

Two new empoascine leafhopper genera, *Thaioasca* and *Mjolinirus*, from Thailand (Hemiptera: Cicadellidae: Typhlocybinae), with a checklist of Empoascini in Thailand

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Abstract

Two new microleafhopper genera of Empoascini, *Thaioasca* Wang, Xu & Qin, **gen. nov.** and *Mjolinirus* Wang, Xu & Qin, **gen. nov.**, based on the type species, *Thaioasca contaminata* Wang, Xu & Qin, **sp. nov.** and *Mjolinirus mediolobus* Wang, Xu & Qin, **sp. nov.** are described from Thailand. Male habitus photos and illustrations of male genitalia of these two new species are given. A checklist of Empoascini from Thailand is also provided.

Key words: Auchenorrhyncha, microleafhopper, morphology, taxonomy, distribution

Introduction

The tribe Empoascini Distant (1908) is the second largest group in the subfamily Typhlocybinae after Erythroneurini (Xu *et al.* 2017a, b; Cao & Zhang 2013). It is rather diverse in the Oriental realm with 72 genera reported, including 53 genera endemic to this area (Suo *et al.* 2016; Xu *et al.* 2017a, b; Yu *et al.* 2020).

In Thailand, the species diversity of Empoascini remains poorly investigated, comprising 11 genera and 17 species of Empoascini reported so far (see the checklist below). This study adds two new empoascine genera based on the specimens from this country. Morphological differences between the new genera and allied genera and placement of both into previously recognized generic-groups in Empoascini are discussed. A checklist of all known empoascine species from Thailand is also provided.

Material and methods

The specimens studied are deposited in the insect collections of the Queen Sirikit Botanical Garden, Thailand (QSBG), Illinois Natural History Survey, Champaign, Illinois (INHS), and the Entomological Museum, Northwest A&F University, China (NWAUF). All illustrations were made by the lead author using the techniques described previously (Xu *et al.* 2017a, b).

Morphological terminology follows that of Zhang (1990) except for an abbreviated system for labeling wing veins, and groups of setae on the male subgenital plate, modified from Dietrich & Dmitriev (2006) and Dworakowska (1994a), respectively; leg chaetotaxy follows Rakitov (1998).

Taxonomy

Thaioasca Wang, Xu & Qin, gen. nov.

Type species: *Thaioasca contaminata* Wang, Xu & Qin sp. nov.

Description. Body robust. Head including eyes distinctly wider than maximum width of pronotum, eyes in dorsal view narrower than distance between basomedial angles and wider than half of distance between basomedial angles (Figs 1, 3). Coronal suture extended nearly to anterior margin of crown (Fig. 3). Ocelli present (Fig. 4). Lateral frontal sutures extended below ocelli, male anteclypeus tapered and weakly convex, not expanded (Figs 2, 4). Forewing narrow, rounded apically, veins R2 and RM confluent for short distance, distal segments of both arising from m cell, vein RM and MCu almost parallel apically (Fig. 5). Hind wing with veins MP and CuA confluent (Fig. 6).

Fore femur with 2 or 3 enlarged AV setae on basal margin. Middle femur with 2 distinct dorsoapical macrosetae. Hind femur setal formula 2+1+1, tibia row AV with 4 macrosetae near apex.

Male basal abdominal sternal apodemes (2S apodemes) developed (Fig 7). Pygofer elongated, extended into sharp point, strongly depressed dorsally in profile, dorsal bridge undeveloped, membranous, ventral appendage robust (Figs 8–12). Subgenital plates fused at least at base, basal setal group submarginal near midlength of plate; marginal microsetae sparse, limited to distal part of plate margin; macrosetae uniseriate basally, somewhat irregular apically; feeble microsetae present but inconspicuous (Figs 8, 10, 13). Style broadened at base, apex tapered and smooth, with preapical setae (Figs 8, 10, 14). Aedeagus shaft tubular, preatrium absent, dorsoatrium well developed, gonopore medial on ventral surface (Figs 8, 9, 15, 16). Connective not delimited, completely fused with base of aedeagus (Figs 8, 10). Anal tube process well-developed but short (Figs 8, 10, 17).

Distribution. Thailand.

Etymology. The generic name combines a prefix referring to the type locality (Thailand) with the name of the type genus of the tribe, *Empoasca*. Gender: feminine.

Notes. *Thaioasca* is included in the *Ficiana* generic group *sensu* Xu *et al.* (2015). The new genus resembles other members of this group in the proportions of the head (crown shorter than width between eyes), the fore- and hind wing venation, and in having the subgenital plates fused basally and the connective fused to the aedeagus. *Thaioasca* differs from *Ficiana* Ghauri, *Dialecticopteryx* Kirkaldy, *Ishiharella* Dworakowska, and *Mahmoodia* Dworakowska in having the coronal suture extended to near the anterior margin of the crown (it extends onto the face in *Ficiana* and *Dialecticopteryx* but absent in *Ishiharella* and *Mahmoodia*). From *Kotwaria* Dworakowska, *Daluana* Ramakrishnan, and *Nimabanana* Dworakowska the new genus differs in having a well-developed anal tube appendage (absent in these other three genera). *Thaioasca* is, so far, the only member of the *Ficiana* group with a ventral appendage on the pygofer; thus, the definition of the group provided by Xu *et al.* (2015) should be modified accordingly. Fusion of the connective with the base of the aedeagus in this group has been confirmed by study of specimens of three genera in addition to the new genus, *Ishiharella*, *Ficiana*, and *Dialecticopteryx*; and is indicated by the original illustrations of male genitalic characters of the type species of the other four included genera (*Mahmoodia*, *Nimabanana*, *Kotwaria*, and *Daluana*; see Dworakowska, 1970a: figs 2, 6; Dworakowska, 1984: figs 65, 75, 76; Dworakowska, 1994b: figs 62, 63; Ramakrishnan, 1982: fig. 8). Further investigations are needed to determine the phylogenetic status and relationships of this group.

Thaioasca contaminata Wang, Xu & Qin, sp. nov.

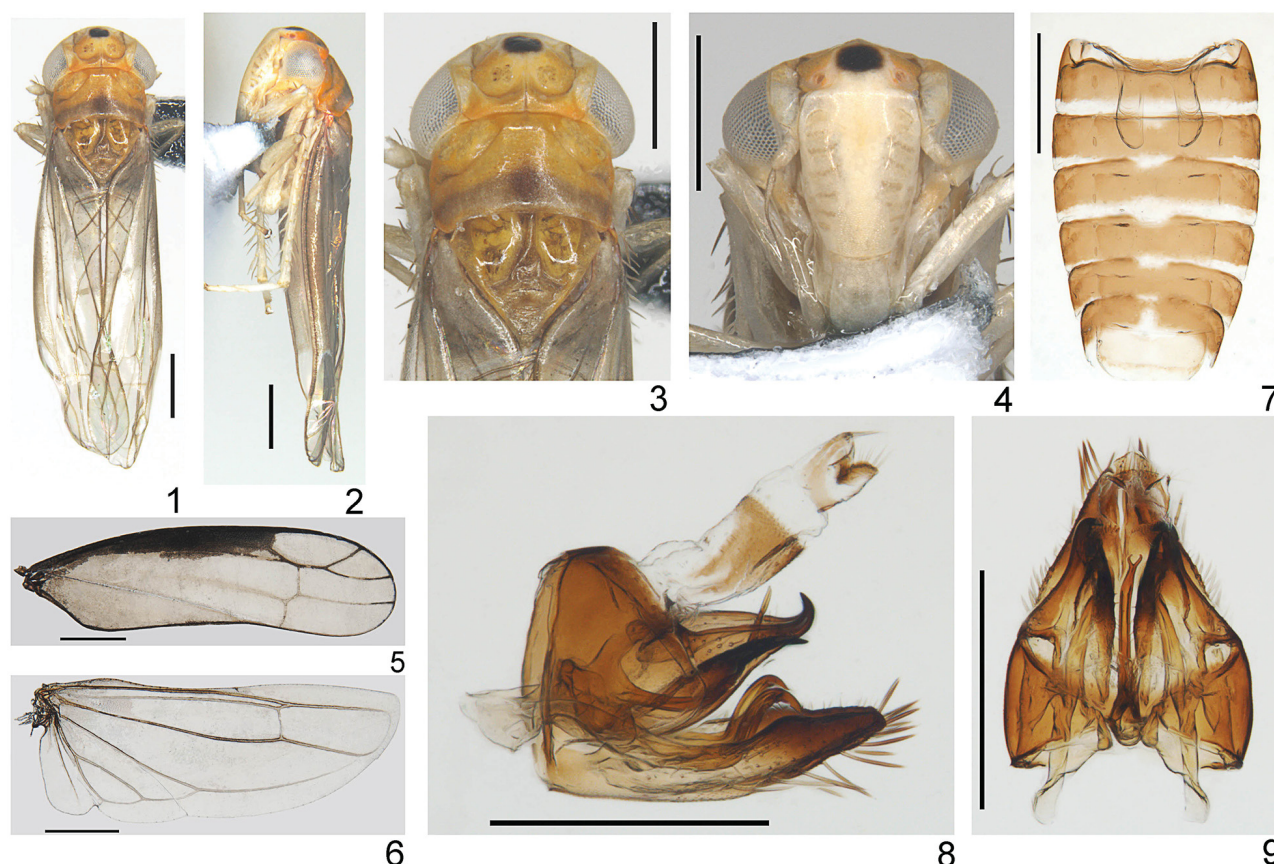
(Figs 1–17)

Description. Body length: Male 4.2–4.4 mm.

General color of body yellowish (Figs 1–4). Head with median black spot at apical transition from crown to face, crown short and broad, rounded anteriorly (Figs 1, 3, 4). Pronotum with yellowish-black, sinuate transverse depression laterally, mid-posteriorly black (Figs 1, 3). Fore- and hind wing subhyaline, veins distinct (Figs 5, 6). Legs whitish (Fig. 2).

2S apodemes extending to middle of segment IV (Fig. 7). Male pygofer with 10–11 tiny setae in depression of dorsal margin; apex of pygofer lobe pointed, curved upward and inward (Figs 8–12); ventral appendage developed

and inflated at base, narrowed and heavily sclerotized distally, surpassing caudal margin of pygofer lobe (Figs 8–12). Subgenital plates large and fused for two-fifths of their length and surpassing pygofer lobe; basal setae (8–9) arranged in 1 or 2 rows, almost same size as macrosetae; marginal setae (8–9) setae not reaching tip of plate; macrosetae (7–8) arising at middle of plate below basal setae; feeble microsetae very sparse and shorter than macrosetae (Figs 8, 10, 13). Aedeagus slender, shaft slightly bent to right side, in lateral view wide basally, then abruptly narrowed, apex bifid in posterior view giving rise to pair of short distally directed processes (Figs 8, 9, 15, 16); gonopore close to middle of shaft, ventral. Style greatly broadened basally, distal part elongate, sinuate in ventral and lateral views, gradually tapering to bluntly rounded tip, with 4–5 fine preapical setae (Figs 8, 10, 14). Anal tube appendage extended nearly half distance to ventral margin of genital capsule, lobe-like with obtuse posteroventral edge (Figs 8–10, 17).

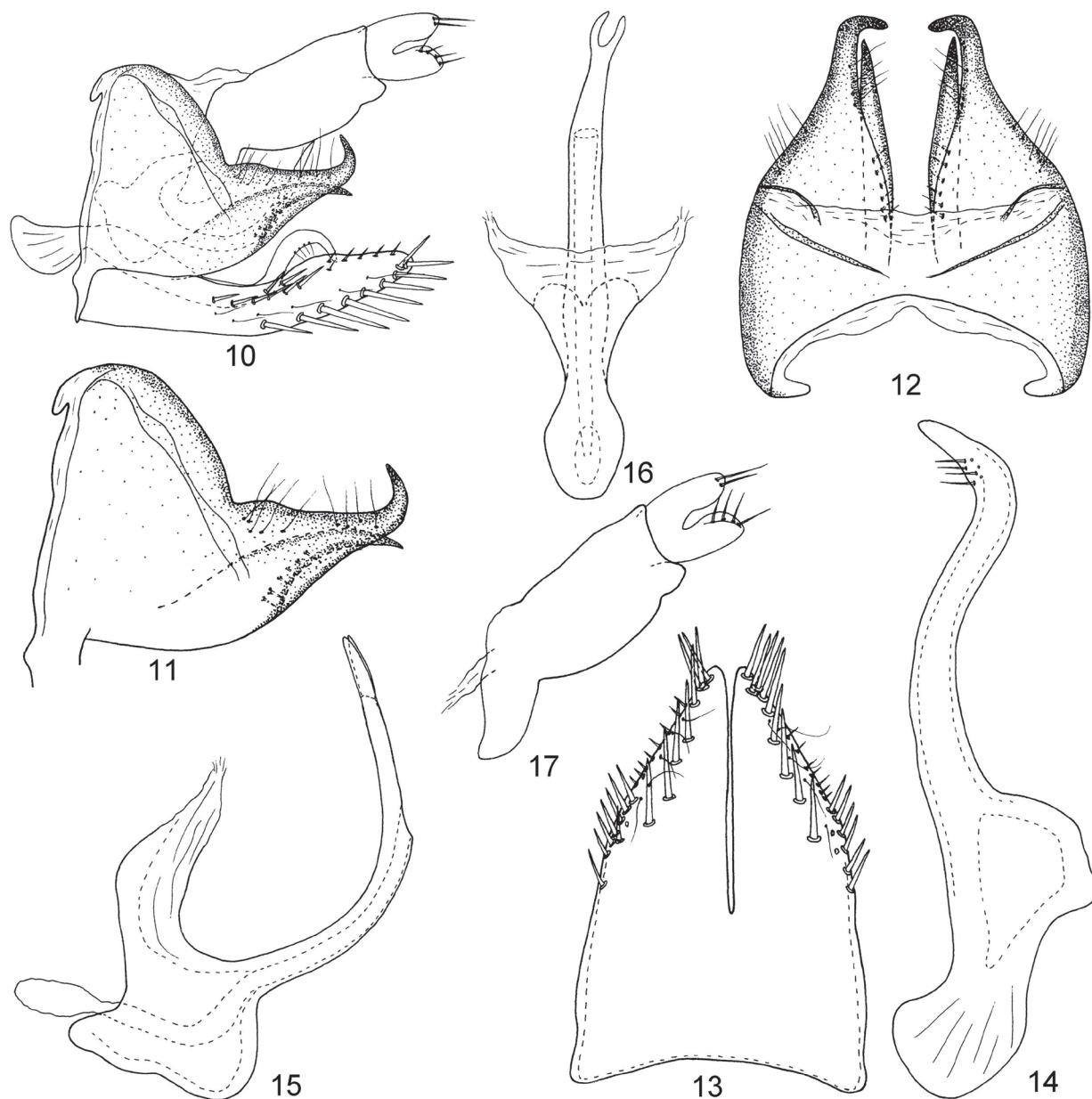


FIGURES 1–9. *Thaioasca contaminata* Wang, Xu & Qin **sp. nov.** 1. male adult (abdomen removed), dorsal view; 2. male adult (abdomen removed), left lateral view; 3. head and thorax, dorsal view; 4. face; 5. forewing; 6. hind wing; 7. abdominal apodeme; 8. male genitalia, left lateral view; 9. male genitalia, dorsal view. Scale bars= 0.5 mm (Figs 1–9).

Holotype. ♂ (QSBG), Thailand Chiang Mai Doi Chiang Dao WS Nature trail, 19°24.278'N 98°55.311'E, 491 m, Malaise trap, March 10–17, 2008, Songkran & Apichart leg., T3155. **Paratypes.** 3♂♂ (INHS), Thailand Nakhon Sawan Mae Wong NP Tha Ta Thai, 15°54.258'N 99°18.862'E, Malaise trap, September 1–7, 2007, Kaewkok N. & Saksit P. leg., T3597; 3♂♂ (NWAUFU), Thailand Nakhon Si Thammarat Namtok Yong NP Hill, evergreen forest, 8°13.891'N 99°47.98'E, 679 m, Pan trap, November 16–17, 2008, Paiboon leg., T4263.

Distribution. Thailand.

Etymology. The specific epithet is derived from the Latin adjective “*contaminatus*”, contaminated, polluted, referring to the dark smudge on the crown.



FIGURES 10–17. *Thaioasca contaminata* Wang, Xu & Qin **sp. nov.** 10. male genitalia, left lateral view; 11. pygofer lobe with ventral appendage, left lateral view; 12. pygofer, dorsal view; 13. subgenital plates; 14. style; 15. aedeagus, left lateral view; 16. aedeagus, dorsal view; 17. anal tube, left lateral view.

***Mjolnirus* Wang, Xu & Qin, gen. nov.**

Type species: *Mjolnirus mediolobus* Wang, Xu & Qin, **sp. nov.**

Description. Head with eyes subequal in width to maximum width of pronotum. Eyes in dorsal view narrower than distance between basomedial angles (Figs 18, 20). Coronal suture extended slightly beyond crown mid-length but not onto face (Fig. 20). Ocelli on crown margin well separated from eyes. Lateral frontal sutures present and extended below ocelli (Fig. 21). Anteclypeus narrowed and slightly convex basally (Figs 19, 21). Forewing narrow, rounded apically, veins R2 and RM confluent at their bases, distal segments of both arising from m cell (Fig. 22), vein MCu well separated with RM apically. Hind wing with vein MP and CuA completely confluent (Fig. 23).

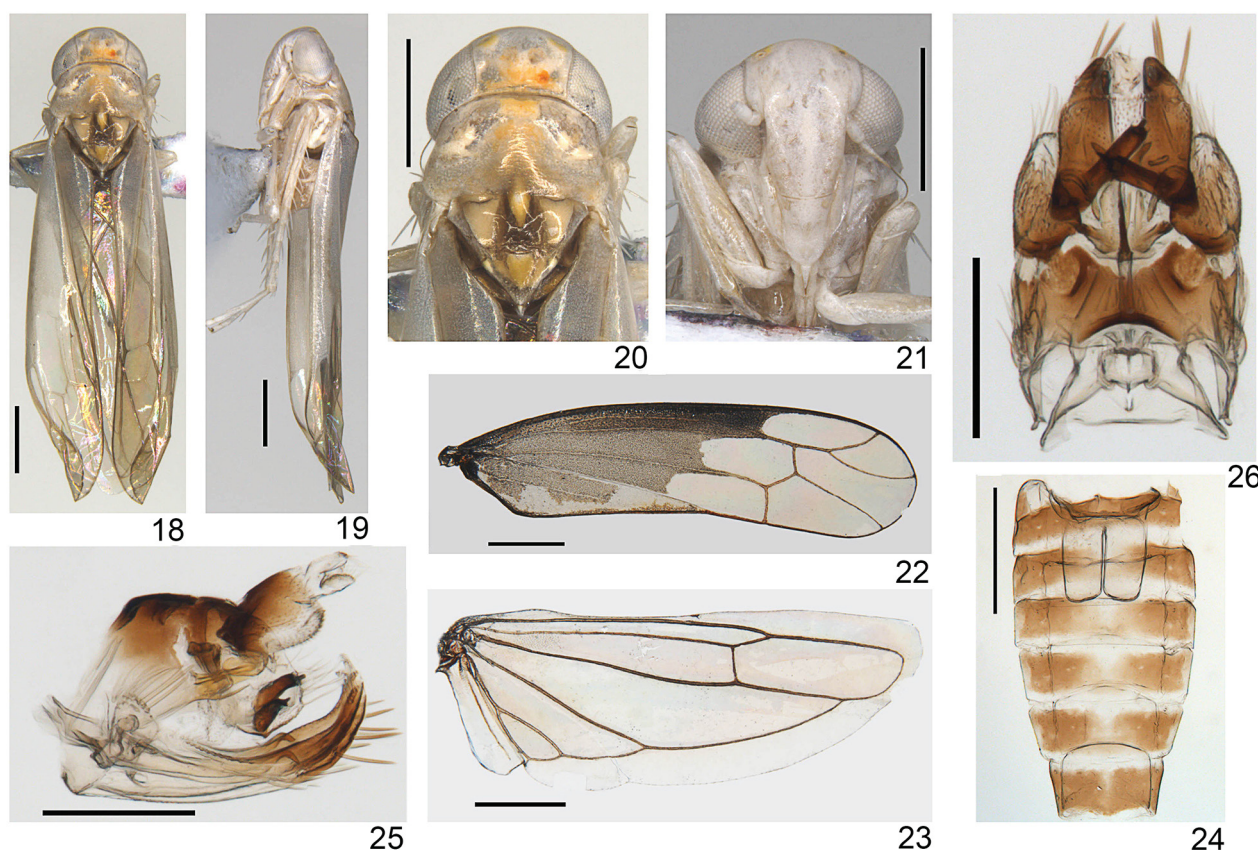
Fore femur with 1 enlarged AV seta on basal margin. Middle femur with 1 distinct dorsoapical macroseta. Hind femur setal formula 2+1+1, tibia with 6 macrosetae in row AV near apex.

Male 2S abdominal apodemes well developed, parallel-sided (Fig. 24). Pygofer lobe with few microsetae along posterodorsal margin; ventral margin infolded; dorsal bridge well delimited, long, ventral appendage present, arising from internal ridge near ventral margin of pygofer lobe (Figs 25–29). Subgenital plate surpassing pygofer lobe, well expanded basally with prominent basolateral projection, gradually narrowing apically; basal setae elongate and stout, arising from basolateral angle; marginal setae well defined, separated into medial and distal groups; macrosetae uniseriate, not reaching tip of plate; feeble microsetae undeveloped (Figs 25, 27, 30). Style slightly broadened basally, apophysis elongate, with short basolateral protrusion, dentifer short with few tiny teeth (Figs 27, 31, 32). Aedeagus with preatrium longer than shaft, shaft with asymmetrical basal processes; dorsal apodeme absent (Figs 25, 26, 33–35). Connective, articulated with aedeagus, with narrow median lobe on anterior margin, caudal margin notched medially (Fig. 36). Anal tube processes short, rounded (Figs 25, 37).

Distribution. Thailand.

Etymology. The new generic name is derived from Proto-Germanic: *Mjöltnir*, the hammer of Thor, the Norse god of thunder, referring to the pygofer processes which resemble hammer handles (Figs 25–29). Gender: masculine.

Notes. *Mjöltnirus* is included in the *Empoasca* generic group based on hind wing veins MP and CuA being confluent, the subgenital plates free through their length, and the connective well separated from the aedeagus. It is similar to *Empoasca* Walsh, but differs in the unique structure of the pygofer and subgenital plate. Among other empoascine genera in the Oriental Region, *Mjöltnirus* superficially resembles *Sharoka* Sohi & Mann, 1993 in having very similar head structure (head with eyes subequal to maximum width of pronotum, coronal suture not extended onto face); and the subgenital plate broadest at the base and tapering towards the apex, with marginal setae divided into two separate groups. It differs from *Sharoka* in the shape of the aedeagus which lacks a dorsal apodeme and has the atrium weakly expanded in caudoventral view (aedeagus with dorsal apodeme, and atrium greatly expanded in caudoventral view in *Sharoka*). Furthermore, *Mjöltnirus* differs from all other known genera of *Empoasca* genus group in having column-like processes arising from the ventral margin of the male pygofer.



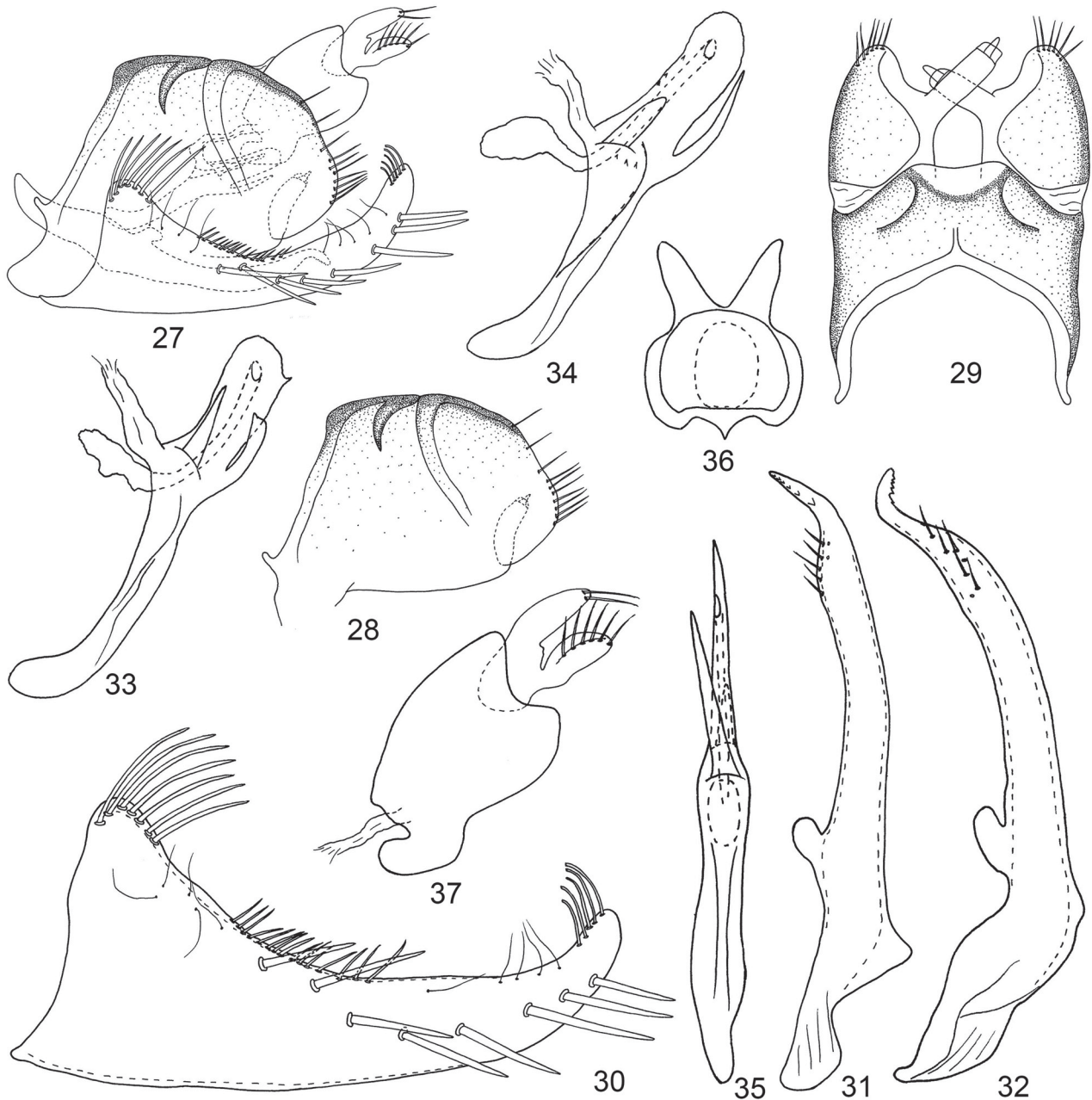
FIGURES 18–26. *Mjöltnirus mediolobus* Wang, Xu & Qin, **sp. nov.** 18. male adult (abdomen removed), dorsal view; 19. male adult (abdomen removed), left lateral view; 20. head and thorax, dorsal view; 21. face; 22. forewing; 23. hindwing; 24. abdominal apodemes; 25. male genitalia, left lateral view; 26. male genitalia, dorsal view. Scale bars = 0.5 mm (Figs 18–26).

Mjolinrus mediolobus Wang, Xu & Qin, sp. nov.

(Figs 18–37)

Description. Body length: male 3.5–3.8 mm.

Ground color faint pale yellowish (Figs 18–21). Eyes silvery gray to black (Figs 18–21). Crown with irregular red spots along coronal suture. Face almost whitish due to long-term storage in ethanol. Mesonotum much darker than head and pronotum (Figs 18, 20). Fore- and hind wing subhyaline, veins distinct (Figs 22, 23). Legs apricot cream-colored (Figs 19, 21).



FIGURES 27–37. *Mjolinrus mediolobus* Wang, Xu & Qin, sp. nov. 27. male genitalia, left lateral view; 28. pygofer lobe with ventral process, left lateral view; 29. pygofer, dorsal view; 30. subgenital plate; 31, 32. style; 33, 34. aedeagus, left lateral view; 35. aedeagus, ventral view; 36. connective; 37. anal tube appendage, left lateral view.

Male 2S abdominal apodemes reaching posterior margin of segment IV, parallel sided (Fig. 24). Male pygofer broad and rounded apically, bearing 8–9 rigid setae along postero-dorsal margin of lobe, dorsal bridge long and well delimited (Figs 25–29); ventral pygofer process unique, extending dorsomesad from ventral margin of pygofer, with apparently eversible nipple-like structure apically. Subgenital plate longer than pygofer lobe in lateral view,

apex rounded and bent dorsad along ventral margin of pygofer lobe; basal setae (6–7) uniseriate, almost same size as macrosetae; marginal setae (20–22) divided into two groups occupying more than half length of dorsolateral margin, one group smooth apically arranged in one row, another group slender, tapered with a blunt tip apically; macrosetae (7–8) not reaching apex of plate; feeble microsetae (12–14) very sparse and inconspicuous (Figs 25, 27, 30). Aedeagus with preatrium elongated, occupying nearly half length of aedeagus in profile; shaft with asymmetrical basal processes, one ridged straight process protruding out of side of shaft and another process at ventral margin basally, slightly curved dorsad (some variation in shape and length of processes observed) (Figs 25, 26, 33–35). Style dentifer with five to seven teeth preceded by four to five setae and few sensory pits (Figs 25, 27, 31, 32). Connective lamellate, longer than wide (Fig. 36). Anal tube process well developed, with broad and rounded apex (Figs 25, 27, 37).

Holotype. ♂ (QSBG), Thailand Chiang Mai Doi Chiang Dao WS Nature trail 19°24.278' N 98°55.311'E, 491 m, Malaise trap, March 10–17, 2008, Songkran & Apichart, leg., T3155; **Paratypes.** 10♂♂ (INHs), 10♂♂ (QSBG), 15♂♂ (NWAUFU), same data as holotype, leg. T3155.

Distribution. Thailand.

Etymology. The name, which is a noun in apposition, is a combination of Latin words: “*medius*”, middle and “*lobus*”, lobe, referring to the median lobe at the anterior margin of the connective.

Checklist of Empoascini in Thailand

Apheliona Kirkaldy, 1907—Oriental, Australasian and Palearctic realms.

Apheliona arooni Dworakowska, 1994—Thailand.

Apheliona setosa Dworakowska, 1994—Thailand, Indonesia.

Apheliona supaniae Dworakowska, 1994—Thailand.

Alebroides Matsumura, 1931—Oriental and Palearctic realms.

Alebroides barbatus Dworakowska, 1997—Thailand, China (Hainan, Hongkong), Nepal.

Alebroides nigroscutellatus (Distant, 1918)—Thailand, China (Hunan, Yunnan, Sichuan, Hainan, Taiwan), India, Nepal, Indonesia, Sikkim, Japan.

Amrasca Ghauri, 1967—Oriental and Australian realms.

Amrasca (*Amrasca*) *splendens* Ghauri, 1967—Thailand, China (Hainan), India, Indonesia, Sri Lanka, Vietnam, Bangladesh.

Amrasca (*Sundapteryx*) *biguttula* (Ishida, 1913)—Thailand, China (Northeast China, Hebei, Shaanxi, Henan, Shandong, Jiangsu, Anhui, Zhejiang, Hubei, Hunan, Jiangxi, Hainan, Taiwan), Japan, India, Indonesia, Pakistan, Philippines, Sri Lanka, Vietnam, Bangladesh, Afghanistan, Micronesia.

Mjolinrus Wang, Xu & Qin, **gen. nov.**—Oriental realm.

Mjolinrus mediolobus Wang, Xu & Qin, **sp. nov.**—Thailand.

Condensella Xu, Dietrich & Qin, 2017—Oriental realm.

Condensella filamenta Xu, Dietrich & Qin, 2017—Thailand, China (Guangxi, Yunnan).

Empoasca (*Livasca*) Dworakowska & Viraktamath 1978—Oriental realm.

Empoasca (*Livasca*) *malliki* Dworakowska & Viraktamath, 1978—Thailand, India, Sri Lanka.

Inflatopina Lu, Dietrich & Qin, 2017—Oriental realm.

Inflatopina aprocessa Xu, Lu, Dietrich & Qin, 2019—Thailand, China (Yunnan).

Ishiharella Dworakowska, 1970b—Oriental realm.

Ishiharella falcata Yu, Yang & Dietrich, 2015—Thailand.

Ishiharella hirsuta Yu, Yang & Dietrich, 2015—Thailand.

Ishiharella multiprotrusa Yu, Yang & Dietrich, 2015—Thailand.

Jacobiasca Dworakowska, 1972—Oriental, Palearctic and Ethiopian realms.

Jacobiasca formosana (Paoli, 1932)—Thailand, China (Fujian, Hunan, Guangdong, Guangxi, Yunnan, Taiwan), India, Malaysia, Pakistan, Sri Lanka.

Keumiata Qin & Dietrich, 2014—Oriental realm.

Keumiata orientalis Qin & Dietrich, 2014—Thailand, China (Yunnan).

Shumka Dworakowska, 1997—Thailand, Oriental realm.
Shumka wareeae Dworakowska, 1997—Thailand.
Thaioasca Wang, Xu & Qin, **gen. nov.**—Oriental realm.
Thaioasca contaminata Wang, Xu & Qin **sp. nov.**—Thailand.
Yunicella Suo, Dietrich & Qin, 2016—Oriental realm.
Yunicella rotunda Suo, Dietrich & Qin, 2016 —Thailand, China (Yunnan).

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