



# 安徽巢湖瓜德鲁普世二叠异蝎蛉科 新类群的发现(昆虫纲, 长翅目)\*

连信能<sup>1,2</sup> 蔡晨阳<sup>1</sup> 黄迪颖<sup>1\*\*</sup>

1 现代古生物学和地层学国家重点实验室, 中国科学院南京地质古生物研究所, 南京 210008;

2 中国科学院大学, 北京 100049

**摘要** 二叠异蝎蛉科是二叠纪长翅目的代表性类群, 也是长翅目的基干类群。二叠纪是长翅目昆虫的繁盛期, 但中国该时期长翅目昆虫化石记录非常稀少, 目前仅报道了1种。本文根据发现于中国安徽省巢湖市瓜德鲁普统银屏组的一枚标本, 建立了1新属1新种——廖氏巢湖异蝎蛉(*Chaohuchorista liaoi* gen. et sp. nov.)。该新属的鉴定特征为翅细长,  $Rs_1$ 和 $Rs_2$ 合并为1条脉,  $Rs_4$ 具2分支, M具5分支,  $M_2$ 具2分支。该新发现增加了中国二叠纪长翅目的多样性。

**关键词** 二叠纪 银屏组 蝎蛉 多样性

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## New discovery of Permochoristidae (Insecta, Mecoptera) from the Guadalupian of Chaohu City, Anhui Province, China

LIAN Xin-neng<sup>1,2</sup>, CAI Chen-yang<sup>1</sup>, HUANG Di-ying<sup>1</sup>

1 State Key Laboratory of Palaeobiology and Stratigraphy, Nanjing Institute of Geology and Palaeontology, Chinese Academy of Sciences, Nanjing 210008, China;

2 University of Chinese Academy of Sciences, Beijing 100049, China

**Abstract** Permochoristidae is a representative of the mecopterans in the Permian and a stem group of Mecoptera. The Permian is a period during which mecopterans were prosperous, however, Permian mecopterans from China are extremely rare, with only one previously reported species. We establish a new genus and species, *Chaohuchorista liaoi* gen. et sp. nov., based on one specimen collected from the Guadalupian Yinping Formation of Chaohu City, Anhui Province, eastern China. The diagnostic characters of the genus include small and elongate forewing,  $Rs_1$  and  $Rs_2$  combined into a single vein,  $Rs_4$  with two branches, M with five branches and  $M_2$  with two branches. Our new finding highlights the mecopteran diversity during the Permian in China.

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\*\* 通讯作者: 黄迪颖, 研究员, e-mail: dyhuang@nigapas.ac.cn

## SYSTEMATIC PALAEOLOGY

**Class** Insecta Linnaeus, 1758

**Order** Mecoptera Packard, 1886

**Family** Permochoristidae Tillyard, 1917

**Subfamily** Pseudonannochoristinae Novokshonov, 1994

**Genus** *Chaohuchorista* gen. nov.

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**Type species** *Chaohuchorista liaoi* gen. et sp. nov.

**Etymology** The generic name is derived from the type locality, Chaochu City, and the mecopteran genus *Chorista*.

**Diagnosis** Small insect with elongate forewing;  $Rs_1$  and  $Rs_2$  merging into a single vein,  $Rs_3$  single, and  $Rs_4$  with two branches; M with five branches and  $M_2$  with two branches.

***Chaohuchorista liaoi* gen. et sp. nov.**

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(Fig. 2)

**Etymology** The specific name “*liaoi*” is in honor of the late palaeontologist, Professor Liao Zhuo-ting, and in recognition of his extraordinary contributions to the Permian geology of China.

**Material** Holotype, NIGP180619. A nearly complete specimen with a poorly preserved wing base. The specimen is housed in the Nanjing Institute of Geology and Palaeontology (NIGP), Chinese Academy of Sciences.

**Diagnosis** Forewing less than 5 mm long with distinct pterostigma; five colored markings including a large colored marking at wing base and other four markings being oblique bands.

**Key words** Permian, Yinping Formation, scorpionflies, diversity

## 1 前言

长翅目 (Mecoptera) 昆虫也称蝎蛉 (scorpionflies), 因一些类群的雄性生殖器膨大呈钳状, 向上举起时形似蝎的尾部而得名。长翅目昆虫是最古老的全变态类昆虫之一 (Kristensen, 1981; Dunford and Somma, 2008), 化石记录可追溯到二叠纪乌拉尔世 (Rasnitsyn *et al.*, 2004)。长翅目与双翅目、蚤目有重要亲缘关系 (Krzeminski and Krzeminska, 2003; Huang *et al.*, 2012), 最近研究认为蚤目实际是特化的长翅目 (Tihelka *et al.*, 2020)。长翅目昆虫化石记录丰富, 已知化石种超过 700 种, 归入 39 科约 210 属 (王吉申, 2020; Novokshonov *et*

**Description** A small forewing 4.6 mm long, 1.5 mm wide, with length/width ratio 3.1; a large colored marking present at wing base, the other four markings wavy with oblique bands across the wing; the third band under the lentoid pterostigma and fused with each other; costal area nearly twice as wide as subcostal area, and costal area broaden from basal one-third, Sc terminating at a distance of 3.0 mm from wing base, possibly with two branches, but only one branch observed due to poor preservation;  $R_1$  2.3 mm long, single, somewhat straight, and apically curved; Rs with four branches running parallel to each other and reaching to wing margin, stem Rs 0.7 mm long, stem  $Rs_{3+4}$  0.3 mm long, stem  $Rs_{4a+b}$  1.1 mm long;  $R_1$  and Rs fused at a distance of 1.2 mm from wing base, with an oblique crossvein connecting  $R_1$  and  $Rs_{1+2}$ ; M with five branches,  $M_2$  bifurcating into two branches,  $M_1$  run parallel to Rs, however,  $M_{2-4}$  curving downwards; stem  $M_{1+2}$  0.9 mm long, stem  $M_{3+4}$  0.3 mm long, stem  $M_{2a+b}$  0.5 mm long, branches of  $M_{2a}$  nearly three times as long as stem  $M_{2a+b}$ ; M fused with CuA at a distance of 0.8 mm from wing base; CuA single and convex, terminating near the middle of the wing, crossvein m-cua oblique and connecting the forks of  $M_{3+4}$  and CuA; CuP single, terminating at a distance of 1.9 mm from wing base, joining wing margin where somewhat shrink; two anal veins straight and running a relatively long distance away from each other; the forks of  $Rs_{4a+b}$  distad to fork of  $M_{2a+b}$ , the fork of  $Rs_{3+4}$  proximal to fork of  $M_{1+2}$ , the fork of Rs distad to fork of M, and the fork of  $R_1 + Rs$  distad to fork of M + CuA.

**Locality and horizon** Yinping mountain, Houdong Village, Sanbing Township, Chaochu City, Anhui Province, China; Guadalupian Yinping Formation.

*al.*, 2016; Ren *et al.*, 2019)。现生类群仅报道了 700 余种, 归于 9 科 40 余属 (王吉申, 2020; Bicha, 2018), 分异度远不及化石类型。

二叠异蝎蛉科 (Permochoristidae Tillyard, 1917) 是长翅目中多样性最高的灭绝科之一, 已报道约 200 种, 归于 40 余属。该科起源于乌拉尔世, 在乐平世非常繁盛, 被认为是中生代长翅目的基干类群之一 (Novokshonov, 1997, 2002)。二叠异蝎蛉具有典型的长翅目昆虫特征, 包括丝状触角, 口器前口式且略微延长, 一对圆且突出的复眼, 雄性生殖器膨大呈钳状等。因其身体较难保存, 大多数属种的建立依赖于翅脉特征。二叠异蝎蛉科翅脉的基本特征为 Sc 多为 2 分支或更多, Rs 具 4 分支

或更多,有时 $Rs_4$ 具2分支, $M$ 通常分6支, $M_2$ 和 $M_4$ 均具2分支。中国的二叠异蝎蛉报道于瓜德鲁普统上部银屏组和中-上三叠统延长组下部(即中三叠世晚期铜川生物群),共2种,即 *Qingochorista conjunctiva* Guo et Hong, 2003 和 *Sinoagetopanorpa permiana* Lin, Nel et Huang, 2010, 后者是中国唯一已描述的二叠纪长翅目昆虫。

本文根据安徽省巢湖市瓜德鲁普统银屏组的一枚标本,建立了二叠异蝎蛉科的1新属1新种——*Chaohuchorista liaoi* gen. et sp. nov., 并将其与该科的其他属种进行了对比。

## 2 材料与方法

标本(NIGP180619)采集自安徽省巢湖市散兵镇后洞村(图1)瓜德鲁普统银屏组下部黑色页岩中。化石伴生大量双壳类、海绵动物、植物及少量鱼类化石,昆虫化石已报道了鞘翅目、半翅目、直翅目、华脉目、魁翅目、舌鞘目及长翅目等(Huang et al., 2007; Lin et al., 2010; Ponomarenko et al., 2014; Szwedo and Huang, 2019; Fu and Huang, 2020; Huang et al., 2020a, 2020b, 2022)。林启彬(1982)曾将该地层归为孤峰组,但该层中螭类化石

*Neomisellina* 指示银屏组属于晚卡匹敦期(Kametaka et al., 2009); 在孤峰组与银屏组界线处所测得的绝对年龄( $261.6 \pm 1.6$  Ma)也表明银屏组化石层属于晚卡匹敦期(Zhang et al., 2019)。

标本使用Zeiss SteREO Discovery V20体视显微镜拍摄,浸泡于70%的酒精中。标本还使用SU 3500扫描电镜(Scanning Electron Microscope)在电压为25 kV,气压为60 Pa的条件下对翅的细节进行观察和拍摄。线条图使用Adobe Illustrator 2019绘制,照片使用Adobe Photoshop CC 2019进行后期处理。

本文长翅目的翅脉名称沿用Minet等(2010)及Bashkuev和Sukatsheva (2021)的命名法。

## 3 系统古生物学

昆虫纲 Class Insecta Linnaeus, 1758

长翅目 Order Mecoptera Packard, 1886

二叠异蝎蛉科 Family Permochoristidae Tillyard, 1917

伪小蝎蛉亚科 Subfamily Pseudonannochoeristinae Novokshonov, 1994

巢湖异蝎蛉属(新属) *Chaohuchorista* gen. nov.

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图1 化石点交通位置图

Fig. 1 Geographic map showing the fossil locality

模式种 *Chaohuchorista liaoi* gen. et sp. nov.

词源 属名源自巢湖市的拼写“Chaochu”和长翅目的一属名 *Chorista*。

属征 小型昆虫, 前翅细长,  $Rs_1$  和  $Rs_2$  合并为一条脉,  $Rs_3$  单分支,  $Rs_4$  具 2 分支,  $M$  具 5 分支,  $M_2$  具 2 分支。

廖氏巢湖异蝎蛉(新属新种) *Chaohuchorista liaoi* gen. et sp. nov.

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(图2)

词源 物种名献给已故地质古生物学家廖卓庭先生, 纪念他对中国二叠纪地层所做的卓越贡献。

材料 正模NIGP180619。一枚近完整的前翅标本, 翅基部的脉保存较差。标本保存于中国科学院南京地质古生物研究所(NIGP)。

鉴别特征 长度小于 5 mm, 翅痣明显, 具 5 条翅斑, 基部翅斑呈块状, 其余 4 条呈倾斜的带状。

描述 前翅, 小型, 长 4.6 mm, 宽 1.5 mm, 长宽比为 3.1; 翅基处翅斑块状, 其余 4 条斑纹呈波浪形条带斜穿翅, 第 3 条翅斑位于透镜状的翅痣下方, 并与翅痣相接。前缘空间的宽度比亚前缘空间宽 2 倍, 且前缘空间在翅偏基部 1/3 处变宽;  $Sc$  结束于距翅基 3 mm 处, 可能具 2 分支, 但由于保存原因仅见 1 分支;  $R_1$  长 2.3 mm, 单分支, 较直, 末端略微弯曲;  $Rs$  具 4 分支, 彼此平行且延伸至翅边缘,  $Rs$  基干长 0.7 mm,  $Rs_{3+4}$  基干长 0.3 mm,  $Rs_{4a+b}$  基干长 1.1 mm;  $R_1$  与  $Rs$  在距翅基 1.2 mm 处融合, 一倾斜的横脉连接  $R_1$  和  $Rs_{1+2}$ ;  $M$  具 5 分支, 其中  $M_2$  分 2 支,  $M_1$  平行于  $Rs$  分支, 然而  $M_{2-4}$  末端向下倾斜;  $M_{1+2}$  基干长 0.9 mm,  $M_{3+4}$  基干长 0.3 mm,  $M_{2a+b}$  基干长 0.5 mm,  $M_{2a}$  较  $M_{2a+b}$  基干长近 3 倍;  $M$  与  $CuA$  在距翅基 0.8 mm 处融合,  $CuA$  单分支且向上凸, 延伸至翅中, 倾斜的横脉  $m-cua$  连接  $M_{3+4}$  的分叉点与  $CuA$ ;  $CuP$  单分支, 延伸至距翅基 1.9 mm 的翅边缘处, 该处翅向内缩; 两条  $A$  脉均为单分支, 且两者相距较宽;  $Rs_{4a+b}$  的分叉点较  $M_{2a+b}$  靠后,  $Rs_{3+4}$  的分叉点较  $M_{1+2}$  分叉点靠前,  $Rs$  的分叉点较  $M$  分叉点靠后,  $R_1 + Rs$  的分叉点较  $M + CuA$  分叉点靠后。

产地层位 中国安徽省巢湖市银屏山; 瓜德鲁普统银屏组。

## 4 讨论

二叠异蝎蛉科的翅脉分异度很大, 许多属与模式属(图3-B)翅脉存在较大区别。新属具有二叠异蝎蛉科的一些典型的翅脉特征, 包括 2 分支的  $Rs_4$  及  $M_2$ 。新属的  $Rs_1$  和  $Rs_2$  合并为一条翅脉,  $M$  具 5 分支, 符合伪小蝎蛉亚科(*Pseudonannochoristinae* Novokshonov, 1994)的基本特征。但其 2 分枝  $Rs_4$  区别于该亚科中具单分支  $Rs_4$  的 *Pseudonannochorista* Novokshonov 1994、*Neochoristella* Riek, 1953、*Nannochoristella* Riek, 1953, 以及  $Rs_3$  与  $Rs_4$  合并为一条脉的 *Miomeca* Novokshonov, 1994, 因此建立 1 新属。

该科中 *Pseudonannochorista* Novokshonov 1994 (图3-C)的  $Rs_1$  与  $Rs_2$  也合并为一条脉, 且具有 5 分支的  $M$  脉, 但 *Pseudonannochorista* 的  $Rs_4$  单分支区别于新属的 2 分支。

该科中具有 2 分支  $Rs_4$  的属有 *Agetopanorpa* Carpenter, 1930 (包括晚出同物异名 *Agetochorista* Martynov, 1933, *Neoageta* Riek, 1953 及 *Agetochoristella* Riek, 1953), *Oochorista* Martynov, 1933, *Stigmarista* Martynova, 1958, *Sinoagetopanorpa* Lin, Nel et Huang, 2010 (图3-D)。但这些属的  $Sc$  具有 3 分支或更多(新属 1 或 2 分支),  $M_4$  具 2 分支(新属单分支), 且通常翅较圆, 而新属较细长, 因此易于区分。

长翅目昆虫在二叠纪已经十分繁盛, 在西伯利亚、中亚地区以及澳大利亚等地的二叠系中有大量的报道(Riek, 1953; Martynova, 1961; Novokshonov, 1997)。但中国二叠纪长翅目化石过去仅报道了 1 种, 也来自银屏组, 即 *Sinoagetopanorpa permiana* Lin, Nel et Huang, 2010。虽然银屏组的 *Sinoagetopanorpa permiana* 也被归入二叠异蝎蛉科, 但其翅较圆,  $Sc$  区域较大,  $R_1$  末端弯曲方式特殊, 与其他二叠异蝎蛉有明显区别, 其分类位置有待进一步讨论。

*Chaohuchorista liaoi* gen. et sp. nov. 的发现增加了中国二叠纪长翅目的多样性, 结合以往在银屏组报道的具有特殊特征的 *Sinoagetopanorpa permiana*, 显示二叠纪中期中国华南长翅目类群的特异性。

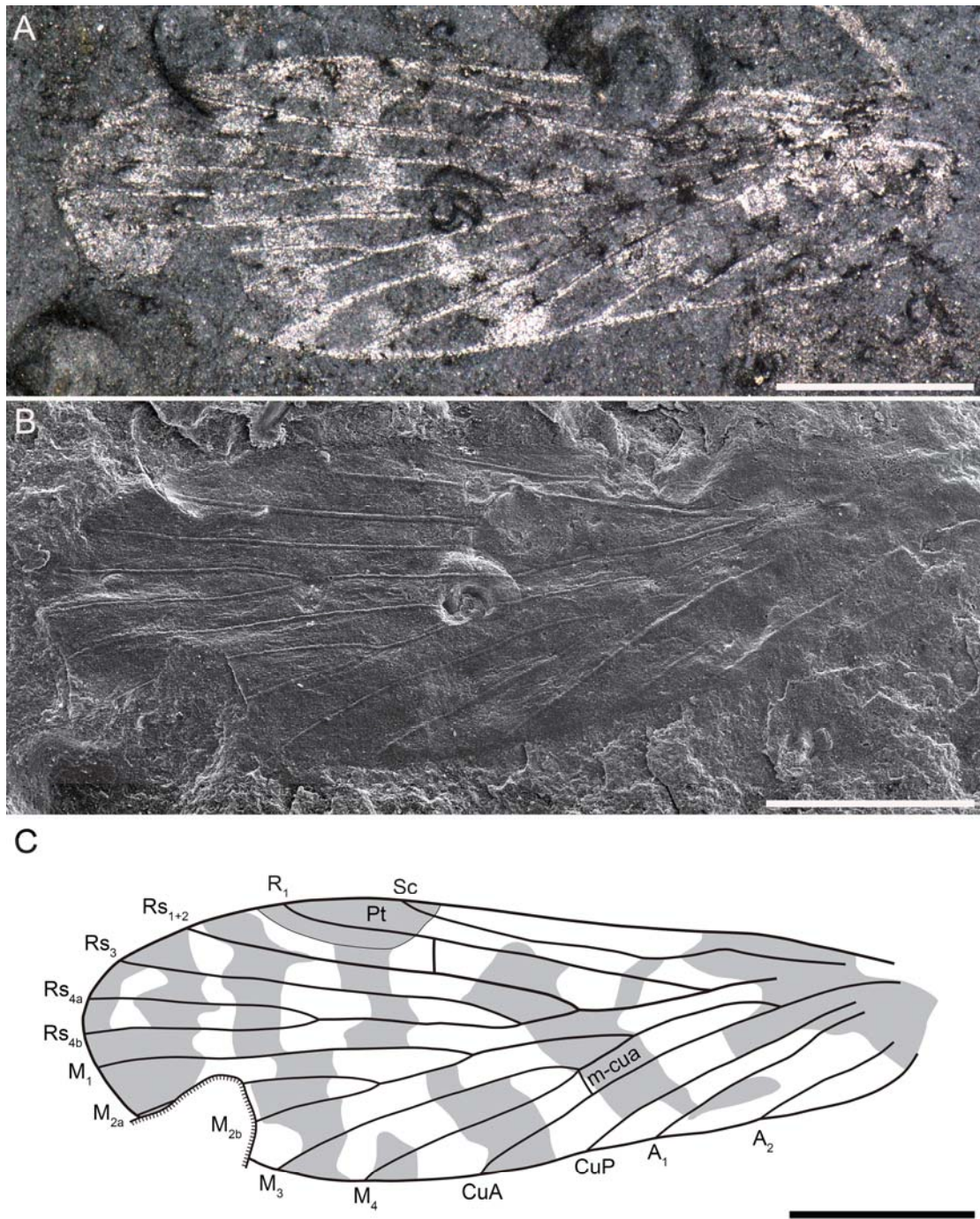


图 2 *Chaohuchorista liaoi* gen. et sp. nov. 前翅

Fig. 2 Photographs and line drawing of the forewing of *Chaohuchorista liaoi* gen. et sp. nov.

正模标本 NIGP180619 采集自中国安徽巢湖银屏山瓜德鲁普统银屏组。A. 体视显微镜照片, 拍摄时浸泡于 70% 的酒精中, 使用顶部光源照射。B. 扫描电镜照片。C. 线条图。比例尺均为 1 mm。缩写: C, 前缘脉; Sc, 亚前缘脉; Pt, 翅痣; R<sub>1</sub>, 第一径脉, Rs, 径分脉; M, 中脉; CuA, 肘脉前支, CuP, 肘脉后支; A, 臀脉; m-cua, 中脉与肘脉前支之间横脉。

Holotype, NIGP180619, from the Guadalupian Yinping Formation of Yinping mountain, Chaohu City, Anhui Province, China. A. Stereomicroscope photograph was taken when the specimen was immersed in 70% ethanol and used reflected top light. B. Scanning electron microscope image. C. Line drawing. Scale bars represent 1 mm in A–C. Abbreviations: C, costa; Sc, subcosta; Pt, pterostigma; R<sub>1</sub>, first branch of the radius; Rs, radial sector; M, media; CuA, anterior cubitus, CuP, posterior cubitus; A, anal vein; m-cua, the crossvein between media and anterior cubitus.

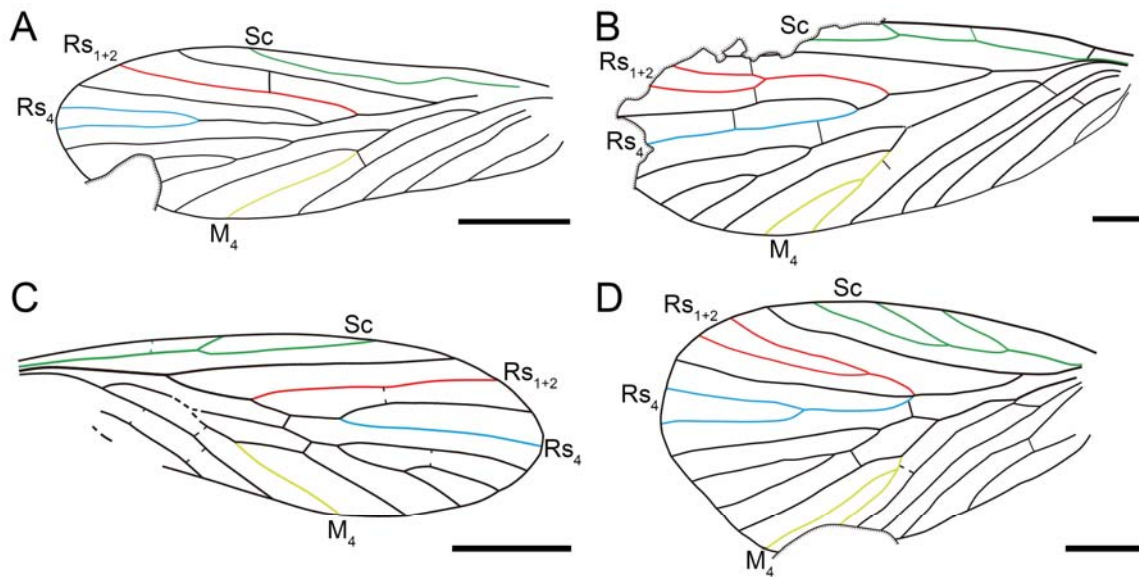


图3 新属与其他一些二叠异蝎蛉科的属的前翅翅脉对比

Fig. 3 Comparison of forewing venation of the new genus and other permochoristid genera

A. 廖氏巢湖异蝎蛉 *Chaohuchorista liaoi* gen. et sp. nov. B. 二叠异蝎蛉科模式属模式种 *Mesochorista proavita* Tillyard 1916 (根据 Willmann, 1984 重绘)。C. *Pseudonannochorista willmanni* Novokshonov, 1994 (根据 Novokshonov, 1994 重绘)。D. *Sinoagetopanorpa permiana* Lin, Nel et Huang, 2010 重绘。比例尺均为 1 mm。

A. *Chaohuchorista liaoi* gen. et sp. nov. B. Type species of Permochoristidae: *Mesochorista proavita* Tillyard 1916 (redrawn from Willmann, 1984). C. *Pseudonannochorista willmanni* Novokshonov, 1994 (redrawn from Novokshonov, 1994). D. New drawing of *Sinoagetopanorpa permiana* Lin, Nel et Huang, 2010. Scale bars represent 1 mm in A–D.

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