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Asiphonipponaphis, a new genus of Hormaphidinae (Hemiptera, Aphididae) causing galls on *Distylium chinense* from China, with description of a new species

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Abstract

The aphid genus *Asiphonipponaphis* **gen. n.** from China is new to science. *Asiphonipponaphis vasigalla* **sp. n.** causing galls on *Distylium chinense* from Hunan, China is described and illustrated. Holotype and paratypes are deposited in the National Zoological Museum of China, Institute of Zoology, Chinese Academy of Sciences, Beijing, China (NZMCAS) and Kogakkan University, Japan.

Keywords

Asiphonipponaphis, Aphididae, Hormaphidinae, new genus, new species, China

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Introduction

The aphid tribe Nipponaphidini in subfamily Hormaphidinae (Hemiptera: Aphididae) occurs in East and Southeast Asia, with *Distylium* as the primary host, on which different shaped and sized galls are produced, and Fagaceae, Lauraceae and Moraceae as the secondary hosts (Ghosh 1988). Pergande (1906) described the first nipponaphidine species causing galls on *Distylium* from Japan. Since then, many gall-forming species on *Distylium* have been described (Matsumura 1917, Monzen 1934, 1954, Takahashi 1958, 1962, Hille Ris Lambers 1959, Noordam 1991, Sorin 1996). Takahashi (1962) and Sorin (1987) reviewed the species which cause galls on *Distylium* in Japan. Blackman and Eastop (1994) keyed the aphid species on *Distylium*, including free-living apterae and alatae emerging from galls. Sorin (2003) keyed the aphid species living on *Distylium racemosum* in Japan based on the galls and their detailed life cycles.

Up to now, at least eighteen species and one subspecies in twelve genera are known to induce galls on *Distylium*. Thirteen species and one subspecies are recorded on *Distylium racemosum*, viz. *Dinipponaphis autumna* (Monzen), *Indonipponaphis fulvicola* Sorin, *Metanipponaphis cuspidatae* (Essig & Kuwana), *M. rotunda* Takahashi, *M. rotunda nakijinensis* Sorin, *Metathoracaphis isensis* Sorin, *Monzenia globuli* (Monzen), *M. ihai* Sorin, *Neothoracaphis yanonis* (Matsumura), *Nipponaphis distychii* Pergande, *N. distyliicola* Monzen, *N. loochooensis* Sorin, *N. monzeni* Takahashi and *Quadrartus yoshinomiyai* Monzen. Five species are recorded on *Distylium stellare*, viz. *Distylaphis foliorum* (van der Goot), *Neohormaphis calva* Noordam, *Reticulaphis distylii* (van der Goot), *Schizoneuraphis gallarum* van der Goot and *S. longisetosa* Noordam. In China, *Neothoracaphis yanonis* also forms galls on *Distylium chinense* (personal observation).

In this study, a new genus and a new species, *Asiphonipponaphis vasigalla* sp. n. causing galls on *Distylium chinense* is described from Hunan, China, further enriching the group of aphid species forming galls on *Distylium*.

Materials and methods

All specimens examined in this study were collected from Jishou University (Jishou City) by X. T. Li.

Aphid terminology in this paper generally follows Ghosh (1988) and Noordam (1991). The unit of measurements in this paper is millimeters (mm).

In Table 1, the following abbreviations have been used: Ant.I, Ant.II, Ant.III, Ant.IV, Ant.Vb, for antennal segments I, II, III, IV and the base of antennal segment V, respectively; PT, processus terminalis; Ant.IIIWD, the widest diameter of antennal segment III; URS, ultimate rostral segment; BW URS, basal width of ultimate rostral segment; 2HT, second hind tarsal segment; MW hind tibia, mid-width of hind tibia; BW Cauda, basal width of cauda; AP, anal plate; GP, genital plate.

Table 1. Biometric data of *Asiphonipponaphis vasigalla* sp. n. (in mm).

Parts (For abbreviations see Materials and methods)		**Fundatrix (n=1)**	**Alate vivipara (n=10)**		
			Mean	**Range**	**Standard Deviation**
Length (mm)	Body length	2.036	2.394	2.204–2.492	0.098
	Body width	1.723	1.162	1.126–1.219	0.029
	Ant.I	0.057	0.062	0.052–0.073	0.008
	Ant.II	0.043	0.048	0.045–0.051	0.003
	Ant.III	0.189	0.406	0.371–0.443	0.023
	Ant.IV	/	0.183	0.156–0.203	0.015
	Ant.Vb	/	0.076	0.065–0.085	0.007
	PT	0.026	0.026	0.020–0.032	0.004
	URS	0.063	0.068	0.065–0.071	0.003
	Hind femur	0.342	0.532	0.516–0.548	0.009
	Hind tibia	0.301	0.684	0.661–0.701	0.012
	2HT	0.072	0.106	0.099–0.111	0.004
	Cauda	0.025	0.048	0.043–0.050	0.002
	BW Cauda	0.035	0.054	0.050–0.057	0.003
	Ant.IIIWD	0.038	0.051	0.048–0.056	0.002
	MW Hind tibia	0.035	0.039	0.035–0.042	0.002
	Cephalic setae	0.026	0.013	0.012–0.017	0.002
	Setae on Tergum I	0.023	0.022	0.015–0.027	0.004
	Setae on Tergum VIII	0.038	0.037	0.032–0.041	0.003
	Setae on Hind tibia	0.024	0.031	0.027–0.033	0.002
No. of setae on	Ant.I	2		1–3	
	Ant.II	2		2	
	Ant.III	0		0	
	Ant.IV	0		0	
	Ant.Vb	0		0	
	PT	0+4		0+5	
	URS	6		6	
	Tergum VIII	4		5–8	
	Cauda	9		12–19	
	Each lobe of AP	9–10		10–15	
	GP	13		39–52	
Ratio (times)	Whole antenna / Body	0.14	0.33	0.32–0.35	0.009
	Hind femur / Ant.III	/	1.32	1.21–1.48	0.084
	Hind tibia / Body	0.15	0.29	0.28–0.31	0.012
	PT / Ant.Vb	/	0.35	0.24–0.48	0.071
	URS / BW URS	1.43	1.29	1.09–1.55	0.159
	URS / 2HT	0.88	0.65	0.61–0.71	0.037
	Cauda / BW Cauda	0.74	0.90	0.80–1.01	0.071
	Cephalic setae / Ant.IIIWD	0.68	0.26	0.22–0.33	0.032
	Setae on Tergum I / Ant.IIIWD	0.61	0.43	0.29–0.53	0.078
	Setae on Tergum VIII / Ant.IIIWD	1.01	0.72	0.58–0.80	0.067
	Setae on hind tibia / MW Hind tibia	0.68	0.79	0.68–0.92	0.081

Specimen depositories: the holotype and ten paratypes of the new species are deposited in the National Zoological Museum of China, Institute of Zoology, Chinese Academy of Sciences, Beijing, China (NZMCAS), and two paratypes in Kogakkan University, Japan.

Taxonomy

***Asiphonipponaphis* gen. n.**
urn:lsid:zoobank.org:act:42BF723C-37E9-4FA5-AFC1-C81FEDA1F066
http://species-id.net/wiki/Asiphonipponaphis

Type species. *Asiphonipponaphis vasigalla* sp. n.

Etymology. The new genus is named for the absence of siphunculi. "*A*" (Latin) means "absent", "*sipho*" (Latin) means "siphunculi", "*nipponaphis*" refers to its affiliation to the tribe Nipponaphidini.

Generic diagnosis. In alatae, antennae 5-segmented, secondary rhinaria annular. Rostrum short, ultimate rostral segment shorter than second hind tarsal segment, with 2 pairs of primary setae and 1 pair of accessory setae. Abdomen with 5 pairs of spiracles, present on abdominal segments II–VI. Siphunculi absent in both fundatrix and emigrant alatae. Cauda knobbed, distinctly constricted at base. Anal plate bilobed. Legs normal. Tarsi 2-segmented, claws normal, first tarsal chaetotaxy of alatae 3, 3, 3. Fore wings of emigrant alatae with pterostigma narrow and long, distal margin of pterostigma forming almost a straight line with the hind margin, media unbranched, not united with cubitus, and two cubitus veins fused at base; hind wings with 2 obliques.

Comments. This new genus is unique in Nipponaphidini by its peculiar galls and morphological characters. Different from other saccate galls on *Distylium*, e.g. galls of *Nipponaphis*, its galls are located on the midrib of leaves and split at the tip when mature, forming a flower-shaped opening, while galls of *Nipponaphis* are located on twigs and usually open on the lateral wall of the galls when mature. It is related to *Quadrartus* Monzen for sharing several characters in alatae, such as spiracles present on abdominal segments II–VI (i.e. 5 on each side of abdomen), distal margin of pterostigma forming almost a straight line with the hind margin, but differs from the latter as follows: antennae 5-segmented (in *Quadrartus*: 4-segmented); media of fore wings unbranched (in *Quadrartus*: once branched); siphunculi absent (in *Quadrartus*: present). It is also related to *Indonipponaphis* Ghosh & Raychaudhuri. Both of them possess 5-segmented antennae in alatae and induce galls on the midrib of leaves of *Distylium*. But the new genus differs from *Indonipponaphis* as follows: abdomen with 5 pairs of spiracles (in *Indonipponaphis*: 4 pairs); media of fore wings unbranched (in *Indonipponaphis*: once branched); siphunculi absent (in *Indonipponaphis*: present).

Taxonomy of Nipponaphidini is mostly based upon the apterae on secondary hosts. The identification of alatae is much more difficult because of the vague descriptions and limited diagnostic characters. But not all species are known by both alate

and apterous morphs. Thus identification of alatae, although confusing, is still very important to the classification of Nipponaphidini. Further observations of life cycles will probably reveal more gall causers on *Distylium*, and acquisition of more morphs will facilitate the taxonomic study and clear up the confusion.

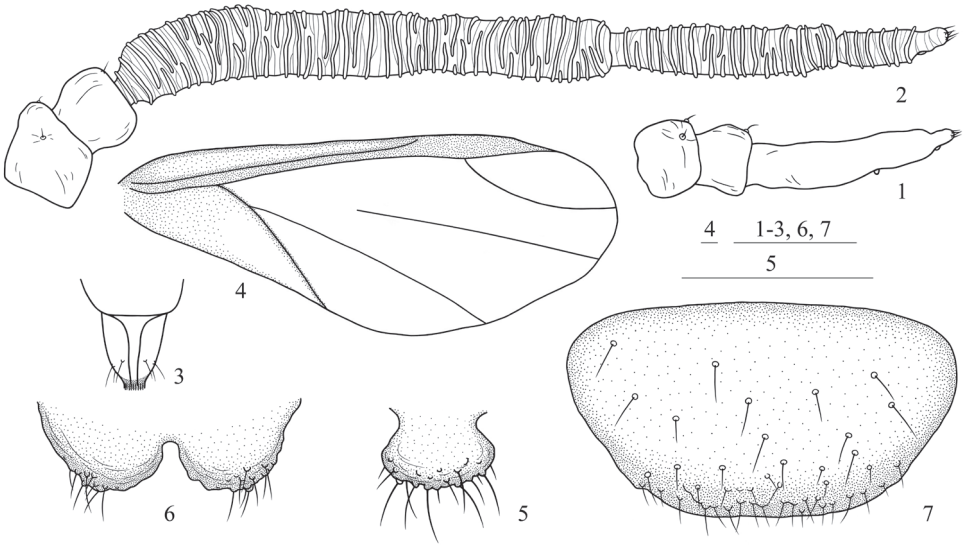
***Asiphonipponaphis vasigalla* sp. n.**
urn:lsid:zoobank.org:act:EAA77666-5C96-4AF6-9C27-87C01F0ED006
http://species-id.net/wiki/Asiphonipponaphis_vasigalla
Figs 1–20

Locus typicus. China (Hunan, 28°17'23"N, 109°43'11"E, altitude 240 m).

Etymology. The new species is named for the shape of gall. "*Vas*" (Latin) means "vase", "*galla*" (Latin) means "gall".

Description. *Fundatrix*: Body oval, nearly round (Fig. 8), reddish brown and covered with thin white wax in life. For morphometric data see Table 1.

Mounted specimens. Body lightly sclerotized, pale in color. Antennae, ultimate rostral segment and legs brown. Head, thorax and abdominal segments I–VII completely fused. Dorsum smooth. Abdominal tergite VIII with dense spinulose imbrications. Spiracles oval, closed, on abdominal segments II–IV, spiracular plates light brown. Dorsal setae of body little, short and pointed. Head with 1 pair of cephalic, 1 pair of spinal, 1 pair of pleural and 1 pair of marginal setae; thoracic nota each with 1 pair of spinal, 1 pair of pleural and 2 pairs of marginal setae; abdominal tergites I–VI each with 1 pair of spinal, 1 pair of pleural and 1 pair of marginal setae; tergite VII with 1 pair of marginal setae; tergite VIII with 4 setae. Cephalic setae, marginal setae on abdominal tergite I and setae on tergite VIII 0.68 times, 0.61 times and 1.01 times as long as widest diameter of antennal segment III, respectively. Front straight. Eyes 3-faceted. Antennae 3- or 4-segmented (Fig. 1); 0.14 times as long as body. Length in proportion of segments I–III: 35 : 26 : 100+16, respectively. Processus terminalis 0.16 times as long as base of the segment III; very thin, basal width 0.47–0.57 times as long as apical width of base of the segment III. Setae on antennae sparse. Segments I–III each with 2, 2, 0+0 setae, respectively. Processus terminalis with 4 apical setae. Primary rhinaria small, round, protuberant and placed wide apart. Rostrum short and thick, not reaching mid-coxae. Ultimate rostral segment blunt wedge-shaped, 1.43 times as long as its basal width, 0.88 times as long as second hind tarsal segment; with 2 pairs of primary setae and 1 pair of accessory setae. Legs normal. Trochanters and femora fused. Hind trochanter and femur 2.11 times as long as the base of antennal segment III, hind tibia 0.15 times as long as body. Setae on legs sparse, fine and pointed. Setae on hind tibia 0.68 times as long as its mid-diameter. First tarsal chaetotaxy: 2, 2, 2. Siphunculi absent. Cauda, anal plate and genital plate with dense spinulose imbrications. Cauda knobbed, indistinctly constricted at base, 0.74 times as long as its basal width, with 9 setae. Anal plate bilobed, each with 9 or 10 setae. Genital plate broad round, with 2 anterior setae and 11 setae along the posterior margin. Two gonapophyses each with 3 or 4 short setae.

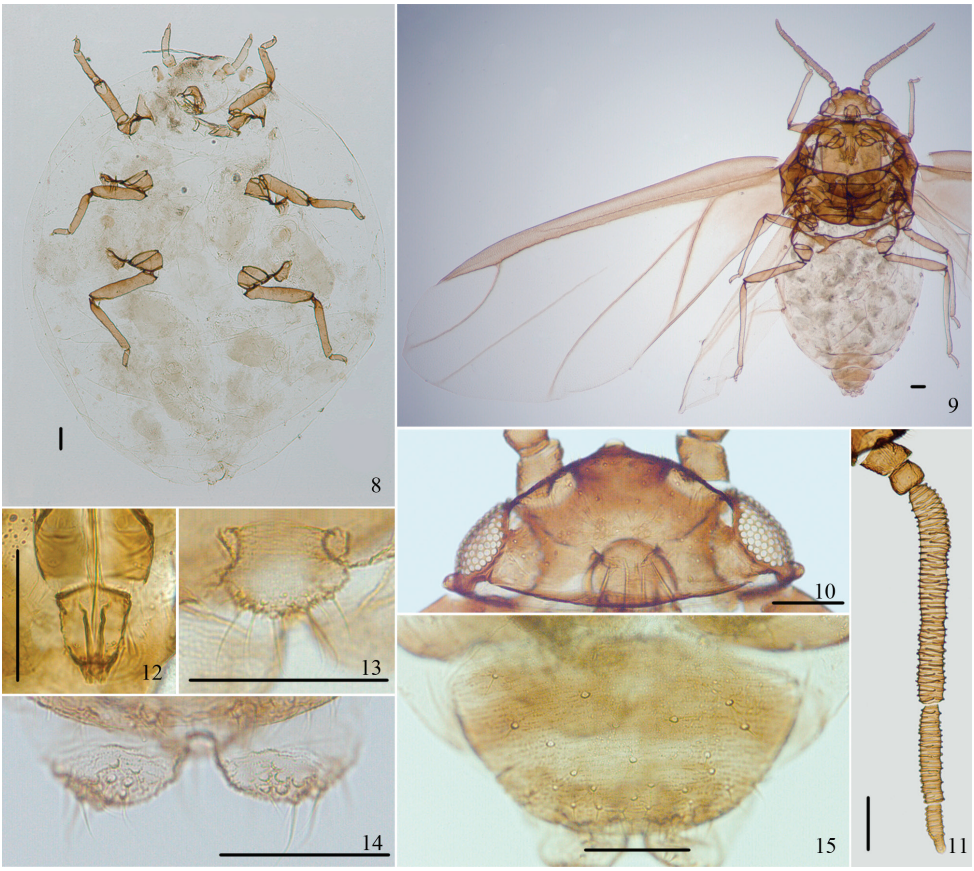


Figures 1–7. *Asiphonipponaphis vasigalla* **sp. n.** Fundatrix **1** antenna. Alate viviparous female (emigrant from galls) **2** antenna **3** ultimate rostral segment **4** fore wing **5** cauda **6** anal plate **7** genital plate. Scale bars = 0.10 mm.

Alate viviparous females (emigrants from galls): Body oval (Fig. 9), cephalothorax black, abdomen dark reddish brown and pterostigma black in life, wings flat in repose. For morphometric data see Table 1.

Mounted specimens. Head, thorax, antennae, ultimate rostral segment, legs and genital plate brown, abdominal tergites VII–VIII with brown broad transverse bands, forewing veins and pterostigma brown, the other parts of body pale. Dorsum of head with sparse imbrications, tibiae, tarsi, venter of femora and abdominal tergites VI–VIII with dense spinulose imbrications. Spiracles oval, closed, on abdominal segments II–VI, spiracular plates brown. Dorsal setae of body short and pointed, on light brown seta-bearing sclerites. Head with 10–25 dorsal setae between antennae and 15–20 dorsal setae between eyes; pronotum with 1 pair of spinal, 1 pair of pleural and 2 pairs of marginal setae; mesonotum with 19–30 setae; abdominal tergite I with 5–8 spino-pleural and 1 pair of marginal setae; abdominal tergite II with 4–9 spino-pleural and 1 pair of marginal setae; abdominal tergite III with 6–8 spino-pleural and 1 pair of marginal setae; abdominal tergites IV–V each with 5–8 spino-pleural and 1 pair of marginal setae; abdominal tergites VI–VII each with 4–6 spino-pleural and 1 pair of marginal setae; tergite VIII with 5–8 setae. Cephalic setae, marginal setae on abdominal tergite I and spinal setae on tergite VIII 0.22–0.33 times, 0.29–0.53 times and 0.58–0.80 times as long as widest diameter of antennal segment III, respectively.

Head (Fig. 10): Front protuberant. Eyes compound. Antennae 5-segmented (Figs. 2, 11), with dense spinulose imbrications on segments III–V; 0.32–0.35 times as long as body. Length in proportion of segments I–V: 15 : 12 : 100 : 45 : 19+7, respectively. Processus terminalis 0.24–0.48 times as long as base of the segment V. Setae on antennae



Figures 8–15. *Asiphonipponaphis vasigalla* **sp. n.** Fundatrix **8** dorsal view of body. Alate viviparous female (emigrant from galls) **9** dorsal view of body **10** dorsal view of head **11** antenna **12** ultimate rostral segment **13** cauda **14** anal plate **15** genital plate. Scale bars = 0.10 mm.

sparse. Segments I–V each with 1–3, 2, 0, 0, 0+0 setae, respectively. Processus terminalis with 5 apical setae. Primary rhinaria small, round and ciliated. Segments III, IV and base of segment V each with 37–44, 16–21, 6–9 annular secondary rhinaria, respectively. Rostrum short, not reaching mid-coxae. Ultimate rostral segment blunt wedge-shaped (Figs. 3, 12), 1.09–1.55 times as long as its basal width, 0.61–0.71 times as long as second hind tarsal segment; with 2 pairs of primary setae and 1 pair of accessory setae.

Thorax: Legs normal. Trochanters and femora fused. Hind trochanter and femur 1.21–1.48 times as long as antennal segment III, hind tibia 0.28–0.31 times as long as body. Setae on legs dense, fine and pointed. Setae on hind tibia 0.68–0.92 times as long as its mid-diameter. First tarsal chaetotaxy: 3, 3, 3. Dorso-apical setae on second hind tarsal segments expanded at apices. Empodial setae pointed, exceeding tip of claws. Fore wings (Figs. 4, 9) with pterostigma narrow and long, distal margin of pterostigma forming almost a straight line with the hind margin, media unbranched, not united with cubitus, and two cubitus veins fused at base; hind wings with 2 obliques.

Figures 16–20. Galls of *Asiphonipponaphis vasigalla* **sp. n.** on *Distylium chinense* **16** small spherical gall on young leaf **17** large long saccate gall **18** large honeydew droplet coated with wax is being expelled through the opening **19** flower-shaped opening at the tip of gall **20** vase-shaped mature galls.

Abdomen: Siphunculi absent. Cauda, anal plate and genital plate with dense spinulose imbrications. Cauda knobbed, distinctly constricted at base (Figs. 5, 13), 0.80–1.01 times as long as its basal width, with 12–19 setae. Anal plate bilobed (Figs. 6, 14), each with 10–15 setae. Genital plate broad round (Figs. 7, 15), with 39–52 setae. Two gonapophyses each with 3–9 short setae.

Specimens examined. Holotype: alate viviparous female, **CHINA:** Hunan (Jishou City, 28°17'23"N, 109°43'11"E, altitude 240 m), 21 Apr. 2010, No. Y8974–1-8, on *Distylium chinense*, coll. X. T. Li (NZMCAS). *Paratypes*: 1 fundatrix and 11 alate viviparous females, with the same collection data as holotype.

Taxonomic notes. The new species is similar to *Indonipponaphis fulvicola* Sorin, but differs from the latter as follows: Fundatrix: body larger, 2.036 mm long (the latter:

about 1.250 mm long); first tarsal chaetotaxy: 2, 2, 2 (the latter: 3, 3, 2); siphunculi absent (the latter: present); cauda knobbed (the latter: round). Alatae from galls: base of antennal segment V with 6–9 secondary rhinaria (the latter: 11–14); abdomen with 5 pairs of spiracles (the latter: 4 pairs); first tarsal chaetotaxy: 3, 3, 3 (the latter: 3, 3, 2); media of fore wings unbranched (the latter: once branched); siphunculi absent (the latter: present); cauda knobbed (the latter: round).

Host plant. *Distylium chinense*.

Biology. The aphids live in galls on the upper side of leaves of *Distylium chinense*. In early March, small galls start to grow on young leaves, often rise from or near the midrib, spherical, pale green, sometimes with a pinkish tinge due to the dense soft hairs on the surface (Fig. 16). Usually one leaf bears only one gall. After about 30 days, the galls when fully developed are large, long, saccate, approximately 3.2 cm in length and 1.1 cm in diameter (Fig. 17). Later, they split at the tip, forming a flower-shaped opening (Figs. 19, 20), through which large honeydew droplets coated with much wax are expelled (Fig. 18). The galls are vase-shaped when mature (Fig. 20). The alate viviparous females mature in the galls in late April and fly to an unknown secondary host.

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Taxonomic position of *Hormaphis similibetulae* Qiao & Zhang, 2004 (Hemiptera, Aphididae): molecular and biological evidences

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Abstract

The taxonomic position of *Hormaphis similibetulae* Qiao & Zhang, 2004 has been reexamined. The phylogenetic position of *H. similibetulae* was inferred by maximum parsimony, maximum likelihood and Bayesian analyses on the basis of partial nuclear elongation factor-1α and mitochondrial tRNA leucine/cytochrome oxidase II sequences. The results showed that this species fell into the clade of *Hamamelistes* species, occupying a basal position, and was clearly distinct from other *Hormaphis* species. A closer relationship between *H. similibetulae* and *Hamamelistes* species was also revealed by life cycle analysis. Therefore, we conclude that *H. similibetulae* should be transferred to the genus *Hamamelistes* as *Hamamelistes similibetulae* (Qiao & Zhang), **comb. n.**

Keywords

Hormaphidinae, *Hormaphis similibetulae*, molecular evidence, biological evidence, new combination, China

Introduction

The aphid tribe Hormaphidini in subfamily Hormaphidinae (Hemiptera: Aphididae) consists of three genera, *Hamamelistes*, *Hormaphis* and *Protohormaphis* (Remaudière and Remaudière 1997). *Hamamelistes* and *Hormaphis* are disjunctively distributed in

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Eurasia and North America (Guo and Qiao 2005), where they are primarily associated with *Hamamelis* and secondarily associated with *Betula*. The taxonomy of these two genera was once in a mess at both the genus and species levels. They are easily confused with one another, and species of the same genus are difficult to distinguish morphologically. This confusion in the taxonomy was due partly to a limitation of diagnostic characteristics and partly to the fact that no combination had been established between different aphid forms on primary and secondary hosts. Distinction of *Hamamelistes* and *Hormaphis* is based mainly upon alatae, galls and life cycles. However, it is not easy to collect all morphs, and the observation of life cycles takes a long time. Molecular studies have shed light on these issues. Based on the mitochondrial cytochrome oxidase II (COII) gene, Aoki et al. (2001) clarified the Japanese *Hamamelistes* species, established the combination between generations on primary and secondary hosts, and elucidated their life cycles. von Dohlen et al. (2002) estimated the phylogeny of Hormaphidini using partial nuclear elongation factor-1α (EF-1α) and mitochondrial tRNA leucine/cytochrome oxidase II (COII) sequences, the monophyly of both *Hamamelistes* and *Hormaphis* was retrieved with strong support.

Qiao and Zhang (2004) described *Hormaphis similibetulae* based on specimens of apterous viviparous females collected from small conical galls on leaves of *Betula albosinensis* in China (Tibet); the specimens were closely related to *Hormaphis betulae* (Mordvilko) but differed from the latter in body color and living habits. In this study, the taxonomic position of *H. similibetulae* was reassessed on the basis of nuclear EF-1α and mitochondrial tRNA/COII sequences. A discussion of life cycles was also included.

Materials and methods

The samples used in this study and the corresponding collection information are listed in Table 1. Eight species of Hormaphidini, covering all the species of *Hamamelistes* and *Hormaphis* were used as ingroups. Three species of Nipponaphidini were chosen as outgroups because Nipponaphidini is considered the sister group of Hormaphidini based on biological and phylogenetic data (Ghosh 1985, von Dohlen and Moran 2000, Ortiz-Rivas and Martínez-Torres 2010). Voucher specimens were preserved in 75% ethanol and deposited in the National Zoological Museum of China, Institute of Zoology, Chinese Academy of Sciences, Beijing, China.

Total genomic DNA was extracted from single aphids preserved in 95% or 100% ethanol using a CTAB protocol modified from Doyle and Doyle (1987). Partial leucine tRNA and the cytochrome oxidase II (COII) gene was amplified with primers 2993+ (Stern 1994) and A3772 (Normark 1996). Sequencing reactions were performed using the corresponding PCR primers from both directions with BigDye Terminator v3.1 Cycle Sequencing Kit (Applied Biosystems, Foster City, CA, USA) and run on an ABI 3730 automated sequencer (Applied Biosystems). Sequences were assembled by Seqman II (DNAStar, Inc., Madison, WI, USA) and verified for protein coding frame-

Table 1. Collection information and GenBank accession numbers for aphid samples used in this study.

Species	Host	Locality	Date	Voucher	EF-1×	tRNA/COII
Hamamelistes betulinus (Horvath)	*Betula davurica*	Japan: Yamanashi, Masutomi	17 Jul. 1998	98081	AF454599*	AF328782*
	Hamamelis japonica	Japan: Aomori, Temmabayashi	7 Aug. 1998	98132	AF454596*	AF328775*
	Betula platyphylla	Japan: Tokyo, Okutamako	20 May 1999	99121	AF454597*	AF328780*
	Betula platyphylla	Japan: Hokkaido, Sapporo	15 Jun. 1999	99187	AF454598*	AF328781*
Hamamelistes kagamii (Monzen)	*Hamamelis japonica*	Japan: Yamanashi, Masutomi	17 Jul. 1998	98084	AF454600*	AF328772*
	*Betula gross*a	Japan: Yamanashi, Sanjonoyu	20 May 1999	99118	AF454601*	AF328779*
	Hamamelis japonica	Japan: Saitama, Shomaru Pass	8 Jul. 1999	99209	AF454603*	AF328773*
	Hamamelis japonica	Japan: Saitama, Shomaru Pass	8 Jul. 1999	99220	AF454602*	AF328774*
Hamamelistes miyabei (Matsumura)	*Hamamelis japonica*	Japan: Yamanashi, Masutomi	17 Jul. 1998	98086	AF454595*	AF328771*
	Betula maximowicziana	Japan: Hokkaido, Sapporo	5 Sep. 1998	98151	AF454593*	AF328776*
	Betula maximowicziana	Japan: Gumma, Mt. Akagi	25 May 1999	99146	AF454594*	AF328777*
	Betula maximowicziana	Japan: Hokkaido, Sapporo	15 Jun. 1999	99182	AF454592*	AF328778*
Hamamelistes spinosus Shimer	*Hamamelis japonica*	USA: Washington, DC	May 1993	93-23	AF454606*	AF328783*
	Betula nigra	USA: UT, Logan	28 May 1999	99-54	AF454607*	AF454619*
	Betula nigra	USA: WI, Madison	28 Jun. 1999	99-57	AF454608*	None
Hormaphis betulae (Mordvilko)	*Betula platyphylla*	Japan: Yamanashi, Masutomi	17 Jul. 1998	98078	AF454609*	None
	Hamamelis japonica	Japan: Saitama, Shomaru Pass	21 May 1999	99130	AF454610*	AF454622*
	Betula platyphylla	Japan: Tokyo, Kazahari Pass	26 Jul. 1999	99224	AF454611*	AF454623*
	Betula sp.	China: Jilin, Ji'an	13 Aug. 2004	15214	DQ493864*	JF730745
Hormaphis cornu (Shimer)	*Hamamelis virginiana*	USA: Georgia, Athens	8 Jun. 1994	94-93	AF454612*	AF454621*
Hormaphis hamamelidis (Fitch)	*Hamamelis virginiana*	USA: Connecticut, Danielson	1 Aug. 1998	98-05	AF454613*	AF454620*
Hormaphis similibetulae Qiao & Zhang	*Betula albosinensis*	China: Tibet, Gongbo'gyamda	5 Jul. 2002	13549	DQ493849*	JF730746
	Betula albosinensis	China: Tibet, Linzhi	6 Aug. 2003	15318	DQ493866*	JF730747
Neohormaphis wuyiensis Qiao & Jiang	*Quercus* sp.	China: Fujian, Mt. Wuyi	18 Jul. 2003	14525	DQ493858*	JF730748
Nipponaphis distyliicola Monzen	*Quercus glauca*	Japan: Shinkiba, Tokyo	16 Apr. 1999	99008	AF454614*	AF454626*
Thoracaphis quercifoliae Ghosh	*Quercus* sp.	China: Fujian, Mt. Wuyi	18 Jul. 2003	14526_2	DQ493851*	JF730749

* Sequences from GenBank.

shifts to avoid pseudogenes (Zhang and Hewitt 1996) using Editseq (DNAStar, Inc.). All sequences were deposited in GenBank under the accession numbers JF730745–JF730749. All EF-1α sequences used in this study were downloaded directly from GenBank (for accession numbers see Table 1), and only exons were used for further analysis. Multiple alignments were done with ClustalX 1.83 (Thompson et al. 1997) and then verified manually. Nucleotide composition and pairwise distances based on Kimura's two-parameter model (K2P) (Kimura 1980) of the aligned sequences were calculated using MEGA 4.0 (Tamura et al. 2007).

Phylogenetic reconstructions were conducted by maximum parsimony (MP), maximum likelihood (ML) and Bayesian analyses for each single gene and a combined dataset. The partition homogeneity test (Farris et al. 1994) based on 100 replicates of a heuristic search algorithm was performed with PAUP*4.0b10 (Swofford 2002) to examine the incongruence between EF-1α and mtDNA. Unweighted MP and ML analyses were carried out using PAUP*. For ML analysis, the best-fit model of nucleotide substitution was selected for each dataset according to the Akaike information criterion (AIC) in Modeltest 3.7 (Posada and Crandall 1998). Heuristic searches were performed with 1000 (MP) or 100 (ML) random-addition sequences and tree-bisection-reconnection (TBR) branch swapping. Bootstrap (BS) analyses were used to assess the relative robustness of branches of the MP (1000 replicates) and the ML (100 replicates) trees (Felsenstein 1985). Bayesian analysis was conducted using MrBayes 3.1.2 (Ronquist and Huelsenbeck 2003) based on the model selected by Modeltest 3.7. In the combined analysis, the mitochondrial and nuclear data were partitioned, and a heterogeneous model was used for each gene partition. The parameters of the model were treated as unknown variables with uniform prior probabilities and were estimated during the analysis. Four Markov chains (three heated and one cold) were run, starting from a random tree and proceeding for one million Markov chain Monte Carlo generations, sampling the chains every 100 generations. Two concurrent runs were conducted to verify the results. The first 2500 trees were discarded as burn-in samples, the remaining trees were used to compute a majority-rule consensus tree with posterior probabilities (PP).

Results and discussion

The final alignments of EF-1α (excluding three introns) and tRNA/COII sequences consisted of 826 and 761 sites, with 131 and 165 parsimony-informative sites, respectively. A single 1- to 2-base-long indel was found in the tRNA. The genetic distance between two distinct samples of *H. similibetulae* was 0 for EF-1α and 0.001 for tRNA/COII. The distances of both genes between *H. similibetulae* and *Hamamelistes* species were much smaller than those between *H. similibetulae* and the other *Hormaphis* species (EF-1α: average of 0.040 and range of 0.038–0.042 to *Hamamelistes*, average of 0.082 and range of 0.078–0.092 to *Hormaphis*; tRNA/COII: average of 0.080 and range of 0.071–0.085 to *Hamamelistes*, average of 0.106 and range of 0.102–0.112 to *Hormaphis*).

For phylogenetic analyses, the partition homogeneity test found no significant conflict between EF-1α and mtDNA (*P*=0.05), indicating that information from both genes could be combined. Combined analysis resulted in similar topology to that obtained in single gene analyses and with higher support for most nodes, so only the combined dataset results were presented. MP analysis yielded eight most parsimonious trees with a length of 611 steps (CI=0.705401, RI=0.845626). ML analysis produced one ML tree based on the optimal model GTR+G selected by AIC in Modeltest 3.7. The 50% majority-rule consensus tree inferred from Bayesian analysis is shown in Fig. 1 and resulted in a topology essentially identical to that obtained in ML analysis, but was different from the strict consensus of MP trees in the position of *H. similibetulae*. All ingroup taxa constituted a monophyletic group with respect to these outgroups and formed two clades. Clade I (100% MP BS, 100% ML BS, 1.00 PP) was comprised of *H. betulae*, *H. cornu*, and *H. hamamelidis*. Clade II (99% MP BS, 99% ML BS, 1.00 PP) consisted of all the *Hamamelistes* species and *H. similibetulae*. Within clade II, two distinct samples of *H. similibetulae* clustered together (100% MP BS, 100% ML BS, 1.00 PP) and were placed as the outermost branch in ML and Bayesian analyses, just as the results based on EF-1α. However, MP analysis revealed the same topology as the mitochondrial analysis: *H. similibetulae* and *Hamamelistes spinosus* were sister groups, although the support value was low (53% BS), and together formed the basal lineage within clade II.

The results of genetic distances and phylogenetic analyses strongly suggested that *H. similibetulae* was more closely related to *Hamamelistes* than to *Hormaphis*. *H. similibetulae* was distinguished by its unique biology, forming galls on leaves of *Betula*. Because of the high morphological similarity with *H. betulae* (Mordvilko), it was placed under the genus *Hormaphis* (Qiao and Zhang 2004). However, the distinction of apterae of *Hamamelistes* and *Hormaphis* from the secondary host *Betula* is very difficult: both of them are aleyrodiform, dorsoventrally compressed, have body segments fused, short antennae with only 2–4 segments, fore and middle legs without tarsi, and hind legs with rudimentary unsegmented tarsi and lack claws. These reductions appear to be related to the organisms' sedentary habits on *Betula* and represent the adaptive convergences selected by their temperate habitat. Although species of both genera migrate between *Hamamelis* and *Betula*, their life cycles are quite different and have proven extremely valuable in distinction (Pergande 1901, von Dohlen and Gill 1989, Aoki and Kurosu 1991, von Dohlen and Stoetzel 1991, Aoki et al. 2001). Firstly, *Hamamelistes* have two-year life cycles due to a long gall phase, while *Hormaphis* complete their life cycles within one year. Secondly, on *Hamamelis*, *Hamamelistes* induce spiny or coral-like galls on leaf or flower buds, whereas *Hormaphis* cause conical galls on the leaves. Lastly, *Hamamelistes* inhabit cockscomb-like or blister-like galls on leaves of *Betula*, but *Hormaphis* live freely on the leaves, not causing any deformation. In China, there is only one species of *Hamamelis*, *H. mollis*, distributed in Sichuan, Hubei, Anhui, Zhejiang, Jiangxi, Hunan and Guangxi Provinces (Zhang and Lu 1995). According to the absence of primary host at high elevations in the Tibetan Plateau, Qiao and Zhang (2004) inferred that *H. similibetulae* was autoecious on *Betula albosinensis*. We agree with their inference, as *Ha. betulinus* and *H. betulae* were also observed living all

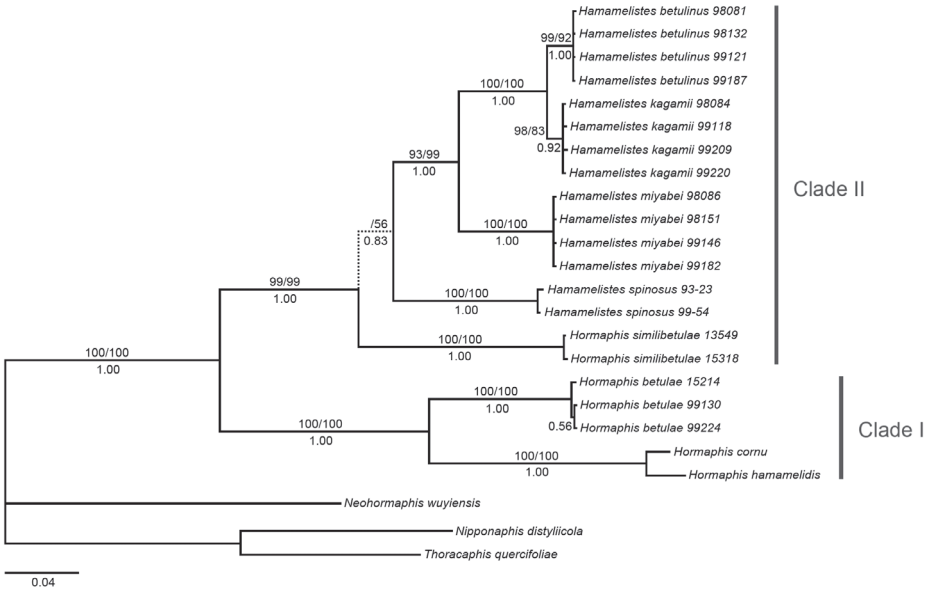

Figure 1. Phylogenetic tree reconstructed from the combined dataset of EF-1α and tRNA/COII sequences. The Bayesian topology and branch lengths are shown. Values above the branches are MP and ML bootstrap percentages, respectively, and Bayesian posterior probabilities are shown below the branches. The broken line indicates inconsistent branch.

year round parthenogenetically on *Betula* in Europe due to lack of primary host (Heie 1980). Although the life cycle of *H. similibetulae* requires further research, it appears to be more similar to that of *Hamamelistes* than to that of *Hormaphis*.

Conclusion

The phylogenetic position of *Hormaphis similibetulae* was inferred by MP, ML and Bayesian analyses on the basis of nuclear EF-1α and mitochondrial tRNA/COII sequences. In all phylogenetic analyses, *H. similibetulae* clustered firmly with *Hamamelistes* and was placed as a basal lineage, clearly differed from other *Hormaphis* species. Life cycle similarities also indicated that *H. similibetulae* was more closely related to *Hamamelistes* species. We therefore conclude that *H. similibetulae* should be transferred to the genus *Hamamelistes* as *Hamamelistes similibetulae* (Qiao & Zhang), comb. n.

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RESEARCH ARTICLE

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The identity of the Neotropical stingless bee *Frieseomelitta meadewaldoi* (Cockerell, 1915) (Hymenoptera, Apidae)

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Abstract

A new study of a surviving syntype of *Trigona meadewaldoi* Cockerell, 1915, was undertaken and several widely employed names for Neotropical stingless bees recognized as junior synonyms. A lectotype is designated for *T. meadewaldoi* and the following new synonymies established: *Tetragona francoi* Moure, 1946, and *Trigona* (*Frieseomelitta*) *freiremaiai* Moure, 1963. These nomenclatural matters are here settled and the species thoroughly characterized in advance of a forthcoming phylogenetic consideration of the genus *Frieseomelitta* von Ihering, 1912.

Keywords

Apoidea, Anthophila, Apidae, Apinae, Meliponini, *Trigona*, *Frieseomelitta*, taxonomy

Introduction

Frieseomelitta von Ihering, 1912 is a genus of New World stingless bees (Apinae, Meliponini), with a wide geographic range occurring from southwestern Mexico (Sinaloa) to the southeast of Brazil (São Paulo), and can be found in forests, cerrado,

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caatinga, and mountainous regions, reaching an elevation of about 1600 m (Iguala, Guerrero, México). Species are moderately aggressive and nest in cavities in living or dead trees (dry), fence posts, &c. In general they apparently are not well adapted to anthropogenic environments, with few records originating in urban areas, with the exception of *Frieseomelitta trichocerata* Moure, 1988 which is quite common in Manaus, Brazil. Species of *Frieseomelitta* are popularly known as little black girls, lacemakers, zamboque, pitch, abreu, long legs, black marmalade, white marmalade, white wings, white girls, or ties nêgo.

Nineteen species are presently recognized, although no formal revision has yet been published, and at least seven undescribed species are known (Oliveira et al. in prep.). The hitherto recognized species are *F. flavicornis* (Fabricius, 1798), *F. varia* (Lepeletier de Saint Fargeau, 1836); *F. longipes* (Smith, 1854); *F. nigra* (Cresson, 1878); *F. paupera* (Provancher, 1888); *F. portoi* (Friese, 1900); *F. doederleini* (Friese, 1900); *F. lehmanni* (Friese, 1901); *F. silvestrii* (Friese, 1902); *F. meadewaldoi* (Cockerell, 1915); *F. parastigma* (Cockerell, 1918); *F. pura* (Cockerell, 1920); *F. paranigra* (Schwarz, 1940); *F. francoi* (Moure, 1946); *F. dispar* (Moure, 1950); *F. freiremaiai* (Moure, 1963); *F. savannensis* (Roubik, 1980); *F. trichocerata*, and *F. languida* Moure, 1989. Herein we attempt to clarify the taxonomic status of three of these names in advance of a phylogenetic study of the genus (Oliveira et al. in prep.).

Smith (1854) established the species, *Trigona dorsalis* (today *Tetragona dorsalis*), for a stingless bee from "Brazil (Pará)". Later (Smith, 1863) redescribed the species based on a series of 10 individuals presented at the International Exhibition of 1862. On pages 499–500 of his work Smith (1863) states, "For the purpose of examination, when describing the species in the present paper, I was supplied with ten examples of each..." and so it is presumed (taking his statement at face value) that there was originally a series upon which he based his description of *T. dorsalis* in 1863.

More than a half century later, Cockerell (1915) noted the incongruence of the two descriptions published by Smith under the name *T. dorsalis*, and after examining the 1854 type for the species, concluded that the 1854 and 1863 descriptions referred to different species altogether. Cockerell (op. cit.) therefore considered the specimen redescribed as *T. dorsalis* by Smith (1863) to be a separate species from the one Smith described under this name in 1854. Accordingly, Cockerell (1915) proposed the name *Trigona meadewaldoi* as a replacement for the species described by Smith in 1863, selecting as epithet a patronym for Geoffroy Meade-Waldo (1884–1916). However, Cockerell never did find the specimens described by Smith (1863).

From 1915 until recently, most melittologists had interpreted *T. meadewaldoi* to be a junior synonym of *Trigona doederleini* Friese, 1900, principally by the fact that many individuals of the latter species were found among specimens from Smith's collection. Given that the 1863 type series was apparently missing or unrecognized, there was no basis upon which to contradict this anecdotal conclusion. While the 1863 description of *T. dorsalis* could be applied in part to *T. doederleini*, there are sufficient discrepancies to suspect that the specimens described by Smith in 1863 were not necessarily conspecific with *T. doederleini*. One of the significant differences between Smith's 1854 *T. dorsalis*

(as noted, now a valid species of *Tetragona*) and his "*T. dorsalis*" of 1863 (clearly a species of *Frieseomelitta*) is the coloration of the face. For example, Smith (1854) notes "Head black; the clypeus, a triangular spot above, the face on each side, the scape in front, and the mandibles, yellow" and "wings testaceous" (1854: 411), while in 1863 he states, "Pale ferruginous, with the head and thorax black above; clypeus, mandibles and antennae pale ferruginous; also a narrow pale line at the inner orbits of the eyes" and "alis hyalinis" (1863: 510). The latter account aptly describes the face and wings of two other potentially conspecific species, *Tetragona francoi* Moure, 1946 and *Trigona freiremaiai* Moure, 1963 (e.g., Figs 4, 5, 7, 8, 10) (*vide infra*). All of these specimens also have identical metatibiae which are taciform in shape (e.g., Figs 3, 5, 10, 14), rather than the more bulky form of *T. doederleini* and other species (e.g., Fig. 13). Moreover, these same features can serve to distinguish *T. doederleini* from *T. meadewaldoi* (a.k.a., the "*T. dorsalis*" of 1863). Indeed, a study of Smith's collection of material labeled by Herbert F. Schwarz as "*Trigona meadewaldoi* = *Trigona doederleini*" and those bearing the label "18" mentioned by Cockerell (1915) are identical with *T. doederleini* (type material of *T. doederleini* was studied by Oliveira 2003 and the lectotype was re-examined for the purposes of the present study, *vide infra*) but do not match Smith's 1863 description of "*T. dorsalis*" (a.k.a., *T. meadewaldoi*). This led us to believe that the material examined by previous authors was not of Smith's syntype series. Baker (1993) noted that Smith's series from the 1863 paper was originally broken up between London and Oxford, and that,

> "The second set, in another part of the type collection (UMO 2), apparently, unfortunately, not seen by Schwarz [Herbert F. Schwarz], is grouped with various vespoids in a tray with the note: 'Honey bees and Wasps of South America. Exhibited in the International Exhibition of 1862. Presented by John Miers Esq F.R.S. 1865. See Memoir by F. Smith in Trans. Entom. Society'"
> (Baker 1993: 232).

As noted by Baker (op. cit.) this set comprises two specimens of each species examined by Smith (1863). For material of "*T. dorsalis*" there are two specimens, one bearing a blue label with "*Trigona dorsalis* Sm" in Smith's hand, the other nothing more than a label reading "18" (as was material Cockerell had available to him). Both of these specimens are of *T. doederleini* and do not match Smith's (1863) description. It can only be presumed that Smith's original series was mixed and that he based his description on a subset of these specimens.

Among material from Smith's collection in The Natural History Museum, London, a single worker individual was discovered missing its head and bearing a blue labeled signed by Smith as "*Trigona dorsalis*" (Figs 1–3, 14). This specimen was apparently not examined by previous authors when studying Neotropical Meliponini (e.g., Cockerell, Schwarz, Moure, or Camargo as none of these authors had placed their usual identification labels with the specimen). In preserved details, this specimen matches perfectly Smith's (1863) description (obviously those characters of the head cannot be confirmed as the head was lost at some point in the past). It was therefore suspected that this could be one of the individuals upon which Smith had based his 1863 redescription. Given that this specimen is almost certainly from Smith's 1863

exhibition series and that, unlike other specimens apparently from that series, it closely matches his description, we conclude that this is material from which he based his account. No other potential syntypes are known in collections and we accordingly select herein this individual to serve as the lectotype for *T. meadewaldoi*.

As alluded to earlier, two further epithets come into play. *Tetragona francoi* was described in detail by Moure (1946), based on a single worker from Riachuelo (Sergipe, Brazil) and collected by the famed agronomist Dr. A. Franco Filho, to whom Moure dedicated the species. Later, Moure (1963) described *Trigona* (*Frieseomelitta*) *freiremaiai*, noting however that the material could prove to be conspecific with, and thereby a junior synonym of, *T. francoi*. Indeed, having now examined the type material for both *T. francoi* and *T. freiremaiai* it is clear that the minor differences mentioned by Moure (1963) are geographic variations of one species. In addition, both are proposed as junior synonyms of *T. meadewaldoi*, the identity of which is established by the newly recognized holotype (*supra*), and which takes priority over both of Moure's epithets. Smith's (1863) account indicating "head and thorax black above" (p. 510) agrees perfectly with both of these putative species in which the head is yellow (or pale yellow to orange-yellow or testaceous in some older specimens) except for a black rectangle on the upper part of the face and vertex (above the upper tangent of the antennal alveoli to the vertex, extending posterior to the ocelli until the occiput), as well as the mesosoma which has a dark brown to black mesoscutum. Although Smith (1863) referred to the wings as hyaline, the wing membrane tends to be very faintly infumate. In *T. doederleini* the mesosoma is similarly yellow with a black mesoscutum but in this species the head is entirely black with yellow markings on the clypeus, supraclypeal area, paraocular area, and gena. Oliveira (2003) clarified the taxonomic status of *T. doederleini*.

Material and methods

The type material considered herein is deposited in the following institutions: AMNH, Division of Invertebrate Zoology (Entomology), American Museum of Natural History, New York, USA; DZUP, Coleção de Entomologia Pe. J.S. Moure Departamento de Zoologia da Universidade Federal do Paraná, Curitiba, Brazil; and NHML, Department of Entomology, The Natural History Museum, London, United Kingdom.

Given the incomplete nature of some material we based the metrics on the most complete of the type material, basically that of the holotype of *T. francoi*) and were made using an ocular micrometer (with precision of 0.001 mm) on a Leica MZ12.5 stereomicroscope. All measurements are in millimeters. Measurements used herein are as follows: length of forewing measured from apex of costal sclerite to apex wing; diameters or width of structures were obtained by taking the maximum diameter or width (e.g., head width, clypeal width, compound eye width, scape diameter, meso- and metafemoral width, meso- and metatibial width, meso- and metabasitarsal width); total body length refers to distance from apex of clypeus to posterior margin of apicalmost metasomal segment; length of head in frontal view was taken from crest of

vertex to medioapical margin of clypeus; width of head in frontal view corresponds to maximum width including compound eyes; height of compound eye in lateral view was taken as its maximum height (length); ocellorbital distance refers to the shortest distance in laterodorsal view between lateral ocellus and upper inner margin of compound eye; interocellar distance is that between the lateral and median ocelli; upper interorbital refers to the distance between the inner margins of the upper compound eye orbits; middle interorbital refers to the distance between compound eyes along a line approximately one alveolar diameter above the upper alveolar tangent; lower interorbital refers to the distance between the inner margins of the lower compound eye orbits; antennal scape length was measured from its apex to its base excluding the radical; lengths of femora, tibiae, and basitarsi were taken along their longitudinal axis from apex to joint with preceding podite.

In addition to morphometric measurements, we examined a suite of morphological characters commonly used in meliponine systematics, including, but not limited to, pilosity, body coloration, and shape of the head, legs, and mesosoma. Morphological terminology follows that of Urban (1967), Camargo et al. (1967), Engel (2001), and Michener (2007), with the addition of the term "taciformes" (for metatibial shape) referring to that form resembling a baseball bat. The following abbreviations are used: DA, alveolus diameter; DE, scape diameter; DP, puncture diameter; T, metasomal tergum. All characters included in the "Diagnosis" refer to workers as this is the caste most frequently found in Nature, while queens and drones are often unknown. In addition, the characters provided are those that make it most easy to recognize the species and not all are necessarily autapomorphic (Oliveira et al. in prep.).

Taxonomy

Genus *Frieseomelitta* von Ihering, 1912

Frieseomelitta meadewaldoi (Cockerell, 1915)

http://species-id.net/wiki/Frieseomelitta_meadewaldoi
Figs 1–5, 7–12, 14

Trigona dorsalis Smith; Smith 1863: 504, 510 [misidentification, *non Trigona dorsalis* Smith, 1854].
Trigona meadewaldoi Cockerell 1915: 32. *Nomen novum pro Trigona dorsalis* Smith, 1863 *non Trigona dorsalis* Smith, 1854.
Tetragona francoi Moure 1946: 437–438. Moure 1963: 39. Syn. n.
Trigona (*Tetragona*) *francoi* (Moure); Moure 1951: 44.
Trigona (*Frieseomelitta*) *francoi* (Moure); Wille 1962: 179.
Trigona (*Frieseomelitta*) *meadewaldoi* Cockerell; Wille 1962: 179.
Trigona (*Frieseomelitta*) *freiremaiai* Moure 1963: 39-43. Wille 1962: 179; Cruz-Landim 1963: 2–4 (as *Friseomelitta* [sic]); Sakagami et al. 1963: 116, 119–121, 124,

126–128; Kerr and Esch 1965: 532, 536; Kerr et al. 1967: 279, 282; Cruz-Landim 1967: 194, 254, 266, 267, 270; Akahira and Beig 1967: 166, 169, 172, 173, 180–181, 184 (Figs 15, 16); Michener 1990: 103. Syn. n.

Frieseomelitta freiremaiai (Moure); Nogueira-Neto 1963: 115; Abdalla 2002: 135.

Trigona (*Tetragona*) *freiremaiai* (Moure); Wille and Michener 1973, pp. 14, 24, 48, 59, 70.

Trigona freiremaiai (Moure); Costa 2002: 94.

Frieseomelitta francoi (Moure); Silveira et al. 2002: 87.

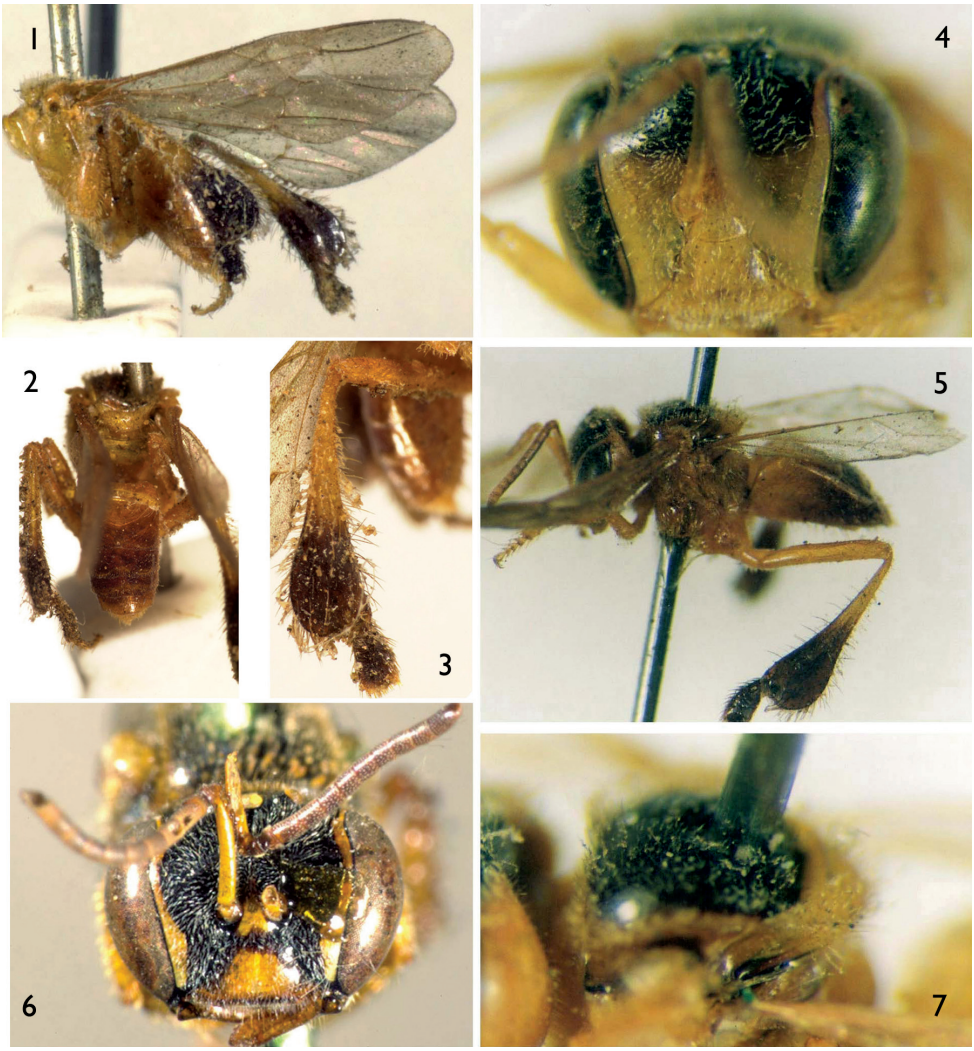
'*Frieseomelitta doederleini* (Friese, 1900)'; Camargo and Pedro 2007: 291 [misidentification].

Lectotype (here designated). Worker (NHML, Figs 1–3, 14): labeled "*Trigona dorsalis* Sm" in Smith's hand on a blue label. Locality given solely as "Brazil" by Smith (1863; *vide etiam* Comments, *infra*) in his redescription of *Trigona dorsalis* Smith, 1854 (in 1854 he provided "Brasil (Pará)" as the type locality for *T. dorsalis*).

Additional type material examined. Worker holotype (DZUP, Figs 4, 5, 7) of *Tetragona francoi* Moure, 1946; labeled "Riachuelo, Sergipe, Brasil, R. Franco col.". Holotype worker (DZUP, Figs 8, 10, 12) of *Trigona* (*Frieseomelitta*) *freiremaiai* Moure, 1963; labeled "Guarapari, ES, Brasil, II.1961"; and 21 paratypes, workers of the same species, labeled "Guarapari, Espírito Santo, Brasil: II.1961" [n=7], "IX.1960, M. Alvarenga col." [n=2]; "Maracás, Bahia, Brasil: 970m, VI.1961, F.M. Oliveira col." [n=5], and "VI.1961" [n=7]. Lectotype worker (AMNH 25290, Figs 6, 13) of *Trigona doederleini* Friese, 1900; labeled "Chiriqui, *Trigona doederleini* Friese, 1910" and with a typical orange Friese "Typus" label.

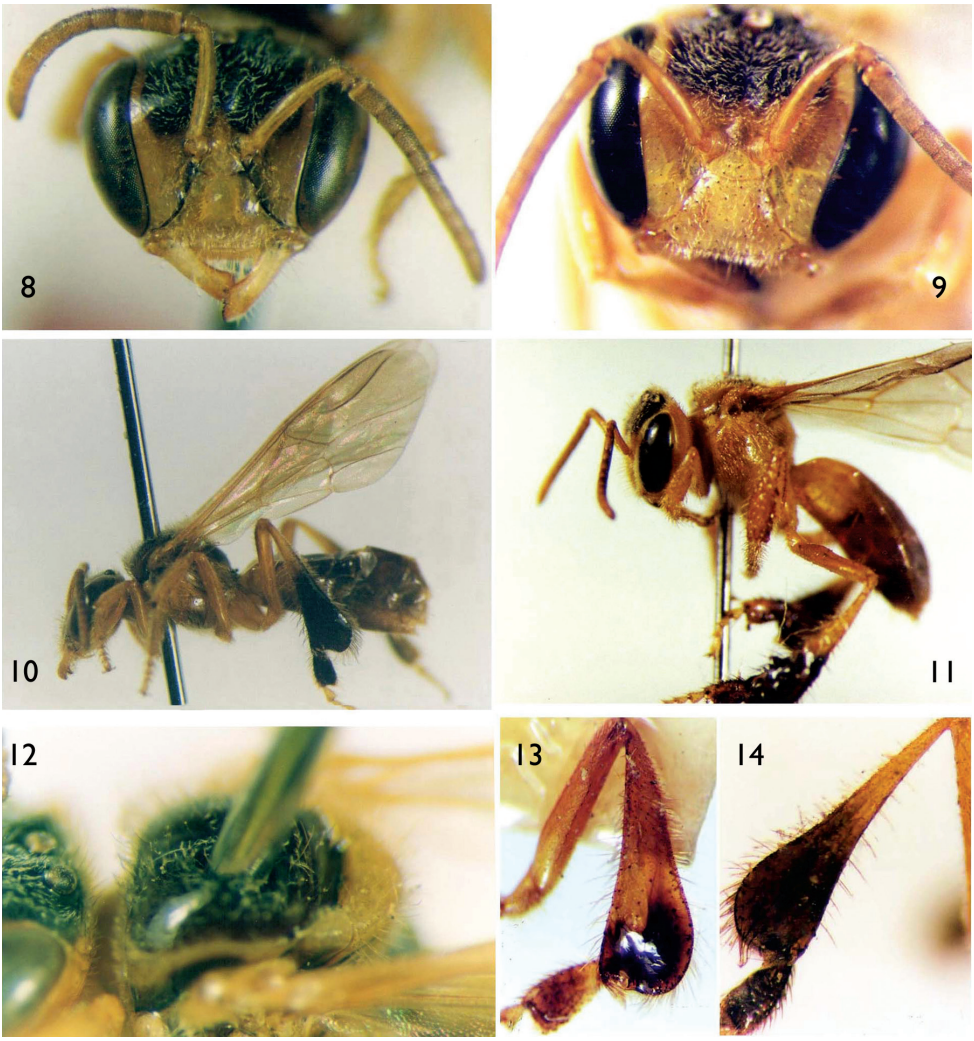
Diagnosis. *Worker*: Integument predominantly pale yellow to amber-yellow except dark brown to black on frons (rectangular area), dark brown to black on mesoscutum (margined by yellow lines), dark brown to black on apical two-thirds of metatibia and metabasitarsus; metasoma largely brown except first tergum, basal half of second tergum, and entirety of apicalmost tergum yellow to amber-yellow. Wing membrane faintly infumate, darker on marginal cell and with apical 6% somewhat white. Plumose setae of dorsal surface of mesotibia with long rachis and setal branches restricted to apical one-third of rachis; plumose setae of dorsal surface of mesobasitarsus forming a broad band. Metasoma elongate; metatibia taciform, with inflated aspect (Fig. 14); forewing marginal cell scarcely open at apex; typically six hamuli on leading edge of hind wing.

Descriptive notes. *Coloration*: Head pale yellow to amber-yellow except for dark brown to black transverse rectangle on upper face extending from above upper alveolar tangent (at a distance of approximately 1 DA) to occiput, bounded laterally by paraocular yellow lines, such paraocular marks even evident on lower yellow portion of face as paler yellow markings, slightly wider below, with greatest width close to tentorial foveae (1.6 DE); genal and paraocular yellow marks join at upper border of compound eye, thereby entirely surrounding orbits; genal marks rather narrow, almost imperceptible, more clearly defined along upper border of compound eye; gena pale yellow



Figures 1–7. *Trigona meadewaldoi* Cockerell, 1915 (lectotype, NHML), *Tetragona francoi* Moure, 1946 (holotype, DZUP), and *Trigona doederleini* Friese, 1900 (lectotype, AMNH) (all are workers). **1** Lateral habitus of *T. meadewaldoi* lectotype as preserved **2** Dorsal view of metasoma of *T. meadewaldoi* lectotype **3** External surface of metatibia of *T. meadewaldoi* lectotype **4** Facial view of *T. francoi* holotype **5** Lateral habitus of *T. francoi* holotype **6** Facial view of *T. doederleini* lectotype **7** Dorsal oblique view of mesoscutum and mesoscutellum of *T. francoi* holotype.

to testaceous; clypeus, supraclypeal area, and paraocular area pale yellow; epistomal sulcus brown to dark brown; scape pale amber-yellow to testaceous, with a brownish spot dorsoapically occupying one-third apical length; pedicel and first flagellomere yellowish ventrally; mandibles yellow to amber-yellow, with brown apex; labrum yellow to amber-yellow. Mesosoma yellow to amber-yellow or testaceous except mesoscutum dark brown to black and bordered laterally by large yellow to amber-yellow streaks,



Figures 8–14. *Trigona meadewaldoi* Cockerell, 1915 (lectotype, NHML; non-type, DZUP), and *Trigona doederleini* Friese, 1900 (lectotype, AMNH) (all are workers). **8** Facial view of *T. freiremaiai* holotype. **9** Facial view of *Frieseomelitta meadewaldoi* from the State of Bahia, Brazil (non-type material). **10** Lateral habitus of *T. freiremaiai* holotype. **11** Lateral habitus of *F. meadewaldoi* (non-type material). **12** Dorsal oblique view of mesoscutum and mesoscutellum of *T. freiremaiai* holotype. **13** Metatibia of *T. doederleini* lectotype. **14** Metatibia of *T. meadewaldoi* lectotype.

such lines a little wider at corners before forming shape of an inverted "J"; tegula yellowish translucent. Wing membranes lightly infumate, darker in marginal cell, apex whitish (apical 6%); veination amber-yellow except R and Rs bordering marginal cell light brown to brown. Legs yellow to amber-yellow or testaceous except dark brown to black on apical two-thirds of metatibia and entirety of metabasitarsus, remaining tarsomeres yellow to amber-yellow. Metasoma largely reddish brown to dark brown; first

tergum and basal half of second tergum yellow to testaceous; remaining terga dusky, with apical tergum yellow to testaceous.

Pubescence: Pubescence pale yellow, relatively thin and short. Face with short plumose setae (longest approximately 0.5 DE), such setae with minute rachis and compactly plumose, branches long, such setae semi-decumbent on lower face and semi-erect on frons and vertex (more distinctly evident in this area); thin erect, long, feathery setae intermingled (2 DE), those in paraocular area slightly shorter, those posterior to ocelli longer and more curved; thin, long (2 DE), erect setae between plumose setae, shorter medially in paraocular area and longer and curved posterior to ocelli; setae of scape short and sparse, the longest approximately 0.5 DE, denser along inner margin near base; pubescence of gena simple, very thin, short, and decumbent by comparison with that of face and body, erect setae posterior to ocelli somewhat more dense and with relatively long rachis (about half length) and sparse apical branches. Simpler setae of mesoscutum slightly longer than twice length of plumose setae (2.5 DE), plumose setae with relatively long rachis and poorly branched apically, slightly shorter on disc (1 DE); anterior and lateral borders with setae with shorter rachis and more abundantly branched; setae of mesoscutellum longer (2 and 3 DE for simple and plumose setae, respectively), with long rachis and relatively few branches; mesepisternum with plumose setae and simpler setae relatively thin and long (1.0–2.5 DE and 3 DE, respectively), setae with short rachis (about half length) and relatively sparse apical branching, some with a longer apical filament. Legs with pubescence yellow to pale yellow except corbicular setae, those on internal surface of metatibia dark brown, on inner surface of metabasitarsus yellowish-brown; dorsal surface of mesotibia with erect setae, some plumose, relatively long (1.5 and 1 DE, respectively), plumose setae with very long rachis and branches scarce, restricted to apical third of rachis; mesobasitarsus with a broad band of erect setae and plumose setae, relatively long (1.5 and 1 DE, respectively) and thin setae forming a prominent band in posterior half; plumose setae of posterior edge of metatibia light brown (3 DE), interspersed with longer, thicker, and fuscous setae (4 DE). First metasomal tergum glabrous; TII with very narrow band of tiny bristles along posterior edge, such bristles increasing in length and thickness on succeeding terga, as well as in density and width of band; T5 with longer setae and wider band range, especially medially, but without plumose setae (band of T3 = one-half that of T4; T4 = one-half that of T5); setae of T6 longer and denser (2 DE), intermingled with very thin plumose setae.

Metrics. Total length 4.75; forewing length 5.54; head width 1.99; clypeal width 1.0; clypeal length 0.46; malar length 0.07; compound eye length 1.21; compound eye width 0.55; upper interorbital distance 1.21; maximum interorbital distance 1.26; lower interorbital distance 0.99; alveolorbital distance 0.34; interalveolar distance 0.12; ocellorbital distance 0.30; interocellar distance 0.12; scape length 0.82; scape diameter 0.12; mesofemoral length 1.46; mesofemoral width 0.29; mesotibial length 1.51; mesotibial width 0.34; mesobasitarsal length 0.84; mesobasitarsal width 0.24; metafemoral length 1.88; metafemoral width 0.27; metatibial length 2.76; metatibial width 0.76; metabasitarsal length 0.82; metabasitarsal width 0.37; maximum width of metasomal tergum II 1.34.

Distribution. BRAZIL: States of Ceará (Choró, Maranguape), Rio Grande do Norte (Martins, Mossoró, Natal, Ipanguaçu), Paraíba (Juazeirinho, Santa Luzia), Pernambuco (Cabo de Santo Agostinho, Igarassu), Bahia (Camamu, Catu, Iaçu, Igrapiúna, Itabuna, Itaparica, Lençóis, Maracás, Milagres, Mucugê), and Espírito Santo (Fundão, Guarapari, Jacaraípe, Nova Almeida, Santa Teresa, São Roque).

Comments. There are specimens of *F. meadewaldoi* from Maracás (Bahia, Brazil) labeled by Moure as "*Frieseomelitta luteola* sp. n." (MS name, *nomen nudum*) in DZUP and it is probable that there are specimens similarly labeled in other collections.

It is of historical interest to note the influence of Brazilian Emperor D. Pedro II who worked tirelessly to bring Brazil to international attention, particularly his endorsement of participation in the Third Universal Exposition of London in 1862 which brought the material studied by Smith (1863). It was at this exposition that various products of Brazil were exhibited, including coffee, mate, rubber, wood, precious stones, machinery, and, of course, bees and their wax and honey, selected from different provinces of Brazil (Almeida 2000). The bees had only vernacular names associated with them and so Smith (1863) was unable to give more precise locality information, simply citing them all as "Brazil", but he did list these vernacular names (most of Tupi origin) and attempted, where possible, to use them as specific epithets (Smith 1863). According to Camargo and Moure (1996: 110) it is possible that the material was collected in southeastern Brazil, perhaps even the eastern region of the State of Minas Gerais, as evidenced by the etymology of the vernacular names employed.

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RESEARCH ARTICLE

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A new species of *Microsphecodes* from Jamaica (Hymenoptera, Halictidae)

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Abstract

A new species of the cleptoparasitic bee genus *Microsphecodes* Eickwort and Stage (Halictinae: Halictini) is described and figured from a male and female collected in Jamaica. *Microsphecodes xaymacensis* Engel, **sp. n.**, is distinguished from its congeners on the basis of integumental coloration and sculpturing, and form of the male pygidial plate and genitalia.

Keywords

Hymenoptera, Apoidea, Anthophila, Halictinae, Halictini, Sphecodina, new species, taxonomy

Introduction

The West Indian sphecodine fauna is, much like the general halictine fauna of the region, poorly documented. Relatively few species have been described and recorded from the West Indies (Table 1) and for nearly all, the biology remains to be characterized [*e.g.*, Raw 1985 (mention of unidentified species); Eickwort 1988]. The West Indian halictid fauna is considered mostly by Eickwort (1988), Snelling (2005), Engel (2001a, 2006a, 2006b), Genaro (2001, 2006, 2007, 2008), and Genaro and Franz (2008), with minor additions by Smith-Pardo (2009) and Engel (2011), but revisions and critical biological investigations are needed greatly. Hosts remain unknown for all of the described West Indian sphecodines.

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Table 1. Checklist of world species of *Microsphecodes*, and other described Caribbean sphecodines[1] (from Engel 2006a, 2006b, 2006c).

Genus *Microsphecodes* Eickwort & Stage	
–Continental	
M. kathleenae (Eickwort)	Costa Rica, Colombia
M. russeiclypeatus (Sakagami & Moure)	Brazil
M. trichommus Michener	Colombia
M. truncaticaudus Michener	Colombia
–Caribbean	
M. dominicanus (Stage)	Dominica
M. kittensis Engel	St. Kitts
M. solitarius (Ashmead)	St. Vincent[2]
M. thoracicus (Ashmead)	St. Vincent
M. xaymacensis **sp. n.**	Jamaica
Genus *Nesosphecodes* Engel	
N. anthracinus Engel	Puerto Rico
N. cubicola Engel	Cuba
N. halictophagus Engel	Dominican Republic
Genus *Sphecodes* Latreille	
S. genaroi Engel	Cuba
S. nigritus Ashmead	St. Vincent
S. tainoi Engel	Cuba

[1] Sphecodines as a whole are quite diverse and the monophyly of *Sphecodes* is questionable. Once phylogenetic studies are completed then the resurrection of former entities such as *Drepanium*, *Proteraner*, and *Sphecodium* should be considered over a retrograde classification lumping all into *Sphecodes* as has been advocated.

[2] The apparent bias in diversity towards St. Vincent (with three sphecodines recorded) is artificial and simply reflects that this is one of the few islands, along with Grenada, for which there is a significant historical monograph (Ashmead 1900). These islands, which are of average size for the Lesser Antilles, do not harbor a greater diversity and once the sphecodines of Dominica, Barbados, Saint Lucia, Curaçao, Guadeloupe, and Martinique are thoroughly surveyed the diversity will undoubtedly grow.

Herein I provide a brief contribution to this fauna by describing a new species of *Microsphecodes* from Jamaica, the first representative of this genus from the island.

Material and methods

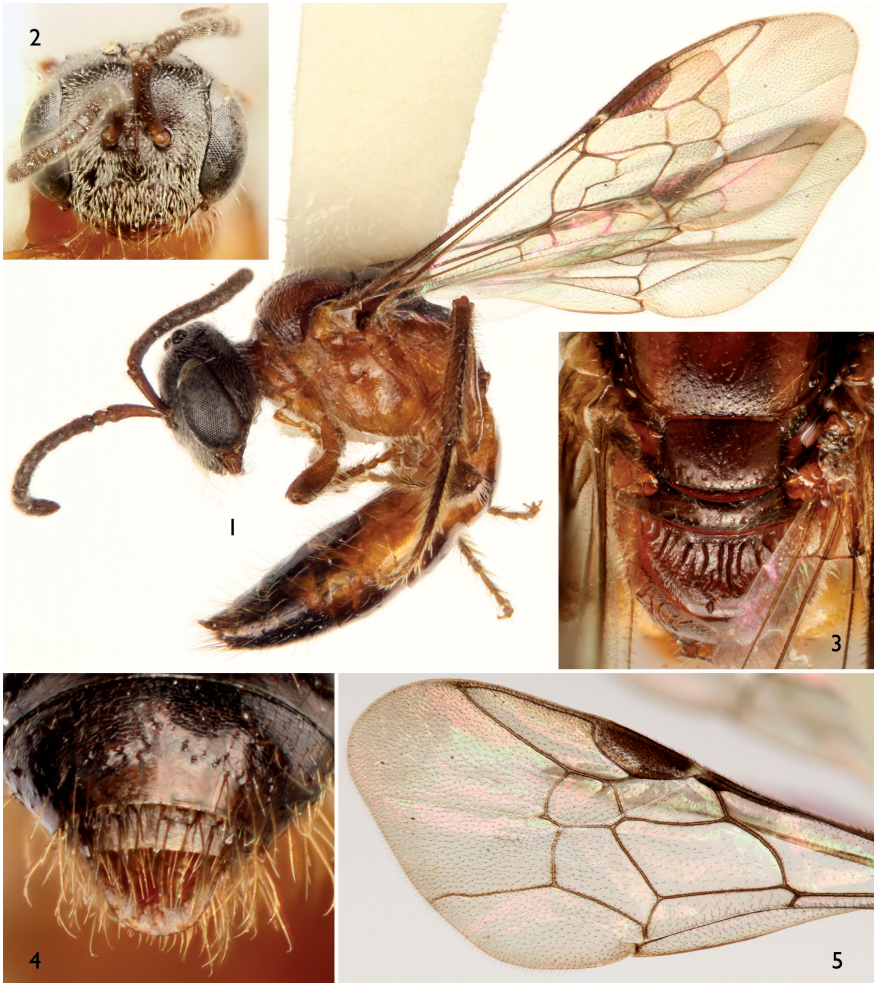
Material is deposited in the Snow Entomological Collection, Division of Entomology, University of Kansas Natural History Museum, Lawrence (SEMC), and the Florida State Collection of Arthropods, Gainesville (FSCA). Morphological terminology follows that of Engel (2001b) and Michener (2007), and the format that of Engel (2006a). Measurements were made using an ocular micrometer on an Olympus SZX12 stereomicroscope, while photographs were prepared with a Nikon D1x digital camera attached to an Infinity K-2 long-distance microscope lens.

Systematics

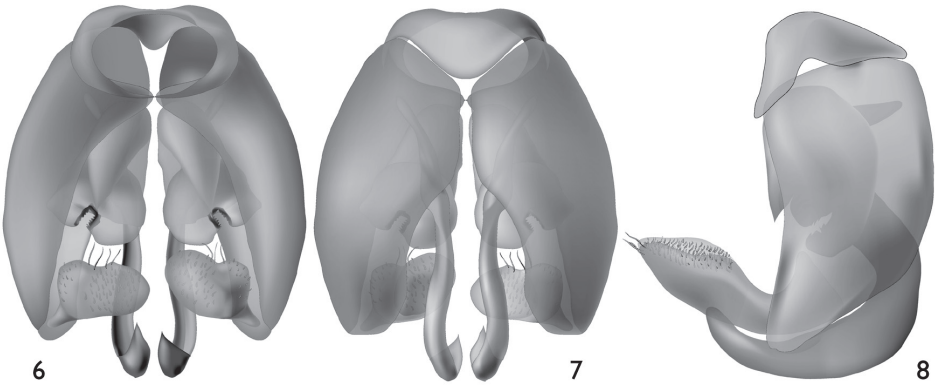
Genus *Microsphecodes* Eickwort and Stage, 1972

***Microsphecodes xaymacensis* Engel, sp. n.**
urn:lsid:zoobank.org:act:3048683A-BF8D-4474-A2F3-BD47C2AB3126
http://species-id.net/wiki/Microsphecodes_xaymacensis
Figs 1–12

Holotype. ♂, Jamaica: Saint Andrew Parrish, Hard war Gap, 2–3-viii-1985 [2–3 August 1985], C.B. & H.V. Weems, G.B. Edwards (FSCA).



Figures 1–5. Photomicrographs of male holotype of *Microsphecodes xaymacensis* Engel, sp. n. **1** Lateral habitus **2** Facial aspect **3** Dorsal view of posterior mesosoma, highlighting propodeum, metanotum, mesoscutellum and posterior third of mesoscutum **4** Pygidial plate **5** Detail of forewing venation.



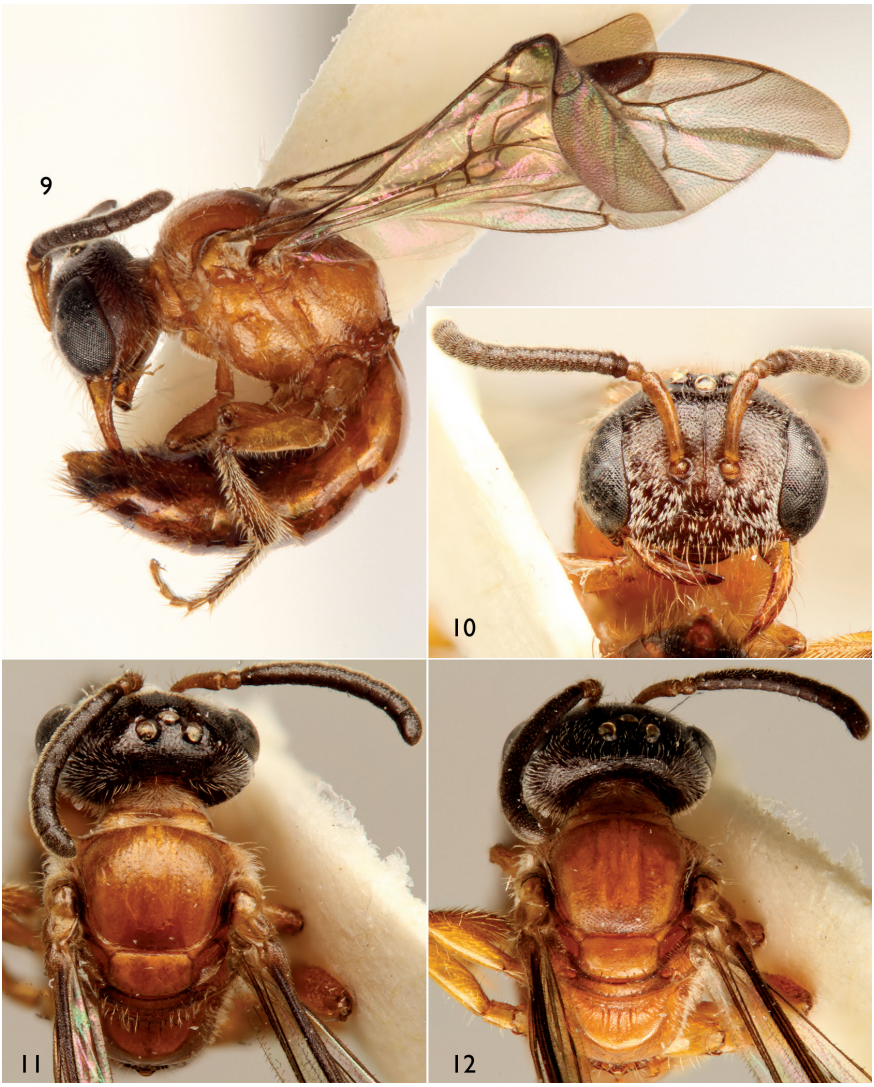
Figures 6–8. Male genitalia of *Microsphecodes xaymacensis* Engel, sp. n. **6** Ventral aspect **7** Dorsal aspect **8** Lateral aspect.

Paratype. ♀, Jamaica: Saint Andrew Parrish, Hard war Gap, 2–3-viii-1985 [2–3 August 1985], C.B. & H.V. Weems, G.B. Edwards (SEMC).

Diagnosis. The new species can be readily distinguished from its congeners by the structure of the male genitalia (Figs 6–8) and the combination of the broad male pygidial plate bordered by elongate simple or apically-branched setae (Fig. 4), hyaline wings (Fig. 5), and the rugoso-striate basal area of the propodeum not enclosed by carinae (Figs 3, 12) (the latter generally typical for West Indian species: *vide* Eickwort and Stage 1972). In addition, the coloration of the new species deviates from other West Indian *Microsphecodes* in the entirely ferruginous or orange-testaceous mesosoma [in *Microsphecodes solitarius* (Ashmead) the entire mesosoma is black except the pronotum and mesosternum are testaceous; in *M. dominicanus* (Stage) the entire mesosomal dorsum is black, the pleura are fuscous, and the venter testaceous; in *M. thoracicus* (Ashmead) the mesoscutum and pleura are testaceous while the mesoscutellum, metanotum, and propodeum are darkly infuscate; and in *M. kittensis* Engel the entire mesosoma is yellow to yellow-testaceous with the mesoscutellum and metanotum black].

Description. *Male*: Total body length 4.85 mm; forewing length 4.1 mm. Head broader than long (width 1.33 mm, length 1.04 mm as measured from clypeal apex to vertex in frontal aspect) (Fig. 2). Frontal line carinate just between antennal toruli to point above upper tangent of toruli equivalent to about torulus diameter, becoming an impressed line from that point onward. Mandibular base meeting lower border of compound eye. Inner margin of compound eye slightly concave just above level of antennal toruli. Gena narrower than compound eye in profile. Scape length 0.42 mm; first flagellomere about as long as second flagellomere. Intertegular distance 0.89 mm. Forewing venation as in figure 5; hind wing with six distal hamuli arranged in a single series. Pygidial plate well delimited, wide, broadly rounded at apex, with slightly depressed shining surface and carinate rim (Fig. 4). Male genitalia as in figures 6–8.

Integument generally shining. Clypeus imbricate with shallow, contiguous punctures; remainder of head distinctly punctate, punctures on lower part of face nearly



Figures 9–12. Photomicrographs of female paratype of *Microsphecodes xaymacensis* Engel, sp. n. **9** Lateral habitus **10** Facial aspect **11** Dorsal view of head and mesosoma highlighting head and mesoscutum **12** Dorsal view of head and mesosoma highlighting mesoscutellum, metanotum, and propodeum.

contiguous, becoming more widely spaced toward upper frons and vertex, separated by 0.25–1.5 times a puncture width, integument between punctures smooth and shining except on lower face finely imbricate, punctures weaker on vertex and sparser around ocelli; postgena faintly imbricate and impunctate. Pronotum with sparsely-scattered, minute punctures, integument between punctures imbricate. Mesoscutum imbricate with punctures separated by 1–2.5 times a puncture width, punctures shallower, fainter, and sparser around median line and along anterior and lateral sections; tegula impunctate and exceedingly faintly imbricate; mesoscutellum sculptured as on

mesoscutum except punctures fainter and separated by 2–3 times a puncture width. Metanotum imbricate. Pleura smooth to faintly imbricate, with sparse minute punctures. Basal area of propodeum with strong, rugulose striae radiating from basal margin (Fig. 3), integument between striae finely imbricate; lateral and posterior surfaces of propodeum imbricate with scattered, faint, coarse punctures. Metasomal terga and sterna faintly imbricate except first metasomal tergum smooth.

Mandible, labrum, and labiomaxillary complex ferruginous; remainder of head nearly black or dark brown; antenna dark brown (Figs 1–2). Mesosoma largely ferruginous (Fig. 1) except darker on median and lateral portions of mesoscutum and entirety of mesoscutellum, metanotum, and dorsal surface of propodeum (Fig. 3). Wing veins brown; wing membrane largely hyaline. Legs ferruginous except meso- and metatibiae and meso- and metatarsi brown. Metasoma largely ferruginous except dark brown on more apical terga and sterna; pygidial plate ferruginous (Fig. 4).

Pubescence relatively sparse, white except somewhat yellow on pleura, legs, and metasoma. Setae generally simple and erect, some with minute branches; face with moderately-dense, appressed, short, plumose setae on lower face and clypeus (Fig. 2).

Female: As described for the male except in usual gender differences as well as the following: Total body length 4.80 mm; forewing length 4.2 mm. Head broader than long (width 1.41 mm, length 1.04 mm). Mandible elongate, without dentition, about as long as compound eye (Figs 9–10). Frontal line carinate just between antennal toruli to point above upper tangent of toruli equivalent to twice torulus diameter, becoming a faintly impressed line from that point onward (Fig. 10). Gena only slightly narrower than compound eye in profile (Fig. 9). Scape length 0.52 mm; first flagellomere slightly shorter than second flagellomere. Intertegular distance 0.89 mm. Inner metatibial spur simple.

Mandible and labiomaxillary complex orange testaceous; labrum, clypeus and face dark reddish brown blending to nearly black on vertex (Figs 10–12); gena dark reddish brown; scape and pedicel orange testaceous; flagellum dark brown; mesosoma orange testaceous except more yellowish on pronotal dorsal surface and propodeal dorsal surface (Figs 11–12); legs orange testaceous except dark reddish brown to ferruginous on meso- and metatibiae and meso- and metatarsi; metasoma orange testaceous blending to ferruginous and to dark brown by third tergum, remaining terga largely ferruginous, with dark brown apical portions.

Mesoscutal punctures more well defined posteriorly and separated by 1–1.5 times a puncture width, otherwise as in male with punctures shallower and fainter anteriorly and more widely spaced.

Setae on legs white and on apical portions of metasoma fuscous.

Etymology. The specific epithet is based on the indigenous Arawakan-speaking Taíno islanders' name for Jamaica, Xaymaca, and meaning "Land of Springs".

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I am grateful to James R. Wiley, Florida State Collection of Arthropods, for bringing this material to my attention; to Ismael A. Hinojosa-Díaz, University of Kansas Natural History Museum, for executing the genitalic figures; and to Michael Ohl and an anonymous reviewer for their helpful comments. This is a contribution of the Division of Entomology, University of Kansas Natural History Museum, partially supported by US National Science Foundation grant DBI-1057366.

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RESEARCH ARTICLE

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A new species of the bee genus *Ctenoplectrella* in middle Eocene Baltic amber (Hymenoptera, Megachilidae)

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Abstract

A new species of the extinct bee genus *Ctenoplectrella* Cockerell (Megachilinae: Ctenoplectrellini) is described and figured from two females preserved in middle Eocene (Lutetian) Baltic amber. *Ctenoplectrella phaeton* **sp. n.** is distinguished from its congeners on the basis of its body proportions, integumental sculpturing, wing venation, and pubescence, and is one of the more distinctive members of the genus. A revised key to the species of *Ctenoplectrella* is provided.

Keywords

Megachilinae, Ctenoplectrellini, paleontology, Tertiary, Eocene, taxonomy

Introduction

The Eocene was the last epoch harboring a truly disparate bee fauna relative to the composition of forms we are so familiar with in today's ecosystems. Following the Eocene-Oligocene transition the bee fauna began to look relatively modern at least

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in terms of the general appearance of the tribes, genera, and subgenera comprising the diversity in the latest Paleogene and Neogene periods. However, from the Eocene and earlier epochs we find regularly taxa that harbor unique combinations of traits that render them challenging to fit amongst their modern counterparts even at higher taxonomic levels, alongside otherwise more modern forms (Engel 1998, 2001, 2004, 2008, 2011, unpubl. data; Wappler and Engel 2003; Engel and Perkovsky 2006; Ohl and Engel 2007; Patiny et al. 2007; Michez et al. 2007, 2009, in press; Wedmann et al. 2009). Those glimpses into the Early Paleogene highlight a diversity of genera and tribes quite distinct, exhibiting not only plesiomorphic features relative to species of today but obviously with unique adaptations and apomorphies which did not persist to the present (e.g., the bizarre facial morphologies of species of *Succinapis* Engel: *vide* Engel 2001). Our knowledge of these remarkable bees continues to grow, mostly from European deposits but now also from distant biogeographic regions such as India (Rust et al. 2010; Engel unpubl. data).

Herein we describe a recently recognized new species of the Eocene bee genus *Ctenoplectrella* Cockerell (1909a, 1909b). The genus was described originally alongside the genus *Glyptapis* Cockerell in a distinct subfamily, Glyptapinae, which Cockerell (1909b) considered to be "near the stem-form of the Megachilidae" but simultaneously indicated that he believed their closest modern relative to be *Ctenoplectra* Smith (hence the name he chose for the group of fossil species considered herein). Cockerell's assertion is difficult to understand given that there is actually little morphological similarity between *Ctenoplectrella* and *Ctenoplectra*, today recognized to be a distinct lineage of Apidae, and even less so between *Glyptapis* and the latter. Engel (2001) provided the first revision of the Eocene bee fauna and recognized *Ctenoplectrella* and *Glyptapis* as definitive megachilids, and at first placed them within the Osmiini, later elevating them both to tribal status alongside the other megachilines (Engel 2005). All four *Glyptapis* species, as well as the known five species of *Ctenoplectrella*, are from Baltic amber (middle Eocene) except for *C. zherikhini* Engel and Perkovsky, which is known from the Late Eocene amber of the Rovno region of the Ukraine (Table 1).

While *Ctenoplectrella* and *Glyptapis* are definite oddities, we have noted a considerable similarity between *Ctenoplectrella* and the rare living genus *Aspidosmia* Brauns [presently in Anthidiini (*vide* Michener 2007), but apparently more basally related among the Megachilinae (Litman et al. in press)], with two species in southern Africa (Brauns 1926; Peters 1972). Both genera share a metatibia with relatively long setae suggesting a scopa and a forewing with a rather elongate prestigma and basal vein strongly arcuate, meeting Cu orthogonally (i.e., at a right angle), and it is likely that they are closely related, with *Aspidosmia* perhaps representing the sole survivors of the ctenoplectrelline lineage. Naturally, this conclusion requires rigorous cladistic testing but is tantalizing given the number of biogeographic connections between the sub-Saharan or East Asian fauna and extinct taxa from the European Paleogene (e.g., Ander 1942; Petrunkevitch 1958; Larsson 1978; Lourenço and Weitschat 1996; Böhme and Weitschat 1998; Engel 2001; Liu and Engel 2010; Weitschat and Wichard 2010).

Table 1. Currently included species in *Ctenoplectrella*.

Species	References
Baltic Amber (Lutetian)	
C. cockerelli Engel, 2001	Engel 2001
C. gorskii Engel, 2008	Engel 2008
C. grimaldii Engel, 2001	Engel 2001
C. phaeton Gonzalez & Engel, sp. n.	Present study
C. viridiceps Cockerell, 1909a	Cockerell 1909a, 1909b; Engel 2001
Rovno Amber (Bartonian-Priabonian?)	
C. zherikhini Engel & Perkovsky, 2006	Engel and Perkovsky 2006

Material and methods

Morphological terminology follows that of Engel (2001) and Michener (2007), while the format for the description generally follows that used by Engel (2001, 2008) and Engel and Perkovsky (2006). Photomicrographs were prepared using a Nikon D1x digital camera attached to an Infinity K-2 long-distance microscopic lens. Measurements were made with an ocular micrometer attached to an Olympus SZX-12 stereomicroscope and are provided for the holotype, with those of the paratype in parentheses.

Systematic paleontology

Tribe Ctenoplectrellini Engel, 2001
Genus *Ctenoplectrella* Cockerell, 1909a

***Ctenoplectrella phaeton* sp. n.**
urn:lsid:zoobank.org:act:0027DEF4-DC4A-46C2-87C4-473120D5BB80
http://species-id.net/wiki/Ctenoplectrella_phaeton
Figs 1–4

Holotype. ♀, AMNH Ba-JVe-161, Baltic amber, middle Eocene (Lutetian). Deposited in the Amber Fossil Collection, Division of Invertebrate Zoology (Entomology), American Museum of Natural History, New York.

Paratype. ♀, on curved edge in same amber piece as holotype and with same repository (Figs 1, 4).

Diagnosis. This species resembles *Ctenoplectrella cockerelli* Engel in the forewing with vein 2rs-m strongly and doubly arcuate, the basal vein confluent with cu-a, the first submarginal cell shorter than the second submarginal cell, and the punctate mesepisternum and terga. However, *C. phaeton* can be distinguished from *C. cockerelli* and

Figure 1. Photograph of majority of amber piece (middle Eocene, Baltic amber) indicating relative positions of two individuals of *Ctenoplectrella phaeton* Gonzalez and Engel, sp. n. (AMNH Ba-JVe-161); holotype is at right, paratype at upper left on curved edge of piece.

remaining species of the genus by its robust body, punctate metepisternum (impunctate in *C. cockerelli*), and much shorter and sparser body pubescence.

Description. *Female*: Total body length 5.77 mm (6.15 mm); forewing length 3.85 mm (3.92 mm). Head slightly wider than long; paraocular carina present; pedicel about as long as combined lengths of first and second flagellomeres; interocellar distance 2.5 times median ocellar diameter, 1.5 times longer than ocellocular distance; ocelloccipital distance about 1.6 times median ocellar diameter. Intertegular distance 1.46 mm. Outer surfaces of pro– and mesotibiae apically with small posterior spine. Prestigma relatively short, slightly more than two times longer than broad (prestigma width measured to its margin); basal vein strongly arcuate, confluent with cu-a; second abscissa of Rs basad 1m-cu by about six times vein width; 2rs-m distad 2m-cu by vein width, 2rs-m doubly arcuate; second submarginal cell slightly longer than first submarginal cell; seven distal hamuli, arranged in a single, evenly-spaced series. Sixth metasomal sternum with broadly rounded apical margin.

Integument in general smooth and shiny between punctures, weakly imbricate laterally on terga. Outer surface of mandible with minute punctures separated by a puncture width or less. Frons with small punctures separated by 1–1.5 times a puncture width, punctures becoming denser towards vertex. Pronotum laterally with minute punctures separated by a puncture width or less. Mesoscutum with small punctures separated by 1–2 times a puncture width (Fig. 2); tegula with

Figures 2–4. Photomicrographs of *Ctenoplectrella phaeton* Gonzalez and Engel, sp. n. (AMNH BaJVe-161) in middle Eocene Baltic amber. **2** Dorsal aspect of holotype female **3** Ventral aspect of holotype female **4** Dorsal aspect of paratype female.

minute, scattered punctures; mesoscutellum about as punctate as on mesoscutum. Metanotum impunctate and smooth. Mesepisternum with faint, scattered, larger punctures than on mesoscutum, nearly impunctate anteriorly to omaulus, punctures denser ventrally. Metepisternum more densely punctate than on mesepisternum, punctures separated by a puncture width or less dorsally, punctures sparse ventrally. Propodeum impunctate basally, lateral and posterior surfaces with minute punctures separated by more than two times a puncture width. Metasomal terga with small punctures separated by 1–2 times a puncture width, without distinct

depressed marginal zones; sterna with coarser punctures than on terga, punctures smaller and finer on first sternum.

Color apparently brown, without maculations. Wing membrane hyaline; veins strong and dark brown.

Face with minute, appressed, simple setae not obscuring integument. Mesoscutum and mesoscutellum with scattered, short, simple setae. Mesepisternum with scattered, erect, longer setae (0.5 times median ocellar diameter) than on mesoscutum. Basal area of propodeum without pubescence; lateral and posterior surfaces with minute, sparse setae (integument largely visible among setae). Legs in general with short, scattered, minutely-branched setae (Fig. 3); basitarsi with denser, slightly longer setae than on tibiae; metatibia with scattered, minutely-branched setae (setal length about 1–1.5 times median ocellar diameter). Metasoma with scattered, short (≤ 0.5 times median ocellar diameter), simple, erect to suberect setae on discs; sternal scopa composed of bands of rather sparse, long (2.5–3.0 times median ocellar diameter), erect, simple setae.

Male: Unknown.

Etymology. The specific epithet is taken from Phaeton and treated as a noun in apposition. In Greek mythology Phaeton died when he tried to drive the chariot of the sun across the sky. Phaeton's sisters wept and their tears turned to amber.

Comments. The supraclypeus, clypeus, and mandibles are obscured by dense *Schimmel* (whitish froth of microscopic bubbles resembling mold) in the holotype and by a fracture in the amber piece in the paratype. However, the strong apical tooth and distinct outer ridge of the mandible is barely visible in the holotype, thus suggesting a similar mandibular shape as in other species of *Ctenoplectrella*.

Revised key to species of *Ctenoplectrella*

(updated from Engel and Perkovsky 2006)

1 Forewing 2rs-m strongly and doubly arcuate, thus second submarginal cell more strongly produced toward wing apex along posterior margin; medioapical margin of clypeus straight (shape of clypeus unknown in *C. phaeton*) **2**

– Forewing 2rs-m relatively straight and therefore second submarginal cell not more strongly produced toward wing apex along posterior margin; medioapical margin of clypeus gently convex ..... ***C. viridiceps*** **Cockerell**

2 Forewing basal vein confluent with cu-a; first submarginal cell shorter than second submarginal cell **3**

– Forewing basal vein distad cu-a; first submarginal cell longer than second submarginal cell ..... ***C. gorskii*** **Engel**

3 Mesepisternum impunctate laterally; metasomal terga faintly imbricate **4**

– Mesepisternum with coarse, faint punctures laterally; metasomal terga with small, scattered punctures **5**

4 Propodeal setae long, erect, and branched; tarsal setae fuscous; gena tapering in width from widest above to narrower below..... ..... ***C. zherikhini* Engel & Perkovsky**

– Propodeal setae scattered, short, and simple; tarsal setae white or off-white; gena of relatively equal width along its length ..... ***C. grimaldii* Engel**

5 Metepisternum punctate; body pubescence distinctly short and sparse..... ..... ***C. phaeton* sp. n.**

– Metepisternum impunctate; body pubescence of moderate length, not distinctly short and sparse ..... ***C. cockerelli* Engel**

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Parachorius semsanganus sp. n. (Coleoptera, Scarabaeidae, Scarabaeinae) from Laos and its significance in the phylogeny of Oriental Deltochilini

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Abstract

The new species *Parachorius semsanganus* **sp. n.** is described from Laos. This enigmatic Oriental deltochiline represents a "morphological link" between *Parachorius* and *Cassolus* by sharing characters of the two genera. The fact that *P. semsanganus* cannot be unequivocally placed in either of these two genera stresses some more general problems of the current classification of *Parachorius* and *Cassolus.* Such problems can be solved only in the course of phylogenetic analysis, the need of which is briefly outlined.

Keywords

Deltochilini, *Parachorius*, *Cassolus,* new species, Laos, "morphological link"

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Introduction

The dung beetle tribe Deltochilini Lacordaire, 1856 (= Canthonini Lansberge, 1874, synonymy according to Bouchard et al. (2011)), displays a Gondwanian distribution and is the most genus-rich tribe of the Scarabaeinae. It comprises 873 species grouped into 91 genera that constitute 40% of the entire generic diversity of the subfamily Scarabaeinae (Davis et al. 2008). However, the monophyly of the tribe is doubtful according to a revision of African genera (Scholtz and Howden 1987), and it appears polyphyletic in the morphology-based and molecular phylogenies (Philips et al. 2004; Ocampo and Hawks 2006; Monaghan et al. 2007; Sole and Scholtz 2010). Such ambiguity highly complicates the diagnosis of the tribe and thus makes a consensus about its generic composition impossible at the moment.

The Oriental genus *Parachorius* Harold, 1873 comprises six species and, according to the last monographic study (Balthasar 1963), belongs to the tribe Pinotini Kolbe, 1905, which is a synonym of the Ateuchini Laporte, 1840 (Smith 2006; Bouchard et al. 2011). Vaz-de-Mello (2007; 2008) places *Parachorius* within the tribe Coprini Leach, 1815 based on morphological phylogenetic analysis of Ateuchini and related taxa. By contrast, another preliminary morphology-based phylogeny of Oriental Deltochilini using aedeagal and somatic characters (Tarasov, unpublished) strongly suggests that *Canthon* Hoffmannsegg, 1817 (the most speciose genus of the Deltochilini), *Parachorius*, and another Oriental deltochiline genus *Cassolus* Sharp, 1875, form a monophyletic group. Therefore, here, we treat *Parachorius* as a deltochiline. Based on study of external morphological characters within the tribe Deltochilini, *Parachorius* seems to be most closely related to the genus *Cassolus*. The genus *Cassolus* includes nine species that are morphologically very heterogeneous. Such morphological variation, especially when compared with the morphology of the known species of *Parachorius*, may indicate a nested position of the latter genus within *Cassolus* (Tarasov, unpublished).

Whilst surveying recent scarab collections from Laos deposited at the Naturhistorisches Museum in Basel, Switzerland (NHMB), we discovered a very interesting deltochiline species displaying a mixed character set between *Parachorius* and *Cassolus*. This species cannot be unequivocally placed in either genus using current taxonomic concepts of these taxa (Balthasar 1963). However, we tentatively place this new species in the genus *Parachorius*.

Discovery of this species supports the above mentioned evidence for the close relationship between *Cassolus* and *Parachorius* as well as our provisory placement of *Parachorius* within the Deltochilini. Its description, provided here, enables its incorporation in the upcoming phylogenetic analysis of the entire generic complex.

Material and methods

All photos were taken with a digital camera attached to a dissecting microscope (Leica MZ16A). Male aedeagi in Figs 1–3 were photographed in glycerin. First, the dissected

aedeagus was macerated in 10% solution of KOH for several hours and then rinsed with distilled water. Finally, the aedeagus was placed in glycerin for taking pictures and subsequent storage.

All the material used in this study is housed in the NHMB.

Species description

Parachorius semsanganus **Tarasov & Keith sp. n.**
urn:lsid:zoobank.org:act:E79FA444-725E-40E6-986A-9FB48B7D232A
http://species-id.net/wiki/Parachorius_semsanganus
Figs 1–5

Type locality. Laos, Xieng Khouang prov., Phou Sane Mt.

Material examined. *Holotype* (NHMB), male bearing the following labels:

LAOS-NE, Xieng Khouang prov., 19°38.20'N 103°20.20'E, Phonsavan (30 km NE): PHOU SANE Mt., 1420 m, 10.-30.v.2009, D. Hauck leg.

NHMB Basel, NMPC Prague Laos 2009 Expedition: M. Brancucci, M. Geiser, Z. Kraus, D. Hauck, V. Kubáň

HOLOTYPE Parachorius semsanganus S. Tarasov & D. Keith det. 2011

Paratypes. 9♀, same data as holotype; 2♂, same data as holotype but Z. Kraus leg.; 4♂, 3♀, LAOS-NE, Xieng Khouang prov., 19°37-8.'N 103°20'E, 30 km NE Phonsavan: Ban Na, Lam Phou Sane Mt., 1300–1500 m, 10.-30.v.2009, M. Brancucci leg.

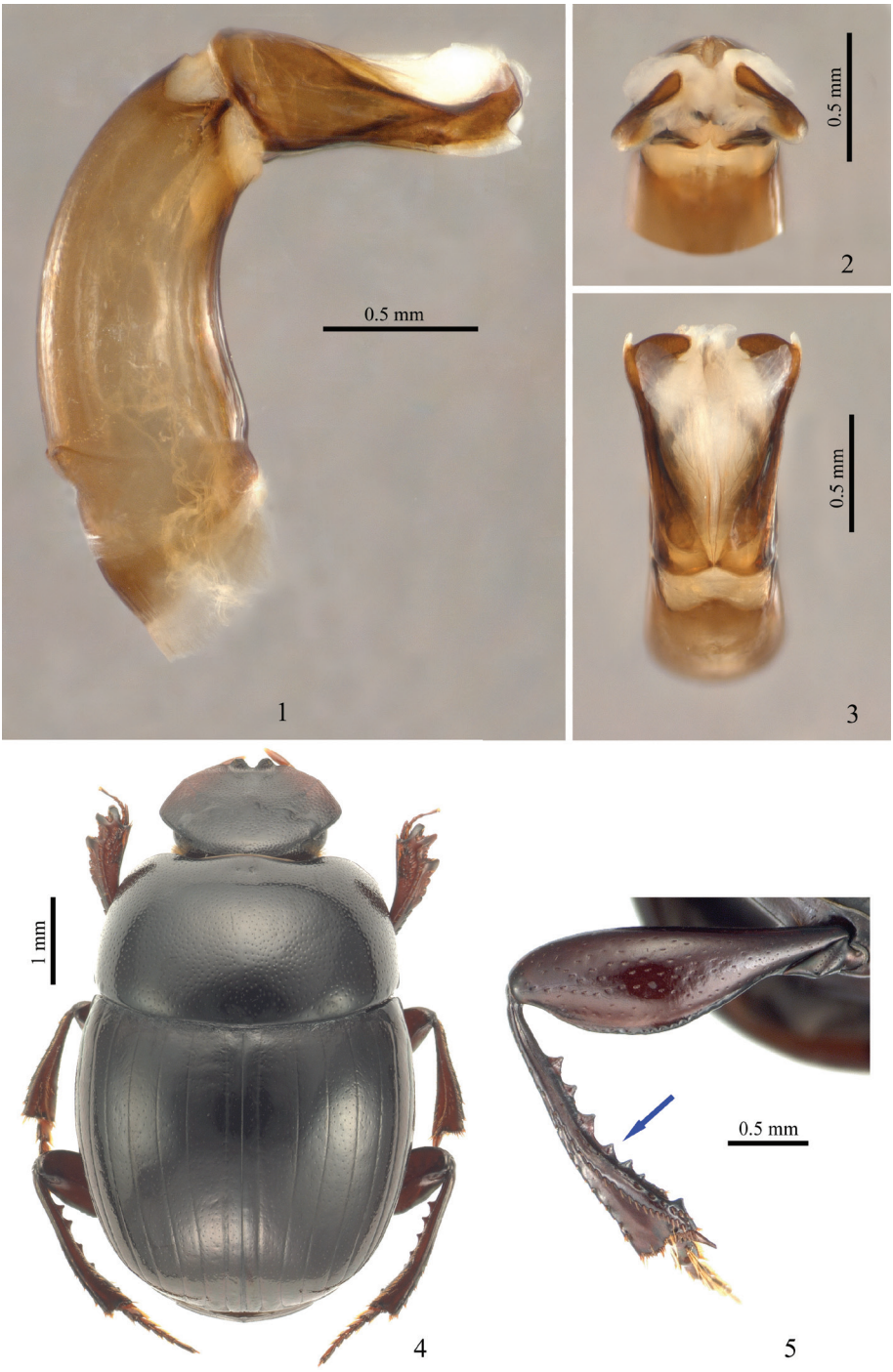
Description. Oval, convex, black, entirely shiny; mouthparts, antennae and legs red-brown. Dorsal body side covered with two types of punctures: larger (normal) punctures and very tiny punctures (which can be observed only under higher magnification of 40x or more) Dorsal and ventral body sides glabrous. Length 8.2–10.6

Male (Fig. 4). Head flat, punctation fine; anterior margin notched medially; notch delimited by 2 prominent triangular obtuse teeth; clypeus laterad of each tooth very slightly notched; eyes completely divided by canthus into lower and upper lobes; lower lobes significantly larger than upper ones; genae and clypeus not distinctly separated from frons; genae rounded and protruding; antennae with 9 segments, antennal club with 3 segments.

Pronotum broadly trapezoidal, punctation fine, separated by 1–2 puncture diameters on disc, becoming slightly denser laterally. Lateral margins of pronotum flattened, arcuate, widest near base; lateral and anterior side marginate, posterior side not marginate; anterior angles obtuse; posterior angles rounded. Prothoracic fovea excavated, delimited by ridge reaching propleural lateral margin.

Elytra with eight striae, sublateral carina forming pseudepipleuron beyond eighth stria; epipleura narrow; interstriae flat with sparse, fine punctation.

Protibiae with three outer teeth; 1st tooth slightly thicker than two others; inner margin with two vertical teeth underneath, located approximately opposite to 2nd and



Figures 1–5. Morphological features of *Parachorius semsanganus* sp. n.: **1–3** paratype, aedeagus **1** aedeagus lateral view **2** aedeagus apical view **3** aedeagus dorsal view **4** male holotype, habitus **5** male paratype, hind leg, arrow indicates teeth on inner tibial margin.

3rd outer teeth; protibial apical spur acute, long, reaching middle or apical portion of 3rd tarsal segment; sometimes protibial teeth and apical spur abraded.

Metafemoral posterior margin with keel bearing indistinct and slight serration on top (Fig. 5). Metatibiae slightly curved, conspicuously denticulate on inner margin (Fig. 5, indicated with arrow); teeth are abraded in some specimens.

Pygidium with rather coarse, uniform, dense punctation.

Aedeagus (Figs 1–3) with converging, spatulate apices of parameres.

Female. Similar to male but with the 1st protibial outer tooth slightly thinner than in males; metafemoral posterior margin not serrate; metatibial inner margin not denticulate.

Variation. All specimens of the type series look very similar to each other. Some variation may be observed in the shape of teeth on the metatibial inner margin, which are less expressed in some males due to abrasion.

Holotype (Fig. 4). The holotype specimen lacks the tarsus of the right middle leg.

Differential diagnosis. The new species is quite distinct among all other known species of *Parachorius* and *Cassolus*. It can be easily separated from them by the following unique set of character states: clypeus near outer side of each clypeal tooth very slightly notched, metatibial inner margin with large teeth (Fig. 5, arrowed), and aedeagus with spatulate apices which are largely bent inward (Figs 1–3).

Distribution and ecology. The species is known from only 16 specimens of the type series collected across a range of altitudes between 1300–1500 m on Phou Sane Mt. of Xieng Khouang province in Laos.

Etymology. The name of the new species is derived from the Latinized Lao words "syam" – link and "sanga" – spectacular. Its meaning "spectacular link" refers to the fact that this species represents a "morphological link" between the genera *Parachorius* and *Cassolus*.

Taxonomic notes. Based on taxonomic concepts of the most recent monographic study dealing with *Parachorius* and *Cassolus* (Balthasar 1963), the morphological differences between these two taxa can be summarized as follows: *Cassolus* are normally smaller than *Parachorius*; the clypeus near the outer side of each clypeal tooth is usually deeply notched in *Cassolus* and not notched in *Parachorius* (very slightly notched in *P. semsanganus* sp. n.); the metatibiae are curved in *Cassolus* and more or less straight in *Parachorius* (slightly curved in *P. semsanganus* sp. n.); some *Cassolus* species have denticles on the inner metatibial margin, whereas the metatibial margin of *Parachorius* is not at all denticulate (distinctly denticulate in *P. semsanganus* sp.n.). As can be seen from this combination of characters, *P. semsanganus* sp. n. is similar, on the one hand, to *Parachorius* and on the other hand to *Cassolus* (in particular to *C. gotoi* Masumoto, 1986). A robust justification of the taxonomic placement of *P. semsanganus* sp. n. requires an extensive phylogenetic analysis embracing both *Parachorius* and *Cassolus.* Such an analysis is currently in preparation and it may, in particular, result in the synonymy of *Parachorius* and *Cassolus*. Therefore to avoid potential nomenclatural changes in the future, we place the new species in the earlier described genus *Parachorius.*

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A new species of *Amphoropsyche* (Trichoptera, Leptoceridae) from Ecuador, with a key to the species in the genus

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Abstract

A new species of *Amphoropsyche* Holzenthal is described from Ecuador. It is similar to a group of species with dorsomesal processes on the preanal appendages (i.e., *A. woodruffi* Flint & Sykora, *A. refugia* Holzenthal, and *A. aragua* Holzenthal), but can be distinguished from these and other members of the genus by the short, digitate dorsomesal processes on the preanal appendages and the broad lateral processes of tergum X of the male genitalia. A key to males of the 14 species now known in the genus is presented based on characters of the genitalia.

Keywords

Trichoptera, Leptoceridae, *Amphoropsyche*, caddisfly, new species, Neotropics, Ecuador, key to species

Introduction

Flint (1968) described the male, female, and larva of a new species of longhorn caddisfly (Leptoceridae, Leptocerinae) from Dominica, Lesser Antilles, and tentatively placed

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it in the Chilean genus *Brachysetodes,* based mainly on wing venation. He also noted that the structure of the male genitalia seemed quite different between the Dominican species, *B. insularis* Flint, and the type species, *B. trifidus* Schmid. He suggested that the discovery of the larva of the Chilean species might show that the 2 species are not congeneric. Based on character differences in the male genitalia, Holzenthal (1985) removed *B. insularis* from *Brachysetodes* and established the genus *Amphoropsyche* for Flint's species along with 9 new species from Ecuador, Colombia and Venezuela. In a separate paper, Holzenthal (1986a) described the immature stages of *Brachysetodes*, confirming Flint's earlier supposition that *Brachysetodes* and *Amphoropsyche* are distinct. Holzenthal (1986b) also described 1 additional species from Bolivia, extending the known geographical range of the genus considerably southwards, and redescribed the larva of the Dominican species. Since the mid 1980s, only 3 additional nominal species were described, all from the Lesser Antilles and Tobago: *A. janstockiana* Botosaneanu, 1990 from Saint Vincent, *A. multispinosa* Botosaneanu, 1993 (in Botosaneanu and Alkins-Koo 1993) from Trinidad, and *A. woodruffi* Flint & Sykora, 1993 from Grenada (subsequently recorded from northern Venezuela by Flint 1996). Flint (1996) considered *A. multispinosa* to be a geographical variant of *A. woodruffi* and changed its status to a subspecies of the latter. In the same paper, Flint (1996) noted the presence of a single female specimen from Tobago with distinctive genitalia probably representing yet another new species; males have still not been collected and the species remains undescribed.

This genus seems to be especially species-rich in mid-elevation streams (e.g., 1500–2500 m) in the northern Andes and more species are expected to be collected and described (Holzenthal 1986b; Flint et al. 1999). *Amphoropsyche* is characterized by the presence of large glands inside the preanal appendages (probably producing pheromones), and the presence of a tuft of strong hairs near the apex of the inferior appendage, probably involved in dispersing these pheromones (Botosaneanu 1990). In this paper, we describe a new species of *Amphoropsyche*, the 14th in the genus, and provide a key to the males of the species.

Materials and methods

This study is based on a single pinned specimen collected in Ecuador by Dr. Oliver S. Flint, Jr., National Museum of Natural History, Smithsonian Institution, and kindly loaned to the first author. Techniques and procedures used in the preparation and examination of the specimen are those outlined by Blahnik and Holzenthal (2004) and Blahnik et al. (2007). The illustration of the genitalia was prepared from a pencil sketch made using a camera lucida mounted on an Olympus BX41 compound microscope. The pencil sketch was then scanned and placed into an Adobe Illustrator (version CS5, Adobe Systems, Inc.) document, to serve as a template, and then traced to create a vector graphic illustration. A graphic tablet and pen (BAMBOO™, Wacom Technology Co.) facilitated careful tracing of the original image.

Terminology used in describing male genitalia follows that of Holzenthal (1985, 1986b). The taxonomic key was based on published illustrations and descriptions of the male genitalia (Holzenthal 1985, 1986b; Botosaneanu 1990; Flint and Sykora 1993, Botosaneanu and Alkins-Koo 1993; Flint 1996 [these papers can be downloaded from the Trichoptera Literature Database at www.trichoplit.umn.edu to facilitate comparisons]) and was constructed using the DELTA system which facilitated taxonomic data coding via the Delta editor v. 1.04 (Dallwitz 1980; Dallwitz et al. 1999 onwards).

The type is deposited in the United States National Museum of Natural History, Smithsonian Institution, Washington, D.C. (NMHN).

Species description

Amphoropsyche tandayapa **Holzenthal & Rázuri-Gonzales, sp. n.**
urn:lsid:zoobank.org:act:405CE4BA-B14D-4CEB-827E-BFE295FD12F0
http://species-id.net/wiki/Amphoropsyche_tandayapa
Fig. 1A–D

Description. This species is characterized by the short, digitate dorsomesal processes of the inferior appendages, the long basoventral projection of the 1st article of the inferior appendages, and the broad, lateral processes of segment X. It is most similar to that group of species also possessing dorsomesal processes on the preanal appendages (i.e., *A. woodruffi*, *A. refugia*, *A. aragua*), but differs in having much shorter processes that are unsclerotized.

Male. Forewing length 4.8 mm. Wings and body color brown. Genitalia as in Fig. 1A–D. Segment IX annular, sternum with anterior part slightly extended anteriorly. Segment X composed of a single mesal process and pair of lateral processes; mesal process lightly sclerotized, apex broadly acute; lateral process broad, bearing apical spine-like setae. Preanal appendages large, oval, almost completely fused along their midlengths, with pair of short, digitate, membranous dorsomesal processes; preanal appendage with large reticulate internal gland with small ventral opening. Inferior appendage elongate, with long basoventral projection; inferior appendage angulate basally in lateral view, bent inwards in ventral view, bearing very short spine-like setae on slightly protruding apicomesal corner; 2nd article of inferior appendage elongate, thin, sinuate, slightly curved inwards, apex narrow, rounded. Phallic apparatus with phallobase well developed; pair of dorsal parameres present; phallotremal sclerite well developed, elongate, widest apically in lateral view.

Female and larva: Unknown.

Holotype male. ECUADOR: Pichincha: 2.3 km S Tandayapa, 1800 m, 6.x.1990, O.S. Flint, Jr. (NMNH).

Etymology. Named after the town of Tandayapa, located near where the holotype was collected.

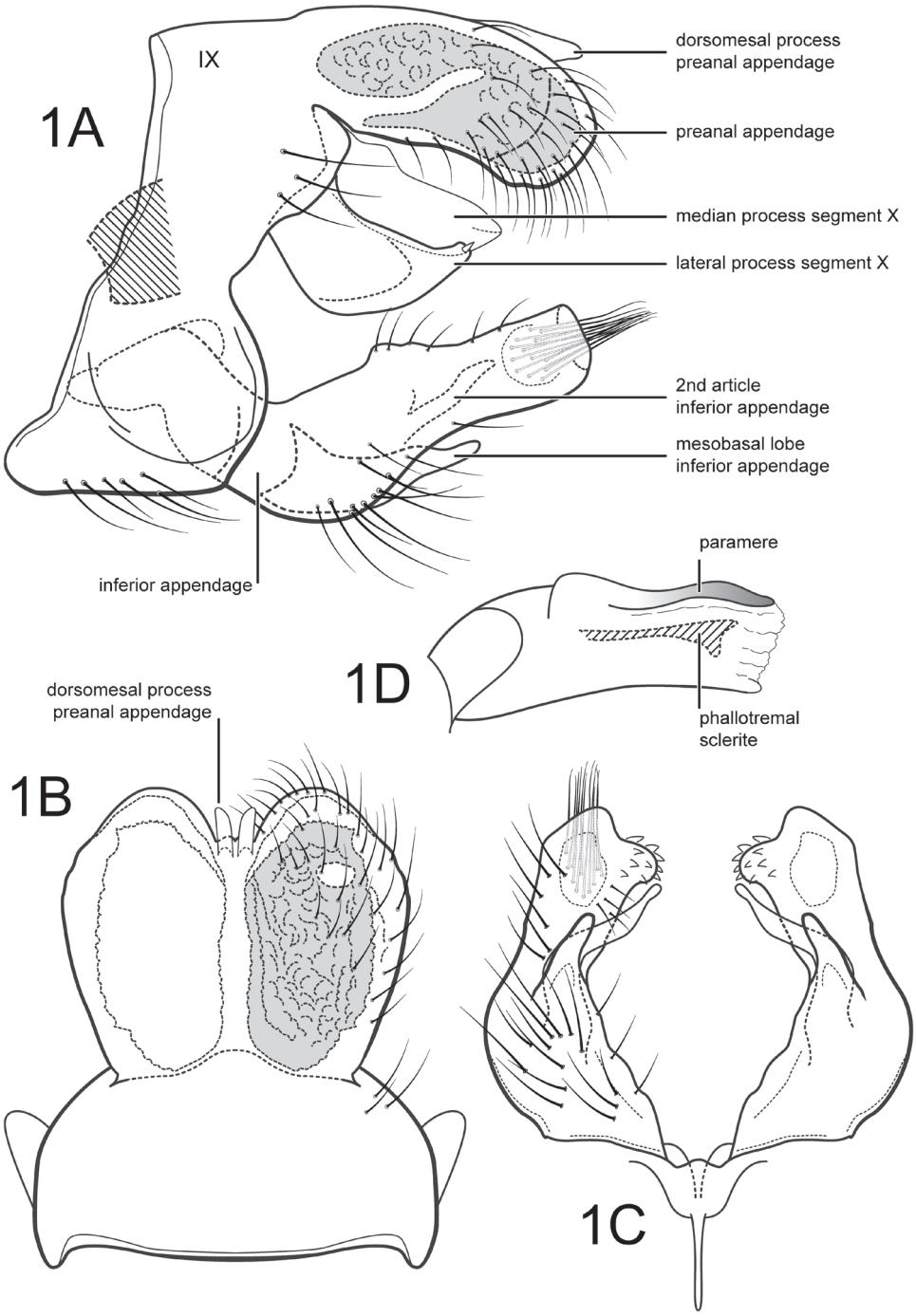

Figure 1. *Amphoropsyche tandayapa*, sp. n. Male genitalia **A** lateral **B** segments IX–X, dorsal **C** inferior appendages, ventral **D** phallus, lateral.

Key to the males of *Amphoropsyche*

1 Preanal appendages completely (Holzenthal 1985, Figs 8B, 10B; Flint and Sykora 1993, Fig. 20) or almost completely fused mesally (if the latter, apical emargination shallow, obtuse) (Fig. 1B; Holzenthal 1985, Fig. 3B) **2**

– Preanal appendages not fused mesally, divided to 1/3 to 2/3 of their length (apical emargination acute) (Holzenthal 1985, Figs 5B, 6B) **6**

2(1) Preanal appendages with dorsomesal process (Holzenthal 1985, Figs 8B, 10B) **3**

– Preanal appendages without dorsomesal process (Holzenthal 1985, Figs 3A–D) ..... ***A. insularis***

3(2) Dorsomesal process of preanal appendages short, digitate, not exceeding length of preanal appendage; dorsomesal processes of preanal appendages not sclerotized (Figs 1A–D) ..... ***A. tandayapa* sp. n.**

– Dorsomesal process of preanal appendages long, exceeding length of preanal appendage (Holzenthal 1985, Figs 8A, 10A; Flint and Sykora 1993, Fig. 18); dorsomesal processes of preanal appendages sclerotized **4**

4(3) Second article of inferior appendages elongate, narrow (Holzenthal 1985, Fig. 8A) **5**

– Second article of inferior appendages short (Flint and Sykora 1993, Figs 18–20; Botosaneanu and Alkins-Koo 1993, Figs 97–101) ..... ***A. woodruffi***

5(4) Dorsomesal process of preanal appendages bifid in dorsal view; ventral subterminal portion of phallobase serrate (Holzenthal 1985, Figs 8A–D) .... ***A. refugia***

– Dorsomesal process of the preanal appendages entire in dorsal view; ventral subterminal portion of phallobase entire (Holzenthal 1985, Figs 10A–D) .... ***A. aragua***

6(1) Second article of inferior appendages present (Holzenthal 1985, Fig. 5A) **7**

– Second article of inferior appendages absent (Holzenthal 1985, Fig. 16C) **13**

7(6) Tergum X with median process and paired lateral processes (Holzenthal 1985, Figs 5A, 14A) **8**

– Tergum X without median process, lateral processes with apical and subapical spinelike projections (Botosaneanu 1990, Figs 1–3) ..... ***A. janstockiana***

8(7) Second article of inferior appendages short (Holzenthal 1985, Fig. 14C) or long, but broad (Holzenthal 1985, Fig. 6C) **9**

– Second article of inferior appendages elongate and narrow (Holzenthal 1985, Fig. 7C) **11**

9(8) Phallus without parameres (Holzenthal 1985, Fig. 6D) **10**

– Phallus with parameres (Holzenthal 1985, Figs 14A–D) ..... ***A. quebrada***

10(9) Second article of inferior appendages short, with apical spine-like seta; lateral process of tergum X with subapical spine-like seta; phallicata with pair of bifid, spiniferous, lateral extensions (Holzenthal 1986b, Figs 1A–D) .... ***A. spinifera***

– Second article of inferior appendages long, but broad, without apical spine-like seta; lateral process of tergum X with several apical spine-like setae; phallicata without lateral, bifid extensions, but phallobase with ventral spine-like process (Holzenthal 1985, Figs 6A–D) ..... ***A. flinti***

11(8) Phallus with parameres (Holzenthal 1985, Fig. 5D) **12**

– Phallus without parameres (Holzenthal 1985, Figs 11A–D) ..... ***A. choco***

12(11) Lateral process of tergum X U-shaped, tip bifid, bearing small spine-like setae (Holzenthal 1985, Figs 5A–D) ..... ***A. napo***

– Lateral process of tergum X tapered to a sharp terminal point, without spine-like setae (Holzenthal 1985, Figs 7A–D) ..... ***A. stellata***

13(6) Parameres small; inferior appendage with basoventral lobe (Holzenthal 1985, Figs 16A–D) ..... ***A. cauca***

– Parameres large; inferior appendage without basoventral lobe (Holzenthal 1985, Figs 12A–D) ..... ***A. ayura***

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SHORT COMMUNICATION

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On Chinese species of *Dianous* group I (Coleoptera, Staphylinidae, Steninae)

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Abstract

Chinese species of *Dianous* group I are studied and three new species are described: *D. fengtingae* **sp. n.** from Hainan Province, *D. zhujianqingi* **sp. n.** from Jiangxi and Guizhou Province, and *D. huanghaoi* **sp. n.** from Yunnan Province. *Dianous shan* Rougemont and *D.* viridicupreus Rougemont are discovered from China for the first time. Their diagnostic characters are illustrated and a key to Chinese species of *Dianous* group I is provided.

Keywords

Coleoptera, Staphylinidae, *Dianous* Group I, China

Introduction

The members of *Dianous* group I have large eyes and simple tarsi, and therefore were regarded as *Stenus* by earlier entomologists. In 1981 Puthz made a systematic comparison between these two genera and revealed that this group without protrudable labium

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surely belonged to *Dianous*. To distinguished it from other members of *Dianous*, the following characters can be used: eyes large, usually without temples; tarsi simple, without tarsal shoes; frons with median portion not elevated.

Up to the present, 59 species of *Dianous* group I have been described, which account for nearly 30 percent of the genus. All of the species are distributed in the Oriental region and seem to be rare. In Chinese fauna, only four species were previously reported by Puthz (2000): *D. yao* Rougemont, 1981 from Guizhou and *D. tonkinensis* (Puthz), 1968 from Yunnan, Puthz (2001): *D. limitaneus* Puthz, 2001 from Yunnan, Shi and Zhou (2010): *D. viriditinctus* (Champion), 1920 from Xizang. In this paper, we complement the list with several new records and new species based on material from South China.

Material and methods

Specimens examined in this paper were all collected near streams through forests and killed with ethyl acetate. For examination of male genitalia, the last three abdominal segments were detached from the body after softening in hot water. The aedeagus together with other dissected pieces were mounted in Euparal (Chroma Geselschaft Schmidt, Koengen, Germany) on plastic slides. Photos of sexual characters were taken with Cannon G7 attached to Olympus SZX 16 stereoscope; habitus photos were taken with a Cannon macro photo lens MP-E 65mm attached to Cannon EOS40D camera.

The type specimens treated in this study are deposited in the following public and private collections:

SHNU Department of Biology, Shanghai Normal University, P. R. China
cPut private collection of V. Puthz, Schlitz, Germany
cRou private collection of G.-M. de Rougemont, London, England

The measurements of proportions are abbreviated as follows:

BL body length, measured from the anterior margin of the clypeus to the posterior margin of 10th abdominal tergite
FL forebody length, measured from the anterior margin of the clypeus to the apex of the elytra (apicolateral angle)
HW width of head including eyes
PW width of pronotum
EW width of elytra
PL length of pronotum
EL length of elytra, measured from humeral angle

Results

Key to Chinese species of *Dianous* group I

1 Pronotum bicolorous with golden bands along the anterior and posterior margins.....**2**

– Pronotum unicolorous.....**3**

2 Head distinctly broader than elytra; femora bicolorous. Habitus (Figs 13, 14), aedeagus (Fig. 3 in Rougemont 1985), female sexual characters (Figs 63–65). BL: 4.8–5.0 mm..... ***D. viridicupreus*** **Rougemont**
China (Xizang), Nepal

– Head narrower than elytra; femora unicolorous. Habitus (Figs 17), sexual characters (Figs 6–10 in Shi & Zhou 2010). BL: 4.3–5.3 mm..... ..... ***D. viriditinctus*** **(Champion)**
China (Xizang), India, Nepal, Bhutan

3 Body, at least head and pronotum, metallic green or golden green **4**

– Body, at least head and pronotum, metallic blue or black with plumbeous lustre.....**6**

4 Elytra relatively narrow, head about as broad as elytra; punctures on head and pronotum moderate in size and distinctly separated, interstices can be as broad as half the diameter of a puncture. Habitus (Figs 5, 6), sexual characters (Figs 36–44). BL: 4.5 mm ..... ***D. shan*** **Rougemont**
China (Yunnan), Myanmar, Thailand

– Elytra relatively broad, head distinctly narrower than elytra; punctures on head and pronotum very coarse and very dense, interstices narrow and sharp **5**

5 Frons between eyes sharply inclined inward forming a deep and broad concavity; punctures on elytra mostly distinctly delimited; paratergites of abdominal tergite 4 broad, slightly declivous. Habitus (Figs 15), aedeagus (Figs 2 in Rougemont, 1981a). BL: 4.0–5.2 mm..... ***D. yao*** **Rougemont**
China (Guizhou), Myanmar, Thailand

– Frons between eyes gently inclined inward forming a shallow and broad concavity, traces of two lateral longitudinal furrows can be recognized at posterior portion of the concavity; punctures on elytra mostly transversely or diagonally confluent; paratergites of abdominal tergite 4 narrow, slightly reflexed. Habitus (Figs 16), male unknown. BL: 4.5–5.2mm..... ***D. limitaneus*** **Puthz**
China (Yunnan)

6 Forebody distinctly metallic blue; femora bicolorous **7**

– Forebody black with plumbeous lustre, sometimes elytra with brassy reflection; femora unicolor.....**8**

7 punctures on frons deep and dense; posterior half of elytra with vorticose sculpture. Habitus (Figs 11, 12), sexual characters (Figs 54–62). BL: 4.6–5.0 mm.....***D. huanghaoi*** **sp. n.**
China (Yunnan)

– punctures on frons shallow and sparse; posterior half of elytra with transverse sculpture. Habitus (Figs 7–10), sexual characters (Figs 45–53). BL: 3.7–4.4 mm..... ***D. zhujianqingi* sp. n.**
China (Jiangxi, Guizhou)

8 Punctation of pronotum and elytra coarser and less confluent; posteromedian part of 7th male sternite (Fig. 29) flattened, without keels. Habitus (Figs 3, 4), sexual characters (Figs 27–35). BL: 4.5–4.9 mm..... ***D. fengtingae* sp. n.**
China (Hainan)

– Punctation of pronotum and elytra smaller and confluent; posteromedian part of 7th male sternite (Fig. 20) with an impression limited by raised keels laterally, and two acute backward projections at its posterior margin. Habitus (Figs 1, 2), sexual characters (Figs 18–26). BL: 4.4–5.9 mm .... ***D. tonkinensis* (Puthz)**
China (Yunnan, Hunan), Vietnam, Thailand, Borneo, Indonesia

***Dianous tonkinensis* (Puthz), 1968**
http://species-id.net/wiki/Dianous_tonkinensis
Figs 1, 2, 18–26

Stenus tonkinensis Puthz, 1968: 447; 1973: 41.
Dianous tonkinensis; Puthz 1981a: 2; Rougemont 1981b: 359; Puthz 1981b: 101, 102; Rougemont 1984: 228; Puthz 2000: 501.

Material examined. CHINA: Yunnan: male, Nabanhe N. R., Mandian, 12.I.2004, Li Li-Zhen & Tang Liang leg. (SHNU); male and female, Nabanhe N. R., Nabancun, N22°10'032", E 100°39'359, alt. 720m, 6.V.2009, Hu Jia-Yao & Yin Zi-Wei leg. (SHNU); **Hunan:** male, Wufeng Town, Houhe N. R., 20. IX.2003, Ohbayashi Nobuo leg. (SHNU)

Distribution. China (Yunnan, Hunan), Vietnam, Thailand, Borneo, Indonesia.

***Dianous fengtingae* Tang et Li sp. n.**
urn:lsid:zoobank.org:act:54B5B60C-2D53-41A9-9B0B-0439F3466B20
http://species-id.net/wiki/Dianous_fengtingae
Figs 3, 4, 27–35

Type material. Holotype. China: Hainan: male, glued on a card with labels as follows: "China: Hainan Prov., Ledong County, Jianfengling N. R., alt. 900m, 16.IV.2010, Feng & Yuan leg." "Holotype / *Dianous fengtingae* / Tang & Li" [red handwritten label] (SHNU). **Paratypes.** male and 4 females, same data as for the holotype. (SHNU); female, Changjiang County, Bawangling, alt. 1000m, 14.XI.2006, Li Li-Zhen leg. (SHNU); 4 females, Changjiang County, Bawangling,

Figures 1–6. Adult habitus of *Dianous.* **1, 2** *D. tonkinensis* **3, 4** *D. fengtingae* **5, 6** *D. shan*. Scales = 1 mm.

alt. 450–650m, 13.IV.2010, Zhu Jian-Qing leg. (female in cPut, female in cRou, rest in SHNU).

Description. Body entirely black, head, pronotum, elytra and basal abdominal tergites with a blue metallic lustre. Antennae blackish brown, with club segments lighter. First two segments of maxillary palpi brownish yellow, last segment brown. Legs blackish with tibiae and tarsi slightly lighter, femora yellowish in basal third.

BL: 4.5–4.9mm; FL: 2.5–2.6 mm.

Proportions of holotype: HW: 63.5, PW: 47, PL: 53, EW: 61, EL: 67.

Head 1.04 times as wide as elytra; interocular area gently inclined inward forming a shallow and broad concavity; punctures round, distinctly delimited, slightly larger on median area than near dorsal margins of eyes, diameter of large punctures about as wide as widest cross section of 2nd antennal segment, interstices smooth, mostly smaller than half diameter of punctures. Antennae when reflexed exceeding posterior margin of pronotum; length of segments from base to apex: 10.0: 7.0: 17.5: 11.0: 9.0: 8.0: 8.0: 7.0: 7.0: 8.0: 10.0.

Pronotum 1.28 times as long as wide, widest slightly before middle and constricted at base; punctures round, partially slightly confluent, distinctly larger than those on frons, interstices smooth, mostly smaller than half diameter of punctures.

Elytra nearly rectangular; punctation on average slightly coarser than that of pronotum, punctures on humeral area mostly distinctly delimited, and those on inner 2/3 portion of elytra (especially those on posterior half) obliquely confluent, interstices similar to those on pronotum.

Length of metatarsi from base to apex: 11.5: 8.5: 5.5: 3.5: 10.5.

Abdomen subcylindrical; 3rd to 6th segments with broad and densely punctate paratergites, paratergites of tergite 4 narrower than greatest width of hind tibia; 7th tergite with an apical membranous fringe; punctures on 3rd tergite as large as one eye facet, interstices smooth.

Male. Seventh sternite (Fig. 29) with a distinct posteriomedian emargination, 8th sternite (Fig. 30) with a broad triangular emargination posteromedially; 9th sternite (Fig. 31) with the apicolateral portion serrate, posterior margin slightly emarginate; 10th tergite (Fig. 32) with the posterior margin broadly rounded. Median lobe of aedeagus (Fig. 18) with an acutely pointed and setose apex (Fig. 19), parameres extending far beyond the apex of median lobe.

Female. Sternite 8 (Fig. 33) pointed posteromedially; valvifer (Fig. 34) with the posterior margin serrate; 10th tergite (Fig. 35) with the posterior margin truncate.

Distribution. China (Hainan).

Diagnosis. The new species is similar to *D. tonkinensis* (Puthz, 1968) from South Asia and *D. lividus* (L. Benick, 1929) from Philippines and Indonesia. It may be distinguished from both by the coarser and less confluent punctation on pronotum and especially on elytra.

Dianous shan **Rougemont, 1981, new to China**

http://species-id.net/wiki/Dianous_shan
Figs 5, 6, 36–44

Dianous shan Rougemont 1981a: 328; 1983c: 18.

Material examined. CHINA: Yunnan: male, Nabanhe N. R., Bengganglahu, 15.I.2004, Li Li-Zhen & Tang Liang leg. (SHNU); female, Nabanhe N. R., Nabancun, N22°09'305", E 100°41'291, alt. 620m, 18.XI.2008, Tang Liang leg. (SHNU)

Distribution. China (Yunnan), Myanmar, Thailand.

Dianous zhujianqingi **Tang & Li sp. n.**
urn:lsid:zoobank.org:act:03F6F311-0FA5-4860-A53B-1F53A74F970A
http://species-id.net/wiki/Dianous_zhujianqingi
Figs 7–10, 45–53

Type material. Holotype. China: Jiangxi: male, glued on a card with labels as follows:"China: Jiangxi Prov., Yushan County, Mt. Sanqingshan, alt. 1000–1200m, 16.X.2010, Peng, Zhai & Zhu leg." "Holotype / *Dianous zhujianqingi* / Tang & Li" [red handwritten label] (SHNU). **Paratypes.** 14 males and 19 females, same data as for the holotype (1 pair in cPut, 1 pair in cRou, rest in SHNU); male and female, Sanqingshan, alt. 700–1000m, 4.V.2005, Hu Jia-Yao & Tang Liang leg. (SHNU); **Guizhou:** male and 2 females, Mt. Fanjing, 23.VII.2003, Li Li-Zhen, Hu Jia-Yao & Tang Liang leg. (SHNU)

Description. Body entirely black with a faint plumbeous lustre, elytra sometimes with brassy reflection. Antennae blackish brown. Maxillary palpi with first segment yellowish, second segment light brown and last segment brown. Legs black with a brownish tint, tibiae and tarsi slightly lighter.

BL: 3.7–4.4 mm; FL: 2.1–2.3mm.

Proportions of holotype: HW: 58.0, PW: 44.5, PL: 49.0, EW: 59.0, EL: 63.5.

Head about as wide as elytra; lateral portions of front slightly rising, medial portion concave; punctures round, distinctly delimited, slightly larger on median area than near dorsal margins of eyes, diameter of large punctures about as wide as apical cross section of 3rd antennal segment, interstices smooth, smaller than or as broad as half diameter of punctures. Antennae when reflexed extending to the posterior margin of pronotum; Length of segments from base to apex: 9.0: 6.5: 9.0: 8.0: 8.0: 5.5: 8.0: 6.0: 7.0: 6.5: 9.0.

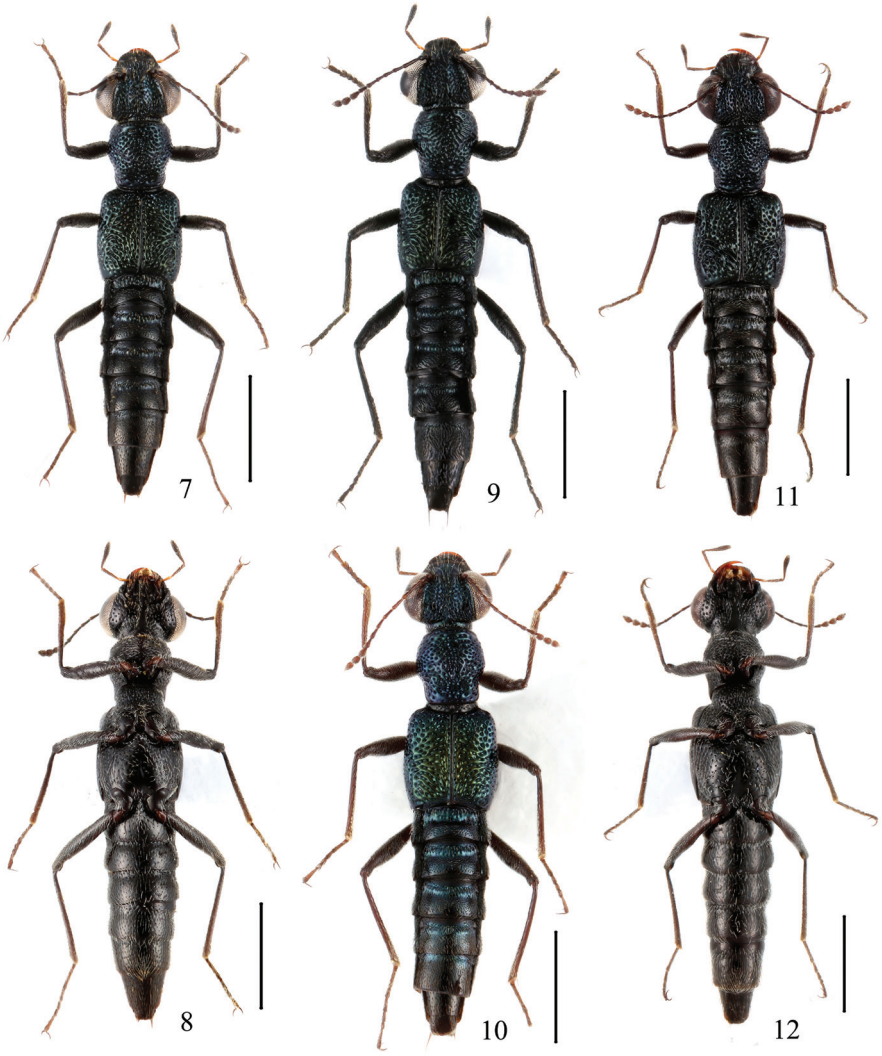
Pronotum 1.10 times as long as wide, widest slightly before middle and constricted at base; punctures partially confluent, diameter of large punctures about as wide as apical cross section of 2nd antennal segment, interstices smooth, mostly smaller than or about as broad as half diameter of punctures.

Elytra nearly rectangular; punctation similar to that of the pronotum, punctures on humeral area mostly distinctly delimited, those on medial two thirds obliquely confluent, interstices similar to those on pronotum.

Length of metatarsi from base to apex as 18.5: 8.0: 5.5: 4.0: 11.5.

Abdomen subcylindrical; 3rd to 6th segments with broad and densely punctate paratergites, paratergites of 4th tergite as broad as greatest width of hind tibia; 7th tergite with an apical membranous fringe; punctures on 3rd tergite slightly smaller than one eye facet, interstices with very indistinct microsculpture.

Male. Seventh sternite (Fig. 47) with a very shallow emargination posteromedially, 8th sternite (Fig. 48) with a triangular emargination posteromedially; 9th sternite (Fig. 49) with distinct apicolateral projections, posterior margin slightly serrate and almost straight; 10th tergite (Fig. 50) with posterior margin broadly round. Median lobe of aedeagus (Fig. 45) with a triangularly pointed and setose apex (Fig. 46), a pair of distinct expulsion hooks, parameres extending far beyond the apex of median lobe.



Figures 7–12. Adult habitus of *Dianous*.**7–10** *D. zhujianqingi* **11, 12** *D. huanghaoi*. Scales = 1 mm.

Female. Eighth sternite (Fig. 51) pointed posteromedially; valvifer (Fig. 52) with posterior margin finely serrate; 10th tergite (Fig. 53) with the posterior margin broadly pointed.

Distribution. China (Jiangxi, Guizhou)

Variability. In a few specimens the punctation of pronotum and elytra is strongly confluent as in Fig. 9. Two specimens show more a distinct brassy reflection on elytra and blue metallic reflection on basal tergites (Fig. 10).

Diagnosis. The new species slightly resembles *D. cyaneovirens* (Cameron, 1930) from India, Nepal, Bhutan and *D. bracteatus* (Champion, 1920) from India, and Nepal. From both it may be easily distinguished by the faint metallic coloration (*D. cyaneovirens* and *D. bracteatus*: strongly metallic green), and from *D. bracteatus* also by darker legs.

Dianous huanghaoi **Tang et Li sp. n.**
urn:lsid:zoobank.org:act:26B88EFE-CE9D-4AE4-9B4A-959AC5225830
http://species-id.net/wiki/Dianous_huanghaoi
Figs 11, 12, 54–62

Type material. Holotype. China: Yunnan: male, glued on a card with labels as follows:"Zhonghutiao, Hutiaoxia Coun., Yunnan Prov., 24.IV.2005, Huang Hao leg." "Holotype / *Dianous Huanghaoi* / Tang & Li" [red handwritten label] (SHNU). **Paratypes.** 2 males and 5 females, same data as for the holotype. (1 pair in cPut; rest in SHNU); 2 females, Yushuizhai, Lijiang, alt. 2600m, 14.IV.2003, stream moss, G. de Rougemont leg. (cRou)

Description. Body entirely black with a faint plumbeous lustre. Antennae blackish brown, antennal club slightly lighter than preceding segments. Maxillary palpi brownish. Legs black with a brownish tint, tibiae and tarsi slightly lighter.

BL: 4.6–5.0mm; FL: 2.6–2.7mm.

Proportions of holotype: HW: 59.5, PW: 44.0, PL: 50.5, EW: 66.0, EL: 69.5.

Head 0.9 times as wide as elytra; lateral portions of frons slightly raised, median portion concave; punctures round to elliptic, distinctly delimited, slightly larger on median area than near dorsal margins of eyes, diameter of largest punctures about as wide as basal cross section of 2nd antennal segment, interstices smooth, smaller than or as broad as half diameter of punctures. Antennae when reflexed extending to the posterior margin of pronotum; Length of segments from base to apex as 9.5: 6.5: 14.5: 8.5: 7.5: 6.5: 7.0: 5.5: 6.0: 5.5: 8.0.

Pronotum 1.15 times as long as wide, widest slightly before middle and constricted at base; punctures partially confluent, similar in size to those on head, interstices similar to those on frons.

Elytra nearly rectangular; punctation similar to that of the pronotum, punctures on humeral area mostly distinctly delimited, those on posterior half of elytra strongly confluent, forming a narrowly vorticose sculpture.

Relative length of segments of hind legs from base to apex as 15.0: 8.5: 5.5: 3.5: 14.5.

Abdomen subcylindrical; 3rd to 6th segments with broad and densely punctate paratergites, paratergites on 4th segment as broad as largest width of hind tibia; 7th tergite with an apical membranous fringe; punctures on 3rd tergite distinctly smaller than eye facet, interstices smooth.

Male. Seventh sternite (Fig. 56) with a very shallow emargination posteromedially, 8th sternite (Fig. 57) with a broad emargination posteromedially; 9th sternite (Fig. 58) with distinct apicolateral projections, posterior margin finely serrate and almost straight; 10th tergite (Fig. 59) with a shallow emargination at middle of posterior margin. Median lobe of aedeagus (Fig. 54) with a triangularly pointed and setose apex (Fig. 55), parameres extending far beyond the apex of median lobe.

Female. Eighth sternite (Fig. 60) with posterior margin hardly pointed at middle; valvifer (Fig. 61) with posterior margin serrate; 10th tergite (Fig. 62) with the posterior margin rounded.

Distribution. China (Yunnan).

Diagnosis. The new species is similar to *D. carinipennis* (Bernhauer, 1914) and *D. nilgiriensis* Puthz, 1995, both from India. It can be distinguished from the latter two species by the less confluent punctation on pronotum and with vorticose sculpture on posterior half of elytra.

***Dianous viridicupreus* Rougemont, 1985, new to China**
http://species-id.net/wiki/Dianous_viridicupreus
Figs 13, 14, 63–65

Dianous viridicupreus Rougemont 1985: 129; 1987a: 49, 50

Material examined. CHINA: Xizang: 2 females, Nielamu County, Zhangmu Town, Lixin village, 27–28.VII.2010, alt. 2400–2600m, Zhu Jian-Qing leg.

Distribution. China (Xizang), Nepal.

Diagnosis. The species was originally described from Nepal and not unsurprisingly was found in China near the border.

***Dianous yao* Rougemont, 1981**
http://species-id.net/wiki/Dianous_yao
Fig. 15

Dianous yao Rougemont 1981a: 330; 1981b: 359; 1983c: 18; Puthz 2000: 431, 502.

Distribution. China (Guizhou), Myanmar, Thailand.

Diagnosis. No Chinese material was examined by us; a photograph of a paratype (cPut) from Myanmar is provided here.

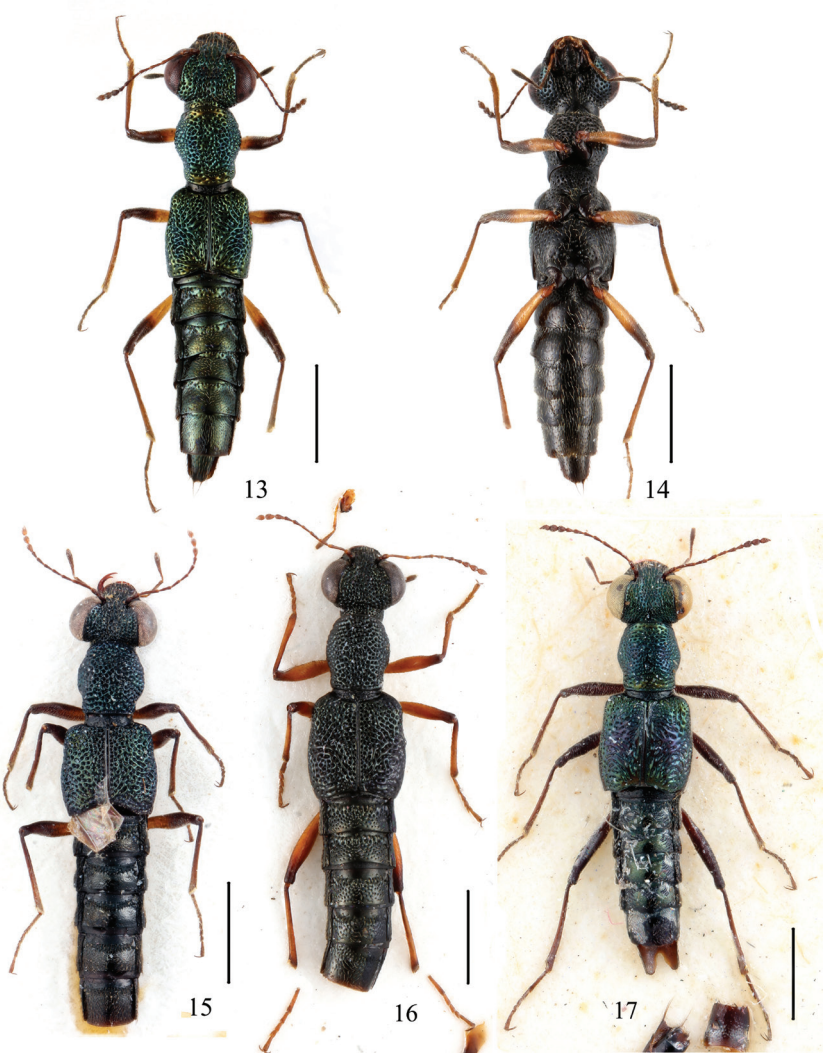
***Dianous limitaneus* Puthz, 2001**
http://species-id.net/wiki/Dianous_limitaneus
Fig. 16

Dianous limitaneus Puthz 2001: 7.

Material examined. Holotype: CHINA: Yunnan: female, Baoshan Xian, Gongshan Mts., Lujiaba, 2400m, 10.X.1996, K. Ishii et al. leg.

Distribution. China (Yunnan).

Diagnosis. This species was only known from the female holotype, which is actually deposited in "the collection of the Laboratory of Entomology, Tokyo University of Agriculture", not in "Shanghai Institute of Entomology, Academia Sinica" (Present



Figures 13–17. Adult habitus of *Dianous.* **13, 14** *D. viridicupreus* **15** *D. yao* **16** *D. limitaneus* **17** *D. viriditinctus*. Scales = 1 mm.

name: Shanghai Entomology Museum, the Chinese Academy of Science) as original published paper described.

***Dianous viriditinctus* (Champion), 1920**
http://species-id.net/wiki/Dianous_viriditinctus
Fig. 17

Stenus viriditinctus Cameron 1930: 335; Abdullah and Qadri 1968: 304
Dianous viriditinctus; Puthz 1981a: 104; Rougemont 1985: 127; Rougemont 1987: 49.

Distribution. China (Xizang), India, Nepal, Bhutan.

Diagnoses. No Chinese material was examined by us, and a photograph of specimen (cPut) from Nepal is provided here.

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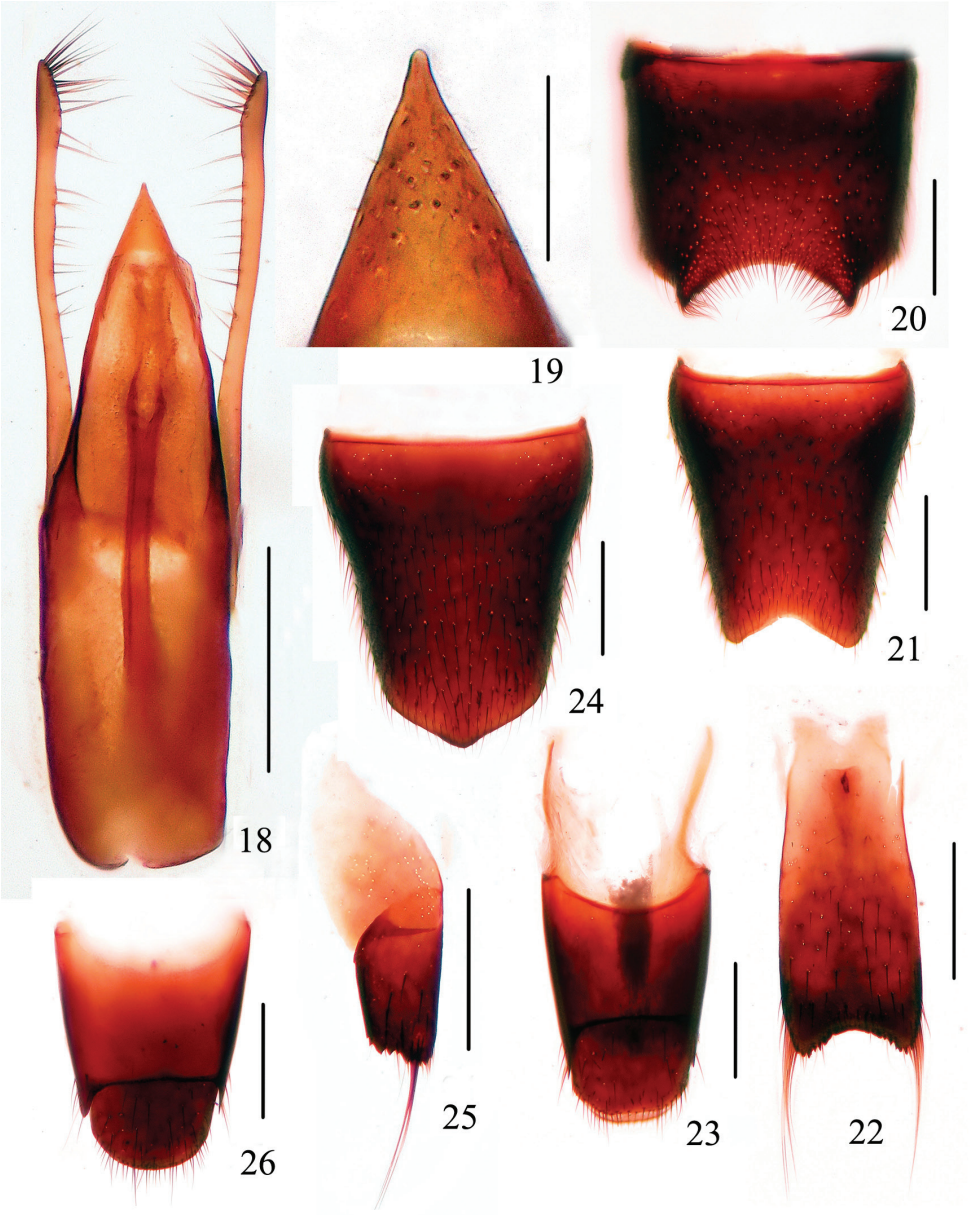
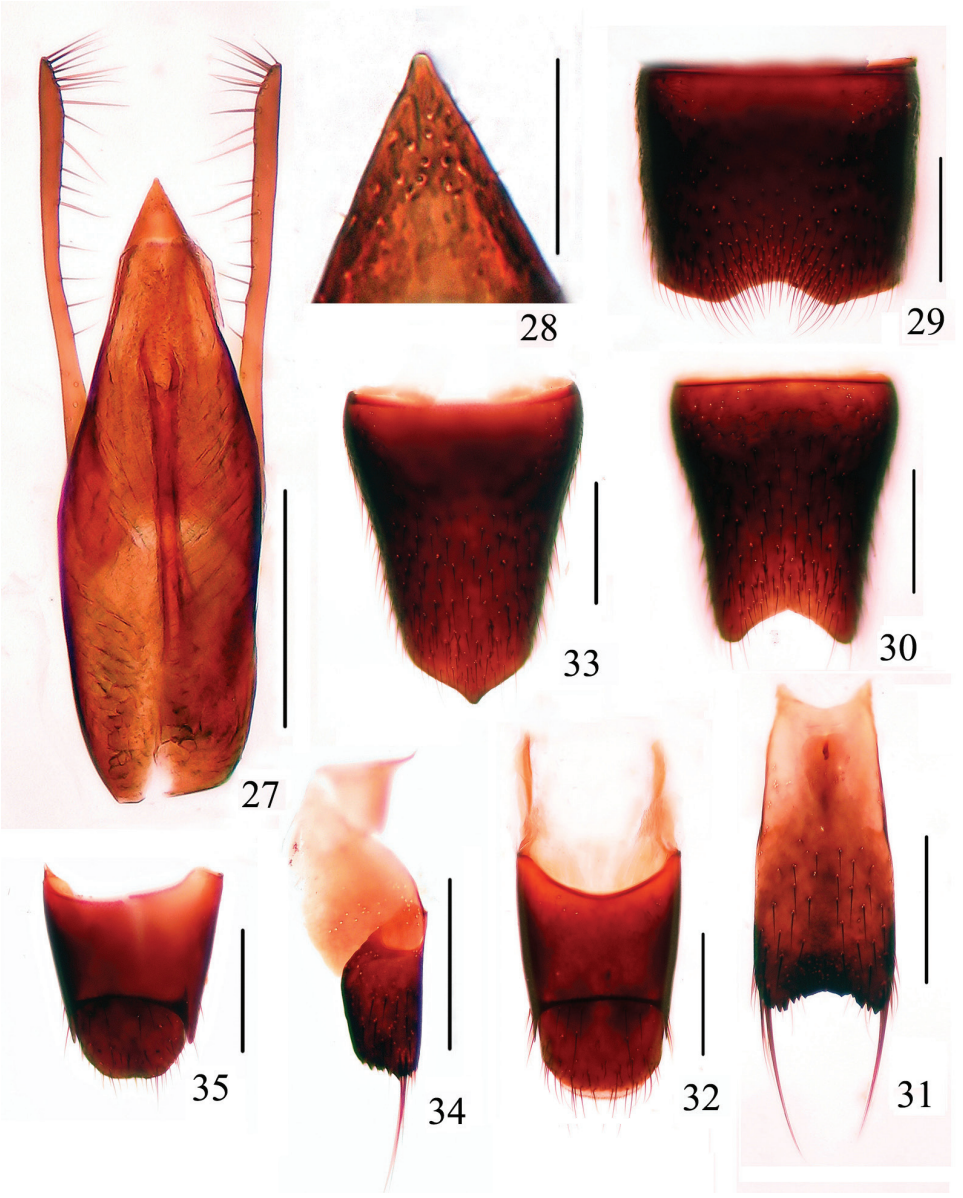
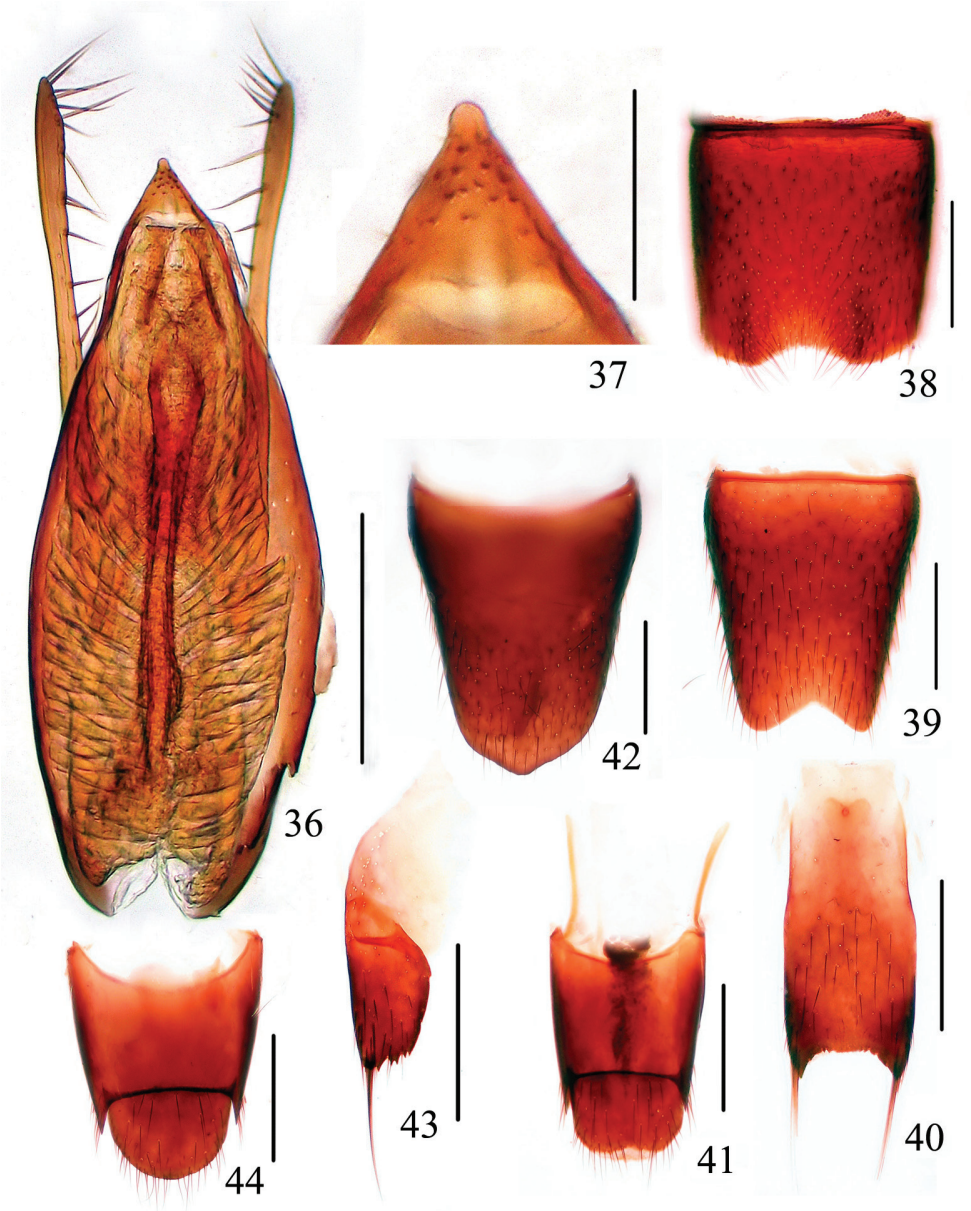


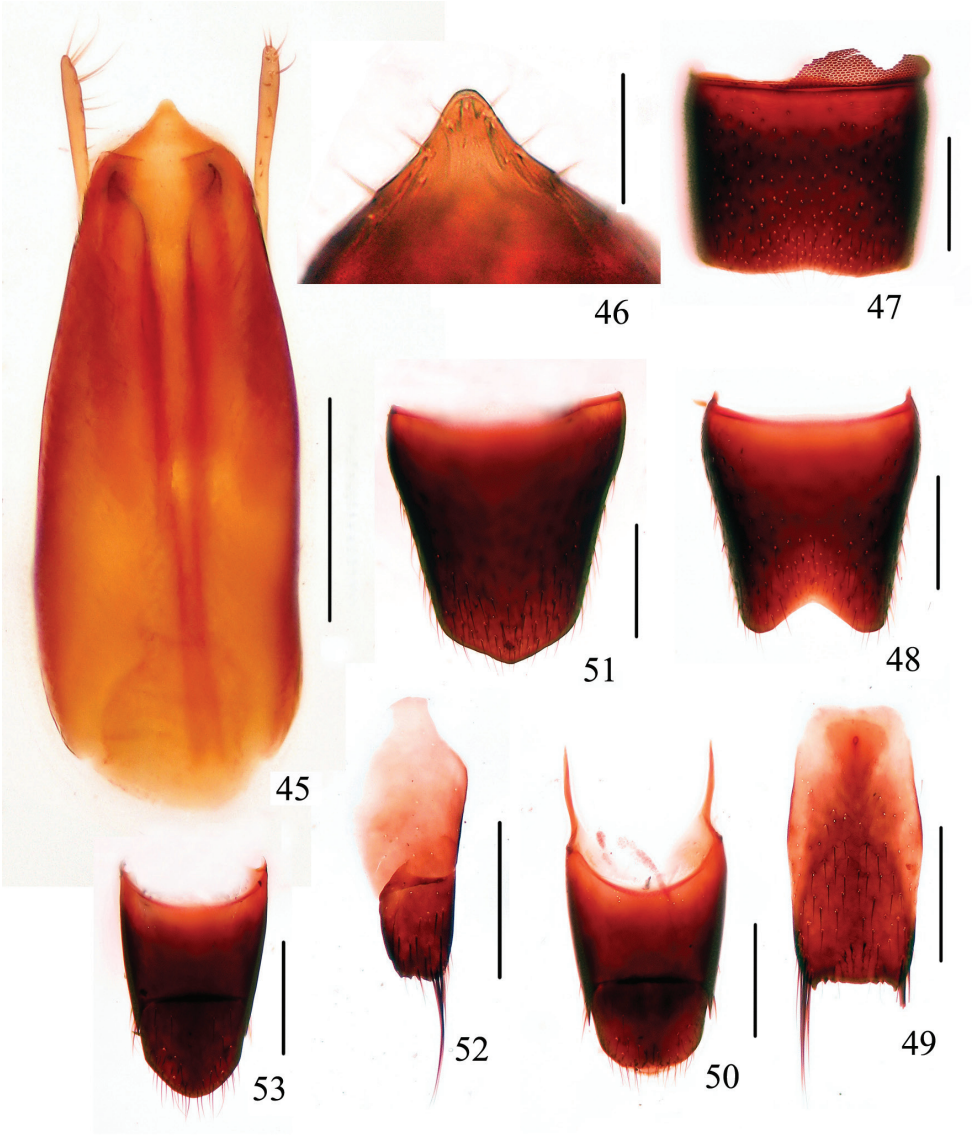
Figures 18–26. *Dianous tonkinensis.* **18** aedeagus **19** apical portion of aedeagus **20** 7th male sternite **21** 8th male sternite **22** 9th male sternite **23** 9th and 10th male tergites **24** 8th female sternite **25** valvifer **26** 9th and 10th female tergites. Scales = 0.25 mm (18, 20–26), scales = 0.05 mm (19).



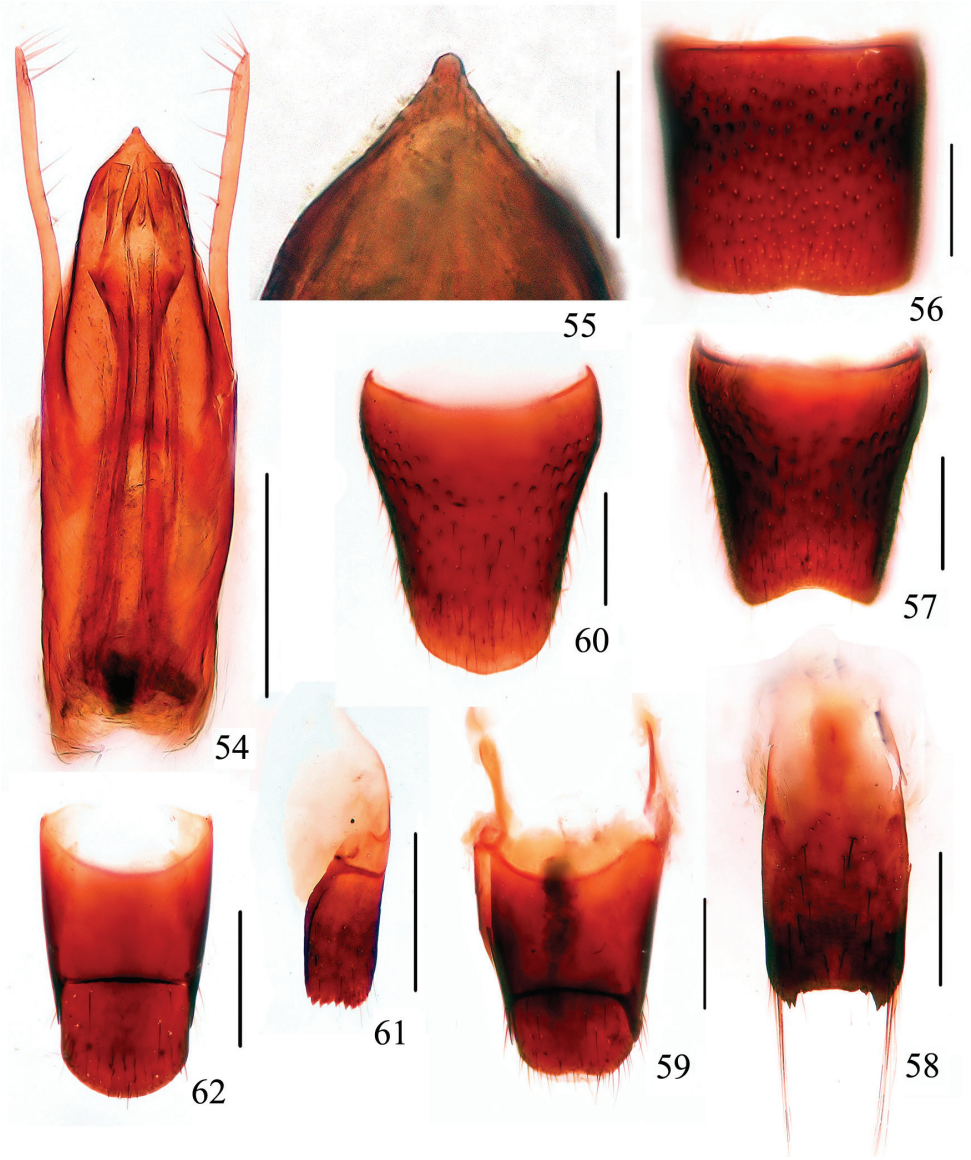
Figures 27–35. *Dianous fengtingae*. **27** aedeagus **28** apical portion of aedeagus **29** 7th male sternite **30** 8th male sternite **31** 9th male sternite **32** 9th and 10th male tergites **33** 8th female sternite **34** valvifer **35** 9th and 10th female tergites. Scales = 0.25 mm (27, 29–35), scales = 0.05 mm (28).



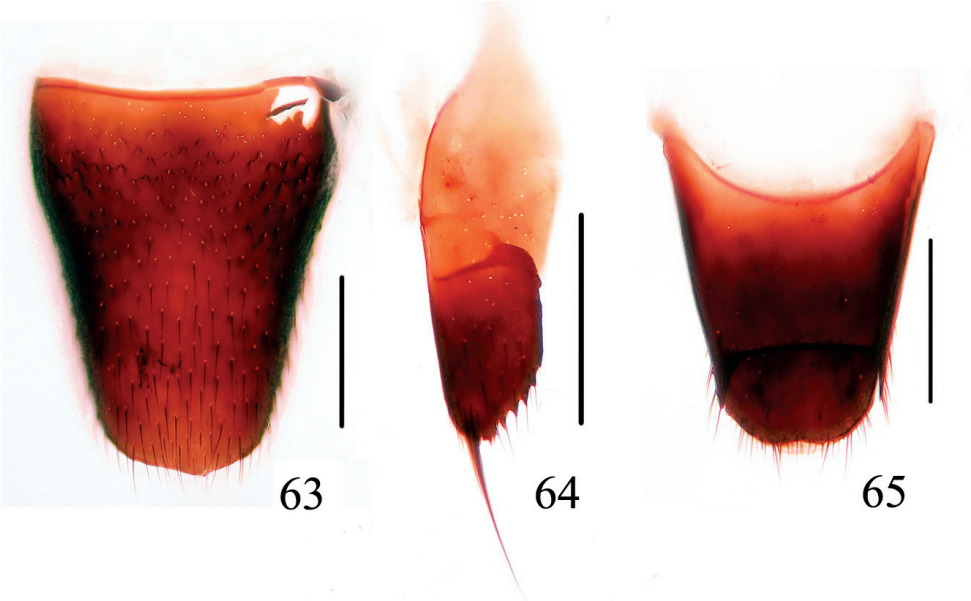
Figures 36–44. *Dianous shan.* **36** aedeagus **37** apical portion of aedeagus **38** 7th male sternite **39** 8th male sternite **40** 9th male sternite **41** 9th and 10th male tergites **42** 8th female sternite **43** valvifer **44** 9th and 10th female tergites. Scales = 0.25 mm (36, 38–44), scales = 0.05 mm (37).



Figures 45–53. *Dianous zhujianqingi*. **45** aedeagus **46** apical portion of aedeagus **47** 7th male sternite **48** 8th male sternite **49** 9th male sternite **50** 9th and 10th male tergites **51** 8th female sternite **52** valvifer **53** 9th and 10th female tergites. Scales = 0.25 mm (45, 47–53), scales = 0.05 mm (46).



Figures 54–62. *Dianous huanghaoi.* **54** aedeagus **55** apical portion of aedeagus **56** 7th male sternite **57** 8th male sternite **58** 9th male sternite **59** 9th and 10th male tergites **60** 8th female sternite **61** valvifer **62** 9th and 10th female tergites. Scales = 0.25 mm (54, 56–62), scales = 0.05 mm (55).



Figures 63–65. *Dianous* viridicupreus. **63** 8th female sternite **64** valvifer **65** 9th and 10th female tergites. Scales = 0.25 mm.