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RESEARCH ARTICLE

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A new genus and species of Macrosiphini (Hemiptera, Aphididae) from China, living on *Isodon eriocalyx*

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Abstract

The aphid genus *Nigritergaphis* **gen. n.** is described, and *N. crassisetosa* **sp.n.** on *Isodon eriocalyx* (Dunn) Kudô (Lamiaceae) from Yunnan, China is described and illustrated. The new species curls and distorts the leaves of this important traditional Chinese medicinal plant, and is evidently specific to this host. Holotype and paratypes are deposited in the National Zoological Museum of China, Institute of Zoology, Chinese Academy of Sciences, Beijing, China.

Keywords

Nigritergaphis, Aphididae, new genus, new species, China, taxonomy

Introduction

Isodon eriocalyx (Dunn) Kudô (Lamiaceae) is an important traditional Chinese medicine plant, and has been used as a folk medicine to treat inflammation as well as reducing blood pressure. Over the past twenty years, plants in the genus *Isodon* have received consider-

able phytochemical and biological attention. These studies have revealed that a number of diterpenoids from genus *Isodon* possess various bioactivities, such as anti-tumor and anti-bacterial activities (Sun et al. 2006; Wang et al. 2013). *Isodon eriocalyx* is distributed mainly in southwest China, e.g. Yunnan, Sichuan, Guizhou and Guangxi provinces. According to the literature, no aphids have previously been recorded from this plant.

About a few years ago, researchers in the field of phytochemistry at the Kunming Institute of Botany found that this plant was being harmed by a small insect, causing the leaves to become curled, swollen and blistered. In 2011 some specimens were submitted for identification, and found to belong to a new genus and species of the aphid tribe Macrosiphini.

Material and methods

All specimens examined in this study were collected at Kunming Institute of Botany, Chinese Academy of Sciences (Yunnan Province: Kunming City, Heilongtan Town) by J.X. Pu. The host plant was identified by the botanist, Prof. H. Peng of that Institute.

Aphid terminology in this paper generally follows that of Stekolshchikov and Qiao (2008). The unit of measurement is millimetres (mm).

Results and discussion

***Nigritergaphis* gen. n.**
http://zoobank.org/A6C6E2DA-EF71-4F53-BCC6-E8739048FF4D
http://species-id.net/wiki/Nigritergaphis

Type-species. *Nigritergaphis crassisetosa* sp.n.

Etymology. The generic name, *Nigritergaphis* is feminine in gender and derived from the Latin words terms "*nigr*-" (=shining black), and "*terg*-" (=dorsum or back) combined with "*aphis*" (=plant louse).

Generic diagnosis. *In apterae*: Body elliptical, of medium size. Median frontal tubercle poorly developed, antennal tubercles developed, diverging, slightly higher than median frontal tubercle, so that frons is shallowly "W"-shaped. Tergum smooth and sclerotic. Dorsal setae of body numerous, long, thick, stiff, and arising from tuberculate bases; ventral setae very sparse. Ultimate rostral segment longer than second hind tarsal segment, with 2–3 pairs of accessory setae. Eyes with relatively few facets. Antennae 5- or 6-segmented, much shorter than body, without secondary rhinaria; processus terminalis about 2–3 times longer than base of the last segment. Mesosternal furca with a short stem or separate arms. First tarsal chaetotaxy 2, 2, 2. Spiracles small, oval or reniform, open; spiracular plates oval. Marginal tubercles absent. Siphunculi short and tapering, slightly swollen towards base, with distinct imbrication and a well-developed flange, and sometimes with one seta. Cauda helmet-shaped, but slightly

acute at apex, with 4 setae. Genital plate with 2 anterior setae and 10–12 posterior setae. *In alatae*: Abdominal tergites each with one pair of marginal patches and an imperfect spino-pleural dark band. Antennae 6-segmented, segments III–V with large and round secondary rhinaria. Fore wing median vein with two-forks, hind wing with two obliques, all veins without fuscous borders.

Taxonomic notes. *Nigritergaphis* belongs to the tribe Macrosiphini of the family Aphididae, but has a unique combination of features justifying the erection of a new genus. Compared with other aphid genera associated with Lamiaceae, it differs by having numerous, thick long and stiff dorsal setae arising from tuberculate bases, and first tarsal chaetotaxy: 2, 2, 2. It is similar to *Roepkea* Hille Ris Lambers in the shape of the cauda, dorsal ornamentation and lack of marginal tubercles, but differs from that genus as follows: siphunculi only with weak imbrications (in *Roepkea*: ornamented with transverse rows of small spicules); body dorsum completely sclerotic and smooth (in *Roepkea*: usually dark, sclerotic, but with pale patches on the marginal areas, and with numerous small spicules).The new genus resembles *Brachycaudus* van der Goot in the shape of cauda, and in dorsal sclerotization, but may be distinguished from that genus by the following: lack of marginal abdominal tubercles (in *Brachycaudus* these are frequently present on several body segments); spiracular pores oval or reniform (in *Brachycaudus* they are circular and large); siphunculi imbricated and without a sharply limited subapical constriction (in *Brachycaudus* rather smooth, and with a sharply limited constriction below the flange).The new genus resembles *Dysaphis* Börner in the shape of spiracular pores and the shape of the cauda, but differs from *Dysaphis* as follows: abdomen of apterae with a complete sclerotic shield (in *Dysaphis* dorsal sclerotization never forms a complete shield); without spinal and marginal tubercles (in *Dysaphis* spinal and marginal tubercles are characteristically present).

***Nigritergaphis crassisetosa* sp.n.**
http://zoobank.org/139676D8-D790-437C-9B80-79AC01C78E02
http://species-id.net/wiki/Nigritergaphis_crassisetosa
Figures 1–38

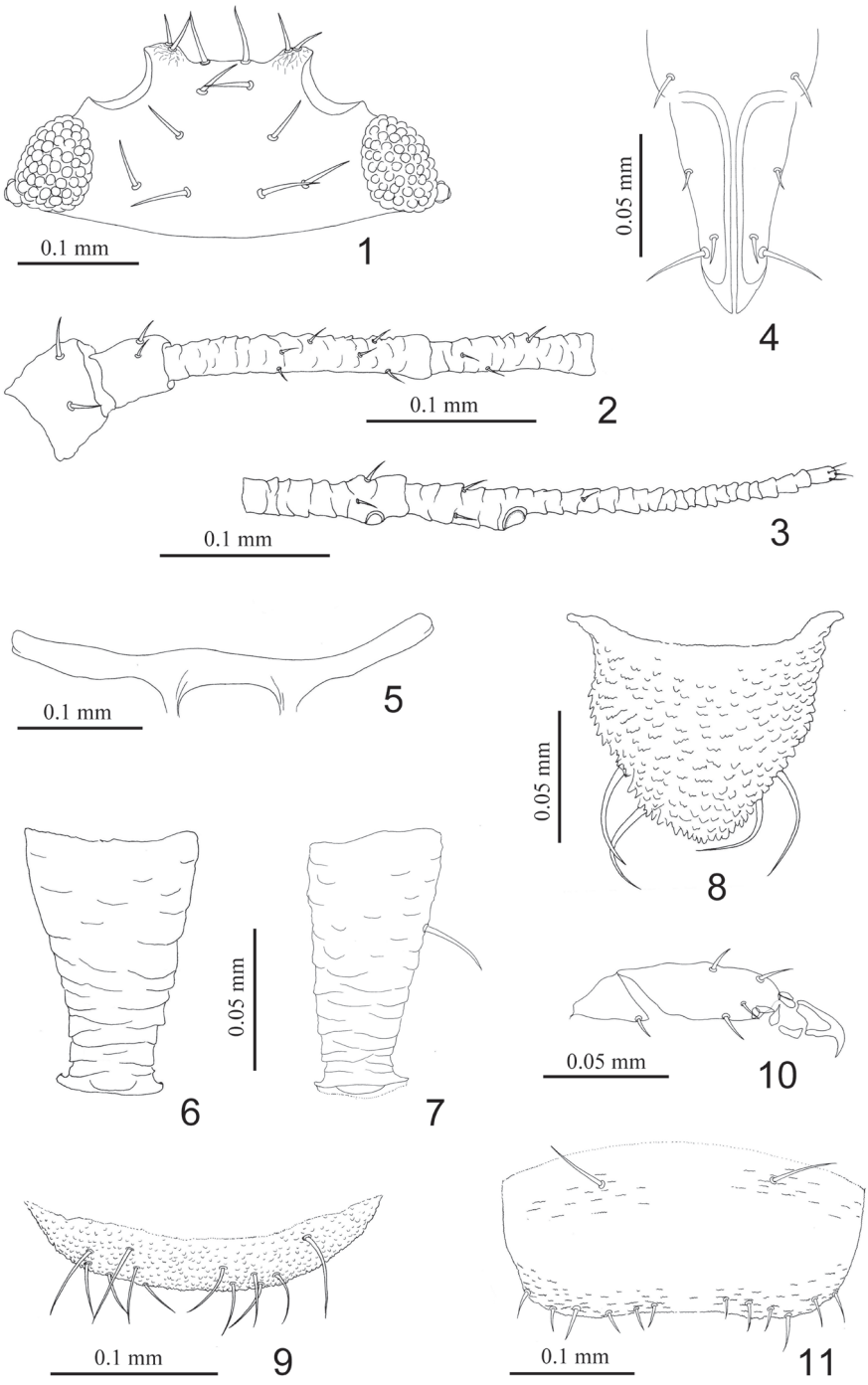
Locus typicus. China (Yunnan: Kunming City, Heilongtan Town, Alt.1922m, E102.44°, N25.8°).

Etymology. The specific name, *crassisetosa* is composed of the Latin words "*crassis*" (= thick) and "*setosa*" (= covered with hairs), due to the long and thick setae of body.

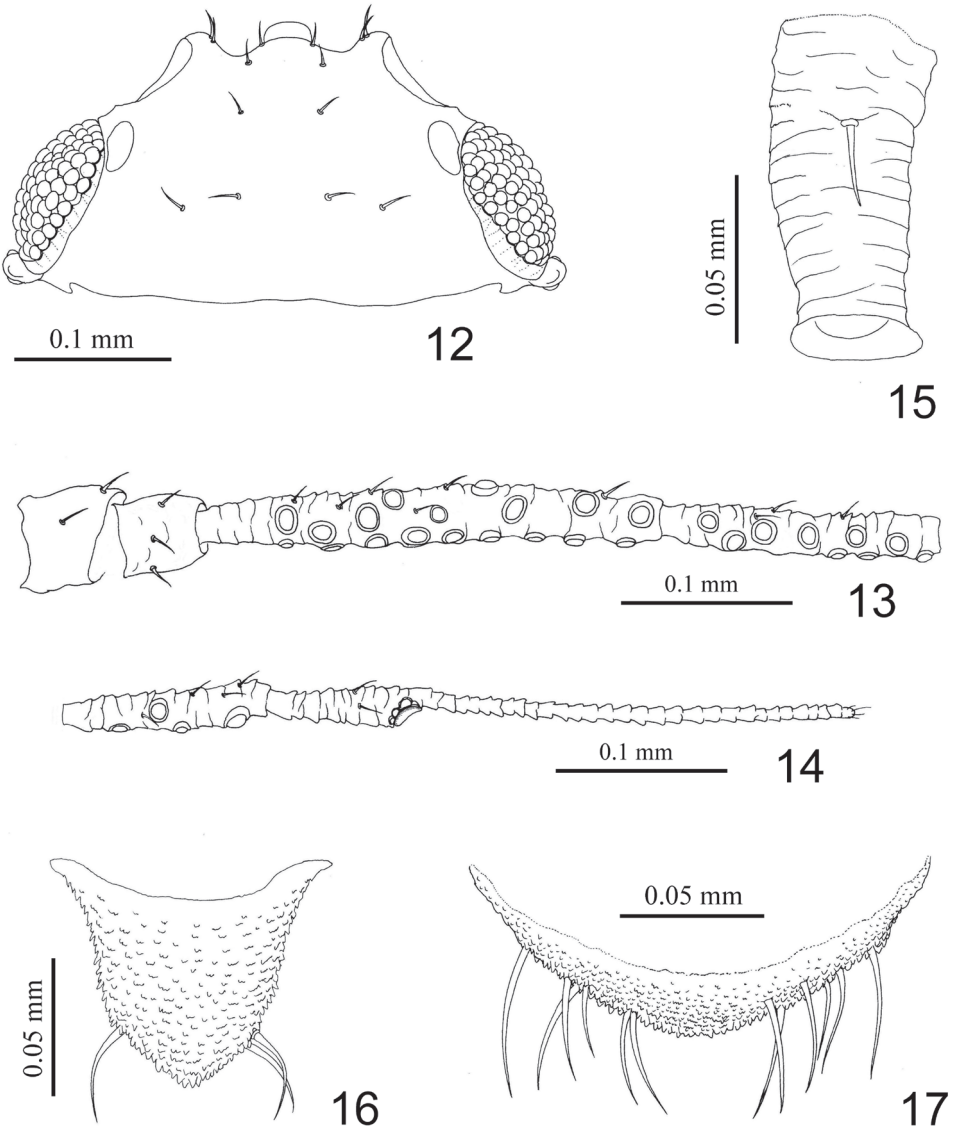
Description. *Apterous viviparous female*: Body elliptical, 1.42–1.58 mm long, 0.77–0.96 mm wide. Adult body black in life, nymphs dark green (Fig. 38).

Mounted specimens. Body. Dorsum brown. Antennal segments I-II dark brown, segment V and base of segment VI brown, others pale. Siphunculi dark brown. For morphometric data see Table 1.

Head. Smooth dorsally, except top surface of median frontal tubercle which is rough. Median frontal tubercle poorly developed, lower than antennal tubercles which



Figures 1–11. *Nigritergaphis crassisetosa* sp. n. Apterous viviparous female: **1** dorsal view of head **2** antennal segments I–IV **3** antennal segments V–VI **4** ultimate rostral segment **5** mesosternal furca **6, 7** siphunculi **8** cauda **9** anal plate **10** hind tarsal segment **11** genital plate.



Figures 12–17. *Nigritergaphis crassisetosa* sp. n. Alate viviparous female: **12** dorsal view of head **13** antennal segments I–IV **14** antennal segments V–VI **15** siphunculus **16** cauda **17** anal plate.

are more developed and have divergent inner faces, so that frons is shallowly "W"-shaped (Figs 1, 18, 19); dorsum of head pigmented (Fig. 18), ventral surface with sparse spinules. Dorsal cephalic setae thick and stiff, arising from tuberculate bases. Head with 3 pairs of frontal setae, 1 pair of dorsal setae between antennae, and 3 pairs of dorsal setae between eyes (Figs 1, 19), frontal setae 2.0–2.8 times as long as basal diameter of antennal segment III. Eyes with about 25 facets. Antennae 5- or 6-segmented (Figs 2, 3, 20), about 0.4 of body length; segments I–II segments slightly

Table 1. Biometric data for *Nigritergaphis crassisetosa* sp. n. (measurements in mm).

	Apterous viviparous females n = 25		Alate viviparous females n=12
	Ant. 5-segmented (n=10)	Ant. 6-segmented (n=15)	
Body length	1.42–1.58	1.43–1.56	1.50–1.64
Body width	0.82–0.96	0.77–0.89	0.69–0.79
Antenna length	0.52–0.62	0.58–0.65	0.72–1.14
Antennal segment I	0.054–0.065	0.05–0.06	0.05–0.06
Antennal segment II	0.040–0.045	0.04–0.05	0.04–0.05
Antennal segment III	0.16–0.21	0.11–0.16	0.23–0.31
Antennal segment IV	0.075–0.085	0.07–0.09	0.13–0.17
Antennal segment V	0.065–0.080	0.07–0.09	0.11–0.14
Antennal segment VIb		0.06–0.08	0.08–0.10
Processus terminalis	0.11–0.15	0.15–0.19	0.21–0.31
Length of setae on ant. seg. III	0.01–0.015	0.011–0.014	0.013–0.015
Ant. seg, III basal diameter	0.02	0.016–0.020	0.02–0.03
Ultimate rostral segment (URS)	0.09–0.095	0.08–0.09	0.08–0.09
Basal width of URS	0.045–0.055	0.04–0.05	0.04–0.05
Hind femur length	0.26–0.30	0.26–0.30	0.35–0.45
Hind tibia length	0.38–0.43	0.45–0.50	0.68–0.81
Midlength width of hind tibia	0.025–0.30	0.04–0.05	0.02–0.03
Hind tarsus segment II	0.06–0.065	0.06–0.07	0.06–0.07
Length of setae on hind tibia	0.02–0.025	0.021–0.026	0.025–0.028
Siphunculus length	0.10–0.11	0.09–0.10	0.09–0.10
Siphunculus basal width	0.045–0.07	0.05–0.07	0.04–0.05
Siphunculus distal width	0.04–0.045	0.03–0.04	0.03–0.04
Cauda length	0.075–0.10	0.07–0.08	0.08–0.09
Basal width of cauda	0.075–0.09	0.09–0.11	0.09–0.11
Length of frontal setae	0.040–0.055	0.041–0.046	0.019–0.024
Length of marginal setae on tergum I	0.055–0.065	0.056–0.066	0.023–0.027
Length of dorsal setae on tergum VIII	0.060–0.080	0.058–0.074	0.031–0.039

rough, segments III–V with weak imbrications, segment VI with distinctly transverse imbrications. Processus terminalis 2.2-2.9 × base of segment VI (6-segmented antennae). Antennal setae short and pointed, segments I–VI (I-V) respectively with 4–5, 3–4, 5–7, 3–4, 3–4, 2–3+2 (3-4, 3-4, 1-3, 3-4, 1-3+3-4) setae; apex of processus terminalis with 3 or 4 setae. Setae on segment III 0.5-0.9 times as long as basal diameter of the segment. Primary rhinaria ciliated, secondary rhinaria absent (Figs 3, 20). Rostrum (Fig. 18) reaching mid-coxae; ultimate rostral segment wedge-shaped, 1.6–2.0 times as long as its basal width, 1.3–1.6 times as long as second hind tarsal segment, with 2-3 accessory setae.

Thorax. Dorsum of thorax imperfectly pigmented (Fig. 18). Pronotum with 3 pairs of spinal, 1 pair of pleural and 2 pairs of marginal setae. Mesosternal furca (Figs 5, 22) with a short stem or separate arms. Base of femora with 2-3 small round pseudo-sensoria. Hind femur 1.9–2.3 times longer than antennal segment III (when antennae 6-segmented). Hind

tibia 0.28–0.34 times as long as body. Setae on legs long and pointed, setae on hind tibiae 0.7–0.9 times as long as middle diameter of the segment. First tarsal chaetotaxy: 2, 2, 2.

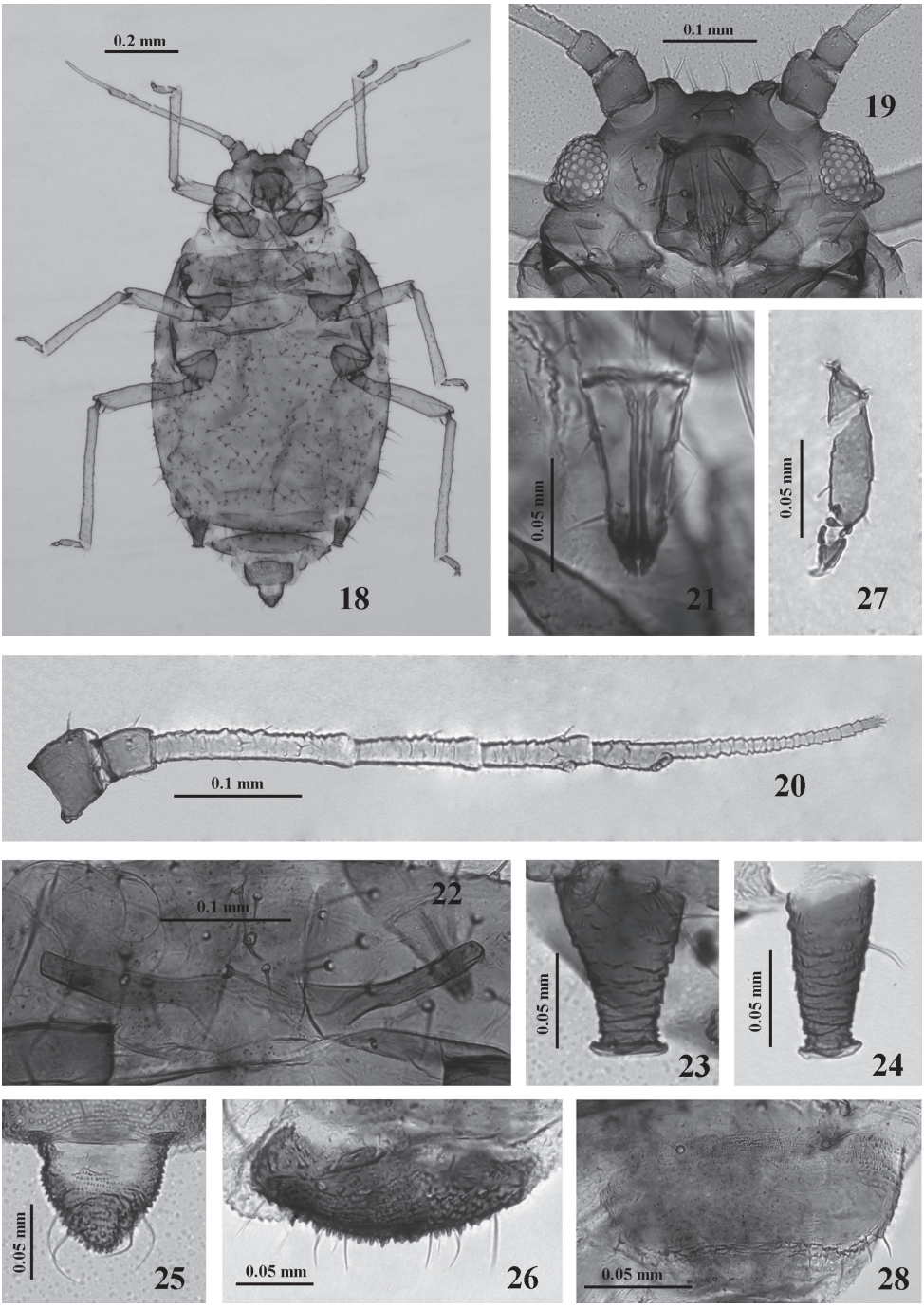
Abdomen. Abdominal tergites smooth, and sclerotic (Fig. 18). Dorsal setae of body numerous, long, thick and stiff, arising from tuberculate base. Marginal setae slightly longer than spinal and pleural setae. Ventral setae very sparse, fine and pointed, distinctly shorter than dorsal setae. Abdominal tergite I with 24–38 dorsal setae, tergite VIII with 4 setae, occasionally 3. Length of marginal setae on tergite I 3.0–4.1 times as long as basal diameter of antennal segment III; dorsal setae on tergite VIII 3.0–4.5 times as long as basal diameter of antennal segment III. Spiracles small, oval or reniform, opened; spiracular plates oval. Siphunculi (Figs 6, 7, 23, 24) short and tapering, with distinct imbrication and a well-developed flange, 1.5–2.5 times as long as their basal width, 1.1–1.5 times as long as cauda; siphunculi of 7 specimens with 1 long seta (Figs 7, 24). Cauda (Figs 8, 25) nearly helmet-shaped, with short rows of spinules; 0.8–1.2 times as long as basal width, with 4 long curved setae. Anal plate semi-circular, with short rows of large spinules; with 10–13 setae. Genital plate (Figs 11, 28) transversely oval, with transverse rows of spinules; 2 anterior setae, 10–12 posterior setae along margin uniformly distributed.

Alate viviparous female: Body elliptical, 1.50–1.64 mm long, 0.69–0.79 mm wide. For morphometric data see Table 1.

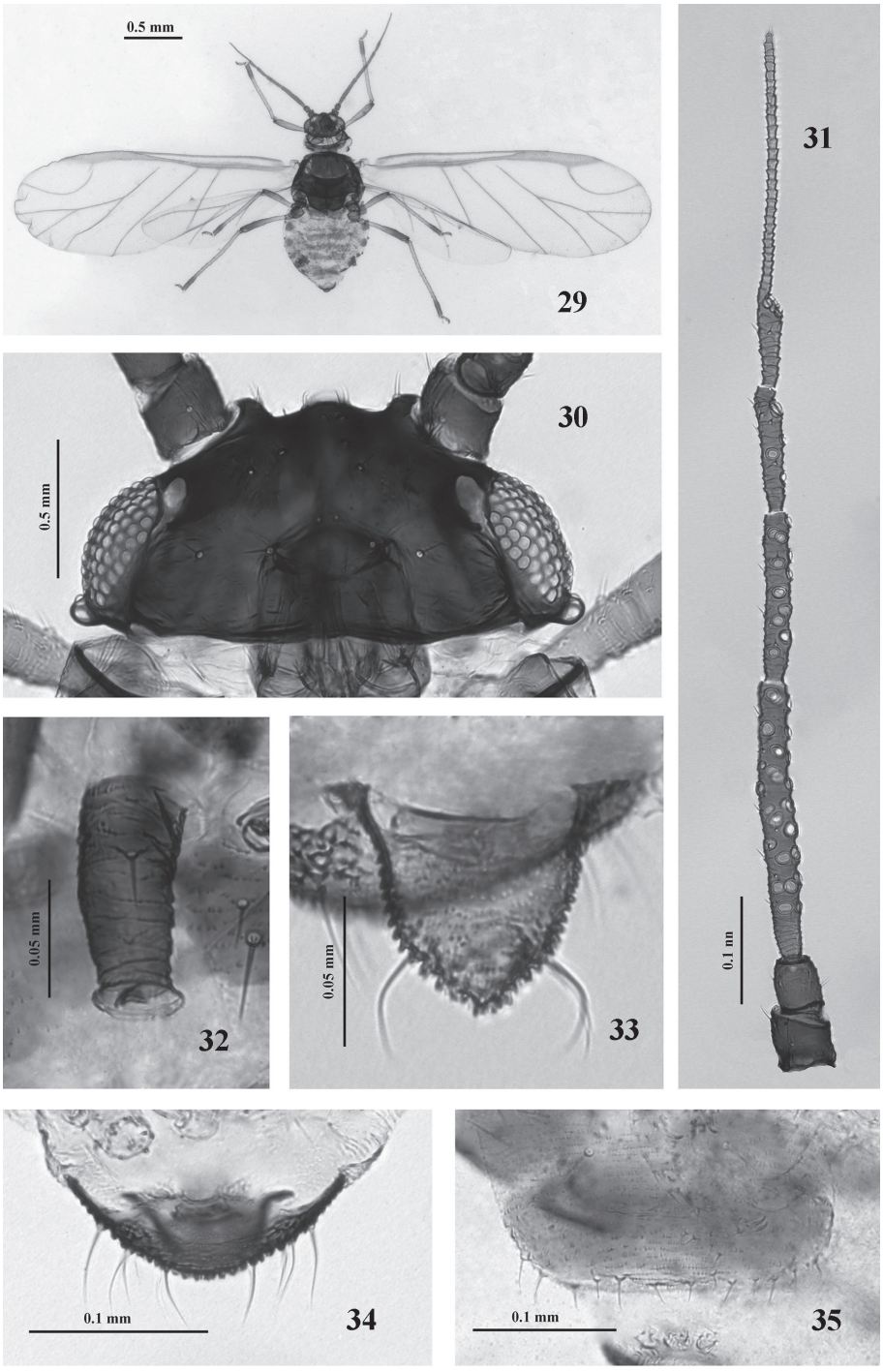
Mounted specimens. Head. Median frontal tubercle weakly developed, slightly lower than antennal tubercles which are more developed with divergent inner faces, frons "W"-shaped (Figs 12, 30); dorsum of head pigmented (Figs 29, 30); ventral surface of head with sparse spinules. Head with 3 pairs of frontal setae, 2 pairs of dorsal setae between antennae, and 2 pairs of setae between eyes (Figs 12, 30). Frontal setae 0.9-1.0 times as long as basal diameter of antennal segment III. Antennae 6-segmented (Figs 13, 14, 31) 0.5–0.7 times as long as body; ventral side of segment I with weak spinulose imbrications, ventral sides of segment II-VI with imbrications. Antennal setae pointed, segments I–VI each with 4-5, 4-5, 6-11, 3-5, 3-5, 2+0, respectively, apex of processus terminalis with 3-4 setae. Setae on segment III 0.5–0.7 times as long as basal diameter of the segment. Primary rhinaria ciliated. Secondary rhinaria large and round, segment III with 18–34, segment VI with 7–12, and segment V with 1–3 (Figs 13, 14, 31). Ultimate rostral segment 1.8–2.2 times as long as its basal width, 1.3–1.4 times as long as second hind tarsal segment, with 2-4 pairs of accessory setae.

Thorax. Dorsum of thorax completely sclerotized (Fig. 29). Pronotum with 2–3 spinal setae, 1 pair of pleural and 1 pair of marginal setae. Base of femora with 3–5 small and round pseudo-sensoria, basal 1/3 rather thin; hind femur 1.4–1.7 times as long as antennal segment III. Hind tibia 0.4–0.5 times as long as body. Setae on hind tibiae 0.9–1.0 times as long as middle diameter of the segment.

Abdomen. Abdominal tergites each with one pair of marginal patches and an imperfect dark spino-pleural band; those on tergites I-III and VIII narrow; marginal patches with spinulose short stripes (Fig. 29). Dorsal setae numerous, thick, stiff and pointed, arising from tuberculate base; ventral setae very sparse, fine and pointed, ap-



Figures 18–28. *Nigritergaphis crassisetosa* sp. n. Apterous viviparous female: **18** dorsal view of body **19** dorsal view of head **20** antennal segments I–VI **21** ultimate rostral segment **22** mesosternal furca **23, 24** siphunculi **25** cauda **26** anal plate **27** hind tarsal segment **28** genital plate.



Figures 29–35. *Nigritergaphis crassisetosa* sp. n. Alate viviparous female: **29** dorsal view of body **30** dorsal view of head **31** antennal segments I–VI **32** siphunculus **33** cauda **34** anal plate **35** genital plate and gonapophyses.

Figures 36–38. *Nigritergaphis crassisetosa* sp. n. **36** damaged shoots of host plants **37** pseudo-galls (leaf roll-like) **38** aphids in the pseudo-gall.

prox. as long as dorsal setae. Abdominal tergite I with 12–16 spino-pleural and 4–6 marginal setae, tergite II with 14–20 spino-pleural and 10–14 marginal setae, tergite III with 14–22 spino-pleural and 11–14 marginal setae, tergite IV with 14–21 spino-pleural and 11–14 marginal setae, tergite V with 14–17 spino-pleural and 8–10 marginal setae, tergite VI with 8–13 spino-pleural and 8–10 marginal setae, tergite VII with 7–10 dorsal setae, tergite VIII with 3–5 setae. Marginal setae on tergite I 0.9–1.3 times as long as basal diameter of antennal segment III; dorsal setae on tergite VIII 1.3–1.9 times as long as basal diameter of antennal segment III. Siphunculi similar in shape to those of apterous viviparous females; 5 of 12 specimens each with 1 long seta on siphunculi (Figs 15, 32); 2.3–2.6 times as long as their basal width, 1.0–1.2 times as long as cauda.

Type series. Holotype: apterous viviparous female, China: Yunnan Province, Kunming City (Heilongtan Town), 11 Dec. 2012, No. Y9259-1-2-2, on *Isodon eriocalyx*, coll. J.X.Pu. Paratypes: 12 apterous viviparous females and 11 alate viviparous females, with the same collection data as holotype; 12 apterous viviparous females and1 alate viviparous female, 27 Oct. 2011, No. Y9162, on *Isodon eriocalyx*, coll. J.X. Pu. The holotype and paratypes of the new species are deposited in the National Zoological Museum of China, Institute of Zoology, Chinese Academy of Sciences, Beijing.

Biology. The species colonizes the underside of the leaves of the host plant, *Isodon eriocalyx*, inducing the leaves to become curled, swollen or blistered to form "pseudogalls", and causing stunting of growth (Figs 36, 37, 38).

Apterae with 5-segmented antennae and 6-segmented antennae occur at different times of year, the former in October, the latter in December. Seemingly, there is a seasonal effect on morphology in this species. No sexual morphs were observed.

Taxonomic notes. Blackman and Eastop (2006, 2013) provided a key to all apterous viviparous females on the plant genus *Isodon*. The new species can be inserted as an additional couplet (couplet 3a) in their key:

1	SIPH strongly swollen, with maximum diameter of swollen part more than 2 × minimum diameter of stem, smooth except for a small subapical polygonal reticulation. SIPH 5.4–8.2 × cauda..... ***Eucarazzia elegans***
–	SIPH not swollen or much less swollen, and less than 3.5 × cauda..... **2**
2	Dorsal hairs long, 2–4 × longer than Ant. III BD **3**
–	Dorsal hairs all or mostly less than 1.5 × Ant. III BD..... **6**
3	Cuticle of head spiculose or granulose dorsally. Dorsal hairs with blunt or pointed apices..... ***Eumyzus clinopodii***
–	Cuticle of head smooth. Dorsal hairs with expanded apices or pointed apices **3a**
3a	Dorsal hairs with pointed apices. Ant. III without secondary rhinaria. First tarsal chaetotaxy: 2, 2, 2. SIPH 1.0–1.2 × cauda which is approximately helmet-shaped ..... ***Nigritergaphis crassisetosa*** **sp.n.**
–	Dorsal hairs with expanded apices. Ant. III with secondary rhinaria. First tarsal chaetotaxy: 3, 3, 3. SIPH 1.2-c.2.5 × cauda which is slender, triangular **4**

Couplets 4 to 20 without modification.

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RESEARCH ARTICLE

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The genus *Microserangium* Miyatake (Coleoptera, Coccinellidae) from China

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Abstract

The genus *Microserangium* Chapin from China is reviewed. Nine species are recognized, including seven new species: *M. erythrinum* Wang & Ren, **sp. n.**, *M. fuscum* Wang & Ren, **sp. n.**, *M. glossoides* Wang & Ren, **sp. n.**, *M. shennongensis* Wang & Ren, **sp. n.**, *M. semilunatum* Wang & Ren, **sp. n.**, *M. deltoides* Wang & Ren, **sp. n.**, *M. dactylicum* Wang & Ren, **sp. n.** Male genitalia of *M. hainanensis* Miyatake, 1961 are described for the first time. All species are described and illustrated. A key and distribution map to the known species from China are given.

Keywords

Coleoptera, Coccinellidae, Serangiini, *Microserangium*, new species, China

Introduction

The genus *Microserangium* was established by Miyatake (1961a) with *M. shikokense* Miyatake, 1961 as the type species, based on its antenna composed of nine antennomeres with the third antennomere strongly triangular, roughly quadrate mandible, and

tarsi with 3 tarsomeres. *Microserangium* is a small genus of Serangiini, mainly reported in the Oriental region (Miyatake 1994).

Chapin (1940) proposed the new genus *Serangiella*, and characterized it as possessing nine antennomeres with the third strongly triangular, a roughly quadrate mandible, and tarsi composed of 4 tarsomeres. He designated *Oeneis flavescens* Motschulsky, 1866, as the type species of *Serangiella*, but without seeing its type material. Ślipiński and Burckhardt (2006) examined the specimens used by Chapin (1940) for the description of *Serangiella* and found that tarsomeres 3 and 4 are partially fused in some specimens. They concluded that this character is unreliable for separating genera of the tribe Serangiini, and synonymised *Microserangium* with *Serangiella*.

However, Hoàng (1977) found that the type species of *Serangiella* was misidentified, and *Oeneis flavescens* Motschulsky did not belong to Coccinellidae. He elected to consider Chapin's misidentified species as a new binomen, *Serangiella flavescens* Chapin, 1940, and treated it as type species of *Serangiella*. Unfortunately, this action was not in accord with article 70 of the 1964 ICZN, which required that cases of misidentified type species be submitted to the Commission for ruling. It was not until the 1999 edition (article 70.3) that authors were given the option of solving these issues themselves by designating as the type species either the species originally cited, or the species actually involved in the misidentification. Ślipiński and Burckhardt (2006) attempted to fix Hoang's type designation by citing article 70.3 along with the name previously cited as type species (*Oeneis flavescens* Motschulsky) and the name of the species selected (*Serangiella flavescens* Chapin). This would have achieved their goal, except that *Serangiella flavescens* Chapin is an unavailable name due to the fact the species was never formally described. Chapin cannot be considered to have described this species even though his genus *Serangiella* is clearly based upon it, and neither Hoang (1977) nor Ślipiński and Burckhardt (2006) provided an official description of the new species in a manner that would satisfy the respective versions of the ICZN in effect during the time of their publications. Therefore, we consider *Serangiella* as an unavailable name and restore *Microserangium* as the valid name for this genus.

At present, *Microserangium* has eight species from the Old World, mostly from Asia with *M. okinawense* Miyatake and *M. hainanensis* Miyatake recorded from China (Miyatake 1961a, 1961b, 1994, Pang et al. 2004, Ślipiński and Burckhardt 2006, Ren et al. 2009, Escalona and Ślipiński 2012, Wang and Ren 2012). In the present paper, nine species of *Microserangium* are reported from China, including seven new species.

Materials and methods

All recently collected specimens from China were preserved in 85% ethanol. External morphology was observed with a dissecting stereoscope (SteREO Discovery V20, Zeiss). The following measurements were made with an ocular micrometer: total length, from apical margin of clypeus to apex of elytra (TL); Total width, across both

elytra at widest part (TW=EW); height, from the highest part of the beetle to elytral outer margins (TH); head width in frontal view, widest part (HW); pronotal length, from the middle of anterior margin to the base of pronotum (PL); pronotal width at widest part (PW); elytral length, along the suture, from the apex to the base including the scutellum (EL). Male and female genitalia were dissected, cleared in a 10% solution of NaOH by boiling for several minutes, and examined with an Olympus BX51 compound microscope.

Specimens were photographed with digital cameras (AxioCam HRc and Coolsnap–Pro*cf* & CRI Micro*Color), connected to the dissecting microscope. The software AxioVision Rel. 4.8 and Image–Pro Plus 5.1 were used to capture images from both cameras, and photos were cleaned up and laid out in plates with Adobe Photoshop CS 8.0.

Terminology follows Ślipiński (2007). Type specimens designated in the present paper are deposited at the Department of Entomology, South China Agriculture University (SCAU), Guangzhou, China.

Taxonomy

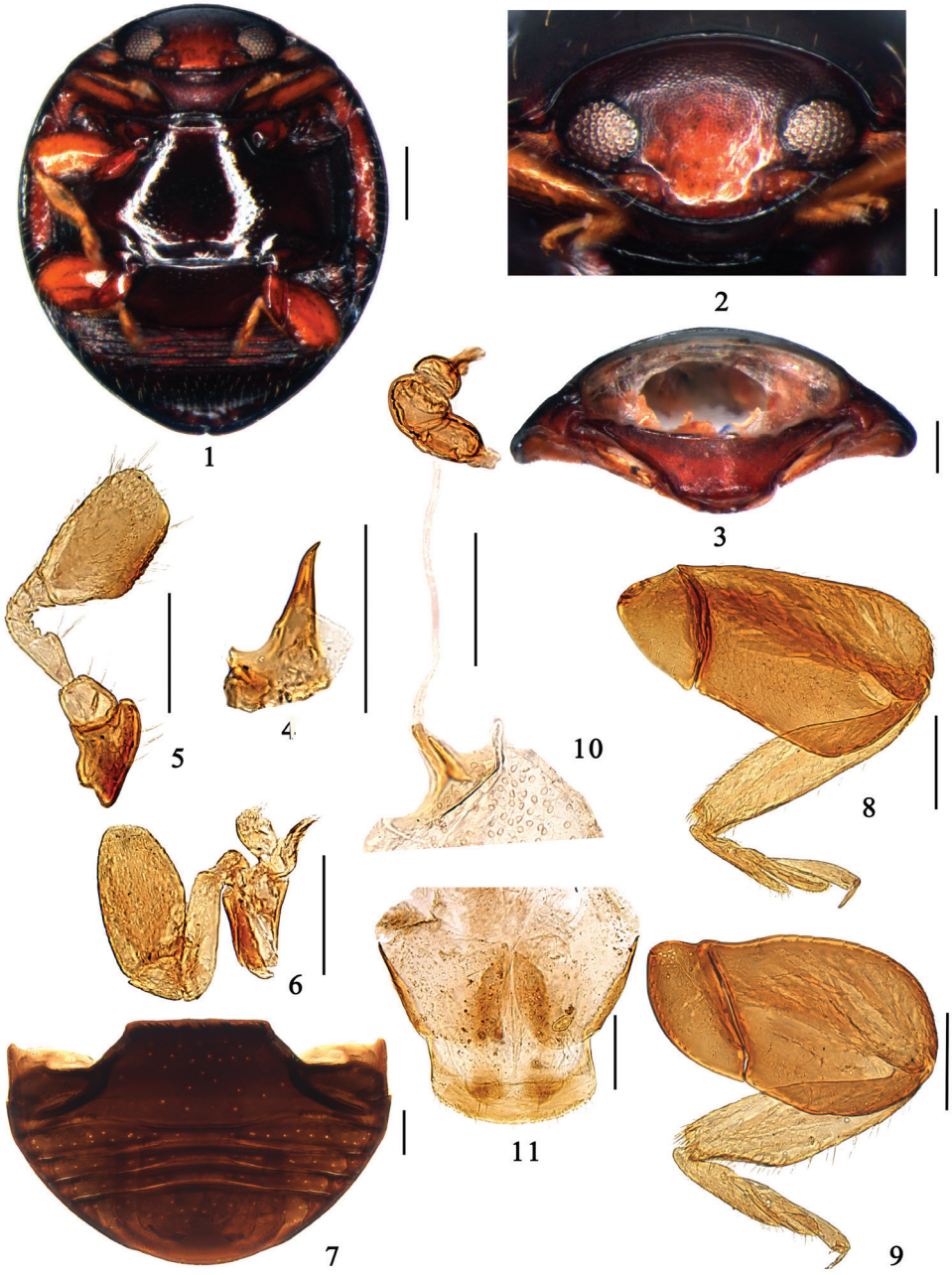
Genus *Microserangium* Miyatake, 1961
http://species-id.net/wiki/Microserangium

Microserangium Miyatake, 1961a: 37. Type species, original designation, *Microserangium shikokense* Miyatake, 1961a.
Serangiella Chapin, 1940: 271. Unavailable name.

Diagnosis. This genus is very similar to *Pangia* Wang & Ren, 2012 but it can be distinguished from the latter as follows: mandible reduced, apical tooth erect (Fig. 4), penis guide usually simple (Figs 25, 33, 41), ovipositor elongate-oval and without styli, spermatheca composed of two or three globular parts (Figs 10–11). In *Pangia*, the mandible is normal, apical tooth is bent, penis guide is strongly asymmetrical and complex, ovipositor is triangularly elongate and usually bearing short styli, and spermatheca has a large part and a small process.

This genus is also similar to *Catanella* Miyatake, 1961, but it can be distinguished from the latter as follows: mandible reduced with erect apical tooth (Fig. 4), antenna with 9 antennomeres, with antennomere 3 strongly triangular (Fig. 5). In *Catanella,* the mandible is normal, apical tooth is bent, antennae with 8 antennomeres, with antennomere 3 elongate and not expanded.

Description. Body minute, hemispherical with head in repose drawn into prothorax and closely fitting ventrally against prominent prosternal lobe (Fig. 1); dorsum glabrous, pronotum and elytral outer margins with sparse long setation (Figs 12–20). Head transverse, ventrally flattened with clypeal region prominent anteriorly (Fig. 2); frontoclypeus deeply emarginated around exposed antennal insertions. Mandible reduced, apical tooth erect (Fig. 4). Antenna with 9 antennomeres; antennomere 1 stout,



Figures 1–11. *Microserangium dactylicum* Wang & Ren, sp. n. **1** ventral view **2** head frontal view **3** prothorax **4** mandible **5** antenna **6** maxilla **7** abdomen **8** fore leg **9** hind leg **10–11** female genitalia. Scale bars: 0.1mm.

antennomere 2 globular and smaller than 1, antennomere 3 strongly triangular; club, oval and flat with apex angulate (Fig. 5). Terminal maxillary palpomere always longer than wide, barrel-shaped, truncate at apex (Fig. 6).

Pronotum strongly transverse, anterior corner rounded. Scutellum relatively large, triangular. Elytra usually smooth without visible punctures. Wings with greatly reduced venation. Prosternum strongly prominent medially forming a broad lobe concealing mouthparts from below; prosternal process subtruncate apically, broad, without carinae (Fig. 3). Mesoventrite very short and broad. Metaventrite large and broad, surface shining and glabrous (Fig. 1). Epipleuron moderately narrow, incomplete, reaching 2/3 of elytral length, with clearly delimited cavities to accommodate apices of meso- and metafemora. Abdomen with 5 ventrites (Fig. 7), ventrite 1 and 5 much longer than 2–4; hind margin of terminal ventrite rounded and smooth. Abdominal postcoxal lines incomplete, reaching lateral margin of ventrite, without associated pits or pores. Femora, especially profemur, broad, flat, closely fitting into depressions on ventral surface, protecting tibiae and tarsi from below; meso- and metatibiae conspicuously protuberant externally beyond middle, usually triangular; tarsus with 3 (Figs 8–9), rarely 4 tarsomeres.

Male genitalia: tegmen strongly asymmetrical, parameres extremely short or distinctly reduced sparsely setose apically (Figs 24–25). Female genitalia: ovipositor oval, without styli; spermatheca small and well sclerotised (Figs 10–11).

Distribution. China, India, Japan, Mayotte Island (Indian Ocean), Sri Lanka, Vietnam.

Key to species of *Microserangium* from China

1 Elytra uniformly black **2**
– Elytral disk yellow or burgundy with dark brown margins (Fig. 12). TL: 1.32–1.42 mm, TW: 1.20–1.30 mm ..... ***M. erythrinum***
2 Frons densely punctate, with variable, medium to large punctures **3**
– Frons finely, sparsely punctate; punctures of one size, without large ones **6**
3 Pronotum densely covered with large and fine punctures. Frons with medium to large punctures **4**
– Pronotum sparsely covered with fine punctures. Frons with four to six moderately large punctures and many fine punctures. TL: 1.15–1.29 mm, TW: 1.02–1.15mm ..... ***M. fuscum***
4 Parameres short and inconspicuous **5**
– Parameres relatively long and conspicuous (Fig. 40). TL: 1.38–1.62mm, TW: 1.19–1.48mm ..... ***M. glossoides***
5 Penis guide in ventral view slender and moderately curved, apex pointed (Fig. 48). TL: 1.25–1.35mm, TW: 1.09–1.15 mm ..... ***M. shennongensis***
– Penis guide in ventral view small and semilunate (Fig. 57). TL: 1.42–1.55mm, TW: 1.24–1.35mm ..... ***M. semilunatum***
6 Punctures at centre of metaventrite moderately large and densely distributed. [TL: 1.52–1.62 mm, TW: 1.35–1.45mm] ..... ***M. hainanensis***
– Punctures on metaventrite fine and sparsely distributed **7**
7 Pronotum black **8**

– Anterior corners of pronotum yellowish brown. [TL: 1.19–1.35mm, TW: 1.02–1.15mm] ..... ***M. deltoides***

8 Inner arm of penis capsule small but conspicuous (Fig. 78). Apical half of the penis guide in ventral view flat and triangular, outer margin arcuate, apex slightly blunt; basal half as Fig. 81. TL: 1.35–1.42mm, TW: 1.15–1.25mm ... . ***M. okinawense***

– Inner arm of penis capsule inconspicuous (Fig. 86). Apical half of the penis guide in ventral view flat and shovel-shaped, outer margin relatively straight, apex finger-shaped. Basal half as Fig. 89. TL: 1.25–1.38mm, TW: 1.12–1.22 mm..... ***M. dactylicum***

Microserangium erythrinum **Wang & Ren, sp. n.**
http://zoobank.org/86B9A892-300A-4B85-AF4F-B69F1E6A6943
http://species-id.net/wiki/Microserangium_erythrinum
Figures 12, 21–28, 93

Diagnosis. This species can be distinguished from other *Microserangium* species by its yellow or burgundy elytral disk with dark brown margins and its penis guide acutely triangular (Figs 12, 25).

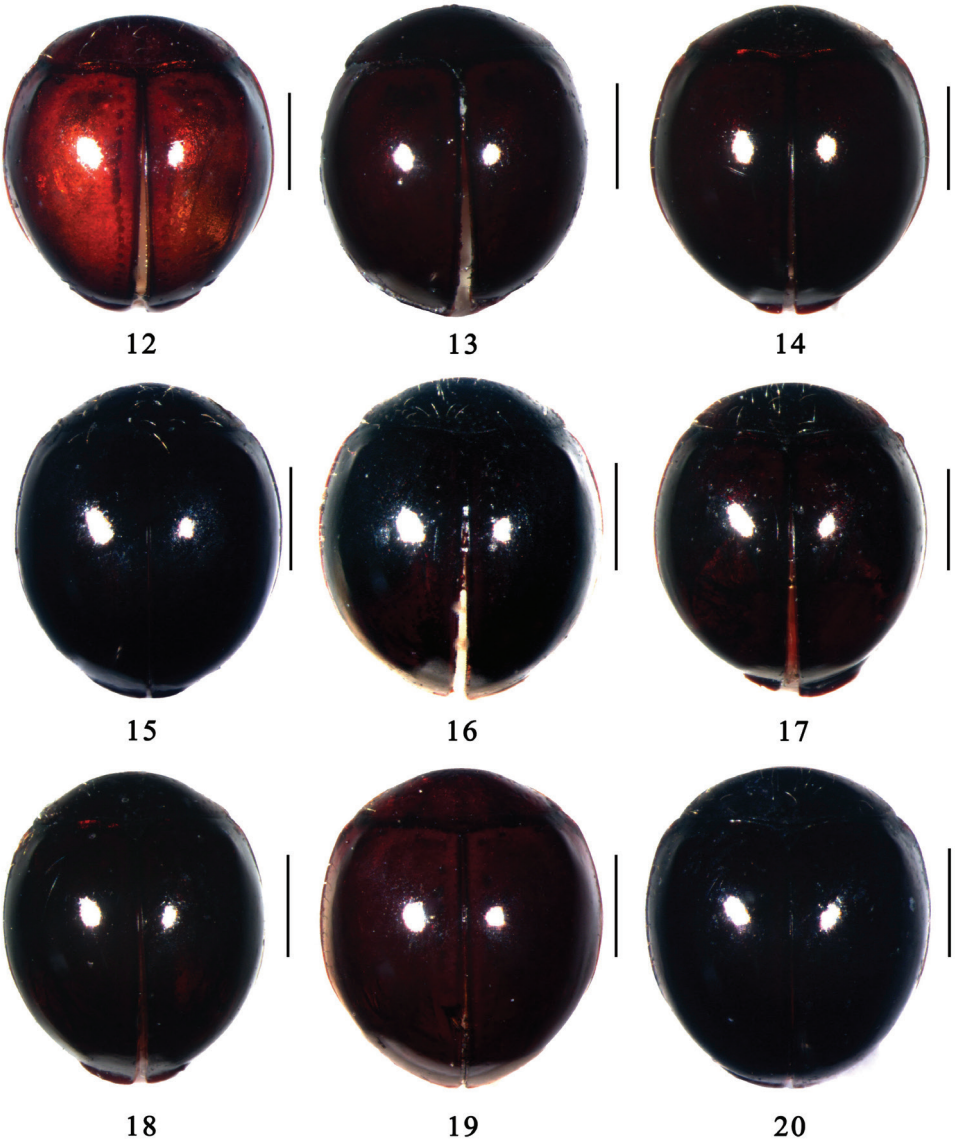
Description. TL: 1.32–1.42mm, TW: 1.20–1.30mm, TH: 0.76–0.86mm, TL/TW: 1.09–1.10; PL/PW: 0.38–0.40; EL/EW: 0.88–0.89; HW/TW: 0.46; PW/TW: 0.73.

Body shiny and glabrous (Fig. 12). Head brown, frons yellowish brown. Pronotum brown to black, scutellum dark brown. Elytra with disk yellow to burgundy and margins dark brown. Underside dark red. Legs yellowish brown, tibiae and tarsi yellow.

Head transverse and ventrally flattened; frontal punctures large and sparsely distributed, with short sparsely distributed setae on frons; eyes round, large and coarsely faceted, widest interocular distance 0.39× width of head. Antennal club oval and flat, apex rounded (Fig. 27).

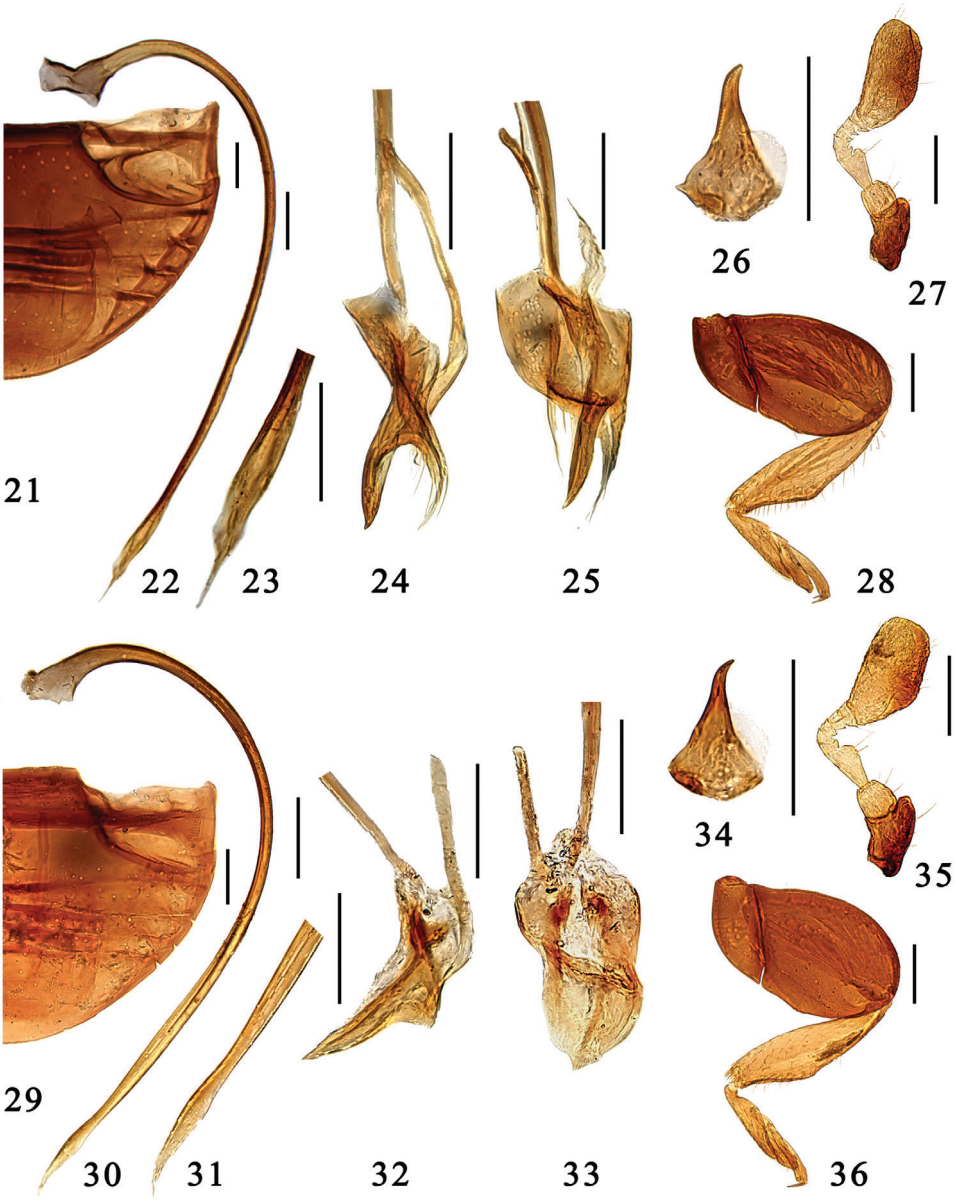
Pronotum transverse, anterior corners rounded. Pronotal disk with large and fine punctures both associated with long sparsely distributed setae, the large punctures distinctly larger than those on frons, 0.5–3.0 diameters apart. Elytra smooth and shiny with sparsely distributed long setae along margins, punctures inconspicuous. Prosternum mat and impunctate. Mesoventrite transverse, very short, surface mat, weakly furrowed. Metaventrite shiny and glabrous, punctures fine and sparsely distributed, 1.0–2.0 diameters apart. Meso- and metatibiae angulate externally beyond middle, almost triangular; tarsus with 3 tarsomeres (Fig. 28).

Male genitalia. Penis strongly curved along entire length, apex narrowed and acicular, penis capsule with short outer arm and indistinct inner one (Figs 22–23). Tegmen slender and strongly asymmetrical. Penis guide in lateral view slender, almost straight, pointed apically (Fig. 24); in ventral view acutely triangular (Fig. 25). Parameres distinct, small, about half as long as penis guide.



Figures 12–20. Dorsal view. **12** *M. erythrinum* Wang & Ren, sp. n. **13** *M. fuscum* Wang & Ren, sp. n. **14** *M. glossoides* Wang & Ren, sp. n. **15** *M. shennongensis* Wang & Ren, sp. n. **16** *M. semilunatum* Wang & Ren, sp. n. **17** *M. hainanensis* (Miyatake, 1961) **18** *M. deltoides* Wang & Ren, sp. n. **19** *M. okinawense* (Miyatake, 1961) **20** *M. dactylicum* Wang & Ren, sp. n. Scale bars: 0.2mm.

Types. Holotype ♂: **China, Yunnan:** Menglun, Xishuangbanna, 21°55.27'N, 101°16.64'E, ca 550m, 21.viii.2005, Wang XM leg. **Paratypes (8)**: **Yunnan:** 1♀, Mengxing, Mengla, Xishuangbanna, 21°52.63'N, 101°27.07'E, ca 690m, 3.v.2008,



Figures 21–36. 21–28 *M. erythrinum* Wang & Ren, sp. n. **21** abdomen **22–25** male genitalia: **22** penis **23** apex of penis **24** tegmen, lateral view **25** tegmen, ventral view **26**mandible **27** antenna **28** hind leg **29–36** *M. fuscum* Wang & Ren, sp. n. **29** abdomen **30–33** male genitalia: **30** penis **31** apex of penis **32** tegmen, lateral view **33** tegmen, ventral view **34**mandible **35** antenna **36** hind leg. Scale bars: 0.1mm.

Wang XM leg.; 1♀, Xishuangbanna Plant Park, Xishuangbanna, 21°56.05'N, 101°15.55'E, ca 550m, 22.viii.2005, Wang XM leg.; 1♀, Nuozadu, Simao, 22°34.0'N, 100°33.39'E, ca 750m, 12.v.2008, Wang XM leg.; 2♂♂, Dadugang,

Puer, 22°22.35'N, 100°56.68'E, ca 950m, 5.v.2009, Ren SX & Wang XM leg.; 1♂1♀, Yaoqu, Mengla, 21°46.98'N, 101°29.34'E, ca 700m, 7.v.2009, Wang XM leg.; 1♂, Daheishan, Jiangcheng, 22°33.74'N, 101°50.87'E, ca 1300m, 17.v.2009, Wang XM leg.

Distribution. China (Yunnan).

Etymology. The specific epithet is formed from the Latin adjective *erythrinus* red colored, referring to the elytral disk being of yellow to burgundy color.

***Microserangium fuscum* Wang & Ren, sp. n.**
http://zoobank.org/1E69C318-0C83-4C22-A24A-870862CD263C
http://species-id.net/wiki/Microserangium_fuscum
Figures 13, 29–36, 93

Diagnosis. This species can be distinguished from other *Microserangium* species by its relatively small body, dark brown dorsum (Fig. 13), fine and sparse pronotal punctation, rather small penis capsule (Fig. 30), and rather wide penis guide (Fig. 33).

Description. TL: 1.15–1.29mm, TW: 1.02–1.15mm, TH: 0.63–0.69mm, TL/TW: 1.11–1.13; PL/PW: 0.34–0.44; EL/EW: 0.89–0.90; HW/TW: 0.45; PW/TW: 0.77.

Body shiny and glabrous (Fig. 13). Dorsum uniformly dark brown. Head brown. Underside reddish brown, legs yellowish brown, tibiae and tarsi yellow.

Head transverse and ventrally flattened; frons with four to six medium punctures and many fine punctures, and several long widely separated setae; eyes round, moderately large and coarsely faceted, widest interocular distance 0.57× width of head. Antennal club oval and flat, apex blunt (Fig. 35).

Pronotum transverse, anterior corners inconspicuous and blunt, glabrous, punctures fine and sparsely distributed, associated with long sparsely distributed setae. Elytra smooth and shiny, with sparse row of long setae along margins, punctures extremely fine and inconspicuous. Prosternum mat and impunctate. Mesoventrite transverse, very short, surface mat, weakly furrowed. Metaventrite shiny and glabrous, punctures in center fine, 1.0–3.0 diameters apart. Meso- and metatibiae angulate externally beyond middle, almost triangular; tarsus with 3 tarsomeres (Fig. 36).

Male genitalia. Penis strongly curved along entire length, apex narrowed and pointed, penis capsule small (Figs 30–31). Tegmen slender and strongly asymmetrical. Penis guide in lateral view slender, almost straight, apex pointed (Fig. 32), in ventral view flat and rather wide (Fig. 33). Parameres small and short, less than 1/3 length of penis guide.

Types. Holotype ♂: **China, Hainan:** Wushi, 19°8.99'N, 109°53.84'E, ca 320m, 14.vii.1999, Peng ZQ leg.; **Paratypes (2)**: 1♀, same data as holotype; 1♂, Nanbin, 18°21.37'N, 109°11.0'E, ca 10m, 24.iii.1998, Peng ZQ leg.

Distribution. China (Hainan).

Etymology. The specific epithet is formed from the Latin adjective *fuscus*, referring to the elytral disk being uniformly dark brown.

***Microserangium glossoides* Wang & Ren, sp. n.**
http://zoobank.org/829EA7BA-0BB7-4CDC-803E-A1F33A41A387
http://species-id.net/wiki/Microserangium_glossoides
Figures 14, 37–44, 93

Diagnosis. This species can be distinguished from other *Microserangium* species by its male genitalia with relatively long parameres and tongue-shaped penis guide (Figs 40–41).

Description. TL: 1.38–1.62mm, TW: 1.19–1.48mm, TH: 0.76–0.82mm, TL/TW: 1.09–1.17; PL/PW: 0.42–0.46; EL/EW: 0.89–1.00; HW/TW: 0.42; PW/TW: 0.73.

Body shiny and glabrous (Fig. 14). Dorsum uniformly dark brown to black. Head yellowish brown. Underside reddish brown, legs yellowish brown, tibiae and tarsi yellow.

Head transverse and ventrally flattened; frontal punctures medium-sized and densely distributed, 1.0–1.5 diameter apart, associated with several long sparsely distributed setae; eyes round, large and coarsely faceted, widest interocular distance 0.42× width of head. Antennal club oval and flat, apex angular (Fig. 43).

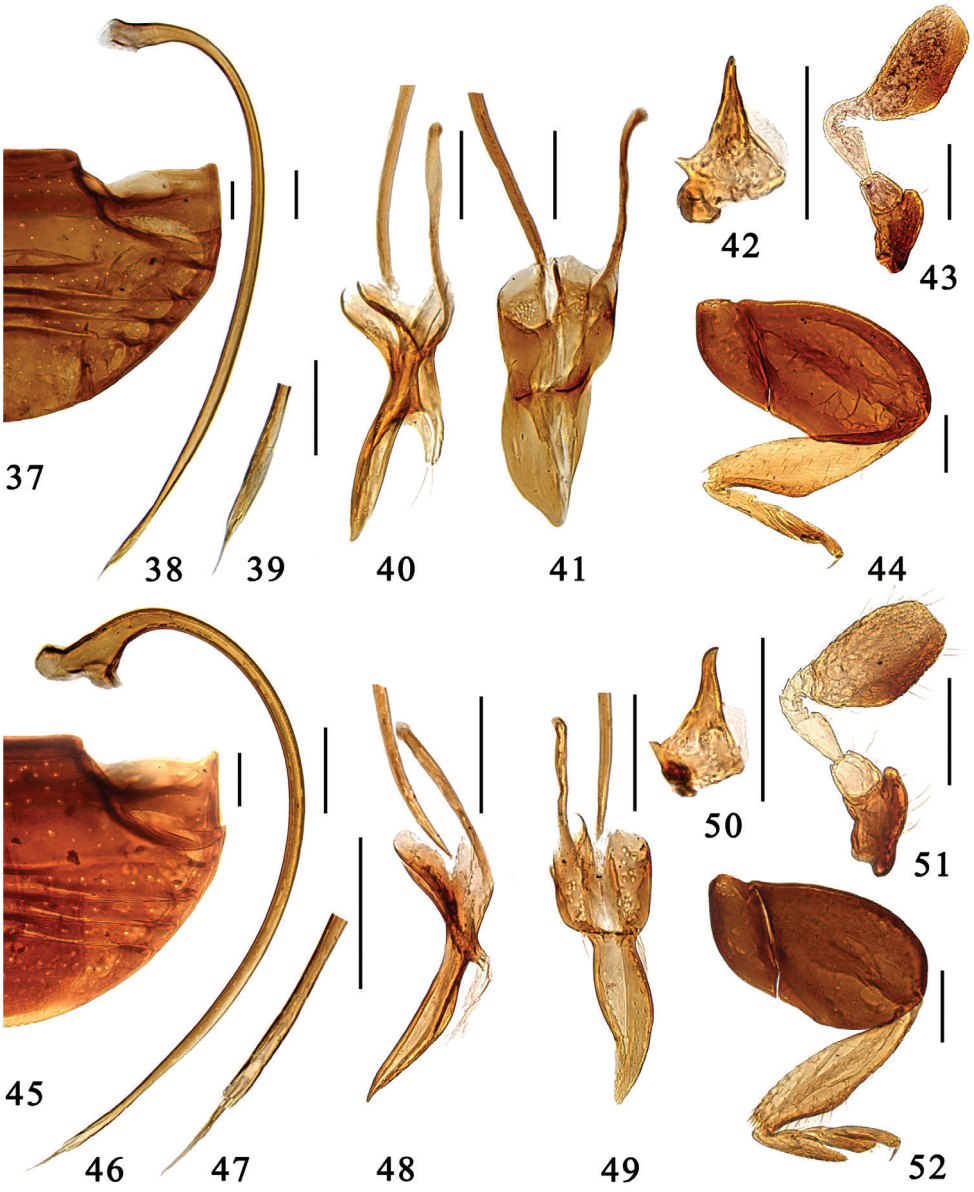
Pronotum transverse, anterior corners inconspicuous and blunt, Pronotal disk densley covered with large and fine punctures both associated with long sparsely distributed setae. Elytra smooth and shiny, with sparse row of long setae along margin, punctures extremely fine and inconspicuous. Prosternum mat and impunctate. Mesoventrite transverse, very short, surface mat, weakly furrowed. Metaventrite shiny and glabrous, punctures at center fine but conspicuous, 2.0–4.0 diameters apart. Meso- and metatibiae angulate externally beyond middle, almost triangular; tarsus with 3 tarsomeres (Fig. 44).

Male genitalia. Penis moderately curved, apex strongly narrowed and acicular, penis capsule with short outer arm and inconspicuous inner one (Figs 38–39). Tegmen slender and asymmetrical. Penis guide in lateral view slender, almost straight, apex pointed (Fig. 40), in ventral view flat and tongue-shape, apex slightly pointed (Fig. 41). Parameres moderately long, slightly less than ½ length of penis guide.

Types. Holotype ♂: **China, Hainan:** Bawangling, 19°05.65'N, 109°6.73'E, ca 330m, 21.iii.1996, Peng ZQ leg. **Paratypes (11)**: **Hainan:** 5♂♂, same data to holotype; 2♂♂, Wuzhishan, 18°47.0'N, 109°31.98'E, ca 650m, viii.1995, Peng ZQ leg.; 1♂, Limushan, 19°16.08'N, 109°47.32'E, ca 280m, 21.iv. 1996, Peng ZQ leg.; 1♂, Shijing, Diaoluoshan, 18°56.15'N, 109°56.90'E, ca 200m, ix. 1995, Peng ZQ leg.; 1♀, Wuzhishan, 18°47'N, 109°31.98'E, ca 650m, 22.xi.1991, Peng ZQ leg.; 1♂, Limushan, 19°16.08'N, 109°47.32'E, ca 280m, 22.vii.2006, Wang XM leg.

Distribution. China (Hainan).

Etymology. The specific epithet is formed from the Latin adjective *glossoides*, referring to the tongue-shaped penis guide.



Figures 37–52. 37–44 *M. glossoides* Wang & Ren, sp. n. **37** abdomen **38–41** male genitalia: **38** penis **39** apex of penis **40** tegmen, lateral view **41** tegmen, ventral view **42**mandible **43** antenna **44** hind leg **45–52** *M. shennongensis* Wang & Ren, sp. n. **45** abdomen **46–49** male genitalia: **46** penis **47** apex of penis **48** tegmen, lateral view **49** tegmen, ventral view **50** mandible **51** antenna **52** hind leg. Scale bars: 0.1mm.

***Microserangium shennongensis* Wang & Ren, sp. n.**
http://zoobank.org/2E6728C1-68D9-4425-B824-A0FBB2FC991B
http://species-id.net/wiki/Microserangium_shennongensis
Figures 15, 45–52, 93

Diagnosis. This species is similar to *M. glossoides*, from which it differs in having a relatively large outer arm of the penis capsule, small parameres, and narrow and curved penis guide (Figs 46–49). In *M. glossoides*, the penis capsule is inconspicuous, the parameres are distinctly longer than in *M. shennongensis*, and the penis guide is tongue-shaped (Figs 38–41).

Description. TL: 1.25–1.35mm, TW: 1.09–1.15mm, TH: 0.66–0.69mm, TL/TW: 1.15–1.17; PL/PW: 0.42–0.44; EL/EW: 0.94–1.11; HW/TW: 0.42; PW/TW: 0.73.

Body shiny and glabrous (Fig. 15). Dorsum uniformly black. Head reddish brown. Underside dark brown, legs brown, tibiae and tarsi yellow.

Head transverse and ventrally flattened; frontal punctures large, conspicuous and densely distributed, 0.5–1.0 diameter apart, associated with long sparsely distributed setae; eyes round, large and coarsely faceted, widest interocular distance 0.50× width of head. Antennal club oval and flat, apex truncated (Fig. 51).

Pronotum short and strongly transverse, anterior corners inconspicuous and blunt. Pronotal disk with densely distributed large and fine punctures both associated with long sparsely distributed setae. Elytra smooth and shiny, with sparse row of long setae along margins, punctures extremely fine and inconspicuous. Prosternum mat and impunctate. Mesoventrite transverse, very short, surface mat, weakly furrowed. Metaventrite shiny and glabrous, punctures fine and densely distributed, 1.5–2.0 diameters apart. Meso- and metatibiae weakly angulate externally beyond middle; tarsus with 3 tarsomeres (Fig. 52).

Male genitalia. Penis strongly curved along entire length, apex narrowed and acicular, penis capsule with short but distinct outer arm and small inner one (Figs 46–47). Tegmen rather slender and strongly asymmetrical. Penis guide in lateral view slender, outer margin arcuate, apex pointed (Fig. 48), in ventral view slender and moderately curved, apex pointed (Fig. 49). Parameres inconspicuous, small.

Types. Holotype ♂: **China, Hunan:** Shennong Valley National Forest Park, Yanling, 26°29.95'N, 114°0.18.98'E, ca 800m, 9.x.2010, Wang XM leg. **Paratypes (4)**: **Hunan:** 1♂3♀♀, same data as the holotype.

Distribution. China (Hunan).

Etymology. The specific epithet refers to the Shennong Valley National Forest Park, the type locality of this ladybird.

***Microserangium semilunatum* Wang & Ren, sp. n.**
http://zoobank.org/0B55E091-1323-469F-A479-57E7F47388D4
http://species-id.net/wiki/Microserangium_semilunatum
Figures 16, 53–60, 93

Diagnosis. The male genitalia of this species are similar to *M. erythrinum*, but this species can be distinguished from the latter by its uniformly dark elytra and semilunate

penis guide (Figs 16, 56–57). In *M. erythrinum*, the elytral disk is yellow or burgundy with dark brown margins and the penis guide is acutely triangular (Figs 12, 24–25).

Description. TL: 1.42–1.55mm, TW: 1.24–1.35mm, TH: 0.76–0.86mm, TL/TW: 1.14–1.15; PL/PW: 0.40–0.44; EL/EW: 0.93–0.98; HW/TW: 0.44; PW/TW: 0.73.

Body shiny and glabrous (Fig. 16). Dorsum uniformly black. Head black, clypeus brown. Underside black, legs dark brown, tibiae and tarsi yellow.

Head transverse and ventrally flattened; frontal punctures large and densely distributed, 0.3–1.0 diameter apart, associated with long sparsely distributed setae; eyes round, large and coarsely faceted, widest interocular distance 0.50× width of head. Antennal club oval and flat, apex blunt (Fig. 59).

Pronotum short and strongly transverse, anterior corner inconspicuous and blunt, mat and shagreened. Pronotal disk with densely distributed large and fine shallow punctures both associated with long sparsely distributed setae. Elytra smooth and shiny, with sparse row of long setae along margins, punctures extremely fine and inconspicuous. Prosternum mat and impunctate. Mesoventrite transverse, very short, surface mat weakly furrowed. Metaventrite shiny and glabrous, punctures fine and sparsely distributed, 2.0–3.0 diameters apart. Meso- and metatibiae strongly angulate externally beyond middle; tarsus with 3 tarsomeres (Fig. 60).

Male genitalia. Penis strongly curved along entire length, apex narrowed and acicular, penis capsule with large outer arm and inconspicuous inner one (Figs 54–55). Tegmen rather slender and strongly asymmetrical. Penis guide in lateral view small, almost straight, apex pointed (Fig. 56), in ventral view small and semilunate (Fig. 57). Parameres conspicuous.

Types. Holotype ♂: **China, Hainan:** Bawangling, 19°05.65'N, 109°6.73'E, ca 330m, 21.iii.1996, Peng ZQ leg. **Paratypes** (12): **Hainan:** 4♂♂1♀, same data to holotype; 1♂1♀, Bawangling, 19°05.65'N, 109°6.73'E, ca 330m, 3.ix.1998, Peng ZQ leg.; 1♂, Bawangling, 19°05.65'N, 109°6.73'E, ca 330m, 20.iv.2000, Peng ZQ leg.; 1♂1♀, Diaoluoshan, 18°56.15'N, 109°56.90'E, ca 200m, 26.vii.2006, Wang XM leg.; 1♂, Diaoluoshan, 18°56.15'N, 109°56.90'E, ca 200m, 7.v.2005, Wang XM leg.

Distribution. China (Hainan).

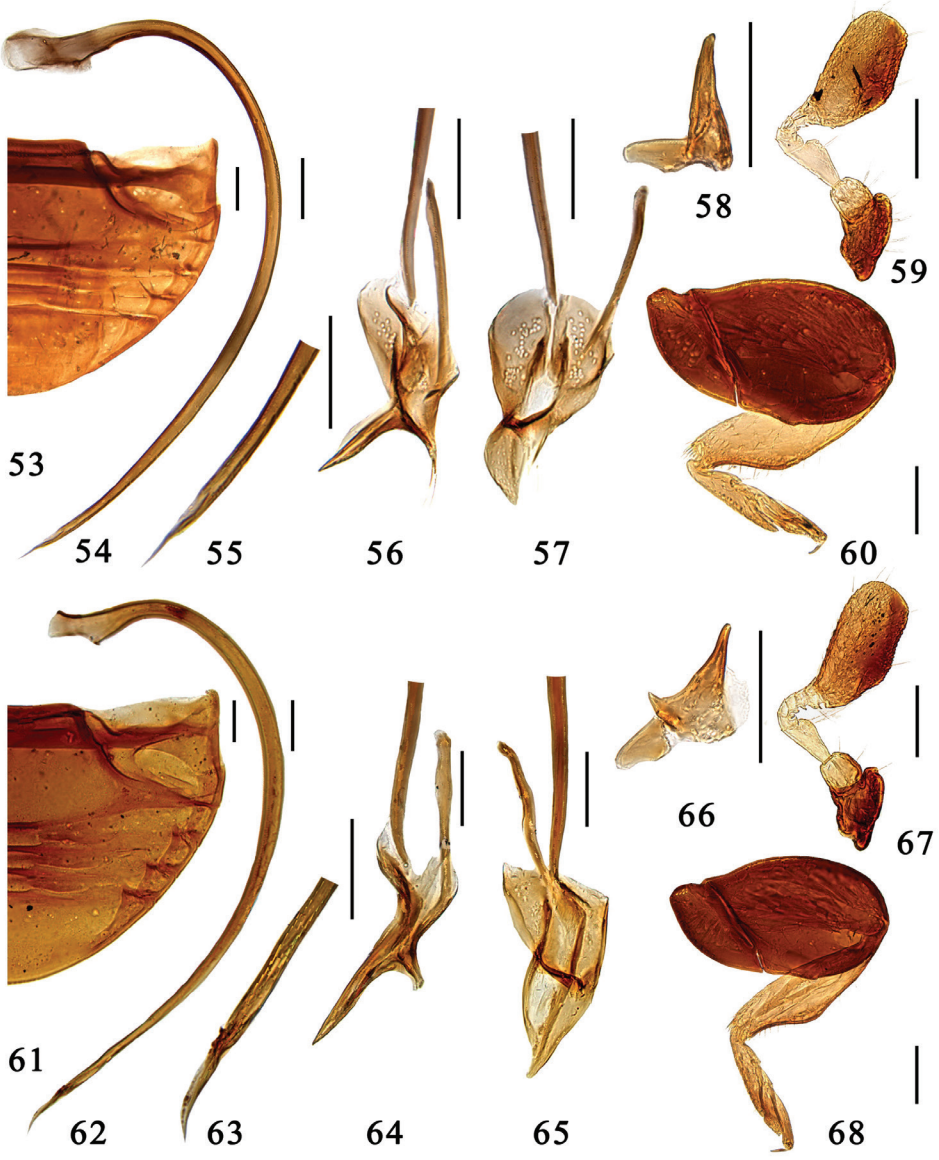
Etymology. The specific epithet is formed from the the Latin adjective *semilunatus*, referring to the semilunate penis guide.

Microserangium hainanensis Miyatake, 1961

http://species-id.net/wiki/Microserangium_hainanensis
Figures 17, 61–68, 93

Microserangium hainanensis Miyatake, 1961b: 144.
Serangiella hainanensis: Ślipiński and Burckhardt 2006: 50.

Diagnosis. This species can be distinguished as follows: frontal punctures fine and sparsely distributed, pronotum densely covered with large punctures associated with long sparsely distributed setae, and punctures in central part of metaventrite



Figures 53–68. 53–60 *M. semilunatum* Wang & Ren, sp. n. **53** abdomen **54–57** male genitalia: **54** penis **55** apex of penis **56** tegmen, lateral view **57** tegmen, ventral view **58**mandible **59** antenna **60** hind leg **61–68***M. hainanensis* Miyatake, 1961 **61** abdomen **62–65** male genitalia: **62** penis **63** apex of penis **64** tegmen, lateral view **65** tegmen, ventral view **66**mandible **67** antenna **68** hind leg. Scale bars: 0.1mm.

moderately large and densely distributed. The penis guide of the male genitalia is also unique (Fig. 65).

Description. TL: 1.52–1.62mm, TW: 1.35–1.45mm, TH: 0.86–0.89mm, TL/TW: 1.11–1.12; PL/PW: 0.44–0.45; EL/EW:0.90–0.91; HW/TW: 0.43; PW/TW: 0.70.

Body shiny and glabrous (Fig. 17). Dorsum uniformly black. Head dark brown, frons brown. Underside dark brown, legs reddish brown, tibiae and tarsi yellow.

Head transverse and ventrally flattened; frontal punctures fine and sparsely distributed, 1.0–2.0 diameters apart, associated with long sparsely distriuted setae, eyes round, large and coarsely faceted, widest interocular distance 0.47× width of head. Antennal club oval and flat, apex blunt (Fig. 67).

Pronotum strongly transverse, anterior corners inconspicuous and blunt, mat and shagreened. Pronotal disk with densely distributed large punctures associated with long sparsely distributed setae. Elytra smooth and shiny, with long sparsely distributed setae along margins, punctures extremely fine and inconspicuous. Prosternum mat and impunctate. Mesoventrite transverse, very short, surface mat weakly furrowed. Metaventrite shiny and glabrous, with densely distributed medium size punctures at center, 1.0–2.0 diameters apart. Meso- and metatibiae angulate externally beyond middle; tarsus with 3 tarsomeres (Fig. 68).

Male genitalia. Penis strongly curved, apex narrowed and pointed, penis capsule with conspicuous outer arm (Figs 62–63). Tegmen slender and strongly asymmetrical. Penis guide in lateral view slender, straight, apex pointed (Fig. 64), in ventral view acute triangular, apex pointed (Fig. 65). Parameres conspicuous, small, short, rectangular with penis guide (Fig. 64).

Specimens examined. China, Hainan: 2♂♂, Tianchi, Jingfengling, 18°44.42'N, 108°51.80'E, ca 820m, viii.1995, Peng ZQ leg. 2♂♂, Xinan, Diaoluoshan, 18°56.15'N, 109°56.90'E, 18.ix.1995, Peng ZQ leg.; 1♂, Bawangling, 19°05.65'N, 109°6.73'E, ca 330m, 5.v.2005, Wang XM leg.

Distribution. China (Hainan).

***Microserangium deltoides* Wang & Ren, sp. n.**

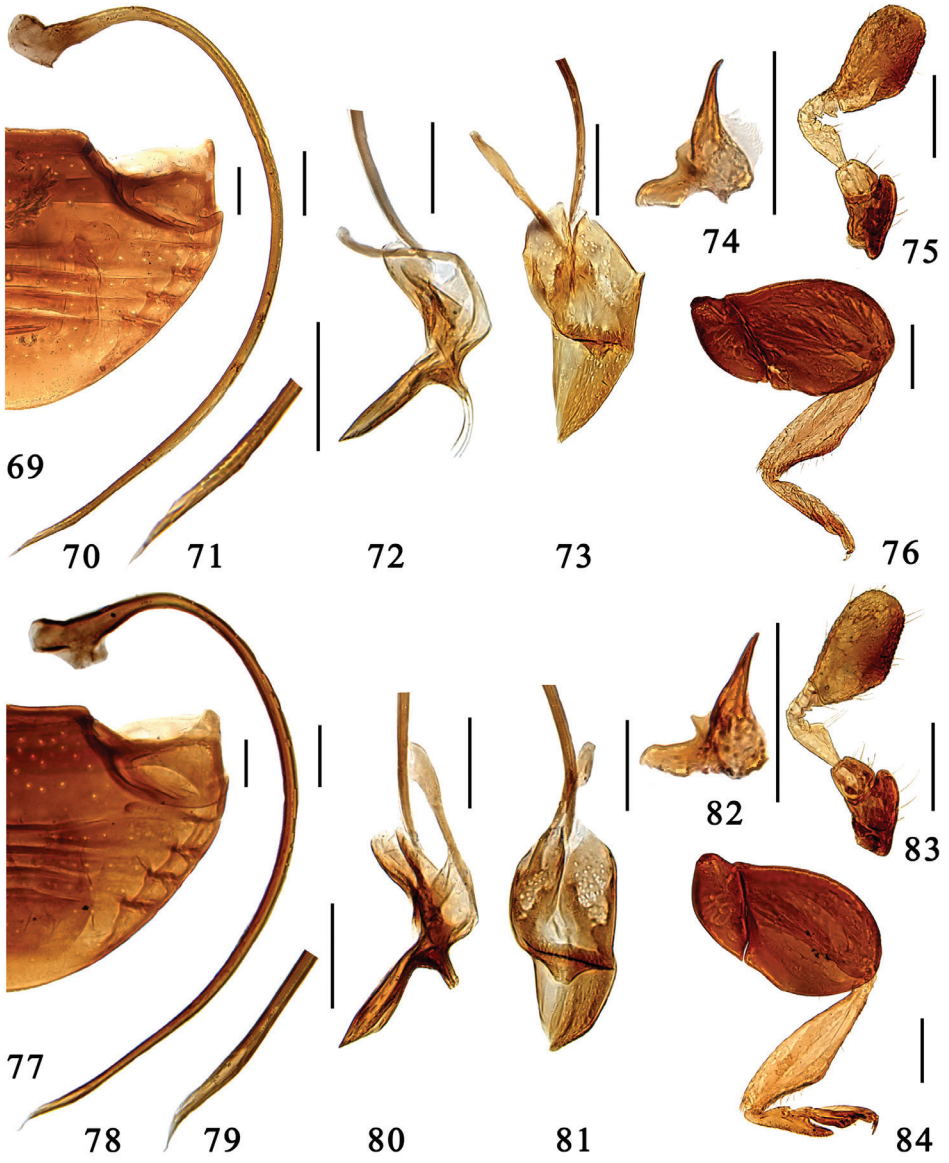
http://zoobank.org/ABCE9651-A3E7-4ECF-8BB7-2DFA0C4E7056
http://species-id.net/wiki/Microserangium_deltoides
Figures 18, 69–76, 93

Diagnosis. This species is similar to *M. okinawense*, but can be separated from the latter by the inconspicuous inner arm of the penis capsule and triangular penis guide (Figs 70–73). In *M. okinawense*, the inner arm of the penis capsule is small but distinct, and the penis guide is almost triangular with inner and outer margins arcuate (Figs 78–81).

Description. TL: 1.19–1.35mm, TW: 1.02–1.15mm, TH: 0.66–0.76mm, TL/TW: 1.16–1.17; PL/PW: 0.38–0.44; EL/EW: 0.87–1.00; HW/TW: 0.43; PW/TW: 0.71.

Body shiny and glabrous (Fig. 18). Dorsum uniformly black, anterior corner of pronotum yellowish brown. Head dark brown, except frons medium brown. Underside dark brown, legs yellowish brown, tibiae and tarsi yellow.

Head transverse and ventrally flattened; frontal punctures fine and sparsely distributed, 1.0–2.0 diameters apart, with long sparsely distributed setae; eyes round, large



Figures 69–84. 69–76 *M. deltoides* Wang & Ren, sp. n. **69** abdomen **70–73** male genitalia: **70** penis **71** apex of penis **72** tegmen, lateral view **73** tegmen, ventral view **74**mandible **75** antenna **76** hind leg **77–84***M. okinawense* Miyatake, 1961 **77** abdomen **78–81** male genitalia: **78** penis **79** apex of penis **80** tegmen, lateral view **81** tegmen, ventral view **82**mandible **83** antenna **84** hind leg. Scale bars: 0.1mm.

and coarsely faceted, widest interocular distance 0.40× width of head. Antennal club oval and flat, apex blunt (Fig. 75).

Pronotum strongly transverse, anterior corners inconspicuous and blunt, mat and shagreened. Pronotal disk with densely distributed large and fine punctures both as-

sociated with long sparsely distributed setae, the finer punctures slightly deeper than the large ones. Elytra smooth and shiny, with long sparsely distributed setae along margins, punctures extremely fine and inconspicuous. Prosternum mat and impunctate. Mesoventrite transverse, very short, surface mat, weakly furrowed. Metaventrite shiny and glabrous, punctures fine and sparsely distributed, 1.5–3.0 diameters apart. Meso- and metatibiae distinctly angulate externally beyond middle, almost triangular; tarsus with 3 tarsomeres (Fig. 76).

Male genitalia. Penis strongly curved along entire length, apex narrowed and pointed, penis capsule with large outer arm and inconspicuous inner one (Figs 70–71). Tegmen slender and asymmetrical. Penis guide in lateral view slender and straight, apex pointed (Fig. 72), in ventral view flat and triangular, apex pointed (Fig. 73). Parameres conspicuous, small (Fig. 72).

Types. Holotype ♂: **China, Guangxi:** Pinglongshan, Fulong, Shangsi, 21°49.88'N, 107°56.79'E, ca 160m, 29.vii.2005, Wang XM leg. **Paratypes (28): Guangxi:** 1♂4♀♀, same data to holotype; 6♂♂3♀♀, Fulong, Shiwandashan, Shangsi, 21°49.88'N, 107°56.79'E, ca 160m, 7.xi.2004, Wang XM et al. leg.; 2♂♂11♀♀, Hongqilinchang, Shiwandashan, Shangsi, 21°52.79'N, 107°55.05'E, ca 900m, 7.xi.2004, Wang XM et al. leg.; **Guizhou:** 1♂, Xianheping, Anlong, 24°58.66'N, 105°36.45'E, ca 1500m, 12.ix.2007, Wang XM leg.

Distribution. China (Guangxi, Guizhou).

Etymology. The specific epithet is formed from the Latin adjective *deltoides*, referring to the triangular penis guide.

***Microserangium okinawense* Miyatake, 1961**
http://species-id.net/wiki/Microserangium_okinawense
Figures 19, 77–84, 93

Microserangium okinawense Miyatake, 1961a: 131; Sasaji 1971: 64.
Serangiella okinawense: Ślipiński and Burckhardt 2006: 50; Ren et al. 2009: 38.

Diagnosis. This species is close to *M. deltoides.* The differences between these two are discussed in the diagnosis of *M. deltoides*.

Description. TL: 1.35–1.42mm, TW: 1.15–1.25mm, TH: 0.76–0.79mm, TL/TW: 1.13–1.17; PL/PW: 0.40–0.42; EL/EW: 0.95–1.00; HW/TW: 0.42; PW/TW: 0.68.

Body shiny and glabrous (Fig. 19). Dorsum uniformly dark brown to black. Head reddish brown. Underside reddish brown, legs yellowish brown, tibiae and tarsi yellow.

Head transverse and ventrally flattened; frontal punctures fine and inconspicuous, with long sparsely distributed setae; eyes round, large and coarsely faceted, widest interocular distance 0.44× width of head. Antennal club oval and flat, apex blunt (Fig. 83).

Pronotum short and strongly transverse, anterior corners inconspicuous and blunt, mat and shagreened. Pronotal disk with densely distributed large and fine shallow punctures both associated with long sparsely distributed setae. Elytra smooth

and shiny, with sparse row of long setae along margins, punctures extremely fine and inconspicuous. Prosternum mat and impunctate. Mesoventrite transverse, very short, surface mat weakly furrowed. Metaventrite shiny and glabrous, punctures in center fine and conspicuous, 1.0–2.0 diameters apart. Meso- and metatibiae protuberant externally beyond middle, almost triangular; tarsus with 3 tarsomeres (Fig. 84).

Male genitalia. Penis strongly curved along entire length, apex narrowed and pointed, penis capsule conspicuous (Figs 78–79). Tegmen rather slender and strongly asymmetrical. Penis guide in lateral view slender, straight, widest in apical 1/3, narrowed at base, apex pointed (Fig. 80); in ventral view flat and shovel-shaped, apex slightly blunt (Fig 81). Parameres conspicuous, small (Fig. 80).

Specimens examined. China, Taiwan: 2♂♂1♀, Pingdong, Shuangliu, 22°13.07'N, 120°47.77'E, 200–400m, 21. X. 2012, S. Ren SX et al. leg.; 1♂1♀, Jiaxian & Tengzhi, 23°4.38'N, 120°36.94'E, 370m-1450m, 25. X. 2012, S. Ren SX et al. leg.; **Hainan:** 4♂♂, Wufenchang, Limushan, 19°16.23'N, 109°47.48'E, ca 280m, ix.1996, Peng ZQ leg. 2♂♂3♀♀, Bawangling, 19°05.65'N, 109°6.73'E, ca 330m, 5.v.2005, Wang XM leg.; 1♂, Yinggeling, 19°02.25'N, 109°33.85'E, ca 830m, 23.xi.1997, Peng ZQ leg.; 1♀, Yinggeling, 19°02.25'N, 109°33.85'E, ca 830m, 8.v.2005, Wang XM leg.; 2♀♀, Limushan, 19°16.08'N, 109°47.32'E, ca 280m, 22.vii.2006, Wang XM leg.

Distribution. China (Hainan, Taiwan).

Microserangium dactylicum Wang & Ren, sp. n.

http://zoobank.org/AED888D3-8A64-4944-B27A-181BDF36DC3E
http://species-id.net/wiki/Microserangium_dactylicum
Figures 20, 85–93

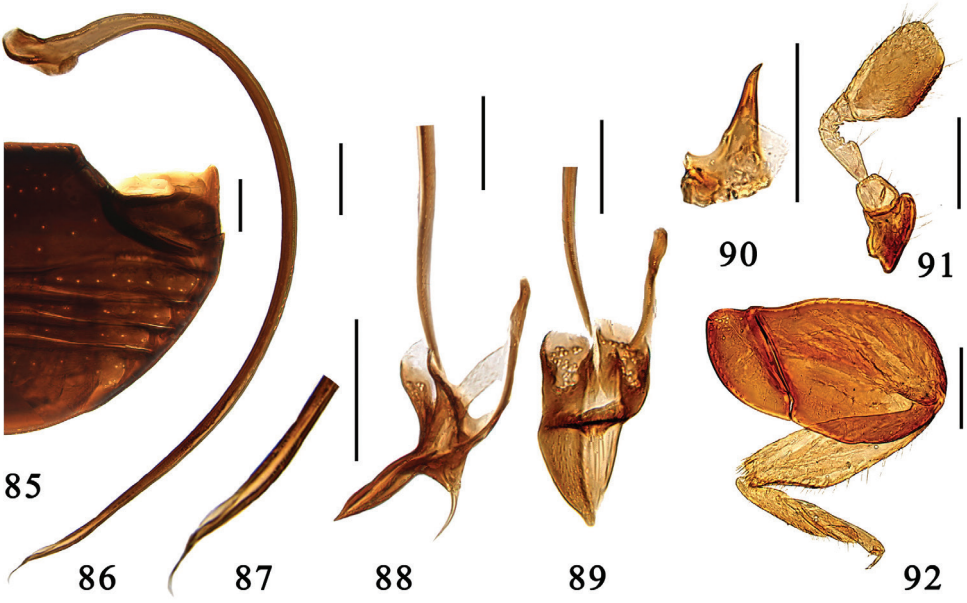
Diagnosis. This species is similar to *M. bacthaiensis* Hoàng, 1978 in morphological characters and male genitalia, but it can be distinguished by the different shape of the penis guide.

Description. TL: 1.25–1.38mm, TW: 1.12–1.22mm, TH: 0.76–0.82mm, TL/TW: 1.12–1.14; PL/PW: 0.42–0.44; EL/EW: 0.94–0.95; HW/TW: 0.43; PW/TW: 0.76.

Body shiny and glabrous (Fig. 20). Dorsum uniformly black. Head brown, except frons yellowish brown. Underside dark brown, except prosternum brown. Legs yellowish brown, tibiae and tarsi yellow (Fig. 1).

Head transverse and ventrally flattened; frontal punctures inconspicuous and sparsely distributed, with long sparsely distributed setae (Fig. 2); eyes round, large and coarsely faceted, widest interocular distance 0.44× width of head (Fig. 2). Antennal club, oval and flat, apex angular (Fig. 5).

Pronotum short and strongly transverse, with anterior corners inconspicuous and blunt, mat and shagreened. Pronotal disk with densely distributed large and fine punctures both associated with long sparsely distributed setae, punctures inconspicuous. Elytra smooth and shiny, with several long setae along margins, punctures extremely fine and inconspicuous. Prosternum mat and impunctate. Mesoventrite transverse, very short, surface mat, weakly furrowed (Fig. 3). Metaventrite shiny and glabrous,



Figures 85–92.*M. dactylicum* Wang & Ren, sp. n. **85** abdomen **86–89** male genitalia: **86** penis **87** apex of penis **88** tegmen, lateral view **89** tegmen, ventral view **90**mandible **91** antenna **92** hind leg. Scale bars: 0.1mm.

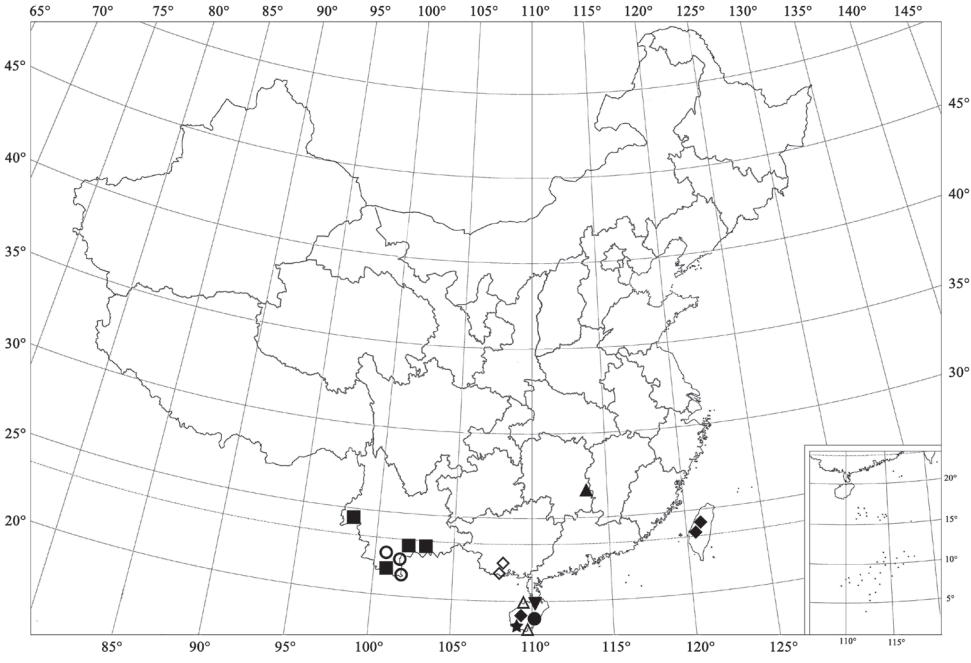


Figure 93. Distribution map. ○ *M. erythrinum* Wang & Ren, sp. n. ● *M. fuscum* Wang & Ren, sp. n. △ *M. glossoides* Wang & Ren, sp. n. ▲ *M. shennongensis* Wang & Ren, sp. n. ▼ *M. semilunatum* Wang & Ren, sp. n. ★ *M. hainanensis* Miyatake, 1961 ◇ *M. deltoides* Wang & Ren, sp. n. ◆ *M. okinawense* Miyatake, 1961 ■ *M. dactylicum* Wang & Ren, sp. n.

punctures fine and sparsely distributed, 3.0–4.0 diameters apart. Meso- and metatibiae protuberant externally beyond middle; tarsus with 3 tarsomeres (Fig. 9).

Male genitalia. Penis strongly curved along entire length, apex strongly narrowed and acicular, penis capsule with large outer arm and inconspicuous inner one (Figs 86–87). Tegmen rather slender and strongly asymmetrical. Penis guide in lateral view slender, straight, apex pointed (Fig. 88), in ventral view flat and triangular, apex finger-shaped (Fig. 89). Parameres conspicuous, small (Fig. 88).

Types. Holotype ♂: **China, Yunnan:** Dadugang, Puer, 22°22.35'N, 100°56.68'E, ca 950m, 26.iv.2008, Wang XM leg. **Paratypes** (20): **Yunnan:** 3♂♂2♀♀, same data to holotype; 2♂♂2♀♀, Tongbiguan, Nabang, Yingjiang, 24°37.86'N, 97°34.75'E, ca 1000m, 22–23.v.5.2008, Wang XM et al. leg.; 2♂♂5♀♀, Ganlongjing, Lianhuatan, Hekou, 22°56.59'N, 103°31.68'E, ca 710m, 20.v.2009, Wang XM et al. leg.; 1♀, Yaoqu, Mengla, 700m, 7.v.2009, Wang XM leg.; 1♂, Ainiguzhai, Jinghong, 21°54.67'N, 101°10.31'E, ca 660m, 11.v.2009, Wang XM leg.; 1♂, Lianhuatan, Hekou, 22°53.86'N, 103°34.04'E, ca 900m, 22.iv.2008, Wang XM leg.; 1♂, Daheishan, Jiangcheng, 22°33.62'N, 101°50.16'E, ca 1240m, 17.v.2009, Wang XM leg.

Distribution. China (Yunnan).

Etymology. The specific epithet is formed from the Latin adjective *dactylicus*, referring to the finger-shaped apex of the penis guide.

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RESEARCH ARTICLE

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Mitochondrial DNA and karyotypic data confirm the presence of *Mus indutus* and *Mus minutoides* (Mammalia, Rodentia, Muridae, *Nannomys*) in Botswana

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Abstract

We use a combination of cytochrome *b* sequence data and karyological evidence to confirm the presence of *Mus indutus* and *Mus minutoides* in Botswana. Our data include sampling from five localities from across the country, including one site in northwestern Botswana where both species were captured in syntopy. Additionally, we find evidence for two mitochondrial lineages of *M. minutoides* in northwestern Botswana that differ by 5% in sequence variation. Also, we report that *M. minutoides* in Botswana have the 2n=34 karyotype with the presence of a (X.1) sex-autosome translocation.

Keywords

Africa, rodent, distribution, karyotype, sex-autosome translocation, cytochrome *b*

Introduction

Delineating geographic distributions of African *Mus* (subgenus *Nannomys* Peters, 1876) in Sub-Saharan Africa has been especially challenging due to a combination of incomplete taxon sampling throughout the region as well as uncertainties in species

identification resulting from their highly conserved morphology. Despite morphological similarities, African pygmy mice (*Nannomys*) are characterized by a high degree of chromosomal variation, including chromosomal rearrangements such as Robertsonian translocations, pericentric inversions, heterochromatin additions, and tandem fusions (see summary in Britton-Davidian et al. 2012). Additionally, whole-arm translocations (WARTs) and novel sex-chromosome determination have been documented in populations in South Africa (Veyrunes et al. 2007, 2013).

Britton-Davidian et al. (2012) produced the most complete phylogenetic analysis of *Nannomys* to date, which included previously published sequences of nine species (Suzuki et al. 2004; Chevret et al. 2005; Veyrunes et al. 2005; Kan Kouassi et al. 2008; Veyrunes et al. 2010; Mboumba et al. 2011; and others). Their phylogeny illuminated the diversity of taxa within this subgenus (including at least one unnamed species from Chad), and clearly indicated that further phylogenetic investigations are necessary to clarify species diversity within *Nannomys*. Their comprehensive review surmised that there are at least 18 species of African pygmy mice and estimated that eight species occur within southern Africa (Britton-Davidian et al. 2012). In addition, their study highlighted important gaps in both geographic and taxonomic sampling for this subgenus, particularly within southern Africa. Included in this underrepresented southern African group is *Mus minutoides*, one of the most widespread pygmy mice, with a distribution encompassing most of Sub-Saharan Africa.

Within the southern African country of Botswana, the taxonomy of *Mus* has never fully been resolved. Early assessments of the regional mammalian fauna (Smithers 1971) concluded that two native forms of *Mus* exist within Botswana: the widespread *Mus minutoides indutus* (Thomas, 1910)—which was later elevated to specific status (Petter and Matthey 1975; Musser and Carleton 1993, 2005)—and an arid-adapted form with large ears and a white band of fur near the rump (referred to as *Leggada* sp. in Smithers 1971) restricted to northwestern Botswana and a single record from Sekhuma Pan in the Jwaneng District of southern Botswana (Petter 1978). This latter species was later described as *M. setzeri* Petter, 1978. De Graaff's (1981) assessment of *Nannomys* in southern Africa concluded that all records for Botswana conform to *M. minutoides*, although he acknowledged that *M. m. indutus* and the desert form (*M. setzeri*) may be distinct species that require further study. More recent evaluations describe allopatric distributions for *M. indutus* and *M. minutoides* and only acknowledge the former within the boundaries of Botswana (Skinner and Chimimba 2005, Happold and Veyrunes 2013). These recent assessments estimated the geographic range for *M. minutoides* as extending from the southwest cape in South Africa through the Zambezian woodlands in the east (Fig. 1a, dark grey). Monadjem (2013a) stated that *M. indutus* replaces *M. minutoides* in the western part of the Zambezian woodlands and extends throughout Botswana and into neighboring countries (Fig. 1a, light grey). Although Britton-Davidian et al. (2012) proposed that the range of *M. minutoides* greatly differs from the map published by Monadjem (2008b), and including the countries of Angola, Botswana, Namibia, Zambia, and Zimbabwe, verified records from their study were only presented for South Africa, Swaziland, and Zimbabwe. However, records

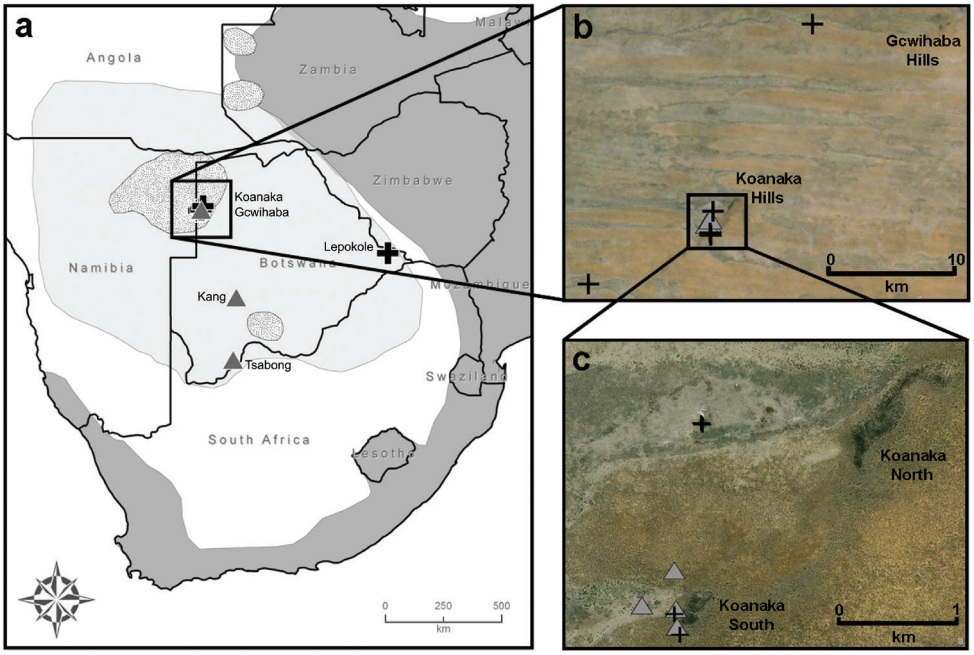

Figure 1. Distributions for three species of *Nannomys* in southern Africa. Dark grey indicates distribution for *Mus minutoides*, light grey for *M. indutus*, and stippled pattern for *M. setzeri*, adapted from Monadjem (2008a), Monadjem (2008b), and Monadjem and Coetzee (2008), respectively. Five trapping localities in Botswana (**a**); black crosses indicate captures for *M. minutoides* and grey triangles for *M. indutus*. Records from northwestern Botswana, Ngamiland District (**b**). Locality of syntopic records for *M. indutus* and *M. minutoides* at Koanaka Hills site (**c**).

of *M. minutoides* have recently been confirmed for Angola and Namibia (Lamb et al. 2014), providing additional support for the extended range map proposed by Britton-Davidian et al. (2012)

Regarding chromosomal rearrangement in southern Africa, *M. minutoides* from South Africa exhibit Robertsonian fusions with two major monophyletic groups showing either a diploid number of 2n=18 – where all of the acrocentric chromosomes are fused to produce metacentric elements, or a 2n=34 – where sex-chromosome translocations have been reported (Veyrunes et al. 2010). Additionally, WARTs have been documented in several populations exhibiting the 2n=18 karyotype in South Africa, which has contributed significantly to reported chromosomal variation, with at least four different cytotypes within this clade (Veyrunes et al. 2007). Currently, the geographic distributions of the 2n=18 and 2n=34 forms of *M. minutoides* are not known outside of the country of South Africa (Veyrunes et al. 2010).

Our objective was to utilize material from recent collecting efforts and molecular techniques to accurately delimit which species of *Nannomys* occur within Botswana. Further, we describe karyotypes for individuals from this region and make comparisons with previously published data from South Africa.

Materials and methods

Our mitochondrial phylogeny was generated from combining previously published sequences deposited on GenBank (Appendix) with those derived from sequencing new specimens collected during field trips to Botswana conducted in 2008, 2009, and 2011 (Table 1, Appendix). We collected 16 specimens of *Mus* from five localities in Botswana including: Gcwihaba Caves (20°00.99'S; 21°15.89'E); Kang (23°32.10'S; 22°32.76'E); Koanaka Hills (20°09.60'S; 21°11.61'E); Lepokole Hills (21°49.59'S; 28°23.94'E); and Tsabong (25°56.57'S; 22°25.44'E) (Fig. 1a–c). Specimens were collected using Sherman live traps, pitfall traps, or Museum Special snap traps. Standard external measurements were recorded in the field (Table 1). Specimens were preserved as skins with complete skeletons (SSPS), skulls only, or as whole bodies in alcohol (alc.) and deposited at the at the Natural Science Research Laboratory (NSRL) at the Museum of Texas Tech University, Lubbock, Texas, USA or the Botswana National Museum, Gaborone, Botswana. Tissue samples were preserved in 95% ethanol, lysis buffer, or flash frozen in liquid nitrogen for future genomic analyses (2011 material) and deposited in the NSRL. Field collecting methods followed taxon specific guidelines for wild mammals (Sikes et al. 2012) as outlined by the Animal Care and Use Committee of the American Society of Mammalogists (Gannon et al. 2007; Sikes et al. 2011).

Genomic DNA was extracted using a DNeasy Blood and Tissue Kit (Qiagen Inc., Chatsworth, California). The complete cytochrome *b* gene (*cytb*, 1140 nucleotides) was amplified following methods outlined in Veyrunes et al. (2010). Cycle sequencing reactions were performed with BigDye terminator version 3.1 and were electrophoresed on an ABI 3100-*Avant* (Applied Biosystems, Foster City, California). Sequences were edited and aligned using SEQUENCHER version 4.9 (Gene Codes Corporation, Ann Arbor, Michigan). Novel sequences (GenBank accession nos. KF184308-KF184323) were aligned with previously published sequences deposited on GenBank using only individuals that exhibited unique haplotypes (Appendix). The final alignment was trimmed to exclude regions with large amounts of missing data due to the large number of GenBank sequences in the alignment that were partial *cytb* sequences. Therefore, a total of 741 base pairs of the *cytb* gene (the first 7 codons and last 126 codons were removed from the analysis) were used in the final alignment for the phylogenetic analysis including 125 individuals.

Appropriate models of evolution were examined using MEGA version 5 (Tamura et al. 2011). Phylogenetic relationships were estimated using Bayesian inference with the program MRBAYES version 3.2 (Huelsenbeck and Ronquist 2001). Four independent Markov chains were run for 50 million generations and trees were logged every 1000th iteration. Log-likelihood values were examined in the program TRACER version 1.5 (Rambaut and Drummond 2007) and the first 5,000 trees were discarded as burn-in. An additional phylogeny was estimated using the Maximum-likelihood method with the program PhyML version 3.0 (Guindon et al. 2010) with a BIONJ starting tree (Gascuel 1997) and 1,000 bootstrap replicates. Kimura 2-parameter genetic distances were calculated using MEGA version 5 (Tamura et al. 2011).

Table 1. Locality information for 16 specimens of *Mus* (*Nannomys*) collected in Botswana during June 2008, July 2009, and August 2011. Verbatim coordinates were recorded in the field using a handheld Garmin GPS Rino 120 unit using the datum WGS84. Elevations given in meters.

Tissue No.	Genbank No.	Species	District	Specific Locality	Verbatim Coordinates	Verbatim Coordinate System	Verbatim SRS	Verbatim Elevation	Latitude	Longitude	Elev.	Coordinate Uncertainty
TK170604	KF184321	*M. indutus*	Kgalagadi	Berry Bush Farm, 8 km N, 2 km E Tsabong (Tshabong)	-25.94283, 22.42405	Decimal degrees	WGS84	971	25°56.57'S	22°25.44'E	970	31.5 m
TK172845	KF184320	*M. indutus*	Kgalagadi	Berry Bush Farms, 8 km N, 2 km E Tsabong (Tshabong)	-25.94283, 22.42405	Decimal degrees	WGS84	971	25°56.57'S	22°25.44'E	970	31.5 m
TK172826	KF184322	*M. indutus*	Kgalagadi	Kalahari Rest, 16 km N, 25 km W Kang	-23.53498, 22.54607	Decimal degrees	WGS84	1158	23°32.10'S	22°32.76'E	1160	31.5 m
TK172785	KF184310	*M. minutoides*	Central	Lepokole Hills, 3.6 km S, 4.9 km E Lepokole Village	-21.82653, 28.39898	Decimal degrees	WGS84	784	21°49.59'S	28°23.94'E	780	31.5 m
TK164851	KF184309	*M. minutoides*	Ngamiland	Koanaka Hills (Ncqumtsa Hills), 150 km W Tsao (Tsau), water hole	34K 0511309 7767149	UTM	WGS84	1019	20°11.58'S	21°06.49'E	1020	31.5 m
TK154612	KF184311	*M. minutoides*	Ngamiland	Koanaka Hills (Ncqumtsa Hills), 150 km W Tsao (Tsau), main camp	34K 0520241 7770802	UTM	WGS84	1024	20°09.60'S	21°11.62'E	1020	31.5 m
TK164817	KF184316	*M. indutus*	Ngamiland	"	34K 0520219 7770803	UTM	WGS84	1021	20°09.60'S	21°11.61'E	1020	31.5 m
TK164820	KF184318	*M. indutus*	Ngamiland	"	34K 0520219 7770803	UTM	WGS84	1021	20°09.60'S	21°11.61'E	1020	31.5 m
TK164753	KF184319	*M. indutus*	Ngamiland	"	34K 0520210 7770958	UTM	WGS84	1020	20°09.51'S	21°11.60'E	1020	31.5 m
TK164752	KF184312	*M. minutoides*	Ngamiland	"	34K 0520198 7770976	UTM	WGS84	1020	20°09.51'S	21°11.60'E	1020	31.5 m
TK164751	KF184315	*M. indutus*	Ngamiland	"	34K 0519948 7770988	UTM	WGS84	1022	20°09.50'S	21°11.45'E	1020	31.5 m
TK164757	KF184323	*M. indutus*	Ngamiland	"	34K 0519948 7770988	UTM	WGS84	1022	20°09.50'S	21°11.45'E	1020	31.5 m
TK164939	KF184317	*M. indutus*	Ngamiland	"	34K 0520201 7771287	UTM	WGS84	1027	20°09.34'S	21°11.60'E	1030	31.5 m
TK164768	KF184313	*M. minutoides*	Ngamiland	"	34K 0520416 7772600	UTM	WGS84	1026	20°08.62'S	21°11.72'E	1030	31.5 m
TK164769	KF184308	*M. minutoides*	Ngamiland	"	34K 0520408 7772612	UTM	WGS84	1020	20°08.62'S	21°11.72'E	1020	31.5 m
TK164967	KF184314	*M. minutoides*	Ngamiland	Gcwihaba Caves, 18.8 km N, 114.2 km W Tsao (Tsau)	34K 0527701 7786660	UTM	WGS84	986	20°00.99'S	21°15.89'E	990	31.5 m

Specimens were karyotyped in the field using bone marrow after 1 h of *in vivo* incubation with Velban (Sigma-Aldrich, St. Louis, Missouri), following the methods described in Baker et al. (2003). *Mus indutus* males were not karyotyped in this study because both males captured died in snap traps. Fluorescent *in situ* hybridization (FISH) experiments were performed using Star*FISH © biotin-labeled mouse chromosome X paints (Cambio), following the manufacturer's instructions and using Cy3-conjugated streptavidin (Invitrogen) for signal detection.

In order to assess the nature of the X-autosome translocation of the specimens that exhibited the translocation, we compared the X-chromosome of our specimens with those from South Africa using images of inverted DAPI-banding, and G-banding (Seabright 1971). Images were captured using the GENUS SYSTEM version 3.7 (Applied Imaging Systems, San Jose, California) through an Olympus BX51 epi-fluorescence microscope. Cy3 and DAPI (4',6-diamidino-2-phenylindole) signals were pseudocolored yellow and red, respectively.

Results

The model with the lowest AICc (Akaike Information Criterion, corrected) and BIC (Bayesian Information Criterion) scores was the General Time Reversible (GTR) model using a discrete gamma distribution (+G) and a fraction of invariable sites (+I). Overall, the two methods of phylogenetic analysis resulted in similar tree topologies, except that the Maximum-likelihood analysis recovered weak support for the south + east *M. minutoides* clade (Fig. 2). Additionally, the relationship between *M. indutus, M.* sp., *M. mattheyi*, *M. haussa*, and the portion of the phylogeny that includes *M. minutoides* and *M. musculoides* was unresolved in the Maximum-likelihood analysis, though it was well-supported using Bayesian inference.

Sixteen *cytb* sequences were generated from specimens from Botswana, corresponding to two species. Seven individuals are phylogenetically related to *M. minutoides* from South Africa and nine individuals cluster with *M. indutus*. Five individuals, captured from the same locality in the Koanaka Hills region of northwestern Botswana, represent two clades within *M. minutoides* that are 5% different in *cytb* sequence variation (Fig. 2). Six of the individuals of *M. indutus* were collected in the Koanaka Hills alongside both of these lineages of *M. minutoides* (Fig. 1c).

Karyotypes for individuals in the *M. minutoides* clade exhibited a diploid number of 34 and fundamental number (as defined by Veyrunes et al. 2004 as the total number of chromosomal arms per diploid genome, instead of number of autosomal arms) of FN=36 (Fig. 3a–d, Table 2). All autosomes were acrocentric in morphology, including the pair 13, which presented a small short arm in some metaphase spreads. The metacentric X chromosome is the largest element of the chromosome complement, followed by the subtelocentric Y chromosome, which is comparable in size with the first autosomal pair. Individuals in the *M. indutus* clade exhibited diploid and fundamental numbers of 36 (Fig. 3e–f, Table 2). All chromosomes had an acrocentric morphology. Due to

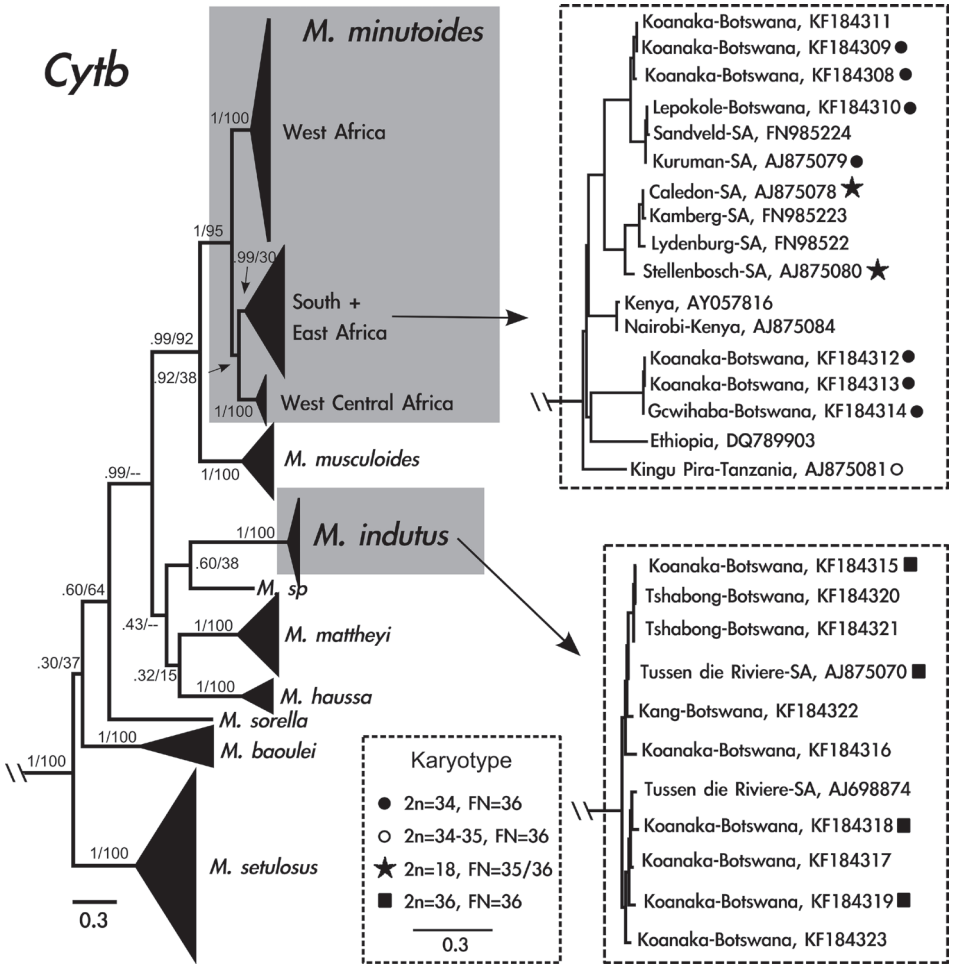

Figure 2. Cytochrome *b* gene tree generated from 741 base pairs including 125 taxa using Bayesian inference. Grey boxes indicate species of interest: *Mus minutoides* and *Mus indutus*. Clades that include *Mus* from Botswana are enlarged to the right of the phylogeny. Diploid and fundamental numbers are shown for individuals sampled in this study and Veyrunes et al. (2005). Identification includes GenBank number and general locality. Support values at nodes are Bayesian posterior probabilities followed by Maximum-likelihood bootstrap support; dashes indicate regions of the tree where Maximum-likelihood analysis resulted in a polytomy.

the lack of male karyotyped specimens, the Y chromosome morphology could not be determined. The FISH with *Mus* X whole chromosome probe allowed the detection of an X-autosome translocation on the karyotypes of *M. minutoides* specimens (Fig. 3b, d), but not for individuals of *M. indutus* (Fig. 3e). Banding results indicate that individuals of *M. minutoides* from Botswana share the same sex-chromosome translocations (X.1) and (Y.1) as *M. minutoides* from South Africa, although differential condensation of the South African chromosomes makes direct comparison difficult (Fig. 3a and b).

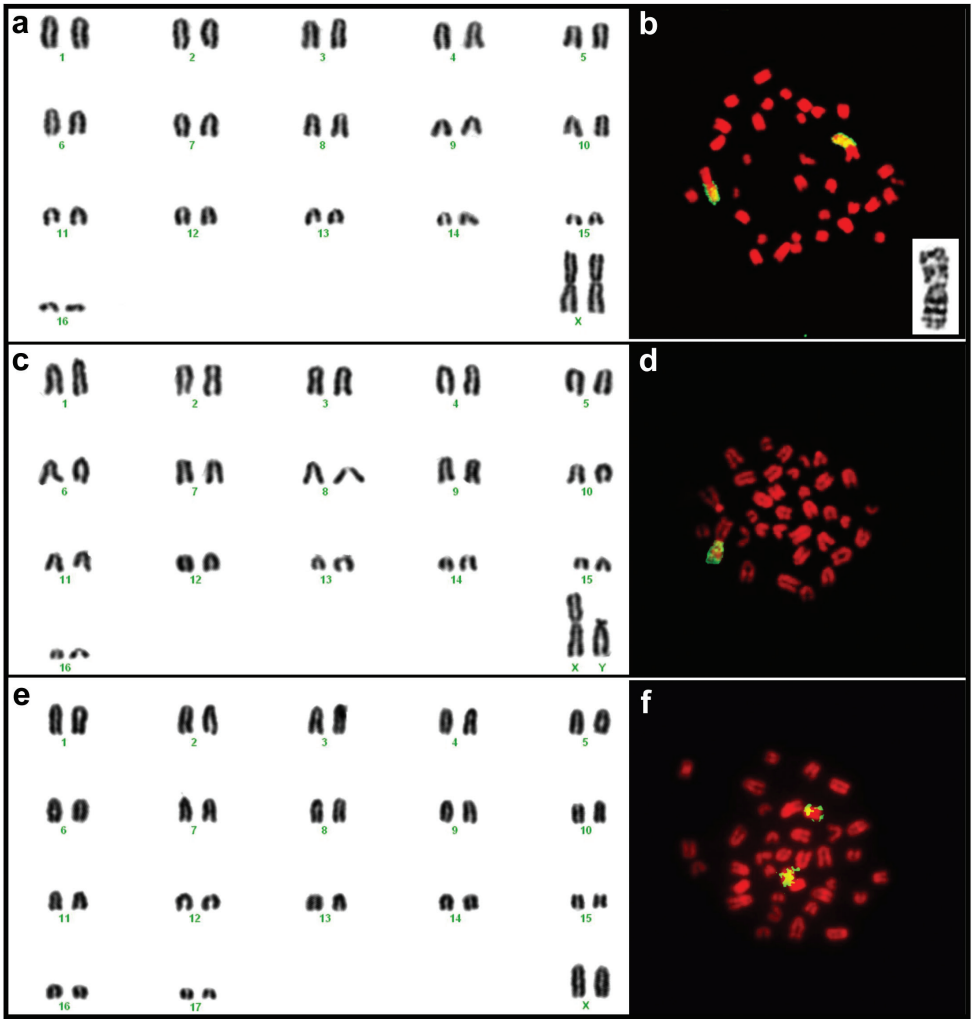

Figure 3. Karyotypes of female TK164752 (**a**) and male TK164768 (**c**) *Mus minutoides* and female TK164753 *M. indutus* (**e**) from Botswana. The chromosome arms identified in yellow on the images to the right of each karyogram correspond to regions of homology to the X chromosome of *M. musculus* detected by FISH for female TK164752 (**b**) and male TK164768 (**d**) *M. minutoides* and female TK164820 *M. indutus* (**f**). Note that in *M. minutoides*, a single chromosome arm shows homology to the X chromosome of the house mouse, indicating the presence of an X-autosome translocation, whereas a whole acrocentric chromosome corresponds to the X of *M. indutus*. The insert on (**b**) represents the (1.X) translocation of individual TK164752 *M. minutoides*, with the long arm corresponding to the X chromosome.

Discussion

Efforts to resolve the geographic distributions of African pygmy mice remain in a state of flux. Regional studies involving DNA sequence data and karyotypes, such as presented here, contribute to a broader understanding of this complex genus. Historical

(see Schmidt et al. 2008) and recent (Ferguson et al. 2010) bioinventories have resulted in extensive collections of *Mus* from Botswana, but there has been little consensus as to whether both *M. minutoides* and *M. indutus* occur in the country.

Mitochondrial sequence and cytogenetic data confirm the presence of both *M. minutoides* and *M. indutus* in Botswana. These specimens represent the first DNA sequences for these two species in Botswana, which we also made available for use in a recent paper by Lamb et al. (2014). Despite previous suggestions that *M. minutoides* and *M. indutus* occur in allopatry, our results confirm that these two species occur in sympatry and even syntopy in northwestern Botswana. Interestingly, we also found two lineages of *M. minutoides* in northwestern Botswana (Koanaka Hills) that were 5% different in *cytb* sequence variation. We hypothesize that these two mitochondrial lineages were separated in the past and have now come back together in a region of secondary contact in the arid savannah region near the Kalahari Desert, a hypothesis that should be tested with broader sampling and using additional genetic markers.

Also of interest is the fact that no *M. setzeri* were collected from either the Koanaka Hills or Gcwihaba Caves although their current range – as delimited by Monadjem and Coetzee (2008) and Skinner and Chimimba (2005) – includes this region of Botswana. We compared our specimens with *M. setzeri* deposited at the National Museum of Natural History, Smithsonian Institution, Washington D.C., USA and found no evidence that any of our individuals correspond to this conspicuous form. Our failure to capture *M. setzeri*, in spite of concerted trapping efforts in this region (> 2600 Sherman trap nights, > 280 pitfall trap nights during June 2008 and July 2009 seasons), is in agreement with Monadjem (2013b) who pointed to the scarcity of this species in collections as evidence for true ecological rarity. Further sampling is clearly warranted to more accurately delimit the exact geographic boundaries of *Nannomys* species both within Botswana and throughout the broader Southern African Subregion (Skinner and Chimimba 2005).

Mus minutoides in Botswana exhibit the 2n=34 karyotype with the diagnostic (X.1) and (Y.1) sex-autosome translocations that have also been documented in specimens from South Africa (Veyrunes et al. 2010), Zambia, Kenya (Castiglia et al. 2002, 2006), Central African Republic, and Ivory Coast (Jotterand-Bellomo 1984, 1986). Veyrunes et al. (2004) propose that 2n=34 with the 1 sex chromosome translocation is the ancestral karyotype for *M. minutoides* and our results provide further support for an early (X.1) translocation before the radiation of *M. minutoides* over a large geographic area. Furthermore, the 2n=34 cytotype is reported in several locations in northern South Africa, but not in southern South Africa or in other countries to the north, including Botswana. The fact that our sampling localities included individuals from the easternmost and northwestern regions of Botswana might be an indicator that this is the predominant cytotype in the country, likely extending into the bordering countries of Zambia, Zimbabwe, and Namibia.

We found that three of our gender identifications made in the field (Table 2, "Gender Field") did not match the identifications made from karyotype assessments (Table 2, "Gender Lab") indicating the potential for X*Y females. Therefore, we attempted to

Table 2. Individuals of *Mus* (*Nannomys*) collected in Botswana including GenBank number, final species identification, gender determined in the field, museum preparation type (Alcoholic=alc; skin, skull, postcranial skeleton=SSPS; or Skull only), collection date, total length (TL), tail length (T), hind foot (HF), ear (E), weight in grams, karyotype, and sex-chromosome.

Genbank No.	Species	Gender "Field"	Prep. Type	Coll. Date	TL	T	HF	E	Weight (g)	Karyotype	Gender "Lab"
KF184315	*M. indutus*	Female	SSPS	16-Jul-09	95	42	13	13	4,5	2n=36, FN=36	XX
KF184316	*M. indutus*	Female	SSPS	22-Jul-09	85	40	10	10	2,9	none	-
KF184317	*M. indutus*	Female	SSPS	27-Jul-09	101	43	14	11	5,1	none	-
KF184318	*M. indutus*	Female	SSPS	22-Jul-09	14	45	12	10	6,3	2n=36, FN=36	XX
KF184319	*M. indutus*	Female	SSPS	15-Jul-09	110	45	13	11	6,75	2n=36, FN=36	XX
KF184320	*M. indutus*	Male	SSPS	18-Aug-11	98	45	15	10	4	none	-
KF184321	*M. indutus*	Female	Alc	25-Aug-11	75	[23]	14	10	3	none	-
KF184322	*M. indutus*	Female	Skull Only	17-Aug-11	109	40	15	11	5	none	-
KF184323	*M. indutus*	Male	SSPS	20-Jul-09	86	42	14	12	4	none	-
KF184308	*M. minutoides*	Female	SSPS	20-Jul-09	107	43	14	12	5,5	2n=34, FN=36	XX
KF184309	*M. minutoides*	Male	SSPS	24-Jul-09	[80]	[23]	13	11	4,6	2n=34, FN=36	XY
KF184310	*M. minutoides*	Female	SSPS	16-Aug-11	93	45	13	10	3,5	2n=34, FN=36	XY
KF184311	*M. minutoides*	Male	SSPS	26-Jun-08	102	47	14	12	5,8	none	-
KF184312	*M. minutoides*	Female	SSPS	15-Jul-09	111	52	15	11	5,5	2n=34, FN=36	XX
KF184313	*M. minutoides*	Female	SSPS	20-Jul-09	99	44	12	9	4	2n=34, FN=36	XY
KF184314	*M. minutoides*	Female	SSPS	26-Jul-09	96	47	14	10	3,7	2n=34, FN=36	XY

examine these specimens for the possibility of sex reversal in *M. minutoides*, which has been documented in other countries (Veyrunes et al. 2013). Although we have tried to identify the X* chromosome in our samples through X chromosome morphology assessment as well as DAPI banding patterns, the particular high degree of condensation of the chromosomes in our *in vivo* bone marrow preparations did not allow us to ascertain the nature of the X chromosomes of two of these three specimens. For one of the individuals, both the morphology and banding patterns of the X chromosome do not seem to correspond to those of the derivative X* chromosome (Fig. 3a), indicating that field misidentification of sex might have been the case for that specimen (the reproductive organs can no longer be clearly seen on the prepared skin of this specimen). Additionally, there were no evident X chromosome polymorphisms in the XX female specimens, which would be expected in populations where X*Y females were present. Due to our small sample, and the relative low frequency of the X* found in populations outside South Africa, we were not able to rule out the presence of the X polymorphism in Botswana. Further collecting efforts, together with an in depth sex determination study, including high quality chromosome preparations suitable for G-banding studies, will be needed to shed further light on this issue.

Our data presented here agree with previous molecular phylogenies of *Nannomys*, with well-defined clades representing *M. minutoides* and *M. indutus* exhibiting diploid and fundamental numbers consistent with those reported in the literature. Veyrunes et al. (2010) detected a wide range of chromosomal variation for *M. minutoides* in South Africa, with one particular clade presenting 2n=34, FN=36. Our *M. minutoides* samples display chromosome conservation as well as sequence similarity to the South African clade bearing karyotypic stasis, indicating that these specimens might be part of a widespread group chromosomally and genetically isolated from the karyotypically diverse 2n=18 *M. minutoides* clade. *Mus indutus* on the other hand exhibits a karyotype not very divergent from the proposed ancestral karyotype for *Nannomys* (2n=36 with all acrocentric chromosomes;Veyrunes et al. 2004), similar to many of the basal lineages included in recent molecular phylogenies (see Britton-Davidian et al. 2012).

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Appendix

Individuals included in the molecular phylogeny representing eleven species with the country of origin, GenBank number and the original citation for the original description. RCA = Central African Republic.

***Mus* (*Nannomys*)**	**Country**	**Genbank No.**	**Reference**
baoulei	Benin	EU603991-92	Kan Kouassi et al. 2008
	Guinea	EU603995	Kan Kouassi et al. 2008
	Ivory Coast	EU603993-94, 98	Kan Kouassi et al. 2008
bufo	Burundi	DQ789905	Mboumba et al. 2011
haussa	Chad	AJ875071	Veyrunes et al. 2005
	Mali	AJ698877	Chevret et al. 2005
	Niger	AJ875072-73	Veyrunes et al. 2005
	Senegal	AJ875074	Veyrunes et al. 2005
indutus	Botswana	KF184315-23	This paper
	South Africa	AJ698874	Chevret et al. 2005
	South Africa	AJ875070	Veyrunes et al. 2005
mattheyi	Burkina Faso	AJ877114	Veyrunes et al. 2005
	Guinea	EU603970-73	Kan Kouassi et al. 2008
	Mali	AJ698876	Chevret et al. 2005
	Mali	AJ875066-67	Veyrunes et al. 2005
	Senegal	AB125781	Suzuki et al. 2004
	Senegal	AJ875068	Veyrunes et al. 2005
	Togo	AJ875069	Veyrunes et al. 2005
minutoides	Botswana	KF184308-14	This paper
	Congo	DQ789929	Mboumba et al. 2011
	Gabon	DQ789911, 20, 26	Mboumba et al. 2011
	Guinea	AJ875076-77	Veyrunes et al. 2005
	Guinea	EU603936-37, 60-61, 64-65	Kan Kouassi et al. 2008
	Ivory Coast	EU603925-28, 30-33,35, 45, 47,49, 54-56, 58, 999, 001-02, 005	Kan Kouassi et al. 2008
	Kenya	AJ875084	Veyrunes et al. 2005
	Kenya	AY057816	Lundrigan et al. 2002
	RCA	DQ789938-39	Mboumba et al. 2011
	South Africa	AJ875078-80	Veyrunes et al. 2005
	South Africa	FN985222-24	Veyrunes et al. 2010
	Tanzania	AJ875081	Veyrunes et al. 2005
musculoides	Cameroon	HM635855-56	Dobigny et al. 2011
	Guinea	EU603968-69	Kan Kouassi et al. 2008
	Guinea	DQ789902	Mboumba et al. 2011
	Ivory Coast	EU603967	Kan Kouassi et al. 2008
	Ivory Coast	DQ789901	Mboumba et al. 2011
	Mali	Z96069	Barome et al. 1998
	Mali	AJ698875	Chevret et al. 2005
	Mali	AJ875075	Veyrunes et al. 2005
	Mali	JX292892-93	Schwan et al 2012

***Mus* (*Nannomys*)**	**Country**	**Genbank No.**	**Reference**
	Cameroon	EU603989	Kan Kouassi et al. 2008
	Cameroon	DQ789900	Mboumba et al. 2011
	Gabon	AJ698873	Chevret et al. 2005
	Guinea	AJ875083	Veyrunes et al. 2005
setulosus	Guinea	EU603976, 78, 82-83, 86	Kan Kouassi et al. 2008
	Ivory Coast	EU603974-75, 77, 79-81, 84-85, 88, 97	Kan Kouassi et al. 2008
	Ivory Coast	GU830865, 67, 69	Coulibaly-N'golo et al. 2011
	RCA	AJ875082	Veyrunes et al. 2005
	RCA	EU603990	Kan Kouassi et al. 2008
sorella	RCA	DQ789904	Mboumba et al. 2011
M. sp.	Chad	AJ875085	Veyrunes et al. 2005
tenellus	Ethiopia	DQ789903	Mboumba et al. 2011

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RESEARCH ARTICLE

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A taxonomic revision of the *silphaeformis* species-group of the genus *Tachinus* Gravenhorst (Staphylinidae, Tachyporinae) from China

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§ *http://zoobank.org/BBACC7AE-9B70-4536-ABBE-54183D2ABD45*

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Abstract

The Chinese species of the *silphaeformis* group of the genus *Tachinus* Gravenhorst are revised with fifteen species being treated. Thirteen of them are described as new: *T. armatus* Feng & Li, **sp. n.** (Sichuan), *T. cavazzutii* Feng, Li & Schülke, **sp. n.** (Sichuan), *T. coronatus* Feng, Li & Schülke, **sp. n.** (Ningxia, Qinghai), *T. hercules* Feng, Li & Schülke, **sp. n.** (Sichuan), *T. hujiayaoi* Feng, Li & Schülke, **sp. n.** (Shaanxi), *T. jiuzhaigouensis* Feng, Li & Schülke, **sp. n.** (Sichuan), *T. linzhiensis* Feng & Li, **sp. n.** (Tibet), *T. maderianus* Feng & Li, **sp. n.** (Sichuan), *T. mengdaensis* Feng, Li & Schülke, **sp. n.** (Qinghai), *T. oblongoelytratus* Feng & Li, **sp. n.** (Sichuan), *T. parahercules* Feng, Li & Schülke, **sp. n.** (Sichuan), *T. paralinzhiensis* Feng & Li, **sp. n.** (Tibet), and *T. yini* Feng, Li & Schülke, **sp. n.** (Sichuan). The two known species are redescribed based on the holotypes and additional material. Illustrations of the habitus and major diagnostic characters, distributional maps, and identification keys of all species are included.

Keywords

Tachinus, *silphaeformis* species group, revision, key, China, distributional maps

Introduction

The genus *Tachinus* Gravenhorst, 1802 currently contains more than 250 valid species, most of them distributed in the Holarctic and Oriental regions, with a few reaching the Neotropics in Central America (Herman 2001). Members of *Tachinus* from China are assigned to three subgenera, viz., *Tachinus* Gravenhorst, 1802, *Tachinoderus* Motschulsky, 1858, and *Latotachinus* Ullrich, 1975.

The *silphaeformis* group is one of the 30 species groups of the subgenus *Tachinus* and includes seven described species (Ullrich 1975; Schülke 1997): *T. silphaeformis* Normand, 1928 from Tunisia, *T. mercatii* Jarrige, 1966 from Italy, *T. starcki* Eppelsheim, 1889 from Russia (West Caucasus), *T. alienus* Ullrich, 1975 from northern India, *T. lacinipennis* (Scheerpeltz, 1976) from Nepal, and *T. lohsei* Ullrich, 1975 and *T. maderi* Bernhauer, 1939 from southwestern China.

In this paper, we aim to revise the Chinese species of the *silphaeformis* group. This includes redescriptions of the two known species and descriptions of thirteen new species. Illustrations of the habitus and major diagnostic features, identification keys, and distributional maps of all species are provided.

Material and methods

More than 1,050 specimens of the *silphaeformis* group were examined. Material from the following collections was used for study:

FMNH	Field Museum of Natural History, Chicago
SNUC	Insect Collection of Shanghai Normal University, Shanghai
MHNG	Museum d'Histoire Naturelle de Genève
NMP	National Museum Praha
NHMB	Natural History Museum Basel
cAss	Private Collection of Volker Assing, Hannover
cFel	Private Collection of Benedikt Feldmann, Münster
cSme	Private Collection of Aleš Smetana, Ottawa
cSch	Private Collection of Michael Schülke, Berlin
cPüt	Private Collection of Andreas Pütz, Eisenhüttenstadt

The dissection procedure was the following: dried specimens were immersed in cold water for 0.5 to 1 hour. After relaxing, the membrane between abdominal segments VI and VII was cut. The dissected parts were mounted in Euparal (Chroma Gesellschaft Schmidt, Koengen, Germany) on a plastic slide.

Habitus photos were taken using a Cannon EOS 40D camera mounted with an MP-E 65 mm Macro Photo Lens. Photos of dissected parts were taken using a Cannon G9 camera mounted on an Olympus CX21 microscope. Drawings and distribution maps were made in Adobe Illustrator CS5.

All measurements are in milimeters. Measurements were made based on the holotype and a random sample of specimens available for each species (holotype in brackets). Relative lengths of the antennomeres are given from single specimens.

The following abbreviations are used in the text:

BL: body length, from the anterior margin of the head to the posterior margin of the abdominal tergite VIII; **FL**: forebody length, from the anterior margin of the head to the posterior margin of the elytra; **PL**: length of the pronotum along the midline; **EL**: length of the elytra along the suture; **SEL**: longitudinal distance from the posterior sutural angle to level of the elytral apex; **HW**: width of the head across the eyes; **PW**: maximum width of the pronotum; **EW**: maximum width of the elytra.

The holotypes of the new species are deposited in **SNUC**.

Taxonomy

silphaeformis species-group

silphaeformis species-group Ullrich, 1975: 273.

Description. Body brown to black, elytra and/or pronotal lateral margins yellowish to pale brownish, surface shiny, elytra sometimes dull; mouthparts and legs reddish brown or yellowish brown, basal four antennomeres sometimes yellowish or pale brownish.

Moderate in size; BL in male: 3.56–4.95; FL in male: 2.61–3.78. Female larger than male, or of similar size, BL: 3.57–5.12; FL: 2.82–4.11.

Body narrowly to broadly elongate-oval, with sides of abdomen evenly narrowing from base to apex. Surfaces of head, pronotum, elytra and abdomen with dense microsculpture and punctation.

Head nearly sub-triangular, shorter than wide. Eyes moderately large. Ocular setae distinct. Maxillary palpi long, robust, palpomere I short, II longer, III shorter than II, palpomere IV conical, more than twice as long as III. Labial palpi short, three-segmented, with palpomere I long, II much shorter, III as long as I. Antennae with basal four antennomeres lacking fine recumbent pubescence, antennomeres V–XI usually with recumbent pubescence; XI longer than X, with apex narrowly rounded.

Pronotum transverse, PL : PW = 0.53–0.75 in male, 0.57–0.76 in female.

Elytra long, EL : PL = 1.49–1.73 in male, 1.50–1.93 in female. Wings fully developed.

Abdominal tergites III–VI each with one pair of pruinose spots near middle, posterior margin of tergite VII with distinct palisade fringe.

Body length, elytral length, elytral microsculpture and shape of posterior margin usually subject to sexual dimorphism.

Male. Elytra shorter, posterior margin without modifications, sutural angle simple; elytral microsculpture often weak. Protarsomeres I–IV strongly dilated; sternite VII (Figs 9–10) with apical margin emarginate, in most species bent ventrad at middle, with large area covered with coarse granules; tergite VIII (Figs 11–12) with sinu-

ate margin or three to four rounded lobes; posterior margin of male sternite VIII (Figs 13–14) with deep bell-shaped emargination; aedeagus (Figs 15–17) with median lobe moderately short and broad, parameres fused at base, of variable shape, often of reduced length, and of latero-apicad orientation.

Female. Elytra longer, posterior margin simply rounded, truncate, slightly to strongly produced at sutural angle; SEL distinctly longer than in male; elytral microsculpture more distinct. Protarsomeres I–IV not dilated; tergite VIII (Figs 18–19) with sinuate apical margin, or with two to three rounded lobes; female sternite VIII (Fig. 20) with six lobes, fimbriate median lobes sometimes fused.

Remarks. Members of this group can be readily separated from those of the other groups by the long and sexually dimorphic elytra, the presence of a pair of pruinose spots on tergites III–VI, the characterically impressed and apically bent male sternite VII, and the unique shape of aedeagus. Most species of this group are very similar in general appearance, except for *T. lohsei* and *T. jiuzhaigouensis*, which are distinguished by their small size and yellow lateral margins of the pronotum. Reliable identifications of the group members require careful examinations of the genital features including the form of the tergite and sternite VIII of both sexes, and the aedeagus.

Data on the natural history is largely unknown for most species. Many species of this group are restricted to higher elevations, mostly above 2,500 m. They were collected, often together with other *Tachinus* species from sifted litter, dung, and decaying mushrooms in mixed coniferous forests, above the forest margin from litter of *Rhododendron* and other subalpine shrubs, or from dung on alpine meadows.

Tachinus (*s. str.*) *armatus* Feng, Li & Schülke, sp. n.

http://zoobank.org/0883CBB7-AAE8-4D29-BB48-1B687F407B79
http://species-id.net/wiki/Tachinus_armatus
Figs 1A, 1B, 9A, 10A, 11A, 13A, 15A, 18A, 20A, 21A

Type locality. China, Sichuan, Nanping, Jiuzhaigou Natural Reserve.

Type material. Holotype: ♂, **CHINA**: Sichuan Prov., Aba A. R., Nanping County, Jiuzhaigou, 27.vii.2001, LI & ZHAO leg. (SNUC). **Paratypes**: 1 ♀, same label data as holotype (SNUC); 1 ♂, 1 ♀, **CHINA**: N-Sichuan Pass btw. Songpan & Nanping, E side, 3450–3500 m, 21.VI.2002, leg. S. Murzin & I. Shokhin (cSch).

Description. Measurements of holotype: BL 4.00; FL 3.06; PL 0.83; EL 1.45; SEL 0.11; HW 0.83; PW 1.33; EW 1.50; relative length of antennomeres I–XI: 23 : 14 : 15 : 10 : 15 : 15 : 15 : 12 : 12 : 12 : 26. Measurements of female paratype: BL 4.89; FL 3.61; FL 3.61; PL 0.89; EL 1.67; SEL 0.28; HW 0.89; PW 1.45; EW 1.72; relative length of antennomeres I–XI: 23 : 16 : 16 : 10 : 13 : 12 : 12 : 12 : 10 : 12 : 26.

Body (Figs 1A, 1B) dark brown; mouthparts and elytra reddish brown; basal four antennomeres and legs reddish yellow.

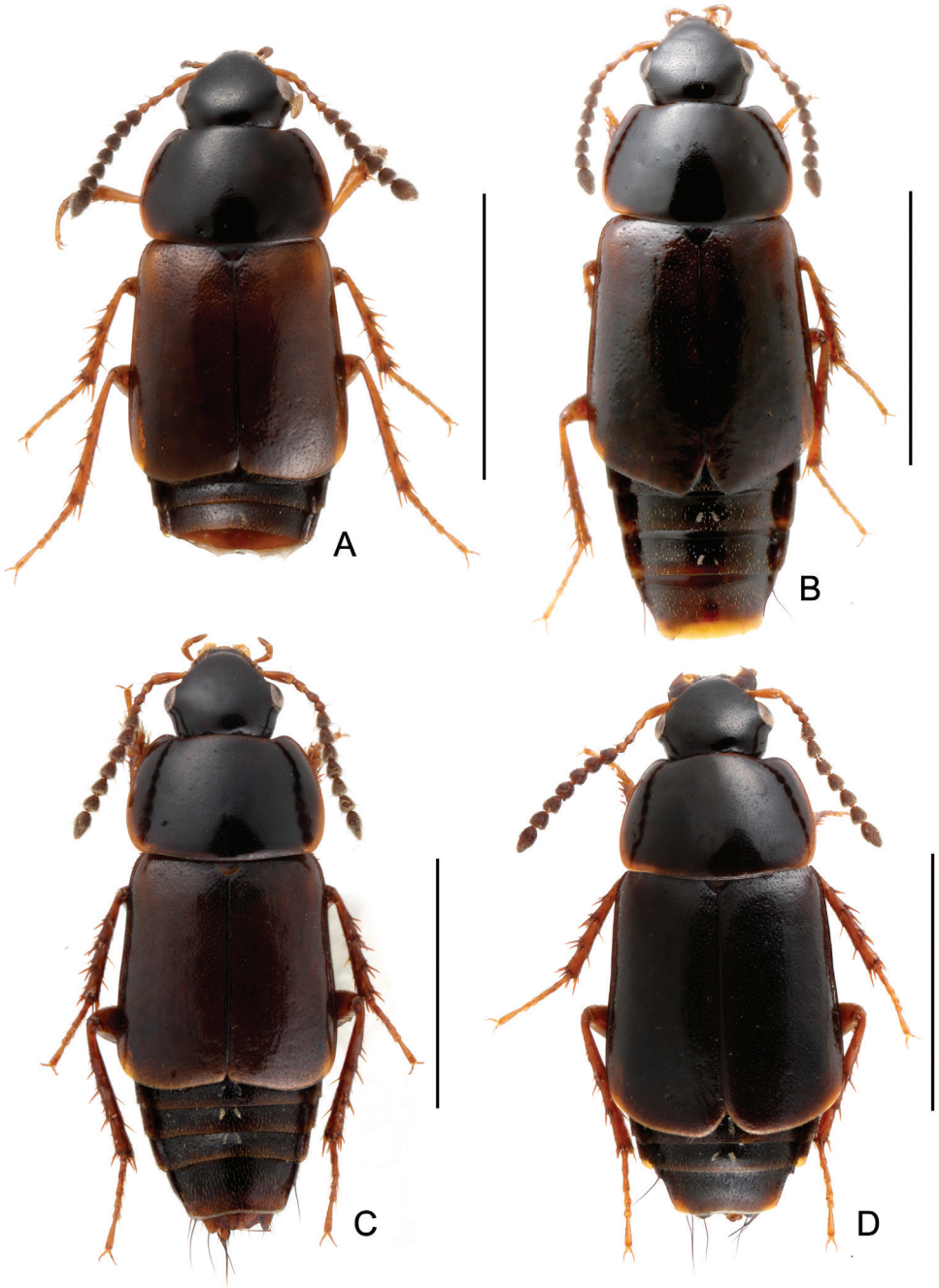

Figure 1. Habitus. **A** *Tachinus armatus*, male holotype **B** *T. armatus*, female **C** *T. cavazzutii*, male holotype **D** *T. cavazzutii*, female. Scales: 2 mm.

Head shorter than wide, HW : PW = 0.58–0.62, disc with microsculpture consisting of irregular striae, punctation fine and sparse. Antennae moderately short, antennomeres X slightly shorter than wide.

Pronotum distinctly wider than long (PL : PW = 0.61–0.62); apical margin transversely concave, base slightly convex; surface with microsculpture consisting of irregular transverse striae, punctation slightly finer than that of head.

Elytra slightly elongate; EL : EW = 0.96; EL : PL = 1.73; EW : PW = 1.13 in male; EL : EW = 0.97; EL : PL = 1.88; EW : PW = 1.19 in female. Surface with microsculpture composed of fine meshes, punctation coarser than that of head.

Surface of abdomen with microsculpture radiating from punctures.

Male. Posterior margin of sternite VII (Figs 9A, 10A) broadly and deeply emarginate, apical margin bent ventrad, with moderately broad area of coarse granules. Tergite VIII (Fig. 11A) with four short lobes, median lobes slightly longer than lateral ones. Sternite VIII (Fig. 13A) broad. Median lobe of aedeagus (Fig. 15A) broad and projecting beyond apex of parameres, parameres fused, forming one apically truncate plate.

Female. Body (Fig. 1B) slightly larger than that of male. Elytra only slightly longer than in male; inner part of posterior margin produced, forming a distinct angle. Microsculpture more distinct than in male. Lobes of tergite VIII (Fig. 18A) completely reduced, posterior margin sinuate, lateral angles each with pair of long setae. Sternite VIII (Fig. 20A) with fimbriate median lobes fused and as long as sublateral ones.

Etymology. The specific name (Latin adjective), meaning "armed", refers to the conspicuous secondary sexual features of the male.

Remarks. Males can be separated from those of the other species by the unique shape of the parameres and of the apex of the median lobe of the aedeagus. Females are distinguished by the shape of tergite VIII, and by the reduced median lobes of the female sternite VIII.

Tachinus (*s. str.*) *cavazzutii* Feng, Li & Schülke, sp. n.

http://zoobank.org/5974F575-1467-4FF9-A334-3FCE17C4A547
http://species-id.net/wiki/Tachinus_cavazzutii
Figs 1C, 1D, 9B, 10B, 11B, 13B, 15B, 18B, 20B, 21B

Type locality. China, Sichuan Province, Nanping, Jiuzhaigou.

Type material. Holotype: ♂, **CHINA**: Sichuan Prov., Aba A. R., Nanping County, Jiuzhaigou, 27.vii.2001, LI & ZHAO leg. (SNUC). **Paratypes**: 11 ♂♂, 11 ♀♀, same label data as holotype (SNUC); 3 ♂♂, 1 ♀, **CHINA**: Sichuan Prov., pass between Pingwu and Nanping, 3100 m, 22.viii.1999, Cavazzuti leg. (cSme, cSch); 2 ♀♀, **CHINA**: N–Sichuan [CH12–20] 60 km N Songpan, road S 301 km 103, N Gongangling pass, 33°10'06"N, 103°43'13"E, 3000 m, forest near creek, litter sifted, 9.viii.2012, leg. M. Schülke (cSch); ♂, **CHINA**: N–Sichuan [CH12–19] 47 km N Songpan, road S 301

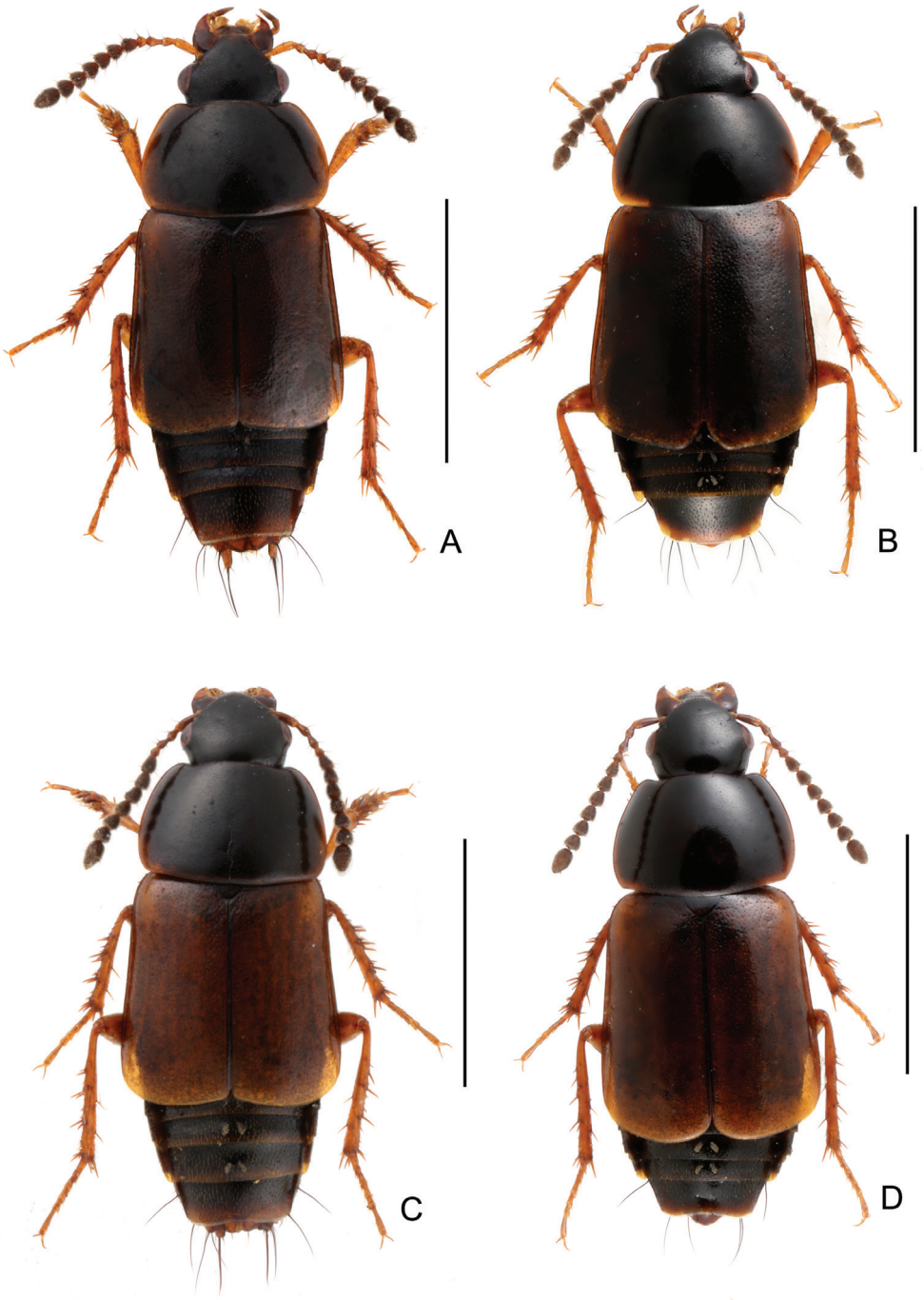

Figure 2. Habitus. **A** *Tachinus coronatus*, male holotype **B** *T. coronatus,* female **C** *T. hercules*, male holotype **D** *T. hercules*, female. Scales: 2 mm.

km 118, N Gongangling pass, 33°03'15"N, 103°43'36"E, 3390 m, spruce forest with shrubs, litter, moss, and mushrooms sifted, 9.viii.2012, leg. M. Schülke (cSch).

Description. Measurements of males (holotype): BL 4.05–4.73 (4.73); FL 3.11–3.78 (3.78); PL 0.89–1.06 (1.06); EL 1.39–1.67 (1.67); SEL 0.10–0.12 (0.12); HW 0.89–1.00 (1.00); PW 1.50–1.67 (1.67); EW 1.78–1.83 (1.83); relative length of antennomeres I–XI: 23 : 13 : 17 : 10 : 14 : 14 : 14 : 15 : 14 : 14 : 25. Measurements of females: BL 4.45–4.73; FL 3.45–3.84; PL 1.00–1.06; EL 1.66–1.68; SEL 0.16–0.18; HW 0.89–0.95; PW 1.50–1.61; EW 1.89–1.95. HW : PW = 0.55–0.63; relative length of antennomeres I–XI: 25 : 17 : 16 : 10 : 15 : 15 : 15 : 15 : 15 : 15 : 22.

Body (Figs 1C, 1D) dark brown; basal four antennomeres, mouthparts, posterior margin of elytra and legs reddish brown.

Head shorter than wide, HW : PW = 0.53–0.67 (0.60), punctation fine and sparse; microsculpture composed of irregular transverse striae. Antennae moderately short, antennomeres X slightly shorter than wide.

Pronotum: PL : PW = 0.53–0.71 (0.63); apical margin transversely sinuate, base slightly arcuate; side broadly rounded, widest in basal third; microsculpture consisting of irregular transverse striae, punctation denser and finer than that of head.

Elytra only slightly elongate, EL : EW = 0.76–0.91 (0.91), EL : PL = 1.31–1.88 (1.58), EW : PW = 1.07–1.22 (1.10) in males; EL : EW = 0.85–0.89, EL : PL = 1.57–1.68, EW : PW = 1.17–1.30 in females; surface with denser and coarser punctation than that of head and with dense microsculpture consisting of transverse meshes.

Abdomen with microsculpture radiating from punctures.

Male. Sternite VII (Figs 9B, 10B) with posterior margin broadly and deeply emarginate, apical margin bent ventrad, with moderately broad area of coarse granules. Tergite VIII (Fig. 11B) with four almost reduced lobes, lateral lobes slightly longer than median ones. Sternite VIII as in Fig. 13B. Aedeagus (Fig. 15B) with median lobe broad and projecting beyond apices of parameres, apical portion of median lobe with slight projection; parameres short, of latero-apicad orientation, broadly triangular in lateral view.

Female (Fig. 1D). Pronotum with microsculpture more distinct, forming transverse meshes. Elytra distinctly longer than that of male; posterior margin rounded; microsculpture denser and more distinct than in male. Abdominal tergite VIII (Fig. 18B) with posterior margin deeply emarginate medially, lateral angles each with one long seta. Sternite VIII (Fig. 20B) with six distinct lobes, fimbriate median lobes separated by shallow emargination.

Etymology. The species is named after Pierfranco Cavazzuti (Pagno, Italy), the collector of some paratypes.

Remarks. Males can be separated from the other species by the apical projection of the median lobe of the aedeagus, and by the broadly triangular parameres (in lateral view). Females are distinguished by the unique shape of tergite VIII.

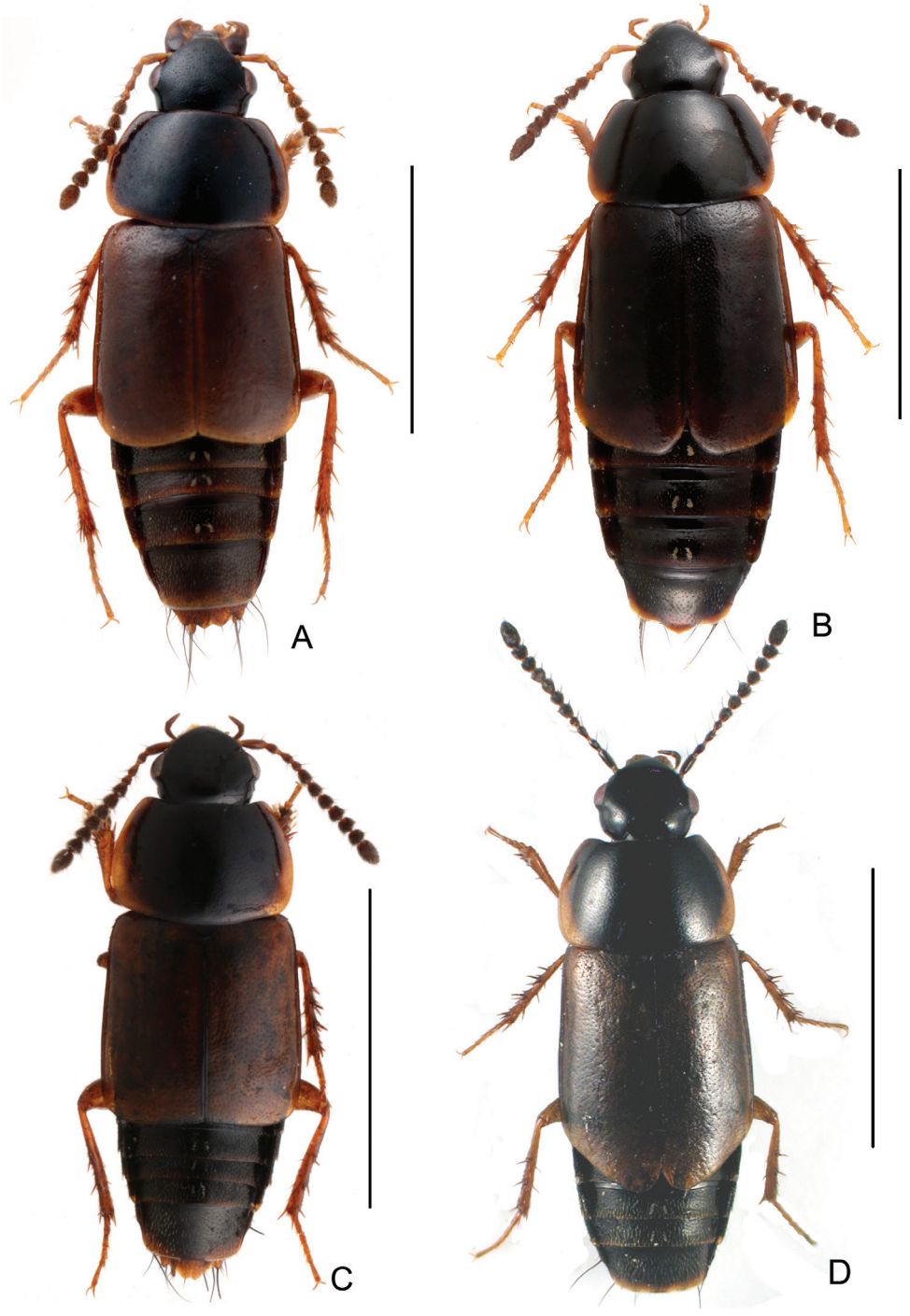

Figure 3. Habitus. **A** *Tachinus hujiayaoi*, male holotype **B** *T. hujiayaoi*, female **C** *T. jiuzhaigouensis*, male holotype **D** *T. jiuzhaigouensis*, female. Scales: 2 mm.

***Tachinus* (*s. str.*) *coronatus* Feng, Li & Schülke, sp. n.**
http://zoobank.org/6E800F79-DAE0-4D7B-9C4D-247E3EDFCA7C
http://species-id.net/wiki/Tachinus_coronatus
Figs 2A, 2B, 9C, 10C, 11C, 13C, 15C, 18C, 20C, 21C

Type locality. China, Ningxia A. R., Jingyuan, Yehegu Valley.

Type material. Holotype: ♂, **CHINA**: Ningxia A. R., Guyuan City, Jingyuan County, Xixia Forestry Station, Yehegu, alt. 1,900 m, 13.vii.2008, Zi-Wei YIN leg. (SNUC). **Paratypes**: 17 ♂♂, 22 ♀♀, same label data as the holotype (SNUC); 4 ♂♂, 2 ♀♀, **CHINA**: Ningxia A. R., Guyuan City, Jingyuan County, Fengtai Forestry Station, alt. 2,400 m, 26.vi.2008, Wen-Xuan BI leg. (SNUC); 1 ♂, 1 ♀, **CHINA**: Qinghai Prov., Xining City, Huzhu County, Beishan, alt. 2,450 m, 28.vii.2004, TANG, HU & ZHU leg. (SNUC); 23 ♂♂, 16 ♀♀, **CHINA**: Qinghai Prov., Xining City, Huzhu County, Beishan, alt. 2,750 m, 29.vii.2004, TANG, HU & ZHU leg. (SNUC); 14 ♂♂, 62 ♀♀, **CHINA**: Qinghai Prov., Yunning Si (Lamasery), 2,890 m, 36°45.6'N, 102°10.6'E, 1.–16.vii.2005, J. Hájek, D. Král & J. Růžička leg. (NMP, cSch).

Description. Measurements of males (holotype): BL 3.67–3.73 (3.67); FL 3.06–3.17 (3.06) mm; PL 0.89–0.95 (0.89); EL 1.45–1.50 (1.50); SEL 0.11–0.17 (0.11); HW 0.83–0.89 (0.83); PW 1.44–1.46 (1.45); EW 1.61–1.67 (1.61); relative length of antennomeres I–XI: 21 : 15 : 15 : 10 : 14 : 12 : 13 : 13 : 13 : 13 : 25. Measurements of females: BL 4.17–4.45; FL 3.34–3.50; PL 0.99–1.01; EL 1.66–1.68; SEL 0.21–0.23; HW 0.89–0.95; PW 1.50–1.61; EW 1.83–1.89; relative length of antennomeres I–XI: 25 : 15 : 16 : 9 : 15 : 14 : 14 : 14 : 13 : 13 : 25.

Body (Figs 2A, 2B) dark brown to black; head and disc of pronotum black; elytra brown; mouthparts, basal four antennomeres, lateral margins of pronotum, small humeral spots on elytra, posterior margin of abdominal tergites and legs reddish brown.

Head slightly transverse, HW : PW = 0.55–0.62 (0.57); surface with fine microsculpture consisting of irregular striae, punctation moderately fine and sparse. Antennomeres X shorter than wide.

Pronotum: PL : PW = 0.61–0.67 (0.61); sides widest near base; surface with microsculpture similar to that of head, punctation slightly finer than that of head.

Elytra: EL : PL = 1.53–1.69 (1.69), EL : EW = 0.87–0.93 (0.93), EW : PW = 1.10–1.16 in males; EL : PL = 1.64–1.70; EL : EW = 0.88–0.92; EW : PW = 1.14–1.26 in females; posterior margin slightly rounded. Surface with coarser punctation than on pronotum, microsculpture distinct, consisting of irregular transverse meshes.

Male. Sternite VII (Figs 9C, 10C) similar to that of *T. hujiayaoi*, with moderately deep triangular emargination at posterior margin, apical margin bent ventrad, with broad area of coarse granules. Tergite VIII as in Fig. 11C, with four almost fused lobes, forming a sinuate apical margin. Sternite VIII as in Fig. 13C. Median lobe of aedeagus (Fig. 15C) short and broad, distinctly projecting beyond apices of parameres, apical portion of median lobe with projection of unique shape. Parameres short, directed latero-apicad.

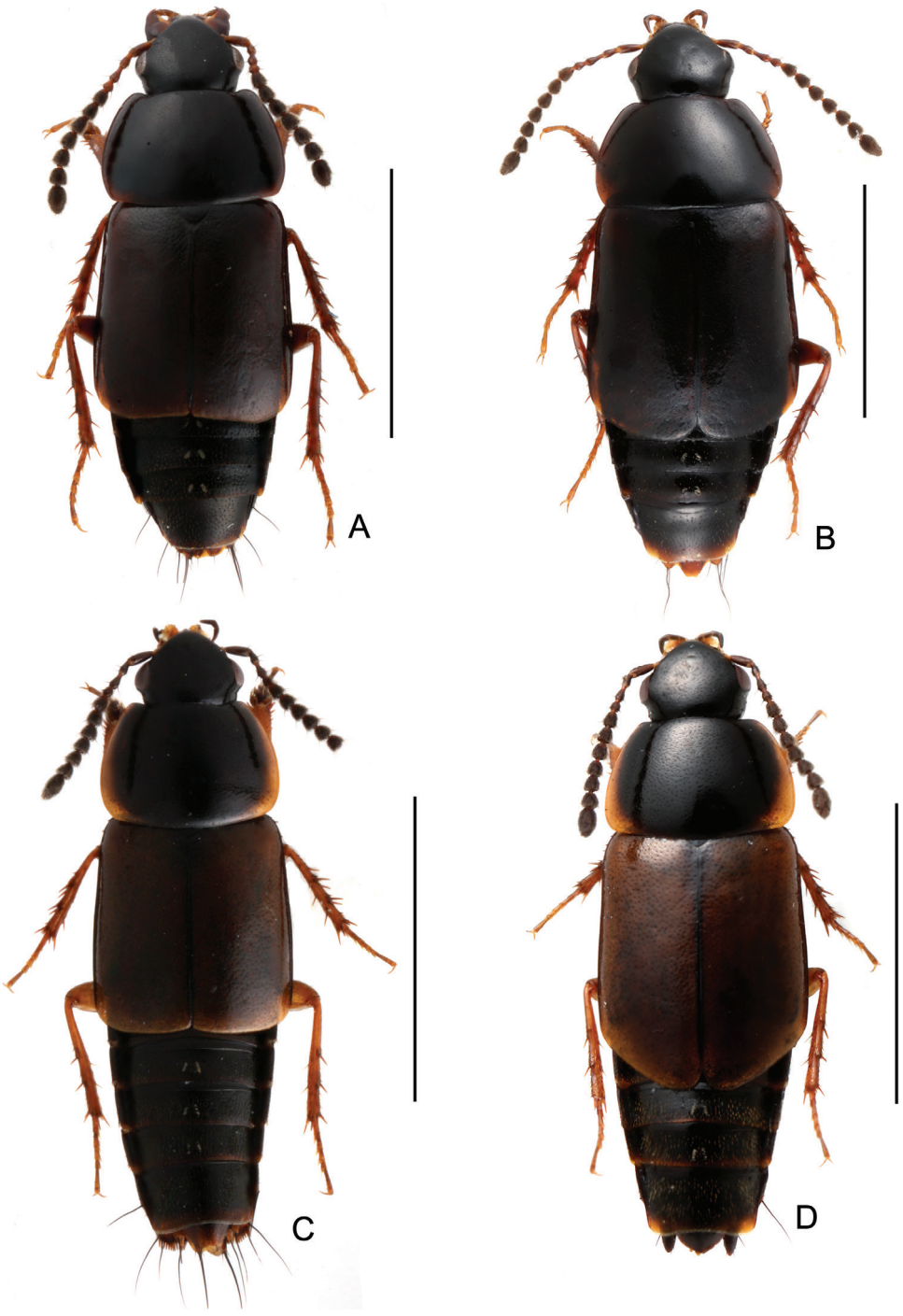

Figure 4. Habitus. **A** *Tachinus linzhiensis*, male holotype **B** *T. linzhiensis*, female **C** *T. lohsei*, male **D** *T. lohsei*, female. Scales: 2 mm.

Female. Pronotum and elytra with microsculpture slightly more distinct. Elytra distinctly longer than in male, apical margin of elytra broadly rounded, without distinct projection near sutural angle. Tergite VIII (Fig. 18C) and sternite VIII (Fig. 20C) similar to those of *T. hujiayaoi*.

Etymology. The specific name (Latin adjective), meaning "crowned", refers to the unique apical projection of the median lobe of the aedeagus.

Remarks. Males of this can be separated from those of the other species by the unique projection on the apex of the median lobe of the aedeagus. Females are distinguished from those of all other species except *T. hujiayaoi* by the shape of the apical margin of tergite VIII with two pairs of long setae.

***Tachinus* (*s. str.*) *hercules* Feng, Li & Schülke, sp. n.**

http://zoobank.org/C7AF0BFD-AD27-40BE-AC4A-CCF9A9AE7FB2
http://species-id.net/wiki/Tachinus_hercules
Figs 2C, 2D, 9D, 10D, 11D, 13D, 15D, 18D, 20D, 21D

Type locality. China, Sichuan Province, Songpan, Huanglongsi.

Type material. Holotype: ♂, **CHINA**: Sichuan Prov., Aba A. R., Songpan County, Huanglongsi, 24.vii.2001, LI & ZHAO leg. (SNUC). **Paratypes**: 25 ♂♂, 29 ♀♀, same label data as holotype (SNUC); 7 ♂♂, 10 ♀♀, **CHINA**: Sichuan Prov., pass between Songpan and Nanping, E–side, 3,450–3,500 m, 21.vi.2002, S. Murzin & I. Shokhin leg. (cSch); ♂, ♀, **CHINA**: Sichuan Prov., Zhangla env., 4,200–4,700 m, 9–11. vii.1991, J. Kaláb leg. (NHMB, cSch) [labelled as paratypes of *Tachinus szechuanensis* Campbell in litteris]; ♂, **CHINA**: Sichuan Prov., Songpan, 2,000 m, 32°30'N, 103°40'E, 13–17.vii.1990, J. Kolibáč leg. (NHMB); 3 ♂♂, 1 ♀, **CHINA**: Sichuan Prov., Min Shan, 33°10'N, 103°50'E, 2,500–4,500 m, 14–16.vii.1990, J. Kolibáč leg. (NHMB); 5 ♂♂, 1 ♀, **CHINA**: Sichuan Prov., pass between Pingwu and Jiuzhaigou, 3,000 m, 10–15.vii.2005, V. Patrikeev leg. (cSch); 1 ♂, 3 ♀♀, **CHINA**: N–Sichuan [CH12–23] Min Shan, 17 km NE Songpan, E pass, 32°44'23"N, 103°44'31"E, 3920 m, N–slope with *Rhododendron* below rocks, litter, moss, and grass roots sifted, 10.viii.2012, leg. M. Schülke (cSch); 3 ♂♂, 3 ♀♀, **CHINA**: N–Sichuan [CH12–24] pass 35 km NNW Songpan, 32°55'32"N, 103°25'56"E, 3600 m, moist N–slope with Salix and other shrubs, litter, grass roots, and moss sifted, 11.viii.2012, leg. M. Schülke (cSch); ♀, **CHINA**: N–Sichuan [CH12–19] 47 km N Songpan, road S 301 km 118, N Gongangling pass, 33°03'15"N, 103°43'36"E, 3390 m, spruce forest with shrubs, litter, moss, and mushrooms sifted, 9.viii.2012, leg. M. Schülke (cSch); ♂♀, **CHINA**: [19] N–Sichuan N Songpan, 33°03'15"N, 103°43'36"E, 3390 m, spruce forest, sifted, 9.viii.2012, V. Assing (cAss); ♀, **CHINA**: [22] N–Sichuan pass ENE Songpan, 4080 m, 32°44'54"N, 103°43'43"E, sifted. 10.viii.2012, V. Assing (cAss).

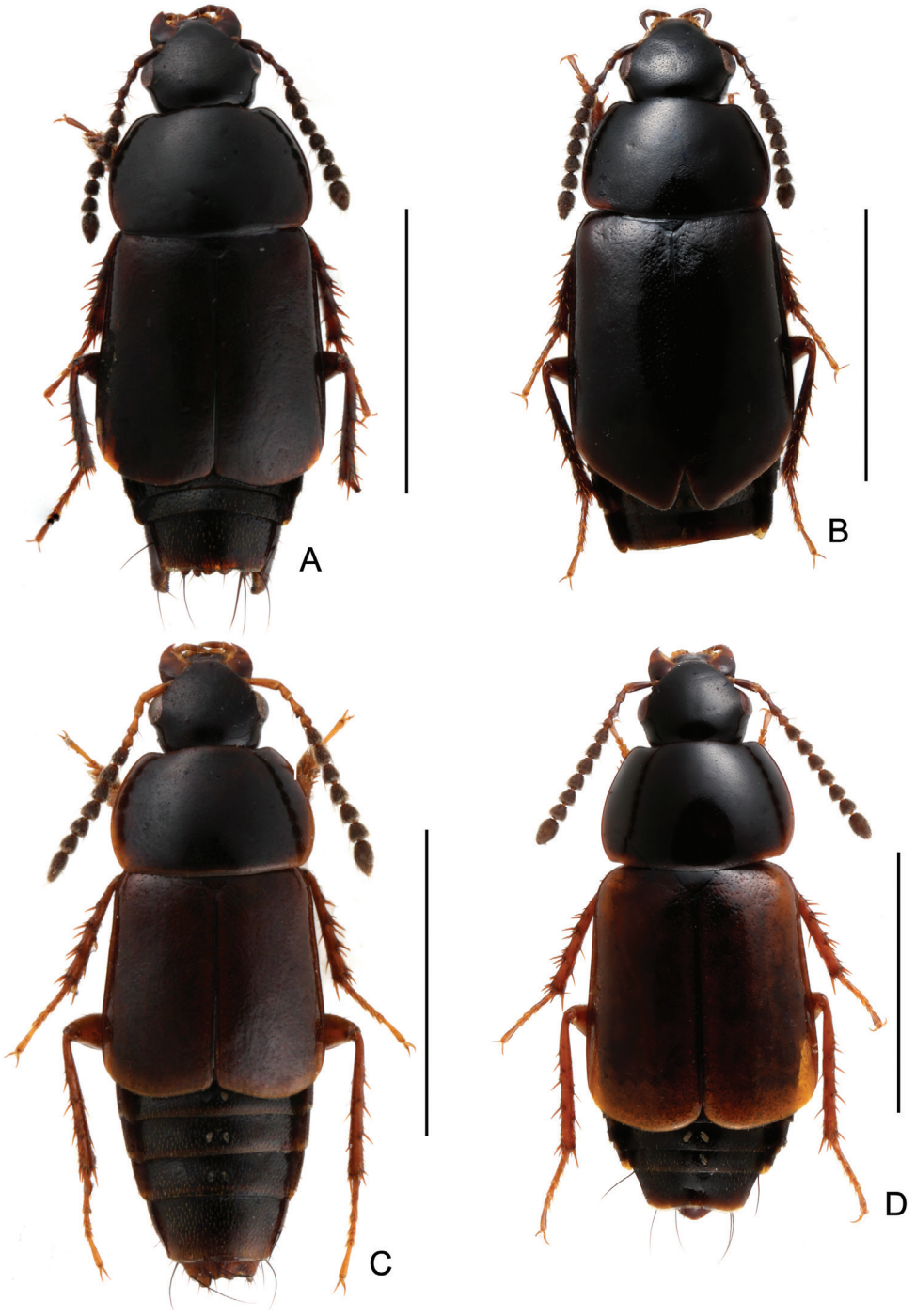

Figure 5. Habitus. **A** *Tachinus maderianus*, male holotype **B** *T. maderianus*, female **C** *T. mengdaensis*, male holotype **D** *T. mengdaensis*, female. Scales: 2 mm.

Description. Measurements of males (holotype): BL 3.61–4.00 (4.00); FL 2.84–3.11 (3.11); PL 0.89–1.00 (1.00); EL 1.45–1.61 (1.61); SEL 0.06–0.11 (0.11); HW 0.88–0.90 (0.89); PW 1.45–1.56 (1.56); EW 1.61–1.78 (1.78); relative length of antennomeres I–XI: 23 : 15 : 15 : 10 : 17 : 14 : 16 : 15 : 15 : 14 : 29. Measurements of females: BL 3.95–4.39; FL 3.39–3.61 mm; PL 0.99–1.01; EL 1.56–1.73; SEL 0.16–0.18; HW 0.94–0.96; PW 1.50–1.56; EW 1.82–1.84; relative length of antennomeres I–XI: 23 : 15 : 15 : 10 : 14 : 14 : 14 : 13 : 14 : 15 : 28.

Body (Figs 2C, 2D) dark brown to black, head black, mouthparts, basal four antennomeres, elytra, posterior margin of each abdominal tergite and legs reddish brown.

Head shorter than wide and narrower than pronotum, HW : PW = 0.56–0.64 (0.57), disc of head with dense microsculpture consisting of irregular striae, basal part with microsculpture consisting of transverse meshes, punctation fine and sparse. Antennae moderately short, antennomeres X shorter than wide.

Pronotum: PL : PW = 0.57–0.69 (0.64), widest at basal third; surface with punctation slightly more distinct than that of head, microsculpture consisting of irregular transverse striae.

Elytra elongate: EL : PL = 1.45–1.81 (1.60), EL : EW = 0.81–1.00 (0.90), EW : PW = 1.03–1.23 (1.14) in males; EL : PL = 1.54–1.75, EL : EW = 0.85–0.95, EW : PW = 1.17–1.23 in females. Microsculpture consisting of fine, short meshes, punctation coarser and denser than that of head and pronotum.

Surface of abdomen evenly pubescent and punctate, microsculpture consisting of transverse lines.

Male. Sternite VII (Figs 9D, 10D) with posterior margin broadly and deeply emarginate, apical margin bent ventrad, with moderately broad area of coarse granules. Tergite VIII (Fig. 11D) with four short lobes, median lobes slightly longer than lateral ones. Sternite VIII as in Fig. 13D. Median lobe of aedeagus (Fig. 15D) broad and with two apical projections, parameres long and directed latero-apicad.

Female. Antennomeres X only slightly shorter than wide (length : width = 0.93). Pronotum with microsculpture more distinct and denser than in male. Elytra slightly longer than in male; apical margin broadly rounded, with microsculpture more distinct, denser and with shorter meshes than in male. Tergite VIII (Fig. 18D) with lobes almost fused, apical margin of median lobe broadly and triangularly projecting beyond lateral lobes; lateral lobes each with one long seta. Sternite VIII (Fig. 20D) with six lobes, fimbriate median lobes nearly fused, with shallow emargination at middle, sublateral lobes as long as median ones.

Etymology. The species is named after the Greek divine hero Heracles, whose Roman name is Hercules.

Remarks. Males of the new species are similar to those of *T. parahercules* externally, and can be separated only by aedeagal characters, they differ from the other species by the shape of the aedeagal median lobe (two apical projections, long parameres directed lateroapically). Females are distinguished by the shape of the apical margin of tergite VIII, from females of the similar *T. hujiayaoi* and *T. coronatus* by the presence of a single pair of long setae on the lateral lobes of tergite VIII.

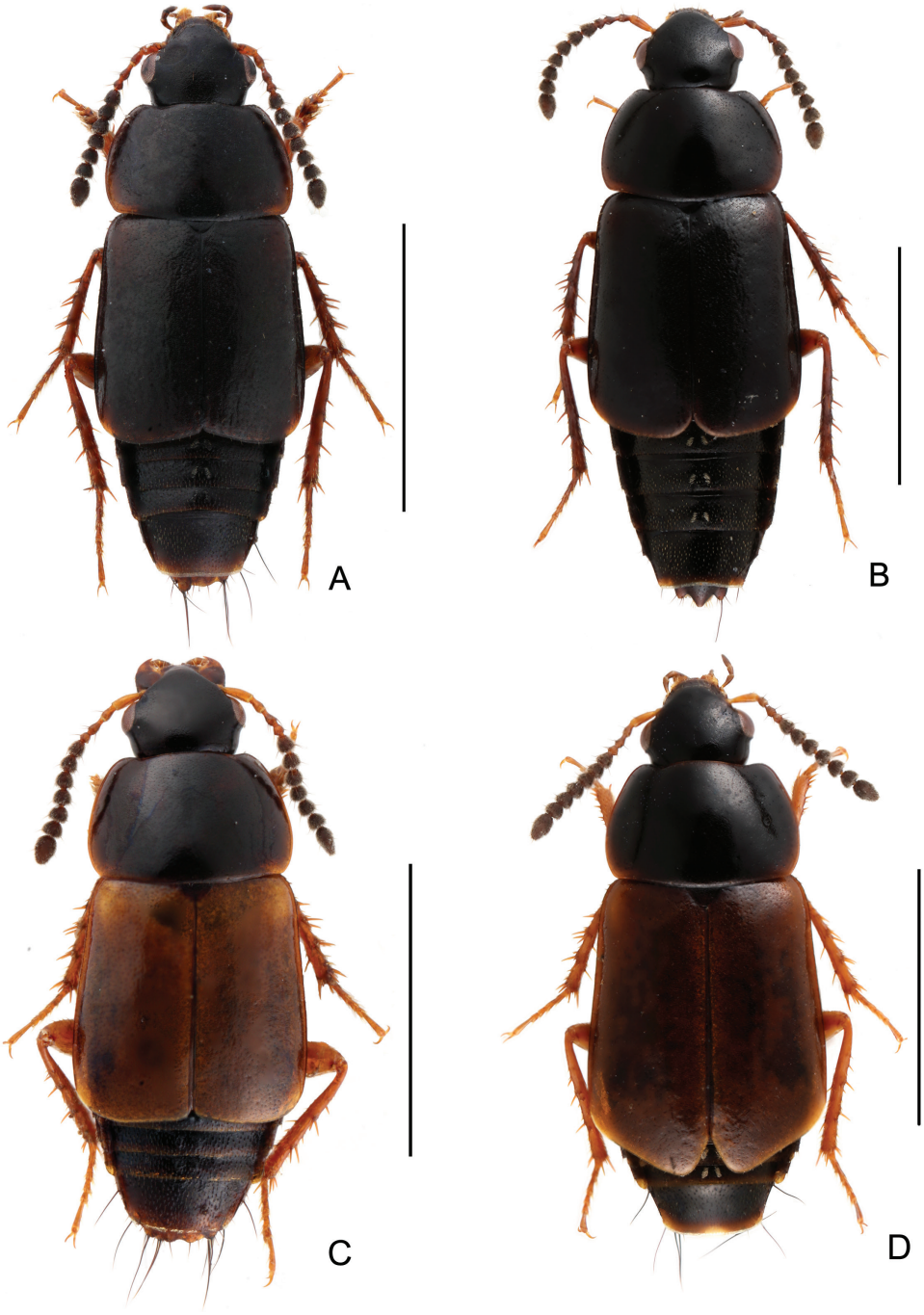

Figure 6. Habitus. **A** *Tachinus oblongoelytratus*, male holotype **B** *T. oblongoelytratus*, female **C** *T. parahercules*, male holotype **D** *T. parahercules*, female. Scales: 2 mm.

***Tachinus* (*s. str.*) *hujiayaoi* Feng, Li & Schülke, sp. n.**
http://zoobank.org/E6D5EFCE-5897-4424-B265-3127A284CF51
http://species-id.net/wiki/Tachinus_hujiayaoi
Figs 3A, 3B, 9E, 10E, 11E, 13E, 15E, 18E, 20E, 21E

Type locality. China, Shaanxi Province, Taibai Mountain.

Type material. Holotype: ♂, **CHINA**: Shaanxi Prov., Baoji City, Taibai County, Mt. Taibai, alt. 2,750–3,300 m, 12.vii.2004, HU, TANG & ZHU leg. (SNUC). **Paratypes**: 56♂♂, 38♀♀, same label data as holotype (SNUC); 11♂♂, 17♀♀, **CHINA**: Shaanxi Prov., Baoji City, Taibai County, Mt. Taibai, alt. 2,750–3,300 m, 12.vii.2004, HU & TANG leg. (SNUC); 22♂♂, 12♀♀, **CHINA**: Shaanxi Prov., Qinling, 33°51'N, 108°47'E, mountain W pass at autoroute km 70, 47 km S Xi'an, 2,300–2,500 m, 26–30.viii.1995, A. Pütz, M. Schülke leg. (cPüt, cSch); 1 ♀, **CHINA**: Shaanxi Prov., Qinling, 33°51'N, 108°47'E, mountain W pass at autoroute km 70, 47 km S Xi'an, 2,500–2,600 m, 26–29.viii.1995, Wrase leg. (cSch); 1 ♀, **CHINA**: S–Shaanxi, Qinling, range W pass on rd. Xi'an–Shagoujie, 45 km SSW Xi'an, 33°52'N, 108°46'E, 2,600 m, 25.vii.2001, A. Smetana leg. (cSme).

Description. Measurements of males (holotype): BL 4.23–4.61 (4.61); FL 3.11–3.22 (3.22); PL 0.89–0.95 (0.95); EL 1.33–1.45 (1.45); SEL 0.08–0.11 (0.11); HW 0.82–0.84 (0.83); PW 1.39–1.45 (1.45); EW 1.56–1.61 (1.61); relative length of antennomeres I–XI: 23 : 17 : 17 : 8 : 13 : 12 : 12 : 13 : 13 : 14 : 27. Measurements of females: BL 4.33–4.45; FL 3.45–3.50; PL 0.89–0.95; EL 1.61–1.72; SEL 0.22–0.28; HW 0.88–1.00; PW 1.45–1.50; EW 1.78–1.83; relative length of antennomeres I–XI: 24 : 18 : 16 : 11 : 15 : 13 : 13 : 13 : 12 : 13 : 30.

Body (Figs 3A, 3B) dark brown to black, disc of elytra brown, mouthparts, basal four antennomeres, lateral margins of pronotum, posterior margin of elytra, abdominal tergites and legs reddish brown.

Head transverse, HW : PW = 0.57–0.60 (0.57) in males, HW : PW = 0.59–0.69 in females; disc with microsculpture consisting of irregular striae, posterior portion with microsculpture consisting of transverse meshes, punctation fine and sparse. Antennae moderately short, antennomeres X slightly shorter than wide.

Pronotum: PL : PW = 0.59–0.68 (0.66), punctation similar to that of head, microsculpture consisting of irregular transverse meshes.

Elytra: EL : EW = 0.83–0.93 (0.90), EL : PL = 1.40–1.63 (1.53), EW : PW = 1.08–1.16 (1.11) in males; EL : EW = 0.88–0.97, EL : PL = 1.69–1.93, EW : PW = 1.19–1.26 in females; apical margin broadly rounded, punctation coarser than that of head and pronotum, microsculpture more distinct than on head and pronotum, consisting of shorter transverse meshes.

Abdomen with fine microsculpture consisting of transverse lines.

Male. Sternite VII (Figs 9E, 10E) triangularly emarginate at posterior margin, apical margin bent ventrad, with moderately broad area of coarse granules. Tergite VIII as in Fig. 11E. Sternite VIII as in Fig. 13E, all four lobes nearly fused, forming a

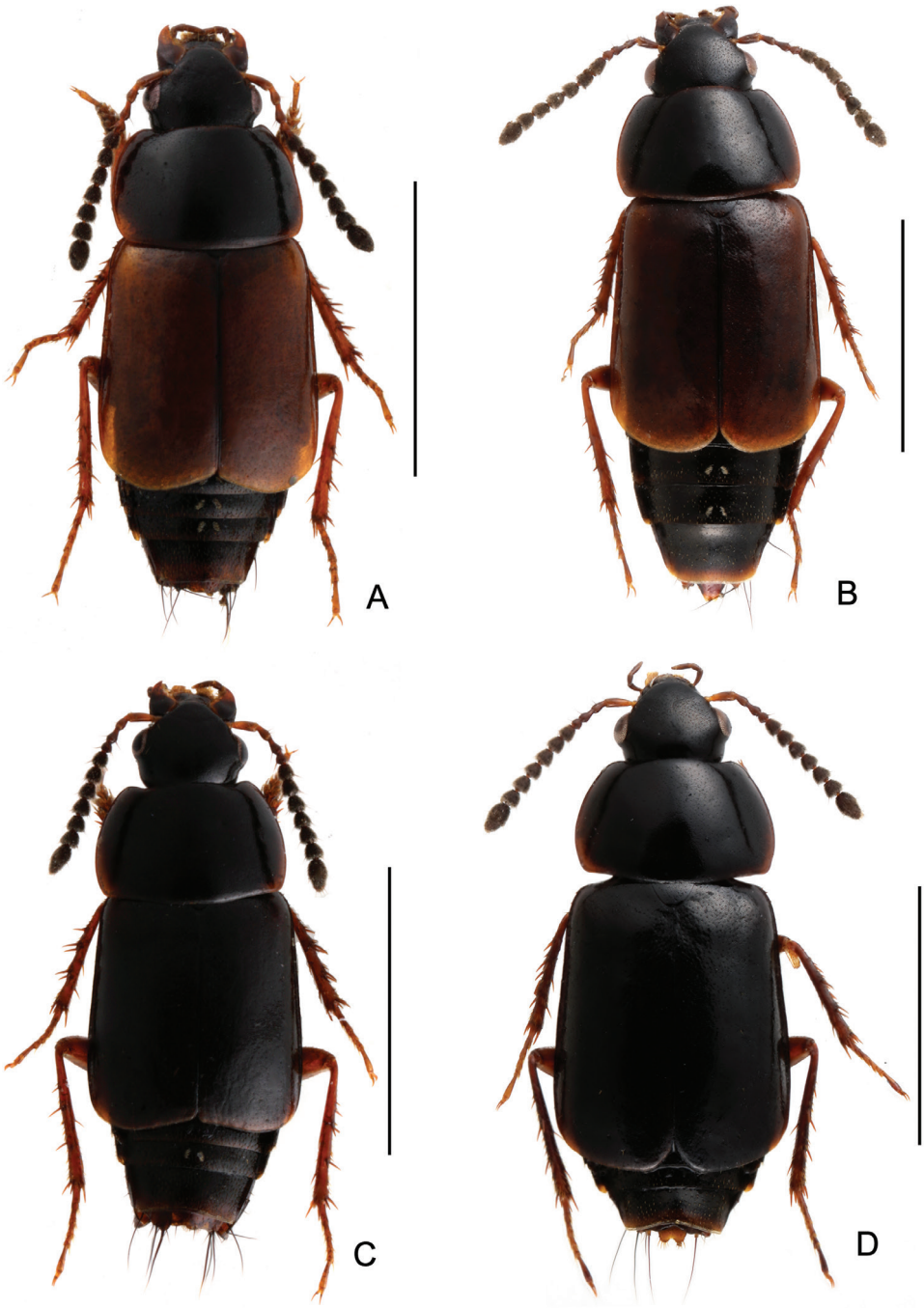

Figure 7. Habitus. **A** *Tachinus paralinzhiensis*, male holotype **B** *T. paralinzhiensis*, female **C** *T. yini*, male holotype **D** *T. yini*, female. Scales: 2 mm.

sinuate apical margin. Median lobe of aedeagus (Fig. 15E) apically distinctly projecting beyond apices of parameres, apical part with characteristic projections.

Female. Elytra slightly longer than in male, inner part of posterior margin weakly produced, forming a broadly obtuse angle. Tergite VIII (Fig. 18E) with lobes almost fused, apical margin of median lobe broadly and triangularly projecting, as long as lateral lobes; lateral lobes each with one pair of long setae. Sternite VIII (Fig. 20E) with six lobes, fimbriate median lobes nearly fused, with small and shallow emargination, sublateral lobes slightly longer than fimbriate median lobes.

Etymology. The species is named after Jia-Yao Hu (Shanghai), a colleague and friend specializing in Paederinae and Quediina.

Remarks. The new species is most similar to *T. coronatus* externally, and can be separated only by aedeagal characters. Males of *T. hujiayaoi* can be differed from those of the other species by the unique shape of the apical projections of the aedeagal median lobe. Females are distinguished from those of all other species except *T. coronatus* by the shape of the apical margin of tergite VIII (lateral lobes each with one pair of long setae).

Tachinus (*s. str.*) *jiuzhaigouensis* Feng, Li & Schülke, sp. n.

http://zoobank.org/22962962-16D0-4562-A5DE-B4B3C8848FE1
http://species-id.net/wiki/Tachinus_jiuzhaigouensis
Figs 3C, 3D, 9F, 10F, 11F, 13F, 15F, 18F, 20F, 21F

Type locality. China, Sichuan, Aba A. R., Nanping, Jiuzhaigou Natural Reserve.

Type material. Holotype: ♂, **CHINA**: Sichuan Prov., Aba A. R., Nanping County, Jiuzhaigou, 27.vii.2001, LI & ZHAO leg. (SNUC). **Paratypes**: ♂, same label data as holotype (SNUC); ♂, **CHINA**: Sichuan Prov., Jiuzhaigou Natural Reserve, 12–17. vi.2000, leg. E. Kučera (cFel); 4 ♂♂, 6 ♀♀, **CHINA**: Sichuan, Jiuzhaigou, 15.vi.–18. vi.2011 leg. Kučera (cSch).

Description. Measurements of holotype: BL 3.61 mm; FL 2.61 mm; PL 0.78 mm; EL 1.17 mm; SEL 0.06; HW 0.72 mm; PW 1.22 mm; EW 1.33 mm; relative length of antennomeres I–XI: 20 : 10 : 12 : 7 : 8 : 10 : 10 : 10 : 9 : 10 : 21. Measurements of females: BL 3.57–3.81; FL 2.82–3.08; PL 0.79–0.83; EL 1.29–1.44; SEL 0.20–0.30; HW 0.73–0.74; PW 1.22–1.26; EW 1.34–1.39; relative length of antennomeres I–XI: 24 : 14 : 16 : 10 : 14 : 14.5 : 14 : 14 : 13 : 12.5 : 26.

Body (Fig. 3C, 3D) brown to black; head and pronotal disc black; lateral margins of pronotum yellow; elytra, posterior margin of each abdominal tergite and legs reddish brown; mouthparts and basal antennomeres black or dark brownish.

Head slightly transverse, HW : PW = 0.58–0.60, punctation fine and sparse, microsculpture consisting of irregular striae on disc, more transverse in posterior portion. Antennomeres X shorter than wide.

Pronotum: PL : PW = 0.64–0.66; surface with fine and sparse punctation, microsculpture indistinct, reduced to irregular transverse striae.

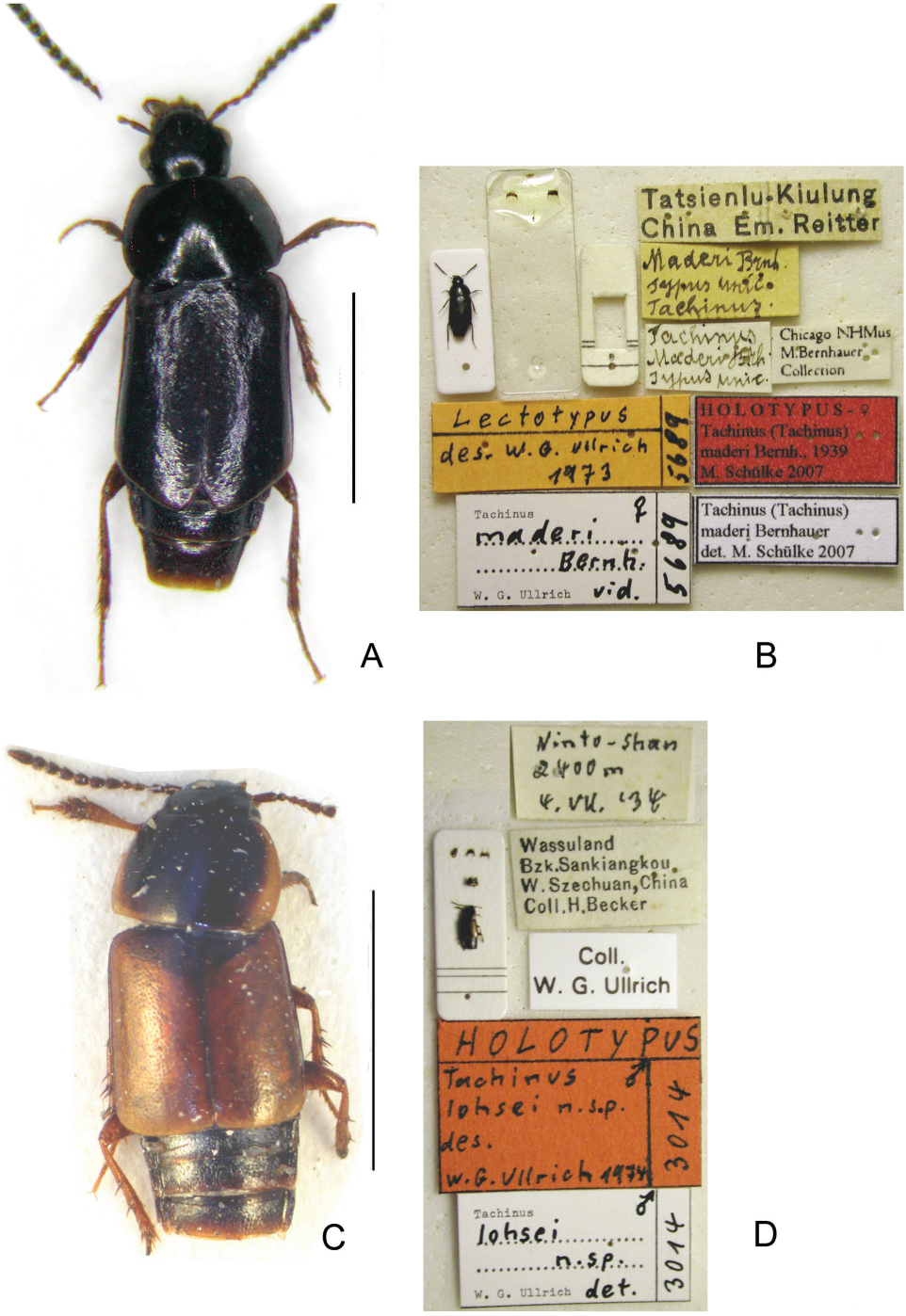

Figure 8. Habitus and labels. **A** *Tachinus maderi*, female holotype, habitus **B** *T. maderi*, female holotype, labels **C** *T. lohsei*, male holotype, habitus **D** *T. lohsei*, male holotype, labels. Scales: 2 mm.

Elytra: EL : PL = 1.50, EL : EW = 0.88, EW : PW = 1.09 in male; EL : PL = 1.61–1.74; EL : EW = 0.93–1.04; EW : PW = 1.08–1.11 in females; punctation shallow, coarser than that of pronotum.

Male. Surface of elytra with microsculpture similar to that of pronotum, often almost completely reduced. Sternite VII (Figs 9F, 10F) as in *Tachinus lohsei*, apical margin of emargination more rounded, hand-shaped projection more slender, in posterior view apical margin bent dorsad. Tergite VIII as in Fig. 11F. Sternite VIII as in Fig. 13F. Median lobe of aedeagus (Fig. 15F) shorter and slightly broader than parameres. Parameres in lateral view straight, not curved ventrad in apical half, apex of parameres angular in ventral view.

Female. Elytra distinctly longer than in male (Fig. 3D), inner part of posterior margin produced, forming a distinct angle. Surface with distinct microsculpture composed of irregular transverse striae in the anterior portion and of irregular meshes in posterior portion. Abdominal tergite VIII (Fig. 18F) trilobed, similar to that of *T. lohsei*, median lobe at least as long as lateral ones, lateral lobes broad and each with one pair of long setae. Sternite VIII (Fig. 20F) with six lobes, fimbriate median lobes separated by deep and narrow emargination.

Etymology. The specific name (adjective) is derived from "Jiuzhaigou", the type locality of this species.

Remarks. *Tachinus jiuzhaigouensis* can be easily separated from the other species of the group by its small size, the broadly yellow lateral margins of the pronotum and the primary and secondary sexual characters. The species is very similar to *T. lohsei*, but the male is distinguished by the more angular apical part of the parameres, the female by the different shape of the median lobe of tergite VIII.

***Tachinus* (*s. str.*) *linzhiensis* Feng & Li, sp. n.**

http://zoobank.org/821FEE94-B530-45C9-8706-D51D0E6DD32C
http://species-id.net/wiki/Tachinus_linzhiensis
Figs 4A, 4B, 9G, 10G, 11G, 13G, 16A, 18G, 20G, 21G

Type locality. China, Tibet A. R., Linzhi County, Basongcuo.

Type material. Holotype: ♂, **CHINA**: Tibet A. R., Linzhi County, Basongcuo, alt. 3,465 m, 9.viii.2004, Li-Zhen LI leg. (SNUC). **Paratypes**: 11 ♂♂, 5 ♀♀, same label data as holotype (SNUC).

Description. Measurements of males (holotype): BL 3.89–4.17 (3.89); FL 2.95–3.17 (2.95); PL 0.94–0.96 (0.95); EL 1.45–1.56 (1.56); SEL 0.06–0.08 (0.06); HW 0.83–0.89 (0.89); PW 1.39–1.45 (1.39); EW 1.56–1.61 (1.56) ; relative length of antennomeres I–XI: 21 : 13 : 14 : 10 : 15 : 12 : 13 : 12 : 13 : 12 : 27. Measurements of females: BL 4.84–5.12; FL 3.61–3.73; PL 0.95–1.00; EL 1.61–1.67; SEL 0.11–0.14; HW 0.88–0.90; PW 1.49–1.51; EW 1.72–1.78; relative length of antennomeres I–XI: 20 : 14 : 15 : 10 : 14 : 14 : 14 : 14 : 14 : 14 : 24.

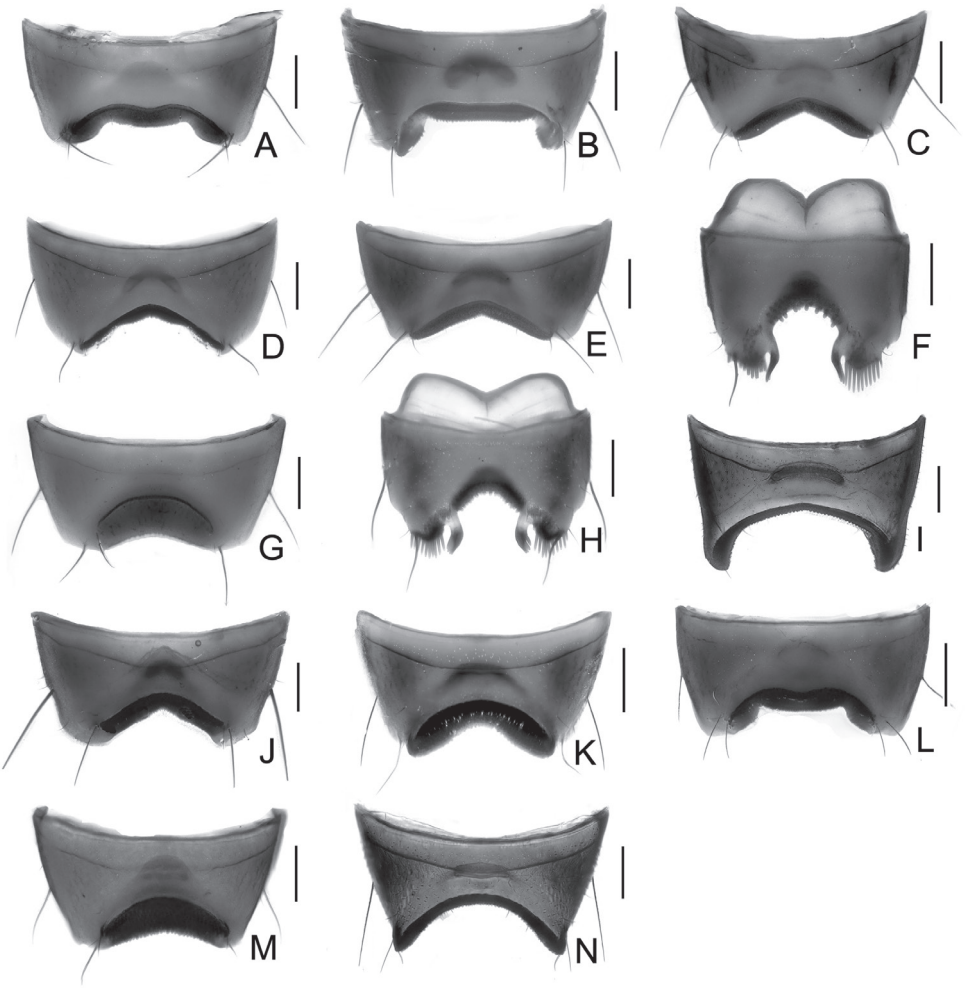

Figure 9. Ventral view of male sternite VII. **A** *Tachinus armatus* **B** *T. cavazzutii* **C** *T. coronatus* **D** *T. hercules* **E** *T. hujiayaoi* **F** *T. jiuzhaigouensis* **G** *T. linzhiensis* **H** *T. lohsei* **I** *T. maderianus* **J** *T. mengdaensis* **K** *T. oblongoelytratus* **L** *T. parahercules* **M** *T. paralinzhiensis* **N** *T. yini*. Scales: 0.2 mm.

Body (Figs 4A, 4B) black to piceous; mouthparts, antennomeres I and IV, elytra and legs reddish brown.

Head slightly transverse, HW : PW = 0.57–0.64 (0.64). Surface of head with distinct microsculpture and fine and sparse punctation. Antennae moderately short, antennomeres X slightly transverse or as long as wide.

Pronotum: PL : PW = 0.63–0.69 (0.68), surface with microsculpture consisting of transverse irregular meshes, punctation finer than that of head.

Elytra short, EL : EW = 0.90–1.00 (1.00), EL : PL = 1.51–1.66 (1.64), EW : PW = 1.08–1.16 (0.12) in males; EL : EW = 0.90–0.97, EL : PL = 1.61–1.76, EW : PW

= 1.14–1.19 in females; with microsculpture consisting of transverse meshes, more coarsely punctate than head and pronotum.

Surface of abdomen with dense microsculpture consisting of transverse lines, punctation similar to that of elytra.

Male. Sternite VII (Figs 9G, 10G) only shallowly emarginate at posterior margin, apical margin bent ventrad, with broad area of coarse granules. Tergite VIII (Fig. 11G) with four short lobes, median lobes broader and slightly longer than lateral ones. Sternite VIII as in Fig. 13G. Aedeagus (Fig. 16A) with parameres much longer than median lobe; parameres directed apicad, slightly curved medially. Parameres projecting beyond apex of median lobe by one quarter length of median lobe.

Female. Elytra only slightly longer than in male, apical margin broadly rounded. Tergite VIII (Fig. 18G) long and broad, distinctly trilobed, lateral lobes shorter than median lobe, apical margin of median lobe slightly emarginate at middle; lateral lobes each with one pair of long setae. Sternite VIII (Fig. 20G) with fimbriate median lobes completely fused.

Etymology. The specific name (adjective) is derived from "Linzhi", the type locality of this species.

Remarks. Males can be separated from those of the other species of the group by the apically strongly elongate aedeagal parameres. Females are distinguished from those of all other species except *T. paralinzhiensis* by the shape of tergite VIII, from those of *T. paralinzhiensis* by the totally fused fimbriate lobe of sternite VIII.

Tachinus (*s. str.*) *lohsei* Ullrich

http://species-id.net/wiki/Tachinus_lohsei

Figs 4C, 4D, 8C, 8D, 9H, 10H, 11H, 13H, 16B, 18H, 20H, 21H

Tachinus (*s. str.*) *lohsei* Ullrich, 1975: 277.

Type locality. China, Sichuan Province, Wenchuan, Yingxiu.

Type material examined. Holotype ♂ (Fig. 8C, 8D): **CHINA**: "Wassuland Bzk. Sankiangkou W Szechuan, China Coll. H. Becker / Ninto Shan 2400 m 4.VII.'34 / Holotypus *Tachinus lohsei* n. sp. des. W.G. Ullrich 1974, '3014' [red] / *Tachinus lohsei* n. sp. ♂ W.G. Ullrich det. 1974, '3014'" (MHNG).

Other material examined. 6 ♂♂, 5 ♀♀, CHINA: Sichuan Prov., Ganzi A. R., Luding County, Hailuogou, Ganheba, alt. 3,300 m, 26.vi.2009, Li-Zhen LI leg. (SNUC); 1 ♂, 1 ♀, CHINA: Sichuan Prov. Ganzi A. R., Luding County, Hailuogou, Gaohaizi, alt. 2,780 m, 28.vi.2009, Li-Zhen LI leg. (SNUC); 4 ♂♂, 1 ♀, CHINA: Sichuan Prov. Ganzi A. R., Luding County, Hailuogou, Shengtaizhan, alt. 3,000 m, 25.vi.2009, Li-Zhen LI leg. (SNUC); 1 ♀, CHINA: Sichuan Prov., Gongga Shan mts., NNE–slope, 4,000 m, 29°53'N, 102°01'E, 9.–11.vii.1994, D. Král & J. Farkač leg. (NHMB); ♂, ♀, CHINA: Sichuan Prov., Gongga Shan–Hailuogou, 2,900–3,200

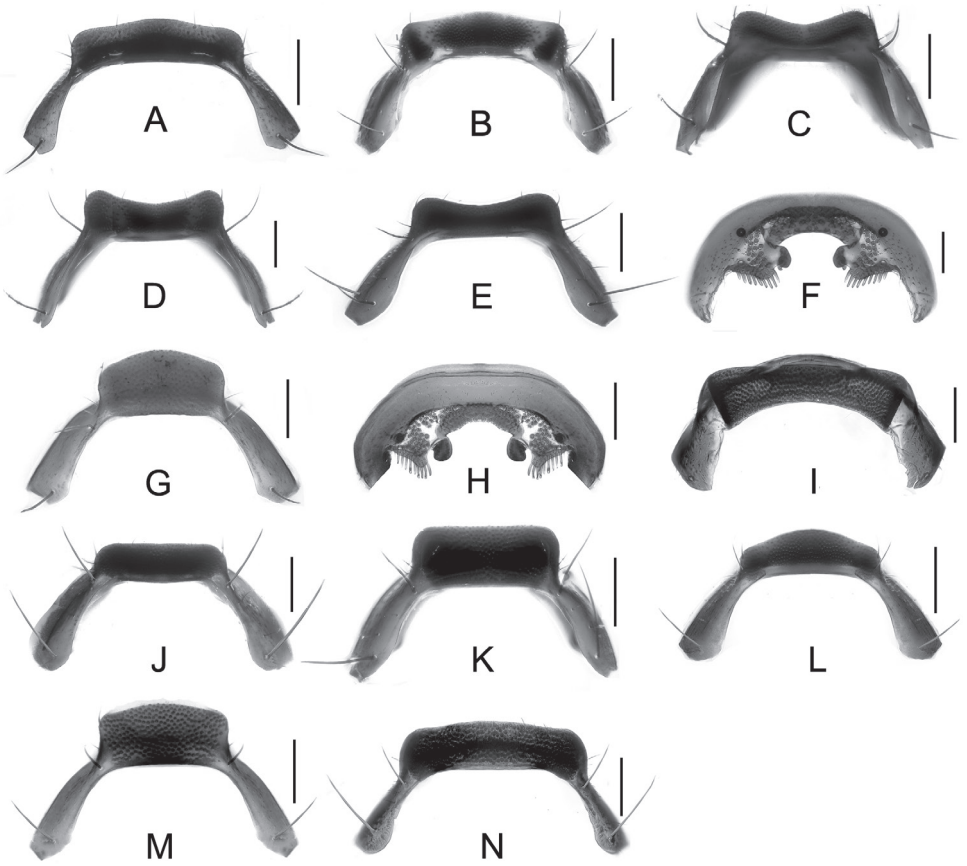

Figure 10. Posterior view of male sternite VII. **A** *Tachinus armatus* **B** *T. cavazzutii* **C** *T. coronatus* **D** *T. hercules* **E** *T. hujiayaoi* **F** *T. jiuzhaigouensis* **G** *T. linzhiensis* **H** *T. lohsei* **I** *T. maderianus* **J** *T. mengdaensis* **K** *T. oblongoelytratus* **L** *T. parahercules* **M** *T. paralinzhiensis* **N** *T. yini*. Scales: 0.2 mm.

m, 29°35'N, 102°00'E, 3–8.vii.1994, D. Král & J. Farkač leg. (cSme, cSch); 1 ♀, CHINA: Sichuan Prov., Gongga Shan, above Camp 2, 2,800 m, 25.vii.1994, A. Smetana leg. (cSme); ♂, CHINA: Sichuan Prov., Gongga Shan, above Camp 2, 2,850 m, 26.vii.1994, A. Smetana leg. (cSme); 1 ♂, 1 ♀, CHINA: Sichuan Prov., Gongga Shan, above Camp 2, 2,800 m, 29°35'N, 102°00'E, 5.vii.1998, A. Smetana leg. (cSme, cSch); 2 ♂♂, 1 ♀, CHINA: Sichuan Prov., Gongga Shan, above Camp 3, 3,200 m, 29°35'N, 102°00'E, 7.vii.1998, A. Smetana leg. (cSme, cSch); 5 ♂♂, 2 ♀♀, CHINA: Sichuan Prov., Gongga Shan, above Camp 3, 3,050 m, 29°35'N, 102°00'E, 6.vii.1998, A. Smetana leg. (cSme, cSch); 1 ♂, 2 ♀♀, CHINA : Sichuan, Gongga Shan, Hailuogou, above Camp 3, 3200 m, 7.VII. 1996 29°35'N, 102°00'E / collected by J. Farkač, P. Kabátek and A. Smetana (NHMB, cSch); 1 ♀, CHINA : Sichuan, Gongga Shan, Hailuogou, above Camp 3, 29°35'N, 102°00'E, 2800–3200

m, 6.–8.VII.1998 J. Farkač / 1998 China Expedition J. Farkač, D. Král, J. Schneider & A. Smetana (NHMB); 1 ♀, CHINA : Sichuan, Gongga Shan, Hailuogou, above Camp 2, 29°35'N, 102°00'E, 2600–2750 m, 3.–6.VII.1998 J. Schneider / 1998 China Expedition J. Farkač, D. Král, J. Schneider & A. Smetana (NHMB); 1 ♂, 1 ♀, CHINA: Sichuan, Gongga Shan, Hailuogou, above Camp 2, 29°35'N, 102°00'E, 2600–2750 m, 3.–6.VII.1998 J. Farkač (NHMB).

Description. Measurements of males: BL 4.06–4.17; FL 2.84–3.22; PL 0.83–0.84; EL 1.31–1.33; SEL 0.03–0.06; HW 0.72–0.73; PW 1.17–1.28; EW 1.33–1.39; relative length of antennomeres I–XI: 22 : 14 : 14 : 8 : 10 : 10 : 11 : 10 : 10 : 12 : 22. Measurements of females: BL 4.17–4.23; FL 2.95–3.11; PL 0.82–0.83; EL 1.50–1.56; SEL 0.11–0.17; HW 0.72–0.78 ; PW 1.27–1.29; EW 1.39–1.45; relative length of antennomeres I–XI: 21 : 14 : 15 : 12 : 13 : 13 : 14 : 12 : 12 : 11 : 25.

Body (Figs 4C, 4D) dark brown to black, head and pronotal disc black, lateral margins of pronotum broadly yellowish brown, elytral disc brown, mouthparts, basal four antennomeres, posterior margin of elytra, abdominal tergites and legs reddish brown.

Head slightly transverse, HW : PW = 0.55–0.62, surface with fine and sparse punctation, microsculpture consisting of discontinuous striae. Antennomeres X slightly shorter than wide in male, but more distinctly shorter than wide in female.

Pronotum: PL : PW = 0.64–0.72, punctation slightly coarser than that of head.

Elytra: EL : PL = 1.56–1.62, EL : EW = 0.94–1.00, EW : PW = 1.04–1.19 in males; EL : PL = 1.79–1.90, EL : EW = 1.03–1.08, EW : PW = 1.08–1.14 in females; apical margin broadly rounded. Surface of elytra with punctation coarser than that of pronotum.

Abdomen with denser and finer punctation than elytra.

Male. Surface of pronotum with weak microsculpture, elytra only with traces of microsculpture. Sternite VII (Figs 9H, 10H) with large basal projection and deep median triangular emargination, coarse granules arranged as inverted “V” in anterior portion of impression, each side of impression with a hand-shaped projection, lateral sides of apical margin with long comb-like setae; apical margin bent dorsad when viewed from behind. Tergite VIII (Fig. 11H) with four lobes, median lobes with small, narrowly rounded emargination between them, and longer than lateral ones. Sternite VIII (Fig. 13H) with four distinct lobes, median lobes longer than lateral ones and separated by a deep, bell-shaped emargination. Aedeagus (Fig. 16B) with median lobe shorter than the parameres, parameres wide and elongate, sides gradually narrowed from apical half to rounded apices; apical third of lateral lobes slightly curved ventrad in lateral view.

Female. Pronotum with microsculpture more distinct, consisting of sinuate transverse striae. Elytra distinctly longer than in male, inner part of posterior margin slightly produced, forming an obtuse angle, microsculpture much more distinct, consisting of short transverse to isodiametric meshes. Tergite VIII (Fig. 18H) distinctly trilobed, median lobe separated from lateral lobes by a deep suture, shorter than lateral ones; lateral lobes broad, each with one pair of long setae. Sternite VIII (Fig. 20H) with six lobes, fimbriate median lobes separated by deep and narrow emargination.

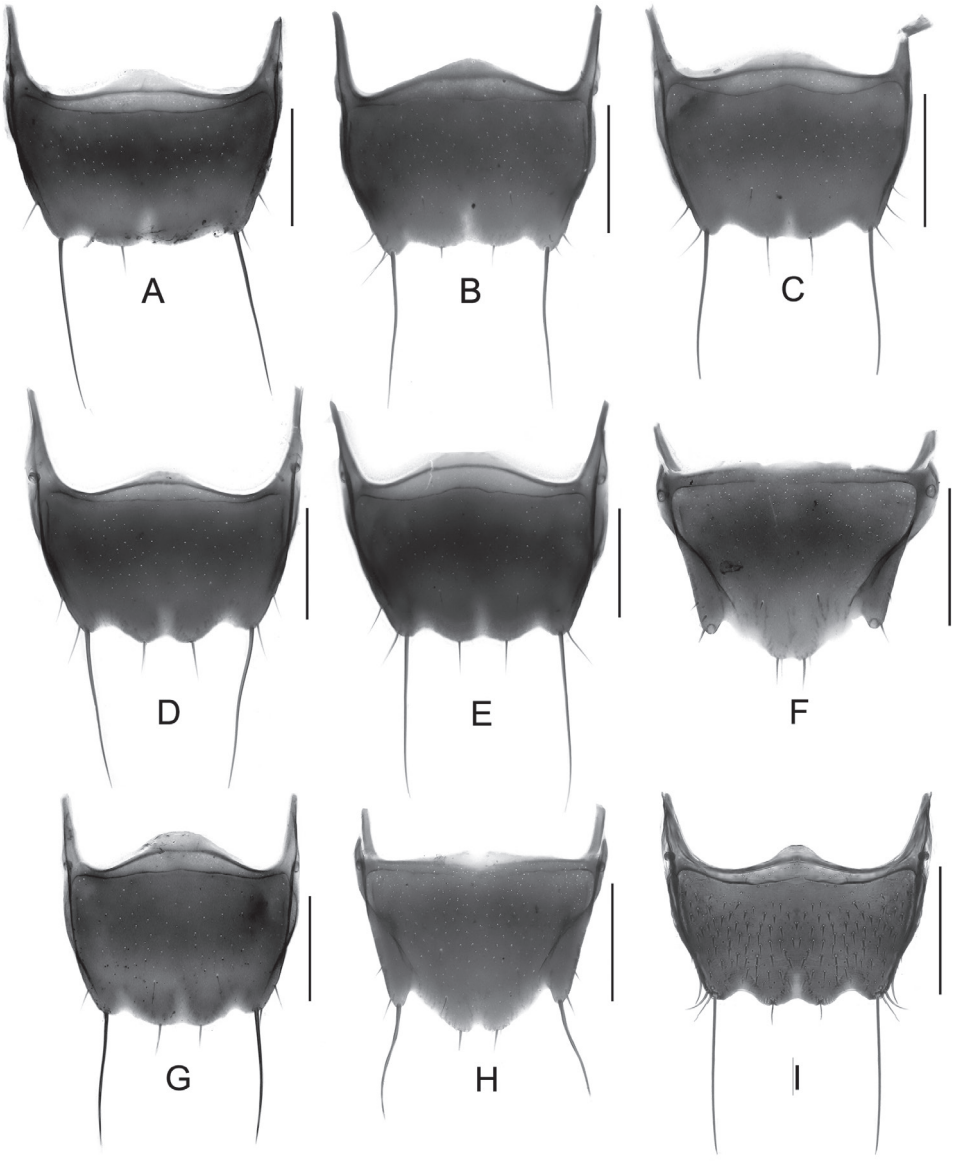

Figure 11. Dorsal view of male tergite VIII. **A** *Tachinus armatus* **B** *T. cavazzutii* **C** *T. coronatus* **D** *T. hercules* **E** *T. hujiayaoi* **F** *T. jiuzhaigouensis* **G** *T. linzhiensis* **H** *T. lohsei* **I** *T. maderianus*. Scales: 0.3 mm.

Remarks. *Tachinus lohsei* can be separated from the other species of the group by its small size, the broadly yellow lateral margins of the pronotum, and the different primary and secondary sexual characters. The species is very similar to *T. jiuzhaigouensis*, but the male is distinguished by the different, more rounded apical part of the parameres, the female by the different shape of the median lobe of tergite VIII.

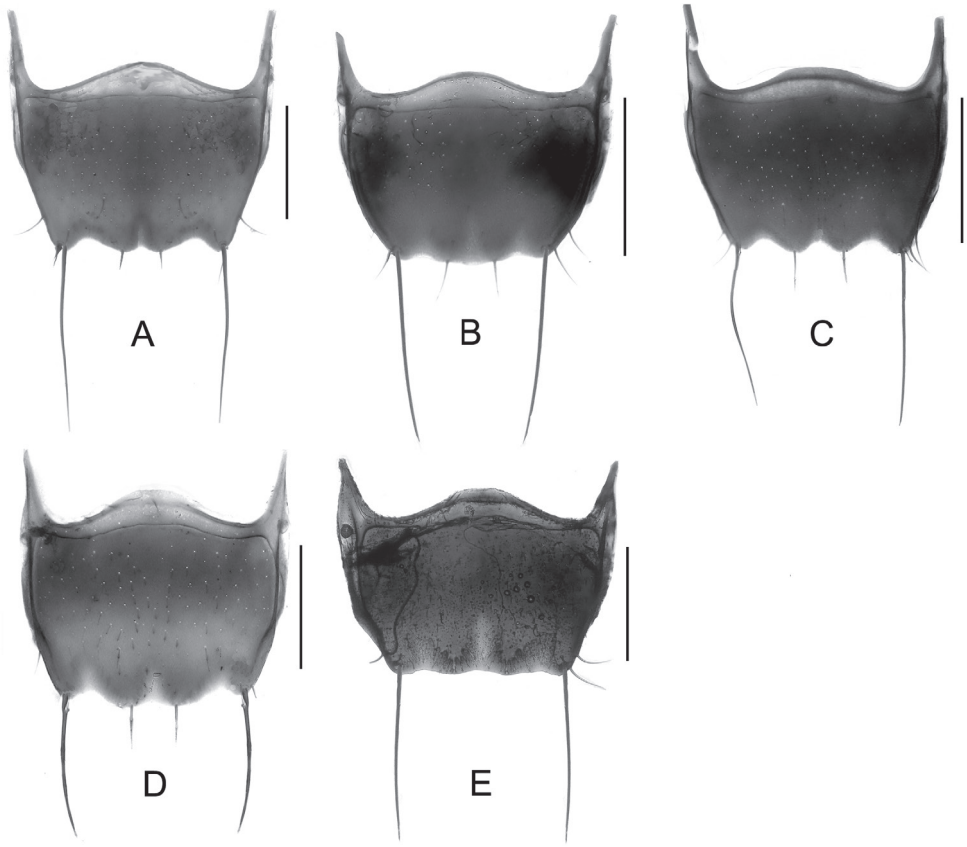

Figure 12. Dorsal view of male tergite VIII. **A** *Tachinus mengdaensis* **B** *T. oblongoelytratus* **C** *T. parahercules* **D** *T. paralinzhiensis* **E** *T. yini*. Scales: 0.3 mm.

***Tachinus* (*s. str.*) *maderi* Bernhauer**
http://species-id.net/wiki/Tachinus_maderi
Figs 8A, 8B, 18I, 20I, 21I

Tachinus (*s. str.*) *maderi* Bernhauer, 1939: 156 f.
Tachinus (*s. str.*) *maderi*: Ullrich 1975: 278.

Type locality. China, Sichuan Province, Kangding.

Type material examined. Holotype ♀ (Fig. 8A, 8B): **CHINA**, "[old mounting plate] / Tatsienlu–Kiulung China Em. Reitter / Maderi Brnh. typus unic. *Tachinus* / *Tachinus Maderi* Brh. Typus unic. / Chicago NHMus. M. Bernhauer Collection / Lectotypus des. W.G. Ullrich 1973 5689 / *Tachinus maderi* Bernh. 1 ♀, W.G. Ullrich vid. 5689 / HOLOTYPUS– ♀ *Tachinus* (*Tachinus*) *maderi* Bernh., 1939 M. Schülke 2007 / *Tachinus* (*Tachinus*) *maderi* Bernhauer det. M. Schülke 2007".

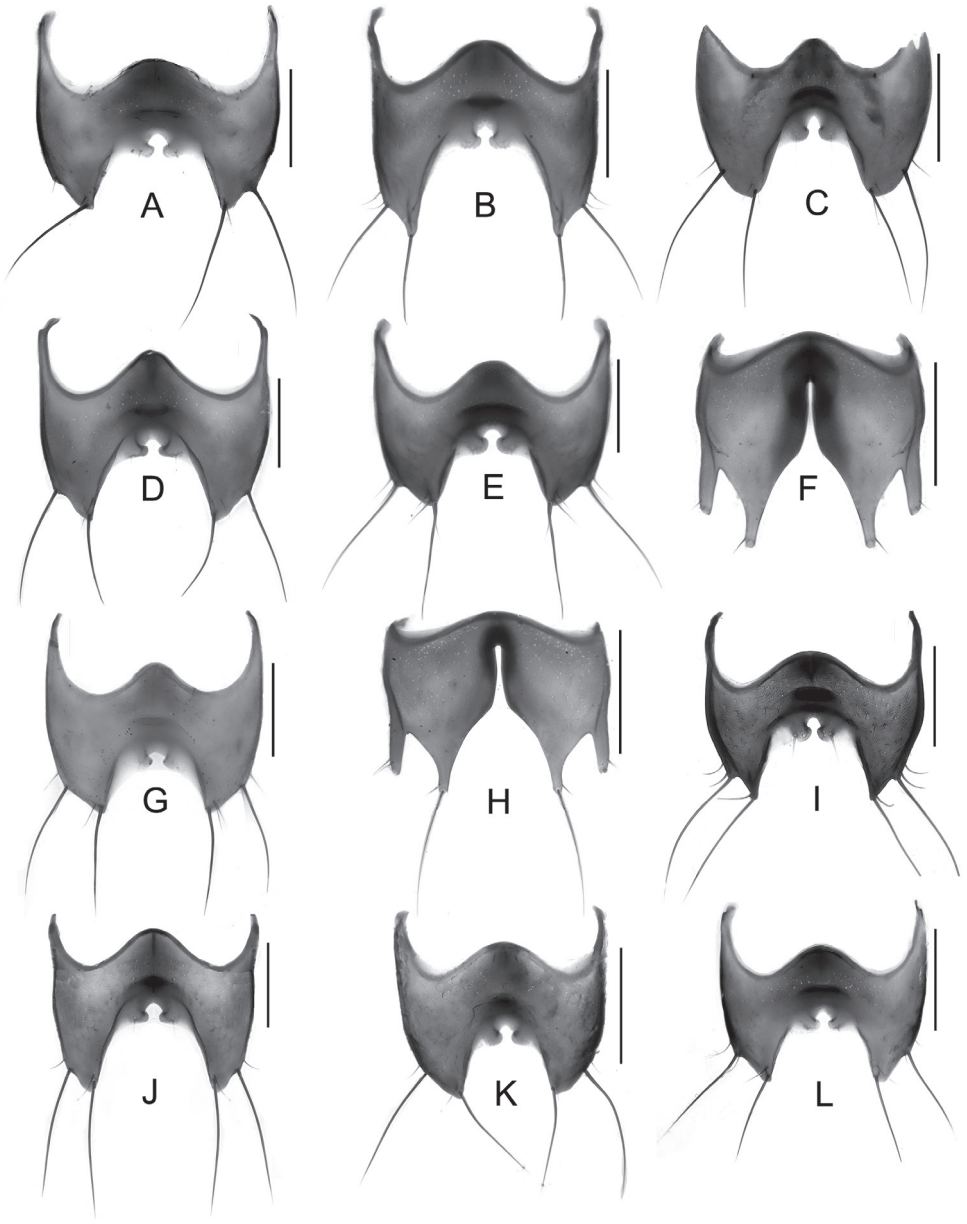

Figure 13. Ventral view of male sternite VIII. **A** *Tachinus armatus* **B** *T. cavazzutii* **C** *T. coronatus* **D** *T. hercules* **E** *T. hujiayaoi* **F** *T. jiuzhaigouensis* **G** *T. linzhiensis* **H** *T. lohsei* **I** *T. maderianus* **J** *T. mengdaensis* **K** *T. oblongoelytratus* **L** *T. parahercules*. Scales: 0.3 mm.

Description. Measurements of female holotype: BL 4.63; FL 3.90; PL 1.07; EL 1.80; SEL 0.34; HW 0.93; PW 1.61; EW 1.78; relative length of antennomeres I–XI: 16 : 9 : 10 : 6.5 : 10 : 8 : 9 : 9 : 8.5 : 8.5 : 16.

Body (Fig. 8A) dark brown to black; margins of elytra, mouthparts, basal four antennomeres and legs paler brown.

Head slightly transverse, HW : PW = 0.58, surface almost without punctation, microsculpture consisting of irregular striae. Antennomeres X only slightly shorter than wide.

Pronotum: PL : PW = 0.67; surface only with very fine and sparse punctation, microsculpture consisting of irregular, mostly transverse striae.

Elytra elongate, EL : EW = 1.01, EL : PL = 1.68, EW : PW = 1.11; inner part of posterior margin distinctly produced, forming a distinct angle. Surface of elytra with uneven and sparse punctation, microsculpture distinct, consisting of fine rhomboid or somewhat transverse meshes.

Abdomen with microsculpture consisting of transverse striae, punctation moderately coarse and dense.

Male. Unknown.

Female. Posterior margin of tergite VIII (Fig. 18I) sinuate, without obvious median lobes, but with short acute lobes at lateral angles, each with one pair of long setae. Sternite VIII (Fig. 20I) with fimbriate median lobes nearly fused; sublateral lobes as long as median ones.

Remarks. Females of this species are distinguished from those of all other species by the slender habitus with exceptionally elongate elytra; from all species except the similar *T. armatus* and *T. parahercules* by the shape of tergite VIII.

Tachinus (*s. str.*) *maderianus* Feng & Li, sp. n.

http://zoobank.org/C486F05A-C320-4BA1-8709-C268C9CD3D8B
http://species-id.net/wiki/Tachinus_maderianus
Figs 5A, 5B, 9I, 10I, 11I, 13I, 16C, 19A, 20J, 21J

Type locality. China, Sichuan, Jiulong, Wahuishan Mountain.

Type material. Holotype: ♂, **CHINA**: Sichuan Prov., Ganzi A. R., Jiulong County, Wahuishan, alt. 3,900 m, 26.viii.2005, [collector unknown] (SNUC). **Paratypes**: 2 ♂♂, 4 ♀♀, same label data as holotype; 1 ♂, 2 ♀♀, **CHINA**: Sichuan Prov., Ganzi A. R., Jiulong County, Wuxuhai, alt. 3,700 m, 18.viii.2005, [collector unknown] (SNUC).

Description. Measurements of males: BL 4.26–4.39; FL 3.34–3.39; PL 0.99–1.01; EL 1.55–1.57; SEL 0.11–0.17; HW 0.83–0.89; PW 1.44–1.46; EW 1.61–1.72; relative length of antennomeres I–XI: 24 : 15 : 15 : 8 : 15 : 13 : 13 : 11 : 12 : 12 : 25. Measurements of females: BL 4.67–4.73; FL 4.00–4.11; PL 0.99–1.01; EL 1.78–1.83; SEL 0.38–0.40; HW 0.88–0.90; PW 1.53–1.56; EW 1.88–1.90; relative length of antennomeres I–XI: 25 : 15 : 18 : 10 : 14 : 14 : 14 : 14 : 14 : 14 : 24.

Body (Figs 5A, 5B) dark brown to black; mouthparts, basal four antennomeres and legs reddish brown.

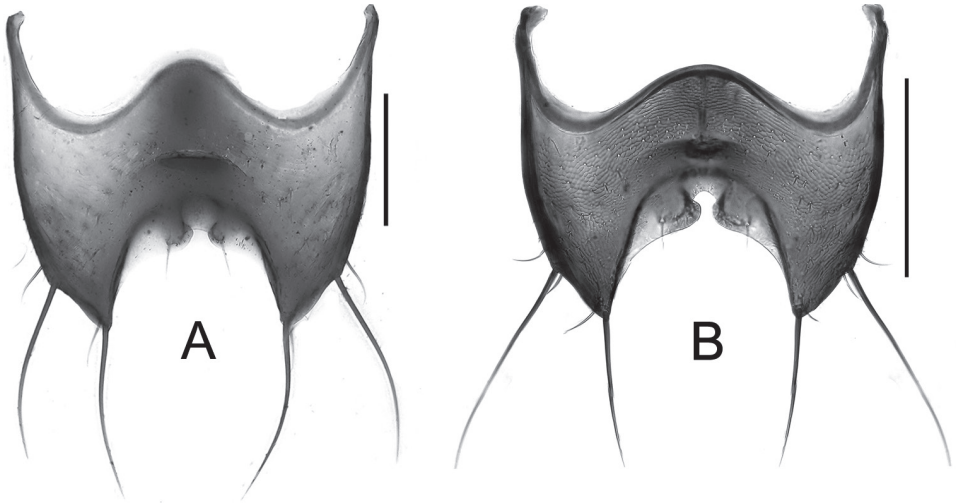

Figure 14. Ventral view of male sternite VIII. **A** *Tachinus paralinzhiensis* **B** *T. yini*. Scales: 0.3 mm.

Head slightly transverse, HW : PW = 0.56–0.62, surface with fine punctation and dense microsculpture consisting of meshes. Antennomeres X distinctly shorter than wide in male, but slightly shorter than wide in female.

Pronotum: PL : PW = 0.68–0.70 (male), PL : PW = 0.63–0.66 (female); surface with punctation similar to that of head, microsculpture consisting of transverse striae.

Elytra: EL : PL = 1.53–1.59, EL : EW = 0.90–0.98, EW : PW = 1.10–1.19 in males; EL : PL = 1.76–1.85, EL : EW = 0.94–0.97, EW : PW = 1.21–1.24 in females; surface with coarser punctation than head and pronotum, microsculpture consisting of transverse meshes.

Abdomen with microsculpture consisting of transverse striae, punctation moderately coarse and dense.

Male. Posterior margin of elytra broadly rounded. Sternite VII (Figs 9I, 10I) with apical margin broadly and deeply emarginate, apical margin bent ventrad, with very broad area of coarse granules. Tergite VIII as in Fig. 11I, all four lobes nearly fused, forming a sinuate apical margin. Sternite VIII as in Fig. 13I. Median lobe of aedeagus (Fig. 16C) as wide as, and longer than parameres, parameres forming one apically truncate plate.

Female. Inner part of posterior margin of elytra distinctly produced, forming a distinct angle. Posterior margin of tergite VIII (Fig. 19A) without distinct lobes, lateral angles each with only one long seta. Sternite VIII (Fig. 20J) with fimbriate median lobes separated by a shallow emargination; sublateral lobes as long as median ones.

Etymology. The specific name (adjective) is derived from the name of the Austrian entomologist Leopold Mader (1886–1961), referring to the similarity of this species to *T. maderi*.

Remarks. Males can be separated from those of other species by the shape of the very broadly bent portion of sternite VII, as well as by the shape of the parameres, and the apical projection of the median lobe of the aedeagus. Females are distinguished by the shape of the apical margin of tergite VIII.

Tachinus (*s. str.*) *mengdaensis* Feng, Li & Schülke, sp. n.

http://zoobank.org/98CD1D38-3279-4E87-ABB4-A87607E0A7F0
http://species-id.net/wiki/Tachinus_mengdaensis
Figs 5C, 5D, 9J, 10J, 12A, 13J, 16D, 19B, 20K, 22A

Type locality. China, Qinghai Province, Xining, Mengda Natural Reserve.

Type material. Holotype: ♂, **CHINA**: Qinghai Prov., Xining City, Xunhua County, Mengda N. R., alt. 2,200–2,500 m, 24.vii.2004, HU, TANG & ZHU leg. (SNUC). **Paratypes**: 18 ♂♂, 27 ♀♀, same label data as the holotype (SNUC); 4 ♂♂, **CHINA**: Gansu Prov., Dagcanglhamo (= Langmusi), 34°04.6'N, 102°37.7'E, 3644 m, J. Hájek, D. Král & J. Růžička leg [date unknown]. (NMP, cSch); 3 ♂♂, 7 ♀♀, **CHINA**: Gansu Prov., Hue er Ge, 5 km SSW Luqu, 3,400 m, 13.vii.1994, A. Smetana leg. (cSme, cSch); ♂, ♀, **CHINA**: Gansu Prov., Xiahe env., 3,000–3,200 m, 28.vii.–3.viii.1993, W. Heinz leg. (cSme); ♀, **CHINA**: Sichuan Prov., S of Langmusi, forest, 3,400–3,500 m, 13–14.VII.1994, K.W. Anton leg. (cSme); 4 ♀♀, **CHINA**: Sichuan Prov., Langmusi, 3,600 m, 14.vii.1994, A. Smetana leg. (cSme, cSch); 5 ♂♂, 4 ♀♀, **CHINA**: Sichuan Prov., Langmusi, 3,500 m, 13.vii.1994, A. Smetana leg. (cSme, cSch).

Description. Measurements of males (holotype): BL 4.23–4.34 (4.24); FL 2.84–2.95 (2.84); PL 0.88–0.90 (0.89); EL 1.28–1.33 (1.33); SEL 0.10–0.12 (0.12); HW 0.82–0.84 (0.83); PW 1.39–1.45 (1.45); EW 1.56–1.67 (1.56); relative length of antennomeres I–XI: 23 : 15 : 17 : 10 : 14 : 16 : 16 : 16 : 14 : 14 : 27. Measurements of females: BL 4.17–4.34; FL 3.34–3.50; PL 0.95–1.00; EL 1.45–1.50; SEL 0.16–0.18; HW 0.71–0.83; PW 1.39–1.50; EW 1.67–1.78; relative length antennomeres I–XI: 24 : 14 : 16 : 10 : 15 : 14 : 14 : 15 : 15 : 16 : 30.

Body (Figs 5C, 5D) reddish to dark brown; mouthparts, margins of pronotum and posterior margin of tergites reddish brown; basal four antennomeres and legs yellowish brown.

Head slightly transverse, HW : PW = 0.47–0.60 (0.57); surface with very fine and sparse punctation, sometimes invisible in the pronounced microsculpture; microsculpture consisting of irregular striae. Antennomeres X slightly shorter than wide.

Pronotum: PL : PW = 0.61–0.72 (0.61); surface with microsculpture consisting of transverse striae, punctation similar to that of head.

Elytra: EL : PL = 1.42–1.51 (1.49), EL : EW = 0.77–0.85 (0.85), EW : PW = 1.08–1.20 (1.08) in males; EL : PL = 1.45–1.58, EL : EW = 0.81–0.90, EW : PW = 1.11–1.28 in females; surface with more distinct punctation than head and pronotum, microsculpture consisting of transverse meshes.

Abdomen with fine punctation, microsculpture consisting of transverse waves.

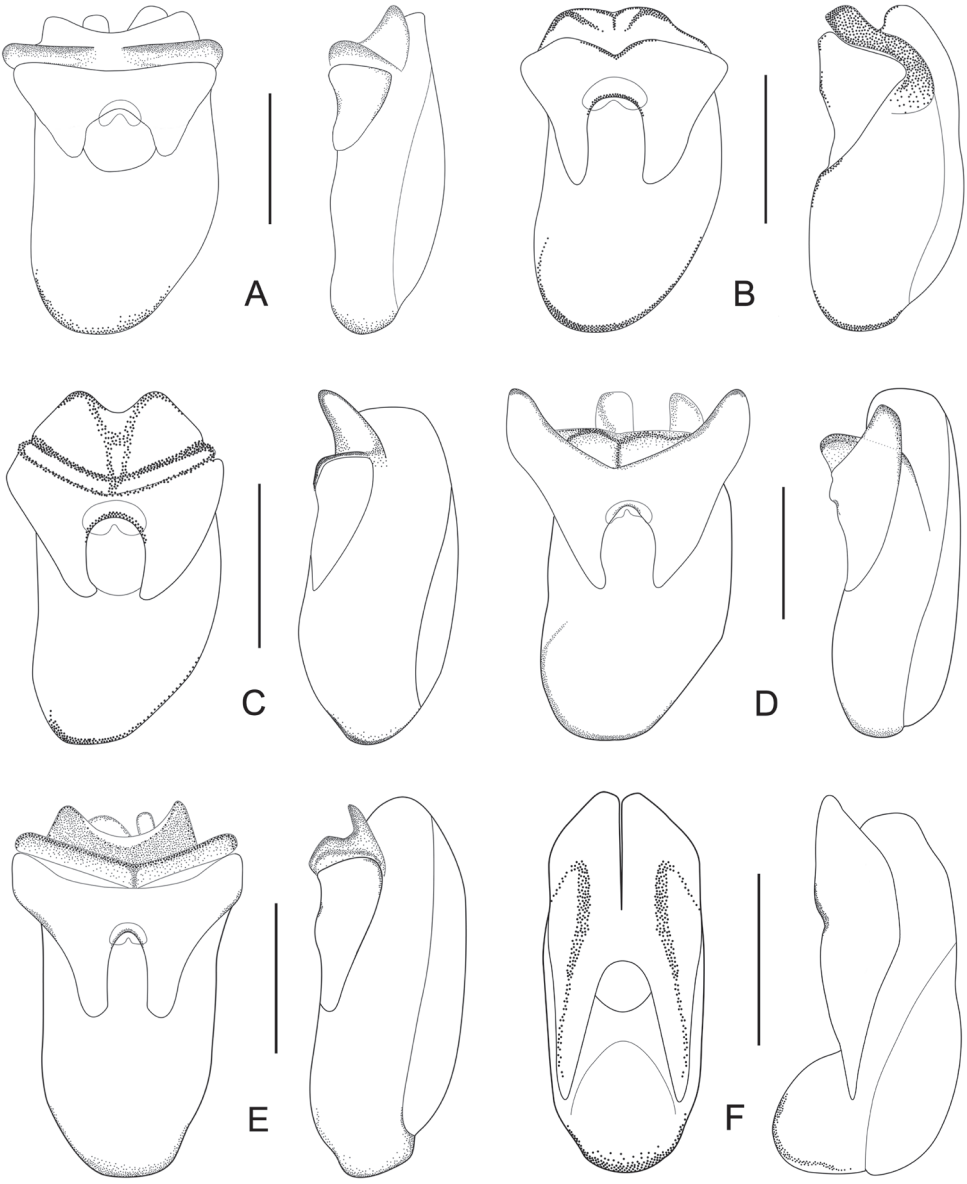

Figure 15. Ventral and lateral view of aedeagus (left: ventral view; right: lateral view). **A** *Tachinus armatus* **B** *T. cavazzutii* **C** *T. coronatus* **D** *T. hercules* **E** *T. hujiayaoi* **F** *T. jiuzhaigouensis*. Scales: 0.3 mm.

Male. Posterior margin of sternite VII (Figs 9J, 10J) with broad triangular emargination medially, apical margin bent ventrad, with broad area of coarse granules. Tergite VIII as in Fig. 12A, all four lobes nearly fused, forming a sinuate apical margin. Sternite VIII as in Fig. 13J. Median lobe of aedeagus (Fig. 16D) broad and projecting

beyond apices of parameres, apical portion of median lobe in lateral view with belt-shaped projection.

Female. Pronotum with microsculpture more distinct, forming more regular transverse meshes. Elytra distinctly longer than in male, apical margins broadly rounded. Tergite VIII (Fig. 19B) transverse, lobes nearly fused, posterior margin of median lobe broadly rounded, lateral lobes each with only one pair of long setae. Fimbriate median lobes of sternite VIII (Fig. 20K) separated by a shallow emargination, slightly shorter than sublateral lobes.

Etymology. The specific name (adjective) is derived from "Mengda", the type locality of this species.

Remarks. This new species can be separated from the other species by the triangular emargination of the apical margin of the male sternite VII, the belt-like projection (lateral view) of the aedeagal median lobe, the shape of the aedeagal parameres, and the broadly rounded median lobe of the female tergite VIII.

***Tachinus* (*s. str.*) *oblongoelytratus* Feng & Li, sp. n.**
http://zoobank.org/30F34AF6-F3F5-4A8F-BAB8-0A94AECCF38E
http://species-id.net/wiki/Tachinus_oblongoelytratus
Figs 6A, 6B, 9K, 10K, 12B, 13K, 16E, 19C, 20L, 22B

Type locality. China, Sichuan, Emeishan.

Type material. Holotype: ♂, **CHINA**: Sichuan Prov. Emeishan City, Mt. Emei, 17.vii.2003, Li-Zhen LI leg. (SNUC). **Paratypes**: 27 ♂♂, 14 ♀♀, same label data as the holotype (SNUC); 7 ♂♂, **CHINA**: Sichuan Prov. Emeishan City, Mt. Emei, 1.viii.2001, LI & ZHAO leg. (SNUC).

Description. Measurements of males (holotype): BL 3.95–4.17 (4.17); FL 2.89–2.95 (2.95); PL 0.88–0.89 (0.88); EL 1.39–1.50 (1.50); SEL 0.10–0.12 (0.12); HW 0.82–0.84 (0.83); PW 1.38–1.40 (1.39); EW 1.55–1.57 (1.56); relative length of antennomeres I–XI: 23 : 14 : 15 : 10 : 13 : 14 : 15 : 12 : 14 : 13 : 26. Measurements of females: BL 4.61–4.89; FL 3.61–3.70; PL 0.89–1.00; EL 1.61–1.72; SEL 0.16–0.18; HW 0.88–0.90; PW 1.49–1.51; EW 1.78–1.83; relative length of antennomeres I–XI: 25 : 14 : 15 : 8 : 15 : 14 : 15 : 13 : 13 : 15 : 30.

Body (Figs 6A, 6B) dark brown to black; head, pronotal disc, elytra and abdomen black; mouthparts, basal four antennomeres, posterior margin of pronotum, posterior margins of posterior abdominal tergites and legs reddish brown.

Head slightly transverse, HW : PW = 0.58–0.61 (0.60); surface with sparse fine punctation, microsculpture consisting of fine striae. Antennomeres X shorter than wide.

Pronotum transverse, PL : PW = 0.59–0.67 (0.63); surface with punctation similar to that of head, microsculpture consisting of transverse striae.

Elytra: EL : PL = 1.56–1.70 (1.70), EL : EW = 1.56–1.70 (0.96), EW : PW = 1.11–1.14 (1.12) in males; EL : PL = 1.61–1.93, EL : EW = 0.88–0.97, EW : PW = 1.18–1.23 in females; apical margin broadly rounded; surface with punctation denser and coarser than that of pronotum, microsculpture consisting of fine transverse meshes.

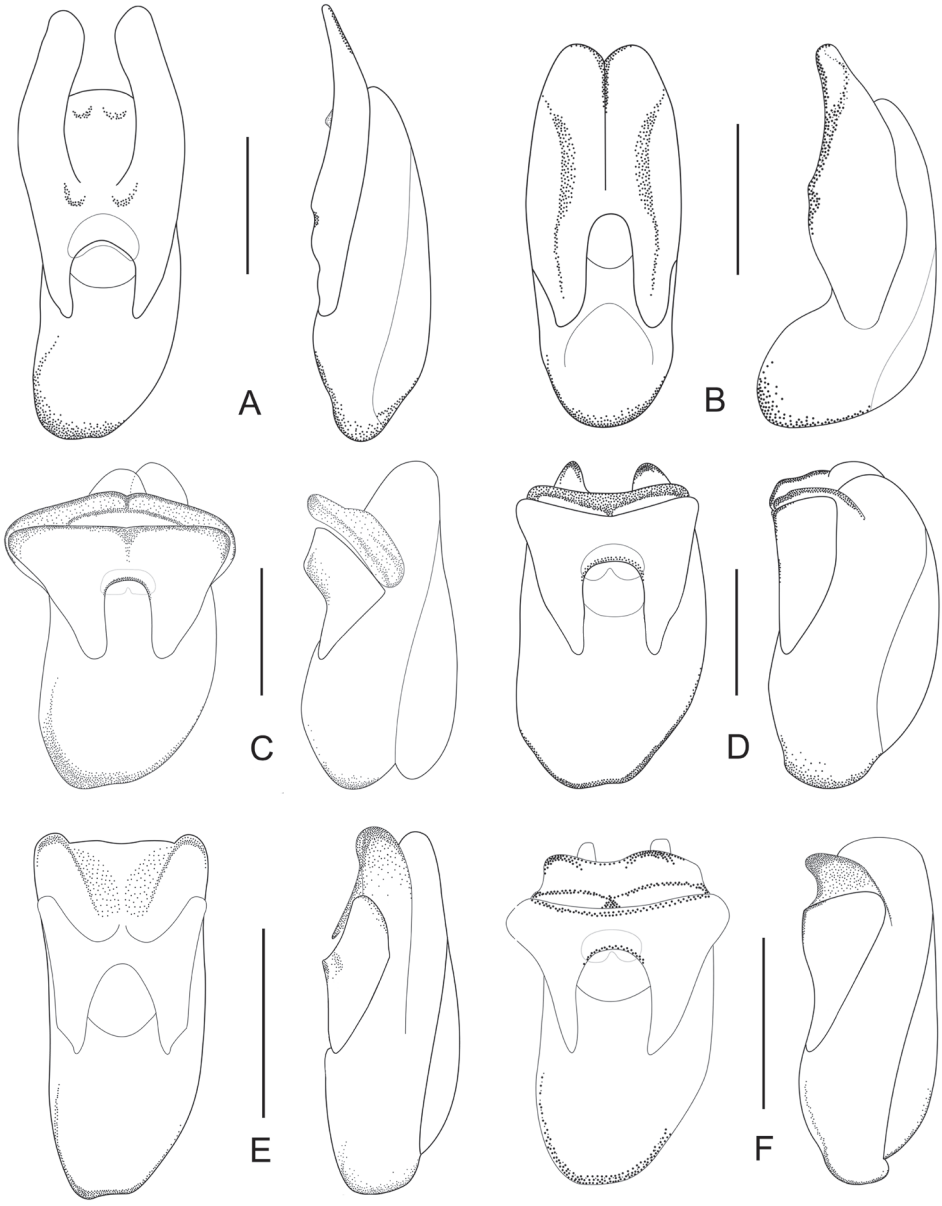

Figure 16. Ventral and lateral view of aedeagus (left: ventral view; right: lateral view). **A** *Tachinus linzhiensis* **B** *T. lohsei* **C** *T. maderianus* **D** *T. mengdaensis* **E** *T. oblongoelytratus* **F** *T. parahercules*. Scales: 0.3 mm.

Male. Sternite VII (Figs 9K, 10K) with semicircular emargination at posterior margin, apical margin bent ventrad, strongly projecting, with large area of coarse granules. Tergite VIII (Fig. 12B) with apical lobes almost fused, forming a sinuate apical margin. Sternite VIII as in Fig. 13K. Median lobe of aedeagus (Fig. 16E) broad and much longer than parameres, apical portion with paired projection.

Female. Elytra only slightly longer than in male, apical margins broadly rounded, only weakly produced near sutural angle. Tergite VIII (Fig. 19C) trilobed, median lobe triangular and broad, lateral lobes short, each with one long seta. Fimbriate median lobes of sternite VIII (Fig. 20L) separated by shallow emargination, sublateral lobes slightly shorter than median ones.

Etymology. The specific name (adjective) is a combination of the Latin adjective "oblongus" and the Greek word "elytron". It refers to the long elytra.

Remarks. Males of this species can be separated from those of the other species of the group by the unique shape of the aedeagus, females by the long median lobe and the chaetotaxy of the lateral lobes (each with one long seta) of tergite VIII.

Tachinus (*s. str.*) *parahercules* Feng, Li & Schülke, sp. n.

http://zoobank.org/7E4002F7-7564-45AF-91F6-6FFC5CB86818
http://species-id.net/wiki/Tachinus_parahercules
Figs 6C, 6D, 9L, 10L, 12C, 13L, 16F, 19D, 20M, 22C

Type locality. China, Sichuan, Aba A. R., Songpan, Huanglongsi.

Type material. Holotype: ♂, **CHINA**: Sichuan Prov., Aba A. R., Songpan county, Huanglongsi, 24.vii.2001, LI & ZHAO leg. (SNUC). **Paratypes**: 20 ♂♂, 18 ♀♀, same label data as the holotype (SNUC); 2 ♀♀, **CHINA**: N–Sichuan [CH12–19] 47 km N Songpan, road S 301 km 118, N Gongangling pass, 33°03'15"N, 103°43'36"E, 3390 m, spruce forest with shrubs, litter, moss, and mushrooms sifted, 9.viii.2012, leg. M. Schülke (cSch); ♀, **CHINA**: [19] N–Sichuan N Songpan, 33°03'15"N, 103°43'36"E, 3390 m, spruce forest, sifted, 9.viii.2012, V. Assing (cAss).

Description. Measurements of males (holotype): BL 3.39–4.23 (4.23); FL 2.89–3.39 (3.39); PL 0.89–1.00 (1.00); EL 1.45–1.50 (1.50); SEL 0.10–0.12 (0.12); HW 0.82–0.84 (0.83); PW 1.33–1.45 (1.45); EW 1.56–1.67 (1.67); relative length of antennomeres I–XI: 24 : 15 : 15 : 8 : 15 : 13 : 13 : 13 : 13 : 13 : 26. Measurements of females: BL 4.06–4.45; FL 3.28–3.37; PL 0.95–1.00; EL 1.45–1.62; SEL 0.28–0.33; HW 0.88–0.90; PW 1.45–1.50; EW 1.83–1.89; relative length of antennomeres I–XI: 22 : 15 : 18 : 9 : 15 : 12 : 14 : 13 : 14 : 14 : 25.

Body (Figs 6C, 6D) dark brown to black; head black; disc of pronotum reddish brown to dark brown; mouthparts, basal four antennomeres, posterior margin of elytra, and posterior margin of abdominal tergites reddish brown. Sometimes elytra paler and with reddish brown humeral spot.

Head slightly transverse, HW : PW = 0.57–0.63 (0.57); surface with microsculpture consisting of irregular striae, punctation fine and sparse. Antennomeres X distinctly transverse in male, but slightly shorter than wide in female.

Pronotum: PL : PW = 0.61–0.75 (0.69); surface with microsculpture consisting of transverse striae, punctation similar to that of head.

Elytra, EL : PL = 1.45–1.69 (1.50), EL : EW = 0.87–0.96 (0.90), EW : PW = 1.08–1.26 (1.15) in males; EL : PL = 1.45–1.71, EL : EW = 0.77–0.89, EW : PW

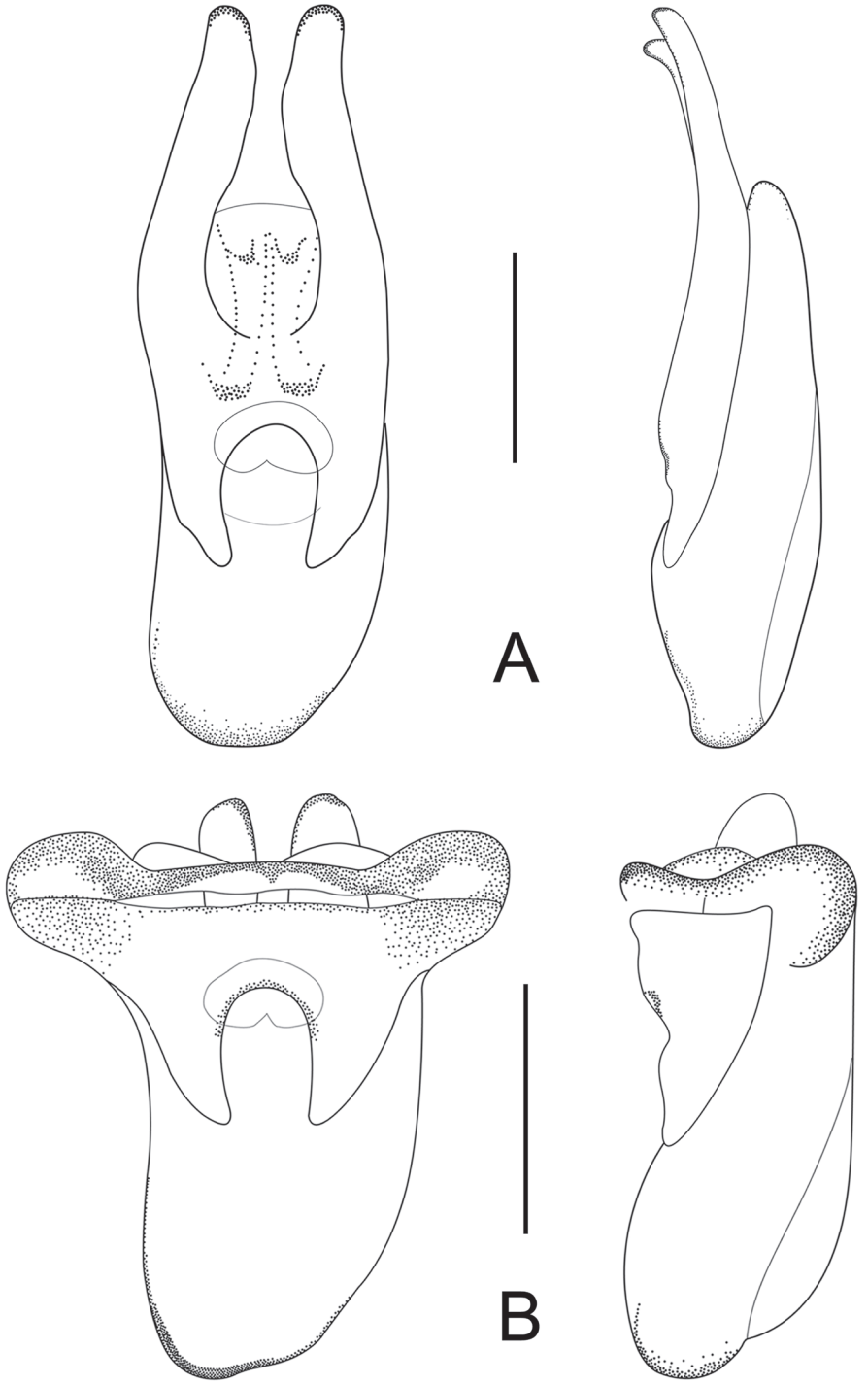

Figure 17. Ventral and lateral view of aedeagus (left: ventral view; right: lateral view). **A** *Tachinus paralinzhiensis* **B** *T. yini*. Scales: 0.3 mm.

= 1.22–1.30 in females; punctation denser and coarser than on head and pronotum, microsculpture consisting of transverse meshes.

Abdomen with denser and finer punctation than elytra; surface with microsculpture consisting of transverse striae.

Male. Sternite VII (Figs 9L, 10L) as in *T. cavazzutii*, apical emargination narrower. Tergite VIII as in Fig. 12C, all four lobes nearly fused, forming an almost regularly sinuate apical margin. Sternite VIII as in Fig. 13L. Aedeagus (Fig. 16F) with broad median lobe projecting beyond the apices of the parameres, parameres slightly broader than the median lobe; apical margin of median lobe with projection directed ventrad in lateral view.

Female. Elytra distinctly longer than in male, with inner part of posterior margin distinctly produced, forming a distinct angle. Microsculpture more distinct, consisting of short, irregular, transverse or rhomboid meshes. Apical lobes of tergite VIII (Fig. 19D) almost fused, forming a smooth to sinuate apical margin, lateral angles each with one pair of long setae. Fimbriate median lobes of sternite VIII (Fig. 20M) completely fused, sublateral lobes slightly longer than median one.

Etymology. The specific name is a combination of the prefix "para" and "hercules" (noun in apposition). It alludes to the similarity of this species to *T. hercules*.

Remarks. Males of this new species are similar to those of *T. hercules*, they can be separated from *T. hercules* by the different shape of the apical emargination of sternite VII, and by the size of the parameres. Females are distinguished by the shape of the apical margin of tergite VIII.

***Tachinus* (*s. str.*) *paralinzhiensis* Feng & Li, sp. n.**
http://zoobank.org/DB5CCBA7-4570-4438-9AF6-351D1340B511
http://species-id.net/wiki/Tachinus_paralinzhiensis
Figs 7A, 7B, 9M, 10M, 12D, 14A, 17A, 19E, 20N, 22D

Type locality. China, Tibet A. R., Milin, Duoxiongla Mountain.

Type material. Holotype: ♂, **CHINA**: Tibet A. R., Milin County, North Duoxiongla Pass, alt. 3,650–3,800 m, 29.viii.2005, Liang TANG leg. (SNUC). **Paratypes**: 6♂♂, 7♀♀, same label data as the holotype (SNUC); 26♂♂, 12♀♀, **CHINA**: Tibet A. R., Linzhi County, Sejila Pass, alt. 4,700 m, 2.viii.2005, Liang TANG leg. (SNUC); 22 ♂♂, 15♀♀, **CHINA**: Tibet A. R., Linzhi County, Mt. Sejila, alt. 3,700 m, 5.viii.2005, Liang TANG leg. (SNUC).

Description. Measurements of males (holotype): BL 3.56–3.86 (3.56); FL 2.88–2.90 (2.89); PL 0.83–0.89 (0.89); EL 1.33–1.50 (1.50); SEL 0.11–0.14 (0.11); HW 0.82–0.84 (0.83); PW 1.32–1.34 (1.33); EW 1.44–1.46 (1.45); relative length of antennomeres I–XI: 21 : 15 : 15 : 9 : 12 : 13 : 14 : 13 : 12 : 12 : 25. Measurements of females: BL 4.73–5.00; FL 3.39–3.78; PL 0.99–1.01; EL 1.67–1.89; SEL 0.14–0.22; HW 0.89–1.00; PW 1.50–1.67; EW 1.77–1.79; relative length of antennomeres I–XI: 22 : 15 : 15 : 10 : 15 : 15 : 15 : 14 : 14 : 14 : 26.

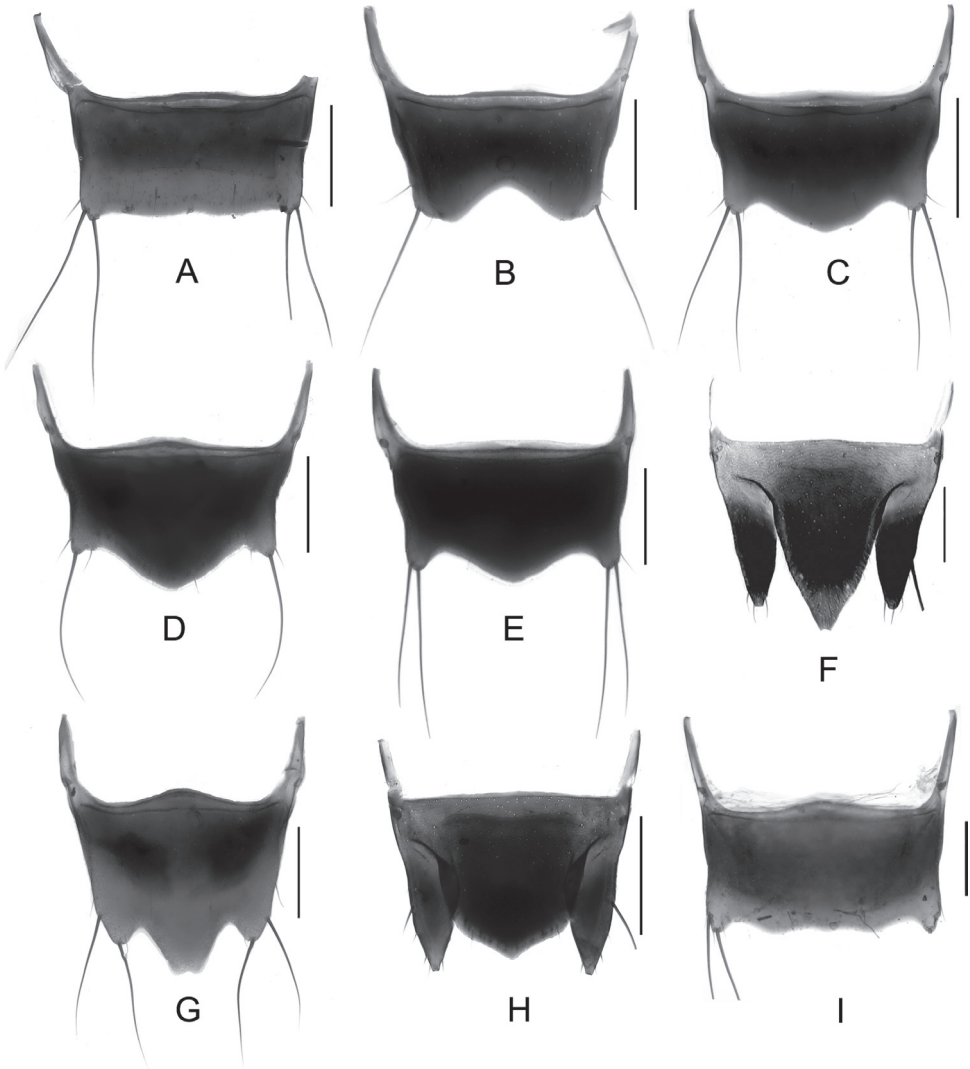

Figure 18. Ventral view of female tergite VIII. **A** *Tachinus armatus* **B** *T. cavazzutii* **C** *T. coronatus* **D** *T. hercules* **E** *T. hujiayaoi* **F** *T. jiuzhaigouensis* **G** *T. linzhiensis* **H** *T. lohsei* **I** *T. maderi*. Scales: 0.2 mm.

Body (Figs 7A, 7B) dark brown; mouthparts, segments I–IV of antennae, elytra and legs reddish brown.

Head slightly transverse, HW : PW = 0.53–0.67 (0.62); surface with fine and sparse punctation and microsculpture consisting of irregular striae or meshes. Antennae moderately long, antennomeres X slightly shorter than wide.

Pronotum: PL : PW = 0.59–0.67 (0.67); surface with microsculpture radiating from punctures; punctation finer than that of head.

Elytra: EL : PL = 1.49–1.81 (1.69), EL : EW = 0.91–1.04 (1.03), EW : PW = 1.07–1.11 (1.09) in males; EL : PL = 1.65–1.91, EL : EW = 0.93–1.07, EW : PW = 1.06–1.19 in females; posterior margin broadly rounded. Surface with microsculpture consisting of transverse meshes; punctation coarser than that of pronotum.

Abdomen with coarse punctation, microsculpture consisting of transverse striae.

Male. Posterior margin of sternite VII (Figs 9M, 10M) with broad, shallow median emargination, apical margin bent ventrad, with large area of coarse granules. Tergite VIII (Fig. 12D) with apical lobes almost fused, forming sinuate apical margin. Sternite VIII as in Fig. 14A. Aedeagus (Fig. 17A) similar to that of *T. linzhiensis*, with short median lobe and long parameres. Parameres projecting beyond the apex of the median lobe by one third of the length of the median lobe.

Female. Elytra only slightly longer than in male, posterior margin broadly rounded, with distinct sutural emargination. Abdominal tergite VIII (Fig. 19E) similar to that of *T. linzhiensis*. Sternite VIII (Fig. 20N) with fimbriate median lobes separated by a shallow emargination. Median lobes slightly longer than sublateral ones.

Etymology. The specific name (adjective) is a combination of the Latin prefix "*para*" and "*linzhiensis*", alluding to the similarity of this species to *T. linzhiensis*.

Remarks. Males are distinguished from those of the other species of the group by the strongly elongate parameres of the aedeagus. Females are distinguished from those of all other species except *T. linzhiensis* by the shape of tergite VIII, from *T. linzhiensis* by the separate fimbriate lobes of sternite VIII.

***Tachinus* (*s. str.*) *yini* Feng, Li & Schülke, sp. n.**
http://zoobank.org/D5B7D6C1-74FD-4E30-9FF1-F29A729D589A
http://species-id.net/wiki/Tachinus_yini
Figs 7C, 7D, 9N, 10N, 12E, 14B, 17B, 19F, 20O, 22E

Type locality. China, Sichuan Province, Luding, Hailuogou Natural Reserve.

Type material. Holotype: ♂, **CHINA**: Sichuan Prov. Ganzi A. R., Luding County, Hailuogou, alt. 3,000 m, 21.vii.2006, HU & TANG leg. (SNUC). **Paratypes**: 17 ♂♂, 29 ♀♀, same data as for the holotype (SNUC); 95 ♂♂, 96 ♀♀, **CHINA**: Sichuan Prov., Gonggashan–Hailuogou, 29°35'N, 102°00'E, 2800–3200 m, 3–6.vii.1994, D. Král & J. Farkač leg. (cSme, cSch); 40 ♂♂, 41 ♀♀, **CHINA**: Sichuan Prov., Gongga Shan, Hailuogou, above Camp 3, 3050 m, 29°35'N, 102°00'E, 6.vii.1996, A. Smetana, J. Farkač & P. Kabátek leg. (cSme, cSch); 10 ♂♂, **CHINA**: Sichuan Prov., Gonggashan mts., 29°53'N, 102°01'E, 4000 m, 9.–11.vii.1994, D. Král & J. Farkač leg. (NHMB, cSch); 6 ♂♂, 5 ♀♀, **CHINA**: Sichuan Prov., Gongga Shan, Hailuogou, above Camp 3, 3200 m, 29°35'N, 102°00'E, 7.vii.1996, A. Smetana, J. Farkač & P. Kabátek leg. (cSme, cSch); 2 ♂♂, 1 ♀, **CHINA**: Sichuan Prov., Gongga Shan, Hailuogou, in front of glacier 1, 2850 m, 29°35'N, 102°00'E, 7.vii.1998, A. Smetana leg. (cSme, cSch); 1 ♂, **CHINA** : Sichuan, Gongga Shan, Hailuogou, above Camp 3, 3200 m, 7.VII. 1996 29°35'N, 102°00'E / collected by J. Farkač, P. Kabátek and A. Smetana (NHMB); 23

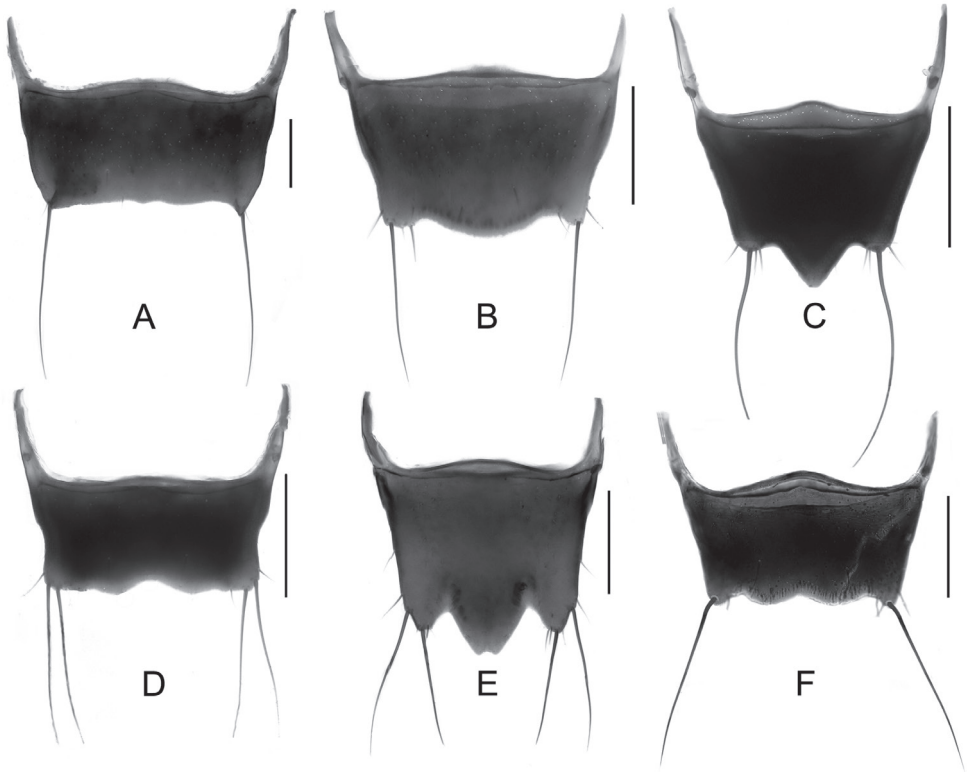

Figure 19. Ventral view of female tergite VIII. **A** *Tachinus maderianus* **B** *T. mengdaensis* **C** *T. oblongo-elytratus* **D** *T. parahercules* **E** *T. paralinzhiensis* **F** *T. yini*. Scales: 0.2 mm.

♂♂, 12 ♀♀, **CHINA**: W Sichuan, Rte. 138, 15 km W Kangding, 3250 m, 29°57'N, 101°54'E 19.VII.98, J. Král / 1998 China Expedition J. Farkač, D. Král, J. Schneider & A. Smetana (NHMB, cSch).

Description. Measurements of males (holotype): BL 3.61–4.00 (3.61); FL 2.95–3.11 (2.95); PL 0.89–0.95 (0.95); EL 1.50–1.56 (1.56); SEL 0.10–0.12 (0.12); HW 0.83–0.89 (0.89); PW 1.39–1.45 (1.45); EW 1.56–1.61 (1.61); relative length of antennomeres I–XI: 20 : 13 : 14 : 8 : 12 : 12 : 12 : 11 : 12 : 11 : 28. Measurements of females: BL 4.06–4.34; FL 3.50–3.67; PL 0.89–1.06; EL 1.50–1.71; SEL 0.27–0.29; HW 0.83–0.89; PW 1.39–1.57; EW 1.56–1.65; relative length of antennomeres I–XI: 20 : 14 : 15 : 9 : 13 : 13 : 14 : 12 : 13 : 14 : 27.

Body (Figs 7C, 7D) black; head, antennomeres V–XI, pronotum, disc of elytra and abdomen black; posterior margin of elytra, posterior margin of posterior abdominal tergites and legs reddish brown. Mouthparts and basal four antennomeres sometimes brownish.

Head slightly transverse, HW : PW = 0.53–0.64 (0.61), surface with fine and sparse punctation, sometimes invisible between microsculpture, microsculpture very

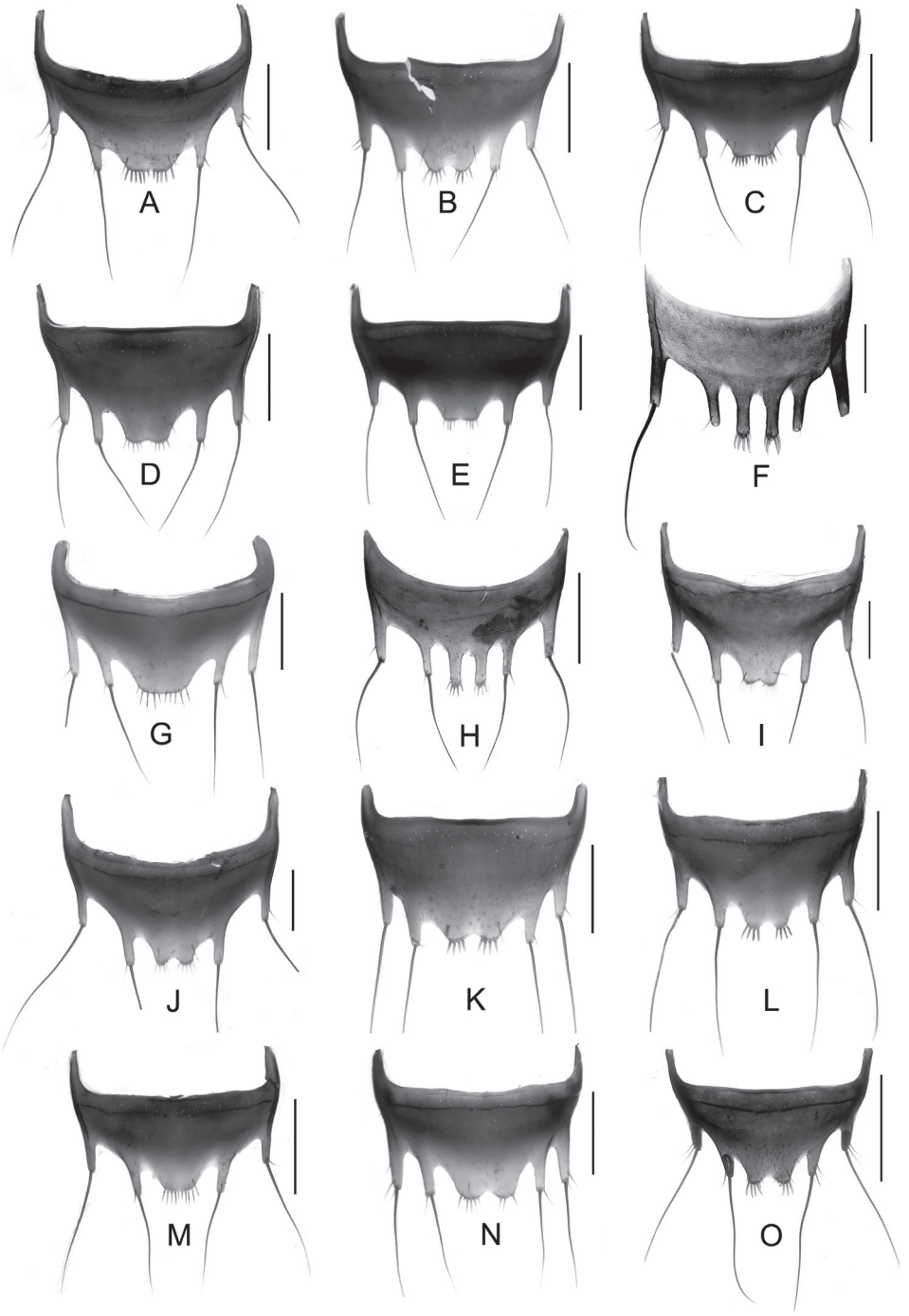

Figure 20. Ventral view of female sternite VIII. **A** *Tachinus armatus* **B** *T. cavazzutii* **C** *T. coronatus* **D** *T. hercules* **E** *T. hujiayaoi* **F** *T. jiuzhaigouensis* **G** *T. linzhiensis* **H** *T. lohsei* **I** *T. maderi* **J** *T. maderianus* **K** *T. mengdaensis* **L** *T. oblongoelytratus* **M** *T. parahercules* **N** *T. paralinzhiensis* **O** *T. yini*. Scales: 0.2 mm.

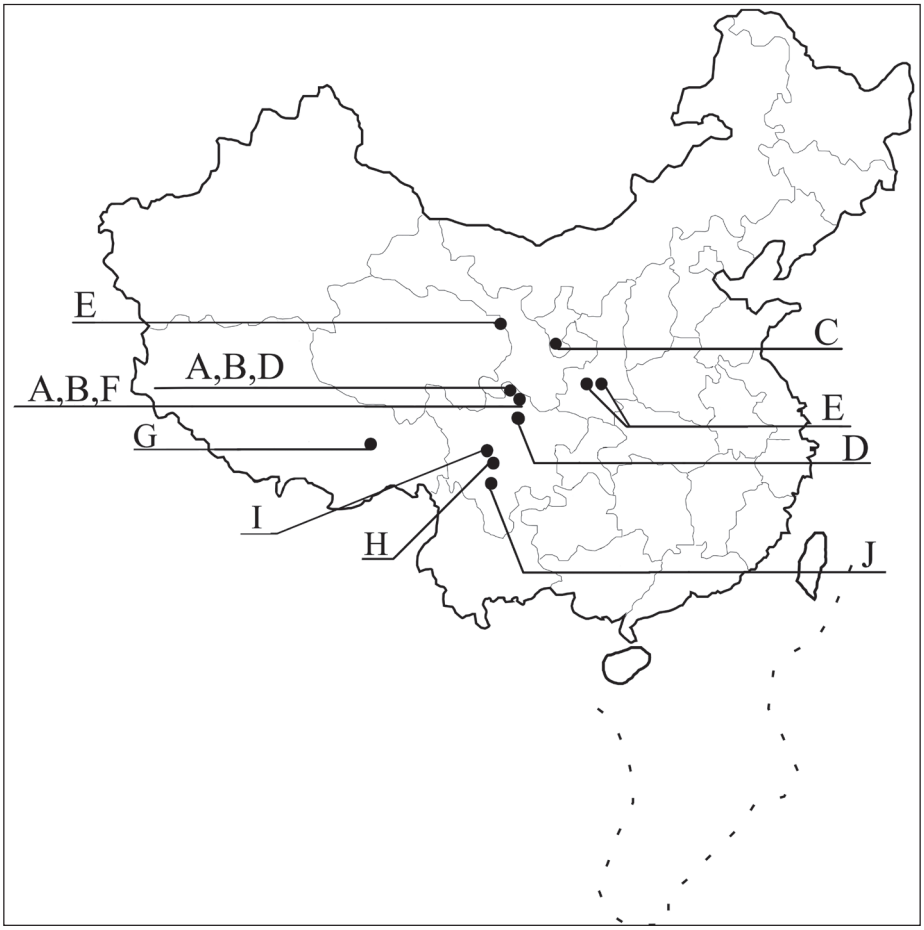

Figure 21. Distribution of the *silphaeformis* species group in China. **A** *Tachinus armatus* **B** *T. cavazzutii* **C** *T. coronatus* **D** *T. hercules* **E** *T. hujiayaoi* **F** *T. jiuzhaigouensis* **G** *T. linzhiensis* **H** *T. lohsei* **I** *T. maderi* **J** *T. maderianus*.

distinct, consisting of irregular meshes on disc, of more transvers meshes on posterior portion. Ocular setae fine but distinct. Antennomeres X shorter than wide.

Pronotum: PL : PW = 0.57–0.76 (0.66), surface with punctation finer than that of head, microsculpture consisting of transverse meshes.

Elytra, EL : PL = 1.58–1.75 (1.64), EL : EW = 0.93–1.00 (0.97), EW : PW = 1.08–1.16 (1.11) in males; EL : PL = 1.42–1.92, EL : EW = 0.91–1.10, EW : PW = 0.99–1.19 in females; punctation denser and coarser than that of pronotum, microsculpture consisting of short transverse meshes.

Abdomen with punctation coarser than that of head, microsculpture consisting of transverse striae or meshes.

Male. Posterior margin of elytra slightly and evenly emarginate at middle. Sternite VII (Figs 9N, 10N) with apical margin broadly and deeply emarginate; apical margin bent ventrad, with broad area of coarse granules. Tergite VIII (Fig. 12E) dis-

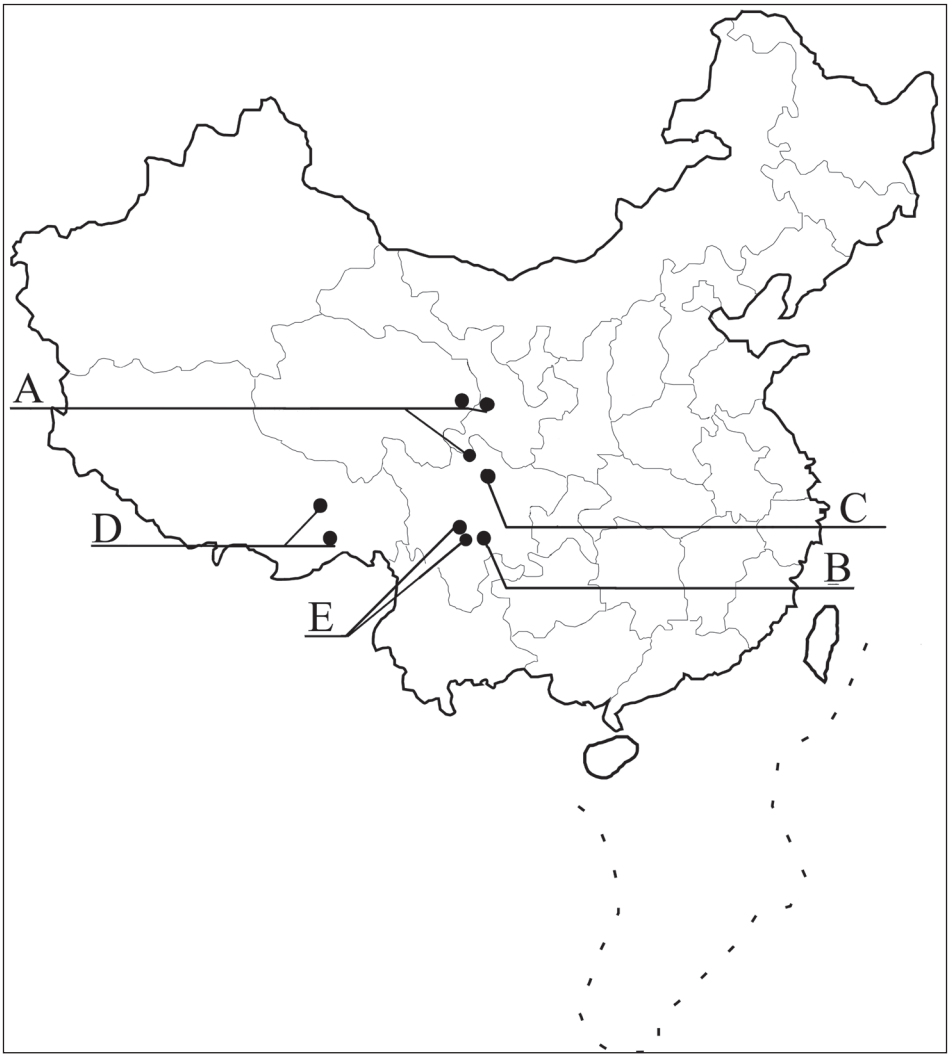

Figure 22. Distribution of the *silphaeformis* species group in China. **A** *Tachinus mengdaensis* **B** *T. oblongoelytratus* **C** *T. parahercules* **D** *T. paralinzhiensis* **E** *T. yini*.

tinctly transverse, lobes almost fused, apical margin weakly sinuate. Sternite VIII as in Fig. 14B. Median lobe of aedeagus (Fig. 17B) with pair of ear-shaped apical projections, parameres as broad as the projection of the median lobe, apically truncate.

Female. Elytra distinctly longer than in male, posterior margin broadly rounded, weakly produced near sutural angle. Abdominal tergite VIII (Fig. 19F) with sinuate posterior margin, lateral angles each with only one long seta. Fimbriate median lobes of sternite VIII (Fig. 20O) separated by shallow emargination, median lobes distinctly longer than sublateral ones.

Etymology. The species is named after Zi-Wei Yin (Shanghai), for his various help during this study.

Remarks. Males of this species can bes eparated from those of the other species by the aedeagal median lobe with broad ear-shaped apical projections. Females are distinguished by the sinuate posterior margin and the chaetotaxy of the lateral angles (each with only one long seta) of tergite VIII, from those of *T. maderianus* by the shape of the sutural angle of the elytra.

Key to males (excluding *T. maderi*)

1 Lateral margins of pronotum broadly yellow (Figs 3C, 4C, 4D). Sternite VII with comb-like setae at sides of posterior margin (Figs 9F, 9H). Sternite VIII with less distinctly produced median portion of anterior margin, emargination at posterior margin deep, bell-shaped (Figs 13F, 13H) **2**

– Lateral margins of pronotum not broadly yellow (Figs 1–2, 3A, 3B, 4A, 4B, 5–7). Sternite VII without comb-like setae. Sternite VIII with distinctly produced median portion of anterior margin, emargination at posterior margin less deep and with small median incision (Figs 13A–E, 13G, 14A–B)..... **3**

2 Parameres in lateral view slightly curved ventrad in apical half, apices more evenly rounded in ventral view (Fig. 16B). Western Sichuan..... ***T. lohsei***

– Parameres in lateral view straight, not curved ventrad in apical half, apices angled at apical ¼ in ventral view (Fig. 15F). Northern Sichuan ..... ***T. jiuzhaigouensis***

3 Parameres distinctly projecting beyond median lobe of aedeagus (Figs 16A, 17A) **4**

– Parameres not projecting beyond median lobe of aedeagus (Figs 15, 16B, 16C, 16D, 16E, 16F, 17B) **5**

4 Aedeagus as in Fig. 16A. Xizang..... ***T. linzhiensis***

– Aedeagus as in Fig. 17A. Xizang..... ***T. paralinzhiensis***

5 Parameres small and short (Fig. 16E), their apices not directed laterad. Sichuan (Emei Shan). ..... ***T. oblongoelytratus***

– Parameres larger, their apices of more lateral (Figs 15A, 15B, 15C, 16C, 16D, 16F, 17B) or latero-apical (Figs 15D, 15E) orientation 6

6 Parameres forming a V, oblique, combined width greater than that of median lobe, reaching apex of median lobe (Fig. 15D). Northern Sichuan ..... ***T. hercules***

– Parameres not forming a V, if combined width greater than that of median lobe, not reaching apex of median lobe **7**

7 Parameres broad, 1.7 times as wide as basal part of median lobe (Fig. 17B), apical part of median lobe distinctly widened. Western Sichuan ..... ***T. yini***

– Parameres 1.3 times as wide as basal part of median lobe at most, apical part of median lobe not distinctly widened **8**

8 Posterior margin of sternite VII with deep and broad semicircular emargination (Fig. 9I). Apical margin of parameres truncate (Fig. 16C). Southern Sichuan ..... ***T. maderianus***

– Posterior margin of sternite VII less deeply and broadly emarginate 9

9 Parameres with basal portion of reduced length, shorter than 1/3 of median lobe (Fig. 15A), forming one apically truncate plate. Northern Sichuan..... ..... ***T. armatus***

– Basal part of parameres not of reduced length, parameres longer than 1/3 of median lobe **10**

10 Posterior margin of sternite VII with broad triangular emargination (Figs 9C, 9E, 9J) **11**

– Posterior margin of sternite VII without triangular emargination (Figs 9B, 9L)..... **13**

11 Median lobe of aedeagus in lateral view with acute projection near apex of ventral side (Figs 15C, 15E)..... **12**

– Median lobe of aedeagus in lateral view without acute projection (Fig. 16D). Qinghai, Gansu, Northern Sichuan ..... ***T. mengdaensis***

12 Projection near apex of ventral side of median lobe (lateral view) small (Fig. 15E), apex of median lobe with larger emargination in ventral view. Shaanxi (Qinling Shan)..... ***T. hujiayaoi***

– Projection near apex of ventral side of median lobe (lateral view) robust (Fig. 15C), apex of median lobe with smaller emargination in ventral view. Ningxia, Qinghai..... ***T. coronatus***

13 Bent portion of sternite VII distinctly broader than 1/3 of the posterior margin (posterior view) (Fig. 10B). Aedeagus as in Fig. 15B. Northern Sichuan . ..... ***T. cavazzutii***

– Bent portion of sternite VII not distinctly broader than 1/3 of the posterior margin (posterior view) (Fig. 10L). Aedeagus as in Fig. 16F. Northern Sichuan..... ***T. parahercules***

Key to females

1 Lateral margins of pronotum broadly yellowish brown, distinctly contrasting with the dark disc (Figs 3C, 3D, 4C, 4D). Median lobe of tergite VIII separated from lateral lobes by deep incision or suture (Fig. 18H, 18F). Median lobes of sternite VIII long and slender, distinctly separated by a deep emargination (Figs 20H, 20F) **2**

– Lateral margins of pronotum not or only narrowly paler than disc. Median and lateral lobes of tergite VIII more or less fused, at most separated apically (Figs 18G or 19E). Median lobes of sternite VIII fused or separated only by a shallow emargination **3**

2 Median lobe of tergite VIII shorter than lateral lobes (Fig. 18H). Western Sichuan ..... ***T. lohsei***

– Median lobe of tergite VIII as long as or longer than lateral lobes (Fig. 18F). Northern Sichuan ..... ***T. jiuzhaigouensis***

3 Tergite VIII not strongly transverse, at base less than 1.5 times as wide as long (Figs 18G, 19E, 19C) **4**

– Tergite VIII strongly transverse, at base more than 1.5 times as wide as long (Figs 18A–E, 18I, 19A–B, 19D–F) **6**

4 Lateral lobes of tergite VIII each with one long setae, median lobe of obtusely triangular shape (Fig. 19C). Sichuan (Emei Shan) ..... ***T. oblongoelytratus***

– Lateral lobes of tergite VIII each with a pair of long setae, median lobe with shallow apical emargination (Figs 18G, 19E) **5**

5 Fimbriate median lobes of sternite VIII fused (Fig. 20G). Xizang... ***T. linzhiensis***

– Fimbriate median lobes of sternite VIII not fused, separated by small and shallow emargination (Fig. 20N). Xizang..... ***T. paralinzhiensis***

6 Lateral lobes or angles of tergite VIII each with only one long seta (Figs 18B, 18D, 19A, 19B, 19F)..... **7**

– Lateral lobes or angles of tergite VIII each with two long setae (Figs 18A, 18E, 19D, 18C, 18I). Species reliably distinguished only based on the male sexual characters..... **11**

7 Apical margin of tergite VIII with broad and deep emargination (Fig. 18B). Northern Sichuan ..... ***T. cavazzutii***

– Apical margin of tergite VIII more or less straight (Figs 19A, 19B, 19F) or distinctly produced (Figs 18D) **8**

8 Apical margin of tergite VIII distinctly produced at middle (Fig. 18D). Northern Sichuan ..... ***T. hercules***

– Apical margin of tergite VIII not distinctly produced at middle..... **9**

9 Apical margin of tergite VIII more or less straight at middle (Fig. 19A). Inner part of posterior margin of elytra produced, forming a distinct angle (Fig. 5B). Southern Sichuan..... ***T. maderianus***

– Apical margin of tergite VIII sinuate or weakly produced at middle (Figs 19B, 19F). Inner part of posterior margin of elytra not produced, posterior margin more or less evenly rounded (Fig. 5D, 7D) **10**

10 Apical margin of tergite VIII sinuate (Fig. 19F). Western Sichuan ..... ***T. yini***

– Apical margin of tergite VIII weakly produced at middle (Fig. 19B). Qinghai, Gansu, Northern Sichuan ..... ***T. mengdaensis***

11 Apical margin of tergite VIII produced at middle (Figs 18E, 18C). Fimbriate median lobes of sternite VIII nearly fused (Figs 20E, 20M). Inner part of posterior margin of elytra not produced (Figs 2B, 3B) **12**

– Apical margin of tergite VIII straight, sinuate or weakly emarginate at middle (Figs 18A, 18I, 19D). Inner part of posterior margin of elytra produced, forming distinct angle (Figs 1B, 6D, 8A) **13**

12 Tergite VIII as in Fig. 18E. Sternite VIII as in Fig. 20E. Shaanxi (Qinling Shan) ..... ***T. hujiayaoi***

– Tergite VIII as in Fig. 18C. Sternite VIII as in Fig. 20C. Ningxia, Qinghai .... ***T. coronatus***

13 Posterior margin of tergite VIII sinuate and distinctly emarginate at middle, postero-lateral angles of tergite VIII broadly rounded (Fig. 19D). Fimbriate median lobes of sternite VIII fused (Fig. 20M). Northern Sichuan .... ***T. parahercules***

– Posterior margin of tergite VIII straight or sinuate at middle, postero-lateral angles of tergite VIII more acute (Figs 18A, 18I) **14**

14 Posterior margin of tergite VIII nearly straight (Fig. 18A). Northern Sichuan..... ***T. armatus***

– Posterior margin of tergite VIII distinctly sinuate (Fig. 18I). Western Sichuan..... ***T. maderi***

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