

Sarasaeschna gaofengensis sp. nov. (Odonata, Aeshnidae), a New Dragonfly Species Described from Yunnan, China

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Abstract *Sarasaeschna gaofengensis* Yeh and Kiyoshi sp. nov. (holotype male, Gaofeng, Yunnan, China) is characterized by razor-like male cerci and widely divaricated epiproct with attenuated apical forks. It possesses a vesica spermalis with flagella adjoining ventral margin of its apical segment and is considered to belong to the *Sarasaeschna pryeri*-group. In the *pryeri*-group, *S. gaofengensis* shares the razor-like male cerci with *S. tsaopiensis* Yeh and Chen described from Taiwan, to which it is believed to be closely related.

Key words: Aeshnidae, *Sarasaeschna*, *pryeri*-group, new species, Yunnan, China

Introduction

The genus *Sarasaeschna* Karube and Yeh is a group of dragonflies belonging to the subfamily Gomphaeschninae which has a basal position within the family Aeshnidae (von Ellenrieder, 2002). Species of *Sarasaeschna* are best diagnosed by their apically divaricate male epiproct and tumid and robust vesica spermalis with elongate and recurved horn- or sickle-like flagella on apical segment. The closest relative of *Sarasaeschna* is the Nearctic genus *Gomphaeschna* Selys (Karube and Yeh, 2001; von Ellenrieder, 2002) which also shares the above-mentioned features and was considered to be the most primitive of the extant aeshnids based on fossil records (Wighton and Wilson, 1986). Karube and Yeh (2001) recognized three species-groups in *Sarasaeschna*, viz. *pyanan*-, *pryeri*- and *niisatoi*-groups, based mainly on vesica spermalis struc-

tures.

So far, *Sarasaeschna* includes 16 species (Schorr and Paulson, 2015; Yeh *et al.*, 2015) chiefly distributed in East Asia and the Indo-Chinese area of the Oriental region (Karube and Yeh, 2001). Three species have been reported from China, namely *S. sabre* (Wilson and Reels) from Hainan (Wilson and Reels, 2001), *S. niisatoi* (Karube) from Hainan (Wilson *et al.*, 2008) and *S. zhuae* Xu from Fujian (Xu, 2008). These species are not closely related to one another belonging to different species-groups, with *S. sabre* in the *pryeri*-group, *S. niisatoi* in the *niisatoi*-group, and *S. zhuae* in the *pyanan*-group (Karube and Yeh, 2001; Xu, 2008). In this article, the authors describe a new species of the *pryeri*-group collected from Yunnan in southwestern China where no representative of *Sarasaeschna* has been recorded before. The authors also compared the new species with the closely

related *S. tsaopiensis* Yeh and Chen from Taiwan with discussion on recognized differential features between them and between *S. gaofengensis* and the other known Chinese *Sarasaeschna*.

Material and methods

The holotype male was collected with a sweeping net in the forest and air-dried in a paper envelope without further treatment. Description was based on inspection of the untreated specimen with a 10X magnifier and a 45X stereomicroscope. Images shown in the illustrations less than 2X life-size were taken using a Nikon D600 SLR digital camera connected to a Micro-Nikkor 60mm f/2.8 lens via extension tubes or, if more than 2X, to a special Macro-Nikkor 35mm f/4.5 lens via a Nikon PB-4 bellow. In cases where image-stacking was necessary to increase depth of field, the Stackshot automated focus device from Cognisys™ was used to take multiple shots of each single image. The multiple images were then imported to Helicon™ software for stacking to get one clear image. Figures 2–4 have been manipulated in Acrobat™ Photoshop CS to enhance the faded pale colour by intensifying saturation. Morphological terminology follows mainly Sugimura *et al.* (2001). Terms of abdominal maculation are those of Walker (1912).

Abbreviations: S1–10 = abdominal segments 1–10. AD = antero-dorsal. MD = medio-dorsal. PD = postero-dorsal. AL = antero-lateral. AML = antero-lateral + medio-lateral. PL = postero-lateral.

Description

Sarasaeschna gaofengensis

Yeh and Kiyoshi sp. nov.

(Figs. 1–6, 9–11)

Material examined. Holotype: ♂, 11–14-VI-2013; Gaofeng, 2,078 m, Lufeng County, Chux-

iong City, Yunnan, China, leg. M. Owada and M. Wang. Holotype to be deposited at South China Agricultural University (SCAU).

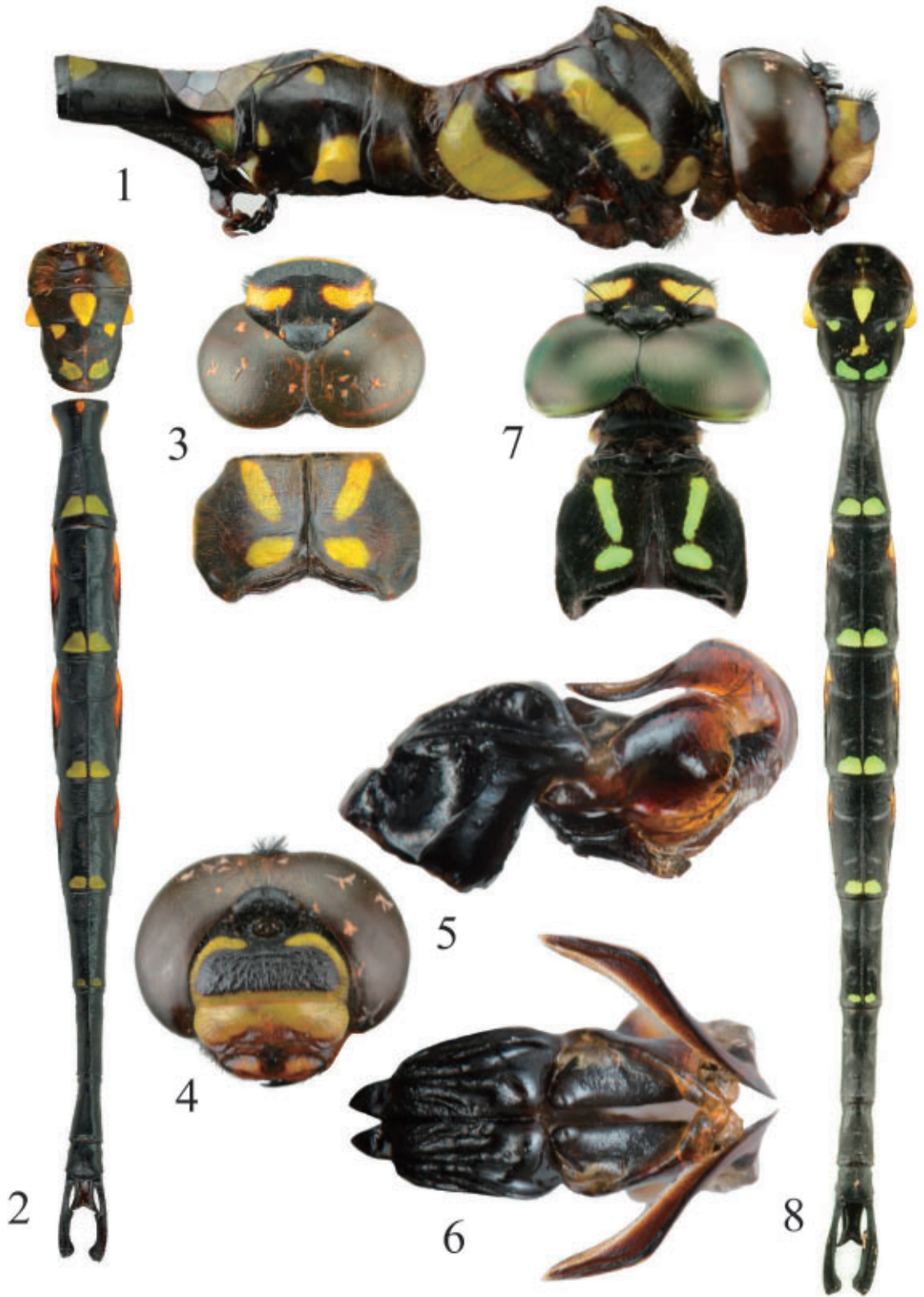
Etymology. The new species is named after its type locality Gaofeng, a montane country in Lufeng County of Chuxiong Yi-people Autonomous Prefecture in central Yunnan, China. Lufeng is famous for its rich preservation of ancient fossils, especially of dinosaurs and primates.

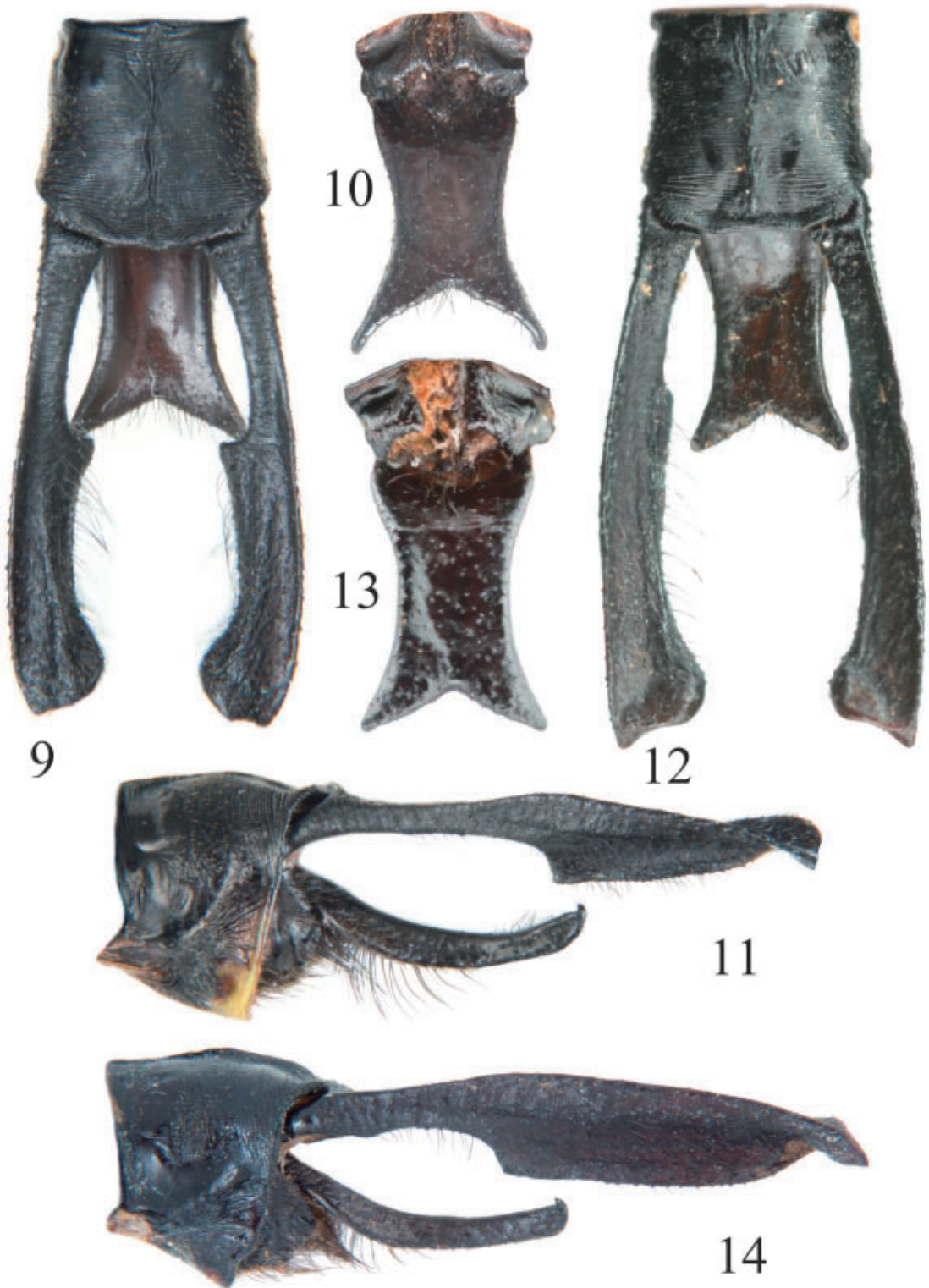
Diagnosis. Body medium-sized and black or dark brown with yellowish markings. Labrum largely yellowish with dark spot at middle; T-mark on postfrons with broad basal stalk much wider than 1/2 of vertex; vertical pale stripes well separated from dorsal pale spots on mesepisternum by 1/2 width of vertex; medial spot on dorsal side of S2 stripe-like and indistinct; S3–7 with sub-triangular and closely adjoining PD spots; male cerci elongate and razor-like as in *S. tsaopiensis*; male epiproct widely and deeply notched with apical forks strongly attenuated.

Holotype (male). HEAD: Labium yellowish brown, median lobe yellow at base. Labrum yellowish, dark brown at margin and middle, anterior margin broadly concave. Anteclypeus yellowish brown; postclypeus yellow, lower margin yellowish brown. Antefrons yellow and smooth at lower 1/3, black and wrinkled at upper 2/3 (Fig. 4), with a weak ridge on dorsal margin. Postfrons medially depressed and black, laterally marked with paired transverse yellow spots being continuous from lower yellow area of antefrons and formed a black T-mark; stalk of T-mark broad, much wider than 1/2 of vertex (Fig. 3). Antenna, vertex, and occiput black. Vertex tumid and obscurely reticulate, about 1/3 as wide as frons. Black hairs scattered on dorsal portion of head, absent on wrinkled area of frons, longer and denser on postfrons, vertex, and occiput.

PTEROTHORAX: Black with yellow markings and covered by long brown hairs; hairs

Figs. 1–8. Body patterns of *Sarasaeschna gaofengensis* Yeh and Kiyoshi sp. nov. and *S. tsaopiensis*. 1–6, *S. gaofengensis*, 7–8, *S. tsaopiensis*. 1, body, lateral; 2 and 8, abdomen, dorsal view; 3 and 7, head and pterothorax, dorsal view; 4, head, frontal view; 5, vesica spermalis, upside down in lateral view; 6, vesica spermalis, ventral view.





Figs. 9–14. Anal appendages of *Sarasaeschna gaofengensis* Yeh and Kiyoshi sp. nov. and *S. tsaopiensis*. 9–11, *S. gaofengensis*, 12–14, *S. tsaopiensis*. 9 and 12, cerci, dorsal view; 10 and 13, epiproct, ventral view; 11 and 14, cerci, lateral view.

denser on mesepisternum and metepimeron. Mesepisternum with an oblique vertical stripe and a dorsal spot; stripe bar-shaped and divergent ventrally from the opposite, ventral end reaching anterior margin of mesepisternum; dorsal spot rounded and much broader than stripe, separated from stripe by a distance about equal to 1/2 width of vertex (Fig. 3). Stripe of mesepimeron rounded at ventral end, of uniform width along ventral 3/4 and gradually narrowing along dorsal 1/4. Metepisternum with a medial and a dorsal spot, medial one narrow and vertical, dorsal one triangular. Metepimeron yellow at posterior 3/4. Mesinfrapisternum largely yellow, metinfrapisternum with a spot at posterior half (Fig. 1). Legs black.

WINGS: Hyaline, veins black, yellowish brown at basal extremity. Pterostigma dark reddish-brown, braced in all wings and underlaid by 1.5–2.5 cells. Venation simple, triangles three-celled, supra-triangles and sub-triangles uncrossed, anal triangles three-celled and anal loops four-celled; both Rspl and Mspl one-rowed, at most with 1 or 2 cells divided into upper and lower parts; costal cross-vein numbers 8 : 15 : 17 : 8 in forewings and 8 : 12 : 11 : 9 in hindwings.

ABDOMEN: Black with yellow markings, S1 and S2 tumid, S3 moderately constricted at middle. Abdomen spindle-shaped from distal half of S3 to S7, slender along S8, and very slightly broadened from distal half of S9 to S10, widest and parallel-sided on S4–6, attenuated toward apex at S7, parallel-sided again on S8; length of S9 + S10 about equal to S8. Dorsally, S2 with a large triangular AD, paired sub-rounded MD, paired sub-rounded PD spots and a tiny medial stripe between MD and PD spots; AD spot of S3 small, PD spots of S3–7 sub-triangular and closely adjoining, same-sized on S3–5, smallest and half-sized to those of S3 on S7 (Fig. 2). Laterally, S1 with large and obscure spot, S2 with rectangular AL and two small PL spots, AL spot covering auricle (Fig. 1); S3 with triangular AL spot; AML spot distinct on S4 and S5 and obscure on S6. Ventrally, S4–6 with paired oval

spots. Auricles well developed and semicircular, protruding backward and armed with two rows of tiny dark denticles on posterior margin. Mid-dorsal carina well present on apical half of S3 to S7. Cerci long and razor-like in dorsal view, 2.2 times as long as S10, basal 1/2 slender, apical 1/2 abruptly broadened, apical part convex and slightly dilated (Fig. 9); lateral profile of cerci roughly sinuate at dorsal margin and gently curved ventrally at apex (Fig. 11). Epiproct gently curved dorsally and 1/2 as long as cerci, widely and deeply notched apically with two forks diverging at about 90°; apical notch with width 2.7 times as long as depth and 1/4 as long as epiproct (Fig. 10).

VESICA SPERMALIS: Tumid and robust, apical segment broadly concave laterally with baso-ventral sclerotized plates pyramid-shaped. Flagella broad and flat, gently twisted through whole length and directed toward 3rd segment (Fig. 6). In lateral view, flagella adjoining ventral margin of apical segment as in other species of the *Sarasaeschna pryeri*-group (Fig. 5).

Female: Unknown.

Measurements (mm). Holotype: ♂ abdomen + cerci 43 mm, hindwing 38 mm, pterostigma (forewing: hindwing) 2.5 : 2.7 mm.

Discussion

Judging from its vesica spermalis morphology, *S. gaofengensis* is here recognized as a member of the *Sarasaeschna pryeri*-group. Within this group, it is most similar to *S. tsaopiensis* both in body pattern and shape of male cerci, which are razor-like. However, male cerci of *S. gaofengensis* are relatively shorter with the basal stalk and apical expansion about equal in length; in *S. tsaopiensis* the apical expansion is two times as long as the basal stalk. Shape of epiproct is also different in these two species, being shorter and more widely divaricate apically in *S. gaofengensis* but more elongate and with less divergent branches in *S. tsaopiensis*. In body pattern, *S. gaofengensis* has a paler face, with a yellowish brown clypeus, whereas clypeus is black or dark

brown in *S. tsaopiensis*. Other features of color pattern that allow distinguishing *S. tsaopiensis* from *S. gaofengensis* (those of *S. gaofengensis* in parenthesis) include: vertex with paired yellow spots (spots absent); vertical stripe on mesepisternum narrower and longer, connected to dorsal mesepisternal spot or separated from it by much less than 1/3 of width of vertex (stripe wider and shorter, and separated from dorsal spot by about 1/2 of width of vertex); AD spot of S2 shorter (longer); medial spot on S2 is distinct and dot-shaped (indistinct and stripe-shaped); PD spots on S2 transversely elongate (sub-rounded); PD spots of S3–5 are roundly shaped (triangularly shaped).

Besides of the different configuration of male anal appendages, *S. gaofengensis* differs from the other known Chinese *Sarasaeschna* species in its body color pattern. *Sarasaeschna niisatoi* can be separated from *S. gaofengensis* by having a reddish brown postclypeus, transversely elliptical MD spots on S2, and additional MD spots on S3–6. *Sarasaeschna sabre* is characterized by having a complete vertical stripe on mesepisternum which is not divided into a ventral stripe and a dorsal spot, and reduced pale markings on dorsum of S2 with only drop-like AD and paired round PD spots; considering the similarly sickle-shaped male cerci and the reduced pale markings on S2, this species is closely related to *S. chingjinlii* Chen and Yeh recently described from Taiwan (Chen and Yeh, 2014). *Sarasaeschna zhuae* differs from *S. gaofengensis* as follows (character states of *S. gaofengensis* in parenthesis): the basal stalk of the T-mark on postfrons is about 1/2 as wide as vertex (much wider than 1/2); the vertical stripe of mesepisternum is connected to the dorsal spot (distinctly separated from each other), MD spots on S2 are rectangular (sub-rounded); and AL spot on S2 connects posteriorly with a small obscure medio-dorsal spot (without the medio-dorsal spot).

Species of *Sarasaeschna* are usually distributed only in a restricted area. They generally occur at wetlands or small water bodies in well-forested areas of remote mountains which are

difficult to access. The potential diversity of the genus is suspected to be high as evidenced by the recent discovery of two additional new species from Taiwan (Chen and Yeh, 2014; Yeh *et al.*, 2015), a relatively small island where five *Sarasaeschna* species have been recorded so far. According to Chen and Yeh (2014) different species of *Sarasaeschna* in Taiwan were loosely segregated from each other in different altitudinal ranges, and two or even three species could coexist at the same site in overlapping zones with mutual differentiation in micro-habitat utilization, or to a less extent, different periods of adult activity. Considering the above facts and also the massive area and diverse habitats of China, the present status of *Sarasaeschna* in the country, where so far only four species have been reported, most likely does not reflect the real diversity and distribution of the genus.

It is strongly suspected that more *Sarasaeschna* species will be discovered from China, provided that a proper search effort in well-forested mountains is conducted. In higher altitudinal or latitudinal areas with cool and wet weather, a clue to find these species is the presence of bogs with *Sphagnum* mosses, which are usually good indicators for the potential habitats of *Sarasaeschna* in Taiwan (pers. obs.).

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