

Revision of the Genus *Phortica* Schiner 1862 in China (Diptera: Drosophilidae)

Yu Cheng¹, Jian-Jun Gao², Hideaki Watabe³, and Hong-Wei Chen^{1,*}

¹Department of Entomology, South China Agricultural University, Tianhe, Guangzhou, Guangdong 510642, China

²Laboratory for Conservation and Utilization of Bio-resources, Yunnan University, Kunming, Yunnan 650091, China

³Biological Laboratory, Hokkaido University of Education, Ainosato, Sapporo 002-8502, Japan

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Yu Cheng, Jian-Jun Gao, Hideaki Watabe, and Hong-Wei Chen (2008) Revision of the genus *Phortica* Schiner 1862 in China (Diptera: Drosophilidae). *Zoological Studies* 47(5): 614-632. The genus *Phortica* from China (with 57 known species) is revised, with descriptions of 9 new species from South China: *P. helva* Chen and Gao, *P. huazhii* Cheng and Chen, *P. huiluo* Cheng and Chen, *P. latifoliacea* Chen and Watabe, *P. multiprocera* Chen and Gao, *P. nudiarista* Cheng and Chen, *P. pavriarista* Cheng and Chen, *P. rhagolobos* Chen and Gao, and *P. xishuangbanna* Cheng and Chen, spp. nov. The southwestern part of China (from Xishuangbanna to the Hengduan Mountains) has remarkably high *Phortica* species diversity, therefore may be the center of diversification of this genus. A checklist of all *Phortica* species in China is given, and a key to these species is provided. <http://zoolstud.sinica.edu.tw/Journals/47.5/614.pdf>

Key words: Distribution, Fauna, Oriental Region, Steganinae, Taxonomy.

Among the 3 subgenera of the genus *Phortica*, *Allophortica* is recorded from the Afrotropical and Palearctic Regions, and *Sinophthalmus* is recorded from the Neotropical Region. Both subgenera are small, being comprised of only a few known species. The 3rd subgenus, *Phortica* (sensu stricto), comprises several dozen known species recorded almost exclusively from the Oriental Region. Since Zhang and Gan's (1986) first report of 4 *Phortica* species from Kunming, Yunnan Province, China, extensive faunal surveys have been conducted in most provinces of China (Table 1), except for some areas (Neimenggu, Shanxi, Jiangsu, Xinjiang, Qinghai, Gansu, Ningxia, Xizang, etc.). Those surveys revealed high species diversity of *Phortica* (sensu stricto) in China, especially its southern part. In the present paper, 8 new species and 2 new records (*P. eparmata* (Okada, 1977) and *P. linae* (Máca and Chen, 1993)) from South China

(Guangdong, Hainan, and Yunnan Provinces), and 1 new species from South China and east Malaysia are added to the Oriental *Phortica* fauna.

MATERIALS AND METHODS

Most specimens examined were captured while they were hovering in front of people's eyes in the forest, or breeding on sap fluxes on tree trunks. Type specimens are deposited in the following institutions: Kunming Institute of Zoology, Chinese Academy of Sciences, Kunming, China (KIZ); Kinabalu Park, Sabah Parks, Sabah, Malaysia (KPSP); Department of Entomology, South China Agricultural Univ., Guangzhou, China (SCAU); and Systematic Entomology, Hokkaido Univ. Museum, Hokkaido Univ., Sapporo, Japan (SEHU). The morphological terminology and definitions of indices follow Chen and Toda (2001).

*To whom correspondence and reprint requests should be addressed. Tel: 86-20-85282535. Fax: 86-20-85280292. E-mail: hongweic@scau.edu.cn

Table 1. (Cont.)

	HL	JL	LN	HeB	SD	SaX	HeN	HuB	AH	ZJ	FJ	JX	HuN	GD	GX	HaN	SC	GZ	YN
<i>foliata</i> (Chen and Toda, 1997)														+	▲	+		▲	
<i>magna</i> (Okada, 1960)						▲		▲			+	+							
<i>omega</i> species complex																			
<i>biprotrusa</i> (Chen and Toda, 1998)								▲				▲	▲		▲			▲	+
<i>hainanensis</i> (Chen and Toda, 1998)																+			▲
<i>omega</i> (Okada, 1977)								▲				+	▲	+	▲		+	▲	+
<i>varipes</i> species group																			
<i>helva</i> Chen and Gao, sp. nov.																			+
<i>variegata</i> species complex																			
<i>acongruens</i> (Zhang and Shi, 1997)									+		▲	▲	▲				▲	▲	+
<i>chi</i> (Toda and Sidorenko, 1996)	+	+	+	▲			▲								+	▲			▲
<i>eugamma</i> (Toda and Peng, 1990)														+	▲				▲
<i>gamma</i> (Toda and Peng, 1990)												▲	+	+	▲	▲	▲	▲	+
<i>iota</i> (Toda and Sidorenko, 1996)		+	+	▲		▲	▲	▲	+	+		+						▲	▲
<i>lambda</i> (Toda and Peng, 1990)											▲	▲	▲	+	▲	▲			+
<i>linae</i> (Máca and Chen, 1993)																▲			
<i>okadai</i> (Máca, 1977)		+	+	+	+	▲	▲	▲	+	+									
<i>pi</i> (Toda and Peng, 1990)									+	+		▲	▲	+	▲	▲	+	+	
<i>pseudopi</i> (Toda and Peng, 1990)									+	+	+	+	▲	+	▲	▲	+	+	+
<i>pseudotau</i> (Toda and Peng, 1990)								▲				▲	▲	+	▲		+	▲	+
<i>psi</i> (Zhang and Gan, 1986)																	▲		+
<i>saeta</i> (Zhang and Gan, 1986)																	▲	▲	+
<i>tau</i> (Toda and Peng, 1990)									+		+	▲	▲	+	▲	▲	+	+	+
<i>uncinata</i> Chen and Gao, 2005																			+
uncomplexed or ungrouped																			
<i>bipartita</i> (Toda and Peng, 1992)														+	▲	+			+
<i>cardua</i> (Okada, 1977)						▲	▲	▲	+		+	▲	▲	+	▲	▲	▲	▲	+
<i>eparmata</i> (Okada, 1977)														▲					
<i>excrescentiosa</i> (Toda and Peng, 1990)														+	▲	▲			+
<i>flexuosa</i> (Zhang and Gan, 1986)						▲	▲	▲	+	+	+	+	▲				▲	+	+
<i>glabtabula</i> Chen and Gao, 2005																			+
<i>hani</i> (Zhang and Shi, 1997)																	▲		+
<i>latipenis</i> Chen and Gao, 2005																			+
<i>orientalis</i> Hendel, 1914														+		+			
<i>pangi</i> Chen and Wen, 2005																+			+
<i>protrusa</i> (Zhang and Shi, 1997)																	▲		+
<i>pseudogigas</i> (Zhang and Gan, 1986)						▲		▲				▲	▲	▲	▲		+	▲	+
<i>setitabula</i> Chen and Gao, 2005																			+
<i>subradiata</i> (Okada, 1977)														▲	▲	▲			+
<i>unipetala</i> Chen and Wen, 2005																			+
<i>huazhii</i> Cheng and Chen, sp. nov.																+			
<i>laifoliacea</i> Chen and Watabe, sp. nov.																			+
<i>multirocera</i> Chen and Gao, sp. nov.																			+
<i>ragolobos</i> Chen and Gao, sp. nov.																			+
Total species	1	3	3	3	1	7	5	9	8	5	9	16	12	22 (1)	20	19 (4)	16	16	42 (14)

Abbreviations for provinces: AH, Anhui; FJ, Fujian; GD, Guangdong; GX, Guangxi; GZ, Guizhou; HaN, Hainan; HeB, Hebei; HeN, Henan; HLJ, Heilongjiang; HuB, Hubei; HuN, Hunan; JL, Jilin; JX, Jiangxi; LN, Liaoning; SaX, Shaanxi; SC, Sichuan; SD, Shandong; ZJ, Zhejiang; YN, Yunnan.

Diagnosis: Ocellar triangle with 1 pair of small setae below ocellar setae; proclinate orbital seta nearer to inner vertical seta than to ptilinal fissure; palpus with hollow sense organ subapically; scutellum swollen in lateral view; aedeagus curved ventrad; aedeagal apodeme laterally flattened, with deep apical notch dividing it into dorsal and ventral branches. For a more-detailed description see Bächli et al. (2004) and Chen et al. (2005a b, 2007).

Classification: Supraspecific divisions within the genus *Phortica* have not yet been fully settled, although the following species group or complexes have been erected: the *variegata* complex by Máca (1977), the *foliiseta* complex by Tsacas and Okada (1983), the *magna* complex by Chen and Toda (1997), the *omega* complex by Chen and Toda (1998), and the *varipes*-group by Máca (2003). According to Chen's (2001) phylogenetic analysis, classifications within the genus *Phortica* will be fully revised in the near future. For the present, we follow the previous classification system within *Phortica*, only assigning some species to known species complexes, except for the *variegata* complex of which the diagnosis is insufficient in the light of a recent phylogenetic analysis by Chen (2001).

I. The *foliiseta* species complex

***Phortica (Phortica) xishuangbanna* Cheng and Chen, sp. nov.** (Figs. 1-3)

Diagnosis: Vertical process of gonopods distinctly asymmetrical, with 2 sclerotized projections (Fig. 3); aedeagal median rod trifoliate apically, with 2 small, separated sclerites (Fig. 3).

Description: Frons brown, medially with thick, dense, minute interfrontal setulae. Male arista plumose, apically not expanded. Legs with dark spots submedially on all femora; all tibiae with 2 dark rings; 5th tarsomere of foreleg without 1 long seta apically. Abdominal tergites yellow, with broad brownish-black posterior bands interrupted medially. Third to 5th sternites longer than wide, without long setae laterally; 6th sternite with a few long setae laterally. **Male terminalia.** Epandrium mid-dorsally constricted, laterally broad, nearly entirely pubescent, with dense setae (Fig. 1). Surstylus with pubescence, numerous setae, and prensisetae on ventral margin to inner surface

(Fig. 2). Paramere (outer paraphysis) strongly sclerotized, knobbed and smooth apically, with 3 sensilla basally to submedially (Fig. 3).

Measurements: BL 2.73 mm in holotype (range in 2 ♂♂ paratypes: 2.60-2.82 mm); ThL 1.56 (1.40-1.60) mm; WL 2.19 (2.00-2.40) mm; WW 1.12 (0.92-1.12) mm. Indices: arb 5-6/3 (4-6/3-5), avd 0.56 (0.50-0.59), adf 1.20 (1.10-1.20), flw 1.40 (1.20-1.50), FW/HW 0.45 (0.40-0.45), ch/o 0.08 (0.07-0.08), prorob 1.25 (1.20-1.40), rcorb 0.70 (0.55-0.80), vb 0.50 (0.35-0.50), dcl 0.60 (0.50-0.60), presctl 0.60 (0.50-0.65), sctl 1.10 (1.00-1.15), sterno 1.00 (1.00), orbito 2.00 (1.80-2.00), dcp 0.22 (0.23-0.25), sctlp 1.20 (1.20-1.30), C 2.00 (1.94-2.13), 4c 1.56 (1.60-2.11), 4v 2.56 (2.70-3.44), 5x 1.17 (1.14-1.17), ac 3.50 (3.16-4.00), M 0.78 (0.70-0.88), C3F 0.57 (0.57-0.68).

Type materials: *Holotype* ♂ (SCAU, No. 120055), labeled "CHINA: Menglun, Xishuangbanna, Yunnan, 21°41'N, 101°25'E, elev., 880 m a.s.l., 21.ix.2003, HW Chen". *Paratypes*. 2 ♂♂, same data as for holotype except for 22 Sept. 2003, SY Wen (SCAU, No. 120056-57).

Etymology: In reference to type locality.

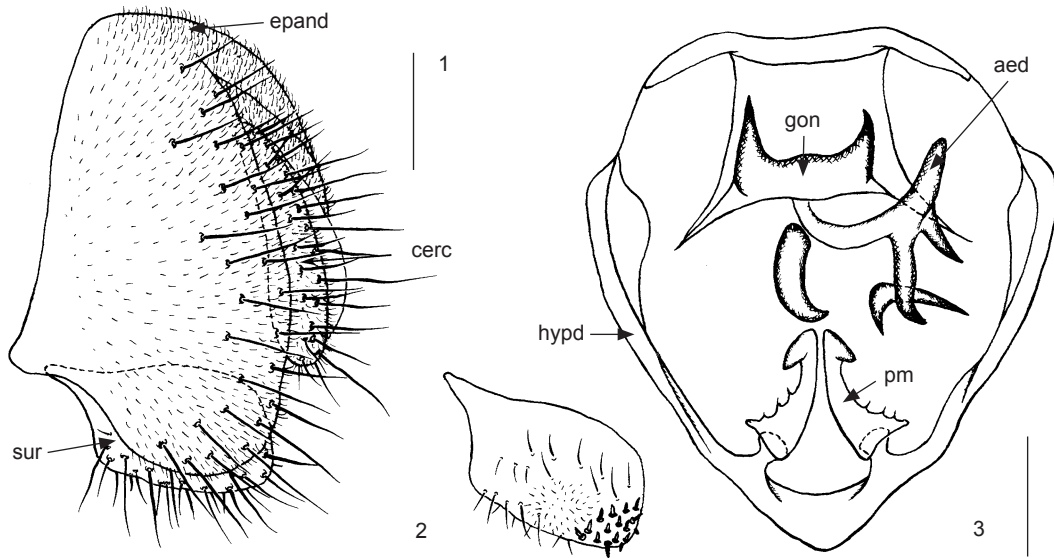
Distribution: China (Yunnan Prov.).

Remarks: The type materials of this new species were regarded as paratypes of *P. afofololata* Chen and Toda in Chen et al. (2005b). Thereafter, morphological characters were found to diagnose these materials from the remaining types of *P. afofololata* Chen and Toda: the male arista (plumose) and terminalia of the new species are very similar to those of *P. afofololata*, whereas it differs from the latter in the aedeagal median rod and vertical process of the gonopods (in *P. afofololata*, aedeagal median rod separated into 2 small, deeply bifurcated sclerites and vertical process of gonopods nearly symmetrical).

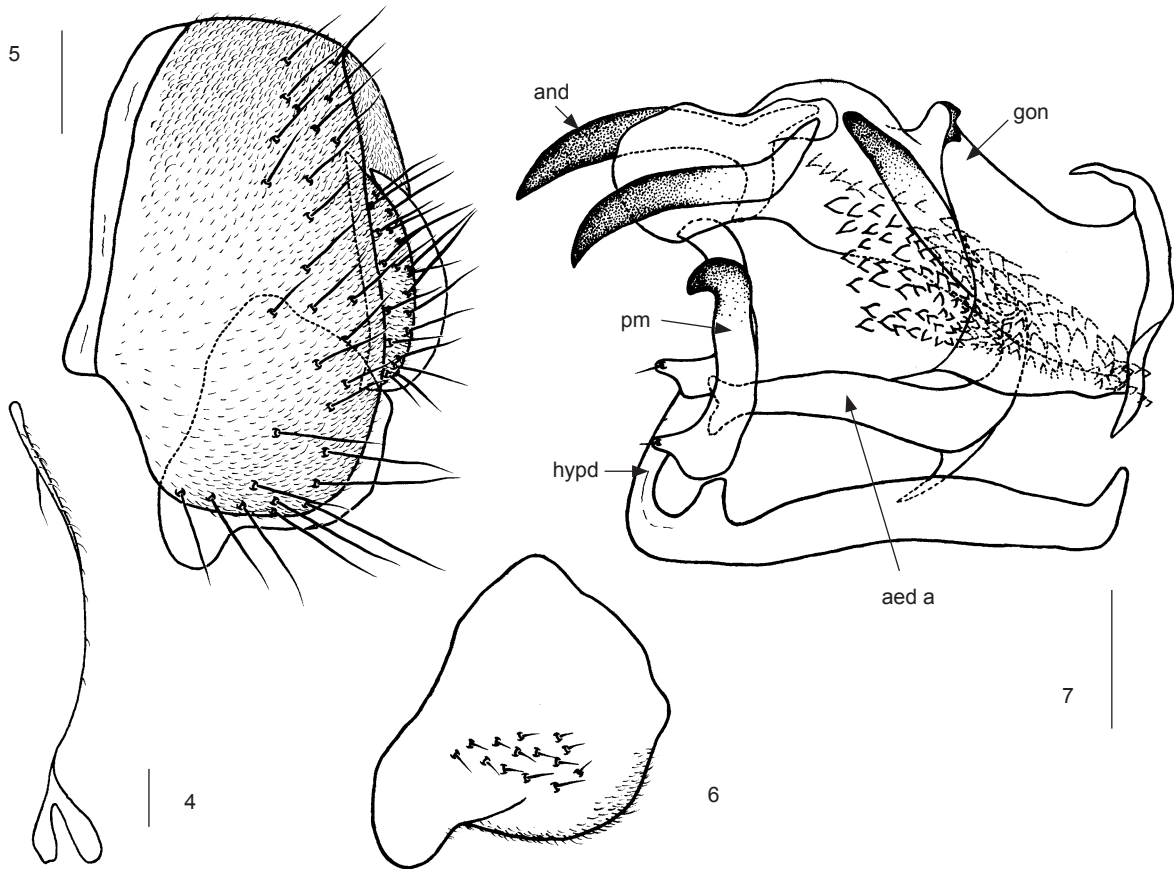
***Phortica (Phortica) huiluoi* Cheng and Chen, sp. nov.** (Figs. 4-7)

Diagnosis: Male arista apically deeply bifurcated, with 1 dorsal branch (Fig. 4); aedeagal median rod broken submedially, its distal 1/2 separated into 2 apically pointed sclerites (Fig. 7); aedeagal outer membrane basally with numerous small, sclerotized, triangular processes (Fig. 7).

Description: Frons dark brown, medially with thick, dense, minute interfrontal setulae. Legs nearly entirely yellow; all tibiae without dark rings;



Figs. 1-3. *Phortica (Phortica) xishuangbanna* Cheng and Chen, sp. nov. ♂. 1. Epandrium (epand), cercus (cerc) and surstylus (sur), lateral view. 2. Surstylus, inner view. 3. Hypandrium (hypd), gonopods (gon), parameres (pm), and aedeagus (aed), ventral view. Scale bars = 0.1 mm.



Figs. 4-7. *Phortica (Phortica) huiluoi* Cheng and Chen, sp. nov. ♂. 4. Arista. 5. Epandrium, cercus, and surstylus, lateral view. 6. Surstylus, inner view. 7. Hypandrium, gonopods, parameres, aedeagus, and aedeagal apodeme (aed a), lateral view. Scale bars = 0.1 mm.

foreleg 5th tarsomere with 1 long seta apically. Abdominal tergites yellow, with broad, brownish-black posterior bands interrupted medially. Third sternite broadened, shorter than wide, with long setae laterally; 4th and 5th sternites slightly shorter than wide, with long setae laterally; 6th sternite without long setae laterally. *Male terminalia*. Epandrium laterally broad, nearly entirely pubescent, with dense setae (Fig. 5). Surstylus with several small setae submedially and pubescence on distal margin in inner surface (Fig. 6). Vertical process of gonopods weakly sclerotized, with 2 small projections on apical margin (Fig. 7). Paramere apically knobbed, basally with 1 sensillum (Fig. 7).

Measurements: BL 2.87 mm in holotype; ThL 1.26 mm; WL 2.23 mm; WW 1.00 mm. Indices. arb 1/0, adf1.14, flw 1.30, FW/HW 0.33, ch/o 0.07, pror 1.30, rcorb 0.60, vb 0.40, dcl 0.50, presctl 0.55, sctl 1.20, sterno 1.00, orbito 1.80, dcp 0.25, sctlp 1.20, C 1.81, 4c 2.00, 4v 3.25, 5x 1.40, ac 3.20, M 0.88, C3F 0.50.

Type material: *Holotype* ♂ (SCAU, No. 120058), labeled “CHINA: Jizushan, Binchuan, Dali, Yunnan, 26°00'N, 100°21'E, elev., 1700 m a.s.l., 17.viii.2005, HL Cao”.

Etymology: Patronym of the collector Mr. HL Cao (SCAU).

Distribution: China (Yunnan Prov.).

Remarks: The aedeagal outer membrane with numerous triangular processes of this new species resembles that of *P. tanabei* Chen and Toda, 2005, but differs from it in the shape of the arista tip and aedeagal median rod (in *P. tanabei*, arista not deeply bifurcated apically; aedeagal median rod not bifurcated, hooked apically, somewhat anchor-like).

***Phortica (Phortica) nudiarista* Cheng and Chen,
sp. nov.
(Figs. 8-12)**

Diagnosis: Arista nearly glabrous, only basally with sporadic pubescence; right (B-type), lateral lobe on vertical process of gonopods submedially bifurcated (Fig. 11).

Description: Frons brown, medially with thick, dense, minute interfrontal setulae. Arista apically expanded, without dorsal branches (Fig. 8). Legs nearly entirely yellow; all tibiae without dark rings; foreleg 5th tarsomere with 1 long seta apically. Abdominal tergites yellow, with broad brownish-black posterior bands interrupted medially. Only

3rd sternite much broadened, with several long setae laterally. *Male terminalia*. Epandrium laterally broad, nearly entirely pubescent, with dense setae (Fig. 9). Surstylus with numerous setae and pubescence, distal margin of inner surface lacking prensisetae (Fig. 10). Paramere apically roundly knobbed, submedially sharply curved, basally with 2 sensilla and a few minute setae (Figs. 11, 12). Vertical process of gonopods asymmetrically triangular. Aedeagus lacking median rod.

Measurements: BL 3.20 mm in holotype (range in 4 ♂ ♂ paratypes: 3.00-3.38 mm); ThL 1.10 (1.10-1.30) mm; WL 2.20 (2.20-2.30) mm; WW 1.00 (1.00-1.10) mm. Indices. arb 0/0, flw 1.10 (1.10-1.20), FW/HW 0.45 (0.45-0.50), ch/o 0.07 (0.07-0.08), pror 1.50 (1.48-1.63), rcorb 0.55 (0.48-0.60), vb 0.50 (0.50), dcl 0.55 (0.50-0.55), presctl 0.55 (0.50-0.65), sctl 1.00 (1.00-1.10), sterno 1.00 (1.00), orbito 1.90 (1.83-1.95), dcp 0.23 (0.23-0.25), sctlp 1.25 (1.20-1.25), C 2.35 (2.23-2.38), 4c 1.63 (1.62-1.67), 4v 3.20 (3.10-3.35), 5x 1.21 (1.20-1.37), ac 3.27 (3.10-3.57), M 0.85 (0.80-0.91), C3F 0.60 (0.63-0.75).

Type materials: *Holotype* ♂ (SCAU, No. 120059), labeled “B-type, CHINA: Menglun, Xishuangbanna, Yunnan, alt. 580 m, 24.xii.2003, HW Chen”. Paratypes. 1 ♂ B-type, same data as for holotype except for elev. 570 m, ? May 1985, XC Liang (KIZ); 8 ♂ ♂ B-type, same data as for holotype except for 8 Mar. 2003, 24-26 Dec. 2003, MJ Toda, SY Wen and HW Chen (2 ♂ ♂, KIZ; 5 ♂ ♂, SCAU, No. 120060-64; 2 ♂ ♂, SEHU).

Etymology: A combination of the Latin words: *nudus* + *arista*, referring to the arista being nearly glabrous.

Distribution: China (Yunnan Prov.).

Remarks: The type materials of this new species were regarded as paratypes of *P. brachychaeta* Chen and Toda in Chen et al. (2005b). The arista of the new species is very similar to that *P. brachychaeta* in the lack of branches, but differs from the latter in the male terminalia (in *P. brachychaeta*, all projections of vertical process of gonopods are strongly pointed apically; and left (A-type) or right (B-type) lateral lobe on the vertical process of gonopods basally deeply bifurcated).

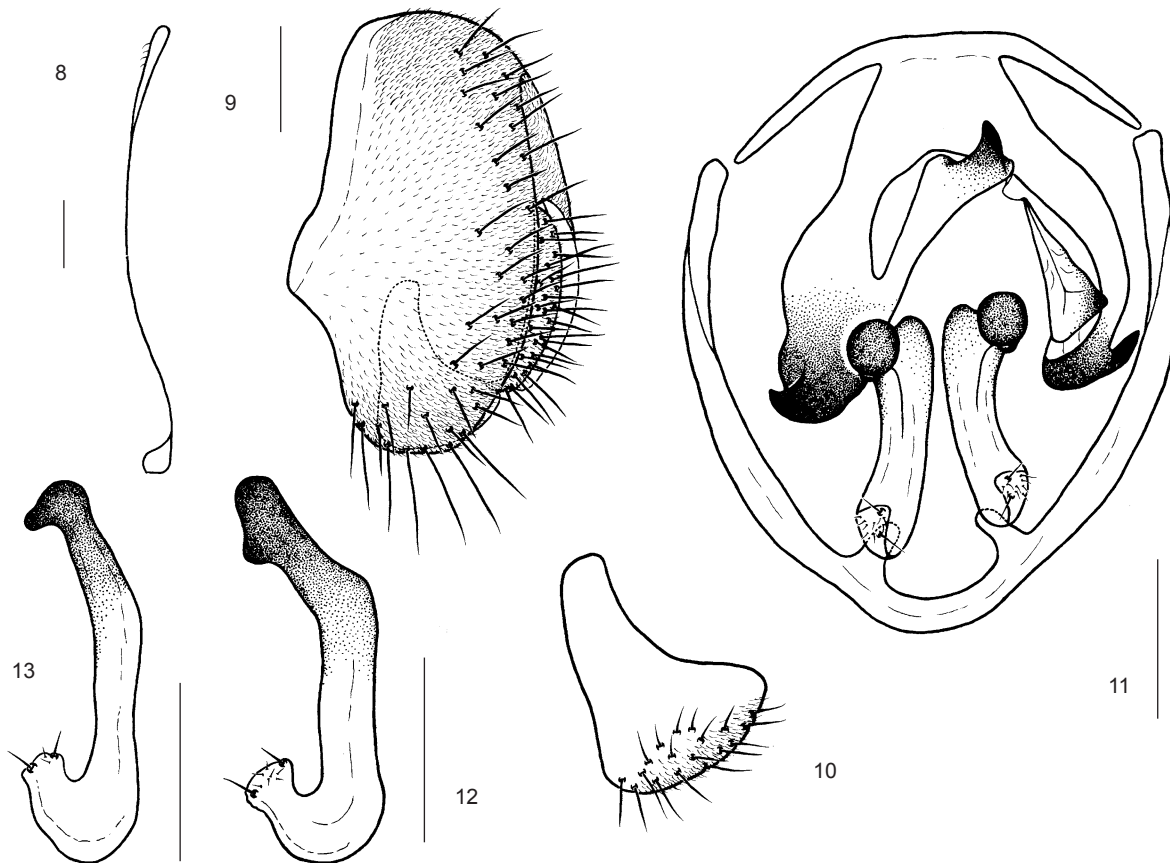
***Phortica (Phortica) pavriarista* Cheng and Chen, sp. nov.**
(Figs. 14-18)

Diagnosis: Arista lacking micropubescent ventrally, slightly expanded apically in male, as wide as base (Fig. 14).

Description: Frons brown, medially with thick, dense, minute interfrontal setulae. Arista apically expanded, with 1 or 2 dorsal branches (Fig. 14). Legs nearly entirely yellow; all tibiae without dark rings; 5th tarsomere of foreleg with 1 long seta apically. Abdominal tergites yellow, with broad brownish-black posterior bands interrupted medially. Only 3rd sternite much broadened, with several long setae laterally. **Male terminalia.** Epandrium laterally broad, nearly entirely pubescent, with dense setae (Fig. 15). Surstylus with numerous setae and pubescence, distal margin of inner surface lacking prenisetae

(Fig. 16). Paramere apically knobbed, submedially slightly sharply curved, basally with 3 sensilla (Figs. 17, 18). Vertical process of gonopods asymmetrically triangular, all projections of vertical process of gonopods round apically (Fig. 18). Aedeagus lacking median rod.

Measurements: BL 3.24 mm in holotype (range in 2 ♂♂ paratypes: 2.80-3.20); ThL 1.56 (1.41-1.50) mm; WL 2.63 (2.34-2.53) mm; WW 1.16 (1.03-1.16) mm. Indices. arb 2/0 (1-2/0), adf 0.69 (0.86), flw 1.13 (1.13-1.21), FW/HW 0.47 (0.46), ch/o 0.05 (0.06), prob 1.20 (1.40), rcorb 0.56 (0.55), vb 0.73 (0.60-0.67), dcl 0.50 (damaged), presctl 0.50 (0.47-0.50), sctl 1.09 (1.04), sterno 0.86 (0.91-0.95), orbito 1.88 (1.88-2.00), dcp 0.31 (0.28-0.31), sctlp 1.15 (1.22-1.31), C 2.06 (0.23-2.35), 4c 1.62 (1.48-1.50), 4v 2.90 (2.75-2.90), 5x 0.93 (1.00-1.08), ac 3.40 (3.10-3.75), M 0.62 (0.65-0.67), C3F 0.71 (0.66-0.68).



Figs. 8-13. *Phortica (Phortica) nudiarista* Cheng and Chen, sp. nov. ♂; **13.** *Phortica (Phortica) brachychaeta* Chen and Toda from Yunnan, China, ♂. **8.** Arista. **9.** Epandrium, cercus, and surstylus, lateral view. **10.** Surstylus, inner view. **11.** Hypandrium, gonopods, and parameres, ventral view. **12, 13.** Parameres, lateral view. Scale bars = 0.1 mm.

Type materials: *Holotype* ♂ (SCAU, No. 120065), labeled “A-type, CHINA: Yixiang, Simao, Yunnan, 22°47’N, 101°02’E, elev., 1200 m a.s.l., 15.ix.2002, HW Chen. *Paratypes*. 2 ♂♂, B-type, data same as for holotype (SCAU, No. 120066-67).

Etymology: A combination of the Latin words: *parvus* + *arista*, referring to the small arisal tip.

Distribution: China (Yunnan Prov.).

Remarks: The type materials of this new species were regarded as a new distribution record of *P. speculum* (Máca and Lin, 1993) in Chen et al. (2005b). The male terminalia are very similar to those of *P. speculum*, but the arista differs from the latter (in *P. speculum* (Figs. 19, 20) the arista is micropubescent ventrally, apically expanded, 3 times as wide as the base).

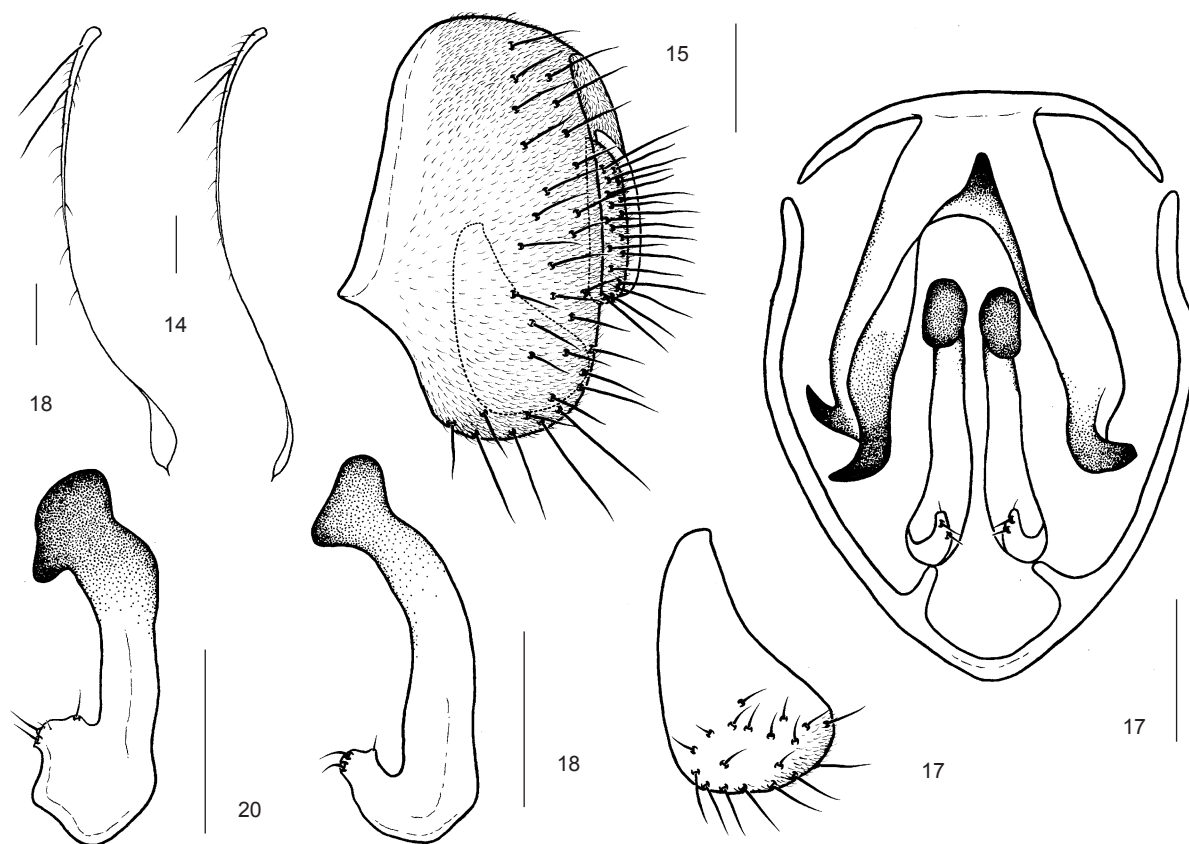
II. The *varipes* species group

Phortica (Phortica) helva Chen and Gao, sp. nov.

(Figs. 21, 22)

Diagnosis: Epandrium small, not reaching ventral margin of 6th tergite, tapering laterally (Fig. 21); cercus fused basally, elongated ventrally, with long setae distally (Fig. 21); surstylus elongated and narrowed, with 1 small preniseta subapically (Fig. 21); paramere with 4 long setae apically (Fig. 22).

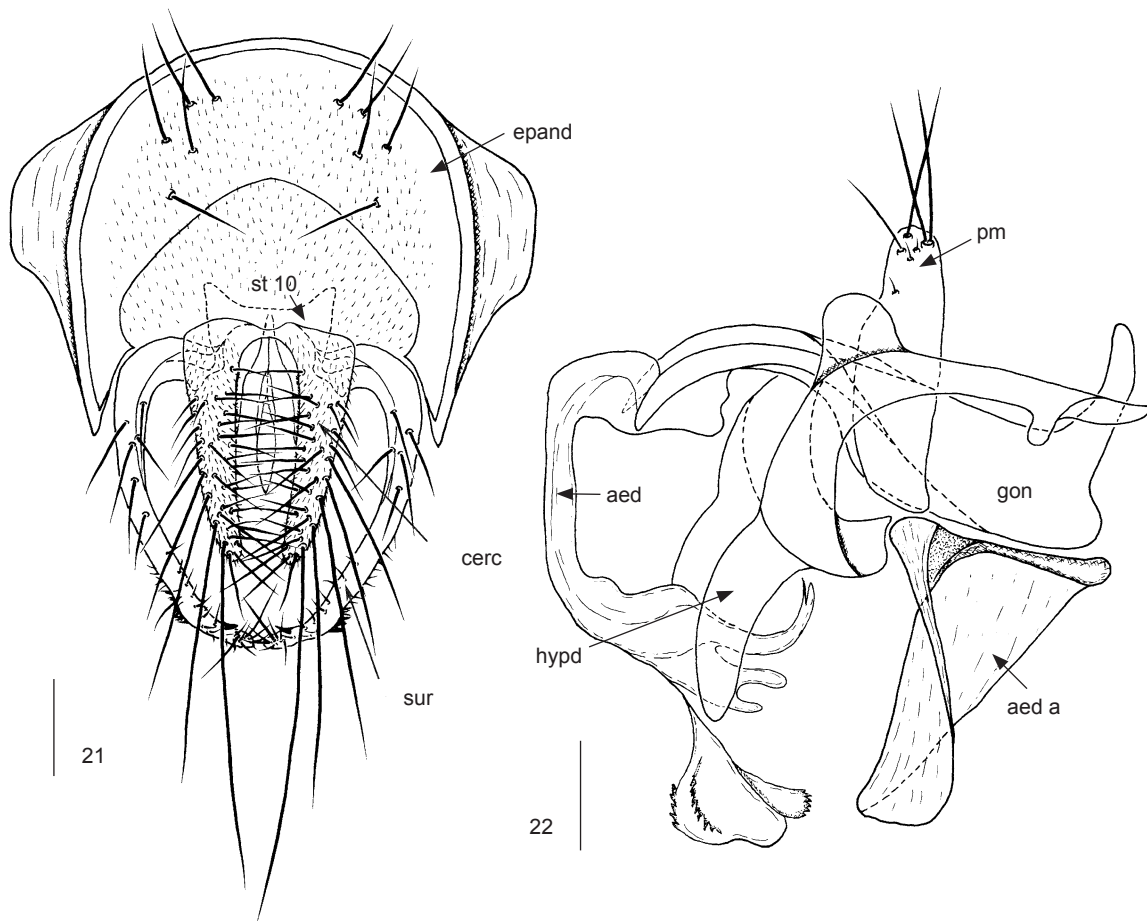
Description: Frons yellow, with thick interfrontal setae. Fronto-orbital plate yellow on lower part, brown on upper part. Pedicel yellow; 1st flagellomere pale. Face yellow. Clypeus entirely yellow. Wing slightly yellow. Legs yellow,



Figs. 14-20. *Phortica (Phortica) pavriarista* Cheng and Chen, sp. nov. ♂. **19, 20.** *Phortica (Phortica) speculum* (Máca and Lin) from Fujian, China, ♂. **14, 19.** Arista. **15.** Epandrium, cercus, and surstylus, lateral view. **16.** Surstylus, inner view. **17.** Hypandrium, gonopods, and parameres, ventral view. **18, 20.** Parameres, lateral view. Scale bars = 0.1 mm.

black on apical parts of mid and hind tibiae. Abdominal 1st to 5th tergites mostly brown, with narrow yellow anterior and posterior margins; 6th tergite nearly black, heavily constricted dorsomedially. *Male terminalia*. Epandrium with 5 setae on dorsal portion per side (Fig. 21). Surstylus with a few (4-6) setae basally and dense smaller setae distally, lacking pubescence (Fig. 21). Additional plate between cerci and 10th sternite small, lacking pubescence (Fig. 21). Hypandrium strongly protruding anterolaterally, with distinct lobe(s) mid-laterally (Fig. 22). Paramere lobe-like, with 3 or 4 sensilla subapically (Fig. 22). Gonopods weakly sclerotized, fused to aedeagus (Fig. 22). Aedeagus weakly sclerotized basally, nearly membranaceous distally (Fig. 22). Aedeagal apodeme strong, nearly triangular (Fig. 22).

Measurements: BL 3.84 mm in holotype (range in 3 ♂♂ and 3 ♀♀ paratypes: 3.12-3.56 mm in ♂♂, 3.88-4.10 mm in ♀♀); ThL 1.59 (1.47-1.59 in ♂♂, 1.63-1.88 in ♀♀) mm; WL 2.63 (2.44-2.59 in ♂♂, 2.78-2.97 in ♀♀) mm; WW 1.25 (1.19-1.22 in ♂♂, 1.28-1.44 in ♀♀) mm. Indices. arb 4/2 (4-5/2-3), avd 0.83 (0.75-0.93), adf 1.71 (1.67-1.85), flw 1.57 (1.56-1.83), FW/HW 0.46 (0.45-0.49), ch/o 0.05 (0.04-0.05), prorb 1.25 (1.00-1.31), rcorb 0.54 (0.46-0.53), vb 0.43 (0.40-0.59), dcl 0.50 (0.42-0.57), presctl 0.56 (0.55-0.61), sctl 1.06 (0.98-1.10), sterno 0.84 (0.78-0.93), orbito 1.40 (1.25-1.70), dcp 0.19 (0.18-0.23), sctlp 1.10 (0.91-1.00), C 2.57 (2.20-3.07), 4c 1.07 (0.86-1.25), 4v 2.11 (1.76-2.24), 5x 1.14 (0.80-1.00), ac 4.29 (2.90-4.14), M 0.57 (0.41-0.55), C3F 0.61 (0.47-0.60).



Figs. 21, 22. *Phortica (Phortica) helva* Chen and Gao, sp. nov. ♂. **21.** Epandrium, cercus, surstylus, 10th sternite, and additional plate, posterior view. **22.** Hypandrium, gonopods, paramere, aedeagal median rod, and aedeagal apodeme, lateral view. Scale bars = 0.1 mm.

Type materials: *Holotype* ♂ (SCAU, No. 120068), labeled “CHINA: Mengyang, Xishuangbanna, Yunnan, 22°20'N, 100°51'E, elev., 700 m a.s.l., 9.ix.2002, HW Chen”. *Paratypes*. CHINA: 3 ♂♂, 3 ♀♀, same data as for holotype (SCAU, No. 120069-74); 1 ♂, Menglun, Xishuangbanna, Yunnan, 800 m, 17 Apr. 2007, JJ Gao (KIZ). MALAYSIA: 1 ♂, Ulu Senagang, Crocker Range, Sabah, 18 Sept. 1999, MJ Toda (KPSP).

Etymology: In reference to the yellowish body color.

Distribution: China (Yunnan Prov.), Malaysia (Sabah).

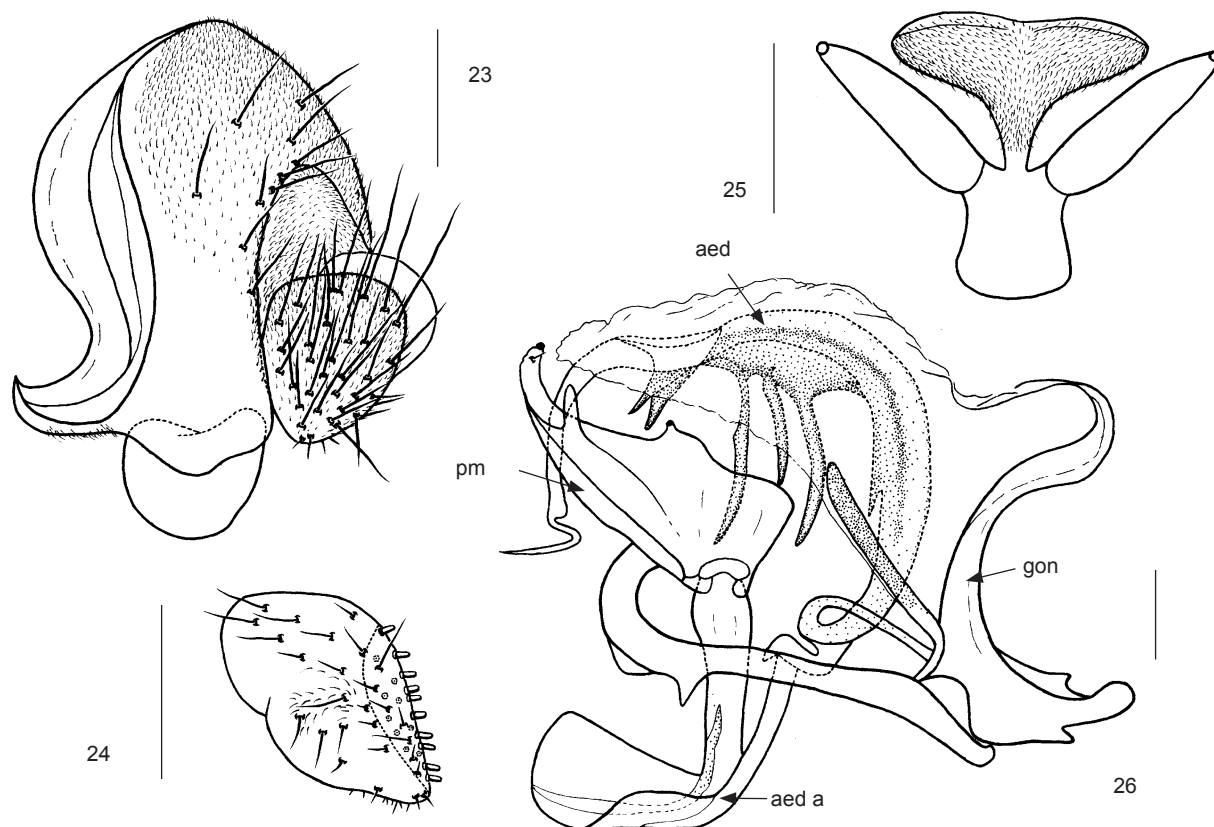
Remarks: This new species is similar to *P. sobodo* Burla, 1954 from Africa in the large 6th sternite, small epandrium, and gonopods fused to the aedeagus, but can be distinguished from it by the cercus and paramere (in *P. sobodo*, either cercus or paramere lack the long setae distally).

III. Species unassigned to any species complex

Phortica (Phortica) huazhii Cheng and Chen, sp. nov. (Figs. 23-26)

Diagnosis: Aedeagal median rod with 1 small, apically bifurcated process and 3 pairs of slender processes submedially (Fig. 26); aedeagal basal branch with 1 slender, rod-like process basolaterally (Fig. 26); surstylus with about 10 prensisetae, sparsely arranged on inner margin (Fig. 24).

Description: Frons brown on upper part, dark brown on lower part, medially with dense minute, interfrontal setulae. Anepisternum lacking setulae. Wing hyaline; r-m and dm-cu crossveins not clouded. Midleg tibia subapically without longer setae on anterior surface. Abdominal 1st to 4th tergites yellow, 1st and 2nd tergites submedially with triangular and laterally with narrow black



Figs. 23-26. *Phortica (Phortica) huazhii* Cheng and Chen, sp. nov. ♂. **23.** Epandrium, cercus, and surstylus, lateral view. **24.** Surstylus, frontal view. **25.** Tenth sternite and additional plate, frontal view. **26.** Hypandrium, gonopods, paramere, aedeagal median rod, and aedeagal apodeme, lateral view. Scale bars = 0.1 mm.

patches; 3rd and 4th tergites with broad medially anteriod protruding dark-brown bands, sublaterally with 1 pair of yellow patches; 5th and 6th tergites nearly entirely black. *Male terminalia*. Epandrium with pubescence anteroventrally, and about 10 setae on dorsal to posterior portion per side (Fig. 23). Surstylus with several small setae and pubescence on outer surface (Fig. 24). Additional plate between cerci and 10th sternite (decasternum) with pubescence, medially connected to 10th sternite (Fig. 25). Hyandrial posterolateral lobe lacking pubescence (Fig. 26). Paramere lacking pubescence, broadened basally, with 1 tooth submedially, 1 finger-shaped process subapically, 1 tooth and 1 sensillum apically (Fig. 26).

Measurements: BL 3.40 mm in holotype (range in 9 ♂♂ paratypes: 3.36-3.84 mm); ThL 1.60 (1.52-1.84) mm; WL 2.72 (2.53-2.81) mm; WW 1.22 (1.16-1.31) mm. Indices. arb 5/4 (5-7/4-5), avd 0.79 (0.60-0.70), adf 1.71 (1.31-1.79), flw 1.79 (1.40-1.69), FW/HW 0.46 (0.44-0.47), ch/o 0.09 (0.07-0.09), prorob 1.20 (1.00-1.18), rcorb 0.47 (0.32-0.48), vb 0.64 (0.38-0.68), dcl 0.47 (0.47-0.56), presctl 0.52 (0.48-0.66), sctl 1.09 (1.02-1.08), sterno 0.89 (0.81-1.00), orbito 1.50 (1.18-1.70), dcp 0.25 (0.22-0.29), sctlp 1.14 (1.00-1.24), C 2.23 (1.70-2.07), 4c 1.54 (1.61-1.89), 4v 3.04 (2.81-3.40), 5x 1.17 (0.95-1.25), ac 3.31 (3.33-3.85), M 0.75 (0.68-0.84), C3F 0.75 (0.73-0.80).

Type materials: *Holotype* ♂ (SCAU, No. 120075), labeled "CHINA: Jianfengling, Ledong, Hainan, 18°41'N, 108°52'E, elev., 940 m a.s.l., 30.xi.2003, HW Chen". *Paratypes*. CHINA: 3 ♂♂, same data as for holotype except 18-21 May 2004 (SCAU, No. 120076-78); 1 ♂, Diaoluoshan, Lingshui, Hainan, 18°10'N, 108°52'E, 740 m elev., 3 Dec. 2003, HW Chen (SCAU, No. 120079); 18 ♂♂, Mt. Wuzhi, 18°48'N, 109°19'E, 440 m elev., 21-23 Apr. 2007, HZ Cao and T Li (6 ♂♂, KIZ; 10 ♂♂, SCAU, No. 120080-89; 2 ♂♂, SEHU).

Etymology: Patronym of the collector Mr. HZ Cao (SCAU).

Distribution: China (Hainan Prov.).

Remarks: The paramere and gonopods of this new species are similar to those of *P. maculiceps* de Meijere in Duda 1924 from Indonesia, but can be distinguished from it by the submedial process of the aedeagal median rod (in *P. maculiceps*, aedeagal median rod has 1 small bifurcated and 1 pair of slender processes submedially; aedeagal basal branch lacks rod-like process).

***Phortica (Phortica) latifoliacea* Chen and Watabe, sp. nov.**
(Figs. 27-30)

Diagnosis: Epandrium roundly expanded ventrally (Fig. 27); surstylus with about 15-17 long strong prenisetae along inner margin (Fig. 28); paramere with pubescence distally, apically with 1 sensillum and 2 teeth, subbasally bifurcated into slender processes: lateral process shorter, ca. 1/4 as long as full length, with 1 sensillum (Fig. 30).

Description: Frons dark brown, medially with several minute interfrontal setulae. Anepisternum lacking setulae. Wing hyaline, slightly yellow; r-m and dm-cu crossveins slightly clouded. Midleg tibia subapically without longer setae on anterior surface. Abdominal 1st to 4th tergites yellow, 1st and 2nd tergites with black triangular patches submedially and narrow patches laterally; 3rd to 5th tergites with broad, dark-brown bands, sublaterally with 1 pair of yellow patches; 6th tergite nearly dark brown, with narrow yellow stripe medially. *Male terminalia*. Epandrium lacking pubescence anteroventrally, with 12 setae on dorsal to posterior portion per side (Fig. 27). Additional plate with pubescence, separated from 10th sternite (Fig. 29). Aedeagal median rod slender, without processes submedially to apically; with 1 pair of curved rod-like processes basolaterally; aedeagal basal branch expanded anteriod, with a few serrated processes along margin (Fig. 30).

Measurements: BL 3.28 mm in holotype (range in 3 ♂♂ paratypes: 3.44-3.76) ThL 1.63 (1.68-1.84) mm; WL 2.59 (2.72-2.81) mm; WW 1.16 (1.22-1.28) mm. Indices. arb 5/4 (5-6/4-5), avd 0.52 (0.50-0.63), adf 1.62 (1.2-1.47), flw 1.46 (1.43-1.57), FW/HW 0.48 (0.47-0.50), ch/o 0.08 (0.06-0.11), prorob 1.10 (1.09-1.25), rcorb 0.41 (0.48-0.55), vb 0.52 (0.48-0.65), dcl 0.60 (0.55-0.57), presctl 0.70 (0.61-0.75), sctl 1.02 (1.02-1.07), sterno 0.93 (0.73-0.90), orbito 1.33 (1.2-1.88), dcp 0.25 (0.25-0.28), sctlp 1.05 (0.87-1.17), C 2.15 (2.00-2.23), 4c 1.50 (1.47-1.52), 4v 2.75 (2.67-2.87), 5x 1.06 (0.90-1.00), ac 3.50 (3.15-3.38), M 0.68 (0.60-0.66), C3F 0.75 (0.70-0.78).

Type materials: *Holotype* ♂ (SCAU, No. 120090), labeled "CHINA: Menglun, Xishuangbanna, Yunnan, 800 m a.s.l., 23.ix.2003, HW Chen". *Paratypes*: 1 ♂, same data as for holotype (SCAU, No. 120091); 2 ♂♂, same data as for holotype except 17 Apr. 2007, JJ Gao (KIZ).

Etymology: A combination of the Latin words: *latilus* and *foliaceus*, referring to the expanded aedeagal basal branch.

Distribution: China (Yunnan Prov.).

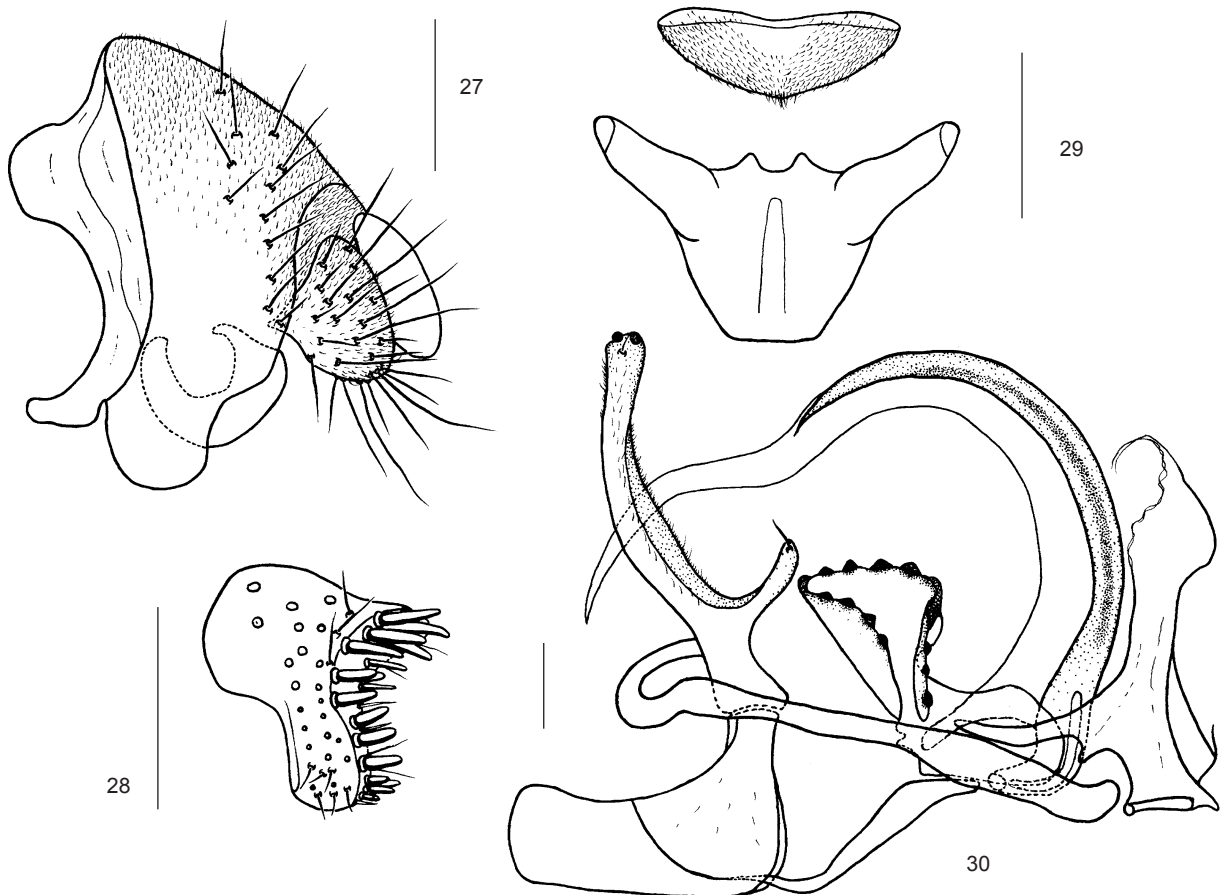
Remarks: The shape of the subbasally bifurcated paramere and the aedeagal median rod without processes of this new species are somewhat similar to those of *P. omega* (Okada, 1977), but it can be distinguished by the epandrium and surstylus (in *P. omega*, the epandrium is not roundly expanded ventrally and the surstylus has no long strong prensisetae).

***Phortica (Phortica) multiprocera* Chen and Gao,
sp. nov.
(Figs. 31-34)**

Diagnosis: Aedeagal basal branch with several sclerotized, radiating processes (Fig. 34);

aedeagal median rod bifurcated basally (Fig. 34).

Description: Frons brown, medially with several minute interfrontal setulae. Anepisternum lacking setulae. Wing slightly yellow, hyaline; r-m and dm-cu crossveins not clouded. Midleg tibia subapically without longer setae on anterior surface. Abdominal tergites yellow; 1st and 2nd tergites with brownish-black patches submedially; 3rd to 5th tergites with medially anterior broad, black, protruding bands; 6th tergite nearly black. **Male terminalia.** Epandrium with pubescence anteroventrally, and 5 setae on dorsal to posterolateral portion per side (Fig. 31). Surstylus pubescent basally, with several setae basally and apically, and several small prensisetae along inner margin (Fig. 32). Additional plate between cerci and 10th sternite with pubescence, connected to 10th sternite (Fig. 33). Paramere bifurcated subapically, with pubescence, 2 sensilla, and 4



Figs. 27-30. *Phortica (Phortica) latifoliacea* Chen and Watabe, sp. nov. ♂. **27.** Epandrium, cercus, and surstylus, lateral view. **28.** Surstylus, frontal view. **29.** Tenth sternite and additional plate, frontal view. **30.** Hypandrium, gonopods, paramere, aedeagal median rod, and aedeagal apodeme, lateral view. Scale bars = 0.1 mm.

black teeth (Fig. 34).

Measurements: BL 2.47 mm in holotype; ThL 1.45 mm; WL 2.59 mm; WW 1.11 mm. Indices. arb 4/2, avd 1.30, flw 1.30, FW/HW 0.48, ch/o 0.12, prorb 1.18, rcorb 0.63, vb 0.38, dcl 0.53, presctl 0.65, sctl 1.10, sterno 0.90, orbito 1.75, dcp 0.23, sctlp 1.68, C 2.01, 4c 1.67, 4v 3.21, 5x 0.79, ac 2.86, M 0.64, C3F 0.73.

Type materials: *Holotype* ♂ (SEHU), labeled "CHINA: Mengkan, Xishuangbanna, Yunnan, 1050 m a.s.l., 14.x.1958, ZZ Chen".

Etymology: A combination of the Greek words: *multus* + *procerus*, referring to the median rod of the aedeagus with lobed processes submedially.

Distribution: China (Yunnan Prov.).

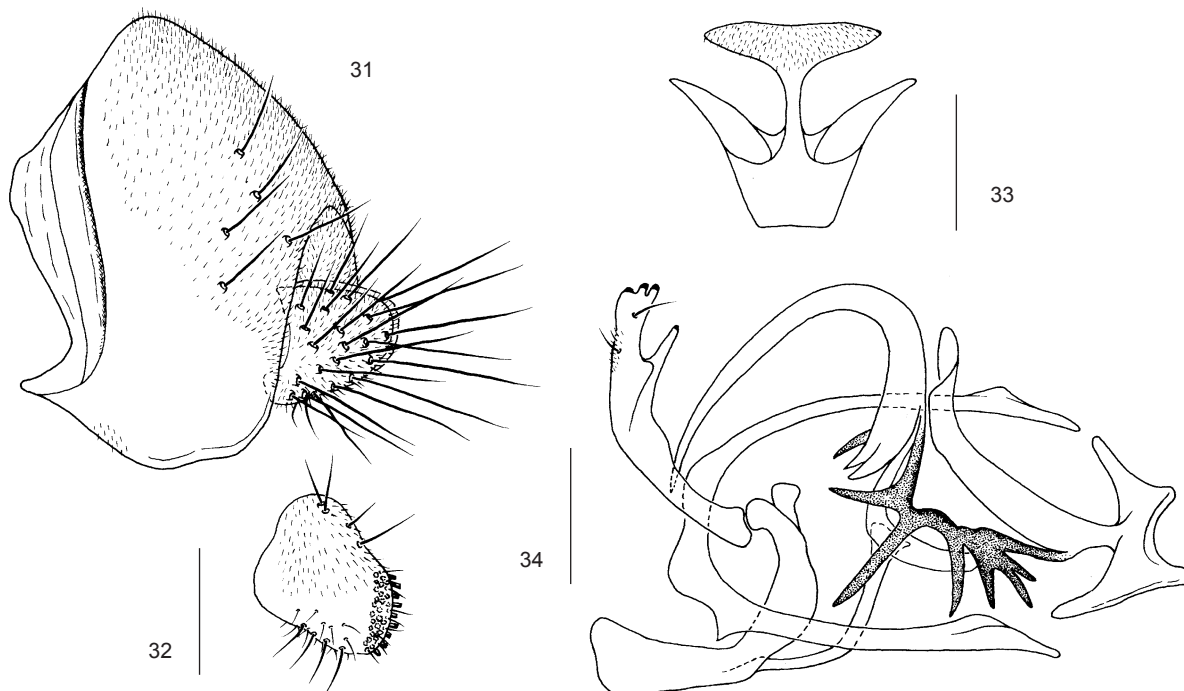
Remarks: The shapes of the paramere and aedeagal median rod of this new species are somewhat similar to those of *P. pi* (Toda and Peng, 1990), but it can be distinguished by the aedeagal basal branch and vertical process of the gonopods (in *P. pi*, the aedeagal basal branch and vertical process of the gonopods have horn-like processes).

***Phortica (Phortica) rhagolobos* Chen and Gao,
sp. nov.**

(Figs. 35-38)

Diagnosis: Paramere apically with 1 sensillum, 2 small teeth, and 1 small triangular projection (Fig. 38); aedeagal median rod with 1 pair of distally bifurcated lobe-like processes submedially (Fig. 38).

Description: Frons yellowish-brown, medially with several minute, interfrontal setulae. Anepisternum lacking setulae. Wing hyaline; r-m and dm-cu crossveins not clouded. Midleg tibia subapically without longer setae on anterior surface. Abdominal 1st to 4th tergites yellow, 1st and 2nd tergites submedially with triangular and laterally with narrow black patches; 3rd and 4th tergites with medially anterior protruding broad, dark-brown bands, sublaterally with 1 pair of yellow patches; 5th tergite black; 6th tergite dark brown with narrow yellow stripe medially. **Male terminalia.** Epandrium lacking pubescence anteroventrally, with 12 setae on dorsal to posterior portion per side (Fig. 35). Surstylus lacking pubescence, with numerous setae and prensisetae



Figs. 31-34. *Phortica (Phortica) multiprocera* Chen and Gao, sp. nov. ♂. **31.** Epandrium, cercus, and surstylus, lateral view. **32.** Surstylus, frontal view. **33.** Tenth sternite and additional plate, frontal view. **34.** Hypandrium, gonopods, paramere, aedeagal median rod, and aedeagal apodeme, lateral view. Scale bars = 0.1 mm.

along apical margin (Fig. 36). Additional plate between cerci and 10th sternite with pubescence, connected to 10th sternite (Fig. 37). Paramere lacking pubescence (Fig. 38). Aedeagal median rod expanded apically (Fig. 38).

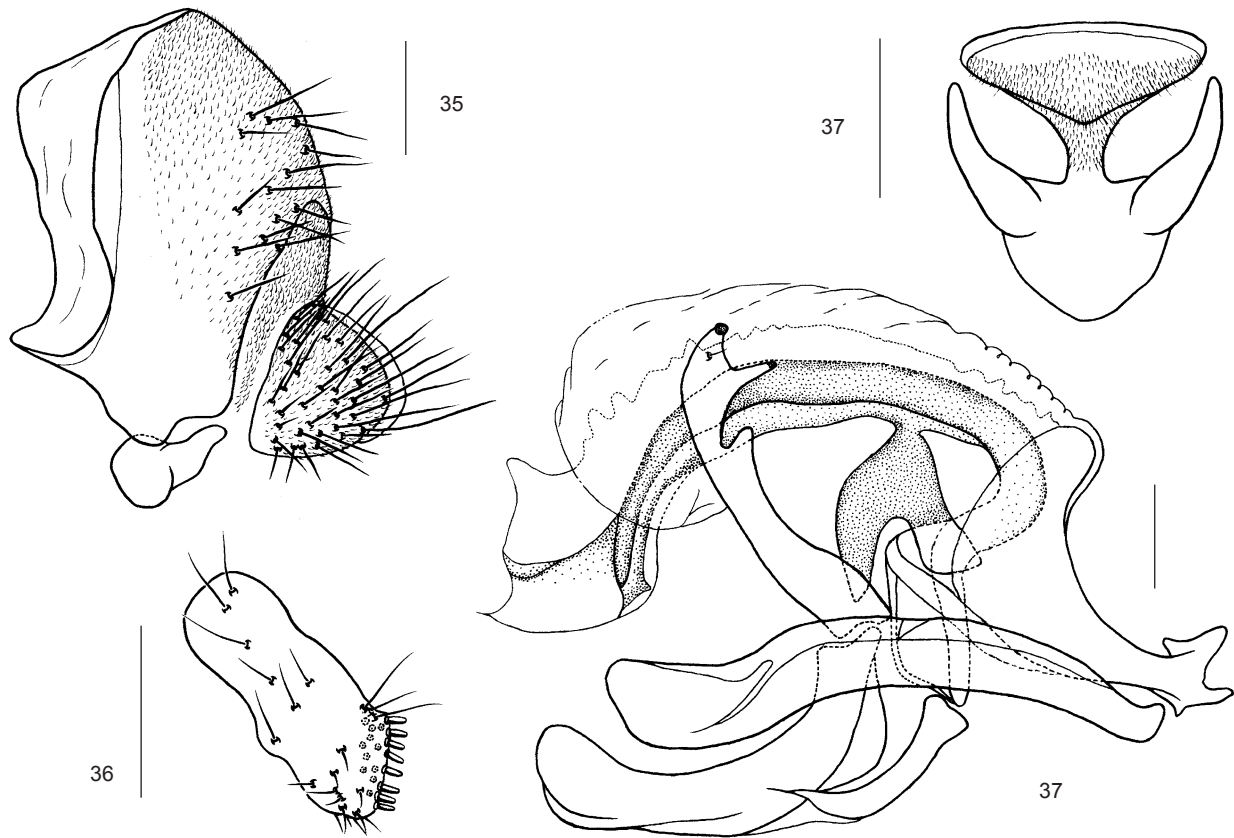
Measurements: BL 3.68 mm in holotype (range in 2 ♂♂ paratypes: 3.60-3.92 mm); ThL 1.68 (1.72-1.84) mm; WL 2.94 (2.78-2.81) mm; WW 1.34 (1.22-1.28) mm. Indices. arb 6/5 (6-7/4-5), avd 0.73 (0.58-0.71), adf 1.38 (1.50-1.71), flw 1.53 (1.57), FW/HW 0.47 (0.48-0.49), ch/o 0.09 (0.06-0.08), pror 0.97 (1.00-1.06), rcorb 0.44 (0.45-0.52), vb 0.68 (0.48-0.53), dcl 0.53 (0.50-0.55), presctl 0.56 (0.50-0.52), sctl 1.07 (1.10), sterno 0.84 (0.76-0.79), orbito 1.45 (1.15-2.00), dcp 0.27 (0.27-0.29), sctlp 1.04 (1.00-1.05), C 2.28 (2.32-2.39), 4c 1.38 (0.94-1.43), 4v 2.62 (1.87-2.76), 5x 0.95 (0.77-1.05), ac 3.79 (3.58-3.67), M 0.61 (0.43-0.57), C3F 0.75 (0.73-0.80).

Type materials: *Holotype* ♂ (SCAU, No. 120092), labeled “CHINA: Menglun, Xishuangbanna, Yunnan, 540 m a.s.l., 13.ix.2002, HW Chen”. *Paratypes*. 2 ♂♂, same data as for holotype except 17 Apr. 2007, JJ Gao (SCAU, No. 120093-94).

Etymology: A combination of the Greek words: *rhagos* and *lobos*, referring to the aedeagal median rod with lobe-like processes submedially.

Distribution: China (Yunnan Prov.).

Remarks: The aedeagal median rod with 1 pair of distally bifurcated lobe-like processes submedially of this new species is similar to that of *P. psi* (Zhang and Gan 1986), but it can be distinguished by the paramere (in *P. psi*, the paramere is tripartite distally; the basal process has 1 sensillum; median process is finger-shaped, without tooth or sensillum; and the distal process has 3 teeth).



Figs. 35-38. *Phortica (Phortica) rhagolobos* Chen and Gao, sp. nov. ♂. **35.** Epandrium, cercus, and surstylus, lateral view. **36.** Surstylus, frontal view. **37.** Tenth sternite and additional plate, frontal view. **38.** Hypandrium, gonopods, paramere, aedeagal median rod, and aedeagal apodeme, lateral view. Scale bars = 0.1 mm.

DISCUSSION

Validity of some new species

Three new species described in the present study, *P. xishuangbanna*, *P. nudiarista*, and *P. pavriarista*, are described for specimens previously treated as type specimens of respective allied species (Chen et al. 2005b). Subsequently, diagnostic characters were found which separated each of them from respective allied species. In addition, the new species status of these 3 forms are also supported by our molecular phylogenetic analysis of DNA sequences of the mitochondrial *COI* and *ND2* genes (to be published elsewhere), as essential species-level genetic divergence was observed between each of them and their respective formerly affiliated species.

Biogeography

Phortica (sensu stricto) is the only subgenus of the genus *Phortica* reported from the Oriental Region. According to Chen et al. (2007), approximately 86 species of this subgenus (78% of those in the world) were recorded from this region. It is now known that 57 *Phortica* species in total are distributed in China (Toda and Peng 1990 1992, Zhang et al. 1996, Chen and Toda 1997

1998, Zhang and Shi 1997, Chen et al. 2005a b, the present study), of which 39 are endemic. Almost all of the Chinese species are limited to south of the Qinling Mountain system, (i.e., the Chinese Oriental Region), except for *P. iota* (Toda and Sidorenko 1996), *P. okadai* (Máca 1977), and *P. chi* (Toda and Sidorenko 1996). The former 2 species are also found in the Palearctic Region, with *P. iota*, which has the widest range, having been recorded as far north as the Russian Far East (Toda et al. 1996). The last species occurs only north of the Qinling Mountain system, with its northernmost record is also from East Siberia (Toda et al. 1996). Therefore, it is likely that the subgenus *Phortica* originated from the Oriental Region and diversified there, giving rise to the current high level of species diversity. It is notable that the area from Xishuangbanna to the Hengduan Mountains in southwestern China proved to have the highest *Phortica* species diversity within the Oriental Region, with 45 *Phortica* (sensu stricto) species from all 5 currently recognized species complexes and groups having been recorded. Moreover, more than 1/2 (24) of these species are found in lower-elevation, tropical-like climate zones, while the others (14) are from higher-elevation, subtropical- or temperate-like zones; 7 are of higher (> 1500 m in elevation), temperate-like habitats. This indicates that the region may



Fig. 39. *Phortica okadai* (Máca, 1977) breeding on sap flux on the trunk of *Ziziphus*.

have served as a major speciation center of the subgenus *Phortica*.

Behavior and breeding sites

Máca (1977) and some references therein reported collecting flies of the *Phortica variegata* species complex, including egg-laying females from the tree sap of *Betula* and *Quercus*, as well as males flying about human eyes or sucking on beads of perspiration. We have very similar experiences with diverse *Phortica* species from different groups and complexes. Even though the flies, mostly males, were collected about the eyes or when pursuing the odor of perspiration and perfume, individuals, both males and females, of the same species can sometimes be captured at the same site by sweeping or aspirating on the sap fluxes of tree trunks, especially of *Ziziphus* (Fig. 39), *Cyclobalanopsis*, *Colubrina*, *Castanea*, and *Quercus* in southern China. Therefore, flies (males and females) of many species of *Phortica* may be feeding and probably breeding on the tree sap, with males attracted to volatile human odors of perfume, beer, etc.

Key to all species of the genus *Phortica* from China (males)

1. Epandrium small, not reaching ventral margin of 6th tergite, tapering laterally; surstylus elongated and narrowed, stick-like; gonopods fused to aedeagus (*varipes* species group) *helva* Chen and Gao, sp. nov.
- Epandrium arch-like, round laterally; surstylus lobe-like; gonopods and aedeagus separated from each other 2
2. Interfrontal setae thick; additional plate between cerci and 10th sternite absent; paramere rod-shaped, basally mostly projecting and with a few sensilla, apically usually knobbed (*foliiseta* species complex) 3
- Interfrontal setae thin and sparse; additional plate between cerci and 10th sternite present; paramere with sensilla apically 18
3. Arista not expanded apically; all tibiae with 2 dark rings; 5th tarsomere of foreleg without long seta apically 4
- Arista expanded apically; all tibiae without dark rings; 5th tarsomere of foreleg with 1 long seta apically 5
4. Vertical process of gonopods nearly symmetric, aedeagal median rod separated into 2 deeply bifurcated sclerites *afoliolata* Chen and Toda
- Vertical process of gonopods distinctly asymmetric; aedeagal median rod apically trifoliated, with 2 small, separated sclerites *xishuangbanna* Cheng and Chen, sp. nov.
5. Surstylus with prensisetae 6
- Surstylus without prensisetae 10
6. Arista with 2 ventral branches submedially; hypandrium asymmetric; aedeagal outer membrane lacking spinules or processes *glabra* Chen and Toda
- Arista without ventral branches; hypandrium symmetrical; aedeagal outer membrane with spinules or processes ... 7
7. Vertical process of gonopods developed, nearly entirely sclerotized apically; aedeagal median rod absent 8
- Vertical process of gonopods small, nearly unsclerotized apically; aedeagal median rod present 9
8. Paramere pointed apically; arista tip with 1 small process medially *spinosa* Chen and Gao
- Paramere round apically; arista tip with 3 small processes medially and laterally *longipenis* Chen and Gao
9. Arista tip unbifurcated apically; paramere not recurved basally; aedeagal median rod not bifurcated, hooked apically, somewhat anchor-like *tanabei* Chen and Toda
- Arista tip deeply bifurcated apically; paramere distinctly recurved basally; aedeagal median rod submedially separated into 2 apically pointed sclerites *huiluoi* Cheng and Chen, sp. nov.
10. Vertical process of gonopods completely symmetrical *symmetria* Chen and Toda
- Vertical process of gonopods asymmetrical 11
11. Vertical process of gonopods triangular, with only 1 sclerotized process apically 12
- Vertical process of gonopods constricted apically, with 2 sclerotized processes apically 15
12. Arista with 1 or 2 dorsal branches basally 13
- Arista without distinct dorsal branches 14
13. Arista with micropubescent ventrally; expanded tip as wide as 3 times base *speculum* (Máca and Lin)
- Arista lacking micropubescent ventrally; expanded tip as wide as base *pavriarista* Cheng and Chen, sp. nov.
14. Projections of vertical process of gonopods apically pointed *brachychaeta* Chen and Toda
- Projections of vertical process of gonopods apically blunt *nudiarista* Cheng and Chen, sp. nov.
15. Arista basally with 1 or 2 distinct dorsal branches; vertical process of gonopods sclerotized only apically, anterior projection on right, lateral lobe of vertical process not bifurcated *foliiseta* Duda
- Arista basally without distinct dorsal branches; vertical process of gonopods strongly sclerotized 16
16. Arista tip broadened, as long as 2/3 wide; posterior projection on right, lateral lobe of vertical process of gonopods with 1 pointed process; paramere strongly curved distally *saltiaristula* Chen and Wen
- Arista tip arrow-like; posterior projection on right, lateral lobe of vertical process of gonopods with 2 processes apically; paramere slightly curved distally 17
17. Anterior projection on right, lateral lobe of vertical process strong, serrated on apical margin *foliisetoides* Chen and Toda
- Anterior projection on right, lateral lobe of vertical process slender, apically pointed, not serrated *sagittaristula* Chen and Wen
18. Surstylus with strong spine on apical margin 19
- Surstylus without strong spine on apical margin 22
19. Surstylus with 3 long and 3 short strong spines on apical margin *pseudogigas* (Zhang and Gan)
- Surstylus with only 1 strong spine on apical margin (*magna* species complex) 20
20. Vertical process of gonopods with no sclerotized process *magna* (Okada)
- Vertical process of gonopods with sclerotized process 21
21. Vertical process of gonopods with 2 sclerotized processes; surstylus with small verrucae on distal margin 21

-*bicornuta* (Chen and Toda)
 - Vertical process of gonopods with only 1 sclerotized process; surstylus without small verrucae on distal margin*foliata* (Chen and Toda)
22. Hind tibia distally with 1 row of strong, longer setae on anterior surface; paramere deeply bifurcated from base (*omega* species complex)..... 23
 - Hind tibia distally without strong, longer setae row on anterior surface; paramere branched distally or submedially 25
23. Sixth tergite with no ornamentation on lateral margins; epandrium pubescent anteroventrally; surstylus basally broad, pubescence on outer surface
 - Sixth tergite with prickly process and/or dense, long setae on lateral margins; epandrium lacking pubescence anteroventrally; surstylus basally narrow, lacking pubescence on outer surface 24
24. Sixth tergite with 2 prickly processes on lateral margins ...
 - Sixth tergite with only 1 prickly process on anterior corners of lateral margins, posterior corners with dense long setae*omega* (Okada)
25. Anepisternum with setulae 26
 - Anepisternum without setula 31
26. Paramere submedially pubescent; vertical process of gonopods slightly narrowed apically
 - Paramere lacking pubescence; vertical process of gonopods not narrowed apically 27
27. Paramere with slender secondary process 28
 - Paramere without secondary process 30
28. Paramere with thick process apically and 2 sharp projections, subapically with 3 sensilla, lacking teeth; thin process glabrous*bipartite* (Toda and Peng)
 - Paramere with thick process and sensilla and teeth apically, lacking projections; thin process with 1 tooth apically 29
29. Aedeagal basal bridge with thick branch
 - Aedeagal basal bridge with dendritic branch
*unirama* Chen and Wen
*eparmata* (Okada, 1977)
30. Aedeagal median rod symmetrically lacking process, expanded subapically*setitabula* Chen and Wen
 - Aedeagal median rod not expanded subapically, with 1 pair of lobe-like processes*pangi* Chen and Wen
31. Sixth tergite constricted at anterior corners of lateral margins 32
 - Sixth tergite not constricted at anterior corners of lateral margins 33
32. Arista with only 1 short ventral branch; vertical process of gonopods not narrowed, unsclerotized apically
 - Arista with 2 or 3 long ventral branches; vertical process of gonopods narrowed and sclerotized apically
*cardua* (Okada)
33. Arista with 4~6 minute dorsal branches; cercus elongated ventrally, with 3 long strong setae apically
 - Arista with long dorsal branches; cercus not elongated, without long strong setae 34
34. Paramere tripartite distally 35
 - Paramere not tripartite distally 50
35. Basal process of paramere: with tooth or sensillum; median process tongue- or finger-shaped, without tooth or sensillum 36
 - Basal process of paramere tongue- or finger-shaped; median process apically with tooth and sensillum 44
36. Aedeagal median rod subbasally or submedially without processes*okadai* (Máca)
 - Aedeagal median rod subbasally or submedially with processes 37
37. Outer membrane of aedeagus with minute transparent spinules; subbasal processes small and rod-like, separated from each other 38
 - Outer membrane of aedeagus lacking minute transparent spinules; subbasal processes lobe-like, fused basally 41
38. Aedeagal median rod submedially with binate long, lobe-like projections 39
 - Aedeagal median rod distally with small triangular projections 40
39. Aedeagal median rod apically with asymmetrical projection; submedial lobe-shaped projection not narrowed basally*acongruens* (Zhang and Shi)
 - Aedeagal median rod subapically with asymmetric projection; submedial lobe-shaped projection narrowed basally*linae* (Máca and Chen)
40. Aedeagal median rod with 2 different-sized projections submedially*gamma* (Toda and Peng)
 - Aedeagal median rod with 2 same-sized projections submedially*eugamma* (Toda and Peng)
41. Aedeagal median rod with 1 pair of asymmetrical processes subbasally and 1 pair of processes as long as 1/2 of median rod submedially
 - Aedeagal median rod with symmetrical, nearly triangular processes subbasally; shorter than 1/3 of median rod 42
42. Aedeagal median rod subapically not expanded, with 1 pair of apically bifurcated, lobe-like processes submedially*psi* (Zhang and Shi)
 - Aedeagal median rod subapically not expanded, without processes submedially 43
43. Aedeagal median rod apically with 2 acute projections per side*iota* (Toda and Sidorenko)
 - Aedeagal median rod apically with only 1 acute projection per side*saeta* (Zhang and Gan)
44. Aedeagal basal bridge with strongly sclerotized hook-like processes 45
 - Aedeagal basal bridge without hook-like processes 47
45. Hook-like processes of aedeagal basal bridge apically bifurcated; vertical process of gonopods with 6 or 7 pairs of small, sawtooth-shaped processes distally
*uncinata* Chen and Gao
 - Hook-like processes of aedeagal basal bridge apically not bifurcated; vertical process of gonopods with horn-like processes apically and basally 46
46. Vertical process of gonopods with 2 pairs of strongly sclerotized horn-like process processes apically and basally; apical longer than basal*pi* (Toda and Peng)
 - Basal horn-like processes of vertical process of gonopods longer than apical*pseudopi* (Toda and Peng)
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*subradiata* (Okada)

- Vertical process of gonopods nearly membranous, apically expanded to round, saccate-like..... *orientalis* (Hendel)
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- Process of aedeagal basal bridge strong sclerotized, without small triangular warts or fine wrinkles on surface .
.....*pseudotau* (Toda and Peng)
- 50. Epandrium roundly expanded ventrally; surstylus with about 15-17 long strong prenisetae along inner margin; additional plate separated from 10th sternite
.....*latifoliacea* Chen and Watabe, sp. nov.
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- 51. Aedeagal basal bridge with several radiating-like processes; aedeagal median rod slightly bifurcated basally*multirocera* Chen and Gao, sp. nov.
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- 53. Arista lacking distinct ventral branch; 6th tergite with 1 spine-like process on anterior corners of lateral margins ..
.....*protrusa* (Zhang and Shi)
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- 54. Aedeagal median rod with transparent, minute sawtooth-like processes submedially.....*flexuosa* (Zhang and Gan)
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.....*rhagolobos* Chen and Gao, sp. nov.
- 55. Vertical process of gonopods curved backward, basally narrowed stalk-like; aedeagal median rod without processes submedially
.....*excrescentiosa* (Toda and Peng)
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- 56. Aedeagal median rod with 1 small process apically not bifurcated and 1 pair of slender processes; vertical process of gonopods strongly sclerotized on lateral margins, basally with 1 pair of pointed processes
.....*lambda* (Toda and Peng)
- Aedeagal median rod with 1 small process apically bifurcated and 3 pairs of slender processes submedially; vertical process of gonopods equably sclerotized, basally without processes..... *huazhii* Cheng and Chen, sp. nov.

Female specimens are difficult, if not impossible, to identify to species only by morphological characters.

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REFERENCES

- Bächli G, CR Vilela, SA Escher, A Saura. 2004. The Drosophilidae (Diptera) of Fennoscandia and Denmark. *In* Fauna Entomologica Scandinavica. Vol. 39. Leiden, New York: Brill, pp. 1-362.
- Chen HW. 2001. A phylogenetic and taxonomic study on the subfamily Steganinae (Diptera, Drosophilidae). PhD dissertation, Hokkaido Univ., Sapporo, Japan, pp. 1-195.
- Chen HW, JJ Gao, SY Wen. 2005a. Species diversity of the subgenus *Phortica* (s. str.) in Yunnan, China, with descriptions of nine new species (Diptera, Drosophilidae). *J. Nat. Hist.* **40**: 3951-3978.
- Chen HW, MJ Toda. 1997. *Amiota* (*Phortica*) *magna* species-complex, with descriptions of three new species from China (Diptera, Drosophilidae). *Jpn. J. Entomol.* **65**: 784-792.
- Chen HW, MJ Toda. 1998. *Amiota* (*Phortica*) *omega* species-complex, with descriptions of two new species from southern China (Diptera, Drosophilidae). *Entomol. Sci.* **1**: 403-407.
- Chen HW, MJ Toda. 2001. A revision of the Asian and European species *In* the subgenus *Amiota* Loew (Diptera, Drosophilidae) and establishment of species-groups based on phylogenetic analysis. *J. Nat. Hist.* **35**: 1517-1563.
- Chen HW, MJ Toda, JJ Gao. 2005b. The *Phortica* (s. str.) *folliiseta* species-complex (Diptera, Drosophilidae) from China and adjacent countries. *Acta Zootax. Sin.* **30**: 419-429.
- Chen HW, MJ Toda, MB Lakim, MB Mohamed. 2007. The *Phortica* sensu stricto (Insecta: Diptera: Drosophilidae) from Malaysia. *Raffles Bull. Zool.* **55**: 23-41.
- Duda O. 1924. Beitrag zur Systematik der Drosophiliden unter besonderer Berücksichtigung der paläarktischen und orientalischen Arten (Dipteren). *Arch. Naturg.* **90**: 172-234.
- Máca J. 1977. Revision of Palaearctic species of *Amiota* subgenus *Phortica* (Diptera, Drosophilidae). *Acta Entomol. Bohemoslov* **74**: 115-130.
- Máca J. 2003. Taxonomic notes on the genera previously classified in the genus *Amiota* Loew (Diptera, Drosophilidae, Steganinae). *Acta Univ. Carol. (Biol.)* **47**: 247-274.
- Máca J, FJ Lin. 1993. The Drosophilidae of Taiwan: genera *Amiota* subgenus *Phortica*. *Bull. Inst. Zool. Acad. Sin.* **32**: 171-183.
- Okada T. 1977. The subgenus *Phortica* Schiner of the genus *Amiota* Loew of Japan and the Oriental Region, with reference to anti-Burla's rule (Diptera, Drosophilidae). *Bull. Biogeog. Soc. Jap.* **32**: 17-31.
- Schiner IR. 1862. Vorläufiger Commentar zum dipterologischen Theile der "Fauna Austriaca". *Wien. Entomol. Monatschr.* **6**: 428-436.
- Toda MJ, TX Peng. 1990. Eight new species of the subgenus *Phortica* (Diptera: Drosophilidae, *Amiota*) from Guangdong Province, southern China. *Entomotaxon* **12**: 41-55.
- Toda MJ, TX Peng. 1992. Some species of the subfamily

- Steganinae (Diptera, Drosophilidae) from Guangdong Province, southern China. *Ann. Soc. Entomol. Fr.* **28**: 201-213.
- Toda MJ, VS Sidorenko, H Watabe, KK Sergey, NN Vinokurov. 1996. A revision of the Drosophilidae (Diptera) in East Siberia and Russian Far East: taxonomy and biogeography. *Zool. Sci.* **13**: 455-477.
- Tsacas L, T Okada. 1983. On the Oriental and New Guinean species of the genus *Amiota* Loew originally described by Duda as *Phortica foliiseta*, with descriptions of three new species (Diptera, Drosophilidae). *Kontyû (Tokyo)* **51**: 228-237.
- Zhang WX, HZ Chen, TX Peng. 1996. The family Drosophilidae. In WQ Xue, CM Chao, eds. *Flies of China*. Shenyang, China: Liaoning Science and Technology Press, pp. 280-489. (in Chinese)
- Zhang WX, YX Gan. 1986. Description of eight new species of drosophilid flies from Kunming (Diptera, Drosophilidae). *Zool. Res.* **7**: 351-365. (in Chinese with English summary)
- Zhang WX, LM Shi. 1997. Subgenus *Phortica* of genus *Amiota* in Hengduan Mountains region, China, with descriptions of three new species (Diptera: Drosophilidae). *Zool. Res.* **18**: 367-375. (in Chinese with English summary)