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A new important species of Nymphidae (Neuroptera) from the Lower Cretaceous Crato Formation of Brazil

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Abstract

Olindanymphes? headsi **sp. nov**. (Neuroptera: Nymphidae) is described from the late Aptian (Lower Cretaceous) Crato Formation of Brazil. Its hindwing is unique in the family by the presence of the few-pectinate both CuA and CuP, each with two to three branches. The few-pectinate CuA in the hindwing is a derived condition known only in three Early Cretaceous species, including the new species.

Key words: Neuroptera, Nymphidae, Cretaceous, Crato Formation, Brazil

Introduction

The family Nymphidae is small, with 35 extant valid species, currently restricted to Australia (and adjacent islands), New Guinea, and possibly the Philippines (New 1982, 1985, 1986, 1988; Oswald 1997, 1998). To date, 24 species in 15 genera of fossil Nymphidae have been described from the Middle Jurassic to the late Eocene (see list in Archibald & Makarkin 2020).

The Nymphidae of the late Aptian Crato Formation of Brazil are known from three species represented by three specimens, namely: *Olindanymphes makarkini* Martins-Neto, 2005, *Santananymphes ponomarenkoi* Martins-Neto, 2005, and *Rafaelnymphes cratoensis* Myskowiak *et al.*, 2016. The two former species were very incompletely and possibly (at least in part) inaccurately described. *Rafaelnymphes cratoensis* is the only species from the Crato Formation, which was more or less adequately described.

Here, the fourth specimen of Nymphidae from the Crato Formation is described based on a hindwing. Unfortunately, the hindwings of the three previously described species are very poorly preserved (being overlapped by the forewings) and not described, except a few, mostly not morphological sentences on those of *Rafaelnymphes cratoensis* (see Myskowiak *et al*. 2016, p. 217). This makes confident attribution of this hindwing to a genus difficult. However, the species should be named because it is rather well preserved, possessing some important character states; the fore- and hindwing of Nymphidae have some common character conditions (see below); and several fossil species (mainly from the Mesozoic) have been described based only on hindwings, *i.e*., *Sialium sipylus* Westwood, 1854, *Nymphites priscus* (Weyenbergh, 1869), *Dactylomyius septentrionalis* Makarkin, 1990a, *Mesonymphes rohdendorfi* Panfilov, 1980, and *Nymphes georgei* Archibald *et al*., 2009.

Material and methods

This study is based on one specimen from the Lower Cretaceous Crato Formation of Brazil housed in the Illinois Natural History Survey Paleontology Collection, University of Illinois at Urbana-Champaign, U.S.A. (INHSP). The Crato Formation is a well-known Lagerstätte famous for its Early Cretaceous biota located in north-eastern Brazil (see more details in Makarkin *et al*. 2017). The photographs of the specimen were taken by M. Jared Thomas (INHSP) using a Canon 5D Mark III DSLR camera with Canon MP-E 65 mm 1e5x macro lens mounted on a Cognisys StackShot automated focus stacking rail.

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The venational terminology follows Breitkreuz (2017). Terminology of details of venation (*e.g.*, spaces, veinlets, traces) follows Oswald (1993).

Abbreviations: A1–A3, first to third anal veins; CuA, anterior cubitus; CuP, posterior cubitus; MA, anterior media; MP, posterior media; MP1, proximal-most branch of MP; MP2, branch of MP distad MP1; RA, anterior radius; RP, posterior radius; RP1, proximal-most branch of RP; RP2, branch of RP distad RP1; Sc, subcosta.

Systematic paleontology

Class Insecta Linnaeus, 1758

Order Neuroptera Linnaeus, 1758

Family Nymphidae Rambur, 1842

Genus *Olindanyphes* Martins-Neto, 2005

Olindanymphes? headsi sp. nov.

Figs 1–3

FIGURE 1. *Olindanymphes? headsi* **sp. nov.**, holotype INHSP 1510 (wetted with ethanol). Scale bar = 5 mm.

Type material. Holotype: INHSP 1510, currently deposited in the Illinois Natural History Survey Paleontology Collection, University of Illinois at Urbana-Champaign, U.S.A., but will be repatriated to an appropriate Brazilian institution to comply with Brazilian laws (S.W. Heads, pers. comm.). A body with one complete hindwing and fragments of hind legs.

Type locality and horizon. Northeastern Brazil: Chapada do Araripe (precise locality unknown). Lower Cretaceous: upper Aptian (Crato Formation: Nova Olinda Member).

Etymology. The specific epithet is formed from the surname of Sam W. Heads in recognition of his contributions to the study of Cretaceous insects.

Diagnosis. Differs from *Olindanymphes makarkini* by absence of crossveins between distal branches of PR [present in *O. makarkini*], and more acute wing apex [more rounded in *O. makarkini*].

Description. Female (?). Body *ca*. 27 mm long; poorly preserved. Details of head not discernible. Pronotum transverse in dorsal view (*ca*. 0.6 as long as wide); covered with dense, probably long setae. Meso- and metanotum dark. Abdomen: apical segments covered with long, dense setae; presumable 9th tergite not extending laterally to ventral part of abdomen, not dilated ventrally (if it is seen in lateral view).

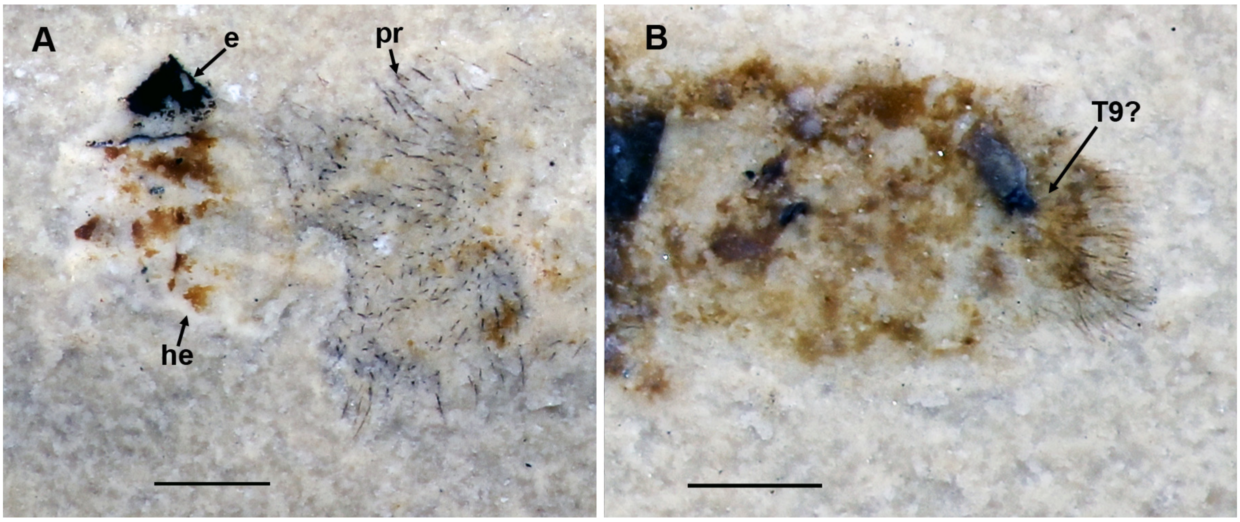

FIGURE 2. *Olindanymphes? headsi* **sp. nov.**, holotype INHSP 1510 (wetted with ethanol). A, head, pronotum (dorsal view); B, apex of abdomen (lateral view?). e, eye; he, head; pr, pronotum; 9T, ninth tergite. Scale bars = 1 mm.

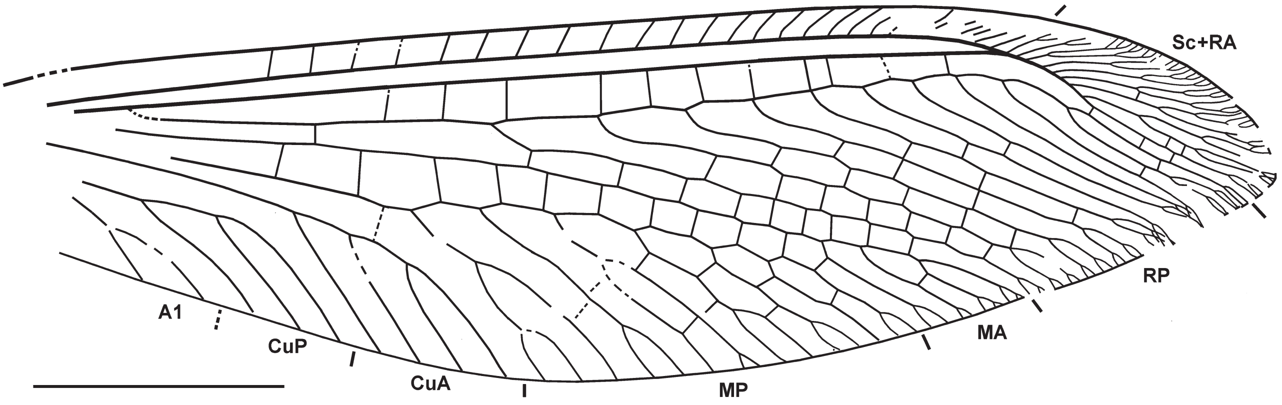

FIGURE 3. Hindwing venation of *Olindanymphes? headsi* **sp. nov.**, holotype INHSP 1510. Scale bar = 5 mm.

Hindwing elongate with sub-acute apex, *ca*. 26 mm as preserved (estimated complete length 27–28 mm), 7.1 mm wide. Costal space relatively narrow. All preserved subcostal veinlets simple. Subcostal space relatively broad: no crossveins detected. RP originates relatively close to wing base at acute angle to RA, with 10 pectinate branches; RP1 twice very shallowly forked; most other branches dichotomously forked. Crossveins between branches of RP irregularly spaced; between distal branches absent, becoming denser proximad (seven detected between RP1, RP2). Ten crossveins between RP/RP1 and MA. Anterior trace of MA slightly convex, with three rather short branches, which once or twice shallowly forked. Crossveins between MA, MP numerous (11 detected). MP with six pectinate branches; MP1, MP3 deeply forked; MP2, MP4, MP5 relatively shallowly forked; RP1 simple. One to two crossveins between branches of MP. Anterior trace of CuA terminally not forked, pectinately forked, with three long simple branches; no crossvein between these branches not detected. Anterior trace of CuP terminally not forked, pectinately branched, with two long simple branches. Presumable A1 deeply forked. Crossveins in basal part of wing indiscernible or absent. Trichosors not detected.

Remarks. Crossvein arrangement and the shape of wing apex in most Nymphidae (except some derived Myiodactylinae) are more or less similar in fore- and hindwings (see *e.g.*, She *et al*. 2013: Fig. 8; She *et al.* 2015: Figs 2, 11, 15). It can therefore, reasonably be assumed that these character states in the undescribed hindwing of *Olindanymphes makarkini* are more or less similar to those of its described forewing. These features in *O. makarkini* and *O.? headsi* **sp. nov.** are different: crossveins are present between distal branches of PR in *O. makarkini*, but absent in *O.? headsi* **sp. nov.** and crossvenation is generally denser in the radial space of *O. makarkini*; the wing apex of *O. makarkini* is obviously more rounded than in *O.? headsi* **sp. nov.**, which is more acute.

This specimen is most probably a female judging from the general view of apical segments of the abdomen, although their structures are mostly not clear.

Discussion

The hindwing of *Rafaelnymphes cratoensis* is the only among the Crato Formation Nymphidae for which minimal morphological data are available. Its RP possesses 16–18 branches (Myskowiak *et al.*, 2016), while only ten in the new species. *Santananymphes ponomarenkoi* was so inadequately described and figured that it is hard to make any comparison (see Martins-Neto, 2005, fig. 1B). Anyway, its forewing apex appears to be rounded (Martins-Neto, 2005, fig. 3B) while it is clearly sub-acute in the new species. The forewing of *Olindanymphes makarkini* was relatively accurately described; its RP possesses nine branches, CuA five branches, and CuP two. These characters are comparable with those of the new species. So, this new species may be preliminary assigned to this genus as *Olindanymphes? headsi* **sp. nov.** It cannot be ruled out also that the species belongs to a new genus. The precise generic attribution of the species may be determined only when a complete specimen with both fore- and hindwings is found.

The hindwing venation of *Olindanymphes? headsi* **sp. nov**. is unique in the family by the presence of the few-pectinate both CuA and CuP, each with two to three branches. This branching of CuA is most similar to that of the Barremian *Baissoleon* Makarkin, 1990b, which is two-branched in *Baissoleon cretaceus* Makarkin, 1990b (from Baissa, Russia) and three-branched in *B. similis* Shi *et al*., 2015 (from the Yixian Formation, China). However, the hindwing CuP in both species of *Baissoleon* is simple in contrast to *O.? headsi* **sp. nov.** Also, the Sc+RA space is very narrow in both species of *Baissoleon*, but broad in *O.? headsi* **sp. nov**.

The other Nymphidae are characterized by the long, strongly pectinate hindwing CuA. Particularly, it is characteristic of all known Jurassic genera (*Nymphites* Haase, 1890, *Mesonymphes* Carpenter, 1929, and *Liminympha* Ren & Engel, 2007) and most Cretaceous genera (*Sialium* Westwood, 1854; *Dactylomyius* Makarkin 1990a; *Cretonymphes* Ponomarenko, 1992; *Spilonymphes* Shi *et al*., 2015) (see Carpenter 1929: Fig. 1; Panfilov 1980: Fig. 115; Ponomarenko 1992: Fig. 1; Shi *et al*. 2013: Figs 2B, 6C, D, 8B, 10; Shi *et al.* 2015: Figs 9, 13; Archibald. & Makarkin 2020: Fig. 4). Therefore, the relative short, few-pectinate CuA in the hindwing is a derived condition, known only in three abovementioned Early Cretaceous species.

In contrast, the short, few-branched CuP in the hindwing is probably a plesiomorphic condition. This state is known in most fossil (in particular, in all known Jurassic species) and all extant species. The long and strongly pectinate hindwing CuP occurs only in three Cretaceous species: *Cretonymphes baisensis* Ponomarenko, 1992; *Sialium sinicus* Shi *et al*., 2015, and *Dactylomyius septentrionalis* Makarkin, 1990a (see Ponomarenko 1992: Fig. 1; Shi *et al*. 2015: Fig, 13c; Archibald & Makarkin 2020: Fig. 4).

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