A new genus of kalligrammatid lacewings from the Middle Jurassic of China (Neuroptera: Kalligrammatidae)

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With 2 Figures

Abstract

*Kallihemerobius pleioneurus* n. g. n. sp. is described and illustrated from the Jurassic Jiulongshan Formation of eastern Inner Mongolia, China. *Kallihemerobius* is noteworthy for the pectinate anterior radial trace of its forewing. Although this trait is generally regarded as characteristic of the neuropteran family Hemerobiidae, the new genus is assigned to the family Kalligrammatidae on the basis of other forewing traits.

Introduction

The family Kalligrammatidae comprises a group of rather large neuropterans currently described only from Jurassic-age compression fossils. To date, eight genera (*Angarogramma* Ponomarenko; *Kalligramma* Walther; *Kalligrammina* Ponomarenko; *Kalligrammula* Handlirsch; *Lithogramma* Ponomarenko; *Meioneurites* Handlirsch; *Palparites* Handlirsch; *Sophogramma* Ren & Guo) and 18 species have been described from a variety of sites in Europe [Germany] and Asia [Kazakhstan, Mongolia, Russia, China] (Carpenter 1992; Handlirsch 1906–08, 1919; Lambkin 1994; Martynova 1947, 1962; Ponomarenko 1968, 1980; Ponomarenko 1984, 1992; Ren & Guo 1996; Walther 2004). An undescribed
Fig. 1. *Kallihemerobius pleioneurus* n. g. n. sp., holotype (NGMC no. NN99010), photograph. Same scale as Fig. 2.
Fig. 2. *Kallihemerobius pleioneurus* n. g., n. sp., holotype (NGMC no. NN99010), line drawing (the absence of crossveins in the subcostal and radial spaces directly below the “pterostigmal” region is due to occluding debris and is artifactual). Scale 5 mm.
kalligrammatid-like specimen has also recently been figured by Bechly (1998: 98) and Bechly et al. (2001: 53, fig. 43) from the Lower Cretaceous of Brazil. If confirmed as a kalligrammatid this specimen would significantly extend both the geographic and temporal ranges of the family. No kalligrammatids are currently known from North America, Africa or Australia.

The present paper describes and discusses a distinctive new kalligrammatid species from the Middle Jurassic Jiulongshan Formation, a lacustrine sedimentary sequence with outcrops in northeastern China (Ren et al. 1995). The paleoenvironment reconstructed for this formation is that of a volcanic region cut by mountain streams (Ren & Lu 1996). Jiulongshan strata have yielded a diverse arthropod fauna that includes insects belonging to the orders Ephemeroptera, Odonata, Plecoptera, Blattodea, Orthoptera, Heteroptera, Homoptera, Neuroptera, Mecoptera, Hymenoptera and Diptera (Hong 1983; Ren 1993, 1996) and freshwater conchostracans (Zhang & Shen 1987). These fossils, and other data, have been used to estimate the age of the Jiulongshan Formation as Late Aalenian or Early Bajocian, early Middle Jurassic (Wang 2000). The lacewing fossil described below was collected by one of the authors (D. Ren) from a section of the Jiulongshan Formation composed of gray tuffaceous sandstone and sandy mudstone that is exposed in the village of Daohugou, Inner Mongolia, China.

**Material and Methods**

**Material:** This study is based on a single specimen contained in the collection of the National Geological Museum of China (NGMC).

**Illustrations:** The line drawing was prepared with the aid of a camera lucida attached to a Wild M5 dissecting microscope.

**Terminology:** Venational terminology follows Oswald (1993a).

**Systematic paleontology**

**Order Neuroptera Linnaeus, 1758**

**Family Kalligrammatidae Handlirsch, 1906**

**Genus Kallihemerobius n. g.**

**Type species:** Kallihemerobius pleioneurus n. sp.

**Derivation of name:** Kalli- (from Greek kallos, beauty) + -hemerobius (from Hemerobius, type genus of the neuropteran family Hemerobiidae); gender: masculine.

**Included species:** (1) Kallihemerobius pleioneurus n. sp.: Middle Jurassic Jiulongshan Formation of Inner Mongolia, China.

**Diagnosis.** – Kallihemerobius can be distinguished by the pectinately branched anterior radial trace of the forewing, a trait not known in any other taxon currently assigned to the family Kalligramatidae.

**Description.** – As for Kallihemerobius pleioneurus n. sp. (see below).

**Kallihemerobius pleioneurus n. sp.**

**Figs 1–2**

**Holotype:** a nearly complete left forewing (forewing inferred from broad costal area) exposed in dorsal view, parts of apical and cubitoanal margins missing or obscured. Sex unknown. NGMC no. NN99010.
Type locality: China, Inner Mongolia, Ningcheng county, Shantou township, Daohugou village.
Type horizon: Jiulongshan Formation, early Middle Jurassic (late Aalenian – early Bajocian stages).
Derivation of name: pleio- (from Greek pleion, more) + -neurus (from Gr. neuron, nerve), in reference to the dense crossvenation of the holotype.

Diagnosis. – As for Kallihemerobius n. g. (see above).

Description. – Forewing (Figs. 1–2): shape obovate, margin apparently continuously convex, though some marginal regions missing (apex) or obscured (cubitoanal margin); length ca. 50 mm, maximum width ca. 29 mm; crossveins very numerous and dense over most of wing, but largely absent adjacent to wing margin; nygmata not discernable; a conspicuous dark oval macula with an internal ring of six small pale spots present in center of wing disc; trichosors present, distinct along margin of MP space (probably more generally distributed around at least distal parts of wing margin, but undetectable due to poor preservation of much of this margin); costal space very wide (in basal half of wing >4 times width of subcostal space), with numerous forked subcostal veinlets, many of which are linked by multiple crossveins; differentiated pterostigmal region apparently absent; humeral area of costal space poorly preserved, presence or absence of recurrent humeral veinlet unclear; subcostal space densely crossvenate; R1 fused with Sc distally; Sc+R1 probably terminating on margin near wing apex (exact position uncertain because wing apex is lacking); Rs almost completely incorporated into R1, resulting in a condition in which anterior radial trace is linear and pectinately branched on posterior side (similar to the condition found in many hemerobiids); anterior radial trace with 10 oblique branches proximal to its fusion with Sc; basalmost branch of anterior radial trace (interpreted here as MA) a short arched vein fused distally with stem of second branch of anterior radial trace (see Discussion below), the latter branched near middle of wing and possibly marking divergence of MA from R; posterior MP trace linear and pectinately branched on anterior side, with six primary, mostly long-stemmed MP branches occupying a broad area of posterior remigium; anterior CuA trace linear, simple at base, pectinate on posterior side more distally, paralleling posterior MP trace nearly to wing margin; CuP dichotomously branched; 1A and 2A long and dichotomously branched; 3A obscure.

Discussion

Based on the intraspecific variation frequently observed in the venation of extant neuropterans, we suspect that the short, arched condition of the vein interpreted here as the base of the MA represents individual variation in the holotype of K. pleioneurus. The “normal” MA state for this species would probably be a condition in which it was not fused with the basal branch of the anterior radial trace.

The most striking venational trait of Kallihemerobius is its pectinately branched anterior radial trace. Pectinate branches such as these are often referred to descriptively in the Neuroptera as multiple “radial sectors”. This condition is unknown in other kalligrammatids, and only rarely encountered in other neuropteran groups – most notably in the family Hemerobiidae, where it is almost universal (Osvald 1993a). Close examination of the holotype reveals no evidence that this condition in
K. pleioneurus is a preservational artifact. It appears, rather, to represent a true reassociation of the branches of the typically pectinate neuropteran Rs with the anterior radial trace.

The presence of this condition in K. pleioneurus suggests a possible phylogenetic association with the family Hemerobiidae. Although such an association cannot be entirely ruled out, it seems unlikely. Recent phylogenetic work on extant hemerobiids by Oswald (1993a, 1993b, 1994) supports the hypothesis that high “Rs” numbers are derived within this family, with multiple lineages independently trending toward the development of higher “Rs” numbers. If Kallihemerobius was a hemerobiid, its high “Rs” number (10) would place it in a very derived position within the Hemerobiidae – a situation that is difficult to reconcile with its numerous apparent similarities with the family Kalligrammatidae (see below). Unfortunately, other putative synapomorphies of the basal lineages of extant hemerobiids are not useful for interpreting the phylogenetic affinities of Kallihemerobius because none pertain to features of the forewing.

We here place Kallihemerobius in the Kalligrammatidae based on the following suite of characters (primarily from Martyanova [1962] and Carpenter [1992]), which it shares with most other kalligrammatid genera: (1) posterior MP trace pectinate on anterior side, (2) crossveins extremely numerous and dense over entire wing except for immediately adjacent to wing margins, (3) at least one prominent macula or eye-spot present on the remigium, typically located near the center of the wing, (4) MA branched in distal portion of wing only, i.e., with a long simple stem, (5) Sc and R1 fused distally, (6) costal area broad, (7) wing size large. This assignment, however, must be regarded as tentative because synapomorphies rigorously demonstrating the monophyly of the Kalligrammatidae have yet to be identified.

In assigning Kallihemerobius to the Kalligrammatidae, we interpret its strongly pectinate anterior radial trace to be a convergent similarity with the Hemerobiidae. Unlike the situation in the Hemerobiidae, however, no kalligrammatid taxa are presently known that exhibit “Rs” counts intermediate between the high number seen in Kallihemerobius and the single Rs present in other known kalligrammatid genera. It will be interesting to see if future kalligrammatid discoveries bridge this character state gap.

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