

**TAXONOMIC NOTES ON THE DRAGONFLY GENUS
SOMATOCHLORA SELYS, 1871 FROM CHINA
(ODONATA: ANISOPTERA: CORDULIIDAE)**

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[Li, H. & Zhang, H.-J. 2018. Taxonomic notes on the dragonfly genus *Somatochlora* Selys, 1871 from China (Odonata: Anisoptera: Corduliidae). Munis Entomology & Zoology, 13 (2): 401-405]

ABSTRACT: The dragonfly genus *Somatochlora* is reviewed and discussed based on the molecular and morphological data, and the following junior synonyms are revealed: *S. dido* Needham, 1930 = *S. taiwan* Inoue & Yokota, 2001 syn. nov. and *S. shennong* Zhang, Vogt & Cai, 2014 syn. nov., *S. uchidai* Forster, 1909 = *S. shanxiensis* Zhu & Zhang, 1999 syn. nov., *S. viridiaenea* Uhler, 1858 = *S. lingyinensis* Zhou & Wei, 1979 syn. nov.; *S. dido* reported by Sui & Sun (1984), Wang (2007) and Qian *et al.* (2011) extremely are misidentification, and should be *S. graeseri* Selys, 1889. Asahina (1942) reported four species, *S. exuberata* Bartenev, 1910, *S. metallica vera* Bartenev, 1914, *S. alpestris* Selys, 1840 and *S. arctica* Zetterstedt, 1840, from Northeastern China before, but they were not discovered by any author until now, and it is need to further evaluation while discovering the specimens.

KEY WORDS: morphology, DNA data, *Somatochlora*, new synonym, China

The dragonfly genus *Somatochlora*, a large group in the family Corduliidae (Odonata: Anisoptera), is established by Selys (1871) with a worldwide distribution. Needham (1930, 1931) respectively reported two species of *Somatochlora* from China primitively, and Asahina (1942) subsequently recorded five *Somatochlora* species from Northeastern China (Manzhouli). Later, many authors (Zhou, 1979; Zhu, 1999; Inoue *et al.*, 2001, 2013; Zhang *et al.*, 2014) successively described new species of *Somatochlora* based on specimens collected from China, meanwhile, some other authors (Sui & Sun, 1984; Wilson *et al.*, 2005; Wang, 2007; Qian *et al.*, 2011; Zhang *et al.*, 2014) also provided reports or records to *Somatochlora* which improving the group diversity. But it also took some confusions or controversies in *Somatochlora* which making the species identifications in trouble.

Based on the examination of holotypes and literature, and the molecular data of mt COI (cytochrome oxidase subunit 1 of mitochondria), the current paper deals with a review and taxonomic notes on the dragonfly genus *Somatochlora*, and try to get base information to make species clear.

MATERIALS AND METHODS

The specimens studied here were collected from Southern Shaanxi, Guangdong, Guizhou Provinces, China. The preparation of genitalia was using 70% alcohol to continually drip the segment 2 of abdomen to soften it, and then taking the penis out gently with a dissecting needle after one hour when the tissue was completely softened. The morphologic observation of the separated penis was under an Olympus Zoom Stereo Microscope (made in Japan).

The DNA sequences data of CO I (cytochrome oxidase subunit 1 of mitochondria) are downloaded from GenBank (National Center of Biotechnology Information, URL: www.ncbi.nlm.nih.gov) which submitted by Inoue (2013). The

phylogenetic tree is built via software MEGA 6.06 of latest version using the method of NJ (Neighbor-Joining).

The material studied is all deposited in the Shaanxi Key Laboratory of Bio-resources, Shaanxi University of Technology, Hanzhong, China (SUHC).

RESULTS

Phylogenetic analysis

The phylogenetic tree (Fig. 1) bases on DNA sequences of mt COI is similar to that by Inoue *et al.* (2013, Figs. 18–19), in the current tree the specimen of *Somatochlora dido* Needham, 1930 from Taiwan is slightly different from those from mainland China. Using the software MEGA 6.06 to get the statistics of *P*-index and *P*-distance from couples of sequences, we can obtain the intraspecific *P*-distance within *S. viridiaenea* is 0.00, *S. uchidai* 0.002, *S. clavata* 0.002, *S. metallica* 0.004, *S. graeseri* 0.007; among five specimens of *S. dido* from Taiwan is 0.002, two specimens from mainland China is 0.002, and in all specimens is 0.011; in all specimens of *S. alpestris* is 0.035, from Japan is 0.000, and from Russia is 0.002.

The interspecific *P*-distance between *S. metallica* and *S. exuberate* is least of 0.029, which against to the normal value of 0.02–0.03 in mt COI within a same species. Therefore, we proposed *S. taiwan* Inoue & Yokota, 2001 is a junior synonym of *S. dido* Needham, 1930; specimens under the name “*S. dido*” from Jiangxi Province extremely are a misidentification, and should be *S. uchidai*, this is agree with the result of the CO I tree; specimens under the name “*S. alpestris*” from Russia and Japan are not a same species.

DISCUSSION

Somatochlora uchidai Forster, 1909

Somatochlora uchidai Forster, 1909: 233

Somatochlora shanxiensis Zhu & Zhang, 1999: 289; Zhang, Vogt & Cai, 2014: 479 **syn. nov.**

Material examined: 3 ♂♂, China: Shaanxi Province, Mian County, Yunwusi, 1400 m, 4. IX. 2016, collected by Hong-Jie Zhang; 2 ♂♂, China: Shaanxi Province, Nanzheng County, Yuanba, 1740 m, 24. VIII. 2016, collected by Hong-Jie Zhang; 1 ♂, China: Shaanxi Province, Nanzheng County, Yuanba, 1450 m, 18. VIII. 2016, collected by Hong-Jie Zhang; 1 ♂, China: Shaanxi Province, Nanzheng County, Liping National Forest Park, 1600 m, 17. VIII. 2016, collected by Hong-Jie Zhang; 2 ♂♂, China: Shaanxi Province, Liuba County, Miaotaizi Forest Farms, 1300 m, 23. VII. 2016, collected by Hong-Jie Zhang; 1 ♂ 1 ♀, China: Shaanxi Province, Liuba County, Zhakoushi Forest Farms, 1700 m, 19. VII. 2013, collected by Hong-Jie Zhang; 3 ♂♂ 1 ♀, China: Shaanxi Province, Liuba County, Zhakoushi Forest Farms, 1700 m, 16. VII. 2011, collected by Hong-Jie Zhang; 1 ♂ 1 ♀, China: Shaanxi Province, Liuba County, Zhakoushi Forest Farms, 1700 m, 21. VII. 2010, collected by Hong-Jie Zhang; 1 ♂, China: Shaanxi Province, Liuba County, Zhakoushi Forest Farms, 1700 m, 03. VIII. 2006, collected by Hong-Jie Zhang; 3 ♂♂, China: Shaanxi Province, Ningshan County, Xunyangba, 1200 m, 03. VIII. 2006, collected by Zu-De Yang; 3 ♂♂, China: Shaanxi Province, Ningshan County, Xunyangba, 1200 m, 14. VIII. 1987, collected by Zu-De Yang; 3 ♂♂, China: Shaanxi Province, Ningshan County, Xunyangba, 26. VII. 1984, collected by Zu-De Yang; 2 ♂♂, China: Henna Province, Luoyang City, Funiushan National Nature Reserve, Baiyunshan, 03. VIII. 2010, collected by Hu Li; 1 ♂, China: Sichuan Province, Pingwu Country, 2020 m, 04. VIII. 2016, collected by Hong-Jie Zhang; 1 ♂, China: Sichuan Province, Chunzhou City, Jiguanshan, 1700 m, 29. VII. 2016, collected by Hong-Jie Zhang.

Distribution. China (Shaanxi, Shanxi, Heilongjiang, Jilin, Henan, Hubei, Jiangxi and Sichuan).

Biology. *Somatochlora uchidai* Forster, 1909 was usually discovered on very dense emergent aquatic plants in small ponds, or brook of 1–3 m wide, or ditches at 1200–2020 m above sea level. Copulation always can be observed between 12:00 and 14:00 in a day.

Notes. *Somatochlora shanxiensis* Zhu & Zhang, 1999 is very similar to *S. uchidai* Forster, 1909 in morphology, their Superior anal appendages and penis share similar shapes, therefore we suggest *S. shanxiensis* should be a junior synonym of *S. uchidai*, and the conclusion is also discussed with Hui-Qian Zhang, pers. comm. (Shanxi University, Taiyuan City, Shanxi Province, China).

Qian et al. (2011) also reported specimens collected from Jilin Province of China and assigned it to be *Somatochlora dido* Needham, 1930. After examination of primary literature and illustration, we find that there are no differences between male genitalia illustrated by Qian *et al.* (2011) and *S. uchidai*, maybe it is a misidentification, and his specimens should be *S. uchidai* Forster, 1909.

***Somatochlora dido* Needham, 1930**

Somatochlora dido Needham, 1930: 114

Somatochlora taiwana Inoue & Yokota, 2001: 217 by Wilson 2005: 150 **syn. nov.**

Somatochlora shennong Zhang, Vogt & Cai, 2014: 480 **syn. nov.**

Material examined. 1 ♂ [Holotype of *Somatochlora shennong* Zhang, Vogt & Cai, 2014], China: Hubei Province, Shennongjia Forestry District, Dajiu National Wetland Park in Shennongjia National Nature Reserve, 31°28'47"N, 110°00'35"E, 1754 m, 9. VIII. 2012, collected by Hao-Miao Zhang; 11 ♂, 3 ♀ [Paratypes of *S. shennong* Zhang, Vogt & Cai, 2014], same data as holotype; 3 ♂♂, same locality and collector, 28. VIII. 2013.

Distribution. China (Shaanxi, Sichuan, Hubei, Heilongjiang, Guangxi, Yunnan and Taiwan).

Notes. Inoue & Yokota (2001) described a new species *S. taiwana* with strong similarity comparing to *S. dido* Needham, 1930 based on a single specimen (male) from Taiwan, China. Wilson (2005) treated *S. taiwana* as *S. dido* based on morphological examination of a single specimen (male) from Guangxi Province, China with intermediate quantitative characteristics between *S. taiwana* and *S. dido*. Based on the morphological and DNA data, Inoue et al. (2013) proposed that *S. taiwana* should be treated as a genuine species.

Our result from DNA sequences also supports *Somatochlora taiwan* and *S. shennong* are conspecific. It is different in length of the superior anal appendage and the distance between the base and the basal spine to the total length of the superiors in specimens from Taiwan, Guangxi and Hubei Provinces of China (Inoue et al., 2013), in specimen from Taiwan its distance is 0.21–0.23, from Guangxi and Hubei is 0.18–0.19. In our four specimens from Shaanxi province the distance between the base and the basal spine to the total length of the superiors is 0.19–0.22, the length of the superior anal appendage is 2.7–2.8 mm. Accordingly, anal appendage itself is very short, the difference of the rate is very small, in addition, the hamule and penis are strongly similar to each other between these specimens, thus, they are should be interspecific differences and diversity, and we propose *S. taiwan* and *S. shennong* are junior synonyms of *S. dido*, they are should be treated as one species.

***Somatochlora graeseri* Selys, 1887**

Somatochlora graeseri Selys, 1887: 58; Ou-Yang, Chen & Chen, 1998: 91

Somatochlora dido, Zhu & Zhang, 1999: 291; Sui & Sun, 1984: 120; Wang, 2007: 62. Misidentification

Distribution. China (Heilongjiang, Henan), Japan.

Notes. Sui & Sun (1984) and Wang (2007) successively reported the species under the name “*Somatochlora dido*” respectively based on specimens collected from Heilongjiang and Henan Provinces of China, after comparing with their descriptions, however, there is no yellow stripe on the sides of synthorax in their specimens, and no yellow spot on the hind wing, and the shape of superior anal appendage is also different from *S. dido*, therefore, it is concluded that the species under the name “*S. dido*” described by Sui & Sun (1984) and Wang (2007) are extremely misidentifications, and it should be assigned to the name “*Somatochlora graeseri* Selys, 1887”.

***Somatochlora viridiaenea* Uhler, 1858**

Somatochlora viridiaenea Uhler, 1858: 31; Needham, 1931: 5; Asahina, 1942: 79

Somatochlora lingyinensis Zhou & Wei, 1979: 111. **syn. nov.**

Distribution. China (Northeastern China, Zhejiang), Japan, Russia.

Notes. *Somatochlora lingyinensis* is established and described by Zhou & Wei (1979) for a single female from lingyin of Hangzhou City of Zhejiang Province, China, and is distinguished from *S. viridiaenea* by the base of superior anal appendage with one triangular tooth and one blunt tooth. After examination of its holotype, the shape of superior anal appendage in *S. lingyinensis* is strongly similar to *S. viridiaenea*, body color pattern is also similar to the latter. Thus, we proposed *S. lingyinensis* should be a junior synonym of *S. viridiaenea*.

As to other species of *Somatochlora* from China also with some uncertainties. Asahina (1942) reported four species, *S. exuberata* Bartenev, 1910, *S. metallica vera* Bartenev, 1914, *S. alpestris* Selys, 1840 and *S. arctica* Zetterstedt, 1840, from Northeastern China before, but they were not discovered by any author until now, and it is need to further evaluation when discovering the specimens or having a chance to examine the former specimens.

ACKNOWLEDGEMENTS

The project was supported by two Doctoral Scientific Research Foundations of Shaanxi University of Technology (nos. SLGKYQD2-17 and SLGBH16-02), a Key Program of Natural Science Foundation of Education Department of Shaanxi Provincial Government (no. 16JS020), and a Young Talent Fund of University Association for Science and Technology in Shaanxi, China (no. 20170209).

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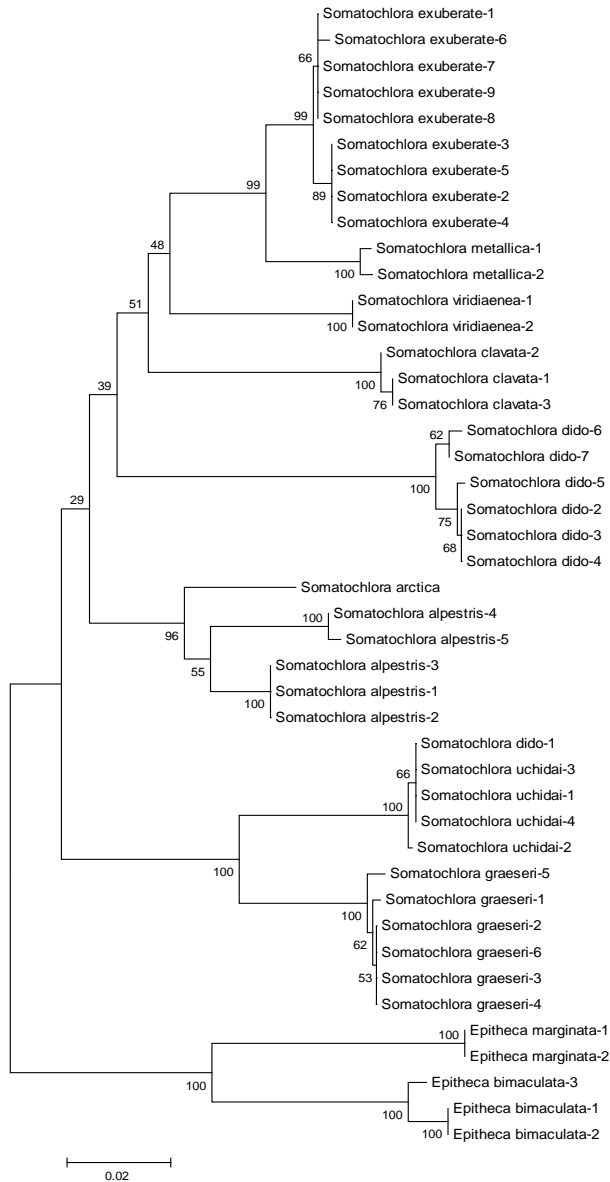


Figure 1. The Phylogenetic tree of *Somatochlora* based on DNA sequences of mt COI using the method of NJ.