ODONATA (DRAGONFLIES AND DAMSELFLIES) OF THE GLENEALY BELAGA OIL PALM PLANTATION AREA, BELAGA, KAPIT DIVISION, MAY 2024

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SUMMARY

The results of sampling of Odonata (dragonflies and damselflies) carried out at the Glenealy Oil Palm Plantations, located just below the Dulit Range and situated in Belaga District, Kapit Division in May 2024 are reported. Details of the research permit and dates on which collecting was carried out are listed. Sampling was mainly conducted in the HCVF and riparian buffer, with some sampling within Oil Palm or in open areas around the estates. Fifty-three (53) species of Odonata from 12 families were collected during the surveys, five of these species were recorded from Kapit Division for the first time and 20 were recorded from Belaga District for the first time. Particularly significant records are *Coeliccia kenyah* (a Near Threatened species), *Oligoaeschna platyura* (a Vulnerable species, recorded from Sarawak for only the second time) and *Pornothemis serrata* (currently a Data Deficient species). Areas such as the riparian buffer around the Belaga River and the areas of HCVF within the plantation will be increasingly important for the conservation of these three species. Twenty-nine (29; approximately 55%) of the species found during the survey are **forest species**, e.g. species dependent on forest for their survival and 13 (approximately 25%) of the species recorded are endemic to Borneo; it is species in one or both of these categories that are typically of highest conservation concern. Species found in different categories of land cover are briefly discussed. Recommendations and suggestions for conservation and further work are given. A list of English names for the species collected is provided in an appendix.

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Introduction

The report describes the results of sampling of the insect order Odonata (dragonflies and damselflies) carried out at the Glenealy Belaga Oil Palm Plantations, located just below the Dulit Range and situated in Belaga District, Kapit Division. The plantation straddles the Belaga River and includes areas of High Conservation Value Forest (HCVF) and a riparian buffer around the Belaga River. The Sekiwa Forest management Unit (FMU) is just to the north of the estates and shares part of its boundary with them. A forest recovery area is situated just south of the estates. Sampling was mainly conducted in the HCVF and riparian buffer, with some sampling within Oil Palm or in open areas around the three estates (the individual estates are referred to as Belaga 1, 2 and 3 hereafter). The dates on which collecting was carried out and details of the research permit issued by the Sarawak Forestry Corporation, are given in Table 1.

Year	Research permit number	Period of validity of permit	Dates on which collecting was carried out
2024	SFC.810-4/6/1(2023)-191	28th August 2023–27th August 2024	12th-17th May 2024

Table 1: Permit number and collecting dates for the 2024 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 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.

The structure of the report is as follows: The locations where sampling was carried out are listed. The species collected are listed with brief notes. A discussion of the results of the collecting and species of particular conservation interest that were found and the conclusions of the report are given. An appendix lists English names for the species collected.

Sampling Locations

The following codes for groups of samplings sites are used below. To my understanding all locations are in Belaga District, Kapit Division. The list is organised by estate. Coordinates are given to four decimal places. Figure 1 shows an overview of the locations sampled.

Figure 1: Overview of locations sampled in 2024.

Belaga 1:

1. Muddy stream in HCVF (accessed at 3.0339N, 114.0808E, ca. 183m a.s.l.):
    a. Open drain-like section beside road.
    b. Inside forest (but very opened up around the first part of the stream).
    c. Tiny high gradient tributary.
    d. Forest pool near stream.
2. Valley below church:
    a. Pool in an otherwise dry streambed or in forest nearby.
    b. High gradient part of stream (highest point reached: 3.0246N, 114.0781E, ca. 230m a.s.l.)
    c. Open, low gradient part of the stream.
3. Open ponds:
    a. Fish pond (3.0225N, 114.0781E, ca. 180m a.s.l.)
    b. Smaller pond near 3a.

Belaga 2:

4. Replanting area at edge of Sungai Belaga Riparian Buffer/HCVF (3.0388N, 114.0568E, ca. 186m a.s.l.)
5. Very tiny stream accessed from 4, in Sungai Belaga Riparian Buffer/HCVF.
6. Stream further along road from 4, in Sungai Belaga Riparian Buffer/HCVF:
    a. Upper part.

   b. Swampy pool in 6a (3.038N, 114.0584E, ca. 190m a.s.l.)
   c. Flooded (by high water levels in Sungai Belaga) lower part.
7. Long stream in HCVF:
   a. Open flooded part at edge of Oil Palm (3.0415N, 114.0559E, ca. 195m a.s.l.)
   b. Same stream in forest, but flooded by Sungai Belaga or with deep mud substrate.
   c. Upper part.
   d. At head of one branch of upper part (3.0447N, 114.0552E, ca. 210m a.s.l.)
   e. Tiny tributary.
8. A tiny stream in HCVF not far from 7 (3.0419N, 114.059E, ca. 210m a.s.l.)
9. Tributary of Sungai Belaga, flooded by the river (3.0421N, 114.0529E, ca. 185m a.s.l.)
10. Outside vehicle workshop (3.045N, 114.0746E, ca. 167m a.s.l.)
11. Ponds (3.0474N, 114.0764E, ca. 178m a.s.l.)

Belaga 3:

12. Stream on slope of foothills of Dulit Range, just below the FMU, in Oil Palm (3.0436N, 114.1131E, ca. 205m a.s.l. at point entered).
13. In Oil Palm near 12.
14. Stream (3.0377N, 114.1211E, ca. 172m a.s.l.) near Belaga 3 Estate buildings:
   a. Above road, open or at edge of rubber trees.
   b. Below road, running through Oil Palm.
15. Marshy areas near to 14b.

Species Recorded

Adult Odonata were collected. Collecting 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. IUCN Red List assessments are also indicated for each named species after the locations (**DD** – Data Deficient; **LC** – Least Concern; **NT** – Near Threatened; **VU** – Vulnerable). A * after the species name indicates a first record from Belaga District, a ** indicates a first record for Kapit Division.

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 rufostigma* (Selys, 1886) — Usually the most common member of the Platystictidae in Sarawak, but not common in the area reported on here. Location 2b. **E, LC**
2. *Drepanosticta versicolor* (Laidlaw, 1913) — Another common platystictid, usually found at tiny muddy seeps and trickles. Locations 5, 7d, 7e, 8. **E, LC**
3. *Telosticta longigaster* Dow & Orr, 2012 — This is by far the most common species of *Telosticta* over a large part of Sarawak. Locations 2b, 7b. **E, LC**

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.

4. *Euphaea impar* Selys, 1859 — A common species on lowland forest streams. Possibly more tolerant of disturbance than other members of this family in Sarawak. Locations 1b, 2b, 7c. **LC**

Philosinidae

A family that was previously included in the Megapodagrionidae, the Philosinidae includes just two genera, of which only the brightly coloured Rhinagrion occurs in Borneo.

5. *Rhinagrion borneense* (Selys, 1886) — Usually a common species on lowland forest streams in Sarawak. Location 7b. **E, LC**

Argiolestidae

Previously included in the Megapodagrionidae (a family now considered confined to the neotropics), the Argiolestidae occur mostly 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.

6. *Podolestes orientalis* Selys, 1862 * — The most common and least specialised *Podolestes* species, found in swamp forest, and at stream pools and ponds in other types of forest. Location 6b. **LC**

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.

7. *Vestalis amaryllis* Lieftinck, 1965 — Usually one of the commoner members of the *amoena*-group of *Vestalis* species in Sarawak. Locations 1b, 7c. **LC**

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.

8. *Heliocypha biseriata* (Selys, 1859) — This species is widely distributed in Sarawak, and is often common on forest streams. Locations 1b, 2b, 7b. **LC**

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.

9. *Coeliccia kenyah* Dow, 2010 — A species with a relatively restricted range from Brunei and Miri Division to Kapit Division; Belaga and Mount Dulit are probably the core of the range of the species. Location 7d. **E, NT**
10. *Coeliccia nigrohamata* Laidlaw, 1918 — A common species of streams and marshy areas in forest. Locations 1c, 2b, 5, 6a, 7c, 7e, 8. **E, LC**
11. *Copera vittata* (Selys, 1863) — A common species of lowland forest. Locations 1b, 5, 6a, 6b, 6c, 7b, 8. **LC**
12. *Prodasineura hyperythra* (Selys, 1886) — This species is widely distributed in lowland forest in Sarawak. Locations 7a, 7b. **E, LC**
13. *Prodasineura verticalis* (Selys, 1860) — A species that is widely distributed in Sarawak and generally quite common on larger forest streams. Location 14b. **LC**

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.

14. *Aciagrion borneense* Ris, 1911 * — A common species of open, standing waters. Location 11. **LC**
15. *Agriocnemis femina* (Brauer, 1868) — A very common and widespread species of open habitats. Locations 1a, 3b, 11, 14a. **LC**
16. *Archibasis tenella* Lieftinck, 1949 ** — Found on low gradient streams in lowland forest. Location 7c. **LC**
17. *Archibasis viola* Lieftinck, 1949 ** — More generalist than the last species, *A. viola* is found in a variety of swampy forest habitats and slow flowing forest streams. Location 6c. **LC**
18. *Argiocnemis* sp. * — 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 6c, 9. (Not yet assessed for the Red List but will be **LC**).
19. *Ceriagrion cerinorubellum* (Brauer, 1865) — A very common species in disturbed habitats. Locations 1a, 14b. **LC**
20. *Pseudagrion microcephalum* (Rambur, 1842) — A common and very widely distributed species of disturbed habitats. Locations 3a, 11, 14a. **LC**
21. *Pseudagrion perfuscatum* Lieftinck, 1937 — A common species of open sections of forest streams. Locations 1a, 7a, 14b. **E, LC**
22. *Stenagrion dubium* (Laidlaw, 1912) — This species is very common on small streams in steep forested terrain in Sarawak. Locations 1c, 2b. **E. LC**
23. *Xiphiagrion cyanomelas* Selys, 1876 A — *Xiphiagrion cyanomelas* is a common lowland pond species in Sarawak. Location 11. **LC**

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).

24. *Anax guttatus* (Burmeister, 1831) — A common species found at standing and slowly flowing waters. Location 3a. **LC**

25. *Oligoaeschna platyura* Lieftinck, 1940 ** — This species had been known only from a few records from East Kalimantan made in the 1930s, an equally old record from the east of Sabah, two records from Brunei made between 1990 and 2000 and a single record from Limbang Division made in 2022. A single male was found in forest, although it agrees with *O. platyura* in some respects it differs significantly in others, coming closer to the even more poorly known *O. mutata* Lieftinck, 1940 (known only from one location in East Kalimantan). The entire genus requires revision and a conservative course is taken here - the specimen from Belaga is treated as *O. platyura* for the time being. Location 2a. **E, VU**

Gomphidae

A large family with a worldwide distribution. 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.

26. *Ictinogomphus decoratus melaenops* (Selys, 1858) * — A very common species on open ponds and open sections of streams. Locations 1a, 3a.
27. *Leptogomphus* sp. cf *coomansi* Laidlaw, 1936 * — A problematic taxon, probably a distinct species but very similar to *L. coomansi*. Location 7d. **E** (not yet assessed for the Red List but widespread in Sarawak and Sabah and, if distinct from *L. coomansi*, will probably be **LC**).

Macromiidae

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

28. *Epophthalmia vittigera* (Rambur, 1842) * — A common species of open ponds, lakes and slowly flowing streams. Location 3a. **LC**
29. *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 12. **E, NT**

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.

30. *Agrionoptera insignis* (Rambur, 1842) * — A species of shady ponds and swamp. Location 2a. **LC**
31. *Brachydiplax chalybea* Brauer, 1868 — A common species of disturbed habitats. Locations 1a, 3b, 11, 15. **LC**
32. *Cratilla metallica* (Brauer, 1878) — A widespread forest species, it breeds in forest pools, including in disturbed forest. Locations 1d, 2a. **LC**
33. *Diplacodes trivialis* (Rambur, 1842) * — A common and widespread species of open habitats. Location 10. **LC**
34. *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. Locations 5, 7b, 7c, 8. **LC**
35. *Nannophya pygmaea* Rambur, 1842 * — A very common species of marshy habitats. Location 14a. **LC**
36. *Neurothemis fluctuans* (Fabricius, 1793) — A very common species of disturbed habitats. Locations 1a, 11, 14b. **LC**
37. *Neurothemis ramburii* (Brauer, 1866) * — A common species of disturbed habitats. Location 11. **LC**

38. *Neurothemis terminata* Ris, 1911 * — A common species but less so in the deep interior of Sarawak. Location 1a. **LC**
39. *Orchithemis pulcherrima* Brauer, 1878 — A common species of swampy forest habitats. Locations 6a, 14a, 15. **LC**
40. *Orthetrum chrysis* (Selys, 1891) — A common species. Locations 6c, 13, 14b. **LC**
41. *Orthetrum glaucum* (Brauer, 1865) — A common species. Location 2c. **LC**
42. *Orthetrum sabina* (Drury, 1773) * — A very common and extremely widespread species that occurs in a great range of habitat types. Locations 4, 11. **LC**
43. *Orthetrum schneideri* Förster, 1903 — A common species in many forested areas. Previously treated as a subspecies of *Orthetrum pruinosum* (Burmeister, 1839). Location 7b. **LC**
44. *Orthetrum testaceum* (Burmeister, 1839) — A very common species of open and disturbed habitats. Locations 4. **LC**
45. *Pornothemis serrata* Krüger, 1902 ** — This is the true *P. serrata* (two other very similar, as-yet-unnamed species also occur in Sarawak), which appears to be a scarce species. Locations 6b, 6c. **DD**
46. *Rhyothemis aterrima* Selys, 1891 ** — A local and uncommon species in Sarawak, most often found at low pH waters and sometimes at open pools within freshwater swamp forest. The Belaga population is atypical in its habitat and differs slightly in wing colour from typical specimens but is otherwise identical. Location 3a. **LC**
47. *Rhyothemis phyllis* (Sulzer, 1776) * — A common pond species. Locations 1a, 3a, 11. **LC**
48. *Rhyothemis triangularis* Kirby, 1889 * — A common pond species. Location 1a. **LC**
49. *Tetrathemis hyalina* Kirby, 1889 * — A moderately common species of swamp forest, forest pools and slow forest streams. Locations 1b, 6b, 6c, 9. **LC**
50. *Trithemis aurora* (Burmeister, 1839) — A common and widespread open habitat species. Locations 4, 11, 14a. **LC**
51. *Trithemis festiva* (Rambur, 1842) — A common species of open sections of streams. Location 14a. **LC**
52. *Tyriobapta torrida* Kirby, 1889 — A common species of slow streams, forested pools and swamps. Locations 1b, 7b, 7c, 9. **LC**
53. *Urothemis signata insignata* (Selys, 1872) — A widespread species that occurs in a variety of standing or slowly flowing water habitats. Location 3a. **LC**

A few additional taxa can be listed for the area on the basis of sight records made during the survey (these records are not included in the tables and counts given in the next section):

- A species of *Dysphaea* (Euphaeidae) seen on the Belaga River just upstream of location 9; it could have been either *D. dimidiata* Selys, 1853 or the riverine *D. lugens* Selys, 1873 (the latter species is currently **DD** on the IUCN Red List) but these two species cannot be reliably separated without specimens.
- *Macrogomphus* sp. (probably *M. quadratus* Selys, 1878), seen at location 1b.
- *Hydrobasileus croceus* (Brauer, 1867) (Libellulidae), a pond species, was seen at locations 3a and 11.
- *Pantala flavescens* (Fabricius, 1798) (Libellulidae), probably the commonest dragonfly in the world, was seen flying over roads and around buildings on a number of occasions.

Discussion

Fifty-three (53) species of Odonata from 12 families were recorded in the survey reported on here. Five of the species were recorded from Kapit Division for the first time (*Archibasis tenella*, *Archibasis viola*, *Oligoaeschna platyura*, *Pornothemis serrata* and *Rhyothemis aterrima*) and a further 15 (for a total of 20) were recorded from Belaga District for the first time. Belaga District has been poorly studied for Odonata to-date so the large number of new additions is to be expected.

Four (4) species collected during the May 2024 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). All species with an IUCN Red List assessment other than Least Concern (LC) are included here.

Species	Comment
Coeliccia kenyah	Currently NT on the IUCN Red List
Oligoaeschna platyura	*Oligoaeschna platyura* is currently VU on the IUCN Red List and only one other location has been recorded for it in Sarawak. If the species found in May 2024 is not *O. platyura* then it is either the even more poorly known *O. mutata* (also VU) or a new species.
Macromia corycia	Currently NT on the IUCN Red List.
Pornothemis serrata	Currently DD on the IUCN Red List but needs reassessment and is very unlikely to be LC.

Table 2: Species recorded during the 2024 Belaga survey and potentially of conservation interest. Red List status: DD – Data Deficient, LC – Least Concern, NT – Near Threatened, VU – Vulnerable.

Further to what is said in Table 2, *Pornothemis serrata* breeds in swampy lowland forest and is a very locally occurring species, its habitat is already highly fragmented and is certainly decreasing rapidly in extent across its range. Areas such as the riparian buffer around the Belaga River and swampy sections in the HCVF at the Belaga Estates will play an increasingly important role in the conservation of this species. HCVF will also play an important (probably the main) role in the conservation of the range restricted *Coeliccia kenyah* which is a low to mid-altitude species barely present within totally protected areas in Sarawak. Similar comments also apply to *Oligoaeschna platyura* which although its exact breeding habitat is unclear is certainly a species of lowland forest and appears to be both very scarce and very local in occurrence. *Macromia corycia* is more common at higher altitudes than are present in the Belaga Estates and the male collected, although flying on a stream in Oil Palm, probably came from 100-200m further up the same stream, in forest within the Sekiwa FMU.

Table 3 summarises the numbers of families and of species so far collected at each of the locations sampled in May 2024 (note that sight records are not included). 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 53 species collected during the May 2024 survey, 29 are forest species (ca. 55%) and 13 (ca. 25%) are endemic to Borneo. All of the species listed in Table 2 are forest species and three of them are endemic (as currently understood) 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
1	18	6	2	0	7
2	10	7	4	1	7
3	9	1	0	0	5
4	3	0	0	0	1
5	4	3	2	0	3
6	9	4	2	1	4
7	16	9	5	1	9
8	4	3	2	0	3
9	3	2	0	0	2
10	1	0	0	0	1
11	10	0	0	0	2
12	1	1	1	1	1
13	1	0	0	0	1
14	12	3	1	0	4
15	2	1	0	0	1

Table 3: Numbers of families and species collected at each of the locations in the Belaga area sampled in 2024.

There has been insufficient sampling to draw many conclusions from the numbers in Table 3 but locations 1 and 7 stands out as that with the highest number (18 and 16 respectively) of species collected as well as forest species (6 and 9 respectively) and species endemic to Borneo (2 and 5 respectively). Location 2 also stands out with four species endemic to Borneo (including the poorly known *Oligoaeschna platyura*) and location 6 is of interest because of the presence of *Pornothemis serrata*. Locations 11 and 14 also had relatively high numbers of species recorded.

Further sampling would undoubtedly add to the number of species from the area and from each individual location. In particular the forest stream sites will certainly not have a complete inventory yet, since many species that use this habitat, especially from the families Gomphidae and Macromiidae, occur at low densities and exhibit behaviour that makes it very difficult to record them during a short survey; longer periods of work are needed to obtain anything approaching a full inventory for these groups. There are some surprising gaps in the odonate fauna that has already been found in the area, most notably the lack of any member of the Devadattidae is extremely surprising since three species of *Devadatta* are known to occur in Belaga, one of which (*Devadatta clavicauda* Dow, Hämäläinen & Stokvis, 2015) is generally common in the lowlands, very disturbance tolerant and can normally be found at streams like those at, for example, locations 1c and 2b. In the author's opinion it is almost certain that *D. clavicauda* is present in the HCVF at the Belaga estates but might be atypically scare there, although there is no obvious reason why this would be the case. *Euphaea subcostalis* Selys, 1873 is another notable absence, this is a conspicuous and usually common species present on many forest streams in the lowlands throughout Sarawak and easily recorded. Sampled streams in the area were all at

the smaller end of the range of suitability for *Euphaea subcostalis* and this might be the reason that the species was not recorded but it is likely to be present somewhere in the area.

It is instructive to consider the results of the survey in terms of land cover. To this end the locations surveyed have been divided into five simple land cover categories, these are listed in Table 4. Note that location 2c is listed as forest edge because it is a small clearing in forest around part of a stream and (only) location 14a is listed as mixed because more than one type of cover is present in close proximity to each other at this site.

Land cover category	**Locations**
Disturbed old growth forest (OG, 15)	1b-c, 2a-b, 5, 6a-c, 7b-e, 8, 9
Forest edge (FE, 3)	1a, 2c, 7a
Oil Palm (OP, 4)	12, 13, 14b, 15
Mixed (M, 1)	14a
Open (O, 5)	3a-b, 4, 10, 11

Table 4: Land cover categories and sampled locations. The abbreviation used for each category in Table 5 is given in parentheses, followed by the number of sampled locations in the category.

Table 5 shows which species were found in which of the land cover categories during the survey. The highest number of species (27) were recorded from old growth forest, although the survey concentrated on this land cover type this result is expected to hold true with more extensive sampling since it is typically true in South East Asia. Eleven and nine species were recorded at the edge of old growth forest and in Oil Palm respectively, six species were recorded in the mixed category and 17 species in the open category (which received a relatively large amount of sampling effort and is relatively easy to sample). Twelve species were found in more than one category. Of species only found in one category, old growth forest has the highest number (23) followed by open (9), forest edge (3), with two species only found in each of the mixed and Oil Palm categories.

Species	OG	FE	OP	M	O
Drepanosticta rufostigma	Yes				
Drepanosticta versicolor	Yes				
Telosticta longigaster	Yes				
Euphaea impar	Yes				
Rhinagrion borneense	Yes				
Podolestes orientalis	Yes				
Vestalis amaryllis	Yes				
Heliocypha biseriata	Yes		Yes		
Coeliccia kenyah	Yes				
Coeliccia nigrohamata	Yes				
Copera vittata	Yes				
Prodasineura hyperythra	Yes	Yes			
Prodasineura verticalis			Yes		
Aciagrion borneense					Yes
Agriocnemis femina		Yes		Yes	Yes
Archibasis tenella	Yes				
Archibasis viola	Yes				
Argiocnemis sp.	Yes				
Ceriagrion cerinorubellum		Yes	Yes		
Pseudagrion microcephalim				Yes	Yes
Pseudagrion perfuscatum		Yes	Yes		
Stenagrion dubium	Yes				
Xiphiagrion cyanomelas					Yes
Anax guttatus					Yes
Oligoaeschna platyura	Yes				
Ictinogomphus decoratus		Yes			Yes
Leptogomphus sp. cf *coomansi*	Yes				
Epophthalmia vittigera					Yes
Macromia corycia			Yes		
Agrionoptera insignis	Yes				
Brachydiplax chalybea		Yes	Yes		Yes
Cratilla metallica	Yes				
Diplacodes trivialis					Yes
Lyriothemis biappendiculata	Yes				
Nannophya pygmaea				Yes	
Neurothemis fluctuans		Yes	Yes		Yes
Neurothemis ramburii					Yes
Neurothemis terminata		Yes			
Orchithemis pulcherrima	Yes		Yes	Yes	
Orthetrum chrysis	Yes		Yes		
Orthetrum glaucum		Yes			
Orthetrum sabina					Yes
Orthetrum schneideri	Yes				
Orthetrum testaceum					Yes
Pornothemis serrata	Yes				

Rhyothemis atterima					Yes
Rhyothemis phyllis		Yes			Yes
Rhyothemis triangularis		Yes			
Tetrathemis hyalina	Yes				
Trithemis aurora				Yes	Yes
Trithemis festiva				Yes	
Tyriobapta torrida	Yes				
Urothemis signata insignata					Yes
Total	**27**	**11**	**9**	**6**	**17**

Table 5: Odonata found in different land cover categories during the May 2024 Belaga survey. See Table 4 for the abbreviations for land cover categories.

Recommendations and Suggestions

In this section some recommendations and suggestions for conservation and further work in the area are given. It should be said at the outset that the HCVF and riparian buffer around the Belaga River appear to be preserving the odonate diversity of the area well, however improvement is always possible.

- Any expansion of the buffer and HCVF is obviously desirable from a conservation perspective.
- It is likely that even the immediately adjacent parts of the Sekiwa FMU on the slopes above Belaga 3 harbour species which have become locally extinct within the estates. Establishment of a small riparian buffer around one of the streams running down from the FMU (initially by simply not clearing the Oil Palm for, say, 10-20m on either side of the stream at the end of the current rotation and planting native tree species under the Oil Palm, with later removal of the Oil Palm as needed to allow the native trees to flourish) would, in the long-term, allow some species to recolonise inside the estates and therefore increase the biodiversity present there.
- Although not related to the HCVF and riparian buffers, the presence of *Rhyothemis aterrima* (in fact an at least slightly atypical form of this species) at the fish pond in Belaga 1 is notable because it is the only site known for the species in Kapit Division – it is desirable to preserve this population and since the species can be recognised without collecting specimens the first step is for simple monitoring of the population through regular visits by conservation staff and for checks for the species at the ponds at the other estates. The main concern here is that if the pond is drained at any point then the species might become extinct there with no other populations sufficiently near to recolonise. It would also be worthwhile to search for the species in the area around the estates to see if additional populations are present nearby.
- Further surveying is highly desirable to develop a more complete inventory (see the last section). Although the HCVF and riparian buffer are the priorities for such surveys, more work is also needed within the Oil Palm, for comparison purposes.
- The Belaga River itself will provide habitat to some species not present on the, much smaller, streams that can be sampled on foot. The river can only be sampled effectively by boat. It is recommended that the feasibility of hiring a boat and boatmen from some nearby community for one or two days to facilitate sampling along the river be investigated before any future survey.

- Although outside of the estates, the nearby forest recovery area is potentially very interesting for Odonata and it would be extremely worthwhile to conduct a survey within this area.

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Glenealy Plantations arranged and facilitated the survey, Belden Giman in particular was the main driver for the survey, which would not have been possible with him. Frankie Eban and Louis Robert, and an estate worker that I only know as Joko, did an admirable job as field assistants.

References

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

Appendix: English Names

Name	English Name
Drepanosticta rufostigma	Common Shadowdamsel
Drepanosticta versicolor	Long-spined Shadowdamsel
Telosticta longigaster	Short-winged Shadowdamsel
Euphaea impar	Dark-tipped Satinwing
Rhinagrion borneense	Bornean Signaltail
Podolestes orientalis	Common Phantom
Vestalis amaryllis	Beautiful Flashwing
Heliocypha biseriata	Window-winged Jewel
Coeliccia kenyah	Kenyah Sylvan
Coeliccia nigrohamata	Hook-marked Sylvan
Copera vittata	Variable Featherlegs
Prodasineura hyperythra	White-Lipped Threadtail
Prodasineura verticalis	Red-striped Threadtail
Aciagrion borneense	Common Slim
Agriocnemis femina	White-backed Wisp
Archibasis tenella	Lesser Streamsprite
Archibasis viola	Violet Streamsprite
Argiocnemis sp.	Common Shadowfly
Ceriagrion cerinorubellum	Painted Coraltail
Pseudagrion microcephalim	Blue Sprite
Pseudagrion perfuscatum	Red-faced Sprite
Stenagrion dubium	Bornean Shortleg
Xiphiagrion cyanomelas	Cyan Lancet
Anax guttatus	Pale-spotted Emperor
Oligoaeschna sp. cf *platyura*	Paddletail sp.
Ictinogomphus decoratus	Common Flangetail
Leptogomphus sp. cf *coomansi*	Slendertail sp.
Epophthalmia vittigera	Royal Pondcruiser
Macromia corycia	Bornean Cruiser
Agrionoptera insignis	Common Grenadier
Brachydiplax chalybea	Blue Lieutenant
Cratilla metallica	Dark-faced Forestskimmer
Diplacodes trivialis	Blue Percher
Lyriothemis biappendiculata	Seepage Bombardier
Nannophya pygmaea	Scarlet Pygmy
Neurothemis fluctuans	Lesser Red Parasol
Neurothemis ramburii	Rambur’s Parasol
Neurothemis terminata	Greater Red Parasol
Orchithemis pulcherrima	Variable Sentinel
Orthetrum chrysis	Tufted Skimmer
Orthetrum glaucum	Blue Skimmer
Orthetrum sabina	Variegated Green Skimmer
Orthetrum schneideri	Pink Skimmer

Orthetrum testaceum	Fiery Skimmer
Pornothemis serrata	Freshwater Marshal
Rhyothemis atterima	Shimmering Flutterer
Rhyothemis phyllis	Phyllis's Flutterer
Rhyothemis triangularis	Blue-based Flutterer
Tetrathemis hyalina	Common Elf
Trithemis aurora	Pink Dropwing
Trithemis festiva	Indigo Dropwing
Tyriobapta torrida	Common Treehugger
Urothemis signata insignata	Scarlet Basker

Table 6: English names for Odonata species collected in the Belaga area sampled in 2024.

Appendices:

ODONATA (DRAGONFLIES AND DAMSELFLIES) OF THE GPSB, BELAGA OIL PALM PLANTATION AREA, BELAGA, KAPIT DIVISION, MAY 2024.

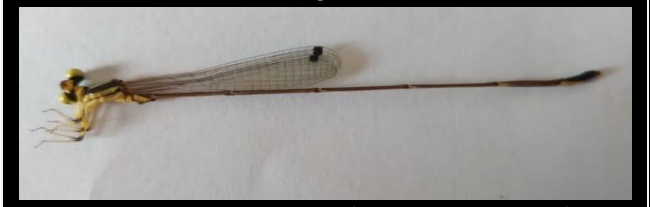
1.

Drepanosticta rufostigma (Selys, 1886)

2.

Drepanosticta versicolor (Laidlaw, 1913)

3.



Telosticta longigaster (Dow & Orr, 2012)

4.

Euphaea impar (Selys, 1859)

5.

Rhinagrion borneense (Selys, 1886)

6.

Podolestes orientalis (Selys, 1862)

7.

Vestalis amaryllis (Lieftinck, 1965)

8.

Heliocypha biseriata (Selys, 1859)

ODONATA (DRAGONFLIES AND DAMSELFLIES) OF THE GPSB, BELAGA OIL PALM PLANTATION AREA, BELAGA, KAPIT DIVISION, MAY 2024.

9.

Coeliccia kenyah (Dow, 2010)

10.

Coeliccia nigrohamata (Laidlaw, 1918)

11.

Copera vittata (Selys, 1863)

12.

Prodasineura hyperythra (Selys, 1886)

13.

Prodasineura verticalis (Selys, 1860)

14.

Aciagrion borneense (Ris, 1911)

15.

Agriocnemis femina (Brauer, 1868)

16.

Archibasis tenella (Lieftinck, 1949)

ODONATA (DRAGONFLIES AND DAMSELFLIES) OF THE GPSB, BELAGA OIL PALM PLANTATION AREA, BELAGA, KAPIT DIVISION, MAY 2024.

17.

Archibasis viola (Lieftinck, 1949)

18.

Argiocnemis sp. (Selys, 1877)

19.

Ceriagrion cerinorubellum (Brauer, 1865)

20.

Pseudagrion microcephalum (Rambur, 1842)

21.

Pseudagrion perfuscatum (Lieftinck, 1937)

22.

Stenagrion dubium (Laidlaw, 1912)

23.

Xiphiagrion cyanomelas (Selys, 1876)

24.

Anax guttatus (Burmeister, 1831)

ODONATA (DRAGONFLIES AND DAMSELFLIES) OF THE GPSB, BELAGA OIL PALM PLANTATION AREA, BELAGA, KAPIT DIVISION, MAY 2024.

25.

Oligoaeschna platyura (Lieftinck, 1940)

26.

Ictinogomphus decoratus melaenops (Selys, 1858)

27.

Leptogomphus sp. cf coomansi (Laidlaw, 1936)

28.

Epophthalmia vittigera (Rambur, 1842)

29.

Macromia corycia (Laidlaw, 1922)

30.

Agrionoptera insignis (Rambur, 1842)

ODONATA (DRAGONFLIES AND DAMSELFLIES) OF THE GPSB, BELAGA OIL PALM PLANTATION AREA, BELAGA, KAPIT DIVISION, MAY 2024.

31.

Brachydiplax chalybea (Brauer, 1868)

32.

Cratilla metallica (Brauer, 1878)

33.

Diplacodes trivialis (Rambur, 1842)

34.

Lyriothemis biappendiculata (Selys, 1878)

35.

Nannophya pygmaea (Rambur, 1842)

36.

Neurothemis fluctuans (Fabricius, 1793)

ODONATA (DRAGONFLIES AND DAMSELFLIES) OF THE GPSB, BELAGA OIL PALM PLANTATION AREA, BELAGA, KAPIT DIVISION, MAY 2024.

37.

Neurothemis ramburii (Brauer, 1866)

38.

Neurothemis terminata (Ris, 1911)

39.

Orchithemis pulcherrima (Brauer, 1878)

40.

Orthetrum chrysis (Selys, 1891)

41.

Orthetrum glaucum (Brauer, 1865)

42.

Orthetrum sabina (Drury, 1773)

ODONATA (DRAGONFLIES AND DAMSELFLIES) OF THE GPSB, BELAGA OIL PALM PLANTATION AREA, BELAGA, KAPIT DIVISION, MAY 2024.

43.

Orthetrum schneideri (Förster, 1903)

44.

Orthetrum testaceum (Burmeister, 1839)

45.

Pornothemis serrata (Krüger, 1902)

46.

Rhyothemis aterrima (Selys, 1891)

47.

Rhyothemis phyllis (Sulzer, 1776)

48.

Rhyothemis triangularis (Kirby, 1889)

ODONATA (DRAGONFLIES AND DAMSELFLIES) OF THE GPSB, BELAGA OIL PALM PLANTATION AREA, BELAGA, KAPIT DIVISION, MAY 2024.

49.

Tetrathemis hyalina (Kirby, 1889)

50.

Trithemis aurora (Burmeister, 1839)

51.

Trithemis festiva (Rambur, 1842)

52.

Tyriobapta torrida (Kirby, 1889)

53.

Urothemis signata insignata (Selys, 1872)