The First Gumillinae (Neuroptera: Osmylidae) from the Cenozoic and the Early Eocene Green River Formation

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Abstract

Nuddsia? jessicae sp. nov. (Neuroptera: Osmylidae: Gumillinae) is described from the early Eocene Green River Formation. We tentatively assigned the species to genus as its venation agrees well with that of the type species of *Nuddsia* from the Early Cretaceous (late Aptian) deposits of Brazil. This is the first species of the subfamily known from the Cenozoic. It is distinguished from other members of Gumillinae by the presence of large dark spots in the apical part of the forewing.

Keywords

Neuroptera, Osmylidae, Ypresian, new species, lance lacewing

Introduction

The Osmylidae constitute a rather small neuropteran family with more 210 extant species, which are widely distributed except in North America (Oswald and Machado 2018). About 70 fossil species of Osmylidae are described from the Early Jurassic to the Miocene (Winterton et al. 2019; Z. Li et al. 2024). Nine subfamilies are currently recognized in the family (Winterton et al. 2019).

The subfamily Gumillinae is currently a relict group, represented only by one Brazilian genus *Gumilla* Navás, 1912 with two rare species whose larvae are unknown (Navás 1912; Martins et al. 2016, 2018). No species have hitherto been described from the Cenozoic, although two fragmentary specimens from the latest Eocene of the Isle of Wight (England) reported as "?Chrysopidae" and "Neuroptera undetermined" by Nel and Jarzembowski (2019). These were later interpreted as belonging to Gumillinae by Perkovsky and Makarkin (2020).

The Gumillinae were most diverse in the Mesozoic; seven genera (14 species) have been described: *Enodinympha* Ren and Engel, 2007 (two species), *Nilionympha* Ren and Engel, 2007 (two species), *Tenuosmylus* Wang et al., 2009 (monotypic), and *Allotriosmylus* Yang et al., 2010 (monotypic) from the Middle Jurassic of Daohugou (China); *Epiosmylus* Panfilov, 1980 from the Middle Jurassic of Daohugou and Kubekovo (Russia), and the Late Jurassic of Karatau (Kazakhstan) (three species); *Kolbasinella* Khramov, 2014 from the Late Jurassic of Karatau (monotypic); and *Nuddsia* Menon and Makarkin, 2008 from the Early Cretaceous of Brazil and mid-Cretaceous of Myanmar (four species) (Panfilov 1980; Ren and Yin 2002; Ren and Engel 2007; Menon and Makarkin 2008; Wang et al. 2009; Martins-Neto and Rodrigues 2010; Yang et al. 2010; Khramov 2014, 2017; Myskowiak et al. 2016; Q. Li et al. 2018; Z. Li et al. 2024).

The comprehensive characteristics of the subfamily were provided by Winterton et al. (2019). Those authors tentatively include in Gumillinae the Early Cretaceous genus *Osmylochrysa* Jepson et al., 2012, but we do not consider it to belong to the subfamily. The venation of this genus is generally different from that of Gumillinae. In particular, their relatively scarce

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radial and medial crossveins are arranged in series (numerous crossveins are not arranged in series in Gumillinae), and its hindwing CuP is long (short in Gumillinae). These character conditions are especially distinct in *Osmylochrysa navasia* Khramov, 2020 from Khasurty (Russia) (Khramov 2020, fig. 36).

Previously, six species in five families of Neuroptera have been described from the early Eocene of the Green River Formation (Colorado, U.S.A): *Xenoberotha angustialata* Makarkin, 2017a (Berothidae), *Epignopholeon sophiae* Makarkin, 2017b (Myrmeleontidae), *Protonolima mantispinoformis* Makarkin, 2019 (Mantispidae), *Osmylidia taliae* Makarkin et al., 2021 (Osmylidae: Protosmylinae), *Megalomus? coloradensis* Makarkin, 2024 and *Pseudonotherobius kohlsi* Makarkin, 2024 (both Hemerobiidae) (Makarkin 2017a, 2017b, 2019, 2024; Makarkin et al. 2021).

Here, a new species of Gumillinae (Osmylidae) is described from the Green River Formation.

Materials and Methods

The specimen was collected by Adira Ahmad-Rizal at a site known as "Site B" in Dayvault et al. (1995) and Gus' Pit (39°43′38.10″N, 107°58′34.14″W) (Antell and Kathirithamby 2016) in Rio Blanco County, Colorado, USA. The site is a quarry that exposes the Parachute Creek Member of the Green River Formation, 2,179 m elevation.

Based on $^{40}Ar/^{39}Ar$ dating, the Green River Formation was found to be 53.5 to 48.5 million years old (Smith et al. 2003, 2008). The Parachute Creek Member was deposited during the late Ypresian, from approximately 51.3 to 48 Ma (see fig. 2 of Smith et al. 2008:57). The age of the site is estimated to be approximately 49 million years old (see Makarkin 2019 for details).

The specimen was wetted by ethanol and photographed with a Keyence VHX-7000 light microscope. The line drawings were prepared from camera images with Adobe Photoshop CS3 (Adobe Systems 2007).

Venational terminology follows Breitkreuz et al. (2017). Terminology of wing spaces and details of venation (e.g., veinlets, traces) follows Oswald (1993). Abbreviations used are as follows: Cu, cubitus; CuA, anterior cubitus; CuP, posterior cubitus; M, media; MA, anterior media; MP, posterior media; R, radius; RA, anterior radius; RP, posterior radius; RP1, proximal-most branch of RP; Sc, subcosta.

Systematic Paleontology

Class Insecta Linnaeus, 1758
Order Neuroptera Linnaeus, 1758
Family Osmylidae Leach, 1815
Subfamily Gumillinae Navás, 1912
Genus *Nuddsia* Menon and Makarkin, 2008

Type species. *Nuddsia longiantennata* Menon and Makarkin, 2008, by original designation.

Included species. *Nuddsia longiantennata* Menon and Makarkin, 2008 and *N.? repartiata* Martins-Neto in Martins-Neto and Rodrigues, 2010, both from the Early Cretaceous (late Aptian) of Brazil; *N. magnifica* (Myskowiak et al., 2016) and *N. simplex* Z. Li et al., 2024, both from mid-Cretaceous amber of Myanmar; *N.? jessicae* sp. nov. from the early Eocene Green River Formation (USA).

Diagnosis. The genus may be distinguished from other genera of Gumillinae by a combination of forewing character states: RP1 originates far distal from wing base (at 0.38–0.48 of complete wing length) [at 0.22–0.31 in *Nilionympha*, *Enodinympha*]; M forked slightly proximad RP1 [much proximad in *Epiosmylus*, *Allotriosmylus*, *Tenuosmylus*; distad in *Gumilla*]; forewing RP with four to six branches [one in *Allotriosmylus*; eight in *Tenuosmylus*; ≥10 in *Nilionympha*, *Enodinympha*]; CuA rather deeply forked distally (except *N. simplex*) [pectinate in *Epiosmylus*].

Remarks. *Kolbasinella* Khramov, 2014 is known only from a hindwing of its type species.

Nuddsia? jessicae
Makarkin and Mock sp. nov.
Figures 1–4

Etymology. From the first name of Jessica Utrup (née Bazeley), an invertebrate paleontologist and Collections Assistant at the Yale Peabody Museum, in recognition of her extensive mentorship and support for students and collections staff, and in celebration of her 20th year in the Division of Invertebrate Paleontology at the Yale Peabody Museum.

Holotype. YPM IP 466062. An incomplete specimen, housed in the Division of Invertebrate Paleontology of the Peabody Museum of Natural History, Yale University, New Haven, Connecticut, USA. Collected by Adira Ahmad-Rizal in a quarry known as Gus' Pit (39°43′38.10″N, 107°58′34.14″W), at 2,179 meters elevation, Rio Blanco County, Colorado, USA (Parachute Creek Member of the Green River Formation). Early Eocene (late Ypresian).

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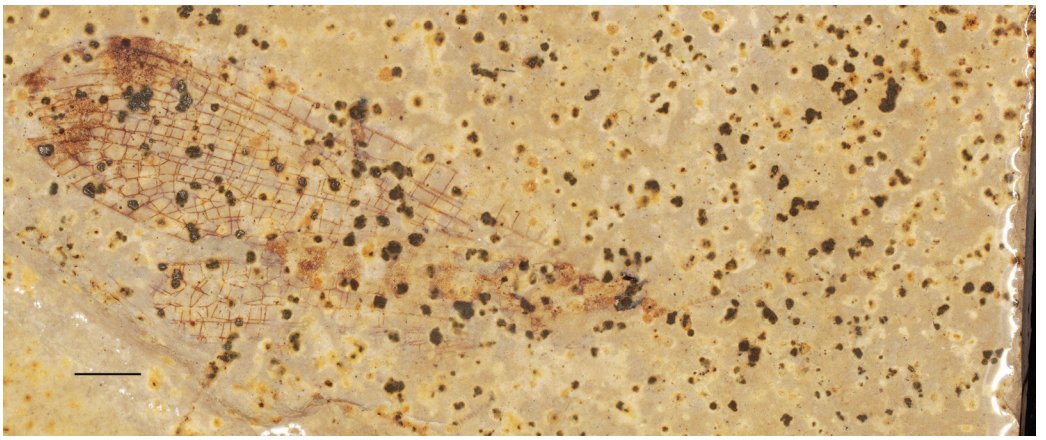


Figure 1. YPM IP 466062, holotype of *Nuddsia? jessicae* sp. nov. Specimen as preserved (wetted by ethanol). Scale bar = 2 mm.

Diagnosis. May be easily distinguished from other species of the genus and the family by the presence of large apical spots in the forewing.

Description. *Head*. Poorly preserved with eyes rather large. Antennae long (incompletely preserved); scapus large, rounded (somewhat dilated distad), covered with scarce, short setae; pedicellus elongate, covered with scarce, short (but longer than on scapys) setae; flagellum slender, 10 mm long as preserved; flagellomeres relatively short, covered with scarce, relatively long setae.

Thorax. Poorly preserved. Prothorax slightly elongate, pale, margined laterally with brown; setae not detected. Mesothorax and metathorax appear usual for Neuroptera, details indiscernible; setae not detected. Legs not preserved.

Forewing ca. 16.5 mm long, 5.4 mm wide. Costal space relatively broad, slightly narrowed basally. All subcostal veinlets simple, rather widely spaced. Subcostal space very narrow proximally, dilated apicad. Distal parts of Sc, RA and their veinlets not discernible. RP originates close to wing base; its anterior trace with four branches. RP1 originates far from origin of RP (at 0.44 of complete wing length). M forked proximad origin of RP1. MA continues stem of M, almost straight for its entire length; with two branches (proximal one simple, distal one forked). MP dichotomously forked. CuA forked distally: anterior branch simple, directed anteriorly at base; posterior branch pectinately branched, with three simple short branches. Crossveins numerous, not arranged in series, occupy entire wing. Color pattern: two large and one small (on tip of wing) apical brown spots.

Hindwing 14 mm long as preserved (estimated complete length ca. 15.5), 4.1 mm wide. Costal space narrow for entire length. All subcostal veinlets simple; rather widely spaced for most length, more closely space distally. Subcostal space very narrow proximally, dilated apicad. Sc, RA probably fused; Sc+RA ended at margin well before wing apex. RP originates close to wing base; its anterior trace with four branches. RP1 originates far from origin of RP (at 0.39 of complete wing length).RP1, RP2, RP4 simple; RP3 forked distally. MA straight for its entire length; with three branches (proximal one forked, two distal ones simple). MP dichotomously forked distally. CuA long, pectinately forked. Crossveins numerous, not arranged in series, occupy entire wing. Color pattern: indiscernible as the wing is completely overlapped by the forewing.

Abdomen. Incomplete, details indiscernible; setae not detected.

Discussion

The new species is tentatively assigned to the Mesozoic genus *Nuddsia* as its venation agrees well with that of the type species, especially by the configuration of RP, MA, MA, and CuA in both fore- and hindwings. These species differ in the following: wings of *N. longiantennata* are slightly narrowed and its crossveins are slightly denser; the scapus in both species is in general rounded, but it is narrowed proximally in the new species (Figure 2A), while it is narrowed distally in *N. longiantennata* (Figure 2C). The scapus is elongate in two species known from the Kachin amber (*N. magnifica* and *N. simplex*), but the venation of *N. magnifica* agrees well with that of *N. longiantennata* and the new species. The venation of *N. simplex* differs from other species by the pectinate

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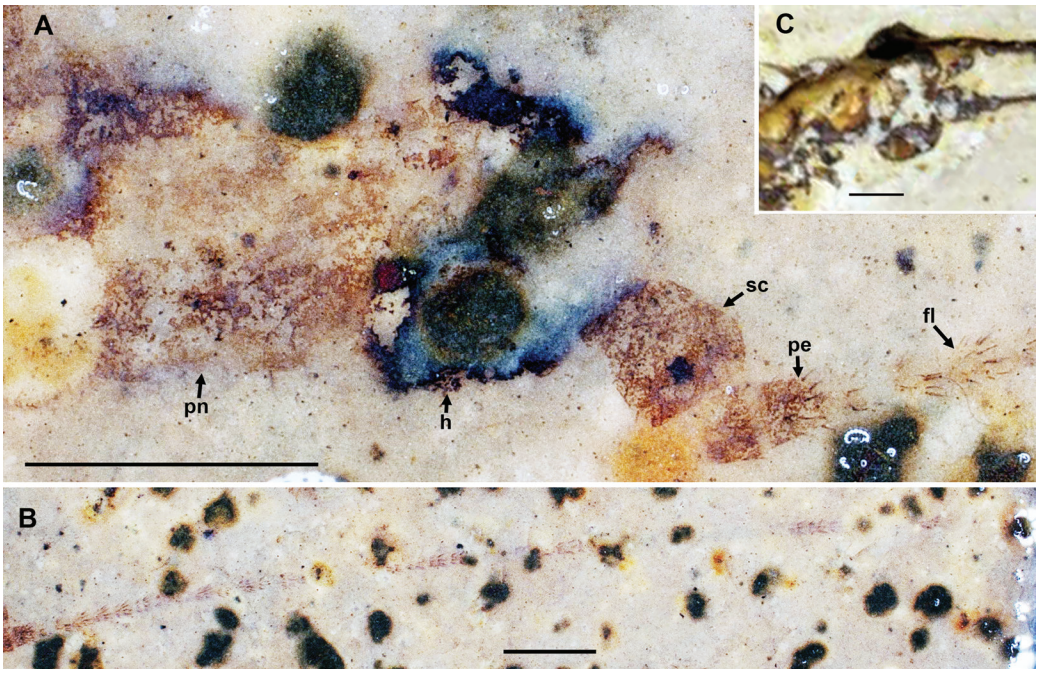


Figure 2. Head and prothorax of *Nuddsia*, dorsal view. **A**. *N.? jessicae* sp. nov., holotype (YPM IP 466062). **B**. Same, flagellum (both wetted by ethanol). **C.** *N. longiantennata* Menon and Makarkin, 2008, holotype (SMNS 66000/263; photo by M. Menon). fl, flagellum; h, head; pe, pedicellus; pn, pronotum; sc, scapus. Scale bars equal 1 mm.

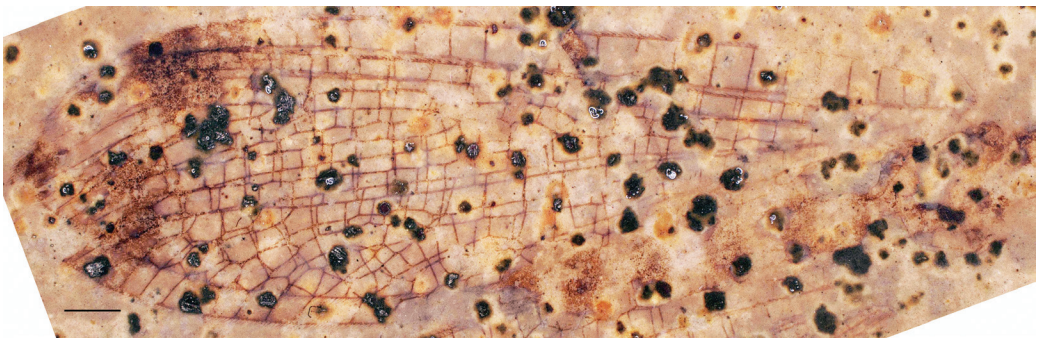


Figure 3. YPM IP 466062, holotype of *Nuddsia? jessicae* sp. nov., Left wings wetted by ethanol. Scale bar = 1 mm.

CuA in the forewing; it is typical *Nuddsia* otherwise. At this time, we have too little material to decide whether the differences in shape of the scapus are specific or generic. In any case, the specimen does not possess character states sufficient to establish a new genus for *N.? jessicae* sp. nov.

Martins-Neto and Rodrigues (2010) depicted the venation of what is most probably the hindwing of *N. repartiata* (Martins-Neto

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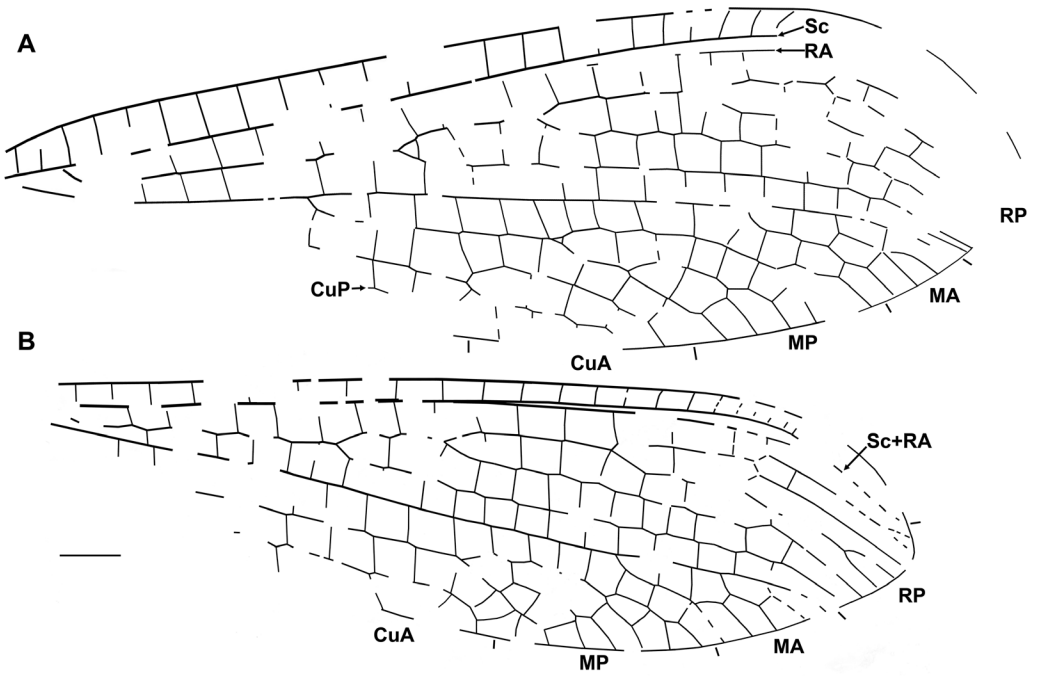


FIGURE 4. YPM IP 466062, holotype of *Nuddsia? jessicae* sp. nov. Wing venation (converted to standard right view). **A**. Left forewing. **B**. Left hindwing. See Materials and Methods for abbreviations. Scale bar = 1 mm (both to same scale).

and Rodrigues 2010, fig. 2A) which they treated as a forewing. The holotype of this species needs to be re-examined to determine whether or not it belongs to the genus *Nuddsia*.

The extant genus *Gumilla* is more similar to *Nuddsia* by the venation than to other Mesozoic genera. In general, the Gumillinae are atypical osmylids. Their antennae are very long and the scapus is large. The ocelli and the basal sinuate crossvein between R and M in the hindwing are lost. The trichosors are limited only to apical part of wings, and the proximal branch of RP often originates far from the wing base. All these features are present in several genera (e.g., *Gumilla*, *Nuddsia*, *Epiosmylus*). Some of the oldest known (Middle Jurassic) gumilline; however, have plesiomorphic venation, and resemble typical osmylids (especially, *Enodinympha* and *Nilionympha*). In these genera, the RP has numerus branches with RP1 originating relatively close to the wing base, the M is forked close to the wing base, and veinlets of the Sc+RA are very dense.

Conclusion

The discovery of *Nuddsia? jessicae* sp. nov., the first gumilline species from the Cenozoic and the early Eocene Green River Formation, is important. It is assigned to a Cretaceous genus previously known from Brazil and Kachin (Burmese) amber, originating from the West Burma Block, which was formerly a part of Gondwana. This is the second genus of Neuroptera known to have survived the Cretaceous-Paleogene event; the first is the widely distributed Mesozoic genus *Mesypochrysa* Martynov, 1927 (Chrysopidae: Limaiinae) recorded from the earliest Eocene Fur Formation, Denmark (Makarkin and Perkovsky 2023; Makarkin et al. 2026). This is seventh species of Neuroptera described from this formation. Its neuropteran assemblage is now represented by the following groups: Osmylidae (Protosmylinae, Gumillinae), Berothidae (Berothinae), Mantispidae (?Calomantispinae), Hemerobiidae (Megalominae, ?Carobiinae)

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and Myrmeleontidae (Myrmeleontinae: ?Gnopholeontini) (Makarkin 2017a, 2017b, 2019, 2024; Makarkin et al. 2021).

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