

Xuan Son National Park, a paradise for Caloptera damselflies in northern Vietnam

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Abstract

During three field trips in 2009-2010 to Xuan Son National Park in Phu Tho province in northern Vietnam, a total of 13 species of damselflies of the superfamily Calopterygoidea were recorded. These records are documented here with field photographs of living damselflies. Observations on their biology and behaviour are also noted. Three of the species are reported from Vietnam for the first time: *Rhinocypha arguta*, an undescribed *Matrona* species and *Vestalaria miao*. The last species was first found in Huu Lien Nature Reserve in Lang Son province in June 2008.

Introduction

Damselflies of the calopterygoid families (i.e. Caloptera) reach their maximum diversity in the montane regions of Indochina and southern China. Although these insects are conspicuous and often among the first species to be netted by dragonfly collectors, our knowledge of them remains inadequate. Descriptions of Caloptera species new to science are published yearly, as are many new distributional records. Do & Dang (2007) included a total of 38 Caloptera damselflies (excluding the genus *Philoganga*) in the checklist of Vietnamese Odonata. Surprisingly, in the three years since that list was published, as many as 10 additional Caloptera species have been found inside the borders of Vietnam. At least three (perhaps four) of these are new species, of which one – *Noguchiphaea mattii* Do, 2008 – has already been described



(Do 2008), the others are new records for Vietnam. All provide yet more evidence of the remarkable diversity of the Vietnamese fauna. Unfortunately, only small, scattered remnants of the habitats of these insects are left in this country, which just 100 years ago was widely covered with dense, primary forest areas.

Phan Quoc Toan (Fig. 1) appears to be the first odonatologist to visit Xuan Son National Park (3 & 4), one of the most efficiently protected areas in the northern part of Vietnam. His first field trip there, in December 2009, yielded two Caloptera species new to Vietnam, with another new to science. Surprisingly, his second visit in July 2010 produced only meagre results. The promising results of the first trip initiated Do Manh Cuong (Fig. 2) to apply for funding from the International Dragonfly Fund (IDF) for a new field trip to Xuan Son in November 2010, to be made together with Phan Quoc Toan. This visit was even more successful than that of the previous year. The results show that Xuan Son has a remarkably rich calopterygoid fauna late in the season (September-December). This national park may be one of the last refuges for at least three Caloptera species, presently very rare and endangered in Vietnam and elsewhere. The combined results of these field trips are presented here.

The Xuan Son National Park is located in Thanh Son district in Phu Tho province (Fig. 3 & 4). It was gazetted as a nature reserve on August 9, 1986. The park, which covers an area of 150.5 km², lies at the extreme south-eastern extent of the Hoang Lien Mountains, in the watershed of the Red River, 45 kilometres south-west of the confluence of the Red and Black Rivers. Hoang Lien Son mountain range is the gateway to the northwest of Vietnam. Elevations at Xuan Son are lower than elsewhere in the Hoang Lien Mountains. There are only three peaks over 1000m a.s.l.: Voi mountain, Ten mountain and Can mountain. The highest point is 1386 m. The nearest point above 2000 m is 40 km from the park to the north-west.

The natural vegetation types at Xuan Son are lowland and lower montane evergreen forest, as well as lowland and lower montane limestone forest. The limestone karst contains a large number of caves, some of which contain river systems, such as Lap stream and Thang stream. Some waterfalls drop from the height of over 50 meters. A total of 91 km² of the park area, including a 24.3 km² primitive forest stand on limestone mountain is protected by law.

The park hosts a population of ethnic minorities, nearly 30 000 people, living in both the core and buffer zone of the park. The main threats to biodiversity are shifting cultivation and forest fire. These would appear to be bigger threats in non-limestone areas, where hillsides are suitable for cultivation. Communities inside the national park, which live in limestone areas, cultivate wet rice on flat valley bottoms. However, the limestone hillsides close to these communities are still covered with primary forest.





Figure 1. Phan Quoc Toan with a specimen of the new *Matrona* species in the hand near the small stream in Lap forest. 15 November, 2010.



Figure 2. Do Manh Cuong near the small stream in Lap forest, where he had found also a *Planaeschna* species. 15 November 2010.



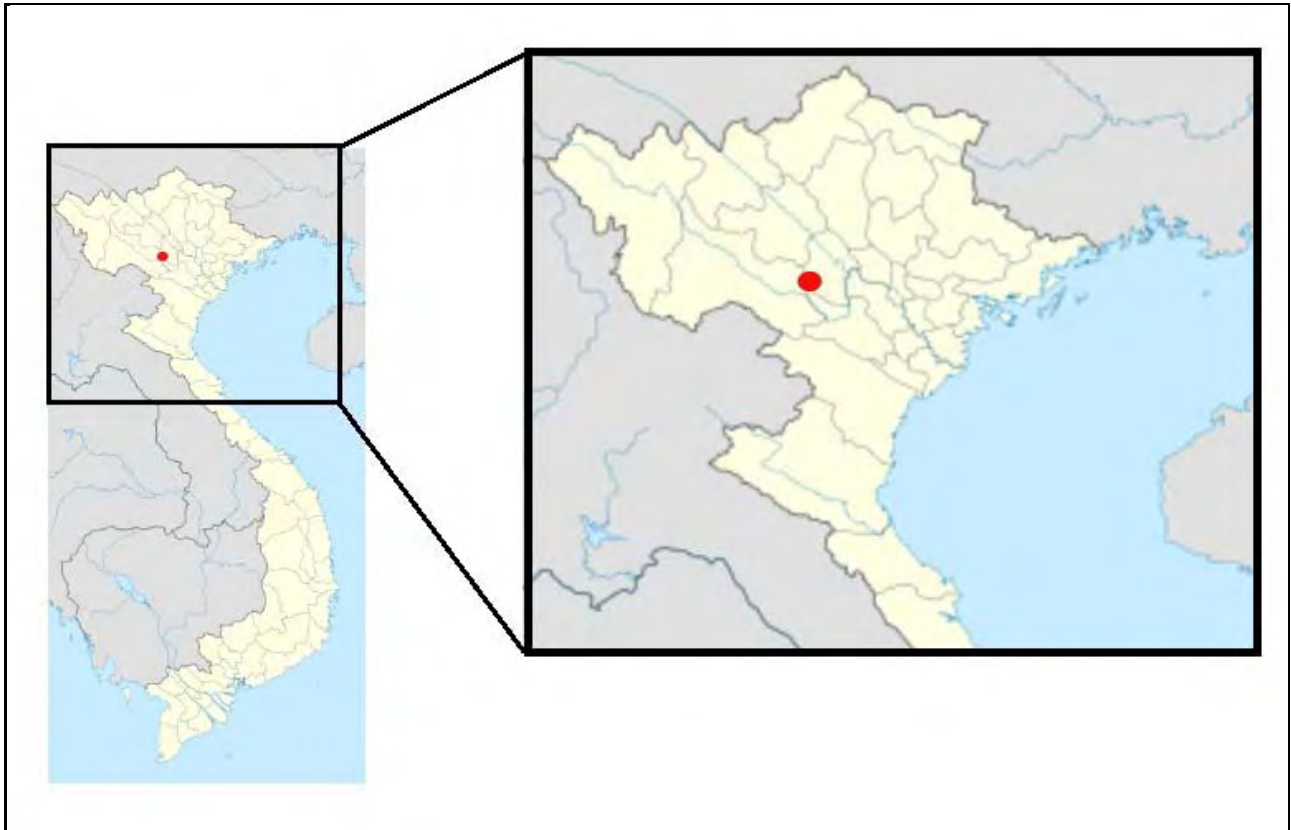


Figure 3. Map of Vietnam showing the location of Xuan Son National Park.



Figure 4. Terrain of Xuan Son National Park.



Study sites and methods

The field trips to Xuan Son National Park were made on 7 December 2009, on 27-29 May 2010 and on 13-15 November 2010. Three rocky streams with boulders were studied:

1) A rather open, mostly unshaded stream (Fig. 5) by the dam which connects Coi and Lap villages. By the dam the stream is 3-5 m wide. The stream has its source on a nearby mountain. The dam is located at 21°06'56,6"N, 104°57'27,4"E.



Figure 5. A rather open stream (1) near the dam which connects Coi and Lap villages. This is a habitat of *Matrona basilaris*, *Matrona* sp.n., *Neurobasis chinensis*, *Euphaea masoni* and *Euphaea decorata*.

2) An open, 5-10 m wide, stream (Fig. 6) in Coi village, 400 m eastwards from the dam. This stream originates from a cave. This stream diverges to form two channels for a distance of 20m; the narrower channel (Fig. 7) is 3-4 m wide. The streams 1 and 2 join southwards from the road passing the dam.

3) A shaded stream in pristine forest near Lap village (Fig. 8). This is a branch of the first stream and it is located ca 400-500 m from the dam. The branch, in fact a combination of several smaller channels, is 1-7 m wide.

For each species, several damselflies were photographed in nature and voucher specimens were collected. The specimens were first treated in acetone for 5 to 8 hours before placing to envelopes. For aesthetic reasons, some photos of species



occurring in the Xuan Son National Park have been replaced by those taken in other localities in Vietnam. The photos are included to illustrate these damselflies and the beauty of the regional Caloptera fauna.



Figure 6. An open forest stream (2) near Coi village. The water originates from an underground cave in a limestone mountain. This is a habitat of *Matrona basilaris*, *Vestalaria miao*, *Heliocypha biforata*, *Heliocypha perforata*, *Euphaea decorata*, and *Euphaea masoni*.



Figure 7. A divergent channel of the stream (2) above. In this slightly narrower and more shady stream section also *Matrona* sp.n. and *Rhinocypha arguta* were found.





Figure 8. A shady sidestream (3) in pristine forest in Lap village. A habitat of *Noguchiphaea yoshikoeae*, *Calopteryx coomani*, *Matrona* sp.n., *Rhinocypha arguta* and *Aristocypha fenestrella*.

Annotated list of Caloptera species recorded

The following 13 species belonging to the superfamily Calopterygoidea were recorded in Xuan Son National Park.

Chlorocyphidae

Aristocypha fenestrella (Rambur, 1842)

Specimens collected: 1 ♂, 1 ♀, 13.XI.2010.

Male has conspicuously coloured, glittering hind wings, with shining violet 'windows'. The dorsum of the synthorax has a broad triangular purple marking. Hind- and middle legs of male have strikingly white tibiae. Females are inconspicuously coloured and have hyaline wings. *A. fenestrella* female differs from *Heliocypha* and *Rhinocypha* females by having a large triangle on mid-dorsum (Fig. 9-11).

A. fenestrella is widespread and quite common in the remaining forested areas in whole Vietnam. This species prefers swift streams with boulders and clear water.





Figure 9. *Aristocypha fenestrella* ♂, Xuan Son National Park – Phan Q.T.



Figure 10. *Aristocypha fenestrella* ♀, Xuan Son National Park – Phan Q.T.





Figure 11. *Aristocypha fenestrella* ♂ in courtship dance while ♀ is ovipositing, Thuong Tien Nature Reserve, Hoa Binh Province – Phan Q.T.

Heliocypha biforata (Selys, 1859)

Specimens collected: 1 ♂, 7.XII.2009; recorded also on 27-29.V.2010.

A species with less colourful and narrower wings than in *A. fenestrella*. The male is superficially similar to *H. perforata*, with cobalt-bluish and violet markings on the synthorax. However, in *H. biforata* the blue markings on the sides of abdomen are reduced to small dots. Females of *H. biforata* have the pale humeral stripe on dorsum hooked at the base (Fig. 12 & 13).

H. biforata is widespread, but rather local in Vietnam. It is less selective as regards to stream habitats than *H. perforata*.





Figure 12. *Heliocypha biforata*, close up of ♂, Eachrang, Son Hoa, Phu Yen province – Do M.C.



Figure 13. *Heliocypha biforata* ♀, Son Kim, Huong Son district, Ha Tinh province – Phan Q.T.



***Heliocypha p. perforata* (Percheron, 1835)**

Specimens collected: 7♂, 2♀, 7.XII.2009; 1♂, 1♀, 13.XI.2010; recorded also on 27-29.V.2010.

This species differs from the above two chlorocyphids by having extensive blue markings on the abdomen. The dark area in wing tips is more extensive than in *H. biforata*. The female is similar to *H. biforata*, but the pale humeral stripe on the dorsum is straight, not hooked at base (Fig. 14 – 18).

H. perforata is quite common and widespread species in Vietnam. It typically occurs on 5-10 m wide forest streams with moderate flow, both in lowlands and mountains up to the altitude of 800-900 m. It was the second odonate species to be described based on specimens originating from Vietnam (Cochinchine).



Figure 14. *Heliocypha perforata*, a close up of ♂ with a red parasitic water-mite under the thorax, Huu Lien N.R., Lang Son province – Do M.C.





Figure 15. *Helioocypha perforata*, two ♂ in an agonistic display, Huu Lien Nature Reserve, Lang Son province – Do M.C.



Figure 16. *Helioocypha perforata* ♂ guarding an ovipositing ♀, Xuan Son National Park – Phan Q.T.





Figure 17. *Heliocypha perforata* pair in copula, Xuan Son Nationalpark – Phan Q.T.





Figure 18. *Heliocypha perforata* ♀ Xuan Son N. P. Phu Tho Province – Phan Q. T.

***Rhinocypha arguta* Hämäläinen & Divasiri, 1997**

Specimens collected: 2♂, 7.XII.2009; 4♂, 5♀, 13-15.XI.2010.

The basic male coloration of this species is black with yellow and orange reddish markings. Head is shining black with pale blue dots. The thorax is black with olive yellow or greenish stripes. The abdomen has broad orange reddish bands on S1-8, whereas S9-10 are all black or with tiny orange reddish dots. The wings are hyaline, slightly darkened at apex with the pterostigma blackish brown, usually pale in the apical half in Xuan Son specimens.

Female (still formally undescribed) has a dark abdomen with a yellowish row of small dots and narrow stripes midlaterally. The pterostigma is broad and distinctly bi-coloured, the greater part being pale (Fig. 19 – 21).

This species is new to Vietnam. Earlier it was known only from two localities in north-eastern and northern Thailand: Phu Kradung mountain plateau in Loei province (Hämäläinen & Divasiri 1997) and from a few streams within Pee Pan Nam mountain range in Chiang Mai province (unpublished), where it was first recorded by Ehira Kenji. It is a late season species.





Figure 19. *Rhinocypha arguta* ♂, Xuan Son National Park – Phan Q.T.



Figure 20. *Rhinocypha arguta* ♀, Xuan Son National Park – Phan Q.T.



Figure 21. *Rhinocypha arguta* ♀ is ovipositing on a wet tree branch on the ground, Xuan Son National Park – Phan Q.T.



Calopterygidae

Calopteryx coomani (Fraser, 1935)

Specimens collected: 4 ♂, 2 ♀, 13.XI.2010.

This large damselfly has a shining metallic bluish-green body. The legs are long, the middle and hind tibiae are distinctly curved. When closed, the wings look dark, although most of the surface of forewings is subhyaline, only the wing tip and costal area being dark. The hind wings are dark, only the wing base is narrowly subhyaline. Female wings quite similarly patterned, but paler, with short, white pseudoptero-stigmata in both wings (Fig. 22 & 23).

C. coomani was described from two male specimens from 'Tonkin' (Fraser 1935). It is rather rare and local species at clean streams in pristine forests on mountains in northern Vietnam. The adults stay in shady bush, often quite a distance from the streams. They can be seen even in rainy weather. They are usually rather inactive and flutter away for a few meters only when disturbed.



Figure 22. *Calopteryx coomani* ♂, Xuan Son National Park – Phan Q.T.





Figure 23. *Calopteryx coomani* ♀, Xuan Son National Park – Phan Q.T.

***Matrona basilaris* Selys, 1853**

Specimens collected: 5 ♂, 3 ♀, 7.XII.2009; 4 ♂, 6 ♀, 13-15.XI.2010.

A colourful, metallic green bodied species, a little smaller than *C. coomani*. Male wings are dark blue, the wing bases have bluish white crossveins, which in sunshine gives the wingbases a conspicuous milky appearance. The tip of the forewing is subhyaline. Female wings are brownish, with bases subhyaline; white pseudoptero-stigmata proportionally slightly longer than in *C. coomani* (Fig. 24 – 26).

In Vietnam *M. basilaris* is a local and rather uncommon inhabitant of forested streams both in lowland and mountains. It is also a rather weak flyer. Females especially tend to stay in shadowy bush near streams.





Figure 24. *Matrona basilaris* ♂, Xuan Son National Park – Phan Q.T.



Figure 25. *Matrona basilaris* ♀, Xuan Son National Park – Phan Q.T.





Figure 26. *Matrona basilaris* ♀ laying eggs, Xuan Son National Park – Phan Q.T.

***Matrona* sp.n.**

Specimens collected: 1 ♂, 3 ♀, 7.XII.2009; 3 ♂, 4 ♀, 15.XI.2010.

This species is a new to science and so far known only from Xuan Son. The species will be described by Phan Quoc Toan and Matti Hämäläinen shortly.

***Neurobasis chinensis* (Linnaeus, 1758)**

Specimens collected: 4 ♂, 2 ♀, 13-15.XI.2010; recorded also on 27-29.V.2010.

A conspicuous medium sized Demoiselle. Body shining metallic green in both sexes, legs long. The male has metallic green hindwings and hyaline forewings. The female has hyaline wings with pale brownish veins; the membrane of the hindwing distinctly darker brown than in the forewing; both wings with white nodal spot and white pseudopteroostigmata, the one on the hindwing being distinctly longer (Fig. 27 – 29).



A quite common species, widely distributed in Vietnam. It prefers rather open, swift running streams in forested areas, both in lowlands and in mountains. *N. chinensis* was among the first dragonfly species to be described for science. For further information on its interesting discovery history, habitats and behaviour, see the book by Orr & Hämäläinen (2007).



Figure 27. *Neurobasis chinensis* ♂, Xuan Son National Park – Phan Q.T.



Figure 28. *Neurobasis chinensis* ♂ wing clapping, displaying the green hindwings, Xuan Son National Park – Phan Q.T.





Figure 29. *Neurobasis chinensis* ♀, Xuan Son National Park – Phan Q.T.

***Noguchiphaea yoshikoeae* Asahina, 1976**

Specimens collected: 5 ♂, 5 ♀, 13-15.XI.2010.

This is a rather small, slender Demoiselle species, characterized by very narrow, hyaline, shortly stalked, wings without pterostigmata; in the male the forewing tip has a peculiar dark marking in the middle. Body largely metallic green with lower side of thorax yellow. Male appendages and female prothorax of unique structure, unknown elsewhere in the family (Fig. 30 – 33).

Until the species was discovered in Vietnam in Tam Dao at the altitude of 700 m in September 2007 (Do 2008), this elusive species was known only from northern Thailand, where it has been recorded from several montane sites in Chiang Mai and Mae Hong Son provinces at the altitude range of 700-1500 m (Asahina 1976, Hämäläinen 2004). The stream (3) in Xuan Son at the altitude of ca 450 m is the lowest known site for this species.

The typical habitat is a shady, 1-3 m wide, stream in good forest on a mountain slope. The adults are on wing in the rainy season, especially at the end of the season.





Figure 30. *Noguchiphaea yoshikoeae* ♂, Xuan Son National Park – Phan Q.T.



Figure 31. *Noguchiphaea yoshikoeae* ♀, Xuan Son National Park – Phan Q.T.





Figure 32. *Noguchiphaea yoshikoae* pair in copula, Xuan Son National Park – Phan Q.T.



Figure 33. *Noguchiphaea yoshikoae* ♀ inserting eggs into a tree branch overhanging a shaded stream, Xuan Son National Park – Phan Q.T.



***Vestalis gracilis* (Rambur, 1842)**

Specimens collected: 2 ♂, 3 ♀, 13-15.XI.2010.



Figure 34. *Vestalis gracilis* ♂, Xuan Son National Park – Phan Q.T.



Figure 35. *Vestalis gracilis* ♀, Huu Lien Nature Reserve, Lang Son province – Phan Q.T.



The body of this medium to rather large sized calopterygid species is pale metallic green with distinct yellow stripes on the sides of the synthorax. The wings are hyaline with the costal margin of the forewing distinctly tinted pale brownish. The tips of both wings are more or less obscurely darkened. There are no pterostigmata. The membrane of hindwing slightly darker. Male and female resemble each other in their colour pattern (Fig. 34 & 35).

A common and widespread species in Vietnam, inhabiting streams in primary or secondary forests. The adults stay close to their breeding sites.

***Vestalaria miao* (Wilson & Reels, 2001)**

Specimens collected: 16 ♂, 4 ♀, 7.XII.2009; 7 ♂, 4 ♀, 13-15.XI.2010.

A medium sized calopterygid with a metallic green body, easy to separate from *V. gracilis* by the darker body colour, metepimeron of synthorax wholly yellow and the three apical abdominal segments of mature males with pale bluish pruinescence. In contrast to other *Vestalaria* species, the inferior appendages of male are very short. In teneral specimens the wings are amber tinted, whereas fully mature specimens have hyaline wings (Fig. 36 & 37).



Figure 36. *Vestalaria miao*, mature ♂, Xuan Son National Park – Phan Q.T.



V. miao was first found in Vietnam in Huu Lien Nature Reserve in Lang Son province during a field trip in June 2008, in which all three authors participated. One male specimen was netted by Phan Quoc Toan on 8 June 2008. He also collected one other male specimen in Huu Lien during our most recent joint trip there on 19 June 2010. The Xuan Son population is the second known for this species in Vietnam. The habitats of this species are rather open forest streams with rocky bottom and fast running clean water. The species, like its congeners, is more abundant late in the season.

The species was originally described from Hainan Island in China (Wilson & Reels 2001). Since then it has also been recorded from Guanqxi (Wilson & Reels 2003) and from Guangdong (Wilson & Xu 2007).



Figure 37. *Vestalis miao*, teneral ♀, Huu Lien Nature Reserve, Lang Son province – Phan Q.T.



EUPHAEIDAE***Euphaea decorata* Hagen in Selys, 1853**

Specimens collected: 3 ♂, 2 ♀, 7.XII.2009; 10 ♂, 7♀, 13-15.XI.2010; recorded also on 27-29.V.2010.

The male of this species is easy to separate from its Vietnamese congeners by the hyaline forewing and hindwing having a broad dark transverse band. Old males have wholly black thorax, but in younger males the thorax has dusky yellowish stripes. In the female the conspicuously brownish tinted basal area of the wings extends well beyond the nodus (Fig. 38 – 41).

In Vietnam *E. decorata* is known only in the northern part of the country, the southernmost record is from Ha Tinh province. The species is rather local, but can be very abundant where found. It inhabits clean forest streams, also rather open ones, both in lowlands and mountains, at least up to 900 m altitude. Adults are most abundant during the rainy season.



Figure 38. *Euphaea decorata* ♂ wings partly opened, Thien Son, Ba Vi National Park, Hanoi – Do M.C.





Figure 39. *Euphaea decorata* ♂, Xuan Son National Park – Phan Q.T.



Figure 40. *Euphaea decorata* ♀. Tam Dao N.P. Vinh Phuc Province – Do M.C.





Figure 41. *Euphaea decorata*, a close-up of ♀, Tam Dao National Park, Vinh Phuc province
– Do M.C.

***Euphaea masoni* Selys, 1879**

Specimens collected: 3 ♂, 1 ♀, 7.XII.2009; 10 ♂, 10 ♀, 13-15 XI 2010; recorded also on 27-29.V.2010.

The male has a dark body and largely dark wings. In the hindwing only the extreme tip and base are hyaline; in the forewing there is a broad dark band in the middle, extending about half of the total length of the wing. The female has either nearly hyaline wings or with the basal part slightly brownish tinted, at most to the level of nodus (Fig. 42 & 43).



Superficially *E. masoni* resembles its two congeners, *Euphaea guerini* Rambur, 1842 (Fig. 44 & 45) and *E. hirta* Hämäläinen & Karube, 2001, both species originally described from specimens from Vietnam. *E. guerini* and *E. masoni* were always treated as two distinct species, until Asahina (1977, 1985, 1996) created some confusion in the taxonomy of these insects by ranking *E. masoni* as subspecies of *E. guerini*. As pointed out by van Tol & Rozendaal (1995) and Hämäläinen & Karube (2001) these two taxa are structurally clearly distinct species, which often occur sympatrically, even in the same streams. In Vietnam *E. masoni* is widespread and quite common stream species.

E. masoni, the type locality of which is Tenessarim in Lower Burma, seems to show some geographical variation within its extensive range extending from the southernmost tip of Thailand to Nagaland in India in the west and to Yunnan and Guanqxi in China in the north. This variability is worth further study.



Figure 42. *Euphaea masoni* ♂ opens its wings, showing a flash of coppery red iridescence, Truong Xuan commune, Quang Binh province – Do M.C.





Figure 43. *Euphaea masoni* ♀, Xuan Son National Park – Phan Q.T.



Figure 44. *Euphaea guerini* ♂, with distinct bluish green shine in opened hindwings. Hang Chuon, Truong Xuan, Quang Binh province – Do M.C.





Figure 45. *Euphaea guerini* ♂, a species not yet recorded in Xuan Son, has a distinct bluish shine in hindwings. Huu Lien Nature Reserve, Lang Son province – Phan Q.T.

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References

- Asahina, S. 1976. Descriptions of one new genus and two new species of Caliphaeinae (Odonata, Calopterygidae) from Thailand, with taxonomic notes of the subfamily. *Kontyû* 44(4): 387-402.
- Asahina, S. 1977. On a small collection of the Odonata from Laos. *Kontyû* 45(2): 165-184.
- Asahina, S. 1985. A list of the Odonata recorded from Thailand. Part XI. Euphaeidae. *Chô Chô* 8(12): 18-38.
- Asahina, S. 1996. Records of the northern Vietnamese odonata taken by the expedition members from the National Science Museum, Tokyo. 4. Libellaginidae, Euphaeidae, Calopterygidae and Amphipterygidae. *Bulletin of the National Science Museum, Tokyo, Series A (Zoology)* 22(4): 189-198.
- Do, M.C. 2008. *Noguchiphaea mattii* sp. nov. from southern Vietnam (Odonata: Calopterygidae). *International Journal of Odonatology* 11(1): 27-34, pl. II excl.
- Do, M.C. & Dang T. H. 2007. Checklist of dragonfly from Vietnam. Vietnam National University Publisher, Hanoi. v + 181 pp.
- Fraser, F.C. 1935. New oriental dragonflies (Order Odonata). *Records of the Indian Museum* 37: 321-333.
- Hämäläinen, M. 2004. Critical species of Odonata in Thailand and Indochina. *International Journal of Odonatology* 7(2): 295-304.
- Hämäläinen, M. & S. Divasiri. 1997. *Rhinocypha arguta* n. sp., a new jewel-damselfly from north-east Thailand (Odonata: Chlorocyphidae). *Entomologische Zeitung* 107(5): 201-204.
- Hämäläinen, M. & H. Karube. 2001. Two new species of Caloptera damselflies from southern Vietnam (Zygoptera: Chlorocyphidae, Euphaeidae). *Odonatologica* 30(2): 209-215.
- Orr, A.G. & M. Hämäläinen. 2007. The metalwing demoiselles (Neurobasis and Matronoides) of the Eastern tropics: their identification and biology. Natural History Publications (Borneo), Kota Kinabalu. x + 115 pp.



- van Tol, J. & F. G. Rozendaal. 1995. Records of Calopterygoidea from Vietnam, with descriptions of two new species (Zygoptera: Amphipterygidae, Calopterygidae, Chlorocyphidae, Euphaeidae), *Odonatologica* 24(1): 89 – 107.
- Wilson, K.D.P. & G.T. Reels. 2001. Odonata of Hainan, China. *Odonatologica* 30(2): 145-208.
- Wilson, K.D.P. & G.T. Reels. 2003. Odonata of Guangxi Zhuang autonomous region, China, part I: Zygoptera. *Odonatologica* 32(3): 237-279.
- Wilson, K.P.D. & Z. Xu. 2007. Odonata of Guangdong, Hong Kong and Macau, South China, part I: Zygoptera. *International Journal of Odonatology* 10(1): 87-128, pls. I-VIII excl.

