The Species of Allacta (Blattodea: Ectobiidae: Pseudophyllodromiinae) Occurring in China, With A Description of a New Species

Authors: Wang, Zong-Qing, Gui, Shun-Hua, Che, Yan-Li, and Wang, Jin-Jun

Source: Florida Entomologist, 97(2) : 439-453

Published By: Florida Entomological Society

URL: https://doi.org/10.1653/024.097.0214

THE SPECIES OF *ALLACTA* (BLATTODEA: ECTOBIIDAE: PSEUDOPHYLLODROMIINAE) OCCURRING IN CHINA, WITH A DESCRIPTION OF A NEW SPECIES

ZONG-QING WANG*, SHUN-HUA GUI, YAN-LI CHE AND JIN-JUN WANG
Institute of Entomology, College of Plant Protection, Southwest University, Beibei, Chongqing, 400716, P.R. China

*Corresponding author; E-mail: zqwang2006@126.com

ABSTRACT

A new *Allacta xizangensis* **sp. nov.** (Blattodea: Ectobiidae: Pseudophyllodromiinae) is described and assigned to the *polygrapha* species group. Four known species, *A. robusta, A. bimaculata, A. transversa, A. ornata*, are re-described and illustrated based on type material and specimens kept in the collection of Southwest University (SWU), Sun Yat-Sen University (SYSU), Hebei University (HBU), China and Institute of Zoology, Chinese Academy of Sciences (IZCAS) and the Russian Academy of Sciences (ZIN). The hitherto unknown male of *A. transversa* is described with a special display of its genitalia. A key is given to identify the males of *Allacta* from China. The tarsomere ultrastructure of all the legs of *A. ornata* was examined by scanning electron microscopy.

Key Words: Dictyoptera, Blattaria, ultrastructure, new species, species group, cockroaches

RESUMEN

Se describe una nueva especie, *Allacta xizangensis*, **sp. nov.** (Blattodea: Ectobiidae: Pseudophyllodromiinae), y asignado al grupo de especies *polygrapha*. Se re-describen e ilustran cuatro especies conocidas, *A. robusta, A. bimaculata, A. transversa, A. ornata*, basado en material de especímenes tipo mantenidos en la colección de la Universidad del Suroeste (SWU), China. Se describe el macho de *A. transversa* desconocido anteriormente con un diagrama especial de su genitalia. Se presenta una clave para identificar a los machos de *Allacta* de China. Se examinó por microscopía electrónica de barrido la ultraestructura del tarsómero de todas las patas de *A. ornata*.

Palabras Clave: Dictyoptera, *Blattaria*, ultraestructura, nueva especie, grupos de especies, cucarachas

The genus *Allacta* is distinguished by the following characters: pulvilli present only on the fourth tarsomere, plus genitalia with 4 principal phallomeres and genital hook on right side. Because of preoccupation with *Abrodiaeta*, Saussure & Zehntner (1895) gave the new replacement name, *Allacta,* for that genus. *Allacta lobata* (Saussure, 1891) from Madagascar, which was accompanied as the fixation of the type species by Kirby (1904) (now the type species of *Anallacta* Shelford), was invalid because this species was not mentioned in the original publication. Hebard (1922) fixed *Abrodiaeta modesta* Brunner as the type species of *Allacta* only based on Brunner's description, because he did not have an opportunity to examine the type material; consequently the generic diagnosis remarkably resembled that of *Balta*. Princis (1969) listed 16 species of *Allacta* throughout the world, 2 of which were marked with a query. Bey-Bienko (1969) described *Allacta bimaculata*, *Allacta robusta* and *Allacta ornata* from Yunnan, China, and *Allacta transversa* (only on basis of female material) from Vietnam; for all of which only morphological descriptions were provided, but without descriptions of male and female genitalia. Roth (1991b) provided a generic diagnosis, described 2 species and transferred 5 species to *Allacta*. In addition to the establishment of 2 species, the exclusion of 3 species and the determination of specific status of *Allacta basivittata* (Bruijning, 1947), he (Roth 1993), more importantly, erected 3 species groups mainly based on color patterns and the male interstylar margin. Shortly afterwards Roth (1995) discovered 10 species from New Guinea and Sarawak. Roth (1996) synonymized *Euhanitschia* Princis and *Compsosilpha* Princis with *Allacta* as a result of 2 included species, plus he clarified the specific status of *Allacta figurata* (Walker, 1871) and *Allacta diluta* (Saussure, 1863). Since then no one has made revisions in this group. There are 41 known species of *Allacta* worldwide at present (Beccaloni 2007).

Herein, we redescribe *Allacta*, provide a revised checklist and redescribe 4 species based on type species, give a key to Chinese species and describe 1 new species from China. The genus is compared to *Sundablatta* Hebard and *Pseudophyllodromia* Brunner and comments are given on the assignment of species group. The tarsomere ultrastructure of all legs of *A. ornata* was examined by scanning electron microscopy.

Materials and Methods

Terminology used in this paper is mainly according to Roth (2003). Measurements are based on specimens examined. The genital segments of the examined specimens were macerated in 10% NaOH and observed in glycerin jelly using a Motic K400 stereomicroscope. All the drawings were made with the aid of a Motic K400 stereomicroscope. Photographs of the specimens were made by a Canon 50D plus a Canon EF 100mm f/2.8L IS USM Macro lens with the aid of the Helicon Focus software; photographs of the tarsomeres using a Leica M205A microscope with Leica DFC Camera, and images were produced using Hitachi S-3000N SEM. The materials examined are deposited in the following collections: Southwest University (SWU), Sun Yat-Sen University (SYSU), Hebei University (HBU), Institute of Zoology, Chinese Academy of Sciences (IZCAS) and Zoological Institute, Russian Academy of Sciences (ZIN), as indicated. The type specimens of the newly described species are deposited in the Insect Collection of Southwest University, and Museum of Hebei University, China.

Taxonomy (*Allacta* and Related Genera)

Genus *Allacta* Saussure & Zehntner

Allacta Saussure & Zehntner, 1895: 45 (New name for *Abrodiaeta* Brunner, 1893). Type species: *Abrodiaeta modesta* Brunner, 1893, by selection; Roth, 1991b: 996; Roth, 1993: 361; Roth, 1995: 51; Roth, 1996: 235.

Abrodiaeta Brunner, 1893: 13. Type species: *Abrodiaeta modesta* Brunner, 1893. [nec *Abrodiaeta* Brunner, 1891]

Pseudochorisoblatta Bruijning, 1948: 90. Type species: *Phyllodromia interrupta* Hanitsch, 1925, by selection. Synonymized by Princis, 1965: 150.

Arublatta Bruijning, 1947: 224. Type species: *Blatta punctata* Walker, 1869. Synonymized by Roth, 1991b: 996.

Euhanitschia Princis, 1950: 178. Type species: *Phyllodromia diagrammatica* Hanitsch, 1923. Synonymized by Roth, 1996: 235.

Compsosilpha Princis, 1950: 180. Type species: *Chorisoblatta karnyi* Hanitsch, 1928. Synonymized by Roth, 1996: 235.

Generic Diagnosis (Revision of Roth (1993))

Tegmina and wings usually fully developed, rarely slightly reduced (females of *A. persoonsi* Roth 1995 and *A. nalapae* Roth 1995); tegmina usually with oblique, rarely suboblique or longitudinal discoidal sectors. Hind wings with radial vein straight, usually simple sometimes forked, median and cubitus veins usually straight or nearly so, latter with 3-6 (usually 4 or 5) complete branches, incomplete branches absent; apical triangle small, subobsolete, or absent. Front femur Type B_2 or B_3; pulvilli present only on fourth tarsomere of all legs, tarsal claws simple, symmetrical, arolia present. Male abdominal terga unspecialized. Male genitalia with 3-4 principal phallomere sclerites: the genital hook on right side, the median, and the left phallomere; additionally, most species have an accessory median phallomere that originates on the right side and curves under the median phallomere to the left side and usually terminates in a setose membrane or a few spines near or under the left phallomere. Ootheca not rotated prior to deposition.

Note: The genus *Allacta* Saussure & Zehntner is closely related to *Sundablatta* and *Pseudophyllodromia* by wing venation, subgenital plate and styles. These 3 genera are placed in the Pseudophyllodromiinae owing to the genital hook on the right side and ootheca not rotated prior to deposition.

Allacta can be distinguished from *Sundablatta* (front femur Type C) by front femur Type B_2 or B_3, from *Pseudophyllodromia* (the front and mid tarsi with pulvilli on the 4 proximal tarsomeres, hind tarsus with a pulvillus only on the fourth tarsomere) by pulvilli present only on the fourth tarsomere of all legs.

Distribution

Oriental and Australasian Regions.

Key to Species of *Allacta* from China (Males)

1. Frons with pale brown transverse bands between or slightly upper the antennal sockets 2

   Frons without transverse band between or slightly upper the antennal sockets 3

2. Disc of pronotum totally blackish brown . . . . . *A. bimaculata*

   Disc of pronotum with irregular maculae . . . . . *A. transversa*

3. Head with 2 dark brown longitudinal stripes reaching from the vertex to the frons between the antennal sockets, and subgenital plate with dissimilar styles . . . . . *A. robusta*

   Head with 1 dark brown longitudinal stripes reaching from the vertex to the clypeus or not, and subgenital plate with similar styles 4

4. Disc of pronotum with star like dark brown spots; hind margin of subgenital plate nearly straight in the middle . . . . . *A. ornata*

   Disc of pronotum with 4 longitudinal symmetrical stripes, the inner 2 stripes reddish brown, slim, the outer 2 stripes dark brown, and strong; hind margin of subgenital plate concave in the middle . . . . . *A. xizangensis*, **sp.nov.**

Description of Species

1. *ALLACTA ROBUSTA* BEY-BIENKO, 1969 (Figs. 1 and 2)

Allacta robusta Bey-Bienko, 1969: 546; Roth, 1993: 380.

Description of Male, Female Unknown

Measurements. Pronotum: length × width 4-4.2 × 5.8-6 mm, tegmen length: 14-14.5 mm, overall length: 17-17.5 mm.

Coloration. Body brownish-yellow or pale brown, head and face yellowish, 2 blackish brown longitudinal stripes between eyes, which extend from vertex to the lower of antennal socket; 1 irregular blackish brown spot below antennal socket. Clypeus pale brown with base blackish brown. Maxillary palpus yellowish brown, with 3rd segment yellowish brown slightly suffused with blackish brown, and 4th and 5th segments blackish brown. Pronotum yellowish brown with irregular and complicated blackish brown maculae in center, lateral parts translucent. Tegmina pale reddish brown. Sternites yellowish brown with lateral parts blackish brown and suffused with blackish brown spots. Cerci blackish brown.

Head and Thorax. Vertex with interocular distance narrow, distinctly less than distance between antennal sockets; ocellae distinct. Third and fourth maxillary palpi of same length, both distinctly longer than fifth. Pronotum transverse nearly trapezoidal, with anterior margin and hind margin almost straight; broadest width behind the middle, latero-posterior angles broadly rounded. Tegmen with median and cubitus veins longitudinal and parallel, both extending to apex. Hind wing with costal veins distally slightly clubbed, 1-4 costal veins unbranched, 5-6 branched; median vein simple and straight; cubitus vein slightly curved backwards in the midsection and with 4 complete branches. Anteroventral margin of front femur type B_3, meaning 5 proximal stout spines succeeded by a row of piliform spinules of uniform length, terminating in 3 large spines increasing in size distally; pulvilli present only on 4th tarsomere, tarsal claws symmetrical and unspecialized, simple and arolia present; foretarsus with the first tarsomere and other 4 tarsomeres about same length, but the first tarsomeres of middle and hind tarsi both distinctly longer than other 4 tarsomeres.

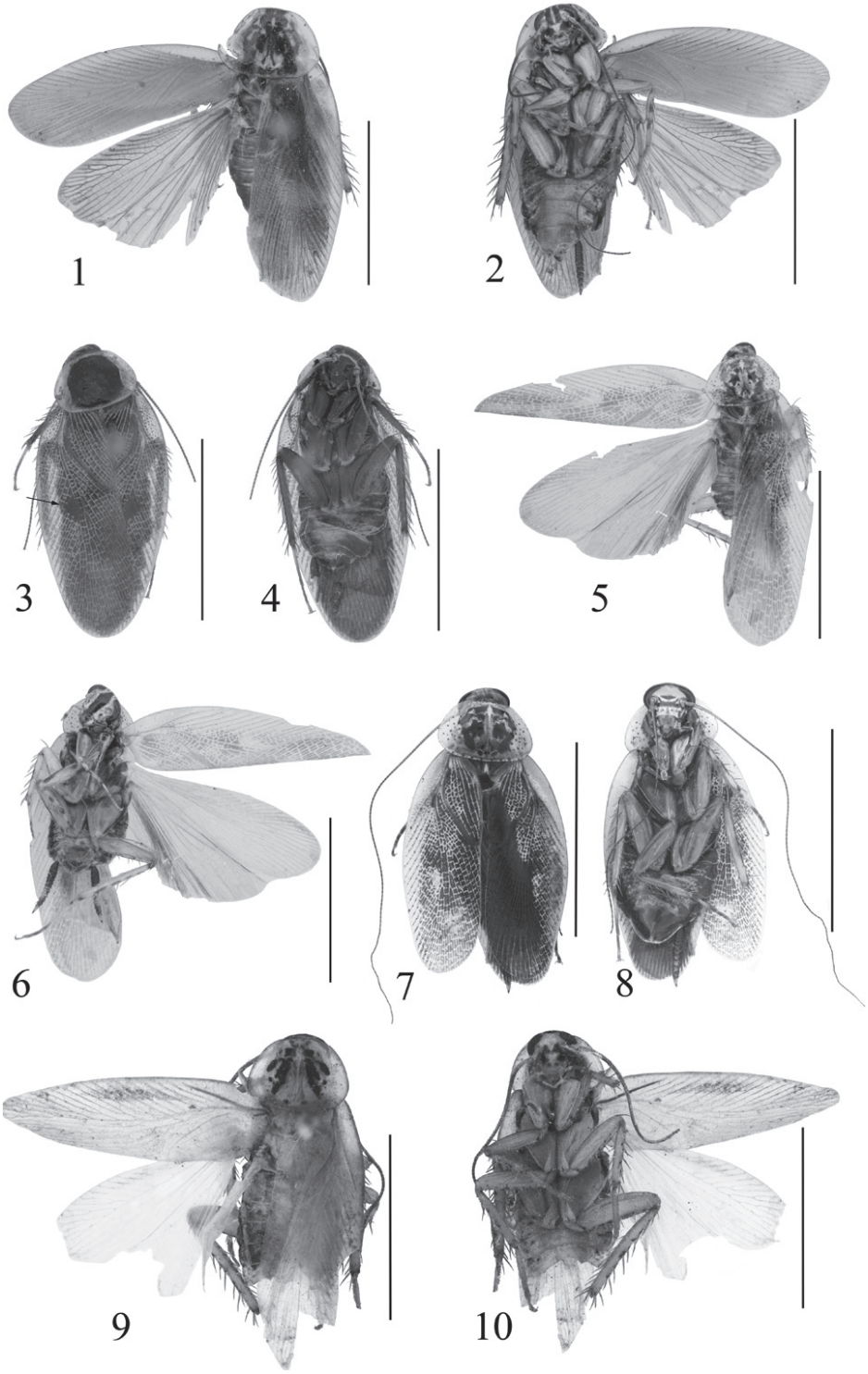
Male Abdomen with Genitalia. Abdominal terga unspecialized. Supra-anal plates short, transverse, nearly triangular, hind margin with 1 slight notch. Subgenital plate symmetrical, hind margin produced (extended backwards) and slightly concave in the middle; 2 styli dissimilar and lying at apex, left style cylindrical with base more or less thick and apex slender, right style nearly triangular, wide and flat, with base wider while apex narrow.

Materials Examined

HOLOTYPE: 1 male, CHINA, Yunnan Prov., Simao, 1300 m, 29-III-1957, coll. Panfilov (ZIN).

Remarks

According to Bey-Bienko (1969), the dissimilar styles on the subgenital plate made this species distinguishable. But Roth (1991b) mentioned that *A. picturata* (Shelford, 1907) also had distinctly dissimilar styles. These 2 species can be distinguished by the following characteristics: 1) front femur type B_3, front femur type B_2 in *A. picturata*; 2) 2 blackish brown longitudinal stripes existing between eyes which extend from vertex to the lower of antennal socket, while in *A. picturata* 4 longitudinal stripes on occiput extend to vertex where middle 2 are larger, whose distal parts directed laterally; 3) hind margin of subgenital plate produced and slightly concave in the middle, while in *A. picturata*, hind margin nearly straight in the middle.



Figs. 1-10. 1-2. *Allacta robusta* Bey-Bienko, male. (1) holotype, dorsal view; (2) holotype, ventral view ; 3-4. *Allacta bimaculata* Bey-Bienko, male : (3) holotype, dorsal view, black arrow indicates dark spot in the middle of tegmen; (4) holotype, ventral view. 5-6. *Allacta ornata* Bey-Bienko, male: (5) holotype, dorsal view : (6) holotype, ventral view ; 7-8. *Allacta transversa* Bey-Bienko, female: (7) dorsal view; (8) ventral view. (9-10) *Allacta xizangensis* **sp. nov.,** male: (9) holotype, dorsal view; (10) holotype, ventral view. Scale bars = 1.0 cm

Distribution

China (Yunnan).

2. *ALLACTA BIMACULATA* BEY-BIENKO, 1969 (Figs. 3 and 4; Fig. 11; Figs. 15-24)

Allacta bimaculata Bey-Bienko, 1969: 545; Roth, 1993: 373.

Description

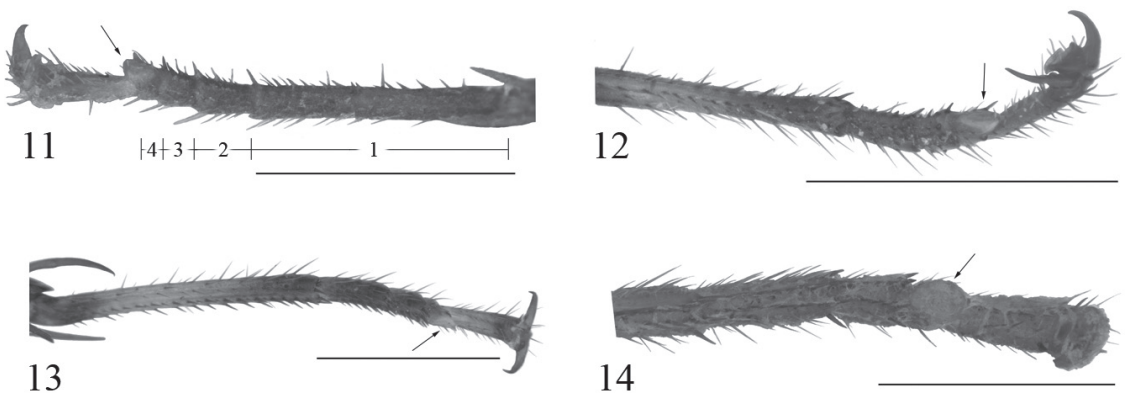
Measurements. Male, pronotum: length × width 3.0 × 4.3-4.8 mm, tegmen length: 12.5-13 mm, overall length: 15.5-17 mm; female, pronotum: length × width 3.0-3.2 × 4.8-5.2 mm, tegmen length: 11.5-12 mm, overall length: 15-15.7 mm.

Coloration. Body pale brown with blackish brown maculae (Fig. 3). Head blackish brown with 1 pale brown transverse band above antennal sockets (Fig. 15). Antenna brown. Maxillary palpus brown and apex dark brown (Fig. 4). Pronotum pale brown with 1 nearly quadrate blackish brown macula in centre (Figs. 3 and 16). Tegmen brown with scattered blackish brown marks, middle area of each tegmen with a sometimes unclear large black spot, veins pale brown (Fig. 3); hind wing pale brown and hyaline. Legs blackish brown, spines reddish brown. Sternites brown, lateral parts and hind margin of each segment blackish brown (Fig. 4). Cerci blackish brown.

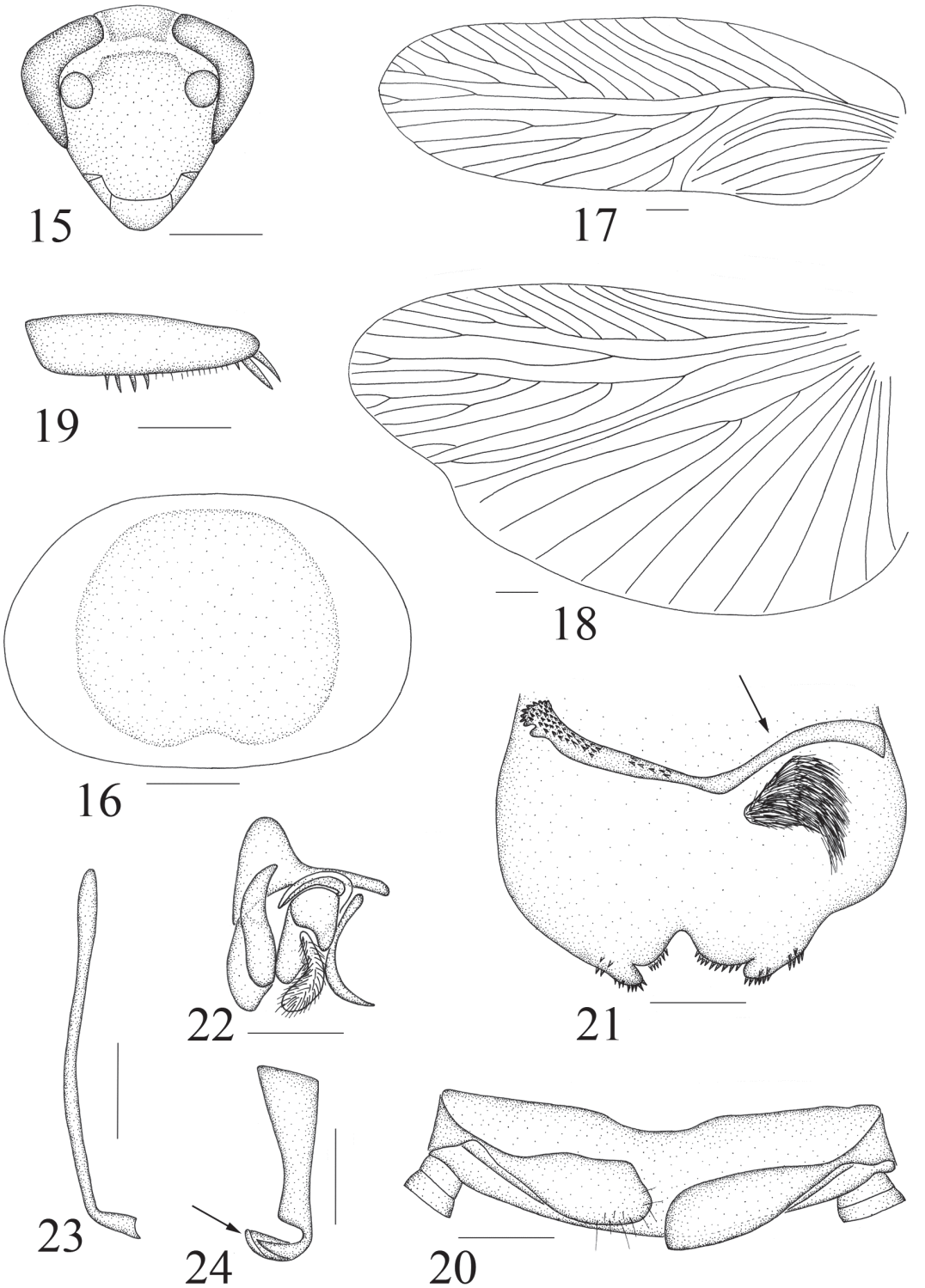
Head and Thorax. Vertex with interocular space a little narrower than distance between antennal sockets. Third and fourth maxillary palpi about same length, both distinctly longer than the fifth. Pronotum nearly elliptical with anterior and hind margins nearly truncate, and lateral margins broadly rounded (Figs. 3 and 16). Tegmina and wings fully developed, both extending beyond the end of abdomen. Tegmen with median vein straight, longitudinal; cubitus veins suboblique, some of which reach the apical margin (Fig. 17). Hind wing with costal veins somewhat clubbed, radius and median veins branched before the middle, cubitus veins curved with 6 complete branches, and apical triangle subobsolete (Fig. 18). Anteroventral margin of front femur type B_3 (Fig. 19); pulvilli only present on 4th tarsomere and about one half of 4th tarsomere (Fig. 11), tarsal claws symmetrical and unspecialized, simple and arolia present; the first tarsomeres of all tarsi distinctly longer than other 4 tarsomeres.

Female is similar to the male.

Male Abdomen with Genitalia. All abdominal terga unspecialized. Supra-anal plate short, transverse, posterior border weakly convex, anterior border in the middle slightly excavated (Fig. 20). Right and left paraprocts (Fig. 20) similar, simple, sheet-like with apex rounded. Subgenital plate (Fig. 21) short and evidently asymmetrical, in dorsal view left lateral margin arched and rounded, right lateral margin arched but curved inwards near apex, hind margin strongly produced and deeply concave in the middle, where many spines are scattered; style nearly cylindrical and with small spines at outer margin. Left phallomere consisting of several sclerites, 1 of which is covered with short hair (Fig. 22). Median phallomere a long and slender rod, whose posterior is curved and posterior margin not curved with angles tapering (Fig. 23); accessary median phallomere a bowlike rod that bears a many spines on left part and a setal brush below right part (Fig. 21). Hook on the right side, slender and with a pre-apical incision (Fig. 24).



Figs. 11-14. Tarsomeres of the hind leg, black arrows indicate pulvilli on the legs ; (11) *Allacta bimaculata* Bey-Bienko, numbers 1-4 indicate the segments of tarsus ; (12) *Allacta ornata* Bey-Bienko, (13) *Allacta transversa* Bey-Bienko, and (14) *Allacta xizangensis* **sp. nov.** Scale bars = 1.0 mm.



Figs. 15-24. *Allacta bimaculata* Bey-Bienko. (15) head, frontal view; (16) pronotum; (17) tegmen; (18) hind wing; (19) front femur; (20) supra-anal plate and paraprocts, ventral view; (21) subgenital plate and accessary median phallomere(indicated by black arrow), dorsal view; (22) left phallomere; (23) median phallomere; and (24) hook-like phallomere, pre-apical incision indicated by black arrow. Scale bars = 1.0 mm in Figs. 15-19, and Scale bars = 0.5 mm in Figs. 20-24.

Materials Examined

CHINA, HOLOTYPE: 1 male, Yunnan Prov., Xishuangbanna, Gannanba, 540 m, 18-IV-1957, Guangji Hong (ZIN). One male, Guangxi Prov., Wuming, Mt. Damingshang, 21-III-1963, Jikun Yang (SWU); 1 female, Yunnan Prov., Xishuangbanna, Damenglong, 650m, 4-V-1958, Zhizi Chen (SWU).

Remarks

Bey-Bienko (1969) stated that *Allacta bimaculata* was characterized by dark spots on the tegmina, distinctive styles, and the color of the head and pronotum. After examining the holotype and specimens kept in collection of SWU, the dark spots on the tegmina are sometimes indistinct, whereas the dark spots on the living individuals in the field are distinct (Fig. 58). However, the transverse band on the head and the dark brown mark on the pronotum, and more importantly, the characters of the male genitalia of this species provided herein are sufficient to distinguish it from other species.

Distribution

China (Yunnan, Guangxi).

3. *ALLACTA ORNATA* BEY-BIENKO, 1969 (Figs. 5 and 6; Fig. 12; Figs. 25-35)

Allacta ornata Bey-Bienko, 1969: 545; Roth, 1993: 386.

Description

Measurements. Male, pronotum: length × width 2.9-3.1 × 4.3-4.9 mm, tegmen: 13.9-15.7 mm, overall length: 15.9-17.4 mm; female, pronotum: length × width 2.6 × 4.0 mm, tegmen: 12 mm, overall length: 14.2 mm.

Coloration. Body pale brown with brown and blackish brown maculae (Fig. 5). Head pale brown with 1 longitudinal blackish brown stripe from vertex to clypeus. Antenna blackish brown. Maxillary palpus pale brown and apex brown (Figs. 6 and 25). Pronotum pale brown and nearly hyaline with irregular brown marks as shown in Fig. 26, and 2 star-shaped blackish brown maculae in center, blackish brown spots spread along the lateral margin (Figs. 5 and 26). Tegmen pale brown with brownish tint spread throughout the veinlets of the middle area, veins brown; hind wing pale brown and hyaline (Figs. 5 and 6). Legs yellowish brown, dorsal margin blackish brown (Fig. 6). Sternites brown, lateral parts and apex of abdomen blackish brown (Fig. 6). Cerci with basal half blackish brown, apical half yellowish brown.

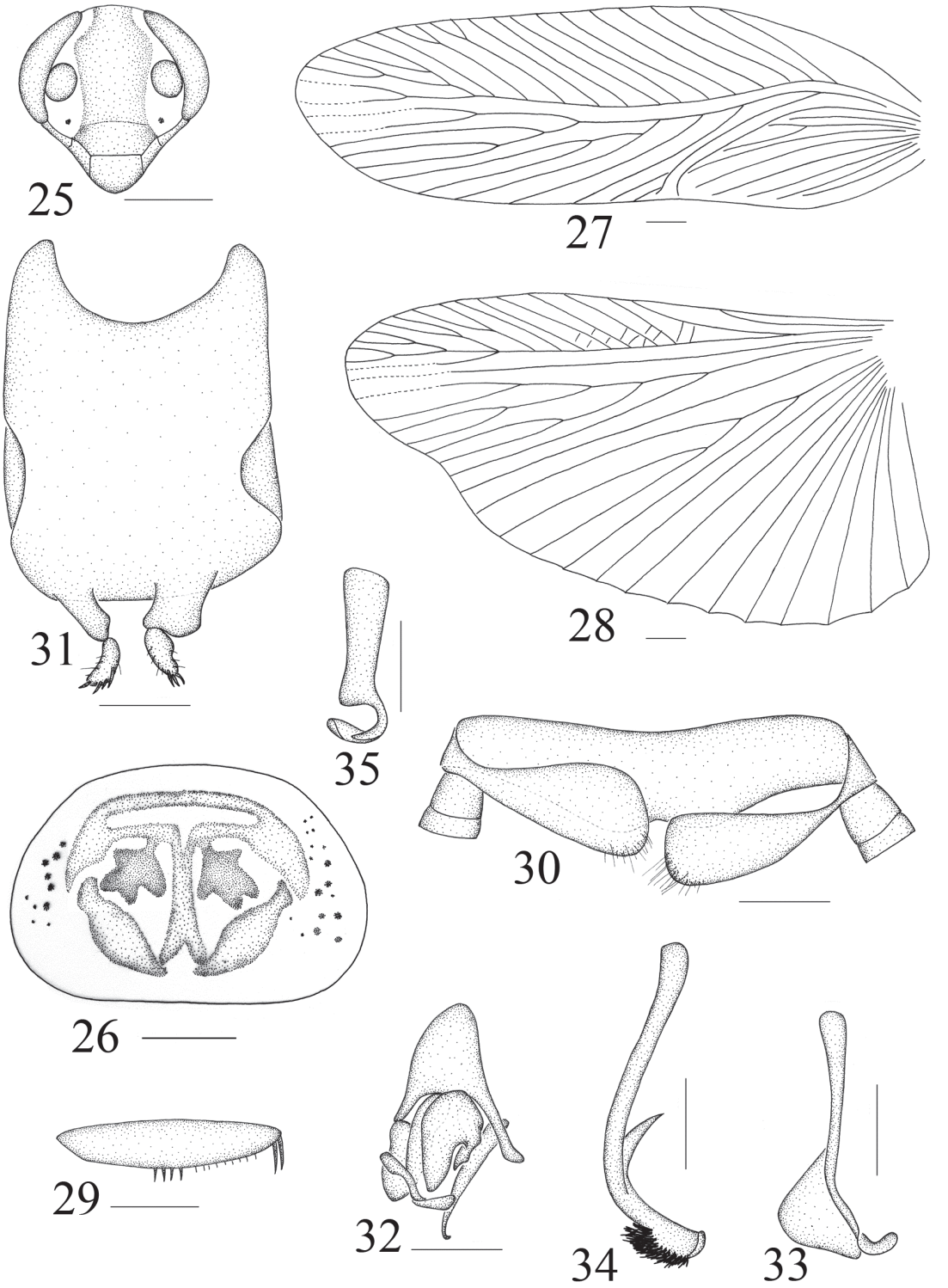
Head and Thorax. Vertex with interocular space a little narrower than distance between antennal sockets. Third and fourth maxillary palpi about same length, both distinctly longer than the fifth. Pronotum nearly elliptical with anterior and hind margins nearly truncate, and lateral margins curved and rounded (Figs. 5 and 26). Tegmina and wings fully developed, both extending beyond end of abdomen. Tegmen long with median vein longitudinal; some cubitus branches reaching the apical margin and others oblique (Fig. 27). Hind wing with costal veins somewhat clubbed, radius branched beyond the middle, and median vein straight and unbranched, cubitus curved with 4 complete branches, and apical triangle absent (Fig. 28). Anteroventral margin of front femur type B_2 (Fig. 29); pulvilli present only on 4th tarsomere (Fig. 12), tarsal claws symmetrical and unspecialized, simple and arolia present.

Female is similar to the male.

Male Abdomen with Genitalia. All the abdominal terga unspecialized. Supra-anal short, transverse, anterior border in the middle slightly excavated and posterior border convexly rounded, but deeply excavated in the middle (Fig. 30). Right and left paraprocts (Fig. 30) similar, simple, sheet-like with apex rounded and hairs sparse and scattered. Subgenital plate (Fig. 31) nearly symmetrical, in dorsal view lateral margins folded upwards, hind margin nearly truncate; 2 sclerites where the styli are different and arise irregularly, the right one more robust than the left; style nearly cylindrical with small spines at outer margin. Left phallomere consisting of several irregular sclerites, 1 of which is spoon-shaped (Fig. 32). Median phallomere is a long slender rod, whose terminal is curved and combined with a sheetlike sclerite (Fig. 33); accessary median phallomere is a curved rod, terminating in a setal brush and bearing a sclerite with tapered apex (Fig. 34). Hook on the right side, slender and with a pre-apical incision (Fig. 35).

Materials Examined

HOLOTYPE: 1 male, CHINA, Yunnan Prov., Xiaomengyang, 810 m, 31-III-1957, Shuyong Wang (ZIN). One female, CHINA, Hainan Prov., Mt. Jianfengling, Tianchi, 26-XI-1964, Zhenyao Chen (SYSU); 1 male, CHINA, Hainan Prov., Lingshui, Mt. Diaoluoshan, 930 m, N 18° 43' E 109° 52', 6-VIII-2010, Guo Zheng (IZCAS); 2 males and 1 female, CHINA, Hainan Prov., Ledong, Mt. Jianfengling, 975m, N 18° 44' E 108° 52', 14-VIII-2010, Guo Zheng (IZCAS); 4 males and 2 females, CHINA, Hainan Prov., Lingshui, Mt. Diaoluoshan, N 18° 43' E 109° 51', 9-VIII-2010, Guo Zheng (IZCAS); 1 male, CHINA, Hainan Prov., Ledong, Mt. Jianfengling, Mingfenggu, 997m, N 18° 44' E 108° 50', 18-VIII-2010, Guo Zheng (IZCAS).



Figs. 25-35. *Allacta ornata* Bey-Bienko. (25) head, frontal view; (26) pronotum; (27) tegmen (apical margin damaged); (28) hind wing; (29) front femur; (30) supra-anal plate and paraprocts, ventral view; (31) subgenital plate, dorsal view; (32) left phallomere; (33) median phallomere; (34) accessary median phallomere; and (35) hook-like phallomere. Scale bars = 1.0 mm in Figs. 25-29, and Scale bars = 0.5 mm in Figs. 30-35.

Remarks

Bey-Bienko (1969) pointed out that *A. ornata* is similar to *A. transversa* in form and color of the pronotum and in the straight vertex margin of the eyes. But these 2 species can be easily differentiated from the head marking and front femur type. In reality, *A. ornata* is more similar to *Allacta megaspila* (Walker, 1868) in form and marks. These 2 species can be distinguished by the following characteristics: 1) hind wing with cubitus curved, only with 4 complete branches, with 5 complete branches in *A. megaspila*; 2) median phallomere a long and slender rod, whose posterior is curved and combined with a sheetlike sclerite, while in *A. megaspila* the median phallomere has a broad flange at about the middle, and the distal end modified and darkly sclerotized, 3) hind margin of subgenital plate nearly truncate, while in *A. megaspila*, hind margin nearly U-shaped.

Distribution

China (Yunnan, Hainan).

4. *ALLACTA TRANSVERSA* BEY-BIENKO, 1969 n. Rec.(Figs. 7 and 8; Fig. 13; Figs. 36-46)

Allacta transversa Bey-Bienko, 1969: 545-547; Roth, 1993: 378.

Description

Measurements. Male, pronotum: length × width 2.5-3.0 × 4.6-4.7 mm, tegmen: 11.8-15.1 mm, overall length: 13.9-17.9 mm; female, pronotum: length × width 2.9-3.1 × 4.7-5.2 mm, tegmen: 11-13 mm, overall length: 13.7-15.8 mm.

Coloration. Body brown with blackish brown maculae (Fig. 7). Head yellowish brown with 1 broad transverse blackish brown band between eyes and 2 slightly narrower transverse bands, upper the antenna sockets or nearly reaching the line between the bottom of the antenna sockets respectively, and the lower 1 branched near the antenna sockets as Fig. 36. Antenna with base segments yellowish brown, others blackish brown. Maxillary palpus yellowish brown and apex brown. Pronotum pale brown and nearly hyaline, with irregular blackish brown marks as Fig. 38 in center, blackish brown spots spread along the lateral margin (Figs. 7 and 38). Tegmen pale brown with dark brownish tint spread throughout the veinlets, veins pale brown; hind wing blackish brown and hyaline (Fig. 7). Legs yellowish brown, apex of femora blackish brown. Sternites blackish brown, yellowish brown in the middle of distal 3 segments (Fig. 8). Cerci blackish brown with apex somewhat yellowish brown.

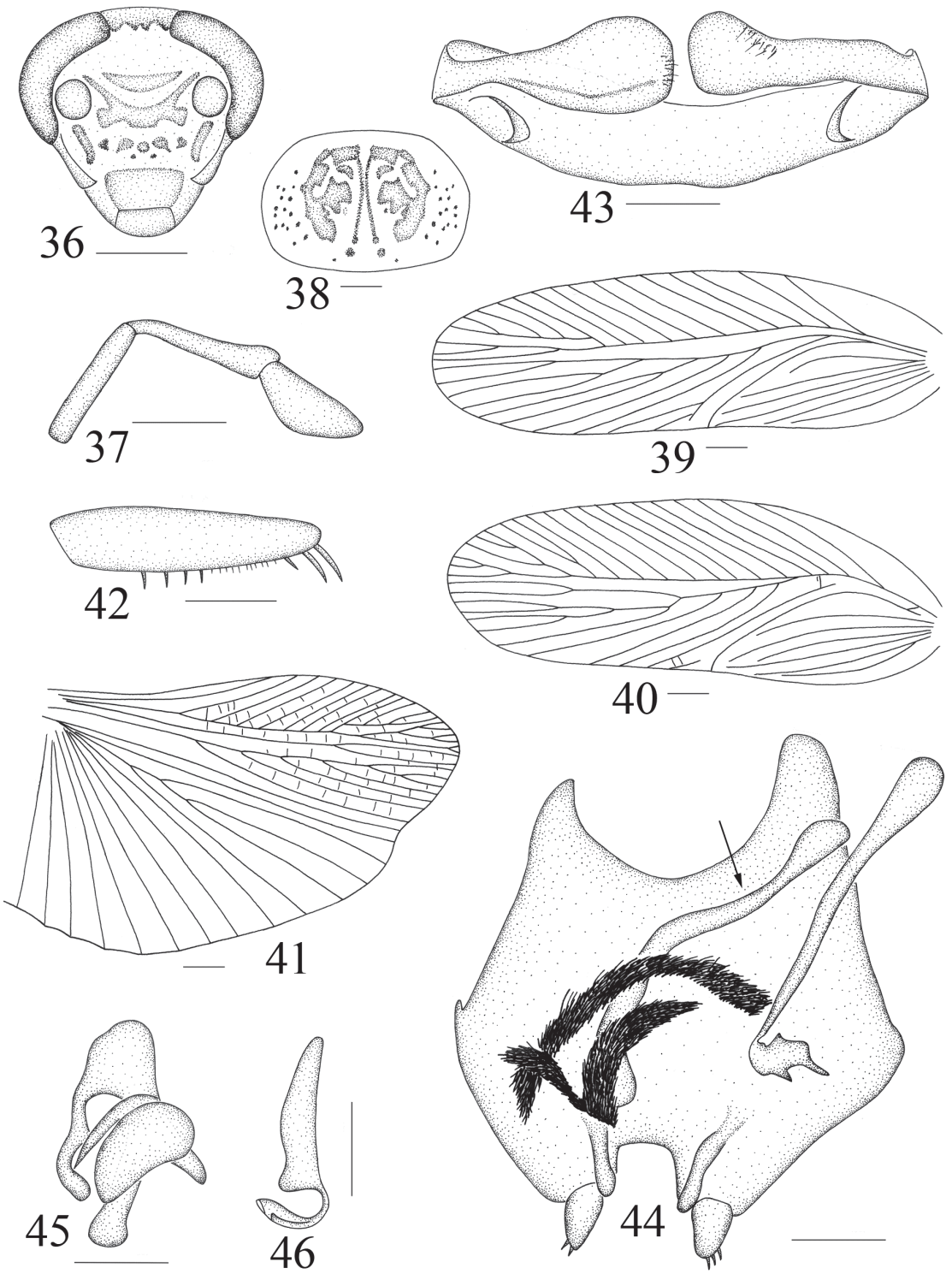
Head and Thorax. Vertex with interocular space evidently narrower than distance between antennal sockets. Third and fourth maxillary palpi about same length, both distinctly longer than the fifth (Fig. 37). Pronotum nearly elliptical with anterior and hind margins nearly truncate, and lateral margins curved and rounded (Figs. 7 and 38). Tegmina and wings fully developed, both extending beyond the end of abdomen. Tegmen long with median longitudinal and cubitus veins oblique, and sometimes varied in different individual (Figs. 39 and 40). Hind wing with costal veins somewhat clubbed, radius and median veins branched beyond the middle, cubitus curved with 5 complete branches, and apical triangle absent (Fig. 41). Anteroventral margin of front femur type B_3 (Fig. 42); pulvilli only present on 4th tarsomere and about one half of 4th tarsomere (Fig. 13), tarsal claws symmetrical and unspecialized, simple and arolia present.

Female is similar to the male.

Male Abdomen with Genitalia. All abdominal terga unspecialized. Supra-anal plate short transverse, anterior border strongly concave and hind margin convexly rounded, but slightly excavated in the middle (Fig. 43). Right and left paraprocts (Fig. 43) similar, simple, sheet-like with apex rounded and scattered with a few hair. Subgenital plate (Fig. 44) nearly symmetrical, in dorsal view left lateral margin curved and rounded with a tooth-like process in the middle, right lateral margin convexly produced into a right angle; hind margin deeply and broadly excavated, nearly straight in the middle; style nearly triangular and with small spines at outer margin. Left phallomere consisting of several irregular sclerites, one of which is more or less elliptical (Fig. 45). Median phallomere a long and slender rod, whose posterior is curved and irregular (Fig. 44); accessary median phallomere a curved rod terminating in a setal brush and bearing a long and curved sclerite scattered with strong hairs (Fig. 44). Hook on the right side, slender and with a pre-apical incision (Fig. 46).

Materials Examined

One male and 1 female, CHINA, Hainan Prov., Mt. Diaoluoshan, 26/28-III-1964, Sikong Liu (SWU); 1 female, CHINA, Hainan Prov., Mt. Jianfengling, Tianchi, 24-II-1982, Wenzhong Huang (SWU); 1 male, CHINA, Hainan Prov., Qiongzhong, Shiyun, 25-VII-1964, Jicai Li and Zhenyao Chen (SYSU); 1 male, CHINA, Hainan Prov., Wenchang, Mt. Tongguling, 4-I-1965, Zhenyao Chen; 1 male, CHINA, Hainan Prov., Qiongshan, 8/9-V-1935, F. K. To (SYSU); 1 female, CHINA, Hainan Prov., Qiongshan, 25-VI-1935, F. K. To (SYSU); 1 male, CHINA, Hainan Prov., 18/22-III-1935, F. K. To (SYSU); 1 male, CHINA, Hainan



Figs. 36-46. *Allacta transversa* Bey-Bienko. (36) head, frontal view; (37) maxillary palpus; (38) pronotum; (39-40) tegmen; (41) hind wing; (42) front femur; (43) supra-anal plate and paraprocts, ventral view; (44) subgenital plate, median phallomere and accessary median phallomere (indicated by black arrow), dorsal view; (45) left phallomere; and (46) hook-like phallomere. Scale bars = 1.0 mm in Figs. 36 and 38-42, and Scale bars = 0.5 mm in Figs. 37 and 43-46.

Prov., Lingshui, Mt. Diaoluoshan, 505 m, N 18° 40' E 109° 52', 10-VIII-2010, Guo Zheng (IZCAS); 2 males and 1 female, CHINA, Hainan Prov., Lingshui, Mt. Diaoluoshan, 494 m, 10-VIII-2010, Guo Zheng (IZCAS); 5 females, CHINA, Hainan Prov., Mt. Jianfengling, Chahekouzhan, 235 m, N 18º 44' E 109° 59', 17-VIII-2010, Guo Zheng (IZCAS).

Remarks

Roth (1993) mentioned that *A. transversa* undoubtedly is related to *A. bimaculata* and probably to *A. polygrapha* from Thailand. Bey-Bienko (1969) claimed that *A. transversa* was distinguished by characteristic transverse bands on the frons. By checking many specimens (including some preserved in alcohol), we found that transverse bands on the frons are changeable and not clear as on the holotype. In addition, a number of species, such as *A. polygrapha*, *A. fascia* and *A. marmorata*, have transverse facial bands. In the light of the factors listed above, it is wise to use male genitalia to differentiate *A. transversa* from other species.

Distribution

China (Hainan), Vietnam.

5. *ALLACTA XIZANGENSIS* **sp. nov.** (Figs. 9 and 10; Fig. 14; Figs. 47-57)

Description of Male, Female Unknown

Measurements. Male, pronotum: length × width 3.8- 4.2 × 5.4-5.7 mm, tegmen: 14-16 mm, overall length: 17-19.2 mm.

Coloration. Body brown with blackish brown maculae (Fig. 9). Head yellowish brown with S-shaped blackish brown maculae between antenna sockets and blackish brown spots below them as shown in Fig. 47. Antenna yellowish brown (Fig. 10). Maxillary palpus yellowish brown and apex brown (Fig. 10). Pronotum pale brown and nearly hyaline with complex blackish brown marks as shown Fig. 49 in center (Figs. 9 and 49). Tegmen pale brown; hind wing pale brown and hyaline (Fig. 9). Legs yellowish brown, base of spines blackish brown (Fig. 10). Sternites brown with blackish brown spots along lateral margins (Fig. 10). Cerci yellowish brown.

Head and Thorax. Vertex with interocular space a little narrower than distance between antennal sockets. Third and fourth maxillary palpi about same length, both distinctly longer than the fifth. Pronotum nearly trapezoid with anterior and hind margins nearly truncate, and lateral margins curved (Figs. 9 and 49). Tegmina and wings fully developed, both entirely covering abdomen (Fig. 9). Tegmen long with median vein longitudinal and part of cubitus veins oblique (Fig. 50). Hind wing with costal and median veins unbranched, cubitus vein curved with 3 complete branches, and apical triangle absent (Fig. 51). Anteroventral margin of front femur type B_3 (Fig. 52); pulvilli only present on 4th tarsomere (Fig. 14), tarsal claws symmetrical and unspecialized, simple and arolia present.

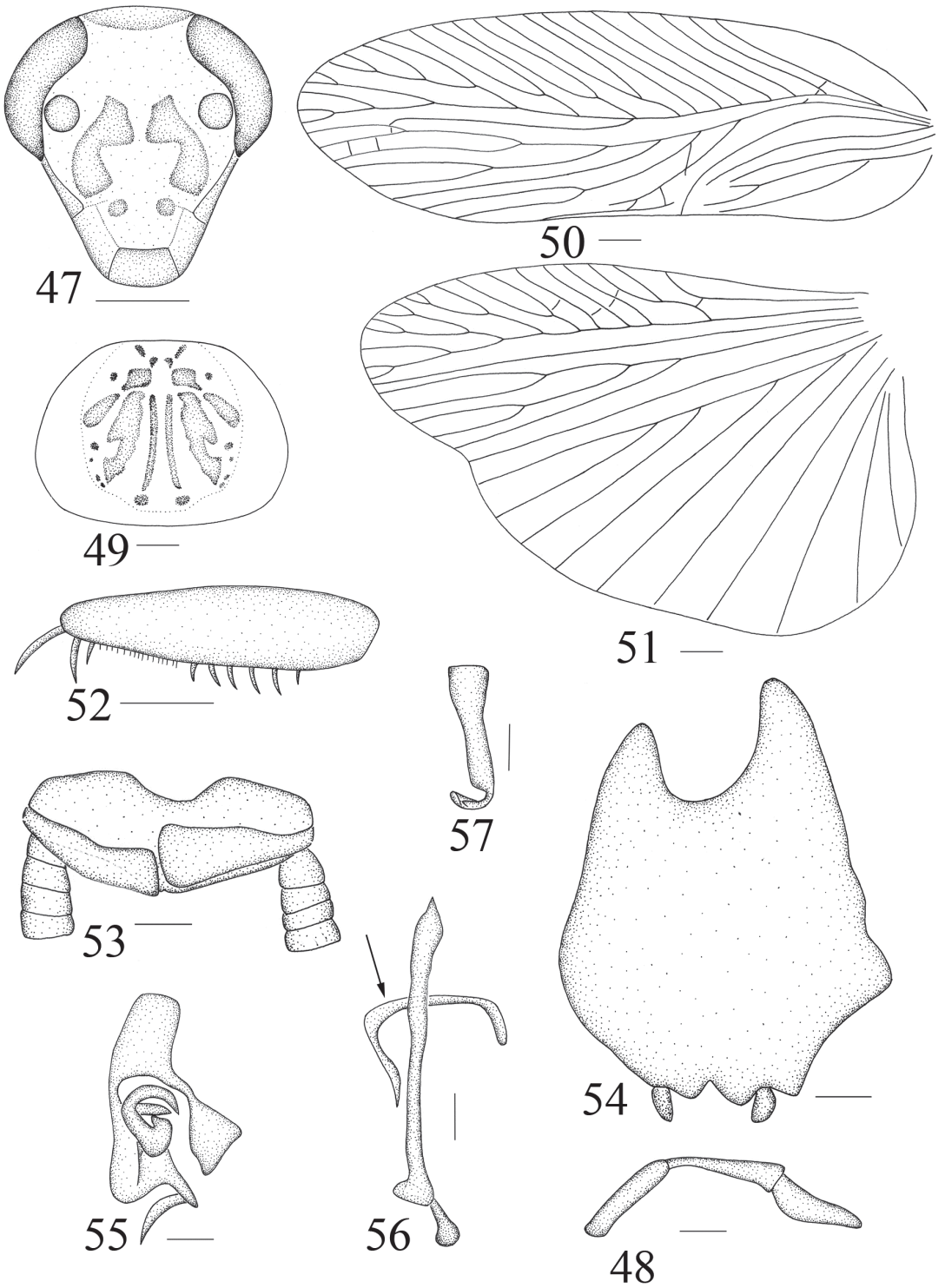
Male Abdomen with Genitalia. All abdominal terga unspecialized. Supra-anal plate short transverse and more or less triangular, anterior border deeply concave in the middle and posterior border convexly rounded, but slightly excavated in the middle (Fig. 53). Right and left paraprocts (Fig. 53) similar, simple, sheet-like with apex rounded. Subgenital plate (Fig. 54) somewhat asymmetrical, in dorsal view left lateral margin curved and rounded, right lateral margin wavy and evidently produced at apical part; hind margin uneven, deeply excavated in the middle; style nearly triangular, the right one a little larger than the left. Left phallomere consists of several irregular sclerites, one of which is a disc more or less C-shaped (Fig. 55). Median phallomere a long and slender rod with anterior acute, whose posterior is curved and rounded, and combined with a hammerlike sclerite (Fig. 56); accessary median phallomere is a curved and C-shaped rod, with 1 tapered apex and the other rounded (Fig. 56). Hook on the right side, slender and with a pre-apical incision, hook portion short (Fig. 57).

Materials Examined

HOLOTYPE: 1 male, CHINA, Xizang Prov., Chayu, 2300 m, 6-VII-1973 (SWU). PARATYPES, 4 males, CHINA, Xizang Prov., Chayu, 6-VIII-2013, Xinglong Bai and Junsheng Shan (HBU)

Remarks

This species resembles *A. transversa*, but can be differentiated by the following characters: 1) head yellowish brown with S-shaped blackish brown maculae and spots, while in *A. transversa* the head is yellowish brown with transverse blackish brown bands slightly above or under the antennal sockets; 2) median phallomere with anterior acute, whose posterior is curved and combined with a hammer-like sclerite, while in *A. transversa*, median phallomere has rounded anterior, whose posterior is curved; 3) interstylar margin is excavated, V-shaped, while in *A. transversa* interstylar margin is excavated, but nearly U-shaped. Based on color pattern of pronotum and male interstylar margin, this species is assigned to the *polygrapha* species group as defined by Roth 1993.



Figs. 47-57. *Allacta xizangensis* **sp. nov.** (47) head, frontal view; (48) maxillary palpus; (49) pronotum; (50) tegmen; (51) hind wing; (52) front femur; (53) supra-anal plate and paraprocts, ventral view; (54) subgenital plate, dorsal view; (55) left phallomere; (56) median phallomere and accessary median phallomere(indicated by black arrow); and (57) hook-like phallomere. Scale bars = 1.0 mm in 47 and 49-52, and Scale bars = 0.5 mm in Fig. 48 and Figs. 53-57.

Etymology

The name of the new species "xizangensis" refers to the type locality, Xizang (aka Tibet), China.

Distribution

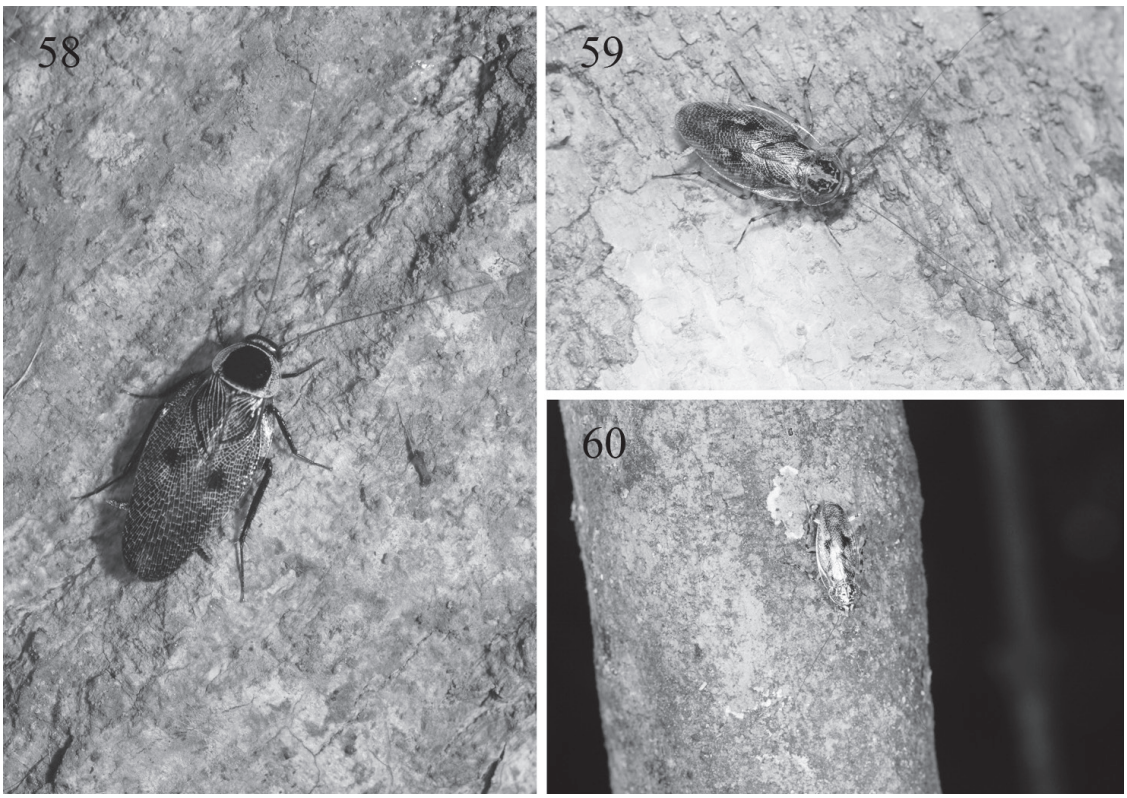
China (Xizang).

Discussion

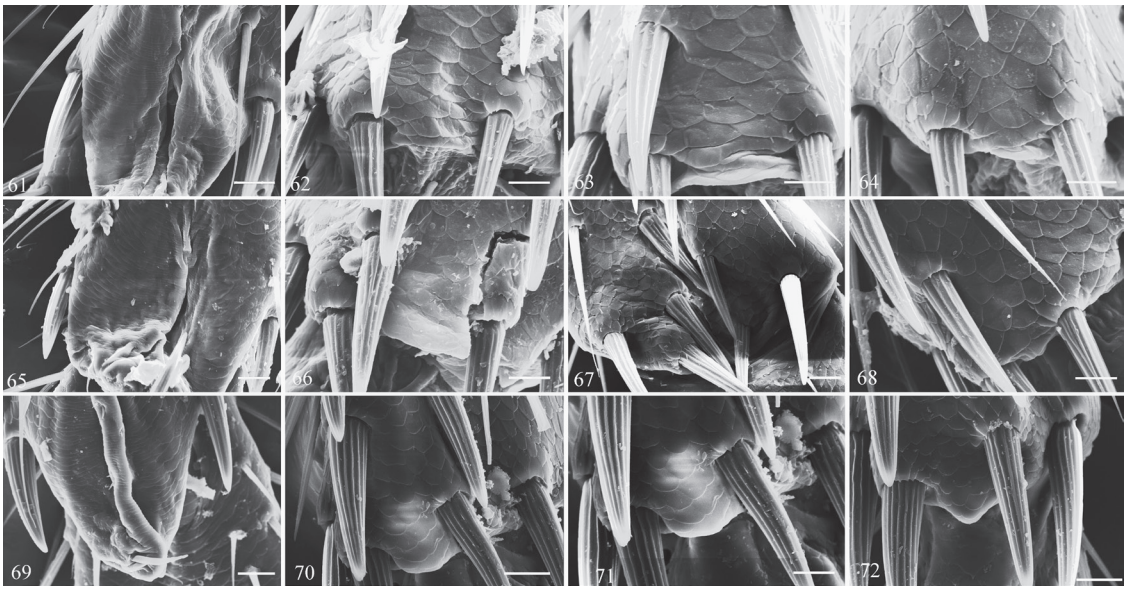
The tarsus of cockroaches is comprised of 5 tarsomeres. Generally speaking, each of the first 4 tarsomeres may bear on its ventral surface a single, colorless pad-like enlargement called the tarsal pulvillus, and there is a soft adhesive lobe called the arolium at the apex of the fifth tarsomere. These structures assist in adhesion to surfaces, even vertical and inverted horizontal surfaces. Tarsal pulvilli are of major taxonomic significance to distinguish *Allacta* (pulvilli only present on fourth tarsomere of all legs, Figs. 61-72).

If the pulvilli of the mid and hind legs are allowed to touch the surface, they become attached so firmly that the cockroach can wrench itself free only by leaving the tarsi behind, clinging to the glass (Roth & Willis 1952). Does having the tarsal pulvillus present only on the fourth tarsomere of all legs affect the ability of the animals to climb? The arolium and the pulvillus are considered to be adaptive characters related to functional requirements for climbing in different environments (Arnold 1974). Adhesive structures are frequently reduced or lost in cave cockroaches, perhaps because the clinging mud or the surface tension of water on moist walls reduce their effectiveness (Mackerras 1967; Roth 1988, 1990, 1991a).

In a tropical forest, a cockroach that perches or forages on leaves during its active period may retain arolia and pulvilli, but these structures may be reduced or lost in a species that never ventures from the leaf litter (Bell et al. 2007). The specimens that we studied here were mainly collected by traditional sweeps of ground litter, and by canopy fogging during the day; however we failed to



Figs. 58-60: *Allacta bimaculata and A. transversa* crawling up tree trunks at night. (58) *Allacta bimaculata* Bey-Bienko on Jianfengling Mountain, Hainan Province, 5-XII-2009; (59) *Allacta transversa* Bey-Bienko in Qinzhou County, Guangxi Province, 25-IV-2009; (60) *Allacta transversa* Bey-Bienko in Thailand where they were crawling up the trunk at midnight. Photographs by Weiwei Zhang.



Figs. 61-72. The tarsomere ultrastructure of *Allacta ornata* Bey-Bienko. 61-64. Foreleg. (61) Distal part of fourth tarsomere; (62) Distal part of third tarsomere; (63) Distal part of second tarsomere; (64) Distal part of first tarsomere. 65-68. Middle leg. (65) Distal part of fourth tarsomere; (66) Distal part of third tarsomere; (67) Distal part of second tarsomere; (68) Distal part of the first tarsomere. 69-72. Hind leg. (69) Distal part of the fourth tarsomere; (70) Distal part of the third tarsomere; (71) Distal part of the second tarsomere; (72) Distal part of the first tarsomere. Scale bars = 20μm in Figs. 61, 65, 67, 69, 70, and 72, and 15μm in Figs. 62, 63, 64, 66, 68, and 71.

capture specimens by searching at night, and only succeeded in obtaining photos of 2 species, which were crawling up tree trunks (Figs. 58-60). We collected large numbers of specimens of *A. ornata* and *A. transversa* (some preserved in alcohol were excluded) in the past 3 years by canopy fogging. The narrative above indicates that the species of *Allacta* are ground or trees climbers, not burrowers and borers. Pulvilli are only present on the fourth tarsomere of all legs, having disappeared on the other 3 tarsomeres (Figs. 61-72). and the number of spines of the fourth tarsomere are obviously fewer than on the other 3 tarsomeres. They walk or climb on tiptoe, which is different from other species with pulvilli present on all tarsomeres, and maybe they run slowly, because the slow leg movements produce little vibration of the substrate (Barth et al. 1988); or the spines on the other 3 tarsomeres help them to climb or to crawl up tree trunks lightly and quickly; thus the spines seem to have totally replaced the pulvilli.

Acknowledgments

We are deeply grateful to Dr. George Beccaloni for his help in borrowing specimens from Dr. Anisyutkin (Russia, ZIN), and also thanks to Dr. Anisyutkin, Prof. S. Q. Li (China, IZCAS) and G. D. Ren (China, HBU) for their kindness in loaning specimens to us. We are grateful to Dr. W. W. Zhang for permitting us to use his biological photos of cockroaches. This study is supported by the National Natural Sciences Foundation of China (30900146, 31093430) and also partly by the Fundamental Research Funds for the Central Universities (XDJK2012B025, XDJK2013B013).

References Cited

Arnold, J. W. 1974. Adaptive features on the tarsi of cockroaches. Intl. J. Insect Morph. Embryol. 3: 317-334.

Barth, F. G., Bleckmann, H., Bohnenberger, J., and Sey-Farth, E. A. 1988. Spiders of the genus *Cupiennius* Simon 1891 (Araneae, Ctenidae). II. On the vibratory environment of a wandering spider. Oecologia 77: 194-201.

Bell, W. J., Roth, L. M., and Nalepa, C. A. 2007. Cockroaches: ecology, behavior, and natural history. The Johns Hopkins University Press, Baltimore, MD. 230 pp.

Brunner Von Wattenwyl, C. 1893. Révision du système des Orthoptères et description des espèces rapportées par M. Leonardo Fea de Birmanie. Ann. Mus. Ciuco di Storia Natl. Genova 33: 5-230.

Beccaloni, G. W. 2007. Blattodea Species File Online. Version 5.0/5.0. World Wide Web electronic publication. http://Blattodea.SpeciesFile.org [accessed 20-VIII-2013].

Bruijning, C. F. A. 1947. An account of the Blattidae (Orthoptera) from Celebes, the Moluccas, and New Guinea. Zool. Meded. 27: 205-252.

Bruijning, C. F. A. 1948. Studies on Malayan Blattidae. Zoologische Meded. 29: 1-174.

Kirby, W. F. 1904. A synonymic catalogue of Orthoptera. I. British Mus., London. 501 pp.

HEBARD, M. 1922. Dermaptera and Orthoptera of Hawaii. Occasional Papers of the Bernice P. Bishop Mus. 7(14): 305-379.

MACKERRAS, M. J. 1967. A blind cockroach from caves in the Nullarbor Plain (Blattodea: Blattellidae). J. Australian Entomol. Soc. 6: 39-44.

PRINCIS, K. 1950. Entomological results from the Swedish expedition 1934 to Burma and British India. Arkiv for Zoologi (N. S.) 1: 203-222.

PRINCIS, K. 1965. Kleine Beitrage zur Kenntnis der Blattarien und ihrer Verbreitung. VIII (Orth.). Eos 41: 135-156.

PRINCIS, K. 1969. Blattariae: Subordo Epilamproidea. Fam.: Blattellidae *In* M. Beier, (ed.), Orthopterorum Catalogus. Pars 13. W. Junk's-Gravenhage (The Hague).

ROTH, L. M. 1988. Some cavernicolous and epigean cockroaches with six new species and a discussion of the Nocticolidae (Dictyoptera: Blattaria). Rev. Suisse Zool. 95: 297-321.

ROTH, L. M. 1990. A revision of the Australian Parcoblattini (Blattaria: Blattellidae: Blattellinae). Mem. Queensland Mus. 28: 531-596.

ROTH, L. M. 1991a. Blattodea; Blattaria (Cockroaches), pp. 320-329 *In* I. D. Naumann et al. [eds.], The Insects of Australia. Vol. 1. CSIRO, Cornell University Press, Ithaca, New York.

ROTH, L. M. 1991b. New combinations, synonymies, redescriptions, and new species of cockroaches, mostly Indo-Australian Blattellidae. Invert. Taxonomy 5: 953-1021.

ROTH, L. M. 1993. The cockroach genus *Allacta* Saussure & Zehntner (Blattaria, Blattellidae: Pseudophyllodromiinae). Entomol. Scandinavica 23: 361-389.

ROTH, L. M. 1995. New species of *Allacta* Saussure & Zehntner from Papua New Guinea, Irian Jaya, and Sarawak (Blattaria, Blattellidae: Pseudophyllodromiinae). Papua New Guinea J. Agric., For. Fish. 38: 51-71.

ROTH, L. M. 1996. The cockroach genera *Sundablatta* Herbard, *Pseudophyllodromia* Brunner, and *Allacta* Saussure & Zehntner (Blattaria: Blattellidae, Pseudophyllodromiinae). Tijdschr. Entomol. 139: 215-242.

ROTH, L. M., AND WILLIS, E. R. 1952b. Tarsal structure and climbing ability in cockroaches. J. Exp. Zool. 119: 483-518.

SAUSSURE, H. DE, AND ZEHNTNER, L. 1895. Revision de la tribu des Perisphaeriens (insectes Orthopteres de la famille des Blattides). Rev. Suisse Zool., Geneve 3: 1-59.