe 8
- 8 Hypandrium with single large curved, serrated projection on one side 9
- Hypandrium not as above 10
- 9 Epiproct with rounded spiculate lobe at each posterior corner, clunium with narrow straight spine near lateral margin *T. sibolangitense* n.sp.
- Epiproct with trapezoid posterior projection bearing three marginal setae, and median stout spine near base of epiproct; clunium with finely setose broad hook-like lobe at each margin *T. alinguum*
- 10 Phallosome with median broad blunt projection anteriorly; hypandrium with pair of broad hooked blunt projections and narrower shorter straight spinous projection to one side of mid-line *T. galihi*
- Phallosome without median projection, hypandrium with two pairs of spines, one pair bulbous basally *T. cornutum* n.sp.
- 11 Phallosome open 12
- Phallosome a closed frame 14
- 12 Hypandrial tongue spinose 13
- Hypandrial tongue as a single pointed spine *T. kalibiruense* n.sp.
- 13 Hypandrial tongue diamond-shaped; epiproct not heavily sclerotized *T. muaraense* n.sp.
- Hypandrial tongue a straight projection with a slightly bulbous spinous apex; epiproct narrowly trapezoid with sclerotized margins, pair of hooked-shaped sclerotizations apically *T. proctum* n.sp.
- 14 Hypandrium symmetrical 15
- Hypandrium asymmetrical 19
- 15 Hypandrium with two apical pairs of pointed prongs, one large, one small 16
- Hypandrium with one pair or no pairs of pointed prongs 18
- 16 Clunium with broad short spinous bluntly-pointed lateral projections *T. bidentatum*
- Clunium with long narrow acutely-pointed lateral projection *T. bidens*
- 17 Phallosome apical tine bifid, its arms curved and slightly hooked *T. godavarensis*
- Phallosome apical tine single 18
- 18 Hypandrium with pair of stout slightly curved spines, tongue broad, divided apically, tongue broad, divided apically, spinous; phallosome with spines on anterior margin *T. adika*
- Hypandrium with pair of spinous lobes, tongue absent, pair of long, sinuous tines, phallosome without spines on anterior margin *T. malayense*
- 19 Phallosome apical tine bifid *T. cinnamonum* n.sp.
- Phallosome apical tine undivided 20
- 20 Phallosome with apical tine broader than long, surface of basal margin of phallosome without spines *T. bromoense*
- Phallosome with apical tine at least twice as long as broad, basal margin of phallosome with pair of shallow lobes beset with short spines 21

- 21 Hypandrium with long narrow bluntly-ending projection and small short spine to one side of mid-line *T. soekarmanni*
 — Hypandrium with spinous tongue curved lateral, a large stout median spine *T. gombakense*

Female

- 1 Fore wing pattern consisting of (over 100) small pigment spots, with or without larger patches 9
 — Fore wing pattern consisting of fewer than 30 pigment patches, an arc of at least four distinct isolated submarginal patches, one in each apical cell 2
- 2 Subgenital plate with pointed lateral “horn” each side of apical lobe 3
 — Subgenital plate without projections lateral to apical lobe 4
- 3 Subgenital plate apical lobe twice as long as broad, disc with pattern of hook-shaped sclerotization and small isolated sclerotized patch each side *T. waykananense* n.sp.
 — Subgenital plate apical lobe as broad as long, disc without hook-shaped pattern, without isolated patches *T. laticornutum*
- 4 Ventral valve of gonapophyses almost as long as dorsal valve *T. kerinciense* n.sp.
 — Ventral valve of gonapophyses less than half as long as dorsal valve 5
- 5 Sclerotized pattern of subgenital plate disc weaker or absent medially, two almost separate lateral sclerotized areas 6
 — Sclerotized pattern of subgenital plate disc continuous across mid-line 8
- 6 Surface of subgenital plate apical lobe with central distinct field of setae; sclerotization of disc in U-shaped pattern *T. arciforme*
 — Subgenital plate apical lobe with scattered setae over surface, not a distinct field, sclerotization of disc not U-shaped 7
- 7 Subgenital plate disc with ornamented “basket-like” pattern centrally; apical lobe with fine setae along posterior margin *T. santosai*
 — Subgenital plate disc without central “basket-like” pattern of sclerotization; apical lobe with row of marginal setae of various lengths, median pair long and stout *T. rachimi*
- 8 Spermapore plate pattern of sclerotization with lateral curved “horns”; areola postica of fore wing almost completely hyaline *T. galihi*
 — Spermapore plate pattern of sclerotization with broad curved area of sclerotization each side of mid-line; areola postica with pigment over posterodistal two-thirds *T. soenarti*
- 9 Ventral valve of gonapophyses short, less than half length of dorsal valve 10
 — Ventral valve of gonapophyses more than two thirds length of dorsal valve 14
- 10 Outer valve of gonapophyses with row of denticles along posterior or mesial margin; a spiral or concentric patch of sclerotization each side of apical lobe of subgenital plate basally *T. pardus*
 — Outer valve without denticles; subgenital plate without concentric or spiral sclerotizations 11

- 11 Apical lobe of subgenital plate broad basally, narrowing towards apex, then broadening apically; outer valve of gonapophyses without posterior lobe 12
 — Apical lobe of subgenital plate more or less straight-sided, rectangular; outer valve of gonapophyses with small posterior lobe 13
- 12 Apical lobe of subgenital plate with distinct “neck”, half as broad as apical margin; outer valve with curved posteroventral spine *T. malayense*
 — Apical lobe of subgenital plate without distinct “neck”, narrowest part only slightly narrower than posterior margin; outer valve without curved spine *T. godavarensis*
- 13 Subgenital plate disc with median unsclerotized area at least 1.5 × wider than sclerotized area on either side of it *T. gombakense*
 — Subgenital plate disc with median unsclerotized area no wider than sclerotized area on either side of it *T. soekarmanni*
- 14 Subgenital plate with a lateral spinous protuberance each side of apical lobe 15
 — Subgenital plate without a lateral spinous protuberance each side of apical lobe 16
- 15 Subgenital plate lateral protuberance longer than width at base, subconical, surface spinous *T. adika*
 — Subgenital plate lateral protuberance no longer than width at base, subconical, surface rugose *T. paradika* n.sp.
- 16 Outer valve of gonapophyses without distinct posterior lobe 17
 — Outer valve of gonapophyses with distinct posterior lobe 20
- 17 Outer valve of gonapophyses with spine or group of spines on mesial margin 18
 — Outer valve of gonapophyses without spines on mesial margin 19
- 18 Outer valve of gonapophyses with single short broad spine *T. sumatrense* n.sp.
 — Outer valve of gonapophyses with three close-set short spines *T. cinnamomum* n.sp.
- 19 Apical lobe of subgenital plate convex-sided, vase-shaped *T. bromoense*
 — Apical lobe of subgenital plate concave-sided *T. alobum* n.sp.
- 20 Apical lobe of subgenital plate broad basally, narrowing to setose apex that is less than one-fifth width of lobe at base *T. cheahae*
 — Apical lobe of subgenital plate broad basally with apical margin more than one-third width of lobe at base 21
- 21 Subgenital plate with papillose “shoulders” basal to apical lobe *T. bidens*
 — Subgenital plate without such ornamentation 22
- 22 Subgenital plate with sclerotized transverse bar at base of apical lobe 23
 — Subgenital plate without sclerotized transverse bar at base of apical lobe 24
- 23 Subgenital plate apical lobe with central unsclerotized oval area beset with setae, without pair of long setae at base of lobe *T. jambiense* n.sp.
 — Subgenital plate apical lobe without such an unsclerotized area, with pair of long setae at base of lobe *T. waykambasense* n.sp.
- 24 Subgenital plate apical lobe with isolated central heavily sclerotized setose area, without a pair of long setae at base of lobe *T. bidentatum*
 — Subgenital plate apical lobe without isolated central heavily sclerotized setose area, with a pair of long setae at base of lobe *T. hammani*



Figs. 2–6. *Trichadenotecnum adika*, ♀, Batuampar: (2) fore wing; (3) hind wing; (4) subgenital plate; (5) gonapophyses; (6) epiproct and paraproct. Figs. 4, 5, 6 to common scale.

***Trichadenotecnum adika* Endang, Thornton & New**

Figs. 2–6

Trichadenotecnum adika Endang *et al.*, 2002: 166.

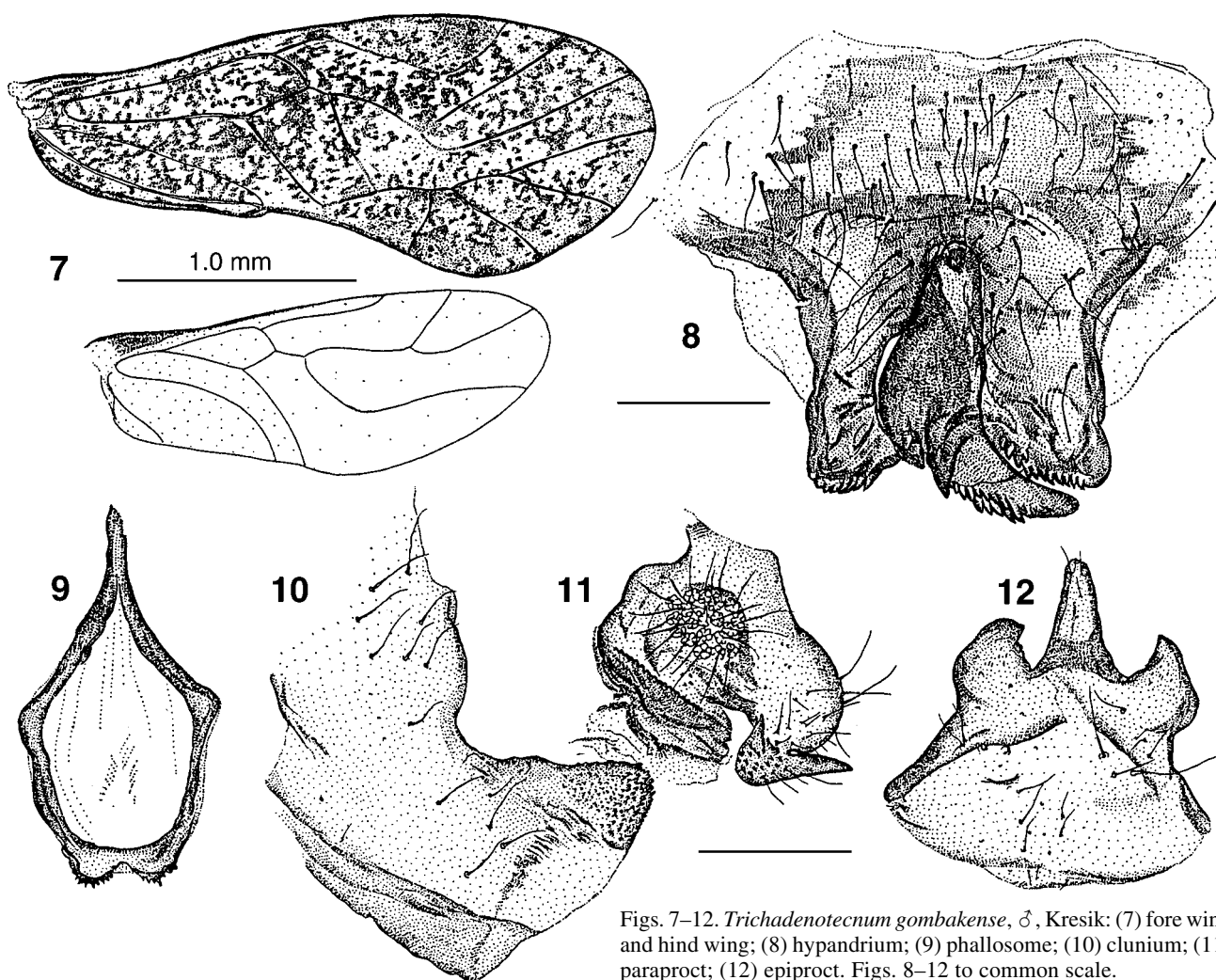
Material examined. Sumatra: West, Batuampar, tea plantation, 1°44'S 101°20'E, 1360 m, 1♂, 3♀♀, 21.I.1997; 1♂, 1♀, 19.VI.1997, ESK. West, PTPN VI, tea plantation, 1°46'S 101°22'E, 1460 m, 1♂, 2♀♀, 19.VI.1997, ESK (vouchers of each sex to ZMB, AMS).

Female

Colouration (after c. 3 years in alcohol). Head yellowish. Epicranial suture dark brown, dark brown confluent patches each side extending to posterior margin of vertex and mesial to each orbit. Eyes greyish black. Ocelli pale, black centripetally. Brown spot each side adjacent to lateral ocelli. Dark brown stripe from median ocellus toward orbits. Frons with dark brown stirrup-shaped mark and lateral curved dark brown mark. Antennal socket bordered with dark brown band. Antenna light brown, except ventral side of scape and

pedicel dark brown. Gena yellowish, with dark brown curved band from ventral margin toward antennal socket. Epistomal suture brown. Clypeal striae dark brown, merging anteriorly, paler lateroanteriorly. Dorsal half of anteclypeus dark brown, otherwise whitish. Labrum dark brown. Maxillary palp dark brown, intersegmental areas pale. Thorax: dorsal lobe brown pale along suture; antedorsum of mesothorax yellowish brown with median pale band; lateral lobe dark brown. Fore wing with brown spots as in Fig. 2. Hind wing (Fig. 3) suffused brown. Legs: coxa and femur dark brown, tibia and tarsal segments light brown, joints pale.

Morphology. IO:D 2.5, eyes small. Fore wing (Fig. 2): first and second sections of vein Cu_{1a} in a straight line; angle of divergence of arms of radial fork about 90°; Ct 20 (t_1) 2 (t_2); subgenital plate (Fig. 4): posterior lobe long, not tapering apically and with long apical setae, two long setae in the middle of the posterior lobe; main plate setose, with lateral conical spiculate projections. Gonapophyses (Fig.



Figs. 7–12. *Trichadenotecnum gombakense*, ♂, Kresik: (7) fore wing and hind wing; (8) hypandrium; (9) phallosome; (10) clunium; (11) paraproct; (12) epiproct. Figs. 8–12 to common scale.

5): dorsal valve with small fine setae on dorsal margin apically, narrow finely setose apical tine; ventral valve short, with bluntly ending narrow apex; outer valve transverse with short posterior lobe and bearing long setae. Epiproct (Fig. 6) trapezoidal with lateral sclerotized prong. Paraproct (Fig. 6) with field of about 23 trichobothria.

Remarks. Endang *et al.* (2002) described this species from a single male specimen collected from Bandung, West Java, at an elevation of 700 m. The female was then unknown. *Trichadenotecnum adika* has a *Loensia* type fore wing pattern (with many small pigment spots over the whole wing membrane and no or indistinct larger submarginal spots in the outer cells) (Thornton, 1961). The material examined above differs from any other Oriental species in details of hypandrium and phallosome. The Sumatran males are clearly referable to *T. adika* and were captured with six females (in three separate samples), so that the sexes are associated clearly. In subgenital plate features, the species resembles *T. laticornutum* (Endang *et al.*, 2002) in having a lateral sclerotized horn-shaped projection on the main plate. The size and shape of this projection, however, is somewhat different; in *T. adika* it is short, tapering distally and conical, whereas in *T. laticornutum* it is long and acuminate distally. *Trichadenotecnum paradika* n.sp., described below, also has a subgenital plate of this rather unusual form.

The posterior lobe of the subgenital plate of *T. laticornutum* is shorter than that of *T. adika*. Furthermore, *T. laticornutum* has a wing pattern conforming to *Trichadenotecnum Enderlein sensu stricto*, whereas the pattern in *T. adika* is *Loensia*-like, as is that of *T. paradika*. The above females are clearly referred to *T. adika* on head and fore wing pattern and in general colouration. *Trichadenotecnum adika* was taken only at high elevations.

Trichadenotecnum gombakense New & Lee

Figs. 7–12

Trichadenotecnum gombakense New & Lee, 1992: 155.

Material examined. Sumatra: SW, Pekon Balak, 4°20'S 104°30'E, cinnamon, 1160 m, 1 ♀, 9.I.1996, ESK; West, PTP Nusantara III, Bedeng Lapan, 2°00'S 101°27'E, tea plantation, 1460 m, 1 ♂, 21.I.1997, ESK; West, Kresik tuo, 1°45'S 101°20'E, tea plantation, 1 ♂, 3 ♀, 22.I.1997, ESK (vouchers of each sex to ZMB, AMS).

Male

Colouration (c. 4 years in alcohol) similar to female, except labrum brown and anteclypeus whitish.

Morphology. IO:D 0.58. Fore wing venation as in Fig. 7. Hypandrium (Fig. 8) asymmetrical: a row of teeth on each margin of tongue, a large toothed apical projection curved

to left, a large stout spine just to left and a shorter one to right of middle of apical margin. Phallosome (Fig. 9) a closed frame with long anterior projection, posteriorly with a pair of low serrated lobes. Epiproct (Fig. 12) broad curved hook each side and a long conical projection distally. Paraproct (Fig. 11) with apical spine, long serrated basal sclerotized ridge, field of about 20 trichobothria. Posterior margin of clunium with a broad rugose lobe each side (Fig. 10).

Dimensions. B 1.5; FW 2.8; HW 1.96; F 0.45; T 0.89; t_1 0.31; t_2 0.08; t_1/t_2 3.87; Ct (t_1) (t_2); f_1 0.44; f_2 0.35; f_1/f_2 1.26.

Remarks. This species was described from female specimens from the Malay Peninsula by New & Lee (1992), and the male has not been recognized previously. The specimen examined is clearly similar in non-sexual characters to *T. gombakense* New. The heavily marked fore wing with indistinct submarginal spots resembles that of *T. bidens* Thornton (1961) from Hong Kong. The ventral gonapophysis valve of *T. bidens* is long, however, and that of *T. gombakense* is short. Although the sides of the subgenital plate apex are sclerotized in both species, the apical lobe in *T. bidens* arises from a very distinct projection or “shoulder”. *Trichadenotecnum gombakense* is thus distinct from *T. bidens* and is a probable member of Yoshizawa’s (2001) *spiniserrulum* group.

One male was found in association with females in recent collections. The phallosome and paraprocts resemble those of *T. soekarmanni* Endang *et al.* (2002) from central Java, but the specimen differs in details of hypandrium and male epiproct. The hypandrium of *T. gombakense* is similar to that of *T. dolabratum* Li & Yang, 1987 (placed in *Loensia* by Li, 2002) from China in the shape of the median tongue, but the phallosome of *T. dolabratum* lacks the posterior serrated lobes. Yoshizawa (2001) described *T. falx* from Japan, allocating it to his *spiniserrulum* group, and it is clearly similar to *T. gombakense* New in wing pattern and details of the female genitalia. Yoshizawa noted two types of wing pattern: densely spotted and sparsely spotted. The fore wing of the holotype of *T. gombakense* (female) is densely spotted. The male genitalic features of *T. falx* are clearly similar to those of the male from Sumatra. Based on the similarity of the wing pattern and its association with the female of *T. gombakense* this male is referred to this species, which was taken only at high elevation in Sumatra.

Trichadenotecnum godavarensis New

Trichadenotecnum godavarensis New, 1971: 197.

Material examined. Sumatra: SW, BBSNP, Skincau, 4°53'S 104°18'E, coffee, 1200 m, 1 ♀, 28.VI.1997, ESK; BBSNP, Sukaraja, 5°22'S 104°23'E, mixed cultivated trees, 400 m, 1 ♀, 25.VI.1997, ESK; West, Jambi, Telun Berasap, Leter W, 1°12'S 101°10'E, citrus, 1320 m, 1 ♀, 19.VI.1997, ESK (one voucher each to ZMB, AMS).

Remarks. This species was described by New (1971) from material collected in Godavari, Katmandu, Nepal. The above specimens are clearly referable to *T. godavarensis* from the wing pattern and terminalia, in which the subgenital plate has a bifurcate sclerotized region on the disc and a blunt apical lobe, a short dorsal gonapophysis valve and an outer valve without a posterior lobe. This constitutes the first record of the species from Indonesia.

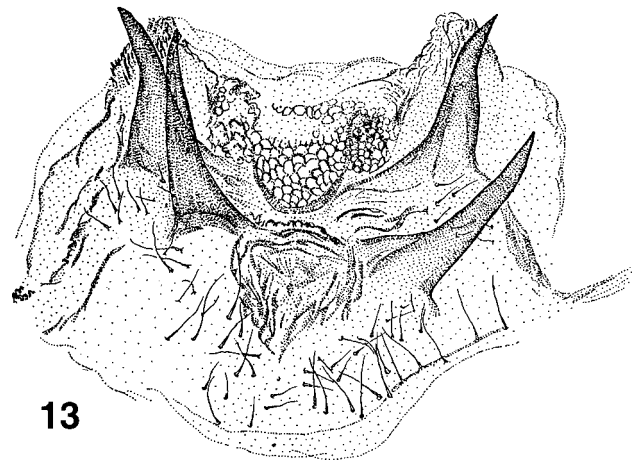


Fig. 13. *Trichadenotecnum krucilense*, ♂, BBSNP, Lombok: (13) hypandrium.

Trichadenotecnum krucilense Endang, Thornton & New

Fig. 13

Trichadenotecnum krucilensis Endang *et al.*, 2002: 165.

Material examined. Sumatra: SW, BBSNP, Lombok, 4°44'S 103°57'E, cinnamon, 540 m, 1 ♂, 26.VII.1997, ESK.

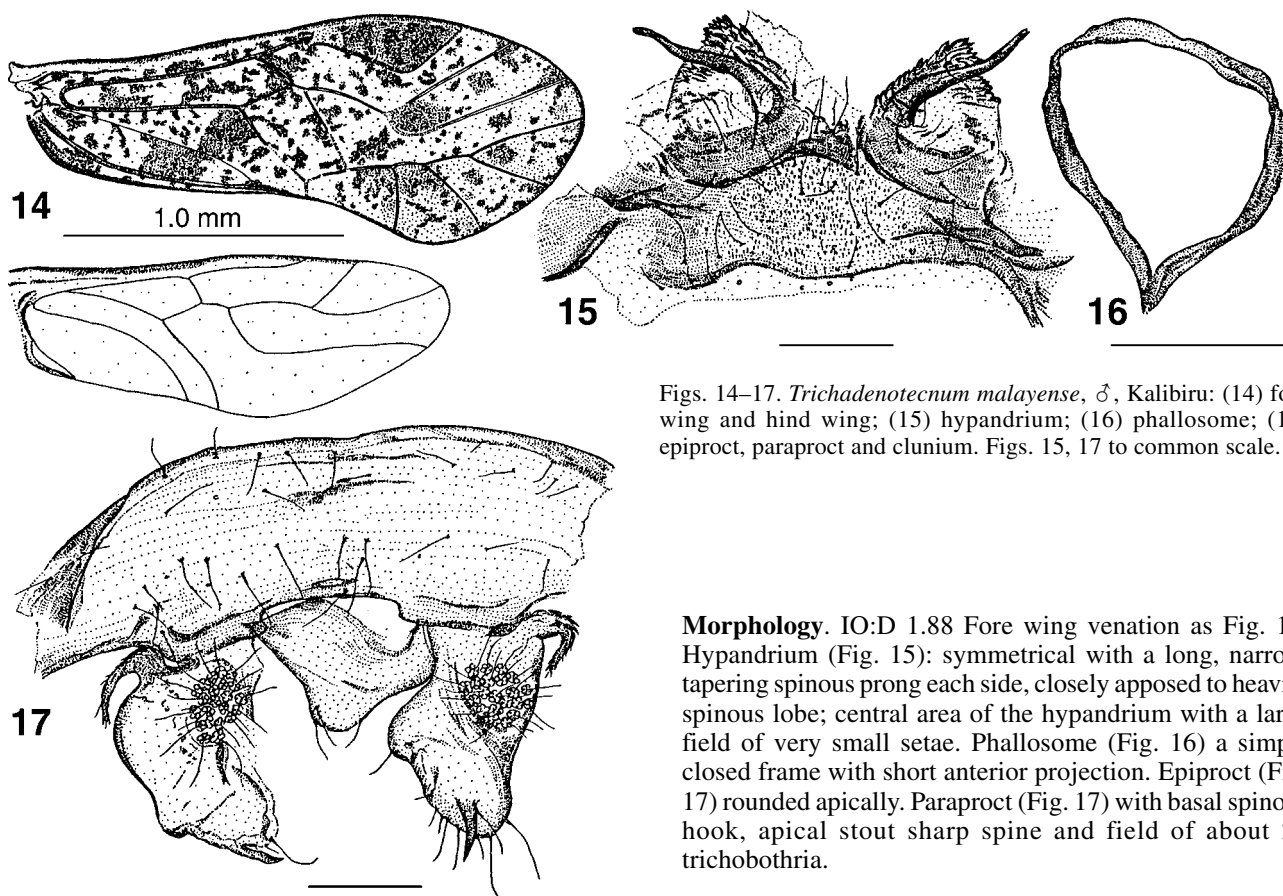
Remarks. This species was described from male material collected at moderate elevation (750 m) in East Java in December 1991. The female is unknown. The above Sumatran specimen agrees with specimens of *T. krucilense* from Java in wing pattern and features of the genitalia. However, the Sumatran male’s hypandrium differs from that of the type in that it has four lateroanterior spikes (Fig. 13) instead of three. This difference might represent intra-specific variation but, alternatively, the individuals might represent distinct species. Despite this difference, we place this specimen in *T. krucilense* and figure its hypandrium in order to facilitate further appraisal.

Trichadenotecnum laticornutum Endang, Thornton & New

Trichadenotecnum laticornutum Endang *et al.*, 2002: 158.

Material examined. Sumatra: West, KSNP, Base camp, 1°41'S 101°13'E, pine, 1600 m, 1 ♀, 22.I.1997, ESK; SW, BBSNP, Palimpangan Liwa, 4°56'S 104°10'E, cloves, 1000 m, 1 ♀, 11.I.1996, ESK (both ZMB); BBSNP, Bukit Penetoh Kubuperahu, 4°54'S 104°10'E, secondary forest with remnants of cultivation, 500 m, 1 ♀, 27.VI.1997, ESK (AMS).

Remarks. Endang *et al.* (2002) described *T. laticornutum* from material collected in Central and East Java in 1991. It can be distinguished from other previously described species by the unusual form of the subgenital plate, with a horn-shaped projection each side of the main lobe. The Sumatran specimens have wing markings and genitalic features similar to those of Javan individuals and, although the posterior lobe of the subgenital plate is relatively longer, we believe them to represent the same species.



Figs. 14–17. *Trichadenotecnum malayense*, ♂, Kalibiru: (14) fore wing and hind wing; (15) hypandrium; (16) phallosome; (17) epiproct, paraproct and clunium. Figs. 15, 17 to common scale.

Trichadenotecnum malayense New

Figs. 14–17

Trichadenotecnum malayense New, 1975: 257.

Material examined. Sumatra: SE, WKNP, Kalibiru, 5°06'S 105°49'E, mixed secondary forest, 20 m, 3♂♂ 2♀♀, 2.VII.1997, ESK; WKNP, Way Kanan, 5°04'S 105°42'E, mixed secondary forest, 20 m, 2♂♂, 1.VII.1997, ESK; WKNP, Kiara tunggal, 5°06'S 105°44'E, mixed secondary forest, 100 m, 1♀, 29.XII.1995, ESK; WKNP, Kalibiru, 4°57'S 105°50'E, mixed secondary forest, 40 m, 1♀, 31.XII.1995, ESK; SW, BBSNP, North Slope of Mt Skincau, 4°53'S 104°17'E, mixed primary forest, 1500 m, 1♂ 1♀, 2.I.1996, ESK; BBSNP, Skincau, 4°52'S 104°18'E, mixed cultivated trees, 1400 m, 1♀, 2.I.1996, ESK; North, LRNP, Ketambe, 3°32'N 97°40'E, mixed secondary forest, 325–560 m, 2♀♀, 6.VI.1996, ESK (vouchers of each sex to ZMB, AMS).

Male

Colouration (c. 4 years in alcohol). Head ground colour yellowish brown. Epicranial suture dark brown, confluent brown patches each side extending to posterior margin of vertex and mesial to each orbit. Eyes black. Ocelli pale black centripetally. A narrow brown band from central ocellus toward each antennal socket. Frons with median broad brown band, lateral to this a dark brown spot. Antenna light brown. Gena unmarked. Epistomal suture dark brown. Postclypeus with distinctive dark brown striation. Basal quarter of anteclypeus dark brown, otherwise pale. Labrum and maxillary palp dark brown. Thorax predominantly dark brown with small paler areas between lobes. Fore wing with dark brown markings as figured (Fig. 14). Legs dark brown, pale between joints.

Morphology. IO:D 1.88 Fore wing venation as Fig. 14. Hypandrium (Fig. 15): symmetrical with a long, narrow, tapering spinous prong each side, closely apposed to heavily spinous lobe; central area of the hypandrium with a large field of very small setae. Phallosome (Fig. 16) a simple closed frame with short anterior projection. Epiproct (Fig. 17) rounded apically. Paraproct (Fig. 17) with basal spinous hook, apical stout sharp spine and field of about 21 trichobothria.

Dimensions. B 1.5; FW 2.1; HW 1.52; F 0.37; T 0.73; t_1 0.26; t_2 0.1; t_1/t_2 2.6; Ct 17 (t_1) 2 (t_2); f_1 0.42; f_2 0.35; f_1/f_2 1.2.

Remarks. This species was described from the Malay Peninsula and, although the species is also known from Java (Endang *et al.*, 2002), Bali and Lombok (Endang & Thornton, 1992), until now the male has been unknown. The above Sumatran specimens clearly resemble the Malaysian material in having the combination of a T-shaped apex to the subgenital plate, very short ventral valve of the gonapophyses and sclerotized posterior spine on the external valve. Four males were found in association with females in Sumatran collections. Based on wing pattern, colouration, and association with females, these male specimens are clearly referable to *T. malayense*. In Sumatra this species was collected at altitudes ranging from 20 m to 1500 m.

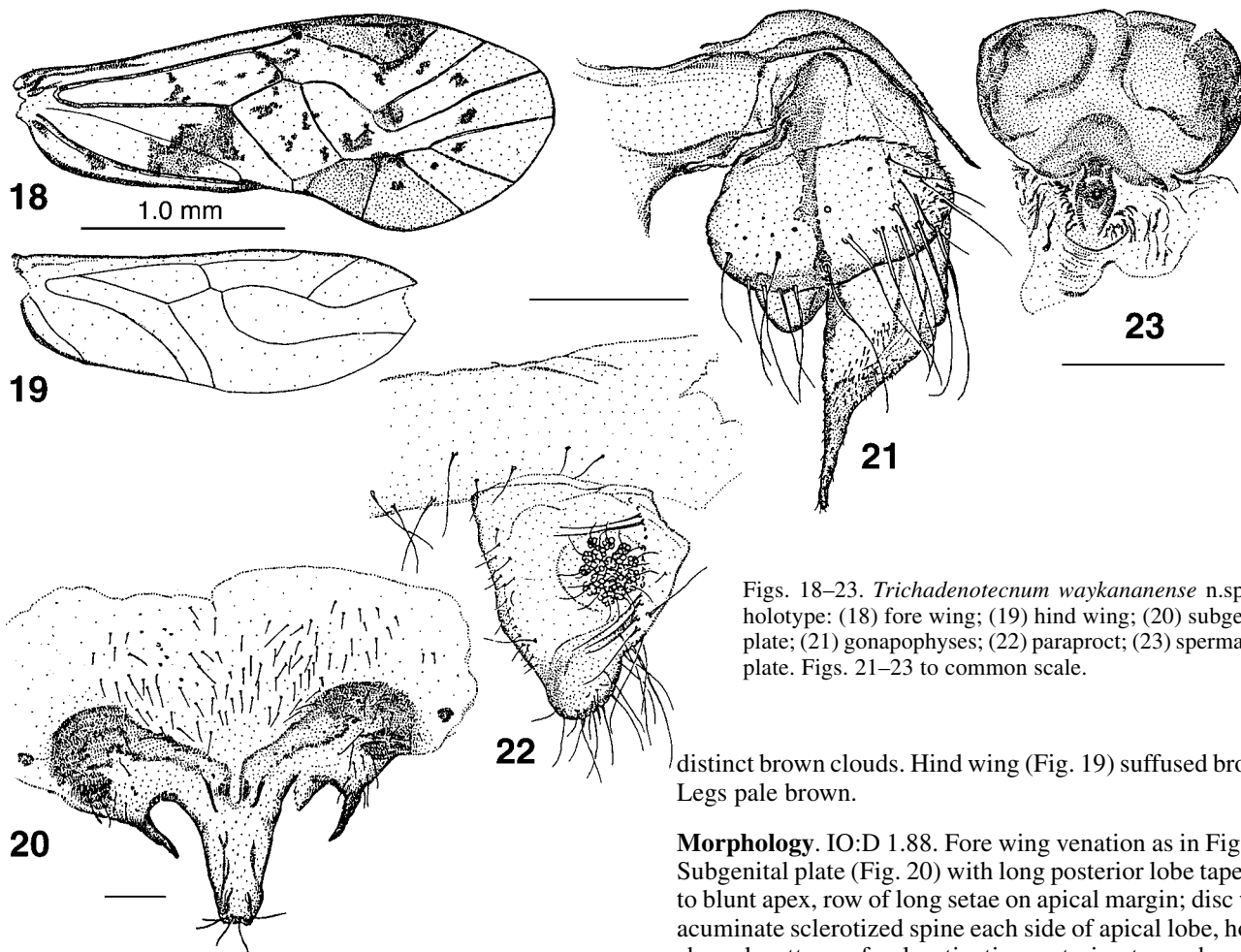
Trichadenotecnum pardus Badonnel

Trichadenotecnum pardus Badonnel, 1955: 231.

Trichadenotecnum pardidum Thornton, 1961: 16. (Badonnel, 1967: 193).

Material examined. Sumatra: SE, Palembang, 3°30'S 104°58'E, protected secondary forest, 20 m, 1♀, 25.I.1996, ESK (ZMB); SW, BBSNP, Sukaraja, 5°22'S 104°23'E, mixed cultivated trees, 400 m, 1♀, 25.VI.1997, ESK (AMS).

Remarks. This widely distributed species has been recorded in Indonesia only from Java (Endang *et al.*, 2002), but is known also from Singapore, Malaysia, Hong Kong and Japan in the southeast Asian region. The Sumatran specimens thus constitute the second record of the species from Indonesia. It was not found above 400 m in Sumatra.



Trichadenotecnum waykananense n.sp.

Figs. 18–23

Material examined. HOLOTYPE ♀, **Sumatra**: SE, Way Kambas National Park, Way Kanan, 5°06'S 105°49'E, mixed secondary forest, 20 m, 2.VII.1997, ESK (ZMB). PARATYPES, **Sumatra**: SE, WKNP, Kali Biru, 4°57'S 105°50'E, mixed secondary forest, 20 m, 4 ♀♀, 2.VII.1997, ESK (one each to ZMB, AMS K196199); South, Tanjung Bintang, 5°10'S 105°28'E, rubber plantation, 250 m, 1 ♀, 19.XII.1995, ESK; North, LRNP, Lawe Gurah, 3°38'N 97°40'E, mixed secondary forest, 325–360 m, 1 ♀, 5.VI.1997, ESK.

Male unknown.

Female

Colouration (c. 4 years in alcohol). Head yellowish. Epicranial suture dark brown with confluent brown patches each side across posterior margin of vertex and mesial to each orbit. Eyes greyish black. Ocelli pale black centripetally. Dark brown spot between eyes and lateral ocelli; anterior to this spot, a dark brown stripe toward anterior of eyes angled toward epistomal suture and merging with lateral dark brown mark on frons, appearing as a hook-shape. Epistomal suture pale. Clypeal striae dark brown, merging medially, appearing as yellowish area laterally. Gena with parallel dark brown bands ventral to orbit. Anteclypeus dark brown. Labrum whitish brown. Maxillary palp yellowish except apical segment dark brown. Antenna brown. Thorax generally yellowish, brown on thoracic scutella and centre of mesothoracic antedorsum. Fore wing as in Fig. 18 with

Figs. 18–23. *Trichadenotecnum waykananense* n.sp., ♀ holotype: (18) fore wing; (19) hind wing; (20) subgenital plate; (21) gonapophyses; (22) paraproct; (23) spermapore plate. Figs. 21–23 to common scale.

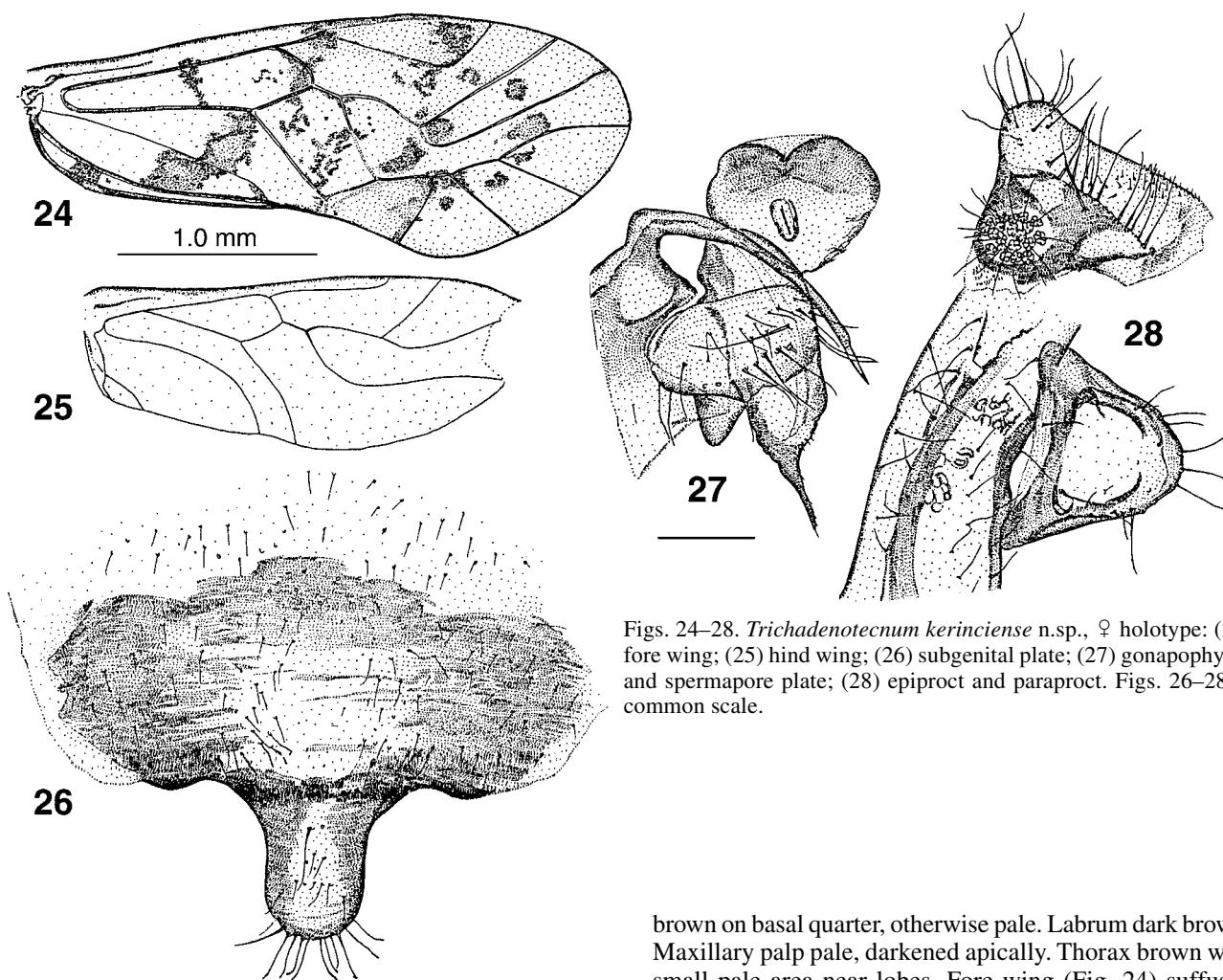
distinct brown clouds. Hind wing (Fig. 19) suffused brown. Legs pale brown.

Morphology. IO:D 1.88. Fore wing venation as in Fig. 18. Subgenital plate (Fig. 20) with long posterior lobe tapering to blunt apex, row of long setae on apical margin; disc with acuminate sclerotized spine each side of apical lobe, hook-shaped pattern of sclerotization anterior to each spine. Gonapophyses (Fig. 21): dorsal valves very short, with long apical spine; ventral valve broad with long setose apical spine; outer valve broad with short posterior lobe and very long stout setae towards its apex and row of shorter setae on posterior margin. Epiproct missing. Paraproct (Fig. 22) with field of about 21 trichobothria. Spermapore plate (Fig. 23) with heavy broad sclerotized area anterior to spermapore.

Dimensions. B 2; FW 2.6; HW 1.96; F 0.53; T 1.5; t_1 0.29; t_2 0.11; t_1/t_2 2.64; Ct 21 (t_1) 2 (t_2); f_1 0.55; f_2 0.54; f_1/f_2 1.01.

Remarks. The wing markings of this species conform to those of typical representatives of *Trichadenotecnum*. The subgenital plate resembles that of *T. laticornutum* Endang *et al.* (2002) by having lateral horn-shaped projections on the posterior margin, but the posterior lobe is longer than that of *T. laticornutum*. The general form of the gonapophyses is also similar in the two species but the outer valve of *T. waykananense* has a distinctly deeper posterior lobe than that of *T. laticornutum*, which is shallow. The fore wing of *T. waykananense* has a distinct brown sub-apical spot in each outer cell and the membrane is darkened on the apical margin, whereas in *T. laticornutum* the sub-apical brown patches are not clearly separated and the membrane is not darkened apically. Furthermore, the basal transverse fascia in the fore wing of *T. laticornutum* is broad and reaches the anterior margin of the wing, whereas in *T. waykananense* it is interrupted and only reaches vein Cu_1 .

This appears to be a lowland species.



Figs. 24–28. *Trichadenotecnum kerinciense* n.sp., ♀ holotype: (24) fore wing; (25) hind wing; (26) subgenital plate; (27) gonapophyses and spermapore plate; (28) epiproct and paraproct. Figs. 26–28 to common scale.

Trichadenotecnum kerinciense n.sp.

Figs. 24–28

Material examined. HOLOTYPE ♀, **Sumatra:** West, Kerinci Seblat National Park, base camp, 1°41'S 101°14'E, 1600 m, beating pines, 23.I.1997, ESK (ZMB). PARATYPES 1 ♀ same data as holotype (ZMB); 8 ♀♀: **Sumatra:** West, KSNP, base camp, 1°41'S 101°14'E, pines, 1600 m, 3 ♀♀, 24.I.1997, ESK (two to AMS K196200 and K196201); KSNP, Base camp, pines, 1°40'S 101°14'E, 1540 m, 3 ♀♀, 20.VI.1997, ESK; West, Sumberjaya, 4°20'S 104°30'E, pines, 850 m, 2 ♀♀, 4.I.1996, ESK.

Male unknown.

Female

Colouration (c. 4 years in alcohol). Head ground colour yellowish. Epicranial suture with dark brown uniform band each side. Confluent brown patches on posterior margin of vertex and mesial to each orbit. Eyes black. Ocelli pale, black centripetally. A narrow brown stripe from central ocellus toward each antennal socket. Frons with median V-shaped mark, a hooked-shaped brown mark each side between median V-shaped mark and antennal socket. Antennal socket bordered with brown band. Antenna light brown. Gena pale. Epistomal suture dark brown. Post-clypeus pale with dark brown striations merging antero-medially and appearing as T-shaped mark. Anteclypeus dark

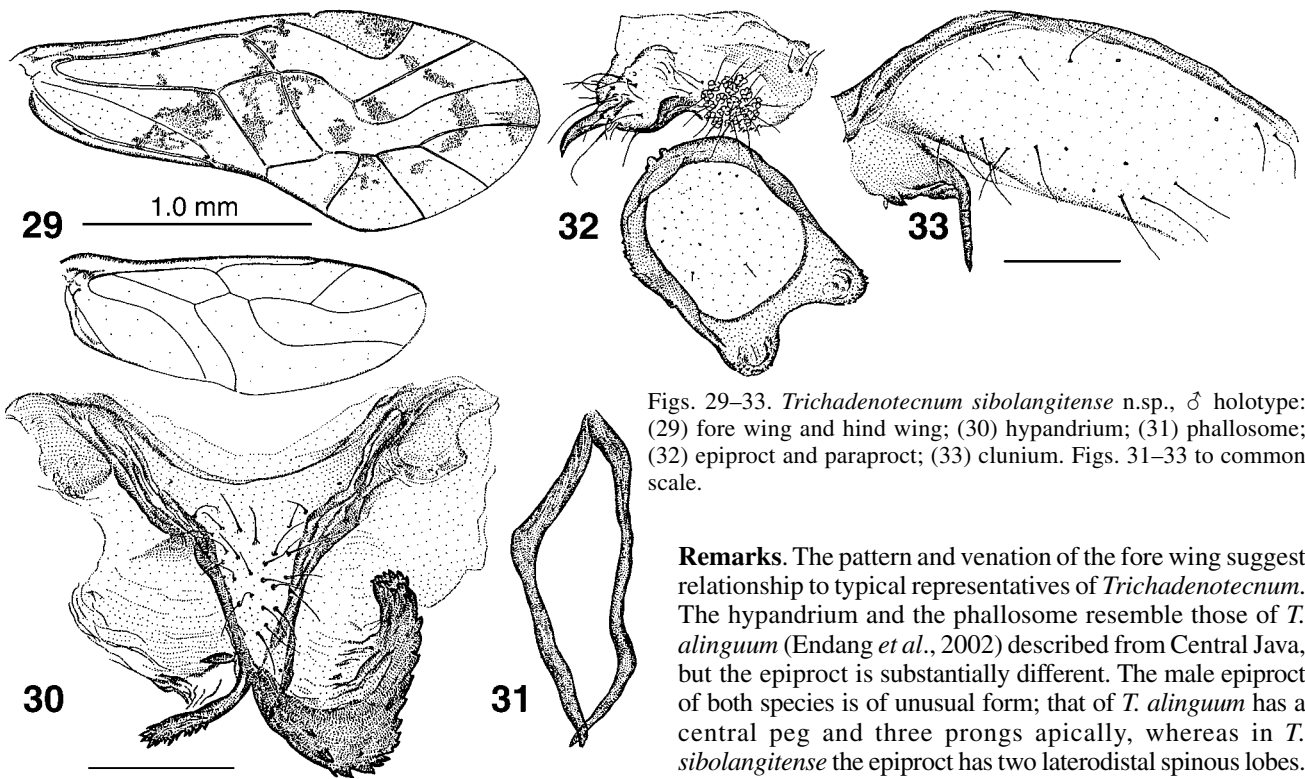
brown on basal quarter, otherwise pale. Labrum dark brown. Maxillary palp pale, darkened apically. Thorax brown with small pale area near lobes. Fore wing (Fig. 24) suffused faint brown with brown pattern. Hind wing (Fig. 25) suffused with light brown. Legs whitish except coxa, apical band on femur and tarsal segment dark brown.

Morphology. IO:D 2. Fore wing venation as in Fig. 24. Subgenital plate (Fig. 26) posterior lobe rounded apically with long setae; main plate with broad sclerotized area, a field of short and long setae along midline of posterior lobe. Gonapophyses (Fig. 27) ventral valve elongate, pointed apically; dorsal valve broad, with long acuminate apex; outer valve broad, setose, with short conical posterior lobe. Spermapore plate (Fig. 27) heavily sclerotized anteriorly. Epiproct (Fig. 28) with fine long setae on the apical margin. Paraproct (Fig. 28) with field of about 20 trichobothria.

Dimensions. B 2.5; FW 3.22; HW 2.4; F 0.73; T 1.2; t_1 0.36; t_2 0.1; t_1/t_2 3.6; Ct 21 (t_1) 2 (t_2); f_1 0.62; f_2 0.58; f_1/f_2 1.06.

Remarks. This species closely resembles *T. galihi* (Endang *et al.*, 2002) and *T. apertum* Thornton from Hong Kong in the form of the female subgenital plate. However, the ventral gonapophysis valve of *T. kerinciense* is longer than in those two species, and the spermapore plate lacks the lateral sclerotized hook apparent in those of *T. apertum* and *T. galihi*. It is attributed tentatively to Yoshizawa's (2001) *majus* group.

Trichadenotecnum kerinciense appears to be a highland species; it was not taken below 850 m.



Figs. 29–33. *Trichadenotecnum sibolangitense* n.sp., ♂ holotype: (29) fore wing and hind wing; (30) hypandrium; (31) phallosome; (32) epiproct and paraproct; (33) clunium. Figs. 31–33 to common scale.

Remarks. The pattern and venation of the fore wing suggest relationship to typical representatives of *Trichadenotecnum*. The hypandrium and the phallosome resemble those of *T. alinguum* (Endang *et al.*, 2002) described from Central Java, but the epiproct is substantially different. The male epiproct of both species is of unusual form; that of *T. alinguum* has a central peg and three prongs apically, whereas in *T. sibolangitense* the epiproct has two laterodistal spinous lobes.

***Trichadenotecnum sibolangitense* n.sp.**

Figs. 29–33

Material examined. HOLOTYPE ♂, Sumatra: North, Sibolangit, 3°05'S 98°48'E, mixed protected primary forest, 500 m, 31.I.1997, ESK (ZMB).

Female. Unknown.

Male

Colouration (c. 4 years in alcohol). Head generally buff. Epicranial suture dark brown with light brown confluent patches each side extending to posterior margin of vertex, and mesial to each orbit. Eyes black. Ocelli pale, black centripetally. Frons unmarked. Gena suffused brown. Antenna brown. Epistomal suture light brown. Postclypeus, anteclypeus and labrum brown. Maxillary palp brown darkened apically. Thorax: dorsal lobe buff; anterior of mesothoracic antedorsum brown; pleura brown with small buff patches. Fore wing (Fig. 29) with subapical brown clouds in apical cells and short basal transverse fascia. Legs dark brown, pale between joints.

Morphology. IO:D 1.2. Fore wing venation as in Fig. 29. Hypandrium (Fig. 30) highly asymmetrical: large curved serrated projection on one side apically and shorter, narrower spinous projection on the other; a median field of long setae. Phallosome (Fig. 31) an open frame, tips of open end overlapping distally. Epiproct (Fig. 32) with laterodistal spinous lobes. Paraproct (Fig. 32) with long apical spine and field of about 19 trichobothria. Clunium (Fig. 33) with long lateral spiculate spine.

Dimensions. B 2.0; FW 2.4; HW 1.57; F 0.42; T 0.78; t_1 0.23; t_2 0.08; t_1/t_2 2.9; Ct 17 (t_1) 2 (t_2); f_1 0.45; f_2 0.4; f_1/f_2 1.13.

***Trichadenotecnum kalibiruense* n.sp.**

Figs. 34–39

Material examined. HOLOTYPE ♂, Sumatra: SE, Way Kambas National Park, Kali Biru, 4°58'S 105°52'E, mixed secondary forest, 20 m, 2.VII.1997, ESK (ZMB).

Female unknown.

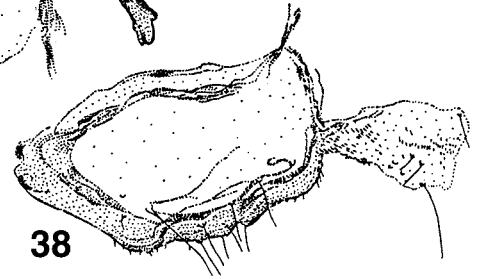
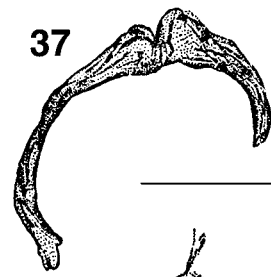
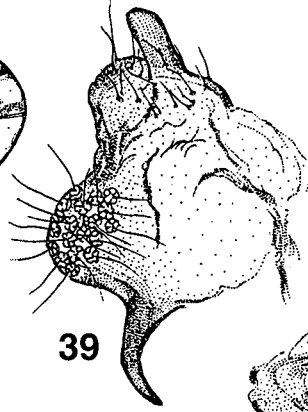
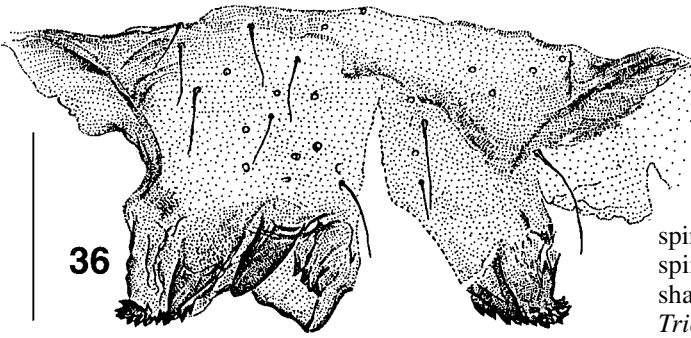
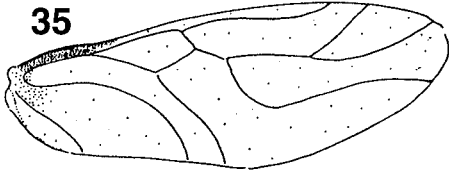
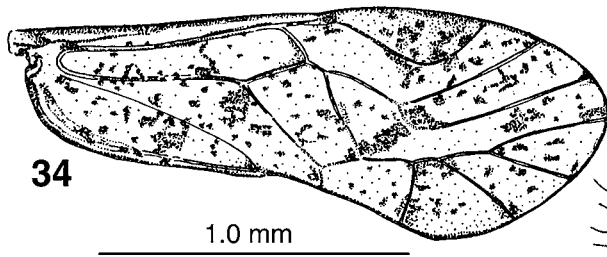
Male

Colouration (c. 4 years in alcohol). Generally brown, with the following exceptions; ocelli pale; eyes and central area between ocelli black; basal ¼ of anteclypeus dark brown, otherwise pale. Fore wing with scattered brown clouds as in Fig. 34. Hind wing suffused brown (Fig. 35).

Morphology. IO:D 2.75. Fore wing venation as in Fig. 34. Hypandrium (Fig. 36) symmetrical: distal row of short sharp teeth each side, a large stout spine at base of each row, and a larger central pointed projection. Phallosome (Fig. 37) an open frame, bilobed anteriorly. Epiproct shallow trapezoidal (Fig. 38). Paraproct (Fig. 39) with basal sclerotized hook and field of about 19 trichobothria.

Dimensions. B 1.5; FW 1.9; HW 1.38; F 0.33; T 0.73; t_1 0.23; t_2 0.08; t_1/t_2 2.88; Ct 17 (t_1) 2 (t_2); f_1 0.23; f_2 0.22; f_1/f_2 1.04.

Remarks. In wing pattern and genitalia features, *T. kalibiruense* differs from any Oriental species of *Trichadenotecnum* described previously. The hypandrium is similar to those of *T. masoni* New from Nepal and *T. bromoense* Endang *et al.* from Mt Bromo, East Java. All three have a lateral serration of the apical lobe and a single large central projection. *Trichadenotecnum masoni* and *T. bromoense*, however, lack the pair of large symmetrical



Figs. 34–39. *Trichadenotecnum kalibiruense* n.sp., ♂ holotype: (34) fore wing; (35) hind wing; (36) hypandrium; (37) phallosome; (38) epiproct; (39) paraproct. Figs. 36–39 to common scale.

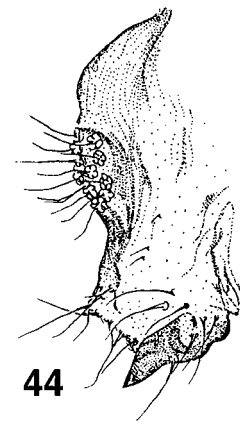
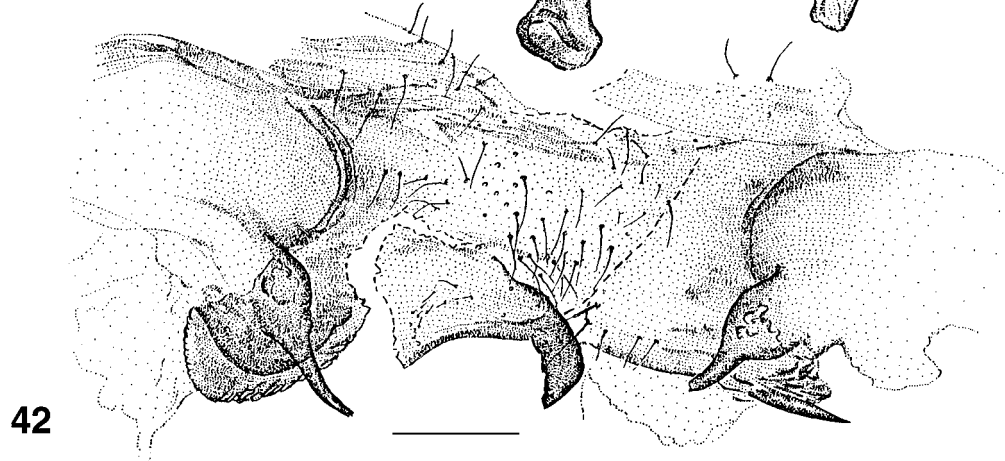
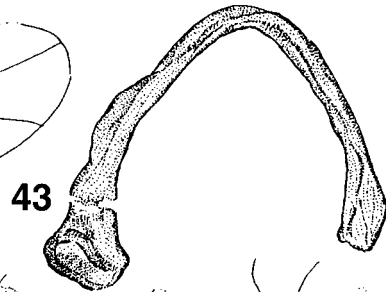
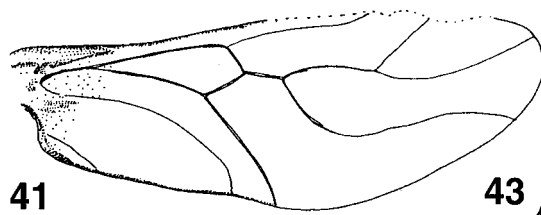
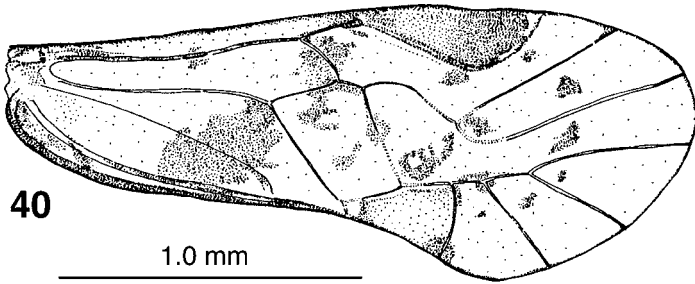
spines and a row of four teeth medially. Moreover, the apical spine of the paraproct in *T. kalibiruense* is longer and more sharply curved than those of *T. masoni* and *T. bromoense*. *Trichadenotecnum bromoense* was referred to Yoshizawa's (2001) *spiniserrulum* group, and the basal paraproct process of the male of *T. kalibiruense* implies a similar position.

***Trichadenotecnum cornutum* n.sp.**

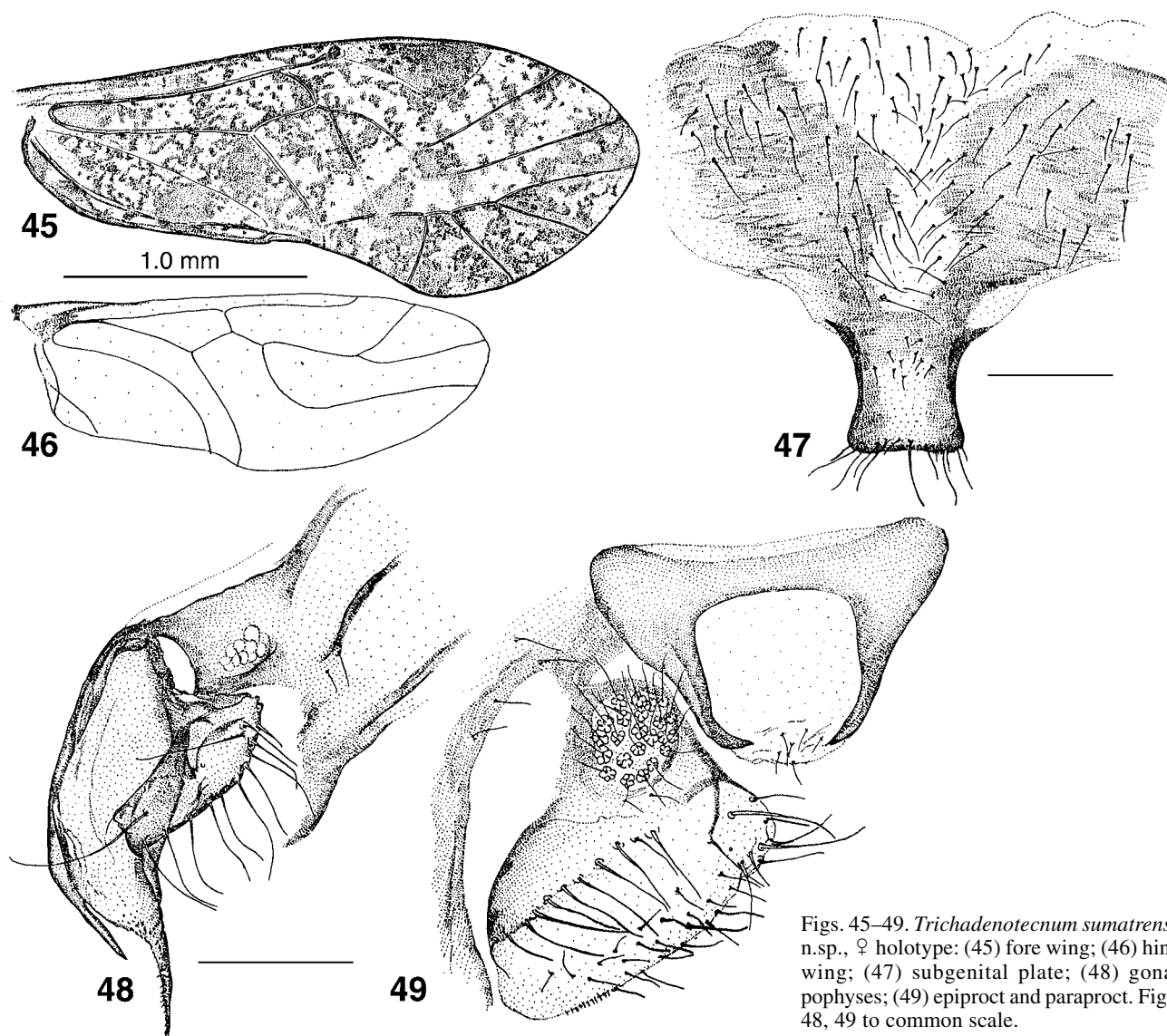
Figs. 40–44

Material examined. HOLOTYPE ♂, Sumatra: SE, Way Kambas National Park, Way Kanan, 5°04'S 105°42'E, mixed secondary forest, 20 m, 30.VI.1997, ESK (ZMB).

Female unknown.



Figs. 40–44. *Trichadenotecnum cornutum* n.sp., ♂ holotype: (40) fore wing; (41) hind wing; (42) hypandrium; (43) phallosome; (44) paraproct. Figs. 42–44 to common scale.



Figs. 45–49. *Trichadenotecnum sumatrense* n.sp., ♀ holotype: (45) fore wing; (46) hind wing; (47) subgenital plate; (48) gonapophyses; (49) epiproct and paraproct. Figs. 48, 49 to common scale.

Male

Colouration (c. 2 years in alcohol). Head pale, epicranial suture dark brown; uniform brown band each side extending to posterior margin of vertex, and mesial to each orbit. Eyes black. Ocelli pale, black centripetally. Frons with lateral dark brown mark contiguous with ventral margin of each eye. Antenna light brown. Gena dark brown anteriorly. Epistomal suture pale. Postclypeus with dark brown striation merging medially, pale lateral area. Labrum pale. Thorax pale with brown patches; pleura with transverse dark brown band ventrally. Fore wing with brown clouds as in Fig. 40. Hind wing (Fig. 41) suffused brown. Legs pale except apical band on femur, tibia and tarsal segments dark brown.

Morphology. IO:D 1.33. Fore wing venation as in Fig. 40. Hypandrium (Fig. 42, damaged) asymmetrical: two asymmetrical lateroapical projections, the left one a long spine and the right one serrated; anteriorly to the serrated projection a pair of symmetrical large spikes flanking curved tongue. Phallosome (Fig. 43) an open frame. Paraproct (Fig. 44) with field of about 11 trichobothria.

Dimensions. B 1.5; FW 1.35; HW 1.71; F 0.49; T 0.96; t_1 0.27; t_2 0.09; t_1/t_2 3; Ct 19 (t_1) 2 (t_2); f_1 0.56; f_2 0.46; f_1/f_2 1.28.

Remarks. *Trichadenotecnum cornutum* has wing markings conforming to those of typical representatives of *Trichadenotecnum*. In general form of the hypandrium, this species differs from any previously described species. The open curved phallic frame of this species most closely resembles those of *T. apertum* Thornton from Hong Kong and *T. galihi* Endang *et al.* from East Java. The hypandria of *T. apertum* and *T. galihi*, however, lack a pair of subapical symmetrical spines.

Trichadenotecnum sumatrense n.sp.

Figs. 45–49

Material examined. HOLOTYPE ♀, **Sumatra:** North, Gunung Leuser National Park, Lawegurah, 3°38'N 97°40'E, mixed primary forest, beating, 325–360 m, 5.VI.1997, ESK (ZMB). PARATYPE ♀, **Sumatra:** SE, WKNP, Kiara Tunggal, 5°06'S 105°44'E, mixed secondary forest, 100 m, beating, 29.XII.1997, ESK (AMS K196202).

Male unknown.

Female

Colouration (c. 4 years in alcohol). Head ground colour yellowish. Epicranial suture dark brown, confluent brown patches each side reaching ocellar tubercle and extending to margin of vertex and mesial to each orbit. Eyes black. Ocelli pale black centripetally. Dark brown band from central ocellus toward anterior of each eye. Frons with median dark brown mark, two dark brown stripes lateral to this. Gena, epistomal suture, postclypeal striations, dorsal half of anteclypeus, labrum and maxillary palp dark brown. Thorax dark brown with small yellowish areas near lobes. Fore wing with dense dark brown markings as in Fig. 45. Hind wing (Fig. 46) suffused brown. Legs dark brown, pale between joints.

Morphology. IO:D 3.83. Fore wing venation as in Fig. 45. Subgenital plate (Fig. 47): apical lobe squarish, setose apically, median area close to main plate with field of very short setae; main plate with lateral oblong sclerotized area and field of long setae along midline of the plate and over sclerotized areas. Gonapophyses (Fig. 48): ventral valve

elongate, pointed apically; dorsal valve broad, with long apical spine; outer valve slender, with long setae, apically with broad short spine. Epiproct as in Fig. 49. Paraproct (Fig. 49) with row of very long stout setae and field of about 20 trichobothria.

Dimensions. B 1.8; FW 2.37; HW 1.82; F 0.47; T 0.82; t_1 0.3; t_2 0.12; t_1/t_2 2.5; Ct 19 (t_1) 2 (t_2); f_1 0.37; f_2 0.33; f_1/f_2 1.05.

Remarks. The subgenital plate of this species suggests relationship with *T. malayense* New (1975) (Malaysia) and *T. godavarensis* New (1971) (Nepal), *T. sufflatum* Li (1993) and *T. himalayense* Li & Yang (1987) (both from China, and both placed in *Trichadenopsocus* by Li, 2002). The fore wing pattern and female gonapophyses, however, differ markedly from these species.

Trichadenotecnum alobum n.sp.

Figs. 50–53

Material examined. HOLOTYPE ♀, Sumatra, Kerinci Seblat National Park, Gunung Tujuh, 1°43'S 101°13'E, 1600 m, mixed secondary forest, 23.I.1997, ESK (ZMB).

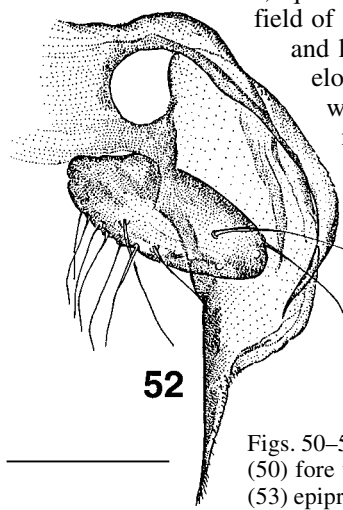
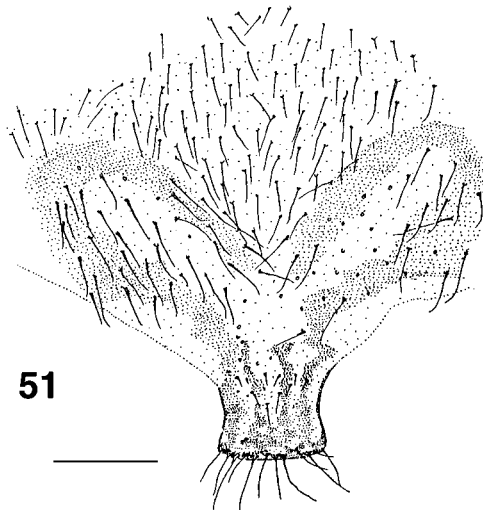
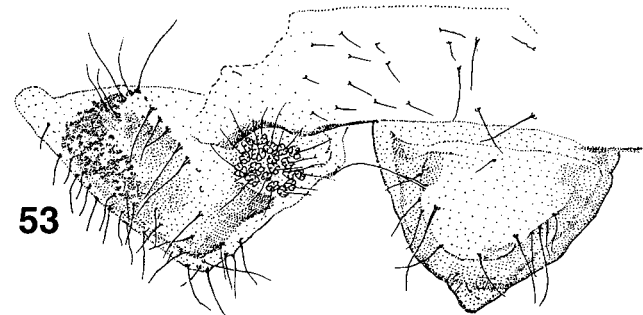
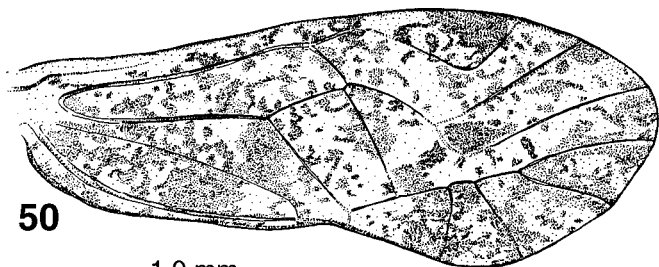
Male unknown.

Female

Colouration (c. 4 years in alcohol). Head ground colour yellowish. Epicranial suture light brown with brown spots each side extending to posterior margin of vertex, and mesial to each orbit. Ocelli pale, black centripetally. Eyes greyish black. Frons with median dark brown stirrup mark, lateral to this two brown bands from epistomal suture towards each orbit. Gena yellowish brown. Antenna brown except scape and pedicel dark brown, and pale between joints of flagellar segments. Epistomal suture light brown. Postclypeus with dark brown striations. Basal ¼ of anteclypeus dark brown, otherwise pale. Labrum and maxillary palp dark brown. Thorax brown with yellow patches on dorsal lobes. Legs brown, pale between joints. Fore wing (Fig. 50) with very dense brown spots. Hind wing (damaged) brown.

Morphology. IO:D 3.5, eyes small. Fore wing venation as in Fig. 50. Subgenital plate (Fig. 51) with short posterior lobe, squarish apically, bearing apical row of long setae, field of short setae on mid line between main plate and lobe. Gonapophyses (Fig. 52) ventral valve elongate, pointed apically, dorsal valve broad, with long acuminate apical spine, outer valve narrow, ovoid, lacking posterior lobe. Epiproct and paraproct as in Fig. 53.

Dimensions. B 1.98; FW 2.4; HW (damaged); F 0.43; T 0.92; t_1 0.28; t_2 0.1; t_1/t_2 2.8; Ct 16 (t_1) 2 (t_2) f_1 0.4; f_2 0.38; f_1/f_2 1.05.



Figs. 50–53. *Trichadenotecnum alobum* n.sp., ♀ holotype: (50) fore wing; (51) subgenital plate; (52) gonapophyses; (53) epiproct and paraproct. Figs. 51, 53 to common scale.

Remarks. In genitalic features *T. alobum* most closely resembles *T. godavarensis* New from Nepal, in having an ovoid outer gonapophysis valve and a broad dorsal valve with a long acuminate apical spine. The ventral valve of *T. godavarensis*, however, is decidedly the shorter. The subgenital plates of both species have short squarish apical lobes with a row of long setae along the apical margin, but the main plates differ, the deeply bifurcate sclerotized region of *T. godavarensis* being distinctive. The absence of a posterior lobe to the outer gonapophysis valve was regarded by Yoshizawa (2001) as an apomorphy for the *spiniserrulum* group but *T. alobum* also has a long ventral valve, unlike typical members of that group.

***Trichadenotecnum muaraense* n.sp.**

Figs. 54–60

Material examined. HOLOTYPE ♂, Sumatra: West, Kerinci Seblat National Park, Muara Emat, 2°03'S 101°42'E, mixed secondary forest with remnants of cultivated trees and shrubs, 240 m, 18.I.1997, ESK (ZMB).

Female unknown.

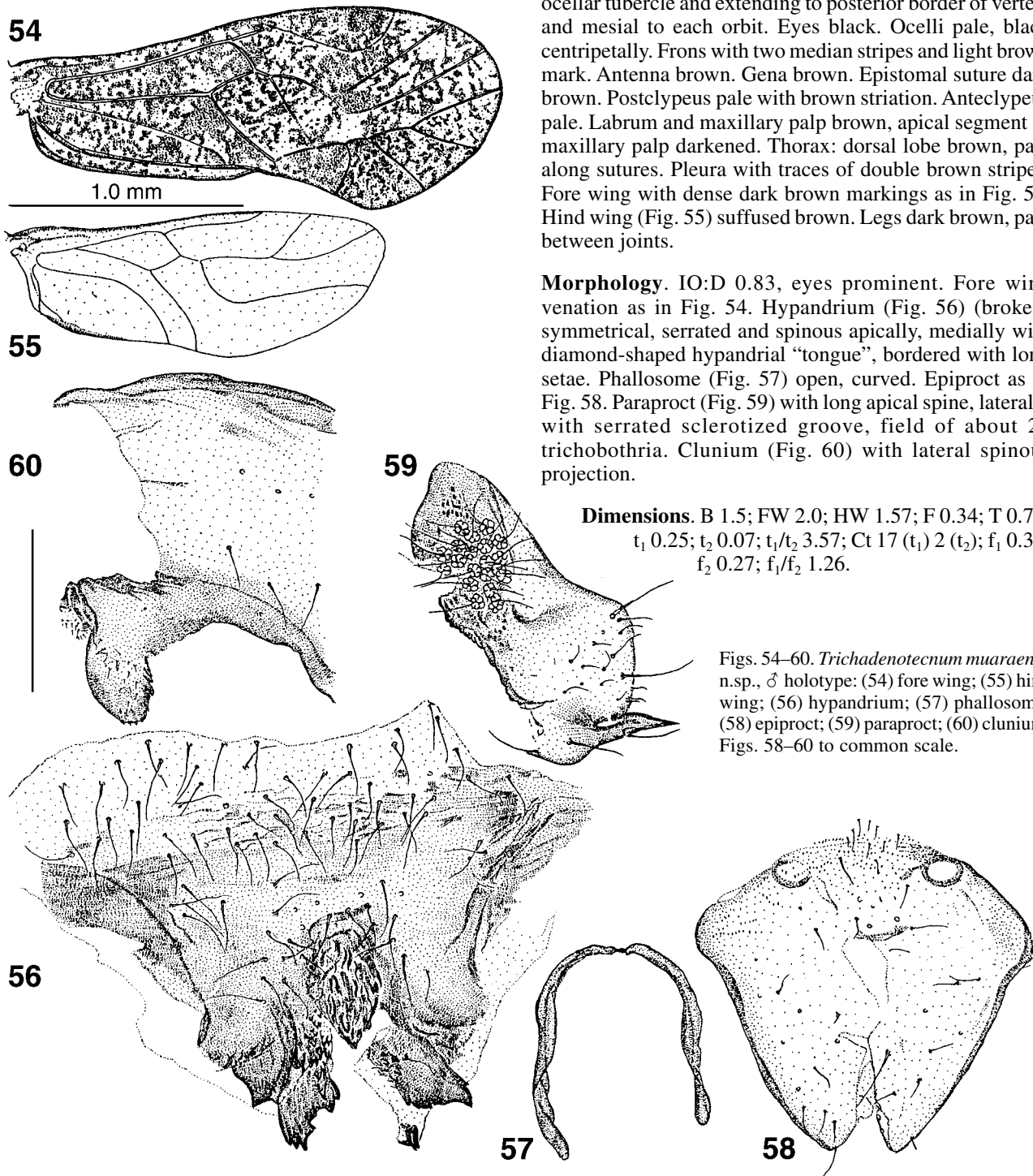
Male

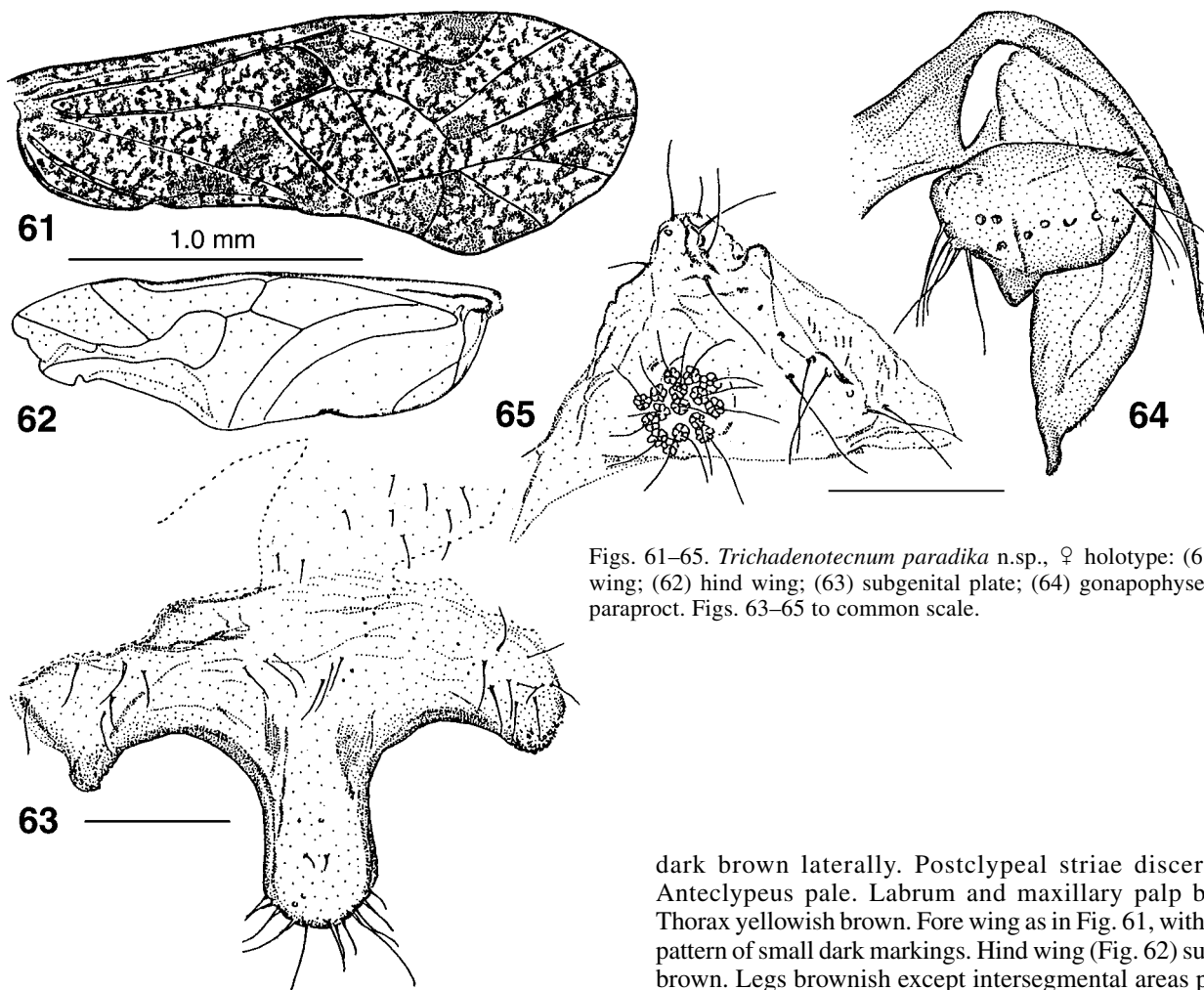
Colouration (c. 4 years in alcohol). Head pale. Epicranial suture dark brown, light brown patches each side reaching ocellar tubercle and extending to posterior border of vertex, and mesial to each orbit. Eyes black. Ocelli pale, black centripetally. Frons with two median stripes and light brown mark. Antenna brown. Gena brown. Epistomal suture dark brown. Postclypeus pale with brown striation. Anteclypeus pale. Labrum and maxillary palp brown, apical segment of maxillary palp darkened. Thorax: dorsal lobe brown, pale along sutures. Pleura with traces of double brown stripes. Fore wing with dense dark brown markings as in Fig. 54. Hind wing (Fig. 55) suffused brown. Legs dark brown, pale between joints.

Morphology. IO:D 0.83, eyes prominent. Fore wing venation as in Fig. 54. Hypandrium (Fig. 56) (broken) symmetrical, serrated and spinous apically, medially with diamond-shaped hypandrial “tongue”, bordered with long setae. Phallosome (Fig. 57) open, curved. Epiproct as in Fig. 58. Paraproct (Fig. 59) with long apical spine, laterally with serrated sclerotized groove, field of about 23 trichobothria. Clunium (Fig. 60) with lateral spinous projection.

Dimensions. B 1.5; FW 2.0; HW 1.57; F 0.34; T 0.73; t_1 0.25; t_2 0.07; t_1/t_2 3.57; Ct 17 (t_1) 2 (t_2); f_1 0.34; f_2 0.27; f_1/f_2 1.26.

Figs. 54–60. *Trichadenotecnum muaraense* n.sp., ♂ holotype: (54) fore wing; (55) hind wing; (56) hypandrium; (57) phallosome; (58) epiproct; (59) paraproct; (60) clunium. Figs. 58–60 to common scale.





Figs. 61–65. *Trichadenotecnum paradika* n.sp., ♀ holotype: (61) fore wing; (62) hind wing; (63) subgenital plate; (64) gonapophyses; (65) paraproct. Figs. 63–65 to common scale.

Remarks. The wing pattern of this species most resembles that of *T. dolabratum* Li & Yang, 1987 (China; placed in *Loensia* by Li, 2002), but the genitalia differ markedly. The median hypandrial tongue of *T. dolabratum* is surrounded by long setae, that are absent in the Sumatran specimen. The phallosome of *T. dolabratum* is a closed frame with a long pointed posterior projection, whereas that of *T. muaraense* is an open frame. Moreover, features of the epiproct and paraproct differ.

***Trichadenotecnum paradika* n.sp.**

Figs. 61–65

Material examined. HOLOTYPE ♀, Sumatra: SE, Pematang, 3°50'S 105°01'E, 40 m, rubber plantation, 13.I.1996, ESK (ZMB).

Male unknown.

Female

Colouration (c. 4 years in alcohol). Head yellowish brown. Epicranial suture light brown. Light brown patches each side of epicranial suture and mesial to each orbit extend to posterior margin of vertex and mesial to each orbit. Ocelli pale black centripetally. Eyes black. Frons with median dark brown V-shaped mark, lateral to this a dark brown band curved towards each orbit. Antennal socket bordered with dark brown. Antennae pale. Epistomal suture pale medially,

dark brown laterally. Postclypeal striae discernible. Anteclypeus pale. Labrum and maxillary palp brown. Thorax yellowish brown. Fore wing as in Fig. 61, with dense pattern of small dark markings. Hind wing (Fig. 62) suffused brown. Legs brownish except intersegmental areas pale.

Morphology. IO:D 1.25. Fore wing venation as in Fig. 61. Subgenital plate (Fig. 63) posterior lobe long, with rounded apex with long and short setae; main plate with posterolateral corrugated projection each side and scattered long setae anteriorly. Gonapophyses (Fig. 64): ventral valve elongate and pointed apically; dorsal valve broad with short apical spine; outer valve broad, short, with small conical posterior lobe, and long stout setae; a small group of very short setae near apex of valve anteriorly. Epiproct missing. Paraproct (Fig. 65) with field of about 16 trichobothria.

Dimensions. B 1.98; FW 2.22; HW 1.83; F 0.4; T 0.84; t_1 0.23; t_2 0.07; t_1/t_2 3.28; Ct 15 (t_1) 2 (t_2); f_1 0.38; f_2 0.33; f_1/f_2 1.15.

Remarks. This single specimen differs from previously described species in the form of the subgenital plate. This resembles those of *T. laticornutum* Endang *et al.*, *T. adika* Endang *et al.* and *T. waykananense* n.sp. in having a lateral corrugated projection each side on the posterior margin, but the projection of *T. paradika* is shorter than in those three species. The fore wing pattern of *T. laticornutum* conforms to that typical of typical representatives of *Trichadenotecnum*. In fore wing pattern and some features of the gonapophyses *T. paradika* most closely resembles *T. adika*. In *T. adika* the dorsal gonapophysis valve has a long setose apical spine whereas in *T. paradika* it is short and has fewer setae. On the form of the subgenital plate, these species may constitute a distinct species group.

Trichadenotecnum proctum n.sp.

Figs. 66–71

Material examined. HOLOTYPE ♂, Sumatra: West, Batu Ampar, 2°00'S 101°25'E, tea plantation, 1360 m, 21.I.1997, ESK (ZMB).

Female unknown.

Male

Colouration (c. 4 years in alcohol). Head ground colour whitish. Epicranial suture light brown, confluent brown patches each side across posterior border of vertex, and mesial to each orbit. Eyes black. Ocelli pale with black crescent mark between them. Frons unmarked. Gena dark brown ventrally. Antenna light brown except scape and pedicel dark brown. Epistomal suture pale medially and brown laterally. Postclypeus with brown striation. Basal quarter of anteclypeus dark brown, otherwise pale. Labrum and maxillary palp dark brown; intersegmental area of maxillary palp pale. Thorax whitish, dark brown along sutures. Fore wing with dense pattern of small dark brown markings as in Fig. 66. Hind wing (Fig. 67) suffused brown. Legs light brown except coxa, trochanter and second tarsal segment dark brown.

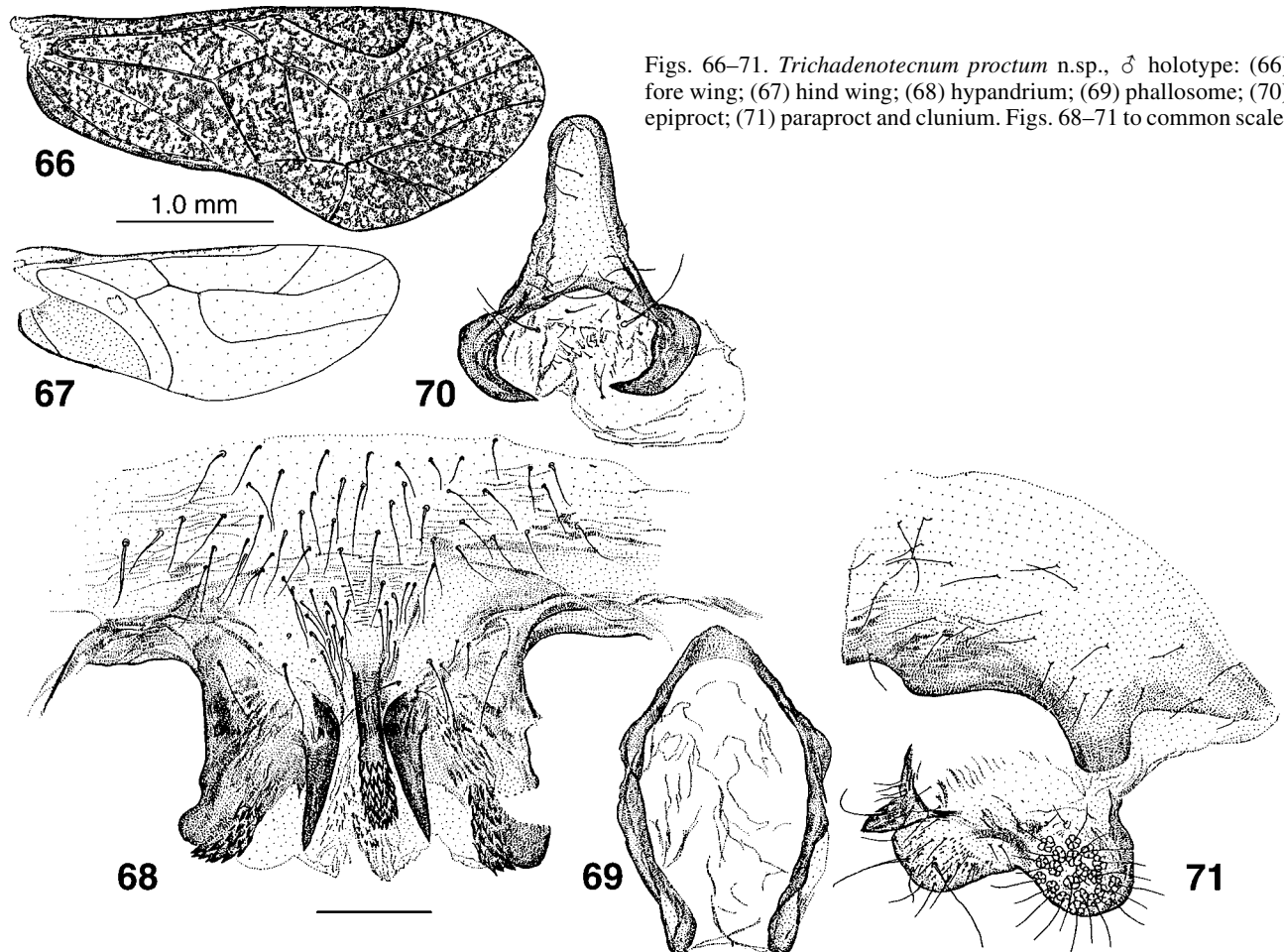
Morphology. IO:D 2.22. Fore wing venation as in Fig. 66. Hypandrium (Fig. 68) symmetrical: lateroapical spinous projection each side, medially to this each side a stout long

spine; tongue slender, spinous distally; two groups of long setae each side of mid-line and scattered long setae on basal area. Phallosome (Fig. 69) “wishbone”-shaped. Epiproct (Fig. 70) with broad lateroapical sclerotized area and long cone-shaped distal lobe. Paraproct (Fig. 71) with broad apical spine and field of about 21 trichobothria.

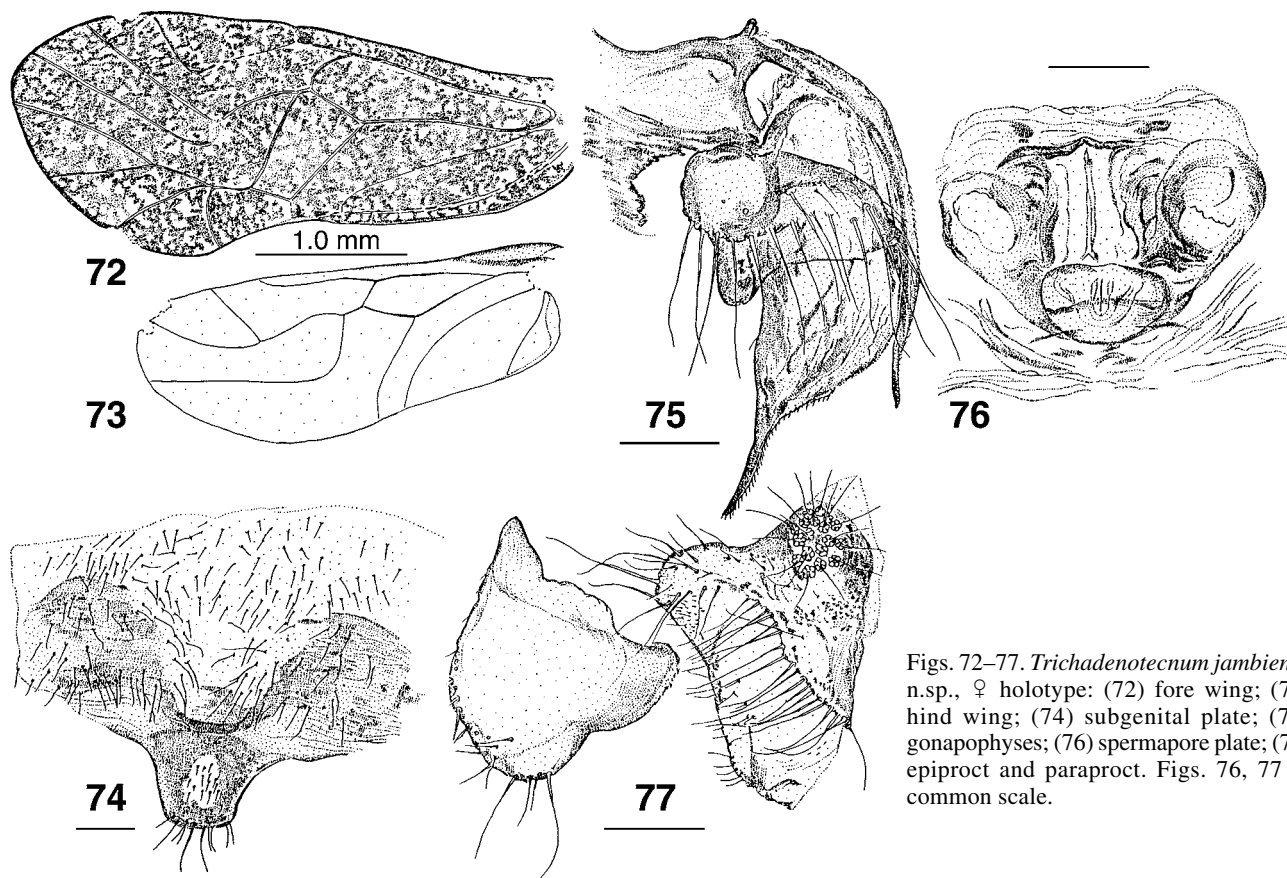
Dimensions. B 2.6; FW 3.3; HW 2.4; F 0.54; T 1.09; t_1 0.33; t_2 0.1; t_1/t_2 3.3; Ct 18 (t_1) 2 (t_2); f_1 0, 63; f_2 0.7; f_1/f_2 0.9

Remarks. Endang *et al.* (2002) described *Trichadenotecnum vaughani* from West Java (1560 m). In fore wing markings and venation, and in the form of the hypandrium, *T. vaughani* agrees with typical representatives of *Trichadenotecnum* (see Thornton, 1961). Endang *et al.* (2002) noted that the general form of its hypandrium resembles that of *T. thorntoni* New, 1975 from Kenya, but the wing pattern of the latter is of *Loensia*-type. The present Sumatran species shows a mosaic of the features of the above two species. The fore wing pattern and hypandrium most resemble *T. vaughani* (asymmetrical with median oblong tongue), differing from it only in small details. The epiproct of *T. vaughani* is pentagonal, whereas that of *T. proctum* is of a quite distinctive shape.

The fore wing of this individual suggests relationship with the following species, known only from the female, and it is possible that they may prove to be conspecific once more material is available for study.



Figs. 66–71. *Trichadenotecnum proctum* n.sp., ♂ holotype: (66) fore wing; (67) hind wing; (68) hypandrium; (69) phallosome; (70) epiproct; (71) paraproct and clunium. Figs. 68–71 to common scale.



Figs. 72–77. *Trichadenotecnum jambiense* n.sp., ♀ holotype: (72) fore wing; (73) hind wing; (74) subgenital plate; (75) gonapophyses; (76) spermaphore plate; (77) epiproct and paraproct. Figs. 76, 77 to common scale.

Trichadenotecnum jambiense n.sp.

Figs. 72–77

Material examined. HOLOTYPE ♀, Sumatra: West, Jambi, Leter W, 1°12'S 101°10'E, citrus, 1320 m, 19.VI.1997, ESK (ZMB).

Male unknown.

Female

Colouration (after about 4 years in alcohol). Head ground colour buff. Epicranial suture pale. Confluent brown patches each side of epicranial suture across posterior margin of vertex, and mesial to each orbit. Eyes black. Ocelli pale, black centripetally. Frons with median light brown mark. Antenna pale except scape and pedicel dark brown. Gena with dark brown patch. Epistomal suture light brown. Postclypeus buff with brown striations, darkened ventrally. Dorsal and ventral of anteclypeus brown, basally and distally, otherwise medially pale. Labrum and maxillary palp dark brown; intersegmental regions of maxillary palp pale. Thorax: dorsal lobes of mesothorax buff and of metathorax brown; thoracic pleura buff with brown patches. Fore wing (Fig. 72) with dense pattern of small dark brown markings. Hind wing (Fig. 73) suffused brown. Legs, coxa and second tarsal segment dark brown, otherwise light brown.

Morphology. IO:D 2.5. Fore wing venation as in Fig. 72. Subgenital plate (Fig. 74): short trapezoidal posterior lobe with long setae apically; field of moderately long setae about midline of lobe; main plate with lateral sclerotized areas and median dark sclerotized transverse bar. Gonapophyses (Fig. 75) ventral valve elongate, pointed apically; dorsal

valve broad with long acuminate apical spine; outer valve with long setae and short posterior lobe. Spermaphore plate heavily ornamented, as in Fig. 76. Epiproct (Fig. 77) with long apical setae. Paraproct (Fig. 77) with field of about 18 trichobothria.

Dimensions. B 2.5; FW 3.4; HW 2.6; F 0.69; T 1.37; t_1 0.1; t_2 0.33; t_1/t_2 3.3; Ct 19 (t_1) 3 (t_2); f_1 0.8; f_2 0.6; f_1/f_2 1.33.

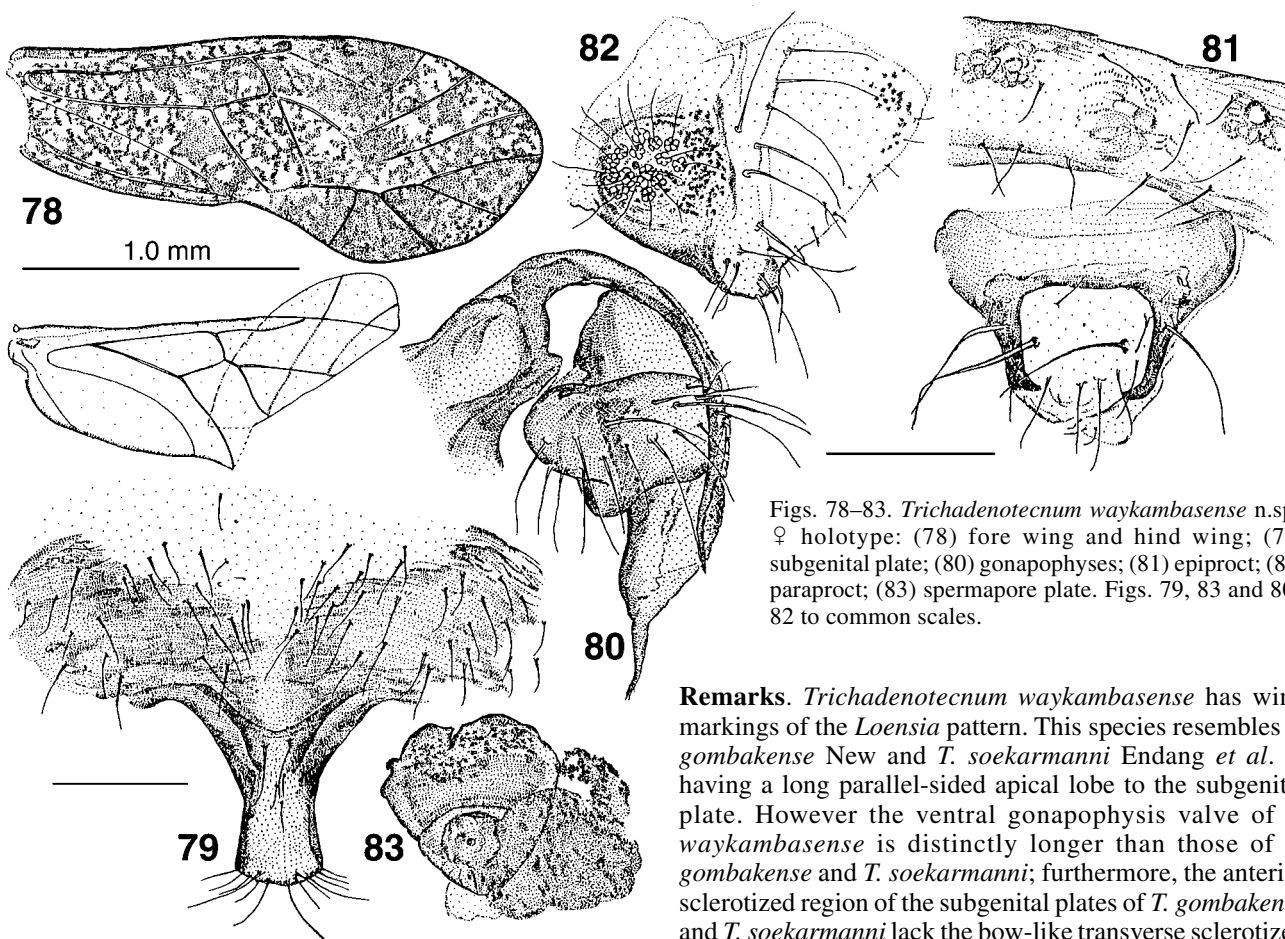
Remarks. *Trichadenotecnum jambiense* has a *Loensia*-type fore wing pattern. In genitalic features, it resembles *T. medium* Thornton from Hong Kong, in that the subgenital plate has a short posterior lobe and a transverse sclerotized bar on the main plate. The dorsal valve of the gonapophyses, however, is broader in *T. jambiense* than in *T. medium*. *Trichadenotecnum jambiense* is also similar to *T. taenianum* Li & Yang from China (placed in *Loensia* by Li, 1999, 2002) in having a short posterior lobe to the subgenital plate, but the subgenital plate of the latter lacks the transverse median sclerotized bar on the main plate and the ventral gonapophysis valve is shorter than that of *T. jambiense*. See comment under *T. proctum*, above.

Trichadenotecnum waykambasense n.sp.

Figs. 78–83

Material examined. HOLOTYPE ♀, Sumatra: SE, Way Kambas National Park, Way Kanan, 5°04'S 105°42'E, mixed secondary forest, 20 m, 30.VI.1997, ESK (ZMB). PARATYPE ♀, same data as holotype (AMS K196203).

Male unknown.



Figs. 78–83. *Trichadenotecnum waykambasense* n.sp., ♀ holotype: (78) fore wing and hind wing; (79) subgenital plate; (80) gonapophyses; (81) epiproct; (82) paraproct; (83) spermapore plate. Figs. 79, 83 and 80–82 to common scales.

Female

Colouration (c. 4 years in alcohol). Head ground colour buff. Epicranial suture dark brown; confluent brown patches each side extending to posterior margin of vertex, and mesial to each orbit. Eyes black. Ocelli pale, black centripetally. A narrow dark brown stripe from median ocellus toward each antennal socket. Antennal socket bordered with dark brown band. Antenna dark brown, pale between joints. Gena with brown markings. Frons with median brown V-shaped mark and dark brown stripe laterally. Postclypeus buff with dark brown striations darkened distally. Anteclypeus dark brown on basal quarter, otherwise pale. Labrum and maxillary palp dark brown. Thorax dark brown, buff along sutures. Fore wing with dense dark brown markings as in Fig. 78. Legs dark brown, pale between joints.

Morphology. IO:D 3. Wing venation as in Fig. 78. Subgenital plate (Fig. 79) posterior lobe long, somewhat rounded apically, with long setae along apical margin; two long setae near base of the lobe; anterior to these a narrow sclerotized bar connecting the lateral sclerotized areas on disc. Gonapophyses (Fig. 80) ventral valve long, with acuminate apical spine; dorsal valve with long pointed apex; outer valve with short posterior lobe. Epiproct (Fig. 81). Paraproct (Fig. 82) with field of about 18 trichobothria. Spermapore plate sclerotized (Fig. 83).

Dimensions. B 1.56; FW 1.9; HW 1.62; F 0.34; T 0.62; t_1 0.2; t_2 0.09; t_1/t_2 2.22; Ct 16 (t_1) 2 (t_2); f_1 0.3; f_2 0.25; f_1/f_2 1.2.

Remarks. *Trichadenotecnum waykambasense* has wing markings of the *Loensia* pattern. This species resembles *T. gombakense* New and *T. soekarmanni* Endang *et al.* in having a long parallel-sided apical lobe to the subgenital plate. However the ventral gonapophysis valve of *T. waykambasense* is distinctly longer than those of *T. gombakense* and *T. soekarmanni*; furthermore, the anterior sclerotized region of the subgenital plates of *T. gombakense* and *T. soekarmanni* lack the bow-like transverse sclerotized bar. *Trichadenotecnum soekarmanni* was attributed to Yoshizawa's (2001) *spiniserrulum* group (Endang *et al.*, 2002), but the long ventral gonapophysis valve of *T. waykambasense* suggests that the two species may be related only more distantly.

Trichadenotecnum cinnamomum n.sp.

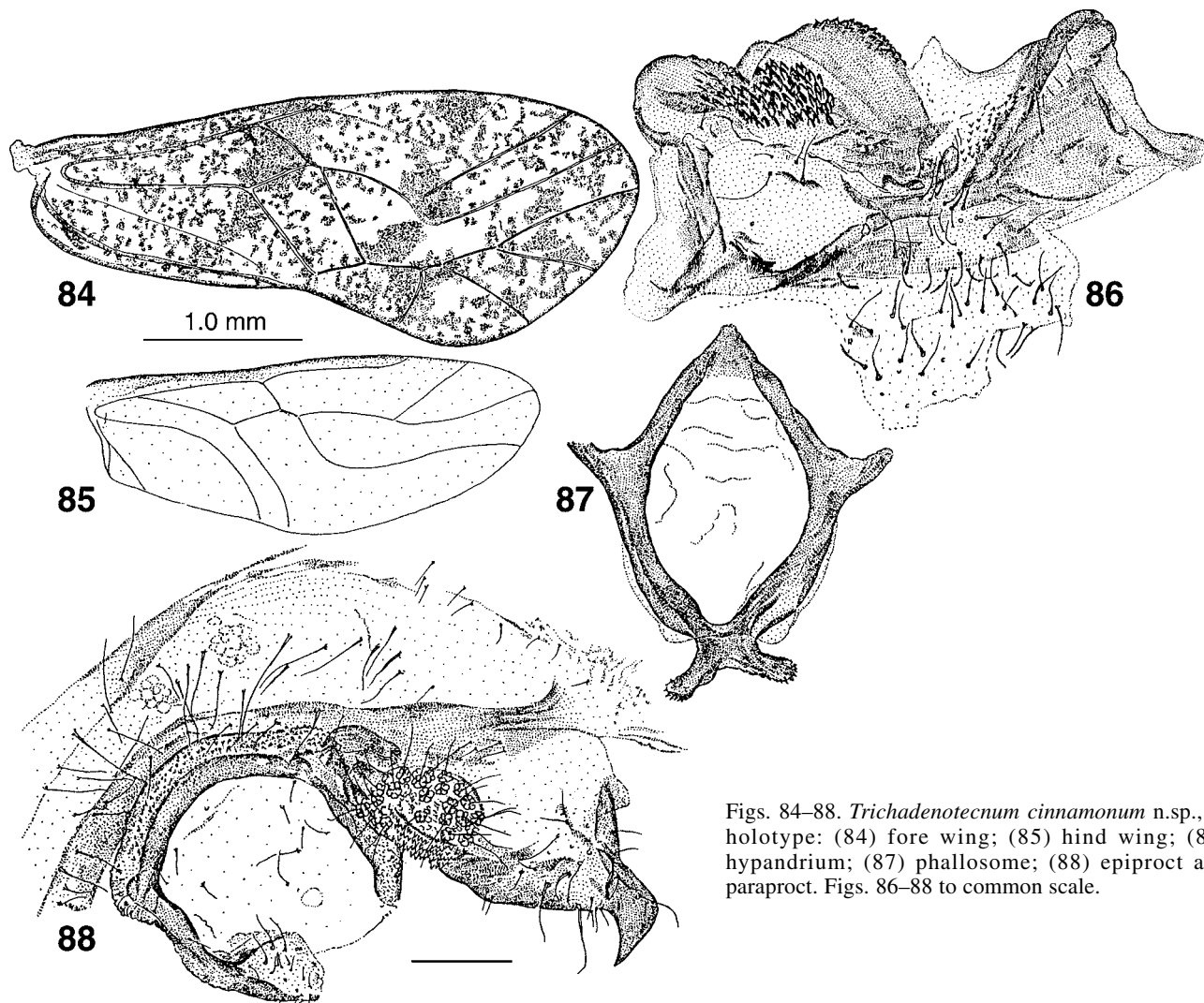
Figs. 84–93

Material examined. HOLOTYPE ♂, Sumatra: West, Kerinci Seblat National Park, East slope of Mt Kerinci, 1°40'S 101°13'E, cinnamon, 1700 m, 20.VI.1997, ESK (ZMB). PARATYPE ♀, same data as holotype (ZMB).

Male

Colouration (c. 4 years in alcohol). Head ground colour buff with the following dark brown: epicranial suture; mark each side of epicranial suture to posterior margin of vertex, and mesial to each orbit; median V-shaped mark on frons, border of antennal socket; epistomal suture; postclypeal striations; basal ¼ of anteclypeus; labrum; maxillary palp. Eyes greyish black. Ocelli pale black centripetally. Antenna light brown, scape and pedicel dark brown and pale between joints. Thorax: dorsal lobes dark brown, buff along sutures; lateral lobes buff dorsally, dark brown ventrally. Fore wing as in Fig. 84, with pattern of scattered small dark brown markings. Hind wing (Fig. 85) suffused brown. Legs dark brown, pale between joints.

Morphology. IO:D 1.0. Wing venation as in Figs. 84, 85. Hypandrium (Fig. 86) asymmetrical: large lateroapical



Figs. 84–88. *Trichadenotecnum cinnamonum* n.sp., ♂ holotype: (84) fore wing; (85) hind wing; (86) hypandrium; (87) phallosome; (88) epiproct and paraproct. Figs. 86–88 to common scale.

spinous lobe on one side; scattered long setae on the midline; field of small spines in subapical region. Phallosome (Fig. 87) a closed frame with bifid rugose distal projection. Epiproct (Fig. 88) with strong lateral prongs and basal corrugated bow-like area. Paraproct (Fig. 88) with broad apical spine, a field of small spines contiguous with field of about 26 trichobothria.

Dimensions. B 2.9; FW 3.65; HW 2.8; F 0.6; T 1.39; t_1 0.42; t_2 0.13; t_1/t_2 3.23; Ct 15 (t_1) 2 (t_2); f_1 0.75; f_2 0.69; f_1/f_2 1.08.

Female

Colouration (c. 4 years in alcohol). As male except whole pleura dark brown, buff along sutures; lateral to eye V-shaped mark on frons as two narrow stripes and narrow brown band from median ocellus toward ventral region of eyes. Fore wing as in Fig. 89. Hind wing as in Fig. 90.

Morphology. IO:D 2.2. Fore wing venation as in Fig. 89. Subgenital plate (Fig. 91): posterior lobe blunt apically with apical row of long setae and field of short setae around midline of lobe; main plate with broad lateral sclerotization. Gonapophyses (Fig. 92): ventral valve elongate, pointed apically; dorsal valve with long apical acuminate point; outer

valve with fine teeth on outer margin of posterior lobe. Epiproct (Fig. 93). Paraproct (Fig. 93) with field of about 24 trichobothria.

Dimensions. B 2.5; FW 3.53; HW 2.67; F 0.65; T 1.25; t_1 0.32; t_2 0.14; t_1/t_2 2.28; Ct 19 (t_1) 3 (t_2); f_1 0.57; f_2 0.55; f_1/f_2 1.04.

Remarks. *Trichadenotecnum cinnamonum* has a *Loensia*-type wing pattern. The phallosome resembles that of *T. godavarensense* New from Nepal in having a bifid apical tine, but the phallosome of *T. godavarensense* lacks the lateral prongs. Furthermore, *T. godavarensense* has a bifid hypandrial tongue, absent in *T. cinnamonum*. In *T. cinnamonum* the epiproct has a basal corrugated bow-like area on the epiproct and a field of spines contiguous to the paraproct trichobothrial field, whereas in *T. godavarensense* these characters are absent. In general, the subgenital plate is similar to that of *T. godavarensense*, but differs slightly in that the anterior sclerotized area of *T. godavarensense* has two pigmented connections between stems of the anterolateral sclerotized area and the sclerotized area of the apical lobe, whereas in *T. cinnamonum* these are absent. The ventral valve of *T. godavarensense* is also somewhat shorter than that of *T. cinnamonum*.

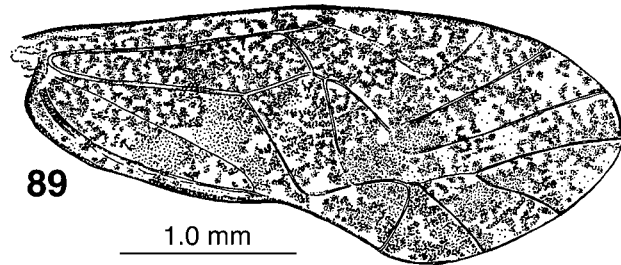
Discussion

Numerous species of *Trichadenotecnum* occur in Indonesia, and many are apparently scarce and have been taken in only small numbers. Many of them appear to be endemic taxa, and it is certain that further species await discovery. Both “true *Trichadenotecnum*” and putative *Loensia*-like taxa are well-represented in the region. Several of the latter appear similar to one or more of the numerous Chinese species but

are distinct on details of terminalia and wing pattern from all species depicted by Li (2002). However, with the considerable diversity of *Trichadenotecnum*-like taxa now known from China, Japan and Indonesia, it is increasingly evident that the complex has proliferated considerably in the eastern Palaearctic and tropical southeast Asia.

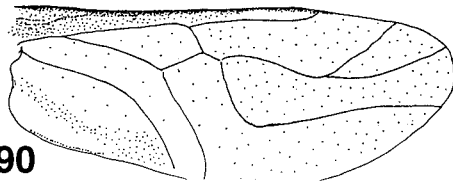
Detailed biogeographical comment is perhaps premature, with further collecting of these relatively scarce psocids needed before any major synthesis can be made. Likewise, division of the Indonesian representatives of the genus into species groups is not straightforward with a number of species difficult to allocate to any group erected by Yoshizawa (2001). Whereas the *spiniserrulum* group and the *majus* group are represented, other species are anomalous. Two species described from elsewhere (*T. gombakense*, *T. godavarensense*) are recorded in Indonesia for the first time. Two previously-described species are from Malaysia (*T. malayense*, *T. gombakense*), and *T. godavarensense* is from Nepal, so that there are clear links with the fauna of mainland southeast Asia.

ACKNOWLEDGMENTS. This paper is dedicated to the memory of Professor Ian Thornton (1926–2002), friend and mentor, whose studies did much to lay the groundwork for understanding the systematics and biogeography of Indonesian Psocoptera. This research was made possible by the award of a fellowship to ESK from the Australian Agency for International Development to undertake Ph.D. studies (of which this paper is a part) at La Trobe University. ESK also thanks the Indonesian Global Environmental Facilities Biodiversity Collection Project for financial assistance through a Small Research Grant for 1995–1996. We are grateful to two reviewers for their perceptive comments on this paper.

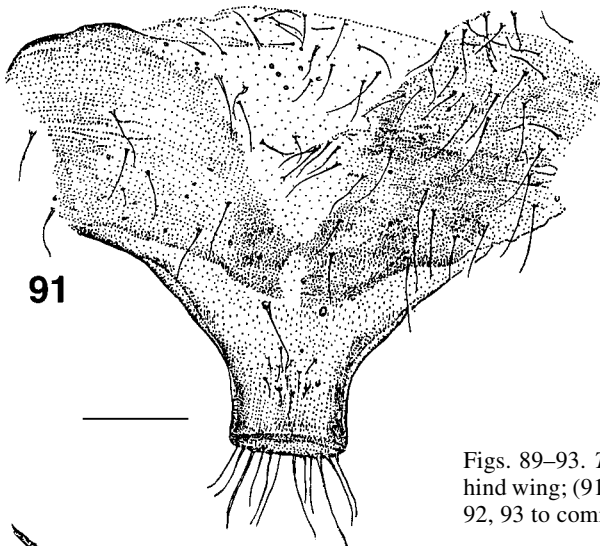


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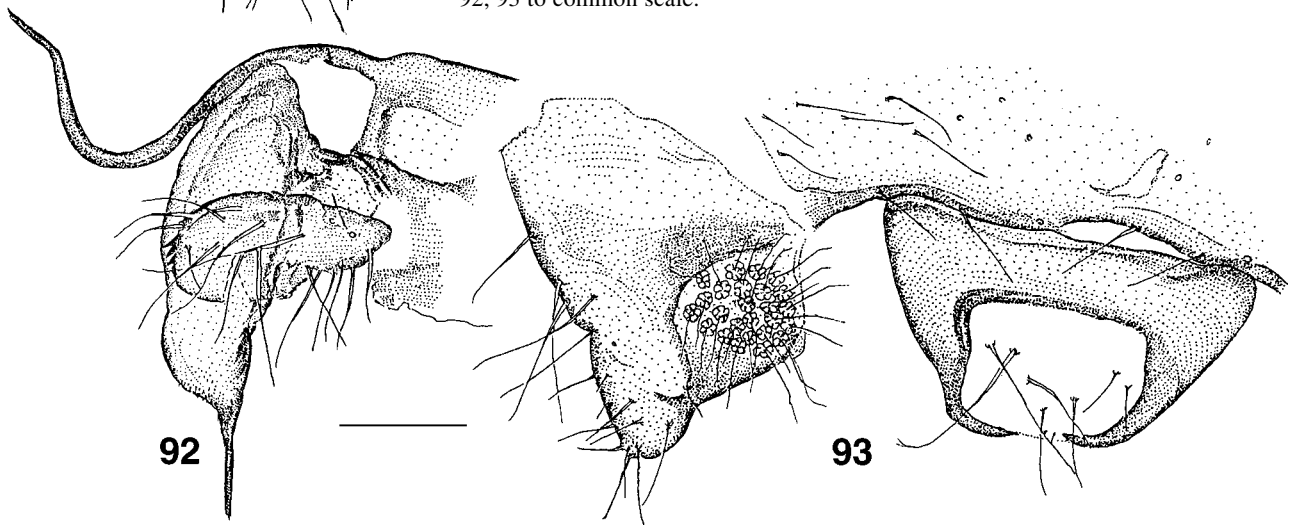


90



91

Figs. 89–93. *Trichadenotecnum cinnamonum* n.sp., ♀ paratype: (89) fore wing; (90) hind wing; (91) subgenital plate; (92) gonapophyses; (93) epiproct and paraproct. Figs. 92, 93 to common scale.



92

93

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