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More Odonata found at the Cardamonean foothills in Koh Kong Province of Cambodia in 2014-2018

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Abstract

Still unpublished data on Odonata of the coastal foothills of the Cardamom Mts. in Koh Kong Province, SW Cambodia obtained in 2014-2018 are provided. *Tetrathemis flavescens* Kirby, 1889 is for the first time reported for Cambodia and *Risiophlebia guentheri* Kosterin, 2015 for SW Cambodia. The photographic records from this area of *Gynacantha basiguttata* Selys, 1882, *Gynacantha demeter* Ris, 1911, *Heliaeschna crassa* Krüger, 1899, *Amphithemis curvistyla* Selys, 1891 and *Pornothemis serrata* Krüger, 1902 have been confirmed by specimens. The known local faunas of two neighbouring rivulets in Koh Kong Province, rich in Odonata, are updated and summarised.

Key words: Odonata, dragonflies, damselflies, fauna, the first country record, Cambodia, Koh Kong Province, Cardamoms, *Tetrathemis flavescens*, *Risiophlebia guentheri*, confirmation of photographic records

Introduction

The Cardamoms are a gentle mountain range facing the Gulf of Siam of the South China Sea, extending from Chanthaburi and Trat Province in East Thailand through south-western Cambodia to the Vietnamese island Phú Quốc. The foothills facing the coast are formed by sandstone and still covered with lowland evergreen forest, partly replaced by expanding plantations, with sandy plateaux occupied by savannah-like communities locally called 'veals'. In Cambodia, this area is divided by Koh Kong, Preah Sihanouk, Kampot and Kep Provinces. Earlier the first author (O.K.) published results of several previous odonatological excursions of the foothills in Koh Kong Province in April (Kosterin 2010) and November/December 2010 (Kosterin 2011), August 2011 (Kosterin 2012), May 2013 (Kosterin 2014a) and April 2015 (Kosterin 2015a). Rich photographic data by the second author (G.C.), who is a permanent resident of Tatai Commune of Koh Kong Province, recorded more interesting species in the Cardamonean foothills (Kosterin et al., 2012; Kosterin & Chartier 2014). Although, after this,

the area could be considered as quite well studied odonatologically, additional short trips by O.K. to the Cardamonean foothills of Koh Kong Province in June 2014 and July 2016 and permanent observations by G.C. provided further interesting findings which are presented herewith. Analogous data for the marshy flat coastal areas rather than mountain foothills of Koh Kong Province were considered in our previous communication (Kosterin & Chartier 2017).

Methods

Odonata were sought by O.K. while walking along brooks and rivulets and by G.C. also on boat trips. Common species were recorded by sight, small series of more interesting species were collected. Odonata were photographed free in purely natural conditions, never posed, by O.K. using Olympus Camedia C8080 and Canon EOS 350D (with Sigma lens) cameras and by G.C. using Olympus TG4 camera. Coordinates were recorded by O.K. using Garmin eTrex H personal GPS navigator and by G.C. using Olympus TG4 camera, but the provided ranges for the areas actually examined, as well as elevations above sea level, were revised using GoogleEarth. The dates are provided in the dd.mm.year format.

Figure 1. *Tetrathemis flavescens*, a male in nature, Cambodia, Koh Kong Province, 17 km ENE of Koh Kong, 'Macromia Rivulet', 3.06.2014. Photo by O.K.

Results

Interesting species findings

Tetrathemis flavescens Kirby, 1889

1 ♂ photographed (Fig. 1), 1 ♂ collected (Figs. 2-3), by O.K., Koh Kong Province, 17 km ENE of Koh Kong, 'Macromia Rivulet' (so nicknamed in Kosterin 2012) 11°40'19" N 103°06'26" E, 299 m a.s.l., 3.06.2014.

Remarks. This species was said to be very rare and confined to Borneo and Belitung (Kirby 1889; Dow & Reels 2013; Dow et al. 2017) so it was by no means expected for the Cardamom Mts. in the continent. A preliminary identification was made on the basis of the characteristically reduced abdominal yellow marking missing the large dorsal yellow spot on S7 and lateral spots on S5 (Figs 1-2) (present in other optional species, *Tetrathemis platyptera* Selys, 1878 and *T. irregularis* Brauer, 1868), and a slight yellowish tint occupying most of the wing membrane (Fig. 2) (confined to the basal wing halves in *T. platyptera* and absent in *T. irregularis*). The identification as *T. flavescens* was confirmed by examination of the appendages (Fig. 3) and their comparison with photographs of those of a specimen of *T. flavescens* from Borneo kindly provided by Rory Dow (Fig. 4 left): *T. flavescens* is characterised by the cerci shorter than the epiproct, with the ventral tooth terminally positioned (R.A. Dow pers. comm.). The Cambodian specimen has a much fainter yellow tint on its wings (Fig. 1) than specimens from Borneo (Fig. 5) and Belitung but its extent in the hind wing to the pterostigma is identical in the Cambodian (Fig. 2) and Bornean (Fig. 5) specimens, while in the fore wing it is even greater in the Cambodian specimen (to ca 2/3 of the distance between the node and pterostigma, Fig. 2) than in the shown Bornean specimen (to ca 1/3 of that distance, Fig. 5).

Strangely, this is so far the only record of any *Tetrathemis* in Koh Kong Province, where *T. platyptera* was expected basing on the records in the nearby Chanthaburi Province of Thailand (Hämäläinen & Pinratana 1999). In Cambodia, this species was once found deeper in the Cambodian Cardamom in Pursat Province, where these mountains are formed by igneous rocks rather than sandstone (Kosterin et al. 2012), once at the Kbal Spean River on the Phnom Kulen Massif in northern Cambodia (14.06.2018, unpublished),

Figure 2. *Tetrathemis flavescens*, a male specimen collected in Cambodia, Koh Kong Province, 17 km ENE of Koh Kong, 'Macromia Rivulet', 3.06.2014. Photo by O.K.

Figure 3. Anal appendages of a male of *Tetrathemis flavescens* collected in Cambodia, Koh Kong Province, 17 km ENE of Koh Kong, 'Macromia Rivulet', 22.07.2016. Photo by O.K.

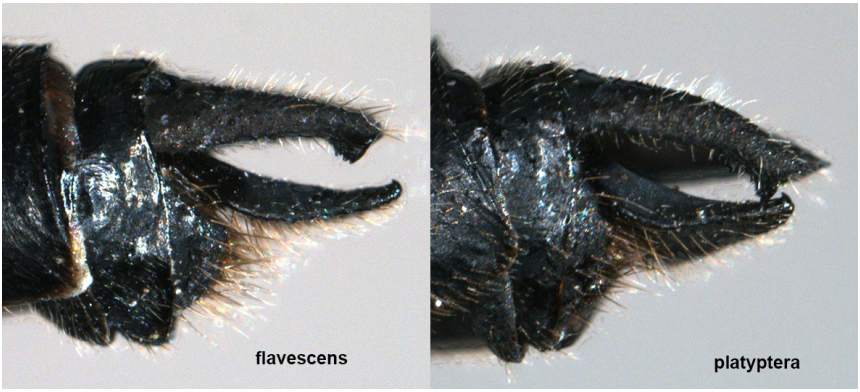

Figure 4. Anal appendages of males of *Tetrathemis flavescens* (left; Malaysia, Sarawak, Miri Division, Gunung Mulu National Park, a swamp pool by trail to Deer Cave, 24.12.2007, leg. & det. R.A. Dow.) and *T. platyptera* (right; Malaysia, Pahang, Cameron Highlands, Sg Relong, 23.09.2008, leg. & det. R.A. Dow.). Courtesy of R.A. Dow.

and appeared numerous in Mondulkiri Province in the east (Kosterin 2016a). One individual of *Tetrathemis* sp. was observed but not collected in Ream National Park, Preah Sihanouk Province that is in the easternmost part of the Cardamom Ecoregion (Kosterin 2015a); the proved presence of two species in this ecoregion makes it an interesting issue which of them occurs there. There may be even three options, for the Sondaic species *T. irregularis* has been reported for the Vietnamese island of Phú Quốc (Bùi 2008).

The finding of *T. flavescens*, thought to be an endemic of Borneo and Belitung, in Cambodia is miraculous, stressing faunal connections between Cambodia and Sundaland (Kosterin & Kompier 2018). However, it is not excluded that this rare species have been overlooked in Peninsular Malaysia and Thailand.

Observations. Two males were found (one photographed, one collected) at ca 10:40 as perching close to each other on thin twigs above black silt with rotting litter at the bank of the rivulet at the upstream end of its broad reach upstream the road. Curiously, according to pers. comm. by Rory Dow, in Borneo and Belitung this species is also usually observed singly and before 11. a.m.

Other species found in the same habitat and day but a bit more upstream, in narrow shaded reaches, were *Vestalis gracilis* (Rambur, 1842), *Euphaea masoni* Selys, 1879 (few males), *Rhinagrion viridatum* Fraser, 1938 (male), *Archibasis viola* Lieftinck, 1949 (males), *Pseudagrion pruinosum* (Burmeister, 1839) (several individuals), *Brachygonia oculata* (Brauer, 1878) (three groups of 2-3 males), a still soft female of *Idionyx thailandica* Hämäläinen, 1985 at maiden flight and a still soft male at maiden flight, which later became the holotype of *Microgomphus alani* Kosterin, 2016. Of these *B. oculata*, *I. thailandica* and, especially, M. *alani* are rare, as well as the earlier found there *Macromia cincta* Rambur, 1842 (Kosterin 2015d).

Figure 5. A male specimen of *Tetrathemis flavescens* from Borneo: Malaysia, Sarawak, Samarahan Division, Kota Samarahan, peat swamp forest on old UNIMAS campus, 25.02.2008, leg. & det. R.A. Dow. Courtesy of R.A. Dow.

Figure 6. A male of *Risiophlebia guentheri* in nature, Koh Kong Province, 16 km ENE of Koh Kong, 'Nannophya Rivulet', 22.07. 2016. Photo by O.K.

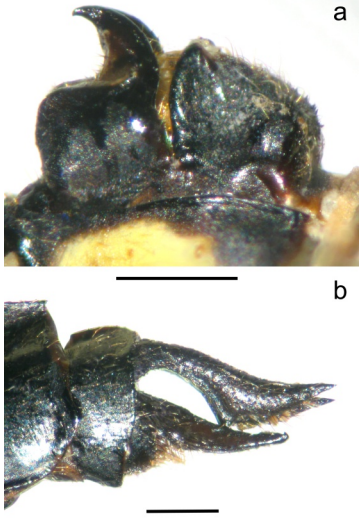

Figure 7. Details of a male of *Risiophlebia guentheri* collected on 23.07.2016 in Koh Kong Province, 16 km ENE of Koh Kong, 'Nannophya Rivulet': a – secondary genitalia; b - anal appendages; lateral views; scale bar 0.5 mm. Photo by O.K.

***Risiophlebia guentheri* Kosterin, 2015**

1 ♂ photographed (Fig. 6) and collected by O.K on 22.07.2016 and 2 ♂♂ collected (Fig. 7) on 23.07.2016, Koh Kong Province, 16 km ENE of Koh Kong, 'Nannophya Rivulet' (so nicknamed in Kosterin 2011, coordinates provided in Kosterin 2011, 2012 and 2014b incorrect, see below); 11°39'50-57" N 103°06'54"-07'00" E, 322-336 m a.s.l.

Remarks. This species was described from Mondulkiri Province in East Cambodia; a report of *Risiophlebia dohrnii* Krüger, 1902 from southern Vietnam by Asahina (1969) most probably referred to it as well (Kosterin 2015b). So the species was supposed to be confined to south-eastern Indochina while the genus to show a gap in Central Indochina and Thailand, as *R. dohrnii* appears in Malay Peninsula and ranges further in Sundaland (Kosterin 2015b). The here reported unexpected finding of this species in the Cardamom Mts. in Cambodia was made in June 2016 but was not published until now; four months later the same species was found in the Thai part of the Cardamoms, in Khao Khitchakut National Park, Chanthaburi Province (Sribal et al. 2018).

Figure 8. Habitat of *Risiophlebia guentheri*, Koh Kong Province, 16 km ENE of Koh Kong, 'Nannophya Rivulet', 22.07.2016. Photo by O.K.

The discovery of a *Risiophlebia* at 'Nannophia rivulet' in the Cardamom Mts in SW Cambodia partly filled the mentioned gap. It would challenge the specific status of *R. guentheri* if these specimens had intermediate states of the diagnostic characters. Fortunately, this was not the case and both Koh Kong and Thai specimens exhibited well expressed main diagnostic characters of *R. guentheri* – the hamulus without a rais-

ed 'heel' (Fig. 7a and Sribal et al., 2018: figs. 17). The Thai specimen shown in Sribal et al. (2018: fig. 18) has the same relatively long epiproct (0.84 of the cercus length) as in the original description of *R. guentheri* (0.83), versus 0.70 in *R. dohrni* (Kosterin 2015). In the Koh Kong specimens the relative epiproct length appeared somewhat less, varying as 0.76-0.78 (Fig. 7b). The size of the Kog Kong males of *R. guentheri* in as large (hw 22.5-23.5 mm, abd without apps. 21.5-22 mm) as in the original description (hw 23 mm, abd. without apps 22 mm), versus hw 18-20 mm and abd. 19-20 mm in males of *R. dohrni* (Kosterin 2015).

Observations. It is noteworthy that the habitat of *R. guentheri* in the Cardamoms at 'Nannophia rivuler" in Koh Kong Province did not resemble that in the type locality in Mondulkiri Province: a deeply shaded small brook with muddy bottom vined with spiny stolons of *Lasia spinosa* (L.) Thwaites, dense bushes and evergreen forest along banks (Fig. 8), versus an open boglet (but mostly without water) filled with thickets of very tall *Cyperus* sp. between sparse bushes and trees in a savannah plateau in the type locality in Mondulkiri Province (Kosterin 2015b: fig. 3). It is however indicative that both these superficially dissimilar habitats were among the only three in which another rare libellulid species, *Amphithemis curvistyla* Selys, 1891 (see below), was so far found in Cambodia. In Thailand, *R. guentheri* was found to perch on "twig above a small and very shallow stream in partly dark swamp forest", that is in the conditions similar to the here reported for the Cambodian part of the Cardamoms (Sribal et al. 2018: page 34).

Figure 9. An immature female of *Amphicnemis valentini*, Cambodia, Koh Kong Province, Tatai Commune, a lower course of an unnamed tributary of the Tatai River estuary, 11.5186 N 103.1233 E, 9.12.2017. Photo by G.C.

New species described

Microgomphus alani Kosterin 2016 was described as collected on the mentioned trips of 2014 and 2017 by O.K. from the 'Macomia Rivulet' and '*Microgomphus* River' (see below) (Kosterin 2016b). *Amphicnemis valentini* Kosterin & Kompier, 2018 was described from the Ream Peninsula in Preah Sihanouk Province and Vietnamese Phú Quốc Island (Kosterin & Kompier 2018). In that publication a photo of this species by G.C. from Koh Kong Province, here presented as Fig. 9, was mentioned.

Previous photographic records confirmed by specimens

Kosterin et al. (2012) published a number of records of Odonata species in the Cardamonean foothills, including *Gynacantha basiguttata* Selys, 1882, *Gynacantha demeter* Ris, 1911 and *A. curvistyla*, basing solely on photographs made in nature at Tatai village in Koh Kong Province by G.C.; Day (2011) and Kosterin & Chartier (2014) published photographic records of, respectively, a female and male of *Heliaeschna crassa* Krüger, 1899, and Kosterin & Chartier (2017) published a photographic record of *Pornothemis serrata* Krüger, 1902 from the same area. The photographic records of the above mentioned species have now been confirmed by specimens.

Gynacantha basiguttata Selys, 1882: 1 ♂ in alcohol, attracted by light and collected by G.C. on 26.02.2017 at Rainbow Lodge, Tatai Commune.

Gynacantha demeter Ris, 1911: 1 ♂ in alcohol, collected by G.C. on 7.12.2016 at Rainbow Lodge, Tatai Commune. We consider this species as distinct from *G. dohrni* Krüger, 1899, but solely because of its shorter cerci: ca 350% (in Asahina 1986: figs. 73-75) - 380% (in our specimen) as long as S10, versus 415% in *G. dohrni* (see Asahina 1986: fig. 76). The males photographed in the same area by G.C. and in photos of "*G. dohrni*" from the southern Vietnam, Đồng Nai Province, Cát Tiên National Park by Tom Kompier (2018) show this ratio to be about 350%

H. crassa: 1 ♂ in alcohol, attracted by light at Rainbow Lodge on 8.01.2018 and collected by G.C.

A. curvistyla: 2 ♀♀ collected by O.K. on 22.07.2016; 2♂♂ and 1 ♀ on 23.07.2016, all teneral, Koh Kong Province and District, 16 km ENE of Koh Kong, 'Nannophya Rivulet', 11°39'50-57" N 103°06'54"-07'00" E, 322-336 m (the same locality as *R. guentheri* (considered above)). Those teneral individuals, with still glittering wings and a yellowish body ground colour, were startled from herbs and commenced maiden flights to the nearby bushes, both shaded and sunny; unfortunately they were not photographed in nature.

Pornothemis serrata Krüger, 1902 was reported for Cambodia by a photograph of a male taken by G.C. on 17.07.2016 at a rivulet in a marshy, semi-mangrove area in Tatai Commune, not at foothills but close to them (Kosterin & Chartier 2017). A mature male specimen has now been collected by him at 10:02 on 16.05.2018, in the locality where the species was for the first time photographically registered in Cambodia at 11°30'48" N 103°07'37" E (Kosterin & Chartier 2017), with 5-6 more individuals seen in the vicinity. The area was a mangrove swamp affected by tide, with water courses brackish but upper reaches of the narrowest with fresh flowing water because of rains,

Figure 10. An immature (a) and mature (b) females of *Pornothemis serrata* in nature in a marshy, semi-mangrove area at the lower reaches of the Tatai estuary; Cambodia, Koh Kong Province, Tatai Commune: a - 11°32'16.7" N, 103°07'23.1" E, 2.05.2017; b - 11°30'48" N 103°07'37" E, 2.06.2017. Photo by G.C.

Figure 11. An immature male of *Pornothemis serrata* in nature in a marshy, semi-mangrove area at the lower reaches of the Tatai estuary; Cambodia, Koh Kong Province, Tatai Commune, 11°30'48" N 103°07'37" E, 29.04.2017. Photo by G.C.

with a variety of mangrove tree species (of which only *Terminalia catappa* L. (Tropical Almond) was identified), and also some *Pandanus odorifer* (Forrsk.) Kuntze, *Calamus* sp. (rattans), *Acanthus ebracteatus* Vahl (Mangrove Holly). Later in the day more individuals were seen in another locality some 200 m to north-west (11°30'54"N, 103°07'35"E)

off the same stream. There the land was higher and the vegetation quite different, including *Melaleuca cajuputi* Pollard, much more abundant *P. odorifer*, *Licuala spinosa* Roxb., some mangrove trees. Besides, some new photographic records of this dragonflies were made by G.C.

At the first locality, a mature female was photographed by G.C. on 2.06.2017 (Fig. 10b) and an immature, yellowish with a dark stripy patterns, male on 29.04.2018 (Fig. 11). Besides, an immature female was photographed (Fig. 10a) on 2.05.2018 at another locality 2.7 km to NNW, up the larger stream opposite to the downstream end of Koh Andet Island, in front of its rocky cascade (11°32'16.7" N, 103°07'23.1" E) and at the base of a hill. Although it is nearby and there is some overlap in flora between the two streams, the two habitats are quite different, and it was quite a surprise to find *P. serrata* at the second location. Note that all records of *P. serrata* were made during April to July.

Minor data on the Tatai village environs

A small temporary stream (Kosterin 2010: fig. 21) downstream the Phum Doung Bridge at Tatai village, at the estuary right bank, 11°33'22,4-32.6" 103°07'57,5"-08'06,3", 3-32 m a.s.l., flows in a valley with sandstone rocks (a small waterfall near the mouth) through primary forest at its lowest reaches and otherwise through secondary bamboo forest. It was examined before by O.K. in the afternoon of 18.04.2010 (no water in the stream), with three species revealed: *V. gracilis* (1♂, 1♀), *E. masoni* (1♀) and *Libellago hyalina* (Selys, 1859) (1♂, 1♀) (Kosterin 2010). Below are the results of two more examinations by both authors in early rainy season when the stream had water, both made at 4-5 p.m. 1.06.2014: *V. gracilis* (few), *Heliocypha biforata* (Selys, 1859) (few ♂♂), *R. viridatum* (1♂), *Copera vittata* (Selys, 1853) (1♂), *Prodasineura* sp. (*verticalis* sensu Asahina, 1984) (1♂, 1♀), *B. oculata* (1♂, perching over a tiny running stream). 22.07.2016 (a short downpoor): *V. gracilis* (few); *Dysphaea gloriosa* Fraser, 1938 (1♂), *Neurothemis fluctuans* (Fabricius, 1793) (1♀ with reddish wings). In total 10 species recorded.

On 25.05.2013 O.K. examined a small stream (Kosterin 2014: 'Macromidia rivulet', loc. 13 therein), 11°36'03-06" N, 103°04'15" E, 114-123 m a.s.l., 10 km E of Koh Kong, flowing through a primary forest at the first low foothills in a sandstone bed and crossing the road from Koh Kong to Tatai, and found there 7 species, including a new record for the country (Kosterin 2014). On a brief examination on 1.06.2014, O.K. found 3 earlier registered *V. gracilis*, *Orthetrum chrysis* (Selys, 1891) and *Trithemis aurora* (Burmeister, 1839), and 5 more species: *Pseudargion williamsoni* Selys, 1836 (several ♂♂), *C. vittata* (2 ♂♂), *Prodasineura* sp. (*verticalis* sensu Asahina, 1984) (several ♂♂), *N. fluctuans* (1 ♂) and *Rhyothemis obsolescens* Kirby, 1889 (several ♂♂).

Unpublished data from localities at the road Koh Kong - Pursat

The road from Koh Kong to Pursat crosses the Cardamonean foothills, which at the distance of some 20-30 km from Koh Kong are mostly covered with still little disturbed primary evergreen tropical forests (but underwent a strong recent deforestation further on, see Kosterin 2015a). Localities at these relatively undisturbed areas close to Koh Kong were examined by O.K. in 2010, 2011, 2013, 2014 and 2016 and provided a rich dragonfly

fauna reported in a number of previous communications (Kosterin 2011; 2012; 2014a; 2015d; 2016b; Kosterin et al. 2015). The results of 2014 (1st, 3rd and 4th June) and 2016 (22nd and 23rd July) have not however been published (although the data from the flat coastal marshes near Koh Kong, examined on the same dates, were summarised by Kosterin & Chartier 2017). In 2014 and 2016, only three localities were examined.

Two of them were neighbouring rivulets flowing through primary forest and crossing the road, conventionally nicknamed as 'Nannophya Rivulet' (in Kosterin 2011; for a photo see fig. 18 therein) and 'Macromia Rivulet (in Kosterin 2012; for a photo see fig. 59b therein and fig. 5a in Kosterin 2016b). The coordinates of the former site provided by Kosterin (2011, 2012) and of the latter provided by Kosterin (2012) were somewhat incorrect and corrected in Kosterin (2014a). However, a typo crawled into the 'corrected' latitude of the 'Nannophya Rivulet' (11°40'44-51" instead of the correct 11°39'44-51"). In 2014 and 2016 both were followed more upstream into the forest than previously. The correct coordinates (in two formats) and more detailed description of habitats are given below:

'Nannophya Rivulet' 11°39'44-57" N, 103°06'54"-07'09" E (11.6622-6658 N, 103.1150-1192 E), 318-336 m a.s.l., 17 km ENE of Koh Kong. Upstream the bridge of the road to Pursat it has a deep part with banks overgrown mostly by forked fern (Kosterin 2011: fig. 18) (in July 2016 found mostly filled with earth during road reconstruction), in a shallower place with submerged plant with long winding leaves; more upstream the river is hidden in dense bushes and tall trees, its bed filled with deep black silt, hardly permeable in November 2011 and May 2013 but drier and rather firm in June 2014 and July 2016, over which shallow stream arms flow and some stolons of *Lasia spinosa* are spread; more upstream it flows in a deep shade of primary forest. Downstream the road the rivulet serves as a border between a forest and a considerable cleared area with a pasture, small fruit tree plantation and tiny village; here the rivulet flows openly and then enters the primary forest again, acquiring rocky sandstone bed and becoming rapidous.

'Macromia Rivulet' 11°40'18-19" N, 103°07'20-29" E (11.6717-6719 N, 103.1222-1247 E), 294-307 m a.s.l., 17 km ENE of Koh Kong. A somewhat larger rivulet examined only upstream the road, close to which it flows openly over a gravel bed, then forms a long and deep (ca 1.5-1.8 m) half-open reach with sandy bottom (Kosterin 2012: fig. 59b) and some floating silty mats at banks; more upstream it flows, with alternating slow reaches with black silty bottom and riffles over sandstone plates, in an shallow valley deeply shaded by a dense primary forest (Kosterin 2016b: fig. 5a).

Both rivers were rich in Odonata fauna and both were visited at different time of the season, so the data on Odonata found there are presented below in a table form (Table 1).

Table 1. Odonata found at 'Nannophya Rivulet' and 'Macromia Rivulet' at the road Koh Kong – Pursat in November-December 2010 (Kosterin 2011), August 2011 (Kosterin 2013), May 2013 (Kosterin 2014a), June 2014 and July 2016 (this paper). Columns are arranged according to seasonal progression rather than chronologically. Codes of abundance: - – not found, 1 – single individual found (sex indicated when clear), 2 – few (2 to 5 individuals), 3 - moderately abundant (5-20), 4 – abundant (~20-100); underlining indicates that specimen(s) was (were) collected at this locality, boldface – that the species was photographed.

	'Nannophia rivulet'					'Macromia rivulet'			
Dates	23.05.2013	3.06.2014	22-23.07.2016	14,16.08.2011	28.11-4.12.2010	23.05.2013	3.06.2014	22-23.07.2016	16.08.2011
Calopterygidae 1. *Vestalis gracilis*	2	3	3	4	2	2	3	3	2
2. *Neurobasis chinensis*	-	-	-	2	-	-	-	-	2
Euphaeidae 3. *Dysphaea gloriosa*	-	-	-	-	-	2	-	-	-
4. *Euphaea masoni*	-	2	-	2	-	-	2	3	-
Chlorocyphidae 5. *Aristocypha fenestrella*	-	-	-	1♂	-	-	-	-	-
6. *Heliocypha biforata*	-	-	1♂	3	-	-	2	2	-
7. *Heliocypha perforata limbata*	-	-	-	-	-	1♂	-	3	-
8. *Libellago hyalina*	-	-	-	-	-	-	-	3	2
Phylosinidae 9. *Rhinagrion viridatum*	-	-	-	-	-	-	1♂	2	-
Coenagrionidae 10. *Agriocnemis nana*	-	2	-	-	-	-	-	-	-
11. *Aciagrion borneense*	-	-	-	-	2	-	-	-	-
12. *Archibasis viola*	-	-	3	2	-	-	3	**3 Fig.12**	-
13. *Argiocnemis rubescens rubeola*	-	1♀	1♀	-	-	-	-	1♂	-
14. *Ceriagrion cerinorubellum*	**2**	1♂	-	-	-	-	-	-	-
15. *Pseudagrion australasiae*	-	1♂	-	-	2	-	-	-	-
16. *Pseudagrion pruinosum*	1♂	3	1♂	2	1♂	2	3	-	2
17. *Pseudagrion rubriceps*	-	-	-	-	**2**	-	-	-	-
18. *Pseudagrion williamsoni*	1♂	1♂	-	2	1♂	-	-	-	-
Platycnemididae 19. *Copera vittata*	-	-	2	2	1	-	-	3	-
20. *Prodasineura autumnalis*	-	-	-	-	-	1♂[1]	-	2	-
21. *Prodasineura verticalis* sensu Asahina, 1984	-	3	2	3	-	1♂	3	-	-
Gomphidae 22. *Ictinogomphus decoratus melaenops*	-	-	-	-	-	-	1♂	-	-
23. *Nepogomphus walli*	-	-	1♀	1♀	-	-	-	-	-
24. *Microgomphus alani*	-	-	-	-	-	-	1♂2	-	-
25. *Paragomphus capricornis*	-	-	-	-	-	-	-	1♂	-

	'Nannophia rivulet'					'Macromia rivulet'			
Dates	23.05.2013	3.06.2014	22-23.07.2016	14,16.08.2011	28.11-4.12.2010	23.05. 2013	3.06. 2014	22-23.07. 2016	16.08. 2011
Synthemisidae 26. *Idionyx thailandica*	-	-	-	-	-	-	1♂	-	-
Cordulliidae 27. *Hemicordulia tenera vikhrevi*	-	-	-	3	-	4	-	2	2
Macromiidae 28. *Macromia cincta*	-	-	-	-	-	1♂	-	-	1♀
Libellulidae 29. *Agrionoptera insignis*	-	-	**2 Fig. 13**	2	-	-	-	-	-
30. *Amphithemis curvistyla*	-	-	3	-	-	-	-	-	-
31. *Brachygonia oculata*	-	-	-	-	-	-	2	-	-
32. *Brachythemis contaminata*	-	-	-	-	1♂	-	-	-	-
33. *Diplacodes nebulosa*	-	-	-	-	2	-	-	-	-
34. *Diplacodes trivialis*	-	1	-	-	-	1♂	-	-	-
35. *Lathrecista asiatica*	-	-	-	-	-	-	-	1♂	-
36. *Nannophya pygmaea*	4	4	-	-	**4**	2	3	-	2
37. *Neurothemis fluctuans*	3	3	3	2	**4**	-	-	-	-
38. *Neurothemis fulvia*	-	-	-	-	-	-	1♂	-	-
39. *Neurothemis intermedia atalanta*	1♂	-	1♂	-	-	-	-	2	-
40. *Neurothemis tullia*	-	-	-	-	1♀	-	-	-	-
41. *Orchithemis pulcherrima*	4	3	3	**4**	-	4	3	-	-
42. *Orthetrum chrysis*	**1**♂	2	2	2	1♂	1♂	1♂	**2**	2
43. *Orthetrum luzonicum*	-	1♂	-	-	-	-	-	-	-
44. *Orthetrum neglectum*	-	-	-	-	-	-	1♂	-	-
45. *Orthetrum sabina*	-	2	2	1	-	-	2	2	-
46. *Pantala flavescens*	-	2	-	-	-	-	-	-	-
47. *Potamarcha congener*	-	-	-	**1**♂	-	-	1♂	-	-
48. *Rhyothemis obsolescens*	4	4	3	**4**	-	4	4	3	2
49. *Risiophlebia guentheri*	-	-	**2**	-	-	-	-	-	-
50. *Tetrathemis flavescens*	-	-	-	-	-	-	**2**	-	-
51. *Trithemis aurora*	2	4	3	3	2	2	4	3	-
52. *Trithemis festiva*	-	-	2	2	-	2	-	2	-
53. *Trithemis pallidinervis*	-	-	-	1	-	-	-	-	-
54. *Zyxomma petiolatum*	-	**1**♀	-	-	-	-	-	-	-

Figure 12. Tandem of *Archibasis viola* in nature at the 'Macromia Rivulet' 17 km ENE of Koh Kong, 22.07.2016. Photo by O.K.

Figure 13. A male of *Agrionoptera insignis* in nature at the 'Nannophya Rivulet' 16 km ENE of Koh Kong, 22.07. 2016. Photo by O.K.

Figure 14. A male of *Paragomphus capricornis* in nature on the gravel bank at an open reach of the 'Macromia Rivulet' 17 km ENE of Koh Kong, 22.07.2016. Photo by O.K.

Figure 15. A female of *Zyxomma petiolatum* in nature at the 'Nannophya Rivulet' 16 km ENE of Koh Kong, 22.07.2016. Photo by O.K.

Figure 16. A medium-sized shallow river 17.5 km NE of Koh Kong, 3-4.06.2014. Photo by O.K.

The following 14 species were added for these two rivulets in 2014 and 2016 (Table 1): *R. viridatum* (on 22.07.2016 a just emerged male was found, along with a mature one), *Agriocnemis nana* (Laidlaw, 1914) (a mature male and female and a number of immature individuals in grass at banks of a pool through which the 'Nannophya rivulet' flows), *Argiocnemis rubescens rubeola* Selys, 1877 (all three individuals met at shaded pools), *Ictinogomphus decoratus melaenops* (Selys, 1857) (at an open sunlit bank of the rivulet broadening near the road), *M. alani* (the holotype caught at maiden flight in a shaded rivulet section), *Paragomphus capricornis* (Förster, 1914) (a very cautious male appeared sitting on gravel near running water in an open part; Fig. 14), *A. curvistyla* Selys, 1891 (see above), *B. oculata* (three groups by 2-3 males perching on a monocotyledonous plant were found at the rivulet bank in its deeply shaded part), *Lathrecista asiatica* (Fabricius, 1798) (a mature male with saturated colour on an sunlit bush), *Neurothemis fulvia* (Drury, 1773), *Orthetrum luzonicum* (Brauer, 1868), *Orthetrum neglectum* (Rambur, 1842) (both by open sunny banks), *Pantala flavescens* (Fabricius, 1798), *Zyxomma petiolatum* Rambur, 1842 (the female was startled from entangled bush branches at midday; it flew for a short distance and sat nearby; Fig. 15).

An observation at the 'Macromia Rivuler' on 22.07.2016: in a good weather day *T. aurora*, *O. chrysis*, *P. capricornis* appeared at water at ca 9:00, *H. tenera* at 9:40, *A. viola* at ca 11:00 (at once in abundance)

A new locality was examined by O.K. further on the new road to Pursat: a medium-sized, shallow and warm river (Fig. 16), 11°43'52"-44'01" N 103°05'26-36" E, 63-66 m a.s.l., 17.5 km NE of Koh Kong, examined on 3-4.06.2014. Medium-sized rivers in evergreen forest are very promising (e.g. the 'Microgomphus River' considered below), but this one surprisingly offered very poor odonate assemblage (especially if compared with the two above considered rivulets examined on one of those days). There were two males of *D. gloriosa*, very many *P. autumnalis* (Fraser, 1922), one male of *P. pruinosum* and

P. williamsoni, many *R. obsolescens*, two females of *Trithemis festiva* (Rambur, 1842) and several males of *Urothemis signata* (Rambur, 1842) (there was also a male of *O. chrysis* at a nearby pool). Most probably, this poor set can be explained by low oxygen in a very warm water of this shallow and slow river. Presence of *U. signata* which tolerates low oxygen and usually occurs at warm lentic habitats can be considered indicative.

Besides, the left bank of the Koh Por River (Fig. 17), now easily accessible from the new road 18 km NE of Koh Kong, at 11°45'16-31" N 103°03'42-46" E, 47-52 m a.s.l., was examined by O.K. on 4.06.2014. This broad area of large boulders with scarce shrubs and pools was strikingly poor: only many *T. aurora*, several *P. autumnalis*, *L. asiatica* (fully coloured) and *O. chrysis* and one *N. fulvia* were observed (all males), all recorded for this place before (Kosterin 2010; 2011).

Figure 17. The Koh Por River 18 km NE of Koh Kong, 3-4.06.2014. Photo by O.K.

Thma Bang revisited

The Thma Bang environs are one of the richest in Odonata Cambodian localities. It was examined by O.K. in April and December 2010 (Kosterin 2010, 2011), August 2011 (Kosterin 2012), May 2013 (Kosterin 2014a) and April 2015 (Kosterin 2015a) and provided two gomphid species new to science, *Burmagomphus asahinai* Kosterin, Makbun and Davvrueng, 2012 and *Microgomphus alani* Kosterin, 2016 (Kosterin et al. 2012a; Kosterin 2016b). A visit by O.K. on 2.06.2014 was not covered in the above mentioned publications. At 'Microgomphus River' (Kosterin 2012: fig. 25), a small hydroelectric power station and the pipe providing water to it, constructed in 2013, were found completely ruined. The same species of Calopterygidae, Euphaeidae, Coenagrionidae and Libellulidae were revealed as in May 2013 (Kosterin 2014a). Macromiidae and Gomphidae are of a special in-

terest. Just one *Macromia* sp. was noticed, and only two species of Gomphidae, represented by two individual each, one of them for each species was collected and already mentioned in earlier publications: a teneral male of *Euthygomphus yunnanensis* (Zhou & Wu, 1992) (Kosterin 2016c) and a male *Gomphidia* sp. (perching on a twig at the bank of the shallow river reach at the bridge, not cautious).

The latter male specimen was mentioned by Kosterin (2016a) under incorrect identification *Gomphidia kruegeri* Martin, 1904, but in fact represented an undescribed species (pers. comm. by Haomiao Zhang). This specimen was so identified at first because of certain characters intermediate between the presumed subspecies *kruegeri* and *fukienensis* Chao, 1955. However, the two latter taxa were proved to be bona species by *H.* Zhang (pers. comm.) while the here collected specimen represented one of a number of undescribed species, and most probably was not conspecific to the second male of '*Gomphidia kruegeri*' reported by Kosterin (2016a) from Mondulkiri Province, probably also representing an undescribed species.

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References

Asahina, S. (1969) South Vietnam Odonata taken by Mr. Y. Inoue. Japanese Journal of Zoology 16: 1–18.

Asahina, S. 1986. A list of the Odonata recorded from Thailand. Part XV. Aeschnidae. Tombo 29 (3-4): 71-106.

Bùi H. M. 2008. Danh luc bắng hính ảnh các loài chuồn chuồn Phú Quốc. Wildlife Art Risk, 47 pp.

Day, L. 2011. Odonata seen at Tatai, Koh Kong Province, Cambodia. International Dragonfly Fund Report 42: 7-10.

Dow, R.A., Alfarisyi, A. & Bilitoni, J.F. 2017. Odonata Survey in Belitung (Indonesia). International Dragonfly Fund Report 108: 1-24.

Dow, R.A. & Reels, G. 2013. Previously unpublished Odonata records from Sarawak, Borneo. Part I. Kuching District excluding Kubah National Park, and Samarahan Division. Faunistic Studies in South-East Asian and Pacific Island Odonata 3: 1-25.

Hämäläinen, M. & A. Pinratana. 1999. Atlas of the Dragonflies of Thailand. Distribution maps by provinces. Brothers of St. Gabriel in Thailand, Bangkok: 176 pp.

Kirby, W.F. 1889. A revision of the subfamily Libellulinae, with descriptions of new genera and species. Transactions of Zoological Society of London 12(9): 249-348, pls 51-57.

Kosterin, O.E. 2010. A glance at the Odonata of the Cambodian coastal regions: end of dry season in 2010. International Dragonfly Fund Report 29: 1-75.

Kosterin, O.E. 2011. Odonata of the Cambodian coastal regions revisited: beginning of dry season in 2010. International Dragonfly Fund Report 40: 1-108.

Kosterin, O.E. 2012. Odonata of the Cambodian coastal regions in late rainy season of 2011. International Dragonfly Fund Report 45: 1-102.

Kosterin, O.E. 2014a. Odonata of the sourth-west and north-east of Cambodia as studied in early rainy season of 2013. International Dragonfly Fund Report 67: 1-94.

Kosterin, O.E. 2014b. Corrigenda to Cambodian Odonata reports published by O.E. Kosterin between 2010 and 2012. International Dragonfly Fund Report 67: 95-96.

Kosterin, O.E. 2015a. Dry season Odonata of the Cardamonean coast (Cambodia and Thailand) revisited. International Dragonfly Fund Report 89: 1-36.

Kosterin, O.E. 2015b. *Risiophlebia guentheri* sp. nov. (Odonata, Libellulidae) from south-eastern Indochina. Zootaxa 3964: 138-145.

Kosterin O.E. 2015d. Taxonomic and faunal notes on *Macromia* Rambur, 1842 from Cambodia (Odonata: Macromiidae). Odonatologica 44: 117-151

Kosterin, O.E. 2016a. A survey of Odonata of Mondulkiri, the elevated eastern province of Cambodia, for ten days in June 2014. International Dragonfly Fund Report 98: 1-85.

Kosterin, O.E. 2016b. *Microgomphus alani* (Odonata, Gomphidae) sp. nov. from Cambodia. Zootaxa 4114 (3): 341-350.

Kosterin, O.E. 2016c. Reconsideration of the genera *Merogomphus* Martin, 1904, and *Anisogomphus* Selys, 1857, including erection of a new genus, with a new species and discussion of additional specimens from Cambodia. Zootaxa 4171 (1): 51-76.

Kosterin, O.E., Chartier, G., Holden, J. & Mey, F.S. 2012. New records of Odonata from Cambodia, based mostly on photographs. Cambodian Journal of Natural History 2012: 150-163.

Kosterin, O.E. & Chartier, *G.* 2014. Two more Odonata species recorded from Cambodia. Cambodian Journal of Natural History 2014: 8-11.

Kosterin, O.E. & Chartier, *G.* 2017. 2017. Update of 2014 and 2016 to Odonata found at the marshy coast of SW Cambodia including three species added for the country. International Dragonfly Fund Report 101: 1-26.

Kosterin, O.E., Karube H., Futahashi *R.* 2015. Two new subspecies of Hemicordulia tenera Lieftinck, 1930 (Corduliidae) from Cambodia and Thailand. International Dragonfly Fund Report 82: 1-19.

Kosterin, O.E., Kompier, *T.* 2018. *Amphicnemis valentini* sp. nov. from the Cardamom ecoregion in Cambodia and Vietnam (Odonata: Coenagrionidae). Zootaxa 4429(2): 281-294.

Sribal U., Paweenpermsuk Y., Thitiarchagul T., Atdhabhan S., Saengamron C., Thepphibalsathit N., Chaychum S., Behrstock R.A., Jadoonkittinan P., Ruangrong R., Ruangrong J., Thammasangwan N., Tersing S., Changong S., Makbun N. 2018. New national records of Odonata from Thailand based mostly on photographs (Odonata: Argiolestidae, Philosinidae, Aeshnidae, Libellulidae). Agrion 22 (1): 30-36.

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