



A new silky lacewing (Neuroptera: Psychopsidae) from the Middle Jurassic of Inner Mongolia, China

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Abstract

Cretapsychops decipiens sp. nov. is described from the Middle Jurassic Jiulongshan Formation of Daohugou, Inner Mongolia in China. The new species is distinguished from the type species known from the Early Cretaceous Wealden Supergroup of England mainly by its longer costal gradate series and distinctive colour pattern of the forewings. The disruptive coloration of its forewings may perform a defensive (concealment) function. The structure of CuA is peculiar in *Cretapsychops* and is different from that of all other known psychopsid genera.

Key words: systematic paleontology, Middle Jurassic, Neuroptera, Psychopsidae, Daohugou, China

Introduction

Psychopsidae, commonly called “silky” lacewings is one of the smaller families of Neuroptera. Today containing about 27 extant species in five genera, the family is restricted to southern Africa, Australia and southern Asia (New 1989; Oswald 1993b, 1995; Wang & Bao 2006).

Up to date, about 40 fossil species have been described in this family (some since reassigned) from the Upper Triassic to the Miocene (Handlirsch 1906–1908; Tillyard 1919, 1922; Krüger 1922, 1923; Martynova 1949; Bode 1953; Zalessky 1953; Martynova 1954, 1962; Macleod 1970; Fujiyama 1978; Panfilov 1980; Ponomarenko 1980; Wang 1980; Hong 1982, 1983; Makarkin 1991, 1994, 1997; Martins-Neto 1997; Engel & Grimaldi 2008; Jepson *et al.* 2009). However, the psychopsid affinity of many of these taxa is strongly in need of revision. Most described specimens are poorly and/or fragmentarily preserved; complete and well-preserved wings are rare. Some fossil genera, e.g., *Sinopsychops* Hong, 1982, *Beipiaopsychops* Hong, 1983 and *Arctopsychops* Makarkin 1994 cannot be placed in the Psychopsidae with certainty, as they are only represented by small wing fragments and some critical characters can not be observed.

In this paper, we describe a new species represented by well-preserved wings from four specimens, from the Middle Jurassic Jiulongshan Formation of the Daohugou Village, Inner Mongolia, China. We assign it to the psychopsid genus *Cretapsychops* Jepson *et al.* 2009 previously known only from the Lower Cretaceous of England. Fossil insects are abundant and diverse in the Daohugou fossil beds, which are currently considered as belonging to the Middle Jurassic Jiulongshan Formation (Ren *et al.* 2002).

Material and methods

All specimens were collected from the Middle Jurassic Jiulongshan Formation in Daohugou Village, Ningcheng County, Inner Mongolia, China. They are housed in the Key Laboratory of Insect Evolution & Environmental Changes, the College of Life Sciences, Capital Normal University (CNU), Beijing, China.

The specimens were examined under a Leica MZ12.5 dissecting microscope and illustrated with the aid of a drawing tube attachment. Line drawings were prepared with CorelDRAW 12 graphics software.

Traditional (*sensu* Wootton, 2003) venational terminology of Comstock (1918) with the recent interpretation of Oswald (1993a, 1993b) and Archibald & Makarkin (2006) is used in the paper. Venational abbreviations are as follows: C, costa; Sc, subcosta; hv, humeral veinlet (i.e., basal-most subcostal veinlet); R, radius; R1, first branch of R; Rs, radial sector; M, media; MA, media anterior; MP, media posterior; Cu, cubitus; CuA, cubitus anterior; CuP, cubitus posterior; 1A–2A, first to second anal veins.

Systematic Paleontology

Class: Insecta Linnaeus, 1758

Order: Neuroptera Linnaeus, 1758

Family: Psychopsidae Handlirsch, 1906

Genus: *Cretapsychops* Jepson *et al.*, 2009

Type species: *Cretapsychops corami* Jepson *et al.*, 2009 (by original designation).

Revised diagnosis. Can be distinguished from other genera by a combination of the following wing characters: in forewing, prominent colour pattern present; costal gradate series present; R1 distally with many long anteriorly directed pectinate branches (veinlets); branches of Rs almost non-dichotomous; crossveins in radial space form four transverse gradate series; CuA peculiarly branched: both branches of primary fork at equal angle to stem, with posterior pectination of anterior branch, and anterior pectination of posterior branch; CuP non-pectinate, with few long branches. 1A dichotomously branched; 2A pectinate. In hind wing, costal gradate series present; branches of Rs non-dichotomous; crossveins in radial space form several (two preserved) gradate series.

Species included. *Cretapsychops corami* Jepson *et al.*, 2009, from the Lower Cretaceous Wealden Supergroup, southern England (Fig. 1), and *Cretapsychops decipiens* **sp. nov.** from the Middle Jurassic Jiulongshan Formation, China.

Cretapsychops decipiens **sp. nov.**

(Figs 2–5)

Etymology. The name of the new species refers to the distinct colour patterns on the forewings, which is derived from the Latin “*decipiens*”, meaning deceptive.

Material. Holotype CNU-NEU-NN2010700, a well-preserved, nearly complete specimen. Paratypes: CNU-NEU-NN2010701, a complete forewing; CNU-NEU-NN2010702, an incomplete forewing; CNU-NEU-NN2010703 P and C (part and counterpart), a nearly complete forewing.

Type locality and horizon. Middle Jurassic, Jiulongshan Formation. Daohugou, Inner Mongolia, China.

Diagnosis. Can be easily distinguished from *C. corami* by longer costal gradate series extended beyond wing mid-point [not extended beyond wing mid-point in *C. corami*], longer forewings [about 20 mm in *C. decipiens* **sp. nov.**, about 15 mm in *C. corami*], different colour pattern (cf. Figs. 1, 2, 5).

Description of the holotype. Body. Only thorax preserved (Fig. 4A). Pronotum subrectangular, with several dark spots, and covered with many long hairs on posterior and lateral edges. Mesonotum almost entirely dark, but pale in lateral edges, middorsal suture on prescutum, two lateral sides of scutellum; covered with long hairs in lateral edges. Metanotum poorly preserved.

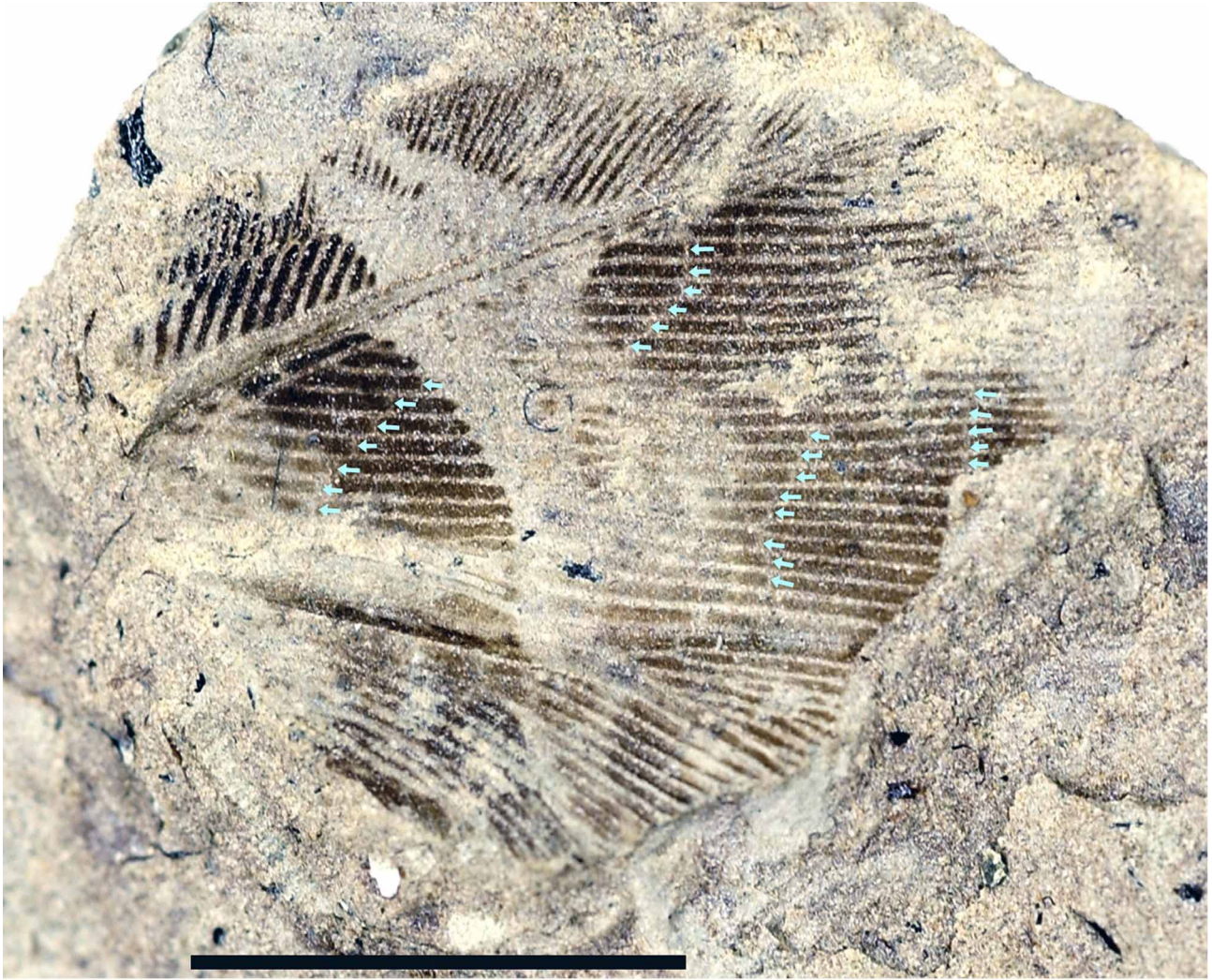


FIGURE 1. *Cretapsychops corami* Jepson *et al.*, 2009. Photograph of the holotype BMNH Pal. PI II 1555a. Arrows indicate the crossveins of the gradate series in the radial space. Scale bar = 5 mm.

Forewing 19.5 mm long, 11.5 mm wide, broadly triangular, with rounded apex. Costal space broad throughout; humeral veinlet strongly recurrent, pectinately branched. Subcostal veinlets dense, once or twice forked. Costal gradate series with at least 37 crossveins in proximal portion of wing, parallel to C, distally curved to Sc. Sc, R1, Rs strong, gradually converging towards apex. Rs with 34 branches, not forked before outer gradate series. Crossveins in radial space form four transverse gradate series; R1 and Rs connected by two crossveins belonging to two distal-most gradate series. M forked far distal to origin of Rs. MA clearly concave, straight before outer gradate series, with five pectinate branches: proximal branch with two long branches, others not forked before end-twigging. MP slightly sinuous, with few distal not-pectinate branches. Cu forking near wing base. CuA peculiarly branched distally: both branches of primary fork at equal angle to stem, with posterior pectination of anterior branch and anterior pectination of posterior branch. CuP few branched. Some crossveins preserved in medio-cubital space. 1A long, dichotomously branched. 2A well-developed, pectinately branched. Anal space broad, nearly as wide as costal space. Trichosors present (Fig. 4B). All veins and wing margins with dense macrotrichia (Fig. 4A). Colour pattern consists of row of deep brown maculae along C in costal space, becoming lighter, smaller towards apex; two deep brown mottled regions in anal space; three patches with irregular wavy margins spreading on pale brown ground in radio-medial space (Fig. 2).

Hind wing. Only anterior and apical parts of right hind wing well preserved; venation in proximal and posterior portions not preserved or hardly visible. Preserved length 17 mm (estimated length about 17.5–18.0

mm), width 9 mm. Costal space broad throughout, width over 4 times combined width of adjacent subcostal and R1 spaces. Subcostal veinlets dense, slightly widely spaced in distal portion than in forewing, mostly once or twice forked; costal gradate series parallel to C then gradually curved to Sc, terminating at Sc near wing apex. Sc, R1 gradually converging towards apex, but not fused. Subcostal space narrow; no subcostal crossveins detected. R1 space very narrow for entire length. Rs with 27-28 branches, not forked proximal to outer gradate series. Two transverse gradate series of crossveins in distal portion of radial space including crossveins between R1 and Rs. Trichosors present. All veins and wing margins with dense macrotrichia.

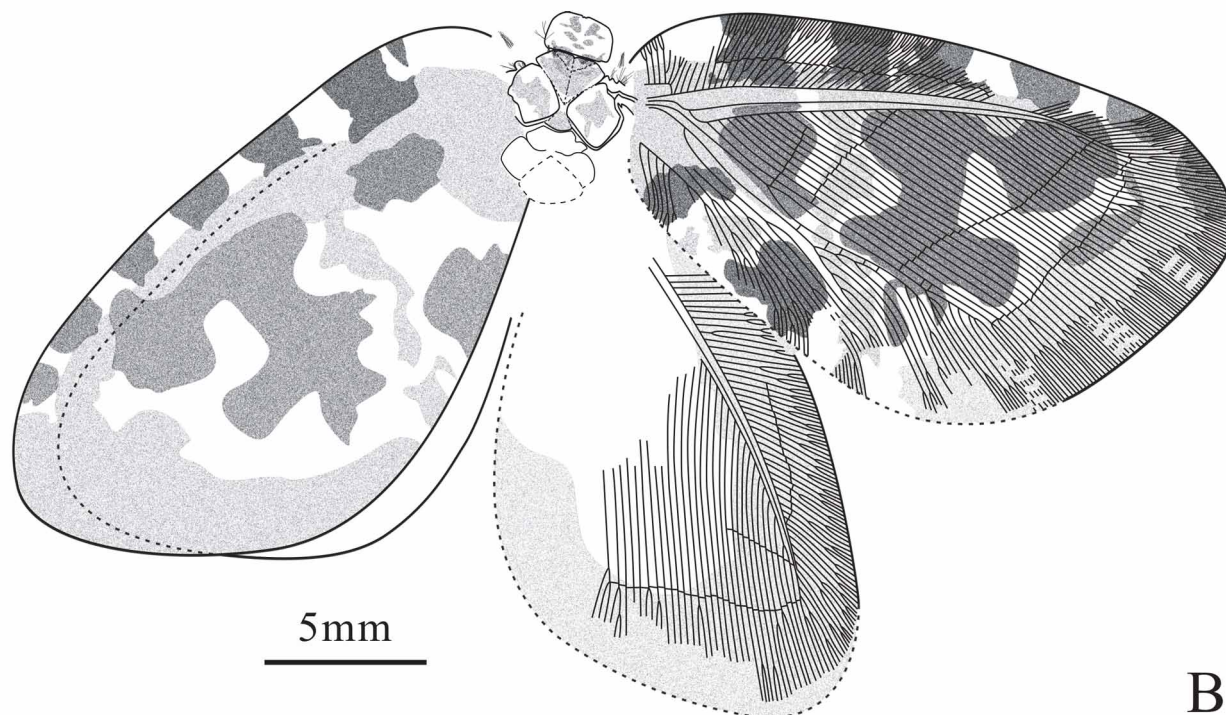
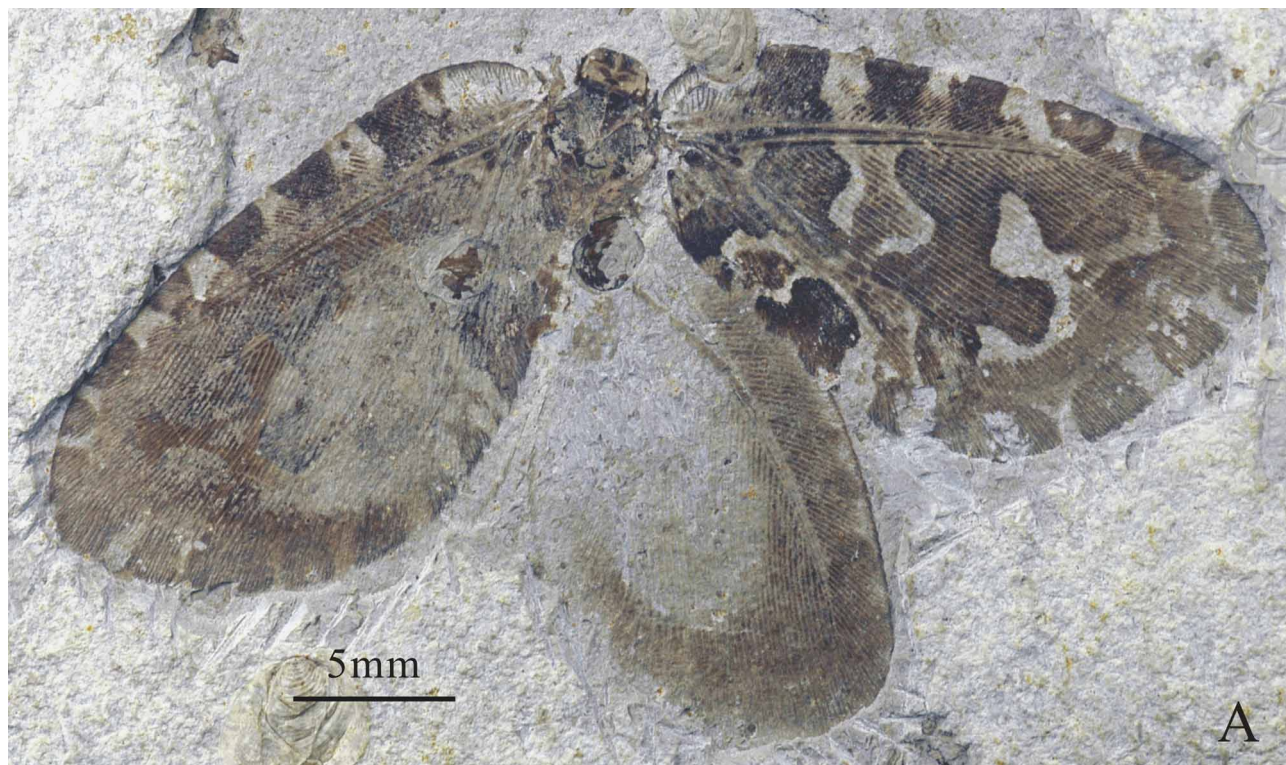


FIGURE 2. *Cretapsychops decipiens* sp. nov. Holotype CNU-NEU-NN2010700. **A**, photograph; **B**, drawing (trichosors are omitted).

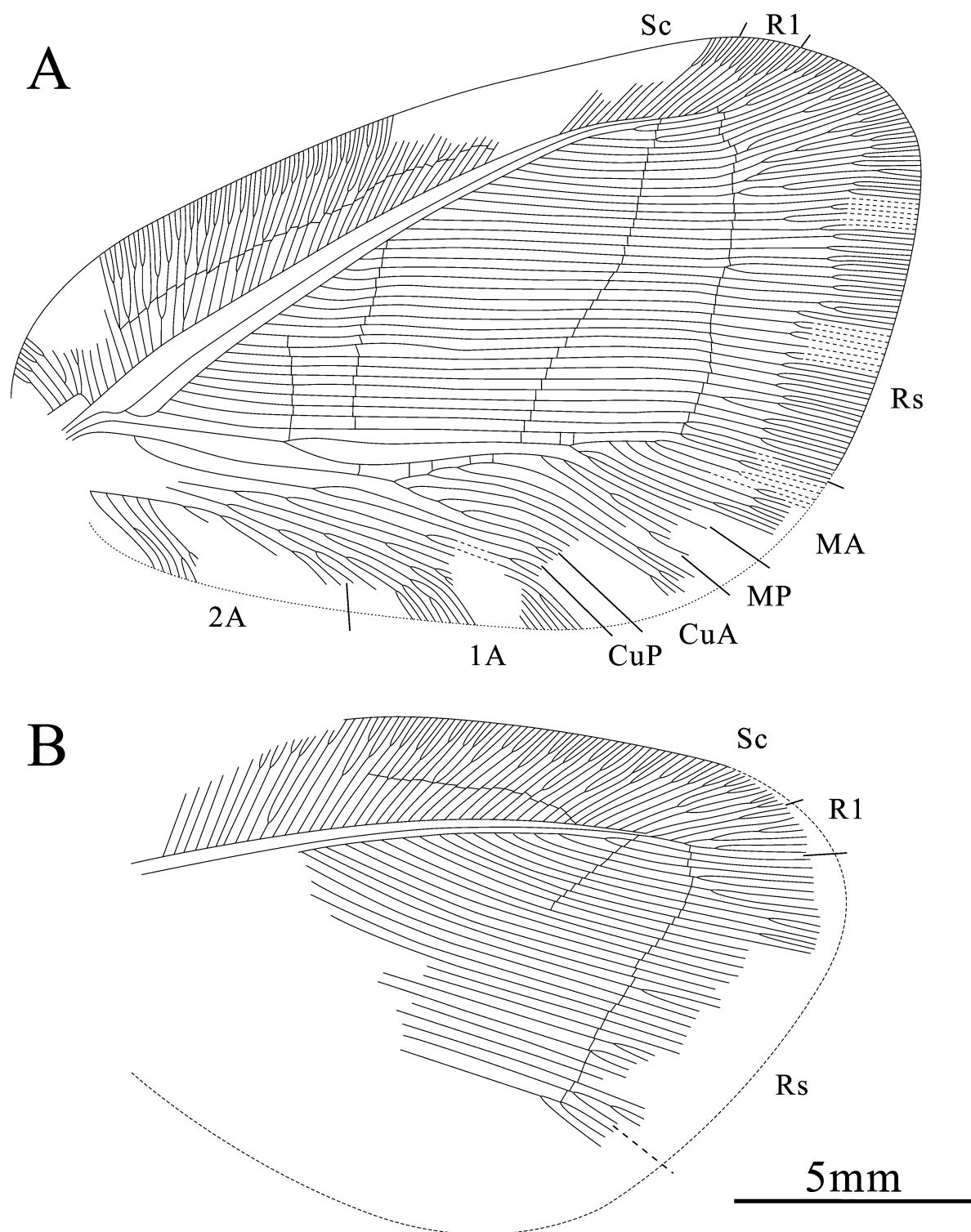


FIGURE 3. *Cretapsychops decipiens* sp. nov. The venation of the holotype CNU-NEU-NN2010700. **A**, forewing; **B**, hind wing. Scale bar = 5 mm.

Remarks. We designate three forewings as paratypes (Fig. 5). Their venation is very similar to that of holotype; they also share a common colour patterning. By these reasons, we assigned these specimens to *Cretapsychops decipiens* sp. nov. Of them, the paratype CNU-NEU-NN2010702 most resembles the holotype both by the venation and the colour pattern. The paratype CNU-NEU-NN2010703 has no distinct colour pattern (probably poorly preserved), but its venation is almost identical to that of the holotype. In this

paratype, unlike other specimens assigned to the species, several subcostal crossveins and numerous (>10) crossveins between R1 and RS are preserved. The assignment of the paratype CNU-NEU-NN2010701 to this species is somewhat problematic. In general, its venation is very similar to that of the holotype, but the innermost gradate series is running at more acute angle to Rs than in the holotype, and the wing apex appears to be somewhat more pointed; also, its colour pattern appears to be a negative image of the holotype colour pattern (i.e., pale areas of the holotype forewing appear dark in this paratype, and vice versa). Therefore, this specimen is only tentatively assigned to *C. decipiens* **sp. nov.**

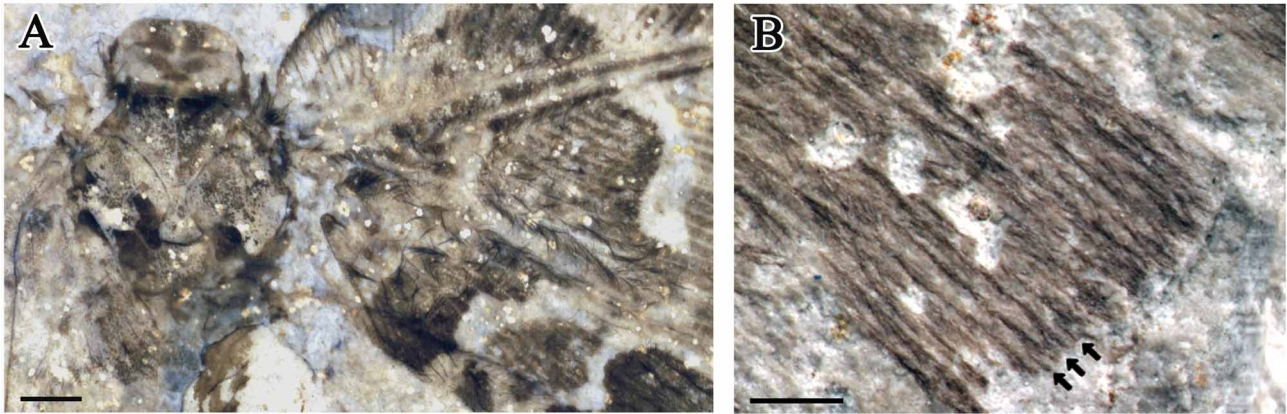


FIGURE 4. *Cretapsychops decipiens* **sp. nov.** Holotype. **A**, photograph of thorax and base of the forewing. Photograph was taken under alcohol. Thorax is covered with long hairs, and veins and wing margins with dense macrotrichia. **B**, detail of the postero-apical margin of the right forewing showing trichosors (arrows). Scale bar = 1 mm (for A), 0.5 mm (for B).

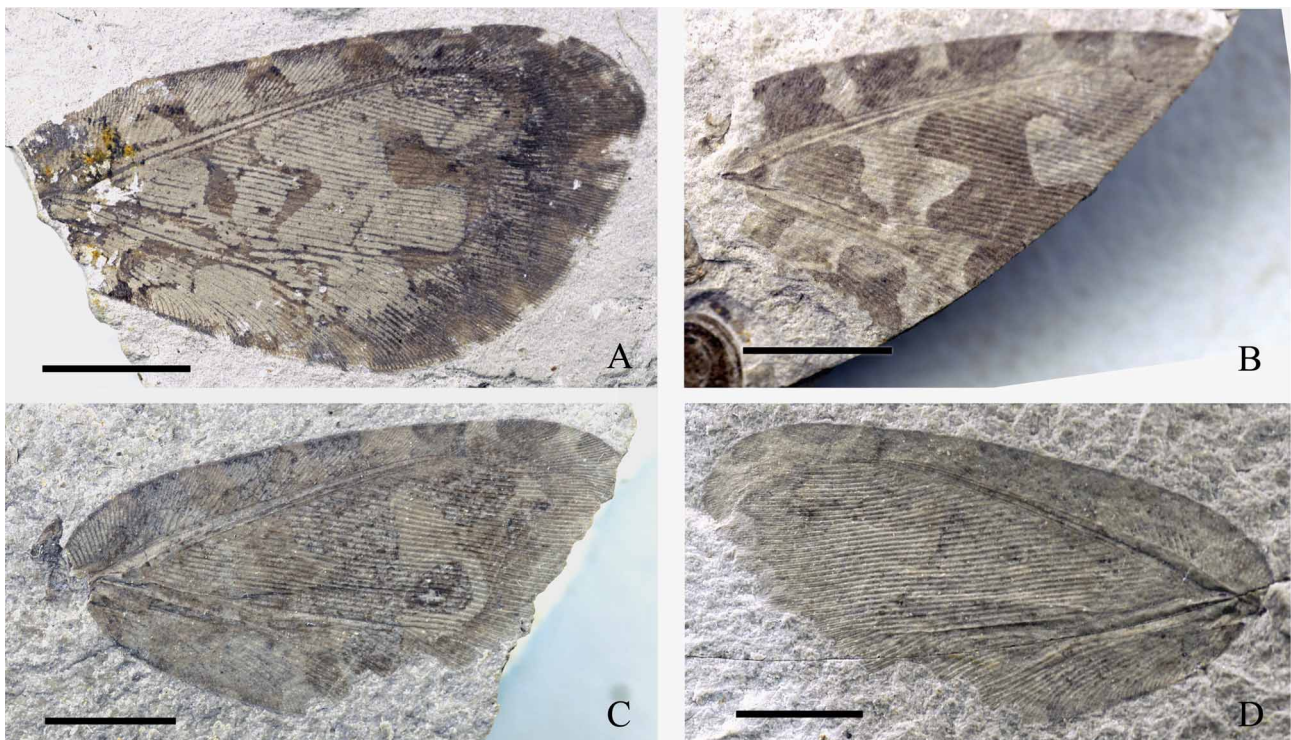


FIGURE 5. *Cretapsychops decipiens* **sp. nov.** Paratypes. **A**, CNU-NEU-NN2010701. **B**, CNU-NEU-NN2010702. **C**, CNU-NEU-NN2010703P. **D**, CNU-NEU-NN2010703C. Scale bar = 5 mm.

Discussion

The forewing of *Cretapsychops decipiens* **sp. nov.** is very similar to that of *C. corami* in having the following common characters: costal space broad with one complete gradate series; branches of Rs mainly simple for most of length; at most few subcostal crossveins detected; four gradate series in radial space (see Fig. 1; gradate series were incompletely drawn in the original description: Jepson *et al.* 2009: Fig. 5A); peculiar configuration of CuA (see diagnosis), the non-pectinate CuP; and similar maculation. Based on these similarities, we conclude that the species are congeneric.

The venation and colour pattern of *Cretapsychops* is most similar to those of *Baisopsychops* Makarkin, 1997 from the Lower Cretaceous locality of Baisa (Transbaikalia, Russia). These genera may be distinguished mainly by the configuration of CuA, which is distinctively branched, with both branches of the primary fork at an equal angle to the stem in the former, and clearly pectinate in the latter. *Cretapsychops* and *Baisopsychops* have a psychopsid appearance, but share a number of character states not characteristic of the extant Psychopsidae (Jepson *et al.* 2009): Sc and R1 converge distally, running very close to each other for some distance; R1 with many long, anteriorly directed pectinate branches (i.e., a “vena triplica” is not developed); R1 space (between R1 and Rs) unusually narrow, especially in the hind wing; and no subcostal crossveins were detected although the wings are well preserved. Anyway, these genera may be certainly assigned to Psychopsidae judging from their general venational pattern concordant with that of this family. Jepson *et al.* (2009) pointed out that the psychopsid forewing venation may be characterized by a combination of five character states: [1] costal space is very broad throughout (width in “pterostigmal region” >2 times the combined width of the adjacent subcostal and R1 spaces); [2] subcostal space with more than four crossveins (usually >10); [3] R1 (or Sc+R1) distally with few branches (if any), usually not pectinate; [4] crossveins in the radial space are arranged in gradate series, and [5] CuA and CuP are pectinately branched. These conditions are here considered as synapomorphies of the family, although they occur not in all genera. The character states of [1] and [4] are developed in *Cretapsychops* and *Baisopsychops*, while the others not.

The distal configuration of Sc and R1 found in *Cretapsychops* and *Baisopsychops* differs from that of the majority of other fossil and extant psychopsid genera, in which the distal approaching parts of Sc and R1 are usually either connected by one crossvein or fuse, forming, together with Rs, the “vena triplica”. The absence of the “vena triplica” and of subcostal crossveins in these two genera is very unusual in spite of their typical psychopsid appearance; also, R1 has more long, pectinate branches (veinlets) than are found in all extant and many fossil species.

The distinctive structure of CuA found in *Cretapsychops* is particularly interesting: both branches of the primary fork are at an equal angle to the stem, with posterior pectination of the anterior branch and anterior pectination of the posterior branch. In all other genera of the family this branching is pectinate. Such a structure of CuA is very similar to the configuration of MP in two fossil genera of Ithonidae (Makarkin & Menon 2007: Figs. 3, 5; Makarkin & Archibald 2009: Figs.2, 3). In all other genera of the Ithonidae (including Polystoechotidae: Winterton & Makarkin 2010), fossil and extant, MP is few-branched or pectinate (in the former Polystoechotidae).

The species is remarkable for the prominent colour pattern of the forewings, with deep brown stripes and patches alternating with pale areas. This appears to be disruptive colouration, a pattern seen in many species of fossil and extant Psychopsidae, as well as in other neuropteran families, and indeed in various animals in general (Cott 1940). For example, the well-known Australian osmylid species *Porismus strigatus* (Burmeister 1839) probably has this type of colouration (Winterton *et al.* 2010: Fig. 1D). Such patterning is very ancient. The wing patterns of the Paleodictyopteran fossil *Homoioptera gigantea* Agnus, 1902 from the Upper Carboniferous show a quite clear disruptive coloration, which might have effectively concealed the insect in the shimmering light under the forest canopy (Shear *et al.* 1990). The beautiful pattern preserved on the wings of this new species may have served this function as well, i.e., disruptive coloration as a concealment strategy that limits the ability of potential predators to distinguish the insect from its surroundings.

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