



Three new species of *Goniagnathus* (Hemiptera: Cicadellidae) from the Indian subcontinent with description of a new subgenus

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Abstract

Tropicognathus **subgen. nov.** of *Goniagnathus* is described with *Goniagnathus fumosus* Distant as the type species. Three new species, *Goniagnathus (Tropicognathus) anufrievi* **sp. nov.** (India: Karnataka), *Goniagnathus (Tropicognathus) nepalicus* **sp. nov.** (Nepal: Kathmandu) and *Goniagnathus (Tropicognathus) zeylanicus* **sp. nov.** (Sri Lanka) are described and illustrated. *G. bicolor* Distant is placed as a junior synonym of *G. fumosus* Distant. A key to the subgenera and species of *Goniagnathus* from the Indian subcontinent is also given.

Key words: Homoptera, morphology, classification, key, distribution

Introduction

The deltocephaline leafhoppers of the genus *Goniagnathus* Fieber (tribe Goniagnathini) are common inhabitants of grassland ecosystem in the Oriental, Afrotropical and Palaearctic regions and have recently also been reported from the Australian region (Fletcher and Zahniser, 2008). They are robust, squat leafhoppers readily recognized by short and broad heads, fused male subgenital plates, male style with membranous fracture at midlength, connective short and fused with aedeagus (Linnavuori, 1978, Fletcher and Zahniser, 2008). Fused subgenital plates are also found in some genera of the tribes Scaphytopiini (Viraktamath and Murthy, 1999; Viraktamath, 2004), Opsiini (Viraktamath and Viraktamath, 1980) and in the subfamily Acostemminae (Zahniser and Dietrich, 2008). Species of the tribe Goniagnathini differ from these in being more robust with short and broad heads. Emeljanov (1999) recognized four subgenera for the Palaearctic species of the genus. Dash and Viraktamath (2001) reviewed the genus for the Indian subcontinent and dealt with nine species, four of which were new to science and also provided a key for the species.

Examination of leafhopper material collected from India, Nepal and Sri Lanka revealed the presence of three undescribed species of *Goniagnathus* and this opportunity is taken to describe these species. In addition, these species and all but one of the previously described Indian species are placed in a new subgenus of *Goniagnathus*. This brings the known species of the genus to 52 for the world, and 12 for the Indian subcontinent. The aedeagus of the holotype male *Goniagnathus concavus* Dash & Viraktamath is illustrated to correct the discrepancy in the original illustration of the aedeagus and the description given by Dash and Viraktamath (2001).

The institutions and their abbreviations used in the text where the material studied will be deposited are as follows.

NHM The Natural History Museum, London, United Kingdom

IARI National Pusa Collection, Indian Agricultural Research Institute, New Delhi, India

IAUP Postgraduate Institute of Agriculture, University of Peradeniya, Sri Lanka
 UASB University of Agricultural Sciences, Bangalore India

Goniagnathus (Tropicognathus) subgen. nov.

Type species: *Goniagnathus fumosus* Distant

Male pygophore with well developed dorsal appendage; caudal margin with few stout setae. Subgenital plates fused but variable in shape. Apophysis of style either of uniform width or widened distally, apex bilobed or bifid. Aedeagal shaft with processes on shaft but lacking ventral basal processes.

Remarks: This subgenus differs from other subgenera in having a dorsal appendage and reduced number of stout setae on the caudal half of the male pygophore.

The subgenus includes, in addition to new species, the following species of *Goniagnathus* from the Indian subcontinent: *appellans* Baker, *concausus* Dash & Viraktamath, *fumosus* Distant, *nervosus* Melichar, *punctifer* (Walker), *quadripinnatus* Dash & Viraktamath, *symphysis* Dash & Viraktamath, *syncerus* Dash & Viraktamath. Examination of the type female of *G. bicolor* Distant in NHM revealed that it is identical with the female *G. fumosus* (Webb, personal communication) and hence it is treated here as a junior synonym of the latter.

Key to subgenera of the genus *Goniagnathus*

(modified from Emeljanov (1999))

1. Male pygophore with dorsal or caudal appendage well developed *Goniagnathus (Tropicognathus)* subgen. nov.
- Male pygophore without a dorsal or caudal appendage 2
2. Fused subgenital plate rounded; apex of style short, strongly dilated, hatchet-shaped; preapical lobe well developed 3
- Fused subgenital plate rectangular; apex of style large, longer than wide, apically truncate; preapical lobe indistinct 4
3. Fused subgenital plate short, upper margin of style strongly oblique; preapical prominence rounded; aedeagal shaft nearly straight, rather S-shaped; base small, without processes, dorsal part not projecting *Goniagnathus (Goniagnathus)* Fieber
- Fused subgenital plate elongate; upper margin of style oblique, nearly transverse; preapical prominence strong, laterally projecting nearly to style apex; aedeagal shaft arcuate, with basal forked process *Goniagnathus (Goniozygotes)* Emeljanov
4. Fused subgenital plate longer than broad; aedeagus without ventral processes 5
- Fused subgenital plate broader than long; Aedeagus with ventral pair of long processes *Goniagnathus (Epistagma)* Emeljanov
5. Dorsal part of aedeagal base not projecting (indistinct); apex of aedeagal base compressed, rounded in sagittal plane *Goniagnathus (Epitephra)* Emeljanov
- Dorsal part of aedeagal base lobe-like, projecting; apex of aedeagal base pointed *Goniagnathus (Episarca)* Emeljanov

Checklist of species of *Goniagnathus* from the Indian subcontinent

Goniagnathus (Epistagma) guttulinervis (Kirschbaum)

Jassus (Athysanus) guttulinervis Kirschbaum 1868: 116

Thamnotettix putoni Lethierry 1874: 444

Goniagnathus (sic) laminatus Ivanoff 1885: 143

Goniagnathus ocellatus Jacobi 1910: 133

Goniagnathus guttulinervis (Kirschbaum), Dash & Viraktamath 2001: 64, figs 1–5.

- Goniagnathus (Tropicognathus) anufrievi* **sp. nov.**
Goniagnathus (Tropicognathus) appellans Baker
Goniagnathus obesus Distant 1918: 43
Goniagnathus apellans Baker 1924: 367 new name for *Goniagnathus obesus* Distant 1916 not Jacobi 1910; Dash & Viraktamath 2001: 66, figs 6–13.
Goniagnathus (Tropicognathus) concavus Dash & Viraktamath
Goniagnathus concavus Dash & Viraktamath 2001: 66, figs 14–19
Goniagnathus (Tropicognathus) fumosus Distant
Goniagnathus fumosus Distant 1918: 43, figs 20–29
Goniagnathus bicolor Distant 1918: 43, **syn. nov.**
Goniagnathus (Tropicognathus) nepalicus **sp. nov.**
Goniagnathus (Tropicognathus) nervosus Melichar
Goniagnathus nervosus Melichar 1903: 180; Dash & Viraktamath 2001: 71, figs 30–37.
Goniagnathus (Tropicognathus) punctifer (Walker)
Bythoscopus punctifer Walker 1858: 104.
Goniagnathus spurcatus Melichar 1903: 181
Goniagnathus punctifer (Walker), Dash & Viraktamath 2001: 71, figs 38–44
Goniagnathus (Tropicognathus) quadripinnatus Dash & Viraktamath
Goniagnathus quadripinnatus Dash & Viraktamath 2001: 74, figs 45–50
Goniagnathus (Tropicognathus) symphysis Dash & Viraktamath
Goniagnathus symphysis Dash & Viraktamath 2001: 76, figs 51–58
Goniagnathus (Tropicognathus) syncerus Dash & Viraktamath
Goniagnathus syncerus Dash & Viraktamath 2001: 76, figs 59–65
Goniagnathus (Tropicognathus) zeylanicus **sp. nov.**

Key to species of *Goniagnathus* from the Indian subcontinent (males)

- 1 Male pygophore without dorsal appendage, with or without caudal appendage..... 2
- Male pygophore with dorsal appendage 3
- 2 Aedeagus with pair of ventral processes exceeding shaft (Palearctic, Oriental) .. *G. (E.) guttulinervis* (Kirschbaum)
- Aedeagus without pair of ventral processes (India: Rajasthan) *G. (T.) syncerus* Dash & Viraktamath
- 3 Aedeagal shaft rather tubular, long and of uniform width..... 4
- Aedeagal shaft constricted before apex; gonopore surrounded by sclerotized rim ending in a lateral short projection (India: Gujarat, Maharashtra, Karnataka, Tamil Nadu) *G. (T.) symphysis* Dash & Viraktamath
- 4 Pygophore lobe strongly narrowed caudally with appendage bordering caudo-dorsal margin only..... 5
- Pygophore lobe broad or broadened caudally, with appendage bordering both caudo-dorsal and caudal margins .. 11
- 5 Aedeagus with pair of processes (Figs 9, 16) 6
- Aedeagus with two pairs of processes (Figs 13, 22, 23)..... 7
- 6 Aedeagus with long processes at midlength (Figs 16, 17); fused subgenital plates with truncate caudal margin (Fig. 15) (Nepal) *G. (T.) nepalicus* **sp. nov.**
- Aedeagal shaft with short curved processes at apex (Figs 9, 11); fused subgenital plate convexly rounded (Fig. 8) (India: Karnataka) *G. (T.) anufrievi* **sp. nov.**
- 7 Aedeagal shaft with pair of apical and asymmetrical median pair of processes (India Gujarat, Maharashtra, Karnataka, Mizoram, Meghalaya, Kerala, Sri Lanka) *G. (T.) punctifer* (Walker)
- Aedeagal shaft with two pairs of processes either near apex or midlength..... 8
- 8 Aedeagal shaft with two pairs of processes near apex..... 9
- Aedeagal shaft with two pairs of processes near midlength..... 10
- 9 Aedeagal shaft with lateral processes slender and shorter than dorsal processes (India: West Bengal, Meghalaya, Maharashtra, Karnataka, Kerala, Lakshadweep Islands) *G. (T.) appellans* Baker
- Aedeagal shaft with lateral processes stouter and longer than dorsal processes (India: Orissa, Karnataka).....
..... *G. (T.) quadripinnatus* Dash & Viraktamath
- 10 Aedeagal shaft with ventral pair of processes directed caudally, about as long as apical length of shaft beyond origin of processes (Fig. 22); subgenital plate with truncate caudal margin (Fig. 20) (Sri Lanka)
..... *G. (T.) zeylanicus* **sp. nov.**
- Aedeagal shaft with ventral pair of processes directed anteriorly, shorter than apical length of shaft beyond origin of processes (Fig 13); subgenital plate with concave caudal margin (India: Gujarat, Karnataka)
..... *G. (T.) concavus* Dash & Viraktamath

- 11 Fused subgenital plate with truncate caudal margin, style extending beyond plate; aedeagal shaft with pair of forked apical processes (India: Gujarat, Maharashtra, Karnataka, Kerala, Tamil Nadu, Andhra Pradesh) *G. (T.) fumosus* Distant
- Fused subgenital plate with caudal margin slightly convex, medially notched; styles not exceeding length of plate; aedeagal shaft with a pair of dorsal and an unpaired prong-like process (India: Andhra Pradesh, Maharashtra, Karnataka, Pondicherry, Kerala, Sri Lanka) *G. (T.) nervosus* Melichar



FIGURES 1–6. Habitus and face of species of *Goniagnathus (Tropicognathus)*. 1&2. *G. (T.) anufrievi* sp. nov.; 3&4. *G. (T.) nepalicus* sp. nov.; 5&6. *G. (T.) zeylanicus* sp. nov.

***Goniagnathus (Tropicognathus) anufrievi* sp. nov.**

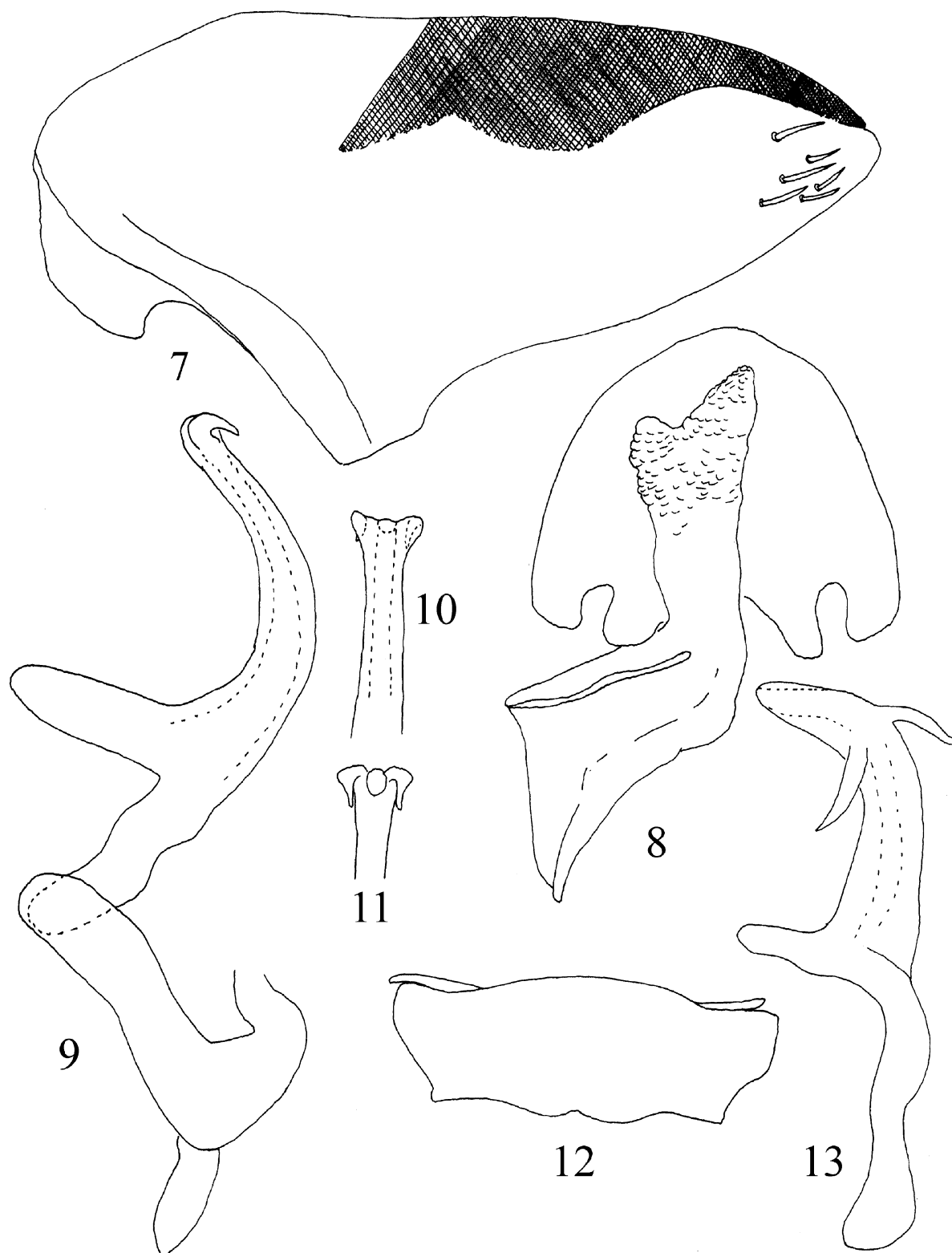
Figs 1, 2, 7–12.

Brown with dark brown markings. A transverse submarginal stripe slightly interrupted in middle and near ocelli dark brown; a median and a lateral ill defined spots flush with transverse stripe dark fuscous. Anterior margin of head cream yellow; short stripe between ocellus and eye solid dark brown; fronto-clypeus with transverse dark brown stripes; antennal pit, area below compound eyes, median spot on clypellus, lateral margin of genae, and oblique spot on upper extremity of lorum dark brown. Pronotum brown, mottled with pale brown spots. Scutellum with brown and dark brown markings. Forewings brown, venation dark brown richly mottled with pale brown. Coxae dark fuscous, fore-femora with dark fuscous spots alternated with pale brown, femora with dark fuscous patches, bases of hind tibial spines dark fuscous. Female paler than male especially on dorsal aspect, transverse stripe on head solid, not interrupted by pale spots.

Head slightly longer medially than next to eyes; pronotum flat with transverse rugae.

Male genitalia: Pygophore gradually narrowed and conically rounded at caudal region, with dorsal appendage broader at anterior region, with strongly sinuate ventral margin, caudal 0.33 comparatively narrower and pointed; anterior apodeme present at dorsal 0.33 portion of anterior margin, bilobed. Fused subgenital

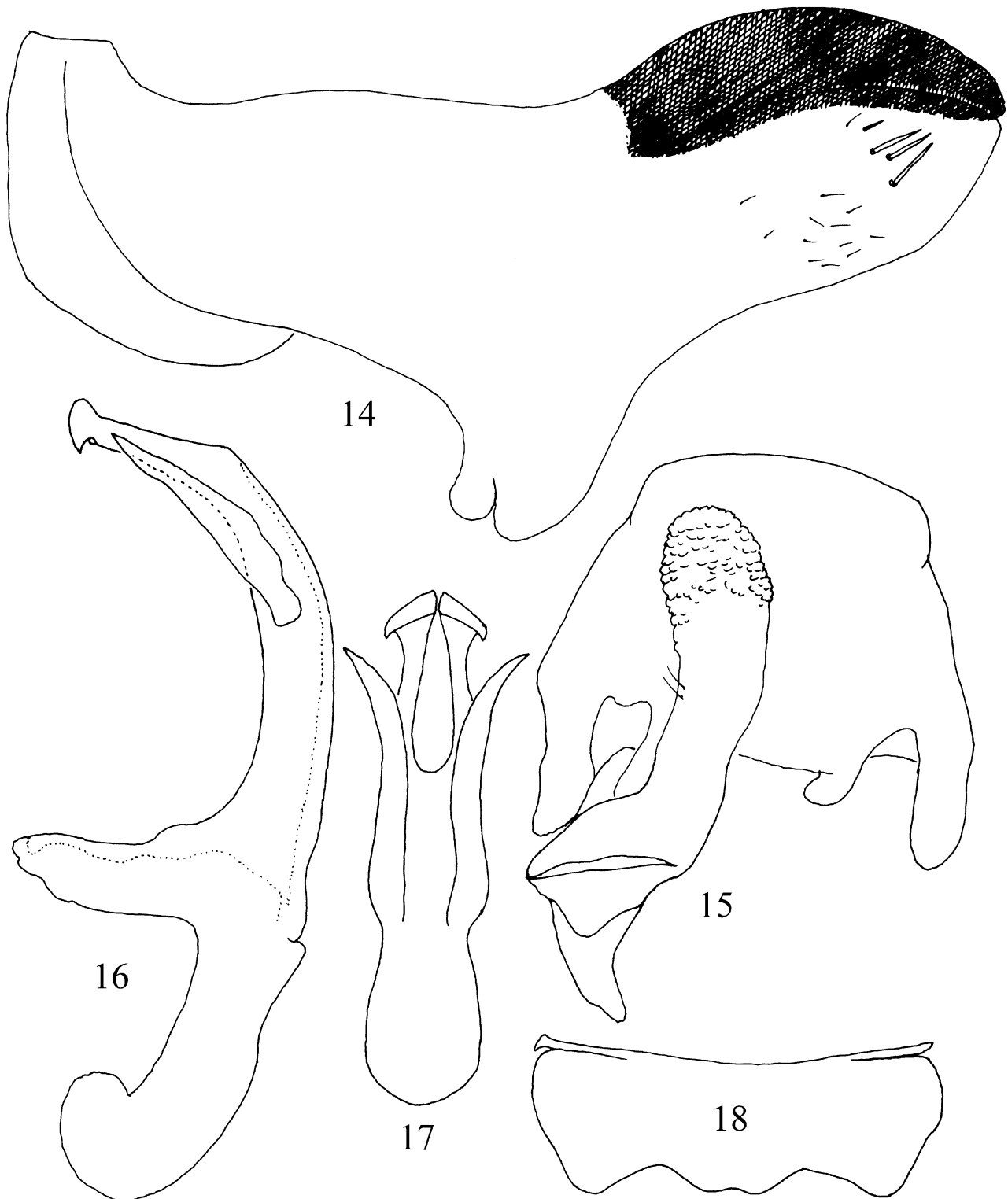
plate and valve caudally rounded. Style with strongly bilobed apophysis, inner lobe longer than outer one. Aedeagus simple, with well developed dorsal apodeme and preatrium, shaft arcuate, narrow caudally, gonopore apical, with recurved hook-like short appendage laterally.



FIGURES 7–13. Species of *Goniagnathus* (*Tropicognathus*): *G. (T.) anufrievi* **sp. nov.** 7. Pygophore lobe, lateral view; 8. Fused subgenital plate and style, dorsal view; 9. Aedeagus and part of style, lateral view; 10, 11. Dorsal and ventral views of apex of aedeagus; 12. Female seventh sternite. *G. (T.) concavus*: 13. Aedeagus lateral view (both dorsal and ventral processes of aedeagal shaft are paired).

Female: Seventh sternite broader than long, caudo-lateral angles prominent, hind margin medially convexly produced with a median notch.

Measurements: Male 4.6 mm long, 2.0 mm wide across eyes; female 6.5 mm long, 2.6 mm wide across eyes.



FIGURES 14–18. *Goniagnathus (Tropicognathus) nepalicus* sp. nov. 14. Pygophore lobe, lateral view; 15. Fused subgenital plate and style, dorsal view; 16. Aedeagus, lateral view; 17. Aedeagus, caudal view; 18. Female seventh sternite.

Material examined: Holotype male INDIA: Karnataka: Gundlupet, 3.vii.2008, Nagaraj, T. (UASB). Paratype: 1 female data as for holotype (IARI)

Remarks: The male is distinctly shorter than the female. *G. anufrievi* resembles *G. appellans* in the shape of the fused subgenital plate but differs in having a broad base to the pygophore appendage and shorter apical curved processes of the aedeagal shaft.

Etymology: This species is named after Dr G. A. Anufriev a renowned Auchenorrhyncha worker, for his help in deciphering the species of *Goniagnathus* from the Indian subcontinent.

***Goniagnathus (Tropicognathus) nepalicus* sp. nov.**

Figs 3, 4, 14–18.

Pale brown with reddish brown and brown markings. Crown with transverse stripe between ocelli, region between eye and ocellus with two thin short transverse stripes, dark brown. Anterior margin of head creamy white. Face with brown and reddish brown transverse stripes on frontoclypeus, brown spots on thorax, scutellum and forewings variable in number and richness. Fore-legs pale brown with reduced brown markings.

Head slightly longer medially than next to eyes.

Male genitalia: Pygophore twice as long laterally as maximum height, with well developed cephalic apodeme, anterior margin strongly oblique, so that articulation with sternum caudally displaced almost to mid-length of pygophore; dorsal appendage about 0.33 as long as length of pygophore, confined to dorsal margin, caudal lobe conical. Fused subgenital plate broader at base, narrowed caudally, with almost straight caudal margin. Style with apophysis rounded. Aedeagus with shaft straight in basal 0.33, then arcuate, with rather hook-like, short, flange on either side apically, with a pair of lateral appendages not reaching apex of shaft, slightly laterally curved and broad at midlength and tapered distally, gonopore subapical, elongate.

Female: Seventh sternite broader than median length, caudo-lateral angles rounded, hind margin with lateral area concavely excavated and median lobe medially emarginated.

Measurements: Male 5.9 mm long, 2.2 mm wide across eyes; female 6.2 mm long, 2.3–2.5 mm wide across eyes.

Material examined: Holotype male, NEPAL: Kathmandu (Tokha-Sundarijal), 1.xi–4.xi.1978, V.K. Thapa (UASB). Paratypes: 1 male, 2 females data as for holotype (BMNH, IARI, UASB).

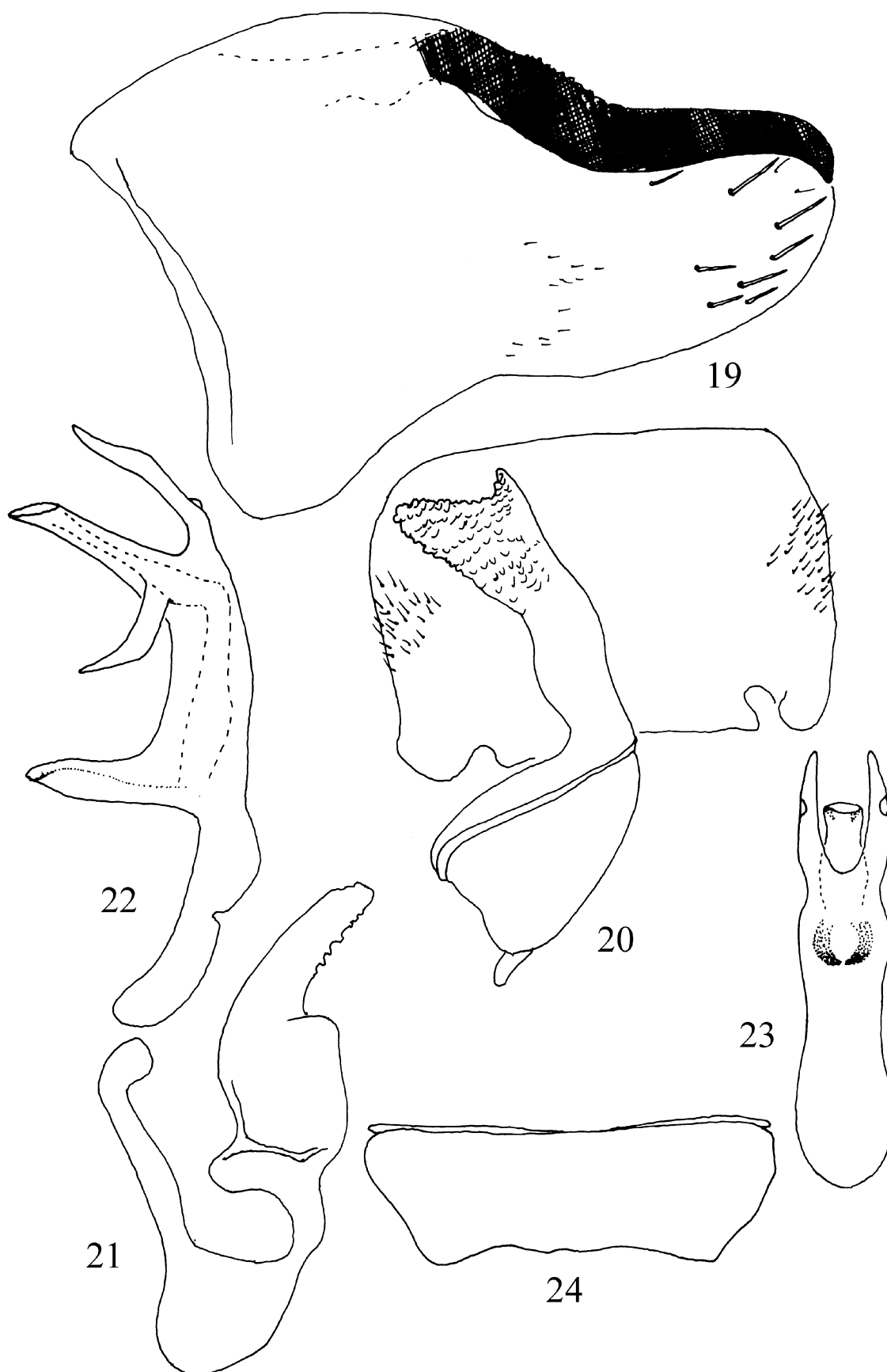
Remarks: *G. nepalicus* resembles *G. punctifer* in having extensive reddish brown markings and in the shape of the apex of subgenital plate. However, the new species differs from *G. punctifer* in having a rounded apex of the apophysis of the style, peculiar pygophore lobe and shape of the aedeagus.

***Goniagnathus (Tropicognathus) zeylanicus* sp. nov.**

Figs 5, 6, 19–24.

Coloration similar to that in *G. nepalicus* but slightly darker with less intensity of reddish brown coloration. Head with anterior marginal creamy yellow band interrupted by dark brown patches, additional transverse stripe of connected dark brown spots posterior to submarginal solid dark brown stripe. Fore femora with three ill defined stripes dark brown.

Male genitalia: Pygophore with caudal lobe rounded, ventral and cephalic margins concave, without apodemes; dorsal appendage half as long as pygophore, caudally narrowed and slightly ventrally curved. Fused subgenital plate broad, rather rectangular, with straight caudal margin. Style with apex of apophysis bifid, mesal lobe shorter and more slender than outer lobe. Aedeagus with shaft bent dorsally at mid-length, with a pair of ventral and a pair of lateral appendages at point of bend; ventral pair of appendages longer than lateral pair and slightly exceeding apex of shaft; gonopore apical.



FIGURES 19–24. *Goniagnathus (Tropicognathus) zeylanicus* sp. nov. 19. Pygophore lobe, lateral view; 20. Fused subgenital plate and style, dorsal view; 21. Style, lateral view; 22. Aedeagus, lateral view; 23. Aedeagus, caudal view; 24. Female seventh sternite.

Female: Seventh sternite broader than long, caudo-lateral angles sub-prominent, hind margin shallowly concave with a median insinuation.

Measurements: Male 6.0 mm long, 2.5–2.6 mm wide across eyes; female 6.6 mm long, 2.6 mm wide across eyes.

Material examined: Holotype male, SRI LANKA: Galagethara, 30.i.2007, R. Gnaneswaran (UASB). Paratypes: 1 male, 1 female, data as for holotype (BMNH, IAUP).

Ramarks: *G. zeylanicus* externally resembles, *G. fumosus*, as they share the similar shape of the fused subgenital plate. However, in *G. fumosus* the styles exceed subgenital plate which is not the case in *G. zeylanicus* and the structure of the aedeagus in the two species is entirely different. This species resembles *G. (T.) concavus* in having both the dorsal and the ventral processes of aedeagal shaft arising at the same level, but differs from it in the shape and direction of the ventral process (compare Figures 22 and 13).

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