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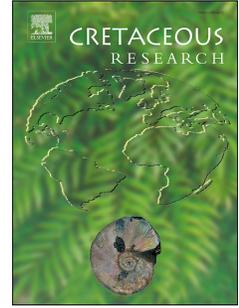
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1 **A new green lacewing species of the extinct subfamily Limaiinae (Insecta: Neuroptera:**
2 **Chrysopidae) from the mid-Cretaceous of Myanmar**

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15

16 **Abstract**

17 Chrysopidae (green lacewings) is one of the species-rich families of Neuroptera. The
18 Cretaceous fossils of green lacewing currently comprise 11 genera and 26 species. Here we describe
19 a new green lacewing species, *Mesypochrysa coadnata* sp. nov., from mid-Cretaceous Burmese
20 amber. The new species belongs to the extinct subfamily Limaiinae and is characterized by the RP
21 with seven zigzagged branches, the forewing CuA with four pectinate branches, and the hind wing
22 CuA with three pectinate branches. The exquisite preservation of the new fossils facilitates the

23 understanding of the genital morphology of the Mesozoic green lacewings.

24

25 **Key words:** Chrysopoidea, Limaiinae, *Mesypochrysa*, Mesozoic, Burmese amber

26

27 1. Introduction

28 Chrysopidae is the second largest family of Neuroptera after Myrmeleontidae, and comprises at
29 least 1416 species assigned to 82 genera (Oswald, 2022). The family is divided into three extant
30 subfamilies, i.e., Apochrysinæ, Chrysopinæ, Nothochrysinæ, and one extinct subfamily Limaiinæ
31 (Breitkreuz, 2018). The fossil records of Chrysopidae are comparatively rich, with about 71 species
32 in 30 genera, which respectively belong to the subfamilies Limaiinæ, Chrysopinæ and
33 Nothochrysinæ. Among them, 35 species in 10 genera belong to Limaiinæ, and these species have
34 been reported from the Middle Jurassic to the Eocene (Archibald and Makarkin, 2015; Khramov et
35 al., 2016). Most species of Limaiinæ are known from the Cretaceous, currently with 10 genera and
36 27 species described from Brazil, China, Mongolia, Russia and the United Kingdom. The Jurassic
37 Limaiinæ comprise two genera and six species described from China and Kazakhstan. This
38 subfamily extended the occurrence from the Eocene, but with only two species of same genus from
39 Canada and Denmark.

40 Hitherto, only one species of Limaiinæ has been described from the Burmese amber, namely
41 *Parabaisochrysa xingkei* Lu et al., 2018, which represents the first finding of this subfamily from
42 an amber inclusion. Compared with the rich records of chrysopid-like larvae from the Burmese
43 amber, the adults of Chrysopidae as well as of Chrysopoidea are rarely found from this deposit (Liu
44 et al., 2016, 2018; Haug et al., 2022).

45 Here we describe a new species of Limaiinae, *Mesypochrysa coadnata* sp. nov., based on three
46 female specimens from mid-Cretaceous Burmese amber. Notably, the new species is the first species
47 of *Mesypochrysa* Martynov, 1927 known to date from the amber inclusion, and represents the
48 youngest fossil record of this genus. The new fossils are exquisitely preserved, and thus provide
49 valuable new data, particularly on the genital morphology, for the Mesozoic green lacewings.

50 2. Material and methods

51 The Burmese amber samples under present study are from the Hukawng Valley in Tanai Township,
52 Myitkyina District of Kachin State, Myanmar (see Yu et al., 2019: fig. 1). The age of this deposit
53 has been dated to be 98.8 ± 0.6 million years (earliest Cenomanian) by U-Pb dating of zircons from
54 the volcanoclastic matrix of the amber (Shi et al., 2012). The specimen is deposited in the Nanjing
55 Institute of Geology and Palaeontology (NIGP), Chinese Academy of Sciences, Nanjing, and was
56 legally collected before June 2017 (see Museum Catalogue Entry in Supplementary Material).

57 Photographs and drawings were made by using Zeiss SteREO Discovery V12 stereo
58 microscope system. The figures were prepared with Adobe Photoshop CS6. Wing venation
59 terminology generally follows Adams (1996) and Breitkreuz et al. (2017). Venational abbreviations:
60 A, anal vein; C, costa; Cu, cubitus; CuA, cubitus anterior; CuP, cubitus posterior; MA, media
61 anterior; MP, media posterior; RA, radius anterior; RP, radius posterior; ScA, subcosta anterior; ScP,
62 subcosta posterior; im, intramedian cell; Psm, pseudomedia; Psc, pseudocubitus.

63

64 3. Systematics of palaeontology

65 Class Insecta Linnaeus, 1758

66 Order Neuroptera Linnaeus, 1758

67 Family Chrysopidae Schneider, 1851

68 Subfamily Limaiinae Martin-Neto & Vulcano, 1989

69 Genus *Mesypochrysa* Martynov, 1927 (Type species: *Mesypochrysa latipennis* Martynov, 1927

70)

71 **Revised diagnosis.** Forewing: costal crossveins simple; two gradate series of crossveins present;

72 RP with 5–20 branches distally bifurcated; cell im proximally connected with stem of RP by a

73 crossvein; MA and MP distally bifurcated; CuA with three to five pectinate branches; CuP distally

74 bifurcated; A1 and A2 long and simple, but sometimes forked marginally; A1 connected with CuP

75 by short crossvein or even partially fused together; A3 short. Hind wing: shape slightly narrower,

76 shorter and distally more acute than forewing; costal space narrow, costal crossveins simple; two

77 gradate series of crossveins present; RP with 5–18 branches; MA and MP distally bifurcated; CuA

78 with three to five pectinate branches; CuP simple or bifurcated; A1 simple, but sometimes forked

79 marginally. Female genitalia: Tergum 8 narrow; tergum 9 posteroventrally broadened; gonocoxites

80 9 broad; ectoprocts paired, ovoid, not fused with tergum 9.

81 **Remarks.** *Mesypochrysa* is the most species-rich genus of Limaiinae, comprising 21 described

82 species, and it can be distinguished from the other limaiine genera mainly by the forewing characters.

83 *Mesypochrysa* can be distinguished from *Limaia* Martins-Neto & Vulcano, 1989 by the forewing

84 RP with most branches distally bifurcated (the forewing RP branches mostly simple in *Limaia*)

85 (Martins-Neto, 1997; Martins-Neto & Vulcano, 1989). *Mesypochrysa* is distinguished from

86 *Drakochrysa* Yang & Hong, 1990 by the forewing RP branches mostly bifurcated distally, and the

87 CuP distally bifurcated (the forewing RP branches mostly simple, and the CuP with four branches

88 in *Drakochrysa*) (Yang and Hong, 1990). *Mesypochrysa* is distinguished from *Aberrantochrysa*

89 Khramov, 2017 by zigzagged RP branches and the presence of two parallel series of gradate veins
90 in the forewing (in *Aberrantochrysa*, the RP branches are smooth, and the inner gradate veins are
91 irregularly arranged in the forewing) (Khramov, 2017). *Mesypochrysa* is distinguished from
92 *Baisochrysa* Makarkin, 1997 and *Parabaisochrysa* Nel, Delclòs & Hutin, 2005 by the presence of
93 two series of gradate veins in the forewing (in *Baisochrysa* and *Parabaisochrysa*, three series of
94 gradate veins are present in the forewing) (Makarkin, 1997; Lu et al., 2018). *Mesypochrysa* is
95 distinguished from *Protochrysa* Willmann & Brooks, 1991 by having simple crossveins in the
96 pterostigmal area (in *Protochrysa*, the crossveins in the pterostigmal area are forked) (Makarkin and
97 Archibald, 2013).

98

99 ***Mesypochrysa coadnata* sp. nov.**

100 (Figs. 1–6)

101 urn:lsid:zoobank.org:act:6159CFE0-2436-4786-B018-CDDFBD039298

102 **Diagnosis.** Forewing RP with seven zigzagged branches; basal most ra-rp crossvein at or slightly
103 distal to separation of first RP branch; MA distally bifurcated; cell im1 and im2 almost equal in
104 length; CuA with four pectinate branches; A1 long and simple; A2 simple or distally bifurcated.
105 Hind wing RP with seven branches; MA and MP separated distal to origin of RP; CuA with three
106 pectinate branches; CuP simple, proximally coalescent with or connected with A1 by a crossvein;
107 A1 simple.

108 **Description.** Female. Body length 6.44–7.46 mm; preserved part of antenna 2.48–7.10 mm long;
109 forewing 8.77–12.72 mm long and 3.24–4.34 mm wide; hind wing 8.42–10.72 mm long and 2.24–
110 3.32 mm wide (All materials are measured by electronic digital caliper, and the range values

111 represent the minimum and maximum lengths of this species, respectively).

112 Head (Fig. 1C, 5C) with vertex distinctly domed and ovoid. Compound eyes large, semi-
113 globular. Antenna long filiform, setose, more than a quarter of forewing length; scape stouter than
114 pedicel and flagellum, about three times as long as wide; pedicel smaller than scape, subcylindrical;
115 flagellomere narrower than scape and pedicel. Mouthparts chewing-mandibulate; maxillary palpus
116 with only three segments visible; labial palpus three-segmented, terminal segment acutely tapering.

117 Prothorax about twice as long as wide; meso- and metathorax robust. Legs long and slender,
118 with short setae; tarsus (Fig. 1B, 5D) five-segmented, tarsomere 1 much longer than other
119 tarsomeres, tarsomeres 2–5 almost equal in length; pretarsus with seven to eight apical setae,
120 including five to six long setae (the medial two longest), and a pair of short setae; pretarsal claws
121 simple, slender and long, with sharp tips. Forewing (Fig. 2A, C, 4A, 5B, 6A) costal space dilated
122 proximally, but strongly narrowed distad, with eight to ten simple crossveins; pterostigma distinct,
123 nearly half of wing length, dark; ScP relatively long, extending nearly to midpoint of pterostigma;
124 subcostal space narrow; RA long, entering wing margin anteriorly to wing apex, with at least six veinlets
125 distally; 1scp-ra present, slightly distal to origin of RP; basal most ra-rp crossvein at or slightly
126 distal to separation of first RP branch; RP with seven zigzagged branches, and most or all of them
127 distally bifurcated; two gradate series of crossveins present in RP, complete and nearly parallel to
128 each other; Psm and Psc not present; 1rp-m slightly distal to separation of MA and MP; MA and
129 MP both distally bifurcated; cell im1 long and narrow, about five times as long as wide, proximally
130 acutely tapering; cell im1 and im2 almost equal in length; 1m-cu present, proximal or slightly distal
131 to separation of CuA and CuP; CuA with four pectinate branches; CuP distally bifurcated; cell c1
132 about 1/3 length of c2; A1 long and simple; A2 simple or distally bifurcated; A1 connected with

133 CuP by a short crossvein; a1-a2 present. Hind wing (Fig. 2B, 4B, C, 6B) slightly narrower, shorter
134 and distally more acute than forewing; costal space narrow, and costal crossveins simple; RP with
135 seven branches, and most of them distally bifurcated; two gradate series of crossveins present in RP;
136 MA and MP both distally bifurcated; MA and MP separated distal to origin of RP; two
137 (NIGP2022001 and NIGP2022002) or three (NIGP180324) crossveins between medial field and
138 CuA; CuA with three pectinate branches; CuP simple, coalescent with A1 for a distance
139 (NIGP2022001 and NIGP2022002) or connected with A1 by a crossvein (NIGP180324); A1 long
140 and simple; A2 simple or distally bifurcated; A3 simple; a1-a2 present; a2-a3 present.

141 Abdomen subcylindrical, setose. Male genitalia: Female genitalia (Fig. 1D, 3C, D, 5E):
142 Tergum 8 much shorter than tergum 7; tergum 9 dorsally strongly shortened, but broadened
143 posteroventrad; gonocoxites 9 well developed, semicircular; ectoprocts paired, ovoid, not fused with
144 tergum 9; callus cerci circula.

145 **Etymology.** The specific epithet is derived from the Latin adjective of *coadnatus*, meaning
146 coalescent, in reference to the hind wing CuP coalescent with A1 in the new species.

147 **Type material.** Holotype: NIGP2022001: amber piece preserving a nearly complete female of
148 *Mesypochrysa coadnata* sp. nov., only the right hind wing, the distal part of flagellum, and the parts
149 of legs are not preserved. It is polished in the form of an elliptical cabochon, transparent, with
150 length×width about 32.9×19.2 mm, height about 11.6 mm. Paratype: NIGP2022002: the specimen
151 preserved with three wings, thorax and abdomen. It is polished in the form of an elliptical cabochon,
152 transparent, with length×width about 42.2×19.4 mm, height about 10.8 mm. NIGP180324: amber
153 piece preserving a nearly complete female adult, only the distal part of flagellum is not preserved.
154 It is polished in the form of an elliptical cabochon, transparent, with length×width about 21.2×6.1

155 mm, height about 3.1 mm.

156 **Remarks.** The new species is assigned to Limaiinae based on the forewing characters, such as the
 157 ScP terminated within the pigmented pterostigma, the RA terminated near wing apex, the cell im
 158 long and narrow, and the 2m-cu crossvein located at the distal part of im (Makarkin, 1997; Nel et
 159 al., 2005; Makarkin and Archibald, 2013). The species is assigned to *Mesypochrysa* based on the
 160 following characters: the presence of two gradate series, the RP branches mostly bifurcated, and the
 161 CuP bifurcated distally in fore- and hind wing, and the forewing A1 and A2 long and simple
 162 (Khramov et al., 2016). The identification of three specimens as one species is based on their
 163 possession of the following characters: the forewing RP with seven zigzagged branches, the
 164 forewing cell im1 and im2 almost equal in length, the forewing CuA with four pectinate branches,
 165 the hind wing RP with seven branches, and the hind wing CuA with three pectinate branches.
 166 Notably, the position between the hind wing CuP and A1 is varies among individuals in the new
 167 species which is also present in some species of Chrysopidae, see details in the discussion below.

168

169 **Key to species of *Mesypochrysa* based on forewing characters**

- 170 1. RP branches mostly bifurcated distally..... 2
 171 - RP branches mostly with three to six forks distally (Panvilov, 1980: fig. 112).....
 172 *M. polyclada*
 173 2. Basal most ra-rp crossvein distinctly proximal to separation of first RP branch 3
 174 - Basal most ra-rp crossvein at or distinctly distal to separation of first RP branch 10
 175 3. CuA with three pectinate branches (Makarkin, 1997: fig. 13) *M. chrysopa*
 176 - CuA with four to six pectinate branches..... 4
 177 4. CuA with four pectinate branches..... 5
 178 - CuA with five to six pectinate branches..... 6
 179 5. Forewing length 22.9–24.5 mm 7
 180 - Forewing length 17.1–17.3 mm 8
 181 6. MA and MP zigzagged (Martins-Neto, 1992: fig. 3a)..... *M. criptovenata*
 182 - MA and MP straight, parallel to each other..... 9
 183 7. Forewing length 22.9 mm, CuA and MP fused (Zhang et al., 2020: fig. 1c)..... *M. binervis*
 184 - Forewing length 24.5 mm, CuA and MP not fused (Nel et al., 2005: fig. 13.1).....

185	<i>M. chrysopoides</i>
186	8. Cell im1 twice as long as im2 (Zhang et al., 2020: fig. 2c).....	<i>M. pusilla</i>
187	- Cell im1 only slightly longer than im2 (Ren and Guo, 1996: fig. 8b).....	<i>M. polyneura</i>
188	9. MA and MP curved posteriad, im1 twice as long as im2 (Makarkin, 1997: fig. 15).....	
189	<i>M. curvimedia</i>
190	- MA and MP straight, im1 slightly longer than im2 (Khramov, 2017: fig. 4c).....	
191	<i>M. naranica</i>
192	10. CuA with two anterior branches bifurcated distally (Khramov et al., 2016: fig. 4b).....	
193	<i>M. sinica</i>
194	- CuA with all branches simple.....	11
195	11. RP with seven to eight branches.....	12
196	- RP with 11–20 branches.....	13
197	12. A2 bifurcated distally (Ren and Guo, 1996: fig. 7b).....	<i>M. miniscula</i>
198	- A2 simple (Figs. 2A, C and 4A).....	<i>M. coadnata</i> sp. nov.
199	13. RP with 20 branches (Makarkin, 1997: fig. 1).....	<i>M. magna</i>
200	- RP with 11–15 branches.....	14
201	14. MA simple (Makarkin, 1997: fig. 17).....	<i>M. augustialata</i>
202	- MA bifurcated distally.....	15
203	15. RP with 15 branches, A1 simple (Nel et al., 2005: fig. 11.6).....	<i>M. intermedia</i>
204	- RP with 11 branches, A1 bifurcated distally (Khramov, 2017: fig. 3).....	<i>M. cannabina</i>
205		

206 **Key to species of *Mesypochrysa* based on hind wing characters**

207	1. Hind wing length 25 mm (Makarkin, 1997: fig. 11).....	<i>M. falcata</i>
208	- Hind wing length 6.7–21.4 mm.....	2
209	2. MA and MP separated distal to origin of RP, MA not coalescent with RP.....	3
210	- MA and MP separated proximal to origin of RP, MA proximally coalescent with RP.....	7
211	3. Hind wing length 15.4 mm (Zhang et al., 2020: fig. 2d).....	<i>M. pusilla</i>
212	- Hind wing length 8.6–12.1 mm.....	4
213	4. Hind wing length 12.1 mm (Martins-Neto and Vulcano, 1989: fig. 1c).....	<i>M. latipennis</i>
214	- Hind wing length 8.6–10.7 mm.....	5
215	5. CuA with four pectinate branches.....	6
216	- CuA with three pectinate branches (Ponomarenko, 2002: fig. 258).....	<i>M. reducta</i>
217	6. RP branches mostly simple (Ren & Guo, 1996: fig. 7b).....	<i>M. miniscula</i>
218	- RP branches mostly bifurcated distally (Figs. 2B and 4B, C).....	<i>M. coadnata</i> sp. nov.
219	7. CuA with five pectinate branches (Makarkin, 1997: fig. 14).....	<i>M. chrysopa</i>
220	- CuA with four pectinate branches.....	8
221	8. RP with six to eight branches.....	9
222	- RP with 10 branches.....	10
223	9. Hind wing length 6.7 mm (Jepson et al., 2012: fig. 15a).....	<i>M. minuta</i>
224	- Hind wing length 11.5 mm (Makarkin, 1997: fig. 18).....	<i>M. minima</i>
225	10. CuA simple (Martins-Neto, 2000: fig. 111).....	<i>M. criptovenata</i>
226	11. CuA bifurcated distally (Nel et al., 2005: fig. 13.2).....	<i>M. chrysopoides</i>
227		

228 Due to poor preservation of important hind wing characters, *M. binervis*, *M. cannabina*, *M.*

229 *curvimedia* and *M. intermedia* are not listed in the key.

230

231 **4. Discussion**

232 The new species differs from many *Mesypochrysa* species, i.e., *M. angustialata*, *M. magna*, *M.*

233 *falcata*, *M. polyclada*, *M. intermedia*, *M. curvimedia*, *M. sinica*, *M. criptovenata*, *M. cannabina*, *M.*

234 *chrysopoides*, *M. binervis*, *M. naranica*, *M. pusilla* and *M. chrysopa* by having the forewing RP

235 with seven branches, while the other species have the forewing RP with more than 10 branches. *M.*

236 *coadnata* sp. nov. can be also distinguished from these species by the following characters: it differs

237 from *M. angustialata* by the forewing MA being bifurcated distally, and the hind wing MA and MP

238 separated distal to the origin of RP (in *M. angustialata*, the forewing MA is simple, and the hind

239 wing MA is proximally coalescent with RP); it differs from *M. magna* by having the forewing MA

240 and MP parallel to each other, and the Psc not present (in *M. magna*, the forewing MA and MP are

241 zigzagged, and the Psc is present); it differs from *M. falcata* by the hind wing being apically rounded,

242 and 8.61–10.72 mm long (in *M. falcata*, the hind wing is apically falcate, and ca. 25 mm long); it

243 differs from *M. polyclada* by the forewing RP branches mostly bifurcated distally (in *M. polyclada*,

244 the forewing RP branches are mostly three to seven forked); it differs from *M. intermedia* by the

245 forewing cell c1 about 1/3 length of c2 (in *M. intermedia*, the forewing cell c1 is about 1/5 length

246 of c2); it differs from *M. curvimedia*, *M. pusilla*, *M. criptovenata*, *M. chrysopa*, *M. binervis* and *M.*

247 *chrysopoides* by the forewing cell im1 and im2 almost equal in length, and the basal most ra-rp

248 crossvein at or slightly distal to the separation of the first RP branch (in the latter, the forewing cell

249 im1 is longer than im2, and the basal most ra-rp crossvein distinctly proximal to the separation of

250 the first RP branch); it differs from *M. cannabina* and *M. naranica* by the forewing RP branches

251 zigzagged, and the A1 simple (in the latter two species, the forewing RP branches are smooth, and

252 the A1 is bifurcated); it differs from *M. sinica* by the forewing CuA with four simple pectinate
253 branches, and the hind wing RP branches mostly bifurcated distally (in *M. sinica*, the forewing CuA
254 with two simple posterior branches and two distally bifurcated anterior branches, and the hind wing
255 RP branches mostly three to six forked) (Panvilov, 1980; Makarkin, 1997; Nel et al., 2005; Khramov
256 et al., 2016; Martins-Neto and Vulcano, 1989; Khramov, 2017; Ponomarenko, 1992; Zhang et al.,
257 2020). The new species differs from *M. polyneura* by the forewing cell im1 and im2 almost equal
258 in length, the basal most ra-rp crossvein at or slightly distal to the separation of the first RP branch,
259 and the A1 and A2 simple (in *M. polyneura*, the forewing cell im1 is distinctly longer than im2, the
260 basal most ra-rp crossvein is distinctly proximal to the separation of the first RP branch, and the A1
261 and A2 are bifurcated distally). The new species resembles *M. miniscula* in the forewing RP with
262 seven to eight branches, the CuA with four pectinate branches, and the CuP bifurcated distally.
263 However, it differs from *M. miniscula* by the forewing RP branches mostly bifurcated, and the hind
264 wing CuP simple (in *M. miniscula*, the forewing RP branches are mostly simple, and the hind wing
265 CuP is bifurcated distally) (Ren and Guo, 1996). There are four species, i.e., *M. minuta*, *M.*
266 *latipennis*, *M. minima*, and *M. reducta*, described based on only hind wing characters. The new
267 species resembles them in the hind wing RP with six to seven branches. However, it differs from *M.*
268 *minuta*, *M. latipennis*, and *M. minima* by the hind wing MA and MP separated distal to the origin
269 of RP, and the CuA with three pectinate branches (in these three species, the hind wing MA is
270 proximally coalescent with RP, and the CuA with four pectinate branches, although the latter
271 character is not preserved in *M. latipennis*). The new species and *M. reducta* share the MA and MP
272 separated distal to the origin of RP, but the new species differs from the latter species by the cell
273 im1 and im2 almost equal in length (Jepson et al., 2012; Martynov, 1927; Makarkin, 1997; Panvilov,

274 1980).

275 Remarkably, among the Mesozoic fossil green lacewings, the fusion between hind wing CuP
276 and A1 is only shared by the Burmese amber limaine species *Parabaisochrysa xingkei* Lu et al.,
277 2018, is of questionable value, as discussed below. The trait is also present in some extant genera of
278 Chrysopidae, e.g., *Berchmansus* Navás, 1913, *Nothochrysa* McLachlan, 1868 and *Apochrysa*
279 Schneider, 1851. However, the relative position between the hind wing CuP and A1 expresses
280 considerable interspecific and intraspecific variation. For example, in *Chrysopodes spinellus* Adams
281 & Penny, 1987, the hind wing CuP is fused with A1, while in *Chrysopodes copius* de Freitas &
282 Penny, 2001, it is not fused with A1. Furthermore, it also varies among individuals in the same
283 species. In *Apochrysa matsumurae* Okamoto, 1912, the hind wing CuP is coalescent with A1 or
284 very close to it. Thus, considering the aforementioned interspecific and intraspecific examples of
285 variation, the fusion between hind wing CuP and A1 may not be a good character for generic and
286 species identification of green lacewings (Tauber, 2007; Adam, 1967; Winterton and Gupta, 2020;
287 Adams and Penny, 1985).

288 The length-width ratio of scape is sometimes used as a diagnostic character to distinguish
289 genera in Chrysopidae. In the new species, the scape is about three times as long as wide, a trait that
290 is used to distinguish *Nineta vittata* (Wesmael, 1841). However, this trait is variable in *Nineta* Navás,
291 1912, and such variation is also present in some genera of Chrysopinae, e.g., *Nacarina* Navás, 1915
292 and *Chrysoperla* Steinmann, 1964. Moreover, similar length-width ratios of scape are also present
293 among different genera. In many species of *Chrysopa* Leach, 1815 and *Leucochrysa* McLachlan,
294 1868, the scape is about two times as long as wide (Aspöck et al., 1980; Garland, 1981; Alayo, 1968;
295 de Freitas and Penny, 2001). Consequently, the reliability of the length-width ratio of scape for

296 generic delimitation needs further evaluation at least for some genera.

297 Finally, it is notable that the female genitalia herein described in *M. coadnata* sp. nov. shares
298 some features with those of Nothochrysinæ and Apochrysinæ, especially the ectoprocts not being
299 fused with tergum 9. In the new species, the ectoprocts and tergum 9 are completely separated which
300 shared by some genera of Nothochrysinæ, e.g., *Kimochrysa* Tjeder, 1966, *Nothochrysa* McLachlan,
301 1868, and *Pimachrysa* Adams, 1957, while the ectoprocts and tergum 9 are partially fused in genera
302 of Apochrysinæ, e.g., *Apochrysa* Schneider, 1851, and *Domenechus* Navás, 1913. The complete
303 separation between ectoprocts and tergum 9, combined with similar venation, suggest that the new
304 species or even *Mesypochrysa* appears to be closely related to Nothochrysinæ which should be
305 further research in the future. This character is also present in many lacewing families, e.g.,
306 Nemopteridae, Hemerobiidae and Nymphidae, and probably is the plesiomorphic condition for the
307 Chrysopidae. However, in most species of Chrysopinae, the female ectoprocts and tergum 9 are
308 fused into a single sclerite, which probably represents a derived condition (Tjeder, 1966; Tjeder,
309 1967; Brooks and Barnard, 1990; Hölzel, 1996; Zhao et al., 2013; New, 1981).

310

311 **5. Conclusion**

312 The presently described new species of Limaiinae from the mid-Cretaceous Burmese amber
313 enriches our knowledge of the species diversity, phylogeny, and morphology of the Mesozoic
314 Chrysopidae. The plesiomorphic separation between the female ectoprocts and tergum 9, first
315 reported in Limaiinae, is consistent with the antiquity of this subfamily in Chrysopidae.

316

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323

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434

435 Fig. 1. *Mesypochrysa coadnata* sp. nov., holotype NIGP200019, female. A. Habitus photo, lateral
436 view; B. Tarsus and pretarsus (arrows indicate a pair of longest apical setae); C. Head, dorsal view;
437 D. Photo of genitalia, lateral view. Scale bar: 1.0 mm (A, C, D); 0.5 mm (B).

438 Fig. 2. Wing venation of *Mesypochrysa coadnata* sp. nov., holotype NIGP200019, female. A.
439 Drawing of left forewing; B. Drawing of left hind wing; C. Drawing of right forewing. Scale bar:
440 1.0 mm.

441 Fig. 3. *Mesypochrysa coadnata* sp. nov., paratype NIGP200020, female. A. Habitus photo, lateral
442 view; B. Habitus photo, lateral view; C. Photo of genitalia, lateral view; D. Drawing of genitalia,
443 lateral view. Scale bar: 1.0 mm.

444 Fig. 4. Wing venation of *Mesypochrysa coadnata* sp. nov., paratype NIGP200020, female. A.
445 Drawing of right forewing; B. Drawing of right hind wing; C. Drawing of left hind wing. Scale bar:
446 1.0 mm.

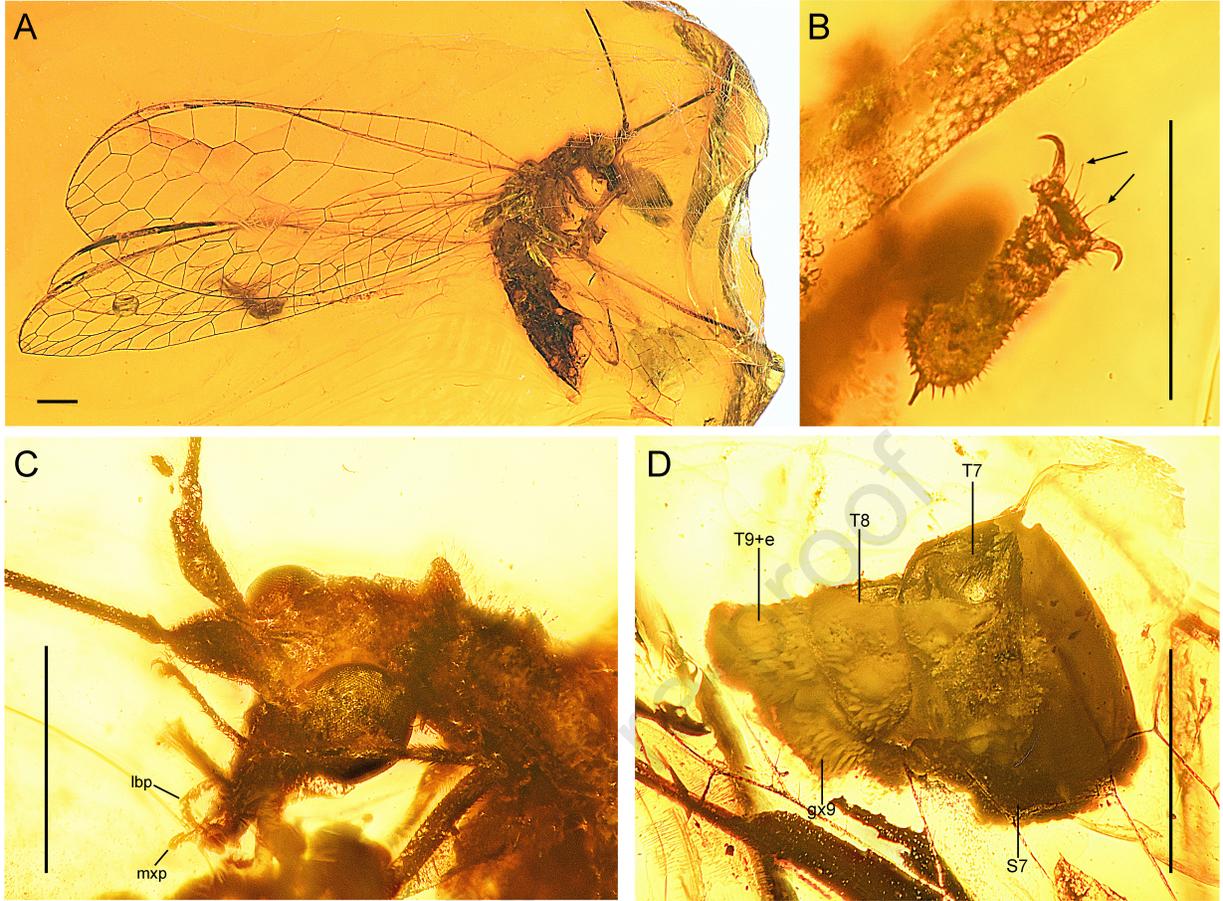
447 Fig. 5. *Mesypochrysa coadnata* sp. nov., paratype NIGP180324, female. A, Habitus photo, lateral
448 view; B, Right forewing, lateral view; C, Head, dorsal view; D, Tarsus and pretarsus; E, Photo of
449 genitalia, lateral view. Scale bars: 1.0 mm (A, B, C, E); 0.5 mm (D).

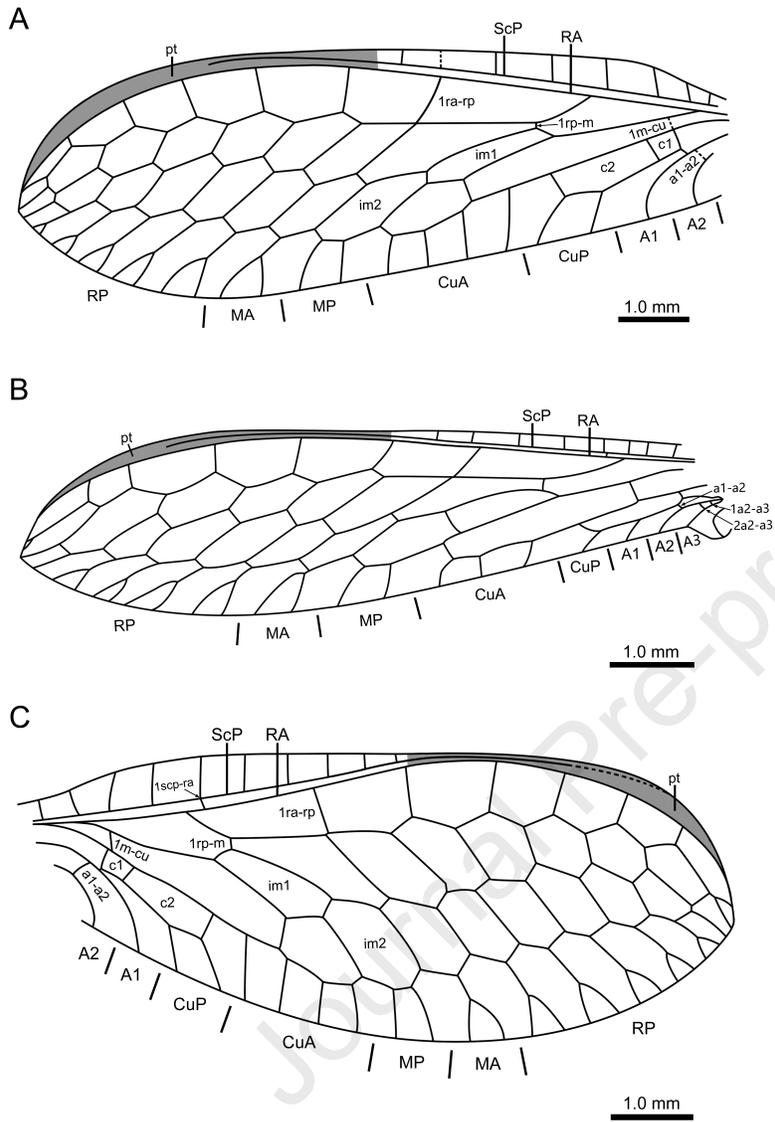
450 Fig. 6. Wing venation of *Mesypochrysa coadnata* sp. nov., paratype NIGP180324, female. A.

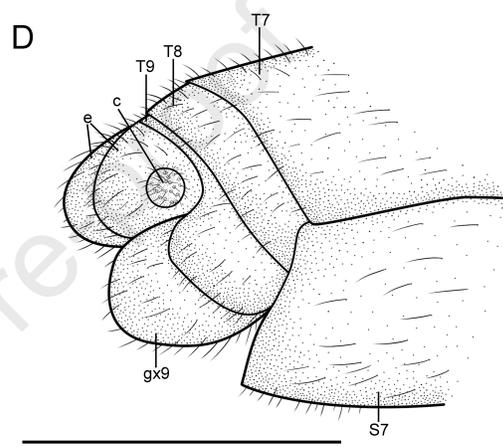
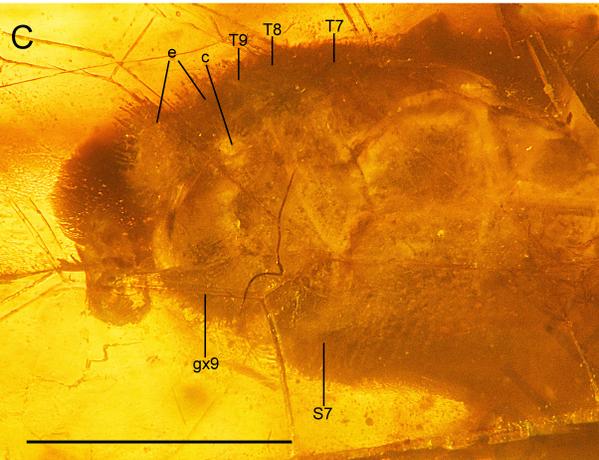
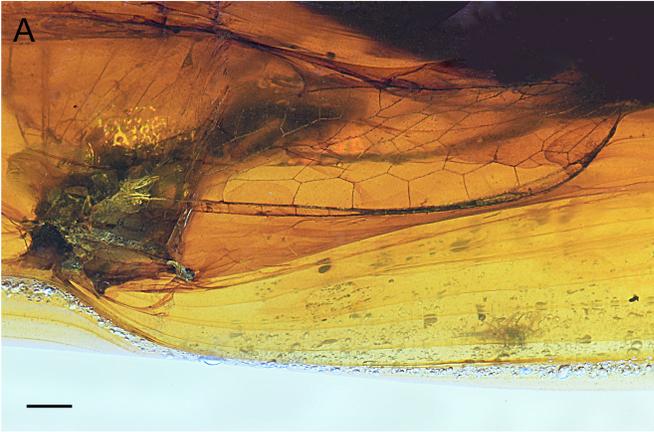
451 Drawing of right forewing; B. Drawing of right hind wing. Scale bar: 1.0 mm.

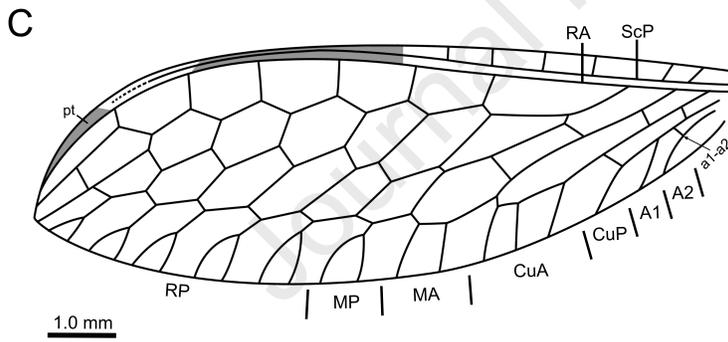
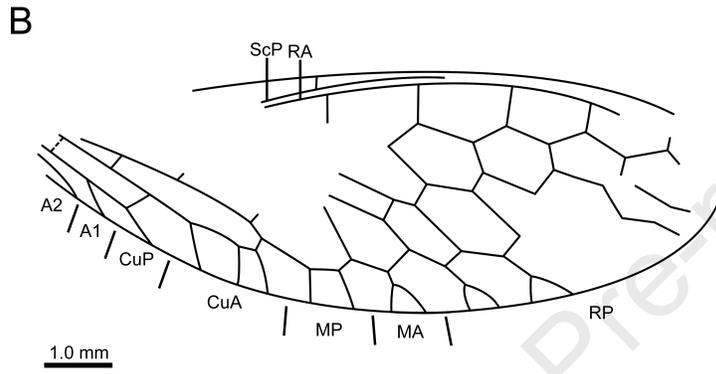
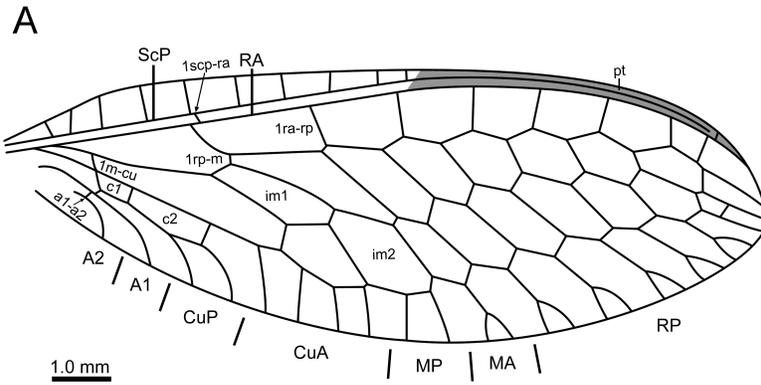
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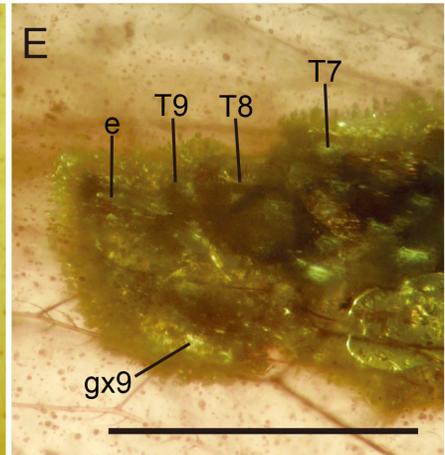
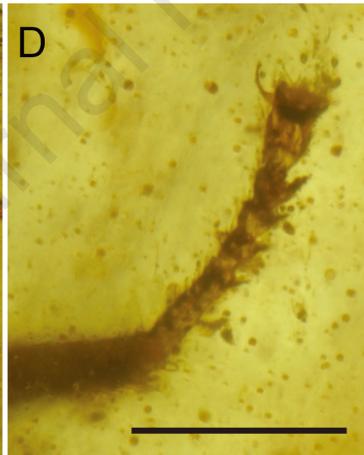
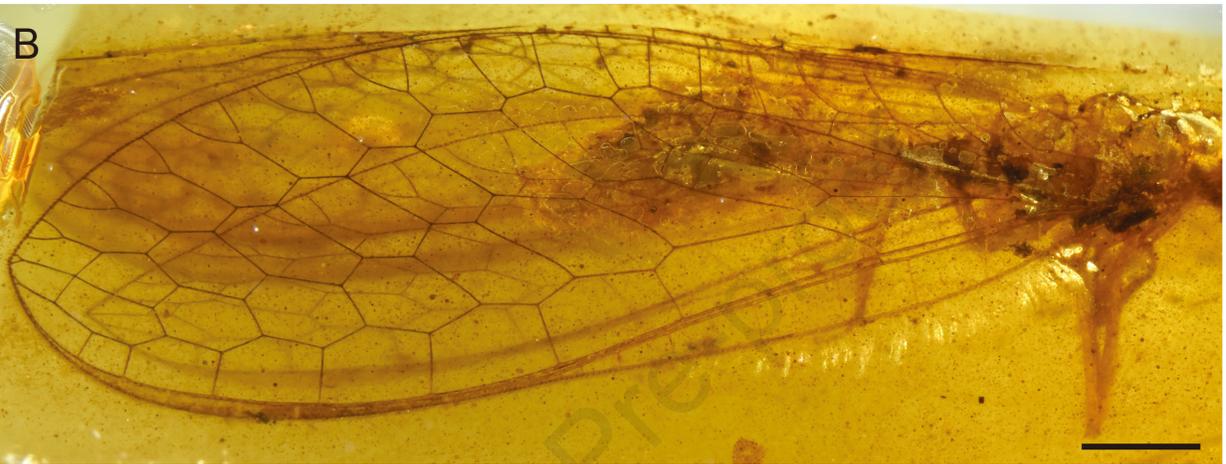
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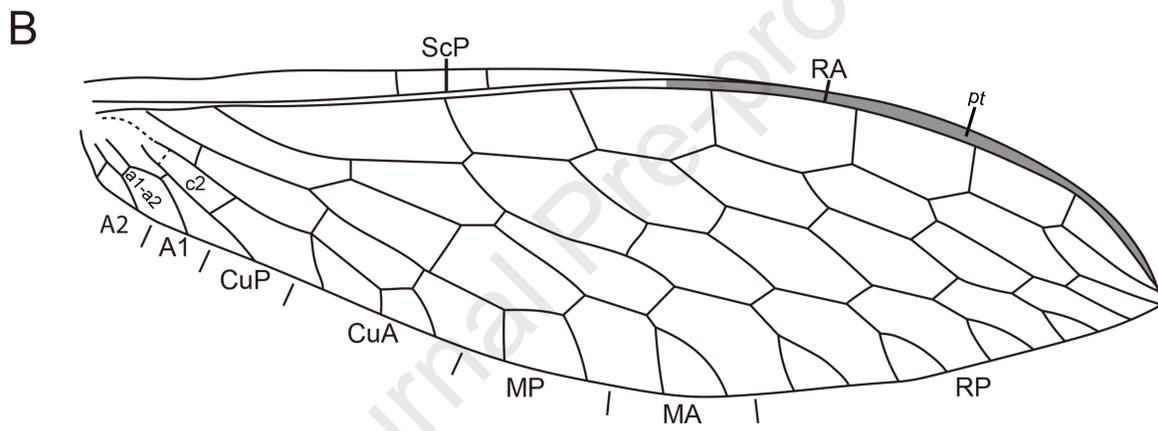
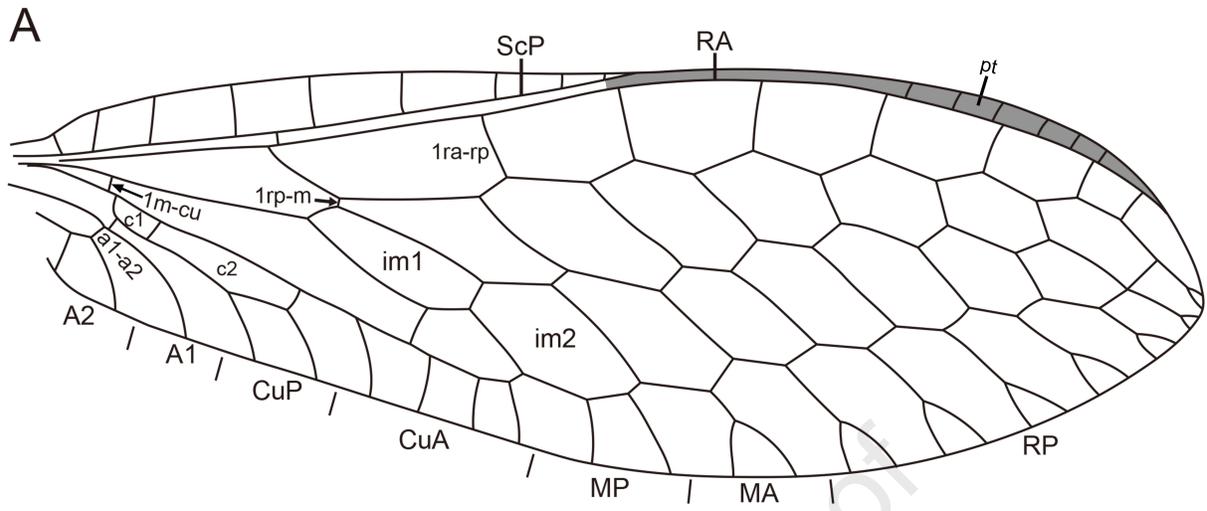












There is no potential conflict of interest reported by the authors.

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The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

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