

A taxonomic study of *Cheiloneurus* Westwood (Hymenoptera, Encyrtidae) from China

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Abstract

Fourteen species of *Cheiloneurus* from China are studied. *Cheiloneurus guangxiensis* Zu, **sp. nov.**, is described as new to science, and *C. boldyrevi* Trjapitzin & Agekyan, 1978, *C. bouceki* Anis & Hayat, 2002, *C. gonatopodis* Perkins, 1906, and *C. hadrodorys* Anis & Hayat, 2002 are newly recorded from China. A key to Chinese species based on females is also presented.

Key words: Chalcidoidea, Cheiloneurini, new species, parasitoids

Introduction

The genus *Cheiloneurus*, established by Westwood (1833), with *C. elegans* Dalman as its type species, is very large and diverse (Noyes and Hayat 1984). It encompasses 151 recognized species worldwide (Noyes 2019). All *Cheiloneurus* species exhibit hyperparasitic behavior, targeting a broad spectrum of parasitoid wasps (Trjapitzin and Zuparko 2004). In China, nine *Cheiloneurus* species have been documented, primarily parasitizing Aphelinidae, Encyrtidae, and Dryinidae, engaging in hyperparasitism on various insects, including Hemiptera (e.g. Coccidae, Pseudococcidae) and Diptera (e.g. Drosophilidae) (Xu and Huang 2004; Li et al. 2020; Wang et al. 2023). *Cheiloneurus* is characterized by distinctive features, including the arrangement of setae in the basal cell of the fore wing, typically infusate fore wings, the presence of an apical tuft of setae on the scutellum, and a hypopygium that does not reach the apex of the gaster (Noyes and Hayat 1984).

Various taxonomists, including Girault (1915) in Australia, Trjapitzin (1989) in the Palaearctic, Hayat and Veenakumari (2017) and Anis and Hayat (2002) in India, Trjapitzin and Triapitsyn (2008) in the New World, and Xu and He (2003) and Shi et al. (1994) in China, have contributed significantly to the taxonomy of the genus *Cheiloneurus*. In this study, we present a comprehensive taxonomic examination of nine known species, introduce one new species, and newly report four other *Cheiloneurus* species from China. The primary objective is to enhance the precision of identifying Chinese *Cheiloneurus* parasitoids. Additionally, we furnish a key for the female species of *Cheiloneurus* in China.



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Materials and methods

Photographs of specimens in ethanol were taken using a Canon EOS 80D camera equipped with a Laowa 25 mm lens. A Motic SMZ-168 stereomicroscope was used to dissect specimens, which were mounted on slides according to Zhang et al. (2022) and Noyes (1982). Slide-mounted specimens were photographed with a digital camera attached to an Olympus BX51 running Olympus cellSens Standard v. 1.18. The pictures were synthesized through Helicon Focus v. 6 and processed using Photoshop 2020. Each characteristic part was measured using an Olympus CX21 equipped with a micrometer in the eyepiece. All materials were deposited in the insect collections of Tianjin Agricultural University (TJAU), China.

Morphological terminology and abbreviations were based on Noyes (2010). The subsequent list provides the employed abbreviations:

AOL	minimum distance between a lateral ocellus and median ocellus
F1–6	funicle segments 1–6
FV	minimum frontovertex width
FWL	fore wing length
HWL	hind wing length
HWW	hind wing width
MS	malar space
MT	mid tibia
OCL	minimum distance between a lateral ocellus and occipital margin
OD	longest diameter of an ocellus
OL	ovipositor length
OOL	minimum distance between a lateral ocellus and the corresponding eye margin
POL	minimum distance between lateral ocelli
SMV	submarginal vein
MV	marginal vein
PMV	postmarginal vein
SV	stigmatal vein
BMNH	The Natural History Museum, London, UK
HAUZ	Department of Plant Protection, Henan Agricultural University, Zhengzhou, China
LUNZ	Department of Entomology, Lincoln University, Canterbury, New Zealand
USNM	United States National Museum of Natural History, Washington DC, USA
BPBM	Bernice Pauahi Bishop Museum, Honolulu, Hawaii
ZAUC	Institute of Applied Entomology, Zhejiang University, Hangzhou, Zhejiang, China
ZAFU	Department of Plant Protection, School of Agriculture and Food Science, Zhejiang Agriculture & Forestry University, Huangzhou, Zhejiang, China
ZDANU	Department of Zoology, Aligarh Muslim University, Aligarh, India
NIES	National Institute of Agro-Environmental Sciences, Ibaraki, Japan

Results

Key to Chinese species of *Cheiloneurus* (females)

- 1 Scutellum without a tuft of bristles at apex.....2
- Scutellum with a tuft of bristles at apex.....4
- 2 Fore wing hyaline.....*C. lateocaudatus* (Xu & He, 2003)
- Fore wing infusate.....3
- 3 F4 yellowish white; lineae calvae closed posteriorly by several lines of setae...
.....*C. hadrodorys* Anis & Hayat, 2002
- F4 dark brown; lineae calvae open posteriorly*C. exitiosus* Perkins, 1906
- 4 Scape at least 4.75× as long as wide.....5
- Scape not more than 4.5× as long as wide.....8
- 5 Fore wing hyaline towards base, at apex and along anterior margin distad of venation6
- Fore wing with basal cell almost completely hyaline, small area at apex of venation and area on opposite margin hyaline7
- 6 F5–F6 yellowish white; ovipositor not more than 1× as long as mid tibia...
.....*C. gonatopodis* Perkins, 1906
- F5–F6 dark brown; ovipositor at least 1.20× as long as mid tibia
.....*C. bouceki* Anis & Hayat, 2002
- 7 Clava not more than 1.78× as long as wide, slightly shorter than F4–F6 combined; head not more than 0.80× as wide as long
.....*C. nankingensis* Li & Xu, 2020
- Clava at least 2.72× as long as wide, slightly longer than F3–F6 combined; head at least 0.90× as wide as long.....*C. elegans* (Dalman, 1820)
- 8 F6 black.....9
- F6 entirely white or mixed with brown11
- 9 Fore wing hyaline towards base, at apex and along anterior margin distad of venation; frontovertex not more than 1/10 width of head
.....*C. axillaris* Hayat, Alam & Agarwal, 1975
- Fore wing with basal cell almost completely hyaline, small area at apex of venation and area on opposite margin hyaline; frontovertex at least 1/9 width of head.....10
- 10 F4–F5 entirely whitish.....*C. claviger* Thomson, 1876
- F4–F5 whitish with a brown stripe on ventral margin.....
.....*C. chinensis* Shi, 1993
- 11 F1 entirely whitish12
- F1 yellowish-brown.....13
- 12 Clava as long as F4–F6 combined; pedicel as long as F1.....
.....*C. quercus* Mayr, 1876
- Clava as long as F3–F6 combined; pedicel at least 1.54× as long as F1....
.....*C. sinensis* Özdikmen, 2011
- 13 Scape at least 3× as long as wide; fore wing at least 3× as long as wide...
.....*C. boldyrevi* Trjapitzin & Agekyan, 1978
- Scape not more than 2.44× as long as wide; fore wing not more than 2.73× as long as wide.....*C. guangxiensis* Zu, sp. nov.

***Cheiloneurus axillaris* Hayat, Alam & Agarwal, 1975**

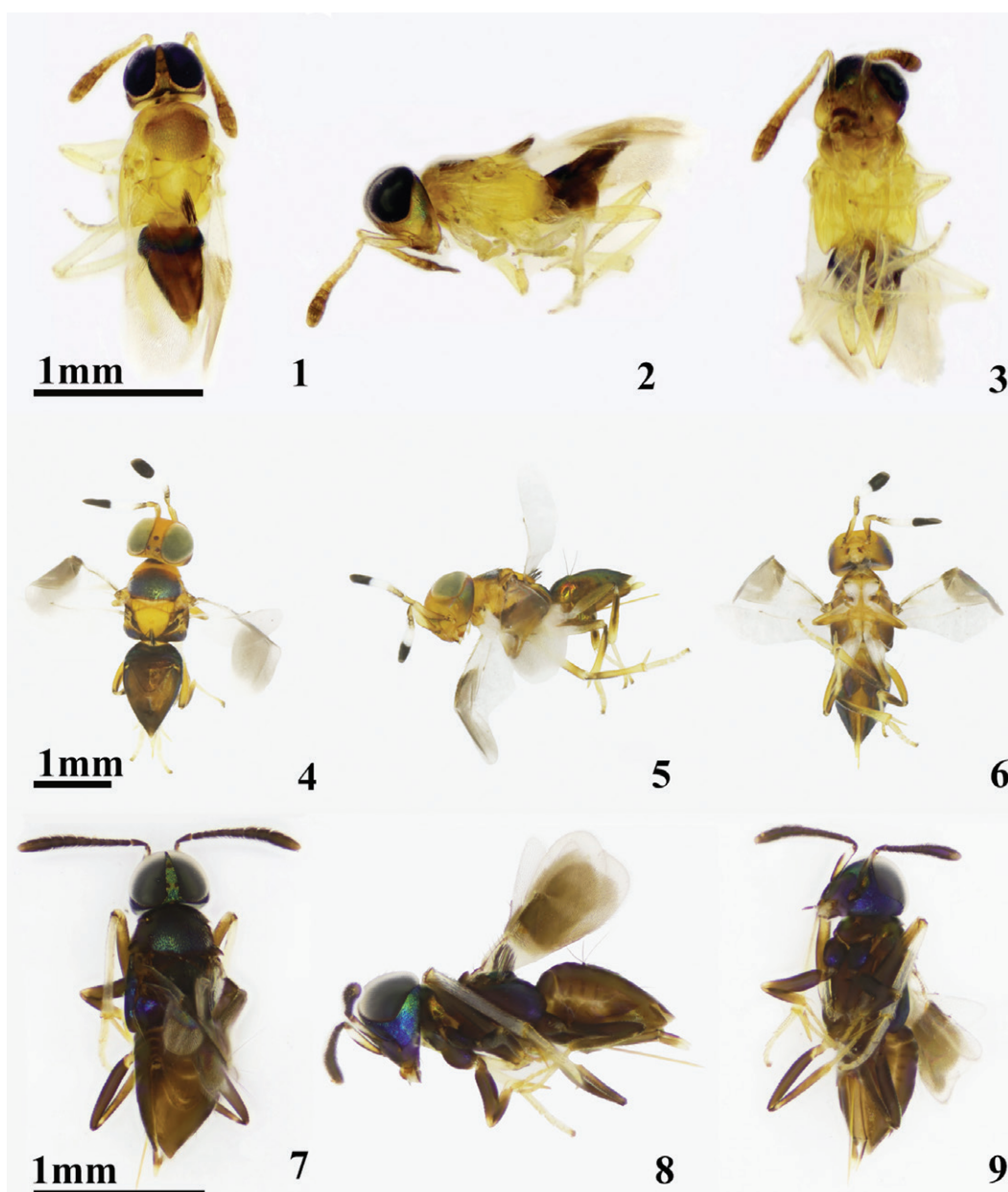
Figs 1–3

Cheiloneurus axillaris Hayat et al. 1975: 47. Holotype ♀, BMNH, India, Maharashtra, not examined.

Cheiloneurus axillaris Anis and Hayat 2002: 171–172.

Cheiloneurus axillaris Xu and He 2003: 103–104, examined plates.

Material examined. CHINA – Yunnan • 2♀; Longchuan; 24°10'59"N, 97°47'32"E; 1336 m elev.; 27 Ari. 2013; Guo-Hao Zu, Xiang-Xiang Jin, Chao Zhang leg.; by yellow pan trapping; TJAU-YN-CHE-001 to 002.



Figures 1–9. 1–3 *Cheiloneurus axillaris* ♀ 1 dorsal habitus 2 lateral habitus 3 ventral habitus 4–6 *Cheiloneurus boldyrevi* ♀ 4 dorsal habitus 5 lateral habitus 6 ventral habitus 7–9 *Cheiloneurus bouceki* ♀ 7 dorsal habitus 8 lateral habitus 9 ventral habitus.

Diagnosis. Female. Length, excluding ovipositor, 1.78–1.89 mm; head dark brown, gena with bluish-green metallic luster; antennal scape brown, with an apical white area; pedicel yellow; funicle yellowish brown; clava dark brown. Legs pale yellow to white.

Description. See Hayat et al. (1975).

Host. Coccidae: *Ceroplastes japonicus*, *Pulvinaria psidii*; Margarodidae: *Icerya* sp. (Hayat et al. 1975).

Distribution. China (Fujian, Yunnan), Bangladesh, India.

***Cheiloneurus boldyrevi* Trjapitzin & Agekyan, 1978**

Figs 4–6, 10–16

Cheiloneurus boldyrevi Trjapitzin and Agekyan, in Trjapitzin 1978: 309–310. Holotype ♀, ZISP, Russia, not examined.

Cheiloneurus boldyrevi Guerrieri and Viggiani 2005: 312–313.

Cheiloneurus boldyrevi Japoshvili et al. 2016: 367.

Material examined. CHINA – Tianjin • 1♀; Xiqing, Tianjin Agricultural University; 39°5'21"N, 117°5'38"E; 13 m elev.; 12–30 Jun. 2023; Hai-Yang Wang, Xin-Yu Cao leg.; by Malaise trapping; TJAU-TJ-CHE-001.

Description. Length, excluding ovipositor, 2.88 mm. Head generally brown; gena with metallic-green luster; antennal scape orange, pedicel and F1–F2 brown, F3 brown with whitish spot in the upper corner of the fore margin, F4–F6 white, clava black, apex paler; basal half of pronotum dark brown and apical half orange, mesoscutum dark brown with metallic-green luster, axilla and scutellum orange, propodeum black, legs orange, fore coxa and basal half of femur, mid basal half of femur, hind coxa, base and apex of tibia whitish. Frontal vertex 0.19× head width; eye height 2.06× malar space (Fig. 10); antennal scape 4.14× as long as wide; pedicel 2.22× as long as wide and longer than F1, funicle 6-segmented, F1–F3 and F5 longer than width, F4 subquadrate, F6 wider than long; clava 3-segmented, 2.26× as long as width, longer than F4–F6 combined (Fig. 11); fore wing 3.33× as long as wide; linea calva not interrupted and open posteriorly (Fig. 13); ovipositor (Fig. 15) 1.36× as long as mid tibia (Fig. 16), distinctly exerted.

Host. Dryinidae: *Neodryinus typhlocybae*; Syrphidae: *Paragus* sp., Syrphidae sp.; Flatidae: *Metcalfa pruinosa* (Guerrieri and Viggiani 2005).

Distribution. China (Tianjin), Armenia, Bulgaria, France, Georgia, Greece, Iran, Italy, Moldova, Netherlands, Portugal, Russia, Spain, Tadzhikistan, Ukraine, Uzbekistan.

Comments. This is the first record from China.

***Cheiloneurus bouceki* Anis & Hayat, 2002**

Figs 7–9, 17–22

Cheiloneurus bouceki Anis and Hayat 2002: 164–165. Holotype ♀, BMNH, India-Karnataka, not examined.



Figures 10–16. *Cheiloneurus boldyrevi* ♀ 10 head 11 antenna 12 mesosoma 13 fore wing 14 hind wing 15 metasoma 16 legs. Scale bars: 100 µm.

Material examined. CHINA – Guangxi • 26♀; Qinzhou, Beibu Gulf University; 21°53'53"N, 108°36'56"E; 24 m elev.; 06–13 Oct. 2019; Wen-Quan Zhen leg.; by Malaise trapping; TJAU-GX-CHE-001 to 026.



Figures 17–22. *Cheiloneurus bouceki* ♀ 17 head 18 antenna 19 mesosoma and metasoma 20 fore wing 21 hind wing 22 legs. Scale bars: 100 µm.

Description. Female. Length, excluding ovipositor, 1.78–1.89 mm. Body generally dark brown; gena with metallic-bluish green luster, frontoververtex metallic-green luster, mandible with three acute teeth (Figs 5–7). Antenna mostly dark brown, an irregular white longitudinal strip in the middle of the scape. Mesosoma dark brown, mesoscutum, axilla, and scutellum with me-

tallic green luster; mesopleuron and propodeum with metallic blue luster. Leg mostly dark brown, basal 1/3 of mid femora, mid tibia, and all tarsi white; frontovertex $0.08\text{--}0.12\times$ head width; eye height $1.17\text{--}1.33\times$ malar space (Fig. 17); antennal scape $5.05\text{--}5.80\times$ as long as wide; pedicel $2\text{--}2.19\times$ as long as wide and longer than F1, funicle 6-segmented, F1–F5 longer than width, F6 subquadrate, funicle with linear sensilla on F2–F6; clava 3-segmented, $2.31\text{--}2.43\times$ as long as width, shorter than F4–F6 combined (Fig. 18); fore wing $2.78\text{--}2.89\times$ as long as wide; linea calva not interrupted and open posteriorly (Fig. 20); ovipositor (Fig. 19) $1.29\times$ as long as mid tibia (Fig. 22), distinctly exerted.

Host. Unknown.

Distribution. China (Guangxi), India.

Comments. This is the first record from China.

***Cheiloneurus chinensis* Shi, Wang, Si & Wang, 1994**

Figs 23–25, 32–38

Cheiloneurus chinensis Shi et al. 1994: 26. Holotype ♀, HAUZ, China, examined plates.

Material examined. CHINA – Henan • 3♀; Gongyi, Luzhuang; $34^{\circ}37'1''\text{N}$, $112^{\circ}52'18''\text{E}$; 213 m elev.; 15 Jun. 2016; Guo-Hao Zu, Nai-Zhi Li, Jian-Wei Zu leg.; by yellow pan trapping; TJAU-HN-CHE-001 to 003.

Diagnosis. Female. Length, excluding ovipositor, 2.4 mm; Antennal (Fig. 33) scape slightly expanded in middle, yellowish brown, ventral margin brown and with an apical one-third white; pedicel brown; F1–F2 brown, F3–F5 white and lower margin brown, F6 dark; clava dark; apical half of mesoscutum darker than basal half (Fig. 34); legs (Fig. 38) yellowish brown, except for fore coxa, basal half of fore femora, basal two-thirds of mid femora, hind coxa and basal of tibia yellowish white.

Description. See Shi et al. (1994).

Host. Coccidae: *Ericerus pela*, *Eulecanium* sp.; Kermesidae: *Kermes quercus* (Xu and Huang 2004).

Distribution. China (Beijing, Liaoning, Henan, Hunan, Hainan, Shandong, Tianjin).

***Cheiloneurus claviger* Thomson, 1876**

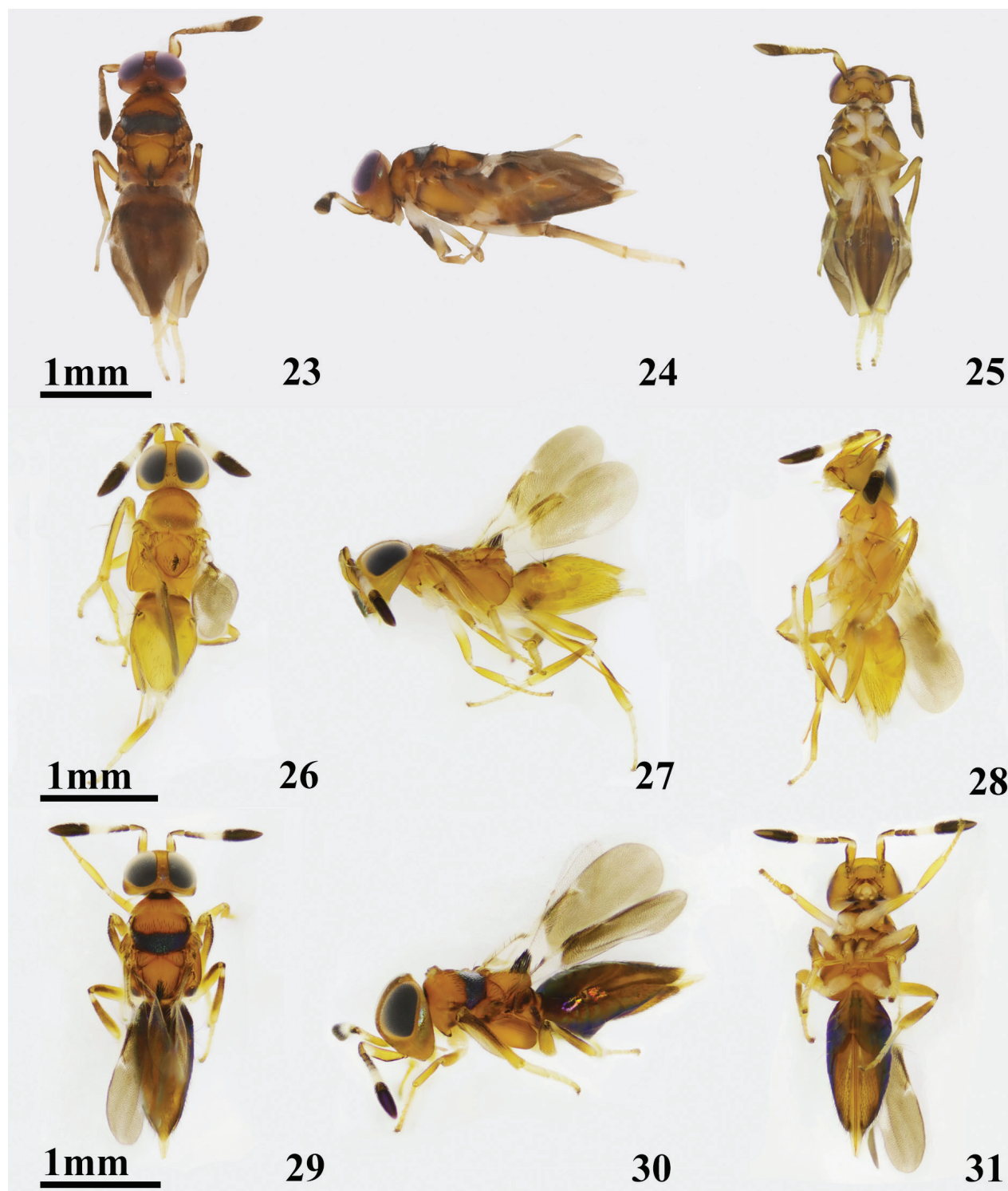
Figs 26–31, 39–51

Cheiloneurus claviger Thomson 1876: 160. Lectotype ♀, LUZN, Sweden, not examined.

Cheiloneurus japonicus Ashmead 1904: 156. Holotype ♀, USNM, Japan. Synonymized with *C. claviger* by Japoshvili et al. (2016: 367).

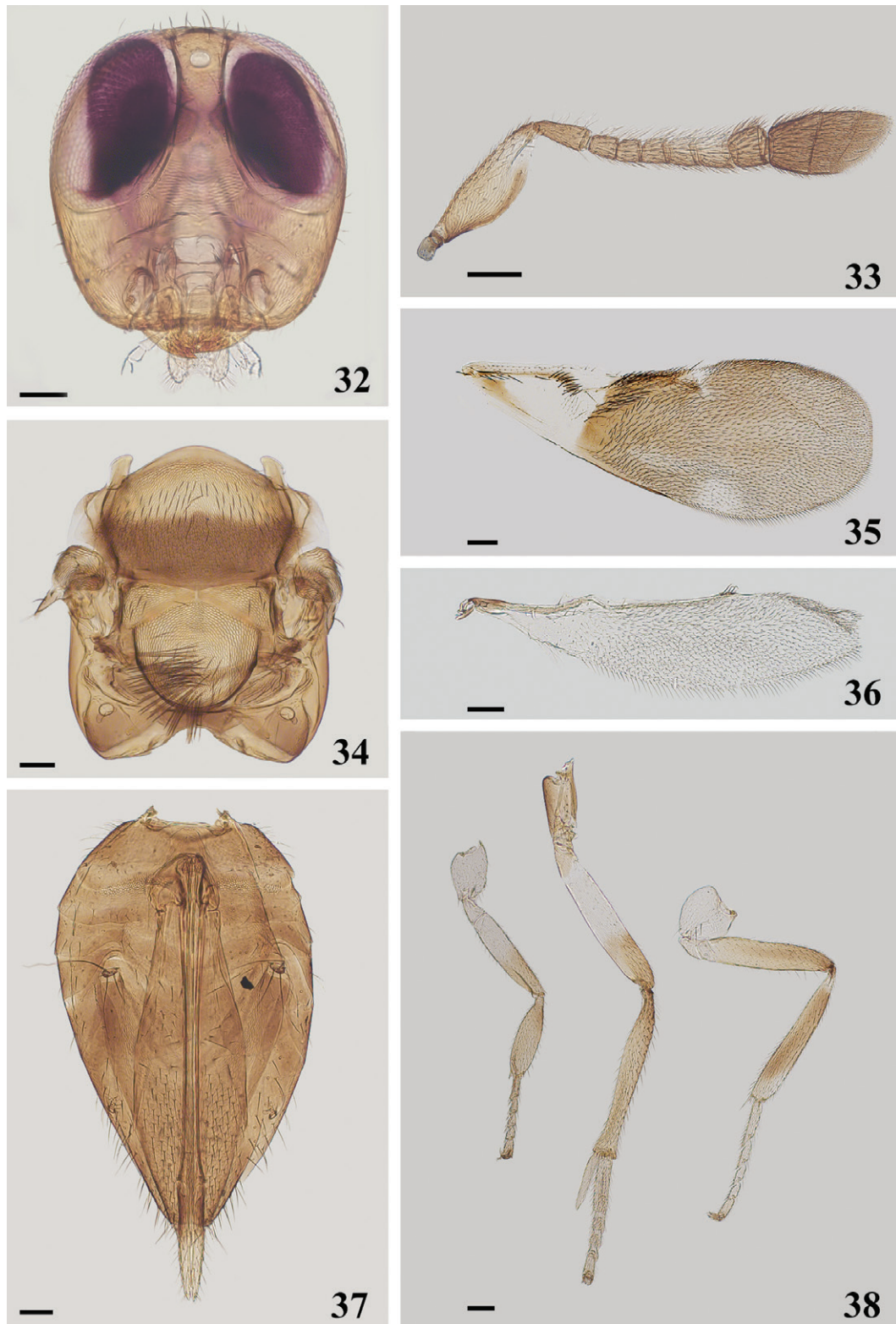
Chiloneurus graeffei Ruschka 1923: 9–10. Holotype ♀, Austria. Synonymized with *C. claviger* by Claridge (1958: 156–161).

Cheiloneurus claviger Shi 1994: 27–28; Xu and Huang 2003: 104–106, examined plates.



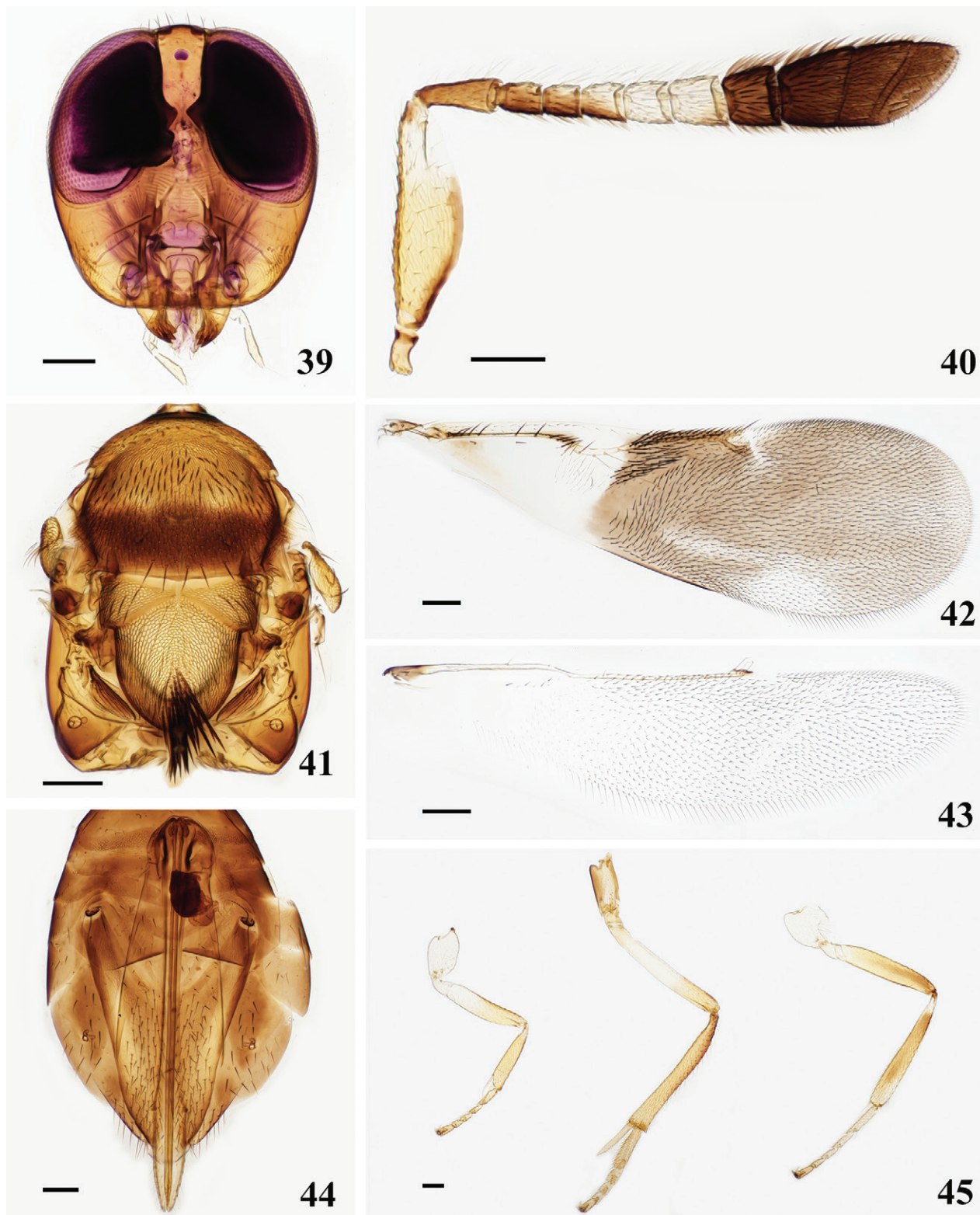
Figures 23–31. 23–25 *Cheiloneurus chinensis* ♀ 23 dorsal habitus 24 lateral habitus 25 ventral habitus 26–31 *Cheiloneurus claviger* ♀ 26 dorsal habitus (Oriental) 27 lateral habitus (Oriental) 28 ventral habitus (Oriental) 29 dorsal habitus (Palaearctic) 30 lateral habitus (Palaearctic) 31 ventral habitus (Palaearctic).

Material examined. CHINA – Liaoning • 1♀; Huludao, Jianchang, Bailong Mountain National Nature Reserve; 40°49'28"N, 119°50'14"E; 716 m elev.; 13 Jul. 2012; Guo-Hao Zu, Ye Chen, Chao Zhang leg.; by yellow pan trapping; TJAU-LN-CHE-001 – Hainan • 1♀; Lingshui Li Autonomous County Diaoluo Mountain; 18°39'35"N, 109°54'57"E; 1499 m elev.; 06 May 2016; Guo-Hao Zu leg.;



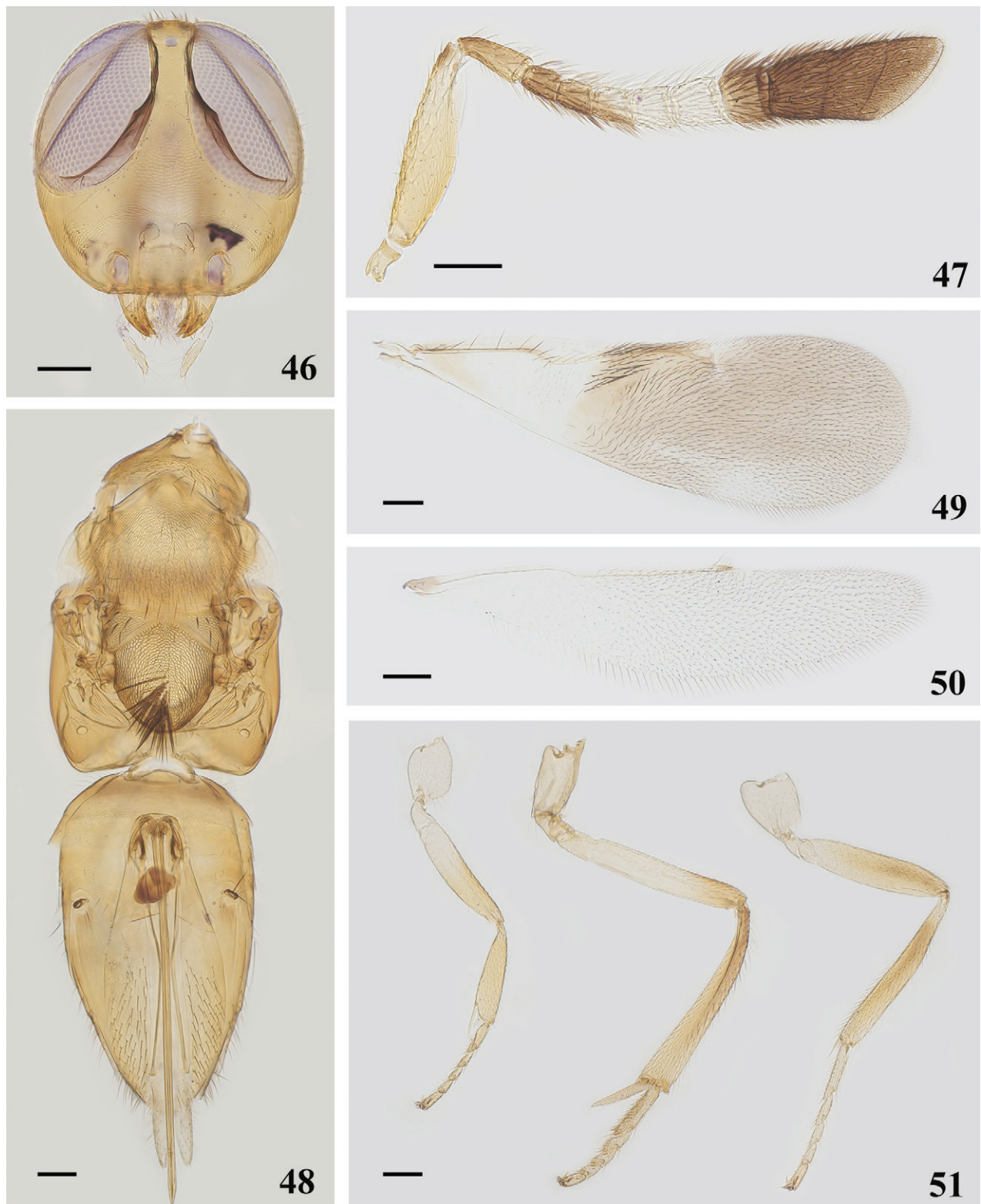
Figures 32–38. *Cheiloneurus chinensis* ♀ 32 head 33 antenna 34 mesosoma 35 fore wing 36 hind wing 37 metasoma 38 legs. Scale bars: 100 µm.

by yellow pan trapping; TJAU-HN-CHE-001 – Beijing • 4♀; Huairou; 40°18'59"N, 116°37'55"E; 58 m elev.; 20–30 May 2012; Guo-Hao Zu leg.; by Malaise trapping; TJAU-BJ-CHE-001 to 004 – Shandong • 1♀; Qingdao, Cha Mountain National Nature Reserve; 26°52'18"N, 119°51'1"E; 560 m elev.; 13 Jul. 2012;



Figures 39–45. *Cheiloneurus claviger* (Palearctic) ♀ 39 head 40 antenna 41 mesosoma 42 fore wing 43 hind wing 44 metasoma 45 legs. Scale bars: 100 µm.

Guo-Hao Zu leg.; by sweep netting; TJAU-SD-CHE-001 – Henan • 3♀; Gongyi, Luzhuang; 34°37'1"N, 112°52'18"E; 213 m elev.; 07 Mar. 2016; Guo-Hao Zu, Nai-Zhi Li, Jian-Wei Zu leg.; by yellow pan trapping; TJAU-HN-CHE-004 – Tianjin • 3♀; Zhangjiawo, Tianjin Academic Agriculture Sciences; 39°6'14"N, 117°3'32"E;



Figures 46–51. *Cheiloneurus claviger* (Oriental) ♀ **46** head **47** antenna **48** mesosoma and metasoma **49** fore wing **50** hind wing **51** legs. Scale bars: 100 µm.

13 m elev.; 29 Oct.–02 Nov. 2021; Guo-Hao Zu, Peng-Hua Bai leg.; by Malaise trapping; TJAU-TJ-CHE-002 to 004.

Diagnosis. Female. Length, excluding ovipositor, 1.75–2.42 mm; Head (Fig. 46) brown, antenna dark brown (Fig. 47), except for F3–F5 almost completely

white; mandible with three acute teeth; fore wing (Fig. 49) with apical two-thirds dark brown, the basal one-third and the hind wing hyaline; F1–F3 longer than width, F4 subquadrate, F5–F6 2.50× as wide as long.

Description. See Xu and Huang (2004).

Host. Aphelinidae: *Coccophagus aterrimus*; Encyrtidae: *Blastothrix hungarica*, *Blastothrix longipennis*, *Blastothrix scenographica*, *Blastothrix turanica*, *Metaphycus insidiosus*, *Microterys* sp., *Microterys cuprinus*, *Microterys intermedius*, *Microterys praedator*, *Microterys sylvius*; Coccidae: *Acanthopulvinaria orientalis*, *Ceroplastes ceriferus*, *Ceroplastes japonicus*, *Chloropulvinaria aurantia*, *Coccus hesperidum*, *Didesmococcus unifasciatus*, *Ericerus pela*, *Eulecanium ciliatum*, *Eulecanium corni*, *Eulecanium giganteum*, *Eulecanium ku-noense*, *Eulecanium kuwanai*, *Eulecanium quercifex*, *Eulecanium rugulosum*, *Eulecanium tiliae*, *Filippia folicularis*, *Filippia viburni*, *Parthenolecanium corni*, *Parthenolecanium persicae*, *Parthenolecanium quercifex*, *Parthenolecanium rufulum*, *Physokermes fasciatus*, *Physokermes hemicryphus*, *Pulvinaria* sp., *Pulvinaria aurantia*, *Pulvinaria betulae*, *Pulvinaria idesiae*, *Pulvinaria populi*, *Pulvinaria vitis*, *Rhizopulvinaria* sp., *Rhodococcus spiraeae*, *Rhodococcus turanicus*, *Saissetia oleae*, *Sphaerolecanium prunastri*, *Stotzia maxima*, *Takahashia japonica*; Eriococcidae: *Eriococcus brachypodii*, *Greenisca brachypodii*, *Neocanthococcus tamaricicola*; Kermesidae: *Kermes miyasakii*, *Kermes vermilio*; Pseudococcidae: *Maconellicoccus hirsutus*, *Nesticoccus sinensis*, *Nipaecoccus filamentosus*, *Phenacoccus aceris*, *Phenacoccus mespili*, *Planococcus citri* (Noyes 2019).

Distribution. China (Liaoning, Hebei, Henan, Shaanxi, Zhejiang, Jiangxi, Hunan, Sichuan, Guangxi), Armenia, Austria, Azerbaijan, Bulgaria, Croatia, Czech Republic, Egypt, France, Georgia, Greece, Hungary, Iran, Israel, Italy, Japan, Kazakhstan, Moldova, Montenegro, Netherlands, Norway, Romania, Russia, Serbia, Slovakia, Spain, Sweden, Tadzhikistan, Turkey, Turkmenistan, Ukraine, England, Uzbekistan.

***Cheiloneurus elegans* (Dalman, 1820)**

Figs 52–57, 61–72

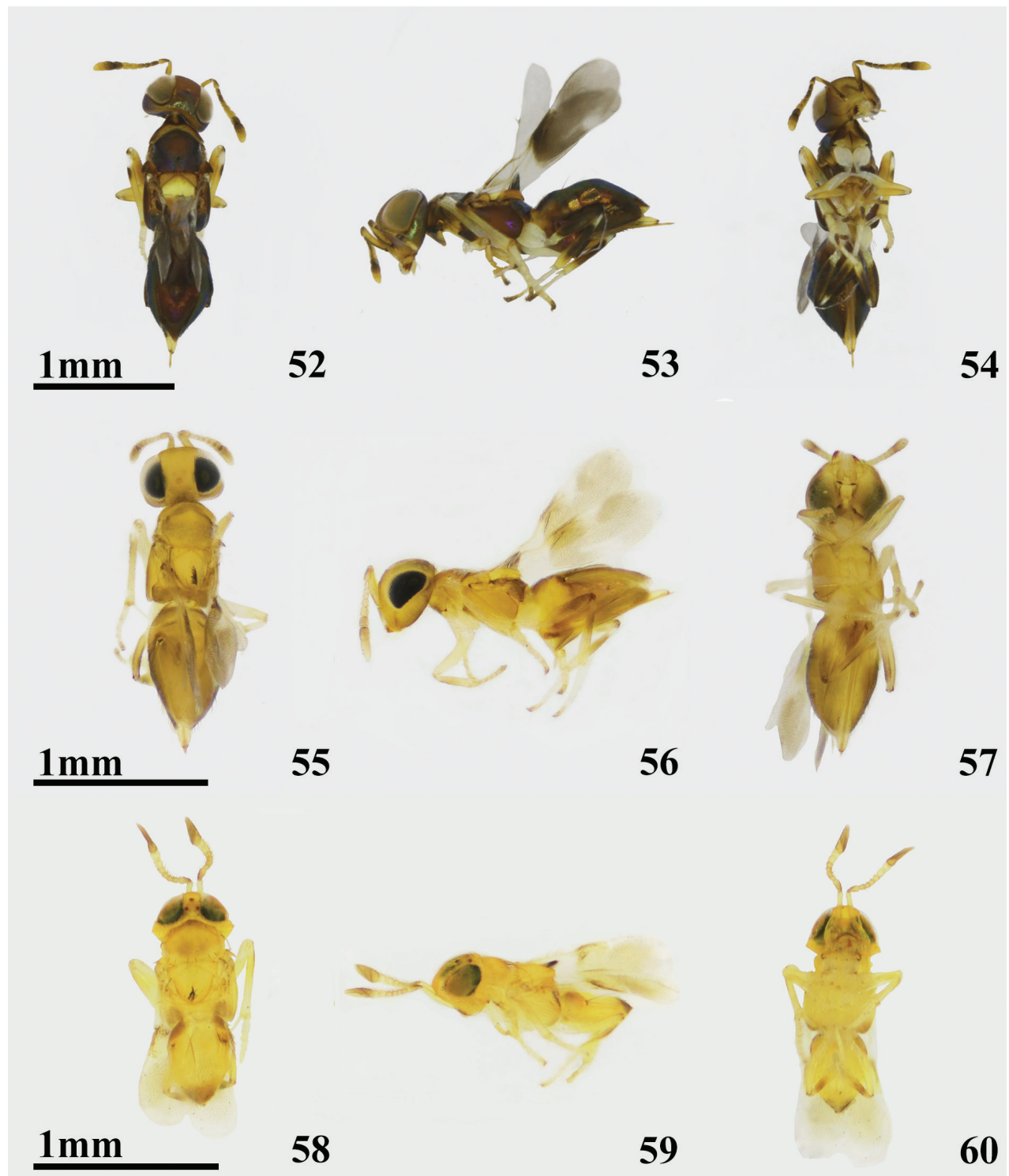
Encyrtus elegans Dalman 1820: 151–152. Syntypes, NHRM, Sweden, lost.

Cheiloneurus elegans (Dalman); Westwood 1833: 343.

Cheiloneurus elegantissimus De Santis 1964: 343–345. Holotype ♀, MLP, Argentina, digital image examined, as subspecies of *C. elegans* (Dalman). Synonymized with *C. elegans* by Noyes (2023: 372–374).

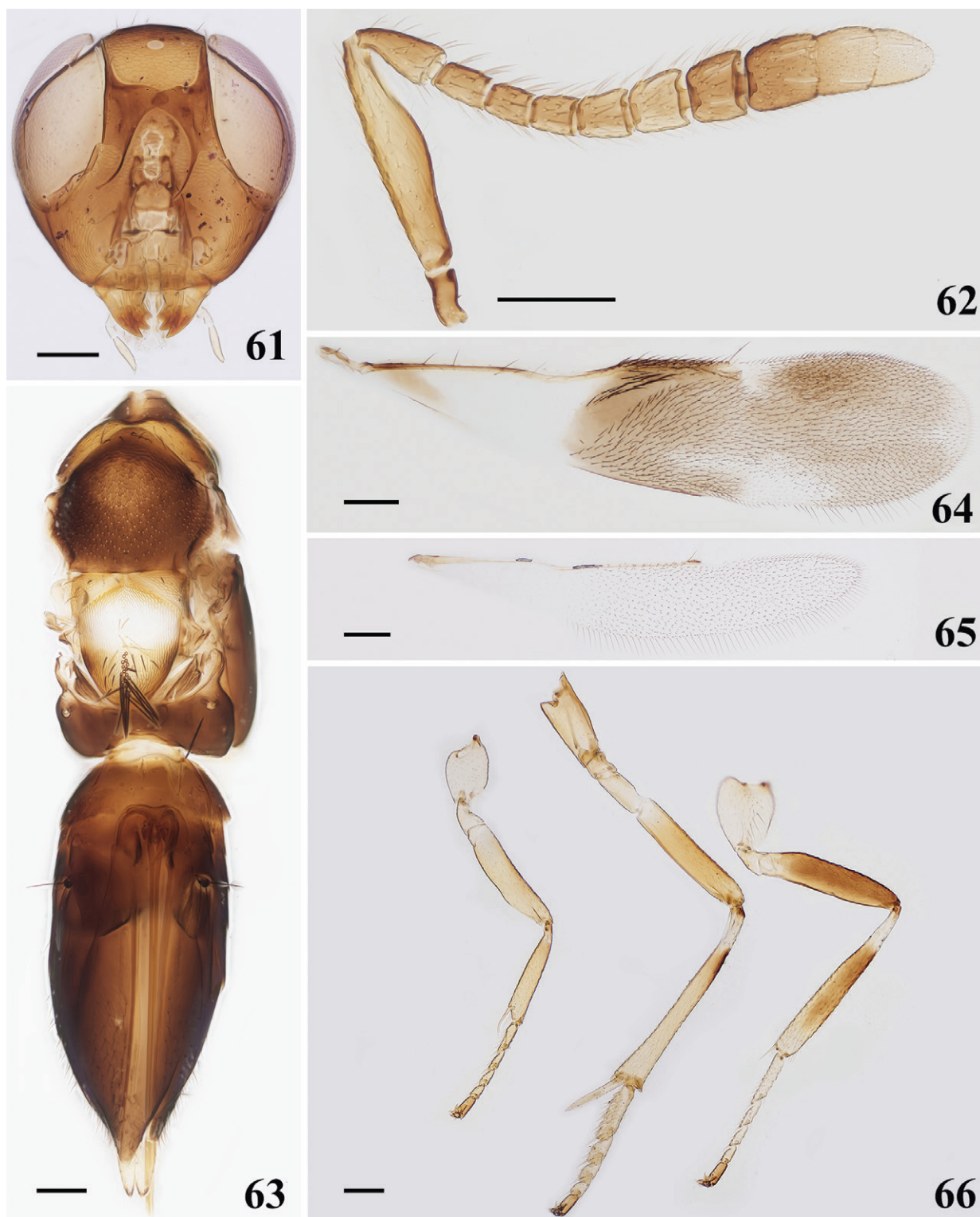
Material examined. CHINA – Guangxi • 26♀; Qinzhou, Beibu Gulf University; 21°53'53"N, 108°36'56"E; 24 m elev.; 09–22 Jun. 2019; Wen-Quan Zhen leg.; by Malaise trapping; TJAU-GX-CHE-027 to 052 – Yunnan • 1♀; Chuxiong Yi Autonomous Prefecture; 25°1'58"N, 101°32'45"E; 1773 m elev.; 15–31 Oct. 2020; Jia-Le Lv leg.; by Malaise trapping; TJAU-YN-CHE-003 – Tianjin • 20♀; Xiqing, Tianjin Agricultural University; 39°5'21"N, 117°5'38"E; 13 m elev.; 14–31 Jul. 2021; Guo-Hao Zu, Ze-Ning Yang leg.; by Malaise trapping; TJAU-TJ-CHE-005 to 024.

Description. Female. Length, excluding ovipositor, 1.30–1.89 mm. Head (Figs 61, 67) yellowish brown to brown, mandible with three acute teeth. Antenna (Figs



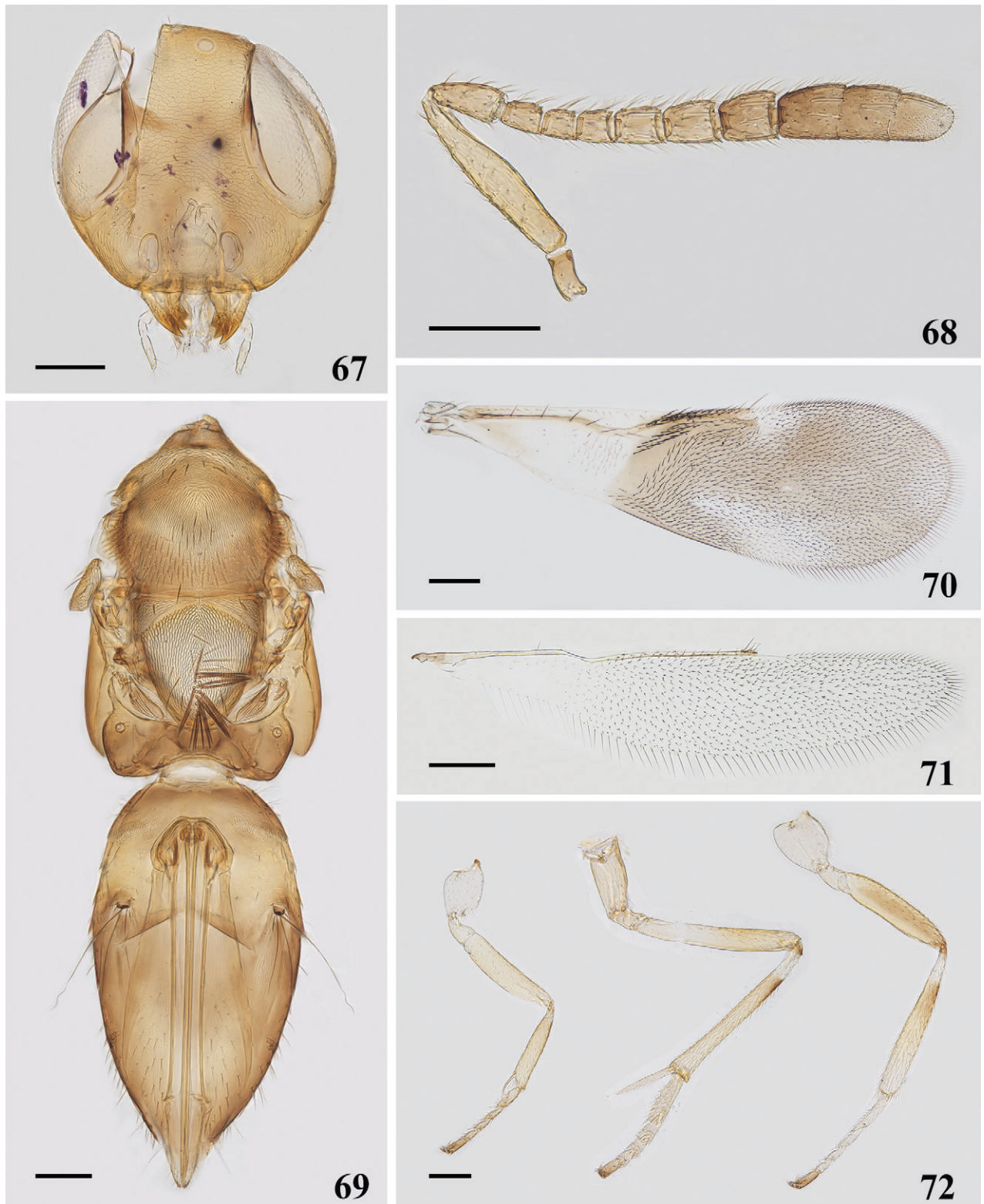
Figures 52–60. *Cheiloneurus elegans* ♀ 52 dorsal habitus (Palearctic) 53 lateral habitus (Palearctic) 54 ventral habitus (Palearctic) 55 dorsal habitus (Oriental) 56 lateral habitus (Oriental) 57 ventral habitus (Oriental) 58–60 *Cheiloneurus gonatopodis* ♀ 58 dorsal habitus 59 lateral habitus 60 ventral habitus.

62, 68) brown to yellow, apex of clava relatively shallow. Mesosoma (Figs 63, 69) yellowish brown, apical half of mesoscutum brown, scutellum yellowish white; fore wing (Figs 64, 70) with apical two-thirds dark brown, basal third and hind wing hyaline (Figs 65, 71); leg yellow (Figs 66, 72), fore coxa, basal half of mid femora, basal third of mid tibial, hind coxa, and basal third of hind tibia white; frontover-



Figures 61–66. *Cheiloneurus elegans* (Palearctic) ♀ 61 head 62 antenna 63 mesosoma and metasoma 64 fore wing 65 hind wing 66 legs. Scale bars: 100 μm.

tex 0.26–0.33× head width; eye height 1.67–2.38× malar space; antennal scape 4.75–5× as long as wide; pedicel 2.09–2.27× as long as wide and longer than F1, funicle 6-segmented, clava 3-segmented, 2.72–2.96× as long as width, longer than F4–F6 combined; fore wing 2.94–4.09× as long as wide; lineula calva not interrupted and open posteriorly; ovipositor 1.51–1.63× as long as mid tibia, slightly exserted.



Figures 67–72. *Cheiloneurus elegans* (Oriental) ♀ **67** head **68** antenna **69** mesosoma and metasoma **70** fore wing **71** hind wing **72** legs. Scale bars: 100 µm.

Variation. There is significant variation in body color, size of F5–F6, and fore wings between specimens collected in the Palaearctic and in the Oriental realms. The specimens from the Palaearctic have a darker body, F5–F6 are longer than wide (Fig. 33), and the fore wing is 4.09× as long as wide, while Ori-

ental specimens have a relatively lighter body color, F5–F6 are wider than long (Fig. 34), and the fore wing is 2.94× as long as wide.

Host. Encyrtidae: *Epidinocarsis lopezi*; Platygasteridae: *Platygaster zosine*; Cecidomyiidae: *Mayetiola destructor*, *Phytophaga destructor*; Acleridae: *Aclerda subterranean*; Coccidae: *Anapulvinaria pistaciae*, *Eulecanium franconicum*, *Physokermes piceae*, *Pulvinaria vitis*, Kermesidae: *Kermes* sp.; Pseudococcidae: *Antonina purpurea*, *Phenacoccus hordei*, *Phenacoccus manihoti*, *Trionymus aberrans* (Noyes 2019).

Distribution. China (Tianjin, Guangxi, Yunnan), America, Argentina, Armenia, Austria, Azerbaijan, Bulgaria, Canada, Croatia, Denmark, England, Finland, France, Georgia, Germany, Hungary, India, Israel, Italy, Kazakhstan, Lithuania, North Macedonia, Mexico, Moldova, Mongolia, Netherlands, Nigeria, Romania, Russia, Saudi Arabia, Serbia, Spain, Sweden, Switzerland, Tadzhikistan, Transcaucasus, Turkey, Turkmenistan, Ukraine, Uzbekistan.

***Cheiloneurus exitiosus* (Perkins, 1906)**

Echthrogonatopus exitiosus Perkins, in Perkins et al. 1906: 256. Holotype ♀, BPBM, Australia, not examined.

Metapterencyrtus nigricornis Hayat 1980: 644. Holotype ♀, ZDANU, India. Synonymized with *exitiosus* by Guerrieri and Viggiani (2005: 305–317).

Echthrogonatopus nigricornis (Hayat); Hayat 1981: 20; Xu and He 2003: 527, examined plates.

Cheiloneurus exitiosus (Perkins); Guerrieri and Viggiani 2005: 305.

Diagnosis. Body dark brown, antennae dark, mesoscutum and axilla with metallic-green luster, scutellum without a tuft of bristles at apex, leg yellowish white, mid coxa dark basally.

Description. See Xu and He (2003).

Host. Bethyridae: *Goniozus* sp.; Dryinidae: *Dryinidae unspecified* sp., *Gonatopus* sp., *Haplogonatopus* sp., *Haplogonatopus vitiensis*, *Pseudogonatopus flavifemur*, *Pseudogonatopus hospes*, *Pseudogonatopus perkinsi*; Delphacidae: *Megamelus proserpina*, *Nilaparvata lugens*, *Sogata* sp., *Sogata furcifera*, *Sogatella furcifera*, Pyralidae: *Cnaphalocrocis medinalis*, *Marasmia exigua* (Guerrieri and Viggiani 2005).

Distribution. China (Fujian, Zhejiang, Jiangxi, Guangxi), American, Australia, Fiji, Guam, India, Malaysia, Philippines.

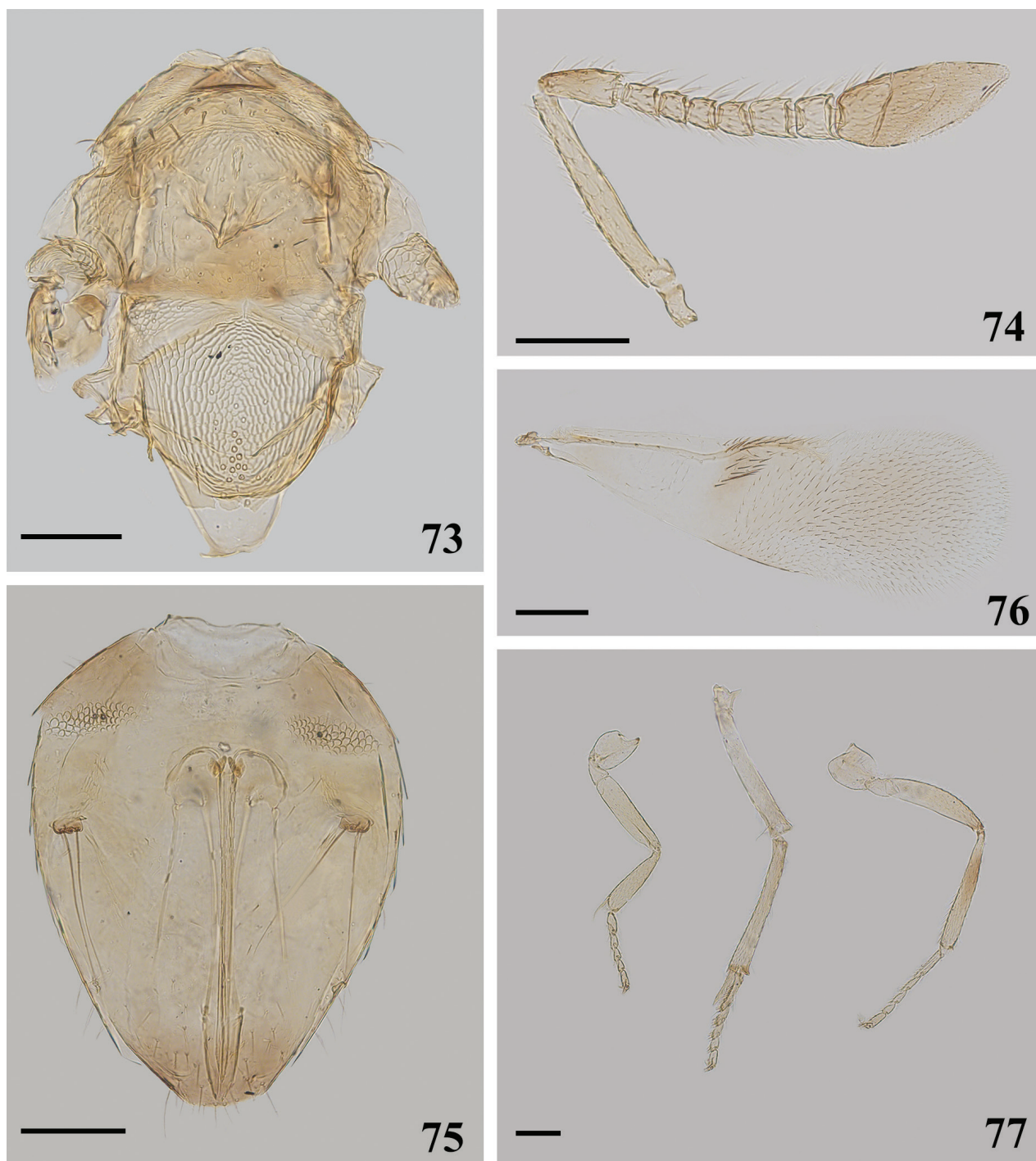
***Cheiloneurus gonatopodis* Perkins, 1906**

Figs 58–60, 73–77

Cheiloneurus gonatopodis Perkins, in Perkins et al. 1906: 261. Lectotype ♀ designated by Noyes 1988: 63: Australia, Queensland, Childers (BPBM).

Cheiloneurus gonatopodis Perkins; Anis and Hayat 2002: 152; Guerrieri and Viggiani 2005: 310.

Material examined. CHINA – Hainan • 1♀; Lingshui Li Autonomous County, Diaoluo Mountain; 18°39'35"N, 109°54'57"E; 1499 m elev.; 15 May 2016; Guo-Hao Zu leg.; by yellow pan trapping; TJAU-HN-CHE-005.



Figures 73–77. *Cheiloneurus gonatopodis* ♀ 73 mesosoma 74 antenna 75 metasoma 76 fore wing 77 legs. Scale bars: 100 μ m.

Description. Female. Length, excluding ovipositor, 1.16 mm. Head yellow, frontovertex brown. Antenna yellowish brown, scape yellow. Mesosoma yellowish brown, leg yellowish white, basal half of hind tibial white. Metasoma mostly yellow, but basally and apically brown, frontovertex 0.21 $\times$ head width; eye height 1.62 $\times$ malar space; antennal (Fig. 74) scape 6.38 $\times$ as long as wide; pedicel 2.23 $\times$ as long as wide and longer than F1–F2 combined, funicle 6-segmented, clava 3-segmented, 2.6 $\times$ as long as width, shorter than F2–F6 combined; fore wing (Fig. 76) 2.96 $\times$ as long as wide; linea calva not interrupted and

open posteriorly; mid tibial spur (Fig. 77) $0.31\times$ as long as mid tibia and shorter than basitarsus, ovipositor (Fig. 75) as long as mid tibia, not exerted.

Host. Dryinidae: *Echthrodelpax* sp., *Pseudogonatopoides mauritanus*, *Pseudogonatopus* sp., *Pseudogonatopus mauritanus*, *Richardsidryinus* sp.; Delphacidae: *Dicranotropis muiri*, *Nilaparvata myersi*, *Perkinsiella saccharicida* (Guerrieri and Viggiani 2005).

Distribution. China (Hainan), Afrotropical, Australia, India, Madagascar, Mauritius, New Zealand.

Comments. This is the first record from China.

***Cheiloneurus guangxiensis* Zu, sp. nov.**

<https://zoobank.org/BDEFCE90-E941-4AC9-B6A6-EA4C172B2EA4>

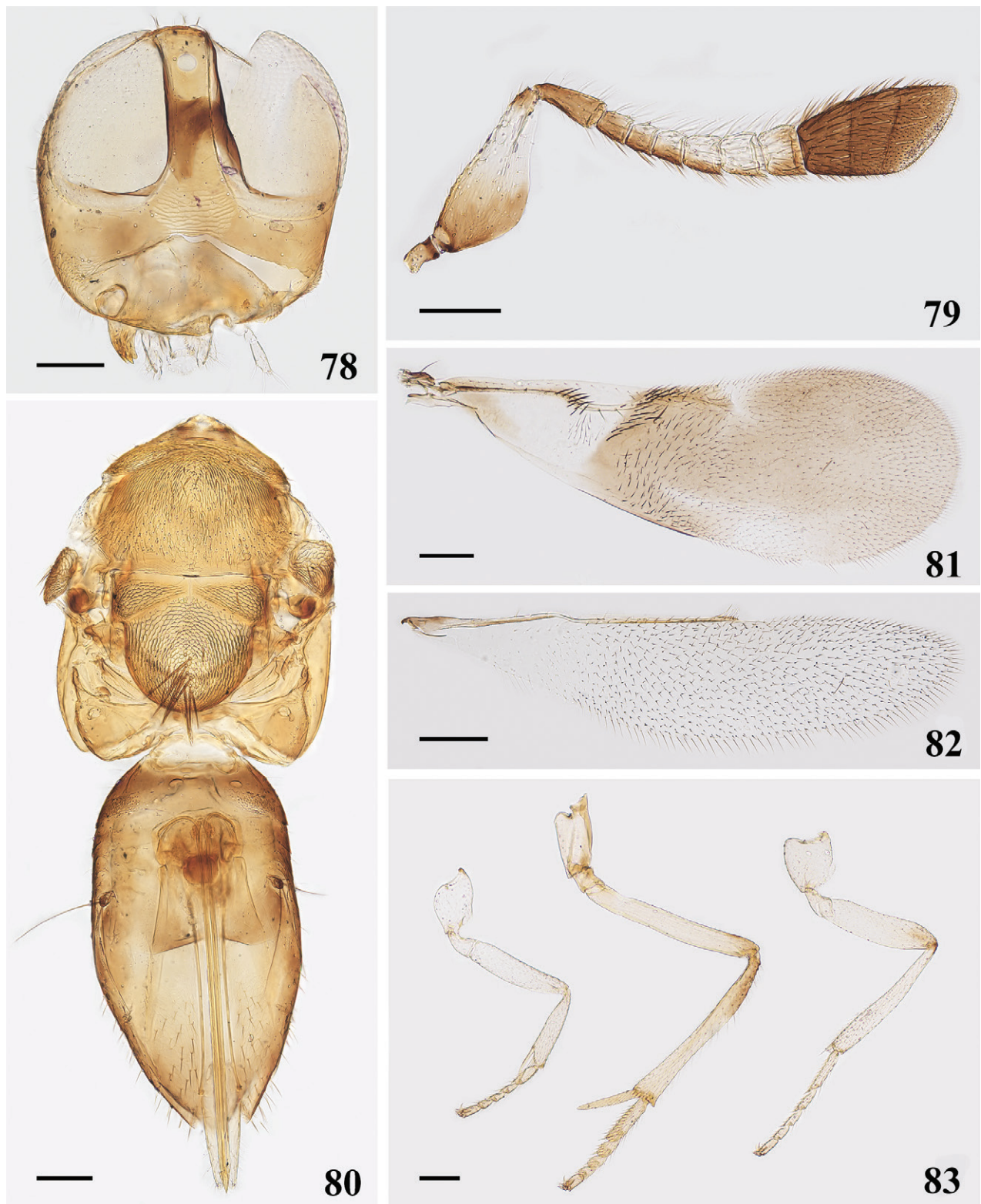
Figs 78–83

Type material. Holotype. ♀, [on slide]; CHINA – Guangxi, Qinzhou, Beibu Gulf University; $21^{\circ}53'53''\text{N}$, $108^{\circ}36'56''\text{E}$; 24 m elev.; 14–24 Dec. 2019; Wen-Quan Zhen leg.; by Malaise trapping; TJAU-GX-CHE-053. **Paratype.** 1♀; same date as holotype; TJAU-GX-CHE-054.

Description. Female. Holotype. Length, 1.51 mm (excluding ovipositor). Head with yellow to yellowish brown and metallic-green luster, basal half of antennal scape brown, apical half white, and dorsal margin brown; pedicel brown; F1 brown with dorsal margin white, F2–F4 lower margin brown and dorsal margin white, F5 lower margin slightly brown and dorsal margin white, F6 white and small part of lower margin brown; clava dark brown. Mesosoma yellow; leg white, nearly transparent, basal third of mid tibia and apical fifth of hind femora brown. Metasoma dark brown, with metallic-blue luster, but slightly yellowish brown in middle and lower part.

Head (Fig. 78) in frontal view, length equal to width, frontovertex $0.14\times$ head width; ocelli forming an angle of 40° , OCL about $1.67\times$ diameter of posterior ocellus, OOL about $0.10\times$ the diameter of posterior ocellus; antennal torulus with its dorsal margin well above lower margin of eye; eye length about $1.77\times$ as long as malar space. Antennal (Fig. 79) scape flattened and expanded, about $2.37\times$ as long as width, pedicel about $2.26\times$ as long as wide, funicle 6-segmented, F1 longer than width, F2–F3 subquadrate, F4–F6 wider than long, clava 3-segmented, $1.98\times$ as long as wide, longer than F3–F6 combined, funicle with linear sensillae on F3–F6. Mandible with three acute teeth. Measurements (μm): HH, 460; HW, 460; FV, 63; OD, 30; POL, 23; OOL, 3; OCL, 50; AOL, 43; EL, 270; MS, 153; length (and width): radicle, 45; scape, 225 (95); pedicel, 88 (39); F1, 38 (35); F2, 35 (35); F3, 38 (38); F4, 45 (48); F5, 48 (55); F6, 46 (63); clava, 206 (103).

Mesosoma (Fig. 80). Mesoscutum densely setose; mesoscutum and scutellum with finely reticulate sculpture, mesoscutum $0.60\times$ as long as wide, scutellum $0.90\times$ as long as wide and with a tuft of bristles at apex. Fore wing (Fig. 81) $2.70\times$ as long as wide, apical half of submarginal vein strongly curved, marginal vein longer than width, and $4.91\times$ as long as postmarginal vein, linea calva not interrupted and open posteriorly, hind wing (Fig. 82) $4.32\times$ as long as width. Mid tibial spur (Fig. 83) $0.35\times$ as long as mid tibia and longer than basitarsus. Measurements (μm): FWL, 960; FWW, 355; submarginal vein, 350; MV, 113; PMV, 23; SV, 45; HWL, 800; HWW, 185; MT, 450; mid tibial spur, 163; mid basitarsus, 140.



Figures 78–83. *Cheiloneurus guangxiensis* sp. nov. ♀ holotype **78** head **79** antenna **80** mesosoma and metasoma **81** fore wing **82** hind wing **83** legs. Scale bars: 100 µm.

Metasoma (Fig. 80) slightly longer than mesosoma, ovipositor 1.51× as long as mid tibia, distinctly exserted. Measurements (µm): OL, 680. [MT, 450].

Male. Unknown.

Host. Unknown.

Etymology. The specific name refers to the province where the type locality is located.

Diagnosis. The new species is similar to *C. chinensis* Shi, Wang, Si & Wang, 1994 but differs from *C. chinensis* as follows: frontovertex 0.14× head width (0.20× in *chinensis*); scape flattened and expanded, about 2.37× as long as wide (scape 3× as long as wide in *chinensis*); F6 white and small part of the lower margin brown (F6 black in *chinensis*); clava longer than F3–F6 combined (nearly equal length F3–F6 combined in *chinensis*); legs off white nearly transparent, mid tibia basal one-third and hind femora apical one-fifth brown (legs brownish yellow except fore tibia; apical third of mid femora, outer margin of hind femora and tibia brown in *chinensis*).

***Cheiloneurus hadrodorys* Anis & Hayat, 2002**

Figs 84–86, 93–98

Cheiloneurus hadrodorys Anis and Hayat 2002: 138, 173–175. Holotype ♀, BMNH, Nepal.

Material examined. CHINA – Guangxi • 6♀; Qinzhou, Beibu Gulf University; 21°53'53"N, 108°36'56"E; 24 m elev.; 11–18 May 2019, 04–13 Jan. 2020; Wen-Quan Zhen leg.; by Malaise trapping; TJAU-GX-CHE-055 to 060 – Yunnan • 1♀; Chuxiong Yi Autonomous Prefecture; 25°1'58"N, 101°32'45"E; 1773 m elev.; 01–15 Jun. 2022; Jia-Le Lv; by Malaise trapping; TJAU-YN-CHE-004.

Description. Female. Length, excluding ovipositor, 1.67–1.89 mm. Body generally brown; gena with metallic-green luster, frontovertex dark brown, mandible with three acute teeth. Antennal radicle brown, scape yellow, and inner margin brown, pedicel and F1–F3 with brown, F4 yellowish white, F5 brown, F6 and clava with dark brown. Pronotum mostly brown, but left and right margin with yellow; mesoscutum dark brown; axilla, scutellum and mesopleuron yellow, propodeum yellow, left and right margin dark brown with metallic-green luster. Leg yellowish white, except apical half of hind femora dark brown. Metasoma mostly brown to dark brown and basal quarter yellow; frontovertex (Fig. 93) 0.24–0.27× head width; eye height 2.13–2.5× malar space; antennal (Fig. 94) scape 5–5.48× as long as wide; pedicel 2.07× as long as wide and longer than F1, funicle 6-segmented, with F1–F6 widening gradually, clava 3-segmented, 2.25–2.25× as long as wide, longer than F4–F6 combined; fore wing (Fig. 96) 3.47–3.71× as long as wide; linea calva closed posteriorly by several lines of setae; mid tibial spur (Fig. 98) 0.36–0.38× as long as mid tibia and longer than basitarsus, ovipositor (Fig. 95) 1.86–2.07× as long as mid tibia, strongly exerted.

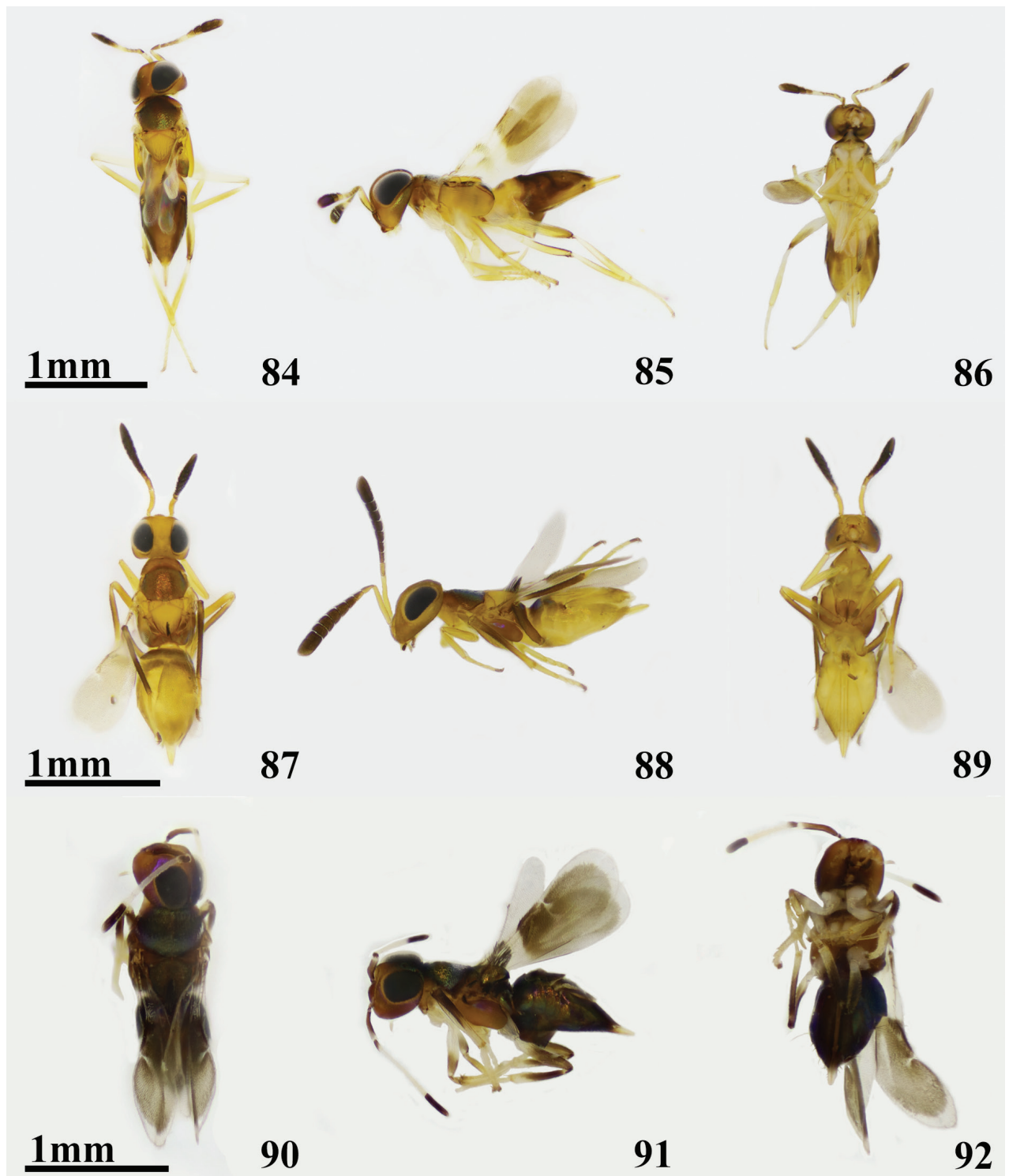
Host. Pseudococcidae: *Saccharicoccus sacchari* (Anis and Hayat 2002).

Distribution. China (Yunnan, Guangxi), India, Nepal, Pakistan, Sri Lanka.

Comments. This is the first record from China.

***Cheiloneurus lateocaudatus* (Xu & He, 2003)**

Echthrogonatopus lateocaudatus Xu and He 2003: 527. Holotype ♀. ZAUC, China, examined plates.



Figures 84–92. 84–86 *Cheiloneurus hadrodorys* ♀ 84 dorsal habitus 85 lateral habitus 86 ventral habitus 87–89 *Cheiloneurus nankingensis* ♀ 87 dorsal habitus 88 lateral habitus 89 ventral habitus 90–92 *Cheiloneurus quercus* ♀ 90 dorsal habitus 91 lateral habitus 92 ventral habitus.

Diagnosis. Body dark, head with dark metallic-blue luster; antennal dark brown dark; scutellum without a tuft of bristles at apex; fore wing hyaline; leg yellowish white but base of mid coxa dark; F1 1.1× as long as wide; F2 and F5 subquadrate; F3–F4 and F6 wider than long; clava slightly shorter than F1–F6 combined.

Description. See Xu and He (2003).

Host. Dryinidae: *Haplogonatopus apicalis*, *Haplogonatopus oratorius* (Xu and He 2003).

Distribution. China (Anhui, Fujian, Guangdong, Guangxi, Guizhou, Hubei, Hunan, Jiangsu, Jiangxi, Shanghai, Sichun, Yunnan, Zhejiang).

***Cheiloneurus nankingensis* Li & Xu, 2020**

Figs 87–89, 99–106

Cheiloneurus nankingensis Li and Xu 2020: 23. Holotype ♀, ZAFU, China; digital image examined.

Material examined. CHINA – Guangxi • 6♀; Qinzhou, Beibu Gulf University; 21°53'53"N, 108°36'56"E; 24 m elev.; 02–17 Nov. 2019, 01–29 Dec. 2019; Wen-Quan Zhen leg.; by Malaise trapping; TJAU-GX-CHE-061 to 066 – Jiangxi • 6♀, 2♂; Jiujiang, De'an; 29°16'6"N, 115°22'38"E; 64 m elev.; 17–19 Aug. 2020, 06–07 Sep. 2020; Yan-Yan Qiao leg.; ex. *Aenasius arizonensis* on *Phenacoccus solenopsis*; TJAU-JX-CHE-001 to 008 – Jiangsu • 2♂; Nanjing, Nanjing Agricultural University; 32°01'10"N, 118°51'21"E; 18 m elev.; 01–31 Oct. 2019; Zhuo-Miao Li leg.; ex. *Aenasius arizonensis* on *Phenacoccus solenopsis*; TJAU-JS-CHE-001 to 002.

Diagnosis. Female. Length, excluding ovipositor, 1.54–1.75 mm; head (Fig. 99) dark brown, with purple sheen; antennal (Fig. 100) scape and pedicel yellowish brown; funicle and clava dark; fore and mid legs yellowish brown, except middle part of mid tibia brown; hind femur and tibia brown, except tibial base white.

Description. See Li et al. (2020).

Host. Encyrtidae: *Aenasius arizonensis*; Pseudococcidae: *Phenacoccus solenopsis* (Li et al. 2020).

Distribution. China (Jiangsu, Jiangxi, Guangxi).

Comments. This species is very similar to *C. compressicommis* (Ashmead, 1894). After comparing with the original description and the text description and figures by Noyes (2023), it was found that *C. nankingensis* is only slightly different from *C. compressicommis* in the color of the male forewing. For this reason, we examined the paratype specimens from Nanjing and the specimens collected from Jiangxi, and reconfirmed the above differences. Therefore, we maintain the same view as Noyes, and the species is still designated as *C. nankingensis* here.

***Cheiloneurus quercus* Mayr, 1876**

Figs 90–92, 107–113

Cheiloneurus quercus Mayr 1876: 744, 746, Austria, not examined.

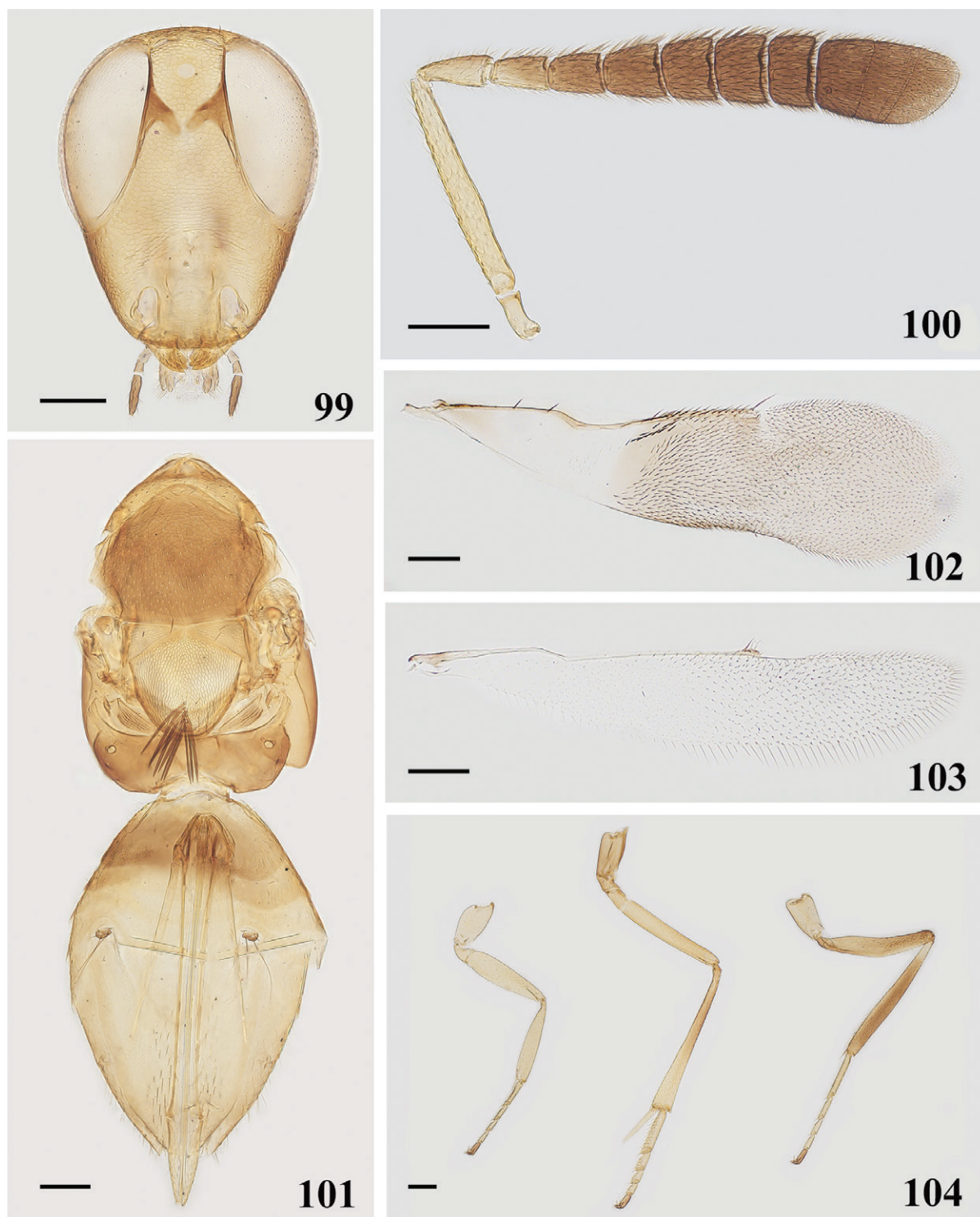
Cheiloneurus tenuicornis Ishii 1928: 147–148. Lectotype ♀, NIES, Japan. Synonymized with *C. quercus* by Trjapitzin (1989: 305).

Cheiloneurus quercus Japoshvili et al. 2016: 368.



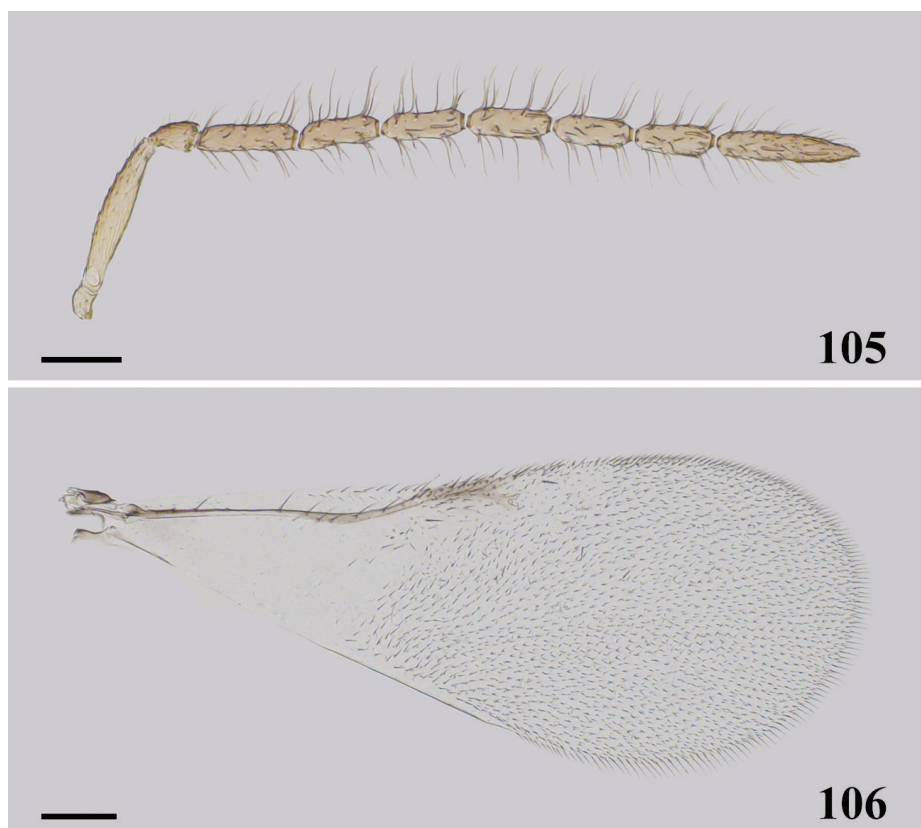
Figures 93–98. *Cheiloneurus hadrodorys* ♀ 93 head 94 antenna 95 mesosoma and metasoma 96 fore wing 97 hind wing 98 legs. Scale bars: 100 µm.

Material examined. CHINA – Henan • 1♀; Gongyi, Luzhuang; 34°37'1"N, 112°52'18"E; 213 m elev.; 07 May 2016; Guo-Hao Zu, Nai-Zhi Li, Jian-Wei Zu leg.; by yellow pan trapping; TJAU-HN-CHE-006 – Tianjin • 1♀; Jixian, Baxian Mountain National Nature Reserve; 40°11'58"N, 117°33'52"E; 1052 m elev.; 01 Oct. 2023; Ke-Long Jiao leg.; by sweep netting; TJAU-TJ-CHE-025.



Figures 99–104. *Cheiloneurus nankingensis* ♀ **99** head **100** antenna **101** mesosoma and metasoma **102** fore wing **103** hind wing **104** legs. Scale bars: 100 µm.

Diagnosis. Female. Length, excluding ovipositor, 1.71–2.0 mm; antennal scape brown, apex white, dorsal margin of pedicel brown, ventral margin of pedicel and all funiculars white, clava dark; mandible with one tooth and a broadly truncate upper tooth; legs pale; all femora apically light brown; basal half of all tibia light brown; metasoma forming a long triangle, slightly shorter and narrower than mesosoma; ovipositor slightly exerted.



Figures 105, 106. *Cheiloneurus nankingensis* ♂ **105** antenna **106** fore wing. Scale bars: 100 μ m.

Description. See Ma (2004).

Host. Coccidae: *Eulecanium* sp., *Pulvinaria vitis*, Kermesidae: *Kermes miasakii*, *Kermes nakagawae*, *Kermes quercus*, *Kermococcus* sp., *Kermococcus miasakii*, *Kermococcus nakagawae*, Pseudococcidae: *Coccura ussuriensis*, *Phenacoccus polyphagus* (Noyes 2019).

Distribution. China (Liaoning, Tianjin, Henan, Shaanxi, Shandong), Austria, Czech Republic, Hungary, Italy, Japan, Russia, Turkey.

***Cheiloneurus sinensis* Özdikmen, 2011**

Cheiloneurus phenacocci Shi, in Shi et al. 1994: 25. Holotype ♀, HAUZ, China; not examined.

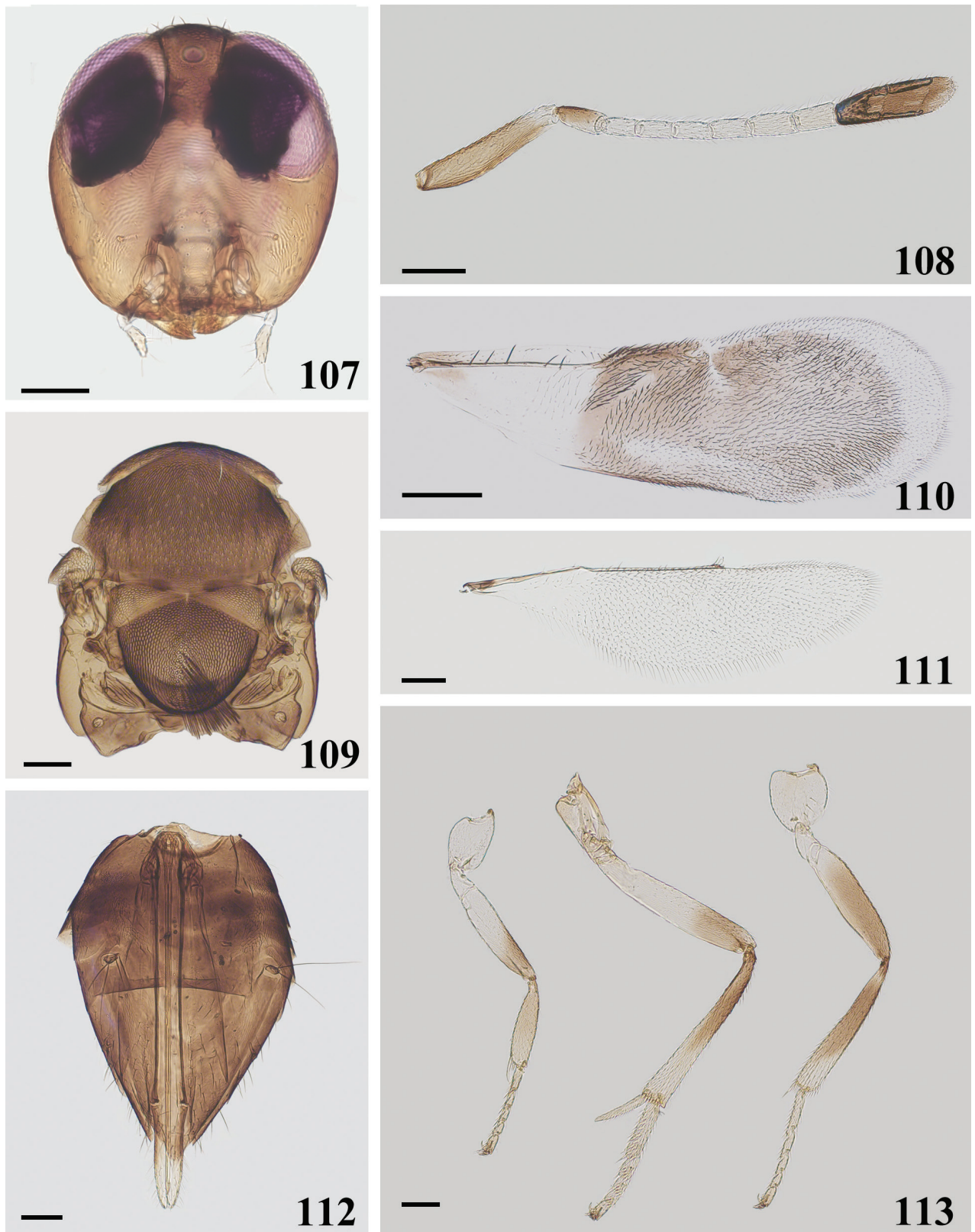
Cheiloneurus sinensis Ozdikmen 2011: 801.

Diagnosis. Female. Antennal scape light brown, basal half of pedicel dark and apical half white; funicle white; clava white; mesosoma brown; axilla yellowish brown, mid tibial spur as long as basitarsus.

Description. See Shi et al. (1994).

Host. Pseudococcidae: *Phenacoccus flaxinus* (Shi et al. 1994).

Distribution. China (Henan, Shaanxi).



Figures 107–113. *Cheiloneurus quercus* ♀ 107 head 108 antenna 109 mesosoma 110 fore wing 111 hind wing 112 metasoma 113 legs. Scale bars: 100 µm.

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Additional information

Conflict of interest

The authors have declared that no competing interests exist.

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Author contributions

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Data availability

All of the data that support the findings of this study are available in the main text.

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