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133

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Checklist of damselflies (Odonata: Zygoptera) from Kon Ka Kinh National Park of the Central Highlands of Vietnam

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Abstract

A checklist of 49 damselfly species from 12 families (Odonata: Zygoptera) recorded from Kon Ka Kinh National Park is provided. A first description of the female *Protosticta socculus* Phan & Kompier, 2016, is given. *Burmargiolestes* cf. *laidlawi* Lieftinck, 1960 and three apparently new species, two *Coeliccia* and one *Protosticta* species, are recorded, all of which are to be described in the future.

Key words: Odonata, damselfly, checklist, Kon Ka Kinh National Park

Introduction

Kon Ka Kinh National Park, situated in Gia Lai Province of the Central Highlands of Vietnam, was established in 1986. It has a management area of 417.8 km^2. The park has been selected as to one of the ASEAN Heritage Parks on account of its high biodiversity. However, the Odonata fauna from this area is poorly known with only six recorded damselfly species: *Coeliccia lecongcoi* Phan, 2019, *Cryptophaea vietnamensis* (van Tol & Rozendaal, 1995), *Indocnemis marijanmatoki* Phan, 2018, *Indocnemis orang* (Förster in Laidlaw, 1907), *Indolestes cyaneus* (Selys, 1862) and *Sinolestes editus* Needham, 1930 (Phan 2018, 2019; Phan et al. 2018, 2019; To & Phan 2019). Here we provide a checklist of 50 damselfly species from 12 families collected from six different sites in the Kon Ka Kinh National Park during six field trips between 2013–2019. The female of *Protosticta socculus* is described for the first time. We provide records of *Burmargiolestes* cf. *laidlawi* and a brief comparison between this species and *B. melanothorax* (Selys, 1891), including a discussion of its distribution. Three recorded species, two *Coeliccia* Kirby, 1890 and one *Protosticta* Selys, 1885 have not been described and will be published in the future.

Material and Methods

Sampling sites

We conducted there six field trips to six collecting locations ('Loc.') inside the Kon Ka Kinh National Park (Fig. 1-3) as follows: Trip 1: from 20-IV-2013 to 25-IV-2013; Trip 2: from

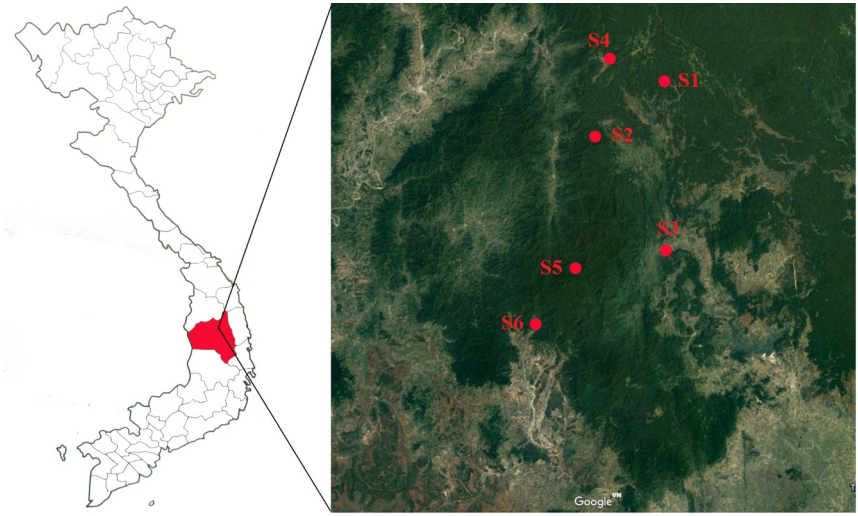

Figure 1. Location of KonKaKinh National Park in Vietnam and the collecting sites.

12-III-2017 to 14-III-2017; Trip 3: from 1-IV-2018 to 9-IV-2018; Trip 4: from 15-IV-2018 to 18-IV-2018; Trip 5: from 20-V-2018 to 26-V-2018; Trip 6: from 26-VI-2019 to 1.VII.2019. All sampling locatities were visited at each field trip. Exact sampling dates are omitted in cases the taxa are common and widespread in the National Park. Locally rare taxa are documented with sampling dates.

Loc. 1 (L1): A marsh near a hydro electric dam at Dak Roong Commune, K'Bang District, Gia Lai Province (14.684N, 108.766E, alt. 923 m).

Loc. 2 (L2): A shaded shallow narrow forest mountain stream (about 1–3 m width), Dak Hro village, Dak Roong Commune, K'Bang District, Gia Lai Province (14.366N, 108.410E, alt. 1,420 m).

Loc. 3 (L3): Ka Pang stream, an open rocky stream in primary forest in Ko Roong Commune, K'Bang District, Gia Lai Province (14.3064N, 108.4488E, alt. 633 m).

Loc. 4 (L4): Several streams with many large rocks in Kon Bong village, Dak Roong Commune, K'Bang District, Gia Lai Province (14.4962N, 108.4091E, alt. 1,081 m).

Loc. 5 (L5): A mountain forest stream near the top of a mountain in Ayun Commune, Mang Yang District, Gia Lai Province (14.22365 N, 108.33409 E, alt. 1,340 m).

Loc.6 (L6): Several mountain forest streams near the Station of the Frankfurt Zoological Society, Vietnam in Ayun Commune, Mang Yang District, Gia Lai Province (14.367N, 108.536E, alt. 1,000 m).

Collecting and preservation of specimens

Collection and preparation of material follows Phan & To (2019). Photos of damselflies in nature were taken with a digital Nikon D850 camera with a Nikon AF Micro 200 mm f/4.0D lens.

Figure 2. Habitat and activities. (A), the first author collecting specimens at location S1; (B), two other expedition members, Mr. Pham Anh Tuan and Ms. Ta Phuong Mai on the trail to the mountain top of S2; (C), Ka Pang stream, S3; (D), a stream at S4.

Figure 3. Habitat and activities. (A), the authors at the No. 4 Ranger Station of the park, near S3; (B), the first author standing at a giant root on the trail to S6; (C) the small and slow water stream of S5; (D), Kon Bong waterfall, S4.

Results

Calopterygidae

Archineura hetaerinoides Fraser, 1933

L3, 6 (observation)

Archineura hetaerinoides is widespread in northern Vietnam (Do & Dang 2007, Kompier pers. comm.), but our records from the Central Vietnam extend its known range much further south. Here we provide the updated information of its distribution of in Vietnam as follows: Cao Bang Prov. (Cun stream, about 2km from Cao Bang city, and Pia Oac National Park, Nguyen Binh District), Lang Son Prov. (Mau Son mountain), Phu Tho Prov. (Xuan Son National Park), Yen Bai Prov. (Tu Le town), Ha Giang Prov. and Lao Cai Prov., all in northern Vietnam; Ha Tinh Prov. (Son Kim Commune, Huong Son District), Quang Nam Prov. (Deo Lo Xo of Phuoc Son District), Kon Tum Prov. (Ngoc Linh Commnue of DakGlei District), Gia Lai Prov. (Kon Ka Kinh National Park) and Lam Dong Prov. (Bidoup Nui Ba National Park), all in central Vietnam including the Central Highlands. Specimens from most of these localities are deposited in the private collection of the first author.

Figure 4. Species in nature, ♂. (A), *Matrona basilaris*; (B), *Euphaea ochracea*; (C), *Rhinocypha watsoni*; (D), *Aristocypha fulgipennis*.

Matrona basilaris Selys, 1953 (Figure 4A)

L2 (2♂♂, , 24.v.2018)

Mnais mneme Ris, 1916

L2, 5, 6, (observation)

Neurobasis chinensis (Linnaeus, 1758)

L2, 5, 6 (observation)

Vestalis gracilis (Rambur, 1842)

L2, 5, 6 (observation)

Chlorocyphidae

Aristocypha fenestrella (Rambur, 1842)

L2–6 (observation)

Aristocypha fulgipennis (Guérin, 1831) (Figure 4D)

L1 (3♂♂, 1♀, 24.v.2018), **L3, 4** (observation)

Heliocypha perforata (Percheron, 1835)

L2 (3♂♂, 4♀♀, 24.v.2018)

Heliocypha biforata (Selys, 1859)

L2 (1♂1♀, 24.v.2018)

Libellago lineata (Burmeister, 1839)

L2 (1♂, 24.v.2018)

Figure 5. Species in nature, ♂. (A), *Rhinocypha seducta*; (B), *Protosticta ngoai*; (C), *Burmargiolestes* cf. *laidlawi*, female; (D), *Burmargiolestes* cf. *laidlawi*, male.

Rhinocypha seducta Hämäläinen & Karube, 2001 (Figure 5A)

L4 (2♂♂, , 28.vi.2019)

This was originally described from Lam Dong Province, southern Vietnam and was recently recorded in Mondulkiri Province, Cambodia (Kosterin 2016). In Vietnam, this species is also found in Dong Nai Prov. (Cat Tien National Park) (Kompier 2019), Gia Lai Prov. (K'BangDistrict), KonTum Prov. (Chu Mom Ray National Park & Mang Den, Kon Plong District) and Dak Lak Prov. (Chu Yang Sin National Park) (Phan personal unpublished data).The female is still undescribed.

Rhinocypha watsoni van Tol & Rozendaal, 1995 (Figure 4C)

L2 (1♂, 23.v.2018), **L6** (1♂, 23.iv.2013; 3♂♂, , 20.v.2018)

Coenagrionidae

Agriocnemis pygmaea (Rambur, 1842)

L6 (4♂♂, 2♀♀, 21.iv.2019)

Agriocnemis rubescens (Selys, 1877)

L6 (2♀♀, 20.iv.2019)

Ceriagrion fallax Ris, 1914

L1 (2♂♂, 2♀, 24.v.2018)

Ischnura senegalensis (Rambur, 1842)

L6 (3♂♂, , 21.iv.2019)

Pseudagrion pruinosum (Burmeister, 1839)

L4 (2♂♂, , 28.vi.2019), **L6** (1♂, 21.iv.2019)

Devadattidae

Devadatta cyanocephala Hämäläinen, Sasamoto & Karube, 2006

L1–6 (observation)

Euphaeidae

Anisopleura bipugio Hämäläinen & Karube, 2013 (Figure 6)

L6 (2♂♂, , 20.v.2018)

Figure 6. *Anisopleura bipugio*, ♂ and close-up of the prothorax showing the two long processes.

Cryptophaea vietnamensis (van Tol & Rozendaal, 1995)

L2 (1♂2♀♀, 24.v.2018), **L3** (2♂♂, , 20.iv.2019), **L6** (1♂, 20.v.2018)

Euphaea guerini Rambur, 1842

L2, 3, 5, 6 (observation)

Euphaea masoni Selys, 1879

L3 (observation)

Euphaea ochracea Selys, 1859 (Figure 4B)

L3 (1♂, 28.vi.2019), **L4** (1♂, 27.vi.2019)

Lestidae

Indolestes cyaneus (Selys, 1862) (Figure 7)

L2 (specimens were listed in Phan et al. 2019)

Orolestes octomaculatus Martin, 1904

L1 (1♂, 12.iii.2017)

Figure 7. *Indolestes cyaneus*, (A), male & (B), in copulation.

Philogangidae

Philoganga loringae Fraser, 1928 (Figure 8)

L1 (1♂, 27.vi.2019)

New record to Vietnamese fauna. Up to now, only two species of *Philoganga*, *P. robusta* Navás, 1936 and *P. vetusta* Ris, 1912, have been recorded in Vietnam. However, it is questionable whether these are separate species. There are no obvious differences in their appendages or genital ligula. Nevertheless colour has been used to identify them. Larger specimens lacking orange on the thorax and abdomen have been identified in Vietnam as *robusta* and specimens with orange that average smaller have been identified as *vetusta* (Kompier pers. comm.). Wilson & Reels (2001) mention other characters to separate the species, but at least in Vietnam these characters are not reliable and appear age related (Kompier 2019; Kompier in litt.) Structure of appendages and genital ligula of the examined *P. loringae* does not provided any difference characters from our specimens of *P. vetusta* from Xuan Son National Park, Phu Tho Province, Tu Le, Yen Bai Province or Pia Oac Nature Reserve, Cao Bang Province, all from northern Vietnam, or from Ba Na Nature Reserve of Da Nang city, central Vietnam. However, in both *P. vetusta* and *P. robusta* (sensu Kompier 2019), the pale or orange pattern on the abdomen of the mature male does not extend beyond S7, wheres is reaches S10 in *P. loringae* (Figure 8). We also collected *Philoganga loringae* with the same abdominal pattern as the K'Bang's specimen from Dak Et, Dak Glei District of Kon Tum Province (1♂1♀, 14.vi.2018, Q.T. Phan leg.; 1♂1♀, same location and collector, 30.iv.2019). It should be note here that, Kompier (in litt.) also recorded *P. loringae* near K'Bang town on 20.vi.2016 (1 male).

Figure 8. *Philoganga loringae*, male

Philosinidae

Rhinagrion hainanensis Wilson & Reels, 2003 (Figure 9A-B)

L3 (1♂, 28.vi.2019), **L6** (3♂♂, , 20.iv.2019)

Figure 9. *Rhinagrion hainanensis*, (A), male & (B), female.

Figure 10. *Calicnemia akahara*, (A), male & (B), in copula.

Platycnemididae

Calicnemia miles (Laidlaw, 1917)

L2 (3♂♂, 1♀, 24.v.2018), **L2** (2♂♂, 1♀, 20.iv.2019), **L6** (4♂♂, , 4.iv.2018)

Calicnemia akahara Phan, Karube & Kompier, 2016 (Figure 10A)

L1 (1♂, 24.v.2018), **L3** (3♂♂, 2♀♀, 28.vi.2019)

Coeliccia hayashii Phan & Kompier, 2016 (Figure 11A-B)

L1 (7♂♂, , 24.v.2018; 5♂♂, 2♀♀, 28.vi.2019)

Coeliccia hayashii has to date only been found in some locations of K'Bang District of Gia Lai Province. The female will formally be published in Kompier et al. (in prep.). We collected a pair shown in Figure 14B.

Coeliccia lecongcoi Phan, 2019

L6 (specimens were listed in Phan 2019)

Coeliccia mientrung Kompier & Phan, 2017

L1 (3♂♂, 1♀, 24.v.2018), **L3** (1♂, 20.iv.2019), **L6** (2♂♂, , 20.v.2018)

Coeliccia sp.

L1 (2♂♂, , 24.v.2018), **L3** (9♂♂, 5♀♀, 28.vi.2019)

This new species is similar to C. *phamiha* Phan & Tran, 2018 by having a large azure stripe on dorsal synthorax but differs by body coloration, the male appendages and female prothorax structure.

Coeliccia sp.

L5 (7♂♂, 5♀♀, 20.iv.2019)

This new species is similar to the widespread *C. scutellum* Laidlaw, 1932 but lacks the two oval yellow spots on the male synthorax and differs from *C. scutellum* by the structure of male genital ligula and female prothorax.

Coeliccia rolandorum Kosterin & Kompier, 2017

L1, 3 (observation), **L2** (5♂♂, 2♀♀, 24.v.2018)

Coeliccia schorri Phan & To, 2019 (Figure 11C)

L1, 2 (specimens were listed in Phan & To 2019)

Figure 11. *Coeliccia* spp. (A), *C. hayashii*, ♂; (B), *C. hayashii* in copula; (C), *C. schorri*, ♂.

Coeliccia scutellum Laidlaw, 1932

L1, 2, 3, 4, 6 (observation)

Copera marginipes (Rambur, 1842)

L1, 2, 5, 6 (observation)

Pseudocopera vittata (Selys, 1863)

L1, 2, 6 (observation)

Indocnemis marijanmatoki Phan, 2018

L2 (specimens were listed in Phan 2018)

Indocnemis orang (Forster in Laidlaw, 1907)

L1, 3, 4, 6 (observation)

Prodasineura autumnalis (Fraser, 1922)

L2 (3♂♂, , 1♀, 24.v.2018)

Prodasineura croconota Ris, 1916 (Figure 12A)

L1, 4 (observation), **L3** (3♂♂, , 2♀♀, 28.vi.2019), **L6** (4♂♂, , 3♀♀, 20.v.2018)

Prodasineura doisuthepensis Hoess, 2007 (Figure 12B)

L1 (5♂♂, , 24.v.2018), **L2** (3♂♂, , 23.v.2018), **L3** (3♂♂, 2♀♀, 28.vi.2019)

This is the first report for Vietnamese fauna in scientific literature although Kompier

Figure 12. *Prodasineura* spp., ♂. (A), *P. croconota* & (B), *P. doisuthepensis*.

(2019) recorded this species on his internet blog. *P. doisuthepensis* was originally described from Doi Suthep National Park, North Thailand (Hoess 2007) and was then recorded in Laos by Yokoi & Souphanthong (2014) and in Cambodia by Kosterin (2016).

Platystictidae

Protosticta caroli van Tol, 2008

L2 (4♂♂, , 23.v.2018), **L6** (9♂♂, , 3♀♀, 20.v.2018)

Protosticta socculus Phan & Kompier, 2016 (Figures 13A-B, 14A-C)

L1 (5♂♂, 1♀, 20.v.2018), **L3** (7♂♂, , 4♀♀, 28.vi.2019)

Protosticta socculus was originally described from Quang Nam Province, central Vietnam based on male specimens (Phan & Kompier 2016). This species is characterized by the male paraprocts with a hollowed out apical half, often decidedly slipper-shaped, with a long spine on their posterior margin (fig. 7D, E in Phan & Kompier 2016). Here we describe the female as follows: Head (Fig. 14A-B). Labrum, genae and anteclypeus pale blue, inferior margin of labrum broadly edged with black. Antennae dark yellowish, second segment brown apically, other segments missing. Epicranium, including postclypeus black. Prothorax yellowish with posterior pronotal lobe black (Fig. 14A). Synthorax black with two distinct yellowish stripes on metepisternum and metepimeron as in Fig. 14A. Legs mostly pale yel-

Figure 13. *Protosticta socculus*, (A), male & (B), female.

low but spines and claws brownish. Wings hyaline, 13–14 postnodal crossveins in both wings. Pterostigma brownish, covering one cell. Abdomen: S1 with a large yellowish spot latero-ventrally; S2 dark brown dorsally and pale yellow ventrally; S3–8 dark brown with whitish basal ring, dark brown laterally and posteriorly; S9 dark brown; S10 black (Fig. 13C). Cerci dark yellowish. Ovipositor brown-blackish, yellow apically (Fig. 14C).

Measurements (mm). Hindwing 21, abdomen incl. appendages 35.

Protosticta ngoai Phan & Kompier, 2016

L2 (1♂, 23.v.2018), **L3** (1♂1♀, 28.vi.2019), **L6** (1♂1♀, 20.iv.2019; 1♂, 20.v.2018)

This species was described based on a single male from Quang Binh Province. However, Phan et al. (in prep.) recorded additional populations from Thua Thien - Hue Prov., Quang Nam Prov. and Gia Lai Prov. and include the description of the female based on a specimens from A Luoi Nature Reserve.

Protosticta sp. nov.

L2 (2♂♂, 2♀♀, 24.v.2018)

This is a new species to science that will be described shortly.

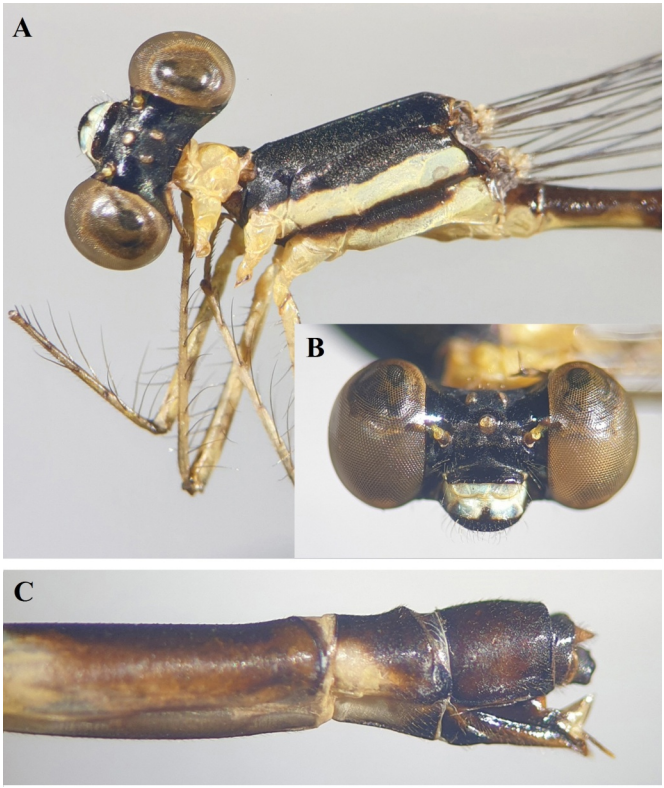

Figure 14. *Protosticta socculus*, ♀. (A), head and thorax, lateral view; (B), head in frontal view; (C), abdominal tip.

Synlestidae

Sinolestes editus Needham, 1930

L2 (specimens were listed in To & Phan 2018)

Incertae sedis group 1

Burmargiolestes cf. *laidlawi* Lieftinck, 1960 (Figures 15C-D, 16A-B)

L2 (1♂, 24.v.2018), **L6** (3♂♂, 1♀, 20.v.2018)

An extensive molecular phylogenetic reconstruction of the Zygoptera, based on mitochondrial (16S, COI) and nuclear (28S) data retained *Burmargiolestes* as a group with unknown or undefined taxonomic relationship (incertae sedis) (Dijkstra et al. 2014).

We collected *Burmargiolestes* specimens from Kon Ka Kinh National Park that appear to be *B. laidlawi* Lieftinck, 1960 on account of its blue face (Fig. 16A-B) as in the original description in Fraser (1933) under *B. melanothorax* and that Lieftinck (1960) correctly established it as a difference species, and by similar appendage morphology (Fig. 16A-B and Fig. 40, p. 90 in Fraser 1933). Kompier

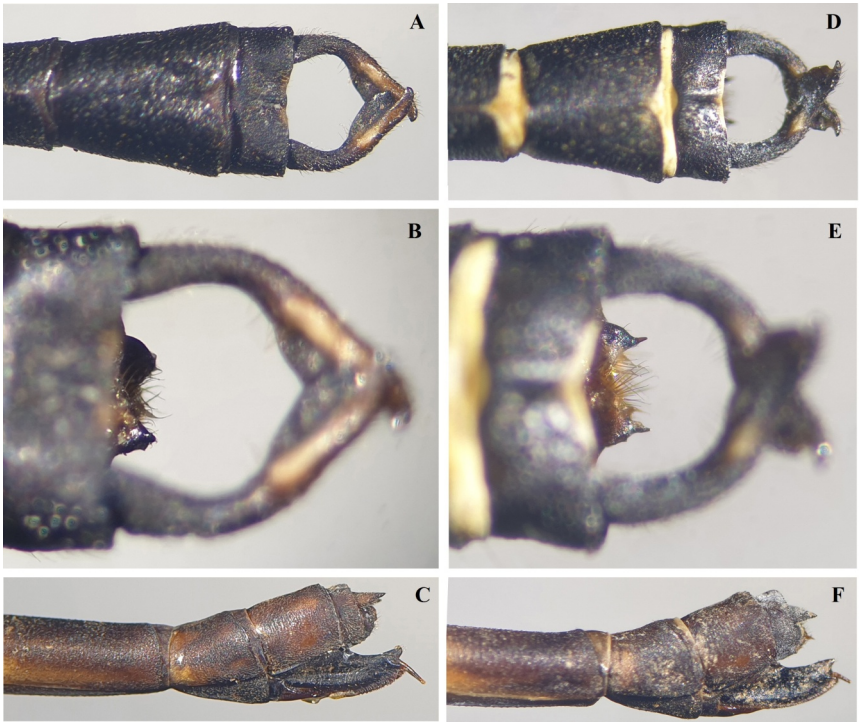

Figure 15. *Burmagiolestes* spp. [A-C] *B.* cf. *laidlawi* & [D-F] *B. melanothorax* (♂ & ♀, Khe Kem, Pu Mat National Park, Nghe An Prov., 14.v.2019, Q.T. Phan leg.). (A, D), abdominal tip including appendages in dorsal view; (B, E), close-up of paraprocts in dorsal view; (C, F), abdominal tip, ♀).

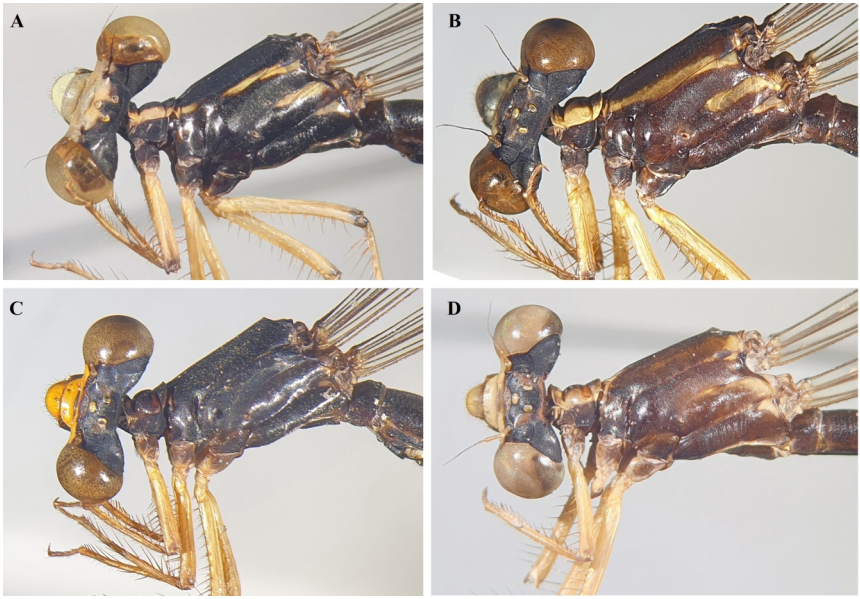

Figure 16. Head and thorax of *Burmargiolestes* spp., ♂ & ♀. (A, B), *B.* cf. *laidlawi* & (C, D), *B. melanothorax*.

(2019) mentions collecting a similar specimen from Quang Nam Prov. and further records by Matti Hämäläinen and Haruki Karube. He also recorded it from Thue Thien-Hue Prov., Quang Binh Prov. and Quang Chi Prov. (Kompier pers. comm.). No males of *Burmargiolestes laidlawi* have to our knowledge been recorded since its description, although Asahina (1985) describes a female (lacking blue face!) from Assam. As Kompier (2019) points out, in view of the large distance to the locations of true *B. laidlawi* (eastern India) and the lack of any records in between India and Vietnam, confirmation of the identity of the Vietnamese specimens as *B. laidlawi* requires further study. Following his view, we therefore publish it here as *B.* cf. *laidlawi*. *Burmargiolestes* Kennedy, 1925 contains only two species, *B. laidlawi*, known up to now only from India and *B. melano-*

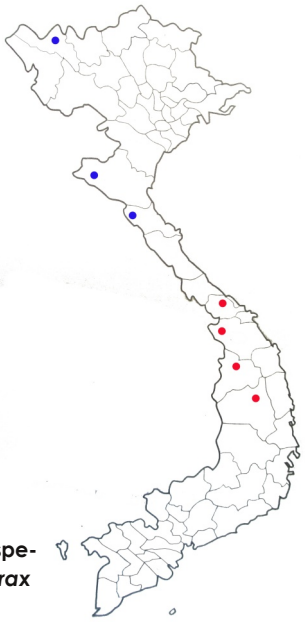

Figure 17. Distribution map of two *Burmargiolestes* species in Vietnam. (●) *B.* cf. *laidlawi*; (●) *B. melanothorax* (Asahina 1997 and own data).

thorax (Selys, 1891) which was known from Thailand, Laos and Vietnam (Asahina 1985, 1997; Fraser 1933, Lieftinck 1960). The latter species was recorded from Lai Chau Prov., North Vietnam by Asahina (1997) and we recently found this species in Pu Mat National Park, Nghe An Prov., and Son Kim, Huong Son District of Ha Tinh Prov., both located in Central Vietnam (Fig. 17). Differences between the two Vietnamese *Burmargiolestes* species are shown in Table 1.

Table 1. Features comparison between the two *Burmargiolestes* species sampled in Vietnam

Characters	*cf. laidlawi*	*melanothorax*
Coloration of labrum, postclypeus and front of head (in male & female)	Pale blue (Fig. 15A-B)	Yellow (Fig. 15C-D)
Male prothorax	Black with a yellow stripe on lateral suture of hind lobe pronotum (Fig. 15A)	Prothorax mostly black (Fig. 15C)
Coloration of male and female synthorax	Black with three yellow stripes (Fig. 16A-B)	Synthorax of male entirely black (Fig. 15C) and with some short yellowish markings on posterior margin of each segment in female (Fig. 15D)
Male abdomen	S8–10 entirely black (Fig. 16A)	S8–9 with white/yellow half rings, S10 entirely black (Fig. 16D)
Appendages	Paraprocts very short, triangular-shaped (Fig. 16B)	Paraprocts elongated, pointed apically (Fig. 16E)

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