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A remarkable new genus of Tettigarctidae (Insecta, Hemiptera, Cicadoidea) from the Middle Jurassic of northeastern China

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Abstract

Tianyuprosbole zhengi, a remarkable new genus and species of Tettigarctidae (Insecta, Hemiptera, Cicadoidea), is described based on a whole-bodied fossil from the Middle Jurassic of Daohugou, northeastern China. The new species possesses a tegmen similar to that of *Cicadoprosbole*, the type genus of Cicadoprosbolinae, and has an exceedingly expanded pronotum as the extant genus *Tettigarcta*. This specimen provides new insights in the evolution and taxonomy of tettigarctids.

Key words: Cicadomorpha, fossil, pronotum, tegmen, Daohugou

Introduction

Tettigarctidae, ancestral to singing cicadas, is the most primitive family of Cicadoidea (Shcherbakov, 2009). This family is now relict, consisting of only one extant genus with two species, *Tettigarcta tomentosa* White, 1845 and *T. crinita* Distant, 1883 (Moulds, 1990). The earliest tettigarctids appeared in the Latest Rhaetian of England (Whalley, 1983; Shcherbakov & Popov, 2002), and subsequent radiations have resulted in a diverse and successful group in the Mesozoic of Eurasia, Australia, Africa and South America (Wang B. *et al.*, 2009).

The extinct family Cicadoprosbolidae was established by Becker-Migdisova (1947) based on a forewing. Recently, many authors treated this family as a synonym of Tettigarctidae, auguring that the position of nodal line and broad costal area and clavus of tegmen are not sufficient enough to erect a new family (Nel, 1996; Nel *et al.,*1998; Menon, 2005). These authors split Tettigarctidae into two subfamilies, Tettigarctinae and Cicadoprosbolinae. Meanwhile, some authors (Evans, 1956; Hamilton, 1990; 1996) still kept it separate from Tettigarctidae (see Menon, 2005). Fossils with well-preserved body structures are likely to aid in disentangling this taxonomic problem. However, most previously described fossil species of Tettigarctidae *s.l.* just included the information of forewings. Herein, a remarkable new genus and species of Tettigarctidae *s.l.* is reported based on one whole-bodied fossil from the Middle Jurassic of northeastern China. The specimen provides new insights into the evolution and taxonomy of tettigarctids.

Material and methods

The specimen described herein was collected from the Middle Jurassic Jiulongshan Formation at Daohugou Village, Ningcheng County, Chifeng City, Inner Mongolia of China. The Middle Jurassic Daohugou biota is well-known for yielding abundant and diverse insect taxa (e.g., Fang *et al.*, 2009; Yang *et al.*, 2011; Wang M. *et al.*, 2012) as well as other invertebrates (e.g., Selden *et al.*, 2008) and vertebrates (e.g., Xu & Zhang, 2005). Our well-

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CuA forming a short stalk with M at basal 0.22 wing length, separating out at basal 0.29 wing length, branching into CuA_1 and CuA_2 just beyond nodal line; branch CuA_1 curved at crossvein m-cua and recurved near wing margin; branch CuA_2 long and sinuous. Vein CuP straight, ending at nodal line. Vein Pcu strong at wing base, ending at near midpoint of tegmen. Vein A1 partly preserved, weak, longitudinal.

Etymology. The species is named after Prof. Xiaoting Zheng, who is the curator of Shandong Tianyu Museum of Nature.

Holotype. STMN48-1037. Housed in Shandong Tianyu Museum of Nature.

Age and locality. Middle Jurassic; Daohugou Village, Ningcheng County, Chifeng City, Inner Mongolia, China.

Discussion

Fossil tettigarctids with body structures were just previously reported from the Upper Jurassic of Karatau (Shcherbakov & Popov, 2002) and Lower Cretaceous of Brazil (Hamilton, 1990; Menon, 2005), and so the classification of extinct Tettigarctidae is mainly based on the information of forewings (see Wang B. *et al.*, 2009). The Middle Jurassic of Daohugou has yielded abundant fossil tettigarctids with well-preserved body impressions (Wang B. et al., 2013) and so far three species within *Shuraboprosbole* Becker-Migdisova, 1949 of Cicadoprosbolinae and one species within *Sunotettigarcta* Hong, 1983 of Tettigarctinae have been described (Wang B. *et al.*, 2009; Li *et al.*, 2012). The pronota of *Shuraboprosbole* spp. and *Sunotettigarcta* sp. from Daohugou are large but not expanded over the mesonotum. Whereas, the pronotum of *Tianyuprosbole* **gen. nov.** is exceedingly expanded as in living *Tettigarcta.*

The tegmen of the new genus is very similar to that of *Cicadoprosbole*, the type genus of Cicadoprosbolinae. Therefore, the exceedingly expanded pronotum of both *Tettigarcta* and *Tianyuprosbole* **gen. nov.** might be the result of convergent evolution. However, the alternative scenario, that these two genera are closely related, could not be excluded. Reduction of the costal area and clavus of the forewing probably suggests an improvement of flight ability, and this evolutionary trend is found in Palaeontinidae and Cicadoidea (Wang B. & Zhang, 2009). The similar tegmen possessed by living *Tettigarcta* and Mesozoic Tettigarctinae might not be homologous. To clarify this evolutionary and taxonomic problem, more fossils with well-presented body structures should be further studied.

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