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THE GENUS *ECTADIA* BRUNNER VON WATTENWYL (ORTHOPTERA: TETTIGONIIDAE: PHANEROPTERINAE), WITH DESCRIPTIONS OF THREE NEW SPECIES FROM CHINA

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***ABSTRACT.* –** The genus *Ectadia* species from China have been reviewed, mostly basing on characters of structures of stridulatory area and abdominal apex. Three new species are described from Southwestern China. Two known species of *Ectadia* in China are redescribed and illustrated. Key to the species of *Ectadia* is included. The genus is also discussed.

***KEY WORDS.* –** *Ectadia*, stridulatory file, abdominal apex, new species, China.

INTRODUCTION

The genus *Ectadia* was first described by Brunner von Wattenwyl (1878) with the type species *E. pilosa* in Kashmir, being the only known species at that time. Later two species, *E. fulva* and *E. abbreviata* from Burma were added by Brunner von Wattenwyl (1893), but the latter was considered as a synonym of the former (Bei-Bienko, 1962). Afterwards Xia & Liu (1989) described one species *E. sulcata* from southwestern China (Location, Yunnan Province). So far there are only three valid species in the world from the Oriental Region. Recently, Ingrisch (1998) proposed that the *Ectadia* is remote from other genera within the tribe Elimaeini, although the genus is well defined.

The structure of male stridulatory apparatus has been used as a reliable taxonomic character (Grochov & Kang, 2002; Ingrisch, 1990; 1998; Nickle, 1984; Ragge, 1980; Rentz, 1985; Shi & Zheng, 1999), but their characters of *Ectadia* species have not been described before. Now there have been recorded two species *E. fulva* and *E. sulcata* from southwestern China. The examination of specimens from several Chinese museums indicates the presence of new species in general collection. In this study, based on the survey of the structure of stridulatory apparatus, abdominal apex and other diagnostic characters, we describe three new species of *Ectadia* from southwestern China and provide generic diagnosis, key and some data on distribution. We also redescribe the genus *Ectadia* and known species in China to give identity of species and the exact comparison.

MATERIALS AND METHODS

Material comes from the following five depositories, i.e., Museum of Shanghai Institute of Entomology, the Chinese Academy of Sciences, Shanghai, China (MSIE); Insect Collection of Beijing Agricultural University, Beijing, China (CAU); Insect Collection of Institute of Zoology, the Chinese Academy of Sciences, Beijing, China (IZAS); Zoological Reference Collection of the Raffles Museum of Biodiversity Research, National University of Singapore (ZRC); and Museo Civico di Storia Naturale, Genoa, Italy (MCSN). All specimens were examined and drawings were made with a Leica MZ12.5 microscope and a drawing mirror.

SYSTEMATICS

Ectadia Brunner von Wattenwyl, 1878

Ectadia Brunner von Wattenwyl, 1878: 103.

Type species. – *Ectadia pilosa* Brunner von Wattenwyl, 1878.

***Description.* –** Brunner von Wattenwyl (1878); Bei – Bienko (1954).

***Redescription.* –** Elimaeini with modified tegminal venation and curved posterior tegminal margin. Lateral lobe of pronotum distinctly longer than high. Tibial tympana conchate on both sides. Male stridulatory area of left tegmen with a coarse Cu_2 vein and an additional adjacent thin vein as that in the tribe Ducetiini (see Gorochov & Kang, 2002) (Figs. 11-13). Stridulatory area with another additional adjacent semi-transparent membranous stridulatory area on the dorsal part of right tegmen (more distal than the mirror), which is also like that in the Ducetiini (Figs. 14-16). Internal genitalia membranous.

***Remarks.* –** One generic character, the anteriorly sloped frons, which Bei-Bienko (1954) thought is insignificant, may be otherwise after examination of all our specimens. Another generic character in Ingrisch (1998), sexual wing dimorphism, is probably a diagnostic character to species of the genus after discovery of new species *E. apicalis*. In addition, all *Ectadia* species from China have yataghan-shaped cerci, upcurved split subgenital plate, membranous internal genitalia, but different species have very different stridulatory file. So co-authors think structure of stridulatory file is another very important diagnostic character to species and relation of Chinese *Ectadia* species is comparatively closer between each other.

KEY TO THE SPECIES OF *ECTADIA*

1. Tegmen with whitish ridge on costal margin; male cerci straight, long, with inner median denticles and narrowed apex ..... *Ectadia pilosa* Brunner von Wattenwyl, 1878
– Tegmen without whitish ridge on costal margin; male cerci with the widest base, basal 1/3 area sharply acuminated, then gradually narrowed till the apex, its shape as yataghan, and without inner median denticles (Figs. 17-19) 2
2. Hind wing shorter than tegmen; tegmen with sharp apex (Fig. 1); ovipositor more than 2.5mm in width (Fig. 23) ..... *Ectadia apicalis*, new species
– Hind wing longer than tegmen; tegmen with approximately rotund apex (Figs. 2-5); ovipositor less than 2 .0mm in width 3
3. Male stridulatory file strongly cambered, with circa 20 rather thick teeth in the basal half area and 50 - 60 narrowly spaced fine teeth in the apical half area (Fig. 7). Hind wing of female slightly longer than tegmen; ovipositor 8mm long, 2.5 times longer than pronotum (Fig. 24) ..... *Ectadia sulcata* Xia & Liu, 1989
– Male stridulatory file not as in Fig. 7. Hind wing of female distinctively longer than tegmen; ovipositor 5-6mm long, not 2.5 times longer than pronotum (Fig. 25) 4
4. Supra-anal plate nearly semicircular, lateral margin slightly convex; male stridulatory file not "S"-shaped 5
– Supra-anal plate approximately rectangular; male stridulatory file slightly "S"-shaped, as in Fig. 8 .... *Ectadia fulva* Brunner von Wattenwyl, 1893
5. Male stridulatory file slightly curved; circa basal 1/4 area with 10 - 15 moderately spaced large teeth, middle 2/4 area with densely spaced fine teeth, apical 1/4 area commonly undeveloped without or with 1-4 widely spaced irregular large teeth (Fig. 9) ..... *Ectadia obsolescens*, new species
– Stridulatory file slightly sinuate; circa basal 1/2 area with densely spaced fine teeth, following 1/6 area with 4 densely spaced large teeth, apical 2/6 area with densely spaced large teeth, which are gradually decreasing in size towards apex (Fig. 10) ..... *Ectadia sinuata*, new species

Ectadia apicalis, new species

(Figs. 1, 6, 17, 20, 23, 26)

***Material examined.* –** Holotype. - male. China: Yunnan Prov.: Tengchong, Dahaoping, 16 Sep.1991-17 Sep. 1991, coll. Liu Zhuyao, Yin Haisheng (MSIE).

Paratypes. – 2 males, 2 females, same data as holotype.

***Description.* –** Male. Size small. Fastigium verticis narrower than the first segment of antennae, sulcate dorsally, not contacting fastigium. Complex eyes approximately round. Pronotom with disc nearly flat; anterior margin slightly concave, posterior margin truncate with small notch in middle; media carina conspicuous; transverse sulcus V-shaped; lateral carina prominent; lateral lobe of pronotum much longer than high, fore margin straight, hind margin obtuse-rounded, ventral margin oblique downward, obtusely crossing hind margin, humeral sinus present but seldom conspicuous. Tegmen surpassing hind wing, with apex gradually acuminated; costal area with irregular venation, C vein undeveloped, Rs vein branching out from behind the middle, confused with M vein; M vein zigzaging from behind the middle and giving off several oblique branches to posterior margin of tegmen (Fig. 1). Stridulatory file comparatively straight but slightly thinner in the middle, with circa 60 densely spaced fine teeth in the basal half area and 9 spaced sparsely spaced large teeth in the apical area (Fig. 6). Anterior coxae without spine, anterior tibiae dorsally sulcate and spinuliferous. All femora ventrally spinulose; posterior femur with 12 spines on ventral margins; posterior tibiae with 21 external spines and 20 internal spines on dorsal margins. The 10^{th} abdominal tergite prolonged backwards, hind margin emarginate; supra-anal plate quadrate; cerci with stoutest base, basal 1/4 area sharply acuminated, then gradually narrowed till the apex; subgenital plate split for almost apical 2/3, upcurved (Figs. 17, 20).
Colour. Body green, tegmen with brown dots.

Female similar to male except abdominal apex. Supra-anal plate triangular; cerci rather short, conical; ovipositor fairly broad and short, upcurved, both margins denticulate; subgenital plate triangular, apex obtuse-rounded (Figs. 23, 26).

Measurements (length in mm). – Body: male 15.0, female 17.0; pronotum: male 4.5, female 4.0; tegmen: male 21.5, female 20.5; tegmen width: male 5.0, female 3.5; hind wing: male 19.5; post femur: male 19, female 17.5; ovipositor: 6.0.

***Etymology.* –** The name of the new species refers to the gradually acuminate tegminal apex.

***Remarks.* –** *Ectadia apicalis* resembles *E. fulva* and *E. sulcata* in the shapes of the supra-anal plate, cerci and the subgenital plate, but differs from the two species in the smaller size, tegmen with gradually acuminate apex, tegmen longer than

hind wing, the structure of male stridulatory file, and female ovipositor shorter and broader.

***Distribution.* –** China.

Ectadia sulcata Xia & Liu, 1989
(Figs. 2, 7, 24, 27)

Ectadia sulcata Xia & Liu 1989: 155. Holotype, male, China, Baoshan, Beimiaoshuiku, (MSIE) [seen].

***Material examined.* –** Holotype – male, China: Yunnan Prov.: Baoshan, Beimiaoshuiku, 20 Sep.1981, coll. He Xiusong (MSIE).

Paratypes – 2 females (including 1 allotype), same data as holotype.

***Redescription.* –** Male. Size small. Hind wing conspicuously longer than tegmen. Stridulatory file strongly curved, with circa 20 large teeth at base half, and 50-60 minutely spaced fine teeth in the apical half area (Fig. 7). The 10th abdominal tergite slightly depressed, lightly prolonged, with hind margin truncate. Supra-anal plate trapezoidal, with lateral margins arcuate, hind margin truncate. Cerci very broad at basal 1/3 area, then sharply acuminate, yataghan-shaped. The subgenital plate with the broadest base, then becoming narrower, split for almost apical 2/3, upcurved.
Female similar to male except the wings and abdominal apex. Hind wing slightly longer than tegmen; supra-anal plate triangular; cerci rather short, conical; ovipositor fairly narrow and long, 2.5 times longer than pronotum, upcurved, both margins denticulate (Fig. 24); Subgenital plate triangular, apex obtuse-round (Fig. 27).

Measurements (length in mm). – body: male 15, female 17; pronotum: male 4.5, female 4.0; tegmen: male 21.5, female 20.5; width of tegmen: male 5, female 3.5; hind wing: male 19.5; hind femur: male 19, female 17.5; ovipositor: 8.0.

Ectadia fulva Brunner von Wattenwyl, 1893
(Figs. 3, 8, 11, 14, 25, 28)

Ectadia fulva Brunner von Wattenwyl, 1893: 167. Holotype, male, Burma, Carin Cheba, (MCSN) [not seen]; Bei-Bienko 1962: 122.
Ectadia abbreviata Brunner von Wattenwyl, 1893: 167, Fig. 58. Holotype, female, Burma, Carin Ghecu, (MCSN) [not seen].

***Material examined.* –** 1 male, China: Guangxi Prov.: Napo, Defu, 100m, 16 Aug.1998, coll. He Tongli (MSIE); 1 male, Yunnan Prov.: Changning, 15 Sep.1991, coll. Liu Zuyao, Wang Tianqi & Xin Haisheng (MSIE); 2 females, Xishuangbanna, Mengla, 620 – 650mm, 21 Apr. 1959, coll. Li Xiaofu & Zhang Facai (IZAS); 1 male, 1 female, Xishuangbanna, Mengla, 23 Jul.– 27 Jul.1995, coll. Liu Xianwei, Zhang Weinian & Jin Xingbao (MSIE); 1 male, Xishuangbanna, Meng'a, 1050-1080mm, 10 May 1958, coll. Pu Fuji (IZAS); 1 male, Xishuangbanna, Yiwu, 800 – 1300mm, 5 Aug.1958, coll. Wang Shuyong (ZRC); China: Fujian Prov.: Jianyang, Aotou, 28 Oct.1974, coll. Li Fashen (CAU).

***Redescription.* –** Male. Size a little larger than the former two species. Hind wing conspicuously longer than tegmen. Stridulatory file rather straight, circa 2/5 at base comparatively thick, middle 2/5 rather thin, and then becoming thicker toward apex; and with narrowly spaced fine teeth in 4/5 area from base as well as 10 widely spaced thick teeth in 1/5 apical area (Figs. 3, 8, 11). The whole area of the stridulatory apparatus of right tegmen bigger, its scraper cambered, comparatively narrow area situated more distally than main structure of the stridulatory apparatus, and proximal area between MA and MP+ CuIA, semi-transparent with a few veinlets (Fig. 14). The 10th abdominal tergite slightly depressed, lightly prolonged backwards, with hind margin truncate. Supra-anal plate approximately rectangular. Cerci very broad at basal 1/3, then sharply acuminate, yataghan-shaped. The subgenital plate with the broadest base, then becoming narrower, split for almost apical 3/5, upcurved.
Female similar to male. Supra-anal plate triangular; Cerci rather short, conical; ovipositor fairly narrow and short, upcurved, both margins denticulate (Fig. 25); Subgenital plate triangular, apex obtuse-round (Fig. 28).

Measurements (length in mm). – body: male 16.5, female 19.5; pronotum: male 4.0, female 4.1; tegmen: male 25, female 24; width of tegmen: male 6.5, female 3.5; hind wing: male 31.5, female 26; hind femur: male 19.5; female 20.5; ovipositor: 5.0.

***Variation.* –** One male specimen from Guangxi Prov. is distinctly larger than others [Measurements (length in mm). – body 18.5; pronotom 4.0; tegmen 30.0; width of tegmen 6.5; hind wing 38.0; hind femur 25.0]. Its stridulatory file was contaminated and no drawing can be obtained, so we put it in this species.

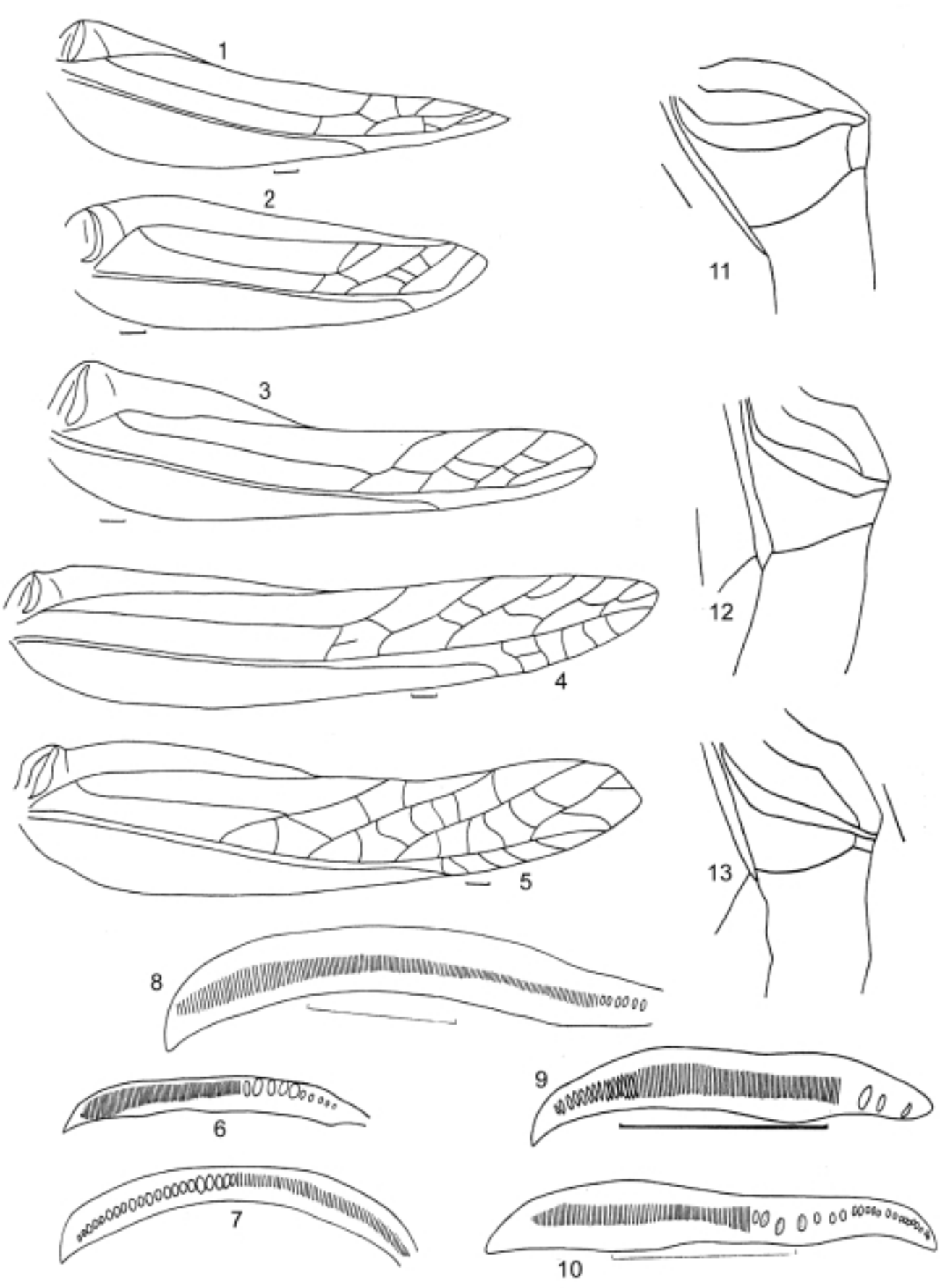
***Distribution.* –** Kashmir, Thailand, Burma and China.

Ectadia obsolescens, new species
(Figs. 4, 9, 12, 15, 18, 21)

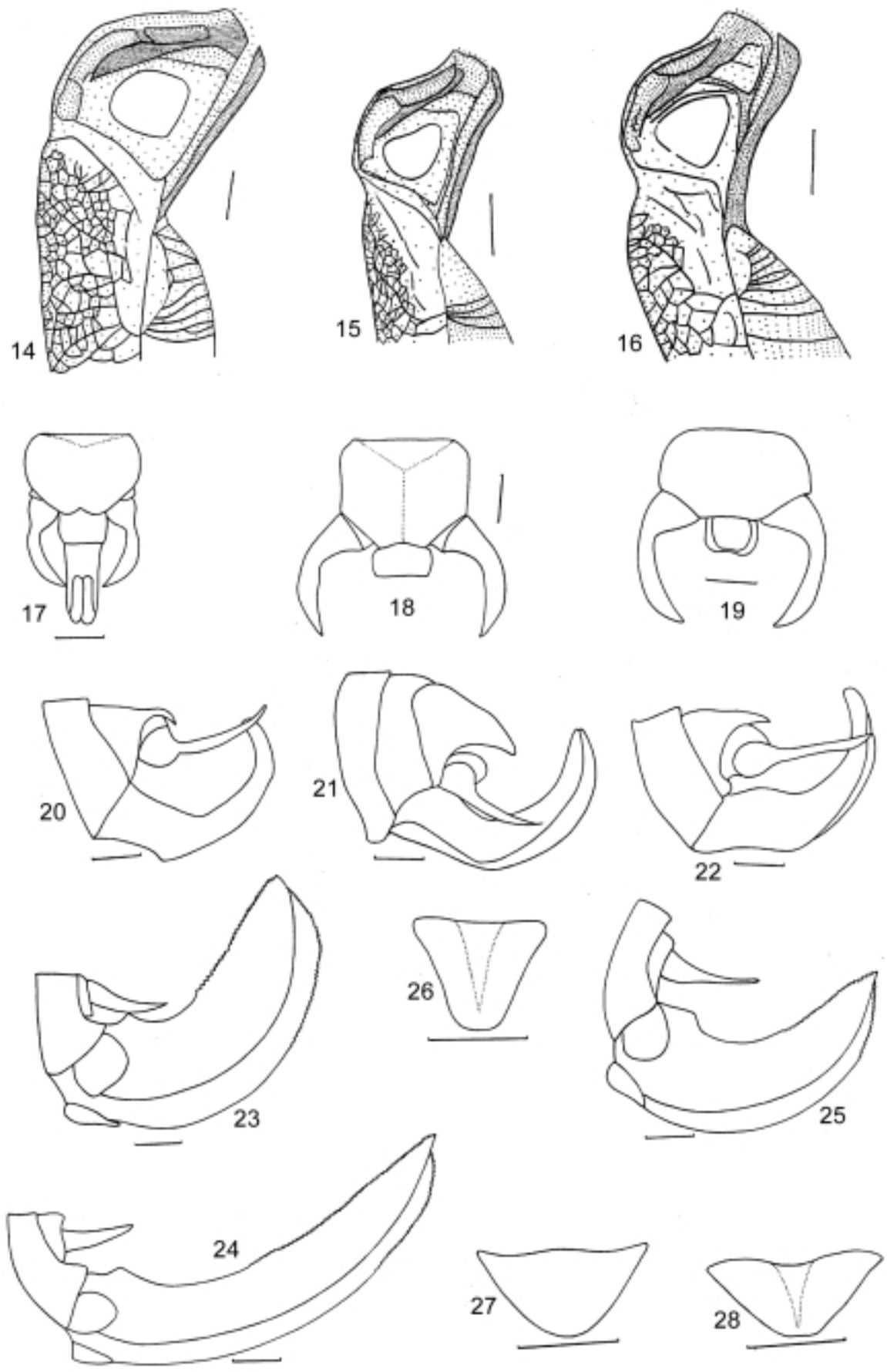
***Material examined.* –** Holotype. – male, China: Yunnan Prov.: Menglongbanna, Mengsong, 1600mm, 22 Apr.– 22 May.1958, coll. Pu Fuji (IZAS).

Paratypes – China: Yunnan Prov.: 5 males, 10 females, same data as holotype (IZAS); 1 male, same data as holotype (ZRC); 1 male, 1 female, Xishuangbanna, Damenglong, 650mm, 22 Jul.1958, coll. Hong Chunpei (IZAS); 1 male, 3 females, Xishuangbanna, Menghun, 1200 – 1400mm, 21 May.1958, coll. Zheng Leyi, Hong Chunpei & Meng Xuwu (IZAS).

***Description.* –** Male. Size, shape of body, comparison between tegmen and hind wing and shape of tegmen similar to *Ectadia fulva*, but different from it as follows. Stridulatory file slightly curved; circa basal 1/4 area with 10-15 moderately spaced large teeth, middle 2/4 area with about 110 densely spaced minute teeth, apical 1/4 area commonly undeveloped without or with 1-4 widely spaced irregular large teeth (Figs. 4, 9, 12). The whole area of the stridulatory apparatus of right tegmen much smaller, its scraper cambered, relatively wider area situated more distally than the main structure of the stridulatory apparatus, proximal area between MA and MP+CuIA, nearly transparent without any veinlets (Fig. 15).



Figs. 1-13. *Ectadia* species. 1, 6, *E. apicalis*, new species; 2, 7, *E. sulcata*; 3, 8, 11, *E. fulva*; 4, 9, 12, *E. obsolescens*, new species; 5, 10, 13, *E. sinuata*, new species. Lateral view of left tegmen (1-5); male stridulatory file on the underside of left tegmen (6-10); male stridulatory area of left tegmen (11-13) (Scale bar = 1 mm).



Figs. 14-28. *Ectadia* species. 17, 20, 23, 26, *E. apicalis*, new species; 24, 27, *E. sulcata*; 14, 25, 28, *E. fulva*; 15, 18, 21, *E. obsolescens*, new species; 16, 19, 22, *E. sinuata*, new species. Male stridulatory area of right tegmen (14-16); dorsal view of male abdominal apex (17-19); lateral view of male abdominal apex (20-22); lateral view of female abdominal apex (23-25); female subgenital plate (26-28) (Scale bar = 1 mm).

Abdominal 10th tergite slightly prolonged backwards, lateral margins convex, hind margin truncate, with a longitudinal furrow on dorsal surface. Supra-anal plate nearly semicircular, lateral margin arcuate, hind margin truncate. Cerci rather stout in the basal 1/3 area, then sharply acuminate, yataghan-shaped; Subgenital plate split for almost apical 1/2, upcurved (Figs.18, 21).

Colour. Lightly yellowish green (maybe more or less green in life). Tegmen with distinctly moderate brownish dots in cells of the radial area and numerous very small dots in the medial and cubital areas.

Female green, similar to male except wings and abdominal apex. Hind wing slightly surpassing the apex of tegmen. Supra-anal plate triangular; cerci rather short, conical; ovipositor short, upcurved, both margins denticulate; subgenital plate triangular, apex obtuse-rounded. Tegmen with indistinct very little dots.

Measurements (length in mm). – body: male 14.5 – 18.0, female 22.0; pronotum: male 3.1 – 3.8, female 3.9; tegmen: male 22.7 – 26.5, female 20.6 - 24; width of tegmen: male 6.5, female 3.5; hind wing: male 17.5 – 19.8, female 23; hind femur: male 17.5 – 20.5; female 19.0; ovipositor: 6.0.

***Variation.* –** One male specimen with undeveloped left hind wing, 1/3 as long as left tegmen; Some male specimens with median femora unarmed on ventral margin.

***Etymology.* –** The name of the species refers to the stridulatory file with the irregular, obsolescent apical area.

***Distribution.* –** China.

Ectadia sinuata, new species

(Figs. 5, 10, 13, 16, 19, 22)

***Material examined.* –** Holotype – male. China: Yunnan Prov.: Menglongbanna, Mengsong, 1600mm, 22 Apr.– 22 May.1958, coll. Pu Fuji (IZAS).

***Description.* –** Male. Size, shape of body, color, comparison between tegmen and hind wing and shape of tegmen similar to *Ectadia obsolescenta*, but different from the latter as follows. Stridulatory file slightly sinuate; circa basal 1/2 area with densely spaced fine teeth, following 1/6 area with 4 densely spaced large teeth, apical 2/6 area with large densely spaced teeth, which are gradually decreasing in size towards apex (Figs. 5, 10, 13). The whole area of the stridulatory apparatus of right tegmen moderate, its scraper cambered, the relatively wider area situated more distally than the main structure of the stridulatory apparatus, proximal area between MA and MP+CuIA, with many veinlets (Fig. 16). Abdominal 10th tergite slightly prolonged backwards, lateral margins convex, hind margin slightly emarginate, with a longitudinal furrow on dorsal surface. Supra-anal plate nearly semicircular, lateral margin slightly convex, hind margin with a round emargination. Cerci rather stout in the basal 1/3 area, then sharply acuminate, yataghan-shaped; Subgenital plate split for almost apical 1/2, upcurved (Figs. 19, 22).
Female unknown.

Measurements of male (length in mm). – body 17.0; pronotum3.6; tegmen: 26.5; width of tegmen 6.5; hind wing 35.0; hind femur 20.0.

***Etymology.* –** The name of the species refers to the slightly sinuate stridulatory file.

***Distribution.* –** China.

DISCUSSION

The structure of male stridulatory apparatus is more important character in taxonomy than before (Gorochov & Kang, 2002; Ingrisch, 1990; 1998; Nickle, 1984; Ragge, 1980; Rentz, 1985; Shi & Zheng, 1999), because of its distinct differences between species and its significance in sonic communication between the different sexes. After having dealt with the structure of stridulatory apparatus of plentiful material of *Ectadia* species from China, we found that the variation of the structure of stridulatory apparatus within each species is tiny but that between different species is very distinct. It shows that the structure of stridulatory apparatus can provide a valuable tool to study the genus *Ectadia*.

Moreover, the stridulatory apparatus is a more rapidly evolving character, because all Chinese *Ectaida* species that have been examined have very similar abdominal apex, but variable stridulatory apparatus, especially between *E. sinuata* and *E. obsolescens*. The distinct difference between those two species only lies in the structure of stridulatory apparatus and supra-anal plate. And the stridulatory apparatus of the holotype of *E. fulva* that was from Kashmir was not studied. The confusion exists during the recognition of this species. Maybe the examination of the structure of the stridulatory apparatus of the holotype will reveal discovery of some new species.

Furthermore, *E. abbreviata* might not be the synonym with *E. fulva*. In our collection, we can distinguish between the females of *E. fulva* and *E. obsolescens* only according to their distribution, for they are very similar to *E. abbreviata*. Thus more material needs to be examined to determine whether species *E. abbreviata* is valid.

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