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Redescription of *Litholingia rhora* Ren, 2002 (Neuroptera: Grammolingiidae) from the Middle Jurassic of Daohugou

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Abstract

A new specimen of the species *Litholingia rhora* Ren, 2002, from the Middle-Upper Jurassic deposit of Daohugou, is used to redescribe the species and precise its diagnosis. We also propose a series of wing venation drawings highlighting the main characteristics of the wing venation all *Litholingia* species. Finally, we summarize the current diversity of the lacewing family Grammolingiidae.

Keywords: emended diagnosis, fossil record, Grammolingiidae, new specimen, taxonomy

Introduction

Within the insect order Neuroptera (lacewings), the superfamily Psychopsoidea (silky lacewings) is sister to the Myrmeleontoidea (antlions) and has an important fossil record with a series of extinct families extending from the Triassic to the Cretaceous (Engel *et al*., 2018: fig. 2). The family Grammolingiidae Ren, 2002 is one of the oldest psychopsoid families and was created to accommodate several fossil neuropterans from the Middle Jurassic of China (Ren, 2002). If most of the recent works on this family follow its placement within the Psychopsoidea, some authors rather suggested that the family Grammolingiidae belongs to the superfamily Osmyloidea (Makarkin *et al*., 2013: fig. 7; Yang *et al*., 2013). Herein, we follow the placement of Grammolingiidae within the Psychopsoidea (Engel *et al*., 2018). Currently, the family encompasses 21 species distributed in five genera (Table 1). This clade is, most of the time, treated as a family, but some authors also proposed a subfamily rank (= Grammolingiinae) within the Panfiloviidae (Engel *et al*., 2018). However, as no phylogenetic analysis supports this placement, in the present work, we retain the family rank of the Grammolingiidae but remain aware that this status can change. The Grammolingiidae lack the vena triplica of the remaining Psychopsidae but share with other psychopsoid families a broadly constructed costal field. Here, we redescribe, using new material, one of the fossil species belonging to the Grammolingiidae, *i.e*., *Litholingia rhora* (initially described from Daohugou), whose type specimen did not permit the observation of specific parts of the wing, which is critical to separate species and define characters for future phylogenies.

Material and methods

The new specimen of *Litholingia rhora* originates from the Middle–Upper Jurassic deposit of Daohugou, Hiafanggou Formation, China. It was first treated as Bathonian–Callovian age (Chen *et al*., 2004) then the dating was refined and a Callovian–Oxfordian age was proposed (Liu *et al*., 2006, 2010) and recent works suggest a late Middle Jurassic to early Late Jurassic age (Huang *et al*., 2018; Huang, 2019; Lian *et al*., 2021). Palaeoflora suggests a subtropical, warm temperate and humid climate (Wang *et al*., 2010). The deposit was formed in the vicinity of an active volcanic area as evidenced by the presence of volcanic tuff levels resulting from periodic heavy ash

TABLE 1. Diversity of the family Grammolingiidae

Genus	Species	Distribution	Period	Locality / Formation	Reference
Chorilingia					
	Chorilingia bakharica Khramov, 2018	Mongolia	Bajocian/Bathonian	Bahar outcrop 208/4 / Togo-Khuduk Formation	Khramov and Vasilenko, 2018
	Chorilingia euryptera Shi *et al*., 2012	China	Callovian/Oxfordian	Daohugou / Haifanggou Formation	Shi *et al*., 2012
	Chorilingia parvica Shi *et al*., 2012	China	Callovian/Oxfordian	Daohugou / Haifanggou Formation	Shi *et al*., 2012
	Chorilingia peregrina Shi *et al*., 2012	China	Callovian/Oxfordian	Daohugou / Haifanggou Formation	Shi *et al*., 2012
	Chorilingia translucida Shi *et al*., 2012	China	Callovian/Oxfordian	Daohugou / Haifanggou Formation	Shi *et al*., 2012
Grammolingia					
	Grammolingia binervis Shi *et al*., 2013	China	Callovian/Oxfordian	Daohugou / Haifanggou Formation	Shi *et al*., 2013
	Grammolingia boi Ren, 2002	China	Callovian/Oxfordian	Daohugou / Haifanggou Formation	Ren, 2002
	Grammolingia sticta Shi *et al*., 2013	China	Callovian/Oxfordian	Daohugou / Haifanggou Formation	Shi *et al*., 2013
	Grammolingia uniserialis Shi *et al*., 2013	China	Callovian/Oxfordian	Daohugou / Haifanggou Formation	Shi *et al*., 2013
Leptolingia					
	Leptolingia calonervis Shi *et al*., 2011	China	Callovian/Oxfordian	Daohugou / Haifanggou Formation	Shi *et al*., 2011
	Leptolingia imminuta Liu *et al*., 2011	China	Callovian/Oxfordian	Daohugou / Haifanggou Formation	Liu *et al*., 2011
	Leptolingia jurassica Ren, 2002	China	Callovian/Oxfordian	Daohugou / Haifanggou Formation	Ren, 2002
	Leptolingia oblonga Khramov, 2012	Mongolia	Tithonian	Khoutiyn-Khotgor / Ulaan-Ereg Formation	Khramov, 2012
	Leptolingia shartegica Khramov, 2010	Mongolia	Tithonian	Shar-Teg, outcrop 443/1 / Sharteg Formation	Khramov, 2010
	Leptolingia tianyiensis Ren, 2002	China	Callovian/Oxfordian	Daohugou / Haifanggou Formation	Ren, 2002
Litholingia					
	Litholingia eumorpha Ren, 2002	China	Callovian/Oxfordian	Daohugou / Haifanggou Formation	Ren, 2002
	Litholingia longa Khramov, 2012	Kyrgyzstan	Toarcian	Sai-Sagul, Shurab III / Sagul Formation	Khramov, 2012
	Litholingia polychotoma Ren, 2002	China	Callovian/Oxfordian	Daohugou / Haifanggou Formation	Ren, 2002
	Litholingia ptesa Shi *et al*., 2011	China	Callovian/Oxfordian	Daohugou / Haifanggou Formation	Shi *et al*., 2011
	Litholingia rhora Ren, 2002	China	Callovian/Oxfordian	Daohugou / Haifanggou Formation	Ren, 2002
Protolingia					
	Protolingia mira Khramov, 2012	Kyrgyzstan	Toarcian	Sai-Sagul, Shurab III / Sagul Formation	Khramov, 2012

rain; the landscape was covered with torrents and rivers as well as deep lakes (Tan *et al*., 2006).

The specimen was examined using a Nikon SMZ25 stereomicroscope and photographed with a Nikon D800 camera. All images are digitally stacked photomicrographic composites of several individual focal planes, which were obtained using Helicon Focus. The figures and drawings were composed with Adobe Illustrator CC2019 and Photoshop CC2019 software. The specimen presented herein is housed in Nanjing Institute of Geology and Palaeontology, Chinese Academy of Science (NIGPAS), China under the accession number NIGP177501.

Wing venation nomenclature is modified from Ren (2002) with additions from Schubnel *et al.* (2019). Abbreviations are as follows: A = anal veins; CuA = cubitus anterior; CuP = cubitus posterior; MA = media anterior; MP = media posterior; PCu = post cubitus (= A1 for other authors, see detailed explanation in Schubnel *et al*., 2019); RA = radius anterior; RP = radius posterior; ScP = subcostal posterior.

Systematic palaeontology

Order Neuroptera Linnaeus, 1758
Superfamily Psychopsoidea Handlirsch, 1906
Family Grammolingiidae Ren, 2002
Genus *Litholingia* Ren, 2002

Type species. *Litholingia rhora* Ren, 2002 p. 57.

Included species. *Litholingia rhora* Ren, 2002 (type species); other species: *Litholingia eumorpha* Ren, 2002, *Litholingia longa* Khramov, 2012, *Litholingia polychotoma* Ren, 2002, *Litholingia ptesa* Shi *et al*., 2011.

***Litholinga rhora* Ren, 2002**

Revised diagnosis. Forewing with RP with branches distally forked (no branch deeply forked), with at least eight posterior branches; PCu terminated on the posterior margin beyond the second dichotomy of RP; CuA forks after the fork of CuP; CuA and CuP forked beyond the second dichotomy of RP; coloration pattern with alternating broad light and smaller dark stripes.

Material. Specimen NIGP177501, housed in the Nanjing Institute of Geology and Palaeontology, Chinese Academy of Science, China.

Locality and horizon. Middle-Upper Jurassic deposit of Daohugou, Haifanggou Formation, China.

Description. Mesothorax massive, *ca*. 3.60 mm wide (distance between forewing insertions), and 3.09 mm long; other body parts not clearly visible. Leg with numerous small setae.

Forewing 54.2 mm long and 18.1 mm wide. Forewing elongate, narrow and pubescent, the main longitudinal veins and wing margin scattered with minute trichobothria. Costal area relatively narrow, slightly wider than subcostal space, with only a series of gradate veins producing two rows of cells, a few simple crossveins near wing base. Subcostal veinlets unforked. ScP running parallel with RA. Dense crossveins present between ScP and RA. RP arising close to the base of the wings, with at least eight branches (some indistinct distally). First branch of RP arising at 0.13 of wing length, no branch of RP deeply forked, second dichotomy of RP located at midlength from first and third dichotomy, anterior to CuA fork and nearly aligned with CuP fork, nearly all branches of RP forked distally. Stem of M short with M fork slightly distal to first RP dichotomy, MA forked far distal from MP fork, MA branches forked near wing margin, with six apical branches. MP forking just after third dichotomy of RP and far from CuA from, with numerous branches forked near wing margin. CuA field larger than MP field forking after second dichotomy of RP and after CuP fork, with numerous branches forked near wing margin. CuP field smaller than CuA field, with five apical branches, CuP finishing near distal part of basal wing third. PCu long and pectinate, terminating slightly distal second dichotomy of RP. Wing base with two or three rows of cells distinctly present between A1 and A2. A2 short, abruptly bent toward wing margin. Dense cross venation between veins over entire wing. Trichosors clearly present

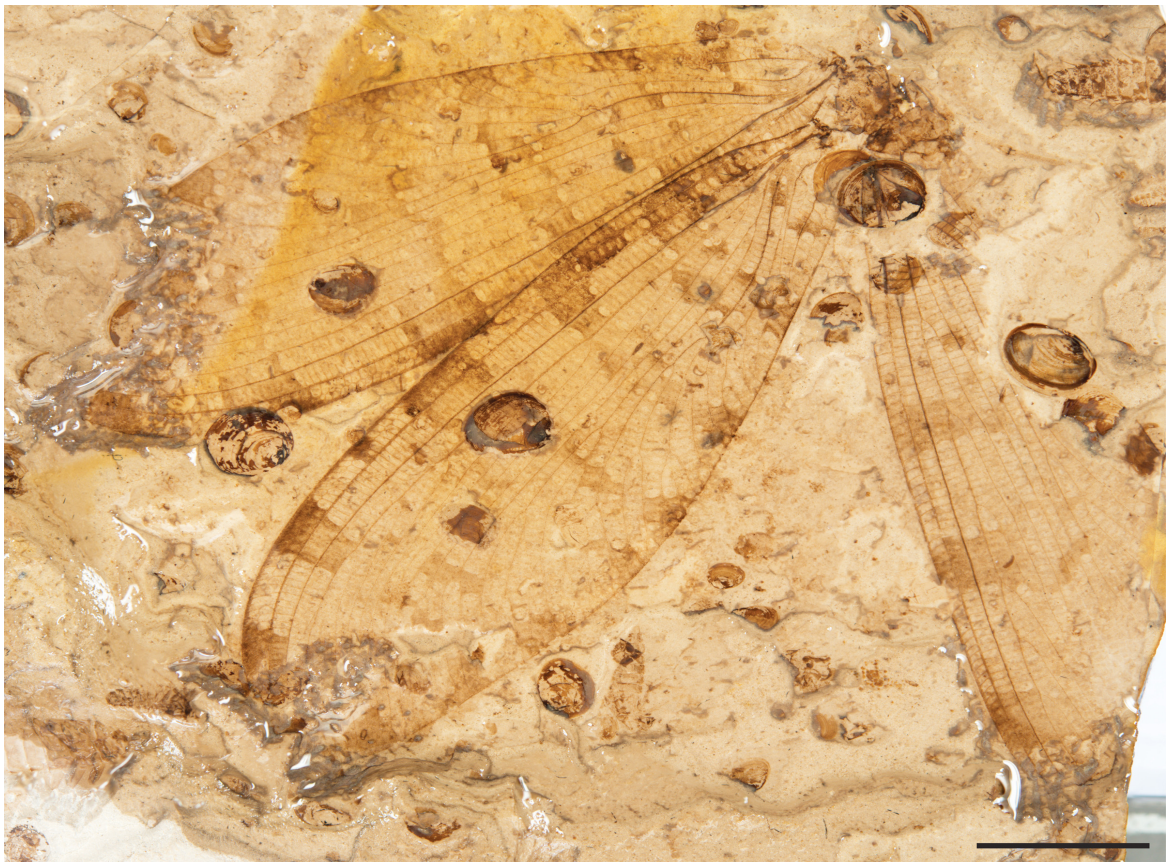

FIGURE 1. *Litholingia rhora* Ren, 2002 Specimen NIGP177501. Habitus. Scale bar = 10 mm.

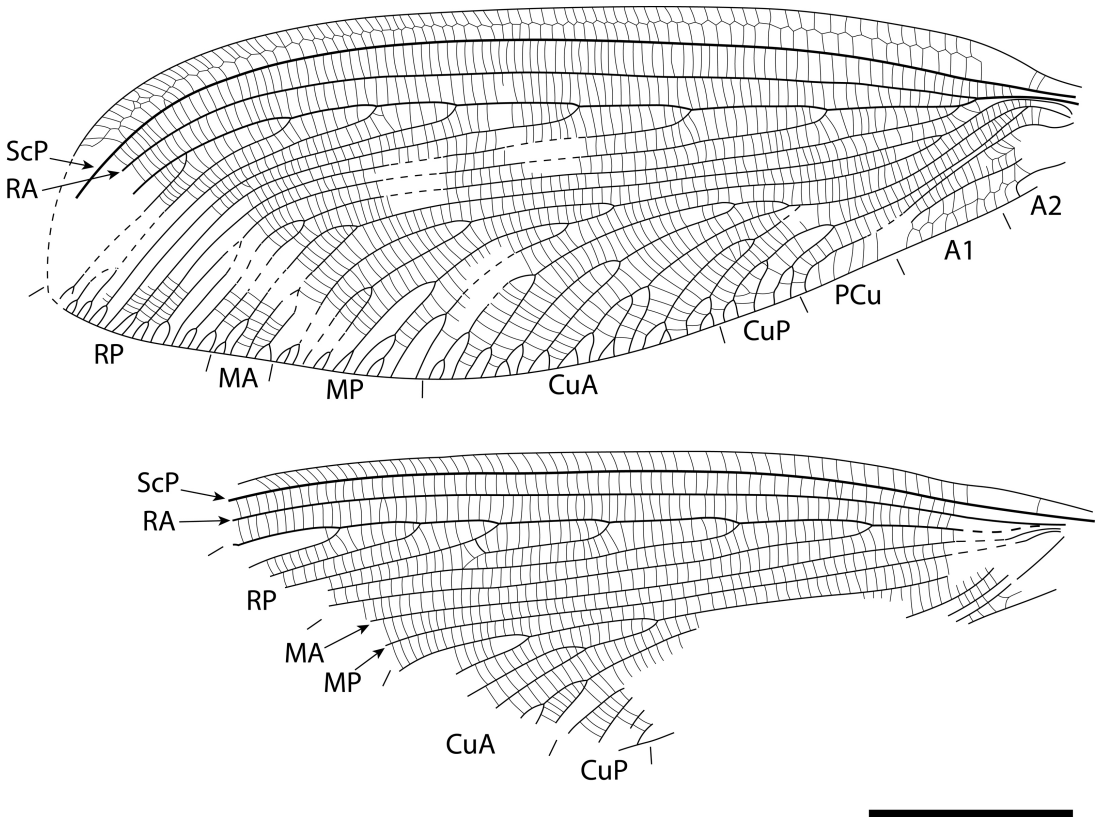

FIGURE 2. *Litholingia rhora* Ren, 2002 Specimen NIGP177501. Interpretative line drawing of fore- and hind wing venations with names of veins labelled, dotted lines represent hypothetical trajectory of veins not preserved (trichosors and coloration pattern omitted). Scale bar = 10 mm.

along wing margin with several of them between each vein along the margin of the wing. Coloration pattern visible with alternating light and dark stripes, light ones (5–6) broader than dark ones, several additional white spots visible on sides of black bands between veins.

Hind wing with a vein configuration similar to forewing, except for costal field with only one row of cells.

Identification key to *Litholingia* species

1. CuP heavily branched (with five branches reaching wing margin), wings coloration pattern with thin dark stripes and broad white stripes.....*Litholingia rhora*
- CuP pectinate or branched, if branched with less than five branches reaching wing margin, wings coloration pattern with broad dark stripes and thin white stripes.....2
2. CuP pectinate.....*Litholingia longa*
- CuP with a variable number of branches but never pectinate.....3
3. Fourth branch of RP deeply forked, three branches of CuA originating at its fork.....*Litholingia polychotoma*
- Fourth branch of RP forked far distad its origin, two branches of CuA originating at its fork.....4
4. Third branch of RP deeply forked, CuP likely with less than four branches, RP with seven branches.....*Litholingia ptesa*
- Third branch of RP forked far distad its origin, CuP with four branches, RP with at least nine branches..... *Litholingia eumorpha*

Discussion

In the Grammolingiidae, the new specimen cannot be attributed to the genus *Chorilingia* owing to its second dichotomy of RP (= most proximal branch of Rs in Shi *et al*., 2012) not separating far from the first RP dichotomy (*vs*. separating far from the first RP dichotomy in *Chorilingia*). Additionally, the second dichotomy of RP is not distad the fork of CuA nor the fork of CuP while it is in *Chorilingia* (Shi *et al*., 2012: 2). Following the key to Grammolingiidae Ren, 2002 initially proposed by Ren (2002), the new specimen cannot be placed in the genus *Leptolingia* because it possesses a forewing with 1A terminated on the posterior margin before the separation of the first branch of Rs from Rs [Here 1A is PCu and the first Rs branch corresponds to the second dichotomy of RP since Ren (2002) considered the first RP dichotomy as MA]. Similarly, the new specimen cannot be attributed to the genus *Grammolingia* because CuA forks after CuP while CuA normally forks before CuP in *Grammolingia* (Ren, 2002). Khramov (2012: 298) proposed the following diagnosis for the genus *Protolingia* "Sc and R1 are fused in the distal part of wing and run by common stem to the wing margin". The condition of ScP and RA in the distal part of the wing is unknown in the new specimen but the different configuration of the costal field is sufficient to prevent attribution of the new specimen to the genus

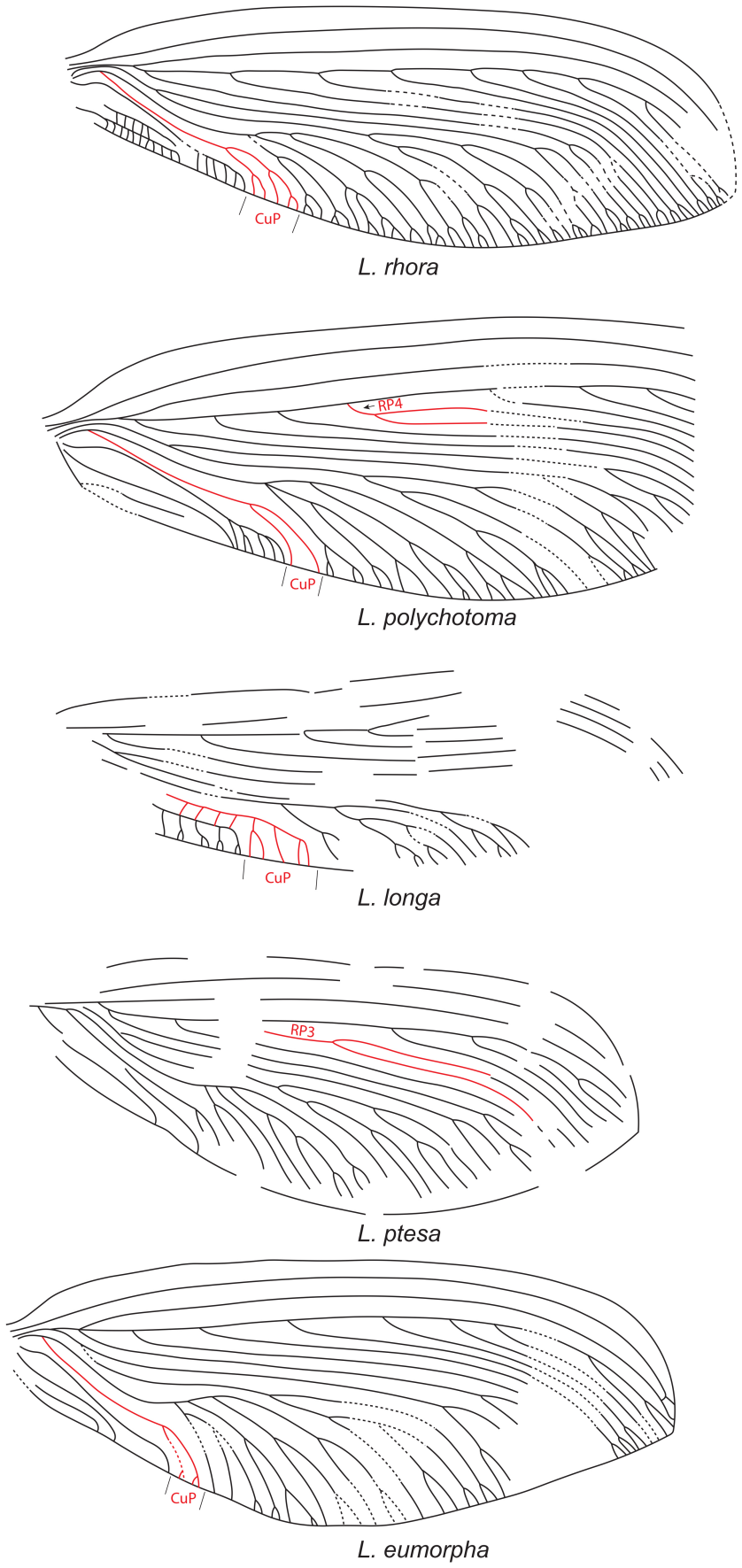

FIGURE 3. Wing venation patterns of *Litholingia* species with diagnostic vein characters highlighted in red and labelled (modified from Ren, 2002; Shi *et al*., 2011; Khramov, 2012).

Protolingia. However, due to the poor preservation of the holotype of *Protolingia* it is important to consider the genus with prudence. The genus *Litholingia* is defined using the following characters (Ren, 2002): Forewing PCu terminated on the posterior margin beyond the separation of the second branch of RP from RP; CuA forks after the fork of CuP; CuA and CuP forked beyond the second dichotomy RP [Note that PCu corresponds to A1, and RP to Rs in Ren (2002)]. All these characters are present in the new specimen; therefore, we place it in the genus *Litholingia*. To date, there are only five species included in the genus *Litholingia*: *L. eumorpha*, *L. longa*, *L. polychotoma*, *L. ptesa*, *L. rhora* (Ren, 2002; Shi *et al*., 2011; Khramov, 2012). *Litholinga longa* is difficult to compare with the new specimen due to the poor preservation of the type material (Khramov, 2012: figs 4, 5). In the original description, it is mentioned that "*L. longa* differs from other four species of *Litholingia* by the pectinate CuP" (Khramov, 2012: 302). The new specimen does not possess a similar configuration of the CuP preventing its attribution to the species *L. longa*. The new specimen can be rapidly separated from *L. ptesa* owing to its coloration pattern with small dark stripes or spots while *L. ptesa* possesses several broad black stripes on the forewings (Shi *et al*., 2011: fig. 4b). Additionally, it differs from *L. ptesa* in lacking a third RP branch forked near its base (*vs*. forked near it base in *L. ptesa*; Shi *et al*., 2011: fig. 4a). Since no branch of RP is forked near its base (= deeply), affinity with *L. polychotoma* is refuted, the latter having the fourth branch of RP deeply forked (Ren, 2002: figs 10, 11). *L. eumorpha* has a relatively simple CuP (*i.e*., with a reduced number of branches; Ren, 2002: figs 8, 9) while the new specimen possesses a CuP with five branches (*i.e*., heavily branched), and a coloration pattern of wings with large dark stripes (Ren, 2002: figs 8, 9) while the new specimen shows a relatively reduced coloration pattern with large white area. Therefore, it is clear the new specimen does not belong to the species *L. eumorpha*. The type species of the genus *Litholingia* (*L. rhora*) possess a similar wing venation with a CuP heavily branched and a distinctive coloration pattern nearly identical to that of the new specimen (Ren, 2002: figs 4–6). Since no character is found to separate the new specimen from *L. rhora*, we attribute it to this species.

The new specimen described in this publication is helpful to document the branching pattern of MA and MP (see description part), which was not preserved in the holotype of the species. It also increases the number of occurrences of the species, these occurrences being essential for macroevolution analyses.

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References

Chen, W., Ji, Q., Liu, D.Y., Zhang, Y., Song, B. & Liu, X.Y. (2004) Isotope geochronology of the fossil-bearing beds in the Daohugou area, Ningcheng, Inner Mongolia. *Regional Geology of China*, 23, 1165–1169.

Engel, M.S., Winterton, S.H. & Breitkreuz, L.C.V. (2018) Phylogeny and evolution of Neuropterida: Where have wings of lace taken us? *Annual Review of Entomology*, 63, 531–551. https://doi.org/10.1146/annurev-ento-020117-043127

Huang, D.Y. (2019) Jurassic integrative stratigraphy and timescale of China. *Science China Earth Sciences*, 62, 223–255. https://doi.org/10.1007/s11430-017-9268-7

Huang, D.Y., Cai, C.Y., Fu, Y.Z. & Su, Y.T. (2018) The Middle-Late Jurassic Yanliao entomofauna. *Palaeoentomology*, 1 (1), 3–31. https://doi.org/10.11646/palaeoentomology.1.1.2

Khramov, A.V. (2010) A new lacewing (Insecta: Neuroptera: Grammolingiidae) from the Upper Jurassic of Mongolia. *Paleontological Journal*, 44, 188–181. https://doi.org/10.1134/S0031030110020103

Khramov, A.V. (2012) The new fossil lacewings of Grammolingiidae (Neuroptera) from the Jurassic of Central Asia and Mongolia, with notes on biogeography of the family. *Zootaxa*, 3478 (1), 297–308. https://doi.org/10.11646/zootaxa.3478.1.28

Khramov, A.V. & Vasilenko, D.V. (2018) New records of Grammolingiidae, Saucrosmylidae, and Panfiloviidae (Insecta: Neuroptera) from the Jurassic of Mongolia and Kyrgyzstan. *Paleontological Journal*, 52, 1391–1400. https://doi.org/10.1134/S0031030118120109

Lian, X.N., Cai, C.Y. & Huang, D.Y. (2021) The early assemblage of Middle–Late Jurassic Yanliao biota: checklist, bibliography and statistical analysis of described taxa from the Daohugou beds and coeval deposits. *Palaeoentomology*, 4 (2), 95–136. https://doi.org/10.11646/palaeoentomology.4.2.1

Liu, Y.X., Liu, Y.Q. & Zhang, H. (2010) LA-ICPMS Zircon U-Pb dating in the Jurassic Daohugou beds and correlative strata in Ningcheng of Inner Mongolia. *Acta Geologica Sinica*, 80, 733–742. https://doi.org/10.1111/j.1755-6724.2006.tb00296.x

Liu, Y.Q., Liu, Y.X., Ji, S.A. & Yang, Z.Q. (2006) U-Pb Zircon age for the Daohugou biota at Ningcheng of Inner Mongolia and comments on related issues. *Chinese Science Bulletin*, 51, 2634–2644. https://doi.org/10.1007/s11434-006-2165-2

Liu, Y.S., Shi, C.F. & Ren, D. (2011) A new lacewing (Insecta: Neuroptera: Grammolingiidae) from the Middle Jurassic of

Inner Mongolia, China. *Zootaxa*, 2897 (1), 51–56. https://doi.org/10.11646/zootaxa.2897.1.5

Makarkin, V.N., Yang, Q., Shi, C. & Dong, R. (2013) The presence of the recurrent veinlet in the Middle Jurassic Nymphidae (Neuroptera): a unique character condition in Myrmeleontoidea. *ZooKeys*, 325, 1–20. https://doi.org/10.3897/zookeys.325.5453

Ren, D. (2002) A new lacewing family (Neuroptera) from the Middle Jurassic of Inner Mongolia, China. *Insect Science*, 9, 53–67. https://doi.org/10.1111/j.1744-7917.2002.tb00172.x

Schubnel, T., Desutter-Grandcolas, L., Legendre, F., Prokop, J., Mazurier, A., Garrouste, R., Grandcolas, P. & Nel, A. (2019) To be or not to be: postcubital vein in insects revealed by microtomography. *Systematic Entomology*, 45, 327–336. https://doi.org/10.1111/syen.12399

Shi, C.F., Wang, Y.J., Yang, Q. & Ren, D. (2012) *Chorilingia* (Neuroptera: Grammolingiidae): A new genus of lacewings with four species from the Middle Jurassic of Inner Mongolia, China. *Alcheringa*, 36, 309–318. https://doi.org/10.1080/03115518.2012.644994

Shi, C.F., Wang, Y.J. & Ren, D. (2013) New species of *Grammolingia* Ren, 2002 from the Middle Jurassic of Inner Mongolia, China (Neuroptera: Grammolingiidae). *Fossil Record*, 16, 171–178. https://doi.org/10.1002/mmng.201300008

Shi, C.F., Yang, Q. & Ren, D. (2011) Two new fossil lacewing species from the Middle Jurassic of Inner Mongolia, China (Neuroptera: Grammolingiidae). *Acta Geologica Sinica*, 85, 482–489. https://doi.org/10.1111/j.1755-6724.2011.00416.x

Tan, J.J., Ren, D. & Shih, C.K. (2006) New cupedids from the Middle Jurassic of Inner Mongolia, China (Coleoptera: Archostemata). *Annales Zoologici*, 56, 1–6.

Wang, Y., Saiki, K., Zhang, W. & Zheng, S. (2010) Biodiversity and palaeoclimate of the Middle Jurassic floras from the Tiaojishan Formation in western Liaoning. *Progress in Natural Science*, 16, 222–230.

Yang, Q., Makarkin, V.N. & Ren, D. (2013) A new genus of the family Panfiloviidae (Insecta, Neuroptera) from the Middle Jurassic of China. *Palaeontology*, 56, 49–59. https://doi.org/10.1111/j.1475-4983.2012.01157.x