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Contribution on the dragonflies and damselflies (Insecta: Odonata) of six limestone forests of northern Vietnam

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Abstract

A list is provided of 191 odonate species recorded from six National Parks and Nature Reserves with karst ecosystems situated in northern Vietnam. The checklist includes first records of odonates for Hang Kia Pa Co and Kim Hy Nature Reserves. Some rare or endemic species of these limestone forests are discussed.

Key words: Odonata, dragonfly, damselfly, *Chlorogomphus canhvang* Kompier & Karube, 2018, *Chlorogomphus nakamurai* Karube, 1995, *Sympetrum eroticum ardens* (McLachlan, 1894).

Introduction

Limestone landscapes – also known as karst – are formed over millennia as soluble rocks dissolve and erode, leaving behind striking towers and cave systems. This habitat usually has a high biodiversity and is rich in endemic species. However, there are few reports on odonates from the limestone forests in Vietnam. For instance, Phan et al. (2011) recorded 13 species of the subfamily Calopterygoidea in Xuan Son National Park, Phu Tho province; von Ellenrieder et al. (2015) provided a checklist from Cuc Phuong and Ba Be National Parks, of 52 and 29 species respectively; and Steinhoff (2012) gave a list of 61 species from the buffer zone of Phong Nha - Ke Bang National Park, central Vietnam. Recently, several new species and new records were discovered from the limestone forests of northern Vietnam such as *Matrona taoi* Phan & Hämäläinen, 2011, *Gomphidictinus kompieri* Karube, 2016, *Rhinocypha arguta* Hämäläinen & Divasiri, 1997, *Asiagomphus monticola* Kompier, 2018, *Planaeschna celia* Wilson & Reels, 2001, *Planaeschna ishigakiana guentherpetersi* (Sasamoto, Do & Vu, 2013) and *Planaeschna tsuchi* Kompier, Karube, Futahashi & Phan, 2021 from Xuan Son National Park (Phan & Hämäläinen 2011; Karube 2016; Kompier 2018; Kompier et al. 2020; Phan et al. 2011b; Sasamoto et al. 2013); *Rhinocypha huai* (Zhou & Zhou, 2006), *Trigomphus kompieri* Karube, 2015, *Asiagomphus superciliaris* Kompier, 2018 and *Paracercion ambiguum* Kompier & Yu, 2016 in Huu Lien Nature Reserve (Karube 2015; Kompier 2018; Ning et al. 2016; Phan et al. 2011a); *Lyriothemis kameliyae* Kompier, 2017 and *Vestalaria miao* (Wilson & Reels, 2001) in Xuan Son National Park and Huu Lien Nature Reserve (Kompier 2017; Phan et al. 2011b); *Coeliccia curua* Kompier, Dow & Steinhoff, 2020 in Ba Be and Xuan Son National Parks and *Coeliccia puchella* Kompier, Dow & Steinhoff, 2020 in Huu Lien Nature Reserve and Cuc Phuong National Park (Kompier et al. 2020); *Prodasineura lancastrei* Phan & Ngo, 2020 in Pu Mat National Park and *P. kong* in Phong Nha - Ke Bang and Ba Be National Parks (Phan & Ngo 2020).

Following, I aim to compile the current knowledge on the odonate fauna of the six studied National Parks and Nature Reserves.

Methods

Field investigation

Odonate records from these six national parks and nature reserves of limestone forests in northern Vietnam (Figure 1) are provided. We conducted field surveys in different types of habitat, sometimes remote, such as mountain streams, wetlands, ponds, canals, rice fields, etc. We conducted field trips under the guidance of the park's officers or with help from local people to save time to find right path, and for more safety during the fieldwork in remote areas (Table 1.).

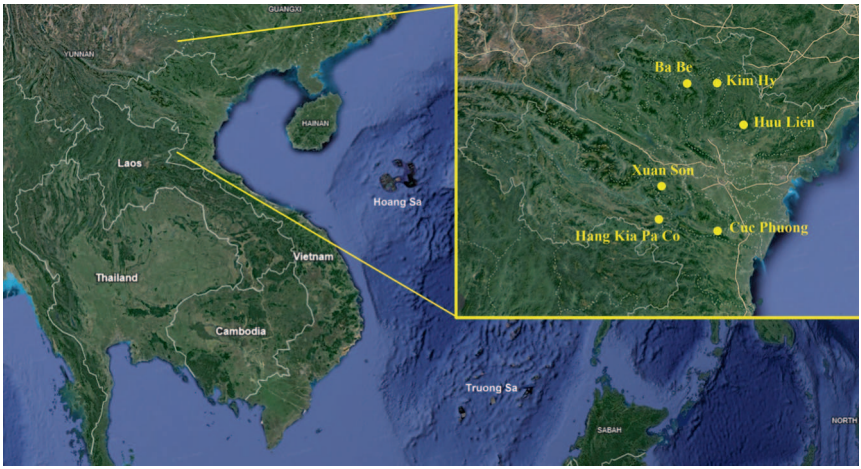


Figure 1. Map of six limestone forest in northern Vietnam.

Investigation of published and unpublished sources

In addition, I analysed published and unpublished records and document them in the following table 1.

Results

Based on the results of our field surveys, several previous publications, and previously unpublished records by T. Kompier from the years 2013-2018 for Xuan Son National Park, Huu Lien Nature Reserve, Ba Be National Park and Cuc Phuong National Park, here I provide an updated checklist of 191 odonate species (17 families) recorded from six National Parks and Nature Reserves with limestone landscapes in northern Vietnam. These are Xuan Son National Park, Phu Tho Province (133 species), Huu Lien Nature Reserve, Lang Son Province (103 species), Hang Kia Pa Co Nature Reserve, Hoa Binh Province (63 species), Kim Hy Nature Reserve, Bac Kan Province (83 species), Ba Be National Park, Bac Kan Province (74 species) and Cuc Phuong National Park, Ninh

Figure 2. The author collecting a male of *Matrona taoi* in Xuan Son National Park.

Table 1. The dates of our investigations and previous publications of odonates from the study sites.

Locations	Dates of our survey	Odonata References
Xuan Son National Park (Figure 2)	7 December 2009; 27–29 May 2010; 13–15 November 2010	Phan et al. (2011b); Sasamoto et al. (2013); Karube (2016); Kompier (2023); Kompier et al. (2020; 2021).
Hang Kia Pa Co Nature Reserve (Figures 3–6)	1-–5 July, 2022.	This study.
Huu Lien Nature Reserve (Figure 7–9)	12–18 June 2018; 8–13 September, 2018; 7–11 June 2020; 6–11 July 2022; 1–10 October 2022; 20–26 September 2023.	Do (2022a); Do & Karube (2011); Do et al. (2012); Hämäläinen (2012, 2014); Karube (2015); Karube (2016a, 2016b); Kompier (2023); Phan et al. (2011a); This study.
Kim Hy Nature Reserve (Figures 10–11)	8–13 July, 2022.	This study.
Cuc Phuong National Park (Figures 12–13)	20–24 June 2018; 21–25 May 2023.	Do (2011b); Do et al. (2011); Karube (1995, 1999, 2014); von Ellenrieder et al. (2015); Kompier & Karube (2018); This study.
Ba Be National Park		von Ellenrieder et al. (2015); Kompier (2018, 2023); Kompier et al. (2020); Phan & Ngo (2020).

Binh Province (97 species). Records for odonates from Hang Kia Pa Co and Kim Hy Nature Reserves are published here for the first time. Among 191 checklisted species, 15 species have been found only in the limestone forests, and 17 species are endemic to Vietnam (table 2) (see pages 14-15).

Figures 3–6. Field survey in Hang Kia Pa Co Nature Reserve. (7), corn farm beside the protected forest of nature reserve; (8), the author rested by Bo Buom stream; (9) the expedition team in Hang Kia Pa Co Nature Reserve (from left to right): Mr. Hoang Quang Duy (Tay Nguyen University), Dr. Nguyen Quang Thai (Institute of Preventive Medicine, Hanoi), the author and Mr. Ngo Quoc Phu (Duy Tan University).

Notes on some species in the limestone forests

Chlorogomphus canhvang Kompier & Karube, 2018

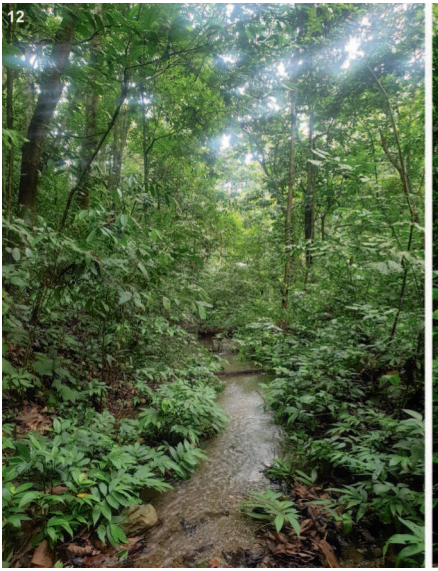
(Figures 14–17) (see page 12)

Specimens examined. 2 males, Cuc Phuong National Park (20.3503°N, 105.6029°E, 436 m), Ninh Binh Province, 25.6.2018, Q.T. Phan leg.; 6 males, 3 females, same location and collector, 13.7.2022, Q.T. Phan leg.

Notes. Do et al. (2011: Fig. 12) and Kompier & Karube (2018: Figure 1b-c) identified their male and female specimens respectively sampled in Cuc Phuong National Park as

Figures 7–9. Habitat of Huu Lien Nature Reserve.

Figures 10–11. Field survey in Kim Hy Nature Reserve; (10), rice field on the trail to the protected forest within the nature reserve; (11), the author near a sign with caption (in Vietnamese) “The protected forest of Kim Hy Nature Reserve. Authorized personnel only”.



Figures 12–13. Habitat of Cuc Phuong National Park.

Chlorogomphus auratus Martin, 1910. Von Ellenrieder et al. (2015: p. 5) also repeated the record of *Chlorogomphus auratus* in Cuc Phuong. However, I confirm here the population in Cuc Phuong is actually *Chlorogomphus canhvang*, instead of *C. auratus* based on the structure of the anal appendages of the males in Cuc Phuong, that are in line with the description of *C. canhvang* by Kompier & Karube (2018), (Figures 15–16), especially the protrusion on posterior margin of 10th abdominal segment is invisible in lateral view (Figure 15). Females of *C. canhvang* and *C. auratus* (a female, collected in Mau Son Mountain in Lang Son Province, 21.5.2015 by Q.T. Phan) are similar in appearance except for the pattern of black on the wing tips, which is much larger, and the central yellow spot on dorsal 2nd abdominal segment (Figure 15), which is narrower than that in *C. auratus* (Figure 16). Other structures like vertex and valvular valvae of these females are very similar.

Table 2. Odonates checklist of limestone forests in Vietnam. Abbreviation: XS = Xuan Son National Park, Phu Tho Province; HL = Huu Lien Nature Reserve, Lang Son Province; HKPC = Hang Kia Pa Co Nature Reserve, Hoa Binh Province; KH = Kim Hy Nature Reserve, Bac Kan Province; BB = Ba Be National Park, Bac Kan Province; CP = Cuc Phuong National Park, Ninh Binh Province. Some species are figured in appendices 1 and 2.

No.	Species	National Park/Nature Reserve					
		XS	HL	HKPC	KH	BB	CP
Zygoptera							
Devadattidae							
1	*Devadatta ducatrix* Lieftinck, 1969	√					
Chlorocyphidae							
2	*Aristocypha fenestrella* (Rambur, 1842)	√	√	√	√	√	√
3	*Heliocypha biforata* (Selys, 1859)	√	√	√	√		√
4	*Heliocypha perforata* (Percheron, 1835)	√	√	√	√	√	√
5	*Libellago lineata* (Burmeister, 1839)	√	√		√	√	√
6	*Rhinocypha huai* (Zhou & Zhou, 2006)		√				
7	*Rhinocypha arguta* Hämäläinen & Divasiri, 1997	√					√
Philogangidae							
8	*Philoganga vetusta* Ris, 1912	√			√		√
Calopterygidae							
9	*Archineura hetaerinoides* Fraser, 1933	√					
10	*Atrocalopteryx atrocyana* (Fraser, 1935)		√				
11	*Atrocalopteryx auco* Hämäläinen, 2014		√				
12	*Atrocalopteryx coomani* Fraser, 1935	√					
13	*Matrona basilaris* Selys, 1853	√					
14	*Matrona taoi* Phan & Hämäläinen, 2011	√			√		
15	*Mnais mneme* Ris, 1916	√	√	√	√		√
16	*Neurobasis chinensis* (Linnaeus, 1758)	√	√	√	√	√	√
17	*Noguchiphaea yoshikoae* Asahina, 1976	√					
18	*Vestalaria miao* (Wilson & Reels, 2001)	√	√				
19	*Vestalis gracilis* (Rambur, 1842)	√	√	√	√	√	√
Euphaeidae							
20	*Anisopleura qingyuanensis* Zhou, 1982	√					
21	*Bayadera bidentata* Needham, 1930	√					
22	*Bayadera serrata* Davies & Yang, 1996	√					
23	*Cryptophaea vietnamensis* (van Tol & Rozendaal, 1995)	√		√	√		√
24	*Dysphaea basitincta* Martin, 1904		√	√	√	√	√
25	*Euphaea decorata* (Hagen in Selys, 1853)	√	√	√	√	√	√
26	*Euphaea guerini* Rambur, 1842	√		√	√		√
27	*Euphaea masoni* Selys, 1879	√	√	√	√	√	√
28	*Euphaea ochracea* Selys, 1879			√	√		√
Lestidae							
29	*Lestes nodalis* (Selys, 1891)		√				
30	*Lestes praemorsus* Hagen in Selys, 1862		√			√	
31	*Orolestes selysi* McLachlan, 1895	√	√			√	√
Coenagrionidae							
32	*Aciagrion migratum* (Selys, 1876)		√			√	
33	*Agriocnemis lacteola* Selys, 1877					√	√
34	*Agriocnemis pygmaea* (Rambur, 1842)	√	√	√	√	√	√
35	*Agriocnemis femina* (Brauer, 1868)	√	√	√	√	√	√

No.	Species	National Park/Nature Reserve					
		XS	HL	HKPC	KH	BB	CP
36	*Argiocnemis rubescens* Selys, 1877		√				√
37	*Ceriagrion auranticum* Fraser, 1922	√	√	√	√	√	√
38	*Ceriagrion azureum* (Selys, 1891)	√				√	
39	*Ceriagrion chaoi* Schmidt, 1964	√					
40	*Ceriagrion fallax* Ris, 1914	√	√	√	√		√
41	*Ceriagrion malaisei* Schmidt, 1964					√	
42	*Ceriagrion nipponicum* Asahina, 1967		√				
43	*Ischnura rubilio* Selys, 1876	√					√
44	*Ischnura rufostigma* Selys, 1876	√				√	
45	*Ischnura senegalensis* (Rambur, 1842)	√	√	√	√		√
46	*Mortonagrion aborense* Laidlaw, 1914		√				√
47	*Paracercion ambiguum* Kompier & Yu, 2016		√				
48	*Paracercion calamorum* (Ris, 1916)	√	√			√	√
49	*Paracercion melanotum* (Selys, 1876)		√				√
50	*Pseudagrion microcephalum* (Rambur, 1842)		√				
51	*Pseudagrion pruinosum* (Burmeister, 1839)	√	√	√	√	√	√
52	*Pseudagrion rubriceps* Selys, 1876	√	√	√		√	√
53	*Pseudagrion spencei* Fraser, 1922	√	√			√	
Rhipidolestidae							
54	*Agriomorpha fusca* May, 1933	√	√	√	√	√	√
Philosinidae							
55	*Philosina buchi* Ris, 1917		√		√		
56	*Rhinagrion hainanensis* Wilson & Reels, 2003	√	√	√	√		√
Platycnemididae							
57	*Coeliccia chromothorax* (Selys, 1891)	√		√			
58	*Coeliccia cyanomelas* Ris, 1912	√		√			
59	*Coeliccia curua* Kompier, Dow & Steinhoff, 2020	√				√	
60	*Coeliccia galbina* Wilson & Reels, 2003		√				
61	*Coeliccia poungyi poungyi* Fraser, 1924	√		√			
62	*Coeliccia pulchella* Kompier, Dow & Steinhoff, 2020		√				√
63	*Coeliccia pyriformis* Laidlaw, 1932	√		√	√	√	√
64	*Coeliccia sasamotoi* Do, 2011	√					
65	*Coeliccia scutellum* Laidlaw, 1932	√	√	√	√	√	√
66	*Coeliccia uenoi* Asahina, 1997	√					√
67	*Matticnemis doi* (Hämäläinen, 2012)		√				
68	*Copera marginipes* (Rambur, 1842)	√	√	√	√	√	√
69	*Copera vittata* (Selys, 1863)	√	√	√	√		√
70	*Pseudocopera ciliata* (Selys, 1863)	√	√	√	√	√	√
71	*Indocnemis orang* (Forster in Laidlaw, 1907)	√	√	√	√		√
72	*Prodasineura autumnalis* (Fraser, 1922)	√	√	√	√	√	√
73	*Prodasineura croconota* Ris, 1916	√	√	√	√		
74	*Prodasineura kong* Phan & Ngo, 2020						√

No.	Species	National Park/Nature Reserve					
		XS	HL	HKPC	KH	BB	CP
Platystictidae							
75	*Drepanosticta emtrai* Dow, Kompier & Phan, 2018	√					
76	*Protosticta trilobata* Fraser, 1933	√					
77	*Protosticta grandis* (Asahina, 1984)			√	√		√
78	*Protosticta nigra* Kompier, 2017	√				√	
79	*Protosticta satoi* Asahina, 1997	√			√	√	√
80	*Protosticta taipokauensis* Asahina & Dudgeon, 1987					√	
81	*Protosticta* sp. (*grandis* type)	√					
82	*Sinosticta debra* Wilson & Xu, 2007	√					
Anisoptera							
Chlorogomphidae							
83	*Chlorogomphus auratus* Martin, 1910	√					
84	*Chlorogomphus canhvang* Kompier & Karube, 2018				√		√
85	*Chlorogomphus nakamurai* Karube, 1995			√			√
86	*Chlorogomphus sachiyoae* Karube, 1995	√					
Gomphidae							
87	*Asiagomphus acco* Asahina, 1996	√			√	√	√
88	*Asiagomphus auricolor* (Fraser, 1920)	√	√			√	√
89	*Asiagomphus monticola* Kompier, 2018	√					
90	*Asiagomphus superciliaris* Kompier, 2018		√		√		
91	*Burmagomphus asahinai* Kosterin, Makbun & Dawwrueng, 2012		√				
92	*Burmagomphus vermicularis* Martin, 1904	√	√	√	√	√	
93	*Euthygomphus koxingai* (Chao, 1954)				√		
94	*Gomphidia abbotti* Williamson, 1907		√	√	√		
95	*Gomphidia kruegeri* Martin, 1904	√	√			√	
96	*Gomphidictinus kompieri* Karube, 2016	√					
97	*Gomphidictinus perakensis* (Laidlaw, 1902)	√					
98	*Gomphidictinus tongi* Zhang, Guan & Wang, 2017						√
99	*Fukienogomphus prometheus* (Lieftinck, 1939)		√	√	√		√
100	*Heliogomphus bidentatus* Kompier & Karube, 2019	√					
101	*Heliogomphus retroflexus* (Ris, 1912)	√					
102	*Heliogomphus scorpio* (Ris, 1912)	√		√	√		√
103	*Ictinogomphus pertinax* (Selys, 1854)	√	√	√	√	√	√
104	*Labrogomphus torvus* Needham, 1931	√	√		√		
105	*Leptogomphus divaricatus* Chao, 1984	√					
106	*Leptogomphus perforatus* Ris, 1912	√	√		√		√
107	*Lamelligomphus camelus* (Martin, 1904)	√				√	
108	*Lamelligomphus formosanus* Matsumura, 1926	√					
109	*Lamelligomphus vietnamensis* Karube, 2015	√					
110	*Macrogomphus albardae* Selys, 1878		√		√	√	√
111	*Megalogomphus sommeri* (Selys, 1854)		√				√
112	*Merogomphus pavici* Martin, 1904	√			√		√
113	*Nihonogomphus schorri* Do & Karube, 2011	√	√		√		

No.	Species	National Park/Nature Reserve					
		XS	HL	HKPC	KH	BB	CP
114	*Nihonogomphus thomassoni* (Kirby, 1900)	√	√				
115	*Paragomphus capricornis* (Foerster, 1914)		√	√	√	√	
116	*Phaenandrogomphus tonkinicus* (Fraser, 1926)	√			√	√	
117	*Sieboldius gigas* (Martin, 1904)		√				
118	*Sinictinogomphus clavatus* (Fabricius, 1775)	√	√		√	√	√
119	*Trigomphus kompieri* Karube, 2015		√				
Aeshnidae							
120	*Anax guttatus* (Burmeister, 1839)	√	√		√	√	√
121	*Anax parthenope* (Selys, 1839)	√	√				√
122	*Boyeria karubei* Yokoi, 2002	√					
123	*Gynacantha basiguttata* Selys, 1882		√				
124	*Gynacantha bayadera* Selys, 1891						√
125	*Gynacantha japonica* Bartenef, 1909	√	√				√
126	*Gynacantha ryukyuensis* Asahina, 1962						√
127	*Gynacantha subinterrupta* Rambur, 1842	√	√			√	√
128	*Heliaeschna uninervulata* (Martin, 1904)						√
129	*Periaeschna magdalena* Martin, 1909	√				√	
130	*Planaeschna celia* Wilson & Reels, 2001	√					
131	*Planaeschna cucphuongensis* Karube, 1999	√					√
132	*Planaeschna ishigakiana guentherpetersi* (Sasamoto, Do & Vu, 2013)	√					
133	*Planaeschna tsuchi* Kompier, Karube, Futahashi & Phan, 2021	√					
134	*Planaeschna* sp.1	√					
135	*Planaeschna* sp.2		√				
136	*Polycanthagyna erythromelas* (McLachlan, 1896)					√	
137	*Sarasaeschna* sp.	√					
138	*Tetracantagyna waterhousei* (McLachlan, 1898)	√	√		√	√	√
Synthemistidae							
139	*Idionyx carinata* Fraser, 1926		√				
140	*Idionyx* cf. *optata* Selys, 1878						√
141	*Idionyx thailandica* Hämäläinen, 1985	√	√	√	√		√
142	*Idionyx selysi* Fraser, 1926	√					
143	*Macromidia rapida* (Martin, 1907)	√		√	√		
Macromiidae							
144	*Epophthalmia elegans* (Brauer, 1865)	√	√		√	√	√
145	*Macromia clio* Ris, 1916	√				√	
146	*Macromia katae* Wilson, 1993		√				
147	*Macromia malleifera* Lieftinck, 1955	√					
148	*Macromia pinratani* Asahina, 1983	√					
149	*Macromia unca* (Wilson, 2004)	√					
Libellulidae							
150	*Acisoma panorpoides* Rambur, 1842	√	√	√	√		
151	*Atratothemis reelsi* Wilson, 2005	√			√		

No.	Species	National Park/Nature Reserve					
		XS	HL	HKPC	KH	BB	CP
152	*Brachydiplax chalybea flavovittata* Brauer, 1868	√	√	√	√	√	√
153	*Brachydiplax farinosa* Kruger, 1902					√	
154	*Brachythemis contaminata* (Fabricius, 1793)	√	√	√	√	√	√
155	*Camacinia gigantea* (Brauer, 1867)	√					
156	*Camacinia harterti* Karsch, 1890	√					√
157	*Cratilla lineata* (Brauer, 1878)	√	√	√	√	√	√
158	*Crocothemis servilia* (Drury, 1773)	√	√	√	√	√	√
159	*Diplacodes trivialis* (Rambur, 1842)	√	√	√	√	√	√
160	*Indothemis carnatica* (Fabricius, 1798)						√
161	*Lyriothemis bivittata* (Rambur, 1842)	√	√			√	√
162	*Lyriothemis kameliyae* Kompier, 2017	√	√				√
163	*Hydrobasileus croceus* (Brauer, 1867)		√			√	√
164	*Hylaeothemis clementia* Ris, 1909	√			√		
165	*Neurothemis fulvia* (Drury, 1773)	√	√	√	√	√	√
166	*Neurothemis intermedia* (Rambur, 1842)	√					
167	*Onychothemis tonkinensis* Martin, 1904	√	√		√	√	
168	*Orthetrum chrysis* (Selys, 1891)	√		√	√		√
169	*Orthetrum glaucum* (Brauer, 1865)	√	√	√	√	√	√
170	*Orthetrum luzonicum* (Brauer, 1868)	√				√	√
171	*Orthetrum melania superbum* Kompier & Futahashi, 2016	√			√		
172	*Orthetrum pruinosum* (Burmeister, 1839)	√	√	√	√	√	√
173	*Orthetrum sabina* (Drury, 1770)	√	√	√	√	√	√
174	*Orthetrum triangulare* (Selys, 1878)	√	√	√	√	√	√
175	*Palpopleura sexmaculata* (Fabricius, 1787)	√	√	√	√	√	
176	*Pantala flavescens* (Fabricius, 1798)	√	√	√	√	√	√
177	*Potamarcha congener* (Rambur, 1842)		√	√	√	√	√
178	*Pseudothemis zonata* (Burmeister, 1839)	√	√	√	√	√	√
179	*Rhodothemis rufa* (Rambur, 1842)		√				√
180	*Rhyothemis variegata* (Linnaeus, 1763)	√	√		√		√
181	*Rhyothemis plutonia* Selys, 1883		√				
182	*Sympetrum eroticum ardens* (McLachlan, 1894)				√		
183	*Tetrathemis platyptera* Selys, 1878	√				√	√
184	*Tholymis tillarga* (Fabricius, 1798)		√	√	√	√	√
185	*Tramea transmarina euryale* (Brauer, 1867)				√		√
186	*Trithemis aurora* (Burmeister, 1839)	√	√	√	√	√	√
187	*Trithemis festiva* (Rambur, 1842)	√	√	√	√	√	√
188	*Trithemis pallidinervis* (Kirby, 1889)		√				
189	*Zygonyx asahinai* Matsuki & Saito, 1995	√					
190	*Zygonyx iris* Selys, 1869	√	√	√	√	√	√
191	*Zyxomma petiolatum* Rambur, 1842	√	√	√		√	√

Figures 14–18. *Chlorogomphus* spp. (14), *C. canhvang*, male; (15–16), appendages of *C. canhvang* in lateral and dorsal view; (17), *C. canhvang*, female; (18), basal abdominal segment of *Chlorogomphus auratus* female, dorsal view.

Chlorogomphus nakamurai Karube, 1995

(Figures 19–20)

Specimens examined. 1 female, Bo Buom stream (20.4064°N, 104.9720°E, 774 m), Hang Kia Pa Co Nature Reserve, Hoa Binh Province, 2.7.2022, Q.T. Phan leg.; 6 males, 1 fe-

Figures 19–20. Male (19) and female (20) of *Chlorogomphus nakamurai*. Taken in Cuc Phuong National Park.

male, Cuc Phuong National Park (20.35030 N, 105.60290 E, 436 m), Ninh Binh Province, 22.5.2023, Q.T. Phan leg.

Notes. Since 1995, *Chlorogomphus nakamurai* has only been found in the two national parks Cuc Phuong (Karube 1995; Kompier 2023; von Ellenrieder et al. 2015) and Ba Vi (Asahina

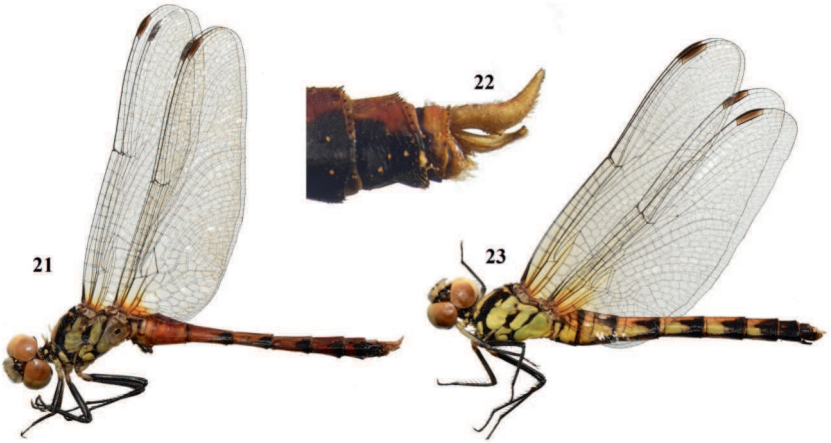
1995) in northern Vietnam. This is a beautiful and large-sized dragonfly (Figures 19–20). Individuals are found at shaded, clear streams in the pristine forests. In Cuc Phuong, we observed hundreds of males patrolling along the forest streams while the females rarely appeared; they normally descend from the tree-canopies for mating and laying eggs in the afternoon. Interestingly, both *Chlorogomphus nakamurai* and *C. canhvang* can be found at the same streams in Cuc Phuong National Park.

Sympetrum eroticum ardens (McLachlan, 1894)

(Figures 21–23)

Specimens examined. 1 male, 1 female, Ban Cuon (22.1365°N, 105.9917°E, 354 m), Kim Hy Nature Reserve, Bac Kan Province, 13.7.2022, Q.T. Phan leg.

Notes. This species is widely distributed in southern China and Taiwan (Zhang 2019) and also in Sa Pa, a high mountain area of Lao Cai Province, northern Vietnam (Kompier 2023). Bac Kan Province is the second province in which it is recorded in Vietnam. *Sympetrum ardens* is characterized by its hooked appendages (Figures 21–23). Synthorax of *Sympetrum eroticum ardens* has black stripes laterally (Figure 21), which can be distinguished from the nominate species *Sympetrum eroticum eroticum* (Selys, 1883) without black stripes on its lateral synthorax.



Figures 21–23. *Sympetrum eroticum ardens*, male and female. (21), habitus of male; (22), anal appendages in lateral view; (23), habitus of female.

Notes on endemic species that are restricted to limestone habitat

In Vietnam, some species have only been recorded from limestone habitats. These are the following 15 species: *Rhinocypha arguta, Atrocalopteryx atrocyana, A. auco, Matrona taoi, Paracercion ambiguum, Coeliccia galbina, C. curua, C. pulchella, C. uenoi, Matticnemis doi, Chlorogomphus canhvang, Sieboldius gigas, Trigomphus kompieri, Planaeschna cucphuongensis* and *Planaeschna tsuchi*. In particular, some of these species have only had been recorded from a single location in Vietnam, for instance *Atrocalopteryx atrocyana, A.*

auco, Paracercion ambiguum, Coeliccia galbina, Matticnemis doi and *Sieboldius gigas* in Huu Lien Nature Reserve.

Among the 191 species recorded in these limestone forests, 17 are endemic species to Vietnam. These are *Atrocalopteryx auco, Matrona taoi, Paracercion ambiguum, Coeliccia pulchella, C. uenoi, C. curua, Matticnemis doi, Protosticta satoi, Chlorogomphus nakamurai, Asiagomphus monticola, A. superciliaris, Gomphidictinus kompieri, Nihonogomphus schorri, Sieboldius gigas, Trigomphus kompieri, Planaeschna cucphuongensis* and *P. tsuchi*.

Notes on the conservation status of odonates in limestone forests

16 species among these 191 recorded species were categorized with high conservation status by the IUCN Red List of Threatened Species (Table 3). 4 are Critically Endangered, 3 Endangered, 5 Near Threatened and 4 Vulnerable species.

Table 3. Conservation status of limestone species.

No.	Species	IUCN Red List of Threatened Species	Distribution (abbreviation see Table 2)
1	*Atrocalopteryx atrocyana* (Fraser, 1935)	NT (Near Threatened)	HL
2	*Atrocalopteryx auco* Hämäläinen, 2014	CR (Critically Endangered)	HL
3	*Atrocalopteryx coomani* Fraser, 1935	NT (Near Threatened)	XS
4	*Chlorogomphus auratus* Martin, 1910	NT (Near Threatened)	XS
5	*Chlorogomphus canhvang* Kompier & Karube, 2018	EN (Endangered)	KH, CP
6	*Chlorogomphus nakamurai* Karube, 1995	VU (Vulnerable)	HKPC, CP
7	*Coeliccia curua* Kompier, Dow & Steinhoff, 2020	EN (Endangered)	XS, BB
8	*Coeliccia pulchella* Kompier, Dow & Steinhoff, 2020	VU (Vulnerable)	HL, CP
9	*Gomphidictinus kompieri* Karube, 2016	EN (Endangered)	XS
10	*Macromia katae* Wilson, 1993	VU (Vulnerable)	HL
11	*Matticnemis doi* (Hämäläinen, 2012)	CR (Critically Endangered)	HL
12	*Paracercion ambiguum* Kompier & Yu, 2016	CR (Critically Endangered)	HL
13	*Planaeschna celia* Wilson & Reels, 2001	VU (Vulnerable)	XS
14	*Protosticta nigra* Kompier, 2017	NT (Near Threatened)	XS, BB
15	*Rhinocypha huai* (Zhou & Zhou, 2006)	NT (Near Threatened)	HL
16	*Trigomphus kompieri* Karube, 2015	CR (Critically Endangered)	HL

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Appendix

Appendix 1. Some damselflies from the studied sites. (1–2), male and female of *Atrocalopteryx atrocyana* (Fraser, 1935) in Huu Lien Nature Reserve, 11.7.2022; (3), *Matrona taoi* Phan & Hämäläinen, 2011 in Kim Hy Nature Reserve, 13.7.2022; (4), *Prodasineura kong* Phan & Ngo, 2020 in Quoc Viet Commune, Trang Dinh District, Lang Son Province, 10.7.2022; (5), *Philosina buchi* Ris, 1917 in Quoc Viet Commune, Trang Dinh District, Lang Son Province, 10.7.2022; (6), *Coeliccia galbina* Wilson & Reels, 2003 in Huu Lien Nature Reserve, 11.6.2020.

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Appendix 2. Some dragonflies in the studied sites. (1), *Labrogomphus torvus* Needham, 1931; (2), *Merogomphus pavici* Martin, 1904; (3), *Sinictinogomphus clavatus* (Frabricius, 1775); (4), *Orthetrum melania superbum* Kompier & Futahashi, 2016. All photos were taken in Kim Hy Nature Reserve, 13.7.2022.

3

4

Published 30.12.2023

Two new records to the Vietnamese Odonata fauna: *Coeliccia loogali* Laidlaw, 1932 and *Rhipidolestes chaoi* Wilson, 2004 (Zygoptera: Platycnemididae, Rhipidolestidae) from a high limestone forest of northern Vietnam

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Abstract

Coeliccia loogali Laidlaw, 1932 and *Rhipidolestes chaoi* Wilson, 2004 are new additions to the Vietnamese fauna. They were discovered on 1-VI-2022 in a high limestone forest in Lai Chau Province, northern Vietnam.

Key words: Odonata, new records, *Coeliccia loogali*, *Rhipidolestes chaoi*, Vietnam.

Introduction

In summer 2022, I conducted a field survey in some frontier areas of northern Vietnam, near the Chinese border. Unfortunately, heavy rain hampered the field survey significantly. When I visited an open stream near Sin Ho Town of Lai Chau Province (Fig. 1), however, the rain stopped for two hours at noon and I was able to collect a few species including two new records for Vietnam: *Coeliccia loogali* and *Rhipidolestes chaoi*. *C. loogali* brings the number of *Coeliccia* species in Vietnam to 31 since the reports by Phan & Bui (2021) and Phan et al. (2021). *Rhipidolestes chaoi* is the fourth member of the genus *Rhipidolestes* known from Vietnam after the records in Asahina (1997) and Kompier (2018).

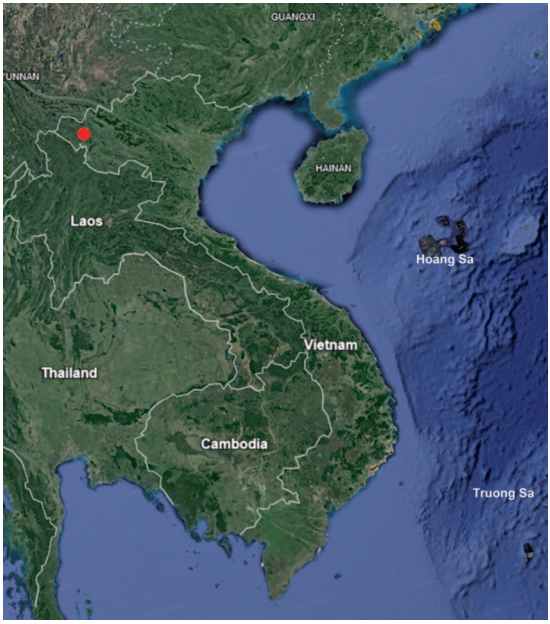

Figure 1. Map of Sin Ho of Lai Chau Province, northern Vietnam.

Methods

I used a Nikon AF Micro 200 mm f4D IF-ED lens with a Nikon D850 digital camera to take photographs of species in nature. Figures of body structures were taken with an Axiocam Erc 5s camera on Zeiss Stemi 508 stereomicroscope using Adobe Photoshop 7.0 to produce the plates.

Methodology of specimen preservation follows Paulson (2023).

Results

Coeliccia loogali Laidlaw, 1932

(Figs 2–3)

Material examined. 12 males, 2 female, an open stream about 10 km west of Sin Ho Town (22.3412 N, 103.2947 E, 1508 m a.s.l.), Lai Chau Province, North Vietnam, 1-VI-2022, Quoc Toan Phan leg.

Notes. A new record for Vietnam. Dow (2020) noted that *Coeliccia loogali* has previously been recorded in northeast India, Myanmar, Thailand and Laos, and is also likely to occur in Yunnan, China and might be found in Vietnam. This study now confirms the occurrence of *C. loogali* in a high mountain area of northwest Vietnam. The male is characterized by bluish marking on synthorax, abdomen and anal appendages black, and genital ligula structurally simple (Figs. 1A, 2A, C, D). Moreover, in the female, posterior pronotal lobe of prothorax with small central projection (Fig. 2B) and abdominal color pattern as in Asahina (1984) (Fig. 2E, F). *C. loogali* shares the same characters of bluish marking on synthorax and black anal appendages with *Coeliccia hoanglienensis* Do, 2007 and *C. bhriulieci* To, Phan & Tran, 2017, the endemic species of northern and central Vietnam respectively.

Figure 2. A male of *Coeliccia loogali* in nature.

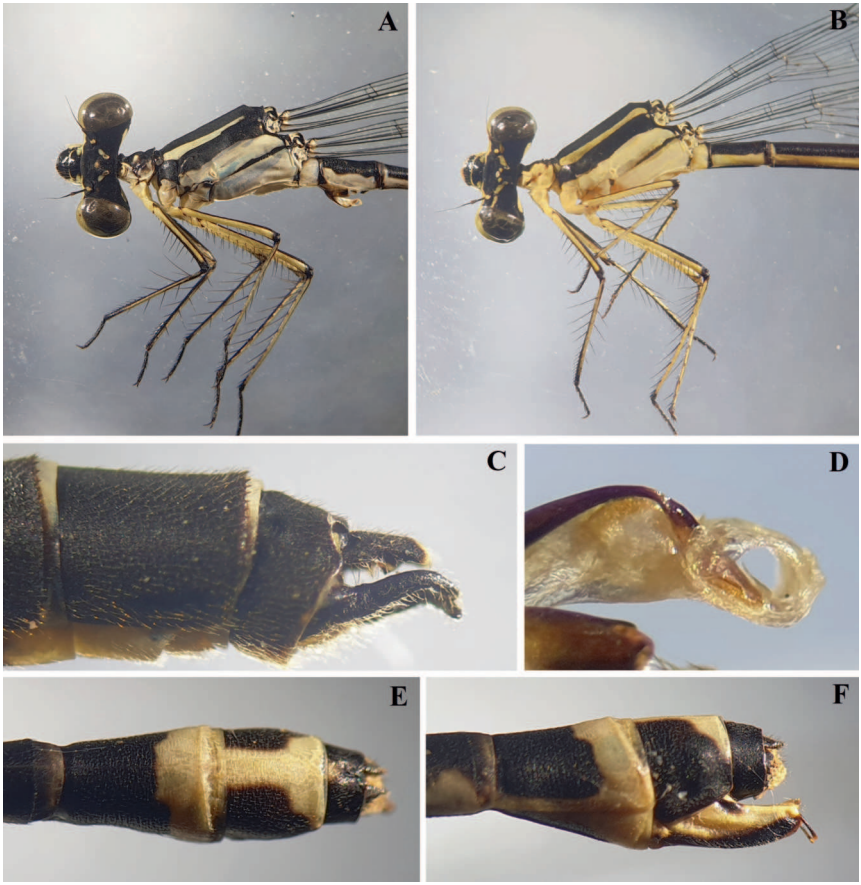

Figure 3. Structures of *Coeliccia loogali.* (A, B), head and thorax of male and female, lateral view; (C), anal appendage of the male, lateral view; (D), genital ligula, lateral view; (E), head and thorax of female, lateral view; (E, F), abdominal tip of the female, dorsal and lateral view.

However genital ligula of *C. loogali* broad lobe apically (Fig. 2D) while in *C. hoanglienensis* and *C. bhriulieci* with two long lateral flagella (Do 2007: Fig. 6; To et al. 2017: Fig. 3d). Females of both *C. hoangliensis* and *C. bhriulieci* are still unknown.

It is noteworthy that, next to about a hundred males along the stream, I only found two females: one was immature and the other was in tandem! Interestingly, no other *Coeliccia* species was found at this stream.

Distribution. Northeast India (Mizoram), Nepal, Myanmar, Thailand (Doi Suthep National Park; Doi Inthanon), Laos, China (Yunnan), Vietnam (Sin Ho, Lai Chau Province; this study).

Figure 4: *Rhipidolestes chaoi* in nature. (A), male & (B), female.

Rhipidolestes chaoi Wilson, 2004

(Figs 4–5)

Material examined. 2 males, 2 females, an open stream about 10 km west of Sin Ho Town (22.3412 N, 103.2947 E, 1508 m a.s.l.), Lai Chau Province, North Vietnam, 1-VI-2022, Quoc Toan Phan leg.

Notes. This record adds a fourth species of the genus *Rhipidolestes* to the Vietnamese odo-

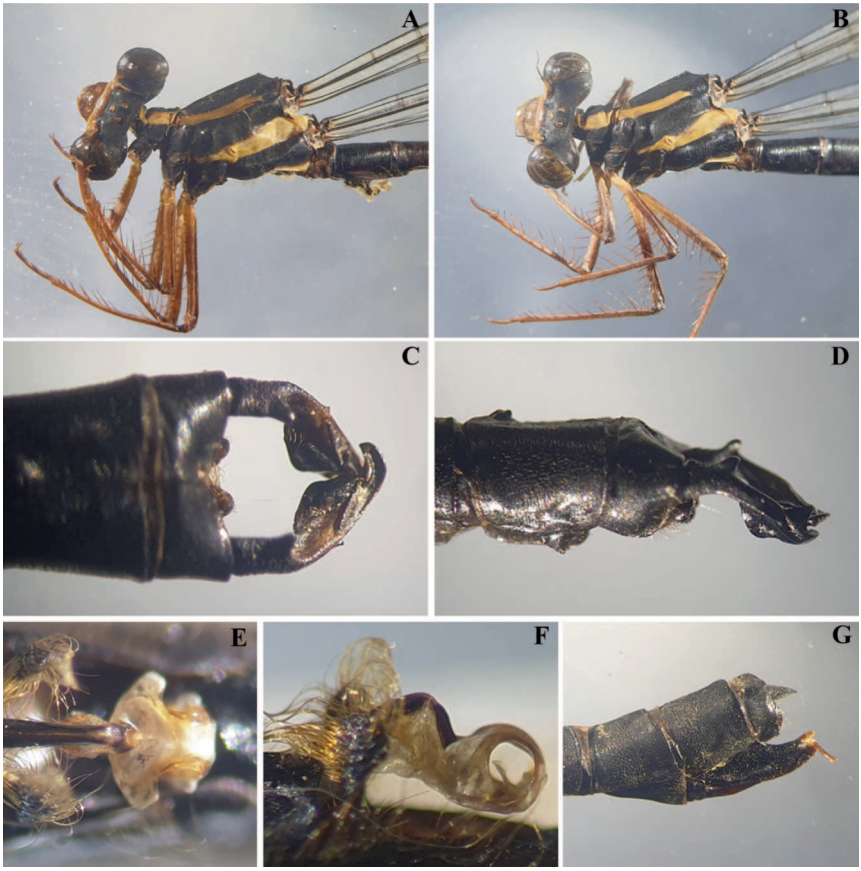

Figure 5: Structures of *Rhipidolestes chaoi.* (A, B), head and thorax of male and female, lateral view; (C, D), male anal appendage, dorsal and lateral view; (E, F), genital ligula, ventral and lateral view; (G), abdominal tip of the female, lateral view.

nate fauna since Asahina (1997) described *R. owadai* Asahina, 1997 from Tam Dao National Park and Kompier (2018) subsequently found *R. jucundus* Lieftinck, 1948 and *R. cyanoflavus* Wilson, 2000 in Hoang Lien and Pia Oac National Parks respectively; all are located in northern Vietnam. *Rhipidolestes chaoi* Wilson, 2004 is known only from south Hunan of southern China (Wilson 2004). Body coloration (Fig. 3A–B) and morphological structures (Fig. 4A–G) of the male and female of the Vietnamese specimens match well with the original description in Wilson (2004), especially the similar ochreous face of the male and female (Fig. 4A-B) and tiny, vestigial projection on dorsal S9 (Fig. 4C).

Distribution. China (Hunan), Vietnam (Sin Ho, Lai Chau Province) (Wilson 2004; this study).

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Swezey, O. & F. Williams, 1942. Dragonflies of Guam. Bernice P. Bishop Museum Bulletin 172: 3-6.
Tillyard, R., 1924. The dragonflies (Order Odonata) of Fiji, with special reference to a collection made by Mr. H.W. Simmonds, F.E.S., on the Island of Viti Levu. Transactions of the Entomological Society London 1923 III-IV: 305-346.

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The manuscript should end with a list of captions to the figures and tables. The latter should be submitted separately from the text preferably as graphics made using one of the Microsoft Office products or as a high resolution picture saved as a .jpg .tif or .ps file. Pictures should be at least 11 cm wide and with a minimum 300 dpi resolution, better 360 dpi. Line drawings and graphics could have 1200 dpi for better details. If you compose many pictures to one figure, please submit the original files as well. Please leave some space in the upper left corner of each picture, to insert a letter (a, b, c...) later. Hand-made drawings should be scanned and submitted electronically. Printed figures sent by the post could be damaged, in which case authors will be asked to resubmit them.

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