

RESULTS OF COLLECTING OF ODONATA CARRIED OUT IN SARAWAK. THE RAVENSCOURT FOREST MANAGEMENT UNIT AND THE PAYA MAGA CONSERVATION AREA IN LIMBANG DIVISION

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A male of *Euphaea basalis*, a species found in the Ravenscourt FMU. Photograph taken by G.T. Reels at Mount Kinabalu, Sabah.

SUMMARY

The results of collecting of Odonata (dragonflies and damselflies) in Limbang Division in July 2020 are reported. Collecting was conducted primarily in the Ravenscourt Forest Management Unit (FMU) with two days spent at the Paya Maga Conservation Area. Details of the research permit and dates on which collecting was carried out are listed. Forty-nine species were recorded during the survey, 36 species were recorded in the Ravenscourt FMU and 22 at Paya Maga. Although the total number of species recorded in the Ravenscourt FMU may appear low, it actually represents high diversity for the altitude range, terrain and habitat types surveyed and the part of Sarawak in which the FMU is situated. Thirty-seven (16 at Paya Maga, 29 at Ravenscourt) of the species recorded during the survey are **forest species**, e.g. species dependent on forest for their survival, and 29 (13 at Paya Maga, 24 at Ravenscourt) are endemic to Borneo; it is species in one or both of these categories that are typically of highest conservation concern. A number of species found during the July 2020 survey are particularly notable: *Devadatta tanduk* and an as-yet-unnamed species of *Coeliccia*, both previously known only from Sabah, were found at Paya Maga; *Protosticta joepani*, *Telosticta ?berawan*, *Telosticta ulubaram*, *Podolestes* species, *Rhinoneura caerulea*, *Euphaea basalis* and *Idionyx montana* are also notable records. Twenty seven species were recorded from Limbang Division for the first time, bringing the total number of Odonata species recorded from the division to 120. A checklist of the Odonata recorded from the Ravenscourt FMU is included in Appendix 1. Appendix 2 contains a list of the species recorded at Paya Maga during the July 2020 survey.

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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 describes the results of collecting of the insect order Odonata (dragonflies and damselflies) carried out within and near to the Ravenscourt Forest Management Unit (FMU) and the Paya (Payeh) Maga Conservation Area in Limbang Division in July 2020. The dates on which collecting was carried out in July 2020, and details of the research permit issued by the Sarawak Forest Department, are given in Table 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	15 th -29 th July 2020

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

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 worlds 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, the management of forest management units, and other interested parties, with useful information for conservation planning and management.

The structure of the report is as follows: the collecting locations from the July 2020 survey are described, followed by an annotated list of the species collected. In particular new records for Limbang Division, significant new distribution data, material presenting taxonomical problems, endemic species and species of special conservation interest are noted. A brief discussion follows. A checklist of the species recorded within the Ravenscourt FMU is given in Appendix 1. A checklist of the species recorded in the Paya Maga Conservation area is given in Appendix 2. However some Odonata were collected on a Forest Department expedition to Paya Maga some years ago, but the results have not, to my knowledge, been published yet, so the list in the appendix is not a full list of the Odonata that have been recorded at Paya Maga. The family level taxonomy for Odonata adopted by Schorr & Paulson (2020) is used in this report.

Collecting Locations

The following codes for groups of samplings sites are used below. The locations are grouped into three areas, Paya Maga, Ravenscourt FMU (where all locations sampled were within a relatively small radius around the Ravenscourt camp) and “other”. Figure 1 shows an overview of the locations sampled. Coordinates are given to 4 decimal places at the entry point for each location.



Figure 1: Overview of locations sampled in July 2020.

Paya Maga Conservation area:

1. A stream system approximately 2 km from the gate, sampled from ca. 730m a.s.l. (4.445N, 115.4991E) to ca. 775m a.s.l. (4.4463N, 115.5E).

2. Two stream systems higher up on the road leading from the gate, sampled from ca. 829m a.s.l. (4.4367N, 115.5142E) to ca. 946m a.s.l. (4.4396N, 115.5159E).

3. Ponds, pools beside and along road leading from the gate.

Ravenscourt FMU camp area

Figure 2 shows the main locations in the Ravenscourt Camp area (using coordinates at the entry point to each sampling site).

4. Camp water supply stream and tributaries. Sampled from entry point at ca. 1,560m a.s.l. (4.0978N, 115.4859E) just below the dam where the water enters the pipe to ca. 1,719m a.s.l. (4.1043N, 115.4886E). This stream is one of the sources of the stream (Sungai Lawan according to people at the camp) that flows through part of the camp.

5. A stream and its tributaries, crossed by the road leading to the water supply stream at ca. 1,388m a.s.l. (4.0887N, 115.4794E), sampled to ca. 1480m a.s.l. (4.0934N, 115.4798E).

6. Sungai Lawan and tributaries upstream of camp, downstream of locations 4 and 5. Entered at ca. 1,345m a.s.l. (4.0865N, 115.4737E), sampled to ca. 1,391m a.s.l. (4.0834N, 115.4836E).

7. A road leading out of the Ravenscourt camp, not currently maintained outside of the camp area with the bridge at (4.076N, 115.4616E) broken so that it is not possible to drive further; a stream system with a large pond at ca. 1,120m a.s.l. (4.058N, 115.4644E) beside the road:

- a. Streams, sampled to ca, 1,193m a.s.l. (4.0605N, 115.4644E).
- b. Pond at road and marshy shady area beside it.

8. First stream system after the broken bridge on the same road as location 7, sampled from ca. 1,161m a.s.l (4.0741N, 115.4622E) to 1,262m a.s.l. (4.0736N, 115.4657E).

9. Junction from the road of locations 7 and 8, stream system reached by cutting down from an old skid path, sampled from ca. 1,052m a.s.l. (4.0661N, 115.4496E) down to ca. 1,030m a.s.l. (4.0654N, 115.4498E).

10. An area reached from the same junction as location 9:

- a. Stream system sampled from ca. 1,130m a.s.l. (4.0791N, 115.4405E) down to ca. 1,082m a.s.l. (4.0777N, 115.4414E).
- b. Ponds just inside forest, ca 1175m a.s.l. (4.0813N, 115.443E).

11. A stream system on the main road leading to the Ravenscourt camp, sampled from ca. 1,016m a.s.l. (4.1284N, 115.4633E) to ca. 1,071m a.s.l. (4.1268N, 115.4645E).

12. Various ponds and pools by logging roads, and beside roads.

Other:

13. Stream sampled briefly at ca. 457m a.s.l. (4.1266N, 115.3185E) on way back.

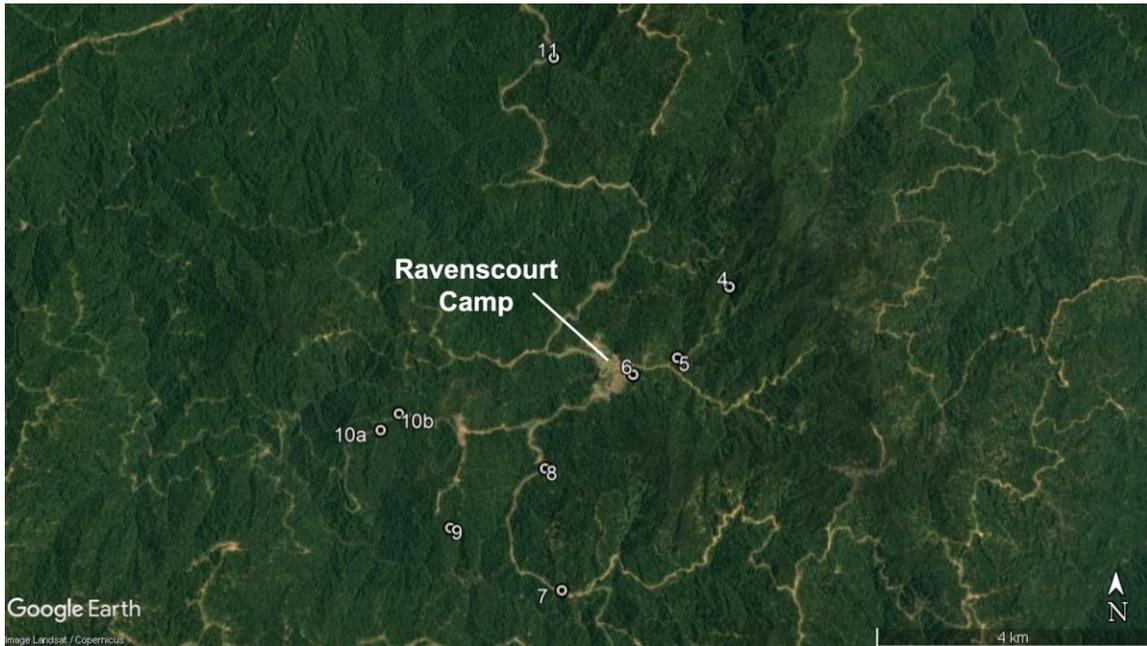


Figure 2: Locations in the Ravenscourt FMU.

Species Collected

Adult Odonata were collected 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. An * after the species authority indicates that the first record from Limbang Division (to my knowledge) was made during this study, an ** after the species authority indicates that the first record from Sarawak was made during this study.

ZYGOPTERA (DAMSELFLIES)

Lestidae

This family is poorly represented in Borneo. They are medium-sized (e.g. *Lestes* species) to large (*Orolestes*) damselflies, found in a variety of habitats.

1. *Orolestes wallacei* (Kirby, 1889)* — A local (i.e. scattered populations confined to small areas) species, most often associated with swamp forest, but also found at a variety of forest and forest edge pools from the lowlands to over 1,100m. Location 10b.

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.

2. *Drepanosticta actaeon* Laidlaw, 1934* — Originally described from Mount Kinabalu, *D. acateon* now appears to be common in the mountainous interior parts of Sarawak and was the most common member of the Platystictidae in the sampled part of the Ravenscourt FMU. Locations 5, 6, 7a, 8, 9, 10a, 11. **E**
3. *Drepanosticta rufostigma* (Selys, 1886) — Generally the most common member of the Platystictidae in Sarawak, but less common in the area reported on here. Locations 1, 9, 10a, 11. **E**
4. *Protosticta joepani* Dow, Phan & Choong, 2020* — A very recently described species, occurring from Mount Kinabalu to ulu Balui but seemingly scarce in most parts of Sarawak. Single individuals were found at five locations in the areas reported on here, all but one of the locations had been disturbed by either logging or local activities; this is significant because the data previously available had suggested that the species might be particularly sensitive to disturbance. A female collected in the highest part of location 4 reached (above 1,700m a.s.l.) and

- included under *P. joepani* here shows some differences from typical examples and might eventually prove to be a different species. Locations 1, 4, 8, 10a, 11. **E**
5. *Telosticta ?berawan* Dow & Orr, 2012* — The male of *T. berawan* is very rarely found and only a single female was found at the location reported here, unfortunately this means that identification is not definite. Location 2. **E**
 6. *Telosticta ulubaram* Dow & Orr, 2012* — This is an uncommon upland and montane species. It was found at very low densities at five locations in the Ravenscourt FMU area, more locations than it has been found at in any area of similar size previously surveyed. These are the first records from logged forest apart from two locations in the upper Baram where helicopter logging had taken place in the area but with no sign of disturbance at the actual sites where the species occurs. Locations 5, 7a, 8, 9, 10a. **E**

Argiolestidae

Previously included in the Megapodagrionidae (a family now considered confined to the neotropics), the Argiolestidae occur from Australia and New Guinea to China. In Borneo the family is represented by the genus *Podolestes*, many of whose species are peat swamp forest specialists.

7. *Podolestes* species* — A large sized species allied to *P. orientalis* and also known from Batang Ai National Park, the Lanjak Entimau Wildlife Sanctuary and the Usun Apau plateau. Location 10b. **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.

8. *Matronoides cyaneipennis* Förster, 1897 — A montane and upland species, known from Mount Kinabalu in Sabah south to Gunung Melatai in Sarawak. Locations 4, 5. **E**
9. *Vestalis amnicola* Lieftinck, 1965 — This species was very common on many forest streams in the areas reported on here. Locations 1, 2, 4, 5, 6, 8, 11. **E**
10. *Vestalis beryllae* Laidlaw, 1915* — A locally occurring species in which the male is distinctive by virtue of its very long abdomen; it is only found in steep terrain. Locations 7a, 10a. **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.

11. *Rhinocypha spinifer* Laidlaw, 1931 — An upland and montane species. Locations 5, 6, 8, 11. **E**
12. *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 2, 9. **E**
13. *Rhinoneura caerulea* Kimmins, 1936* — A seemingly rare montane species only known from a few locations in Sarawak. Location 4. **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.

14. *Devadatta aran* Dow, Hämäläinen & Stokvis, 2015* — Common in mountainous areas in the interior of northeast Sarawak. Locations 1, 2, 4, 5, 6, 7a, 8, 9, 10a, 11.

E

15. *Devadatta tanduk* Dow, Hämäläinen & Stokvis, 2015** — This species is recorded from Sarawak for the first time, it was previously known from locations in Sabah. Locations 1, 2. **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.

16. *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, however it is less common in the altitudinal range surveyed within the Ravenscourt FMU. Location 13. **E**
17. *Euphaea basalis* (Laidlaw, 1915)* — A montane species known from Sabah and Sarawak but rare in Sarawak. Location 4. **E**
18. *Euphaea subcostalis* Selys, 1873 — A common on lowland forest streams in Sarawak. Locations 1, 13.
19. *Euphaea subnodalis* (Laidlaw, 1915)* — A species of larger, rocky streams in the interior, most common in upland areas. Locations 6. **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.

20. *Coeliccia borneensis* (Selys, 1886) — A locally occurring species of small forest streams. Locations 7a, 9. **E**
21. *Coeliccia campioni* Laidlaw, 1918* — A species once thought to have a very restricted range but whose distribution is now known to extend from Limbang Division to ulu Engkari in Sri Aman division. Locations 1, 2, 9, 11. **E**
22. *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. Locations 6, 11. **E**
23. *Coeliccia nemoricola* Laidlaw, 1912 — A montane species known from the Tama Abu Range north and east to Mount Kinabalu, also with a population in the Hose Mountains. Locations 4, 5, 6, 7a, 8, 10a, 11. **E**
24. *Coeliccia* species cf *nemoricola* Laidlaw, 1912 A — A fairly common but still unnamed species, superficially similar to the last. Locations 7a, 9, 10a. **E**
25. *Coeliccia* species cf *nemoricola* Laidlaw, 1912 B** — A problematic form, previously only known from the Crocker Range in Sabah and possibly merely a variant of the last. However if it is a distinct species then the records here are the first from Sarawak. Locations 1, 2. **E**

26. *Coeliccia nigrohamata* Laidlaw, 1918 — A common species of streams and marshy areas in forest. Locations 2, 9, 10a, 11. **E**

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.

27. *Ceriagrion bellona* Laidlaw, 1915 — A very common species in disturbed habitats in the interior of Sarawak. Locations 3, 7b, 10b, 12.
28. *Stenagrion dubium* (Laidlaw, 1912) — This species is very common on small streams in steep forested terrain in Sarawak. Locations 2, 5, 6, 7a, 8, 9, 10a, 11. **E**
29. *Teinobasis laidlawi* Kimmins, 1936* — A locally occurring species of forest pools. Location 10b.
30. *Xiphiagrion cyanomelas* Selys, 1876 B* — *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 but recent evidence suggests that they are actually distinct. The typical lowland species is referred to as *X. cyanomelas* A here and the other species (the one recorded during this study) as *X. cyanomelas* B. Locations 10b, 12.

ANISOPTERA (DRAGONFLIES)

Macromiidae

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

31. *Macromia westwoodii* Selys, 1874* — One of the more common *Macromia* species occurring in Sarawak. Location 4.

Synthemistidae

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

32. *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. Location 2.
33. *Idionyx* sp. cf *yolanda* Selys, 1871* — An unnamed species allied to *I. yolanda*.. Location 2. **E**

Corduliidae

This family is poorly represented in Borneo, with only three members.

34. *Procordulia fusiformis* Lieftinck, 1977 — A poorly known montane species. Location 7b. **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.

35. *Camacinia gigantea* (Brauer, 1867)* — A very large sized species, found at shady ponds but local in occurrence. Location 3.
36. *Cratilla lineata* (Brauer, 1878)* — This species is found at pools in disturbed forest. Location 3.

37. *Cratilla metallica* (Brauer, 1878) — A widespread forest species, it breeds in forest pools, including in disturbed forest. Location 12.
38. *Diplacodes trivialis* (Rambur, 1842)* — A common and widespread species of open habitats. Location 12.
39. *Hylaeothemis clementia* Ris, 1909 — A local and poorly known species that is found in forested hill and montane areas. Location 12.
40. *Lyriothemis biappendiculata* (Selys, 1878) — A local but widespread species, most often found in small swampy areas and at heads of streams in mixed dipterocarp forest. Location 10a.
41. *Neurothemis fluctuans* (Fabricius, 1793) — A very common species of disturbed habitats. Locations 3, 12.
42. *Neurothemis terminata* Ris, 1911 — A common species but less so in the deep interior of Sarawak. Location 3.
43. *Orthetrum chrysis* (Selys, 1891) — A common species. Location 12.
44. *Orthetrum glaucum* (Brauer, 1865) — A common species. Locations 6, 12.
45. *Orthetrum pruinosum schneideri* Förster, 1903 — A common species in many forested areas. Locations 3, 7b, 12.
46. *Orthetrum testaceum* (Burmeister, 1839) — A very common species of open and disturbed habitats. Location 3.
47. *Tramea transmarina euryale* Selys, 1878* — A common but under-recorded open habitat species. Location 3.
48. *Trithemis aurora* (Burmeister, 1839)* — A common and widespread open habitat species. Location 7b.
49. *Trithemis festiva* (Rambur, 1842)* — A common species of open sections of streams. Location 13.

Discussion

Forty-nine species of Odonata from 13 families were recorded in the survey reported here. Of these two (*Devadatta tanduk* and an as-yet-unnamed species of *Coeliccia* that was already known from the Crocker Range in Sabah) had not been recorded in Sarawak before. Twenty-seven of the species collected had not been recorded in Limbang Division before, at least to my knowledge. With these results, 120 species of Odonata are now known from Limbang Division. Twenty-two species were found at Paya Maga, 36 species at Ravenscourt FMU and three species at a location outside of the Ravenscourt FMU.

Forty-nine species is at first sight a low total for a survey of the duration of that reported here. However only two days were spent at Paya Maga, the location outside Ravenscourt FMU was only sampled briefly during a stop on the return journey to Miri and all locations sampled at Ravenscourt FMU were above 1,000m a.s.l. The diversity of Odonata drops with altitude and above 1,000m a.s.l. the number of species found is typically relatively low, except where there are extensive plateaus such as Usun Apau or that around Bario (this is not the case within the sampled part of the Ravenscourt FMU). The figure of 36 species for the Ravenscourt FMU is actually relatively high for the altitude range, types of habitat sampled and the part of Sarawak in which the FMU is situated. For example only 26 species of Odonata have been recorded within Pulong Tau National Park, adjacent to Ravenscourt FMU and where the altitudinal range and habitat types sampled are comparable to that sampled within the Ravenscourt FMU, and where some larval sampling has been conducted (it was not at Ravenscourt), boosting the number of species recorded. As another example, only 32 species of Odonata were recorded during the 2017 Heart of Borneo expedition to the Tama Abu Forest Reserve, again with a similar range of habitats sampled to those within the Ravenscourt FMU but where the altitudinal range sampled (ca. 700-1,200m a.s.l.) is lower so that a higher number of species might have been expected. There are certainly additional species to be found even within the relatively small part of Ravenscourt FMU already surveyed, for instance members of at least two families (Aeshnidae and Gomphidae) were seen at several locations but could not be approached closely enough to allow collection. A checklist of the species recorded in the Ravenscourt FMU is given in Appendix 1 to this report. A list of the species recorded at Paya Maga is also given, in Appendix 2. However, as noted in the introduction to this report, there are certainly additional but unpublished records of Odonata from Paya Maga so that the list given in Appendix 2 is not a full list of the species known to occur in that area.

A number of rare and/or poorly known species were found during the survey, most notably *Protosticta joepani*, *Telosticta ?berawan*, *Telosticta ulubaram*, *Podolestes* species, *Rhinoneura caerulea*, *Devadatta tanduk*, *Euphaea basalis*, *Coeliccia* sp. cf *nemoricola* B and *Idionyx montana*.

Species collected during the July 2020 survey and possibly worthy of special attention from a conservation viewpoint are listed in Table 2 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 author 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 reasonable precautionary approach advocated by the IUCN.

Species	Comment
<i>Protosticta joepani</i>	A recently described species with only a few locations known in Sarawak. Has a draft VU assessment for the IUCN Red List.
<i>Telosticta ?berawan</i>	<i>Telosticta berawan</i> is a poorly known species with very few known locations. VU on the IUCN Red List.
<i>Telosticta ulubaram</i>	<i>Telosticta ulubaram</i> has a restricted range in north-eastern Sarawak, VU on the IUCN Red List.
<i>Podolestes</i> sp.	An as-yet-unnamed species only known from a few locations, all in Sarawak.
<i>Rhinoneura caerulea</i>	A montane species, currently only known from Sarawak and with few locations ever recorded. DD on the IUCN Red List.
<i>Devadatta tanduk</i>	DD on the IUCN Red List, previously only known from Sabah.
<i>Euphaea basalis</i>	A montane species known from Sabah and Sarawak but with very few locations known in Sarawak. NT on the IUCN Red List.
<i>Coeliccia</i> sp. cf <i>nemoricola</i> B	An as-yet-unnamed species only known from Paya Maga and the Crocker Range in Sabah.
<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.

Table 2: Species recorded during the July 2020 survey and potentially of conservation interest. Red List status: DD – Data Deficient, NT – Near Threatened, VU – Vulnerable.

Table 3 summarises the numbers of families and of species so far collected at Paya Maga and in the Ravenscourt FMU in July 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 49 species recorded during the July 2020 survey, 37 are forest species and 29 are endemic to Borneo. Table 4 gives the same figures for each of the individual locations sampled in July 2020.

Location	Number of species	Number of Forest Species	Number of species endemic to Borneo	Number of species in Table 2	Number of families
Paya Maga	22	16	13	4	9
Ravenscourt FMU	36	29	24	5	12

Table 3: Numbers of families and species collected at Paya Maga and Ravenscourt FMU in July 2020.

Location	Number of species	Number of Forest Species	Number of species endemic to Borneo	Number of species in Table 2	Number of families
1	8	8	7	3	5
2	11	11	10	4	7
3	8	2	1	0	1
4	8	8	7	3	7
5	8	8	8	1	6
6	9	8	8	0	7
7	12	10	10	1	7
8	8	8	8	2	6
9	10	10	10	1	5
10	16	14	13	3	8
11	11	11	11	1	6
12	9	3	1	0	1
13	3	2	1	0	1

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

Location S10 stands out as that with the highest number of both families and species recorded, this is because a greater variety of habitats (forest pools as well as forest streams) are included under this location than any other surveyed. Locations 2, 7, 9, and 11 have high (for sites only surveyed on a single day and the altitude range) numbers of species and of forest-dependent and endemic species.

Within the Ravenscourt FMU area locations 4 and 5 taken together (the highest locations sampled) are of particular interest. Twelve species (all forest dependent) were recorded at

these two locations, 11 of which are endemic to Borneo and four of which are listed in Table 2, including the Vulnerable species *Protosticta joepani* and *Telosticta ulubaram* and the Data Deficient *Rhinoneura caerulea* and the Near Threatened *Euphaea basalis*; the latter two species were only found at location 4. Additionally a Red Langur (*Presbytis rubicunda*), Vulnerable on the IUCN Red List, was seen at location 4. Four species (*Matronoides cyanipennis*, *Rhinoneura caerulea*, *Euphaea basalis* and *Macromia westwoodii*) were only found at locations 4 and/or 5 during the July 2020 survey.

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References

IUCN, 2012. IUCN Red List Categories and Criteria: Version 3.1. Second edition. Gland, Switzerland and Cambridge, UK: IUCN. iv + 32pp.

Schoor, M & Paulson, D. (2020). World Odonata List. <https://www.pugetsound.edu/academics/academic-resources/slater-museum/biodiversity-resources/dragonflies/world-odonata-list2/> (Last accessed 21 August 2020).

Appendix 1: Checklist of Odonata recorded from the Ravenscourt 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 Ravenscourt FMU.

Zygoptera

Lestidae

1. *Orolestes wallacei* (Kirby, 1889)

Platystictidae

2. *Drepanosticta actaeon* Laidlaw, 1934
3. *Drepanosticta rufostigma* (Selys, 1886)
4. *Protosticta joepani* Dow, Phan & Choong, 2020
5. *Telosticta ulubaram* Dow & Orr, 2012

Argiolestidae

6. *Podolestes* species

Calopterygidae

7. *Matronoides cyaneipennis* Förster, 1897
8. *Vestalis amnicola* Lieftinck, 1965
9. *Vestalis beryllae* Laidlaw, 1915

Chlorocyphidae

10. *Rhinocypha spinifer* Laidlaw, 1931
11. *Rhinocypha* sp. cf. *spinifer* Laidlaw, 1931
12. *Rhinoneura caerulea* Kimmins, 1936

Devadattidae

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

Euphaeidae

14. *Euphaea basalis* (Laidlaw, 1915)
15. *Euphaea subnodalis* (Laidlaw, 1915)

Platycnemididae

16. *Coeliccia borneensis* (Selys, 1886)
17. *Coeliccia campioni* Laidlaw, 1918
18. *Coeliccia cyaneothorax* Kimmins, 1936
19. *Coeliccia nemoricola* Laidlaw, 1912
20. *Coeliccia* sp. cf. *nemoricola* Laidlaw, 1912
21. *Coeliccia nigrohamata* Laidlaw, 1918

Coenagrionidae

22. *Ceriagrion bellona* Laidlaw, 1915
23. *Stenagrion dubium* (Laidlaw, 1912)
24. *Teinobasis laidlawi* Kimmins, 1936
25. *Xiphiagrion cyanomelas* Selys, 1876 B

Anisoptera

Macromiidae

26. *Macromia westwoodii* Selys, 1874

Corduliidae

27. *Procordulia fusiformis* Lieftinck, 1977

Libellulidae

28. *Cratilla metallica* (Brauer, 1878)
29. *Diplacodes trivialis* (Rambur, 1842)
30. *Hylaeothemis clementia* Ris, 1909
31. *Lyriothemis biappendiculata* (Selys, 1878)
32. *Neurothemis fluctuans* (Fabricius, 1793)
33. *Orthetrum chrysis* (Selys, 1891)
34. *Orthetrum glaucum* (Brauer, 1865)
35. *Orthetrum pruinosum schneideri* Förster, 1903
36. *Trithemis aurora* (Burmeister, 1839)

Appendix 2: Checklist of Odonata recorded from the Paya Maga Conservation area in July 2020.

Zygoptera

Platystictidae

1. *Drepanosticta rufostigma* (Selys, 1886)
2. *Protosticta joepani* Dow, Phan & Choong, 2020
3. *Telosticta ?berawan* Dow & Orr, 2012

Calopterygidae

4. *Vestalis amnicola* Lieftinck, 1965

Chlorocyphidae

5. *Rhinocypha* species cf *spinifer* Laidlaw, 1931

Devadattidae

6. *Devadatta aran* Dow, Hämäläinen & Stokvis, 2015
7. *Devadatta tanduk* Dow, Hämäläinen & Stokvis, 2015

Euphaeidae

8. *Euphaea subcostalis* Selys, 1873

Platynemididae

9. *Coeliccia campioni* Laidlaw, 1918
10. *Coeliccia* species cf *nemoricola* Laidlaw, 1912 B
11. *Coeliccia nigrohamata* Laidlaw, 1918

Coenagrionidae

12. *Ceriagrion bellona* Laidlaw, 1915
13. *Stenagrion dubium* (Laidlaw, 1912)

Anisoptera

Synthemistidae

14. *Idionyx montana* Karsch, 1891
15. *Idionyx* sp. cf *yolanda* Selys, 1871

Libellulidae

16. *Camacinia gigantea* (Brauer, 1867)
17. *Cratilla lineata* (Brauer, 1878)
18. *Neurothemis fluctuans* (Fabricius, 1793)
19. *Neurothemis terminata* Ris, 1911
20. *Orthetrum pruinosum schneideri* Förster, 1903
21. *Orthetrum testaceum* (Burmeister, 1839)
22. *Tramea transmarina euryale* Selys, 1878