

RESULTS OF COLLECTING OF ODONATA CARRIED OUT
IN SARAWAK. GERENAI FOREST MANAGEMENT UNIT
AND ADAJACENT AREAS IN THE UPPER BARAM, 2020
WITH UPDATES ON THE ODONATA OF AREAS IN THE
SAME REGION SAMPLED PREVIOUSLY

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A male of *Tramea* species cf *virginia* (Rambur, 1842), a species found near to Long Silat. Photograph by the author.

SUMMARY

The results of collecting of Odonata (dragonflies and damselflies) in the Gerenai Forest Management Unit (FMU) and adjacent areas in the Upper Baram are reported. Details of the research permits and dates on which collecting was carried out are listed. The report is split into two parts. Part 1 deals with a survey made in February 2020. Part 2 updates information provided on areas in the same part of the Upper Baram (for convenience referred to here as the Kalulong-Moh-Usun Apau (KMUA) region) in previous reports. Eighty-one species of Odonata were recorded during the February 2020 survey, of which one (*Camacinia gigantea*) had not been recorded in Miri Division before. Fifty-two of the species recorded are **forest species**, e.g. species dependent on forest for their survival, and 37 are endemic to Borneo; it is species in one or both of these categories that are typically of highest conservation concern. Fifty-four species were collected at sites actually within the Gerenai FMU. A number of species found during the February 2020 survey are particularly notable: *Protosticta joevani*, *Telosticta ?berawan*, *Macromia corycia*, *Macromia* sp. (possibly a new species), *Idionyx montana*, *Rhyothemis regia* (rare in Sarawak) and *Tramea* sp. cf *virginia*; these are all considered to be of conservation concern, at least within Sarawak.

Part 2 of the report includes a full list of the 125 species now known from the KMUA region, as a table indicating which species are known from which particular areas within the KMUA region, including Usun Apau National Park, Gunung Kalulong and the Sungai Moh drainage (including the Sungai Moh Wildlife Sanctuary). Fifty-seven of these species are endemic to Borneo and 19 of these are considered to be of conservation concern. A checklist of the Odonata recorded from the Gerenai FMU is included in Appendix 1, with a few older records from the area included, 62 species are now known from the FMU. Appendix 2 contains a summary of the taxonomic changes that have occurred since the last reporting on the Odonata from the KMUA region was done.

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Introduction

The report is part of a series of reports on collecting of Odonata in Sarawak in 2005-2020. These reports either update reports previously written on collecting carried out in 2005-2019, or are the first reports on collecting in areas sampled for the first time in 2020.

This report is divided into two parts. The first part describes the results of collecting of the insect order Odonata (dragonflies and damselflies) carried out within and near to the Gerenai Forest Management Unit (FMU) in the Upper Baram, Miri Division in February 2020. The dates on which collecting was carried out in February 2020, and details of the research permit issued by the Sarawak Forest Department, are given in Table 1. Because not all locations covered are, to my understanding, within the Gerenai FMU, a checklist of the species recorded within the FMU is given in Appendix 1.

Year	Research permit number	Period of validity of permit	Dates on which collecting was carried out
2020	(177)JHS/NCCD/600–7/2/107/Jld,2	10 th September 2019–9 th September 2020	17 th –29 th February 2020

Table 1: Permit number and collecting dates for the February 2020 survey.

Since the areas visited in February 2020 overlap to some extent with areas previously sampled for Odonata by the author and associates and because taxonomic changes have occurred since these areas were reported on (these changes are summarised in Appendix 2), updated lists of species known from these areas (the Gunung Kalulong area, the Sungai Silat drainage and the Sungai Moh drainage) are presented in the second part. The Sungai Lowing area, sampled for the first time in February 2020, is also included in the second part, and so is Usun Apau (with an updated checklist) so that the entire area between the Baram River and Kapit Division from Gunung Kalulong and surrounds to the Moh drainage, Usun Apau and the border with Kalimantan is covered. The Gunung Kalulong area was surveyed briefly in December 2007 and again in October 2009, with a longer surveyed focused on the area in July 2010; the last report on Odonata including results from this area is Dow & Reels (2011). The Sungai Silat area was only sampled on one day in 2014 previously, with a few additional records of species found at Long Silat itself on occasions when the author has stayed there. The Sungai Moh area was sampled in August 2014, this survey was reported on in Dow (2014a). Usun Apau National Park (not visited at all in February 2020) was sampled in April-May 2012 and this survey was reported on in Dow *et al.* (2013). Table 2 gives details of the research permits under which the earlier surveys were made.

Year	Research permit number	Period of validity of permit	Area and dates on which collecting was carried out
2007	NPW.907.4.2(11)–113	28 th November 2007–27 th November 2008	Gunung Kalulong area: 17 th -19 th December 2007
2009/2010	NCCD.907.4(IV)–49	1 st August 2009–31 st July 2010	Gunung Kalulong area: 6 th -10 th October 2009, 14 th –21 th July 2010
2012	NCCD.907.4.4(Jld.7)-51	6 th January–4 th October 2012	Usun Apau: 23 rd April-4 th May
2014	NCCD.907.4.4(Jld.10)-249	29 th May 2014–28 th May 2015	Sungai Silat area: 9 th July 2014; Sungai Moh area: 20 th –29 th August 2014

Table 2: Permit numbers and collecting dates for earlier surveys in the areas covered in February 2020 or near to them.

Odonata are insects with aquatic larvae; representatives of the order can be found at almost all freshwater habitats. They are carnivorous as both adults and larvae and are not vectors for any human disease; indeed they play at least some role in keeping mosquito populations under control. Although present on every continent apart from Antarctica, the order is most diverse in the world's tropical regions. In the wet tropics many species are forest dwelling and may be particularly sensitive to environmental disturbance; for this reason they are considered to be good candidates for ecological indicator species.

This series of reports will hopefully provide the Sarawak Forest Department, the Sarawak Forestry Corporation, the staff of the national parks and other protected areas, and other interested parties, with useful information for conservation planning and management.

The structure of the report is as follows: in Part 1 the collecting locations from the February 2020 survey are described, followed by an annotated list of the species collected. In particular new records for the Miri Division, significant new distribution data, material presenting taxonomical problems, endemic species and species of special conservation interest are noted. A brief discussion follows. In Part 2 the areas covered are defined and an up-to-date list of all species recorded from these areas is presented, followed by a discussion. A checklist of the species of Odonata recorded with the Gerenai FMU is given in Appendix 1. Updates to the taxonomy of Odonata from areas covered in Part 2 since the last reporting on those areas was done are summarised in Appendix 2. The family level taxonomy for Odonata adopted by Schorr & Paulson (2020) is used in this report.

Part 1: February 2020 Survey

This part considers only the results of the February 2020 survey.

Collecting Locations

The following codes for groups of samplings sites are used below. They are organised by areas, where possible by the river basin in which each site is situated. However two locations, Gerenai Camp and one in the vicinity of Gunung Kalulong, are placed in separate groups without mention of a river basin. Where it is clear to me I have indicated which groups of locations are within the Gerenai FMU and which are not. Locations L2, L3 and L4 are presumably within the area proposed for the Julan Mujan National Park. Figure 1 shows an overview of the locations sampled.



Figure 1: Overview of locations sampled in February 2020.

Kalulong area

Outside of the Gerenai FMU.

K1. Pond beside road in Kalulong area. Sampled briefly in the afternoon while on the way to Gerenai Camp. [3.15714N, 114.63415E, 331m a.s.l.]

Sungai Lowing area

This area is under the Gerenai FMU and includes locations in the Sungai Lowing drainage but below Usun Apau. Figure 2 shows locations in the Kalulong and Sungai Lowing areas in more detail.

L1. Sungai Lowing in the vicinity of the bridge on the main timber road. [Representative coordinates: 3.01018N, 114.76208E, 240-285m a.s.l.]

L2. Stream system 1 between main road and Usun Apau. [Representative coordinates: 2.97925N, 114.74919E, 610-686m a.s.l.]

L3. Stream system 2 between main road and Usun Apau. [Representative coordinates: 2.97492N, 114.75745E, 640-680m a.s.l.]

L4. Pools along logging road and on skid paths and found foraging on skid paths in vicinity of L2 and L3.

L5. Ponds near Long Anap Junction. [Representative coordinates: 3.03911N, 114.76162E, 466m a.s.l.].

Sungai Paku

To my understanding this stream, only sampled very briefly, is in a service logging area rather than within the Gerenai FMU.

P1. Sungai Paku near bridge. [Representative coordinates: 2.943N, 114.86515N, 230m a.s.l.].

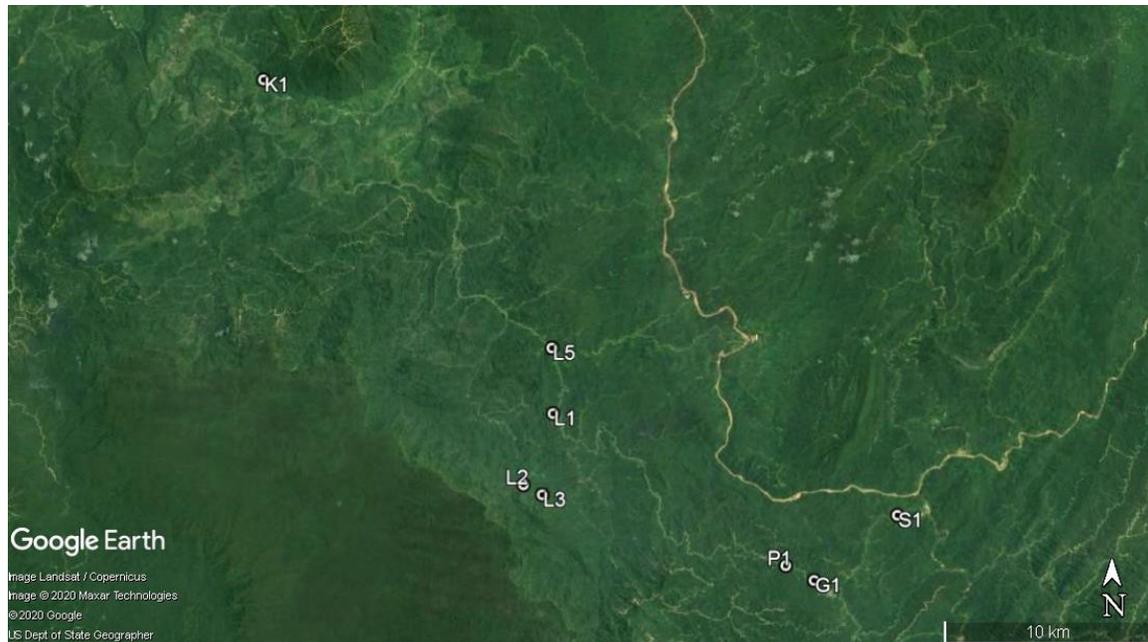


Figure 2: Locations in the Kalulong and Sungai Lowing areas.

Sungai Moh area

This area is under the Gerenai FMU and includes areas within the Sungai Moh drainage but outside of the Sungai Moh Wildlife Sanctuary.

M1. Streams accessed from the first part of an old logging road, used in 2014 by the author as the first part of the route to reach what is now the Sungai Moh Wildlife Sanctuary. [Representative coordinates: 2.89976N, 115.00767E, 715-815m a.s.l.]

M2. Pond formed where stream dammed by road 1. [2.98539N, 115.06187E, 315m a.s.l.]

M3. Stream above M3. [Representative coordinates: 2.98614N, 115.06097E, 330m a.s.l.]

M4. Pond formed where stream dammed by road 2. [2.97512N, 115.04953E, 331m a.s.l.]

M5. Stream crossed by road, only sampled briefly late in the afternoon. [Representative coordinates: 2.95351N, 115.04123E, 383m a.s.l.]

Sungai Silat area

To my understanding all of the sampled locations here, within the Sungai Silat drainage, are actually outside of the Gerenai FMU and are either in a service logging area or land

used for shifting and other agriculture by the inhabitants of Long Silat. Figure 3 shows locations in the Sungai Moh and Sungai Silat areas in more detail.

- S1.** Pond on road to Long Silat. [2.96546N, 114.91422E, 420m a.s.l.]
- S2.** Mostly shaded pond by road leading to, for instance, Long Jekitan and Long Bee; all locations below were accessed using this same road and its junctions. [2.90355N, 114.88575E, 285m a.s.l.]
- S3.** Sungai Betau including pools beside it. [Representative coordinates: 2.87628N, 114.8548E, 250-290m a.s.l.]
- S4.** Pond by Sungai Betau. [2.87579N, 114.85593E, 246m a.s.l.]
- S5.** Stream system 1 after Long Bee Junction. [Representative coordinates: 2.79524N, 114.81906E, 550-620m a.s.l.]
- S6.** By road in S5 area.
- S7.** Stream system 2 after Long Bee Junction. [Representative coordinates: 2.78939N, 114.80493E, 400-555m a.s.l.]
- S8.** Stream system 1 (last accessible system) on a road leading to relatively high altitude. [Representative coordinates: 2.76825N, 114.86764E, 745-810m a.s.l.]
- S9.** Stream system 2 (penultimate accessible system) on same road as S8. [Representative coordinates: 2.77014N, 114.86588E, 730-850m a.s.l.]
- S10.** Pools etc. along high road.
- S11.** Pond on ridge top in southwest of area. [2.78659N, 114.77908E, 515m a.s.l.]
- S12.** Stream in south of area and adjacent pond. [Representative coordinates: 2.75562N, 114.81142E, 640-695m a.s.l.]

Gerenai Camp

- G1.** In and around buildings. [2.93658N, 114.87763E, 301m a.s.l.]

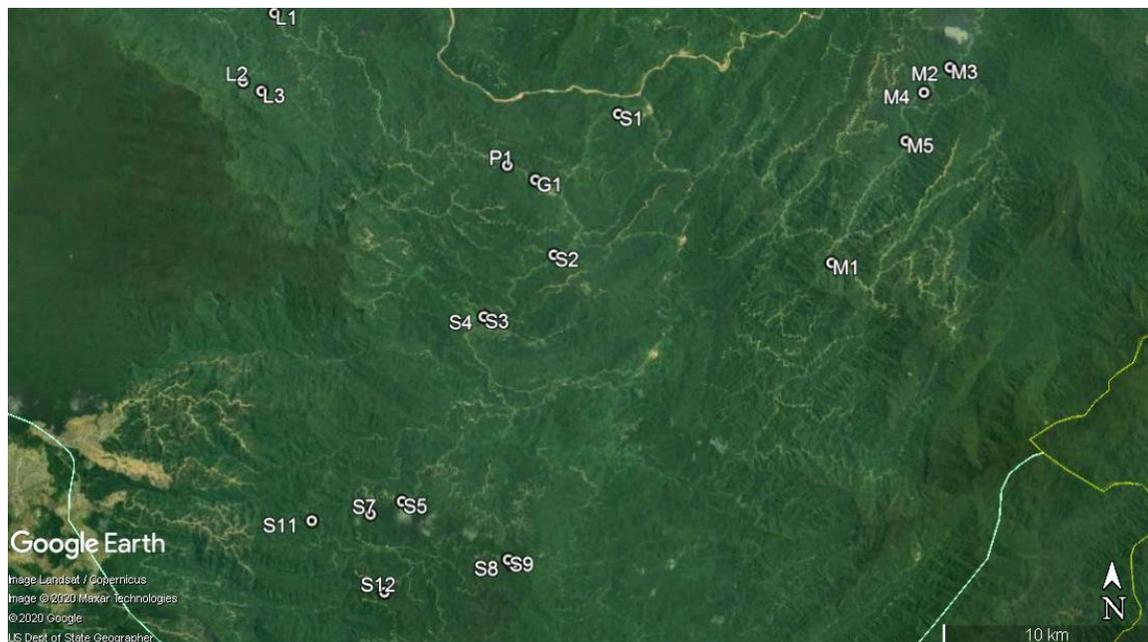


Figure 3: Locations in the Sungai Moh and Sungai Silat areas.

Species Collected

Adult Odonata were collected. Collecting of adults was carried out using handheld nets.

At each location the aim was to collect at least one specimen of each species present. In cases where species are difficult to distinguish in the field, or of particular interest, an effort was made to take longer series of specimens. However many adult odonates are difficult to capture, hence not every species encountered was successfully collected. Many common species are only represented by one or a few specimens in the material collected; this does not necessarily imply that they are less common at the locations sampled than elsewhere, it merely reflects that after the collection of an initial voucher specimen to prove their presence in the area, little effort was spent on collecting further specimens of such species. The locations listed for each species are those where specimens were collected, unless otherwise noted. An **E** after the locations indicates that the species is endemic to Borneo.

* - First record definitely from Miri Division made during this study.

ZYGOPTERA (DAMSELFLIES)

Platystictidae

The Platystictidae is a moderately large family which presents many taxonomic problems. They occur from India across most of Asia, and southwards as far as New Guinea, with species in three subfamilies; a separate subfamily occurs in the neotropics. It is widely recognised that the old world Platystictidae are in need of a major revision. There are many platystictid species in Sarawak, due to difficulties in determining whether some forms are separate, unnamed, species or local variants of known species it is not possible to give an exact figure, but over 30 species are already known to occur in the state. More species will undoubtedly be found.

1. *Drepanosticta actaeon* Laidlaw, 1934 — Originally described from Mount Kinabalu, *D. acateon* now appears to be common in the mountainous interior parts of Sarawak. Locations L2, L3, S8, S9. **E**
2. *Drepanosticta attala* Lieftinck, 1934 — An extremely local (i.e. scattered populations confined to small areas) forest stream species, more often found on larger streams than most members of the Platystictidae in Borneo. Location L1. **E**
3. *Drepanosticta* species cf *crenitis* Lieftinck, 1933 — A small sized species or complex of species, common in Sarawak; often over-looked because of its size and cryptic colouration. Locations S7, S9. **E**
4. *Drepanosticta dentifera* Kimmins, 1936 — Another small sized species or complex of closely related species; the form reported here can reasonably be assumed to be the true *D. dentifera* whose type locality is the relatively nearby Mount Dulit. Location L2. **E**
5. *Drepanosticta rufostigma* (Selys, 1886) — The most common member of the Platystictidae in Sarawak. Locations L2, L3, M1, M3, S5, S7, S8, S9, S12. **E**
6. *Drepanosticta versicolor* (Laidlaw, 1913) — Another common platystictid, usually found at tiny muddy seeps and trickles. Locations L3, M1, S5, S8. **E**
7. *Protosticta joepani* Dow, Phan & Choong, 2020 — A very recently described species, occurring from Mount Kinabalu to ulu Balui but seemingly scarce in Sarawak. This species may be particularly sensitive to disturbance and it is notable that although the population reported here was in logged forest, the species was only found on one section of a tiny tributary stream with no signs of any disturbance around it. Location L3. **E**

8. *Telosticta ?berawan* Dow & Orr, 2012 — The male of *T. berawan* is very rarely found and only females were seen at the location reported here, unfortunately this means that identification is not definite. Location S8. **E**
9. *Telosticta longigaster* Dow & Orr, 2012 — This is by far the most common species of *Telosticta* over a large part of Sarawak, but it is relatively scarce in the upper Baram. Locations L2, L3. **E**

Calopterygidae

A large cosmopolitan family of medium- to large-sized damselflies found on forest streams and rivers. At least eight species occur in Sarawak. In Borneo the family is dominated by the *amoena*-group of the genus *Vestalis*; most of the species in this group are very similar, with metallic green bodies and clear wings, which flash with bright metallic colours when caught by the sun.

10. *Neurobasis longipies* Hagen, 1887 — This species can be abundant on lowland forest streams. Locations L1, S3.
11. *Vestalis amaryllis* Lieftinck, 1965 — Usually one of the commoner members of the *amoena*-group of *Vestalis* species in Sarawak, but becoming less common in the upper Baram. Locations S5, S12.
12. *Vestalis amnicola* Lieftinck, 1965 — A very common species on forest streams in the upper Baram. Locations L1, L3, M1, M5, S3, S5, S7, S9. **E**
13. *Vestalis beryllae* Laidlaw, 1915 — A local species in which the male is distinctive by virtue of its very long abdomen; it is only found in steep terrain. Locations L2, M3, S9. **E**

Chlorocyphidae

The members of this old world family are small and mostly very brightly coloured. At least 15 species occur in Sarawak. They are found on forest streams and are notable for their courtship and agonistic behaviour.

14. *Heliocypha biseriata* (Selys, 1859) — This species is widely distributed in Sarawak, and is often common on forest streams, but becomes uncommon in many parts of the upper Baram. Location S12.
15. *Rhinocypha aurofulgens* Laidlaw, 1931 — This is a species of rocky forest streams. Locations L1, S3. **E**
16. *Rhinocypha* species cf *spinifer* Laidlaw, 1931 — A problematic form, allied to *R. spinifer* but differing in colouration and behaviour, typically found on small, steep forest streams. Locations L4, S8. **E**

Devadattidae

This small family includes only a single genus, *Devadatta*, and was previously included in the Amphipterygidae. Only one species, *Devadatta podolestoides*, was thought to occur in Sarawak until recently, when it was discovered that a number of distinct but very similar species had all been treated as *D. podolestoides*. The true *D. podolestoides* has not been found east of the Lupar River.

17. *Devadatta aran* Dow, Hämäläinen & Stokvis, 2015 — Common in mountainous areas in the interior of northeast Sarawak. Locations S8, S9. **E**
18. *Devadatta clavicauda* Dow, Hämäläinen & Stokvis, 2015 — Usually the most common *Devadatta* species in the lowlands of Sarawak and also occurring at higher altitudes. Locations M1, M3, S5, S9, S12, G1. **E**
19. *Devadatta somoh* Dow, Hämäläinen & Stokvis, 2015 — Common in hilly and mountainous areas of Sarawak east of the Lupar River. Locations L2, S5, S7. **E**

Euphaeidae

These are medium-sized damselflies of forest streams and rivers. The family, well represented in Sarawak with eight species recorded, is mostly Asian but reaches as far west as extreme south-eastern Europe. Species are mostly darkly coloured, but some have iridescent wing markings.

20. *Dysphaea ulu* Hämäläinen, Dow & Stokvis, 2015 — This species had been confused with *D. dimidiata* until recently. *Dysphaea ulu* appears to be scarce in coastal areas but to become more common in the interior of Sarawak. Locations L11, S3. **E**
21. *Euphaea impar* Selys, 1859 — A common species on lowland forest streams. Possibly more tolerant of disturbance than other members of this family in Sarawak. Location S12.
22. *Euphaea subcostalis* Selys, 1873 — Another species that is quite common on forest streams in Sarawak, but that may be less tolerant of disturbance than *E. impar*. Locations L1, L3, M11, M5, S7, S12.
23. *Euphaea subnodalis* (Laidlaw, 1915) — A species of larger, rocky streams in the interior, most common in upland areas. Locations L1, S3. **E**
24. *Euphaea tricolor* Selys, 1859 — This species is quite common on forest streams and rivers in a number of areas in Sarawak. Locations L1, S3. **E**

Platycnemididae

The Calicnemiinae and Platycnemidinae are the subfamilies occurring in Borneo that have traditionally been placed in the Platycnemididae. The Calicnemiinae are represented by *Coeliccia* and the Platycnemidinae by *Copera* and *Pseudocopera*. More recently old world species formerly placed in the Protoneuridae, and the enigmatic genus *Onychargia*, have been transferred to the Platycnemididae.

25. *Coeliccia borneensis* (Selys, 1886) — A locally occurring species of small forest streams. Locations L2, L3, L4. **E**
26. *Coeliccia campioni* Laidlaw, 1918 — A species once thought to have a very restricted range but whose known distribution is now known to extend from the upper Baram, Gunung Mulu and Eastern Brunei to ulu Engkari in Sri Aman division. Locations L2, L3, M1. **E**
27. *Coeliccia cyaneothorax* Kimmins, 1936 — A species of local occurrence, it appears to favour small rock pools at the edge of streams on forested hills and mountains. Location M1. **E**
28. *Coeliccia* species cf *nemoricola* Laidlaw, 1912 — A problematic form. The true *C. nemoriciola* is known from the Tama Abu Range in Sarawak and the Crocker Range in Sabah. Locations L2, M1, S5, S12. **E**
29. *Coeliccia nigrohamata* Laidlaw, 1918 — A common species of streams and marshy areas in forest. Locations L2, L3, M1, S5, S7, S9, S10, S12. **E**
30. *Copera vittata* (Selys, 1863) — Fairly common in shaded habitats, generally at lentic (i.e. standing) or sometimes slowly flowing waters. Locations L5, M2, S3.
31. *Prodasineura dorsalis* (Selys, 1860) — This species is widespread in Sarawak, but local in occurrence in most areas. Location S12. **E**
32. *Prodasineura hosei* (Laidlaw, 1913) — A local species, but widespread in Sarawak. Location S12. **E**
33. *Prodasineura hyperythra* (Selys, 1886) — This species is widely distributed in lowland forest in Sarawak. Locations S3, S12. **E**

34. *Prodasineura verticalis* (Selys, 1860) — A species that is widely distributed in Sarawak and generally quite common on larger forest streams, but becoming scarcer in the upper Baram. Locations L1, S3.

Coenagrionidae

This is a large, cosmopolitan and very diverse family, and includes both forest and non-forest species. Fourteen genera are currently known from Sarawak, with over 40 species.

35. *Aciagrion borneense* Ris, 1911 — This is a fairly common species of open, lentic waters, but less common in the deep interior. Location L5.
36. *Agriocnemis femina* (Brauer, 1868) — A very common and widespread species but, like the previous species, less common in the deep interior of Sarawak. Locations L5, S1.
37. *Amphicnemis* species *martini*-group — A problematic form from a complex of very similar species, most often found in low pH swamp. A single female was found perched high on a bank above a stream, presumably it had come from an undetected swampy area somewhere in the vicinity. Location S3. **E**
38. *Argiocnemis* species — A possibly un-described species, widespread in Malaysia, it is similar to *A. rubescens rubeola* Selys, 1877, but differs in size and mature colouration, as well as habitat. Locations L5, M2, S2, S12.
39. *Ceriagrion bellona* Laidlaw, 1915 — A very common species in disturbed habitats in the interior of Sarawak. Locations L4, L5, M4, S12.
40. *Pseudagrion lalakense* Orr & van Tol, 2001 — A locally common species in parts of Sarawak. Location S4. **E**
41. *Pseudagrion microcephalum* (Rambur, 1842) — A common and widespread species, but not common in the upper Baram. Typically found at ponds. Location L5.
42. *Pseudagrion perfuscatum* Lieftinck, 1937 — A common species of open sections of forest streams. Locations K1, S7, S12. **E**
43. *Stenagrion dubium* (Laidlaw, 1912) — This species is very common on small streams in steep forested terrain in Sarawak. Locations L2, L3, M3, S5, S7, S8, S9, S12, G1. **E**
44. *Xiphiagrion cyanomelas* Selys, 1876 A — *Xiphiagrion cyanomelas* is a common and widely distributed stream species. However it has long been known that two forms occur in Sarawak, the typical form with very short antehumeral stripes, normally found at lower altitudes and a form normally found at higher altitudes with long antehumeral stripes (there are other differences as well). It had been thought that these forms represented altitudinal variation in a single species and it was expected that intermediate forms would be found at intermediate altitudes. However both forms were found together on one small pond at ca 500m a.s.l. in the Sungai Lowing area with no intermediates. It now appears likely that the two forms are actually two species. The typical lowland species is referred to as *X. cyanomelas* A here and the other species as *X. cyanomelas* B. Locations K1, L4, L5, S1, S2, S4.
45. *Xiphiagrion cyanomelas* Selys, 1876 B — See the previous species. Location L4.

ANISOPTERA (DRAGONFLIES)

Aeshnidae

A medium-sized family with a worldwide distribution. Many species are large or very large. The majority of species found in Sarawak are crepuscular (dusk and evening flying).

46. *Anax panybeus* Hagen, 1867 — A widespread species, under-recorded due to difficulty of capture. Location S3.
47. *Gynacantha basiguttata* Selys, 1882 — A relatively common *Gynacantha* in Sarawak. Females were collected when they were attracted to lights in a building in the evening. Location G1.

Gomphidae

A large family with a worldwide distribution, but relatively poorly represented in Borneo. The Gomphidae have well-separated eyes, which distinguishes them from all other families of Anisoptera found in Borneo. Gomphids are typically very wary and elusive; many species are poorly known.

48. *Heliogomphus* species — A freshly emerged female, presently not identifiable beyond genus. Location L3.
49. *Ictinogomphus decoratus melaenops* (Selys, 1858) — A very common species on open ponds and open sections of streams. Locations L5, S4.
50. *Leptogomphus pendleburyi* Laidlaw, 1934 — Originally described from Mount Kinabalu, *L. pendleburyi* has been considered as one of the most elusive of the Bornean *Leptogomphus*. However it now appears to be relatively common in steep, forested terrain over much of the Sarawak. Location S7. **E**
51. *Leptogomphus williamsoni* Laidlaw, 1912 — A locally common but elusive forest stream species, typically found in hilly and mountainous terrain. Locations L2, S9.

Macromiidae

Formerly included in the Corduliidae, the representatives of this family are fast flying; most species occur on forest streams.

52. *Epopthalmia vittigera* (Rambur, 1842) — A common species of open ponds, lakes and slowly flowing streams. Location L5.
53. *Macromia corycia* Laidlaw, 1922 — A poorly known species, endemic to Borneo as it is currently understood but possibly a junior synonym of the more widespread *M. gerstaeckeri* Krüger, 1899. Location L1.
54. *Macromia westwoodii* Selys, 1874 — One of the more common *Macromia* species occurring in Sarawak. Locations S12, G1.
55. *Macromia* species — A large sized species allied to the previous one but differing in significant details; probably a new species. Location L4. **E**

Synthemistidae

Bornean species now generally accepted to fall within the Synthemistidae were previously included in the Corduliidae or treated as *incertae sedis*.

56. *Idionyx montana* Karsch, 1891 — A poorly known species but with an increasing number of records from Sarawak, it may prove to be common in the interior of the state. Locations S5, S12.
57. *Macromidia fulva* Laidlaw, 1915 — A fairly common forest stream species. Location G1. **E**

Libellulidae

The largest family of the Odonata, with a worldwide distribution. Considerable variety exists in this family of mostly small- to medium-sized species. Males are often brightly coloured.

58. *Aethriamanta gracilis* (Brauer, 1878) — A locally common pond species. Locations K1, L5, S1.
59. *Camacinia gigantea* (Brauer, 1867)* — A very large sized species, found at ponds but local in occurrence. Not recorded in Miri Division before this to my knowledge. Locations S1, S2.
60. *Cratilla lineata* (Brauer, 1878) — This species is found at pools in disturbed forest. Location L4.
61. *Cratilla metallica* (Brauer, 1878) — A widespread forest species, it breeds in forest pools, including in disturbed forest. Location L4.
62. *Nannophya pygmaea* Rambur, 1842 — A very common species of marshy habitats in coastal regions of Sarawak, but less common in the deep interior of Sarawak. Location S1.
63. *Neurothemis fluctuans* (Fabricius, 1793) — A very common species of disturbed habitats. Locations L4, L5, M2, M4, S2, S4, S12.
64. *Neurothemis ramburii* (Brauer, 1866) — More local than the last species, especially in the deep interior of Sarawak, but found in similar habitats. Location L5.
65. *Neurothemis terminata* Ris, 1911 — A common species but less so in the deep interior of Sarawak. Location S7.
66. *Onychothemis coccinea* Lieftinck, 1953 — A forest stream species, locally common in Sarawak. Locations L1, S3.
67. *Orthetrum chrysis* (Selys, 1891) — A common species. Locations K1, L4, M2, M4
68. *Orthetrum glaucum* (Brauer, 1865) — A common species. Locations L4, M1, S3, S6, S10, S12.
69. *Orthetrum pruinatum schneideri* Förster, 1903 — A common species in many forested areas. Locations L4, M1, M2, S3, S6, S10, S12.
70. *Orthetrum sabina* (Drury, 1773) — A very common and extremely widespread species that occurs in a great range of habitat types. Locations S1, S4.
71. *Orthetrum testaceum* (Burmeister, 1839) — A very common species of open and disturbed habitats. Locations K1, L4, L5, M2.
72. *Rhyothemis regia* (Brauer, 1867) — This is only the second record of this species from Sarawak. It is widely distributed in the Philippines, Sulawesi and the lesser Sunda Islands, and has been recorded in Sabah several times in recent years. It may eventually prove to be a locally common species in the upper Baram. Location K1.
73. *Rhyothemis triangularis* Kirby, 1889 — A common pond species. Locations L5, M2, M4, S1, S2.
74. *Tetrathemis hyalina* Kirby, 1889 — A moderately common species of swamp forest, forest pools and slow forest streams. Location M2.
75. *Tramea transmarina euryale* Selys, 1878 — A common but under-recorded open habitat species. Locations S1, S11.
76. *Tramea* species cf *virginia* (Rambur, 1842) — There is one old record (Hincks 1930) of *T. virginia* from Sarawak (the only record from Borneo); it is more typically a species from more northern latitudes, common in southern China and the record from Bintulu was thought to be of a windblown vagrants from the north. However a male was collected from the Sungai Sii area on the other side of the Baram River from the area covered here in 2014 and a male and a female were

collected at a pond near to Long Silat during the survey reported on here. These specimens have differences from typical *T. virginia* and may be a new species or a species only previously known from east of Borneo. The status of these specimens is a matter for further study, but it is now clear that, whatever species they actually are, they are resident in Sarawak, not occasional migrants from the north of Asia. Location S1.

77. *Trithemis aurora* (Burmeister, 1839) — A common and widespread open habitat species. Locations K1, L5, M2, M4, S12.
78. *Trithemis festiva* (Rambur, 1842) — A common species of open sections of streams. Locations K1, L1, P1, S3, S6, S10, S12.
79. *Tyriobapta torrida* Kirby, 1889 — A common species of slow streams, forested pools and swamps. Locations L5, M2, M4, S12.
80. *Zyxomma obtusum* Albarda, 1881 — This is a widespread species that exhibits crepuscular behaviour.. Location G1.
81. *Zyxomma petiolatum* Rambur, 1842 — A common species, most active in the late afternoon and at dusk. Location G1.

Discussion

Only a brief discussion is given here, since the results of the February 2020 survey are better interpreted in the broader discussion in part 2 of this report. Eighty-one species of Odonata from 12 families were recorded in the survey reported here. Of these one (*Camacinia gigantea*) had not been recorded in Miri Division before. With these results, 217 species of Odonata are now known from Miri Division, the most of any of Sarawak's administrative Divisions. Despite the fact that all habitats sampled had been disturbed to a greater or lesser extent either by the activities of the local people or by logging in the past, some rare and/or poorly known species were found during the survey, most notably *Protosticta joepani*, *Telosticta ?berawan*, *Macromia corycia*, *Macromia* sp. (possibly a new species), *Idionyx montana*, *Rhyothemis regia* (rare in Sarawak) and *Tramea* sp. cf *virginia*. Fifty four species were collected at sites that, to the author's understanding, are within the Gerenai Forest Management Unit. A checklist of all records (to the author's knowledge) from the Gerenai Forest Management Unit, including a few generated prior to 2020 (see part 2 of this report) is given in Appendix 1.

Species collected during the February 2020 survey and possibly worthy of special attention from a conservation viewpoint are listed in Table 3 below. Species are included in the table both because of global conservation concern (e.g. species that are or might be globally threatened) and because of local conservation concern (e.g. species that are or might be threatened in Sarawak). Almost all species only found at five or less locations in Sarawak during surveys carried out by the authors and others in 2005-2020 are considered to be of local conservation concern, but other criteria have also been used. Criteria used to judge whether a species is of global conservation concern broadly follow IUCN (2012) guidelines for species which do not already have a Red List threat assessment. For species that do have a Red List assessment or a draft Red List assessment, those placed in a threat category other than Least Concern or Data Deficient (DD) have been included, also some that were assessed as DD, except where sampling and taxonomic research after the assessments were made would result in a change of category to Least Concern (LC) if reassessed now. Also, those assessed as LC but that

would be placed in a different category if reassessed now are included. Not only named species of certain identity are included, but unnamed species if definitely new, and some of uncertain status, but which if they are distinct species would qualify as threatened if taking the precautionary approach advocated by the IUCN.

Species	Comment
<i>Drepanosticta dentifera</i>	This species, described from Mount Dulit, is only known with certainty from a small area. DD on the IUCN Red List.
<i>Protosticta joepani</i>	A recently described species with only a few locations known in Sarawak and possibly particularly sensitive to disturbance.
<i>Telosticta ?berawan</i>	A poorly known species with very few known locations. VU on the IUCN Red List.
<i>Macromia corycia</i>	As currently understood this species is endemic to Borneo and known from relatively few locations in Sarawak. NT on the IUCN Red List.
<i>Macromia</i> sp.	Likely to be a new species, so far only found from the Sungai Lowing drainage.
<i>Idionyx montana</i>	Species with few locations known in Sarawak at present, although it may ultimately prove to be fairly common in the state. DD on the IUCN Red List.
<i>Rhyothemis regia</i>	The record reported here is only the second for Sarawak.
<i>Tramea</i> species cf <i>virginia</i>	The record reported here is only the third for Sarawak.

Table 3: Species recorded during the February 2020 survey and potentially of conservation interest. Red List status: DD – Data Deficient, NT – Near Threatened, VU – Vulnerable.

Table 4 summarises the numbers of families and of species so far collected at each of the locations sampled in February 2020. The number of **forest species** (e.g. species dependent on forest for their survival) is also listed along with the numbers of species endemic to Borneo; it is the species in one or both of these categories that are typically most important from a conservation point of view. Additionally the numbers of species listed as of conservation concern in Table 2 are also included for each location. Of the 81 species recorded during the February 2020 survey, 52 are forest species and 37 are endemic to Borneo.

Location	Number of species	Number of Forest Species	Number of species endemic to Borneo	Number of species in Table 2	Number of families
K1	8	0	1	1	2
L1	12	11	7	1	7
L2	12	12	12	1	6
L3	13	13	12	2	7
L4	12	5	2	0	4
L5	16	3	0	0	5
P1	1	0	0	0	1
M1	11	10	8	0	6
M2	10	5	0	0	3
M3	4	4	4	0	4
M4	6	1	0	0	2
M5	2	2	1	0	2
S1	9	0	0	1	2
S2	5	1	0	0	2
S3	15	12	7	0	7
S4	5	0	1	0	3
S5	10	10	8	1	6
S6	3	1	0	0	1
S7	10	8	8	0	8
S8	7	7	7	1	4
S9	10	10	10	0	6
S10	4	2	1	0	2
S11	1	0	0	0	1
S12	23	17	9	1	10
G1	7	5	3	0	6

Table 4: Numbers of families and species collected at each of the locations sampled in February 2020.

Location S12 stands out as that with the highest number of species, this is because a greater variety of habitats are present at this single location than any other surveyed. L5 also has a high number of species but low family diversity, low numbers of forest-dependent species and no endemic species, this is typical for the habitat (ponds). Locations L1, L2, L3, M1, S3, S7 and S9 have high (for sites only surveyed on a single day) numbers of species and of forest-dependent and endemic species; these are all forest stream sites.

Part 2: Updated information on the Odonata of the Kalulong-Moh-Usun Apau region

This part of the report updates information on areas for which earlier data on Odonata is available and including locations dealt with in Part 1 above. Usun Apau National Park, not covered in Part 1, is also included since it logically forms part of the same area. The Sungai Lowing area, surveyed for the first time in February 2020, is also included in this part. These areas taken together cover much of the region on the right side (going upstream) of the Baram River from Gunung Kalulong and adjacent peaks to the Sungai Moh drainage and Usun Apau and the boundaries with Kapit Division and Kalimantan (see Figure 4); for convenience this entire region is referred to as the Kalulong-Moh-Usun Apau (KMUA) region here. With the results from February 2020 the KMUA is the best studied part of the whole upper Baram area for Odonata, but new records are still being made in this area. It is not known to me if the KMUA area has any significance in a broader biogeographic sense, however the available data do suggest that it is more diverse for Odonata than, for instance, the Tama Abu Range to its north.

Definition of areas

Of the areas below, three are defined by river basins but two (the Kalulong area and Usun Apau) are not, this is largely for convenience.

Kalulong area (K)

Locations on and around Gunung Kalulong and adjacent peaks, Surveys for Odonata in this area have been made in 2007, 2009 and 2010 (see Table 2), the last report including the area was Dow & Reels (2011).

Sungai Lowing area (L)

As defined in part 1 of this report.

Sungai Moh area (M)

Locations in the Sungai Moh drainage, including the Sungai Moh Wildlife Sanctuary, part of which was surveyed for Odonata (Dow 2014a) prior to being gazetted as a Wildlife Sanctuary.

Sungai Silat area (S)

Locations in the Sungai Silat drainage. A small amount of data from this area has been generated previously as parts of previous surveys outside of the Silat drainage but for which Long Silat was used as the starting point.

Usun Apau National Park (U)

Locations within Usun Apau National Park, part of which was surveyed for Odonata in 2012 (Dow *et al.* 2013).

Other (O)

Other sites within the KMUA area, this includes locations P1 and G1 from part one of this report and also a few records from below the boundary of Usun Apau National Park made on route to the national park in 2012.



Figure 4: The Kalulung-Moh-Usun Apau (KMUA) region. K – Kalulung area, L – Sungai Lowing area, M – Sungai Moh area, S – Sungai Silat area, U – Usun Apau.

Species recorded

The species recorded (including the records from the February 2020 survey) in the KMUA region are listed in Table 5 below. Presence in an area is indicated by a ● in the table. Records from within what is now the Sungai Moh Wildlife Sanctuary are indicated by ●●. Notes are provided (after the table) on some species that are not listed in part 1 of this report. This list includes some records from prior to 2020 that, to the authors understanding, are within the Gerenai FMU; these earlier records bring the total known from the FMU to 62 species. A checklist of all records from the Gerenai FMU is given in Appendix 1. Taxonomic changes since the last reports on the Odonata of areas K, M and U were submitted are summarised in Appendix 2.

Suborder/family/species	K	L	M	S	U	O	Endemic	Notes
Zygoptera								
Lestidae								
<i>Orolestes wallacei</i> (Kirby, 1889)			••			•		
Platystictidae								
<i>Drepanosticta actaeon</i> Laidlaw, 1934	•	•	•	•			Yes	
<i>Drepanosticta attala</i> Lieftinck, 1934		•					Yes	
<i>Drepanosticta</i> sp. cf <i>crenitis</i> Lieftinck, 1933	•		••	•			Yes	
<i>Drepanosticta dentifera</i> Kimmins, 1936	•	•			•		Yes	
<i>Drepanosticta dulitensis</i> Kimmins, 1936	•		••				Yes	
<i>Drepanosticta</i> cf <i>forficula</i> Kimmins, 1936			••		•		Yes	
<i>Drepanosticta rufostigma</i> (Selys, 1886)	•	•	••	•	•		Yes	
<i>Protosticta joepani</i> Dow, Phan & Choong, 2020	•	•					Yes	Note 1
<i>Protosticta versicolor</i> Laidlaw, 1913	•	•	••	•			Yes	
<i>Telosticta</i> sp. cf <i>belalongensis</i> Dow & Orr, 2012	•						Yes	Note 2
<i>Telosticta berawan</i> Dow & Orr, 2012			••	•			Yes	
<i>Telosticta kajang</i> Dow & Orr, 2012					•		Yes	Note 3
<i>Telosticta longigaster</i> Dow & Orr, 2012	•	•					Yes	
<i>Telosticta ulubaram</i> Dow & Orr, 2012			••				Yes	Note 4
Argiolestidae								
<i>Podolestes orientalis</i> Selys, 1862			••					
<i>Podolestes</i> sp.			••		•		Yes	Note 5
Calopterygidae								
<i>Matronoides cyaneipennis</i> Förster, 1897					•		Yes	
<i>Neurobasis longipes</i> Hagen, 1887	•	•	••	•	•			
<i>Vestalis amaryllis</i> Lieftinck, 1965	•		••	•	•			
<i>Vestalis amnicola</i> Lieftinck, 1965	•	•	••	•	•		Yes	

Suborder/family/species	K	L	M	S	U	O	Endemic	Notes
<i>Vestalis amoena</i> Hagen in Selys, 1853	•							
<i>Vestalis atropa</i> Lieftinck, 1965	•		••				Yes	
<i>Vestalis beryllae</i> Laidlaw, 1915	•	•		•	•		Yes	
Chlorocyphidae								
<i>Heliocypha biseriata</i> (Selys, 1859)	•		••	•				
<i>Libellago semiopaca</i> (Selys, 1873)	•							
<i>Rhinocypha aurofulgens</i> Laidlaw, 1931	•	•	••	•	•		Yes	
<i>Rhinocypha spinifer</i> Laidlaw, 1931			••		•		Yes	
<i>Rhinocypha</i> sp. cf <i>spinifer</i> Laidlaw, 1931	•	•		•			Yes	
<i>Sundacypha petiolata</i> (Selys, 1859)	•							
Devadattidae								
<i>Devadatta aran</i> Dow, Hämäläinen & Stokvis, 2015	•		••	•	•		Yes	
<i>Devadatta clavicauda</i> Dow, Hämäläinen & Stokvis, 2015	•		••	•	•	•	Yes	
<i>Devadatta somoh</i> Dow, Hämäläinen & Stokvis, 2015	•	•		•			Yes	
Euphaeidae								
<i>Dysphaea dimidiata</i> Selys, 1853	•		••	•				
<i>Dysphaea ulu</i> Hämäläinen, Dow & Stokvis, 2015		•	••	•	•		Yes	
<i>Euphaea impar</i> Selys, 1859	•		••	•	•			
<i>Euphaea subcostalis</i> Selys, 1873	•	•	••	•	•			
<i>Euphaea subnodalis</i> (Laidlaw, 1915)	•	•	••	•	•		Yes	
<i>Euphaea tricolor</i> Selys, 1859		•	••	•			Yes	
Philosinidae								
<i>Rhinagrion borneense</i> (Selys, 1886)	•		••	•	•		Yes	
Incertae sedis								
<i>Bornargiolestes fuscus</i> Dow, 2014	•						Yes	Note 6
Platycnemididae								
<i>Coeliccia</i> sp. cf <i>arcuata</i> Lieftinck, 1940					•		Yes	Note 7

Suborder/family/species	K	L	M	S	U	O	Endemic	Notes
<i>Coeliccia borneensis</i> (Selys, 1886)	•	•	••				Yes	
<i>Coeliccia campioni</i> Laidlaw, 1918		•	•				Yes	
<i>Coeliccia cyaneothorax</i> Kimmins, 1936			•		•		Yes	
<i>Coeliccia kenyah</i> Dow, 2010	•						Yes	Note 8
<i>Coeliccia</i> sp. cf <i>nemoricola</i> Laidlaw, 1912	•	•	••	•	•		Yes	
<i>Coeliccia nigrohamata</i> Laidlaw, 1918	•	•	••	•	•		Yes	
<i>Coeliccia southwelli</i> Dow & Reels, 2011			••				Yes	Note 9
<i>Copera vittata</i> (Selys, 1863)		•	••	•				
<i>Elattoneura analis</i> (Selys, 1860)					•			
<i>Onychargia atrocyana</i> Selys, 1865					•			
<i>Prodasineura dorsalis</i> (Selys, 1860)	•		••	•	•		Yes	
<i>Prodasineura hosei</i> (Laidlaw, 1913)			••	•	•		Yes	
<i>Prodasineura hyperythra</i> (Selys, 1886)			••	•	•		Yes	
<i>Prodasineura verticalis</i> (Selys, 1860)	•	•		•				
Coenagrionidae								
<i>Aciagrion borneense</i> Ris, 1911		•						
<i>Argiocnemis femina</i> (Brauer, 1868)		•		•				
<i>Amphicnemis</i> new sp.					•		Yes	Note 10
<i>Amphicnemis</i> sp. cf <i>martini</i> Ris, 1911			••	•			Yes	
<i>Archibasis tenella</i> Lieftinck, 1949			••		•			
<i>Argiocnemis</i> species		•	••	•	•		Yes	
<i>Ceriagrion bellona</i> Laidlaw, 1915	•	•	••	•	•	•		
<i>Pseudagrion lalakense</i> Orr & van Tol, 2001				•			Yes	
<i>Pseudagrion microcephalum</i> (Rambur, 1842)		•						
<i>Pseudagrion perfuscatum</i> Lieftinck, 1937	•			•			Yes	

Suborder/family/species	K	L	M	S	U	O	Endemic	Notes
<i>Stenagrion dubium</i> (Laidlaw, 1912)	•	•	••	•	•	•	Yes	
<i>Teinobasis laidlawi</i> Kimmins, 1936	•		••		•		Yes	
<i>Xiphiagrion cyanomelas</i> Selys, 1876 A	•	•	•	•		•		Note 11
<i>Xiphiagrion cyanomelas</i> Selys, 1876 B		•						
Anisoptera								
Aeshnidae								
<i>Anax panybeus</i> Hagen, 1867	•			•				
<i>Gynacantha basiguttata</i> Selys, 1882				•		•		
<i>Heliaeschna</i> sp.				•	•			Note 12
<i>Indaeschna grubaueri</i> (Förster, 1904)					•			
<i>Tetracanthagyna degorsi</i> Martin, 1896			•					
Gomphidae								
<i>Borneogomphus</i> sp.	•						Yes	Note 13
<i>Gomphidia maclachlani</i> Selys, 1873			••		•			
<i>Heliogomphus</i> sp.		•			•	•		
<i>Ictinogomphus decoratus melaenops</i> (Selys, 1858)		•		•				
<i>Leptogomphus pendleburyi</i> Laidlaw, 1934	•			•			Yes	
<i>Leptogomphus sii</i> Dow, Stokvis & Ngiam, 2017	•						Yes	
<i>Leptogomphus williamsoni</i> Laidlaw, 1912	•	•		•			Yes	
<i>Leptogomphus</i> sp.					•		Yes	Note 14
<i>Macrogomphus quadratus</i> Selys, 1878	•							
Macromiidae								
<i>Epophthalmia vittigera</i> (Rambur, 1842)		•						
<i>Macromia corycia</i> Laidlaw, 1922		•	••				Yes	
<i>Macromia cydippe</i> Laidlaw, 1922					•			
<i>Macromia westwoodii</i> Selys, 1874	•			•	•	•		
<i>Macromia</i> sp.		•						
Synthemistidae								

Suborder/family/species	K	L	M	S	U	O	Endemic	Notes
<i>Idionyx montana</i> Karsch, 1891			••	•	•			
<i>Macromidia fulva</i> Laidlaw, 1915	•		••		•	•	Yes	
Corduliidae								
<i>Procordulia fusiformis</i> Lieftinck, 1977			•				Yes	
Libellulidae								
<i>Aethriamanta gracilis</i> (Brauer, 1878)	•	•		•				
<i>Agrionoptera sexlineata</i> Selys, 1879			••					
<i>Camacinia gigantea</i> (Brauer, 1867)				•				
<i>Cratilla lineata</i> (Brauer, 1878)	•	•				•		
<i>Cratilla metallica</i> (Brauer, 1878)	•	•	••		•	•		
<i>Hylaeothemis clementia</i> Ris, 1909			•		•			
<i>Lyriothemis biappendiculata</i> (Selys, 1878)	•		••		•			
<i>Lyriothemis cleis</i> Brauer, 1868			•	•	•			
<i>Nannophya pygmaea</i> Rambur, 1842				•				
<i>Nesoxenia lineata</i> (Selys, 1879)			••		•			
<i>Neurothemis fluctuans</i> (Fabricius, 1793)	•	•	••	•				
<i>Neurothemis ramburii</i> (Brauer, 1866)		•						
<i>Neurothemis terminata</i> Ris, 1911				•				
<i>Onychothemis coccinea</i> Lieftinck, 1953	•	•	••	•				
<i>Orchithemis pulcherrima</i> Brauer, 1878			••		•			
<i>Orthetrum chrysis</i> (Selys, 1891)	•	•	•		•			
<i>Orthetrum glaucum</i> (Brauer, 1865)	•	•	••	•				
<i>Orthetrum pruinatum</i> <i>schneideri</i> Förster, 1903	•	•	••	•	•	•		
<i>Orthetrum sabina</i> (Drury, 1773)				•				

Suborder/family/species	K	L	M	S	U	O	Endemic	Notes
<i>Orthetrum testaceum</i> (Burmeister, 1839)	•	•	••					
<i>Pantala flavescens</i> (Fabricius, 1798)	•							
<i>Pornothemis serrata</i> Krüger, 1902			••		•			Note 15
<i>Rhyothemis regia</i> (Brauer, 1867)	•							
<i>Rhyothemis triangularis</i> Kirby, 1889		•	•	•				
<i>Tetrathemis hyalina</i> Kirby, 1889			•					
<i>Tamea transmarina euryale</i> Selys, 1878				•				
<i>Tamea</i> sp. cf <i>virginia</i> (Rambur, 1842)				•				
<i>Trithemis aurora</i> (Burmeister, 1839)	•	•	•	•				
<i>Trithemis festiva</i> (Rambur, 1842)	•	•	••	•		•		
<i>Tyriobapta torrida</i> Kirby, 1889		•	••	•	•			
<i>Zyxomma obtusum</i> Albarda, 1881						•		
<i>Zyxomma petiolatum</i> Rambur, 1842				•		•		
<i>Zygonyx ida errans</i> Lieftinck, 1953					•		Yes	
Totals	62	51	69 (57)	62	54	15	57	

Table 5: Species recorded from the Gunung Kalulong area (K), the Sungai Lowing area (L), the Sungai Moh area (M), the Sungai Silat area (S), Usun Apau (U) and other sites (O) in the KMUA region. Species recorded from the Sungai Moh Wildlife Sanctuary are indicated by a ••. The total number of species recorded for each area is given at the bottom of the table, the total for the Sungai Moh Wildlife Sanctuary is in parentheses.

Note 1: Not yet assessed for the IUCN Red List.

Note 2: Freshly emerged males and a female, not definitely identifiable to species but certainly not any of the other named *Telosticta* species.

Note 3: Only known from Usun Apau and the Hose Mountains.

Note 4: A species with a seemingly small range, only known from the upper Baram.

Note 5: A scarce, large sized form, allied to but probably distinct from *P. orientalis*.

Note 6: A scarce and very locally occurring species, possibly particularly sensitive to disturbance.

Note 7: *Coelliccia arcuata* is known from Sabah and the east and south of Kalimantan. A form found on the Usun Apau plateau (but so far nowhere else in Sarawak) is structurally similar to *C. arcuata* but not identical and smaller. The status of the Usun Apau form is the subject of ongoing investigation.

Note 8: A locally occurring species with a restricted range.

Note 9: A very locally occurring species, known from very few locations.

Note 10: An as yet unnamed species, unusual in the genus in that it has only been found above 1000m a.s.l.

Note 11: See the comments on this and the next species in Part 1 of this report.

Note 12: Records of females currently not identifiable beyond genus.

Note 13: *Borneogomphus* was only described in 2014 (Karube & Sasamoto 2014), from the Mount Kinabalu area in Sabah. In Sarawak larvae and females have been found on Gunung Kalulong and Gunung Penrissen and in the Hose Mountains (unpublished record). The adult female specimens all differ from the single named species *B. teramotoi* Karube & Sasamoto, 2014 and are likely to belong to one or more new species.

Note 14: Although only identified to genus this taxon is listed as endemic to Borneo on the basis that all other *Leptogomphus* species (unlike, for instance, *Heliogomphus* species) known from Borneo are endemic to the island.

Note 15: This species is actually a composite of three separate species, but until the genitalia of the type specimen (in a museum in Poland) is examined in detail it is not possible to know which one is the true *P. serrata*.

Discussion

One hundred and twenty five species of Odonata have now been recorded in the KMUA, this is more than one-third of the total currently known to occur in the whole of Borneo. Fifty seven of the species recorded from the KMUA are currently regarded as endemic to Borneo. These species are from 17 families (note that for convenience and because the sole genus included, *Bornargiolestes*, certainly does not belong in any of the other families, the category *incertae sedis* is counted as a family here, although *incertae sedis* actually means unplaced). Only one family known to occur in Borneo, the Chlorogomphidae, has not yet been recorded in the entire area, adults from the Chlorogomphidae are exceptionally elusive in Borneo and it is certain that this family does actually occur in the area. It is already clear that the area covered here is extremely

diverse for Odonata and I predict that a significant number of additional species are present in the area but have not yet been detected.

Table 6 lists the numbers of species, forest-dependent and endemic species present in each of the five areas within the KMUA area that have been surveyed for Odonata. The number of families and the number of species considered to be of conservation concern (those listed in Table 3 above and/or Table 8 below) are also listed.

Location	Number of species	Number of Forest Species	Number of species endemic to Borneo	Number of species in Tables 3 or 8	Number of families
K	62	49 (79%)	33 (53%)	7	14
L	51	34 (67%)	24 (47%)	5	10
M	69	60 (87%)	34 (49%)	7	16
S	62	42 (68%)	27 (44%)	3	13
U	55	52 (95%)	28 (51%)	7	14

Table 6: Numbers of families and species collected at each of five areas in the KMUA region.

The numbers of species recorded from each of the five areas within the KMUA included in Table 6 are fairly similar, the Sungai Lowing area has the lowest total but has also received the least sampling effort. Usun Apau has the second lowest total but is at higher altitude than the other locations and can be expected to have a somewhat lower number of species because of this. Usun Apau and the Sungai Moh area stand out with high percentages of forest-dependent species and Usun Apau and the Kalulong area stand out for having more than 50% of the species recorded endemic to Borneo.

Table 7 below summarises the numbers of species per family recorded from each of the areas being discussed here.

Family	K	L	M	S	U
Platystictidae	9	7	8	5	4
Lestidae	0	0	1	0	0
Argiolestidae	0	0	2	0	1
Calopterygidae	6	3	4	4	5
Chlorocyphidae	5	2	3	3	2
Devadattidae	3	1	2	3	2
Euphaeidae	4	4	6	6	4
Philosinidae	1	0	1	1	1
Incertae sedis	1	0	0	0	0
Platycnemididae	6	6	10	7	9
Coenagrionidae	5	8	7	8	6
Aeshnidae	1	0	1	3	2
Gomphidae	5	3	1	3	3
Macromiidae	1	3	1	1	2
Synthemistidae	1	0	2	1	2
Corduliidae	0	0	1	0	0
Libellulidae	14	14	19	17	11

Table 7: Numbers of species per family recorded in five areas in the KMUA region.

Table 8 below lists 19 species recorded from the KMUA region and worthy of special attention from a conservation perspective. The reader is referred to the remarks in the paragraph before Table 3.

Species	Comment
<i>Drepanosticta dentifera</i>	See Table 3.
<i>Protosticta joepani</i>	See Table 3.
<i>Telosticta</i> sp. cf <i>belalongensis</i>	Only one location known in Sarawak.
<i>Telosticta</i> ? <i>berawan</i>	See Table 3.
<i>Telosticta kajang</i>	Only two locations known, DD on the IUCN Red List, likely to be re-assessed to a high threat category.
<i>Telosticta ulubaram</i>	VU on the IUCN Red List, likely to be re-assessed as EN.
<i>Podolestes</i> sp.	If a distinct species then only known from a few locations.
<i>Bornargiolestes fuscus</i>	NT on the IUCN Red List but will be re-assessed as EN or VU.
<i>Coeliccia</i> sp. cf <i>arcuata</i>	Only a single location known in Sarawak.
<i>Coeliccia kenyah</i>	NT on the IUCN Red List but will be reassessed as VU.
<i>Coeliccia southwelli</i>	DD on the IUCN Red List.
<i>Amphicnemis</i> new sp.	Only two locations known, both in Sarawak.
<i>Borneogomphus</i> sp.	Only three locations known for the genus in Sarawak, likely to be a new species.
<i>Macromia corycia</i>	As currently understood this species is endemic to Borneo and known from relatively few locations in Sarawak. NT on the IUCN Red List. See Table 3.
<i>Macromia</i> sp.	Likely to be a new species, so far only found from the Sungai Lowing drainage. See Table 3.
<i>Idionyx montana</i>	Species with few locations known in Sarawak at present, although it may ultimately prove to be fairly common in the state. DD on the IUCN Red List. See Table 3.
<i>Pornothemis serrata</i>	Will be assessed as DD for the IUCN Red List because of the taxonomic issue described in Note 15 below Table 5 above.
<i>Rhyothemis regia</i>	The record reported here is only the second for Sarawak. See Table 3.
<i>Tramea</i> species cf <i>virginia</i>	The record reported here is only the third for Sarawak. See Table 3.

Table 8: Species recorded from the KMUA region and potentially of conservation interest. Red List status: DD – Data Deficient, EN – Endangered, NT – Near Threatened, VU – Vulnerable.

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Appendix 1: Checklist of Odonata recorded from the Gerenai Forest Management Unit

The list below summarises the species of Odonata that, to the author's knowledge and his understanding of the boundary of the FMU, have been recorded within the Gerenai FMU. Of the 62 species listed below, 54 were recorded during the 2020 survey, 45 are forest-dependent species and 30 are endemic to Borneo.

Zygoptera

Lestidae

1. *Orolestes wallacei* (Kirby, 1889)

Platystictidae

2. *Drepanosticta actaeon* Laidlaw, 1934
3. *Drepanosticta attala* Lieftinck, 1934
4. *Drepanosticta dentifera* Kimmins, 1936
5. *Drepanosticta rufostigma* (Selys, 1886)
6. *Protosticta joepani* Dow, Phan & Choong, 2020
7. *Protosticta versicolor* Laidlaw, 1913
8. *Telosticta longigaster* Dow & Orr, 2012

Calopterygidae

9. *Neurobasis longipes* Hagen, 1887
10. *Vestalis amnicola* Lieftinck, 1965
11. *Vestalis beryllae* Laidlaw, 1915

Chlorocyphidae

12. *Rhinocypha aurofulgens* Laidlaw, 1931
13. *Rhinocypha spinifer* Laidlaw, 1931
14. *Rhinocypha* sp. cf *spinifer* Laidlaw, 1931

Devadattidae

15. *Devadatta aran* Dow, Hämäläinen & Stokvis, 2015
16. *Devadatta clavicauda* Dow, Hämäläinen & Stokvis, 2015
17. *Devadatta somoh* Dow, Hämäläinen & Stokvis, 2015

Euphaeidae

18. *Dysphaea ulu* Hämäläinen, Dow & Stokvis, 2015
19. *Euphaea subcostalis* Selys, 1873
20. *Euphaea subnodalis* (Laidlaw, 1915)
21. *Euphaea tricolor* Selys, 1859

Platycnemididae

22. *Coeliccia borneensis* (Selys, 1886)
23. *Coeliccia campioni* Laidlaw, 1918
24. *Coeliccia cyaneothorax* Kimmins, 1936
25. *Coeliccia* sp. cf *nemoricola* Laidlaw, 1912
26. *Coeliccia nigrohamata* Laidlaw, 1918
27. *Copera vittata* (Selys, 1863)
28. *Prodasineura verticalis* (Selys, 1860)

Coenagrionidae

29. *Aciagrion borneense* Ris, 1911
30. *Agriocnemis femina* (Brauer, 1868)
31. *Argiocnemis* species

32. *Ceriagrion bellona* Laidlaw, 1915
33. *Pseudagrion microcephalum* (Rambur, 1842)
34. *Stenagrion dubium* (Laidlaw, 1912)
35. *Xiphiagrion cyanomelas* Selys, 1876 A
36. *Xiphiagrion cyanomelas* Selys, 1876 B

Anisoptera

Aeshnidae

37. *Tetracanthagyna degorsi* Martin, 1896

Gomphidae

38. *Heliogomphus* sp.
39. *Ictinogomphus decoratus melaenops* (Selys, 1858)
40. *Leptogomphus williamsoni* Laidlaw, 1912

Macromiidae

41. *Epophthalmia vittigera* (Rambur, 1842)
42. *Macromia corycia* Laidlaw, 1922
43. *Macromia* sp.

Synthemistidae

44. *Idionyx montana* Karsch, 1891
45. *Macromidia fulva* Laidlaw, 1915

Corduliidae

46. *Procordulia fusiformis* Lieftinck, 1977

Libellulidae

47. *Aethriamanta gracilis* (Brauer, 1878)
48. *Cratilla lineata* (Brauer, 1878)
49. *Cratilla metallica* (Brauer, 1878)
50. *Hylaeothemis clementia* Ris, 1909
51. *Neurothemis fluctuans* (Fabricius, 1793)
52. *Neurothemis ramburii* (Brauer, 1866)
53. *Onychothemis coccinea* Lieftinck, 1953
54. *Orthetrum chrysis* (Selys, 1891)
55. *Orthetrum glaucum* (Brauer, 1865)
56. *Orthetrum pruinosum schneideri* Förster, 1903
57. *Orthetrum testaceum* (Burmeister, 1839)
58. *Rhyothemis triangularis* Kirby, 1889
59. *Tetrathemis hyalina* Kirby, 1889
60. *Trithemis aurora* (Burmeister, 1839)
61. *Trithemis festiva* (Rambur, 1842)
62. *Tyriobapta torrida* Kirby, 1889

Appendix 2: Taxonomic changes since the last reports on areas within the KMUA area were submitted

Table 9 lists taxonomic changes at family level.

Report	Name in report	Name now	Notes
Dow & Reels 2011, Dow <i>et al.</i> 2013	Amphipterygidae	Devadattidae	The genus <i>Devadatta</i> is now placed in its own family Devadattidae. See Dijkstra <i>et al.</i> (2014).
Dow & Reels 2011, Dow <i>et al.</i> 2013	Megapodagrionidae	Argiolestidae (<i>Podolestes</i>) or Philosinidae (<i>Rhinagrion</i>) or <i>incertae sedis</i> (<i>Bornargiolestes</i>)	Species from Borneo formerly placed in the Megapodagrionidae are now all placed in different families or considered as <i>incertae sedis</i> (unplaced). See Dijkstra <i>et al.</i> (2014).
Dow & Reels 2011	Protoneuridae	Platycnemididae	Old world species previously placed in Protoneuridae are now placed in the Platycnemididae. See Dijkstra <i>et al.</i> (2014).

Table 9: Summary of taxonomic changes at family level since the last reporting on the areas covered in this report.

Table 10 lists taxonomic changes at species level.

Report	Name in report	Name now	Notes
Dow & Reels 2011	<i>Drepanosticta</i> <i>?actaeon</i>	<i>Drepanosticta actaeon</i>	See Dow (2017).
Dow & Reels 2011	<i>Drepanosticta</i> ?new species A	<i>Telosticta ulubaram</i>	See Dow & Orr (2012).
Dow 2014a	<i>Drepanosticta</i> species	<i>Drepanosticta</i> cf <i>forficula</i>	Specimen re-identified.
Dow & Reels 2011	<i>Protosticta</i> new species	<i>Telosticta longigaster</i>	See Dow & Orr (2012).
Dow & Reels 2011	<i>Protosticta</i> species	<i>Protosticta joepani</i>	See Dow <i>et al.</i> (2020).
Dow & Reels 2011	<i>Protosticta</i> ?new species	<i>Telosticta</i> sp. cf <i>belalongensis</i>	See Dow & Orr (2012).
Dow 2014a	<i>Telosticta</i> species	<i>Telosticta</i> ?berawan	Specimens re-identified.
Dow & Reels 2011	<i>Devadatta</i> <i>podolestoides</i>	<i>Devadatta aran</i> , <i>Devadatta clavicauda</i> , <i>Devadatta somoh</i>	<i>Devadatta podolestoides</i> has been split into five species, four of which occur in Sarawak and three in the areas covered by this report. See Dow <i>et al.</i> (2015).
Dow 2014a, Dow <i>et al.</i> 2013	<i>Devadatta</i> species A	<i>Devadatta clavicauda</i>	See Dow <i>et al.</i> (2015).
Dow 2014a, Dow <i>et al.</i> 2013	<i>Devadatta</i> species C	<i>Devadatta aran</i>	See Dow <i>et al.</i> (2015).
Dow <i>et al.</i> 2013	<i>Dysphaea dimidiata</i>	<i>Dysphaea ulu</i>	See Dow <i>et al.</i> (2015).
Dow 2014a	<i>Dysphaea</i> species	<i>Dysphaea ulu</i>	See Dow <i>et al.</i> (2015).
Dow & Reels 2011	<i>Bornargiolestes</i> species	<i>Bornargiolestes fuscus</i>	A teneral female specimen from Gunung Kalulong assigned to <i>B. fuscus</i> by Dow (2014b) but excluded from the type series.
Dow <i>et al.</i> 2013	<i>Coelliccia arcuata</i>	<i>Coelliccia</i> sp. cf <i>arcuata</i>	Specimens from Usun Apau are much smaller than typical for <i>C. arcuata</i> and differ in some other respects, this is possibly a new species.

Report	Name in report	Name now	Notes
Dow 2014a	<i>Coelliccia</i> species cf <i>borneensis</i>	<i>Coelliccia borneensis</i>	There are insufficient grounds at present to consider the form found in the Ulu Moh area as distinct from <i>C. borneensis</i> .
Dow <i>et al.</i> 2013	<i>Onychargia atrocyana</i>	<i>Onychargia atrocyana</i>	No change to identification but this species was previously placed in the Coenagrionidae and is now placed in Platycnemididae.
Dow 2014	<i>Amphicnemis</i> species cf <i>dactylostyla</i>	<i>Amphicnemis</i> sp. cf <i>martini</i>	This group of species is problematic, it is unclear how many species are involved and until the taxonomic issues are resolved all forms from the group are best referred to the first described species <i>A. martini</i>
Dow <i>et al.</i> 2013	<i>Heliaeschna ?idae</i>	<i>Heliaeschna</i> sp.	It is considered unsafe at this time to attempt to put any species name to the female reared from a larva collected on Usun Apau.
Dow & Reels 2011	<i>Burmagomphus</i> species	<i>Borneogomphus</i> species	<i>Borneogomphus</i> is a recently described genus (Karube & Sasamoto 2014), the single female from Gunung Kalulong was collected prior to the description of <i>Borneogomphus</i> and initially misidentified. Likely to be a new species.
Dow & Reels 2011	<i>Leptogomphus ?coomansi</i>	<i>Leptogomphus sii</i>	See Dow <i>et al.</i> (2017).

Report	Name in report	Name now	Notes
Dow & Reels 2011	<i>Leptogomphus</i> species	<i>Leptogomphus pendlebutyi</i>	See Dow <i>et al.</i> (2017).
Dow & Reels 2011	<i>Macromia euterpe</i>	<i>Macromia westwoodii</i>	Re-identified, <i>M. euterpe</i> no longer considered to occur in Sarawak and probably a junior synonym of <i>M. westwoodii</i> anyway (see Dow <i>et al.</i> 2019).
Dow 2014a, Dow <i>et al.</i> 2013	<i>Idionyx</i> species	<i>Idionyx montana</i>	Female specimens now identified as <i>I. montana</i> .
Dow <i>et al.</i> 2013	<i>Zygonyx iris errans</i> and <i>Zygonyx ida</i>	<i>Zygonyx ida errans</i>	All Bornean records of <i>Zygonyx</i> are now known to refer to a single species, formerly treated as a subspecies of <i>Z. iris</i> , but better considered as a subspecies of <i>Z. ida</i> or a distinct species, endemic to Borneo.

Table 10: Summary of taxonomic changes at species level since the last reporting on the areas covered in this report.