

Descriptions of Psychodidae (Diptera) from the Western Ghats of India

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Abstract. Three new species of Psychodidae from the Western Ghats of India are described and illustrated. Specimens are from a single Malaise trap sample taken in 2007. *Horaiella pectinata* sp. nov. represents the first record of Horaiellinae from southern India; *Gondwanoscurus jezeki* sp. nov. and *Saximormia gladiator* sp. nov. represent new genus records for India and range extensions for both genera. *Telmatoscopus arcuatus* Vaillant, 1965 is transferred to *Gondwanoscurus* Ježek, 2002. A research prospectus for Indian Psychodidae is given.

Key words. Diptera, Psychodidae, moth flies, new species, new records, biodiversity, taxonomy, India, Oriental Region

Introduction

Little is known about the Psychodidae of India. DUCKHOUSE (1987) provided a review of the few taxonomic works that involved Indian (mainly non-phlebotomine) Psychodidae; only the work of IPE et al. (1986) was omitted, likely due to timing of the two publications. Subsequent to the work of QUATE (1962), IPE et al. (1986), IPE & SINGH (1994) and ILANGO (1994) each described at least one new species of non-phlebotomine Psychodidae. Despite this, at least three species described by IPE et al. (1986) are likely to be synonyms (see discussion by JEZEK & VAN HARTEN 2009), while that described by IPE & SINGH (1994) appears to be a synonym as well (Curler, pers. observ.).

To date, only one record exists for a non-phlebotomine psychodid from the Western Ghats of India (QUATE 1962, *Psychoda lucia*). Recently, a small number of Psychodidae, including some new taxa, were sorted from a Malaise trap sample taken in Wayanad, Kerala, India. Here, we describe three new species from this locality and comment on their distribution and possible relationships.

Material and methods

Study area. Specimens of Psychodidae were collected from the understory of the rainforest near a rocky stream flowing behind the Vythiri Resorts (11.30.520N–076.0453E, 863 m a.s.l.) in Vythiri, Wayanad (Dist.), Kerala, India. This locality is part of the Western Ghats biodiversity hotspot. Vythiri lies on the western edge of the Wayanad Plateau, approximately where the plateau begins an abrupt westward descent toward the Malabar plains. Vythiri is one of the wettest regions in India with an average annual rainfall above 3900 mm and the temperature ranges between 7–35°C. The climate is largely driven by southwest Monsoon (June to July) which contributes approximately 80 % of the rains and the northeast Monsoon (September to October) contributing approximately 15 % of the rains. The natural vegetation is mid-elevation tropical wet evergreen (*Cullenia-Messua-Palaquium* type). The presence of south Indian tree ferns (*Cyathea nilgirensis* Holttum) in the understory makes these forests distinguishable. Similar to the rest of the Western Ghats, this area has undergone tremendous land-use changes in the past century, where forests gave way for plantations of commercial crops such as tea, coffee, cardamom, etc.

Specimen collection and preparation. All individuals were collected in a Malaise trap and preserved in 95% ethanol. Specimens were macerated in cold potassium hydroxide (KOH) and mounted in Canada balsam. Observations and measurements were completed using an Olympus BX50 compound microscope equipped with differential interference contrast, and a Wild M5 stereomicroscope fitted with an ocular micrometer. Measurements are in millimeters, given as a mean followed by a range in parentheses where applicable. Total length of *Horaiella pectinata* was measured in lateral view from the anterior margin of the pronotum to the apex of the epandrial lobe. Head height was measured from the vertex to the ventral margin of the clypeus, except in *H. pectinata* where the mouthparts were included in this measurement. For *H. pectinata*, the head width was not measured because the specimen was slightly shifted on the slide, which would result in an inaccurate reading. Palpal ratios were computed as proportions, considering the basal palp segment as 1. Drawings were rendered with the aid of a drawing tube on the Olympus system.

Specimens are deposited with the following (acronyms used below): the Museum of the Zoological Survey of India, Western Ghats Regional Centre at Kozhikode, Kerala (ZSI-WGRC) and the National Museum of Natural History, Smithsonian Institution, Washington, D.C. (USNM).

Terminology. Descriptive terms used in this paper mainly follow CUMMING & WOOD (2009) except wing venation, which follows KRZEMINSKI (1992). It remains unclear whether cerci are present or absent in Psychodinae (see discussion in CURLER & MOULTON 2012). Despite the possibility that the claspers articulated posteriorly with the epandrium of Psychodinae may be, at least partially, derived from cerci, they are referred to here as “epandrial claspers” as an indication that their origin is not clearly understood. Also, the transparent sensory organs inserted on various antennal flagellomeres are termed “ascoids”, following WAGNER & IBÁÑEZ-BERNAL (2009). The term “flagellomere” is abbreviated below as “f”.

Taxonomy

Horaiella pectinata sp. nov.

Type material. HOLOTYPE: ♂, INDIA: KERALA: Wayanad, Vythiri Resort, near small stream, 1.–19.ii.2007, coll. M.E. Irwin (Malaise trap); deposited ZSI-WGRC (No: ZSI/WGRC/IR/IV/4471).

Diagnosis. Male. A small *Horaiella*, total length 0.99. Palpus 3-segmented; wing length less than 2 mm, radial fork arising basal to the apex of R_{2+3} , medial fork arising at level of R_{2+3} apex; terminalia with gonostyli gradually curved at base and apex, 9th tergum with lateral lobes digitiform, directed posterolaterally; cerci each with row of conical setae inserted posterodorsally, appearing pectinate.

Description. Male (Figs 1–5): *Measurements* (n=1): head height 0.26; head width (not measured); wing length 1.67; wing width 0.47; head with transverse row of ten elongate, rigid setae inserted anterodorsally; eyes rounded, dichoptic, widely separated; antenna with 17 articles; scape inconspicuous, about ½ the length of pedicel, slightly recessed within frons; pedicel globular; flagellomere one about 1.5× as long as f 2; f 2–12 gradually decreasing in length, f 13 appearing swollen, wider than preceding flagellomeres, f 14 slightly longer than preceding flagellomere, apical flagellomere about 1/3 the length of preceding flagellomere; f 1–12 with a single digitiform ascoid inserted ventrally to ventrolaterally about ¼ the length from apex of f 1 and mid-length on f 2–12. Palpus with three segments; palp segment two with numerous hyaline sensilla inserted posteromedially; palp segment proportions 1-1-1.5.

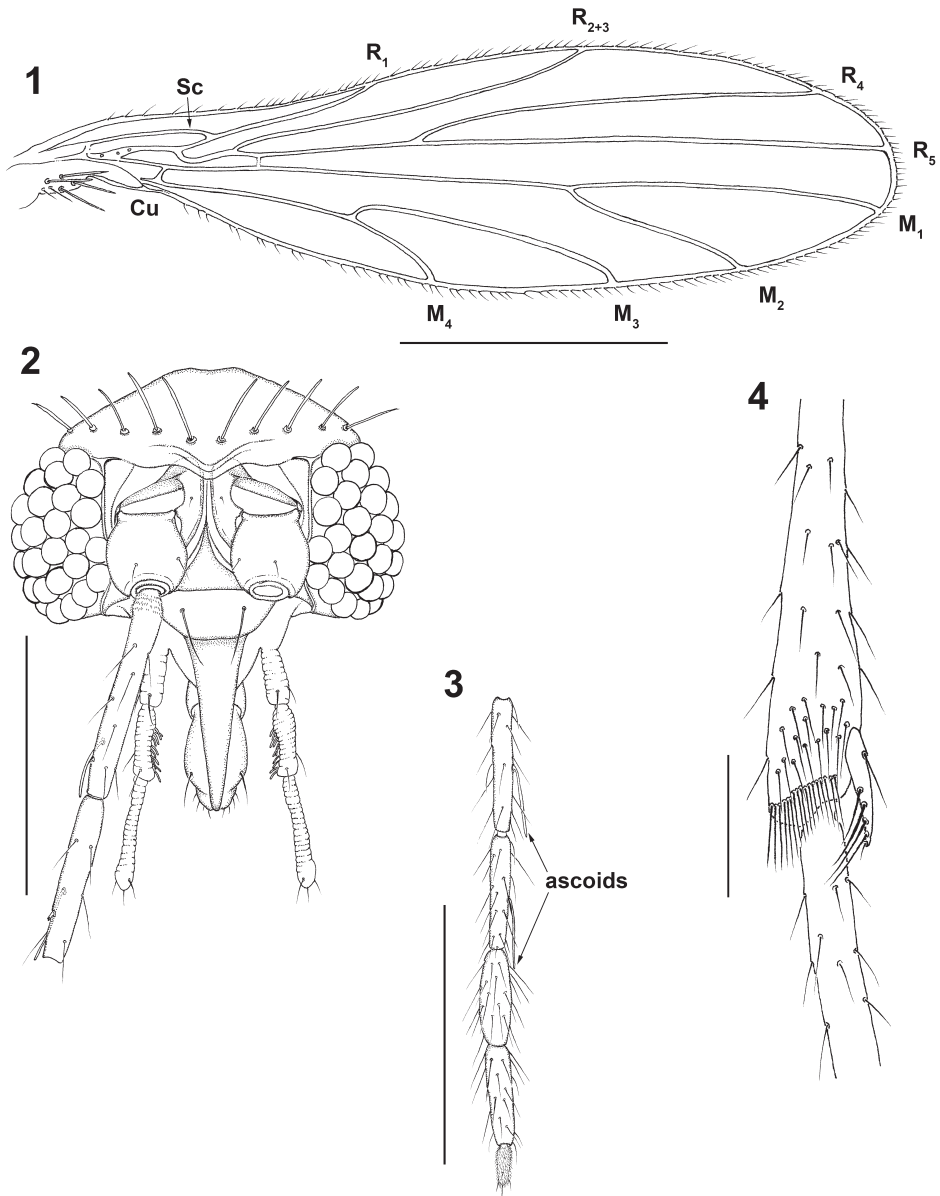
Thorax (Figs 1, 4). Wing with radial fork arising basal to the apex of R_{2+3} , medial fork arising at level of R_{2+3} apex; branches of medial fork divergent in comparison to those of radial fork; Sc ending in R_1 , R_s with three branches, M with four branches. Foretibiae each with spur-like projection inserted posteroapically; spur-like projection with a row of four conspicuous setae and one smaller seta inserted distally on its medial surface.

Terminalia (Fig. 5). unrotated, epandrium placed dorsally; epandrium with digitiform lobes posteriorly; lobes directed posterolaterally; gonostyli gradually curved at base and apex, sinuous in dorsal view, slightly longer than gonocoxites; cerci each with row of conical setae inserted posterodorsally, appearing pectinate, with one prominent clavate seta inserted dorsomedially; aedeagus bifurcate, branches divergent; parameres fleshy, bilobed posteriorly, encircling aedeagus.

Etymology. From the Latin adjective *pectinatus*, meaning “comblike, toothed” in reference to the remarkable cerci of this species; both have a row of tooth-like setae arranged in the shape of a comb.

Distribution. Recorded only from the type locality.

Comments. It is generally not advisable to describe a species based on a single specimen. In doing so, there is a greater possibility that interspecific variation will be overlooked and/or morphology will be misinterpreted; however, in some cases there are valid reasons to take this chance. *Horaiella* is a taxon that is rarely collected and most species of this group are described from limited material. For *H. pectinata* sp. nov., the excellently preserved holotype presented a unique opportunity to adequately describe a species of this poorly known genus from a region where it was not previously known to occur. Given the unique morphology of the



Figs 1–4. *Horaiella pectinata* sp. nov. 1 – wing; 2 – male head, frontal view; 3 – flagellomeres 11–15; 4 – apex of right fore tibia, with base of tarsus 1, mesal view. Scale bars: 1, 4 = 0.50 mm; 2–3 = 0.15 mm

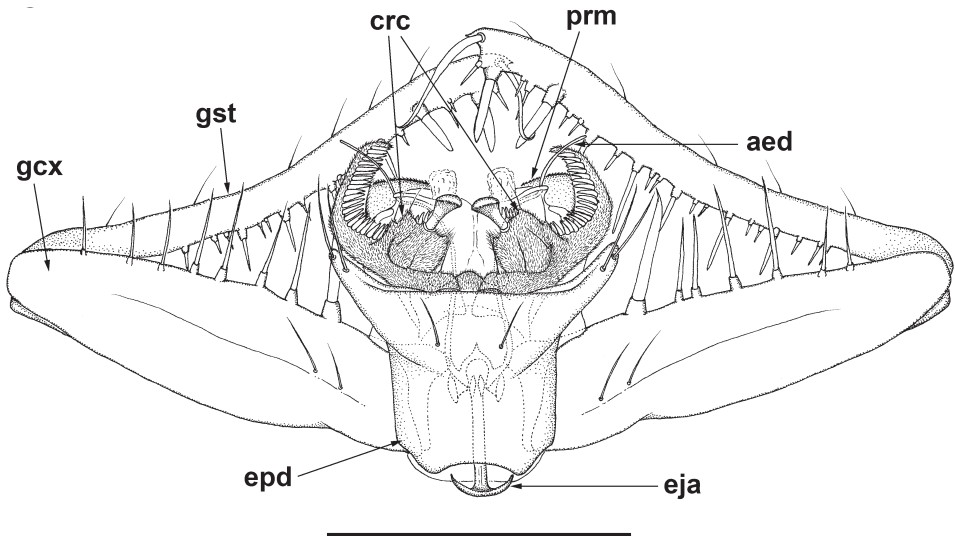


Fig 5. *Horaiella pectinata* sp. nov. male genitalia, dorsal view. Abbreviations: aed – aedeagus; crc – cerci; eja – ejaculatory apodeme; epd – epandrium; gcx – gonocoxite; gst – gonostyle; prm – paramere. Scale bar 0.15 mm.

new species, it is impossible to confuse it with other described species. Nonetheless, collection of additional material will make it possible to understand the morphology in greater detail.

Horaiella, and consequentially Horaiellinae, previously included four described species: *H. prodigiosa* Tonnoir, 1933 and *H. consimilis* Tonnoir, 1933 from West Bengal, *H. kuantunensis* Alexander, 1953 from southeastern China, and *H. iota* Curler, 2006 from central Thailand (CURLER et al. 2006). *Horaiella pectinata* sp. nov. increases the total number of described species to five. Based on the wing venation, three palp segments (as opposed to four in Himalayan and Chinese species), and the small body size (compared to Himalayan and Chinese species), *H. pectinata* is most similar to *H. iota*. Nonetheless, the aforementioned similarities are somewhat superficial given there are also marked differences in the genitalia of these two species. Most notably, *H. iota* does not have cerci developed for clasping, while *H. pectinata* does not have distinct parameres with the setose lobes found in all other described *Horaiella*. Lastly, the lack of torsion in the male genitalia of *H. pectinata* is a significant difference from the other described species.

Horaiella remains restricted to the Oriental Region; however, the significant variations in morphology among known species of this group, as well as the relatively discontinuous distribution suggest that more species remain to be discovered. Indeed, more species need to be examined before it will be possible to characterize the subfamily adequately and determine relationships within Horaiellinae.

Gondwanoscurus jezeki sp. nov.

Type material. HOLOTYPE: ♂, INDIA: KERALA: Wayanad, Vythiri Resort, near small stream, 1.–19.ii.2007, coll. M.E. Irwin (Malaise trap); deposited ZSI-WGRC (No:ZSI/WGRC/IR/IV/ 4472). PARATYPES: 1 ♂ 9 ♀♀, same data as holotype (1 ♂ and 1 ♀ deposited USNM, 8 ♀♀ deposited ZSI-WGRC).

Diagnosis. Male. Wing ovate, posterior margin slightly more convex than anterior, with patches of light infuscation apically on longitudinal veins; gonostyli bifurcate along apical 1/3, with ventral rami slightly longer than dorsal rami; epandrial claspers sinuous apically.

Female. Wing similar to male, sexual dimorphism not pronounced; sternum 8 with prominent bulge medially, posterior emargination U-shaped.

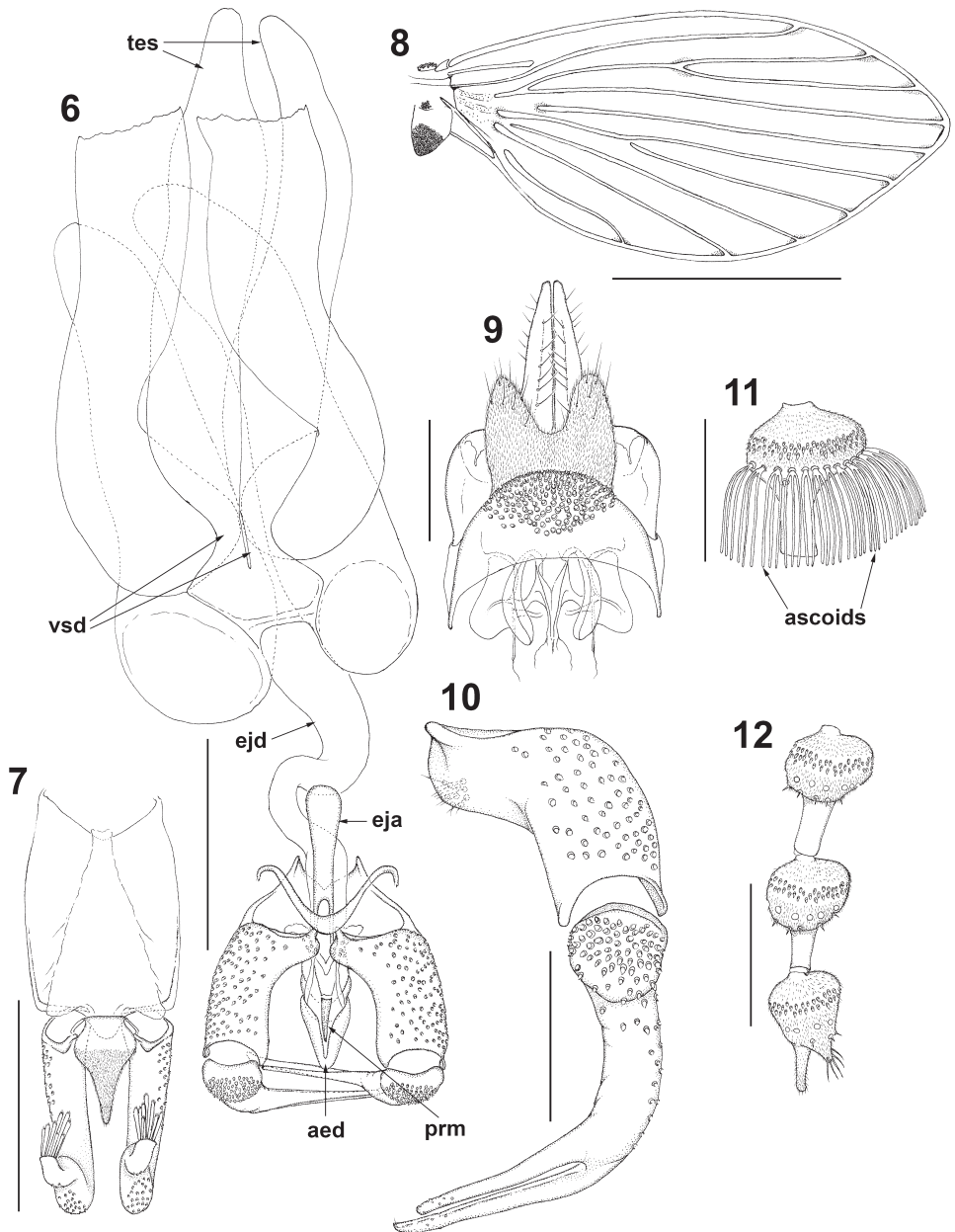
Description. Male (Figs 6–8, 10–12). Measurements (n = 2): head width 0.42 mm (0.41–0.46), head height 0.50 mm (0.48–0.52), wing length 2.30 mm (2.20–2.40), wing width 1.05 mm (1.00–1.10), palp segment proportion: 1.00-2.67-2.67-3.34. Head: frontal setae alveoli patch trapezoidal, without posterior extension; antennae with 16 articles, with scape approximately 1.5 times longer than wide; flagellomeres nodiform, with nodes exerted slightly medially; ascoids with 2–3 digitiform branches, arranged in single row around each node. Wing: ovate, with posterior margin slightly more convex than anterior margin; medial fork incomplete in some specimens, basal to radial fork, both forks arising basal to apex of M_4 . Terminalia: gonocoxites approximately three times longer than wide, with anterodorsal extensions touching medially; gonostyli globular at base, with apical 2/3 curved medially, constricted, apical 1/3 bifurcate; rami digitiform, with ventral ramus slightly longer than ventral ramus; parameral sheath tapered from base to apex, closely fitting shape of aedeagus; paramere visible as central acuminate sclerite, articulated with basal portion; basal portion of paramere obscured in holotype and paratype; distal part of aedeagus comprised of a single V-shaped sclerite in dorsal view, articulated with ejaculatory apodeme at apex; epandrium about 1.5 times as long as wide; epandrial claspers elongate, about 1.5 times the length of epandrium, with approximately 10 tenacula inserted dorsoapically; tenacula with apices frayed, not bifurcate.

Female (Fig. 9). Wing: ovate, posterior margin slightly more convex than anterior, proportionally less convex than in male; M_2 complete at base. Terminalia: sternum 8 with prominent bulge medially; bulge covered externally by setae alveoli; posterior lobes of sternum 8 setose, tapered slightly, rounded apically in ventral view; deeply emarginated posteriorly; posterior emargination U-shaped.

Etymology. Named for Jan Ježek, in recognition of his contributions to our knowledge of Psychodidae.

Distribution. Recorded only from the type locality.

Comments. With the exception of *Gondwanoscurus socotrensis* Ježek & Tkoč, 2012, described from the northeastern part of the Afrotropical Region (Socotra Island), most species of this genus have been described from the central or eastern part of the Oriental Region including Thailand, Malaysia and northern Borneo (Malaysia, Sabah) (CURLER 2009). *Gondwanoscurus jezeki* sp. nov. represents the first record of this genus for India and the westernmost record in the Oriental Region. Similarities between *G. socotrensis* and *G. jezeki* are striking (e.g. infuscated wing membrane at the apices of longitudinal veins, paramere with conical distal appendage) and the two species are undoubtedly close relatives. Perhaps the most obvious difference between *G. jezeki* and other species of *Gondwanoscurus* is the shape of



Figs 6–12. *Gondwanoscurus jezeki* sp. nov. 6 – male genital tract, hypandrium, gonopods, and aedeagus, dorsal view; 7 – epandrium, proctiger and epandrial claspers, dorsal view; 8 – wing; 9 – female genitalia, ventral view; 10 – left gonopod, dorsal view; 11 – flagellomere 5, with ascoids, dorsal view; 12 – apical flagellomeres, ascoids removed, dorsal view. Abbreviations: aed – aedeagus; eja – ejaculatory apodem; ejd – ejaculatory duct; prm – paramere; tes – testes; vsd – vasa deferentia. Scale bars: 6–7 = 0.25 mm; 8 = 1 mm; 9–12 = 0.10 mm.

the epandrial claspers, being sinuous (most visible in lateral view). *Gondwanoscurus jezeki* also differs from *G. socotrensis* in that the male wing is not significantly broader in the male as in the latter species. Females of *G. socotrensis* and *G. jezeki* are also similar, differing only in the shape of sternum 8: the former has a posterior emargination V-shaped while that in the latter is U-shaped.

Specimens of *G. jezeki* were fixed in a way that made maceration difficult and incomplete. Despite this circumstance, most characters were readily visible – including some structures (male genital tract) that are not often preserved when caustic reagents are used for maceration. Based on an examination of *G. jezeki*, it is desirable to see the entire male genital tract of other species in Psychodinae in order to determine whether there is any variation in these structures among genera.

Gondwanoscurus arcuatus (Vaillant, 1965) comb. nov.

Telmatoscopus (*Telmatoscopus*) *arcuatus* Vaillant, 1965: 222.

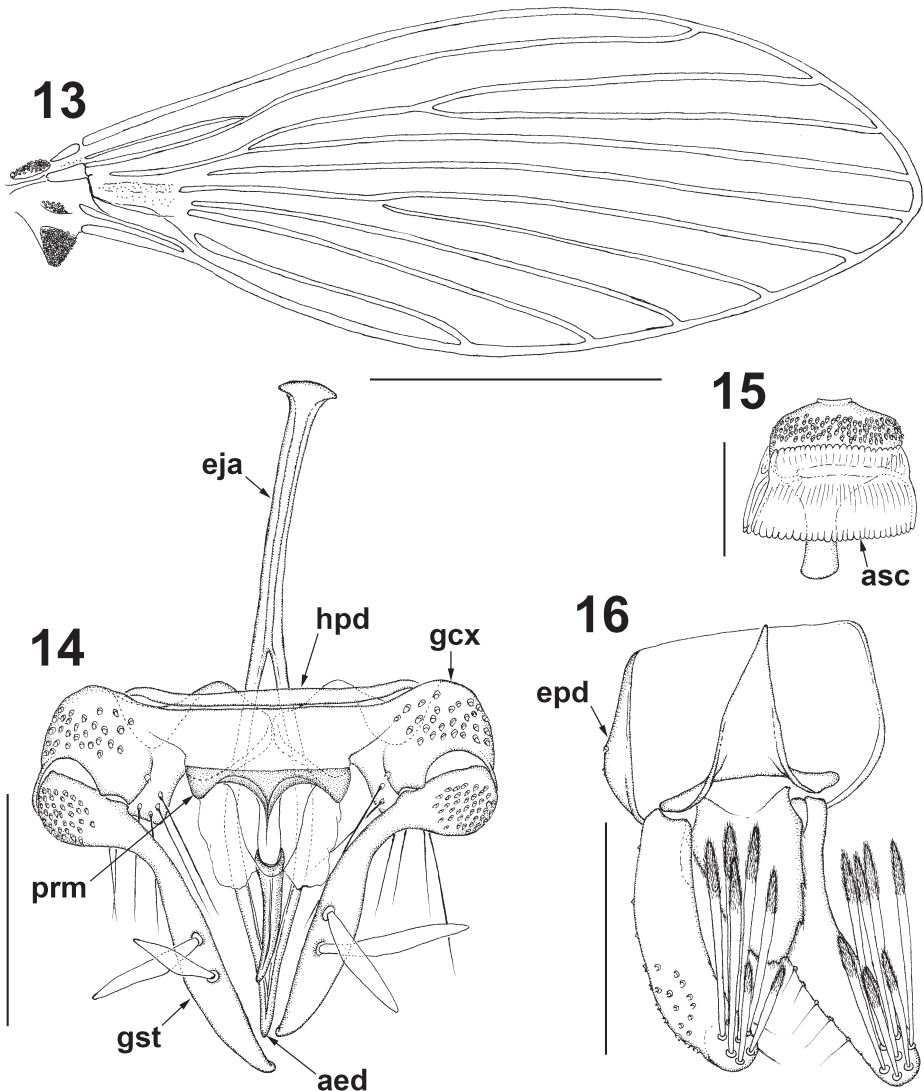
Comments. *Gondwanoscurus arcuatus*, described from Nepal, is a species of this genus previously overlooked by JEŽEK (2002) and CURLER (2009). Relatively few illustrations were given in the original description, making it difficult to compare with other *Gondwanoscurus*. Nonetheless, figures of the male genitalia provided by VAILLANT (1965) confirm at least that *G. arcuatus* is more similar to the species from western India and Socotra Island than to any other congeners. Overall, the male genitalia of *G. arcuatus*, *G. jezeki* and *G. socotrensis* are similar, with differences mainly in the length of structures (e.g. gonocoxites, rami of gonostyli, epandrial claspers).

Saximormia gladiator sp. nov.

Type material. HOLOTYPE: ♂, INDIA: KERALA: Wayanad, Vythiri Resort, near small stream, 1.–19.ii.2007, coll. M.E. Irwin (Malaise trap); deposited ZSI-WGRC (No: ZSI/WGRC/IR/IV/4473). PARATYPES: 2 ♂♂, same data as holotype; deposited ZSI-WGRC and USNM.

Diagnosis. Male. Ascoids appearing ribbed, with anterior and posterior margins scalloped (Fig. 15); gonostyli dorsoventrally compressed along apical half, each with prominent paired, spathiform setae inserted dorsally.

Description. Male (Figs 13–16). Measurements (n = 3): head width 0.28 mm, head height 0.33 mm (0.32–0.36), wing length 1.63 mm (1.56–1.70), wing width 0.63 mm (0.60–0.66), palpomere proportion: 1.00–2.50–2.50–3.50. Eye bridge as in other *Saximormia*, with four facet rows touching at median; frontal setae alveoli patch quadrate, without median dorsal projection. Antennae: scape about as long as wide; flagellomeres nodiform, most with several basiconic sensilla inserted apically on node; ascoids present on f 1–14, appearing ribbed, with anterior and posterior margins scalloped reminiscent of a pleated lamp shade; f 14 with apical process digitiform, approximately as long as node. Wing with Sc connected apically to R₁, radial and medial fork arising basal to apex of M₄, medial fork incomplete, R₅ apex posterior to wing apex. Terminalia: hypandrium inconspicuous, band-like, without modification; gonocoxites flat at base, globular at apex, with bases fused dorsomedially; gonocoxal apodemes



Figs 13–16. *Saximormia gladiator* sp. nov. 13 – wing; 14 – male genitalia: hypandrium, gonopods, and aedeagus, dorsal view; 15 – flagellomere 5, with ascoids; 16 – epandrium, proctiger and epandrial claspers, dorsal view. Abbreviations: aed – aedeagus; asc – ascoid; eja – ejaculatory apodem; epd – epandrium; gcn – gonocoxite; gst – gonostyle; prm – paramere. Scale bars: 13 = 0.50 mm; 14, 16 = 0.10 mm; 15 = 0.05 mm.

dorsoventrally compressed, plate-like, similar to ball and socket type (of Maruinini); gonostyli nearly three times as long as gonocoxites, dorsoventrally compressed along apical half, each with prominent paired, spathiform setae inserted dorsally; aedeagus clearly symmetrical, acuminate apically; parameres fused dorsally, encircling aedeagus, with a conical, moveable appendage dorsally; posterior appendage of paramere directed posterodorsally when at rest, directed anterodorsally when gonopods opened; epandrium hexagonal in dorsal view, about 1.5 times wider than long; hypoproct prominent, tongue-shaped, with dentation posteriorly; epandrial claspers tapered from base to apex, curved dorsally, each with seven tenacula inserted dorsoapically; tenacula frayed apically.

Etymology. From the Latin *gladiator*, meaning “swordsmen” in reference to the conspicuous, spathiform (sword-like) setae on the male gonostyli. Noun in apposition.

Distribution. Recorded only from the type locality.

Comments. *Saximormia gladiator* represents the first record of this genus for India, and the westernmost record for the Oriental Region. Only three species of *Saximormia* Ježek, 1984 have previously been described (JEŽEK 2010), and while their morphology is generally similar, *S. gladiator* is clearly unique due to the presence of prominent setae on the gonostyli. Few specimens of *S. gladiator* were available for study, and those that were did not slide mount in a way that was entirely conducive to studying genitalic morphology.

Discussion

As noted by DUCKHOUSE (1987), the limited sample of psychodid species described from India includes remarkable taxa such as *Horaiella* and *Neotelmatoscopus* Tonnoir, 1933. Species examined in our study are equally as intriguing and important to closing gaps in our knowledge of not only the Indian fauna, but also the world fauna. Improving our understanding of rarely collected taxa such as Horaiellinae is likely to help significantly with resolving the phylogeny of Psychodidae. Moreover, describing the new genera and species likely to be present in India would surely shed light on our understanding of the Oriental Psychodidae fauna in general. This further underscores the urgent need to document the biodiversity of regions such as the Western Ghats while it remains possible to do so.

Acknowledgements

Best wishes to Jan Ježek on his 70th birthday. We are grateful to M. E. Irwin and E. Schlinger for collecting and sorting the specimens, respectively. A. J. Jacobson kindly assisted with recording measurements. This work was supported in part by the Samuel W. Williston Dipterology Fund, Smithsonian Institution, Washington, D.C. (award to GRC).

We are grateful to the Kerala Forests and Wild life Department for permits, and the Schlinger Foundation, USA, for funding in support of fieldwork. Thorough reviews from Gunnar Mikalsen Kvitte and Danilo Pacheco Cordeiro helped to improve the manuscript.

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