



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

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Abstract

The lacewing family Dilaridae (pleasing lacewings) is poorly known in Southeast Asia, currently with only five described species. In this paper, we provide a revision of the species of the genus *Dilar* Rambur, 1838 from Southeast Asia. Eleven species of *Dilar* are recorded in this region, with seven species herein described as new to science, i.e. *Dilar abnormis* Zhang, Liu & Winterton, **sp. nov.**, *Dilar lineatus* Zhang, Liu & Winterton, **sp. nov.**, *Dilar loeimensis* Zhang, Liu, Winterton, **sp. nov.**, *Dilar ohli* Zhang, Liu, Aspöck & Aspöck, **sp. nov.**, *Dilar rotundatus* Zhang, Liu & Winterton, **sp. nov.**, *Dilar sumatranus* Zhang, Liu, Aspöck & Aspöck, **sp. nov.**, and *Dilar zimmermannae* Zhang, Liu, Aspöck & Aspöck, **sp. nov.** Re-descriptions of *Dilar grandis* (Banks, 1931), and *Dilar marmoratus* (Banks, 1931) are also provided. Dilaridae are recorded in Indonesia (Sumatra), Myanmar, and northern Thailand for the first time. A key to the *Dilar* species from Southeast Asia is given.

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

Introduction

The pleasing lacewing genus *Dilar* Rambur, 1838 is the most species-rich group of the family Dilaridae, currently with 62 species widely distributed in the Palaearctic and Oriental regions (Oswald 1998, 2013; Aspöck *et al.* 2015; Zhang *et al.* 2015). The taxonomy of *Dilar* has been well studied for the species from Europe by Aspöck *et al.* (1980, 2015) and Monserrat (1988, 2014), and for the species from East Asia by Zhang *et al.* (2014a, b, c, 2015). The *Dilar* fauna from Central Asia and the Near East has also been noticed for a long period and studied with a number of species described by Aspöck & Aspöck (1967, 1968) and Aspöck *et al.* (2015). Southeast Asia consists of the countries that are geographically south of China, east of India, west of New Guinea and north of Australia, including Brunei, Cambodia, Christmas Island, East Timor, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam. This area mainly belongs to the Oriental region and its transition zones with the Palaearctic region, either in the north or on high elevations, are well known as having extraordinarily rich biodiversity. However, there are quite a few records of pleasing lacewings in Southeast Asia. Hitherto, only six pleasing lacewing species have been described from this area: i.e. four species of *Dilar* from Malaysia, Thailand and Vietnam, one species of *Berothella* Banks, 1934 (Dilarinae) from Malaysia, and one species of *Nallachius* Zakharenko, 1991 (Nallachiinae) from Vietnam (Banks 1931a, b, 1934; Zakharenko 1991; Oswald & Schiff 2001, New 2003). We recently examined a number of specimens of *Dilar* collected from Indonesia, Malaysia, Myanmar, Thailand, and Vietnam, which enabled us to present a review of the *Dilar* species in Southeast Asia, while the other

two species of *Berothella* and *Nallachusius* from Southeast Asia will be re-described in another future paper. Eleven species of *Dilar* are herein recorded in Southeast Asia, with seven new species. Descriptions and redescriptions are provided for nine species. A key to males of all species of *Dilar* from Southeast Asia is also given.

Material and methods

Specimens for the present study are deposited in the Entomological Museum, China Agricultural University (CAU), Beijing, China; the California State Collection of Arthropods (CSCA), California Department of Food and Agriculture, Sacramento, U.S.A.; the Collection of Horst & Ulrike Aspöck (HUAC), Vienna, Austria; the Naturhistorisches Museum Wien (NHMW), Vienna, Austria; the Museum of Comparative Zoology (MCZ), Cambridge, U.S.A.; the Museum für Naturkunde, Leibniz-Institut für Evolutions- und Biodiversitätsforschung an der Humboldt-Universität zu Berlin (MFN), Berlin, Germany.

Genitalic preparations were made by clearing the apex of the abdomen in a cold, saturated KOH solution for 3–4 h. After rinsing the KOH with acetic acid and water, the apex of the abdomen was transferred to glycerin for further dissection and examination. Habitus photos of adults were taken by using Nikon D90 digital camera with Nikon MICRO NIKKOR 105 mm lens, and the genitalic figures were made by hand drawing under Motic SMZ168 stereo microscope. The terminology of the genitalia generally follows Aspöck and Aspöck (2008).

Taxonomy

Genus *Dilar* Rambur

Dilar Rambur, [1838] 1837–1840: 445. Type species: *Dilar nevadensis* Rambur, [1838] 1837–1840: pl. 9, monotypy. *Cladocera* Hagen, 1860: 56. Nomen nudum.

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

Fuentemus Navás, 1909a: 154. Type species: *Dilar campestris* Navás, 1903: 380, original designation.

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

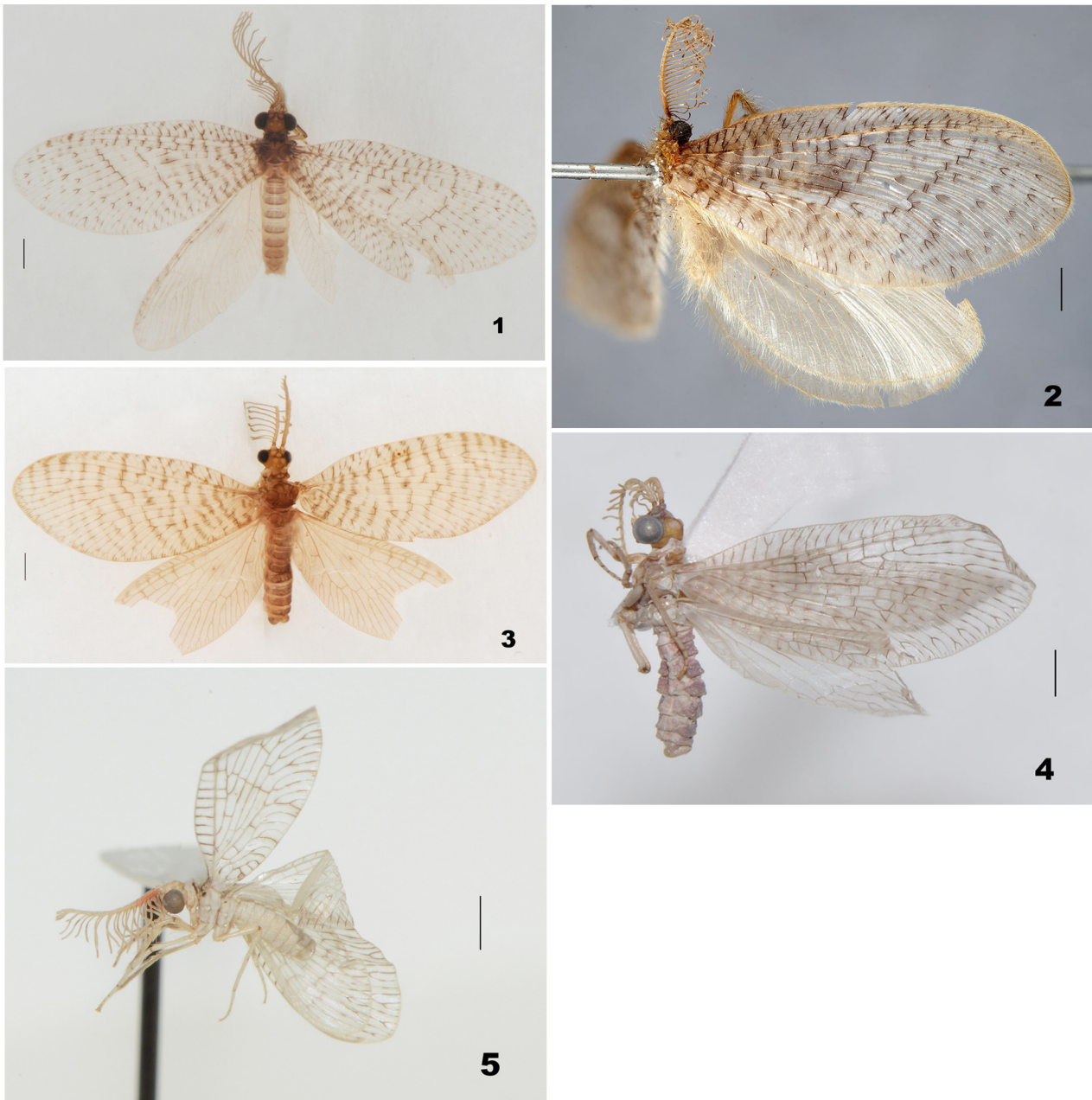
Rexavius Navás, [1909b] 1908–1909: 664. Type species: *Dilar nietneri* Hagen, 1858: 482, subsequent designation by Navás, 1914: 10.

Note. See diagnosis of *Dilar* in Zhang *et al.* (2014a, b, c, 2015). The current distribution is summarized in Aspöck *et al.* (2015). Notably, there are two other genera of Dilaridae in Southeast Asia, i.e. *Berothella* and *Nallachusius*. Both genera can be clearly distinguished from *Dilar* by the forewing MA separating from Rs but not from R.

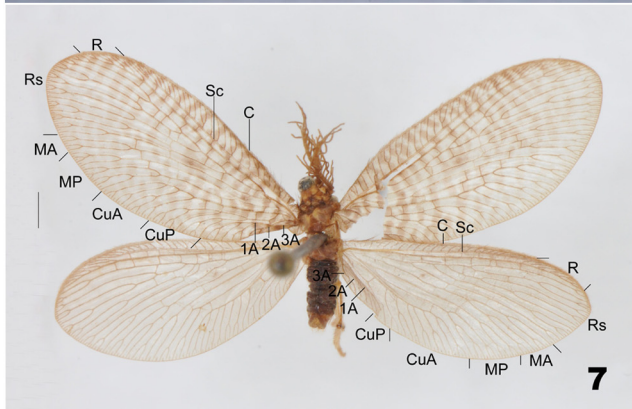
Key to males of *Dilar* from Southeast Asia

1. Tergum 9 medially with a dorsoprocessus (Figs. 18, 22, 42, 46; Oswald & Schiff 2001: fig. 5) 2
- Tergum 9 medially without dorsoprocessus (Figs. 11, 26, 30, 34, 38) 6
2. Gonocoxite 10 submedially without projection connecting to gonocoxite 9 (Figs. 22, 43; Oswald & Schiff 2001: fig. 9) 3
- Gonocoxite 10 submedially with a pointed projection connecting to gonocoxite 9 (Figs. 18, 46) 5
3. Gonocoxite 9 acutely produced distad in dorsal view; gonocoxite 10 distally incurved (Fig. 22) 4
- Gonocoxite 9 obtuse at tip; gonocoxite 10 distally outcurved (Fig. 43; Oswald & Schiff 2001: fig. 9) 4
4. Body small-sized, forewing length ca. 6 mm; forewing with few dark markings; tergum 9 with a well developed, long dorsoprocessus, male ectoproct has a pair of spinous dorsal projections *Dilar macleodi* Oswald & Schiff
- Body medium-sized, forewing length more than 10 mm; forewing with a number of scattered brown markings; tergum 9 with a short and un conspicuous dorsoprocessus, male ectoproct without dorsal projection *Dilar sumatranus* Zhang, Liu, Aspöck & Aspöck, **sp. nov.**
5. Gonocoxite 10 strongly incurved, with bifid tip (Fig. 18) *Dilar grandis* (Banks)
- Gonocoxite 10 slenderly elongate, with unforked tip (Fig. 46) . *Dilar zimmermannae* Zhang, Liu, Aspöck & Aspöck, **sp. nov.**
6. Gonarcus (Fig. 11) convex posteriad, medially with a pair of long, hook-like projections directed anteriorly *Dilar abnormis* Zhang, Liu & Winterton, **sp. nov.**
- Gonarcus not convex posteriad, medially without any projection 7
7. Forewing with indistinct, irregularly patterned dark markings; gonarcus expanded on both ends 8

- Forewing with distinct brown markings, arranging a number of transverse bands; gonarcus not expanded on both ends9
- 8. Gonocoxite 10 (Fig. 27) slenderly elongate, strongly incurved, submedially with a pointed projection connecting to gonocoxite 9 *Dilar loeinensis* Zhang, Liu & Winterton, **sp. nov.**
- Gonocoxite 10 (Fig. 31) slightly incurved, spindled anteroposteriorly but inflated at middle, without projection connecting to gonocoxite 9 *Dilar marmoratus* (Banks)
- 9. Gonocoxite 10 (Fig. 38) slenderly elongate on anterior half but strongly inflated on posterior half, with rotunded tip *Dilar rotundatus* Zhang, Liu & Winterton, **sp. nov.**
- Gonocoxite 10 slenderly elongate throughout or short and broad submedially with a long projection 10
- 10. Gonocoxite 9 much shorter than gonocoxite 10, with rounded tip; gonocoxite 10 slenderly elongate through *Dilar vietnamensis* Zakharenko
- Gonocoxite 9 (Fig. 35) much longer than gonocoxite 10, with acutely pointed tip; gonocoxite 10 short and broad, submedially with a long blade-like projection. *Dilar ohli* Zhang, Liu, Aspöck & Aspöck, **sp. nov.**



FIGURES 1–5. Adults of *Dilar* spp. 1. *D. abnormis* Zhang, Liu & Winterton, **sp. nov.**, male holotype; 2. *D. grandis* (Banks), male holotype; 3. *D. lineatus* Zhang, Liu & Winterton, **sp. nov.**, male holotype; 4. *D. loeinensis* Zhang, Liu & Winterton, **sp. nov.**, male holotype; 5. *D. macleodi* Oswald & Schiff, male paratype.



FIGURES 6–10. Adults of *Dilar* spp. 6. *D. marmoratus* (Banks), male holotype; 7. *D. ohli* Zhang, Liu, Aspöck & Aspöck, **sp. nov.**, male holotype; 8. *D. rotundatus* Zhang, Liu & Winterton, **sp. nov.**, male holotype; 9. *D. sumatranus* Zhang, Liu, Aspöck & Aspöck, **sp. nov.**, male holotype; 10. *D. zimmermannae* Zhang, Liu, Aspöck & Aspöck, **sp. nov.**, male holotype. Scale bars: 1.0 mm.

***Dilar abnormis* Zhang, Liu & Winterton, sp. nov.**
(Figs. 1, 11–17)

Diagnosis. This species is characterized by the broadly inflated male gonocoxites 9 and 10, and by the gonarcus

medially with a pair of long, hook-like projections directed anteriorly. The forewing of this species is densely spotted, with spots arranging into several transversely arcuate stripes.

Description. Male. Body length 5.6 mm; forewing length 8.1 mm, hindwing length 6.4 mm.

Head yellowish brown, with pale yellowish brown setose tubercles. Compound eyes blackish brown. Antenna pale yellowish brown, pedicel with brown annular stripes, flagellum unipectinate on most flagellomeres, longest branch nearly 7.0 times as long as relevant flagellomere.

Prothorax brown, pronotum dark brown, medially with a pair of ovoid markings; mesothorax yellowish brown, mesonotum dark brown on anterior and lateral margins, scutellum with posterior half dark brown; metanotum pale yellowish brown, slightly darker on lateral margins. Legs pale yellowish brown, femora blackish brown at tip. Wings hyaline, slightly smoky brown, with numerous dark spots. Forewing ~2.0 times as long as wide, densely spotted, proximal spots slightly darker, arranging as transversely arcuate pattern, an immaculate area present distal to median nygma. Hindwing ~2.2 times as long as wide, much paler than forewing, immaculate. Veins pale yellow, crossveins much darker than longitudinal veins.

Abdomen yellow, pregenital segments dorsally yellowish brown. Tergum 9 in dorsal view with an arcuate anterior incision and a deeply V-shaped posterior incision, leaving a narrow median portion and a pair of subtriangular hemitergites, which are obtuse distally and densely haired. Sternum 9 obviously shorter than tergum 9, arcuately convex posteriad. Ectoproct in dorsal view nearly quadrate, posterodorsally with a pair of bifid unguiform projections and a pair of short, feebly sclerotized, digitiform projections, posteroventrally with a pair of short and flattened projections. Gonocoxite 9 broadly inflated, sac-like, with strongly sclerotized, spoon-shaped tip; gonocoxite 10 subtriangular, with strongly sclerotized, spinous tip; gonarcus slender on both ends, laterally coalesced to bases of gonocoxites 9, medial part subtriangular, strongly sclerotized, with a pair of long, hook-like projections, which are directed anteriorly. Hypandrium internum trapezoidal, with lateral margins slightly arcuate.

Female. Body length 5.0 mm; forewing length 7.4 mm, hindwing length 6.1 mm.

Sternum 7 in lateral view nearly trapezoidal, in ventral view subtrapezoidal, with truncate posterior margin. Abdominal segment 8 with sclerotized trapezoidal gonocoxite 8. Bursa copulatrix with colleterial gland tubular, relatively short, with distal half curved upwards; basal part of bursa copulatrix sac-like in lateral view but nearly oval in ventral view. Ectoproct rather small, ovoid.

Materials examined. Holotype ♂, THAILAND: Chiang Mai, Doi Inthanon NP, Checkpoint 2 [18°31.554'N, 98°29.940'E], 1700 m, 8–15.V.2007, Y. Areeluck (CAU). Paratypes 1♀, same as holotype (CAU); 1♂, THAILAND: Chiang Mai, Doi Inthanon NP, Checkpoint 2, 1700 m, 15–22.IV.2007, Y. Areeluck (CSCA).

Distribution. Thailand (Chiang Mai).

Etymology. The specific epithet “*abnormis*” refers to the unique male gonarcus medially with a pair of long, hook-like projections, only present in the new species in *Dilar*.

Remarks. Although it is not a remarkable species based on the appearance, the male genitalia of this new species is unique among all *Dilar* species by the gonarcus medially with a pair of long projections. In all the other known species of *Dilar*, the gonarcus is slender, beam-shaped sclerite, medially without any projection.

***Dilar grandis* (Banks)**

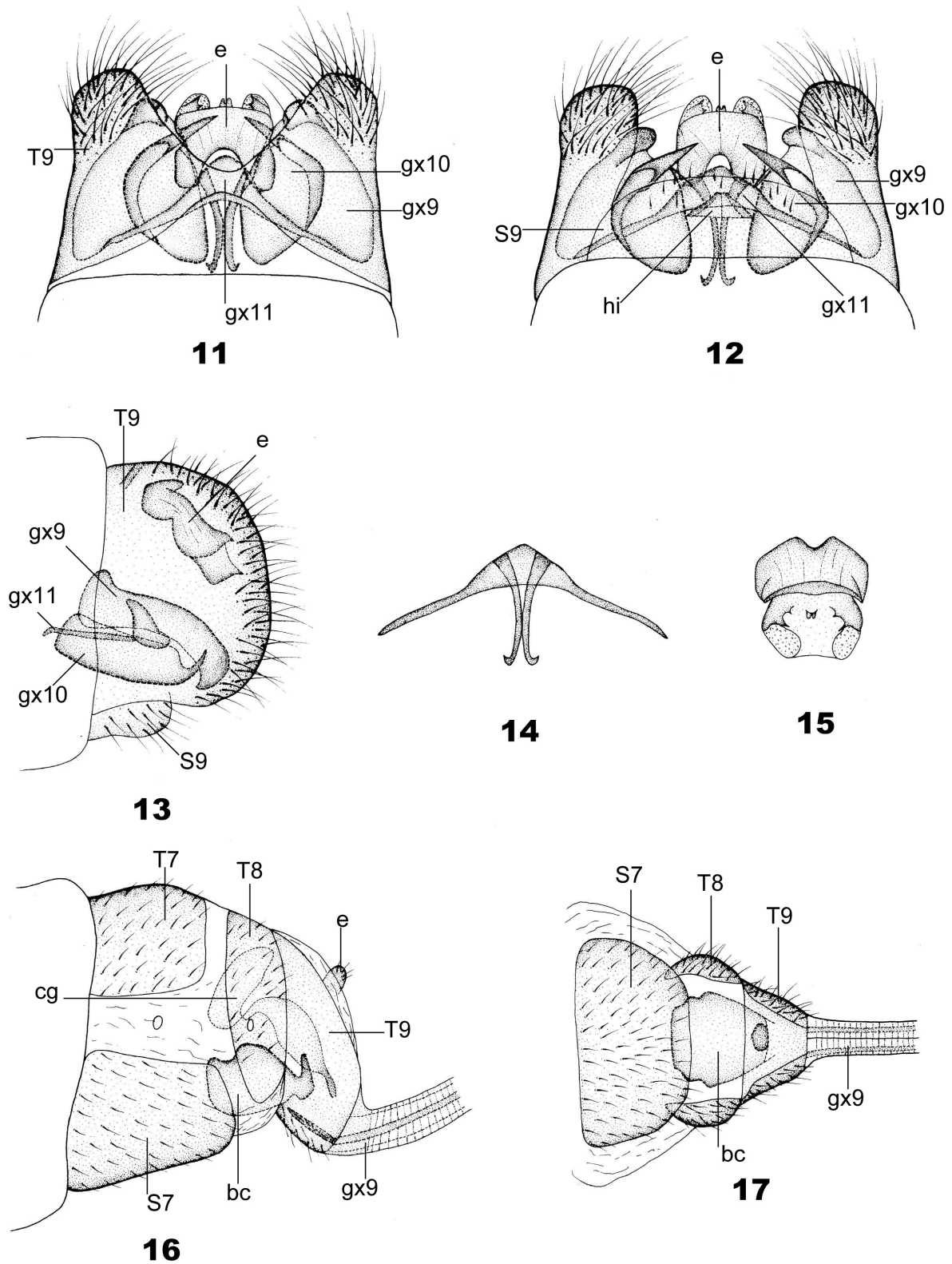
(Figs. 2, 18–21)

Rexavius grandis Banks, 1931a: 413. Type locality: Malaysia (Sabah).

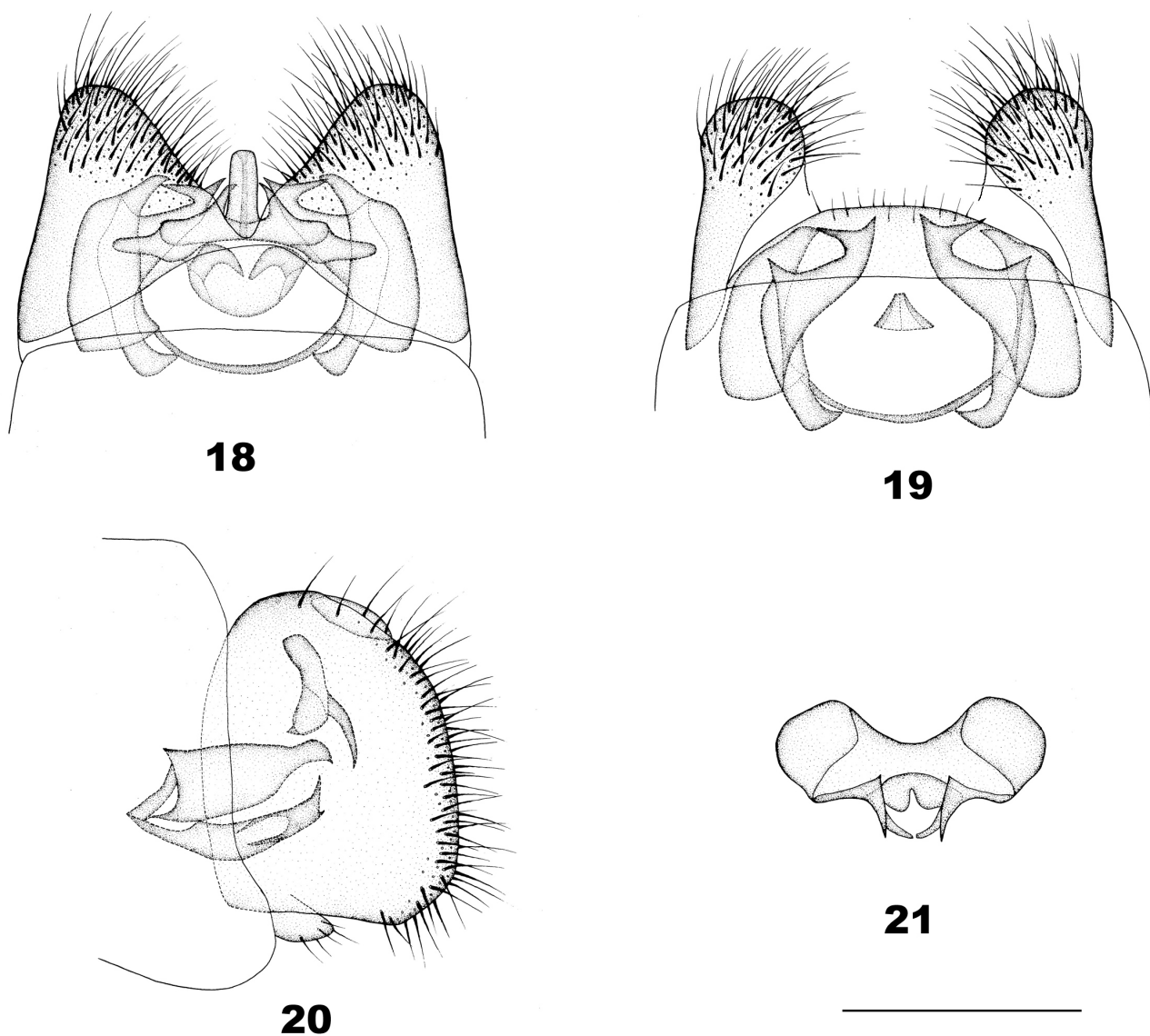
Diagnosis. This species is characterized by the male tergum 9 dorsally with a long posteromedial projection, the strongly incurved male gonocoxite 10, which bears a spindle projection connecting to gonocoxite 9 submedially and is bifid at tip. Besides, in the forewing of this species there are several dark brown spots, most of which are concentrated on branching points of longitudinal veins.

Description. Male. Body length 5.0–5.8 mm; forewing length 11.0–16.0 mm, hindwing length 9.0–12.0 mm.

Head pale yellowish brown, with pale yellow setose tubercles. Compound eyes blackish brown. Antenna with ca. 30 segments, yellowish brown, pedicel with brown annular stripes, flagellum unipectinate on most flagellomeres, longest branch nearly 8.0 times as long as relevant flagellomere.



FIGURES 11–17. *Dilar abnormis* Zhang, Liu & Winterton, *sp. nov.* 11. Male genitalia, dorsal view; 12. Male genitalia, ventral view; 13. Male genitalia, lateral view; 14. Male gonarcus, dorsal view; 15. Male ectoproct, caudal view; 16. Female genitalia, lateral view; 17. Female genitalia, ventral view. bc: bursa copulatrix; cg: colleterial gland; e: ectoproct; gx11: eleventh gonocoxites (= gonarcus); gx9: ninth gonocoxite; gx10: tenth gonocoxite; hi: hypandrium internum; S7–9: sternum 7–9; T7–9: tergum 7–9. Scale bars: 0.5 mm.



FIGURES 18–21. *Dilar grandis* (Banks). 18. Male genitalia, dorsal view; 19. Male genitalia, ventral view; 20. Male genitalia, lateral view; 21. Male ectoproct, caudal view. Scale bars: 0.5 mm.

Prothorax pale yellow, pronotum yellowish brown, with anterior margin and posterolateral corners yellow, medially with a pair of ovoid markings; mesothorax pale yellowish brown, mesonotum dark brown on anterior and lateral margins; metanotum pale yellowish brown, slightly darker on lateral margins. Legs yellowish brown, femora blackish brown at tip. Wings pale yellow, nearly hyaline. Forewing ~2.3 times as long as wide, with several dark brown spots, proximal spots slightly darker, most of which are concentrated on branching points of longitudinal veins, a big brown spot present around median nygma, and an immaculate area present distal to median nygma. Hindwing ~2.2 times as long as wide, immaculate. Veins pale brown, crossveins much darker than longitudinal veins.

Abdomen pale yellow, pregenital segments dorsally yellowish brown. Tergum 9 in dorsal view with an arcuate anterior incision, a nearly V-shaped posterior incision and an elongate dorsoprocessus, leaving a pair of broad hemitergites, which are obtuse distally and densely haired. Sternum 9 much shorter than tergum 9, arcuately convex posteriad. Ectoproct in dorsal view with an arcuate anterior incision, posterodorsally with a pair of elongate unguiform projections, posteroventrally with a pair of nearly ovoid flattened projections and a pair of incurved unguiform projections. Gonocoxite 9 inflated, with blunt tip; gonocoxite 10 incurved, with tip strongly sclerotized and bifid, submedially extended a spindled projection connecting to gonocoxite 9; gonarcus slenderly beam-shaped, laterally connecting to bases of gonocoxites 9. Hypandrium internum nearly trapezoidal, with lateral margins slightly arcuate.

Female. Unknown.

Materials examined. Holotype ♂, “B[ritish].N[orthern]. Borneo, Mt. Kinabalu, Kamborangah [1°4'N, 114°14'E], 7000 ft [= 2190 m], 4.IV.1929/Rexavius grandis Bks [= Banks] Type/Type/Ex F.M.S. Museum. B.M. 1955-354” (BMNH). Paratypes 4♂, same data as holotype, 1/2.IV.1929 and 27/29.V.1929 (BMNH); 1♂, same data as holotype, 6.V.1929 (MCZ).

Distribution. Malaysia (Sabah).

Remarks. This species is one of the two species of *Dilar* currently known from Borneo and it is probably the largest species among all known *Dilar* species with male forewing length ranging 11–16 mm. This species could be a member of the *Dilar quangxiensis* species-group (see Zhang *et al.* 2015) based on the presence of the dorsoprocessus of the male tergum 9 and the male gonocoxite 10 submedially with a spindle projection connecting to gonocoxite 9. However, *D. grandis* can be distinguished from the other group members by the male gonocoxite 10 distinctly bifid distad, forming a short and a long spinous projections. In other species of the *D. quangxiensis* group, the male gonocoxite 10 has a simple or slightly bifurcated apex.

***Dilar lineatus* Zhang, Liu & Winterton, sp. nov.**

(Figs. 3, 22–25)

Diagnosis. This species is characterized by the forewings with many regularly arranged dark stripes, and by the male gonocoxite 10, which is slightly longer than gonocoxite 9, anteriorly strongly incurved, and acutely pointed at tip.

Description. Male. Body length 5.1 mm; forewing length 10.8 mm, hindwing length 9.0 mm.

Head pale yellowish brown, with pale yellow setose tubercles. Compound eyes blackish brown. Antenna pale yellowish brown, pedicel with brown annular stripes, flagellum unipectinate on most flagellomeres, longest branch nearly 8.0 times as long as relevant flagellomere.

Prothorax pale yellow, pronotum pale brown, with anterior margin and posterolateral corners yellow, medially with a pair of ovoid markings; mesothorax yellowish brown, mesonotum dark brown on anterior and lateral margins, scutellum with posterior half dark brown; metanotum pale yellowish brown, slightly darker on lateral margins. Legs pale yellow, femora blackish brown at tip. Wings hyaline, slightly smoky brown, with numerous dark stripes. Forewing ~2.0 times as long as wide, densely striped, proximal stripes slightly darker, arranging as transversely arcuate pattern. Hindwing ~2.0 times as long as wide, almost immaculate. Veins pale yellow, crossveins much darker than longitudinal veins.

Abdomen yellowish brown, pregenital segments dorsally dark brown. Tergum 9 in dorsal view with a shallowly arcuate anterior incision, a deeply U-shaped posterior incision and a short dorsoprocessus, leaving a wide median portion and a pair of sub trapezoidal hemitergites, which are obtuse distally and densely haired. Sternum 9 obviously shorter than tergum 9, slightly concave posteriad. Ectoproct in dorsal view nearly trapezoidal, posteroventrally with a pair of semicircular and flattened projections, posterodorsally with a pair of bifid unguiform projections, a pair of short, feebly sclerotized, digitiform projections and a pair of strongly sclerotized, pointed projections. Gonocoxite 9 in dorsal view broad on proximal half, with incurved, unguiform tip; gonocoxite 10 slightly longer than gonocoxite 9, strongly incurved anteriorly, with pointed tip; gonarcus slenderly beam-shaped, laterally connecting to bases of gonocoxites 9. Hypandrium internum narrowly trapezoidal, with lateral margins slightly arcuate.

Female. Unknown.

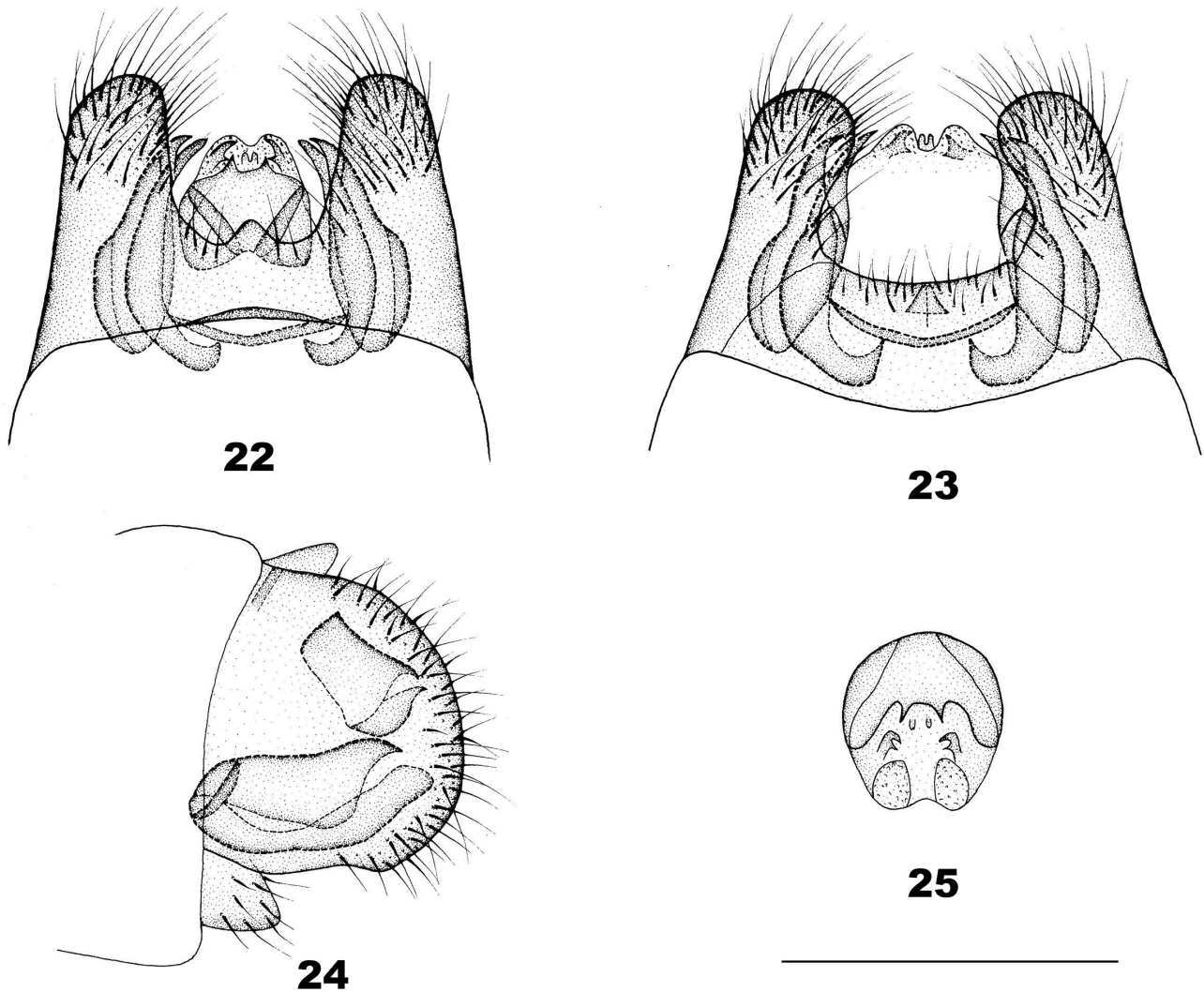
Materials examined. Holotype ♂, VIETNAM: Thua Thien Hue, Bach Ma National Park [16°11'36.2"N, 107°51'15.4"E], 1206 m, 2–17.VI.2000, B. Hubley (CAU). Paratypes 1♂, VIETNAM: Thua Thien Hue, Bach Ma National Park [16°11'58.7"N, 107°51'26.8"E], 1450 m, 2–16.VI.2000, B. Hubley (CAU).

Distribution. Vietnam (Thua Thien Hue).

Etymology. The specific epithet “*lineatus*” refers to the forewings with many regularly arranged dark stripes in the new species.

Remarks. The new species resembles *D. abnormis* Zhang, Liu & Winterton, **sp. nov.** and *D. loeinensis* Zhang, Liu & Winterton, **sp. nov.** from northern Thailand, but it can be distinguished from the other Vietnamese species, i.e. *D. ohli* and *D. vietnamensis* based on the wing marking patterns. In the latter two species the forewing brown

markings are much darker and more regularly arranged as transverse stripes, while in the former three species the forewing brownish markings are more discrete. Based on the genitalia, the new species seems to be closely related to *Dilar insularis* Zhang, Liu & Aspöck, 2014 from Hainan and Taiwan in having similar male gonocoxites 9 and 10, but it can be distinguished from the latter species by the absence of the submedial projection of the male gonocoxite 10.



FIGURES 22–25. *Dilar lineatus* Zhang, Liu & Winterton, **sp. nov.** 22. Male genitalia, dorsal view; 23. Male genitalia, ventral view; 24. Male genitalia, lateral view; 25. Male ectoproct, caudal view. Scale bars: 0.5 mm.

Dilar loeinensis* Zhang, Liu & Winterton, **sp. nov.*

(Figs. 4, 26–29)

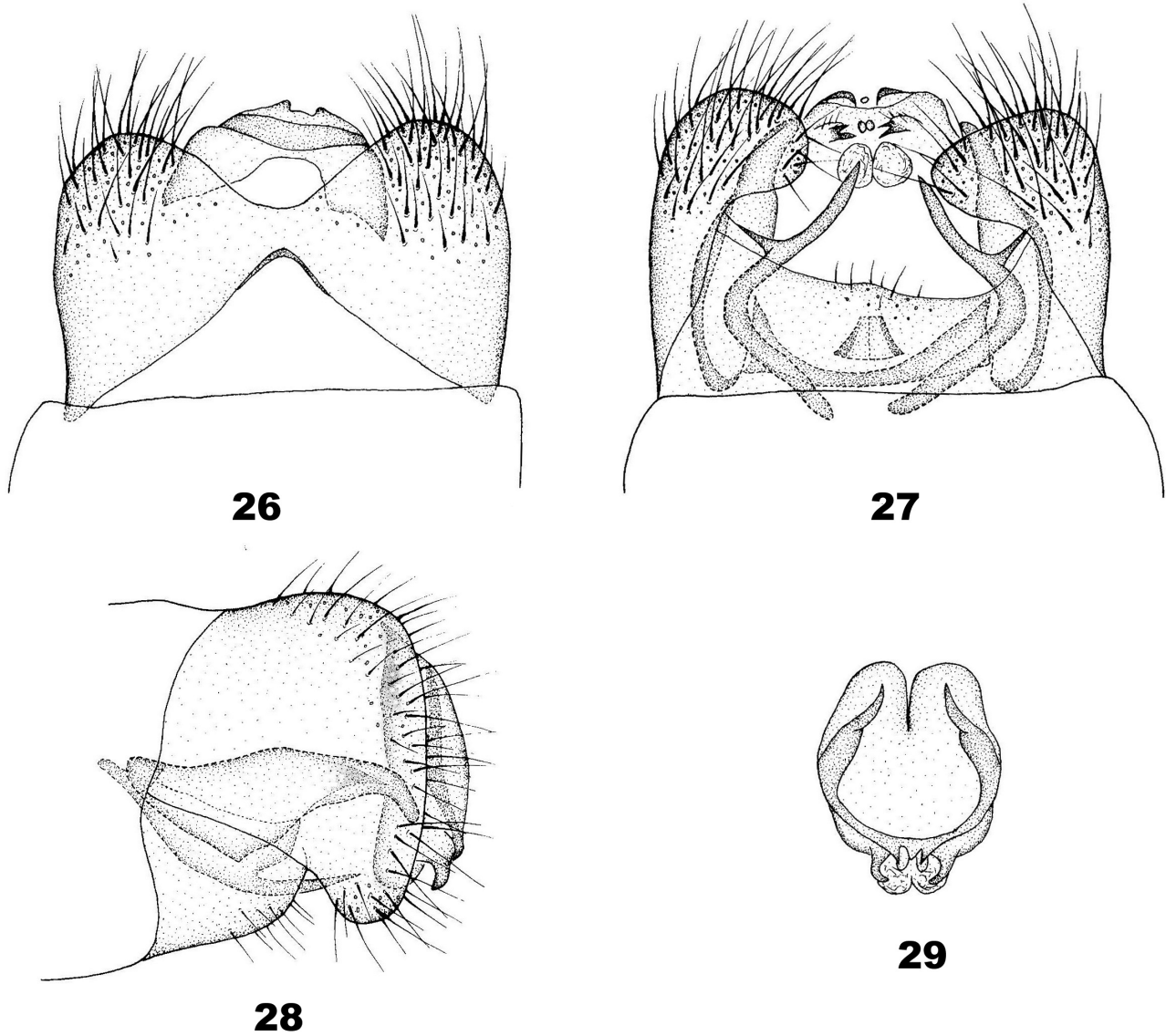
Diagnosis. This species is characterized by the forewings with numerous pale brown markings, and the male complexes of gonocoxites 9, 10, and 11 with strongly incurved gonocoxite 10, which submedially extended a pointy projection connecting to gonocoxite 9.

Description. Male. Body length 5.5 mm; forewing length 8.0 mm, hindwing length 6.5 mm.

Head yellowish brown, with pale yellowish brown setose tubercles. Compound eyes blackish brown. Antenna pale yellowish brown, pedicel with brown annular stripes, flagellum unipectinate on most flagellomeres, longest branch nearly 7.0 times as long as relevant flagellomere.

Prothorax brown, pronotum dark brown, medially with a pair of ovoid markings; mesothorax yellowish brown, mesonotum dark brown on anterior and lateral margins, scutellum with posterior half dark brown; metanotum pale

yellowish brown, slight darker on lateral margins. Legs pale yellowish brown, femora blackish brown at tip. Wings hyaline, slightly smoky brown, with numerous pale brown spots. Forewing ~2.0 times as long as wide, densely spotted, proximal spots slightly darker, arranging as transversely arcuate pattern, an immaculate area present distal to median nygma. Hindwing ~2.2 times as long as wide, much paler than forewing, immaculate. Veins pale yellow, crossveins much darker than longitudinal veins.



FIGURES 26–29. *Dilar loeimensis* Zhang, Liu & Winterton, **sp. nov.** 26. Male genitalia, dorsal view; 27. Male genitalia, ventral view; 28. Male genitalia, lateral view; 29. Male ectoproct, caudal view. Scale bars: 0.5 mm.

Abdomen yellow, pregenital segments dorsally yellowish brown. Tergum 9 in dorsal view with a deeply arcuate anterior incision and a nearly V-shaped posterior incision, leaving a narrow median portion and a pair of subtrapezoidal hemitergites, which are obtuse distally and densely haired. Sternum 9 obviously shorter than tergum 9. Ectoproct in dorsal view with a deeply arcuate anterior incision, posteroventrally with a pair of short and flattened projections, a pair of bifid unguiform projections and a pair of short, feebly sclerotized, digitiform projections. Gonocoxite 9 slightly inflated proximally, with unguiform tip; gonocoxite 10 slenderly elongate, strongly curved, and submedially extended a pointy projection connecting to gonocoxite 9; gonarcus slenderly beam-shaped, slightly inflated on both ends, laterally connecting to bases of gonocoxites 9. Hypandrium internum trapezoidal, with lateral margins slightly arcuate.

Female. Unknown.

Materials examined. Holotype ♂, THAILAND, Loei, Phu Kradueng NP, Forest protection unit Loei. 5 (Phakbung) [16°50.493'N, 101°41.726'E], 25.II–1.III.2007, Malaise trap, Songkran Kamtue, T1506 (CSCA).

Distribution. Thailand (Loei).

Etymology. The specific epithet “*loeinensis*” refers to the type locality, i.e. Loei, in northern Thailand.

Remarks. The new species seems to be somewhat related to the species of the *D. guangxiensis* group by the male gonocoxite 10 with submedial projection connecting to gonocoxite 9. However, the dorsoprocessus of the male tergum 9 that is present in all species of the *D. guangxiensis* group is absent in *D. loeinensis* Zhang, Liu & Winterton, **sp. nov.**

***Dilar macleodi* Oswald & Schiff**

(Fig. 5)

Dilar macleodi Oswald & Schiff, 2001: 74. Type locality: Malaysia (Sarawak: Gunung Buda).

Diagnosis. This is a very small species of *Dilar*, with male forewing length ca. 6 mm. It is a pale species, but with some dark thoracic markings. The forewing markings are also reduced, not arranged as transverse bands as that in many other *Dilar* species.

Materials examined. Paratypes 2♂, MALAYSIA: Sarawak, Gunung [= Mt.] Buda, ca. 64 km S Limbang, 4°13'N, 114°56'E, Malaise, 5–25.IX.1996, N. Schiff (NHMW).

Distribution. Malaysia (Sarawak).

Remarks. This species was well described by Oswald & Schiff (2001) so a re-description is apparently unnecessary in this paper. It appears to be closely related to *D. sumatranus* Zhang, Liu, Aspöck & Aspöck, **sp. nov.** (see Remarks under the latter species).

***Dilar marmoratus* (Banks)**

(Figs. 6, 30–33)

Rexavius marmoratus Banks, 1931b: 385. Type locality: Thailand (Nakhon Si Thammarat).

Diagnosis. This species is characterized by the forewings with reduced dark markings except for the discontinued brownish marginal stripes, the male gonocoxite 9 slenderly elongate distad with a subrectangular lobe submedially, and the gonocoxite 10 spindled anteroposteriorly but strongly inflated medially.

Description. Male. Forewing length 9.5 mm, hindwing length 8.6 mm.

Head pale yellowish brown, with pale yellow setose tubercles. Compound eyes blackish brown. Antenna with ca. 27 segments, yellowish brown, pedicel with brown annular stripes, flagellum unipectinate on most flagellomeres, longest branch nearly 6.0 times as long as relevant flagellomere.

Prothorax pale yellow, pronotum yellowish brown, with anterior margin and posterolateral corners yellow, medially with a pair of ovoid markings; mesothorax pale yellowish brown, mesonotum dark brown on anterior and lateral margins; metanotum pale yellowish brown, slight darker on lateral margins. Legs yellowish brown, femora blackish brown at tip. Wings pale yellow, nearly hyaline. Forewing ~2.2 times as long as wide, with only a few brown spots on costal area, a big brown stripe present around median nygma, and a few discontinued brownish marginal stripes. Hindwing ~2.2 times as long as wide, pale yellow, almost immaculate. Veins pale brown, crossveins much darker than longitudinal veins.

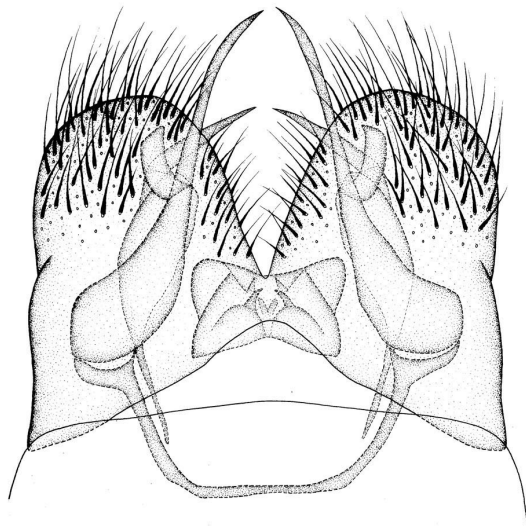
Abdomen pale yellow, pregenital segments dorsally yellowish brown. Tergum 9 in dorsal view with an arcuate anterior incision and a deeply V-shaped posterior incision, leaving a pair of broad hemitergites, which are obtuse distally and densely haired. Sternum 9 much shorter than tergum 9, arcuately convex posteriad. Ectoproct in dorsal view with an arcuate anterior incision, posterodorsally with a pair of unguiform projections, posteroventrally with a pair of subovoid, flattened projections, a pair of bifid unguiform projections and a pair of short, feebly sclerotized, digitiform projections. Gonocoxite 9 anteriorly strongly inflated, posteriorly slenderly elongate and acutely pointed at tip, submedially with a nearly rectangular lobe; gonocoxite 10 spindled anteroposteriorly, but inflated medially; gonarcus beam-shaped, nearly U-shaped, laterally expanded on both ends and connecting to bases of gonocoxites 9. Hypandrium internum nearly trapezoidal, with lateral margins slightly arcuate.

Female. Unknown.

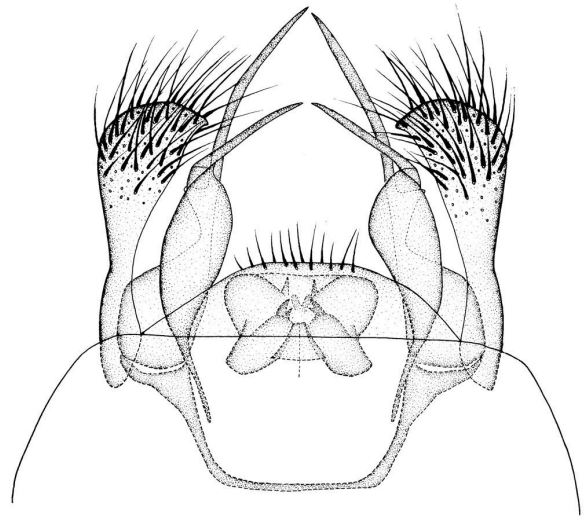
Materials examined. Holotype ♂, “Peninsular Siam, Nakon Sri Tamarat, Khao Luang [8°31'N, 99°47'E], 2000 ft [= 610 m], III.1929, H.M. Pendlebury” (MCZ).

Distribution. Thailand (Nakhon Si Thammarat).

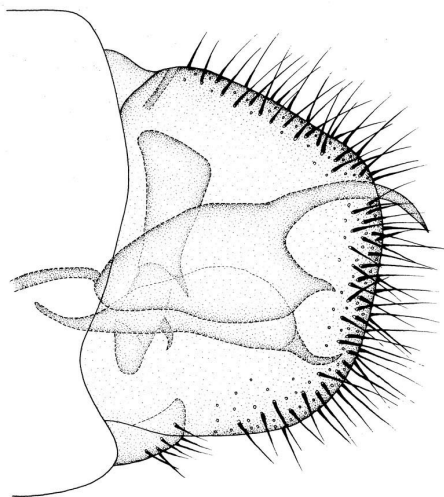
Remarks. This species could be a member of the *Dilar hastatus* species-group (see Zhang *et al.* 2015) based on the bifurcated male gonocoxite 9 and the U-shaped gonarcus laterally expanded on both ends. However, *D. marmoratus* differs from all other members of the *D. hastatus* group by the male gonocoxite 9 bifurcated into a long spinous and a short unguiform projections. In the other species of the *D. hastatus* group, if the male gonocoxite 9 is bifurcated, the two projections formed by the bifurcation are almost equal in length.



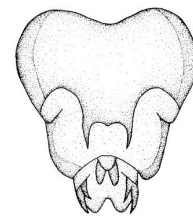
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FIGURES 30–33. *Dilar marmoratus* (Banks). 30. Male genitalia, dorsal view; 31. Male genitalia, ventral view; 32. Male genitalia, lateral view; 33. Male ectoproct, caudal view. Scale bars: 0.5 mm.

***Dilar ohli* Zhang, Liu, Aspöck & Aspöck, sp. nov.**

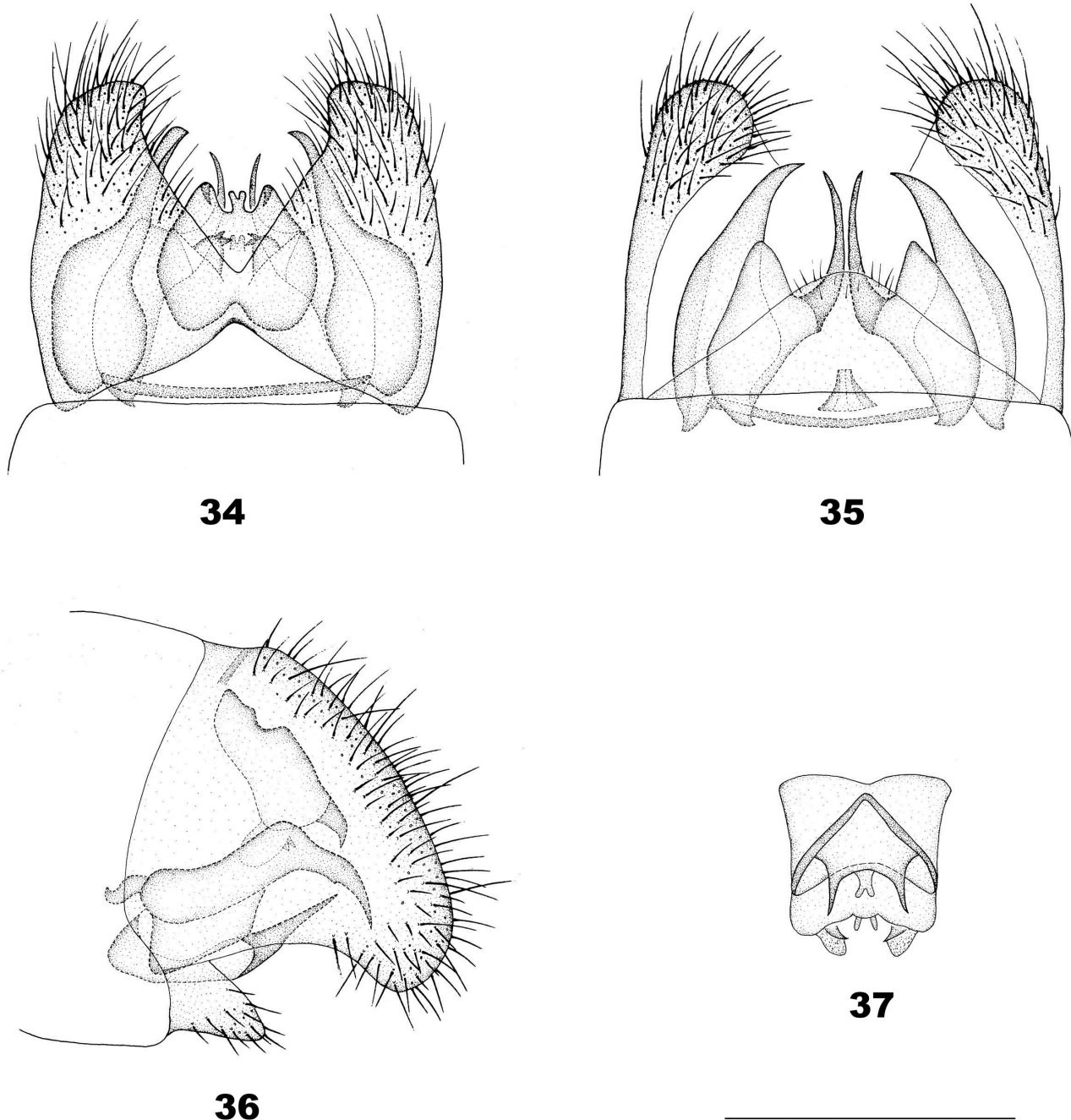
(Figs. 7, 34–37)

Diagnosis. This species is characterized by the forewings with numerous brown stripes, and by the short and broad male gonocoxite 10, submedially with a long, spinous projection.

Description. Male. Body length 4.0 mm; forewing length 9.1 mm, hindwing length 7.5 mm.

Head pale yellowish brown, with pale yellow setose tubercles. Compound eyes blackish brown. Antenna pale yellowish brown, pedicel with brown annular stripes, flagellum unipectinate on most flagellomeres, longest branch nearly 5.0 times as long as relevant flagellomere.

Prothorax pale yellowish brown, pronotum yellowish brown, with anterior margin and posterolateral corners slightly paler, medially with a pair of ovoid markings; mesonotum yellowish brown, slightly darker on anterior and lateral margins; metanotum pale yellowish brown, slightly darker on lateral margins. Legs pale yellowish brown, femora blackish brown at tip. Wings hyaline, slightly smoky brown, with numerous brownish stripes. Forewing ~1.9 times as long as wide, with a number of brownish stripes, which are present as transversely arcuate pattern and slightly darker proximally, an immaculate area present distal to median nygmata. Hindwing ~2.0 times as long as wide, slightly paler than forewing, almost immaculate. Veins pale brown.



FIGURES 34–37. *Dilar ohli* sp. nov. 34. Male genitalia, dorsal view; 35. Male genitalia, ventral view; 36. Male genitalia, lateral view; 37. Male ectoproct, caudal view. Scale bars: 0.5 mm.

Abdomen yellowish brown, pregenital segments dorsally dark brown. Tergum 9 in dorsal view with a deeply arcuate anterior incision and a deeply V-shaped posterior incision, leaving rather narrow median portion and a pair of subtrapezoidal hemitergites, which are obtuse distally and densely haired. Sternum 9 obviously shorter than tergum 9, subtriangular. Ectoproct in dorsal view posteriorly with a pair of decurved unguiform projections and a short, bifurcated median projection, in ventral view medially with a pair of bifid unguiform projections and a pair of short, feebly sclerotized, digitiform projections. Gonocoxite 9 proximally inflated, with a narrowed and ventromedially curved apex; gonocoxite 10 short and broad, submedially with a long, spinous projection, which is laterally curved distad; gonarcus slenderly beam-shaped, laterally connecting to bases of gonocoxites 9. Hypandrium internum nearly trapezoidal, with lateral margins slightly arcuate.

Female. Unknown.

Materials examined. Holotype ♂, “Tonkin, Montes Mauson [a locality in Lang Son Province, Vietnam, 19°45'N, 107°45'E], 2000–3000' [609–914 m], April, Mai, H. Fruhstorfer/Rexavius nietneri” (MFN). Paratype 1♂, same as holotype (MFN).

Distribution. Vietnam (Lang Son).

Etymology. The new species is dedicated to Dr. Michael Ohl who kindly helped us for the examination of the collection of Dilaridae in MFN.

Remarks. The new species resembles another Vietnamese species, *D. vietnamensis*, in having similar wing marking patterns. However, the male genitalia between these two species are quite different. In *D. ohli* Zhang, Liu, Aspöck & Aspöck, **sp. nov.** the male gonocoxite 9 is posteriorly curved with spinous apex, and the male gonocoxite 10 is short and broad, submedially with a long spinous projection. However, in *D. vietnamensis* the male gonocoxite 9 is straightly directed with rounded apex, and the male gonocoxite 10 is slenderly elongated, without any additional projection. Actually, we could not find any species closely related to this peculiar new species based on the characteristics of the male genitalia.

***Dilar rotundatus* Zhang, Liu & Winterton, sp. nov.**

(Figs. 8, 38–41)

Diagnosis. This species is characterized by the male gonocoxite 10, which is slenderly elongated and incurved anteriorly, but inflated posteriorly with round tip. The forewing of this species is densely spotted, with spots arranging as several transversely arcuate stripes.

Description. Male. Body length 4.8 mm.

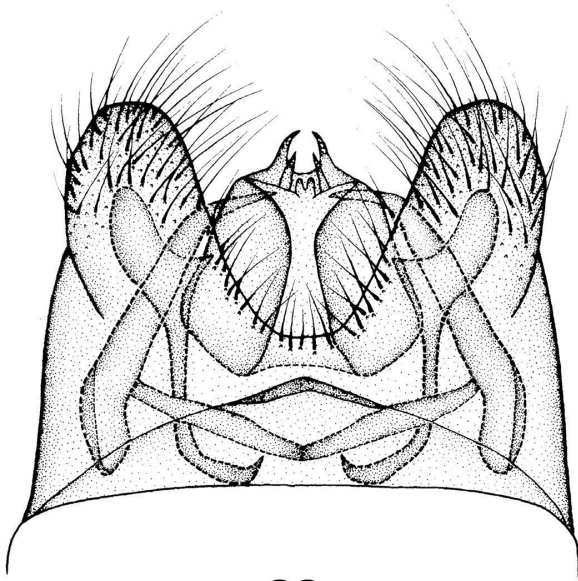
Head pale yellowish brown, with pale yellow setose tubercles. Compound eyes blackish brown. Antenna pale yellowish brown, flagellum with all flagellomeres lost.

Prothorax yellowish brown, pronotum pale brown, medially with a pair of ovoid markings; mesothorax yellowish brown, mesonotum dark brown on anterior and lateral margins, scutellum with posterior half dark brown, laterally with a pair of pale yellow oblique stripes; metanotum yellowish brown, slight darker on lateral margins. Legs pale yellowish brown, femora blackish brown at tip. Wings hyaline, slightly smoky brown, with numerous dark spots. Forewing densely spotted, proximal spots slightly darker, arranging as transversely arcuate pattern, an immaculate area present distal to median nygma. Hindwing slightly paler than forewing, immaculate.

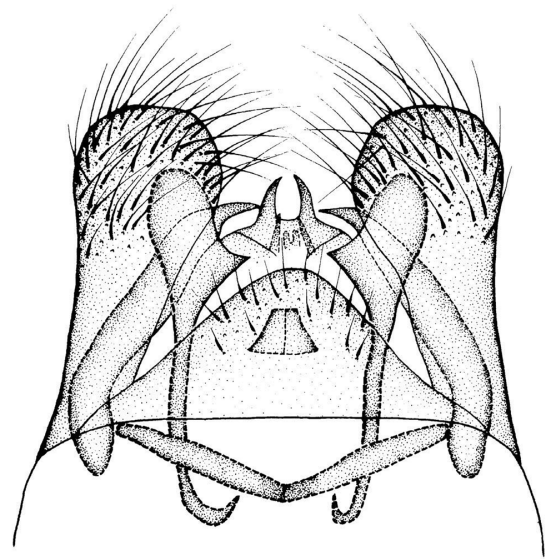
Abdomen brown, pregenital segments dorsally dark brown. Tergum 9 elongated, in dorsal view with an arcuate anterior incision and a deeply U-shaped posterior incision, leaving rather narrow median portion and a pair of subtriangular hemitergites, which are obtuse distally and densely haired. Sternum 9 obviously shorter than tergum 9, subtriangular. Ectoproct in dorsal view nearly hexagonal, posterodorsally with a pair of spinous projections and a pair of short, feebly sclerotized, digitiform projections, posteroventrally with a pair of unguiform projections. Gonocoxite 9 anteriorly broad and spoon-shaped in lateral view, posteriorly narrowed and strongly curved posteroventrally, with spinous tip; gonocoxite 10 slenderly elongated with hook-like anterior apex, but strongly inflated posteriorly with rotund tip; gonarcus slenderly beam-shaped, laterally connecting to bases of gonocoxites 9. Hypandrium internum nearly trapezoidal, with lateral margins slightly arcuate.

Female. Unknown.

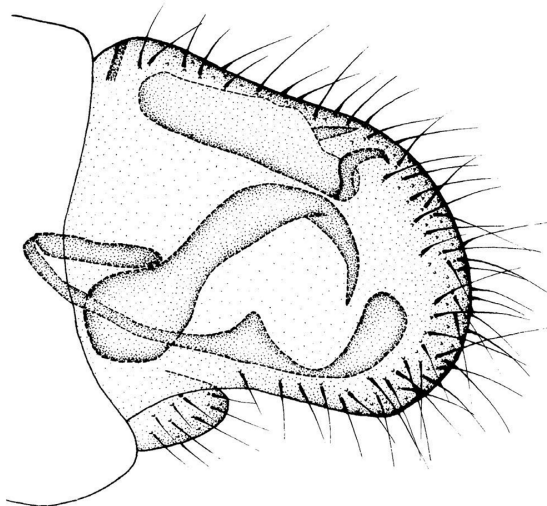
Materials examined. Holotype ♂, THAILAND: Loei, Phu Ruea NP, Pha Lon Noi [17°30.502'N, 101°20.868'E], 1343 m, 12–19.III.2007, Patikhom Tumtip (CAU).



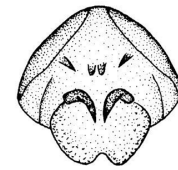
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FIGURES 38–41. *Dilar rotundatus* Zhang, Liu & Winterton, **sp. nov.** 38. Male genitalia, dorsal view; 39. Male genitalia, ventral view; 40. Male genitalia, lateral view; 41. Male ectoproct, caudal view. Scale bars: 0.5 mm.

Distribution. Thailand (Loei).

Etymology. The specific epithet “*rotundatus*” refers to the male gonocoxite 10 with inflated and rotund tip in the new species.

Remarks. Although the single type of this new species is poorly preserved with largely damaged wings, the male genitalia clearly shows that it is a peculiar species based on the male gonocoxite 10 with a slenderly elongated anterior portion and a strongly inflated, rounded posterior apex. We could not find any species closely related to this new species based on the male genital characteristics.

***Dilar sumatranus* Zhang, Liu, Aspöck & Aspöck, sp. nov.**

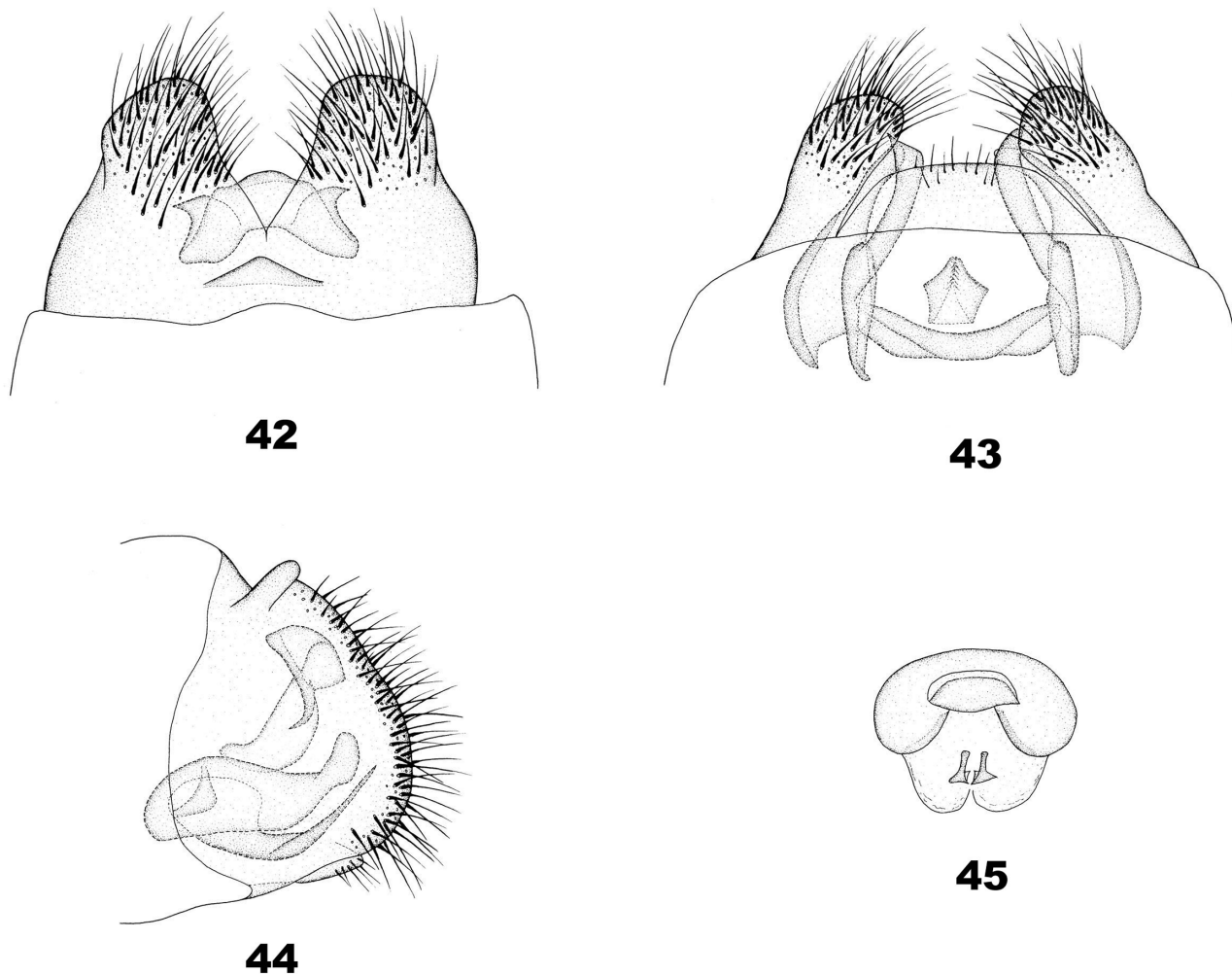
(Figs. 9, 42–45)

Diagnosis. This species is characterized by the male ectoproct in dorsal view posterolaterally with a pair of outcurved unguiform projections, and the slender male gonocoxite 10 with outcurved unguiform tip.

Description. Male. Body length 3.8 mm.

Head pale yellowish brown, with pale yellow setose tubercles. Compound eyes blackish brown. Antenna pale yellowish brown, flagellum unipectinate on most flagellomeres, longest branch nearly 6.0 times as long as relevant flagellomere.

Prothorax yellowish brown, pronotum pale brown, medially with a pair of ovoid markings; mesothorax yellowish brown, mesonotum dark brown on anterior and lateral margins; metanotum yellowish brown, slight darker on lateral margins. Legs pale yellowish brown, femora blackish brown at tip. Wings largely damaged, with remaining part hyaline and covered by many long hairs.



FIGURES 42–45. *Dilar sumatranus* sp. nov. 42. Male genitalia, dorsal view; 43. Male genitalia, ventral view; 44. Male genitalia, lateral view; 45. Male ectoproct, caudal view. Scale bars: 0.5 mm.

Abdomen pale yellow, pregenital segments dorsally yellowish brown. Tergum 9 in dorsal view slightly concaved anteriorly and with a deeply V-shaped posterior incision, leaving a wide median portion and a pair of subtrapezoidal hemitergites, which are obtuse distally and densely haired. Sternum 9 obviously shorter than tergum 9, subtrapezoidal. Ectoproct in dorsal view with a nearly arcuate anterior incision and a slightly arcuate posterior projection, posterolaterally with a pair of outcurved, unguiform projections. Gonocoxite 9 in dorsal view broad on proximal half, with obtuse tip; gonocoxite 10 slenderly elongate, with outcurved, unguiform tip; gonarcus beam-shaped, laterally connecting to bases of gonocoxites 9. Hypandrium internum narrowly trapezoidal, with lateral margins slightly arcuate.

Female. Unknown.

Materials examined. Holotype ♂, INDONESIA: Sumatra, Utara Dairi [2°0'39"N, 98°58'42"E], 8.VI.1997, E.W. Diehl (HUAC).

Distribution. Indonesia (Sumatra).

Etymology. The specific epithet “*sumatranus*” refers to Sumatra where the single specimen of this new species was collected.

Remarks. The new species represents the first record of Dilaridae in the island Sumatra, Indonesia, despite the single type which is largely damaged. The completely preserved male genitalia of the new species shows that it appears to be closely related to *D. macleodi* from Borneo in having similar male gonocoxites 9 and 10. However, the new species can be distinguished from *D. macleodi* by the indistinct dorsoprocessus of the male tergum 9, the pointed apex of the male gonocoxite 10, and the absence of dorsal projections on the male ectoproct. In *D. macleodi* there is a well developed dorsoprocessus on the male tergum 9, the apex of the male gonocoxite 10 is obtuse [note that the gonocoxite 10 was erroneously interpreted as gonocoxite 9 in Oswald and Schiff (2001)], and the male ectoproct has a pair of spinous dorsal projections.

***Dilar vietnamensis* Zakharenko**

Dilar vietnamensis Zakharenko, 1991: 142. Type locality: Vietnam (Onang Ninh, Dongkho).

Diagnosis. This species is characterized by the forewing with remarkably dark transverse bands, the male gonocoxite 9 with rounded apex, and the slenderly elongated male gonocoxite 10 with spinous tip.

Distribution. Vietnam (Binh Thuan).

Remarks. The types of this species are unavailable for us. However, based on the illustrations of the wings and male genitalia in the original description (Zakharenko 1991), this species should be valid. We could not find the geographical coordination of the type locality “Onang Ninh, Dongkho” of this species. Nevertheless, we found “Dong Kho (11°07'N, 107°46'E)” which is locality of Binh Thuan Province in southern Vietnam.

***Dilar zimmermannae* Zhang, Liu, Aspöck & Aspöck, sp. nov.**

(Figs. 10, 46–49)

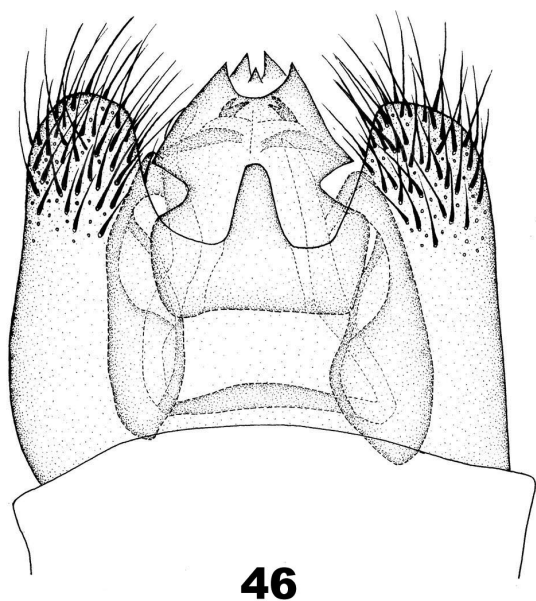
Diagnosis. This species is characterized by the forewing with numerous brownish spots, by the male tergum 9 with a dorsoprocessus, and the slenderly elongate male gonocoxite 10, which submedially bears a pointy lobe connecting to gonocoxite 9.

Description. Male. Body length 5.0–8.0 mm; forewing length 10.0–12.0 mm, hindwing length 8.0–10.0 mm.

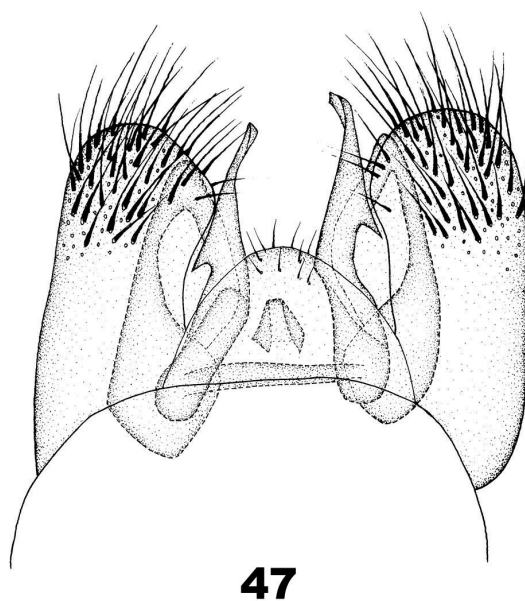
Head brown, with pale yellow setose tubercles. Compound eyes blackish brown. Antenna with ca. 28 segments, yellowish brown, pedicel with brown annular stripes, flagellum unipectinate on most flagellomeres, longest branch nearly 3.0 times as long as relevant flagellomere.

Prothorax pale yellowish brown, pronotum brown, with anterior margin and posterolateral corners yellow, medially with a pair of ovoid markings; mesothorax pale yellowish brown, mesonotum dark brown on anterior and lateral margins; metanotum pale yellowish brown, slightly darker on lateral margins. Legs brown, femora blackish brown at tip. Wings hyaline, slightly smoky brown. Forewing ~2.1 times as long as wide, with numerous pale brown spots, distal spots slightly darker, an immaculate area present distal to median nygmata. Hindwing ~2.2 times as long as wide, much paler than forewing, with indistinct brownish spots.

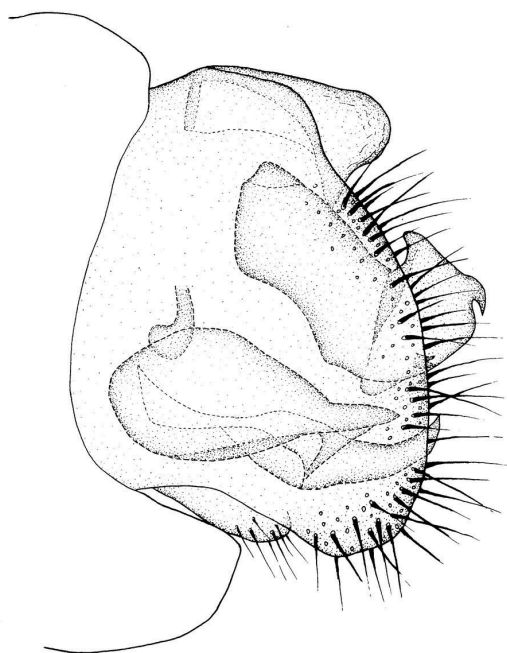
Abdomen yellowish brown, pregenital segments dorsally dark brown. Tergum 9 in dorsal view with a shallowly arcuate anterior incision, a nearly U-shaped posterior incision and a long dorsoprocessus, leaving a pair of broad hemitergites, which are obtuse distally and densely haired. Sternum 9 obviously shorter than tergum 9, subtriangular. Ectoproct in dorsal view distinctly narrowed at middle, posteriorly with a transverse ridge, which is arcuately concaved, a pair of bifid projections and a trifurcate lobe present posterior to transverse ridge, posteroventrally with a pair of bifid unguiform projections. Gonocoxite 9 broadly inflated with blunt tip; gonocoxite 10 slenderly elongate, submedially with a pointy lobe connecting to gonocoxite 9; gonarcus slenderly beam-shaped, laterally connecting to bases of gonocoxites 9. Hypandrium internum nearly trapezoidal, with lateral margins slightly arcuate.



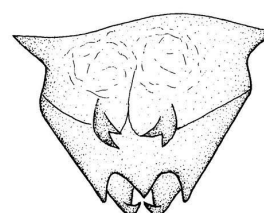
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FIGURES 46–49. *Dilar zimmermannae* sp. nov. 46. Male genitalia, dorsal view; 47. Male genitalia, ventral view; 48. Male genitalia, lateral view; 49. Male ectoproct, caudal view. Scale bars: 0.5 mm.

Female. Unknown.

Materials examined. Holotype ♂, MYANMAR: Chin State, Natmataung Nat. Park, WNW Kanpetlet township [21°12'44"N, 94°00'58"E], 2340 m, 1.VI.2010, D. Zimmermann (NHMW). Paratypes 3♂, same data as holotype (NHMW); 5♂, MYANMAR: Chin State, Natmataung Nat. Park, WNW Kanpetlet township [21°13'24"N, 93°58'50"E], 2470 m, 31.V.2010, D. Zimmermann (NHMW).

Distribution. Myanmar (Chin).

Etymology. The new species is dedicated to Mag. Dominique Zimmermann (NHMW) who collected all the specimens.

Remarks. The late Prof. Bo Tjeder (1901–1992), one of the most famous neuropterologists had studied this

new species (as *Dilar burmanus* Tjeder, which is, however, an unavailable name due to lack of formal description and differentiation) in his comparative morphological study on the genitalia of Neuropterida (Tjeder 1954). Based on the recently collected materials from northern Myanmar, we confirm that the specimens herein studied belong to the species (i.e. *Dilar burmanus*) studied by Tjeder (1954). However, it is obligatory to give this species a new name due to the unavailability of *Dilar burmanus* Tjeder based on the Article 13.1 of ICZN (1999). The new species also represents the first record of Dilaridae in Myanmar. The new species apparently belongs to the *Dilar guangxiensis* species-group (see Zhang *et al.* 2015) by the presence of dorsoprocessus on the male tergum 9 and the male gonocoxite 10 submedially with a pointed projection connecting to the male gonocoxite 9. It is distinguished from the other members of the *D. guangxiensis* group by the male ectoproct medially narrowed and ridged dorsad and also by the details of the male gonocoxites 9 and 10.

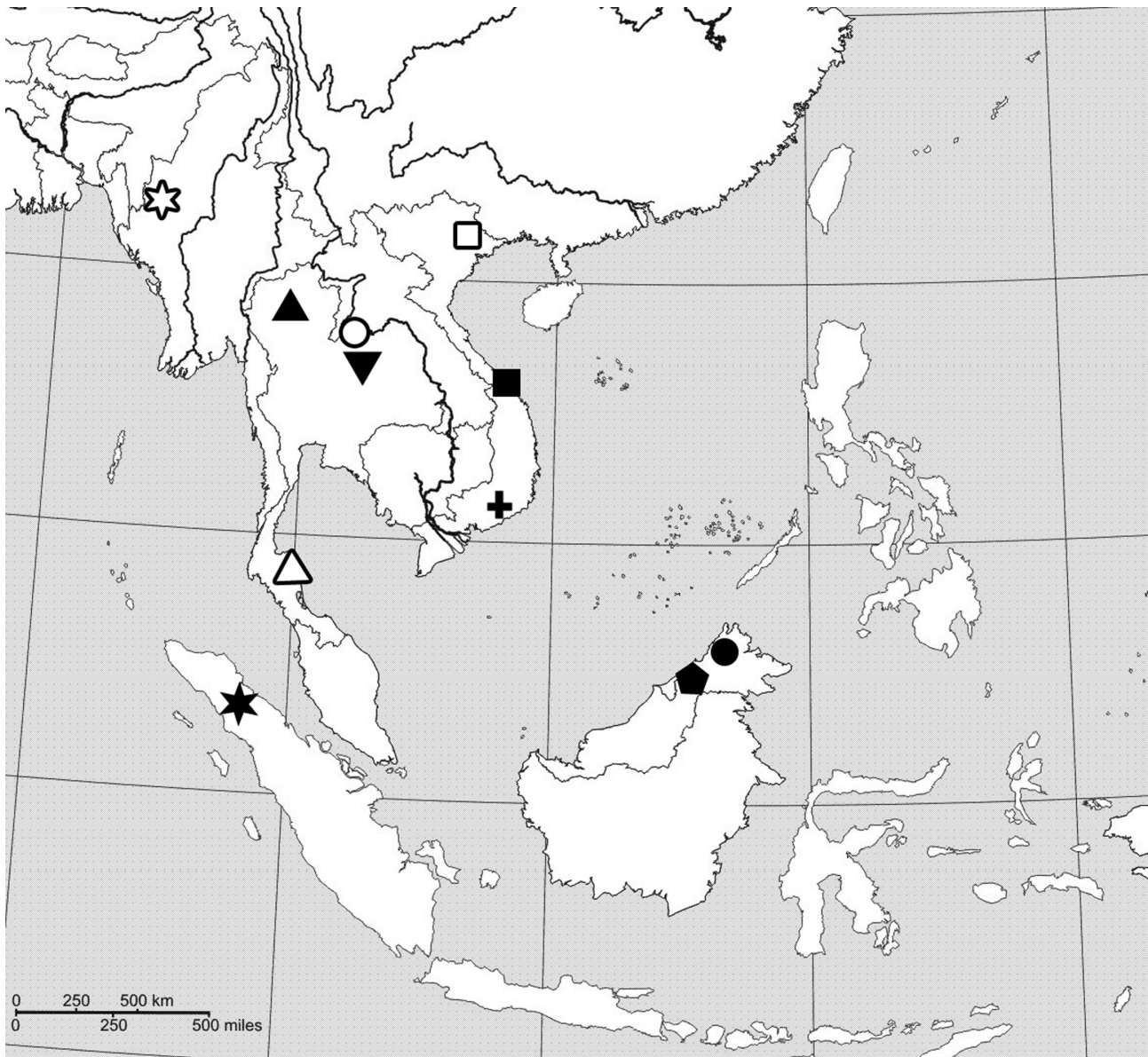


FIGURE 50. Geographic distribution of the species of *Dilar* from Southeast Asia. ▲: *Dilar abnormis* Zhang, Liu & Winterton, **sp. nov.**; ●: *Dilar grandis* (Banks); ■: *Dilar lineatus* Zhang, Liu & Winterton, **sp. nov.**; ▼: *Dilar loeinensis* Zhang, Liu & Winterton, **sp. nov.**; ◆: *Dilar macleodi* Oswald & Schiff; △: *Dilar marmoratus* (Banks); □: *Dilar ohli* Zhang, Liu, Aspöck & Aspöck, **sp. nov.**; ○: *Dilar rotundatus* Zhang, Liu & Winterton, **sp. nov.**; ★: *Dilar sumatranus* Zhang, Liu, Aspöck & Aspöck, **sp. nov.**; ⊕: *Dilar vietnamensis* Zakharenko; ☆: *Dilar zimmermannae* Zhang, Liu, Aspöck & Aspöck, **sp. nov.**

Discussion

The knowledge on the species diversity and distribution of *Dilar* from Southeast Asia is considerably updated based on the present findings. The genus was first recorded from northern Myanmar, northern Thailand, northern and central Vietnam, and Sumatra (Indonesia). However, there are still several countries of Southeast Asia lacking record of *Dilar*, such as Cambodia, Laos, and Philippines. The Malay peninsula and Java are also the open areas for *Dilar*. We believe that these regions should harbour some species of *Dilar*. Moreover, compared with the rich fauna of *Dilar* from southern China (Zhang *et al.* 2014b, c, 2015), the known species diversity of this genus from Southeast Asia seems to be much lower than the real one. Therefore, it is still premature to infer the phylogenetic positions and biogeography of the *Dilar* species from Southeast Asia. Extensive investigation for pleasing lacewings should be carried out for this interesting region.

Acknowledgements

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