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New taxa of the Lygistorrhinidae (Diptera: Sciaroidea) and their implications for a phylogenetic analysis of the family

HEIKKI HIPPA, INGEGERD MATTSSON & PEKKA VILKAMAA

Heikki Hippa & Ingegerd Mattsson, Swedish Museum of Natural History, PO Box 50007, SE-104 05 Stockholm, Sweden. E-mail: heikki.hippa@nrm.se
Pekka Vilkamaa, Finnish Museum of Natural History, Zoological Museum, PO Box 17, FI-00014 University of Helsinki, Finland. E-mail: pekka.vilkamaa@helsinki.fi

Table of Contents

Abstract 1
Introduction 2
Material and methods 2
Characters of the Lygistorrhinidae 3
Characters used in the phylogenetic analysis 6
Phylogeny of the Lygistorrhinidae 10
Key to genera of Lygistorrhinidae 11
New taxa of Lygistorrhinidae 12
Labellorrhina gen. n. 12
Labellorrhina quantula sp. n. 13
Labellorrhina grimaldii sp. n. 14
Blagorrhina gen. n. 14
Blagorrhina blagoderovi sp. n. 16
Blagorrhina brevicornis sp. n. 17
Gracilorrhina gen. n. 17
Gracilorrhina gracilis sp. n. 19
Lygistorrhinidae sp. 1 (female) 19
Lygistorrhinidae sp. 2 (female) 20
Acknowledgements 20
References 21

Abstract

New Oriental taxa of the Lygistorrhinidae - *Blagorrhina* gen. n., with *B. blagoderovi* sp. n. and *B. brevicornis* sp. n.; *Gracilorrhina gracilis* gen. n., sp. n.; and *Labellorrhina* gen. n., with *L. grimaldii* sp. n. and *L. quantula* sp. n. - are described, and two undescribed species, known only from females, are characterized. Based on this new material, the family is redefined. The phylogenetic

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relationships among the taxa of Lygistorrhinidae were studied by parsimony analysis using 43 morphological characters from the adults of 25 ingroup and one outgroup species. The cladistic analysis produced 14 most parsimonious cladograms. The solution obtained suggests unambiguously the following phylogeny: *Palaeognoriste* Meunier and "*Lygistorrhina" asiatica* Senior-White are successively sister groups of the rest of the Lygistorrhinidae; there is a clade *Labellorrhina* + (*Gracilorrhina* + (*Blagorrhina* + ((*Seguyola* Matile + (*Loyugesa* Grimaldi & Blagoderov + *Matileola* Papp))))) with a monophyletic *Lygistorrhina* Skuse – *Probolaeus* Williston lineage as sister group. The phylogeny among the latter group remains largely unresolved.

Key words: Lygistorrhinidae, phylogeny, morphology, new taxa

Introduction

The Lygistorrhinidae is a small family of Sciaroidea that is widely distributed but restricted to tropical and subtropical regions. Our current understanding of the characters of the family is essentially based on Thompson (1975), who also reviewed the taxonomic history of the group up to that time. There are about 20 described extant species, and, because of the distinct morphological characters of the group, there has been no doubt as to the monophyly of the family. On the other hand, the proper systematic rank and the sister-group relationships of the taxon have been the subject of much controversy since Edwards (1925) ranked it as a subfamily (Tuomikoski 1966; Thompson 1975; Matile 1990a, 1990b; Matile 1997). The most recent contribution is that of Hippa and Vilkamaa (in press) who, like Matile (1997), on the basis of a cladistic analysis, suggested a close relationship between the Lygistorrhinidae and the Mycetophilidae s. str. Recently Grimaldi and Blagoderov (2001) and Blagoderov and Grimaldi (2004) have studied phylogenies within the family, using parsimony analyses and including Mesozoic fossils in the latter study.

Our aim here is firstly to describe some new taxa discovered in the Oriental Region, and secondly, by means of a cladistic analysis, to place these taxa in the phylogenetic system of the family. We have omitted from the present paper the study of the phylogenetic relationships among the speciose *Lygistorrhina–Probolaeus* lineage and the question of the possible synonymy of these names (see Thompson 1975). In our phylogenetic and descriptive work, we have applied some new and previously neglected morphological characters and have also reinterpreted some of those already in use.

Material and methods

The specimens

The new material was collected mainly by using Malaise traps. These specimens were stored in ethanol before mounting. We mounted them on microscope slides in Euparal,

after dehydrating in absolute ethanol or, in the case of certain specimens, after treatment with potassium hydroxide (KOH). The material of *Lygistorrhina sanctaecatharinae* was originally pinned, but was mounted on slides after treatment with KOH and dehydration. The material studied here is deposited in the following collections: Finnish Museum of Natural History; Zoological Museum, Helsinki (MZH); National Museum of Wales, Cardiff (NMWC); and Swedish Museum of Natural History, Stockholm (NRM).

Phylogenetic analysis

For the analysis, 43 adult morphological characters were coded for 25 ingroup and one outgroup species. The data matrix (Appendix 1) was based on the one given by Grimaldi and Blagoderov (2001), although some characters were excluded because we could not code the states, and some new characters were added. The character states for *Matileola yangi* were taken from the original description (Papp 2003). The new taxa and *Lygistorrhina sanctaecatharinae* were coded from actual specimens. We did not try to find characters to resolve the phylogeny among the species of *Lygistorrhina* and *Probolaeus*. The data matrix for analysis was constructed and manipulated with the computer programme Winclada version 1.00.08 (Nixon 2002). Phylogenetic relationships were studied by parsimony analysis, using the computer programme NONA, version 2.0 (Goloboff 1999), together with Winclada, to search for the most parsimonious cladograms. The search parameters used with NONA were 'hold100000; hold/1000; mult*1000; max*; sswap*;. With these commands and settings, the programme makes a heuristic search and swaps branches with 'tree bisection-reconnection'. The unsupported nodes were collapsed to accept only unambiguous support for the nodes in the strictest sense, i.e., only if all possible states between the ancestor and descendant node are different. Bremer support values were calculated by NONA, using the following command sequence: hold 2000; sub 1; find*; hold 4000; sub 3; find*; hold 8000; sub 5; find*; hold 16000; sub 7; find*; hold 32000; sub10; find*; bsupport;. The resulting cladograms and their strict consensus cladogram (Fig. 1) and character optimizations were studied with Winclada. The characters were equally weighted in the analysis. Multistate characters were analyzed unordered. The character states were coded as (-) when the character involved was absent from a terminal and as (?) when the state was not known. The programme used does not differentiate between these cases. Selected species were used as terminals. The data matrix (Appendix 1) includes most described extant species of the family and our new undescribed species. To obtain the characters, specimens of the latter were studied from slide mounts and most of the former from the literature. *Diadocidia* of the Diadocidiidae was chosen as the outgroup. This study is based mainly on males because females of these taxa are too poorly known.

Characters of the Lygistorrhinidae

Type-genus *Lygistorrhina* Skuse, 1890: 589.

Thompson (1975) was the first to characterize the Lygistorrhinidae comprehensively, with a detailed discussion of the morphological features and their homologies. Tuomikoski (1966) before him, and later Matile (1990a, 1990b) and Grimaldi and Blagoderov (2001), have characterized the morphology of the Lygistorrhinidae. In the following description, additional information on a number of little-studied characters is given, especially those that we believe to have relevance in the study of the phylogeny of the Sciaroidea as a whole and also in the study of the phylogeny among lygistorrhinid groups. The characters of the Mesozoic taxa included in the Lygistorrhinidae by Blagoderov and Grimaldi (2004) are discussed separately.

Description

Head roundedly conical posteriorly, not flat, with or without a distinct row of postocular bristles of variable size. Ocelli 3 or 2 in number, close to one another, in an equilateral triangle or more in a transverse row in larger species of *Lygistorrhina* and *Probolaeus* where the median ocellus is much smaller than the lateral ones. Dichoptic or holoptic; compound eye with interommatidial setae, without interommatidial microtrichia; ommatidia equal in size or becoming larger dorsally and laterally. Frons at least in some species with a medial membraneous stripe, possibly for regulating the distance of the compound eyes. Mouthparts forming a proboscis composed of an elongated one-segmented maxillary palpus, hypopharynx and labella, and in at least some of the species the more basal part of the labium is also elongated. Length of proboscis varying from one-tenth of the height of the head to several times that. Maxillary lacinia absent. Hyaline sensilla on palpus scattered, at least usually in low pits with one to several sensilla in each, but with no true sensory pit. Antenna from 2 + 14 to 2 + 10 segmented; flagellomeres with a honeycomb-like facetted surface structure, with long trichia, short sharp peg-like sensilla, with long seta-like non-socketed sensilla (trichia), and with strong socketed setae on the basal flagellomere, with or without similar setae on other flagellomeres up to the last one, sexual dimorphism in this character not clear, but socketed setae on all flagellomeres have been observed in both sexes. Scutum evenly setose or with a non-setose lateral space. **Thorax**. Scutellum with a subapical row of setae. Posterior pronotum non-setose. Anterior pronotum setose. Episternum 1 setose, epimeron distinct from episternum as a non-setose sclerite. Prosternum not expanded laterally, so that only the extreme lateral margin is visible in lateral view. The suture between anepisternum and katepisternum distinct or obliterated anteriorly, both sclerites non-setose. Ventral part of anepimeron not distinct from katepisternum. Pleural pit distinct (at least in larger species of *Lygistorrhina* and *Probolaeus*) or indistinct, in the former case not cutting the anterior margin of anepimeron. Laterotergite more or less strongly produced posteroventrally, setose or non-setose. Meron absent. Episternum 3, or episternum 3 plus epimeron 3, higher than wide, weakly sclerotized, with more strongly sclerotized marginal areas including anterior margin, the latter ending basally at level of anterior margin of laterotergite or more anteriad so that it seems to meet

the posteroventral margin of katepisternum, non-setose. Posterior parts of thorax non-setose, in profile evenly curved, phragma not produced and no sign of its intrusion into basal segment of abdomen. **Legs**. Front tibia longer than front femur. Tibial spurs 1:2:2, 1:1:2, or 0:1:2. Tibial vestiture consisting of microtrichia, trichia and socketed setae, the former shorter than the latter. All tibiae with the longer tibial vestiture (trichia and setae) in rows even if the arrangement is weak in some cases. Front tibia with or without the tibial organ, i.e., an apical prolateral area of modified vestiture. Large spine-like setae on tibiae absent. Tarsal claws simple, pointed, or those on tarsus 2 apically blunt and more or less expanded, in a few species the claws of front tarsus similar even if the modification is weaker. Pulvilli one-branched, seta-like, giving an impression of two-branched claws. **Wing**. Costa extending beyond apex of R5, in *Seguyola* with a swelling at apex of R1. Subcosta joining costa or ending free, in the latter case often very weak. R1 long to short, ending in costa from well in apical half to well in basal half. R4 absent. Sclerotized Rs and r-m present only in the fossil *Palaeognoriste*, in all recent species non-sclerotized and scarcely discernible with certainty, both veins strongly basalized to near wing base. M with distinct but free ending stM and M1 and M2, or basal parts more or less extensively absent so that only separate apical parts of M1 and M2 are visible. CuA1 and CuA2 with a long common stem (stCuA) or separated, in the latter case both extending to wing base or CuA1 evanescent before wing base. CuP distinct. Anal area with variable sclerotizations. Wing membrane non-setose, posterior veins (M, Cu, CuP) and Sc non-setose, R1 and R2 setose or non-setose, C setose. Posterior margin of wing with both dorsal and ventral setae. Microtrichia on wing membrane not arranged in rows. **Abdomen**. Tergites without plaques, male sternite 9 absent. Gonocoxites with a ventral medial cleft between the sides, but narrowly fused basoventrally, gonocoxal apodemes separate, anteriorly not extending to level of the base of gonocoxites. Gonostylus with a basolateral apophysis, with a basomesial impression and a long seta in this area, with an apical tooth except in *Loyugesa* where it is absent. Aedeagus membraneous except for a more or less sclerotized apodeme, without aedeagal teeth. Tegmen present in all the taxa studied, probably representing the fused ventral branched of parameres, dorsal branches of parameres free (all taxa studied in the *Seguyola*-clade) or more or less completely fused with the lateral part of tegmen (all taxa studied in the *Lygistorrhina*-clade). Female (unidentified species of *Lygistorrhina* from Malaysia, *Probolaeus sanctaecatharinae*, three unidentified species of *Probolaeus* from Costa Rica and the Lygistorrhinidae sp. 1 and sp. 2 described in this paper) with normal sciaroid terminalia, sternite 8 ventrally cleft near to base, cercus two-segmented, two sclerotized spermathecae present.

Blagoderov and Grimaldi (2004) included five new Mesozoic genera in the Lygistorrhinidae: *Archaeognoriste*, *Lebanognoriste*, *Plesiognoriste*, *Protognoriste*, and *Leptognoriste*. These all have normal sciaroid mouthparts. Their wing venation shows a reduction of M similar to recent Lygistorrhinidae and Eocene fossils. At least in some of these genera, the front tibia is shorter than the front femur, reminiscent more of mycetophilids than

of lygistorrhinids. The monophyly of the Lygistorrhinidae in the new sense was shown by the cladistic analysis carried out by Blagoderov and Grimaldi (2004), in which the true Mycetophilidae were excluded. In this respect, we do not consider their results to be definitive, but at present we are unable to discuss these fossil taxa further.

Diagnostic characters

The diagnostic characters are generally known and have been repeatedly discussed (Tuomikoski 1966; Thompson 1995; Matile 1990a, 1990b; Grimaldi and Blagoderov 2001; Blagoderov and Grimaldi 2004), and so they will not be discussed in detail here. Recent and Palaeocene Lygistorrhinidae are distinguished from all other Sciaroidea by the presence of a proboscis consisting of maxillary palpi, hypopharynx, and elongated labella. The proboscis found in other Sciaroidea is different: In *Gnoriste* (Mycetophilidae) and in *Rhynchoheterotricha* (*Heterotricha* group without family placement) it is formed by an elongation of the ventral part of the head so that the mouthparts, including the labial palps, are at the apex of this elongation; in *Aphrastomyia* (Mycetophilidae) it is very similar but the palpi are at the base of the proboscis and the unsclerotized labella are elongated and reflex to the back of the basal part of the proboscis; in *Eugnoriste* (Sciaridae) it is formed by the clypeus, labrum, basal parts of labium and hypopharynx, the labella being unmodified; and in *Rhynchosciara* (Sciaridae) the proboscis consists of the same elements as in the latter, but it is short and broad. In some Keroplatidae, *Rhynchoplatyura*, *Asindulum*, *Macrorrhyncha* and *Cloeophoromyia*, the proboscis consists of the labrum, hypopharynx, and different elements of the labium, either an elongated prementum or also elongated labellar segments 1 and 2. In these keroplatids, the maxillary palpus is normal, five-segmented, and is not a part of the proboscis in the same way as in the Lygistorrhinidae.

Characters used in the phylogenetic analysis

The characters used were largely the same as those used by Grimaldi and Blagoderov (2001), with some modifications and additions that are explained under the respective characters below. Blagoderov and Grimaldi (2004) added two further characters from the episternum 3, which we have not been able to apply because almost none of the nominal species in *Lygistorrhina* and *Probolaeus* could be checked.

0. *Length of proboscis*: (0) short, ca. as long as or shorter than width of hind femur (Fig. 3A, B; Matile 1990a: Figs 1 and 2, 1990b: Fig. 1005); (1) long, from slightly shorter than to equal to length of hind femur (Fig. 2A, B and C; Grimaldi and Blagoderov 2001: Figs 1, 3a and 3c); (2) very long, longer than length of hind femur (Grimaldi and Blagoderov 2001: Fig. 3a; Matile 1990a, Fig. 6, 1990b: Figs 1003, 1004, 1006).
Grimaldi and Blagoderov (2001) had two different characters for the length of the proboscis, longer and shorter (vestigial) when compared with what we have coded as state 1. We think it is more logical to use only one multistate character.

1. *Length of maxillary palp*: (0) much shorter than labellum (Fig. 2A, C); (1) as long as labellum (Figs 2B, 3A, B).

2. *Male*: (0) dichoptic (Fig. 2A, C); (1) holoptic (Grimaldi and Blagoderov 2001: Fig. 3b).

3. *Size of facets of compound eyes*: (0) equal (Fig. 3A, B); (1) dorsal and lateral larger than medial and ventral (Fig. 2A, C).

4. *Median ocellus*: (0) present (Fig. 2A); (1) absent, but its site clearly discernible (Fig. 3 A); (2) absent (Figs 2C, 3B).

5. *Number of antennal flagellomeres*: (0) 14; (1) 12.

6. *Length of antenna*: (0) as long as or longer than height of head (Fig. 2A, C); (1) much shorter than height of head (Fig. 3B).

7. *Shape of flagellomeres*: (0) not flattened laterally (Grimaldi and Blagoderov 2001: Fig. 3A, B, C); (1) laterally flattened, ventrally expanded (Fig. 4D); (2) laterally flattened, ventrally strongly expanded (Fig. 4E).

8. *Position of seta-like sensilla on antennal flagellomeres*: (0) scattered (Fig. 4A, D, E); (1) in one whorl (Fig. 4B, F).

9. *Colour of flagellum*: (0) unicolourous; (1) with a colour pattern.

10. *Shape of scutum*: (0) slightly convex (Grimaldi and Blagoderov 2001: Fig. 4a); (1) dome-shaped (Figs 5A, 6A, 7A; Grimaldi and Blagoderov 2001: Fig. 4b).

11. *Setosity of scutum*: (0) setose all over (Figs 5A, 7A); (1) a non-setose stripe between dorsocentral and lateral setosity (Fig. 6A).

12. *Form of laterotergite*: (0) slightly produced (Grimaldi and Blagoderov 2001: Fig. 4b); (1) produced strongly lobe-like posteroventrally (Figs 5A, 6A, 7A; Grimaldi and Blagoderov 2001: Fig. 4b).

13. *Setae on laterotergite*: (0) present (Figs 5A, 7A; Grimaldi and Blagoderov 2001: 4a); (1) absent (Fig. 6A; Grimaldi and Blagoderov 2001: Fig. 4b).

14. *Position of anterior edge of notum*: (0) just above fore coxa, or barely anteriad (Fig. 6A; Grimaldi and Blagoderov 2001: Fig. 4b); (1) well anteriad of fore coxa (Figs 5A, 7A; Grimaldi and Blagoderov 2001: Fig. 4a).

15. *Position of anterior edge of episternum 3 in relation to anterior margin of laterotergite*: (0) approximately at the same level or posteriad (Figs 5A, 6A, 7A; Grimaldi and Blagoderov 2001: Fig. 4b); (1) much anteriad to laterotergite (Grimaldi and Blagoderov 2001: Fig. 4a).
This remarkable character, discovered by Grimaldi and Blagoderov (2001), is not quite clear-cut. In *Gracilorrhina* and *Blagorrhina*, coded as 0, it is slightly shifted anteriad but not as much as in *Lygistorrhina* and *Probolaeus.*

16. *Shape of wing apex*: (0) normal (Fig. 8A–E); (1) unusually broadly rounded (Matile 1990a: Fig. 1, 1990b: Fig. 1005).
Grimaldi and Blagoderov (2001) coded an unusually broadly rounded wing apex for both *Seguyola* and *Loyugesa*. In our opinion, the wing is similar in *Loyugesa* to that which can be regarded as the normal type of wing in the Lygistorrhinidae, and we have coded it as such.

17. *C at apex of R1*: (0) normal (Fig. 8A–E); (1) with a swelling (Matile 1990a: Fig. 1, 1990b: Fig. 1005).

18. *Sc*: (0) joining C (Grimaldi and Blagoderov 2001: Figs 5a, b, 6a, c); (1) ending free (Fig. 8A–E).

19. *Length of R1 in relation to wing length*: (0) long; ending at middle of costal margin or more apically (Grimaldi and Blagoderov 2001: Fig. 5a, b); (1) short, ending in basal half of costal margin (Fig. 8A–E; Grimaldi and Blagoderov 2001: Fig. 1).

20. *Fork of M*: (0) complete (Grimaldi and Blagoderov 2001: Fig. 5a); (1) incomplete (Fig. 8A–E; Grimaldi and Blagoderov 2001: Fig. 5b).

21. *StCuA*: (0) present (Fig. 8A, D); (1) absent (Fig. 8B, C, E).

22. *R-s*: (0) present (Grimaldi and Blagoderov 2001: Figs 5a, 6a); (1) absent or unsclerotized (Fig. 8A–E).

23. *Setosity of R1*: (0) setose (Fig. 8A, B, C, E); (1) non-setose (Fig. 8D).

24. *Setosity of R5*: (0) setose (Fig. 8A, E); (1) non-setose (Fig. 8B, C, D).

25. *Colour of apical part of wing membrane*: (0) without a dark patch (Fig. 8D); (1) with a dark patch (Fig. 8A, B, C, E).
Grimaldi and Blagoderov (2001) defined this character as apical ¼ of the wing hyaline

or dark. We have included in our state 1 all those cases in which there is a dark apical patch of any size and even those cases where the patch is restricted to the apex of cell r1.

26. *Dark basal patch on cell r1*: (0) absent (Fig. 8A, D); (1) a restricted patch present at tip of R1 (Fig. 8B, C); (2) an extensive patch present, extending to apical half of the cell (Fig. 8E).

27. *Colour of the area around bases of M1 and M2*: (0) without a dark patch (Fig. 8A–E); (1) with a dark patch (Matile 1990b: Fig. 1003, Skuse 1890: Fig. 1).

28. *Colour of the area around apex of Cu2*: (0) without a dark patch (Fig. 8A–E); (1) with a dark patch (Matile 1990a: Fig. 6).

29. *Colour of costal cell*: (0) Unicolourous (Fig. 8A–E); (1) with a dark base and hyaline apical part (Matile 1990a: Fig. 1, 1990b: Fig. 1005).
Grimaldi and Blagoderov (1991) used a character "costal edge darkly infuscate with two clear 'windows' in this area (vs. without such infuscation or windows)", which was an autapomorhy of *Seguyola*. We have divided this character into two, one dealing with the colour of the costal cell and the other with the radial cell. The "window" in the costal cell is unique for *Seguyola*, whereas the "window" in the radial cell is also found in the new genus *Labellorrhina.*

30. *Concavity on proximal half of lateral surface of hind coxa*: (0) absent (Grimaldi and Blagoderov 2001: Fig. 4b); (1) present (Grimaldi and Blagoderov 2001: Fig. 4a).

31. *Spur on T1*: (0) present; (1) absent.

32. *Number of spurs on T2*: (0) two; (1) one.

33. *Shape of T3*: (0) normal (e. g. Matile 1990a: Fig. 6, 1990b: Figs. 1003, 1004 1006); (1) club-shaped (Figs. 5B, 6B, 7B).
In all Lygistorrhinidae the hind tibia is at least slightly club-shaped. We have coded those cases as normal in which the greatest width of the inflated apical part is less than three times the subbasal width of tibia. *Gracilorrhina gracilis* (Fig. 6B) could be coded as normal or inflated depending on how the states are delimited. We have coded it as inflated because it gives the impression of a flattening similar to that in *Labellorrhina*, *Blagorrhina*, *Seguyola* and *Loyugesa*. See also under character 20.

34. *Row of thick setae at apex of T3*: (0) absent (Figs 6C, 7C); (1) present (Fig. 5C).

35. *Microtrichia on T3*: (0) absent (Fig. 5C); (1) present (Figs 6C, 7C).

36. *Shape of basitarsomere 3*: (0) slender, at most slightly broader than basitarsomere 1 (Figs. 5B, 6B, 7B; Matile 1990a: Fig. 6, 1990b: Figs. 1003, 1004, 1005); (1) inflated, conspicuously broader than basitarsomere 1 (Grimaldi and Blagoderov 2001: Fig. 1, Matile 1990a: Fig. 1, 1990b: Fig. 5).
Grimaldi and Blagoderov (2001) used a character "apical half of hind tibia and entire hind basitarsomere inflated (vs. slightly and gradually expanded distad, but not dramatically so)" which fitted well with the taxa known at that time. In our new material there are taxa showing the club-shaped hind tibia without an inflated tarsus, and that is why we have divided the character of Grimaldi and Blagoderov (2001) into two.

37. *Shape of claws of tarsus 1*: (0) pointed (similar to Fig. 6D); (1) blunt (similar to Fig. 5D).

38. *Shape of claws of tarsus 2*: (0) pointed (Fig. 6D); (1) blunt (Fig. 5D).

39. *Aggregation of thickened setae at apex of male tergite 9*: (0) absent (Matile 1990a: Fig. 3); (1) present (Fig. 9A; Grimaldi and Blagoderov 2001: Fig. 7a, b).
Grimaldi and Blagoderov (2001) coded *Loyugesa khuati* as state 0. However, according to their illustration of the male hypopygium, this should be state 1 and it has been corrected as such in our matrix.

40. *Apodemes of male tergite 9*: (0) absent (Matile 1990a: Fig. 3); (1) present (Figs 9A, C, 10A, 11A, C; Grimaldi and Blagoderov 2001: Fig. 7b).

41. *Shape of gonostylus*: (0) stout (e.g., Grimaldi and Blagoderov 2001: Fig. 7b); (1) slender (Figs 9A–C, 10A, B, 11A–D; Grimaldi and Blagoderov 2001: Fig. 7a).

42. *Size*: (0) wing length 1.0 mm; (1); wing length 1.4 mm or more.

Phylogeny of the Lygistorrhinidae

The parsimony analysis with NONA produced 14 shortest cladograms (78 steps, CI 61, RI 82), of which the strict consensus cladogram was fully resolved except for the almost completely unresolved clade containing the species of *Lygistorrhina* and *Probolaeus* (Fig. 1). However, the monophyly of this whole group is rather well supported by five character states, three of which are unique: male eyes dichoptic (Character 0: 2), position of anterior edge of episternum 3 much anteriad to laterotergite (15: 1), and concavity on proximal half of lateral surface of hind tibia present (30: 1). The other main clade of the cladogram,

including *Seguyola* + (*Loyugesa* + *Matileola*) and the new *Labellorrhina*, *Gracilorrhina*, and *Blagorrhina*, was based on six character states, four of which were unique: dorsal and lateral facets of compound eyes larger than medial and ventral (3: 1), dome-shaped scutum (10: 1), restricted dark patch at tip of R1 (26: 1), and club-shaped T3 (33: 1). The successive nodes in this clade were mostly supported by fewer character states, but these were mainly unique. *Palaeognoriste* and *Lygistorrhina asiatica*, respectively, appeared as the most basal taxa in the cladogram.

Our character data were able to give a phylogenetic placement for our new taxa, as well as to place the enigmatic *Lygistorrhina asiatica*, the latter remaining in an unresolved polytomy in the cladogram of Grimaldi and Blagoderov (2001). Otherwise, with the natural exception of the new taxa, their cladogram is identical with ours. Blagoderov and Grimaldi's (2004) new analysis, which was less inclusive of terminals with extant taxa but which included a number of fossils that were regarded by the authors as members of the Lygistorrhinidae, produced a rather similar result. If the results of our cladogram were applied to the classification, then we would have to expect a new generic name for *Lygistorrhina asiatica.*

Key to genera of Lygistorrhinidae

We include *Lygistorrhina asiatica* in the key separately because a new genus is needed for it. According to the phylogenetic analysis (Fig. 1) it is the sister group of all other living Lygistorrhinidae. *Lygistorrhina* (*Lygistorrhina*) and *Lygistorrhina* (*Probolaeus*) are separated even if their monophyly is not yet shown. The sexual dimorphism in the species of the Lygistorrhinidae is largely unknown and it is possible that some of the characters used below apply only to males.

1. Number of ocelli 3 2
- Number of ocelli 2 6
2. Rs present, sclerotized ..... ***Palaeognoriste*** Meunier
- Rs absent or discernible only as a non-sclerotized fold 3
3. Proboscis short, at most two and a half times the height of head 4
- Proboscis long, four or more times as long as the height of head 5
4. Subcosta ending in costa, R1 meeting costa at the middle of wing .... ***"Lygistorrhina" asiatica*** Senior-White
- Sc ending free, R1 meeting costa well within the basal half of wing .... ***Labellorrhina*** gen. n.
5. Middle tibia with two apical spurs ..... ***Lygistorrhina*** Skuse, subg. ***Lygistorrhina***
- Middle tibia with one apical spur .... ***Lygistorrhina*** Skuse, subg. ***Probolaeus*** Williston
6. Hind basitarsomere swollen, as broad as apical part of hind tibia 7
- Hind basitarsomere thin, narrower than apical part of hind tibia (Figs 5B, 6B, 7B) 9

7. C with a swelling at the apex of vein R1, proboscis very short, about one-tenth the height of head ..... ***Seguyola*** Matile
- C without a swelling at the apex of R1, proboscis long, as long as or longer than the height of head 8
8. Number of antennal flagellomeres 12, R1 meeting the costal margin well in basal half of wing ..... ***Loyugesa*** Grimaldi & Blagoderov
- Number of antennal flagellomeres 14, R1 meeting the costal margin at the middle of wing ***Matileola*** Papp
9. Number of antennal flagellomeres 14, the flagellomeres ventrally greatly expanded (Fig. 4E), proboscis one-half the height of head (Fig. 3A), CuA1 and CuA2 with a long common stem (stCuA) (Fig. 8D) ..... ***Gracillorrhina*** gen n.
- Number of antennal flagellomeres 12, the flagellomeres normal, not ventrally expanded (Fig. 4D), proboscis longer than the height of head, CuA1 and CuA2 separate (Fig. 8E) ..... ***Blagorrhina*** gen. n.

New taxa of Lygistorrhinidae

***Labellorrhina* gen. n.**

Type-species *Labellorrhina quantula* sp. n.

Description. Small-sized Lygistorrhinidae, total length about 1.5 mm, wing length about 1 mm.

Head. Number of ocelli 3. Compound eyes dichoptic, the facets becoming larger laterally and dorsally. Interommatidial setae as long as the facets. Frons without dorsolateral setae. Prefrons/face non-setose. Clypeus setose. Labella as long as or slightly shorter than height of head. Palpi one-half to three-fourths of the length of labella, apically pointed, with several low dorsal pits with a hyaline sensillum in each. Hypopharynx slightly shorter than labella. Length of antenna about 1.5 times the height of head. Flagellum with 14 flagellomeres, these from as long as broad to shorter than broad, not expanded on ventral half, with the longer seta-like sensilla in one whorl.

Thorax. Scutum roundedly dome-shaped, extending more anteriorly than base of coxa 1, wholly setose. Suture between anepisternum and katepisternum complete, extending to anterior margin of the sclerites. Pleural pit indistinct. Laterotergite produced lobe-like posteroventrally, setose. Anterior margins of episternum 3 and laterotergite at the same vertical level. **Legs**. Long, length of basitarsomere 1/length of scutum + scutellum 0.89–1.07. Coxa 2 longer than coxa 3, its apex not reaching the apex of coxa 3. Coxa 3 without a basolateral depression, with only a few setae. Femur 1 and 2 slender, femur 1 a little broader than femur 2, femur 3 about twice as broad as femur 1, or femur 1 and 2 distinctly

thickened but less than femur 3 which is 1.5 times as broad as femur 1. Tibia 1 socketed setae placed in several dorsal and ventral stripes and in a medial stripe on both lateral sides, all subequal in size, non-socketed setae/trichia half as long as socketed setae, in several distinct stripes through the whole length and on all sides, microtrichia absent except at extreme base, dot-like sensilla present as a medial row on distal half of retrolateral side; tibial organ absent; the spur present. Tibia 2 similar to tibia 1; two spurs present, the prolateral one shorter than the retrolateral one. Tibia 3 club-shaped, the greatest width of enlarged apical part a little more than twice the subbasal width of tibia, expansion of apical part beginning well in basal half of tibia, microtrichia absent except at extreme base, dot-like sensilla in a scattered laterodorsal stripe on apical third of the retrolateral side, non-socketed setae/trichia over whole tibia in more or less distinct stripes, pattern of socketed setae similar to that on tibia 1 and 2 but the dorsal retrolateral setae conspicuously stronger than other setae, and with a transverse subapical retrolateral row of many strong dark setae; two spurs present, the longer retrolateral one twice the apical width of tibia, the shorter prolateral one half of that. Basitarsomere 3 slender, about twice as broad as basitarsus 1. Length of basitarsomere 1/length of tibia 1 0.53–65. Claws of legs 1 and 2 blunt, those of leg 3 pointed. **Wing**. Costa without a swelling at junction with R1. H absent. Sc ending free or wholly absent, in the former case curved towards R1. R1 very short, meeting C at its basal fifth, setose. R5 non-setose. M1 and M2 straight. Distance between apices of M1 and M2 smaller than distance between M2 and CuA1. CuA1 and CuA2 separate. Anal lobe not prominent. Haltere shorter than thorax.

Abdomen. Sternum 8 without a posterior process. Gonostylus narrow, about 4 times as long as broad, with a long apical tooth, with a long curved subbasal mesial seta. Parameres weak, curved, their apices not reaching beyond apical margin of tegmen.

Etymology. The generic name is a combination of the word “labellum” and the last part of the name *Lygistorrhina*. The name is feminine.

Discussion. With a wing length of approximately 1 mm, *Labellorrhina* species are the smallest Lygistorrhinidae known. They are combined with *Gracilorrhina, Blagorrhina, Loyugesa*, *Matileola*, and *Seguyola*, and are distinguished from other Lygistorrhinidae by the strongly club-shaped hind tibia, and from all except *Seguyola* by a short R1 which ends at the costa well within the basal half of the wing. *Labellorrhina* is distinguished from all of these by having three ocelli instead of two, by having a transverse retrolateral row of strong setae subapically on the hind tibia, and by the characteristic wing pattern with the two dark patches in an otherwise clear wing. *Labellorrhina* is similar to *Gracilorrhina* and *Matileola* in having a plesiomorphous 14-segmented antennal flagellum instead of having a smaller number of segments.

***Labellorrhina quantula* sp. n.**

Material studied. Holotype male: BRUNEI, Ladan Forest Res., logged forest, Malaise

trap, XII.1992–II.1993, M. J. Sahat (MZH). *Paratypes*: same data as holotype, 9 ♂, same data but 'primary forest', 3 ♂ (MZH, NMWC and NRM).

MALE. Head. Fig. 2A. Flagellomere 4, Fig. 4 B. **Thorax**. Fig. 5A. Anterior pronotum with 5–8 setae. Episternum 1 with 3–4 setae. Laterotergite with 1–4 setae. **Legs**. Fig. 5A–C. Femur 1 and 2 slender with straight or concave dorsal and ventral margins, about one half of thickness of femur 3. Tibia 3 with a transverse subapical retrolateral row of 8 – 10 strong setae. Length of basitarsomere 1/length of tibia 1 0.58–0.65. **Wing**. Fig. 8C. Wing length 0.98–1.06 mm. Haltere pale. **Abdomen**. Hypopygium, Fig. 9A and B.

Discussion. For the distinguishing characters between *L. quantula* and *L. grimaldii*, see under the latter.

Labellorrhina grimaldii sp. n.

Material studied. Holotype male: MALAYSIA, Selangor, Ulu Gombak, Univ. of Mal. Field Stud. Center, forest, 244 m (800 ft.), Malaise trap, 2–8. III. 1997, H. Hippa, M. Jaschhof & B. Viklund (NRM).

MALE. Similar to *L. quantula*. **Head.** Mouthparts, Fig. 2B. Flagellomere 4, Fig. 4F. Anterior pronotum with four setae. **Thorax.** Episternum 1 with 6 setae. Laterotergite with 2 setae. **Legs.** Femur 1 and 2 distinctly thickened, with convex dorsal and ventral margins, more than half the thickness of femur 3. Tibia 3 with a transverse subapical retrolateral row of 4 or 5 strong setae. Length of basitarsomere 1/length of tibia 1 0.53–0.54. **Wing.** Fig. 8B. Wing length 0.96–0.97 mm. Hypopygium, Figs. 9C and D.

Etymology. The species epithet is dedicated to Dr. David Grimaldi, American Museum of Natural History, New York, to acknowledge his contribution to the study of Lygistorrhinidae.

Discussion. Labellorrhina grimaldii is similar to *L. quantula*, but is distinguished by, for example, the following characters: antennal flagellomeres shorter than broad (in *L. quantula* as long as broad), maxillary palpus longer, three-fourths of the length of labellum (only slightly more than half of labellum), the subapical retrolateral comb of strong setae on hind tibia consisting of 4 to five setae (8 to 10 setae), and the tegmen more rectangular in shape (Fig. 9A and C). Furthermore, the junction between C and R1 seems to be less acute in *L. grimaldii* than in *L. quantula* (Fig. 8B and C), and the dark patch at the apex of R1 is of the same intensity as the subapical patch in *L. grimaldii*, not weaker than the subapical patch as in *L. quantula* (this difference is not very clear in Fig. 8B and C).

Genus *Blagorrhina* gen. n.

Description. Small-sized Lygistorrhinidae, total length about 2.5 mm, wing length about 1.5 mm.

Head. Number of ocelli 2, no rudiment of the medial ocellus discernible. Dichoptic, the facets becoming larger dorsally and posteriorly. Interommatidial setae as long as diameter of the larger facets. Frons without dorsolateral setae. Prefrons/face non-setose. Clypeus with two setae. Labella about one-and-a-half times the height of head. Palpi about half the length of labella, apically pointed, with a few low dorsal pits with from one to a few hyaline sensilla each. Hypopharynx approximately as long as labella. Antenna as long as or slightly longer than height of head. Flagellum with 12 flagellomeres, these subglobular, from slightly longer to slightly shorter than the numerous, scattered, broad, seta-like sensilla.

Thorax. Scutum roundedly dome-shaped, extending more anteriorly than base of coxa 1, wholly setose. The suture between anepisternum and katepisternum complete or anteriorly indistinct or absent. Pleural pit indistinct. Laterotergite produced lobe-like posteroventrally, setose. Anterior margins of episternum 3 and laterotergite at the same vertical level. **Legs**. Long, tibia1/ length of scutum + scutellum 0.96–0.99. Coxa 2 longer than coxa 3, its apex not reaching apex of coxa 3. Coxa 3 without a basolateral depression. Femur 1 and 2 slender, femur 1 broader than femur 2, femur 3 stout, twice as broad as femur 1. Tibia 1 with two dorsal and two ventral stripes of socketed setae and a medial stripe of such setae on both pro- and retrolateral sides, all setae subequal in size, trichia half the length of socketed setae, placed prolaterally in a few stripes that change basally into one ventral and one dorsal stripe towards apex before vanishing at apical third, retrolaterally in a couple of ventral stripes and with a few scattered ones on distal half, with microtrichia throughout the whole length on all sides except distally and distoventrally, tibial organ subapically on the prolateral side not differentiated, dot-like sensilla present in a row on distal half of retrolateral surface; the spur absent. Tibia 2 similar to tibia 1, one spur present, 2.5–3.0 times the width of tibial apex. Tibia 3 club-shaped, greatest width of the enlarged apical part 3 times the subbasal with of tibia, widened apical part extending well into basal half of tibia; whole of tibia 3 microtrichose on all sides, trichia absent except for a scattered pro- and retrolateral stripe on apical fourth, these about half the length of the setae on lateral sides, scattered setae of equal size on all sides, dorsal setae conspicuously longer than the others especially towards apex, apex without a transverse row of several strong setae on retrolateral side; dot-like sensilla scattered in a stripe on apical half of tibia only on retrolateral side; two spurs present, the longer retrolateral one about two-and-a-half times the width of tibial apex, the shorter retrolateral one about one-and-a-half times the width of tibial apex. Length of basitarsomere 1 / length of tibia 1 0.6–0.7, basitarsomere 3 about 3–4 times as broad as basitarsomere 1. Claws of leg 1 blunt, of legs 2 and 3 pointed. **Wing**. Costa without a swelling at junction with R1. Humeral cross vein weak. Sc vestigial, ending free, but directed towards R1. R1 short, meeting C well basal from the middle of wing, setose. R5 setose. M1 straight, slightly curved at the visible part of its base. M2 straight. Distance between apices of M1 and M2 smaller than that between M2 and CuA1. CuA1 and CuA2 separate. Haltere shorter than thorax.

Abdomen. Sternite 8 with roundly angulate posterior margin but without a distinct process. Gonostylus narrow, about 3 times longer than broad, with a long apical tooth, with a long straight subbasal mesial seta. Parameres sigmoid, the apices not reaching posteriorly behind the apical margin of tegmen.

Etymology. The generic name is a combination of parts of the names *Lygistorrhina* and Blagoderov (see under *Blagorrhina blagoderovi*). The name is feminine.

Discussion. Blagorrhina is similar to *Loyugesa* and *Matileola*, but differs from the former, for example, by being dichoptic and from both by having the scutum entirely setose, not with a lateral non-setose stripe, by having a well-developed flap-like protruding posteroventral margin of the laterotergite, by lacking the conspicuously inflated basitarsomere, and by having CuA1 and CuA2 separate. From *Seguyola*, which is the sister group of *Loyugesa* + *Matileola*, *Blagorrhina* differs by the longer proboscis, as long as the height of the head, instead of a very short one, one-tenth the head; by the roundedly dome-shaped scutum, instead of angularly dome-shaped; by lacking the spur on front tibia; by having slender, not tumid, hind basitarsomere; by lacking a costal swelling at the apex of R1; by having R1 shorter, ending well in the basal half of the wing instead of extending well into the apical half; by its normal, not usually broad wing shape. *Blagorrhina* is also similar to *Gracilorrhina*. All the genera discussed differ from other Lygistorrhinidae by having only two ocelli. *Blagorrhina* is distinguished from *Gracilorrhina* by, for example, having the proboscis as long as the height of the head, not only about half of it; by having 12 flagellomeres instead of 14; by having a normal, not serrated antennal flagellum; by the lack of a non-setose lateral stripe on the scutum; by separate CuA1 and CuA2; and by having the anterior part of the wing dark.

Blagorrhina blagoderovi sp. n.

Material studied. Holotype male: MALAYSIA, Pahang, Genting Highlands, Awana, Malaise trap near the cable car route, about 3300 feet, 10–22. III.1997, M. Jaschhof, H. Hippa & B. Viklund (NRM). *Paratypes*: same data as holotype, 6 ♂ (NRM); MALAYSIA, Awana, lower cable-car station, primary forest, net+exhaustor, 6.III.1997, M. Jaschhof, 1 ♂ (NRM).

MALE. **Head**. Fig. 2C. Length of antenna about 1.5 times height of head, flagellomere 4, Fig. 4A. Colour of head light brown, darker brown at vertex and dorsal part of occiput, colour of antenna similar to ground-colour of head, without any colour pattern, setae of head dark.

Thorax. Fig. 7A. Suture between anepisternum and katepisternum complete or abbreviated so that it does not reach anterior margin of sclerites. Anterior pronotum with 3–5 setae. Episternum 1 with 7–11 setae. Laterotergite with 2–4 setae. Colour pale brown, darker brown mediodorsally, colour of setae dark. **Wing**. Fig. 8E. Wing length 1.25–1.45 mm. Colour tinged with brown, more strongly so anteriorly. Haltere brown, basal half of

stem pale. **Legs**. Fig. 7B and C. Length of spur on tibia 2 two-and-a-half times apical width of tibia. Basitarsomere 1/tibia 1 0.66–0.69. Basitarsomere 3 three times as broad as basitarsus 1. Legs concolourous with thorax, leg 1 paler towards apical parts

Abdomen. Colour as on thorax but slightly paler. Hypopygium, Fig. 11A and B.

FEMALE. Unknown.

Etymology. The species epithet is dedicated to Dr. Vladimir Blagoderov, now Department of Entomology, Iowa State University, Ames, to acknowledge his contribution to the study of Lygistorrhinidae.

Discussion. For discussion, see under *B. brevicornis* below.

***Blagorrhina brevicornis* sp. n.**

Material studied. Holotype male: MALAYSIA, Pahang, Cameron's Highlands, Gunung Berenban, 1800 m, Malaise trap, 20–26. XI. 1994, Th. Pape (NRM). *Paratypes*: same data as holotype, 4 ♂ (NRM); MALAYSIA, Cameron's Highlands, 1400 m, Malaise trap, 17–22. XI. 1994, Th. Pape, 1 ♂ (NRM).

MALE. As for *B. blagoderovi* except: Length of antenna approximately equal to height of head. Flagellomere 4, Fig. 4 D. Anterior pronotum with 5–7 setae. Episternum 1 with 7–10 setae. Laterotergite with 1–3 setae. Length of spur on tibia 2 three times as long as apical width of tibia. Length of basitarsomere 1/length of tibia 1 0.71–0.74. Basitarsomere 3 four times as broad as basitarsomere 1. Wing length 1.49–1.75 mm. Hypopygium, Fig. 11C and D.

FEMALE. Unknown.

Discussion. Blagorrhina brevicornis seems to be larger than *B. blagoderovi*, but the sizes will certainly be found to overlap when more material is studied. In the characters of the hypopygium, the difference in the shape of the tegmen should be noted: in *B. brevicornis* the whole tegmen is relatively shorter and it is apicolaterally rather rounded, not with concave sides.

Genus *Gracilorrhina* gen. n.

Type-species *Gracilorrhina gracilis* sp. n.

Description. Small-sized Lygistorrhinidae, total length about 2.5 mm, wing length about 1.5 mm.

Head. Number of ocelli 2, a rudiment or the site of the median ocellus discernible in a depression in front of vertex. Dichoptic, all facets similar in size. Interommatidial setae slightly longer than diameter of ommatidia. Frons with rows of dorsolateral setae. Prefrons/face non-setose. Clypeus non-setose. Labella about one half of height of head. Palpi

about two-thirds as long as labellum, with several low dorsal pits with a hyaline sensillum in each. Hypopharynx about one-third as long as labellum. Antenna about 4 times the height of head. Flagellum with 14 flagellomeres, these laterally flattened and strongly ventrally expanded on their basal two-thirds, in dorsal and ventral view several longer than broad, in lateral view as long as broad, this modification of flagellomeres diminishing towards the apex of flagellum and even rather weak on flagellomere 1, seta-like sensilla on flagellomeres numerous, scattered.

Thorax. Scutum roundedly dome-shaped, anteriorly extending to the same level as base of coxa 1, the setae unevenly distributed with a wide non-setose stripe between medial and lateral setae. Suture between anepisternum and katepisternum incomplete, anteriorly obliterated. Katepisternum unusually high. Pleural pit indistinct. Laterotergite produced lobe-like posteroventrally, with or without setae. Anterior margins of episternum 3 and laterotergite at the same vertical level. **Legs**. Very long, tibia 1/length of scutum plus scutellum 1.36–1.42. Coxa 1 unusually long, more than 1.5 times length of coxa 3. Coxa 2 conspicuously longer than coxa 3, its apex not reaching apex of coxa 3. Coxa 3 without a basolateral depression, with setae only apically. Femur 1 and 2 slender, approximately equally broad, femur 3 stouter, twice as thick as femur 1. Tibia 1 with two dorsal, two ventral and one pro- and one retrolateral row of socketed setae of equal size, with trichia of half the length of setae on all sides, in rather distinct rows, with microtrichia through the whole length on all sides, tibial organ subapically on prolateral side not differentiated, dot-like sensilla present in a row on retrolateral surface; spur lacking. Tibia 2 with chaetotaxy, trichiation and sensillar pattern similar to tibia 1; one spur present, 1.5 times apical width of tibia. Tibia 3 club-shaped, greatest width of enlarged apical part 2.5 times the subbasal width of tibia, widened apical part scarcely extending to basal half; whole of hind tibia microtrichose on all sides, a few stripes of trichia on both pro- and retrolateral sides of the expanded apical part, scattered setae of equal size on all sides of tibia but with a broad non-setose dorsal stripe on both pro- and retrolateral sides, on the narrow basal half of tibia the setae only in one dorsal, ventral, prolateral and retrolateral stripes, apex without a transverse row of several strong setae on retrolateral side; dot-like sensilla scattered in a stripe on apical half of tibia, coinciding with both pro- and retrolateral non-setose stripes; two spurs present, the longer retrolateral one about twice, the shorter retrolateral one about 1.5 times, width of tibial apex. Length of basitarsomere 1/length of tibia 1 0.82–0.93, basitarsomere 3 about twice the thickness of basitarsomere 2. Claws of all legs pointed. **Wing**. Wing length 1.34–1.54 mm. Costa without a swelling at junction with R1. Humeral cross vein weak. Subcosta vestigial, ending free but directed towards R1. R1 short, meeting costa well basal of middle of wing, non-setose. R5 non-setose. M1 slightly curved. M2 sigmoid. Distance between apices of M1 and M2 greater that that between M2 and CuA1. Haltere long, longer than thorax.

Abdomen. Sternite 8 strongly modified, with a posterior process. Gonostylus narrow, nearly 4 times as long as broad, with a long apical tooth, with a long straight subbasal

mesial seta. Tegmen with a nose-like ventral protuberance well basad of apical margin. Parameres only slightly curved, almost straight, the apices reaching more posteriorly than the posterior margin of tegmen.

Etymology. The generic name is a combination of the name of the type-species and the last part of the name *Lygistorrhina*. The name is feminine.

Discussion. In the male characters, *Gracilorrhina* differs from all other known Lygistorrhinidae by the shape of the antennal flagellomeres, which are unusually ventrally expanded on the basal two-thirds (Fig. 4E), giving the flagellum a serrate impression. Only a slight tendency towards a similar modification is seen in the species of *Blagorrhina, Labellorrhina quantula*, and Lygistorrhinidae sp. 1. *Gracilorrhina* is similar to *Blagorrhina, Loyugesa, Matileola*, and *Seguyola* in having the median ocellus reduced. *Gracilorrhina* differs from them all by having 14 flagellomeres instead of fewer. *Gracilorrhina* differs from *Blagorrhina* by having stCuA present and a non-setose lateral stripe on scutum; from *Loyugesa* and *Matileola* by the slender hind basitarsomere, from *Loyugesa* by being dichoptic; and from *Seguyola* by lacking a conspicuous colour pattern on wings, by lacking a swelling on the costa at the apex of R1, by having R1 short, in the basal half of the wing instead of extending well into the apical half, and by having a slender, not tumid, hind basitarsomere. See also under Lygistorrhinidae sp. 1 below.

Gracilorrhina gracilis sp. n.

Material studied. Holotype male: MALAYSIA, Pahang, Genting Highlands, Gunung Ulu Kali, 1745 m (5725 ft.), Malaise trap, 5–22.III.1997, H. Hippa, M. Jaschhof & B. Viklund (NRM). *Paratypes*: same data as holotype, 23 ♂ (NRM).

MALE. Head. Fig. 3A. Flagellomere 4, Fig. 4E. Colour light brown, darker brown at vertex and on dorsal part of occiput, colour of setae dark, colour of antenna similar to ground-colour of head, without any colour pattern.

Thorax. Fig. 6A. Anterior pronotum with 2 or 3 setae. Episternum 1 with 2–4 setae. Laterotergite with 0–2 setae. Colour pale brown with a darker brown medial stripe over scutum and scutellum, colour of setae dark **Wing**. Fig. 8D. Wing length 1.34–1.54 mm. Colour hyaline, tinged with brownish especially anteriorly and in many specimens also broadly along posterior margin. **Legs**. Fig. 6B, C and D. Unicolourous and concolourous with thorax, or coxa 2 and whole of hind leg slightly darker than the other parts. **Abdomen**. Colour unicolourous pale brown, paler than thorax. Hypopygium, Fig. 10A and B.

FEMALE. Unknown.

Discussion. For its distinguishing characters, see under *Gracilorrhina* above.

Lygistorrhinidae sp. 1 (female)

Material studied: MALAYSIA, Pahang, Cameron's Highlands, 1400 m, Malaise trap, 27. XI. 1994, Th. Pape, 1 ♀ (NRM).

FEMALE. Total length about 2 mm. **Head**. Fig. 3B. Antennal flagellomere 4, Fig. 4C. Unicolourous light brown, darker brown around ocelli. Thorax similar to Fig. 7A. Anterior pronotum with 5 setae, episternum 1 with 5 setae, laterotergite with 2 setae. **Legs** similar to *B. blagoderovi*, Fig. 7B and C. Tarsal claws of all legs pointed. **Wings** similar to *B. blagoderovi*, Fig. 8E. Wing length 1.27–1.28 mm. **Abdomen** similar to *B. blagoderovi*, terminalia, Fig. 12A.

MALE: Unknown.

Discussion. This female resembles the species of *Blagorrhina* and *Gracilorrhina*. It differs from both by having only 10 flagellomeres, from the former by having the mouthparts much shorter and by having a totally setose scutum, and from the latter by the separate CuA1 and CuA2. We leave the placement of this species until either its male or the females of the other related groups are discovered.

Lygistorrhinidae sp. 2

Material studied: MALAYSIA, Pahang, Genting Highlands, Awana, primary forest, 6.III.1997, M. Jaschhof, 1 ♀ (NRM).

FEMALE. Total length about 2.5 mm. **Head** similar to Lygistrorrhinidae sp. 1 except for antennal flagellomere with 13 segments, the lateral rows of setae on frons absent and clypeus with about 10 setae; the proboscis is broken from near base. **Thorax** similar to Fig. 6A. Anterior pronotum with 7 setae. Epimeron 1 with 7 setae. Laterotergite non-setose. **Wing**, Fig. 8A. Wing length 1.74 mm. **Legs** similar to *G. gracilis*, Fig. 6B, C and D, but the legs are generally a little stouter. Tarsal claws of all legs pointed. **Abdomen** paler than thorax, terminalia, Fig. 12B.

MALE: Unknown.

Discussion. This female has considerable similarity to the male of *Gracilorrhina gracilis* but differs significantly by having a colour pattern on the wing (Fig. 8A). The general structure is similar to that of *Gracilorrhina, Blagorrhina*, *Loyugesa*, *Matileola*, and *Seguyola*. The lack of mouthpart characters in the single specimen before us makes it impossible to discuss its affinities further.

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Appendix 1. Data matrix for the phylogenetic analysis. A = 0/1 polymorphism.

	0000000000111111111122222222233333333334444
	0123456789012345678901234567890123456789012
Diadocidia sp.	0-0000000001001000000000000000000100001000
Lygistorrhina asiatica	1000000000000010000011101000000000?0?????0
Lygistorrhina carayoni	2100000000001011000011100000001000??0??0100
Lygistorrhina hamoni	2100?000010010110010111001011010000??0??0100
Lygistorrhina insignis	2100000000001011001011100101101000??0??0100
Lygistorrhina legrandi	2100?000010010110010111001011010000??0??0100
Lygistorrhina magna	2100000000001011000011100000001000??0??0100
Lygistorrhina nassreddinei	2100000000001011001011100000001000??0??0100
Lygistorrhina pictipennis	2100000000001011001011100101101000??0??0100
Probolaeus barretoi	2100000000001011000011100000001010??0??0100
Probolaeus brasiliensis	2100000000001011001011100000001010??0??0100
Probolaeus coxatus	2100000000001011001011100000001010??0010100
Probolaeus edwardsina	2100000000001011000011100000001010??0??0100
Probolaeus sanctaecatharinae	2100000000001011001011100000001010000010100
Probolaeus urichi	2100000000001011001011100000001010??0??0100
Probolaeus sp. ”Costa Rica”	2100000000001011000011100100001010000??0100
Loyugesa khuati	1010221000110100001110111120000111O?1??0110
Matileola yangi	1?011010?011?1??00101?1??02000?111??1?????0
Seguyola variegata	0001231?0010001011100011111001001l??1??1010
Seguyola vicina	0001231?0010001011100011111001001l??1??1010
Palaeognoriste sp.	1000000000000010000001001000000000?0??0100
Blagorrhina blagoderovi	1001220100101010001111100120000111010100100
Blagorrhina brevicornis	1001220100101010001111100120000111010100100
Gracilorrhina gracilis	0000100200111A0000111011101000011101000O100
Labellorrhina grimaldii	1001000010101010001111101110000001100110101
Labellorrhina quantula	1001000010101010001111101110000001100110101

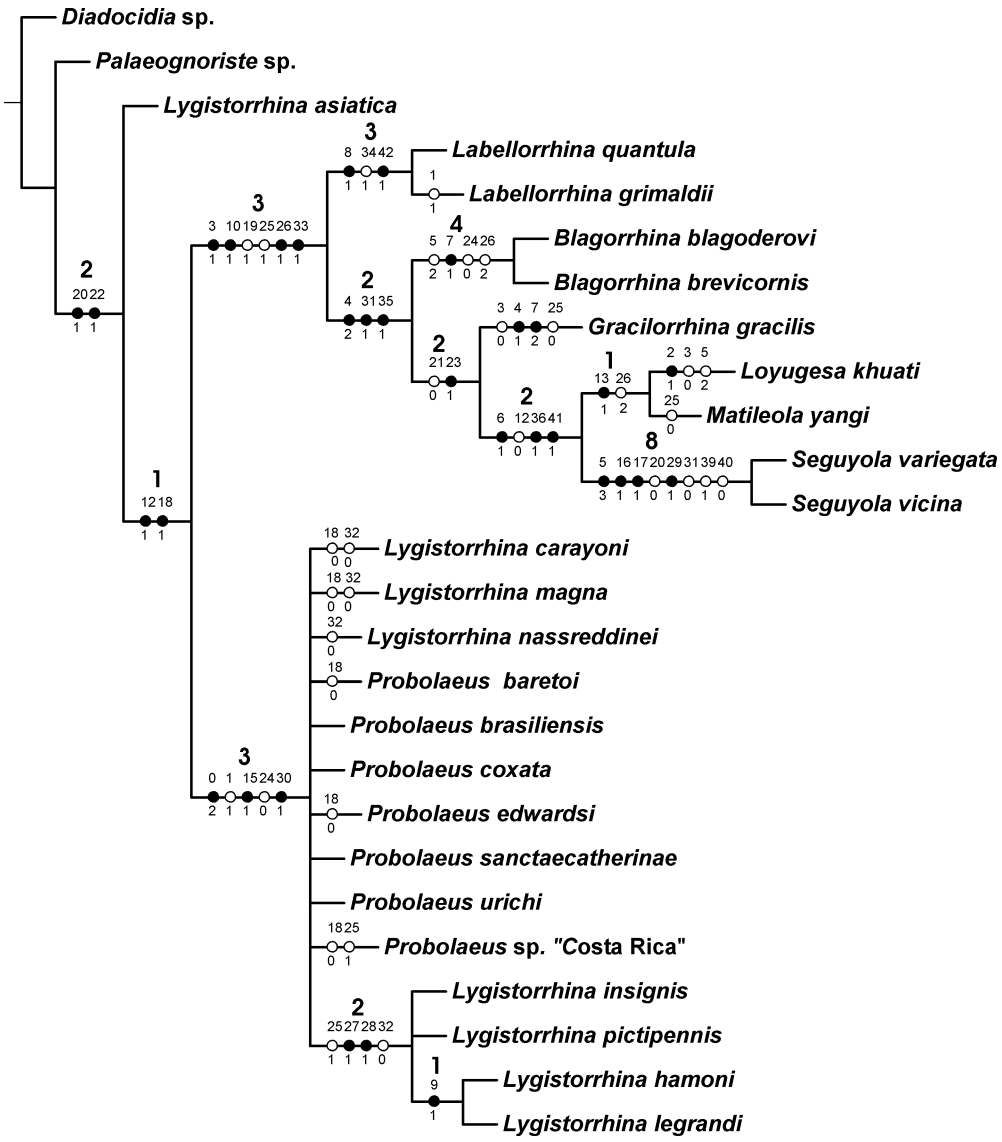

FIGURE 1. Phylogeny of Lygistorrhinidae. The strict consensus cladogram of 14 most parsimonious cladograms (78 steps, CI 61, RI 82) obtained with the program NONA. Black dot = unique (reversals allowed), open circle = homoplastic synapomorphy. Large numbers above branches refer to Bremer support values.

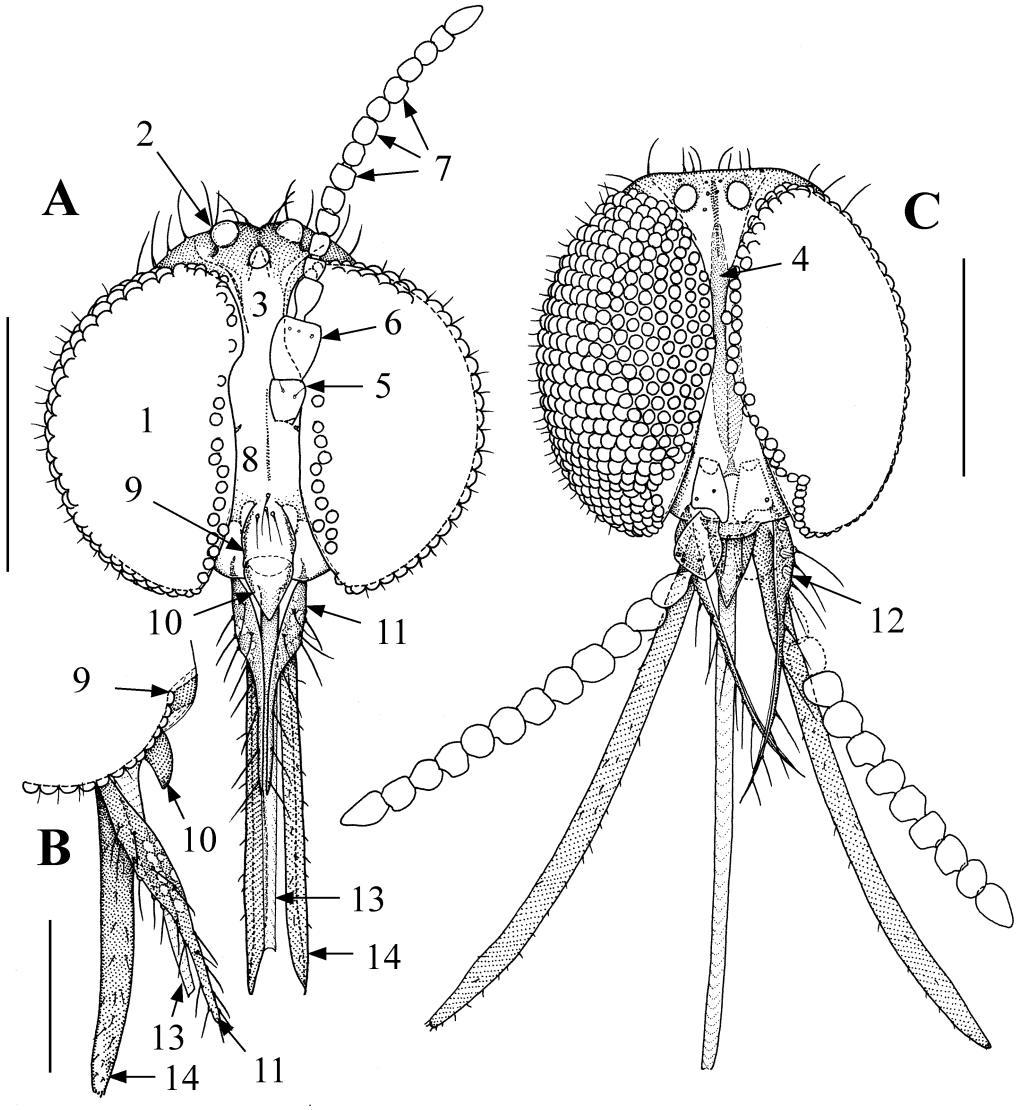

FIGURE 2. Male head, frontal view (A and C) and ventral part of head, lateral view (B). A: *Labellorrhina quantula* sp. n. (paratype). B: *Labellorrhina grimaldii* sp.n. (holotype). C: *Blagorrhina blagoderovi* sp. n. (paratype). Scale 0.20 mm. 1: compound eye, 2: ocellus, 3: frons, 4: membraneous stripe, 5: scapus, 6: pedicellus, 7: flagellomeres, 8: face, 9: clypeus, 10: labrum, 11: maxillary palp, 12: hyaline sensilla, 13: hypopharynx, 14: labellum.

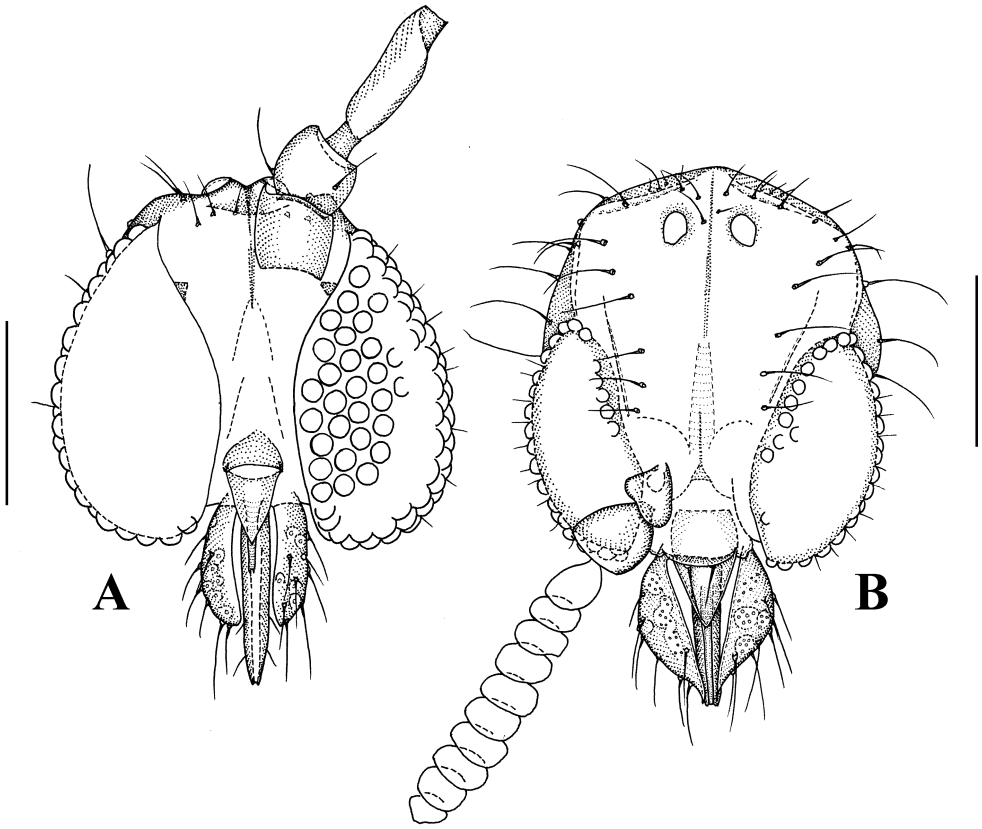

FIGURE 3. Male (A) and female (B) head, frontal view. A: *Gracilorrhina gracilis* sp. n. (paratype). B. Lygistorrhinidae sp. 1 (Malaysia). Scale 0.10 mm.

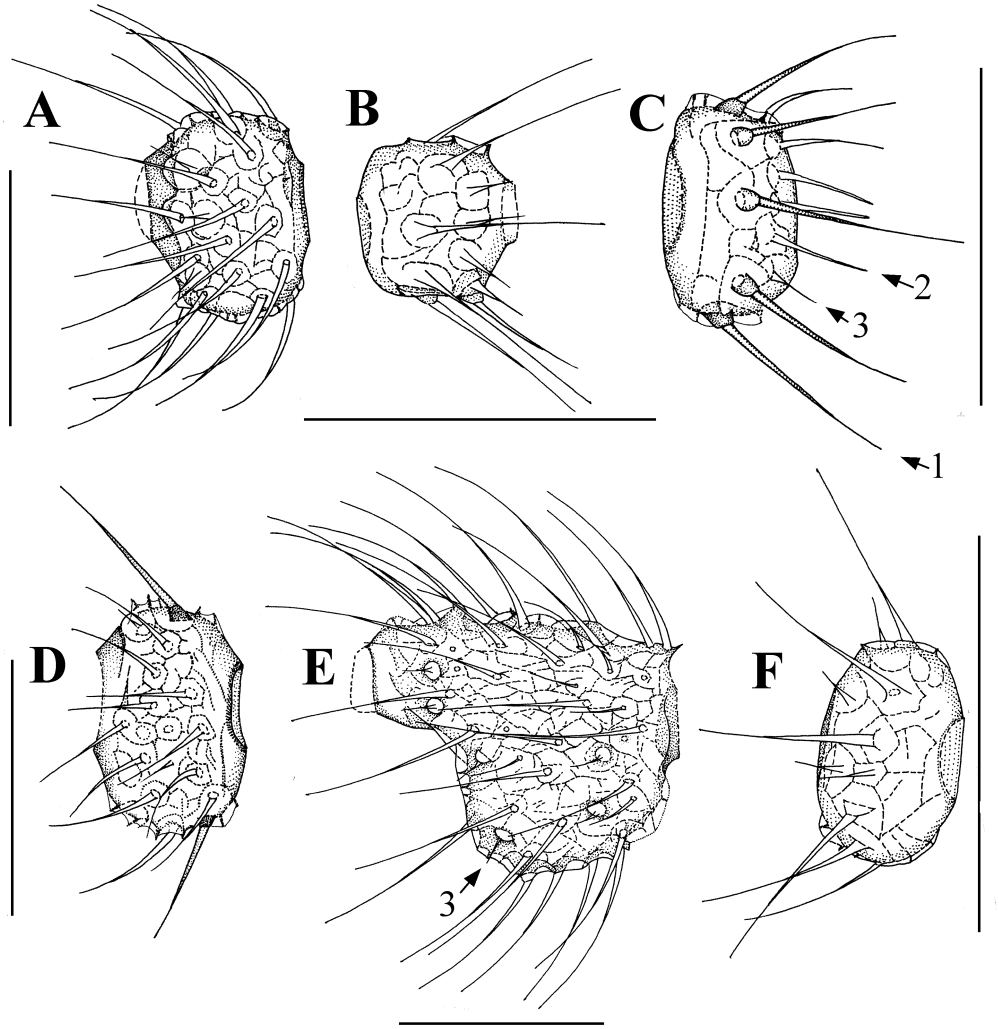

FIGURE 4. Antennal flagellomere 4, lateral view. A: *Blagorrhina blagoderovi* sp. n. (paratype). B: *Labellorrhina quantula* sp. n. (paratype). C: Lygistorrhinidae sp. 1 (Malaysia). D: *Blagorrhina brevicornis* sp. n. (paratype). E: *Gracilorrhina gracilis* sp. n. (paratype). F: *Labellorrhina grimaldii* sp. n. (holotype). Scale 0.05 mm. 1: socketed seta, 2: seta-like sensillum/unsocketed seta, 3: peg-like sensillum.

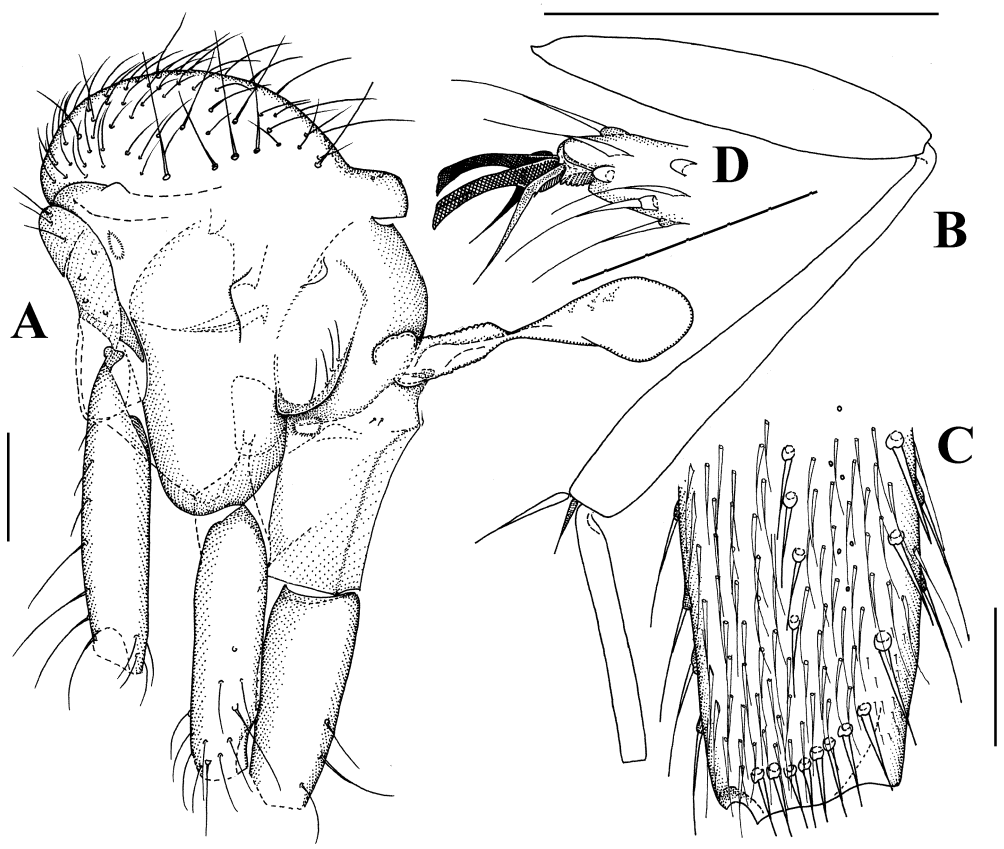

FIGURE 5. *Labellorrhina quantula* sp. n. (paratypes): male thorax (A), lateral view, hind femur, tibia and basitarsomere (B), retrolateral view, apical part of hind tibia (C), retrolateral view and apical part of middle tarsus (D), lateral view. Scale for A 0.10 mm, for B 1 mm, for C and D 0.05 mm.

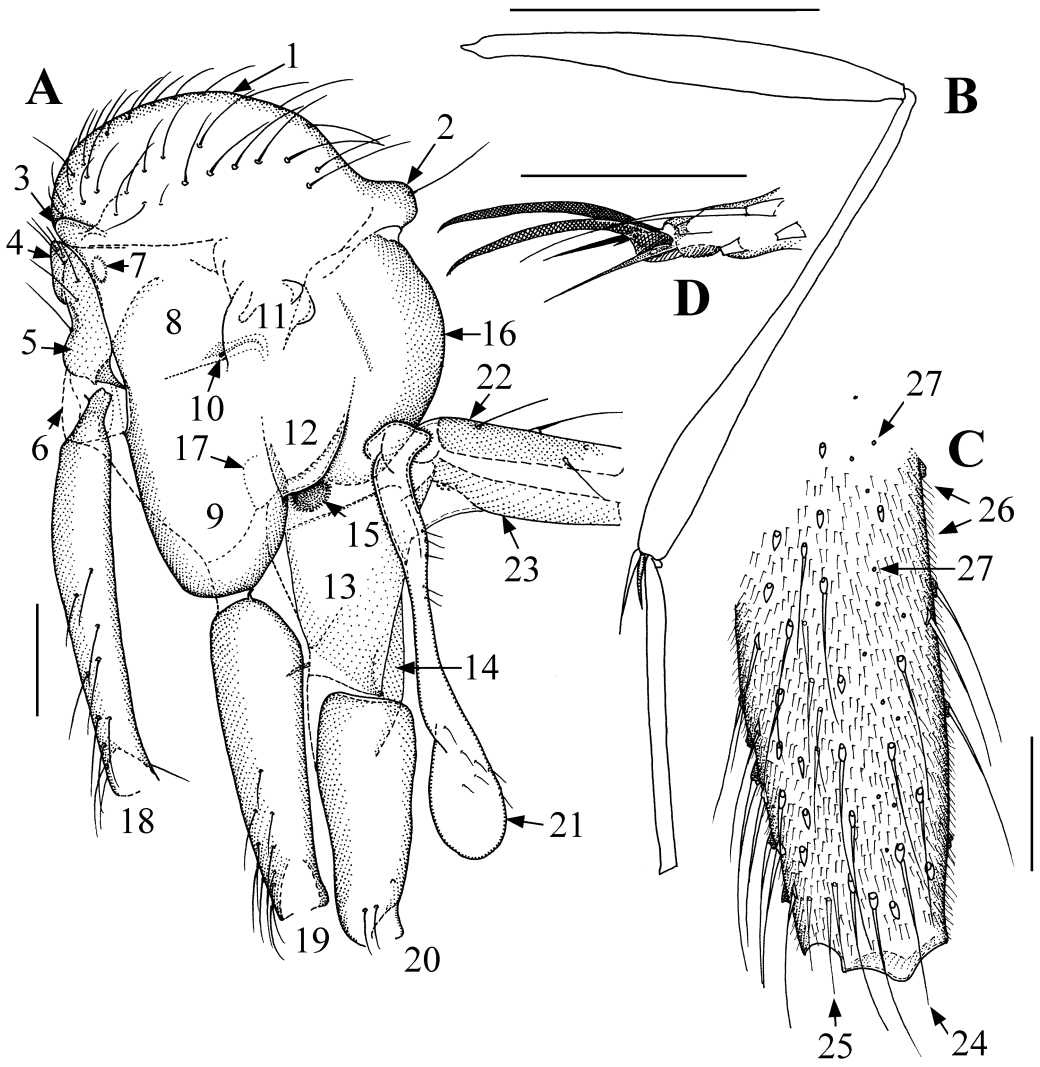

FIGURE 6. *Gracilorrhina gracilis* sp. n. (paratypes): male thorax (A), lateral view, hind femur, tibia and basitarsomere (B), prolateral view, apical part of hind tibia (C), retrolateral view and apical part of middle tarsus (D), prolateral view. Scale for A 0.10 mm, for B 1 mm, for C and D 0.05 mm. 1: scutum, 2: scutellum, 3: posterior pronotum, 4: anterior pronotum, 5: episternum 1, 6: prosternum, 7: anterior spiracle, 8: anterior anepisternum, 9: katepisternum, 10: position of pleural pit, 11: epimeron 2, 12: laterotergite, 13: episternum 3, 14: epimeron 3, 15: posterior spiracle, 16: mediotergite, 17: furcasternum 2, 18: coxa 1, 19: coxa 2, 20: coxa 3, 21: haltere, 22: abdominal tergite 1, 23: abdominal sternite 1, 24: socketed seta, 25: non-socketed seta (trichium), 26: microtrichia, 27: dot-like sensillum.

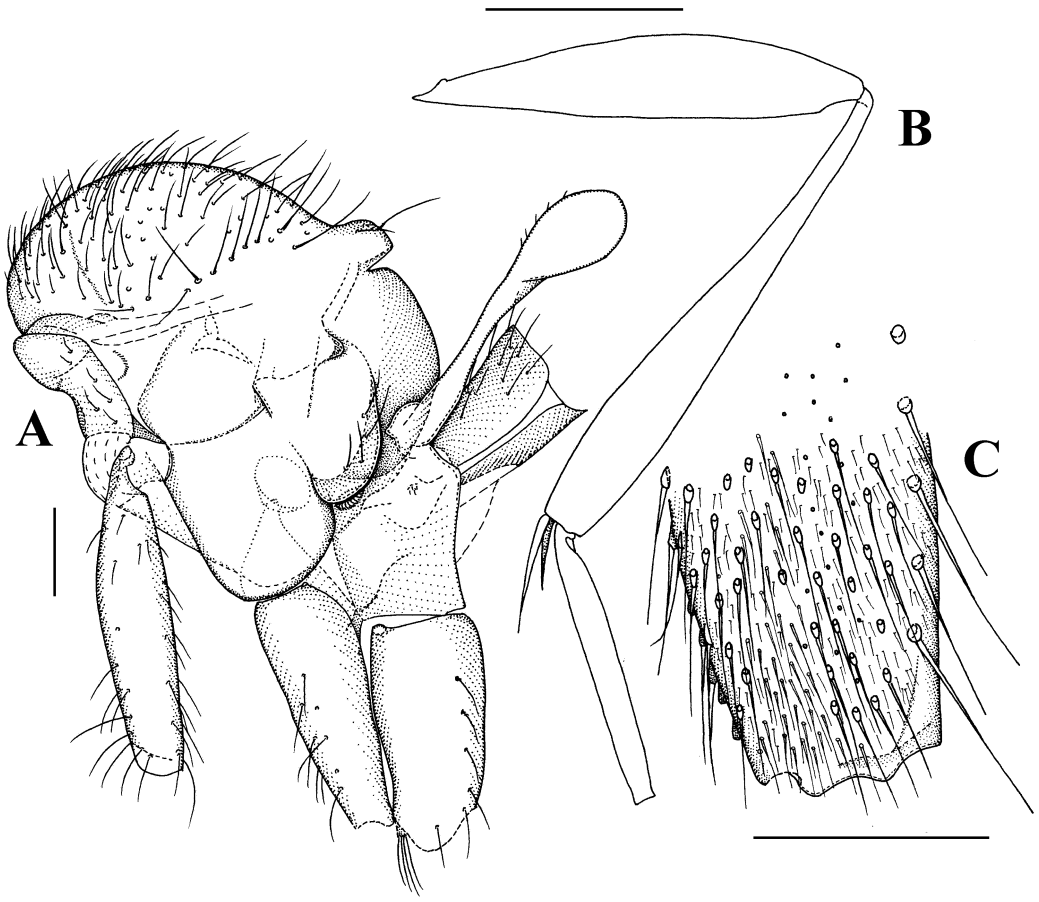

FIGURE 7. *Blagorrhina blagoderovi* sp. n. (paratypes): male thorax (A), lateral view, hind femur, tibia, and basitarsomere (B), retrolateral view, and apical part of hind tibia (C), retrolateral view. Scale for A and C 0.10 mm, for B 1 mm.

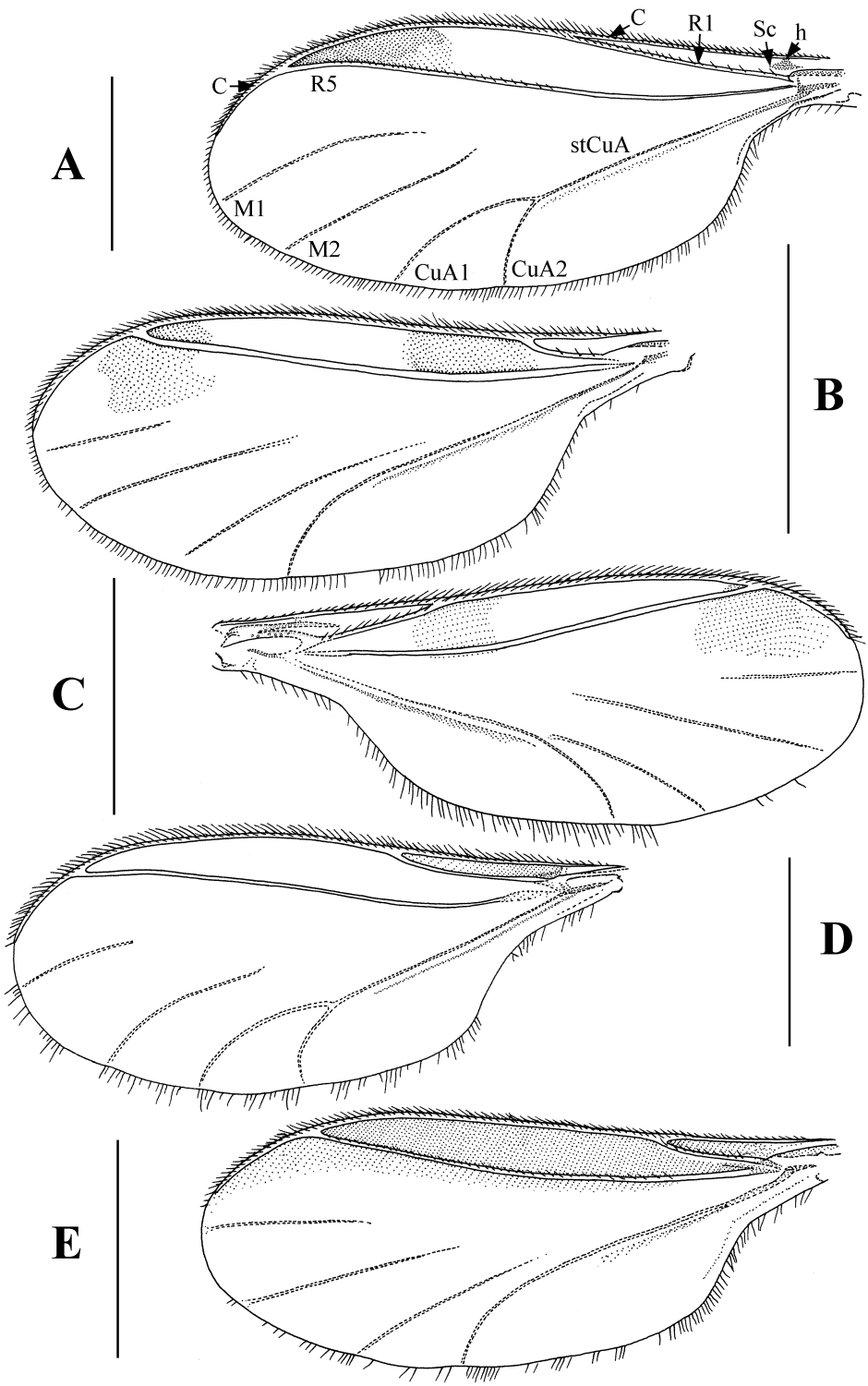

FIGURE 8. Male (B-E) and female (A) wing, dorsal view. A: Lygistorrhinidae sp. 2 (Malaysia). B: *Labellorrhina grimaldii* sp. n. (holotype). C: *L. quantula* sp. n. (paratype). D: *Gracilorrhina gracilis* sp. n. (paratype). E: *Blagorrhina blagoderovi* sp. n. (paratype). Scale 0.50 mm.

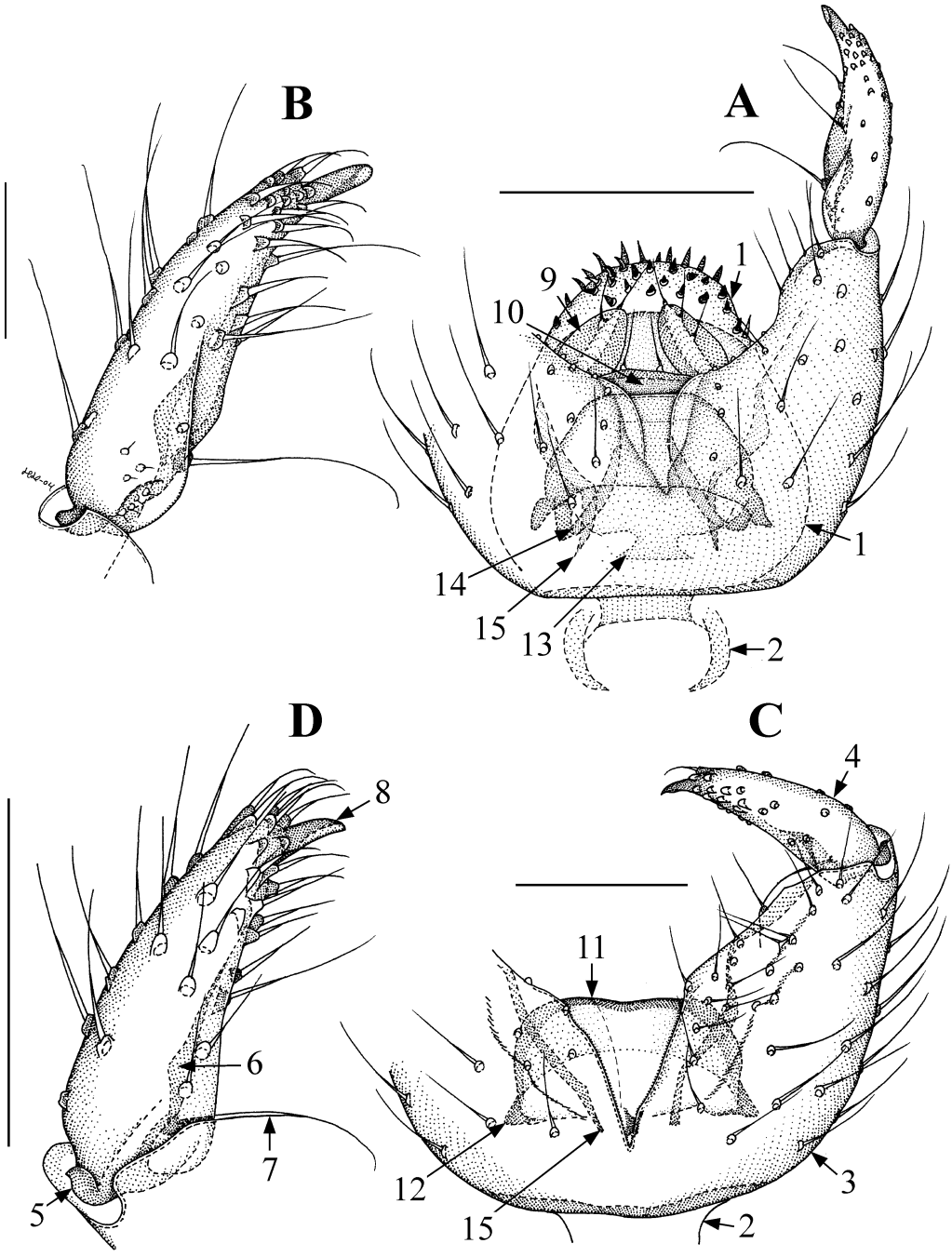

FIGURE 9. Part of male hypopygium (A, C) and gonostylus (B, D), ventral view. A and B: *Labellorrhina quantula* sp. n. (holotype). C and D: *L. grimaldii* sp. n. (holotype). Scale 0.05 mm. 1: tergite 9, 2: apodeme of tergite 9, 3: gonocoxite, 4: gonostylus, 5: basolateral apophysis of gonostylus, 6: basomesial impression of gonostylus, 7: elongated basomesial seta of gonostylus, 8: apical tooth of gonostylus, 9: cercus, 10: sternite 10, 11: tegmen, 12: apodeme of tegmen, 13: aedeagal apodeme, 14: parameral apodeme, 15: gonocoxal apodeme.

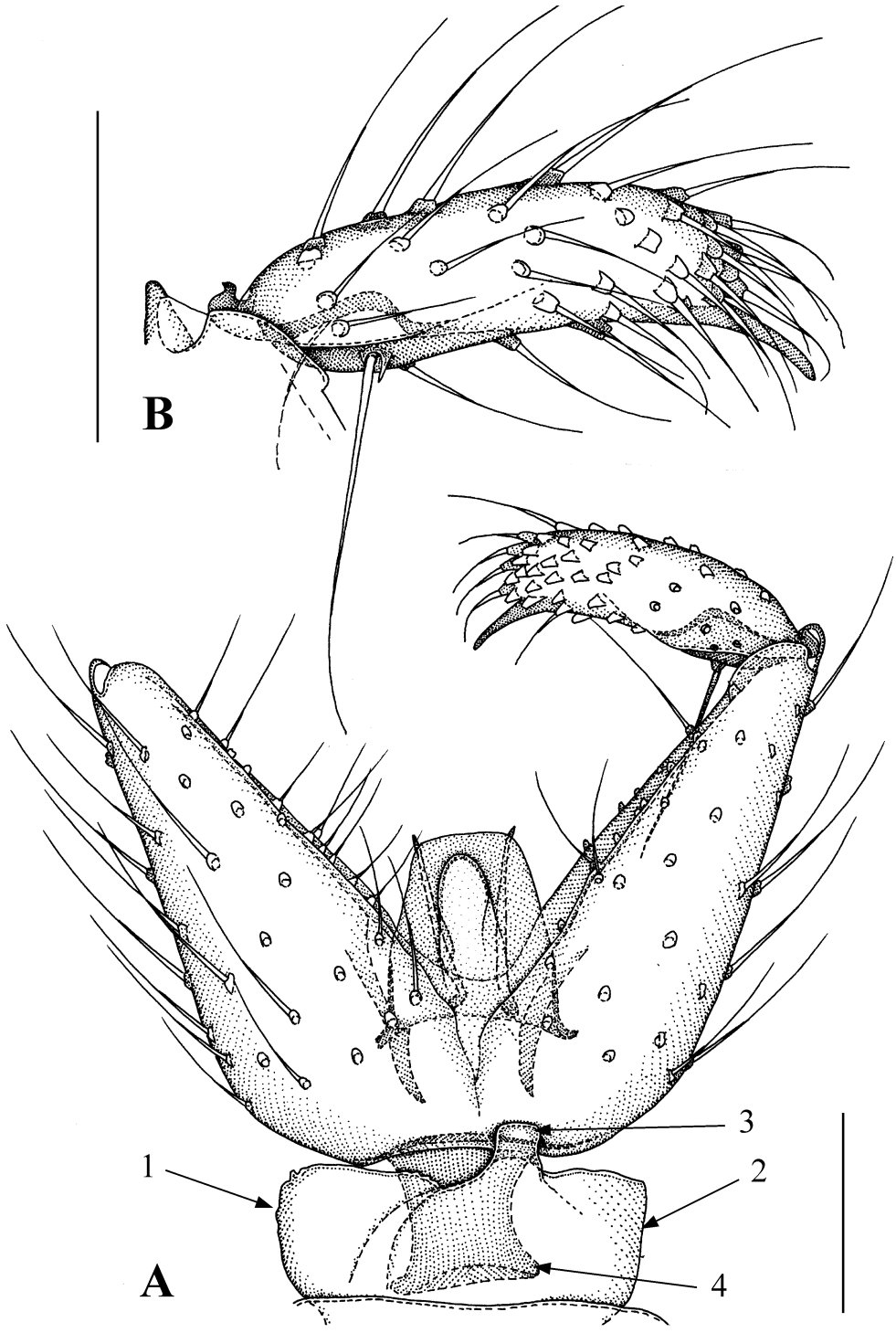

FIGURE 10. *Gracilorrhina gracilis* sp. n. (holotype): part of male hypopygium (A) and gonostylus (B), ventral view. Scale 0.05 mm.

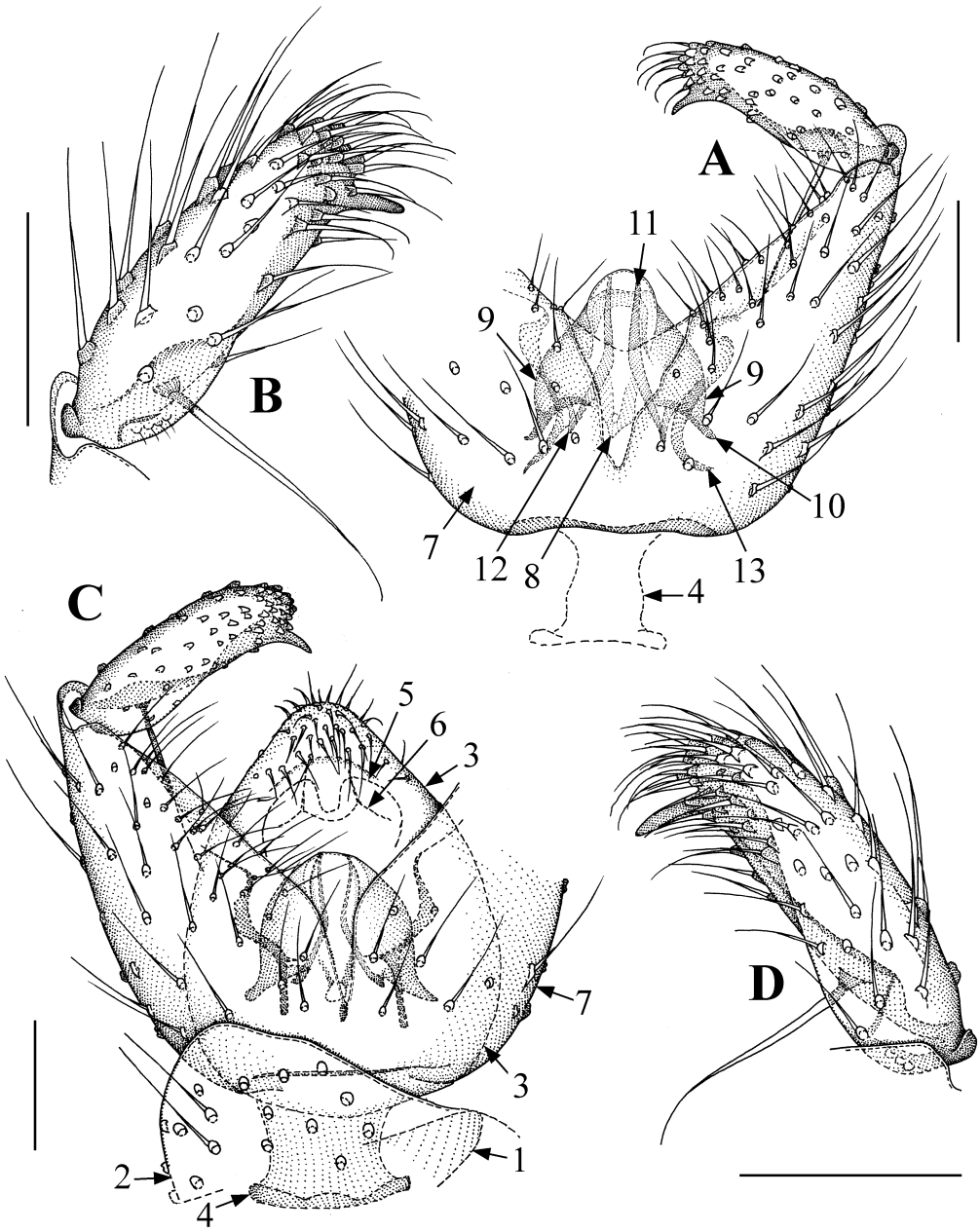

FIGURE 11. Part of male hypopygium (A, C) and gonostylus (B, D), ventral view. A and B: *Blagorrhina blagoderovi* sp. n. (holotype). C and D: *B. brevicornis* sp. n. (holotype). Scale 0.05 mm. 1: sternite 8, 2: tergite 8, 3: tergite 9, 4: apodeme of tergite 9, 5: cercus, 6: sternite 10, 7: gonocoxite, 8: aedeagal apodeme, 9: tegmen, 10: apodeme of tegmen, 11: paramere, 12: parameral apodeme, 13: gonocoxal apodeme.

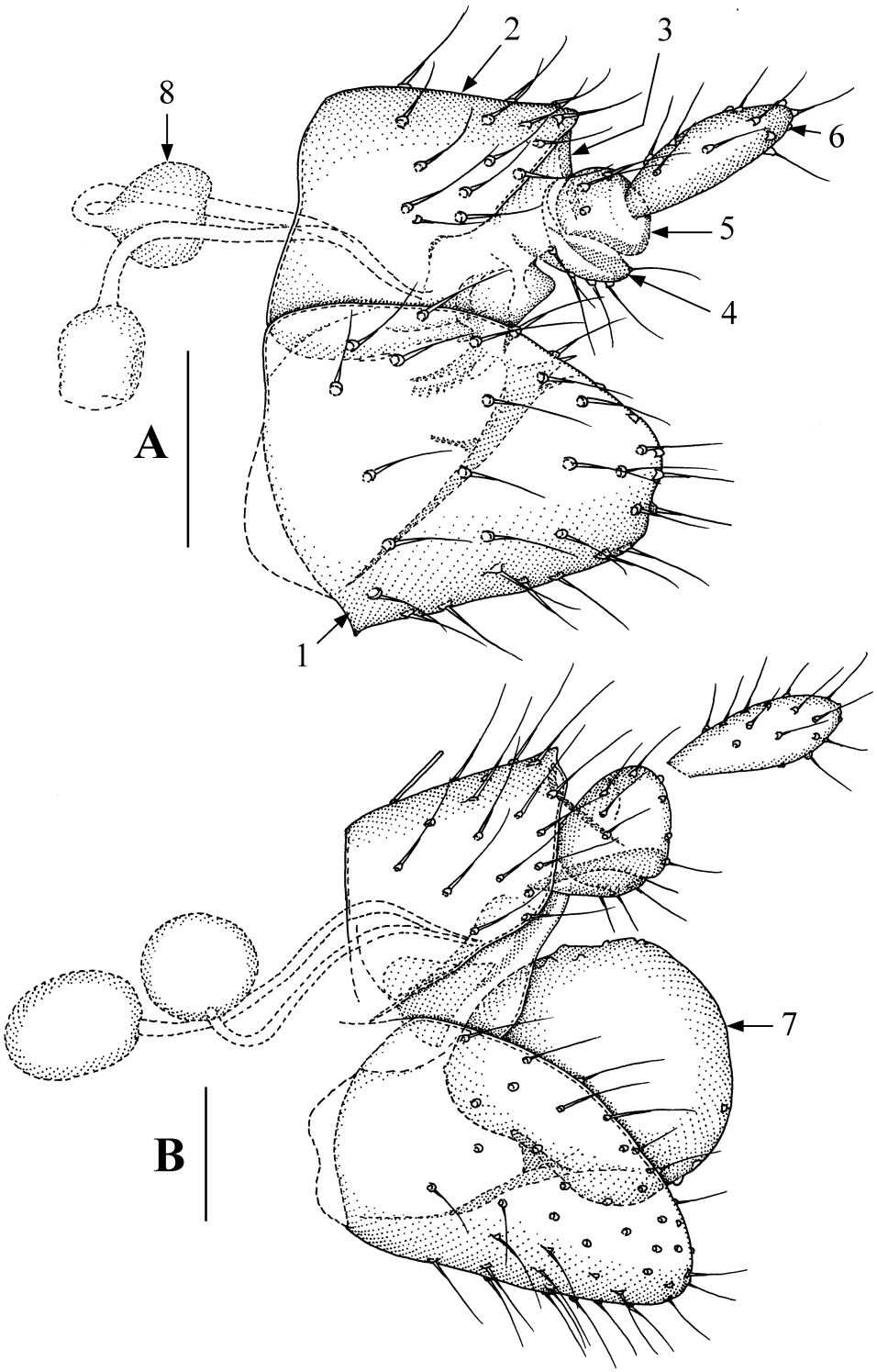

FIGURE 12. Female terminalia, lateral view. A: Lygistorrhinidae sp. 1 (Malaysia). B: Lygistorrhinidae sp. 2. (Malaysia). Scale 0.05 mm. 1: sternite 8, 2: tergite 9, 3: tergite 10, 4: sternite 10, 5: basal segment of cercus, 6: apical segment of cercus, 7: egg, 8: spermatheca.

