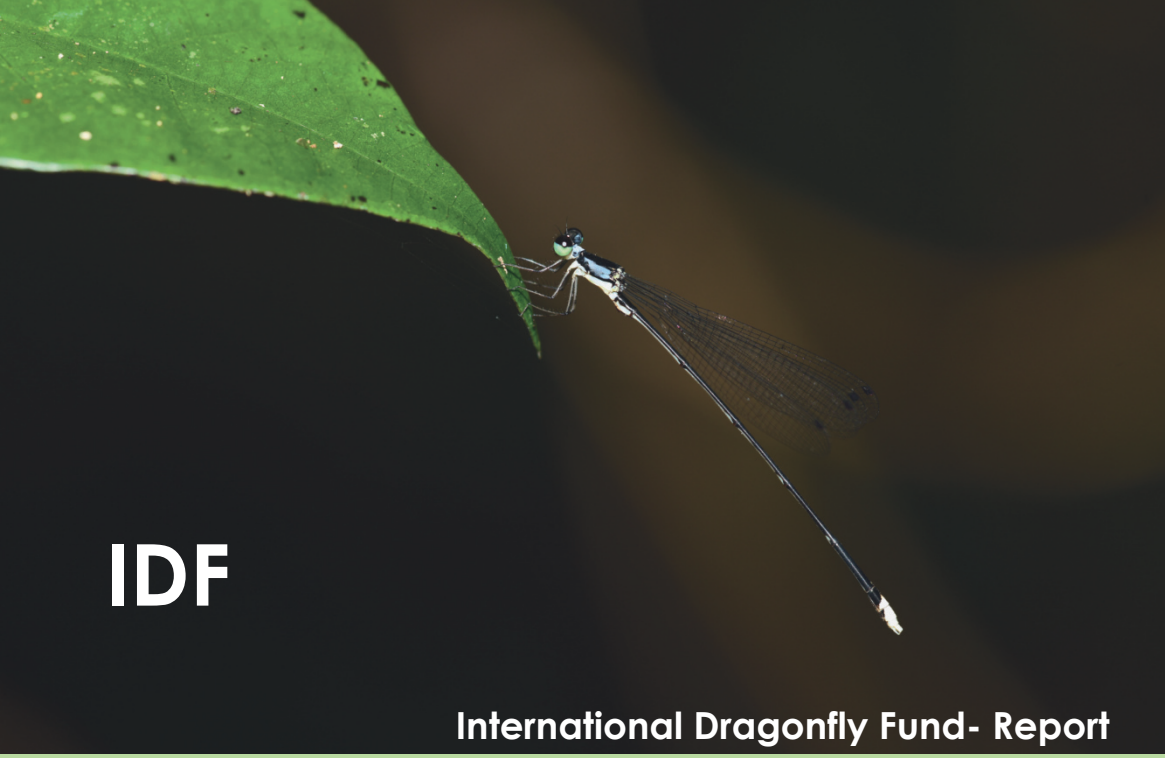

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Contribution to the dragonflies and damselflies (Insecta: Odonata) of Bach Ma National Park, central Vietnam

Phan Quoc Toan[1], Haomiao Zhang[2], Tosaphol Saetung Keetapithchayakul[1], Ruibin Song[2], Pham Quoc Tuan[3] & Nguyen Ba Vu Lam[3]

[1]The Center for Entomology & Parasitology Research, College of Medicine and Pharmacy, Duy Tan University, 120 Hoang Minh Thao, Lien Chieu, Da Nang, Vietnam
Email: pqtoan84@gmail.com (QTP); keetapithchayakul.ts@gmail.com (TSK)

[2]South China DNA Barcoding Center, Kunming Institute of Zoology, Chinese Academy of Sciences, Kunming, PR China
Email: zhanghaomiao@mail.kiz.ac.cn (HZ); 643754724@qq.com (RS)

[3]Department of Science and International Cooperation, Bach Ma National Park, Loc Tri, Phu Loc District, Thua Thien Hue Province
Email: tuanphamquoc@gmail.com (PQT); lamklbachma2014@gmail.com (NBVL)

Abstract

A checklist of 131 dragonfly and damselfly species from Bach Ma National Park of central Vietnam is provided. Of these, 102 species are newly recorded for the National Park. The regional status of *Periaeschna magdalena* Martin, 1909 is discussed and, based on detailed morphological examination, corrected to *Periaeschna yazhenae* Xu, 2012. Morphological differences between *Coeliccia schorri* Phan & To, 2019 from the type locality and specimens from Bach Ma NP are also discussed. Notes on conservation and the regional distribution of dragonflies and damselflies in Bach Ma are included.

Key words: Odonata, checklist, Bach Ma, Vietnam

Introduction

Bach Ma National Park is located in Thua Thien - Hue Province, central Vietnam, and covers an area of 22,031 hectares and a buffer zone of 21,300 hectares. Most of the park is covered by high evergreen forest (ranging in altitude from approximately 1,000 to 1,444 m.a.s.l.) with the highest peak, Mount Mang, about 1,702 m a.s.l. A total of 894 insect species have been recorded in Bach Ma National Park, including 310 of Lepidoptera, 220 of Coleoptera, 60 of Hemiptera, and 304 species of other orders (according to the Geographic book of Thua Thien Hue Province: https://web.archive.org/web/20140508031104/http://www1.thuathienhue.gov.vn/portal_ge/Views/LevDetail.aspx?OneID=2&TwoID=71&ThreeID=698). However, this source of information does not contain any data on the order Odonata.

Prior to this study, most odonate species in Bach Ma National Park were recorded by Karube (2002, 2004, 2011a, 2011b, 2012, 2013, 2014a, 2014b, 2015) and Karube et al. (2020); listing 24 taxa. These include descriptions of nine new species, one new subspecies, and records of 14 additional species:

2002: Descriptions of *Planaeschna bachmaensis* (= *Aeschnophlebia bachmaensis* (Karube, 2002)) and *P. owadai* (= *Aeschnophlebia owadai* (Karube, 2002), per Paulson et al. 2025)

2004: Description of *Planaeschna viridis* (= *Aeschnophlebia viridis* (Karube, 2004)); first description of the female of *A. bachmaensis*, the confirmation of *A. owadai*, and records of *Aeschnophlebia* sp., *Periaeschna magdalena* Martin, 1904 (misidentified, see below), *Polycanthagyna erythromelas* (McLaclan, 1896), *Anax immaculifrons* Rambur, 1842 (= *Anax aurantiacus* Makbun, Wongkamhaeng & Keetapithchayakul, 2022, according to Makbun et al. (2022)), and *Anax nigrofasciatus* Oguma, 1915

2011a, b: Descriptions of *Cephalaeschna asahinai* Karube, 2011, *Planaeschna asahinai* (= *Aeschnophlebia asahinai* (Karube, 2011)) and *Idionyx asahinai* Karube, 2011; records of *Macromia moorei malayana* Laidlaw, 1928, *M. pinratani vietnamica* Asahina, 1996 (= *Macromia pyramidalis pyramidalis* Martin, 1907, per Kosterin & Edelfosse, 2024), and *Procordulia asahinai* Karube, 2007

2012: Record of *Anotogaster klossi* Fraser, 1919

2013: Descriptions of *Chlorogomphus aritai* Karube, 2013 and the subspecies *Ch. nasutus hamalaineni* Karube, 2013; records of *Ch. tunti* Needham, 1930 and *Ch. vietnamensis* Asahina, 1969

2014a, b: Descriptions of *Megalestes australis* Karube, 2014 and *Leptogomphus inouei* Karube, 2014

2015: Records of *Leptogomphus uenoi* Asahina, 1996 and *Macromidia kelloggi* Asahina, 1978

2020: Record of *Amphigomphus nakamurai* Karube, 2001

Phan et al. (2018) recorded three euphaeid species (*Anisopleura bipugio, A. qingyuanensis* and *Cryptophaea vietnamensis*). Phan & Keetapithchayakul (2024) found larvae of *Anisopleura* spp., *Euphaea* spp., *Bayadera* spp., and described *C. vietnamensis*. Kompier et al. (2021) provided photos of *Aeschnophlebia viridis* and *P. asahinai* from Bach Ma species. Kompier (in litt.) also recorded additional species during two visits (5-8 August 2016 and 7 May 2017): *Protosticta socculus, P. ngoai, Mattigomphus tamdaoensis* (Karube, 2001), *Sieboldius nigricolor* (Fraser, 1924), and *Nannophyopsis clara* (Needham, 1930) (see Table 1).

In this study, we present a checklist of 131 odonate species from Bach Ma National Park, compiled from: (1) previously published records, (2) observations by Kompier (in litt.) and (3) eight field surveys conducted by the authors. Of these, 102 species are newly recorded to the park.

Survey Dates and Localities

Field surveys

- QTP: 22-29 July 2017.
- PQT & TSK: 16-20 May 2023; 6-11 August 2023; 9-13 June 2024; 9-15 July 2024; 16-17 November 2024.
- PQT, HZ & RS: 17-21 May 2023; 25-28 April 2024; 6-11 May 2024.

Collecting sites

- S1 (16.1960N, 107.8580E, 1314 m a.s.l.): Nameless reservoir (~20 x 20 m) and rocky stream above it (Figures 1A-B).
- S2 (16.1972N, 107.8579E, 1102 m a.s.l.): Several small streams with partly dense woody shore vegetation along the trail to Do Quyen waterfall (Figure 2 A, C).
- S3: Streams near the Tri Sao trail (16.2236 N, 107.8530 E, 436 m a.s.l.): Open streams with large stones (Figure 3).
- S4 (16.1379°N, 107.8432°E, 127 m a.s.l.): Streams and swamps near Mo Rang Ranger Station (Figure 4A, C).

Material and Methods

To accurately identify species to the species level for some easily confused species or species with a narrow distribution range, we collected specimens from 10:00 AM to 5:00 PM during survey sessions, using hand nets. After collection, the specimens were placed in paper bags for 12-24 hours to empty their bowels. Subsequently, the specimens were immersed in acetone solution for 8-12 hours, then removed and to the acetone will allowed to evaporate completely. The collection time and location were recorded (Bui et al., 2021).

Specimens that are easily confused were studied using a stereomicroscope to clearly visualize the structure of the anal appendages or genitalia. To identify the specimens, several published papers were consulted.

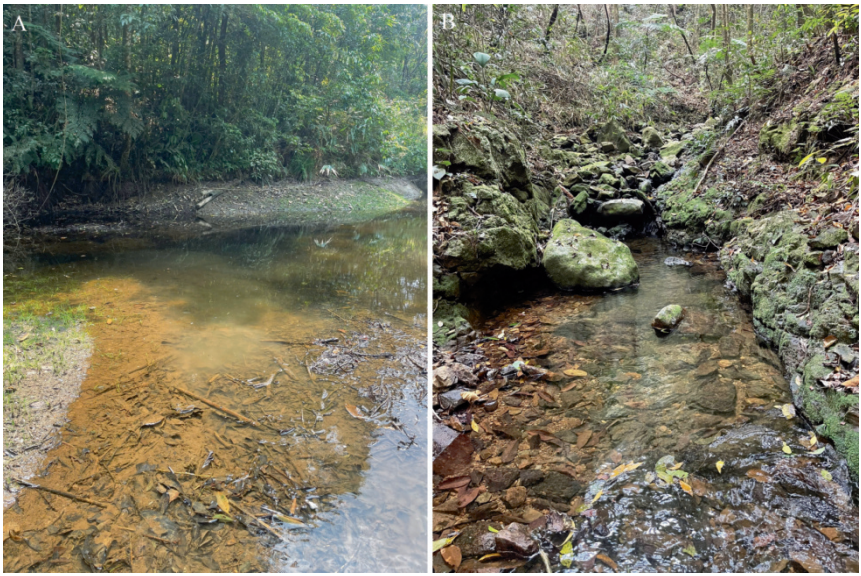

Figure 1. Habitat S1. (A), border of reservoir; (B), the stream flows into the reservoir.

Figure 2. Habitat S2. (A), Ngu Ho (five lakes) stream; (B), the trail to Do Quyen waterfall; (C), small stream near Do Quyen waterfall; (D), forest of Bach Ma, seen from the hotel in S1.

Results

We provide a checklist of 131 odonate taxa (including 53 Zygoptera and 78 Anisoptera) in Bach Ma National Park. This list is based on published sources (Karube 2002, 2004, 2011a, 2011b, 2012, 2013, 2014a, 2014b, 2015); Karube et al. (2020), Phan et al. (2018), Kompier (in litt.), and the authors' field investigations (Table 1).

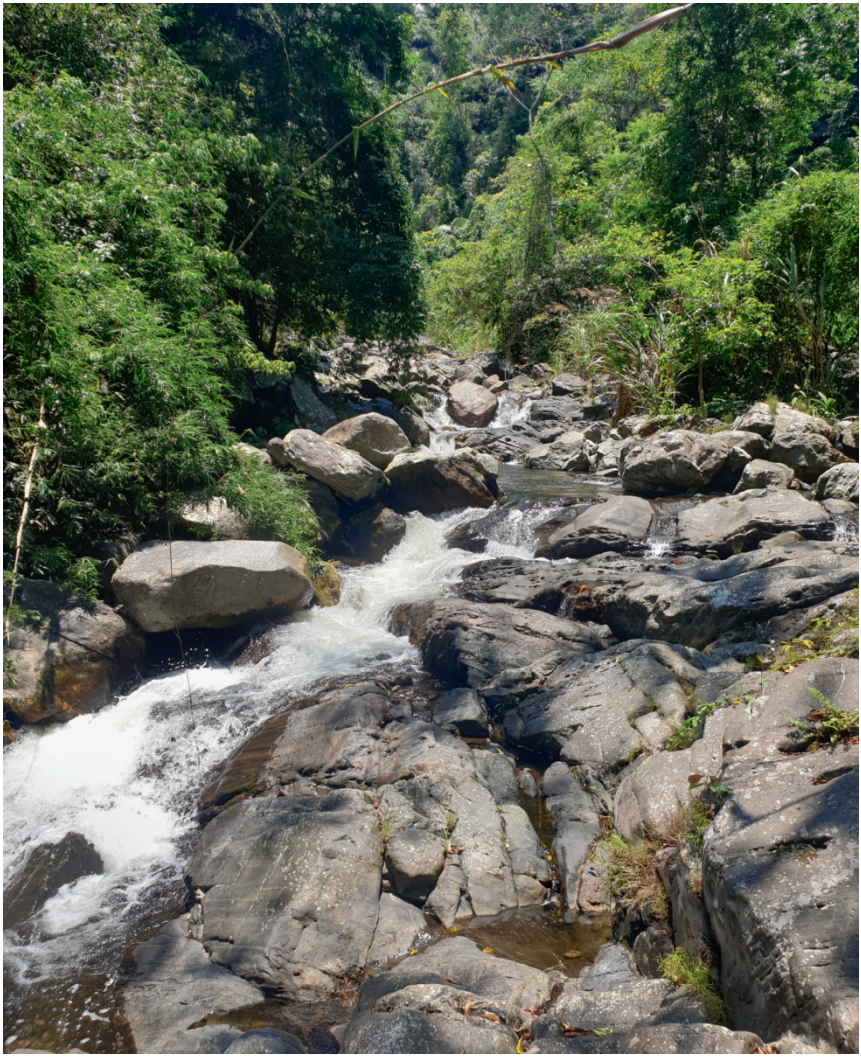

Figure 3: Habitat S3: Streams near the Tri Sao trail.

Notes on some Odonata species in Bach Ma National Park (Figures: see Appendix)

Karube (2004) reported a record of *Periaeschna magdalena* Martin, 1909 in Bach Ma. After careful examination, we identified the specimens from Bach Ma as *Periaeschna yazhenae* Xu, 2012; this species represents a new record for Vietnam. *Periaeschna yazhenae* can be distinguished from *P. magdalena* by the following characteristics: the frons is all dark brown (Figure 9A), whereas *P. magdalena* bears a distinct “T”-shaped mark; the face of *yazhenae* is also dark brown (Figure 9B), in contrast to the lighter, yellow coloration in *P. magdalena*;

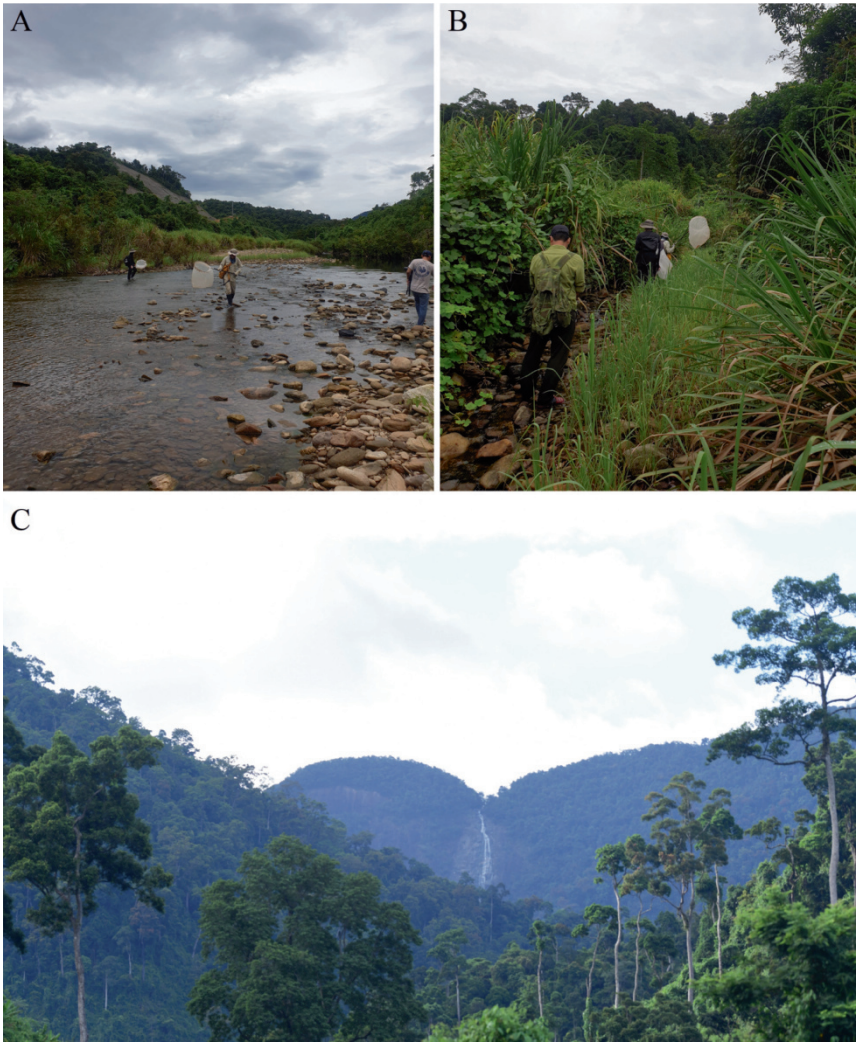

Figure 4. Habitat S4. (A), HZ collected specimens in an open stream of S4; (B), surveyed in a small stream of S4; (C), Do Quyen waterfall, seen from Mo Rang Ranger Station.

the wing-bases of *P. yazhenae* are black (Figure 9A), while those of *P. magdalena* are completely hyaline. Kompier (in litt.) noted that all his specimens previously identified as "*magdalena*" lack the "T" mark on the frons and have darkened wingbases, suggesting they are in fact *P. yazhenae*. Consequently, the presumed occurrence of *P. magdalena* in Vietnam may be due to misidentification. All previous records – and therefore the presence – of *P. magdalena* in Vietnam require further study.

Table 1: List of dragonflies and damselflies of Bach Ma National Park.

No.	Species	Distribution	References
	Zygoptera		
	Calopterygidae		
1	*Caliphaea thailandica* Asahina, 1976	S1,2	this study
2	*Mnais mneme* Ris, 1916	S1,2,3,4	this study
3	*Neurobasis chinensis* (Linnaeus, 1758)	S3,4	Kompier (in litt.); this study
4	*Noguchiphaea yoshikoae* Asahina, 1976	S1,2	this study
5	*Vestalis gracilis* (Rambur, 1842)	S3,4	this study
	Chlorocyphidae		
6	*Aristocypha fenestrella* (Rambur, 1842)	S1,2,3,4	Kompier (in litt.); this study
7	*Aristocypha fulgipennis* (Guérin, 1831)	S3,4	this study
8	*Libellago lineata* (Burmeister, 1839)	S4	this study
9	*Heliocypha perforata* (Percheron, 1835)	S1,2,3,4	this study
10	*Heliocypha biforata* (Selys, 1859)	S4	this study
11	*Rhinocypha watsoni* van Tol & Rozendaal, 1995	S1,2,3,4	Kompier (in litt.); this study
	Coenagrionidae		
12	*Aciagrion borneense* Ris, 1911	S4	this study
13	*Agriocnemis femina* (Brauer, 1868)	S3,4	Kompier (in litt.); this study
14	*Argiocnemis rubescens* Selys, 1877	S4	this study
15	*Ceriagrion auranticum* Fraser, 1922	S4	this study
16	*Ceriagrion fallax* Ris, 1914	S1,3,4	this study
17	*Ischnura senegalensis* (Rambur, 1842)	S4	this study
18	*Mortonagrion aborense* (Laidlaw, 1914)	S4	this study
19	*Pseudagrion pruinosum* (Burmeister, 1839)	S3,4	this study
20	*Pseudagrion rubriceps* Selys, 1876	S4	this study
	Devadattidae		
21	*Devadatta cyanocephala* Hämäläinen, Sasamoto & Karube, 2006	S3,4	Kompier (in litt.); this study
	Euphaeidae		
22	*Anisopleura bipugio* Hämäläinen & Karube, 2013	S1,2	Phan et al. (2018); Kompier (in litt.); this study
23	*Anisopleura qingyuanensis* Zhou, 1982	S1	Phan et al. (2018); Kompier (in litt.); this study
24	*Bayadera hyalina* Selys, 1879	S1,2	Kompier (in litt.); this study
25	*Cryptophaea vietnamensis* (van Tol & Rozendaal, 1995)	S1,2	Phan et al. (2018); Kompier (in litt.); this study
26	*Euphaea guerini* Rambur, 1842	S3,4	this study
27	*Euphaea masoni* Selys, 1879	S3,4	this study
28	*Euphaea ochracea* Selys, 1859	S1,2,3,4	this study
29	*Euphaea saola* Phan & Hayashi, 2017	S1,2	Kompier (in litt.); this study
	Philogangidae		
30	*Philoganga vetusta* Ris, 1912	S1,2,3,4	Kompier (in litt.); this study
	Philosinidae		
31	*Rhinagrion hainanense* Wilson & Reels, 2003	S3,4	this study
	Platycnemididae		
32	*Calicnemia akahara* Phan, Karube & Kompier, 2016	S1,2	Kompier (in litt.); this study
33	*Calicnemia miles* (Laidlaw, 1917)	S3,4	this study
34	*Coeliccia diomedea* Kompier, Dow & Steinhoff, 2020	S3,4	this study
35	*Coeliccia cyanomelas* Ris, 1912	S1,2	Kompier (in litt.); this study

No.	Species	Distribution	References
36	*Coeliccia mientrung* Kompier & Phan, 2017	S1,2	Kompier (in litt.); this study
37	*Coeliccia phamiha* Phan & Tran, 2018	S4	this study
38	*Coeliccia scutellum* Laidlaw, 1932	S3,4	Kompier (in litt.); this study
39	*Coeliccia schorri* Phan & To, 2019	S3,4	this study
40	*Copera marginipes* (Rambur, 1842)	S3,4	this study
41	*Copera vittata* (Selys, 1863)	S3,4	this study
42	*Onychargia atrocyana* Selys, 1865	S3,4	this study
43	*Pseudocopera ciliata* (Selys, 1863)	S4	this study
44	*Indocnemis orang* (Forster in Laidlaw, 1907)	S1,2,3,4	Kompier (in litt.); this study
45	*Prodasineura autumnalis* (Fraser, 1922)	S3,4	Kompier (in litt.); this study
46	*Prodasineura croconota* Ris, 1916	S3,4	this study
	Platystictidae		
47	*Protosticta caroli* van Tol, 2008	S1,2,3,4	Kompier (in litt.); this study
48	*Protosticta grandis* (Asahina, 1984)	S4	this study
49	*Protosticta ngoai* Phan & Kompier, 2016	S1,2,3	Kompier (in litt.)
50	*Protosticta socculus* Phan & Kompier, 2016	S1	Kompier (in litt.)
	Rhipidolestidae		
51	*Agriomorpha fusca* May, 1933	S1,2	this study
52	*Burmagiolestes cf. laidlawi* Lieftinck, 1960	S2	Kompier (in litt.); this study
	Synlestidae		
53	*Megalestes australis* Karube, 2014	S1,2	Karube (2014a); Kompier (in litt.); this study
	Anisoptera		
	Aeshnidae		
54	*Aeschnophlebia asahinai* (Karube, 2011)	S1,2	Karube (2004)
55	*Aeschnophlebia bachmaensis* (Karube, 2002)	S1	Karube (2002, 2004); this study
56	*Aeschnophlebia owadai* (Karube, 2002)		Karube (2002)
57	*Aeschnophlebia viridis* (Karube, 2004)	S1,2	Karube (2004); Kompier (in litt.); this study
58	*Aeschnophlebia* sp.		Karube (2004)
59	*Anax aurantiacus* Makbun, Wongkamhaeng & Keetapithchayakul, 2022	S2	Karube (2004); this study
60	*Anax guttatus* (Burmeister, 1839)	S1	Kompier (in litt.); this study
61	*Anax nigrofasciatus* Oguma, 1915	S1,2	Karube (2004); Kompier (in litt.);
62	*Cephalaeschna asahinai* Karube, 2011	S1	Karube (2011); Kompier (in litt.); this study
63	*Gynacantha ryukyuensis* Asahina, 1965	S1,2	this study
64	*Periaeschna yazhenae* Xu, 2012	S1,2	Karube (2004); Kompier (in litt.); this study
65	*Polycanthagyna erythromelas* (McLachlan, 1896)	S1,2	Karube (2004); Kompier (in litt.); this study
66	*Tetracanthagyna waterhousei* McLachlan, 1898	S3,4	this study
	Chlorogomphidae		
67	*Chlorogomphus aritai* Karube, 2013	S1,2	Karube (2013); this study
68	*Chlorogomphus nasutus hamalaineni* Karube, 2013	S1,2	Karube (2013); Kompier (in litt.); this study
69	*Chlorogomphus sachiyoae* Karube, 1995	S2	This study

No.	Species	Distribution	References
70	*Chlorogomphus tunti* Needham, 1930	S1,2	Karube (2013); Kompier (in litt.); this study
71	*Chlorogomphus vietnamensis* Asahina, 1969	S2,3,4	Karube (2013); this study
	Corduliidae		
72	*Procordulia asahinai* Karube, 2007	S2	Karube (2011); this study
	Cordulegastridae		
73	*Anotogaster klossi* Fraser, 1919	S1,2	Karube (2012); Kompier (in litt.); this study
	Gomphidae		
74	*Amphigomphus nakamurai* Karube, 2001		Karube et al. (2020)
75	*Burmagomphus vermicularis* (Martin, 1904)	S4	this study
76	*Davidius* sp.	S1	this study
77	*Ictinogomphus pertinax* (Selys, 1854)	S3,4	this study
78	*Gomphidia kruegeri* Martin, 1904	S4	this study
79	*Gomphidictinus kompieri* Karube, 2016	S3,4	this study
80	*Heliogomphus aluoiensis* Karube, Phan & Ngo, 2020	S1,2	this study
81	*Heliogomphus chaoi* Karube, 2004	S4	this study
82	*Lamelligomphus camelus* (Martin, 1904)	S3,4	this study
83	*Lamelligomphus vietnamensis* Karube, 2015	S3,4	this study
84	*Leptogomphus inouei* Karube, 2014	S1,2,3,4	Karube (2014b)
85	*Leptogomphus uenoi* Asahina, 1996	S3,4	Karube (2015)
86	*Mattigomphus tamdaoensis* (Karube, 2001)	S1	Kompier (in litt.)
87	*Megalogomphus sommeri* (Selys, 1854)	S3,4	this study
88	*Melligomphus phantoani* (Ngo & Nguyen, 2021)	S1	Kompier (in litt.); this study
89	*Merogomphus pavici* (Martin, 1904)	S4	this study
90	*Paragomphus capricornis* (Förster, 1914)	S3,4	this study
91	*Sieboldius nigricolor* (Fraser, 1924)	S1	Kompier (in litt.)
	Libellulidae		
92	*Aethriamanta gracilis* (Brauer, 1878)	S4	this study
93	*Acisoma panorpoides* Rambur, 1842	S4	Kompier (in litt.); this study
94	*Atratothemis reelsi* Wilson, 2005	S1,2	this study
95	*Brachydiplax chalybea chalybea* Brauer, 1868	S4	Kompier (in litt.); this study
96	*Brachythemis contaminata* (Fabricius, 1793)	S3,4	this study
97	*Cratilla lineata* (Brauer, 1878)	S4	this study
98	*Crocothemis servilia* (Drury, 1773)	S3,4	Kompier (in litt.); this study
99	*Diplacodes trivialis* (Rambur, 1842)	S1,3,4	Kompier (in litt.); this study
100	*Hydrobasileus croceus* (Brauer, 1867)	S4	this study
101	*Lathrecista asiatica* (Fabricius, 1798)	S3,4	this study
102	*Lyriothemis* sp.	S1,2	this study
103	*Lyriothemis bivittata* (Rambur, 1842)	S3,4	this study
104	*Nannophyopsis clara* (Needham, 1930)	S1	Kompier (in litt.)
105	*Neurothemis fulvia* (Drury, 1773)	S4	this study
106	*Neurothemis tullia* (Drury, 1773)	S4	this study
107	*Onychothemis testacea* Laidlaw, 1902	S3,4	this study
108	*Orthetrum chrysis* (Selys, 1891)	S3,4	this study
109	*Orthetrum glaucum* (Brauer, 1865)	S3,4	Kompier (in litt.); this study
110	*Orthetrum pruinosum* Burmeister, 1839	S3,4	this study

No.	Species	Distribution	References
111	*Orthetrum sabina* (Drury, 1770)	S3,4	Kompier (in litt.); this study
112	*Orthetrum triangulare* (Selys, 1878)	S3	this study
113	*Pantala flavescens* (Fabricius, 1798)	S3,4	Kompier (in litt.); this study
114	*Potamarcha congener* (Rambur, 1842)	S4	this study
115	*Pseudothemis zonata* (Burmeister, 1839)	S4	this study
116	*Rhyothemis plutonia* Selys, 1883	S1,2,3,4	this study
117	*Rhyothemis triangularis* Kirby, 1889	S4	this study
118	*Rhyothemis variegata* (Linnaeus, 1763)	S4	Kompier (in litt.); this study
119	*Tholymis tillarga* (Fabricius, 1798)	S4	Kompier (in litt.); this study
120	*Tramea transmarina euryale* Brauer, 1867	S1,4	this study
121	*Trithemis aurora* (Burmeister, 1839)	S3,4	Kompier (in litt.); this study
122	*Trithemis festiva* (Rambur, 1842)	S3,4	this study
123	*Zygonyx asahinai* Matsuki & Saito, 1995	S1,2	Kompier (in litt.); this study
124	*Zygonyx iris* Selys, 1869	S3,4	Kompier (in litt.); this study
125	*Zyxomma petiolatum* Rambur, 1842	S4	this study
	Macromiidae		
126	*Epophthalmia vittata* Burmeister, 1839	S1,2	Kompier (in litt.); this study
127	*Macromia moorei malayana* Laidlaw, 1928		Karube (2011); Kompier (in litt.)
128	*Macromia pyramidalis pyramidalis* Martin, 1907	S1,2	Karube (2011); Kompier (in litt.); this study
	Synthemistidae		
129	*Idionyx asahinai* Karube, 2011	S1,2	Karube (2011); this study
130	*Idionyx thailandica* Hämäläinen, 1985	S3,4	this study
131	*Macromidia kelloggi* Asahina, 1978	S3,4	Karube (2015)

The record of *Coeliccia schorri* from Bach Ma extends the known geographic distribution of this species further north in Vietnam. It was originally described from Ka Bang District of Gia Lai Province (Phan & To 2019). Males of *Coeliccia schorri* from Bach Ma National Park are somewhat different from those at the type locality by the pattern on abdominal segments 8–10. Additionally, the anal appendages are white (Figure 6C), whereas they are blue in the Ka Bang population (see Fig. 16 in Phan & To 2019). However, the structures of their genital ligula and male anal appendages, as well as a long, erected spine on the posterior pronotal lobes in females, are similar to the original description.

Noguchiphaea yoshikoae (Figure 5E-F) formerly was known from Xuan Son, Tam Dao and Pia Oac-Pia Den National Parks, all located in northern Vietnam (Phan et al. 2011; Phan pers. data; Kompier 2025). The new record from Bach Ma, dated November 2024, represents the fourth known locality of *Noguchiphaea yoshikoae* and significantly extends its distribution southwestward.

In a recent study by Phan & Keetapithchayakul (2024), the larval stage of *Cryptophaea vietnamensis* was described. Despite this advancement, the larvae of over 50 regional species remain undescribed. In November 2024, we collected a single larva of *Davidius* sp., which was identified following Chao (1990), and provisionally categorized it as "sp." pending rearing to adulthood for definitive identification. Larvae of *Devadatta cyanocephala, Anisopleura* cf. *bipugio, Calicnemia akahara, Chlorogomphus* cf. *aritai, Leptogomphus inouei*, and *Idionyx thailandica* were also collected during our surveys in the National Park.

It is worth noting that, according a recent study by Kosterin (2024), *Epophthalmia frontalis* Selys, 1871 from Vietnam (i.e., see Karube et al. 2020) are actually *E. vittata*. Makbun et al. (2022) also described *A. aurantiacus* (distributed in Southeast Asia) and separated it from *Anax immaculifrons* Rambur, 1842 (which occurs from South Asia westward to Europe). Thus, records of *Anax immaculifrons* in Vietnam (e.g. Karube 2004) should be corrected to *A. aurantiacus*. Furthermore, identifications of *Macromia pinratani vietnamensis* in previous publications should be revised to *Macromia pyramidalis pyramidalis* Martin, 1907, as defined by Kosterin & Delfosse (2024).

Notes on the conservation and distribution of dragonflies and damselflies in Bach Ma National Park

According to the IUCN Red List of Threatened Species (https://www.iucnredlist.org/), four odonate species found in Bach Ma National Park are classified as Vulnerable (VU): *Coeliccia schorri* (Figure 6C), *Megalestes australis* (Figure 6D), *Leptogomphus inouei* (Figure 15C), and *Chlorogomphus aritai*. Two species are considered Near Threatened (NT): *Coeliccia diomedea* and *Idionyx asahinai* (Figure 16C-D). Three species are listed as Endangered (EN): *Aeschnophlebia asahinai* (Figure 10A-D), *Gomphidictinus kompieri,* and *Heliogomphus aluoiensis* (Figure 15A-B). All these species have restricted distributions and have been recorded from very few locations in Vietnam (see, for example, Kompier et al. 2021 for the distribution of *Coeliccia diomedea*).

Among the 131 species recorded in Bach Ma National Park, 20 are endemic to Vietnam. These include *Rhinocypha watsoni, Anisopleura bipugio* (Figure 5A), *Euphaea saola* (Figure 5D), *Calicnemia akahara, Coeliccia diomedea, C. mientrung, C. phamiha* (Figure 6B), *C. schorri* (Figure 6C), *Megalestes australis* (Figure 6D), *Aeschnophlebia asahinai* (Figure 10A-D), *A. bachmaensis, A. viridis* (Figure 11A-D), *Cephalaeschna asahinai, Chlorogomphus aritai, C. vietnamensis, Gomphidictinus kompieri, Heliogomphus aluoiensis* (Figure 15A-B), *Lamelligomphus vietnamensis, Leptogomphus inouei* (Figure 15C), and *Melligomphus phantoani* (Figure 15D). Of these, *Cephalaeschna asahinai, Aeschnophlebia bachmaensis* and *A. viridis* are even endemic to Bach Ma National Park.

We assessed odonate species diversity in Bach Ma National Park at four sites situated at different elevations: sites S1 an S2 are located above 1000 m a.s.l., while sites S3 and S4 lie below 300 m a.s.l. area total of 32 species (24.4% of all recorded species) were found exclusively at S1–2, including *Caliphaea thailandica, Noguchiphaea yoshikoae* (Figure 5E), *Anisopleura bipugio* (Figure 5A), *A. qingyuanensis* (Figure 5B), *Bayadera hyalina* (Figure 5C), *Euphaea saola, Megalestes australis, Coeliccia cyanomelas* (Figure 6A), *Protosticta ngoai, Protosticta socculus, Anotogaster klossi* (Figure 14C-D), *Davidius sp., Mattigomphus tamdaoensis, Melligomphus phantoani, Sieboldius nigricolor, Atratothemis reelsi, Nannophyopsis clara, Lyriothemis* sp., and most species from the families Aeshnidae and Chlorogomphidae. These species are typically associated with high mountain habitats in Vietnam (for instance, see the distribution of *Anisopleura bipugio, A. qingyuanensis, Bayadera hyalina* and *Euphaea saola* in Phan et al. 2018).

Some species show specific habitat preferences. For example, *Procordulia asahinai* (Figure 14A-B) and *Nannophyopsis clara* can only be found at the reservoir near site S1. *Anax aurantiacus* was observed exclusively in the five lakes along the Ngu Ho stream near

S2. *Chlorogomphus nasutus hamalaineni* (Figure 13A-B) and *C. tunti* (Figure 13C-D) co-occur along some streams at S1 and S2. Females of *Chlorogomphus aritai* usually fly very high and far away from streams, whereas males have never been observed along the streams but can commonly be spotted near the main road. *Chlorogomphus vietnamensis* was rarely seen at S2 (only one female specimen collected) but was quite common at S3 and S4. *Burmagiolestes* cf. *laidlawi* was collected near a very narrow, short, and densely vegetated stream close to S2.

A total of 63 species (48% of all recorded species) were found exclusively at S3 and S4, both situated at elevations of 300 m a.s.l. or lower. Most species of the families Coenagrionidae and Libellulidae were found at S4, which provides a wide variety of aquatic habitats, include open streams, small streams, swamps, ponds, and lakes. An exception is the libellulid *Atratothemis reelsi*, which was recorded at S1–S2.

The remaining 37 species (28.2% of the total) were found at all four collecting sites, across both elevation ranges. Most of them are very common and widespread species in Vietnam, such as *Aristocypha fenestrella, Mnais mneme, Heliocypha perforata, Euphaea ochracea, Philoganga vetusta* (Figure 7A-B), *Protosticta caroli* or *Rhyothemis plutonia*, while *Rhinocypha watsoni* and *Leptogomphus inouei* are endemic to Vietnam, both were also found at all four sites.

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Appendix

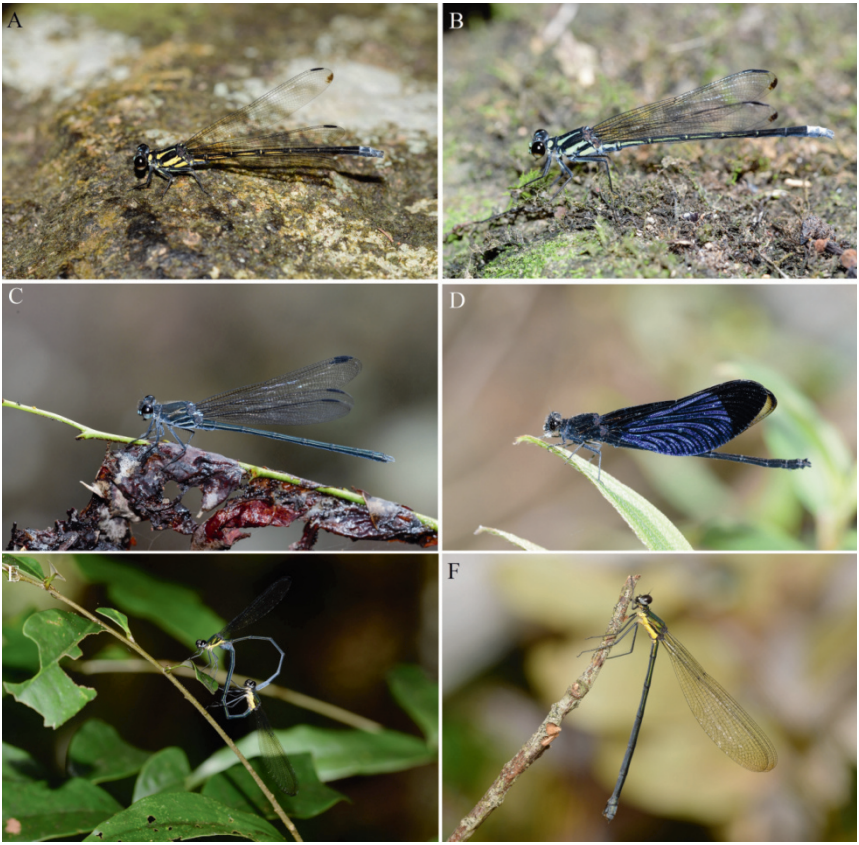


Figure 5. Euphaeidae species. (A), *Anisopleura bipugio*, male (S1, 9 August 2023); (B), *Anisopleura qingyuanensis*, male (S1, 9 August 2023); (C), *Bayadera hyalina*, male (S1, 22 July 2023); (D), *Euphaea saola*, male (S1, 7 April 2023); (E-F), *Noguchiphaea yoshikoae*, pair and female (S1, 17 November 2024).

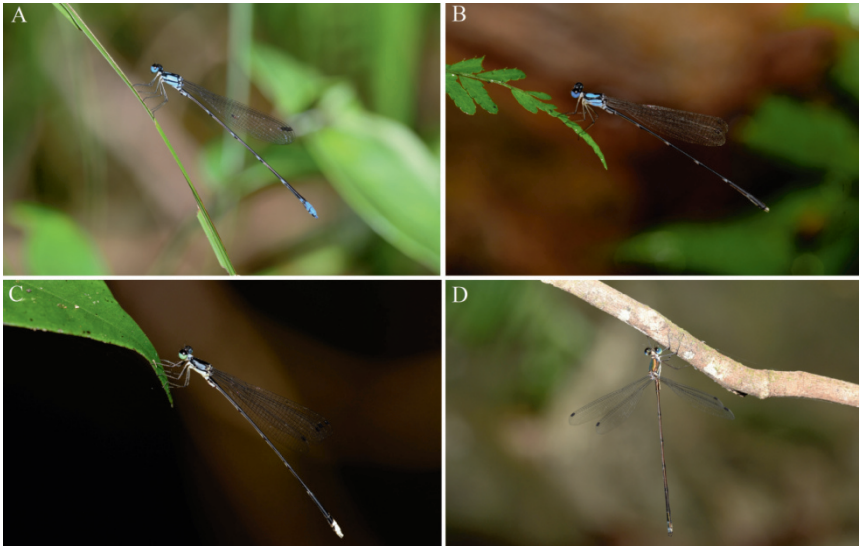


Figure 6. *Coeliccia* & *Megalestes* species. (A), *Coeliccia cyanomelas*, male (S2, 13 June 2024); (B), *Coeliccia phamiha*, male (S4, 1 August 2023); (C), *Coeliccia schorri*, male (S3, 19 May 2023); (D), *Megalestes australis*, male (S1, 9 August 2023).

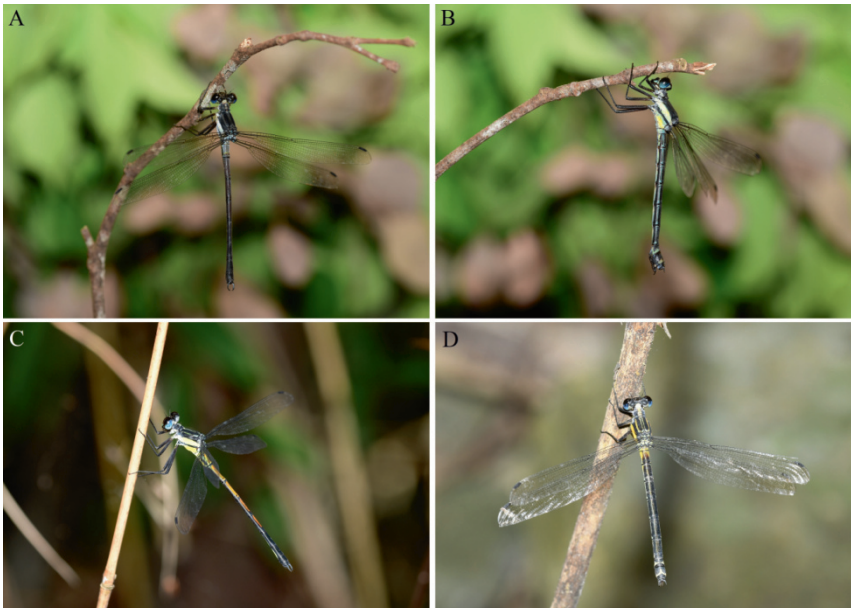


Figure 7. *Philoganga vetusta*. (A, B), male and female, dark-abdomen form (S1, 13 June 2024); (C, D), male and female, orange-abdomen form (S1, 11 May 2024).

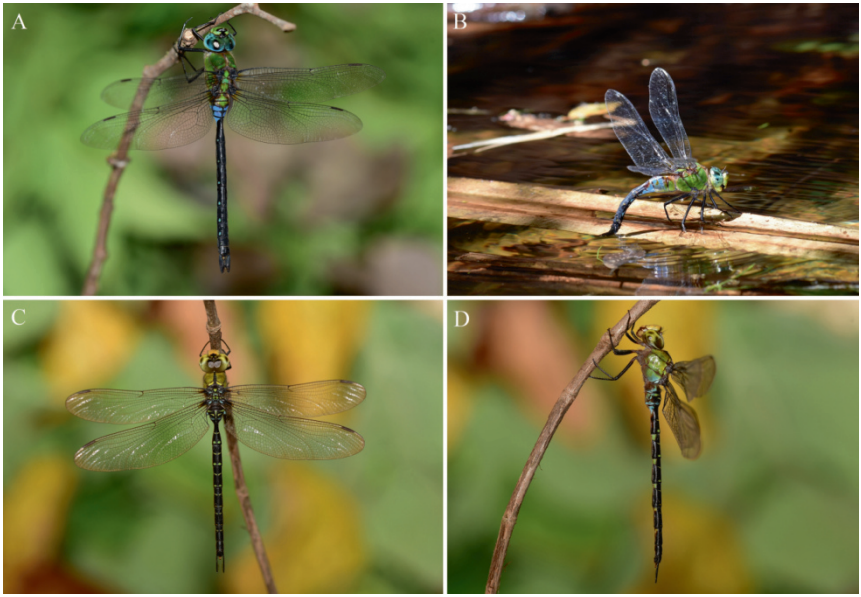


Figure 8. Aeshnidae species. (A, B), *Anax nigrofasciatus*, male and female (S1, 13 June 2024); (C, D), *Gynacantha ryukyuensis*, male in dorsal and lateral view (S2, 13 July 2024).

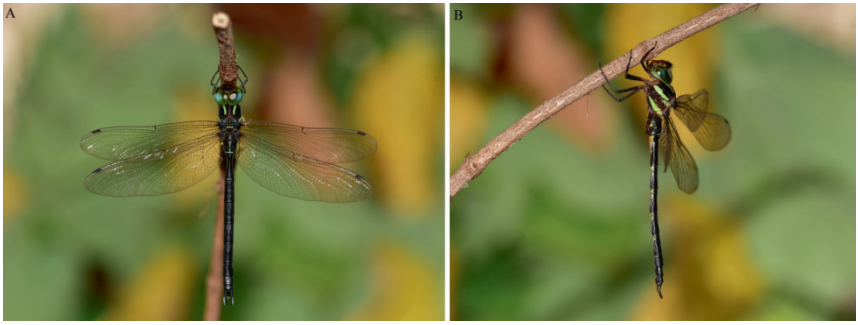
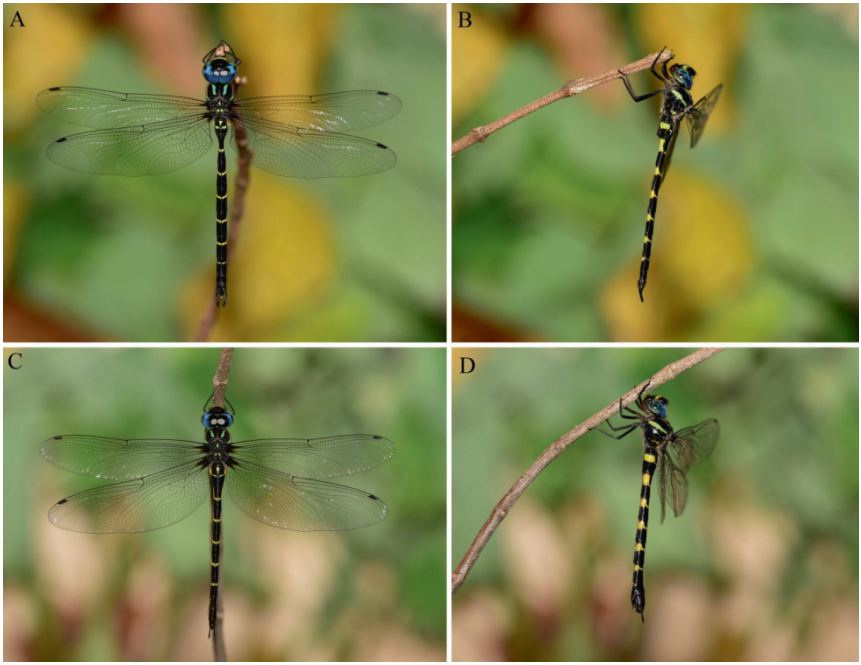


Figure 9. *Periaeschna yazhenae*, male in (A), dorsal view and (B), lateral view (S2, 13 July 2024).

Opposite page 37, top: Figure 10. *Aeschnophlebia asahinai*. (A, B), male in dorsal and lateral view (S1, 13 July 2024); (C, D), female in dorsal and lateral view (S1, 13 July 2024).

Opposite page 37, bottom: Figure 11. *Aeschnophlebia viridis*. (A, B), male in dorsal and lateral view (S1, 13 July 2024); (C, D), female in dorsal and lateral view (S1, 13 July 2024).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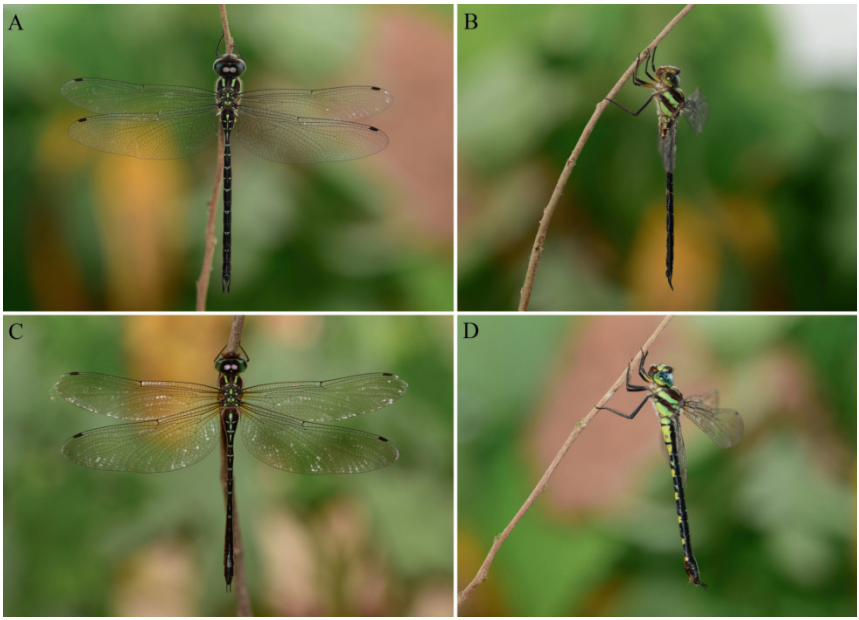
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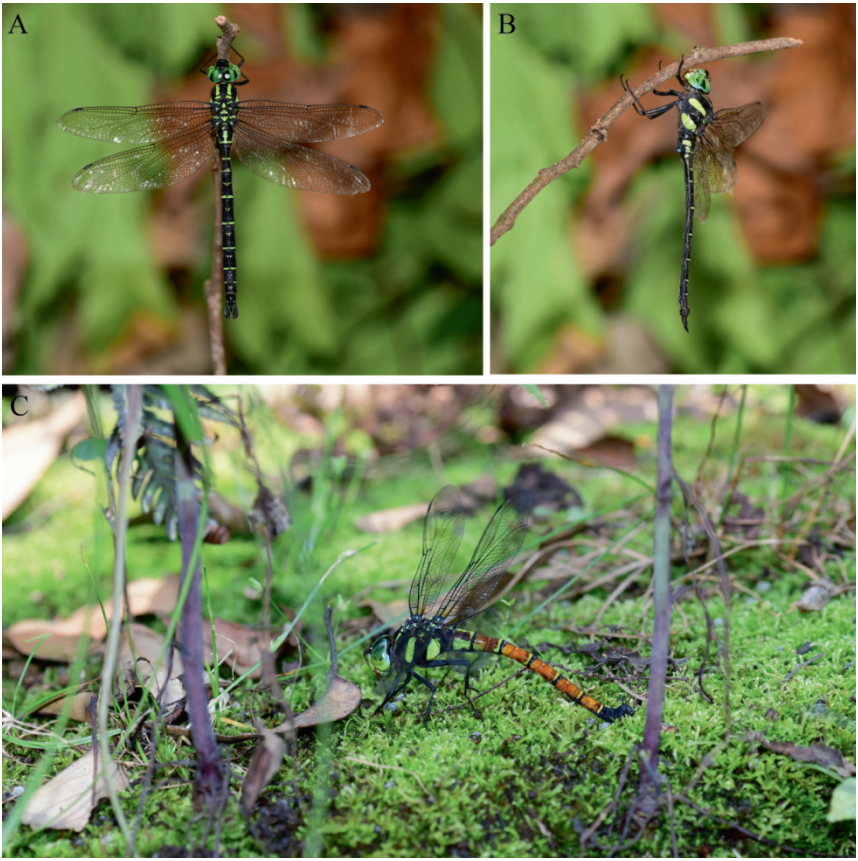
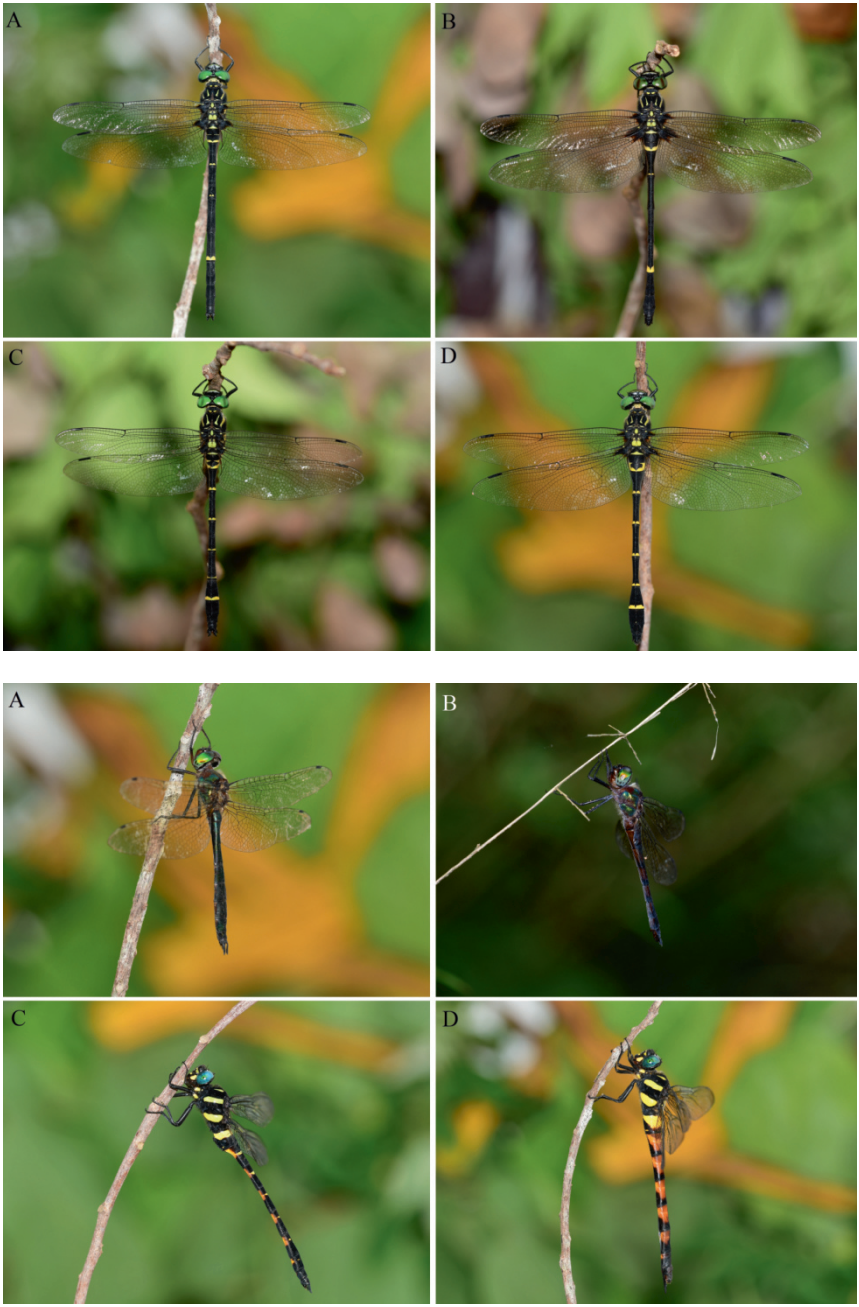


Figure 12. ***Polycanthagyna erythromelas*****. (A, B), male in dorsal and lateral view (S1, 13 June 2024); (C), female laying eggs (S1, 7 April 2024).**

Opposite page 39, top: Figure 13. ***Chlorogomphus*** **species. (A, B),** ***Chlorogomphus nasutus hamalaineni*****, male and female in dorsal view (S1, 11 May 2024); (C, D),** ***Chlorogomphus tunti*****, male and female in dorsal view (S1, 13 June 2024).**

Opposite page 39, bottom: Figure 14. Corduliidae and Cordulegastridae species. (A, B), ***Procordulia asahinai*****, male and female (S1, 11 May 2024); (C, D),** ***Anotogaster klossi*****, male and female in lateral view (S1, 11 May 2024).**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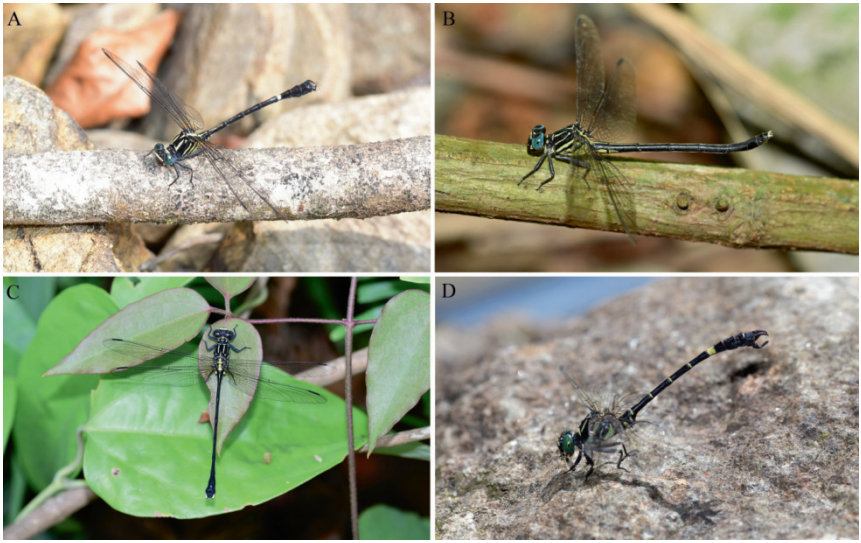

Figure 15. Gomphidae species. (A, B), *Heliogomphus aluoiensis*, male and female (S1, 7 April 2024); (C), *Leptogomphus inouei*, male (S1, 3 May 2023); (D), *Melligomphus phantoani*, male (S1, 9 August 2023).

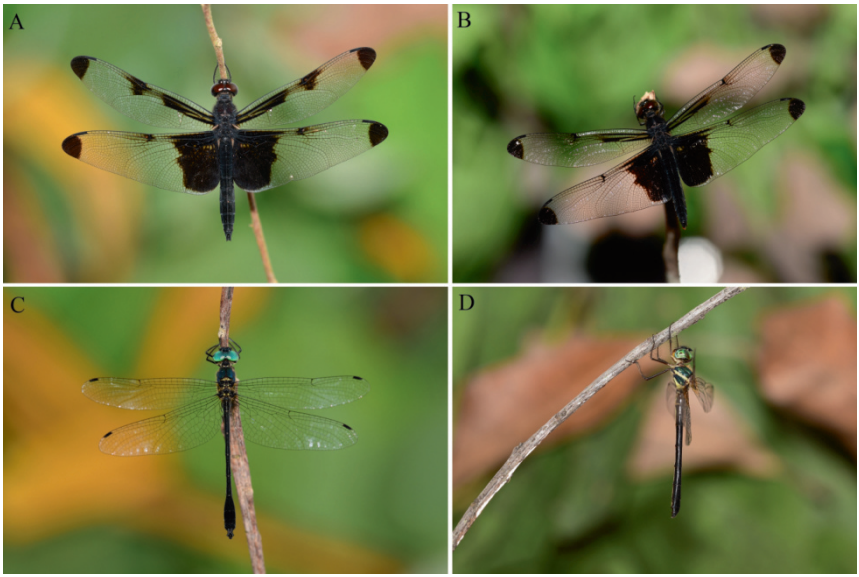

Figure 16. Libellulidae and Synthemistidae species. (A, B), *Atratothemis reelsi*, male and female (S1, 11 May 2024); (C, D), *Idionyx asahinai*, male and female (S1, 11 May 2024).

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