



A review of the pleasing lacewing genus *Dilar* Rambur (Neuroptera, Dilaridae) from South Asia

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Abstract

The pleasing lacewing genus *Dilar* Rambur, 1838, is poorly known from South Asia, previously only three species were accounted. Here, we present a revision of *Dilar* from South Asia, with descriptions of five new species, namely *Dilar austroindicus* **sp. nov.**, *Dilar biprojectus* **sp. nov.**, *Dilar clavatus* **sp. nov.**, *Dilar miralobatus* **sp. nov.**, and *Dilar truncatus* **sp. nov.** In addition, *Dilar nietneri* Hagen, 1858, from Sri Lanka is re-described. A key to males of *Dilar* from South Asia is provided.

Key words: Neuropterida, taxonomy, new species, Oriental region

Introduction

Dilar Rambur, 1838, is the most species-rich group of the neuropteran family Dilaridae, currently with approximately 70 extant species that are widely distributed in the Palaearctic and Oriental regions (Liu *et al.* 2017; Oswald 2019). Recently, the taxonomy of the genus has been well studied for the fauna of Central Asia, East Asia, Southeast Asia, West Asia and Southeast Europe (Monserrat 2014; Zhang *et al.* 2014a,b,c, 2015, 2016; Aspöck *et al.* 2015; Martins *et al.* 2018; Li *et al.* 2019).

South Asia is composed of India, Pakistan, Bangladesh, Nepal, Bhutan, Sri Lanka, and Maldives, mainly with subtropical and tropical climates. The species of *Dilar* from this region are poorly known. Two species of *Dilar* are distributed around Kashmir, and they have been recently re-described and determined to biogeographically belong to Central Asia (Li *et al.* 2019). An additional three species—*Dilar geometroides* H. Aspöck & U. Aspöck, 1968, from China and Nepal, *Dilar harmandi* (Navás, 1909) from China, India, and Nepal, and *Dilar nietneri* Hagen, 1858, from Sri Lanka (H. Aspöck & U. Aspöck 1968; Zhang *et al.* 2014b)—are known from that part of Asia which forms per definitionem South Asia. *Dilar nietneri* was previously described based on external morphology, but without a detailed description of the genital characters, while the other two species were adequately described in Zhang *et al.* (2014b).

In this paper, we present a taxonomic review of *Dilar* from South Asia. Eight species of *Dilar* are herein recorded for this region, including five new species from central-western India and Sri Lanka, namely *Dilar biprojectus* **sp. nov.**, *Dilar austroindicus* **sp. nov.**, *Dilar clavatus* **sp. nov.**, *Dilar miralobatus* **sp. nov.** and *Dilar truncatus* **sp. nov.** The species *D. nietneri* is re-described and illustrated. A key to males of these species of *Dilar* from South Asia is given.

Material and methods

The specimens examined in the present study are deposited in the Natural History Museum (NHM), London, U.K.; in the Museum für Naturkunde, Leibniz-Institut für Evolutions- und Biodiversitätsforschung an der Humboldt-Universität zu Berlin (MFN), Berlin, Germany; in the California Academy of Sciences (CASC), San Francisco, CA, U.S.A.; in the Personal Collection of the late William R. Bert Hynd (PCWH), Farnham, Surrey, U.K., in the Collection of Hubert and Renate Rausch (CHRR), Scheibbs, Austria, and in the Collection of Horst Aspöck & Ulrike Aspöck (HUAC), Vienna, Austria. Information which clarifies the often cryptic locality names or abbreviations on the specimen labels is placed in square brackets, and geographic coordinates are provided if known.

Genitalic preparations were made by clearing the apex of the abdomen with KOH in 120° for about 6–8 minutes. After rinsing the KOH with distilled water, the apex of the abdomen was transferred to glycerin for further examination. Habitus photos of adults were taken by using Nikon D90 digital camera with Nikon MICRO NIKKOR 105 mm lens and Canon EOS 5D Mark IV digital camera with Canon MICRO PHOTO MP-E 65mm lens. The photos of genitalia were taken by using Nikon D800 with Leica DM 2000 optical microscope, and the genitalic figures were drawn by hand using a Nikon SMZ745 stereo microscope.

The terminology of wing venation generally follows Adams (1970) and Kukulová-Peck & Lawrence (2004). Terminology of the genitalia generally follows that of U. Aspöck & H. Aspöck (2008). The abbreviations used for wing veins are as follows: A, anal vein (here: A1, A2, A3); C, costa; CuA, cubitus anterior; CuP, cubitus posterior; MA, media anterior; MP, media posterior; R, radius; Rs, radius sector; Sc, subcosta.

Taxonomy

Genus *Dilar* Rambur, 1838

Dilar Rambur, [1838] 1837–1840: pl. 9, figs 4 and 5. **Type species:** *Dilar nevadensis* Rambur, [1838] 1837–1840: pl. 9 (monotypy).

Cladocera Hagen, 1860: 56. Nomen nudum.

Lidar Navás, 1909: 153. **Type species:** *Dilar meridionalis* Hagen, 1866: 295 (original designation).

Fuentenus Navás, 1909: 154. **Type species:** *Dilar campestris* Navás, 1903: 380 (original designation).

Rexavius Navás, [1909] 1908–1909: 664. **Type species:** *Dilar nietneri* Hagen, 1858: 482 (designated by Navás 1914: 10).

Nepal Navás, [1909] 1908–1909: 661. **Type species:** *Nepal harmandi* Navás, [1909] 1908–1909: 661 (original designation).

Notes. See detailed diagnosis of *Dilar* and current distribution in Liu *et al.* (2017). Notably, there is another genus of Dilaridae in South Asia, i.e. *Neonallachus* Nakahara, 1963, based on the record in Hynd (1992). *Neonallachus* can be clearly distinguished from *Dilar* by the forewing MA separating from R but not from RA (see Liu *et al.* 2017).

Key to males of *Dilar* from South Asia

1. Tergum 9 dorsally with a posteromedial projection (= dorsoprocessus) (Zhang *et al.* 2014b: figs 4, 8) 2
- Tergum 9 dorsally without posteromedial projection (= dorsoprocessus) (Figs 8, 12, 16, 20, 26, 31) 3
2. Gonocoxites 10 slenderly elongate in dorsal view; fused gonocoxites 11 slenderly bean-shaped in dorsal view (Zhang *et al.* 2014b: fig. 4) *D. geometroides* Aspöck & Aspöck
- Gonocoxites 10 rather short in dorsal view; fused gonocoxites 11 with a pair of elongate spinous projections extended laterally in dorsal view (Zhang *et al.* 2014b: fig. 8) *D. harmandi* (Navás)
3. Fused gonocoxites 11 medially with a rod-shaped projection (Figs 16, 27) 4
- Fused gonocoxites 11 medially without a projection 5
4. Forewing nearly hyaline, without obvious dark markings (Fig. 3); gonocoxite 9 much shorter than gonocoxite 10; distal half of gonocoxite 10 slenderly elongate, with spinous apex (Figs 16, 17) *Dilar clavatus* sp. nov.
- Forewing proximally with distinct dark brown stripes (Fig. 6); gonocoxite 9 longer than gonocoxite 10; gonocoxite 10 bean-shaped, not elongate (Fig. 27) *D. nietneri* Hagen
5. Gonocoxite 9 with two short projections, one distal and one subdistal (Figs 12, 13) *D. biprojectus* sp. nov.
- Gonocoxite 9 distally and subdistally with no more than one projection 6
6. Gonocoxite 9 subdistally with a medially directed swollen lobe; fused gonocoxites 11 nearly U-shaped (Fig. 20)
- *Dilar miralobatus* sp. nov.
- Gonocoxite 9 subdistally without additional lobe; fused gonocoxites 11 nearly W-shaped 7

7. Gonocoxite 9 posteriorly truncate (Fig. 31); gonocoxite 10 arcuate on inner margin (Fig. 32) *Dilar truncatus* sp. nov.
 - Gonocoxite 9 posteriorly forming an elongated, anteromedially directed projection (Fig. 8); gonocoxite 10 nearly right-angled on inner margin (Fig. 9) *Dilar austroindicus* sp. nov.

***Dilar austroindicus* sp. nov.**

(Figs 1, 8–11)

Diagnosis. The new species is characterized by the forewings with numerous pale brown markings, arranged as several inconspicuous transverse stripes; the male genital sclerites with gonocoxite 9 incurved, elongated and narrowed on distal half, with anteromedially directed swollen tip, and the gonocoxite 10 with inner margin medially nearly right-angled.

Description. Male. Body length 3.1 mm; forewing length 6.3 mm, hindwing length 5.8 mm.

Head generally brown, with yellowish brown setose tubercles. Vertex brown. Frons yellowish brown, medially with a dark brown rounded marking. Compound eyes blackish brown. Antenna pale brown, flagellum pectinate on most flagellomeres, medial branches much longer than those on both ends, longest branch nearly 3.0 times as long as corresponding flagellomere, distal seven flagellomeres simple.

Thorax yellow, pro- and mesonotum yellowish brown. Legs yellow, femora dark brown at tip. Wings hyaline, slightly pale yellow. Forewing 2.3 times as long as wide, with numerous pale brown markings, arranged as several inconspicuous transverse stripes; longitudinal veins pale yellow, interrupted by numerous brown spots; crossveins pale yellow. Hindwing 2.0 times as long as wide, almost immaculate.

Abdomen yellow. Tergum 9 in dorsal view with an arcuate anterior incision, a nearly U-shaped posterior incision, leaving a pair of broad hemitergites, which are obtuse distally and densely haired. Sternum 9 (Fig. 9) subtrapezoidal, membranous, only half of the length of tergum 9. Ectoproct subtriangular (Figs 8–9, 11), in dorsal view with an arcuate anterior incision, posteroventrally with a pair of nearly semicircular and flattened projections (Fig. 9); posterodorsally with a pair of bifurcate unguiform projections (Fig. 8). Gonocoxite 9 (Fig. 8) broadly inflated on proximal half, incurved, elongated and narrowed on distal half, forming an anteromedially directed projection which is slightly swollen at tip. Gonocoxite 10 (Fig. 9) almost as long as gonocoxite 9, obtuse and incurved proximally, inflated medially, with inner margin nearly right-angled in ventral view, distally with incurved and slenderly elongated apex. Fused gonocoxites 11 (Fig. 8) nearly W-shaped, laterally connecting to proximal half of gonocoxites 9 and gonocoxites 10. Hypandrium internum absent.



FIGURE 1. *Dilar austroindicus* sp. nov., male holotype, habitus. Scale bar: 2.0 mm.

Female. Unknown.

Materials examined. Holotype ♂, India, Tamil Nadu, Alagar Hills, 21km. N[orth]. Madurai, 28.IX.1985, C. W. & L. B. O'Brien (CASC).

Distribution. India (Tamil Nadu).

Etymology. The specific epithet “*austrorindicus*” refers to the distribution of this new species, restricted to southern India.

Remarks. *Dilar anstroindicus* sp. nov. appears to be closely related to *D. biprojectus* sp. nov. and *D. truncatus* sp. nov. in having similar male complexes of the gonocoxites 9, 10 and 11, with the inflated gonocoxite 9 distally or subdistally forming a projection directed medially (Figs 8, 12, 31), the gonocoxite 10 inflated on proximal half and falcate on distal half (Figs 9, 13, 32), and the fused gonocoxites 11 anteriorly convex at middle (Figs 8, 12, 31). However, *D. anstroindicus* sp. nov. can be distinguished from the two latter species by the gonocoxite 9 distally forming an anteromedially directed projection, which is swollen at tip (Fig. 8) and by the gonocoxite 10 with its inner margin medially nearly right-angled (Fig. 9). In *D. biprojectus* sp. nov., the male gonocoxite 9 subdistally and distally forms two short projections, one directed posteriorly and the other anteromedially (Fig. 12). In *D. truncatus* sp. nov., the male gonocoxite 9 distally is truncate and subdistally forms a short medially directed projection (Fig. 31). The two latter species have arcuate inner margins on the male gonocoxite 10 (Figs. 13, 32).

Dilar biprojectus sp. nov.

(Figs 2, 12–15)

Diagnosis. The new species is characterized by the forewing with numerous pale brown markings which are arranged as transverse arcuate stripes; male gonocoxite 9 with distally and subdistally two short projections, and the male gonocoxite 10 is distally incurved and with falcate apex.

Description. Male. Body length 3.0 mm; forewing length 5.9 mm, hindwing length 5.3 mm.

Head generally yellowish brown, with pale yellowish brown setose tubercles. Vertex yellowish brown. Frons yellow. Compound eyes blackish brown. Antenna yellowish brown, flagellum pectinate on most flagellomeres, medial branches much longer than those on both ends, longest branch nearly 3.0 times as long as corresponding flagellomere, distal seven flagellomeres simple.

Thorax yellow, meso- and metathorax yellowish brown, and mesoscutellum with a brown subtriangular marking. Legs yellow, femora and tibiae dark brown at their tips. Wings hyaline, slightly smoky brown. Forewing 3.0 times as long as wide, with dense dark brown markings, arranged as transverse arcuate stripes; longitudinal veins pale yellow, interrupted by many brown spots; crossveins pale yellow. Hindwing 2.0 times as long as wide, paler than forewing.

Abdomen yellow. Tergum 9 in dorsal view with an arcuate anterior incision, a nearly U-shaped posterior incision, leaving a pair of broad hemitergites, which are obtuse distally and densely haired. Sternum 9 (Fig. 13) subtrapezoidal, membranous, only half of the length of tergum 9. Ectoproct subtriangular (Figs 12–13, 15), in dorsal view with an arcuate anterior incision, posteroventrally with a pair of nearly semicircular and flattened projections (Fig. 13); posterodorsally with a pair of unguiform projections (Fig. 12). Gonocoxite 9 (Fig. 12) inflated, distally with short projection and subdistally with anteromedially directed additional projection which is slightly longer than the distal projection. Gonocoxite 10 (Fig. 13) almost as long as gonocoxite 9, proximally and medially swollen, distally slenderly elongate, with incurved and falcate apex. Fused gonocoxites 11 nearly W-shaped, laterally connecting to proximal half of gonocoxites 9 and 10 (Figs 12–13). Hypandrium internum subtrapezoidal (Fig. 13).

Female. Unknown.

Materials examined. Holotype ♂, India, Mahar[ashtra], 5km. SW Mahabaleshwar, 19.X.1985, C. W. & L. B. O'Brien (CASC). Paratype 1♂, same data as holotype (CASC).

Distribution. India (Maharashtra).

Etymology. The species name “*biprojectus*” refers to the shape of gonocoxite 9, with two short projections distally and subdistally.

Remarks. For differentiation, see Remarks under *Dilar anstroindicus* sp. nov.



FIGURE 2. *Dilar biprojectus* sp. nov., male holotype, habitus. Scale bar: 2.0 mm.

***Dilar clavatus* sp. nov.**

(Figs 3, 16–19)

Diagnosis. The new species is characterized by the forewing with inconspicuous brown markings, the male genital sclerites with gonocoxite 9 nearly spindle-shaped with acutely pointed base and obtuse tip, the gonocoxite 10 swollen at base and slenderly elongated with incurved spinous tip, and the fused gonocoxites 11 medially with a rod-shaped projection.

Description. Male. Body length 2.6–3.0 mm; forewing length 4.5–4.8 mm, hindwing length 4.0–4.2 mm.

Head generally brown, with pale yellow setose tubercles. Vertex brown. Frons yellow, medially with a dark brown rounded marking. Compound eyes blackish brown. Antenna brown, flagellum pectinate on most flagellomeres, medial branches much longer than those on both ends, longest branch nearly 4.0 times as long as corresponding flagellomere, distal seven flagellomeres simple.

Thorax brown, meso- and metathorax yellow, mesonotum brown, paler on posterior, metanotum yellow. Legs pale brown, femora and tibiae dark brown at their tips. Wings hyaline, slightly smoky brown. Forewing 3.0 times as long as wide, with dense inconspicuous pale brown markings, arranged irregularly; longitudinal veins pale yellow, interrupted by numerous brown spots; crossveins brown. Hindwing 2.6 times as long as wide, almost immaculate.

Abdomen pale brown. Tergum 9 in dorsal view with an arcuate anterior incision, a nearly U-shaped posterior incision, leaving a pair of broad hemitergites, which are obtuse distally and densely haired. Sternum 9 (Fig. 17) subtrapezoidal, membranous, only half of the length of tergum 9, membranous. Ectoproct subtriangular (Figs 16–17, 19), in dorsal view with an arcuate anterior incision, posteroventrally with a pair of nearly semicircular and flattened projections (Fig. 17); posterodorsally with a pair of unguiform projections (Fig. 16). Gonocoxite 9 (Fig. 16) nearly spindle-shaped, strongly inflated on proximal half, with acutely pointed base, slightly narrowed on distal half, with obtuse tip. Gonocoxite 10 (Fig. 17) longer than gonocoxite 9, nearly spoon-shaped on proximal half, slenderly elongate on distal half, with incurved and spinous apex. Fused gonocoxites 11 (Fig. 17) nearly W-shaped, medially

with a rod-shaped projection, laterally connecting to proximal half of gonocoxites 9 and 10. Hypandrium internum absent.

Female. Unknown.

Materials examined. Holotype ♂, Ceylon, Anu[radhapura] Dist[riect]. Irrigation Bungalow Padaviya, 180 ft [55 m], 27.II–9.III.1970, Davis & Rowe (PCWH). Paratypes 2♂, same data as holotype (PCWH); 1♂, Ceylon, Anu[radhapura] Dist[riect]. Wildlife Soc. Bungalow Hunuwilagama, Wilpattu, 200 ft [61 m], 10–19.III.1970, Davis & Rowe (PCWH).

Distribution. Sri Lanka (North Central).

Etymology. The species name “*clavatus*” refers to the peculiar configuration of the fused male gonocoxites 11, which medially has a rod-shaped projection.

Remarks. A significant feature of *Dilar clavatus* **sp. nov.** is the fused male gonocoxites 11 medially with a rod-shaped projection (Figs 16, 17). Of all known species of *Dilar*, only two others have a similar structure, namely *Dilar nietneri* and *Dilar abnormis* Zhang, Liu & Winterton (Zhang *et al.* 2016). *D. clavatus* **sp. nov.** and *D. nietneri* both from Sri Lanka have similar male fused gonocoxites 11, which medially bear a rod-shaped projection (Figs 16, 27), but *D. abnormis* from Thailand has a pair of long hook-like projections (Zhang *et al.*, 2016: fig. 11).

Accordingly, *D. clavatus* **sp. nov.** and *D. nietneri* appear to be closely related, but the male gonocoxites 9 and 10 of these two species have obvious differences. In *D. clavatus*, the male gonocoxite 9 is spindle-shaped, shorter than gonocoxite 10 (Fig. 16), and the distal half of male gonocoxite 10 is slenderly elongate with spinous apex (Fig. 17). However, in *D. nietneri* the male gonocoxite 9 is nearly rectangular, longer than gonocoxite 10, and the male gonocoxite 10 is falcate bean-shaped (Fig. 27).



FIGURE 3. *Dilar clavatus* **sp. nov.**, male holotype, habitus. Scale bar: 2.0 mm.

***Dilar geometroides* Aspöck & Aspöck, 1968**

Dilar geometroides Aspöck & Aspöck, 1968: 15. Type locality: Nepal (Janakpur).

Dilar aspersionis Yang, 1988: 197. Type locality: China (Tibet: Linzhi).

Diagnosis. This species is characterized by the forewing with numerous pale brown markings, the male gonocoxite 9 rather inflated, and the gonocoxite 10 slenderly elongate and bifid at the tip.

Materials examined. 1♂, W-Nepal: Modi-Khola, Pothana-Landrung, 25 km NW Pokhara (406), 24.15N 83.50E, 1600–1900 m, 7.V.1984, leg. Holzschuh Carolus / 84-406 (CHRR); 4♂, OST-Nepal: Koshi Sig.:507 / 85, Basantapur, 27.10N 87.30E, 2300 m, 30.V.–2.VI.1984, leg. Holzschuh C. / 85-507 (CHRR); 2♂, E-Nepal: Dhankuta, Arun-Valley, Chichila, 2000 m, 31.V.1983, leg. C. Holzschuh / 83-316 (CHRR); 1♂ India, Sikkim / McLachlan Coll. B.M. 1938–674 (NHM).

Distribution. China (Tibet), India (Sikkim), Nepal (Dhaulagiri, Janakpur, Kosi).

Dilar harmandi (Navás, 1909)

Nepal harmandi Navás, 1909: 661. Type locality: India (West Bengal).

Diagnosis. This species is characterized by the forewing with several scattered yellowish brown spots, the male gonocoxite 10 rather short, and the gonocoxites 11 with a pair of elongate spinous projections that extend laterally and connect to the median part of gonocoxite 9.

Materials examined. 1♂, Nepal, Bagam, Sindhupalchok Sarmatang, 27.57N 85.36E, 2500 m, 4.VI.1989, leg. C. Holzschuh / 909-89 (CHRR); 1♂, West-Nepal, Myagdi Distr[ict], Ghorepani, 28.24N 83.42E, 2800–3000 m, 11.VI.1986, leg. Carolus Holzschuh / Sig.:86-N-8 (CHRR); 1♂, West-Nepal: am Fluß, Kalu Gandaki Khola, Kalopani-Kopehepani, 1500–2400 m, 20.V.1984, leg. C. Holzschuh / 84-417 (CHRR); 3♂, W-Nepal: Ghar-Kola, Chitre, 35 km NW, Pokhara, 28.30N 83.40E, 2400 m, 26–31.V.1984, leg. C. Holzschuh / 84-421 (CHRR); 1♂, W-Nepal: Modi-Khola, Landrung, 25 km NW Pokhara, 28.14N 83.58E, 1100–1800 m, 3–6.VI.1984, leg. Holzschuh Carolus / 84-424 (CHRR); 2♂, W-Nepal: Modi-Kola, Banthanti-Landrung, 25 km NW Pokhara, 28.14N 83.58E, 1600–2500 m, 2.VI.1984, leg. Holzschuh Carolus / 84-423 (CHRR); 1♂, West-Nepal: am Fluß, Kalu Gandaki Khola, Kalopani, 2400 m, 17–19.V.1984, leg. C. Holzschuh / 84-415 (CHRR); 2♂, W-Nepal: Myagdi Distr[ict], Hille-Ghorepani, 28.23N 83.42E, 1600–2600 m, 10.VI.1986, leg. C. Holzschuh / 84-N-7 (CHRR); 1♂, Ost-Nepal: Koshi Sig.:507 / 85, Basantapur, 27.10N 87.30E, 2300 m, 30.V.–2.VI.1984, leg. Holzschuh C. / 85-507 (CHRR); 1♂, Ost-Nepal, Koshi Sig.: 507 / 85, Basantapur, 27.10N 87.30E, 2300 m, 30.V.–2.VI.[1984], leg. Holzschuh C. (CHRR); 1♂, West-Bhutan, Thimphu Distr[ict], Taba, 2600 m, 4–17.VII.1988, leg. Carolus Holzschuh / 88B809 (CHRR); 1♂, West-Bhutan, Thimphu Distr[ict], Taba, 2600 m, 20–30.VI.1988, leg. Carolus Holzschuh / 88B805 (CHRR); 2♂, W-Bhutan, Paro Prov[ince], Chiley-La, 3000–3500 m, 10–13.VII.1990, leg. C. Holzschuh / 90/001 (CHRR); 1♂, West-Bhutan, Paro Distr[ict], Chiley-La, 3000 m, 21.VI.1988, leg. Carolus Holzschuh / 88B806 (CHRR).

Distribution. Bhutan (Paro, Thimpu) (new country record), China (Tibet), Nepal (Bagmati, Dhaulagiri, Gandaki, Kosi, Mechi).

Dilar miralobatus sp. nov.

(Figs 4, 20–23)

Diagnosis. The new species is characterized by the forewing with numerous pale brown markings, arranged as inconspicuous transverse stripes, the male genital sclerites with gonocoxite 9 bifurcated, subdistally with an additional swollen lobe and distally with elongate spinous apex, the gonocoxite 10 slenderly elongate and incurved at a right angle on distal half, and the fused gonocoxites 11 nearly U-shaped.

Description. Male. Body length 2.9–3.2 mm; forewing length 5.4–5.7 mm, hindwing length 4.6–4.9 mm.

Head brown, with pale brown setose tubercles. Vertex dark brown. Frons pale brown. Compound eyes blackish brown. Antenna brown, flagellum pectinate on most flagellomeres, medial branches much longer than those on both ends, longest branch nearly 3.0 times as long as corresponding flagellomere, distal seven flagellomeres simple.

Pro-, meso- and metathorax brown, pro- and metanotum yellowish brown, mesonotum brown, darker on posterior. Legs pale brown, femora and tibiae dark brown at their tips. Wings hyaline, slightly pale yellow. Forewing 2.1 times as long as wide, with dense pale brown spots, arranged as transverse stripes; longitudinal veins pale yellow, interrupted by numerous brown spots; crossveins pale brown. Hindwing 2.0 times as long as wide, almost immaculate.

Abdomen pale brown. Tergum 9 in dorsal view with an arcuate anterior incision, a nearly U-shaped posterior incision, leaving a pair of broad hemitergites, which are obtuse distally and densely haired. Sternum 9 (Fig. 21) subtrapezoidal, membranous, only half of the length of tergum 9. Ectoproct subtriangular (Figs. 20–21, 23), in dorsal view with an arcuate anterior incision, posteroventrally with a pair of nearly semicircular and flattened projections (Fig. 21); posterodorsally with a pair of subtriangular projections (Fig. 20). Gonocoxite 9 (Fig. 20) inflated on proximal half, bifurcated, narrowed and slenderly elongated on distal half, subdistally with an additional swollen lobe directed medially, distally with spinous tip directed posteriad. Gonocoxite 10 (Fig. 21) almost as long as gonocoxite 9, inflated on proximal half, slenderly elongate and incurved at a right angle on distal half. Fused gonocoxites 11 (Fig. 20) nearly U-shaped, laterally connecting to proximal half of gonocoxites 9 and 10. Hypandrium internum absent.

Female. Unknown.

Materials examined. Holotype ♂, Ceylon, Anu[radhapura] Dist[riect]. Irrigation Bungalow Padaviya, 180 ft [55 m], 27.II–9.III.1970, Davis & Rowe (PCWH). Paratype 2♂, Ceylon, Anu[radhapura] Dist[riect]. Wildlife Soc. Bungalow Hunuwilagama, Wilpattu, 200 ft [61 m], 10–19.III.1970, Davis & Rowe (PCWH).

Distribution. Sri Lanka (North Central).

Etymology. The specific epithet “*miralobatus*” refers to the male gonocoxite 9 subdistally with an additional swollen lobe directed medially.

Remarks. *Dilar miralobatus* sp. nov. can be distinguished from the other *Dilar* species by the male with the bifurcated gonocoxite 9, distally with spinous apex and subdistally with an additional medially directed swollen lobe (Fig. 19); the gonocoxite 10 incurved at a right angle on distal half (Fig. 20), and the fused gonocoxites 11 nearly U-shaped (Fig. 19). In the other seven *Dilar* species from south Asia, the gonocoxite 9 has no additional lobes.



FIGURE 4. *Dilar miralobatus* sp. nov., male holotype, habitus. Scale bar: 2.0 mm.

Dilar nietneri Hagen, 1858

(Figs 5–6, 24–30)

Dilar nietneri Hagen, 1858: 482. Type locality: Sri Lanka.

Diagnosis. This species is characterized by the forewing solely with distinct dark brown stripes proximally, the male gonocoxite 9 distinctly longer than gonocoxite 10, and the male gonocoxites 11 medially with a rod-shaped projection.

Description. Male. Body length 6.0 mm; forewing length 11.5 mm, hindwing length 9.0 mm.

Head generally brown, with yellow setose tubercles. Vertex brown. Frons yellow. Compound eyes blackish brown. Antenna brown, flagellum pectinate on most flagellomeres.

Thorax yellowish brown; pronotum brown, meso- and metanotum yellowish brown, darker on scutellum and lateral margins. Legs yellow, femora dark brown at tip. Wings hyaline, slightly smoky brown. Forewing 2.3 times as long as wide, proximally with distinct dark brown stripes; longitudinal veins pale yellow, interrupted by numerous brown spots; crossveins brown. Hindwing 2.5 times as long as wide, almost immaculate.

Abdomen pale brown. Tergum 9 (Fig. 26) in dorsal view with an arcuate anterior incision, a nearly U-shaped posterior incision, leaving a pair of broad hemitergites, which are obtuse distally and densely haired. Sternum 9 reduced, membranous. Ectoproct in dorsal view with an arcuate anterior incision, posteroventrally with a pair of nearly semicircular and flattened projections (Fig. 28); posterodorsally with a pair of unguiform projections and a pair of short, feebly sclerotized, digitiform projections (Fig. 28). Gonocoxite 9 (Fig. 27) inflated, with outer margin on proximal half curved dorsally. Gonocoxite 10 (Fig. 27) shorter than gonocoxite 9, bean-shaped, incurved and falcate. Fused gonocoxites 11 (Fig. 27) nearly U-shaped, medially with a rod-shaped projection, laterally connecting to proximal half of gonocoxites 9 and 10. Hypandrium internum absent.

Female. Body length 7.8 mm; forewing length 12.8 mm, hind wing length 11.5 mm.

Sternum 7 in lateral view nearly trapezoidal, in ventral view nearly rectangular, with truncate posterior margin. Abdominal segment 8 narrower than segment 7 with convex posterior margin, without sclerotized subgenitale. Bursa copulatrix in lateral view rod-shaped, anteriorly with an additional rounded sac, in ventral view sac-like with a concave incision (Figs 29, 30). Ectoproct small, ovoid.

Materials examined. Lectotype ♂ (herewith designated), Ceylon, Nietner / Syn-Typus von: *Dilar nietneri* Hagen 1858 / *Rexavius nietneri* Hg. / H. & U. Aspöck vid. 1967 / glue containing abdomen on paper-strip soluble in KOH (MFN). Paralectotype 1♀, Ceylon, Nietner S. / Syn-Typus von: *Dilar nietneri* Hagen 1858 / *Rexavius nietneri* Hg. / H. & U. Aspöck vid. 1967 / 634 (MFN). 1♀, Ceylon / *Dilar nietneri*, M[c] L[achlan] / McLachlan Coll. B.M. 1938–674. (NHM).

Distribution. Sri Lanka.

Remarks. *Dilar nietneri* was originally described by Hagen (1858) from Sri Lanka based on external morphology only. We re-described it based on the male lectotype and female paralectotype. It is notable that this species appears to be closely related to *D. clavatus* in having similar male fused gonocoxites 11, which medially have a rod-shaped projection (See Remarks, under *Dilar clavatus* **sp. nov.**).



FIGURES 5–6. *Dilar nietneri* Hagen, 1858, habitus. 5. male lectotype; 6. female paralectotype. Scale bar: 2.0 mm.

Moreover, we examined one female specimen deposited in the Natural History Museum, London, which was previously identified as *D. nietneri*. But this specimen shows one distinct difference in having obvious dark brown markings covering almost the whole wing; however, in the lectotype and paralectotype, the wing shows obvious dark brown markings only on the proximal part or no obvious markings (Figs 5, 6). Considering that available female specimens and related knowledge are scarce in Sri Lanka, and since this specimen may be from the same series from which the lectotype and paralectotype were selected, we currently treat this female specimen as *D. nietneri*.

***Dilar truncatus* sp. nov.**

(Figs 7, 31–34)

Diagnosis. The new species is characterized by the forewing with pale brown markings arranged as several inconspicuous stripes, the male genital sclerites with gonocoxite 9 distally truncate and subdistally with short medially directed projection, and the gonocoxite 10 distally with incurved and falcate apex.

Description. Male. Body length 4.0 mm; forewing length 6.4 mm, hind wing length 5.6 mm.

Head generally brown, with pale yellowish brown setose tubercles. Vertex dark brown. Frons with a blackish brown transverse stripe marking between antennae sockets. Compound eyes blackish brown. Antenna brown, flagellum pectinate on most flagellomeres, medial branches much longer than those on both ends, longest branch nearly 3.5 times as long as corresponding flagellomere, distal seven flagellomeres simple.

Pro-, meso- and metathorax yellowish brown, pronotum yellow; mesonotum brown, darker on posterior, metanotum yellow. Legs pale brown, femora and tibiae dark brown at their tips. Wings hyaline, slightly smoky brown. Forewing 2.0 times as long as wide, with brown spots, arranged as several inconspicuous transverse arcuate stripes; longitudinal veins pale yellow, interrupted by numerous brown spots; crossveins pale yellow. Hindwing 2.0 times as long as wide, almost immaculate.



FIGURE 7. *Dilar truncatus* sp. nov., habitus. Scale bar: 2.0 mm.

Abdomen yellow. Tergum 9 (Fig. 31) in dorsal view with an arcuate anterior incision, a nearly U-shaped posterior incision, leaving a pair of broad hemitergites, which are obtuse distally and densely haired. Sternum 9 (Fig. 32) subtrapezoidal, membranous, only half of the length of tergum 9. Ectoproct subtriangular (Figs 31–32), in dorsal view with an arcuate anterior incision, posteroventrally with a pair of nearly semicircular and flattened projections (Fig. 32); posterodorsally with a pair of unguiform projections (Fig. 31). Gonocoxite 9 (Fig. 31) inflated, posteriorly truncate, subdistally with digitiform projection on inner margin which is directed medially. Gonocoxite 10 (Fig. 32) almost as long as gonocoxite 9, incurved and falcate, slightly swollen on proximal half, slenderly elongate on distal half. Fused gonocoxites 11 (Fig. 31) nearly W-shaped, laterally connecting to proximal half of gonocoxites 9 and 10. Hypandrium internum absent.

Female. Unknown.

Materials examined. Holotype ♂, Ceylon, Anu[radhapura] Dist[riect]. Wildlife Soc. Bungalow Hunuwilagama, Wilpattu, 200 ft [61 m], 10–19.III.1970, Davis & Rowe (PCWH).

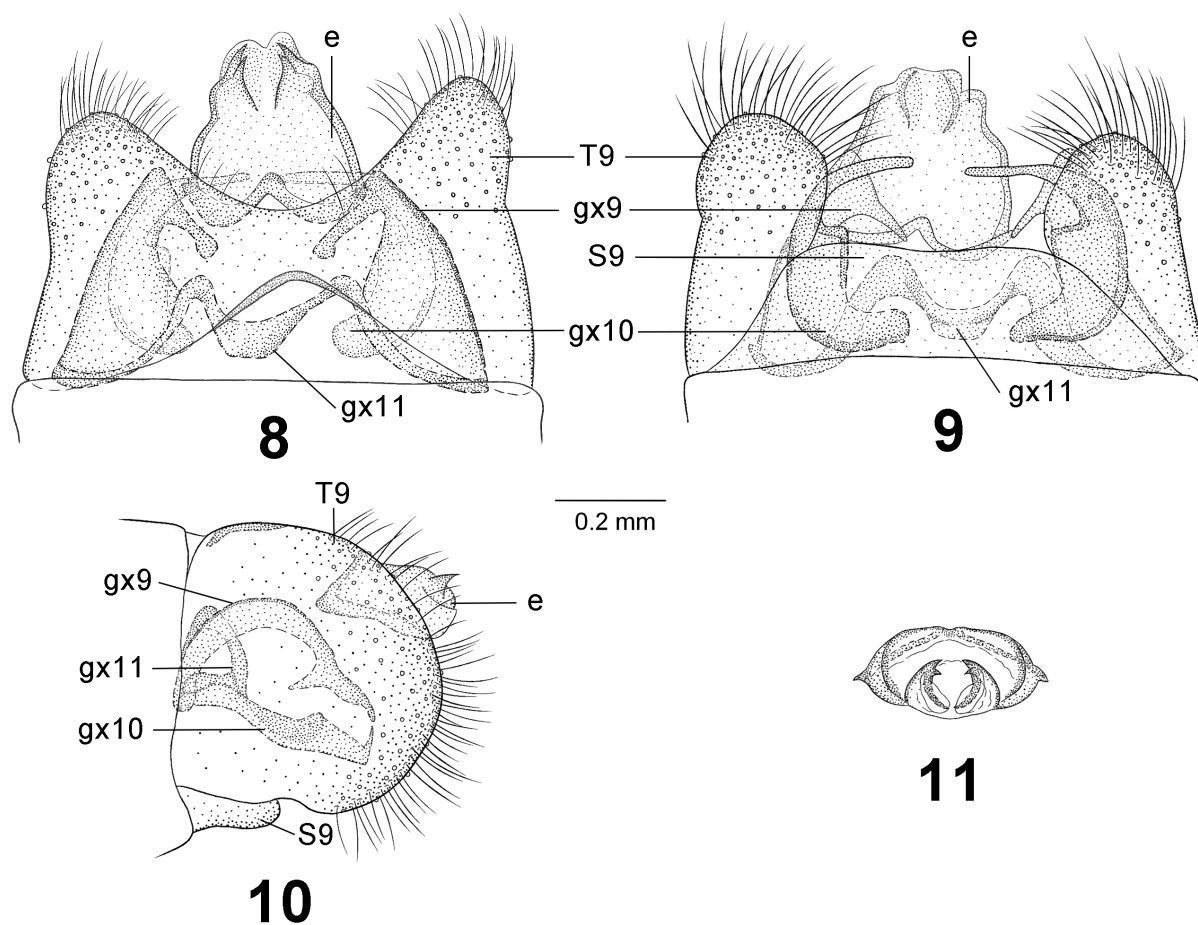
Distribution. Sri Lanka (North Central).

Etymology. The specific epithet “*truncatus*” refers to the shape of male gonocoxite 9, which is posteriorly truncate.

Remarks. For differentiation, see Remarks under *Dilar austroindicus* sp. nov.

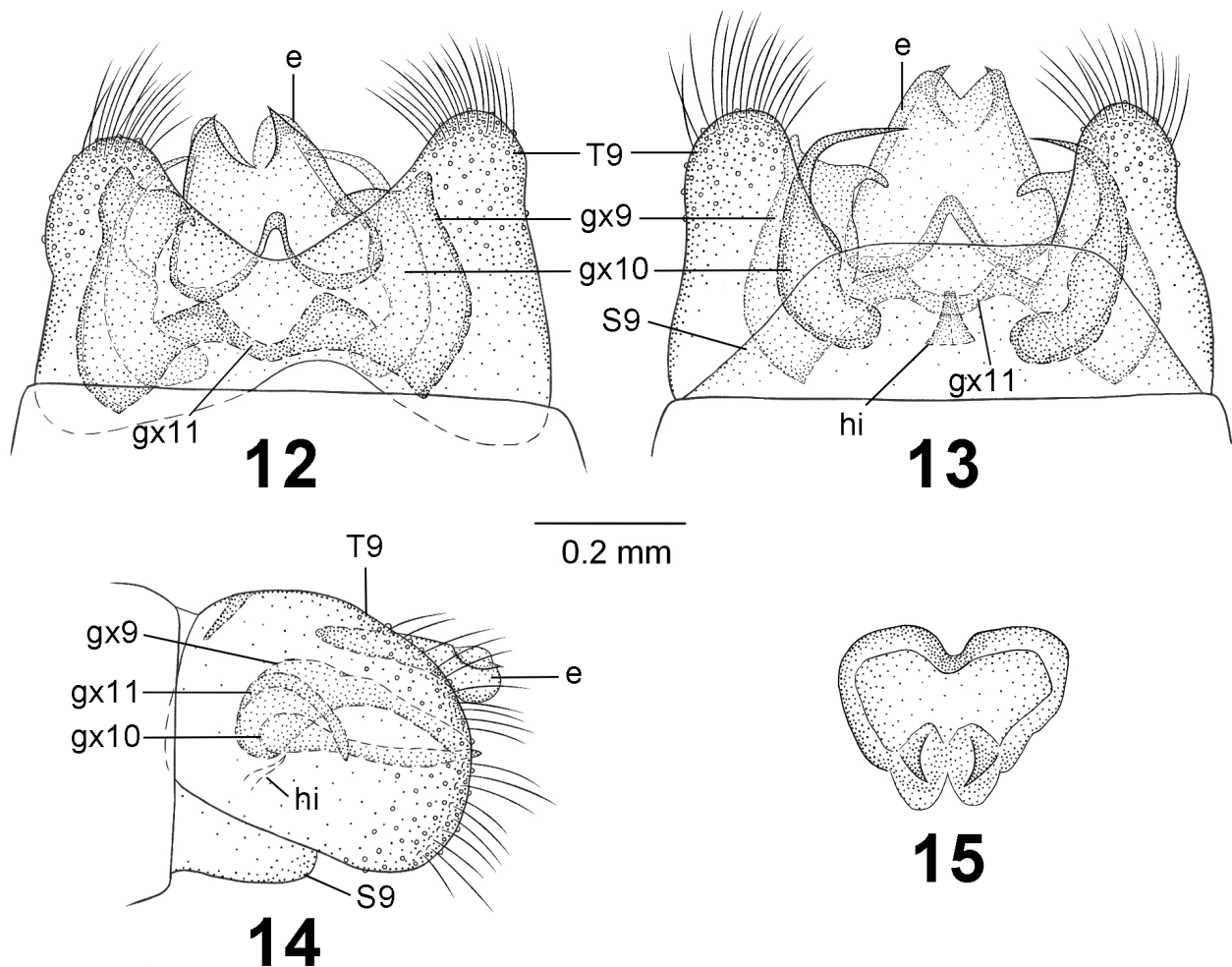
Discussion

Knowledge on the species diversity and distribution of *Dilar* in South Asia is updated and revised in the present work. Currently, eight species are recorded from this region. According to the currently known distributions of these species in South Asia (Fig. 35), there are no records of *Dilar* from Bangladesh or the Maldives.

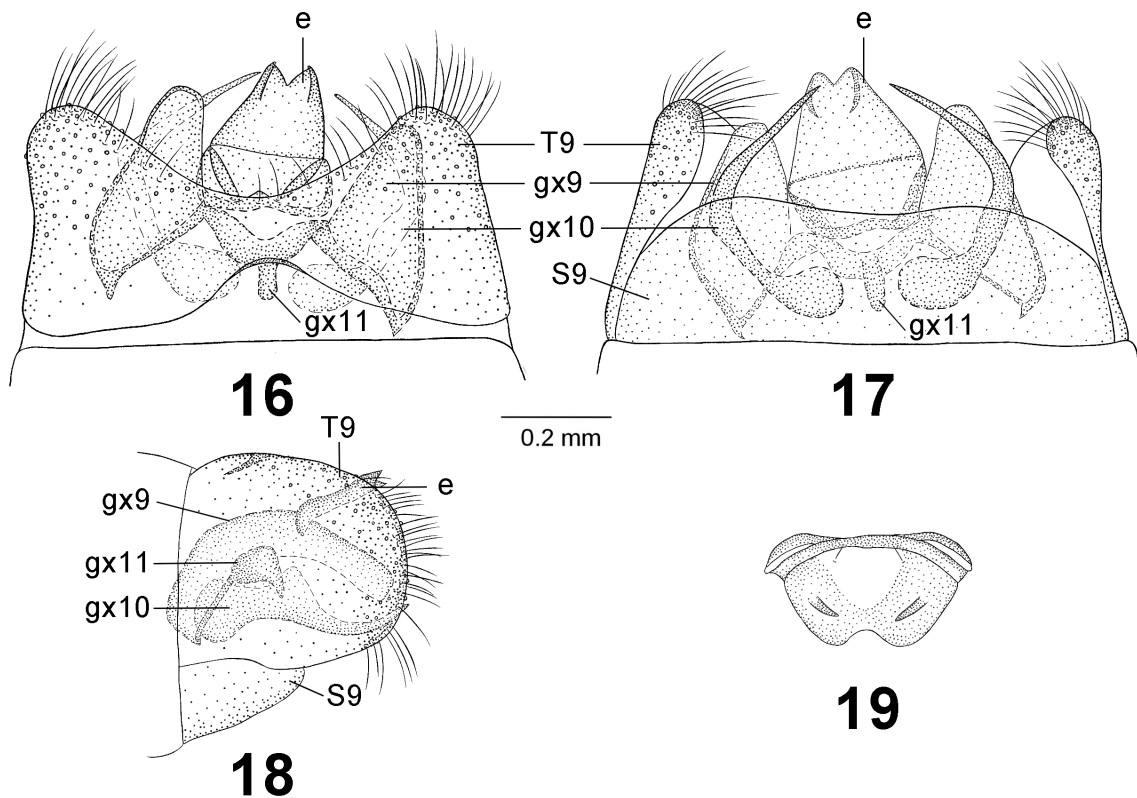


FIGURES 8–11. *Dilar austroindicus* sp. nov., male holotype. 8. genitalia, dorsal view; 9. genitalia, ventral view; 10. genitalia, lateral view; 11. ectoproct, caudal view. e: ectoproct; gx9: gonocoxite 9; gx10: gonocoxite 10; gx11: fused gonocoxites 11; S9: sternum 9; T9: tergum 9. Scale bar: 0.2 mm.

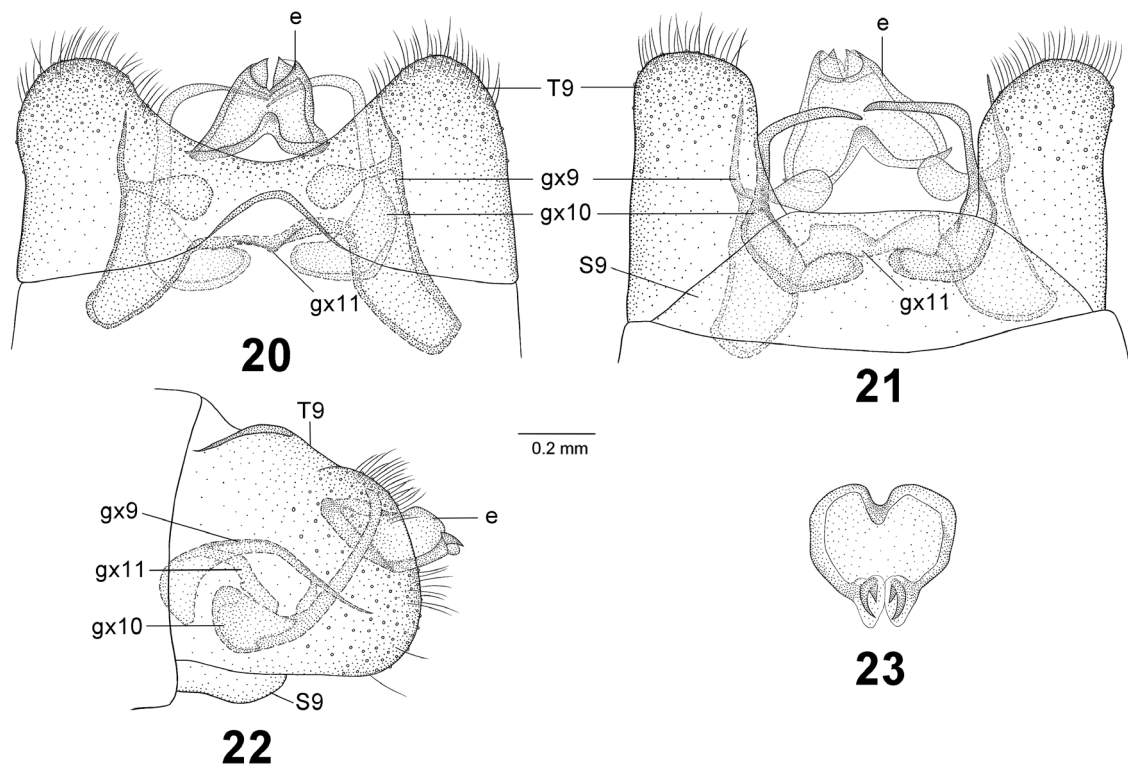
A quick glance at the map documenting the distribution of the species dealt with in this paper reveals a concentration of species in the north (*D. geometroides* and *D. harmandi*) and one in Sri Lanka (*D. clavatus* **sp. nov.**, *D. nietneri*, *D. miralobatus* **sp. nov.** and *D. truncatus* **sp. nov.**). Only two species (*D. austroindicus* **sp. nov.** and *D. biprojectus* **sp. nov.**) have been recorded from the Indian subcontinent south of 20° s.l. This pattern reflects activities of collecting rather than a biogeographical background. The species from northeastern India and adjacent areas, i.e. *D. geometroides* and *D. harmandi*, also occur in Tibet (Zhang *et al.* 2014b). These two species may be interpreted as Nepalese faunal elements in the sense of de Lattin (1967) and thus belong to a transitional zone of the Palaearctic and Oriental regions. Considering the vastly different male genital characters in the species from the northern part of South Asia, the *Dilar* species from the southern part of South Asia appear to be only distantly related to the above “northern” species. Indeed, the southern species are more closely related to each other based on the generally similar complex of male gonocoxites 9, 10 and 11. Moreover, it is notable that the two species *D. clavatus* **sp. nov.** and *D. nietneri* are characterized by the fused male gonocoxites 11 medially with a projection. However, among the other four *Dilar* species from the southern part of South Asia, i.e. *D. austroindicus* **sp. nov.**, *D. biprojectus* **sp. nov.**, *D. miralobatus* **sp. nov.** and *D. truncatus* **sp. nov.**, the fused male gonocoxites 11 medially is clearly convex, suggesting that the six species from southern part of South Asia have close relationship. It is surprising that *Dilar* has such a rich species diversity in Sri Lanka. Thus, a high species diversity of *Dilar* from southern India with rainforest habitats is to be expected.



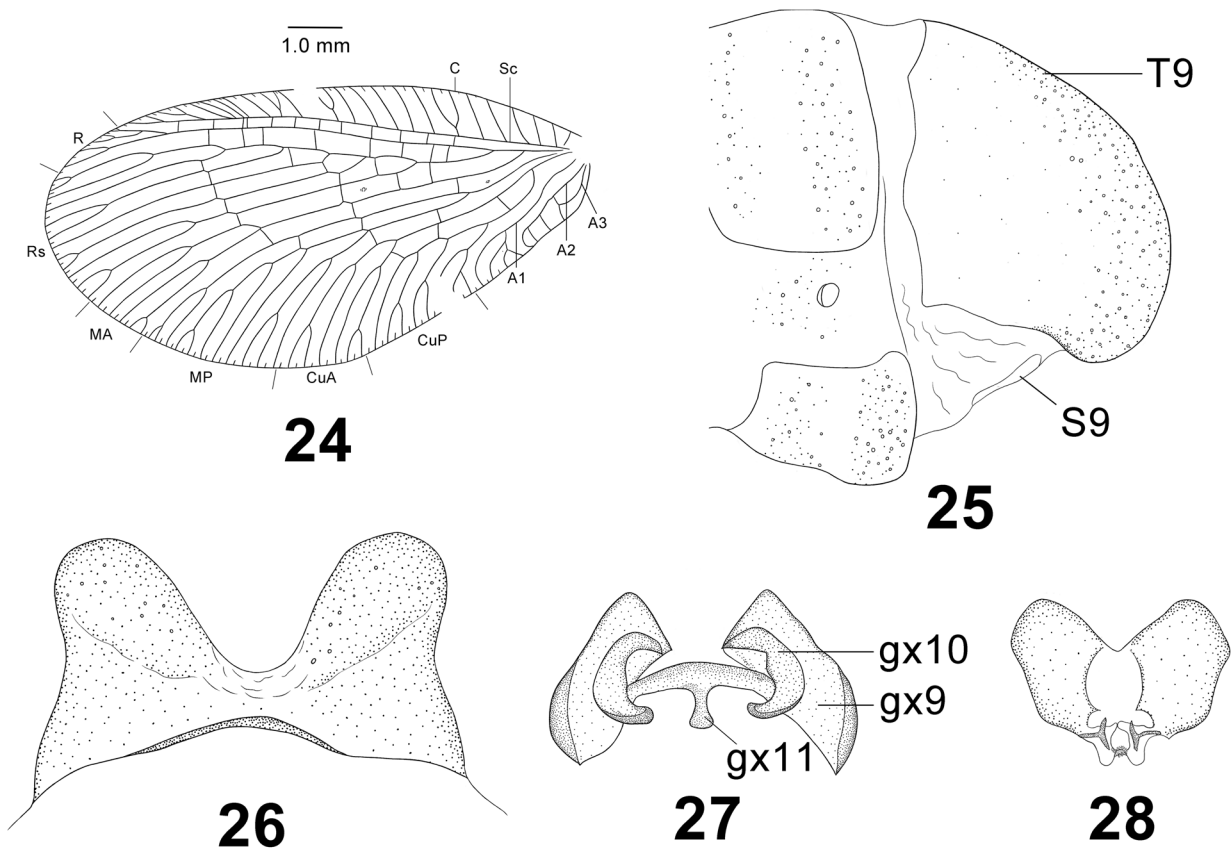
FIGURES 12–15. *Dilar biprojectus* **sp. nov.**, male holotype. 12. genitalia, dorsal view; 13. genitalia, ventral view; 14. genitalia, lateral view; 15. ectoproct, caudal view. e: ectoproct; gx9: gonocoxite 9; gx10: gonocoxite 10; gx11: fused gonocoxites 11; hi: hypandrium internum; S9: sternum 9; T9: tergum 9. Scale bar: 0.2 mm.



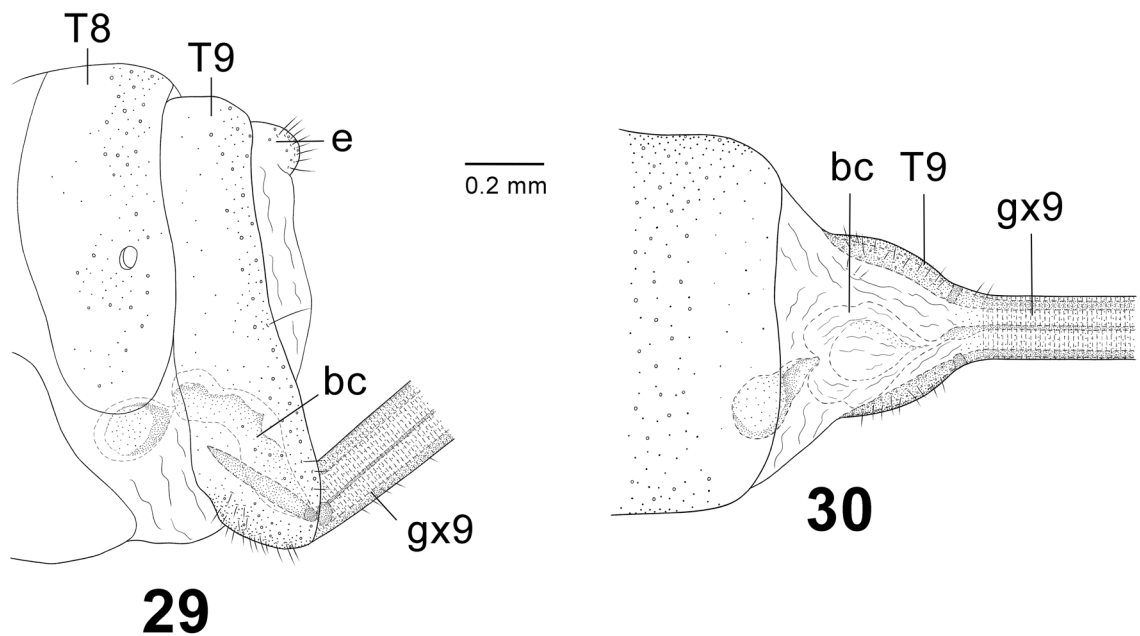
FIGURES 16–19. *Dilar clavatus* sp. nov., male holotype. 16. genitalia, dorsal view; 17. genitalia, ventral view; 18. genitalia, lateral view; 19. ectoproct, caudal view. e: ectoproct; gx9: gonocoxite 9; gx10: gonocoxite 10; gx11: fused gonocoxites 11; S9: sternum 9; T9: tergum 9. Scale bar: 0.2 mm.



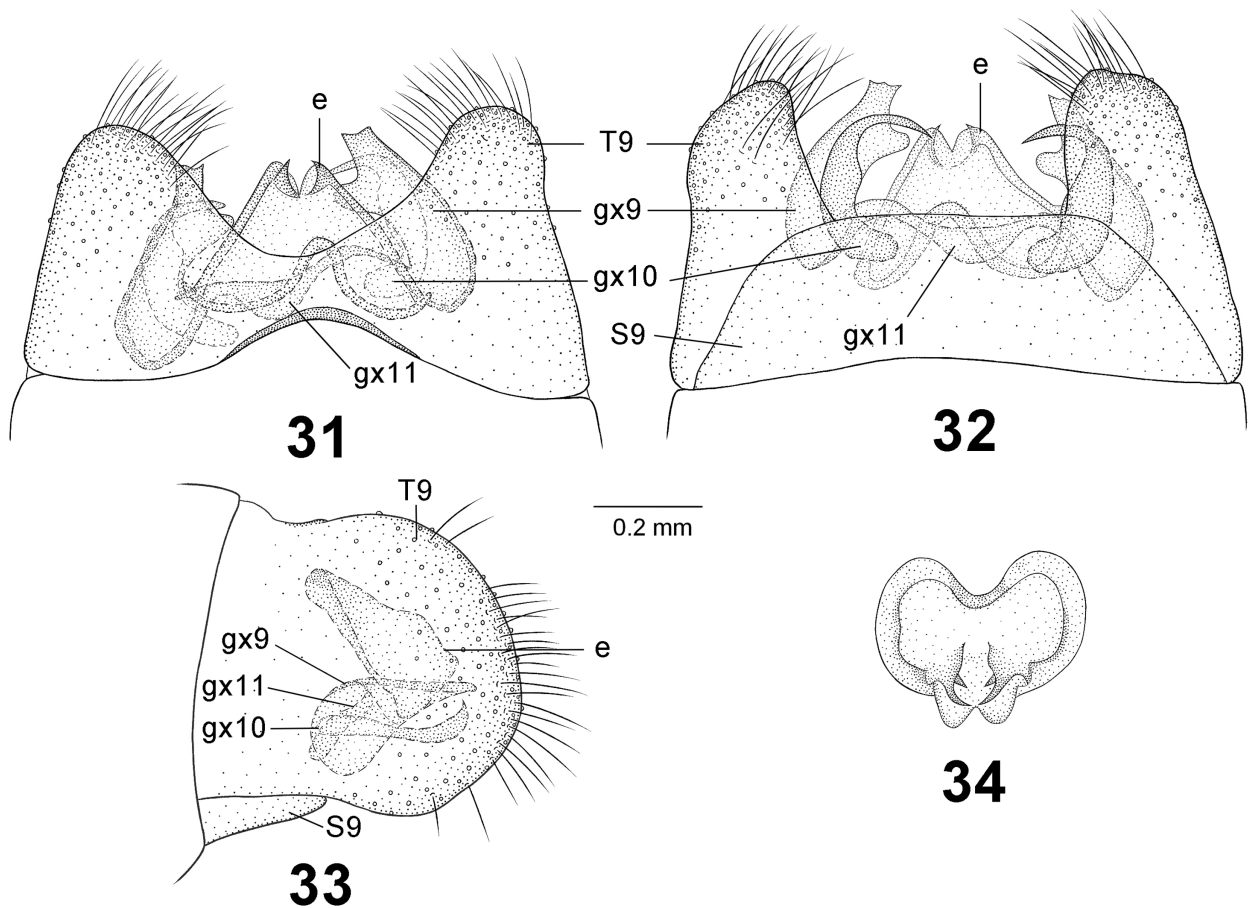
FIGURES 20–23. *Dilar miralobatus* sp. nov., male holotype. 20. genitalia, dorsal view; 21. genitalia, ventral view; 22. genitalia, lateral view; 23. ectoproct, caudal view. e: ectoproct; gx9: gonocoxite 9; gx10: gonocoxite 10; gx11: fused gonocoxites 11; S9: sternum 9; T9: tergum 9. Scale bar: 0.2 mm.



FIGURES 24–28. *Dilar nietneri* Hagen, 1858, lectotype male. 24. left forewing; 25. genitalia, lateral view; 26. tergum 9, dorsal view; 27. gonocoxites complex, ventral view; 28. ectoproct, dorsal view. gx9: gonocoxite 9; gx10: gonocoxite 10; gx11: fused gonocoxites 11; S9: sternum 9; T9: tergum 9. Scale bar: 1.0 mm (Fig. 24). Note: Figs 24–28 are after H. Aspöck & U. Aspöck unpublished.



FIGURES 29–30. *Dilar nietneri* Hagen, 1858, female. 29. genitalia, lateral view; 30. genitalia, ventral view. bc: bursa copulatrix; e: ectoproct; gx9: gonocoxite 9; T8–9: tergum 8–9. Scale bars: 0.2 mm.



FIGURES 31–34. *Dilar truncatus* sp. nov., male holotype. 31. genitalia, dorsal view; 32. genitalia, ventral view; 33. genitalia, lateral view; 34. ectoproct, caudal view. e: ectoproct; gx9: gonocoxite 9; gx10: gonocoxite 10; gx11: fused gonocoxites 11; S9: sternum 9; T9: tergum 9. Scale bar: 0.2 mm.

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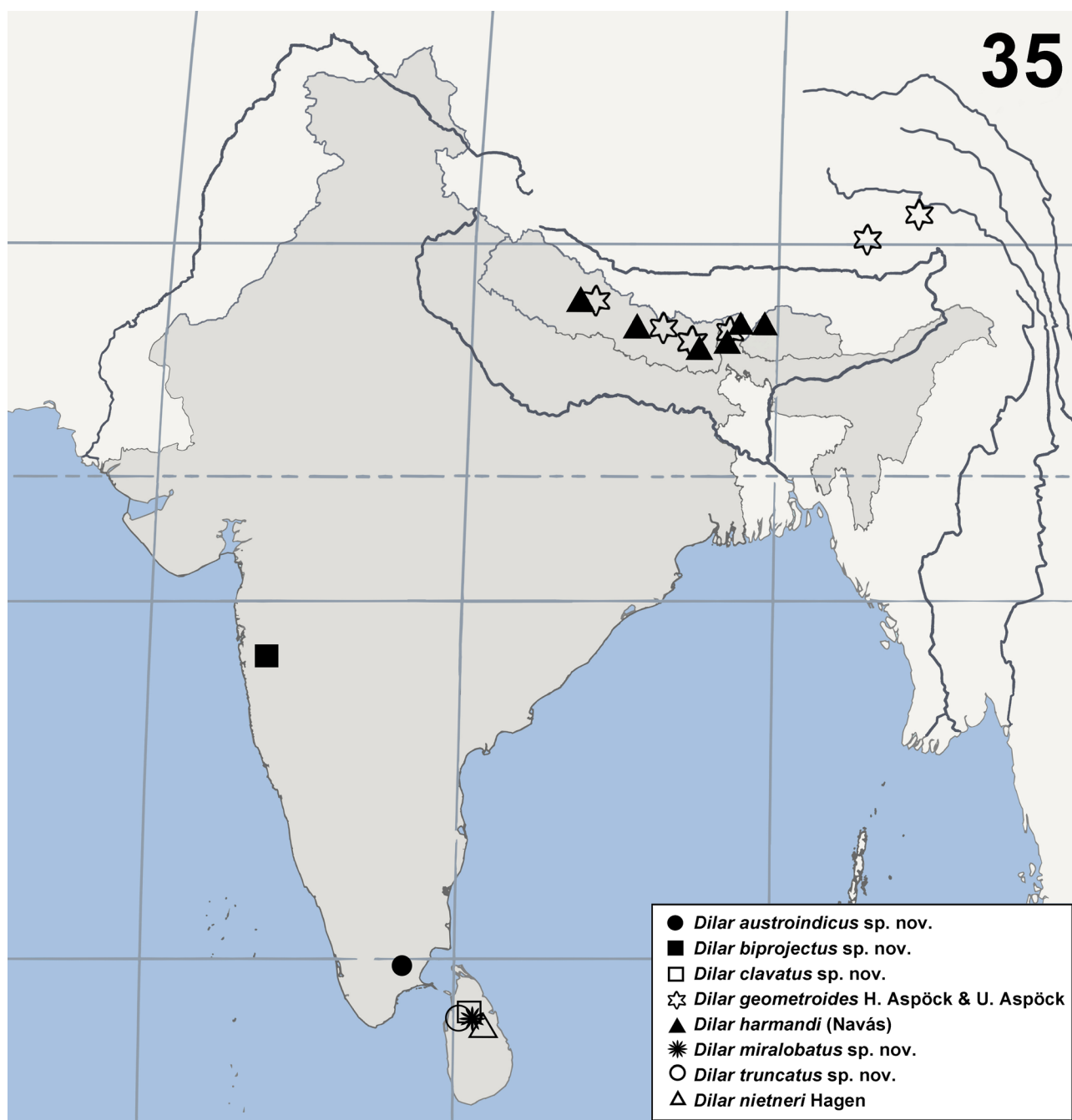


FIGURE 35. Geographic distribution of the species of *Dilar* Rambur, 1838 from South Asia.

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