**Atrocalopteryx auco** spec. nov. from Vietnam, with taxonomic notes on its congeners (Odonata: Calopterygidae)

Matti Hämäläinen

Naturalis Biodiversity Center, P.O. Box 9517, 2300 RA, Leiden, The Netherlands. E-mail: matti.hamalainen@helsinki.fi

Abstract

*Atrocalopteryx auco* Hämäläinen, spec. nov. (holotype ♀, from Vietnam, Lang Son province, Huu Lien, Tan Lai, alt. 260 m, 9 June 2008, deposited at RMNH, Leiden, The Netherlands) is described and illustrated for both sexes and compared with other species in the genus. The new combination *Atrocalopteryx laosica* (Fraser, 1933), comb. nov. is made. An annotated list of *Atrocalopteryx* species and keys to both sexes are presented. Male of *A. auco* differs from the other two completely opague-winged species (*A. atrata* and *A. atrocyana*) by having whitish crossveins on the under surface of the wings and by having the underside of abdominal segments 8–10 strikingly yellowish. The female of *A. auco* can be easily separated from *A. atrata* and *A. atrocyana* by the presence of whitish pseudopterostigma in both wings. Problems in the definition of the genus *Atrocalopteryx* are discussed.

**Key words:** Odonata, Calopterygidae, *Atrocalopteryx*, new species, new combination, key, Vietnam

Introduction

The genus *Atrocalopteryx* Dumont, Vanfleteren, De Jonckheere & Weekers, 2005, with *Calopteryx atrata* Selys, 1853 as its type species, was established on the basis of a molecular phylogeny of the family Calopterygidae. Dumont & al. (2005) showed that the genus *Calopteryx* Leach, 1815, as defined at that time, was not a monophyletic group, with *C. atrata* being recovered together with species of the genus *Matrona* Selys, 1853 rather than with the other *Calopteryx* species studied. The same conclusion had been earlier made by Misof & al. (2000).

*Calopteryx atrocyana* (Fraser, 1935) was transferred to *Atrocalopteryx* by Wilson & Xu (2007) and this combination was confirmed in molecular studies by Dumont & al. (2007). The latter authors also wrote: “The relationships within *Atrocalopteryx* are less straightforward, although clearly, ‘*Calopteryx* coomani’ ([Fraser, 1935]) is seen to belong in *Atrocalopteryx* or a closely related taxon... ”. Later Guan & al. (2012a) concluded that, besides *coomani*, also *Calopteryx melli* Ris, 1912, belongs to the genus *Atrocalopteryx*. The authors also transferred *Calopteryx oberthueri* McLachlan, 1894, to *Atrocalopteryx*, but with some reservations (see p. 569). In the present paper *Calopteryx laosica* Fraser, 1933, is transferred to the genus *Atrocalopteryx*. Some problems in the definition of the genus are discussed.
In November 2013 Sébastien Delonglée (Hanoi, Vietnam) sent me photos of a calopterygid male specimen that he had collected a few days earlier at Huu Lien in Lang Son province in the northern part of Vietnam and asked me to identify the species. I could see that it was an *Atrocalopteryx* species, but it did not match any of the known species in this genus. To my surprise, I soon found four specimens, three males and one female, of the same species in my own collection. I had collected them at Huu Lien in June 2008, at a stream only five kilometres away from Sébastien Delonglée’s site, but had misidentified them and they had lain forgotten in my collection. Also some photographs had been taken before the damselflies were collected (Fig. 1). This new species is described here as *Atrocalopteryx auco*, and its distinguishing characters with the other species of the genus are discussed.

*Atrocalopteryx auco* spec. nov.

(Figs. 1–9)

**Material studied:** **Holotype♂:** Vietnam, Lang Son province, Huu Lien, Lan Chau community, a sidestream of Boc stream, 21° 43’ 34’’ N, 106° 23’ 15’’ E; alt. ca 260 m, 9 June 2008, M. Hämäläinen leg. Deposited at RNMH (Leiden).

**Paratypes:** 2 ♂, 1 ♀, same data as for the holotype; 1 ♂, Vietnam, Lang Son province, Huu Lien, Tan Lai community, 21° 40’ 40’’ N, 106° 22’ 42’’ E; alt. ca 220 m, 9 November 2013, Sébastien Delonglée leg.

**Etymology.** The specific epithet *auco* is named after Âu Cơ, a character in the Vietnamese mythology. Âu Cơ was a young, beautiful mountain fairy who fell in love with Lac Long Quân (the Dragon Lord of Lac). They married and she gave birth to an egg sac from which hatched a hundred children known collectively as the Bach Viet, the ancestors of the Vietnamese people. Âu Cơ is widely honoured as the mother of Vietnamese civilization.

**Description of holotype male.** Head: Eyes in living specimen dark brown above, pale greenish below (Fig. 1; cf. Figs. 2, 6–7). Labium largely yellowish brown, tips of lateral lobes black. Labrum black with yellow lateral spots; base of mandibles with pale spots (cf. Fig. 6). Clypeus, frons and vertex dark metallic green. Antennae black with the anterior surface of pedicel yellow. A distinct postocular tubercle is present on the occiput.

Thorax: Prothorax dark metallic green. Synthorax dark, lustrous metallic green with yellowish markings restricted to a distinct narrow yellow stripe on the lower half of metepimeron bordering the second lateral suture and to a yellow triangle on lower part of metinfraepisternum (cf. Figs. 4, 7). Ventral side of synthorax dark. Legs black, middle and hind coxae with small yellowish markings. Hind tibiae distinctly curved, middle tibiae slightly curved (Figs. 1, 4).

Wings: Wings moderately broad; in hind wing the length/breadth ratio is 3.5. Both wings dark opaque brown throughout (Figs. 1, 4). Under surface with a distinct reddish brown sheen viewed from certain angles; on upper side the sheen is less distinct. On upper side all main veins and crossveins are dark. On underside of hind wing main veins paler and most crossveins yellowish (cf. Figs. 2, 7), more distinctly so in basal half of wing. On underside of fore wing veins only paler than wing membrane at base; yellow crossveins occur only at base, except in costal and subcostal fields yellow crossveins present slightly apicad to nodus. Median space open, without crossveins. Cubital
field with 17–18 crossveins in fore wing, 22–22 in hind wing. Quadrangle with 13–15 crossveins in fore wing, 17–15 in hind wing. Antenodals (the first series) 36–37 in fore wing and 31–33 in hind wing. Vein IR2 runs parallel with RA after its origin (cf. Fig. 8).

Abdomen shining metallic green on dorsum and on sides, except ventrolateral edge of S10 and fine ventral and caudal margins on tergites of S8–9 yellow. Underside dark with apical end of S3–7 obscurely paler, underside of S8–10 conspicuously yellow (cf. Fig. 9). Anal appendages black, with basal part of inferiors distinctly yellow; appendages of typical structure for genus. Penis similar to that of A. atrata. Measurements (mm): Hind wing 40; abdomen (incl. appendages) 54.

Variation in male paratypes. One of the paratypes collected in 2008 is teneral, the other not fully mature (semi-mature). The paratype collected in 2013 is a mature specimen; Figs. 6–9 illustrate this specimen, which resembles the holotype in the colour of body and wings. In the teneral specimen the metallic colour of the body is already weakly developed, legs are brownish and wings pale brownish with distinct violet shine. In the semi-mature paratype the wings have greenish or violet iridescent sheen depending on angle of view, except on the wingtip; on upper surface the tip is blackish brown, but on under surface it has a distinct coppery sheen. The body colour of this paratype resembles that of the holotype. The venation in the paratypes is similar to that of the holotype, with insignificant variation in the numbers of crossveins and antenodals. Measurements (mm): Hind wing 41–43; abdomen (incl. appendages) 53–56.

Description of female (Figs. 3, 5). Head: Eyes in living specimens above paler brown than in male, eyes below pale yellowish (Fig. 3). Colour pattern of head similar to male, but yellow on labrum more extensive, not divided into two separate dots. A small postocular tubercle present.

Thorax: Metallic green, yellow on sides more extensive than in male. Also lower border of metepimeron and anterioventral edge of mesepimeron obscurely yellowish, and metinfraepisternum pale (Fig. 5). Venter of synthorax pale brownish. Legs as in male.


Abdomen black with slight metallic shine; S8–9 with brownish dorsal stripe, lower 2/3rd of lateral side and venter of S8–9 brownish, S10 brownish throughout. Measurements (mm): Hind wing 45; abdomen (incl. appendages) 52.

Distribution. So far known only at Huu Lien, Lang Son province, in northern Vietnam.

Notes on the habitat and biology. A. auco has been found along streams (3–7 m wide) with moderate flow in rather open surroundings in a valley (alt. ca 200–260 m) surrounded by
limestone karst peaks. At the site where the holotype was collected a stream emerges from underground beneath a karst peak. The immediate surroundings are cultivated land, but at least in 2008–2009 there was a small bamboo thicket left, where these damselflies took shelter. The flight period of A. auco extends from early June to early December at least. The damselflies are alert and difficult to approach, unlike A. atrocyana, which are more docile.

Huu Lien has been designated as a nature reserve covering ca 120 sq km. Much of the area of the reserve is forested, but since the two valleys inside the reserve have a population of ca 3000 people, the forests in the reserve are suffering from continuing exploitation. In some sites A. auco can be seen together with A. atrocyana, which is locally abundant in Huu Lien. However, the latter species prefers shadier streams in good forest environments. It can often be seen in shady places away from streams.

**Distinguishing characters. Male**—Only two of the earlier known Atrocalopteryx species, A. atrata (Figs. 10–11) and A. atrocyana (Figs. 12–13), have completely opaque wings in the male sex. In all other species there are hyaline portions in the wings (Figs. 14–17). The mature male of A. auco spec. nov. differs from the other two opaque-winged species by having yellowish crossveins on the under surface of the wings (Figs. 2, 7); the pale crossveins are present throughout the hind wing, but in the fore wing present only in the basal area, extending apicad to the nodus at the upper wing border. On the upper surface of both wings the crossveins are dark. Also in atrata and atrocyana the crossveins are dark coloured on the upper surface of the wings, but in these species the under surface of the wings does not have yellowish crossveins. In atrata and atrocyana there are obscurely pale longitudinal veins on the basal part of the under surface of wings. Moreover, at some angles the crossveins of the costal field look pale, but not yellowish. In atrocyana the wings are proportionally much broader than in auco and atrata. In mature males of atrocyana and atrata both surfaces of the blackish wings reflect a bluish metallic sheen in certain angles, but in atrocyana the bluish sheen is more conspicuous. In mature males of auco the upper surface of the wings is dark brown with a slight sheen, while the under surface reflects a reddish-brown sheen (Fig. 1).

Auco male differs from the other two species by having the underside of abdominal segments 8–10 strikingly yellowish (Fig. 9), the yellow extending along the lateroventral border of terga and covering part of the intersegmental rings of S8 and S9, lower half of sides of S10, and base of inferior appendages. In atrata and atrocyana these are all black. Unlike the other two species, in auco there is a short yellow stripe along the second lateral suture of the synthorax (Fig. 7).

On the head of auco (Fig. 6) there are two yellow lateral spots on the labrum and a yellow spot at the base of the mandibles. In atrata and atrocyana these yellow markings are absent. In auco there is a distinct postocular tubercle on the occiput, while in atrata the tubercle is absent and in atrocyana it is vestigial.

**Female**—The female of auco (Fig. 3) can be easily separated from atrata and atrocyana by the presence of whitish pseudopterostigma in both wings; this is absent in atrata (Fig. 18), atrocyana (Fig. 19), and laosica. The females of both A. coomani (Fig. 20) and A. melli (Fig. 21) have quite similarly shaped white pseudopterostigma as auco, but the three species can be separated by characters presented in the key (p. 571). Moreover, auco female is smaller than the other two species, and in auco the yellow on metepisternum and metepimeron is more restricted.
Problems in the definition of the genus *Atrocalopteryx*

The original definition of the genus *Atrocalopteryx* by Dumont & al. (2005) was very brief and largely based on the morphological characters provided by de Selys Longchamps (1853) for his “2me Groupe: (C. atrata)” within the “Sous-genre Calopteryx”.

1) Wings comparatively long and narrow, without pterostigma in both sexes. 2) Postocular tubercles on occiput very small or absent. (In *Calopteryx* there are distinct postocular tubercles). 3) After diverging from RP3 (R4+5) the vein IR2 does not merge with RA (radius) but runs parallel with RA to the point where R2 originates from IR2 (Fig. 22). (In *Calopteryx* the basal portion of IR2 merges with RA (radius) after its origin 1–2 cells beyond the arculus and then diverges from RA after a distance of a few cell rows (Fig. 23).

None of the characters in the original definition of *Atrocalopteryx* are now valid after the inclusion of several other species in the genus. “Wings without pterostigma in both sexes” applies only to the type species of the genus *A. atrata* and to *A. atrocyana*, *A. laoisa* and *A. fasciata*; females of the other species have pseudopterostigmata. In *A. auco* there is a distinct postocular tubercle, similar to that in most *Calopteryx* species; in *C. cornelia* Selys, 1853, the postocular tubercle is obsolete.

The venational character, IR2 running alongside and not merging with RA, applies to all other known *Atrocalopteryx* species, except for *A. oberthueri*. However, there is some individual variability in this character in many *Calopteryx* species, including the type species of the genus *C. virgo* (Linnaeus, 1758). In most specimens of *C. japonica* Selys, 1869, and *C. cornelia*, IR2 does not merge with RA but runs separately.

A character shared by all known *Atrocalopteryx* (and also *Matrona*) species is the more or less curved shape of middle and hind tibiae (Figs. 1–5, 10–21), whereas in *Calopteryx virgo* and most other *Calopteryx* species the tibiae are straight. However, neither is this character usable as a definite distinguishing character between *Atrocalopteryx* and *Calopteryx*, as some species of the latter genus, such as *C. cornelia, C. maculata* (Palisot de Beauvois, 1807) and *C. dimidiata* Burmeister, 1839, also have slightly curved tibiae.

It may be difficult to find definite morphological characters to separate the calopterygid genera established on the basis of molecular characters. It may be better to delay the attempts to define the genus *Atrocalopteryx* until the phylogenetic affinities of all calopterygid species are known. Guan & al. (2012a) concluded as follows: “*Atrocalopteryx oberthueri* is sister to all *Atrocalopteryx* and *Matrona* combined. It would in fact be equally defensible to single *A. oberthueri* out in a separate genus, as to merge the whole clade into a single genus [= *Matrona]*”.

All *Matrona* (in the present sense) species can be easily separated from *Atrocalopteryx* species by the presence of several crossveins in the median space in both fore and hind wings. The crossveins are often partly reticulated. In *Atrocalopteryx* species the crossveins are lacking.

Although molecular evidence of the relationship of *Calopteryx laoisa* Fraser, 1933, is as yet unavailable, I confidently include *laoisa* in *Atrocalopteryx* based on structural evidence alone. I
have studied the male holotype of *laosica* from Laos (BMNH, London) and several male specimens from northern Vietnam (from Sapa and from unspecified locality in ‘Tonkin’). A female specimen from ‘Tonkin’ (at MNHN, Paris) was also available for study. In *laosica* IR2 is free, there are no postocular tubercles and middle and hind tibiae are slightly curved.

After the transfer of *laosica* to *Atrocalopteryx*, no *Calopteryx* species remain within the Oriental zoogeographical region. The extant species of the genus *Calopteryx* appear to be confined solely to the Holarctic. Of the known *Atrocalopteryx* species only *A. atrata* extends northwards to the Palaeartic region, and the ranges of *A. atrata* and *C. japonica* meet in northeastern China. In Japan the range of *A. atrata* overlaps with that of *C. japonica* and *C. cornelia*.

**Annotated list of *Atrocalopteryx* species**

**Atrocalopteryx atrata** (Selys, 1853)

*Synonyms: Calopteryx grandeva* Selys, 1853; *Calopteryx longipennis* Selys, 1854, *Calopteryx smaragdina* Selys, 1853; *Vestalis tristis* Navás, 1932.

Type locality: Shanghai area in Zhejiang, China (cf. Selys Longchamps & Hagen, 1854).

Distribution: distributed throughout eastern China, from northern Guangxi, reaching as far north as the Primorye region in the far east of Russia. The species also occurs on the Korean peninsula and on the main islands of Japan, apart from Hokkaido.

Notes: *A. atrata* exhibits considerable variability over its range. The variability in wing breadth is significant, especially in the Zhejiang (incl. the type series) and Fujian populations, even within the same population. As already pointed out by Hämäläinen (2004, 2005), the female holotype of *C. grandeva* Selys, 1853 (type locality Zhoushan Island, only ca 100 km from Shanghai) falls within the limits of variability of *atrata* and must therefore be ranked as a synonym of *atrata*. In northern parts of China *atrata* specimens tend to be smaller and their wings darker than in south. In Japan the wings appear to be proportionally narrower than in China and the wing surface shinier than in the topotypical atrata. Detailed studies, including molecular analysis, are needed to find out whether it really is a question of a single taxon only. Should the Japanese populations represent a different taxon, the name *longipennis* Selys, 1854, is available. Lieftinck (1971) wrote on *C. longipennis* as follows: “Synonymous with, or subspecies, of *C. atrata* Selys.”

**Atrocalopteryx atrocyana** (Fraser 1935)

Type locality: ‘Tonkin’ (obviously Dong Mo, Lang Son province, Vietnam).

Distribution: northern Vietnam; China: Guizhou and Guangdong. (Not yet recorded from Guangxi, where it is also expected to occur).

**Atrocalopteryx auco** Hämäläinen, spec. nov.

Type locality: Huu Lien, Lang Son province, Vietnam.

Distribution: So far known only from northern Vietnam.

**Atrocalopteryx coomani** (Fraser, 1935)

Type locality: ‘Tonkin’ (northern Vietnam).

Distribution: northern Vietnam; ?China (its occurrence in Guangxi is expected, but no confirmed records are known).

**Atrocalopteryx fasciata** Yang, Hämäläinen & Zhang, 2014
Type locality: Yingjiang, Dehong, Yunnan, China.
Distribution: China: Yunnan.
Note: For details, see Yang & al. (2014).

Atrocalopteryx laosica (Fraser, 1933), comb. nov.
Type locality: Muang Cha, Laos.
Note: For the possible occurrence in China, see Yang & al. (2014).

Atrocalopteryx melli (Ris, 1912)
Atrocalopteryx melli melli (Ris, 1912)
Type locality: ‘Tsa-Yiu-San’ in northern Guangdong, China.
Distribution: China: Guangxi, Guangdong, Fujian, Jiangxi, Zhejiang.

Atrocalopteryx melli orohainani Guan, Han & Dumont, 2012
Type locality: Diaoluoshan, Hainan, China.
Distribution: China: Hainan.
Note: A subspecies erected largely on the basis of its DNA sequence, with a 2.6 % base difference in the COI gene. It is larger in size and with wings clearer than in the continental subspecies. For details, see Guan & al. (2012b). Female not yet described.

Atrocalopteryx oberthueri (McLachlan, 1894)
Synonym: Agrion grahami Needham, 1930
Type locality: ‘Ta-chien-lu’, Sichuan, China.
Distribution: China: Sichuan, Yunnan; Laos.

Key to the species of Atrocalopteryx

Males

1  Both pairs of wings completely opaque ........................................ 2
   Wings with hyaline or subhyaline areas .................................... 5
2  Underside of S7–10 dark. No distinct yellow markings laterally on synthorax or on labrum .......... 4
   Underside of S7–10 distinctly yellow. A narrow lateral yellow stripe on synthorax; yellow spots on labrum .......... auroco
   Clypeus shining metallic blue, wings proportionally very broad; hind wing length / maximum breadth ratio 2.7–3.1 .......................... atrocyana
   Clypeus shining metallic green, wings narrower; hind wing length / maximum breadth ratio 3.2–3.7 ......................... atrata
3  Tips of wings opaque .................................................. 6
   Tips of wings hyaline or subhyaline ....................................... 7
4  Fore and hind wings similarly coloured ........................................... melli
   Opaque area larger in hind wing than in fore wing .................. coomani
   Base of wings opaque with apical one fifth of wings hyaline. oberthueri
   Base of wings hyaline or subhyaline, opaque area covering central area of wings, tips hyaline or subhyaline, more broadly so in fore wing .................. 8
5  Opaque area in middle covers more than half of wing length .................. laosica
   Opaque area in middle covers less than half of wing length ............... fasciata
Females

1. Wings lacking white pseudopterostigma ................................................................. 2
2. White pseudopterostigma present on both wings ................................................. 5
3. Wings opaque brownish throughout ................................................................. 3
4. Wing tips hyaline, more broadly so in fore wing ............................................... 4
5. Wings very broad; main veins and crossveins on underside of hind wing only slightly paler than wing membrane; metepimeron without distinct yellow border ................................................................. 4
6. Wings narrower; main veins and crossveins on underside of hind wing distinctly paler than wing membrane; metepimeron narrowly bordered with yellow ................................................................. 4
7. Opaque area in middle covers more than half of wing length ................................ 5
8. Opaque area in middle covers less than half of wing length ................................. 5
9. Wingtips hyaline; pseudopterostigma long and narrow, 6–7 times longer than broad .......... 6
10. Wings largely opaque; pseudopterostigma short and broad, at most 3 times longer than broad ................................................................. 6
11. Fore and hind wings similarly coloured ............................................................ 7
12. Opaque area larger in hind wing than in fore wing .............................................. 7
13. Wings mostly opaque; subhyaline portion only at wing base ................................ 8
14. Wings mostly subhyaline; opaque only at wing tips ........................................... 8

Acknowledgements

I am grateful to Sébastien Delonglée, whose record in Huu Lien lead to the discovery of the existence of this new species. He also kindly donated a paratype male for me to study and provided excellent photographs of that specimen taken when still alive and field photographs of other species in the genus. Best thanks go also to Cuong Do for help in arranging our joint field work at Huu Lien and for a photo to be used in this paper. Rory Dow, Roy Futahashi, Tom Kompier, Shan-lian Mo, Akihiko Sasamoto, Xin Yu and Hao-miao Zhang have kindly provided either specimens, photographs and/or relevant information. Albert Orr kindly reviewed and improved the manuscript text and Sami Karjalainen helped in making the layout of the illustrations.

References


Guan, Z-Y., Han, B-P. & Dumont, H.J. (2012b) Atrocalopteryx melli orohainani ssp. nov. on the island of Hainan, China (Zygoptera: Calopterygidae). Odonatologica, 41, 37–42.


FIGURES 1–3. *Atrocalopteryx auco* spec. nov. photographed in the field. 1) Male holotype photographed by Matti Hämäläinen at the type locality before it was collected; 2–3) Male (2) and female (3) photographed by Tom Kompier at Huu Lien (Tan Lai) on 17 November 2013. Specimens not collected.
FIGURES 4–5. *Atrocalopteryx auco* spec. nov. 4) habitus of holotype male; 5) habitus paratype female.
FIGURES 6–9. *Atrocalopteryx auco* spec. nov., paratype male photographed alive by Sébastien Delonglée on 9 November 2013. 6) head; 7) head, thorax and bases of wing; 8) details of venation at wing base; 9) tip of abdomen, lateroventral view.
FIGURES 22–23. Detail of venation in hind wing. 22) female of *Atrocalopteryx atrata* from China (Fujian); 23) female of *Calopteryx virgo* from Finland.