

The first Early Cretaceous damsel–dragonfly (Odonata: Stenophlebiidae: *Stenophlebia*) from western Liaoning, China



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ABSTRACT

A well-preserved forewing of the damsel–dragonfly *Stenophlebia liaoningensis* sp. nov. is described from the Lower Cretaceous Yixian Formation in the Huangbanjigou Village, western Liaoning, China. This is the first discovery of the genus *Stenophlebia* in China, although it was widely distributed in Europe during the Late Jurassic. The discovery adds to the biodiversity of Stenophlebiidae in the Chinese Cretaceous, and provides insight on the evolution of this extinct family.

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1. Introduction

The superfamily Stenophlebioidea comprises two families: Prostenophlebiidae and Stenophlebiidae, with the latter widely distributed in the Jurassic–Cretaceous of Germany, Spain, England, France, China, Mongolia and Kazakhstan (Fleck et al., 2003; Nel et al., 2015).

Until now, only two stenophlebiid damsel–dragonflies have been reported from the Lower Cretaceous of China: *Sinostenophlebia zhanjiakouensis* (Hong, 1984) from the Lower Cretaceous Qingshila Formation of Hebei (Hong, 1984), and *Yixianstenophlebia magnifica* (Nel & Huang, 2015) from the Lower Cretaceous Yixian Formation of Inner Mongolia (Nel & Huang, 2015). Here we

describe a well preserved forewing from the Lower Cretaceous Yixian Formation of the Huangbanjigou outcrop, western Liaoning and attribute it to the genus *Stenophlebia*. Except *S. karatavica* (Pritykina, 1968) from the Jurassic of Kazakhstan, this genus is known by several species from the Upper Jurassic of Europe (Fleck et al., 2003), viz., *S. amphitrite* (Hagen, 1862), *S. eichstaettensis* (Nel et al., 1993), *S. phryne* (Hagen, 1862), *S. latreillei* (Germer, 1839), and *S. rolhuggeri* (Bechly et al., 2003). The new discovery is the first damsel–dragonfly belonging to the typical genus of the family from the Lower Cretaceous of China. It extends the range both stratigraphically and geographically of this extinct dragonflies.

2. Material and methods

The specimen described herein was collected from the lower Yixian Formation of the Huangbanjigou outcrop in Beipiao, western Liaoning Province, China (47° 37' N, 120° 50' E, Fig. 1). The Mesozoic strata near Huangbanjigou Village consist of the Yixian Formation and the underlying Tuchengzi Formation. The layer yielding the

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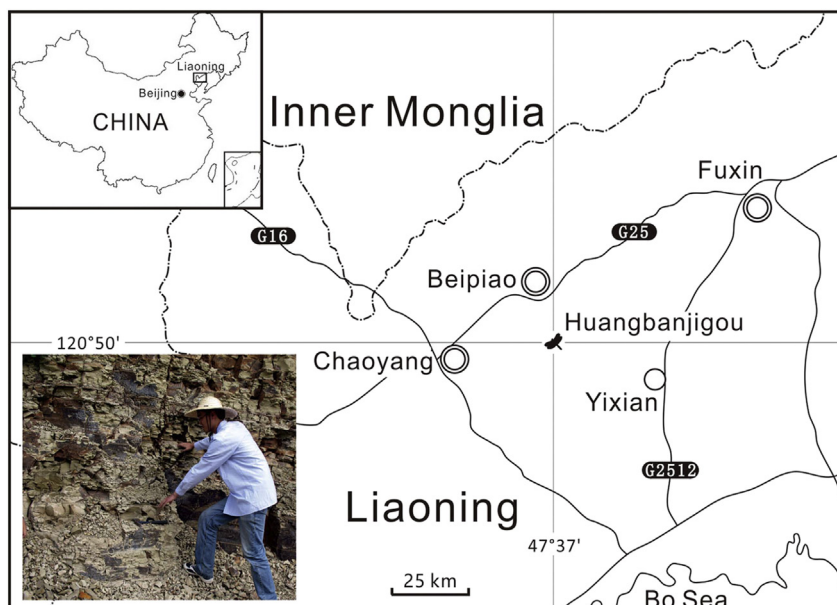


Fig. 1. Geological sketch map and photograph showing the location of the Huangbanjigou outcrop.

damsel–dragonfly belongs to the Jianshangou Bed of the Yixian Formation and was dated at about 125 Ma (Chang et al., 2009) (earliest Aptian; Cohen et al., 2013).

The specimen was examined dry using a Nikon SMZ1000 stereomicroscope. Photographs were taken using a Canon 5D digital camera and the line drawings were prepared from photographs using image-editing software (CorelDraw X7.0 and Adobe Photoshop CS6). The specimen is housed in the Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences (NIGPAS).

The nomenclature of the dragonfly wing venation used in this paper is based on the interpretations of Riek (1976) and Riek and Kukalová-Peck (1984), as modified by Nel et al. (1993) and Bechly (1996). Vein abbreviations are as follows: AA, anterior anal; Arc, arculus; Ax0, Ax1, Ax2, primary antenodal crossveins; Cr, nodal crossvein; CuAa, distal branch of anterior cubitus; CuAb, proximal branch of anterior cubitus; IR1, IR2, intercalary radial veins; MA, anterior median; MP, posterior median; Msp1, median supplement; N, nodus; 'O', oblique vein; Pt, pterostigma; RA, anterior radius; RP, posterior radius; Rsp1, radial supplement; ScP, posterior subcosta; Sn, subnodal crossvein; T, discoidal triangle.

The higher classification of fossil and extant Odonatoptera, as well as family and generic characters followed in the present work, is based on the phylogenetic system proposed by Bechly (1996, 2014) and Fleck et al. (2003) for Stenophlebiptera.

3. Systematic palaeontology

Order Odonata Fabricius, 1793

Infraorder Stenophlebiptera Bechly, 1996

Superfamily Stenophlebioidea Needham, 1903

Family Stenophlebiidae Needham, 1903

Genus *Stenophlebia* Hagen, 1866

Type species: *Stenophlebia amphitrite* Hagen, 1862

***Stenophlebia liaoningensis* sp. nov.**

(Figs. 2–6)

Derivation of name. Named after Liaoning Province.

Type Material. NIGP 163029, imprint of a slightly damaged forewing, deposited in the Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences, Nanjing, China.

Locality and Horizon. Huangbanjigou Village, Beipiao City, Liaoning Province, China; Jianshangou Bed of the Yixian Formation, Lower Cretaceous (lowermost Aptian).

Diagnosis. Small species distinct in having the following forewing characters: wing narrow and short, 42 mm long; Cr long, with two cells below it, and well aligned with distal part of ScP; Sn short, one cell long; supplementary veinlet below Sn aligned with RP2 and three cells long; Arc midway between Ax1 and Ax2; base of IR1 two cells distal of base of RP2.

Description. Forewing, 42.2 mm long, width at level of N 7.8 mm; distance from base to Arc 5.1 mm, from Arc to N 16.1 mm, from N to Pt 11.9 mm, from Pt to wing apex 15.9 mm. CuP separating from MP + Cu and fused with AA immediately opposite Arc. MA divided into MAa and MAb, at angle of 90°; MAa basally nearly straight and curved distally; MAb straight. Median space free of crossveins, and submedian space with six crossveins preserved. Discoidal space divided into transverse crossed T and longitudinal free hypertriangle, separated by crossvein beginning at bend of MP + CuA and fused with MAb in costal distal angle of discoidal space. T transverse (Fig. 4), divided into two cells, 2.0 mm long and 0.9 mm wide, length of its anterior side 1.0 mm, of basal side 1.7 mm, of distal side MAb 2.0 mm. Hypertriangle quadrangular, 1.6 mm long and 0.3 mm wide at base. Subdiscoidal space long and probably foot shaped. CuA separating from MP at posterior angle of T and reaching AA at right angle. CuAa reaching posterior margin well basal of nodal level. Area between MP and CuAa widened distally, with seven rows of cells along wing margin. Anal area narrow. Postdiscoidal area basally with two rows of cells and greatly widened distally. A concave Msp1 and a long, secondary, straight, longitudinal convex vein parallel to MP, beginning just distal of T. MP and RP3/4 curved. Nodal structures well preserved (Fig. 5), vein Cr between N and RA long, oblique and perfectly aligned with general trend of ScP, with two cells below it; Sn short, one cell long but more oblique. Base of RP2 one cell distal of end of Sn; three supplementary cells and secondary longitudinal short 'stenophlebiid' vein, well aligned with RP2, just basal of base of RP2, between RP and IR2. Antenodal area

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