

Matrona annina sp. n. from southern China (Odonata, Calopterygidae)

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Matrona annina sp. n. from Guangdong and Guangxi (China) is described and illustrated for both sexes. The new species differs from its sympatric congener *M. basilaris* Selys, 1853 by its brown wings, reduced bluish-white reticulation at wing base and in details of the structure of the superior anal appendages. An NJ-tree derived from the ITS region (ITS1, 5.8S gene, and ITS2) of *M. annina* and *M. basilaris* specimens, collected from the same stream, is presented. A mean of 3.4% difference in the ITS sequences was found between the two species.

Keywords: Odonata, Calopterygidae, *Matrona*, new species, China.

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Introduction

The genus *Matrona* Selys, 1853 has proven to be much more speciose than earlier thought. As recently as 12 years ago only one species was recognized, *M. basilaris* Selys, 1853 with two additional subspecies *nigripictus* Selys, 1879 and *japonica* Förster, 1897.

Clear differences in the density of wing reticulation and wing colour pattern suggest that *M. nigripictus* is best treated as a distinct species, rather than subspecies of *M. basilaris* (Hämäläinen 2004, Hämäläinen et al. 2011). The Taiwanese *Matrona* form, which formerly was simply called *Matrona basilaris* ssp. (e.g. Lieftinck et al. 1984, Wang 2000) was named as a distinct species, *M. cyanoptera*, by Hämäläinen & Yeh (2000). The specific status of both *M. nigripictus* and *M. cyanoptera* is well supported also by the molecular phylogeny of these insects (Dumont et al. 2007; Guan et al. 2012). The other insular taxon, *M. japonica* from the Ryukyu archipelago, has also been provisionally raised to species status by Hämäläinen et al. (2011), with further studies on its status and variability under way

(R. Futahashi, A. Sasamoto & M. Hämäläinen, *in litt.*). There are still many open questions as regards geographical variability and its taxonomic consequences in both *M. nigripictus* and *M. basilaris* (s.str.) within their range on the Asian mainland; also the status of the Hainan populations of *M. basilaris* should be studied (Guan et al. 2012).

Recently, three new continental *Matrona* species have been described: *M. oreades* Hämäläinen, Yu & Zhang, 2011 and *M. corephaea* Hämäläinen, Yu & Zhang, 2011 from China and *M. taoi* Phan & Hämäläinen, 2011 from northern Vietnam. *M. oreades*, a rare species, is restricted to the western part of central China (Sichuan, Hubei, southern Gansu). *M. corephaea* seems to have a wide range in southern and central China (Guizhou, Hunan, Hubei, Henan, Zhejiang); it was found by Guan Zhaoying from Hunan in Zhangjiajie National Forest Park on 1–5 September 2011 and by Zhang Haomiao from Hubei in Shennongjia National Reserve in July–September 2012. All three species are sympatric with the widespread *M. basilaris*, and can be seen in the same streams. All have rather pale, brownish

wings without any 'milky' coloration at wing base. Therefore even in the field the males are easy to separate from *M. basilaris*. The wing reticulation is distinctly sparser than in *M. basilaris*. Although so far molecular data are lacking, it is expected that these three species will be shown to be related to each other, forming a distinct species group, the *M. oreades*-group (Hämäläinen et al. 2011, Phan & Hämäläinen 2011).

Recently and rather surprisingly, yet another *Matrona* form (Fig. 1) was found from a few lowland streams in Guangdong. Superficially this damselfly resembles *M. basilaris* (Fig. 2), which also occurs in the same streams. However, in the new form the wings of males are brown even in mature specimens (as opposed to opaque black in *M. basilaris*) and the whitish reticulation at wing base is duller and less extensive. Females differ from *M. basilaris* by their paler brown coloration. There are also small differences in the structure of the male appendages. These specimens are described here as a new species.

Material and methods

Molecular analysis. One pair of *M. annina* collected from the type locality (Shimentai Nature Reserve) and one pair of *M. basilaris* from the same stream were preserved in 70% ethanol for molecular studies, which were carried out by Ms Guan Zhaoying from the Institute of Hydrobiology, Jinan University, Guangzhou. DNA was extracted from isolated pieces of thoracic muscle. DNA extraction, PCR amplification, and sequencing used methods identical to Dumont et al. (2007). For sequence alignments, the program MAFFT (Katoh et al. 2009) was used, with alignment option G-INS-I, which assumes that the entire region under study can be aligned, and to which the Needleman–Wunsch algorithm applies. Phylogenetic analysis and tree construction were carried out using Neighbour-Joining in PAUP 4.0b 10 (Swofford 2003).

Matrona annina sp. n.

Figs 1, 3–8, 12

Type material. Holotype ♂: **China**, Guangdong Province, Qingyuan City, Yingde County, Shimentai Nature Reserve, alt. ca 180 m, 27.viii.2011, Zhang Haomiao leg. Deposited at RMNH (Leiden, the Netherlands). **Paratypes** (all Zhang Haomiao leg.): 7 ♂, 5 ♀, [1 ♂, 1 ♀ preserved in ethanol], same locality and date as holotype; 1 ♀, China, Guangdong Province, Shaoguan City, Wengyuan County, Wengcheng Village, Hengshishui River, Fupiqiao, 13.x.2008; 4 ♂, 2 ♀, China, Guangdong Province,



Fig. 1. Male of *Matrona annina*. Photographed at the site of the holotype on 27 August 2011. Photo by Wu Hongdao.



Fig. 2. Male of *Matrona basilaris*. Photographed at Chebaling Biosphere Reserve (Shixing County, Shaoguan City, Guangdong) on 3 October 2008. Photo by Mo Shanlian.

Shaoguan City, Wengyuan County, Shangba Village, Hengshishui River, 15–18.x.2009; 1 ♂, as before, 16.x.2010; 4 ♂, as before, 29.x.2010.

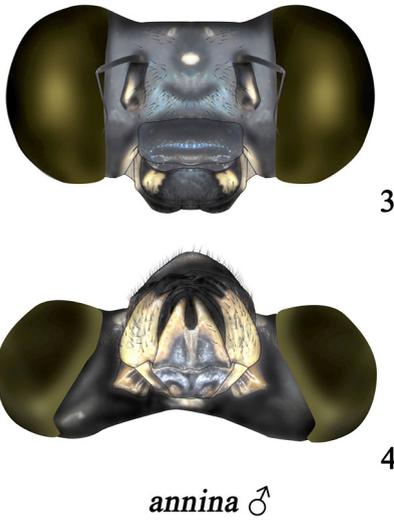
Non type specimens. 1 ♂, China, Guangxi province, Gongcheng, Dawangshan, 2–4.vi.2004, local collector leg. (In collection of Haruki Karube, Kanagawa Prefectural Museum, Odawara, Japan.)

Etymology

The specific epithet *annina* is a noun in apposition, from 'Annina', a diminutive form of the female personal name 'Anna', which derives from the Hebrew 'Hannah'.

Description of male holotype

Head. Eyes in life brown above, pale bluish green below (cf. Fig. 1). Labium largely yellowish, basal part of middle lobe darkened, the hooks of lateral lobes dark brown (Fig. 4). Labrum dark metallic, with

*annina* ♂**Figs 3, 4.** *Matrona annina*, holotype male. – 3, frontal view of head; 4, ventral view of head.*annina* ♀**Figs 5, 6.** *Matrona annina*, wings. – 5, holotype male; 6, paratype female.

a pair of small yellowish spots. Base of mandibles mainly yellowish. Anteclypeus dark metallic green, with paler central greyish area basally. Postclypeus shining metallic green, frons and vertex metallic green with dark green reflections. Antennae with anterior surface of scape dark brown, pedicel black with

a distinct yellowish spot at base anteriorly, apical segments blackish brown (Fig. 3).

Thorax. Prothorax shining metallic green. Synthorax shining metallic green with fine pale yellowish-ochre margin to metepimeron, incomplete along metapleural suture and ventral margins of metepisternum and mesepimeron, as in Figs 1 and 7. Ventral side of synthorax pale yellow-ochre, with poststernum broadly black apically, more narrowly black basally. Legs black, with the exception of mid and hind coxa. Mid coxa yellowish behind with a narrow yellowish stripe on lateral edge. Hind coxa yellowish behind and partly yellowish laterally. Tibiae moderately bent, hind tibiae more distinctly so (cf. Fig. 7).

Wings. Wings reddish amber with bluish-white reticulation at the base (Fig. 5). Hind wing slightly darker. Main longitudinal veins brown throughout the wings. Median space with 8–9 partly reticulated crossveins in fore wing, 7–9 in hind wing. Cubital field with 30–31 crossveins in forewing, 35–37 in hindwing. Quadrangle with 20–21 crossveins in forewing, 29–30 in hindwing. Antenodals (the costal series) number 59–64 in forewing and 57–60 in hindwing.

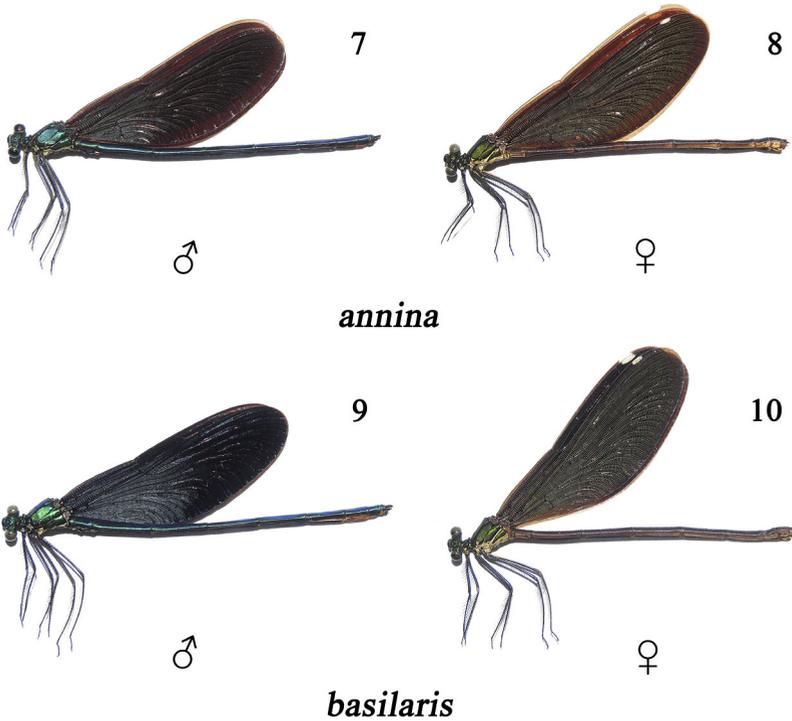
Abdomen. Metallic green throughout dorsally, lower third of the side of S10 pale brown. Ventral side of abdomen black on S1–S7 with only the lower edge of tergites very narrowly pale. Sternites of S8–S10 pale brown, ventral edge of sternite on S8 more broadly pale brown. Appendages of typical shape for the genus; black, except the basal part of the inferiors which is pale on the underside. The superior appendages somewhat tapered for the basal 3/5 then bent inwards strongly by about 56°, this distal part expanding apically and bearing strong outer spines (cf. Fig. 12).

Measurements (mm). Total length 70; abdomen (incl. appendages) 57.5; fore wing 43.5; hind wing 44.

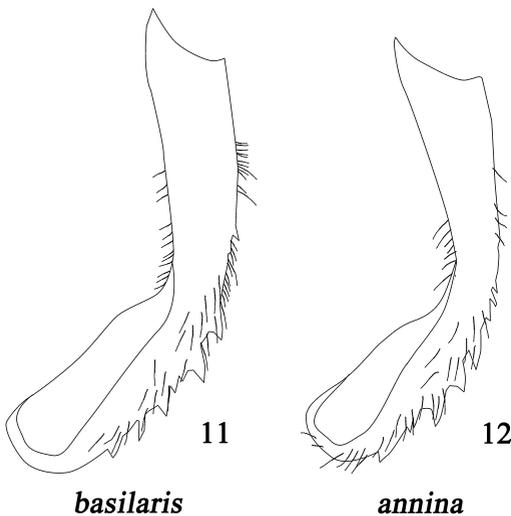
Description of female

Head. Eyes in life brown above, lower part extensively pale yellowish ochre. Labium largely yellow-ochre, middle lobe tinted yellowish brown, hooks of lateral lobes brown. Labrum mainly yellowish with upper and lower margins narrowly black, at middle of the upper margin the dark colour extends halfway down. Anteclypeus brownish. Postclypeus shining metallic green, frons and vertex metallic green with dark green reflections. Antennae with scape and most of pedicel conspicuously creamy yellow, the apical segments black.

Thorax. Prothorax metallic green. Synthorax metallic coppery light green with pale ochreous margins posteriorly on metepimeron, along metapleural suture and ventrally on metepisternum and mesepimeron and postero-ventral corner of mesinfraepisternum;



Figs 7–10. *Matrona* spp. habitus. – 7–8. *M. annina* paratypes; 7, male; 8, female. – 9–10. *M. basilaris*; 9, male; 10, female.



Figs 11, 12. *Matrona* spp. superior anal appendage, dorsal view. – 11, *M. basilaris*; 12, *M. annina*, paratype.

yellow-ochreous colour more extensive than in male. Ventral side of synthorax largely pale yellowish ochre with dark markings on poststernum much smaller than in male. Legs as in male (Fig. 8).

Wings. Wings light orange-tinged umber (Fig. 6). Venation brown. White pseudopteroostigmata in both wings, covering 8–10 cells. Median space with 5–6 partly reticulated crossveins in fore wing, 6–8 in hind wing. Cubital field with 21–27 crossveins in forewing, 31–34 in hindwing. Quadrangle with 16–17 crossveins in forewing, 18–22 in hindwing. Antenodals (the first series) number 43–45 in forewing and 37–44 in hindwing.

Abdomen. Dark sepia throughout above and in basal segments, ventro-lateral margin orange-ochre on S6–S10, becoming broader and paler distally so that S9–S10 are largely yellowish ochre on their sides and ventrally. S2–S7 with obscure broad dark reddish brown annuli at posterior margins. S8–S10 with pale ochre mid-dorsal stripe, very narrow on S8, much broader on S9–10. Sternum of S1–S8 black. Ovipositor mainly pale yellowish-ochre. Cerci black.

Measurements (mm). Abdomen (incl. appendages): 50.5–54.5; hind wing: 42.5–43.5.

Variability in male paratypes

In some specimens, especially younger ones, the clypeus has a bluish green sheen.

The size of the yellow spots on the labrum is somewhat variable. The scape can be paler brown, even

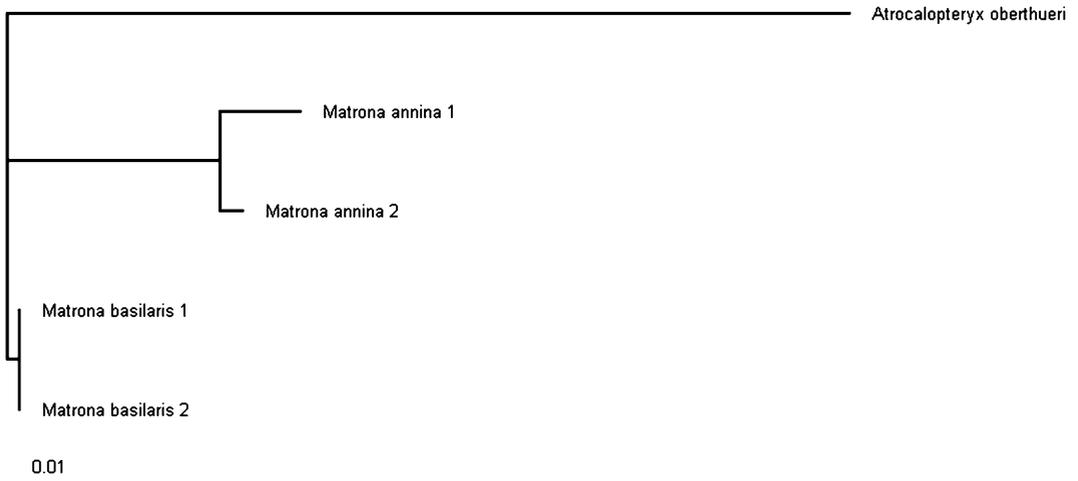


Fig. 13. Estimate of the Neighbor-Joining tree of *Matrona annina* and *M. basilaris* (100 bootstraps, 10 replicas), using *Atrocalopteryx oberthueri* (from Sichuan, China), as an outgroup, based on ITS sequences. Sequences accession numbers through Genbank: *Atrocalopteryx oberthueri* JQ341025, *Matrona annina*-1 JX852702, *Matrona annina*-2 JX852701, *Matrona basilaris*-1 JX852699, *Matrona basilaris*-2 JX852700.

largely yellowish. On the thorax, in some specimens the apex of the metallic green patch on metepimeron is connected to a darkened band continuing to metinfraepisternum. The extent of pale colouring on the underside of the abdomen tip is somewhat variable, in younger specimens the lower edge of the tergites are more broadly pale. In younger males the dorsum of the abdomen shows a bluish sheen at certain angles. The venational details are somewhat variable.

Measurements (mm). Abdomen (incl. appendages): 54–58.5; hind wing: 40–44.

Diagnostic comments

Although *M. annina* has brownish wings like the members of the *M. oreades*-group, it differs from them by the presence of bluish-white reticulation at the wing base, and by the slightly denser reticulation. We provisionally include this species in the *M. basilaris*-species group. It can be distinguished from *M. basilaris* by a combination of structural characters and differences in colour pattern as presented in Table 1.

Habitat and notes on biology

The type locality of *M. annina* is a lowland, well vegetated, rocky stream with large boulders at the altitude of ca 180 m. At the type locality, specimens were collected in the afternoon and at twilight, from 13:00 h to 19:00 h. No activity was recorded in the morning. Before 16:00 h, when sunshine was strong, both males and females perched in the dense, shady forest near the stream. They were very wary

and when disturbed they would fly deeper into the bush or higher into the trees. Several aeshnid species, including a group of *Gynacantha japonica* Barteneff, 1909, a male of *Boyeria karubei* Yokoi, 2002 and several *Planaeschna* spp. were also startled while collecting *M. annina*.

At twilight, *M. annina* males perched on plants or on the soil near the stream, waiting for the females. At that time also the females became active and perched rather low near the stream. Most of them were foraging, and no courtship behaviour or oviposition was observed. It was also noticed that although males of *M. annina* also hold territories along the stream bed at twilight, they seldom patrol or engage in protracted contests as does the common *M. basilaris*. Their behaviour was more like that of the sedentary, non aggressive males of *Atrocalopteryx melli* (Ris, 1912). Both these species, as well as *Vestalaria miao* (Wilson & Reels, 2001), were also active at dusk at the *M. annina* type locality. It appeared that *M. basilaris* males were stronger and more aggressive and easily drove away males of *M. annina* from their territories.

M. annina was also found in many lowland streams and rivers in Shaoguan City, in the northern part of Guangdong province. There it also co-occurs with several calopterygoid species, such as *M. basilaris*, *Vestalaria velata* (Ris, 1912), *Euphaea opaca* Selys, 1853 and *Heliocypha perforata* (Percheron, 1835). The substrate of most streams and rivers in the Shaoguan area consists of fine sand, unlike the rocky streams in Shimentai.

Table 1. Differentiating characters of *Matrona annina* and *Matrona basilaris*.

Character	<i>Matrona annina</i> male	<i>Matrona basilaris</i> male
Labrum	Dark metallic with a pair of small yellow spots	Metallic green without yellow spots
Wing colour	Reddish umber	Bluish black
Area of bluish-white reticulation at the wing base on hind wing	Less than basal half of hind wing, slightly beyond the nodus	Over basal half of hind wing
Superior appendages in dorsal view	bent inward ca 56° at about 3/5 of their length and thence expanded	bent inward ca 45° at about 1/2 their length and thence expanded
	<i>Matrona annina</i> female	<i>Matrona basilaris</i> female
Wing colour	Pale orange-umber	Dark brown

Distribution

China (Guangdong and Guangxi).

Results and discussion of molecular studies

A phylogenetic tree (Neighbor-Joining tree) derived from the 4 + 1 sequences is shown in Fig. 13. Since according to Guan et al. (2012), *Atrocalopteryx oberthueri* (McLachlan, 1894) is sister to all *Atrocalopteryx* and *Matrona* combined, *A. oberthueri* was used as the outgroup. An average 3.4% difference in the sequence of the ITSs gene (16 or 19 base substitutions) was found between *M. annina* and *M. basilaris*. These molecular data seem to support their status as distinct species; a conclusion which was already reached earlier from morphological differences and observations on their behaviour in the field.

Acknowledgements

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References

- Dumont, H.J., A. Vierstraete & J.R. Vanfleteren, 2007. A revised molecular phylogeny of the Calopterygidae (Zygoptera: Calopterygidae). – *Odonatologica* 36: 365–372.
- Guan, Z., B.-P. Han, A. Vierstraete & H.J. Dumont, 2012. Additions and refinements to the molecular phylogeny of the Calopterygidae s.l. (Zygoptera: Calopterygidae). – *Odonatologica* 41: 17–24.
- Hämäläinen, M., 2004. Caloptera damselflies from Fujian (China), with description of a new species and taxonomic notes (Zygoptera: Calopterygoidea). – *Odonatologica* 33: 371–398.
- Hämäläinen, M., X. Yu & H.-M. Zhang, 2011. Descriptions of *Matrona oreades* spec. nov. and *M. corephaea* spec. nov. from China (Odonata: Calopterygidae). – *Zootaxa* 2830: 20–28.
- Hämäläinen, M. & W.-C. Yeh, 2000. *Matrona cyanoptera* spec. nov. from Taiwan (Odonata: Calopterygidae). – *Opuscula zoologica fluminensia* 180: 1–6.
- Katoh, K., G. Asimenos & H. Toh, 2009. Multiple alignment of DNA sequences with MAFFT. – *Methods in Molecular Biology* 539: 39–64.
- Lieftinck, M.A., J.C. Lien & T.C. Maa, 1984. Catalogue of Taiwanese dragonflies (Insecta: Odonata). – Asian Ecological Society, Taichung, 2 + 81 pp.
- Phan, Q.T. & M. Hämäläinen, 2011. *Matrona taoi* spec. nov., a new damselfly species from northern Vietnam (Odonata: Calopterygidae). – *Zootaxa* 2927: 63–68.
- Swofford, D.L., 2003. PAUP^{RM}: Phylogenetic analysis using parsimony (^{RM} and other methods). [Version 4]. – Sinauer Associates, Sunderland, Massachusetts.
- Wang, L.-J., 2000. Dragonflies of Taiwan. – Renrenyuei Limited Liability Company Press, Taipei, 349 pp.

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