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A new genus with two new species of mesosciophilids from the Middle Jurassic of China (Diptera: Nematocera: Mesosciophilidae)

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Mesosciophilidae is one of the extinct families of the suborder Nematocera in Diptera. Six genera and 17 species of mesosciophilids have so far been described from the Holarctic Region, including China, Kazakhstan, Kirghizia, Russia and Transbaikalia. Herein, a new genus with two new species, *Similsciophila singularis* gen. et sp. nov. and *Similsciophila sinuata* sp. nov. from the late Middle Jurassic, Jiulongshan Formation of Daohugou Village, Inner Mongolia, China, are described based on their venation and body characters. A new key to genera of mesosciophilid gnats is provided.

http://zoobank.org/urn:lsid:zoobank.org:pub:8A772D35-29A8-49AA-9B7F-D9994992EE71

Keywords: Mesosciophilidae; Jiulongshan Formation; Daohugou; Inner Mongolia

Introduction

Mesosciophilidae is an extinct family in Diptera. In 1946, Rohdendorf first described the members of Mesosciophilidae as a subfamily Mesosciophilinae within the family of Allactoneuridae (Rohdendorf 1946). Later, Allactoneuridae was renamed as Fungivoritidae (Rohdendorf 1964). In 1985, Kovalev thought that Fungivoritidae was a junior synonym of Pleciofungivoridae, and raised the subfamily Mesosciophilinae to the level of family Mesosciophilidae (Kovalev 1985). In 1993, Blagoderov revised the diagnosis of Mesosciophilidae, and erected the genus *Mesosciophilopsis* with three species from the Neocomian, Lower Cretaceous of Transbaykal, Baysa (Blagoderov 1993). In 2007, Zhang established the genus *Paramesosciophilodes*, and referred two species respectively to the genera of *Mesosciophila* and *Paramesosciophilodes* within the Mesosciophilidae from the Jiulongshan Formation in Daohugou, Chifeng, Inner Mongolia, China (Zhang 2007). Soon afterwards, Zhang reviewed all records of mesosciophilid gnats, added three species into three genera, and thought that a Chinese species *Sinosciophila meileyingziensis* Hong, 1992 might be a member of the Mesosciophilidae (Zhang 2008). In 2009, Li and Ren described the genus *Jurasciophila* with three species from the late Middle Jurassic Jiulongshan Formation of Daohugou in southeastern Inner Mongolia, China (Li and Ren 2009). In 2012, Wang et al. assigned two species to *Mesosciophila* and *Paramesosciophilodes* within Mesosciophilidae (Wang et al. 2012). To date, six genera and 17 species of mesosciophilids have been described from the Holarctic Region, and the majority of fossil mesosciophilids are described from the Middle or Late Jurassic, with some from the Early Cretaceous (Table 1).

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Table 1. A list of fossil Mesosciophilidae of the world.

Genus	Species	Locality	Age
Mesosciophila	*Mesosciophila venosa* Rohdendorf, 1946	Karatau, Chimkent Oblast, Kazakhstan	Karabastau Fm., J_3
	Mesosciophila eucalla Zhang, 2007	Daohugou, Ningcheng, Inner Mongolia, China	Jiulongshan Fm., J_2
	Mesosciophila abstracta Zhang, 2008	Daohugou, Ningcheng, Inner Mongolia, China	Jiulongshan Fm., J_2
	Mesosciophila sigmoidea, Wang et al., 2012	Daohugou, Ningcheng, Inner Mongolia, China	Jiulongshan Fm., J_2
Mesosciophilodes	*Mesosciophilodes augustipennis* Rohdendorf, 1946	Karatau, Chimkent Oblast, Kazakhstan	Karabastau Fm., J_3
	Mesosciophilodes similis Rohdendorf, 1964	Sogyuty, Tonskiy, Kirghizia	Karabastau Fm., J_3
	Mesosciophilodes synchrona Zhang, 2008	Daohugou, Ningcheng, Inner Mongolia, China	Jiulongshan Fm., J_2
Mesosciophilina	*Mesosciophilina bolshakovi* Kovalev, 1985	Siberia, Russia	Itat Fm., J_2
	Mesosciophilina irinae Kovalev, 1985	Siberia, Russia	Itat Fm., J_2
Mesosciophilopsis	*Mesosciophilopsis curtus* Blagoderov,1993	Baissa, Buryat, Yeravnenskiy, Transbaikalia	Zaza Fm., K_1
	Mesosciophilopsis expletus Blagoderov, 1993	Baissa, Buryat, Yeravnenskiy, Transbaikalia	Zaza Fm., K_1
	Mesosciophilopsis minor Blagoderov, 1993	Baissa, Buryat, Yeravnenskiy, Transbaikalia	Zaza Fm., K_1
Paramesosciophilodes	*Paramesosciophilodes ningchengensis* Zhang, 2007	Daohugou, Ningcheng, Inner Mongolia, China	Jiulongshan Fm., J_2
	Paramesosciophilodes eximia Zhang, 2008	Daohugou, Ningcheng, Inner Mongolia, China	Jiulongshan Fm., J_2
	Paramesosciophilodes aequus Wang et al., 2012	Daohugou, Ningcheng, Inner Mongolia, China	Jiulongshan Fm., J_2
Jurasciophila	*Jurasciophila curvula* Li and Ren, 2009	Daohugou, Ningcheng, Inner Mongolia, China	Jiulongshan Fm., J_2
	Jurasciophila lepida Li and Ren, 2009	Daohugou, Ningcheng, Inner Mongolia, China	Jiulongshan Fm., J_2

Note: (Notice: J_2-Middle Jurassic, J_3-Late Jurassic, K_1-Early Cretaceous).

Based on a combination of unique wing venation characters of three well-with two new species, *Similsciophila singularis* sp. nov. and *Similsciophila sinuata* sp. nov. These specimens were collected from the late Middle Jurassic Jiulongshan Formation of Daohugou Village in the Ningcheng County, Chifeng City, southeastern Inner Mongolia, China. Many fossil insects have been described from this locality in recent years (Ren et al. 2010, 2012), such as mecopterans (Ren 1994), dipterans (Zhang et al. 2008, 2011), neuropterans (Wang et al. 2010), orthopterans (Gu et al. 2012) and heteropterans (Yao et al. 2012).

Material and methods

This study is based on three specimens housed in the Key Lab of Insect Evolution & Environmental Changes, Capital Normal University, Beijing, China (Curator: Dong Ren). Line drawings were prepared from high-resolution photographs with CorelDraw 12 graphic software. Wing venation nomenclature is after Wootton and Ennos (1989); Shcherbakov et al. (1995); Mostovski (1997); Blagoderov et al. (2002) and Zhang (2008). In some literature, the anal vein A is called CuP. In this paper, vein A is used. Cell r length is measured from the forking point of bRs from R_1 to the forking point of R_{2+3} from R_1.

Systematic palaeontology

Order **DIPTERA** Linnaeus, 1758
Suborder **NEMATOCERA** Latreille, 1825
Family **MESOSCIOPHILIDAE** Rohdendorf, 1946
Similsciophila gen. nov.

Type species: *Similsciophila singularis* sp. nov.
Species included: *Similsciophila singularis* sp. nov. and *Similsciophila sinuata* sp. nov.

Diagnosis

Body medium-sized, covered with long and dense pubescence. Mesonotum convex. Scutellum sharp and clearly projecting. Forewing Sc elongate, shorter than one-half of wing length; sc-r situated distinctly basal to Rs origin, arising near midway between h to Sc ending at margin; cell r distinctly large, longer than one-sixth of wing length; Rs furcated distad to fork of M_{1+2}; bRs longer than r-m; R_1 slightly curved; both R_1 and R_{4+5} divergent terminally; R_{4+5} arched near its mid-length; stem of M not developed and thin; M_{1+2} furcated slightly distad to level of Sc ending. Tibiae and tarsi with short sparse setae.

Etymology

The generic name is derived from the Latin (*simil-*), in reference to similar, and *sciophila* is from the generic name *Mesosciophila*.

Remarks

Based on the venation, *Similsciophila* gen. nov. is distinguished from *Mesosciophilopsis* Blagoderov, 1993 and *Jurasciophila* Li and Ren, 2009 by the following characters: wing longer and wider; cell r distinctly larger, and longer than one-sixth of wing length. The new genus is similar to the genus *Paramesosciophilodes* Zhang, 2007, but differs mainly by bRs longer than r-m. It also differs from *Mesosciophilina* Kovalev, 1985, *Mesosciophilodes* Rohdendorf, 1946 and *Mesosciophila* Rohdendorf, 1946 in that R_{4+5} arched near its mid-length.

Distribution

China.

Key to genera of mesosciophilid gnats

1. Cell r distinctly small, equal to or shorter than one-sixth of wing length 2
- Cell r distinctly large, longer than one-sixth of wing length 3

2. bRs equal to or shorter than r-m ..... *Mesosciophilopsis* Blagoderov, 1993
- bRs significantly longer than r-m ..... *Jurasciophila* Li and Ren, 2009

3. R_{4+5} arched near its mid-length 4
- R_{4+5} slightly arched or almost linear near its mid-length 5

4. bRs equal to or shorter than r-m ..... *Paramesosciophilodes* Zhang, 2007
- bRs longer than r-m ..... *Similsciophila* gen. nov.

5. Cross-vein r-m converges with M_{1+2} at obtuse angle 6
- Cross-vein r-m converges with M_{1+2} at right angle .... *Mesosciophilina* Kovalev, 1985

6. R_{2+3} straight, almost perpendicular to R_{4+5} ..... *Mesosciophilodes* Rohdendorf, 1946
- R_{2+3} oblique, cross with R_{4+5} at obtuse angle ..... *Mesosciophila* Rohdendorf, 1946

Similsciophila singularis sp. nov.
(Figures 1A–D, 2A–F, 3A, B)

Diagnosis

Wing membranous, 2.2–2.4 times as long as wide; R_{2+3} slightly curved, almost perpendicular to R_{4+5}; bRs long and 1.1–1.4 times as long as r-m; dM_{1+2} about 1.4–1.8 times as long as bM_{1+2}; bM_{1+2} about 2.0–2.4 times as long as m-cu.

Material

Holotype No. CNU-DIP-NN2011226, a well-preserved complete body with a haltere and two wings. Paratype No. CNU-DIP-NN2011147 p/c, a specimen in lateral aspects with part of wings overlapping.

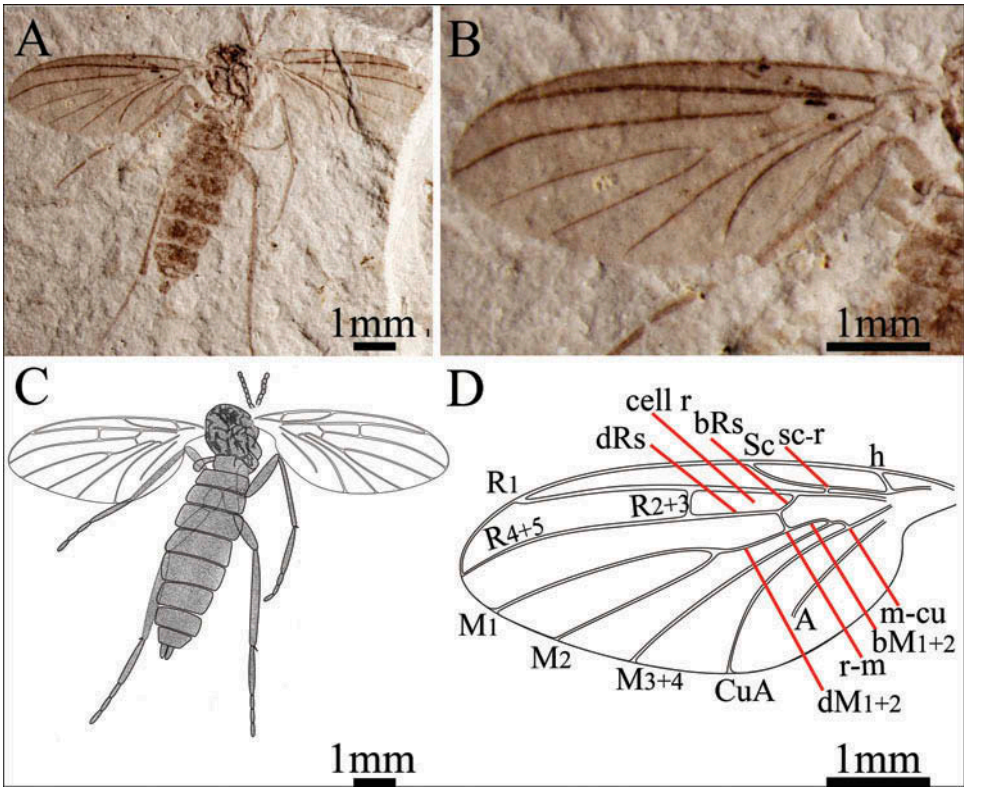

Figure 1. *Similsciophila singularis* gen. et sp. nov., holotype, CNU-DIP-NN2011226. (A) Photograph of habitus (dorsal aspect); (B) photograph of wing part; (C) line drawing of habitus; (D) line drawing of wing venation.

Etymology

The specific name is from the Latin (*singularis*), meaning single, for all the veins are single.

Locality and horizon

Late Middle Jurassic, Jiulongshan Formation, Daohugou Village, Shantou Township, Ningcheng County, Inner Mongolia, China (Ren et al. 2010).

Description

Medium-sized mesosciophilid gnats, male adult, in dorsal aspects. Wings out-spread. Head poorly preserved. Antennae 19 segments (as preserved on Paratype), with all flagellomeres oblong and nearly the same size in length and width. Body covered with long dense pubescence. Mesonotum convex, scutellum clearly projecting. Abdomen thin, subcylindrical, about 2.7 times as long as head and thorax combined, with eight abdominal segments, first five segments gradually widened distally, sixth, seventh and

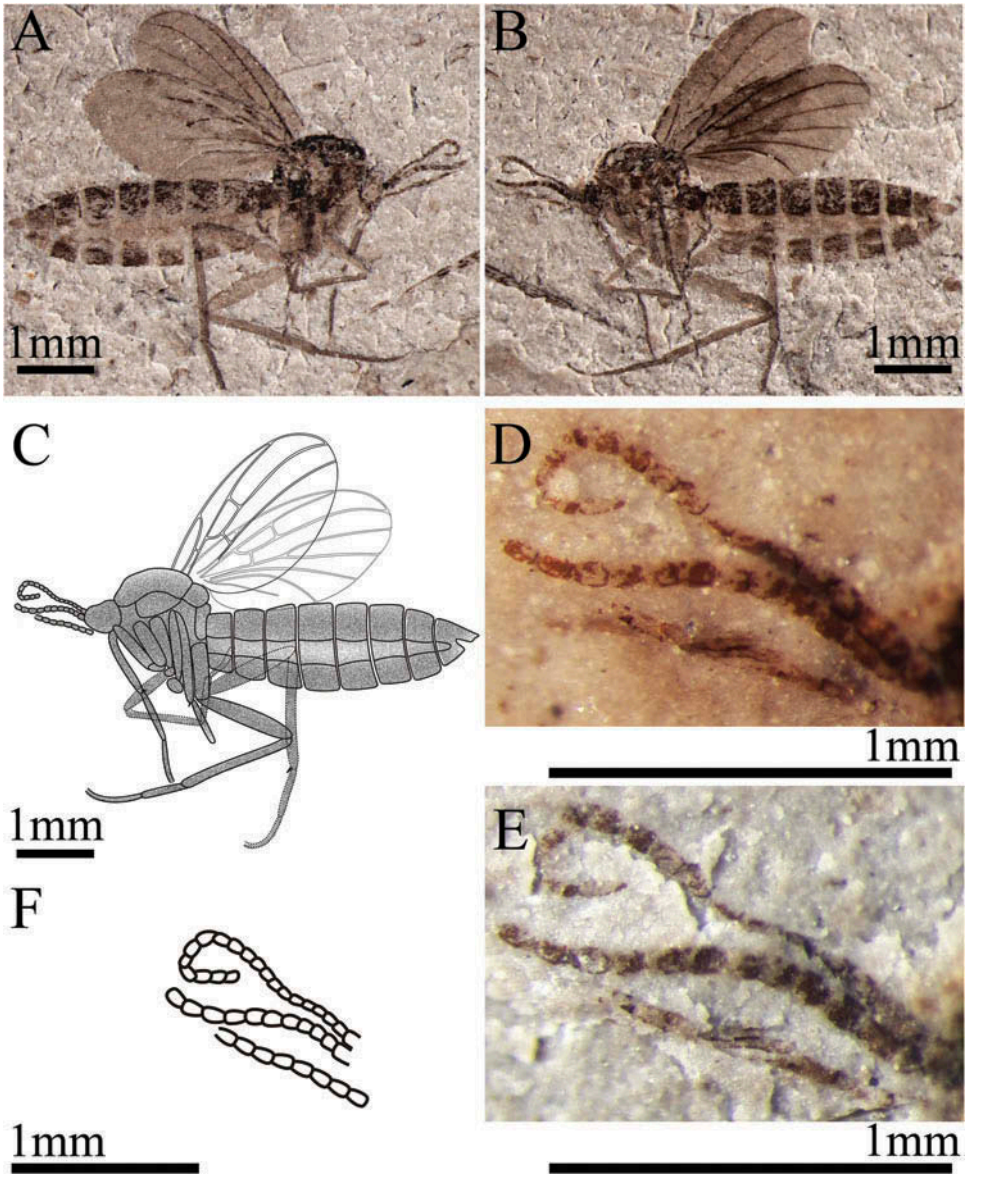

Figure 2. *Similsciophila singularis* gen. et sp. nov., paratype, CNU-DIP-NN2011147 p/c. (A) Photograph of habitus (lateral aspect), part; (B) photograph of counterpart; (C) line drawing of holotype, counterpart; (D) photograph of antennae; (E) photograph of antennae with alcohol; (F) line drawing of antennae.

eighth gradually narrowed terminally. Male genitalia relatively small, distinctly narrower than eighth abdominal segment. Haltere well-preserved, spatulate, and with its inner margin straight. Legs relatively thin and long, coxae and femora clavate; femora, tibiae and tarsi with two rows of sparse and short setae.

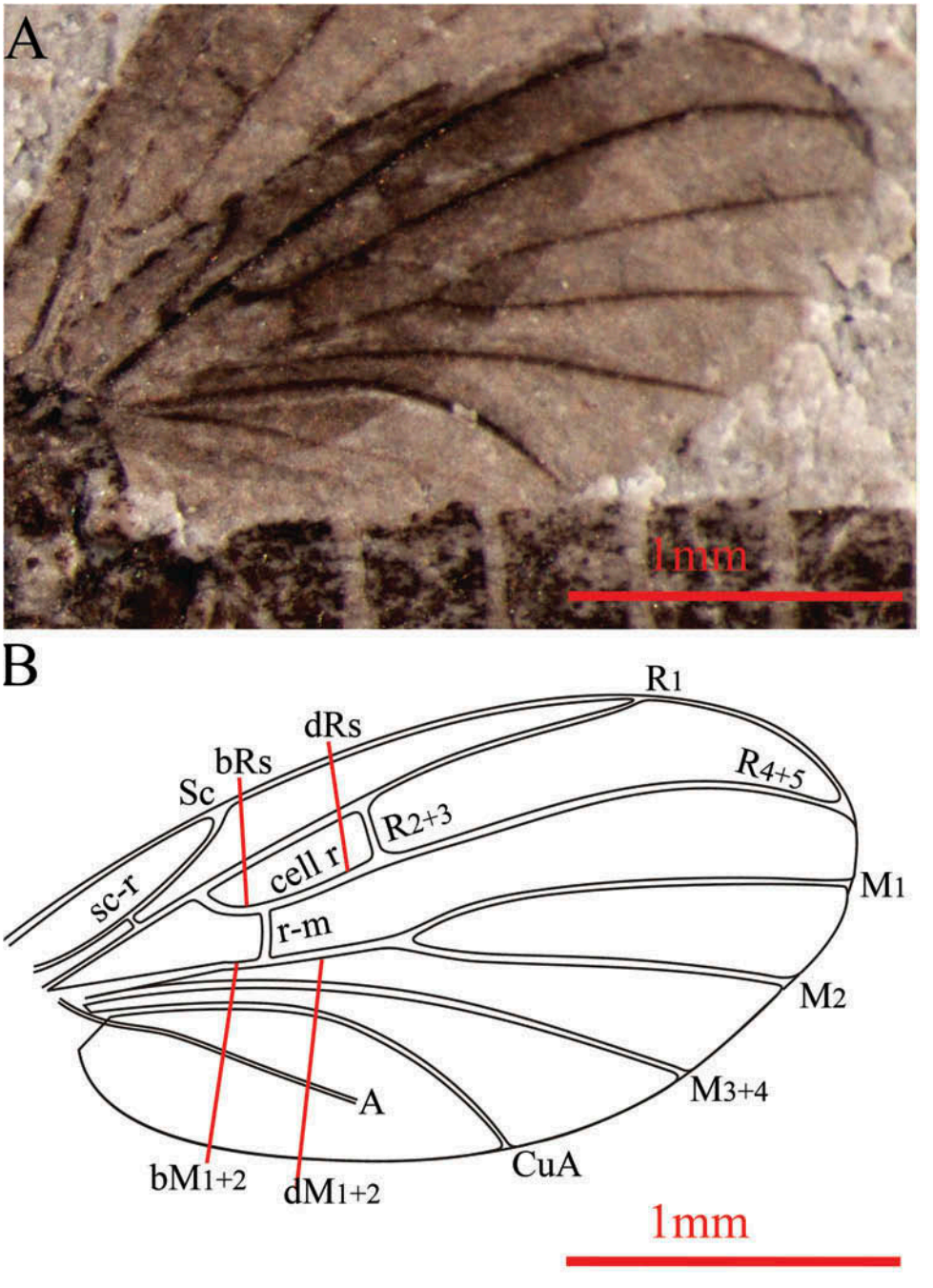

Figure 3. *Similsciophila singularis* gen. et sp. nov., paratype, CNU-DIP-NN2011147 p/c. (A) Photograph of wing part; (B) line drawing of wing part.

Wing membranous, oblong, darker in colour in costal area, 2.4 times as long as wide, and not reaching apex of abdomen at rest. C strong, ending beyond wing apex, at which R_{4+5} ending. Sc long, about 0.4 times as long as wing (shorter than one-half of wing length), and ending far distal to crossing of bRs and r-m. h distinct, and curved. sc-r well developed, situated distinctly basal to Rs origin, arising near midway between h to Sc ending at margin. Cell r distinctly large, longer than one-sixth of wing length (about 0.2 times as long as wing length). The section of R from sc-r to Rs origin about 1.8 times as long as bRs. R furcated to three branches (R_1, R_{2+3} and R_{4+5}). Both R_1 and R_{4+5} running somewhat divergent terminally. R_{2+3} and R_{4+5} arched. Forking of Rs beyond level of forking of M. Rs usually strongly furcated, arising from less than basal one-third of length of wing, with nearly 0.4 times as long as R_{4+5}, basal near to midwing to R_{2+3} and R_{4+5}, but furcated distad to fork of M_{1+2}. bRs significantly long, and 1.3 times as long as r-m. R_1 slightly curved, relatively long (nearly 0.7 times of length of wing). R_{2+3} slightly curved, beyond level of M_{1+2} forking, almost perpendicular to R_{4+5}. R_{4+5} strongly arched near its midway. Stem of M not developed, thin, usually thinner than its branches, and furcated to M_1, M_2 and M_{3+4}. M_1 arched upwards, and subparallel to R_{4+5}. M_2 nearly straight. r-m short, slightly oblique, nearly upright with M_{1+2}, almost parallel to R_{2+3}, intersected at M_{1+2}, which furcated to bM_{1+2} and dM_{1+2}. dM_{1+2} about 1.7 times as long as bM_{1+2}, and longer than r-m. bM_{1+2} about 2.3 times as long as m-cu. CuA running close to M_{3+4} basally, but neither coalescent. Vein A short, slightly curved at its midway, ending far from posterior margin of wing.

Dimensions (mm)

CNU-DIP-NN2011226 (male, Holotype): Body length 6.2 (excluding head, antenna length 0.9, width 0.1; thorax length 1.6, width 1.3; abdomen length 4.6, width 1.6); wing length 4.7, width 2.0; hind leg length 4.4 (femur length 0.9, tibia length 2.2, tarsus length 1.3).

CNU-DIP-NN2011147 (male, Paratype): Body length 5.5 (antenna length 1.5, width 0.1; head length 0.4, width 0.7; thorax length 1.5, width 1.3; abdomen length 3.6, width 1.1); wing length 2.6 (missing basal part), width 1.4; hind leg length 3.5 (femur length 0.8, tibia length 1.2, tarsus length 1.5).

Similsciophila sinuata sp. nov.
(Figures 4A–D)

Diagnosis

Wing membranous 2.2 times as long as wide; R_{2+3} strongly curved, and usually strongly sigmoid; bRs long and about 2.0 times as long as r-m; dM_{1+2} about 1.3 times as long as bM_{1+2}; bM_{1+2} about 5.8 times as long as m-cu.

Material

Holotype No. CNU-DIP-NN2011511, an incomplete body with two wings and a haltere, in lateral aspects.

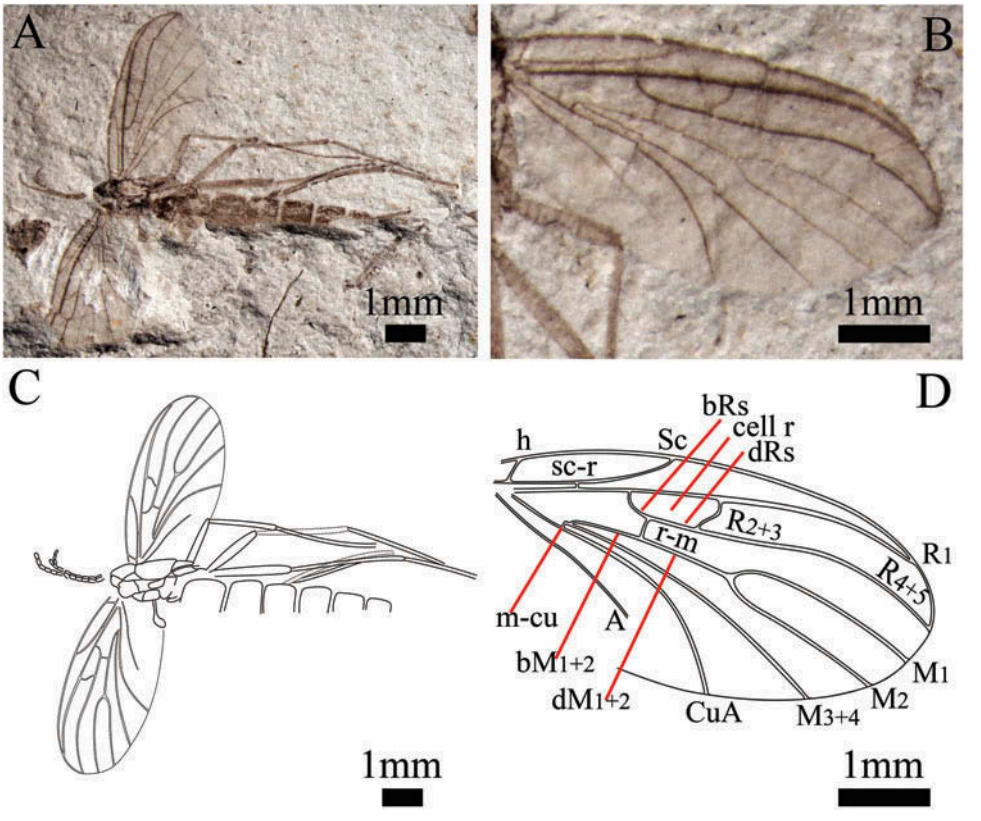

Figure 4. *Similsciophila sinuata* sp. nov., holotype, CNU-DIP-NN2011511. (A) Photograph of habitus (lateral aspect); (B) photograph of wing part; (C) line drawing of habitus; (D) line drawing of wing venation.

Etymology

The specific name is from the Latin (*sinua*-), meaning that vein R_{2+3} is more arching.

Locality and horizon

Late Middle Jurassic, Jiulongshan Formation, Daohugou Village, Shantou Township, Ningcheng County, Inner Mongolia, China (Ren et al. 2010).

Remark

This new species is differentiated from *Similsciophila singularis* gen. et sp. nov. by the following characters: (1) R_{2+3} of the new species is strongly curved, and usually strongly sigmoid (versus slightly curved, almost perpendicular to R_{4+5}); (2) the ratio of bRs and r-m of the two species is diverse (2.0 versus 1.1–1.4); (3) the ratio of dM_{1+2} and bM_{1+2} of the two species is different (1.3 versus 1.4–1.8); (4) the ratio of bM_{1+2} and m-cu of the two species is dissimilar (5.8 versus 2.0–2.4).

Description

Mesosciophilid gnats medium-sized, in lateral aspects. Wings outspread. Head poorly preserved. Antennae well-preserved, 13-segmented, longer than head, with all flagellomeres oblong and nearly the same size in length and width. Body covered with long dense pubescence. Mesonotum convex, scutellum sharp and clearly projecting. Abdomen incomplete preserved. A haltere well-preserved, spatulate, and its inner margin a bit straight. Legs thin long, clavate, and covered with two rows of sparse and short setae.

Wing membranous, oblong, darker in colour in costal area, 2.2 times as long as wide, and not reaching apex of abdomen at rest. C strong, ending beyond wing apex, at which R_{4+5} ending. Sc relatively long, about 0.4 times as long as wing, and ending far distal to crossing of bRs and r-m. h distinct. sc-r well developed, arising near midway between h to Sc ending at margin, and situated distinctly basal to Rs origin. Cell r distinctly large, longer than one-sixth of wing length, and nearly 0.2 times as long as wing length. The section of R from sc-r to Rs origin about 1.6 times as long as bRs. R furcated to three branches. R_1 slightly curved, relatively long, and about 0.6 times length of wing. R_1 and R_{4+5} running divergent terminally. Rs robust, arising from less than basal one-third of length of wing, furcated basal near to midwing to R_{2+3} and R_{4+5}, and nearly 0.4 times as long as R_{4+5}. bRs distinctly long, and 2.0 times as long as r-m. R_{2+3} arched, strongly curved, and usually strongly sigmoid, beyond level of M_{1+2} forking, almost perpendicular to R_{4+5}. R_{4+5} strongly arched near its midlength. R_{4+5} and M_1 arched and subparallel. r-m short, slightly oblique, furcated M_{1+2} to bM_{1+2} and dM_{1+2}, and shorter than dM_{1+2}. Veins of bM_{1+2} and r-m forming nearly a right angle. dM_{1+2} about 1.3 times as long as bM_{1+2}. M furcated to M_1, M_2 and M_{3+4}. Stem of M not developed, thin, and usually thinner than its branches. Forking of M beyond level of forking of Rs. M_{1+2} furcated slightly distad to level of Sc ending. M_1 arched upwards, and subparallel to R_{4+5}. M_2 almost straight. bM_{1+2} about 5.8 times as long as m-cu. CuA running close to M_{3+4} basally, but neither coalescent. A slightly curved at its midway, ending far from posterior margin of wing.

Dimensions (mm)

CNU-DIP-NN2011511: Body length 6.6 (antenna length 2.0, width 0.1; thorax length 1.6, width 1.0; abdomen length 5.0, width 1.3); wing length 4.6, width 2.2; hind leg length 7.0 (femur length 2.2, tibia length 2.9, tarsus length 1.9).

Discussion

To compare the difference of two key characters for various genera, we reviewed the previous work in literature and the two aforementioned new species and set up Table 2. The most remarkable generic features of *Mesosciophilina* (Kovalev, 1985), reported from the Middle Jurassic, are that cell r is distinctly large, longer than one-sixth of wing length, and r-m is significantly shorter than bRs, which are regarded as 'obvious ancestral characters' (Zhang 2002). But, the generic features of *Mesosciophilopsis* (Blagoderov 1993), described from the Early Cretaceous, are cell r distinctly small, shorter than one-sixth of wing length, and r-m significantly longer than bRs, which are regarded as 'derived characters' (Zhang 2002).

Table 2. Comparison of two key characters among genera.

Genus	Age	cell r	r-m
Mesosciophilina	Middle Jurassic	longer than 1/6 of wing length	markedly shorter than bRs, bRs 2.3 times as long as r-m
Similsciophila gen. nov.	late Middle Jurassic	longer than 1/6 of wing length	not markedly shorter than bRs, bRs only 1.1–2.1 times as long as r-m
Jurasciophila	late Middle Jurassic	shorter than 1/6 of wing length	markedly shorter than bRs, bRs 1.6 times as long as r-m
Mesosciophilopsis	Early Cretaceous	shorter than 1/6 of wing length	markedly longer than bRs. bRs 0.6 times as long as r-m

Furthermore, the generic features of *Jurasciophila* (Li and Ren, 2009), which was found in the late Middle Jurassic Jiulongshan Formation of China, have transitional characters of cell r small, shorter than one-sixth of wing length, and r-m significantly shorter than bRs (Li and Ren 2009). In comparison, the *Similsciophila* gen. nov., which was found in the late Middle Jurassic Jiulongshan Formation of China, has characters of cell r distinctly large, longer than one-sixth of wing length, and r-m from significantly to slightly shorter than bRs, bRs 1.1–2.0 times as long as r-m. Therefore, we infer that *Similsciophila* gen. nov. also has 'obvious ancestral characters'.

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