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Odonata of Gunong Mulu National Park in Sarawak, Malaysian Borneo

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Abstract

Records of Odonata collected in Gunong Mulu National Park in Sarawak are presented. Between 2005 and 2019, in 12 surveys that lasted between one week and five months, 163 species were collected. The collections from Gunong Mulu National Park are of importance for the taxonomic study of dragonflies and damselflies in Borneo; several species have been described based on material collected in the Park.

Bahasa Melayu Abstract

Rekod Odonata yang telah dikumpul di Taman Negara Gunong Mulu di Sarawak adalah dibentangkan di sini. Antara tahun 2005 dan 2019, dari 12 survei yang telah dijalankan selama satu minggu hingga lima bulan, sebanyak 163 spesies telah dikutip. Koleksi dari Taman Negara Gunong Mulu adalah penting untuk kajian taksonomi pepatung dan pepatung jarum di Borneo; beberapa spesies telah diperihalkan berdasarkan material yang telah dikumpul di taman negara ini.

Note: Gunong Mulu National Park is frequently given as Gunung Mulu National Park. Gunung is a newer spelling for Gunong (mountain), and when the National Park was gazetted, it was with the old spelling (Sarawak Government Gazette 1974), so that the correct name is Gunong Mulu National Park.

Key words: Odonata checklist, dragonflies, damselflies, Gunong Mulu National Park, Sarawak, Borneo

Introduction

Gunong Mulu National Park (GMNP) is located in northeast Sarawak, Malaysian Borneo, and was established in 1974 (Anderson, Jermy & Gathorne-Hardy 1982). It covers 528 km² of an isolated mountain range and some surrounding lowland forest. Gunung (Mount) Mulu is the highest peak at 2,376 m a.s.l. (Anderson, Jermy & Gathorne-Hardy 1982). While Gunung Mulu itself consists of sandstone, the surrounding area is largely made up of limestone karst formations, and the National Park is consequently renowned for its caves, some of which are among the largest and longest in the world (UNESCO 2000). Furthermore, apart from a small area around the headquarters, the National Park is covered exclusively by old-growth forest. Due also to the large elevational range from 50–2,376 meters, the park harbours a rich biodiversity, with several different vegetation types, endemic plant and frog species and a high number of bird species (e.g. Burner et al. 2016; UNESCO 2000; Proctor et al. 1983; Dehling 2008; Sang, Kiew & Geri 2013).

Until relatively recently the only published records of Odonata from GMNP were those in Matsuki & Kitagawa (1992, 1993); there is also a record in Ris (1909) of a specimen of *Lyriothemis cleis* Brauer, 1868 from "Ms. Mulu, 3000". However over the course of the last 14 years, Gunong Mulu National park has also been surveyed relatively extensively for odonates. The authors, in various combinations, have visited the Park 12 times between 2005 and 2019, and surveys lasted between one week and 5 months (see Table 1).

Table 1. Dates of surveys at GMNP and authors taking part.

Dates	Authors present
16 th April-24 th April 2005	R.A. Dow
4 th February-21 st February 2006	R.A. Dow & G.T. Reels
24 th December 2007-31 st January 2008	S.G. Butler & R.A. Dow
4 th September-13 th September 2008	R.A. Dow
15 th September-12 th October 2009	S.G. Butler
3 rd May-7 th May 2010	R.A. Dow
10 th -25 th February 2012	S.G. Butler
10 th May-24 th May 2012	R.A. Dow
7 th September-14 th September 2012	C.Y. Choong
27 th March – 30 th August 2014	P.O.M. Steinhoff
15 th November – 3 rd December 2016	P.O.M. Steinhoff
9 th June–20 th June 2019	R.A. Dow

Unfortunately most of the specimens collected in the May 2012 survey was among material lost in transport to Europe (see Dow, Reels & Ngiam 2015). The collections of Odonata made in Gunong Mulu National Park have played an important role in taxonomic studies on the Odonata from Borneo published in recent years. Several previously unknown species have been described based exclusively or parti-

ally on material collected in the National Park (e.g. Dow 2010b, 2014a, 2014b; Dow, Hämäläinen & Stokvis 2015, Dow, Stokvis & Ngiam 2017, Dow & Orr 2012a; 2012b; Hämäläinen, Dow & Stokvis 2015, Orr & Hämäläinen 2013). Furthermore, larvae have been described and matched to the adult based on material collected in Gunong Mulu National Park (Orr & Dow 2015; Steinhoff, Butler & Dow 2016; Butler, Steinhoff & Dow 2016).

A list of species recorded within the National Park up until 2006 was published in Dow & Reels (2008), however some of the identifications in that paper are now out-of-date and all records are included here (details are not given for those records that were included in later taxonomic papers). Records of larval collection and rearing conducted by the first author in 2014 were published in Steinhoff (2015).

Here we summarize all records of Odonata from GMNP made during the 12 surveys listed in Table 1. Species collected are listed with locations below. Detailed records are given in an appendix. Many larval records, and some adult records, cannot be definitely assigned to species and might or might not actually be some species already included in the main list. To avoid accidental inflation of the number of species known from GMNP we have placed such records under a separate 'Additional Records' heading in the appendix.

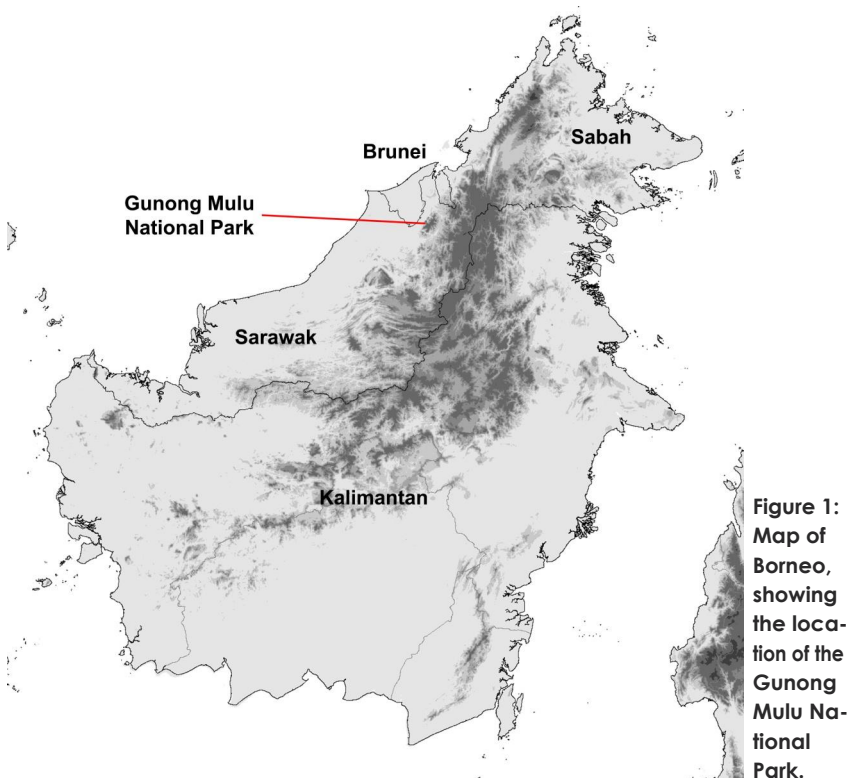


Figure 1: Map of Borneo, showing the location of the Gunong Mulu National Park.

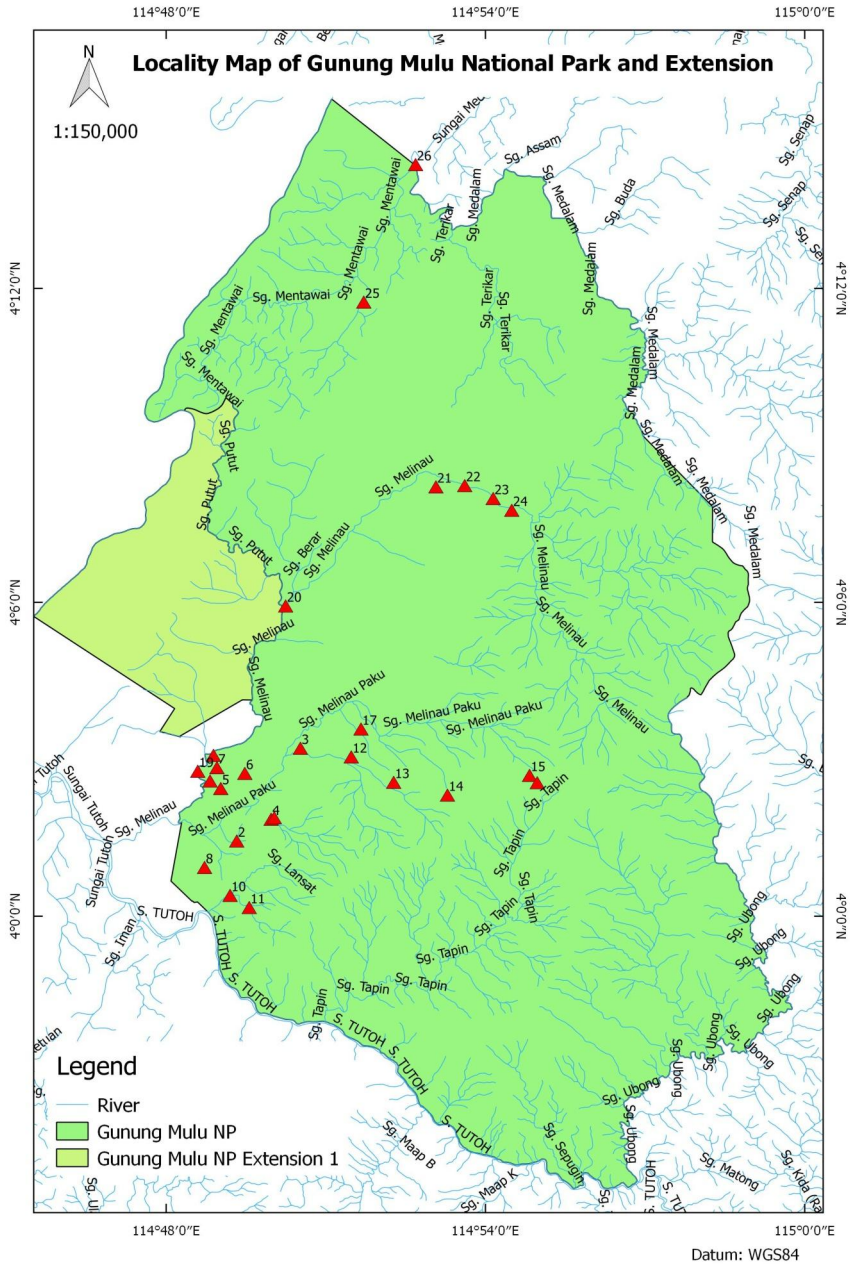


Figure 2: Map of the Gunung Mulu National Park, sampling locations are indicated by red triangles and location numbers.

Research area and Methods

The headquarters of Gunung Mulu National Park is located on the bank of the Sungai ("river") Melinau and surrounded by alluvial forest. An extensive network of boardwalks extends from the headquarters through the surrounding lowland rainforest and leads to the entrances of several caves as well as to a trail that eventually leads up to the summit of Gunung Mulu itself. Many rivers, streams and forest pools can be accessed rather easily through this system of boardwalks and trails. From the summit trail, water bodies at higher altitude can be accessed. Three campsites exist along the summit trail at different altitudes (Camp 1 at ~150 m, Fig. 4A; Camp 3 at ~1350 m and Camp 4 at ~1800 m), from which surveys can be undertaken. To access the more northern areas around Camp 5 and Sungai Mentawai as well as the more southern areas around Sungai Lansat, one has to travel upstream or downstream by boat.

Adult Odonata were collected by hand netting; specimens of two species (*Nesoxenia lineata* (Selys, 1879) and *Tetracanthagyna* sp.) were also caught as by-catch in mist-nets used for bird monitoring. Sampling methods for larvae were explained in Steinhoff (2015).

Sampling locations

Numerous lentic and lotic water bodies within the Gunung Mulu National Park have been surveyed during the sampling activities in the past 14 years; too many to list individually here. Furthermore, it is a common feature of forest pools and small streams in limestone areas that they carry water only temporarily. We have therefore lumped locations by general area and similarity of habitats. The numbering system is used throughout the text. Fig. 2 gives an overview of the locations sampled within the park, Figs. 3-7 portray individual streams, pools and habitats.

1 Park Headquarters (4°02'32.8"N 114°48'49.4"E)

1a At the ponds in the clearing.

1b At lights at the Research Centre and other park buildings.

1c Around the park HQ area but not associated with water or attracted to lights.

2 Stream running past the Bat Observatory (4°01'23.9"N 114°49'19.5"E)

This stream is a tributary of the Sungai Melinau Paku (Location 4).

2a At and near the Bat Observatory including a small section at Bat Observatory where forest has been cleared on one bank.

2b Downstream from the Bat Observatory.

2c A small, muddy tributary.

3 Alluvial forest on Summit and Deer Cave Trails and old trail (now a dead end) to the Marriot Hotel (formerly the Royal Mulu Resort) and mixed dipterocarp forest on Summit Trail before last river crossing before junction with old trail to Sarawak Chamber (4°03'10.4"N 114°50'31.3"E)

3a Streams and rivers, excluding the Bat Observatory stream, Sungai Lupar and the Sungai Melinau Paku.

3b Swampy areas and forest pools (including pools on the trail), or otherwise in forest.

3c Trailside.

4 Sungai Melinau Paku (now often referred to as Sungai Paku) (4°01'48.9"N 114°49'04.3"E)

4a Sungai Melinau Paku upstream from Bridge on Deer Cave Trail.

4b Sungai Melinau Paku downstream from the Bridge.

5 Sungai Lupar (4°02'24.2"N 114°49'01.5"E)

5a Sungai Lupar upstream from Botany Loop.

5b Small muddy tributaries of Sungai Lupar.

5c Trailside on Botany Loop.

6 Paku Valley Loop (4°02'41.5"N 114°49'28.6"E)

6a swampy areas and swampy streams.

6b Paku Valley Loop, trailside.

7 Night Walk Trail (4°02'48.1"N 114°48'57.2"E)

7a Swamp pools near to the Sungai Melinau and elsewhere along the trail.

7b Trailside.

8 In forest without trail between the Bat Observatory and Long Iman (4°00'53.6"N 114°48'43.2"E)

8a Streams.

8b Swampy areas and forest pools.

9 In the "Garden of Eden" area (4°01'53.0"N 114°50'01.9"E)

9a Stream flowing into Deer Cave.

9b tributaries of stream flowing into Deer Cave.

9c Garden of Eden area, trailside Valley Walk.

9d Area east (outside) from the Garden of Eden, stream flowing into Deer Cave (upstream from Waterfall).

9e big tributary of **9c**, joining at the Waterfall.

9f Tributaries of **9c,d**.

10 Sungai Lansat (4°00'21.6"N 114°49'12.0"E)

10a Main stream sampled from the mouth (Long Lansat) to rather far upstream.

10b Tributaries.

11 Area southeast of Sungai Lansat (4°00'07.7"N 114°49'33.6"E)

11a Larger streams.

11b Tributaries.

12 Camp 1 area (4°03'00.4"N 114°51'28.6"E)

12a Main stream at Camp 1 (tributary of **12d**).

12b Smaller streams near Camp 1.

12c Trailside near Camp 1.

12d Large stream crossed by summit trail before junction old trail to Sarawak Chamber.

13 Between Camp 1 and Camp 3 (4°02'31.3"N 114°52'16.4"E)

13a High gradient streams in MDF about one hour from Camp 1 (at "Camp 2" and above) on the lower slopes of Gunung Mulu.

13b Streams away from the trail slightly lower on the mountain.

13c Trailside on the lower slopes of Gunung Mulu.

14 Camp 3 area (4°02'16.6"N 114°53'17.1"E)

14a Forest pools near to and above Camp 3.

14b Stream at km 11.5 near to Camp 3.

14c Stream "Jeffry" at km ≈12.6 (down left of the trail).

14d Stream above km 13 (down right of the trail).

14e Various small streams in this area, and trailside.

15 Camp 4 area (4°02'39.2"N 114°54'49.6"E)

15a Near to Camp 4 at pools and tiny stream heads near Summit Trail.

15b Camp 4 area, tributary of Sungai Tapin, down at Camp 4.

15c At Camp 4 Helipad.

16 Stream almost directly down slope from Camp 4, ca one hours walk (4°02'30.8"N 114°54'58.3"E).

This is another tributary of Sungai Tapin.

17 Streams on the old trail to the Sarawak Chamber (4°03'32.4"N 114°51'39.6"E)

18 Alluvial forest close to Sungai Melinau and to park buildings at HQ area, as far as streams on trail to Moon Milk Cave (4°03'02.2"N 114°48'53.3"E)

18a Streams.

18b Pools, tree holes and in forest away from water.

18c Trailside in alluvial forest close to Sungai Melinau and to Park buildings at base camp as far as streams on trail to Moon Milk cave.

19 On the Sungai Melinau between the park HQ and the trail to camp 5 (4°02'44.0"N 114°48'35.6"E)

20 Sungai Litut (approximate coordinates 4°05'53.5"N 114°50'14.6"E)

This location is shown as Sungai Putut in Fig. 2, the true name of the stream seems to be a matter of some controversy.

20a Sungai Litut.

20b Small tributary.

20c Swampy area.

21 Between the Sungai Melinau and Camp 5 (4°08'10.1"N 114°53'04.1"E)

21a At streams crossed by trail.

21b Trailside and trail pools.

21c Larger forest pools.

21d Streams somewhat away from trail.



Figure 3: The Gunong Mulu National Park. A View of Camp 1 as seen from the summit trail. B Bats leaving the Deer Cave at dusk. C Entrance of the Deer Cave. To get to sampling location 9, one has to cross through the Deer Cave to the other site of the Karst rock formation. D The Gunong Mulu National Park as seen from a hill outside of the park's borders. E Typical mossy forest of high elevations (above ~3500m a.s.l.) at Gunong Mulu. F The Gunong Mulu summit as seen from the helipad at Camp 4. All photos by Philip O.M. Steinhoff.

22 Sungai Melinau at camp 5 (4°08'11.6"N 114°53'36.5"E)

23 Researchers Trail to Bat Cave (4°07'56.8"N 114°54'08.6"E)

23a Streams crossing trail.

23b Streams away from trail.

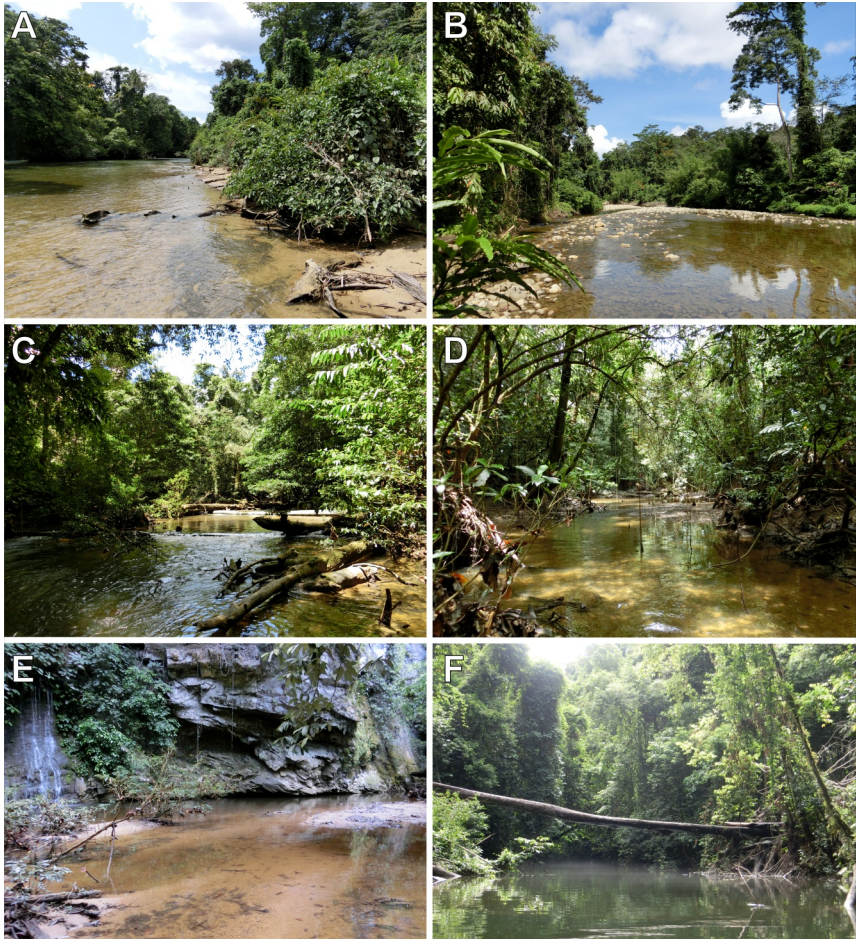


Figure 4: Streams and rivers. A The Sungai Melinau a little upstream of the HQ (location 19) has a sandy bed, but B a very rocky bed higher upstream at Camp 5 (location 22). C, D The Sungai Melinau Paku (location 4) is generally characterized by slow flow, alternating shaded and sunny stretches and a mix of sandy substrate (at deeper sections) and rocky parts (at more shallow sections). E The Sungai Melinau Paku at the waterfall. F The main stream at Long Lansat (location 10a) is deep and slow flowing close to the estuary into the Sungai Tutoh, but more shallow and faster flowing higher upstream. All photos by Philip O.M. Steinhoff.

24 Bat Cave Plateau (4°07'43.3"N 114°54'29.6"E)

24a Sandy pools and streams.

24b Partially submerged streams.

24c Kerangas forest around the streams.

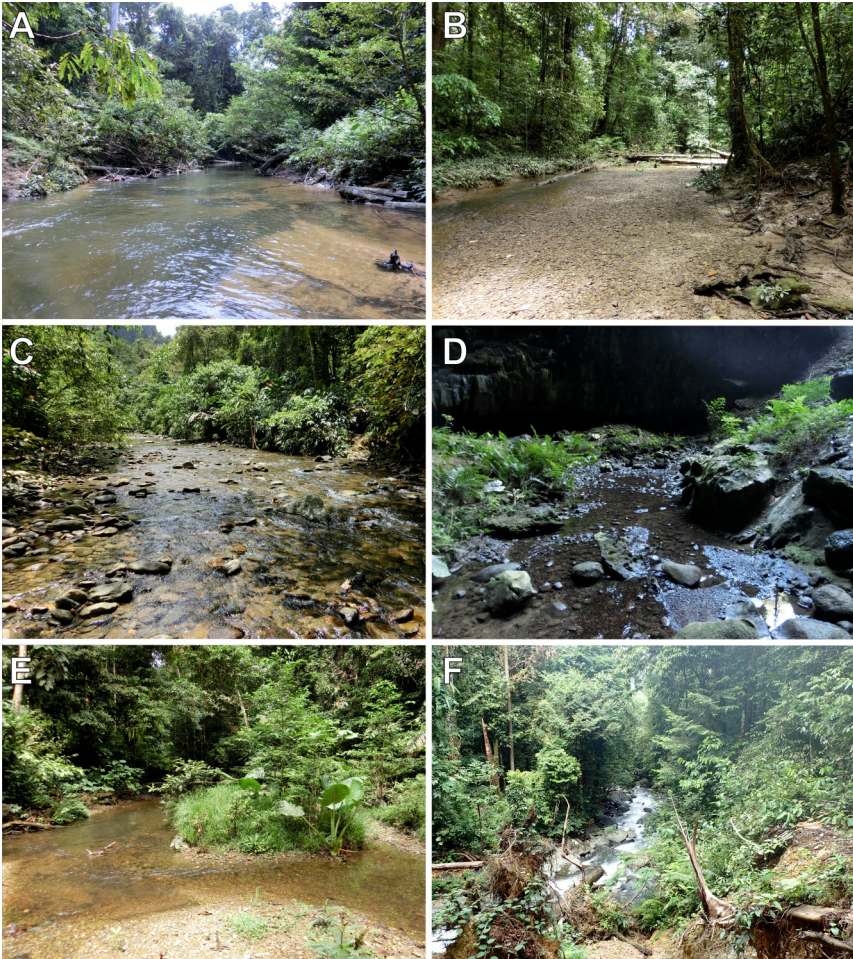


Figure 5: Streams and rivers. A, B Sampling location 4; water level of streams can differ greatly depending on the rainfall, frequent treefalls further shape stream morphology. C The stream flowing into the Deer Cave (location 9a) is rocky and fast flowing. D In the Karst-systems of the Mulu NP, streams are often flowing underground; stretches where streams submerge are usually almost vegetation-free, shaded from overhanging rocks and banks are covered in bat-guano. E The stream running past the bat observatory (location 2b). D The main stream at Camp 1 (location 12a). All photos by Philip O.M. Steinhoff.

25 Head Hunters Trail (approximate coordinates 4°11'42.0"N, 114°51'42.7"E)

- 25a** Sungai Terikan at Lubang Cina.
- 25b** Small streams crossed by the trail.
- 25c** Trailside and swampy areas by the trail.



Figure 6: Clear mountain streams and streamlets. **A** Rocky stream east of the Garden of Eden (location 9d). **B** Typical streamlet tributary of **A**, almost bare of sediment except for moss growing on the bedrock and stretches with small pools in which leaf litter can accumulate. **C**, **D** Rocky streams on the mountain slope are often difficult to follow because of the frequent waterfalls (location 9). **E-G** Typical shaded forest streams on the slopes of Gunung Mulu that can hold a great variety of species (**E**, **F** location 9, **G** location 23). All photos by Philip O.M. Steinhoff.

26 Mentawai (4°14'19.7"N 114°52'41.2"E)

26a Sungai Mentawai.

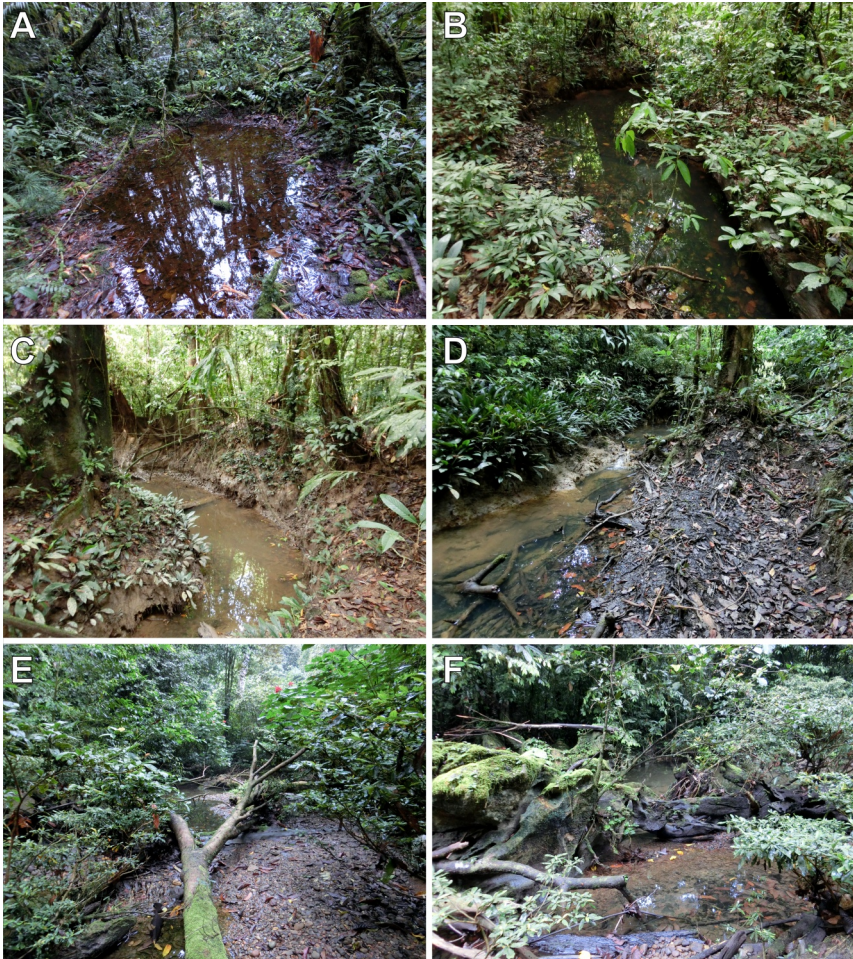


Figure 7: Muddy streams and pools. A Small pools are frequent in lowland parts of the park, especially during rainy periods, but rare at higher elevation where the slope is steep (location 14a). B, C The steep banks of lowland streams at the Paku Valley loop (location 6a) indicate the frequent and quick changes of water level that occur here. D The Sungai Lupar (location 5). E, F During dry periods, treefalls and rocks will create a mosaic of pools within the beds of lowland streams (location 3). All photos by Philip O.M. Steinhoff.

26b Tributaries to Sungai Mentawai.

26c Areas along the 'boundary trail'.

26d Around the park buildings.

26e Sungai Terikan trail.

27 Subcamp approximately 8 km upstream of location 26 (coordinates not available)

27a. Sungai Mentawai and some swamps at the subcamp site.

27b. Sungai Babi, a tributary to the Sg. Mentawai.

27c. A transect with some swamps and small streams.

Species collected

We collected a total of 163 species from 18 families (11 Zygoptera, 7 Anisoptera) over the research period. Although the sampling effort varied between the different locations, the long period of collecting enables us to derive some qualitative information about the differences in species richness and species assemblages at the various locations (Fig. 8). While the largest number of species was collected at locality 26 (51 species from 12 families) and locality 2 (49 species from 13 families), the largest diversity of families was found at locality 13 (36 species from 14 families). Generally, fewer species were found at forest pools than at streams, and species number declined steeply above ~1200m asl (Locations 14, 15 and 16; Fig. 8). Some species are illustrated in Figs. 9-15.

Zygoptera

Lestidae

1. *Orolestes wallacei* (Kirby, 1889)

This species inhabits swampy forest areas and forest ponds.

Locations: **2b; 3c**

Platystictidae

2. *Drepanosticta actaeon* Laidlaw, 1934

Locations: **12a; 12d; 13a**

3. *Drepanosticta attala* Lieftinck, 1934

Locations: **2b; 3a**

4. *Drepanosticta* cf. *crenitis* Lieftinck, 1933

Locations: **13a,b**

5. *Drepanosticta* cf. *dentifera* Kimmins, 1936

Location: **13a**

6. *Drepanosticta dultensis* Kimmins, 1936

This species was found at Mulu for the first time in 2014 and was found exclusively at waterfalls of smaller, fast flowing forest streams. Males can be found perching on vegetation directly over the water current.

Locations: **11a,b; 13a,b**

7. *Drepanosticta* cf. *forficula* Kimmins, 1936

Locations: **9c,f; 13a,c**

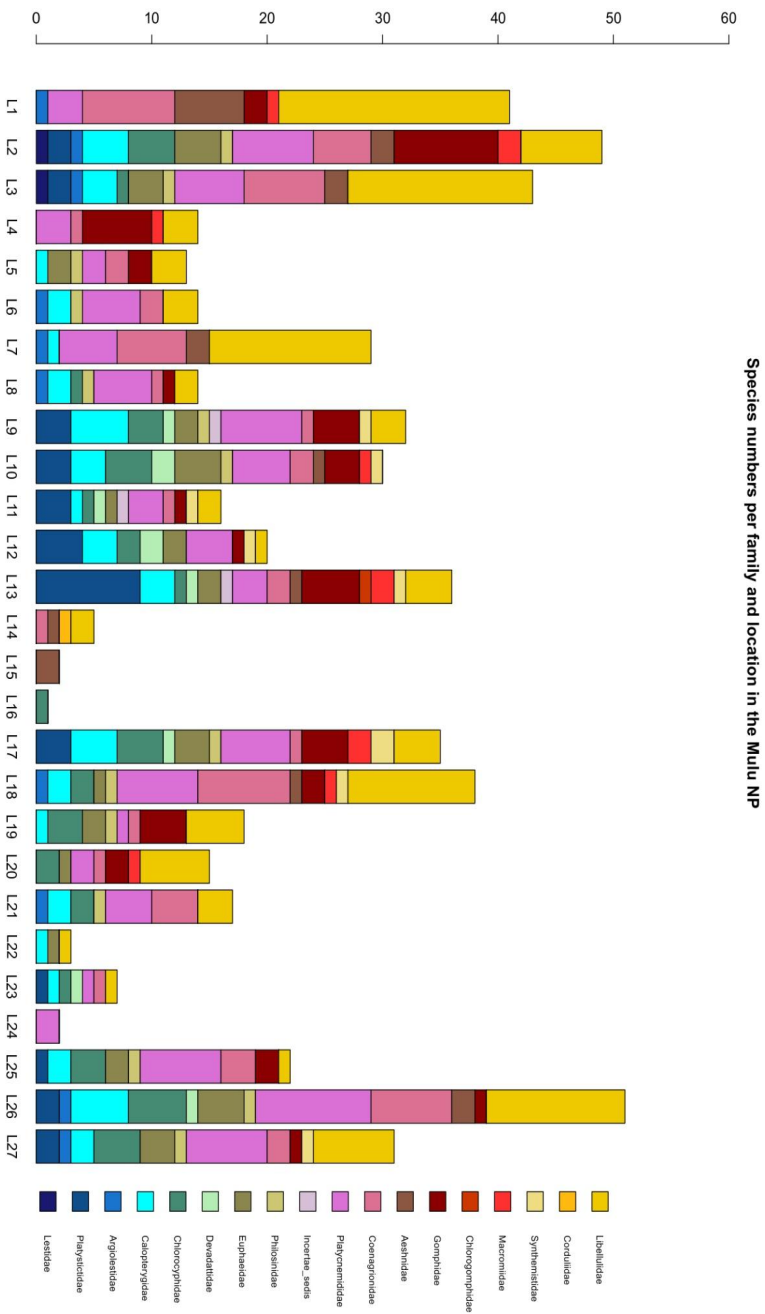


Figure 8: Number of species recorded by family and location. Note that while low species numbers at locations 14, 15 and 16 are due to fewer species breeding at these high elevations, low species numbers at locations 22, 23 and 24 are most likely due to the lower sampling effort at those locations.

8. *Drepanosticta rufostigma* (Selys, 1886)

This is the most common species of the family in Mulu, and can be found at almost every small forest stream there.

Locations: **2b,c; 3c; 9a,d,e,f; 10a,b; 11b; 12a,c; 13a; 17; 23a; 27b**

9. *Drepanosticta simuni* Dow & Orr, 2012

This species remains known only from the holotype, see Dow & Orr (2012a). It is possible that this species usually perches high in the canopy, as it is known for some other platystictids such as *D. attala*, and is thus rarely caught.

Location: **12c**

10. *Drepanosticta versicolor* (Laidlaw, 1913)

Locations: **10b; 13a,c; 17; 25c; 26b; 27b,c**

11. *Protosticta* cf. *kinabaluensis* Laidlaw, 1915

Location: **13a**

12. *Telosticta berawan* Dow & Orr, 2012

The male of this species is structurally very similar to that of *T. dayak* but differs in mature colouration and behaviour. Two teneral males collected at and near to the type locality by the first author in 2014 are very likely to be this species but since *T. dayak* occurs at the foot of Mount Mulu and might occur higher up, these teneral specimens cannot be assigned to *T. berawan* with absolute confidence.

Location: **13a**

13. *Telosticta dayak* Dow & Orr, 2012

Locations: **9f; 12b; 12c; 17; 26b,c**

14. *Telosticta longigaster* Dow & Orr, 2012

This species is widely distributed in Sarawak, but in GMNP, where it is approaching the eastward edge of its known range, it seems to be restricted to forest streams in the south-western part, where it is locally common.

Locations: **10b; 11b**

Argiolestidae

15. *Podolestes orientalis* Selys, 1862

Locations: **1a; 2c; 3a,b; 6a; 7a,b; 8b; 18a,b; 21a,b; 26a,b,d,e; 27b**

Calopterygidae

16. *Neurobasis longipes* Hagen, 1887

Locations: **2a,b; 4a; 9a; 10a; 17; 19; 25a; 26b**

17. *Vestalis amabilis* Lieftinck, 1965

This is the rarest species of the genus *Vestalis* in Mulu, where it has only been found at tributaries of the Sungai Mentawai. As noted in Dow et al. (2018: 38) it tends to prefer habitats where other *Vestalis* species are absent, however *V. amoena* was also found at the sampled tributaries of Sungai Mentawai, and was more com-

mon there.

Location: **26b**

18. *Vestalis amaryllis* Lieftinck, 1965

Locations: **2a; 3a; 6a; 8a; 9a; 12c; 17; 21a,d; 23b; 26e**

19. *Vestalis amnicola* Lieftinck, 1965

Locations: **3a,c; 9a,d,e; 11a; 13a; 26a; 27c**

20. *Vestalis amoena* Hagen in Selys, 1853

Locations: **2a,b; 4a,b; 5a; 6a,b; 7b; 8a; 9a; 10a; 17; 18a; 25a; 26a,b; 27a**

21. *Vestalis atropha* Lieftinck, 1965

Locations: **2a,b; 3a; 9d; 10a; 12a,c; 13a; 17; 18c; 21a; 22**

22. *Vestalis beryllae* Laidlaw, 1915

Locations: **12c; 13a,c**

Chlorocyphidae

23. *Heliocypha biseriata* (Selys, 1859)

Locations: **2a,b,c; 3a; 4a; 9a; 10a; 17; 18c; 19; 20a; 25a; 26a; 27a**

24. *Libellago aurantiaca* (Selys, 1859)

This is a widespread species in Sarawak, but in Mulu it is apparently restricted to the Sungai Mentawai area.

Locations: **26a; 27a**

25. *Libellago hyalina* (Selys, 1859)

Locations: **18a; 26c**

26. *Libellago semiopaca* (Selys, 1873)

Locations: **2b; 4a,b; 19**

27. *Libellago stictica* (Selys, 1859)

Locations: **2b; 4a,b; 19; 25a**

28. *Rhinocypha aurofulgens* Laidlaw, 1931

Locations: **4a; 9a; 10a; 12d; 17**

29. *Rhinocypha cucullata* Selys, 1873

Locations: **2a,b; 4a; 10a; 20a; 21b; 25a; 26a,b,e; 27c**

30. *Rhinocypha spinifer* Laidlaw, 1931

Location: **13a**

31. *Rhinocypha stygia* Förster, 1897

Locations: **9a,d,e; 10a; 11a; 12d; 17; 23b**

32. *Rhineura caerulea* Kimmins, 1936

Specimens collected high on Gunung Mulu in May 2012 were among those lost in transit back to Europe, but since there is no doubt over the genus to which they belonged, and very little doubt over the species, they are listed here.

Location: **16**

33. *Sundacypha petiolata* (Selys, 1859)

Locations: **8a; 17; 21a,d; 26b,e**

34. *Sundacypha striata* Orr, 1999

Location: **27c**

Devadattidae

35. *Devadatta aran* Dow, Hämäläinen & Stokvis, 2015

Location: **12c**

36. *Devadatta clavicauda* Dow, Hämäläinen & Stokvis, 2015

Locations: **9a,b,d,e,f; 10b; 11a,b; 12a,c; 13a,b,c; 17, 26b**

37. *Devadatta somoh* Dow, Hämäläinen & Stokvis, 2015

Locations: **10b; 23a,b**

Euphaeidae

38. *Dysphaea dimidiata* Selys, 1853

Locations: **2a; 2b; 3b; 4a,b; 5a; 9a; 19; 25a; 26a,b; 27a**

39. *Dysphaea ulu* Hämäläinen, Dow & Stokvis, 2015

Locations: **10a; 17**

40. *Euphaea impar* Selys, 1859

Locations: **2a,b,c; 3a; 4a,b; 5a; 9a; 10b; 13b; 17; 18a; 26b,e; 27a**

41. *Euphaea subcostalis* Selys, 1873

Locations: **2a,b,c; 3a; 9a; 10a; 11a,b; 12a,d; 13a; 17; 22; 26a,b; 27a**

42. *Euphaea tricolor* Selys, 1859

Locations: **2a,b; 4a; 10a; 12a; 19; 20a; 25a; 26a**

Philosinidae

43. *Rhinagrion borneense* (Selys, 1886)

This is one of the most common species in Mulu, never found in great numbers but occurs at almost every lowland stream.

Locations: **2a,b,c; 3a,b,c; 4a; 5a; 6a; 8a; 9a; 10a; 17; 18a; 19; 21a; 25a; 26a,b; 27a**

Incertae sedis

44. *Bornargiolestes fuscus* Dow, 2014

Locations: **9c; 11a,b; 13a,b,c**

Platycnemididae

45. *Coeliccia borneensis* (Selys, 1866)

Locations: **1b; 3c; 6b; 7a,b; 8b; 11b; 12c; 18a,c; 25c**

46. *Coeliccia campioni* Laidlaw, 1918
Locations: **9f; 13a**
47. *Coeliccia cyaneothorax* Kimmins, 1936
Locations: **9e,f; 10a,b; 11b; 17**
48. *Coeliccia macrostigma* Laidlaw, 1918
See Dow (2016); only a single female of this species has been collected at Mulu.
Location: **26c**
49. *Coeliccia* new sp.
Locations: **7a; 8b; 25c; 26b,c; 27c**
50. *Coeliccia* cf. *nemoricola* Laidlaw, 1912
This is the unnamed species mentioned in (for instance) Dow et al. (2018). Specimens from locations 14 and 15 are problematic and may represent one or more additional species but this is not definite at this time. Therefore the higher altitude specimens are listed in the Additional Records section.
Locations: **6a; 7a; 9c,f; 12b,c; 13a,b,c; 13b; 27c**
51. *Coeliccia nigrohamata* Laidlaw, 1918
Locations: **3a,c; 6a,b; 7a; 8b; 9a,f; 10b; 11b; 12b,c; 13b; 17; 18a,b; 21a; 25c; 26c,e; 27b,c**
52. *Copera vittata* (Selys, 1863)
Locations: **1a; 2a,b; 3b,c; 6a,b; 7b; 17; 18a,b,c; 21,b; 25c; 26a,d**
53. "*Elattonera*" *analisis* (Selys, 1860)
Locations: **2a,b,c; 3a; 4a; 5a; 6a; 8a,b; 10a,b; 17; 18a; 24a,c; 25a; 26b,e; 27a,c**
54. *Onychargia atrociana* Selys 1865
Locations: **1b; 2a; 18b**
55. *Prodasineura collaris* (Selys, 1860)
Location: **18a**
56. *Prodasineura dorsalis* (Selys, 1860)
Locations: **3a; 9a,d; 10b; 17; 20b; 21a; 25b, 26c,e**
57. *Prodasineura hosei* (Laidlaw, 1913)
Locations: **2a; 4a; 9a; 10a; 12d; 17; 24a; 26b; 27c**
58. *Prodasineura hyperythra* (Selys, 1886)
Locations: **2b,c; 3a; 5a,b; 8a; 9a; 18a; 21a; 25b; 26e**
59. *Prodasineura* sp. cf. *peramoena* (Laidlaw, 1913)
See the comments on this species in Dow et al. (2019).
Locations: **26b,c; 27c**
60. *Prodasineura tenebricosa* Lieftinck, 1937
Although the first published record from Sarawak of this species is in Dow et al. (2019), the first record from the state was made at GMNP in 2007.
Locations: **2b; 4a**

61. *Prodasineura verticalis* (Selys, 1860)

Locations: **2a,b; 4a; 19; 20a,b; 26a; 27a**

Coenagrionidae

62. *Aciagrion borneense* Ris, 1911

This is a species of open water bodies and thus only found at ponds and flooded areas in the clearings around the Park HQ.

Location: **1a**

63. *Agriocnemis femina* (Brauer, 1868)

This is a species of open water bodies and thus only found at ponds and flooded areas in the clearings around the Park HQ.

Location: **1a**

64. *Amphicnemis martini*-group Ris, 1911

Locations: **2b; 3a; 7a,b; 18b,c; 25c; 26b,c**

65. *Amphicnemis remiger* Laidlaw, 1912

Locations: **7a; 21b; 25c; 26b,c; 27a**

66. *Amphicnemis wallacii*-group Selys, 1863

Locations: **1a,b; 2b; 3a,b,c; 5a; 6a; 7a,b; 8b; 10a,b; 18a,b,c**

67. *Archibasis tenella* Lieftinck, 1949

Locations: **2a,b; 3a; 4a; 5a; 18a; 26e**

68. *Archibasis viola* Lieftinck, 1949

Locations: **3b,c; 7a; 18a**

69. *Argiocnemis rubescens rubeola* Selys, 1877

Locations: **1a,b**

70. *Argiocnemis* sp.

Locations: **1a,b; 2b; 3a,b,c; 6b; 7a,b; 18a,b; 20b, 21b; 25c; 26c,e; 27a**

71. *Ceriagrion bellona* Laidlaw, 1915

A single male, conforming to *C. bellona* with a hand lens examination, was collected in 2012 at a pond near Camp 3 on Gunung Mulu. Unfortunately this specimen was among those lost in transport to Europe before it could be examined under a microscope; given the great similarity of many species of *Ceriagrion* to one-another at least some doubt must remain over the identification. This species was also collected in the Mentawai area in 2006.

Locations: **14a; 26c**

72. *Ceriagrion cerinorubellum* (Brauer, 1865)

Locations: **1a; 18b; 26c**

73. *Mortonagrion falcatum* Lieftinck, 1934

Locations: **26c**

74. *Pericnemis dowi* Orr & Hämäläinen, 2013

Location: **13c**

75. *Pericnemis kiautarum* Orr & Hämäläinen, 2013

Location: **18a**

76. *Pseudagrion lalakense* Orr & van Tol, 2001

Location: **1a**

77. *Pseudagrion perfuscatum* Lieftinck, 1937

Location: **19**

78. *Pseudagrion pilidorsum* (Brauer, 1868)

Locations: **2a,b; 3a.**

79. *Stenagrion dubium* (Laidlaw, 1912)

Locations: **9f; 10b; 11b; 13a; 17; 23a,b**

80. *Teinobasis cryptica* Dow, 2010

Locations: **7a; 18a; 21b**

81. *Teinobasis laidlawi* Kimmins, 1936

Locations: **3b; 21a**

82. *Xiphiagrion cyanomelas* Selys, 1876

Location: **1a**

Anisoptera

Aeshnidae

83. *Anax panybeus* Hagen, 1867

Location: **1b**

84. *Gynacantha dohrni* Krüger, 1899

Locations: **1b, 26c**

85. *Gynacantha* sp.

Locations: **1b; 2a; 3c; 7b; 26c**

86. *Heliaeschna crassa* Krüger, 1899 / *idae* (Brauer, 1865)

Two males of either *H. crassa* or *H. idae* (or one of each) were collected when they came to lights in the evening in 2012. Unfortunately these specimens were lost in transport back to Europe. The two species are very similar to one another and without the specimens it is not possible to determine which they were.

Location: **1b**

87. *Heliaeschna simplicia* (Karsch, 1891)

Locations: **1b; 15c**

88. *Indaeschna grubaueri* (Förster, 1904)

This is a common species of shaded forest pools in Sarawak and at GMNP it has been found from almost sea level to 1,300 meters a.s.l.

Locations: **1b; 3b,c; 14a**

89. *Oligoaeschna foliacea* Lieftinck, 1968

Location: **7b**

90. *Tetracanthagyna plagiata* (Waterhouse, 1877)

In addition to the (larval) record below, this species was seen at location 2b in 2004.

Location: **18a**

91. *Tetracanthagyna* sp. or spp.

Larval records only, not of *T. plagiata*. Locations: **2b; 10a; 13a; 15c**

Gomphidae

92. *Acrogomphus jubilaris* Lieftinck, 1964

Only larvae of this elusive species have been found, but several of them have successfully been reared to adulthood. The final instar larva of the species was recently described from Mulu (Butler, Steinhoff & Dow 2016).

Locations: **9a,b; 10a; 13a,b; 20a**

93. *Gomphidia maclachlani* Selys, 1873

Locations: **2b; 4a; 5a; 17; 19; 25a**

94. *Heliogomphus borneensis* Lieftinck, 1964

One larvae from location 13a appears in the clade associated with *H. borneensis* in the COI gene trees in Dow & Stokvis (2018) and is included here on this basis.

Locations: **8b; 13a**

95. *Heliogomphus* cf. *olivaceus* Lieftinck, 1961

A male and a female collected in 2008 are at least allied to, and may actually be, *H. olivaceus*, a poorly known species from the Palawan region of the Philippines; see Dow & Stokvis (2018).

Locations: **2b; 17**

96. *Ictinogomphus decoratus melaenops* (Selys, 1858)

Location: **1a**

97. *Leptogomphus coomansi* Laidlaw, 1936

This is the most common species of the genus at GMNP. At location 2, males of this species have repeatedly been found to appear at the stream just before sunset and perch on broad leaves over the water.

Locations: **2a,b; 12c; 17; 19; 25a; 26c; 27b**

98. *Leptogomphus pendleburyi* Laidlaw, 1934

Locations: **9d; 13b**

99. *Leptogomphus sii* Dow, Stokvis & Ngiam 2017

Location: **10a**

100. *Leptogomphus williamsoni* Laidlaw, 1912

Locations: **9d,f; 11b; 13a,b**

101. *Macrogomphus* sp. or spp.

Locations: **2a,b; 5a; 10a; 13a; 18a; 20a**

102. *Megalogomphus* sp. A

See the comments on Bornean *Megalogomphus* in Dow et al. (2019), they apply

here as well.

Locations: **2b; 4a; 19**

103. *Megalogomphus* sp. B

Locations: **2b; 4b**

104. *Merogomphus*? sp.

Larval records only, tentatively placed under *Merogomphus* based on limited molecular data.

Location: **2c**

105. *Microgomphus chelifer* Selys, 1858

One larva from location 18a has been matched to *M. chelifer* using DNA barcoding (Naturalis unpublished data).

Location: **18a**

106. *Microgomphus* sp. cf. *chelifer* [B]

Locations: **2a,b; 4a; 9a**

107. *Onychogomphus marijanmatoki* Dow, 2014

See Dow (2014b); this species remains known only from the holotype from GMNP.

Locations: **4a, 17**

108. *Sieboldius japonicus* Selys, 1854

Locations: **1b; 2b; 4a,b; 19**

Chlorogomphidae

109. *Chlorogomphus* sp.

Location: **13a**

Macromiidae

110. *Epophthalmia vittigera* (Rambur, 1842)

Location: **1a**

111. *Macromia* sp. cf. *arachnomina* Lieftinck, 1953

Larval record.

Location: **18a**

112. *Macromia callisto* Laidlaw, 1922

A larval record, matched to the adult using DNA barcoding, see Dow et al. (2019).

Location: **2b**

113. *Macromia cincta* Rambur, 1842

Location: **27a**

114. *Macromia corycia* Laidlaw, 1922

Locations: **17; 20a**

115. *Macromia cydippe* Laidlaw, 1922

Locations: **2c; 4a; 10a; 17**

116. *Macromia westwoodii* Selys, 1874

Location: **13b**

Synthemistidae

117. *Idionyx yolanda* Selys, 1871

Locations: **18a; 27b**

118. *Idionyx* cf. *yolanda* Selys, 1871

See the comments in Dow & Stokvis (2018).

Locations: **9d; 11a; 12a; 13a**

119. *Macromidia fulva* Laidlaw, 1915

Locations: **10a; 17**

120. *Macromidia genialis erratica* Lieftinck, 1948

Location: **17**

Corduliidae

121. *Procordulia fusiformis* Lieftinck, 1977

Location: **14a**

Libellulidae

122. *Aethriamanta gracilis* (Brauer, 1878)

Location: **1a**

123. *Agrionoptera insignis* (Rambur, 1842)

Locations: **1a,b; 3b; 18b; 21c**

124. *Agrionoptera sexlineata* Selys, 1879

Locations: **3b; 7a; 26d**

125. *Brachydiplax chalybea* Brauer, 1868

Locations: **1a,b**

126. *Brachydiplax* cf. *farinosa* Krüger, 1902

Locations: **1a; 3b; 18a,b,c**

127. *Brachygonia oculata* (Brauer, 1878)

Locations: **2b; 3b; 7a; 26e; 27b**

128. *Cratilla metallica* (Brauer, 1878)

Locations: **1c; 3b; 7b; 9a; 13a; 14a; 18c; 21a**

129. *Hydrobasileus croceus* (Brauer, 1867)

Location: **1a**

130. *Lyriothemis biappendiculata* (Selys, 1878)

Locations: **8b; 9f; 12b; 13c; 17; 18a; 23b; 26c; 27b**

131. *Lyriothemis cleis* Brauer, 1868

Locations: **3c; 5c; 7b; 18b; 25c**

132. *Lyriothemis magnificata* (Selys, 1878)
Reared from a larva found in a tree hole.
Location: **18b**
133. *Nannophya pygmaea* Rambur, 1842
Locations: **1a; 4a; 20c**
134. *Nesoxenia lineata* (Selys, 1879)
Locations: **1a; 5c; 7a,b**
135. *Neurothemis fluctuans* Fabricius, 1793
Locations: **1a; 3c; 5c; 7b; 19**
136. *Neurothemis ramburii* (Brauer, 1866)
Locations: **1a; 3b**
137. *Neurothemis terminata* Ris, 1911
Locations: **1a; 7b**
138. *Onychothemis coccinea* Lieffinck, 1953
Locations: **2b; 4a; 9a; 17; 19; 27a**
139. *Onychothemis culminicola* Förster, 1904
Locations: **2b, 19**
140. *Orchithemis pruinans* (Selys, 1878)
Location: **26e**
141. *Orchithemis pulcherrima* Brauer, 1878
Locations: **3b,c; 7a,b; 8b; 18a,c; 20c; 26c**
142. *Orchithemis xanthosoma* Laidlaw, 1911
Location: **7b**
143. *Orthetrum borneense* Kimmins, 1936
This is a species with a montane distribution, known at Mulu only from above 1000m a.s.l. It is the most common adult and larva encountered in forest pools at this altitude and the final instar larva of the species has recently been described from GMNP (Steinhoff, Butler and Dow 2016).
Locations: **14a; 14e**
144. *Orthetrum chrysis* (Selys, 1891)
Locations: **3b; 6a; 26d; 27a,b**
145. *Orthetrum glaucum* (Brauer, 1865)
Location: **26d**
146. *Orthetrum pruinatum schneideri* Förster, 1903
Locations: **2a,b; 3c; 11a; 13a**
147. *Orthetrum testaceum* (Burmeister, 1839)
Locations: **1a,c; 18c; 19; 20a; 26d**
148. *Pantala flavescens* (Fabricius, 1798)
Location: **26d**

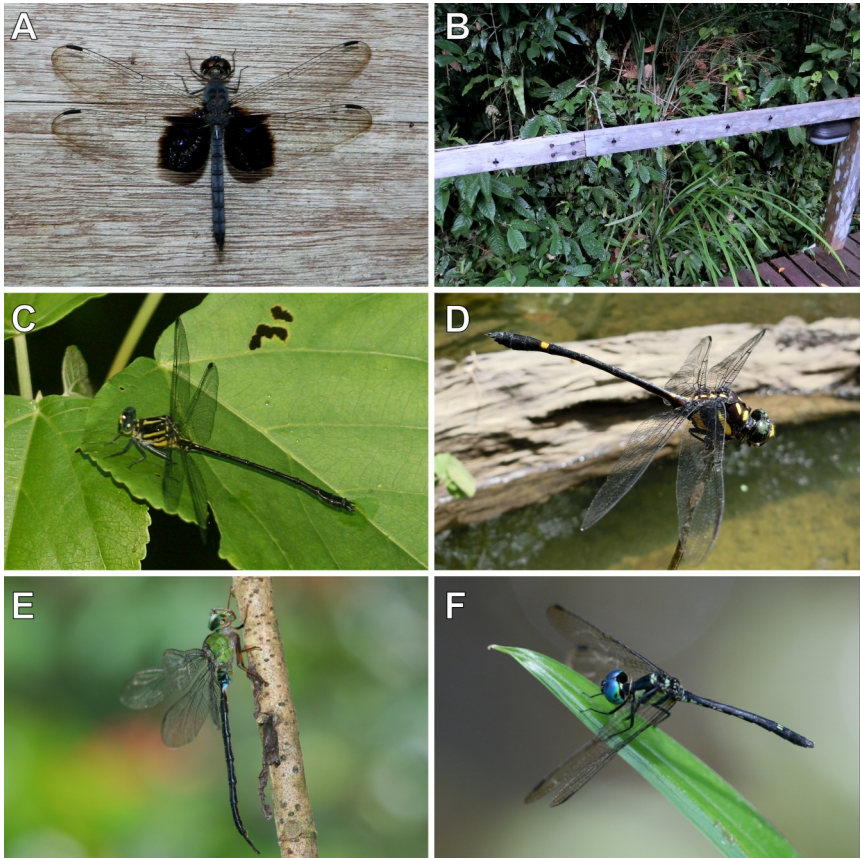


Figure 9: Anisoptera. A, B Males of *Tyriobapta torrida* can frequently be observed “lining up” on the boardwalk handrail in the lowland part of the Mulu NP. **C** *Leptogomphus coomansi* is a common gomphid at Mulu and has been observed perching close to the water at dusk. **D** A male *Gomphidia maclachlani* perches in the sun at the Bat Observatory stream (location 2). **E** *Gynacantha dohrni* is one of the most common species collected at artificial lights in the dark. **F** *Tetrathemis irregularis*, male. All photos by Philip O.M. Steinhoff.

149. *Panothemis serrata* Krüger, 1902 **A**

Comments made in Dow et al. (2019) apply equally well here.

Locations: **7a; 26c; 27b**

150. *Panothemis serrata* Krüger, 1902 **B**

Locations: **3b; 7a**

151. *Rhodothemis rufa* (Rambur, 1842)

Location: **1a**



Figure 10: *Brachygonia oculata*, male. Photo by Philip O.M. Steinhoff.

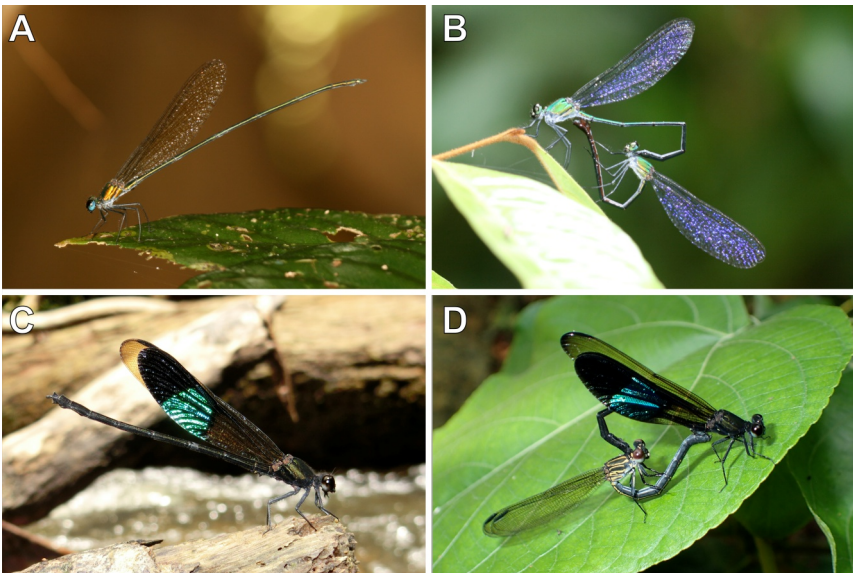


Figure 11: Calopterygidae & Euphaeidae. A *Vestalis beryllae* can be found at streams on the lower slopes of Gunung Mulu. B *Vestalis* sp. mating. C *Euphaea tricolor* male, guarding its territory. D *Euphaea subcostalis*, mating. All photos by Philip O.M. Steinhoff.



Figure 12: *Dysphaea dimidiata*, male. Photo by Philip O.M. Steinhoff.



Figure 13: Females of *Heliocypha biseriata* oviposit into a floating piece of dead wood, while a male guards them. Photo by Philip O.M. Steinhoff.



Figure 14: Chlorocyphidae. A *Libellago stictica* male perching close above the water surface. B *Heliocypha biseriata* mating. C *Libellago semiopaca*, male. D Males of *Rhinocypha aurofulgens* can frequently be found perching on stones in the middle of large streams. E *Rhinocypha cucullata*, male. F Different from most other chlorocyphids, males of *Rhinocypha stygia* commonly perch on plants rather high above the water. All photos by Philip O.M. Steinhoff.

152. *Rhyothemis obsolescens* Kirby, 1889

Location: **1a**

153. *Rhyothemis triangularis* Kirby, 1889

Location: **1a**

154. *Risiophlebia dohni* (Krüger, 1902)

Locations: **1b; 7a; 20c**



Figure 15: Coenagrionidae, Platycnemididae & Platystictidae. A *Amphicnemis wallacii*, male. B Fresh female of *Amphiemnemis* sp.; immature females of several species within this genus are distinctively red and turn metallic, blue or green when mature. C *Coelliccia* cf *nemoricola*, male. D *Drepanosticta dulitensis* has been found at waterfalls of steep, shaded streams, often perching on the tips of leaves hanging over the water current. E Male *Telosticta dayak* photographed at locality 26b. F Male *Rhinagrion borneense* photographed at locality 26b. Photos A – D by Philip O.M. Steinhoff, photos E & F by Chee Yen Choong.

155. *Tetrathemis flavescens* Kirby, 1889

Location: **3b**

156. *Tetrathemis hyalina* Kirby, 1889

See the comments under this species in Dow et al. (2019)

Locations: **1a; 3b; 4a; 6a; 17; 18a; 21a**

157. *Trithemis aurora* (Burmeister, 1839)
Locations: **1a,c; 2a**
158. *Trithemis festiva* (Rambur, 1842)
Locations: **2a,b; 17; 19; 20a; 22**
159. *Tyriobapta kuekenthali* (Karsch, 1900)
Locations: **7a,b, 20c; 26e; 27b**
160. *Tyriobapta laidlawi* Ris, 1919
Locations: **26b,c**
161. *Tyriobapta torrida* Kirby, 1889
Locations: **1a,b; 2a; 3b; 6a; 7a; 13c; 18a,c; 26a; 27a**
162. *Zygonyx ida errans* Lieftinck, 1953
Location: **11a**
163. *Zyxomma petiolatum* Rambur, 1842
Locations: **1a; 3b; 18a**

Discussion

With regard to the Odonata fauna, GMNP is among the most intensively studied protected areas in Sarawak and arguably in the whole of Borneo. However, as obvious from Fig. 2, many areas within the National Park have not yet been investigated. Even so 163 (or more) species have already been recorded within the National Park, a very high total. Given the scattered and local distribution of many species collected within the park, it is likely that additional species could be found if more of the park's area could be surveyed. Furthermore, as outlined above (and also see the 'Additional Records' section in the appendix), some of the taxa collected in the National Park could not be identified to species level and some of them represent as yet undescribed species.

An advantage of the relatively long period over which we have been visiting GMNP is that natural changes to the habitat at some locations have been observed. For instance parts of the Bat Observatory stream downstream of the Bat Observatory (location 2b) have become considerably more open as a result of tree falls by 2019 than they were previously and the section immediately before the confluence with the Melinau Paku has become shallower on average. Such changes may have influenced the species present at the location. Most strikingly, the larger ponds in the HQ clearing used to have extensive sunlit areas but by 2019 were almost completely shaded. A number of common open pond species that had previously occurred at these ponds were not seen in 2019 and are likely no longer present at the location (for instance *Pseudagrion lalakense* and *Ictinogomphus decoratus*). Another change that has occurred in the HQ clearing is that large open spaces have been greatly reduced by the construction of additional buildings; for many years the lights outside the research centre were an affective light trap for Aeshnidae foraging in the clearing at dusk but are now visible only for a short distance and during 10 nights in 2019 not a single specimen was caught at these lights, in marked contrast to earlier sampling periods.

The data on Odonata species collected over the past years in GMNP are of importance for taxonomic studies of Odonata in Borneo. Beyond taxonomy our results will be important for future studies on, for example, ecology and conservation biology. The results presented here can thus potentially serve as a basis for future detailed research on different aspects of Bornean Odonata biology at GMNP.

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Appendix: Detailed specimen records and additional records

Authors' names are abbreviated as SB (Stephen Butler), CYC (Chee Yen Choong), RAD (R. A. Dow), GTR (Graham T. Reels) and POMS (Philip O.M. Steinhoff).

Detailed specimen records

Records of adults reared from larvae collected by POMS in 2014 are given in Steinhoff (2015).

Zygoptera

Lestidae

Orolestes wallacei

2b – ♂, 18.x.2009, SB. **3c** – ♂, 10.vi.2014, POMS.

Platystictidae

Drepanosticta actaeon

See Dow (2017) for material collected at Mulu prior to 2019.

12d – ♂ (in forest some meters from the stream bank), 12.vi.2019, RAD.

Drepanosticta attala

2b – 2 ♀♀, 28.xii.2007, RAD; ♂, 2.i.2008, RAD; 2 ♂♂, 6.ix.2008, RAD; 10.v.2014, POMS; ♀ (teneral), 17.vi.2019, RAD. **3a** – ♀, 6.iv.2014, POMS.

Drepanosticta cf crenifis

13a – ♀, 13.i.2008, RAD. **13b** – ♂, 1.v.2014, POMS; ♀, 31.v.2014, POMS.

Drepanosticta cf dentifera

13a – 2 ♂♂, 11.i.2008, RAD.

Drepanosticta dulitensis

11a – ♂, 20.vii.2014, POMS; ♂, 24.vii.2014, POMS. **11b** – ♂, ♀, 23.vii.2014, POMS. **13a** – 2 ♂♂, 2.v.2014, POMS; ♂, 27.v.2014, POMS. **13b** – ♂, 19.vi.2014, POMS.

Drepanosticta cf forficula

9c – ♂, 24.iv.2014, POMS. **9f** – ♂, 8.v.2014, POMS. **13a** – ♂, 19.ii.2006, RAD; ♀, 6.i.2008, RAD. **13c** – ♂, 6.i.2008, RAD.

Drepanosticta rufostigma

Most material not collected by POMS or CYC listed in Dow (2017).

3c – specimens collected in 2012 and lost. **9a** – 2 ♂♂, 6.ii.2006, JS. **9d** – ♀, 23.iv.2014, POMS. **9e** – 3 ♂♂, 10.iv.2014, POMS. **9f** – 2 ♂♂, 22.iv.2014, POMS. **10b** – ♂, 21.v.2014, POMS. **11b** – ♂, 21.vii.2014, POMS. **13a** – ♀, ♂, 19.xi.2016, POMS. **23a** – 2 ♂♂, ♀, 15.v.2014, POMS. **27b** – 4 ♂♂, 12.ix.2012, CYC.

Drepanosticta simuni

This species remains known only from the holotype, see Dow & Orr (2012a).

Drepanosticta versicolor

10b – ♀, 26.xii.2007, RAD. **13a** – 2 ♀♀, 5.i.2008, RAD. **13c** – ♂, 19.ii.2006, RAD. **17** – 2 ♀♀, 13.i.2008, LS. **25c** – ♂, 11.ii.2006, JS. **26b** – ♂, 9.ix.2012, CYC. **27b** – ♂, 12.ix.2012, CYC. **27c** – ♀, 11.ix.2012, CYC.

Protosticta sp. cf kinabaluensis

13a – ♀, 19.ii.2006, RAD.

Telosticta berawan

See Dow & Orr (2012b) for material collected at Mulu except by POMS.

13a – 3 ♀♀, 31.v.2014, POMS; ♀♂ (teneral), ♀, 19.vi.2014, POMS; ♀♂ (teneral), 20.vi.2014, POMS.

Telosticta dayak

See Dow & Orr (2012b) for material collected at Mulu except by POMS and CYC.

9f – ♂ 8.v.2014, POMS. **26b** – 2 ♂♂, 7.ix.2012, CYC; 3 ♂♂, 9.ix.2012, CYC. **26c** – 2 ♂♂, 9.ix.2012, CYC.

Telosticta longigaster

See Dow & Orr (2012b) for material collected at Mulu before 2012.

10b – 2 ♂♂, 21.v.2014, POMS. **11b** – ♂, 21.vii.2014, POMS; ♀, ♂, 23.vii.2014, POMS.

Argiolestidae*Podolestes orientalis*

1a – ♂, 17.ix.2009, SB. **2c** – 2 ♂♂, 29.iii.2014, POMS. **3a** – ♂, 24.iv.2005, RAD. **3b** – 2 ♂♂, 16.iv.2005, RAD; 2 ♂♂, 5.ii.2006, RAD; ♂, 14.i.2008, RAD. **6a** – ♂, 2.iv.2014, POMS; ♂, ♀, 24.v.2014, POMS; ♂, 14.vi.2019, RAD. **7a** – ♂, 31.xii.2007, RAD; ♂, 15.ii.2012, SB; 2 ♂♂, 11.vi.2019, RAD. **7b** – ♂, 21.ix.2009, SB. **8b** – ♂, 17.iv.2005, RAD. **18a** – ♂, 9.ii.2006, RAD; 3 ♂♂, 25.xii.2007, RAD; 2 ♂♂, 15.i.2008, RAD. **18b** – ♂, 17.ii.2006, RAD; ♂, 5.ix.2008, RAD. **21a** – ♀, 13.v.2014, POMS. **21b** – ♂, 14.ii.2006, RAD. **26a** – ♂, 7.ix.2012, CYC. **26b** – ♂, 7.ix.2012, CYC; ♂, 9.ix.2012, CYC. **26d** – ♂, 7.ix.2012, CYC. **26e** – 2 ♂♂, 8.ix.2012, CYC. **27b** – ♂, 12.ix.2012, CYC.

Calopterygidae*Neurobasis longipes*

2a – ♂+♀, 16.iv.2005, RAD. **2b** – ♂, 5.ii.2006, RAD; ♂, 5.ii.2006, GTR; ♂, ♀, 5.ii.2006, LS; ♂, 28.xii.2007, RAD; ♂, 15.ix.2009, SB; ♂, 18.x.2009, SB; ♂, 22.ix.2009, SB; 2 ♂♂, ♀, 27.iii.2014, POMS; ♂, 10.vi.2019, RAD. **4a** – 3 ♂♂, 2 ♀♀, 13.i.2008, Biden. **9a** – 2 ♂♂, 6.ii.2006, GTR. **10a** – ♀, 8.ii.2006, LS; ♂, 26.xii.2007, RAD; ♀, 9.i.2008, LS. **17** – ♀, 7.i.2008, LS; ♀, 15.vi.2019, RAD. **19** – 2 ♀♀, 19.ii.2006, LS. **25a** – ♀, 11.ii.2006, LS. **26b** – 2 ♂♂, 13.ii.2006, LS; 2 ♂♂, 7.ix.2012, CYC.

Vestalis amabilis

26b – 2 ♂♂, 13.ii.2006, RAD.

Vestalis amaryllis

2a – ♂, 17.iv.2005, RAD. **3a** – ♂, 7.ix.2008, RAD; ♂, 22.ix.2009, SB; ♂, 10.iv.2014, POMS. **6a** – 3 ♂♂, 2.iv.2014, POMS; ♂, 3.iv.2014, POMS; ♂, 6.v.2014, POMS. **8a** – ♂, 17.iv.2005, RAD. **9a** – ♂, 22.ii.2012, SB. **12c** – ♂, 13.i.2008, RAD. **17** – 4 ♂♂, 11.i.2008, RAD. **18a** – specimens collected in 2012 and lost. **21a** – ♂, 10.ii.2006, RAD; ♂, 12.v.2014, POMS. **21d** – ♂, 12.v.2014, POMS. **23b** – ♂, 14.v.2014, POMS. **26e** – 3 ♂♂, 8.ix.2012, CYC.

Vestalis amnicola

3a – ♂, 12.vi.2014, POMS. **3c** – ♂, 10.iv.2014, POMS; ♂, 23.iv.2014, POMS. **9a** – ♂, 6.ii.2006, RAD; ♂, 6.ii.2006, JS. **9d** – ♂, 08.v.2014, POMS. **9e** – 3 ♂♂, 23.iv.2014, POMS. **11a** – ♂, 20.vii.2014, POMS. **13a** – ♂, 19.ii.2006, LS; ♂, 18.vi.2014, POMS. **26a** – ♂, 9.ix.2012, CYC. **27c** – ♂, 11.ix.2012, CYC.

Vestalis amoena

2a – 9 ♂♂, 16.iv.2005, RAD; ♂+♀, 17.iv.2005, RAD; ♂, 15.ix.2009, SB. **2b** – 2 ♂♂, 5.ii.2006, RAD; 3 ♂♂, 5.ii.2006, GTR; 2 ♂♂, 5.ii.2006, LS; 3 ♂♂, 24.xii.2007, RAD; 4 ♂♂, 28.xii.2007, RAD; ♂, 30.xii.2007, RAD; 5 ♂♂, 2.i.2008, RAD; ♂, 6.ix.2008, RAD; ♂, 5.v.2010, RAD; 4 ♂♂, 27.iii.2014, POMS; ♂, 28.iii.2014, POMS; 2 ♂♂, 10.vi.2019, RAD. **4a** – ♂, 21.iv.2005, RAD; ♂, 7.v.2010, RAD. **4b** – ♂, 5.ii.2006, RAD. **5a** – specimens collected in 2012 and lost. **6a** – ♂, 3.iv.2014, POMS. **6b** – ♂, 6.iv.2014, POMS. **7b** – ♂, 20.ix.2009, SB. **8a** – 2 ♂♂, 17.iv.2005, RAD. **9a** – ♂, 6.ii.2006, RAD. **10a** – 3 ♂♂, 19.iv.2005, RAD; ♂, 8.ii.2006, RAD; 6 ♂♂, 8.ii.2006, GTR; 2 ♂♂, 8.ii.2006, LS; ♂, 26.xii.2007, RAD; ♂, 9.i.2008, RAD. **17** – 4 ♂♂, 7.i.2008, RAD; 3 ♂♂, 13.i.2008, LS. **25a** – 2 ♂♂, 11.ii.2006, LS; ♀, 11.ii.2006, JS. **26a** – 2 ♂♂, 7.ix.2012, CYC. **26b** – ♂, 12.ii.2006, RAD; ♂, 13.ii.2006, RAD; 3 ♂♂, 13.ii.2006, LS; 2 ♂♂, 7.ix.2012, CYC. **27a** – ♂, 10.ix.2012, CYC.

Vestalis atropha

2a – ♂, 10.iv.2014, POMS. **2b** – 2 ♂♂, 28.xii.2007, RAD. **3a** – ♂, 22.iv.2014, POMS. **9d** – ♂, 24.iv.2014, POMS. **10a** – ♂, 19.iv.2005, RAD. **12a** – ♂, 21.iv.2005, RAD. **12c** – ♂, 13.i.2008, RAD. **13a** – ♂, 02.v.2014, POMS. **17** – ♂, 7.i.2008, RAD; ♂, 13.i.2008, RAD. **18c** – ♂, 25.xii.2007, RAD. **21a** – ♂, 10.ii.2006, RAD. **22** – ♂, 11.ii.2006, RAD; ♂, 13.v.2014, POMS.

Vestalis beryllae

12c – 2 ♂♂, 22.iv.2005, RAD. **13a** – ♂, 19.ii.2006, RAD; 4 ♂♂, ♀, 6.i.2008, RAD; ♂, 31.v.2014, POMS. **13c** – ♂, 19.ii.2006, RAD; ♂, 11.ix.2008, RAD; ♂, 19.vi.2014, POMS.

Chlorocyphidae

Heliocypha biseriata

2a – ♂, 16.iv.2005, RAD. **2b** – ♀, 16.iv.2005, RAD; 2 ♂♂, 5.ii.2006, LS; ♀, 6.ii.2006, GTR; ♂, 30.xii.2007, RAD; 3 ♂♂, ♀, 15.ix.2009, SB (1 ♂ reared from larva, emerged 19.ix.2009); ♂, 10.vi.2019, RAD. **2c** – ♂, 24.xii.2007, RAD. **3a** – ♂, 22.ix.2009, SB. **4a** – ♂, 24.ii.2012, SB; 2 ♂♂, 27.iii.2014, POMS. **5a** – specimens collected in 2012 and lost. **9a** – ♂, 6.ii.2006, RAD; ♂, 22.ii.2012, SB. **10a** – ♂, 8.ii.2006, LS; ♂, 9.i.2008, SB; ♀, 9.i.2008, LS; ♂, 21.v.2014, POMS. **17** – ♂, 13.i.2008, RAD; ♂, 15.vi.2019, RAD. **18c** – ♂, 12.ix.2009, SB. **19** – ♂, ♀, 16.ii.2006, JS; ♀, 16.ii.2006, LS; ♂, 10.ix.2009, SB. **20a** – 3 ♂♂, 10.x.2009, SB. **25a** – 2 ♂♂, 11.ii.2006, JS. **26a** – ♂, ♀, 13.ii.2006, LS. **27a** – ♂, 14.ix.2012, CYC.

Libellago aurantiaca

26a – ♂, 13.ii.2006, RAD. **27a** – 2 ♂♂, 10.ix.2012, CYC.

Libellago hyalina

18a – ♂, 9.ii.2006, RAD; 3 ♂♂, 25.xii.2007, RAD; ♂, 11.vi.2019, RAD. **26c** – 2 ♂♂, 13.ii.2006, JS.

Libellago semiopaca

2b – ♂, 28.iv.2014, POMS. **4a** – specimens collected in 2012 and lost; ♂, 18.vi.2019, RAD. **19** – 2 ♂♂, 16.ii.2006, RAD; 2 ♂♂, 20.iv.2014, POMS.

Libellago stictica

2b – ♂, 16.iv.2005, RAD; ♂, 5.ii.2006, GTR; ♂+♀, 7.ii.2006, RAD; ♀, 7.ii.2006, GTR; 2 ♂♂, 28.xii.2007, RAD; ♂, 15.ix.2009, SB; ♂, 5.v.2010, RAD; 2 ♂♂, 18.x.2009, SB; ♂,

27.iii.2014, POMS; ♂, 27.iv.2014, POMS; ♂, 17.vi.2019, RAD. **4a** – ♂, ♀, 22.ix.2009, SB; ♂, 24.ii.2012, SB. **4b** – ♂, 29.iii.2014, POMS. **19** – 2 ♂♂, ♀, 16.ii.2006, JS. **25a** – ♂, 11.ii.2006, RAD.

Rhinocypha aurofulgens

4a – specimens collected in 2012 and lost. **9a** – ♂, 6.ii.2006, RAD; ♂, 6.ii.2006, GTR; ♂+♀, 10.iv.2014, POMS. **10a** – 2 ♂♂, 19.iv.2005, RAD; ♂, 8.ii.2006, RAD; 2 ♂♂, 26.xii.2007, RAD; ♂, 9.i.2008, RAD. **12d** – 2 ♂♂, 09.iv.2014, POMS. **17** – specimens collected in 2012 and lost; 2 ♂♂, 17.vi.2019, RAD.

Rhinocypha cucullata

2a – 2 ♂♂, 16.iv.2005, RAD; ♂, 06.iv.2014, POMS. **2b** – 2 ♂♂, 5.ii.2006, RAD; 2 ♂♂, 5.ii.2006, GTR; ♂, 28.xii.2007, RAD; ♂, 30.xii.2007, RAD; ♂, 6.ix.2008, RAD; 2 ♂♂, 5.v.2010, RAD; 2 ♂♂, 27.iii.2014, POMS; ♂, 10.vi.2019, RAD. **4a** – ♂, 7.v.2010, RAD; ♂, 12.vi.2019, RAD. **10a** – ♂, 19.iv.2005, RAD. **20a** – ♂, 10.x.2009, SB; ♂+♀, 20.ii.2012, SB. **21a** – ♂, 10.ii.2006, RAD. **25a** – ♂, 11.ii.2006, JS; 5 ♂♂, 11.ii.2006, LS. **26a** – 2 ♂♂, 13.ii.2006, RAD. **26b** – ♂, 13.ii.2006, RAD; 2 ♂♂, 7.ix.2012, CYC. **26e** – ♂, 8.ix.2012, CYC. **27c** – ♂, 11.ix.2012, CYC.

Rhinocypha spinifer

13a – ♀, 22.iv.2005, RAD; 2 ♀♀, 19.ii.2006, RAD; ♀, 12.i.2008, RAD; ♂, 13.ix.2008, RAD; 4 ♀♀, 31.v.2014, POMS; 3 ♂♂, 18.vi.2014, POMS; ♂, 20.vi.2014, POMS.

Rhinocypha stygia

9a – ♂, 6.ii.2006, JS; ♂, 6.ii.2006, LS. **9d** – 2 ♂♂, 23.iv.2014, POMS; ♂, 24.iv.2014, POMS. **9e** – ♂, 24.iv.2014, POMS. **10a** – ♂, 19.iv.2005, RAD; ♂, 8.ii.2006, RAD; ♂, 9.i.2008, SB; ♂, 9.i.2008, RAD; ♂, 21.v.2014, POMS. **11a** – ♂, 20.vii.2014, POMS. **12d** – ♂, 12.vi.2019, RAD. **17** – ♂, 7.i.2008, RAD; 2 ♂♂, 13.i.2008, RAD; ♂, 10.ix.2008, RAD; 2 ♂♂, 15.vi.2019, RAD. **23b** – ♂, 15.v.2014, POMS.

Rhinoneura caerulea

16 – ♂+♀, 16.v.2012, Penan guides; ♂, 17.v.2012, RAD.

Sundacypha petiolata

8a – 2 ♂♂, 17.iv.2005, RAD. **17** – ♂, 7.i.2008, RAD; ♂, 11.i.2008, RAD; 2 ♂♂, 13.i.2008, RAD; ♂, 16.vi.2019, RAD. **21a** – 2 ♂♂, 10.ii.2006, RAD; ♂, 10.ii.2006, JS. **21d** – ♂, 13.v.2014, POMS. **26b** – ♂, 13.ii.2006, RAD. **26e** – ♂, 8.ix.2012, CYC.

Sundacypha striata

27c – ♂, 11.ix.2012, CYC.

Devadattidae

Devadatta aran

See Dow, Hämäläinen & Stokvis (2015) for specimens collected.

Devadatta clavicauda

See Dow, Hämäläinen & Stokvis (2015) for specimens not collected by CYC or prior to 2019.

17 – ♂, 15.vi.2019, RAD. **26b** – 3 ♂♂, 7.ix.2012, CYC.

Devadatta somoh

See Dow, Hämäläinen & Stokvis (2015) for specimens not collected by POMS.

Euphaeidae

Dysphaea dimidiata

See Hämäläinen, Dow & Stokvis (2015) for most material collected at Mulu.

2a – ♂, 22.ix.2009, SB. **2b** – ♂, 27.xi.2016, POMS; ♂, 17.vi.2019, RAD. **4a** – 2 ♂♂, 18.vi.2019, RAD. **4b** – ♂, 22.ix.2009, SB. **26b** – ♂, 7.ix.2012, CYC. **27a** – ♂, 10.ix.2012, CYC.

Dysphaea ulu

See Hämäläinen, Dow & Stokvis (2015) for most material collected at Mulu.

Euphaea impar Selys, 1859

2a – ♂, 16.iv.2005, RAD; ♂, 22.ix.2009, SB; ♀, 06.iv.2014, POMS. **2b** – ♂, 2.i.2008, RAD; ♂, 27.iii.2014, POMS. **2c** – ♂, 24.xii.2007, RAD. **4a** – ♂, 12.vi.2019, RAD. **5a** – material collected in 2012 and lost. **9a** – ♂, 6.ii.2006, RAD; ♂, 22.ii.2012, SB. **10b** – ♂, 19.iv.2005, RAD; ♂, 26.xii.2007, RAD. **13b** – ♂, 5.i.2008, LS. **17** – ♂, 7.i.2008, RAD; ♂, 11.i.2008, RAD; ♂, 15.vi.2019, RAD. **18a** – ♀, 15.i.2008, RAD. **26b** – ♂, 13.ii.2006, RAD. **26e** – ♂, ♀, 8.ix.2012, CYC. **27a** – ♂, 11.ii.2012, CYC.

Euphaea subcostalis

2a – ♂, 16.iv.2005, RAD; ♂, 15.ix.2009, SB. **2b** – 2 ♂♂, 16.iv.2005, RAD; 2 ♂♂, 5.ii.2006, RAD; ♂, 28.xii.2007, RAD; ♂, 4.i.2008, RAD; ♂, 19.ii.2012, SB; 2 ♂♂, 27.iii.2014, POMS; ♂, 10.vi.2019, RAD. **2c** – ♂, 24.xii.2007, RAD. **3a** – ♂, 22.ix.2009, SB. **9a** – ♂, 6.ii.2006, RAD; ♂, 6.ii.2006, JS; 6 ♂♂, 6.ii.2006, LS. **10a** – 3 ♂♂, 19.iv.2005, RAD; 2 ♂♂, 26.xii.2007, RAD. **11a** – ♂, 20.vii.2014, POMS. **11b** – ♀+♂, 21.vii.2014, POMS. **12a** – ♂, 29.iv.2014, POMS. **12d** – 2 ♂♂, 4.i.2008, RAD; ♂, 9.iv.2014, POMS; 2 ♂♂, 12.vi.2019, RAD. **13a** – ♂, 5.i.2008, RAD. **17** – 2 ♂♂, 7.i.2008, RAD; 2 ♂♂, ♀, 7.i.2008, LS; ♂, 11.i.2008, RAD; ♂+♀, 13.i.2008, RAD; ♂, 15.vi.2019, RAD. **22** – ♂, 11.ii.2006, RAD. **26a** – ♂, 12.ii.2006, LS. **26b** – 2 ♂♂, 13.ii.2006, RAD; 4 ♂♂, 13.ii.2006, LS; ♂, 7.ix.2012, CYC. **27a** – ♂, 10.ix.2012, CYC.

Euphaea tricolor

2a – ♂, 16.iv.2005, RAD. **2b** – ♂, 5.ii.2006, RAD; ♂, 2.i.2008, RAD; ♂, 10.vi.2019, RAD. **4a** – ♂, 7.v.2010, RAD; 2 ♂♂, 29.iii.2014, POMS; ♂, 12.vi.2019, RAD. **10a** – ♂, 21.v.2014, POMS. **12a** – ♂+♀, 21.iv.2005, RAD. **19** – ♂, 16.ii.2006, RAD; ♂, 16.ii.2006, LS; ♂, 21.iv.2014, POMS. **20a** – 2 ♂♂, 10.x.2009, SB; ♂, 20.ii.2012, SB; ♂, 16.vi.2019, RAD. **25a** – ♂, 11.ii.2006, LS. **26a** – 2 ♂♂, 7.ix.2012, CYC; ♂, 9.ix.2012, CYC.

Philosinidae

Rhinagrion borneense

2a – ♂, 16.iv.2005, RAD; ♂, 15.ix.2009, SB (reared, emerged 3.x.2009); ♂, 22.ix.2009, SB. **2b** – ♂, 5.ii.2006, RAD; ♂, 2.i.2008, RAD; ♂, 4.i.2008, SB; ♂, 27.iii.2014, POMS; 2 ♂♂, 10.vi.2019, RAD. **2c** – ♂, 24.xii.2007, RAD; 2 larvae, 14.i.2008, SB. **3a** – ♂, 12.vi.2019, RAD. **3b** – ♂, 29.iii.2014, POMS; ♀, 26.v.2014, POMS. **3c** – ♂, 22.ix.2009, SB. **4a** – ♀, 21.iv.2005, RAD. **5a** – specimens collected in 2012 and lost. **6a** – ♂, 2.iv.2014, POMS; ♂, 14.vi.2019, RAD. **8a** – ♂, 17.iv.2005, RAD. **9a** – ♂, 6.ii.2006, RAD;

♂, ♀, 6.ii.2006, JS; 2 ♂♂, 6.ii.2006, LS; ♂, 22.ii.2012, SB. 10a – 2 ♂♂, 19.iv.2005, RAD; ♂, 8.ii.2006, LS; ♂, 26.xii.2007, RAD; ♂, 9.i.2008, LS. 17 – 2 ♂♂, 7.i.2008, RAD; 2 ♂♂, 7.i.2008, LS; ♂, 13.i.2008, LS; ♂, 15.vi.2019, RAD. 18a – 2 ♂♂, 25.xii.2007, RAD; larva, 15.i.2008, SB; ♂, 15.i.2008, RAD. 19 – ♂, 16.ii.2006, RAD. 25a – 2 ♂♂, 11.ii.2006, JS. 26a – ♂, 7.ix.2012, CYC. 26b – ♂, 13.ii.2006, RAD; 3 ♂♂, 13.ii.2006, LS; ♂, 7.ix.2012, CYC. 27a – ♂, 11.ix.2012, CYC.

Incertae sedis

Bornargiolestes fuscus

See Dow (2014a) for material collected at Mulu except by POMS.

9c – ♀, ♂, 12.vi.2014, POMS. **11b** – ♂, 19.vii.2014, POMS. **13a** – ♀, 19.vi.2014, POMS.

Platycnemididae

Coeliccia borneensis

See Dow (2010a) for material collected by RAD at Mulu.

6b – ♂, 24.v.2014, POMS. **11b** – ♀, 21.vii.2014, POMS.

Coeliccia campioni

See Dow (2010a) for material collected by RAD at Mulu.

9f – ♂, 8.v.2014, POMS; ♂, 22.v.2014, POMS. **13a** – ♂, 1.v.2014, POMS; ♂, 18.vi.2014, POMS.

Coeliccia cyaneothorax

9e – ♂, 22.iv.2014, POMS; ♂, 23.iv.2014, POMS. **10a** – ♂, 8.ii.2006, RAD. **10b** – ♂, 19.iv.2005, RAD. **11b** – ♂, 23.vii.2014, POMS. **17** – ♂, 13.i.2008, RAD.

Coeliccia macrostigma

See Dow (2016).

Coeliccia cf nemoricola

6a – ♂, 12.vi.2014, POMS. **7a** – ♂, 15.vi.2014, POMS. **9c** – ♂, 22.iv.2014, POMS; ♂, 23.iv.2014, POMS. **9f** – ♂, 23.iv.2014, POMS; ♂, ♀, 24.iv.2014, POMS. **12b** – 9 ♂♂, ♀, ♂+♀, 4.i.2008, RAD; 2 ♂♂, ♀, 9.iv.2014, POMS; ♂, 29.iv.2014, POMS. **12c** – 2 ♀♀, 24.iv.2005, JS; ♀, 7.i.2008, RAD. **13a** – ♂, 19.ii.2006, RAD; 2 ♂♂, ♀, 19.ii.2006, JS; ♀, 5.i.2008, LS; ♀, 6.i.2008, RAD; ♂, 8.i.2008, RAD; ♂, 18.vi.2014, POMS. **13b** – ♂, 5.i.2008, LS. **13c** – 2 ♀♀, 19.ii.2006, RAD; ♀, 12.i.2008, RAD; 2 ♀♀, 13.ix.2008, RAD; ♀, 13.ix.2008, JS. **23b** – 4 ♂♂, 14.v.2014, POMS. **27c** – ♂, 11.ix.2012, CYC.

Coeliccia nigrohamata

3a – ♂, 2.i.2008, RAD; 2 ♂♂, 10.vi.2019, RAD. **3c** – ♂, ♀, ♂+♀, 7.ix.2008, RAD. **6a** – 2 ♂♂, 28.iii.2014, POMS; 2 (♂+♀), 2.iv.2014, POMS. **6b** – ♂+♀, 28.iii.2014, POMS. **7a** – ♂, 15.ii.2006, RAD; ♀, 06.iv.2014, POMS. **8b** – 2 ♂♂, ♀, 17.iv.2005, RAD. **9a** – 2 ♂♂, 6.ii.2006, GTR; ♂, 6.ii.2006, JS. **9f** – 4 ♂♂, ♂+♀, 24.iv.2014, POMS; ♂, 26.vi.2014, POMS. **10b** – ♂, 19.iv.2005, RAD; ♂, 26.xii.2007, RAD. **11b** – ♂, 21.vii.2014, POMS. **12b** – 2 ♂♂, 4.i.2008, RAD; ♂, 29.iv.2014, POMS. **12c** – ♀, 24.iv.2005, RAD. **13b** – 2 ♂♂, 5.i.2008, LS. **17** – 3 ♂♂, 7.i.2008, RAD; ♂, 7.i.2008, Pa'Eh; 3 ♂♂, ♂+♀, 11.i.2008, RAD; ♂, 15.vi.2019, RAD. **18a** – ♂, 15.i.2008, RAD; 2 ♂♂, 13.v.2014, POMS. **18b** – ♂, **17**.ii.2006, RAD. **21a** – 3 ♂♂, 10.ii.2006, RAD. **23a** – ♂, 14.v.2014, POMS; ♂, 15.v.2014, POMS. **25c** – 2 ♂♂, 11.ii.2006, RAD. **26c** – ♀, 13.ii.2006, JS. **26e** – 4 ♂♂, 8.ix.2012, CYC. **27b** – 2 ♂♂, 12.ix.2012, CYC. **27c** – ♂, 11.ix.2012, CYC.

Coeliccia new sp.

7a – 2 ♂♂, 25.xii.2007, RAD; 4 ♂♂, ♂+♀, 31.xii.2007, RAD; 2 ♂♂, 5.ix.2008. **8b** – ♂, 17.iv.2005, RAD. **25c** – 2 ♂♂, 11.ii.2006, JS; ♂, 14.ii.2006, RAD. **26b** – ♀, 13.ii.2006, RAD; ♂, 7.ix.2012, CYC; 2 ♂♂, 9.ix.2012, CYC. **26c** – 2 ♂♂, ♀, 13.ii.2006, JS; ♂, ♂+♀, 9.ix.2012, CYC. **27c** – 3 ♂♂, 11.ix.2012, CYC.

Copera vittata

1a – ♂, 20.iv.2005, RAD; ♂, 19.ix.2009, SB; ♂, 20.ix.2009, SB; ♂, 16.x.2009, SB; 3 ♂♂, 15.vi.2019, P. Dow. **2a** – ♂, ♀, 6.iv.2005, RAD. **2b** – ♀, 5.ii.2006, LS; ♂+♀, 7.ii.2006, RAD; ♀, 27.iii.2014, POMS. **3b** – ♂, 17.iv.2005, RAD; ♂, 5.ii.2006, RAD; ♀, 31.iii.2014, POMS. **3c** – ♂, ♀, 18.ii.2006, JS. **6a** – 2 ♂♂, 29.iii.2014, POMS; ♂, ♂+♀, 11.vi.2019, RAD; ♂+♀, 14.vi.2019, RAD. **6b** – ♂, 24.v.2014, POMS. **7b** – ♂, 21.ix.2009, SB. **17** - material collected in 2012 and lost. **18a** – ♂, 9.ii.2006, RAD; 3 ♂♂, 25.xii.2007, RAD; ♂, 13.v.2014, POMS. **18b** – ♂, 5.ix.2008, RAD; ♂, 20.ix.2009, SB. **18c** – ♂, 17.ii.2006, RAD; 2 ♂♂, 7.i.2008, SB. **21b** – ♂, 10.ii.2006, JS. **25c** – ♂, 11.ii.2006, JS; ♂, 11.ii.2006, LS; 2 ♂♂, ♀, 14.ii.2006, JS. **26a** – ♂, 12.ii.2006, LS. **26d** – ♂, 7.ix.2012, CYC.

"*Elattonera*" *analis*

2a – ♂, 16.iv.2005, RAD. **2b** – ♂, 5.ii.2006, RAD; 2 ♂♂, 5.ii.2006, LS; ♀, 2.i.2008, RAD; ♂, ♀, 8.ix.2008, RAD; ♂, 15.ix.2009, SB; ♂, 27.iii.2014, POMS; ♂, 28.iii.2014, POMS; ♂+♀, 30.iii.2014, POMS; ♀, 6.iv.2014, POMS; 2 ♂♂, 10.vi.2019, RAD. **2c** – ♂, 24.xii.2007, RAD. **3a** – ♂, 12.vi.2019, RAD. **4a** - material collected in 2012 and lost. **5a** - material collected in 2012 and lost. **6a** – ♂, 2.iv.2014, POMS; ♂, 26.v.2014, POMS. **8a** – ♂, 17.iv.2005, RAD. **8b** – ♂, 17.iv.2005, RAD. **10a** – 2 ♂♂, 19.iv.2005, RAD; 2 ♂♂, 26.xii.2007, RAD. **10b** – 2 ♂♂, 8.ii.2006, GTR. **17** – ♂, 7.i.2008, RAD; ♂, 30.iv.2014, POMS. **18a** – ♂, 25.xii.2007, RAD; ♂, 15.i.2008, RAD. **24a** – ♂, 14.v.2014, POMS. **24c** – ♂, 14.v.2014, POMS. **25a** – 4 ♂♂, 11.ii.2006, RAD; ♂, 11.ii.2006, JS. **26b** – ♂, 13.ii.2006, RAD. **26e** – 2 ♂♂, 8.ix.2012, CYC. **27a** – 2 ♂♂, 10.ix.2012, CYC; ♂, 13.ix.2012, CYC. **27c** – ♂, 11.ix.2012; CYC.

Onychargia atrocyana

1b – ♀, 27.xii.2007, RAD; ♂, 9.i.2008, RAD. **2a** – ♂, 8.ix.2008, RAD. **18b** – specimens collected in 2012 and lost.

Prodasineura collaris

18a – ♂, 15.i.2008, RAD; ♂, ♂+♀, 9.ix.2008, RAD.

Prodasineura dorsalis

3a – 2 ♂♂, 2.iv.2014, POMS. **9a** – ♂, 22.ix.2012, SB. **9d** – ♂, 24.iv.2014, POMS. **10b** – ♀, ♂+♀, 26.xii.2007, RAD. **17** – ♂, 11.i.2008, RAD; ♂, 10.ix.2008, RAD; ♂+♀, 10.ix.2008, JS. **20b** – 2 ♂♂, 10.x.2009, SB. **21a** – ♂, 10.ii.2006, RAD; ♂, 2 ♀♀, 10.ii.2006, JS. **25b** – ♂, ♀, 11.ii.2006, RAD. **26c** – ♂+♀, 13.ii.2006, JS. **26e** – ♂+♀, 8.ix.2012, CYC.

Prodasineura hosei

2a – 2 ♂♂, 16.iv.2005, RAD. **4a** – ♂, 7.v.2010, RAD. **9a** – ♂, 6.ii.2006, RAD; ♂, 6.ii.2006, GTR; ♂+♀, 2 ♀♀, 6.ii.2006, JS; ♂, 10.iv.2014, POMS. **10a** – ♀, 26.xii.2007, RAD. **12d** – 2 ♂♂, 9.iv.2014, POMS. **17** – ♂, 7.i.2008, RAD; ♂, 11.i.2008, RAD; ♂, 13.i.2008, RAD; 2 ♂♂, 10.ix.2008, RAD; 2 ♂♂, 10.ix.2008, JS; ♂, 30.iv.2014, POMS; ♂, 15.vi.2019, RAD. **24a** – ♂, 14.v.2014, POMS. **26b** – ♂, 13.ii.2006, RAD. **27c** – 4 ♂♂, ♂+♀, 11.ix.2012, CYC.

Prodasineura hyperythra

2b – ♂+♀, ♂, 5.ii.2006, RAD; ♀, 7.ii.2006, GTR; ♂+♀, ♂, 2.iv.2014, POMS. **2c** – ♂, 16.iv.2005, RAD; ♂, 24.xii.2007, RAD; ♂+♀, 2.i.2008, RAD; ♂, 28.iii.2014, POMS. **3a** – ♂, 18.ii.2006, RAD; ♂, 12.vi.2019, RAD. **5a** – specimens collected in 2012 and lost. **5b** – 2 ♂♂, 31.iii.2014, POMS. **8a** – 2 ♂♂, 17.iv.2005, RAD. **9a** – ♂, 6.ii.2006, GTR. **18a** – 2 ♂♂, 25.xii.2007, RAD; ♂, 15.i.2008, RAD; ♂, 3.v.2010, RAD. **21a** – ♂, 10.ii.2006, RAD; ♂, ♂+♀, 10.ii.2006, JS; ♂+♀, ♂, 13.v.2014, POMS. **25b** – ♂+♀, 14.ii.2006, JS. **26e** – 3 ♂♂, ♀, 8.ix.2012, CYC.

Prodasineura sp. cf. *peramoena*

26b – ♂, 13.ii.2006, RAD; ♂, 7.ix.2012, CYC; ♂, 9.ix.2012, CYC. **26c** – 2 ♂♂, 13.ii.2006, JS. **27c** – ♂+♀, 11.ix.2012, CYC.

Prodasineura tenebricosa

2b – ♂, 30.xii.2007, RAD; ♂, ♀, 8.ix.2008, RAD; ♀, 5.v.2010, RAD. **4a** – ♂, 18.vi.2019, RAD.

Prodasineura verticalis

2a – 2 ♂♂, 16.iv.2005, RAD; ♂, 10.iv.2014, POMS. **2b** – ♂, 5.ii.2006, RAD; ♂, 30.xii.2007, RAD; ♂, 2.i.2008, RAD; ♂, 27.iii.2014, POMS; 2 ♂♂, 7.v.2014, POMS. **4a** – ♂, 21.iv.2005, RAD. **19** – 2 ♂♂, 16.ii.2006, JS; ♂, 21.iv.2014, POMS. **20a** – ♂+♀, 20.ii.2012, SB. **20b** – 2 ♂♂, 10.x.2009, SB. **26a** – ♂, 13.ii.2006, LS; ♂, 7.ix.2012, CYC; ♂+♀, ♂, 8.ix.2012, CYC. **27a** – ♂, 10.ix.2012, CYC.

Coenagrionidae*Aciagrion borneense*

1a – ♂, 20.iv.2005, RAD.

Agriocnemis femina

1a – ♂, 20.iv.2005, RAD; ♂, 15.ii.2012, SB; 3 ♂♂, ♀, 25.v.2014, POMS.

Amphicnemis martini-group

2b – 2 ♂♂, 26.v.2014, POMS. **3a** – ♀, 24.iv.2005, RAD. **7a** – ♀, 7.iv.2014, POMS; 4 ♂♂, 11.vi.2019, RAD. **7b** – 2♀♀, 8.iv.2014, POMS. **18b** – ♂, 17.ii.2006, RAD. **18c** – specimens collected in 2012 and lost. **25c** – ♂, 11.ii.2006, RAD; 3 ♀♀, 11.ii.2006, JS; ♂, ♀, 14.ii.2006, JS. **26b** – 2 ♂♂, 13.ii.2006, RAD. **26c** – ♂, 13.ii.2006, JS.

Amphicnemis remiger

7a – ♂, 25.xii.2007, RAD; ♀, 6.iv.2014, POMS; 11 ♂♂, 5.v.2014, POMS; ♀, 15.vi.2014, POMS; 3 ♂♂, 11.vi.2019, RAD. **21b** – ♀, 10.ii.2006, RAD. **25c** – ♂, 11.ii.2006, RAD; ♂, 2 ♀♀, 11.ii.2006, JS; ♀, 14.ii.2006, JS. **26b** – ♀, 13.ii.2006, LS. **26c** – 2 ♂♂, 13.ii.2006, JS. **27a** – ♀, 10.ix.2012, CYC; ♂, ♀, 13.ix.2012, CYC.

Amphicnemis sp. *wallacii*-group

1a – ♂, ♀, 5.iv.2014, POMS. **1b** – ♂, 6.ii.2006, RAD; ♀, 7.ii.2006, RAD; ♀, 2.i.2008, RAD; ♀, 15.ix.2009, SB; ♂, 13.ii.2012, SB; ♀, 24.ii.2012, SB. **2b** – 2 ♂♂, ♀, 16.iv.2005, RAD; 3 ♂♂, 5.ii.2006, RAD; ♂, 30.xii.2007, RAD; ♂, 4.i.2008, SB; ♂, 6.ix.2008, RAD; ♂, 14.ii.2012, SB; 5 ♂♂, 2 ♀♀, 4.iv.2014, POMS; 2 ♂♂, ♀, 10.vi.2019, RAD; ♂, 17.vi.2019, RAD. **3a** – ♂, 29.iii.2014, POMS; ♀, 3.iv.2014, POMS; ♂, ♀, 4.iv.2014, POMS. **3b** – 3 ♂♂, 2 ♀♀, 16.iv.2005, RAD; ♀, 5.ii.2006, RAD; 2 ♂♂, 5.ii.2006, GTR; ♀, 18.ii.2006, JS; ♂, 18.ii.2006, LS; 3 ♂♂, 27.xii.2007, RAD; ♂, 2.i.2008, RAD; ♀, 6.i.2008, SB; ♀, 4.iv.2014, POMS; 4 ♂♂, 10.vi.2019, RAD.

3c – 2 ♂♂, 7.ix.2008, RAD; ♀, 25.ix.2009, SB; ♀, 19.ii.2012, SB; ♂, 10.iv.2014, POMS. **5a** – specimens collected in 2012 and lost. **6a** – ♀, 3.iv.2014, POMS. **7a** – 2 ♂♂, 15.ii.2006, RAD; ♀, 20.ii.2006, RAD; 2 ♂♂, 29.xii.2007, RAD; 3 ♂♂, 25.xii.2007, RAD; 2 ♂♂, 31.xii.2007, RAD; ♂, 2 ♀♀, 6.iv.2014, POMS; ♂, 2 ♀♀, 8.iv.2014, POMS; ♂, 5.v.2014, POMS; 2 ♂♂, ♀, 10.vi.2019, RAD; 2 ♂♂, 2 ♀♀, 11.vi.2019, RAD; ♂, 19.vi.2019, RAD. **7b** – ♀, 25.ii.2012, SB. **8b** – 5 ♂♂, ♀, 17.iv.2005, RAD. **10a** – ♂, ♀, 19.iv.2005, RAD. **10b** – ♂, 19.iv.2005, RAD; ♂, 21.v.2014, POMS. **18a** – 2 ♂♂, 9.ii.2006, RAD; 4 ♂♂, 15.i.2008, RAD. **18b** – 3 ♂♂, 17.ii.2006, RAD; 2 ♂♂, 2 ♀♀, 17.ii.2006, JS; 4 ♂♂, 25.xii.2007, RAD; 2 ♂♂, 5.ix.2008, RAD. **18c** – 3 ♂♂, 3.v.2010, RAD.

Archibasis tenella

2a – ♂, 16.iv.2005, RAD. **2b** – ♂, 8.ix.2008, RAD. **3a** – 2 ♂♂, 6.v.2014, POMS. **4a** – specimens collected in 2012 and lost **5a** – specimens collected in 2012 and lost. **18a** – ♂, 15.i.2008, RAD; ♂, 3.v.2010, RAD. **26e** – ♀, 8.ix.2012, CYC.

Archibasis viola

3b – ♂, 2.iv.2014, POMS. **3c** – 2 ♂♂, ♀, 5.iv.2014, POMS. **7a** – ♂, 31.xii.2007, RAD. **18a** – 2 ♂♂, 9.ii.2006, RAD; 2 ♂♂, 25.xii.2007, RAD.

Argiocnemis rubescens rubeola

1a – ♂, 20.iv.2005, RAD; ♂, 20.ix.2009, SB. **1b** – ♂, 17.ii.2006, RAD.

Argiocnemis sp.

1a – ♂, 18.iv.2005, RAD; 2 ♂♂, 16.ix.2009, SB; ♂, 17.ix.2009, SB; ♂, 20.ix.2009, SB; ♂, ix-x.2009, SB (reared, emerged 16.x.2009); ♂, 15.ii.2012, SB; ♂, 5.iv.2014, POMS; ♂+♀, 11.v.2014, POMS. **1b** – ♀, 16.ii.2006, RAD; ♀, 2.i.2008, RAD; ♂, 5.ix.2008, RAD; ♂, 15.ii.2012, SB. **2b** – ♂, 5.ii.2006, RAD; ♂+♀, 2.iv.2014, POMS. **3a** – ♂, 24.iv.2005, RAD; ♂, 12.vi.2019, RAD. **3b** – ♂, 16.iv.2005, RAD; ♂, ♀, 5.ii.2006, RAD; 2 ♂♂, 5.ii.2006, GTR; ♂, 6.ii.2006, GTR; ♂, ♀, 7.ii.2006, GTR; ♂, 18.ii.2006, JS; 4 ♂♂, 27.xii.2007, RAD; 2 ♂♂, 31.iii.2014, POMS; ♂, 3.iv.2014, POMS. **3c** – ♂, 2.i.2008, RAD; 2 ♀♀, 7.ix.2008, RAD. **6b** – ♀, 24.v.2014, POMS. **7a** – ♀, 31.xii.2007, RAD. **7b** – ♂, 15.ii.2012, SB. **18a** – 5 ♂♂, 9.ii.2006, RAD; ♂, 25.xii.2007, RAD. **18b** – 2 ♂♂, 17.ii.2006, RAD; ♀, 5.ix.2008, RAD. **20b** – ♀, 10.x.2009, SB. **21b** – ♂, 10.ii.2006, RAD. **25c** – 2 ♀♀, 11.ii.2006, RAD; 2 ♂♂, ♀, 14.ii.2006, RAD. **26c** – 2 ♀♀, 13.ii.2006, Joseph. **26e** – ♂, 8.ix.2012, CYC. **27a** – 2 ♂♂, 13.ix.2012, CYC.

Ceriagrion bellona

14a – ?♂ (specimen lost, field identification only), 15.v.2012, RAD. **26c** – ♂, ♀, 13.ii.2006, JS.

Ceriagrion cerinorubellum

1a – ♂, 20.iv.2005, RAD; ♂, 16.ix.2009, SB; ♂, 17.ix.2009, SB. **18b** – specimens collected in 2012 and lost. **26c** – ♂, 13.ii.2006, JS.

Mortonagrion falcatum

26c – ♀, 13.ii.2006, JS.

Pericnemis dowi

13c – ♂, 12.i.2008, RAD.

Pericnemis kiautarum

18a – ♀, 9.ix.2008, RAD.

Pseudagrion lalakense

1a – 2 ♂♂, 20.iv.2005, RAD; 2 ♂♂, 16.ix.2009, SB.

Pseudagrion perfuscatum

19 – ♂, 16.ii.2006, JS.

Pseudagrion pilidorsum

2a – 3 ♂♂, 16.iv.2005, RAD; ♂, 5.ii.2006, RAD; ♂, 28.xii.2007, RAD; 3 ♂♂, 15.ix.2009, SB (1 reared from larva, emerged 19.ix.2009); 2 ♂♂, 5.v.2010, RAD; ♂+♀, 10.iv.2014, POMS; 2 ♂♂, ♂+♀, 10.vi.2019, RAD. **2b** – ♂, 24.xii.2007, RAD; ♂, 27.iii.2014, POMS; ♂, 28.iii.2014, POMS. **3a** – ♂, 6.iv.2014, POMS.

Stenagrion dubium

9f – 3 ♂♂, 9.v.2014, POMS. **10b** – ♂, 8.ii.2006, RAD; 3 ♂♂, 19.ii.2006, RAD; ♂+♀, 19.ii.2006, JS; ♂, 26.xii.2007, RAD; ♂, 9.i.2008, LS. **11b** – ♂, 21.vii.2014, POMS; ♂+♀, 23.vii.2014, POMS. **13a** – 5 ♂♂, 22.iv.2005, RAD; 4 ♂♂, 5.i.2008, LS; ♂, 6.i.2008, RAD; 4 ♂♂, ♀, 6.i.2008, LS & Pa'Eh; 3 ♂♂, 11.i.2008, JS; ♂, 12.i.2008, LS; 2♀♀, 18.iv.2014, POMS; 3 ♂♂, 1.v.2014, POMS; 2 ♂♂, 19.xi.2016, POMS. **17** – 3 ♂♂, 7.i.2008, Pa'Eh; ♂, 10.i.2008, JS; ♂, 11.i.2008, RAD; ♂, 13.i.2008, RAD; ♂, 15.vi.2019, RAD. **23a** – ♂, 15.v.2014, POMS. **23b** – ♂, 15.v.2014, POMS.

Teinobasis cryptica

See Dow (2010b) for material collected by RAD prior to 2019.

7a – ♀, 6.iv.2014, POMS; 2♀♀, 19.vi.2019, RAD.

Teinobasis laidlawi

See Dow (2010b) for material collected by RAD.

3b – ♂, 4.iv.2014, POMS. **21b** – 5 ♂♂, 13.v.2014, POMS.

Xiphiagrion cyanomelas

1a – ♂, 20.iv.2005, RAD.

Anisoptera**Aeshnidae***Anax panybeus*

1b – ♂, 16.xii.2009, Park staff.

Gynacantha dohrni

1b – 2 ♂♂, 18.iv.2005, RAD; ♀, 20.iv.2005, RAD; ♂, 5.ii.2006, RAD; ♂, 6.ii.2006, RAD; ♂, ♀, 9.ii.2006, RAD; ♂, 10.ii.2006, RAD; ♂, 24.xii.2007, RAD; ♂, ♀, 26.xii.2007, RAD; ♂, 31.xii.2007, RAD; ♂, 1.i.2008, RAD; ♂, 7.i.2008, RAD; ♂, 7.i.2008, SB; ♂, ♀, 8.i.2008, SB; ♀, 9.i.2008, RAD; ♂, 15.i.2008, RAD; ♂, ♀, 3.ix.2008, RAD; ♂, 5.ix.2008, RAD; ♀, 3.v.2010, RAD; ♀, 6.v.2010, RAD; ♀, 7.v.2010, JS; ♂, 11.ii.2012, SB; ♀, 22.ii.2012, SB; ♀, 25.ii.2012, SB; ♂, 28.iii.2014, JS; ♂, 3.iv.2014, POMS; 2 ♂♂, 9.iv.2014, POMS. **26c** – ♂, 9.ix.2012, CYC.

Gynacantha species

1b – ♀, 10.x.2009, SB; ♀, 27.iii.2014, POMS; ♀, 6.iv.2014, POMS; ♀, 7.iv.2014, POMS; ♀, 13.iv.2014, POMS; ♀, 14.vi.2014, POMS; ♀, 27.xi.2016, POMS. **2a** – ♀, 20.iv.2014, POMS. **3c** – ♀, 21.iv.2014, POMS. **7b** – ♂, 11.vi.2019, RAD. **26c** – ♀, 13.ii.2006, JS.

Heliaeschna crassa/idae

1b – specimens collected in 2012 and lost, RAD; ♀, 12.iv.2014, POMS.

Heliaeschna simplicia

1b – ♂, 19.ii.2006, RAD; ♀, 2.iv.2014, POMS. **15c** – ♀, 10.iv.2009, JS.

Indaeschna grubaueri

1b – ♀, 8.vi.2006, E. McArthur (found dead in park office). **3b** – larva, 6.i.2008, SB.
3c – ♂, 20.ii.2006, RAD.

Oligoaeschna foliacea

7b – ♂, 24.vi.2014, POMS.

Tetracanthagyna sp. or spp.

2b – 3 larvae, 4.i.2008, SB; ♀, 8.ix.2008, RAD; 3 larvae, 8.x.2009, SB. **10a** – 2 larvae, 9.i.2008, SB. **13a** – larva, 12.i.2008, SB. **15c** – ♂, 1.vii.2014, Vivien Chua.

Tetracanthagyna plagiata

18a – larva, 7.i.2008, SB.

Gomphidae

Acrogomphus jubilaris

See Butler et al. 2016 and Steinhoff 2015 for some records.

10a – larva, 9.i.2008, SB. **12b** – larva, 18.xi.2016, POMS. **13a** – 7 larvae, 12.i.2008, SB. **20a** – larva, 10.x.2009, SB.

Gomphidia maclachlani

2b – 2 ♂♂, 16.iv.2005, RAD; ♂, 7.ii.2006, GTR; ♂, 2.i.2008, RAD; larva, 14.i.2008, SB; larva, 18.x.2009, SB; 2 ♂♂, 5.v.2010, RAD; 2 ♂♂, 30.iii.2014, POMS; ♂, 6.iv.2014, POMS. **4a** – ♂, 7.v.2010, RAD; ♂, 24.ii.2012, SB; ♂, 18.vi.2019, RAD. **5a** – specimens collected in 2012 and lost. **17** – specimens collected in 2012 and lost; 2 ♂♂, 15.vi.2019, RAD. **19** – ♂, 16.ii.2006, RAD. **25a** – ♂, 11.ii.2006, LS.

Heliogomphus borneensis

8b – 2 ♂♂, 17.iv.2005, RAD. **13a** – larva, 11.ix.2008, RAD.

Heliogomphus cf *olivaceus*

2b – ♂, 30.xii.2007, RAD. **17** – ♀, 10.ix.2008, RAD.

Ictinogomphus decoratus melaenops

1a – ♂, 20.iv.2005, RAD; ♂, 7.x.2009, SB; larva, 11.x.2009, SB.

Leptogomphus coomansi

See Dow, Stokvis & Ngiam (2017) for most adult records from Mulu prior to 2019.

2b – ♀, 1.xii.2016, POMS; ♀ (teneral), 17.vi.2019, RAD. **27b** – ♂, 10.ix.2012, CYC.

Leptogomphus pendleburyi

See Dow, Stokvis & Ngiam (2017) for adult records from Mulu.

Leptogomphus sii

See Dow, Stokvis & Ngiam (2017) for adult records from Mulu.

Leptogomphus williamsoni

See Dow, Stokvis & Ngiam (2017) for adult records from Mulu.

13a – larva, 12.i.2008, SB.

Macrogomphus sp. or spp.

2a – larva, 1.xii.2016, POMS. **2b** – larva, 18.x.2009, SB. **5a** – 2 larvae, 24.ix.2009, SB.

10a – larva, 9.i.2008, SB. **13a** – larva, 19.xi.2016, POMS. **18a** – larva, 7.i.2008, SB.

20a – 8 larvae, 10.x.2009, SB.

Megalogomphus sp. A

The larval record from location 19 has been matched to this species with DNA barcoding (unpublished Naturalis data). Two other *Megalogomphus* larvae from the same location and date are listed in the 'Additional records' section since the two *Megalogomphus* species known from Borneo often occur together.

2b – ♂, 6.ix.2008, RAD; ♀, 8.ix.2008, RAD; ♂, 27.iii.2014, POMS. **4a** – specimens collected in 2012 and lost; ♂, 18.vi.2019, RAD. **19** – larva, 7.i.2008, SB.

Megalogomphus sp. B

2b – ♂, 30.xii.2007, RAD; ♂, 5.v.2010, RAD; ♂, 17.vi.2019, RAD. **4b** – specimens collected in 2012 and lost.

Merogomphus sp.

2c – 2 larvae, 14.i.2008, SB.

Microgomphus chelififer

18a – larva, 7.i.2008, SB.

Microgomphus cf. *chelififer*

2a – ♀, 22.ix.2009, SB. **2b** – larva, 4.i.2008, SB; ♀, 8.ix.2008, RAD; ♀, 7.iv.2014, POMS; larval records by POMS in Steinhoff 2015. **4a** – ♀, 7.v.2014, POMS; 2 ♀♀, 18.vi.2019, RAD. **9a** – ♀, 6.ii.2006, JS.

Onychogomphus marjanmatoki

See Dow (2014b), also:

17 – ♀, 15.vi.2019, RAD.

Sieboldius japonicus

1b – ♂, 8.xi.2012, E. McArthur (found outside park office). **2b** – larva, 4.i.2008, SB; ♂, 28.iv.2014, POMS. **4a** – ♂, 7.v.2010, RAD; ♂, 18.vi.2019, RAD. **4b** – specimens collected in 2012 and lost; ♂, 17.vi.2014, POMS. **19** – ♂, 10.ii.2006, RAD; ♂, 16.ii.2006, JS.

Chlorogomphidae*Chlorogomphus* species

13a – larva, 12.i.2008, SB.

Macromiidae*Epoththalmia vittigera*

1a – larva, 10.i.2008, SB; 2 larvae, **17.x.2009**, SB.

Macromia sp. cf. *arachnomina*

18a – 5 larvae, 15.i.2008, SB; 3 larvae, 12.x.2009, SB.

Macromia callisto

2b – larva, 14.i.2008, SB.

Macromia cincta

27a – 2 ♂♂, 14.ix.2012, CYC.

Macromia corycia

17 – ♀, 7.i.2008, RAD. **20a** – 6 larvae, 10.x.2009, SB.

Macromia cydippe

2c – larva, 8.x.2009, SB. **4a** – larva, 25.ix.2009, SB. **10a** – ♀, 19.iv.2005, JS; 3 larvae, 9.i.2008, SB. **17** – 2 ♂♂, ♂+♀, 7.i.2008, RAD.

Synthemistidae

Idionyx yolanda

18a – ♂, 9.ix.2008, RAD. **27b** – ♀, 12.ix.2012, CYC.

Idionyx cf. *yolanda*

9d – ♀, 22.v.2014, POMS. **11a** – ♀, 21.vii.2014, POMS. **12a** – ♀, 1.v.2014, POMS. **13a** – ♀, 19.ii.2006, RAD; ♂, 19.ii.2006, JS; ♀, 18.iv.2014, POMS; ♀, 31.v.2014, POMS; ♀, 19.vi.2014, POMS.

Macromidia fulva

10a – ♀, 19.iv.2005, RAD. **17** – ♂ (teneral), 10.ix.2008, RAD.

Macromidia genialis erratica

17 – ♂, 7.i.2008, RAD; ♀, 13.i.2008, RAD.

Corduliidae

Procordulia fusiformis

14a – ♂, 12.ix.2008, RAD.

Libellulidae

Aethriamanta gracilis

1a – ♂, 20.iv.2005, RAD.

Agrionoptera insignis

1a – ♂, 1.v.2014, POMS. **1b** – ♀, 6.ii.2006, RAD. **3b** – ♂, 5.ii.2006, RAD; 2♂♂, 4.iv.2014, POMS. **18b** – ♂, 5.ix.2008, RAD. **21c** – ♂, 10.ii.2006, RAD.

Agrionoptera sexlineata

3b – ♂, 7.ix.2008, RAD. **7a** – ♂, 11.vi.2019, RAD. **26d** – 2 ♂♂, 7.ix.2012, CYC.

Brachydiplax chalybea

1a – ♂, 20.iv.2005, RAD; ♂, 13.iv.2014, POMS. **1b** – ♂, 27.xii.2007, RAD.

Brachydiplax cf. *farinosa*

1a – 2 ♂♂, 11.ii.2012, SB. **3b** – ♂, 16.iv.2005, RAD; ♂, 18.ii.2006, RAD; 4 ♂♂, 24.xii.2007,

RAD; 2 ♂♂, 27.xii.2007, RAD; ♂, 13.i.2008, SB; ♂, 6.i.2008, SB; ♂, 27.iii.2014, POMS; ♂, 10.vi.2014, POMS; ♂, 10.vi.2019, RAD. **18a** – ♂, 25.xii.2008, RAD. **18b** – 2 ♂♂, 20.ix.2009, SB. **18c** – ♂, 7.x.2009, SB.

Brachygonia oculata

2b – ♂, 15.ix.2009, SB. **3b** – ♂, 16.iv.2005, RAD; ♂, 5.ii.2006, GTR; ♂, 6.i.2008, SB; ♂, 21.ii.2012, SB. **7a** – 2 ♂♂, 29.xii.2007, RAD; 2 ♂♂, 8.iv.2014, POMS; ♂, 10.vi.2019, RAD; ♂, 11.vi.2019, RAD. **26e** – ♂, 8.ix.2012, CYC. **27b** – ♂, 13.ix.2012, CYC.

Cratilla metallica

1c – ♀, 17.ii.2006, RAD; ♂, 10.vi.2019, P. Dow. **3b** – ♂, 21.iv.2005, RAD; ♂, 18.ii.2006, RAD. **7b** – ♂, 13.ii.2012, SB. **9a** – ♂, 6.ii.2006, RAD. **13a** – ♂, 19.ii.2006, LS. **14a** – ♂, 9.vii.2014, POMS. **18c** – ♂, 7.i.2008, SB. **21a** – ♂, 13.v.2014, POMS.

Hydrobasileus croceus

1a – ♂, 20.iv.2005, RAD.

Lyriothemis biappendiculata

8b – ♂, 17.iv.2005, RAD. **9f** – ♀, 13.vi.2014, POMS. **12b** – ♂, 4.i.2008, RAD; ♂, 9.iv.2014, POMS. **13c** – ♀, 11.ix.2008, RAD. **17** – ♂, 11.i.2008, RAD. **18a** – ♂, 9.ix.2008, RAD. **23b** – ♂, 15.v.2014, POMS. **26c** – ♂, 9.ix.2012, CYC. **27b** – ♂, 12.ix.2012, CYC.

Lyriothemis cleis

3c – ♀, 13.i.2008, SB; ♂, 6.ix.2008, RAD. **5c** – ♂, 15.vi.2014, POMS. **7b** – ♂, 25.ii.2012, SB. **18b** – ♂, 9.ii.2006, RAD. **25c** – ♀, 11.ii.2006, RAD; ♂, 14.ii.2006, RAD.

Lyriothemis magnificata

18b – ♀, ix–x.2009, SB (reared, emerged 12.x.2009).

Nannophya pygmaea

1a – ♂, 20.iv.2005, RAD. **4a** – specimens collected in 2012 and lost. **20c** – ♂, 10.x.2009, SB.

Nesoxenia lineata

1a – ♂, 25.v.2014, POMS. **5c** – ♀, 13.vii.2014, POMS. **7a** – ♂, 21.ii.2012, SB. **7b** – ♂, 20.ii.2006, RAD.

Neurothemis fluctuans

See Seehausen & Dow (2016) for most material from GMNP collected before 2012.

1a – ♂, ♀, 5.iv.2014, POMS; ♂, 25.v.2014, POMS. **5c** – ♂, 31.iii.2014, POMS. **7b** – ♀, 20.ix.2009, SB.

Neurothemis ramburii

1a – ♂, 5.iv.2014, POMS. **3b** – ♂, 31.iii.2014, POMS; ♂, 4.iv.2014, POMS.

Neurothemis terminata

1a – ♂, 16.x.2009, SB; ♂, 8.iv.2014, POMS; ♂, 25.v.2014, POMS. **7b** – ♀, 5.iv.2014, POMS.

Onychothemis coccinea

2b – ♀, 16.iv.2005, RAD; 2 ♂♂, 7.ii.2006, RAD; ♂, 7.ii.2006, GTR, ♂, 28.xii.2007, RAD; ♂, 30.xii.2007, RAD; 2 ♂♂, 5.v.2010, RAD; 2 ♂♂, 27.iii.2014, POMS; ♂, 27.xi.2016, POMS; ♂, 10.vi.2019, RAD. **4a** – specimens collected in 2012 and lost. **9a** – ♂, 6.ii.2006, RAD. **17** – specimens collected in 2012 and lost. **19** – 2 ♂♂, 16.ii.2006, RAD; ♂, 16.ii.2006, JS. **27a** – ♂, 13.ix.2012, CYC; ♂, 14.ix.2012, CYC.

Onychothemis culminicola

2b –♂, 10.vi.2019, RAD. **19** – 2 ♂♂, 16.ii.2006, RAD; ♂, 11.v.2014, POMS.

Orchithemis pruinans

26e – ♂, 8.ix.2012, CYC.

Orchithemis pulcherrima

3b – ♂, 2.iv.2014, POMS; ♂, 10.vi.2019, RAD. **3c** – ♂, 7.ix.2008, RAD. **7a** – ♂, 31.xii.2007, RAD; ♂, 8.iv.2014, POMS. **7b** – ♂, 25.xii.2007, RAD; ♂, 15.i.2008, RAD; ♂, 7.x.2009, SB; 2 ♀♀, 18.ii.2012, SB. **8b** – ♂, **17**.iv.2005, RAD. **18a** – ♂, 9.ix.2008, RAD. **18c** – 2 ♀♀, 9.ix.2008, RAD. 20c – ♂, 10.x.2009, SB. **26c** – ♂, 9.ix.2012, CYC.

Orchithemis xanthosoma

7b – ♂, 29.xii.2007, RAD.

Orthetrum borneense Kimmins, 1936

Records of larva and reared out adults by POMS in Steinhoff, Butler & Dow 2016.

14a – 2 ♂♂, 12.ix.2008, RAD; 2 ♂♂, 13.ix.2008, RAD; ♂, 30.v.2014, POMS. 14e – ♂, larva, 12.ix.2008, JS.

Orthetrum chrysis

3b – ♂, 2.iv.2014, POMS. **6a** –♂, 14.vi.2019, RAD. **26d** – ♂, 13.ii.2006, JS. **27a** – ♂, 12.ix.2012, CYC. **27b** – ♂, 10.ix.2012, CYC.

Orthetrum glaucum

26d – ♂+♀, 13.ii.2006, JS.

Orthetrum pruinatum schneideri

2a – ♂, 16.iv.2005, RAD. **2b** – ♂, 30.iii.2014, POMS; ♂, 10.v.2014, POMS. **3c** – ♂, 7.ix.2008, RAD; ♀, 22.ix.2009, SB. **11a** – ♂, 24.vii.2014, POMS. **13a** – ♂, 19.ii.2006, RAD.

Orthetrum testaceum

1a – ♂, 19.ix.2009, SB; ♂, 13.iv.2014, POMS. **1c** – ♂, 7.ii.2006, RAD. **18c** – ♂, 12.x.2009, SB. **19** – ♂, 2 ♀♀, 16.ii.2006, RAD; ♂, 11.v.2014, POMS. **20a** – ♂, 20.ii.2012, SB. **26d** – ♂, 12.ii.2006, JS; ♂, 7.ix.2012, CYC.

Pantala flavescens

26d – 2 ♂♂, 13.ii.2006, JS.

Panothemis serrata Krüger, 1902 A

7a – 2 ♂♂, 31.xii.2007, RAD; ♂, 20.ix.2009, SB; ♀, 21.ix.2009, SB; ♀, 21.ii.2012, SB. **26c** – ♀, 13.ii.2006, JS. **27b** – ♂, 13.ix.2012, CYC.

Panothemis serrata Krüger, 1902 B

3b – ♂, 24.xii.2007, RAD; ♂, 7.ix.2008, RAD; 3 ♂♂, 6.v.2014, POMS. **7a** –♂, 11.vi.2019, RAD.

Rhodothemis rufa

1a – ♂, 20.iv.2005, RAD; ♂, 25.v.2014, POMS.

Rhyothemis obsolescens

1a – ♂, 6.x.2009, SB.

Rhyothemis triangularis

1a – 3 ♂♂, 20.iv.2005, RAD.

Risioophlebia dohrni

1b – ♀, 26.xii.2007, RAD. **7a** – 2 ♂♂, 8.iv.2014, POMS. **20c** – ♂, 10.x.2009, SB.

Tetrathemis flavescens

3b – ♂, 24.xii.2007, RAD; ♂, 6.v.2014, POMS.

Tetrathemis hyalina

1a – ♂, 20.iv.2005, RAD; 2 ♂♂, 19.ix.2009, SB; ♀, 23.ix.2009, SB (reared, emerged 8.x.2009); ♂, 27.ix.2009, SB (reared, emerged 3.ix.2009); ♂, 11.ii.2012, SB; ♂, 8.iv.2014, POMS. **3b** – ♀, 24.xii.2007, RAD; ♂, 2.i.2008, RAD; ♂, 29.iii.2014, POMS. **4a** – ♂, 7.v.2010, RAD. **6a** – ♂, 14.vi.2019, RAD. **17** – specimens collected in 2012 and lost. **18a** – 2 ♂♂, 9.ii.2006, RAD; ♂, 25.xii.2007, RAD. **21a** – 2 ♂♂, 19.ix.2009, SB; ♂, 20.ix.2009, SB.

Trithemis aurora

1a – ♂, 17.ix.2009, SB; ♂, 19.ix.2009, SB. **1c** – ♂, 25.ii.2012, SB. **2a** – ♂ (reared), ix–x.2009, SB.

Trithemis festiva

2a – ♂ (reared), ix–x.2009, SB' **2b** – ♂, 17.vi.2019, RAD. **17** – specimens collected in 2012 and lost. **19** – ♂, 16.ii.2006, JS. **20a** – ♂, 10.x.2009, SB. **22** – ♂, 11.ii.2006, RAD.

Tyriobapta kuekenthali

7a – ♂, 20.ii.2006, RAD; ♂, 29.xii.2007, RAD; ♂, 31.xii.2007, RAD; 2 ♂♂, 8.iv.2014, POMS; 3 ♂♂, 11.vi.2019, RAD. **7b** – 2 ♂♂, 21.ii.2012, SB. **20c** – 10.x.2009, SB. **26e** – ♂, 8.ix.2012, CYC. **27b** – ♂, ♀, 13.ix.2012, CYC.

Tyriobapta laidlawi

26b – 2 ♂♂, 13.ii.2006, RAD; ♂, 7.ix.2012, CYC; ♂, 9.ix.2012, CYC. **26c** – 2 ♂♂, 13.ii.2006, JS.

Tyriobapta torrida

1a – ♂, 20.iv.2005, RAD; ♂, 19.ix.2009, SB; ♀, 20.ix.2009, SB; ♂, 15.vi.2019, P. Dow. **1b** – ♀, 5.i.2008, SB. **2a** – ♂ (in backwater), 10.vi.2019, RAD. **3b** – ♂, ♀, 16.iv.2005, RAD; ♂, ♀, 2.iv.2014, POMS. **6a** – ♂, 14.vi.2019, RAD. **7a** – ♂, 31.xii.2007, RAD. **13c** – ♀, 11.ix.2008, RAD. **18a** – 25.xii.2007, RAD; ♂, 15.i.2008, RAD. **18c** – ♂, 17.ii.2006, RAD. **26a** – 2 ♂♂, 7.ix.2012, CYC. **27a** – ♂, 12.ix.2012, CYC.

Zygonyx ida errans

11a – ♂, 19.vii.2014, POMS.

Zyxomma petiolatum

1a – ♂, 4.ii.2006, GTR; 2 ♂♂, 5.i.2008, SB. **3b** – larva, 14.i.2008, SB; ♂, 31.iii.2014, POMS. **18a** – ♂, 3.v.2010, RAD.

Additional records

Various larvae from both suborders, and also some teneral specimens and mature females from two Anisopteran families cannot be assigned with confidence to any of the taxa in the list above at present, although at least some of them will belong under those taxa. Problematic *Coeliccia* specimens from higher altitudes on Gunung Mulu are also listed here. These are listed here rather than above, in order to avoid both

artificially inflating the number of species recorded from GMNP and unwarranted lumping. Records of larvae collected by POMS in 2014 are given in Steinhoff 2015.

Argiolestidae

Podolestes cf. orientalis

2b – larva (♀), 8.x.2009, SB.

Chlorocyphidae

Rhinocypha sp. or spp.

2b – 2 larva, 29.xi.2016, POMS.

Platycnemididae

Coeliccia sp.

14a – 2 ♂♂, ♂+♀, 23.iv.2005, RAD; ♂, 28.v.2014, POMS; ♂, ♀, 30.v.2014, POMS. **14c** – 3 ♂♂, ♀, 29.iv.2014, POMS. **14d** – 3 ♂♂, ♀, 29.iv.2014, POMS; 4 ♂♂, 29.v.2014, POMS. **14e** – 3 ♂♂, 23.iv.2005, RAD; ♂, ♀, 23.iv.2005, JS; ♂, 12.ix.2008, RAD; 2 ♂♂, 13.ix.2008, RAD; ♂, 13.ix.2008, JS; 4 ♂♂, 15.iv.2014, POMS; ♀, 17.iv.2014, POMS. **15a** – ♀, 10.iv.2009, JS; ♂, 30.v.2014, POMS.

Aeshnidae

Indaeschna sp.

12b – larva, 18.xi.2016, POMS.

Tetracanthagyna sp. or spp.

10a – larva (♂), 19.x.2009, SB. **12b** – larva, 18.xi.2016, POMS. **13a** – larva, 19.xi.2016, POMS. **18a** – 2 larvae, 12.x.2009, SB.

Gomphidae

Heliogomphus sp. or spp.

2b – larva, 18.x.2009, SB. **10a** – larva, 19.x.2009, SB. **13a** – larva, 12.i.2008, SB; larva, 18.iv.2008, JS.

Leptogomphus sp. or spp.

2b – larva, 4.i.2008, SB; larva, 23.xi.2016, POMS; larva, 27.xi.2016, POMS; larva, 1.xii.2016, POMS. **10a** – 7 larvae, 9.i.2008, SB; 5 larvae, 19.x.2009, SB. **13a** – 2 larvae, 12.i.2008, SB; 4 larva, 19.xi.2016, POMS.

Megalogomphus sp. or spp.

2b – 7 larvae, 8.x.2009, SB; 2 larva, 23.xi.2016, POMS; larva, 1.xii.2016, POMS. **4a** – 2 larvae, 25.ix.2009, SB. **10a** – larva, 19.x.2009, SB. **19** – 2 larvae, 7.i.2008, SB.

Microgomphus sp. or spp.

2a – ♂ (feneral, reared from larva), 19.ii.2012, SB; larva, 1.xii.2016, POMS. **2b** – larva, 24.ix.2009, SB; 6 larva, 23.xi.2016, POMS. **4a** – ♂ (feneral), 24.ii.2012, SB. **10a** – 3 larvae, 19.x.2009, SB. **18a** – larva, 7.i.2008, SB; larva, 15.i.2008, SB.

Undetermined genus (Burmagomphus or Merogomphus)

2a – 2 larvae, 15.ix.2009, SB; larva, 1.xii.2016, POMS. **2b** – larva, 18.x.2009, SB. **4a** – 4 larvae, 25.ix.2009, SB. **20a** – 3 larvae, 10.x.2009, SB.

Macromiidae

Macromia cf. *westwoodii*

Larval records from a small stream near Camp 1, one of which has been analyzed for the COI marker and found to be quite distinct from other examples of *M. westwoodii*; however there is a possibility that this could be because a non-coding copy of the marker has been analyzed rather than the true COI, see Dow et al. (2019).

12b – larva, 9.i.2008, SB; larva, 11.i.2008, SB; larva, 12.i.2008, SB. **13a** – larva, 19.xi.2016, POMS.

Synthemistidae

Idionyx sp. or spp.

13a – ♀, 6.i.2008, RAD. **18a** – larva, 7.i.2008, SB; larva, 15.i.2008, SB; larva, 12.x.2009, SB. **20b** – larva, 10.x.2009, SB.

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