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Dow, Rory & Marcel Silvius

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1-37

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Results of an Odonata survey carried out in the peatlands of Central Kalimantan, Indonesia, in 2012

Rory A. Dow¹ & Marcel J. Silvius²

¹Naturalis Biodiversity Centre, P.O. Box 9517, 2300 RA Leiden, The Netherlands.

Email address: rory.dow230@yahoo.co.uk

²Wetlands International, P.O.Box 471, 6700AL Wageningen, The Netherlands

Abstract

The results of a survey of Odonata (dragonflies and damselflies) in the peatlands of Central Kalimantan, Indonesia, in 2012 are presented. Fifty four species of Odonata found in the area in June-July 2012 are listed, along with brief notes and the locations in which they were found. Of the species found, twelve had not been recorded in Central Kalimantan previously, and of these at least four are completely new to science. Six species, originally described from Central Kalimantan and not recorded anywhere since 1953, were rediscovered. At least sixteen of the species found during the survey are considered to be of conservation concern. The discovery of at least four new species to science in a relatively short survey indicates a high probability of occurrence of many more species that are awaiting discovery, and that many undiscovered species may be lost or highly threatened because of the rapid demise of peat swamp forest habitats. A checklist of the Odonata known from Central Kalimantan is provided in an appendix.

Key words

Odonata, Borneo, Central Kalimantan, Indonesia, peat swamp forest, biodiversity, conservation status

Introduction

This report describes the results of a preliminary survey of the insect order Odonata (dragonflies and damselflies) carried out in the province of Central Kalimantan (Kalimantan Tengah), Indonesia, from June 17 – July 1, 2012. The Odonata of Kalimantan in general and Central Kalimantan in particular have been poorly studied. The vast majority of Odonata records from Central Kalimantan originate from just two short periods of fieldwork, one carried out in the vicinity of Ampah in 1948 (Lieftinck 1950a, 1950b, 1951, 1953a) and the other at few locations inland of Sampit in 1950 (Lief-



tinck 1953b). A search of the literature on the Odonata of the region revealed records of only 102 species; this should be compared with the known odonate fauna of Sarawak in Malaysian Borneo, which has a smaller land area, but has in excess of 280 species known already (Dow unpublished). A complete checklist of the known odonate fauna of Central Kalimantan is given in the appendix, based on the sources cited above and on records in Dow (2010b), Dow *et al.* (2007), Dumont (2013), Lieftinck (1932, 1937, 1954, 1964, 1965), Orr (2002), Orr & Hämäläinen (2013), Ris (1911) and van Tol & Norma-Rashid (1995). The true odonate diversity of Central Kalimantan must be substantially greater than the records to-date indicate.

One of the main aims of the survey was to attempt to relocate as many as possible of the nine species originally described and only known from the province and not recorded after 1953 (see Table 1). Arguably one further species could have been included in Table 1: *Teinobasis suavis*, described from the vicinity of Ampah. The only record of this species since its description (Lieftinck 1953a) is of a female from peat swamp in western Sarawak (Dow 2010a), which is not definitely the true *T. suavis*.

As peat swamp forest biodiversity has received relatively little scientific attention the value of this particular wetland habitat for biodiversity conservation is poorly understood. Some comparisons with biodiversity values of other tropical forest habitats (Paoli *et al.* 2010) lacked reference to special wetland species groups such as freshwater fish and dragonflies. Posa *et al.* (2011) found that from 2236 plant and vertebrate species recorded in peat swamp forests, a total of 252 were restricted to peat swamp forests (172 plants and 80 fish species), but noted that lack of sampling in peat swamp forests may have contributed to a skewed picture. They also noted that peat swamp forests support a substantial number of rare, specialised and threatened species. Our survey intended to contribute to a better understanding by compiling evidence of the biodiversity conservation value of peat swamp forests. Over the last decades tropical peat swamp forest habitat in the Greater Sundas and in peninsular Malaysia has become severely threatened. Much of the currently remaining peat swamp forests is degraded through logging and drainage, contributing disproportionately to the global carbon dioxide emissions (Hooijer *et al.* 2010). 'Business-as-usual' projections of future conversion rates, based on historical rates over the past two decades, indicate that 6–9 Mha of peatland in insular Southeast Asia may be converted to plantations by the year 2020 (Miettinen *et al.* 2012). The survey was therefore carried out entirely in the lowlands and concentrated on peat swamp areas, including many areas where logging and conversion to agriculture and plantations remains a severe threat. Most of the remaining peat swamp forests, including those in protected areas, are affected by drainage from illegal logging channels, which contributes to a high fire risk. It seems very important to improve the knowledge on this threatened habitat, especially its freshwater biodiversity, as this may add to the growing concern over its loss.

Family	Species
Argiolestidae	<i>Podolestes atomarius</i>
Argiolestidae	<i>Podolestes furcifer</i>
Chlorocyphidae	<i>Libellago dorsocyana</i>
Platycnemididae	<i>Elatoneura erythromma</i>
Platycnemididae	<i>Prodasineura abbreviata</i>
Platycnemididae	<i>Prodasineura quadristigma</i>
Coenagrionidae	<i>Amphicnemis dactylostyla</i>
Coenagrionidae	<i>Amphicnemis pandanicola</i>
Coenagrionidae	<i>Amphicnemis platystyla</i>

Table 1: Odonata species originally described from Kalimantan Tengah, only known from the province and not recorded after 1953.

The results of the survey were extremely interesting, especially given the relatively short time available. Fifty-four species were found, including six of the nine species not recorded since 1953 or before. Four of the species found were new to science. Twelve species were recorded from the province for the first time. Much valuable data on species distributions and habitat was generated. However all of the habitats sampled were disturbed to a greater or lesser extent, and most had no protected status whatsoever; even though the other locations have some protection it is clear that they still face serious threats. Many of the Odonata found during the survey appear to be specialists in peat swamp habitat types that are rapidly vanishing, and some seem to be extremely local in occurrence; it is clear that a substantial number of the species found are under threat.

Survey Locations

The numbering system for locations introduced here is used throughout the rest of the report. The survey locations are indicated in Fig. 1.

1. Main road Palangkaraya-Buntok, near Palangkaraya (capital of Central Kalimantan) and in ex Mega Rice Project Block E:
 - a. Peat swamp forest in ex Mega Rice Project Block E (1.936S, 114.056E).
 - b. Streams (e.g. Fig. 2) (1.988S, 113.972E; 1.982S, 113.980E; 2.005S, 113.949E).
 - c. Alluvial swamp by streams.
 - d. Open habitats: marshes, streams, roadside drains/ditches and ponds
2. Buntok-Ampah area:
 - a. Large muddy stream (1.802S, 115.056E).
 - b. Smaller blackwater streams (e.g. Fig. 3) (1.741S, 114.987E; 1.598S, 114.761E).
 - c. Peat swamp forest around the above streams.
 - d. Margin of lake at Buntok



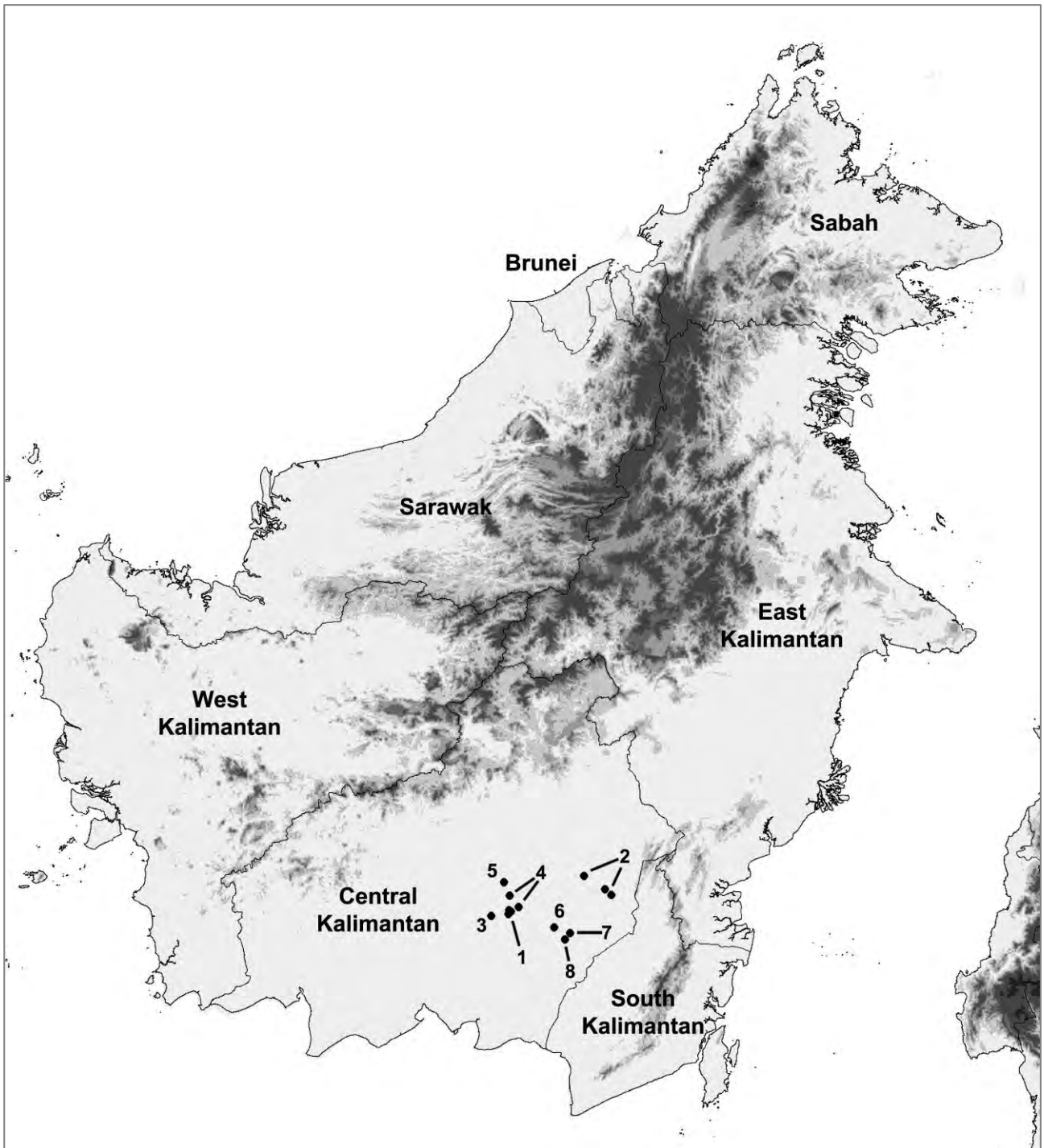


Figure 1. Map of Borneo with survey locations in Central Kalimantan indicated.

3. On Jalan Tjilik Riwut near Palangkaraya (2.030S, 113.766E):
 - a. Stream (e.g. Fig. 4).
 - b. Surrounding swampy forest.
 - c. Open pools.
4. Left road Palangkaraya-Buntok:
 - a. Peat swamp forest including streams at Bereng Rambang (e.g. Fig. 5) (1.808S, 113.960E).

- b. Stream in degraded alluvial forest (1.966S, 113.956E).
 - c. Drainage ditch at forest edge at Bereng Rambang.
5. Sebangau (1.664S, 113.902E) – peat swamp forest, CIMTROP Natural Laboratory Block C (e.g. Fig. 6).
 6. Tuanan (2.152S, 114.441E):
 - a. Peat swamp forest (e.g. Fig. 7).
 - b. Open and disturbed habitats.
 - c. Sungai Kapuas.
 7. Begantung (2.213S, 114.611E) – peat swamp forest (trail at Camp site Borneo Orangutan Survival Foundation).
 8. Camp Release (2.283S, 114.559E) – deeply flooded blackwater forest.



Figure 2. A stream in ex Mega Rice Project Block E. Photograph by M. Silvius.



Figure 3. Small black water stream between Buntok and Ampah. Photograph by M. Silvius.



Figure 4. Stream at Jalan Tjilik Riwut near Palangkaraya. Photograph by M. Silvius.



Figure 5. Pool in peat swamp forest at Bereng Rambang. Photograph by M. Silvius.



Figure 6. Peat swamp forest at Sebangau. Photograph by M. Silvius.



Figure 7. Peat swamp forest at Tuanan. Photograph by M. Silvius.

Species Found

The classification used here follows Dijkstra, Bechly et al. (2013) for Anisoptera and Dijkstra, Kalkman et al. (2013) for Zygoptera. First records for Central Kalimantan are marked with an *.

Zygoptera

Argiolestidae

1. *Podolestes atomarius* Lieftinck, 1950

A species not reported since 1953 (Lieftinck 1953a, 1953b). We found it in every peat swamp site surveyed; it was common at many localities. Fig 8. Locations 1.a, 2.b, 4.a, 5, 6.a and 7.



Figure 8. *Podolestes atomarius*, male, in peat swamp forest at Tuanan Photograph by M. Silvius.

Calopterygidae

2. *Vestalis amaryllis* Lieftinck, 1965

This and the next are both common species in the lowlands of Borneo. However, in Kalimantan Tengah they were both found in peat swamp and kerangas habitats; in Sarawak they are typically replaced by *Vestalis amabilis* Lieftinck, 1965 in these habitats. – Locations 6.a and 7.

3. *Vestalis amoena* Hagen in Selys, 1853

Locations 2.b and 3.a.

Chlorocyphidae

4. *Libellago aurantiaca* (Selys, 1859)

A widespread species. Location 1.b.

5. *Libellago hyalina* (Selys, 1859)

Another widespread species, common in low pH habitats. Locations 1.b, 2.a, 2.b, 3.a, 4.b, 6.a and 7.

6. *Libellago lineata* (Burmeister, 1839)

This is a very widespread species in tropical and subtropical Asia, but the only records from Borneo until now were of a few individuals from Central Kalimantan. Although only found at two locations during this survey, it was abundant on the banks



Figure 9. *Libellago lineata*, male, on the banks of the Sungai Katibas at Tuanan. Photograph by M. Silvius.

of the Sungai Kapuas at Tuanan, and is likely to be common on rivers and larger streams in the province. Fig. 9. Locations 2.a and 6.c.

7. *Libellago semiopaca* (Selys, 1873)

Another widespread species. Location 2.a.

8. *Pachycypha aurea* Lieftinck, 1950

Until recently this distinctive species was only known from Central Kalimantan, but it was discovered in Sarawak in 2010 (Dow & Reels 2011), although some questions remain about the taxonomic status of the Sarawak populations. It was either collected or seen at almost every peat swamp site sampled, but was always at very low densities and exceptionally wary. A freshly emerged female is shown in Fig. 10. Locations 5, 6.a and 7.



Figure 10. *Pachycypha aurea*, freshly emerged female, Begantung. Photograph by M. Silvius

Euphaeidae

9. *Euphaea impar* (Selys, 1859)

A common species on streams in mixed dipterocarp forest, but less common in the swampy habitats surveyed in Kalimantan Tengah. Location 3.a.

Platycnemididae

10. *Coeliccia* new species 1*

A morphologically remarkable species from the *membranipes*-group, found at several of the deep peat sites surveyed. A description is being prepared by the first author. Fig. 11. Locations 1.a, 5 and 6.a.



Figure 11. *Coeliccia* new species, male, Tuanan. Photograph by M. Silvius.



11. *Coeliccia* species*

A problematic member of the *membranipes*-group, morphologically very close to *C. nigrohamata* Laidlaw 1918 but with different markings in the male. Only found at one site with no protection, this species must be regarded as a conservation priority at least until the issue of its relationship with *C. nigrohamata* is settled. Fig. 12. Location 4.a.



Figure 12. *Coeliccia* species, male, Bereng Rambang. Photograph by M. Silvius.

12. *Copera vitatta* (Selys, 1863)

A common species of shady ponds and swamps. Location 2.b.

13. *Elattoneura aurantiaca* (Selys, 1886)

A widespread species of low pH streams, abundant at many locations surveyed. Locations 1.b, 2.b, 3.a, 4.a, 4.b, 5, 6.a and 7.

14. *Elattoneura coomansi* Lieftinck, 1937*

Another widespread species, but more local in occurrence than the last; it had not been recorded from Central Kalimantan until now. Locations 1.b, 3.a, 6.c and 8.

15. *Elattoneura erythromma* Lieftinck, 1953

This species has not been recorded since 1953 (Lieftinck 1953b) but, like *Podolestes atomarius*, we found it at every peat swamp site surveyed, and it was typically common where found. Fig. 13. Locations 1.a, 1.b, 2.b, 4.a, 5, 6.a and 7.



Figure 13. *Elattonneura erythromma*, male, Buntok area. Photograph by M. Silvius.

16. *Elattonneura longispina* Lieftinck, 1937*

This species had not been recorded from Central Kalimantan previously. Typical individuals (Fig. 14) were found at a stream near Buntok. Smaller sized individuals with reduced and atypical pale markings (Fig. 15) were found at a number of peat swamp sites and were initially assumed to be a new species. However two males which, while agreeing more closely with typical *longispina*, show some characteristics of the peat swamp form, were found in swampy kerangas at location 3.b; these individuals may represent an intermediate form and raise doubts over the status of the peat swamp form. Further investigation is needed before this issue can be resolved.

- a. *Elattoneura longispina* – Location 2.a and 3.b.
- b. *Elattoneura* species cf *longispina* – Locations 2.c, 4.a and 6.a.



Figure 14. *Elattonneura longispina*, male, Bintulu Division, Sarawak. Photograph by R.A. Dow.



Figure 15. *Elattonneura* sp cf *longispina*, male, in peat swamp forest at Tuanan. Photograph by M. Silvius.

17. *Prodasineura abbreviata* Lieftinck, 1951

Another species that had not been recorded since 1953, it was found at just one small stream in shallow peat over sand, between Buntok and Ampah. Originally described from Ampah, where apparently little or no forest remains (local information), this species must be regarded as a conservation priority with the available data. Fig. 16. Location 2.b.



Figure 16. *Prodasineura abbreviata*, male, Buntok area. Photograph by M. Silvius.

18. *Prodasineura quadristigma* Lieftinck, 1951

Also not recorded between 1953 and the present survey, and only found at one stream (larger than that at which *P. abbreviata* was found). This species must also be regarded as a conservation priority. Fig. 17. Location 2.b.

19. *Prodasineura* new species*

A species discovered at two streams near Palangkaraya during this survey, and which, like the other *Prodasineura* species above, must be regarded as a conservation priority. A description is being prepared by the first author and R. Ngiam. Fig. 18. Locations 1.b and 4.b.



Figure 17. *Prodasineura quadristigma*, male, Buntok area. Photograph by M. Silvius.





Figure 18. *Prodasineura* new species, male, Bereng Rambang. Photograph by M. Silvius.

Coenagrionidae

20. *Aciagrion borneense* Ris, 1911*

A widespread and common species, but it had not been recorded from Central Kalimantan before this survey. Locations 1.d, 3.c and 6.b.

21. *Agriocnemis femina femina* (Brauer, 1868)

A very widespread species. Location 6.b.

22. *Agriocnemis minima* (Selys, 1877)*

Not recorded from Central Kalimantan before this, but we found it to be common at many sites. Fig. 19 shows an immature female. Locations 1.d, 2.d, 3.c, 4.c and 6.b.

23. *Amphicnemis erminea* Lieftinck, 1953

Probably the least specialist of the *Amphicnemis* species now known from Central Kalimantan, occurring in a wide variety of swamp forest habitats. Fig. 20. Locations 1.c, 2.c, 3.b and 6.a.



Figure 19. *Agriocnemis minima*, female, Jalan Tjilik Riwut. Photograph by M. Silvius.



Figure 20. *Amphicnemis erminea*, male, Buntok area. Photograph by M. Silvius.



24. *Amphicnemis pandanicola* Lieftinck, 1953

This species was rediscovered during the present survey. It appears to be a peat swamp forest specialist, and only a small number of individuals were collected, suggesting that it might be both scarce and local in occurrence. Locations 1.a, 6.a and 7.

25. *Amphicnemis platystyla* Lieftinck, 1953

Also rediscovered during the present survey, and also apparently a peat swamp forest specialist, but considerably more common than *A. pandanicola*. The female (Fig. 21) has not yet been described. Locations 1.a, 2.c, 4.a, 5, 6.a and 7.



Figure 21. *Amphicnemis platystyla*, female, Tuanan. Photograph by M. Silvius.

26. *Amphicnemis* new species 1*

Another peat swamp specialist, clearly a new species, and quite common at a number of sites. A description has been submitted to *Odonatologica* by the first author. Locations 1.a, 2.c, 5, 6.a and 7.

27. *Amphicnemis* new species 2*

Another peat swamp species, probably more specialised to deep peat sites than the last. Nearly every individual collected appears to be freshly emerged, possibly indicating seasonal emergence, but far more data is needed before this can be reliably established. Fig. 22. Locations 1.a, 5 and 6.a.



Figure 22. *Amphicnemis* new species 2, male, Sebangau. Photograph by M. Silvius.

28. *Archibasis incisura* Lieftinck, 1949

Widely distributed but local and rarely encountered. Location 4.b.

29. *Archibasis tenella* Lieftinck, 1949

Widely distributed in Borneo. Location 2.b.

30. *Archibasis viola* Lieftinck, 1948

A common and widely distributed species. Location 5.

31. *Ceriagrion cerinorubellum* (Brauer, 1865)

A very common species. Locations 1.a, 2.d, 4.a and 6.a.

32. *Ischnura senegalensis* (Rambur, 1842)

Remarkably the first published record of this extremely widespread and common species from Central Kalimantan was only published in 2013 (Dumont 2013). Location 1.d.

33. *Mortonagrion aborense* (Laidlaw, 1914)*

Another new record for Central Kalimantan, found at a number of swampy locations. This species is unlikely to be a true *Mortonagrion*, and will probably be placed in its own genus in the near future. Locations 1.a, 1.b, 2.a, 2.b, 3.b, 4.b and 6b.

34. *Mortonagrion falcatum* Lieftinck, 1934*

Also a new record for Central Kalimantan; this species is widespread but extremely local in occurrence. Location 3.c.

35. *Mortonagrion forficulatum* Lieftinck, 1953

A rarely encountered peat swamp forest specialist, known only from southern and south eastern Kalimantan. Fig. 23. Location 5.



Figure 23. *Mortonagrion forficulatum*, male, Sebangau. Photograph by M. Silvius.



36. *Pseudagrion coomansi* Lieftinck, 1937

This species appears to be a specialist of open blackwater habitats, where it is often common. Fig. 24. Locations 1.b, 1.d, 2.d, 6.b and 8.



Figure 24. *Pseudagrion coomansi*, male (above), female (below), near Palangkaraya. Photograph by M. Silvius.

Anisoptera

Gomphidae

37. *Ictinogomphus acutus* (Laidlaw, 1914)

A specialist species of blackwater streams. Fig. 25. Location 2.b.





Figure 25. *Ictinogomphus acutus*, male, near Buntok. Photograph by M. Silvius.

Libellulidae

38. *Brachydiplax chalybea chalybea* Brauer, 1868

A common and widespread species. Locations 1.d and 6.b.



Figure 26. *Brachygonia ophelia*, male, Begantung. Photograph by M. Silvius.



39. *Brachygonia oculata* (Brauer, 1878)

A common and widespread peat swamp species. Locations 1.a, 1.c, 2.c, 3.b and 6.a.

40. *Brachygonia ophelia* Ris, 1910

Although quite widely distributed, this species is very local in occurrence and appears to be a peat swamp forest specialist. Fig. 26. Locations 5 and 7.

41. *Brachygonia puella* Lieftinck, 1937

Known from Borneo and Belitung, this species appears to favour open and semi-open marshy low pH habitats. Location 1.d.

42. *Chalybeothemis fluviatilis* Lieftinck, 1933

A widespread but usually rather local species, most common in, but not confined to, blackwater habitats. Fig. 27. Location 1.d but seen at other locations, e.g. 7.



Figure 27. *Chalybeothemis fluviatilis*, male, Begantung. Photograph by M. Silvius.

43. *Nannophya pygmaea* Rambur, 1842

This is a common species of open, lentic waters, but one that is easily overlooked (despite its bright red colouration) because of its tiny size. Locations 1.d, 3.c and 6.b.

44. *Neurothemis fluctuans* (Fabricius, 1793)

Another common species of open, lentic habitats. Locations 1.a, 5 and 6.b.

45. *Orchithemis* species

Surprisingly, only one teneral female specimen from this swamp loving genus was collected. Probably *O. pulcherrima*, but all three species known from the genus have been recorded in Central Kalimantan and identification of females to species is sometimes problematic. Location 7.

46. *Orthetrum chrysis* (Selys, 1891)

A common and widespread species. Locations 6.b and 7.

47. *Orthetrum sabina sabina* (Drury, 1773)

A very common species, often found in highly disturbed habitats. Location 1.d.

48. *Pornothemis serrata* Krüger, 1902

A locally common species of swamp forest. Location 5.

49. *Raphismia inermis* Ris, 1910

A very poorly known and extremely local species, apparently a peat swamp forest specialist. One male and one female (Fig. 28) were collected. Locations 1.a and 5.



Figure 28. *Raphismia inermis*, female, Sebangau. Photograph by M. Silvius.

50. *Rhodothemis rufa* (Rambur, 1842)

A common and widespread species. Location 1.d.



51. *Rhyothemis phyllis phyllis* (Sulzer, 1776)

A common species of open and disturbed habitats. Location 7.

52. *Risiophlebia dohrni* (Krüger, 1902)*

A local swamp forest species, this is the first record from Central Kalimantan. Fig 29. Location 4.a.



Figure 29. *Risiophlebia dohrni*, male, Bereng Rambang. Photograph by M. Silvius.

53. *Tyriobapta laidlawi* Ris, 1919

A widespread swamp forest species, apparently confined to low pH habitats. Locations 1.a, 4.a, 5 and 6.a.

54. *Urothemis signata insignata* (Selys, 1872)

A fairly common open habitat species. Although it is certainly not confined to such habitats, it is often most abundant at black water sites. Location 6.b.

Discussion

Although the survey reported here was short, the results were very encouraging. Six of the species listed in Table 1 were rediscovered: *Podolestes atomarius*, *Elattoneura erythromma*, *Prodasineura abbreviata* *Prodasineura quadristigma*, *Amphicnemis panda-nicola* and *Amphicnemis platystyla*. Of these species, three (*P. atomarius*, *E. erythrom-*

ma and *A. platystyla*) were found at many of the sites surveyed and appear to be common in the remaining peat swamp forest in the area surveyed. The other three species were found at fewer sites and/or in much smaller numbers; in particular the two *Prodasineura* species were each found only at single sites, which were both completely unprotected.

The remaining three species listed in Table 1 were all described from locations further west than the survey area, and it is quite possible that they have never occurred in the survey area. Searches in and west of the Sampit area should be made for these species.

Teinobasis suavis was discussed in the Introduction. Whether or not the female from Sarawak is actually this species, it must be regarded as of high conservation concern at the moment; apparently there is no good forest habitat left around Ampah (e.g. the type locality appears to have been destroyed) and the location in Sarawak is unprotected and likely to be lost to development in the future. The priority for this species is for further searches to find extant populations.

Twelve species were recorded from Central Kalimantan for the first time (but also see note 1 in the appendix). Of these, four appear to be new to science, a remarkable number given the length of the survey, especially as three of these (*Amphicnemis* new species 1 and 2, *Coeliccia* new species) appear to be common at a number of sites. The other new species (*Prodasineura* new species) appears to be much more local in occurrence, it was found at only two sites; neither of these sites has any degree of protection.

Four of the other species recorded in the province for the first time (*Elattoneura coomansi*, *Aciagrion borneense*, *Agriocnemis minima* and *Mortonagrion aborense*) also appear to be common there. See the list of species found for a discussion of *Coeliccia* species and *Elattoneura longispina*. *Mortonagrion falcatum*, although widespread, is very local in occurrence, so it is not surprising that it was found at only one location. *Risioptionia dohrni* was only found at one location but might have been expected to be found at others, as it is a widespread swamp forest species, but was not found at many apparently suitable locations.

A number of species collected during the survey must be regarded as, at least potentially, of conservation concern; these are listed in Table 2. All species that appear to specialists of peat swamps and black water habitats are all included in the Table, even if they were common at a number of sites. This is because even though some of the peat swamp sites have some degree of protection (e.g. Begantung, Sebangau and Tuanan) they are still very vulnerable to threats such as fire and illegal logging. The discovery of at least four species new to science in a relatively short survey indicates a high probability of occurrence of many more species that are awaiting discovery in Central Kalimantan, and that many undiscovered species may be lost or highly threatened by the rapid demise of peat swamp forest habitat.



Species	Comment
<i>Podolestes atomaureus</i>	Apparent peat swamp forest specialist.
<i>Pachycypha aurea</i>	Apparent peat swamp forest specialist.
<i>Coelliccia</i> new species 1	Apparent peat swamp forest specialist.
<i>Coelliccia</i> species	Apparent peat swamp forest specialist; only found at one location.
<i>Elattoneura erythromma</i>	Apparent peat swamp forest specialist.
<i>Elattoneura longispina</i>	The form of this species found in peat swamp forest might be a distinct species, in which case it will be a peat swamp specialist.
<i>Prodasineura abbreviata</i>	Habitat at type location believed to have been destroyed; only found at one completely unprotected site in the 2012 survey; currently listed as Data Deficient in the IUCN Red List.
<i>Prodasineura quadristigma</i>	Habitat at type location believed to have been destroyed; only found at one completely unprotected site in the 2012 survey.
<i>Prodasineura</i> new species	Only found at two completely unprotected sites.
<i>Amphicnemis pandanicola</i>	Apparent peat swamp forest specialist; currently listed as Data Deficient in the IUCN Red List.
<i>Amphicnemis platystyla</i>	Apparent peat swamp forest specialist; currently listed as Data Deficient in the IUCN Red List.
<i>Amphicnemis</i> new species 1	Apparent peat swamp forest specialist.
<i>Amphicnemis</i> new species 2	Apparent peat swamp forest specialist.
<i>Mortonagrion forficulatum</i>	Apparent peat swamp forest specialist.
<i>Brachygonia ophelia</i>	Apparent peat swamp forest specialist; currently listed as Data Deficient in the IUCN Red List.
<i>Raphismia inermis</i>	Apparent peat swamp forest specialist.

Table 2: Species found in Central Kalimantan in 2012 and potentially of conservation interest.

Four of the species (*Prodasineura abbreviata*, *Amphicnemis pandanicola*, *Amphicnemis platystyla* and *Brachygonia ophelia*) listed in the Table are considered as Data Deficient in the IUCN Red List, none of the others have published threat assessments. The data obtained in the 2012 survey, in one case (*Brachygonia ophelia*) in conjunction with other data obtained since the Red List assessment was written, is likely to be sufficient to allow reassessment of *Amphicnemis pandanicola*, *Amphicnemis platystyla* and *Brachygonia ophelia* as Vulnerable; *Prodasineura abbreviata* would either remain as Data Deficient, or move to Endangered. Moreover, given the degree of threat that Southeast Asian peat swamp forest faces, any peat swamp forest specialist species that is not extremely widespread and that is assessed now and not Data Deficient would have to be placed in the Near Threatened or a higher threat category.

The survey has revealed that peat swamp forests in Central Kalimantan have a high importance to Odonata biodiversity conservation. During the survey no primary peat swamp forest was encountered. All forests, even in protected areas, had suffered ex-

tensively from logging, and most were bisected by illegal logging channels. At site 4 (Bereng Rambang) chainsaws were heard continuously during the survey work. Apart from logging, fire remains a high risk in all these peat swamp forests areas, including the protected areas, and without further conservation and habitat rehabilitation measures (including peatland rewetting by blocking drainage/logging channels) it seems only a matter of time before these forests and their specialist fauna to disappear.

The high number of peat swamp specialists found suggests that, contrary to common belief among scientists, peat swamp forests have a high number of endemics. The rapid rate of deforestation means that many such endemics may have been lost already, and many others are highly threatened. Effective conservation requires local knowledge and capacity. It is therefore a matter of utmost urgency to develop local awareness on the unique dragonfly fauna of peat swamp forests in Central Kalimantan and enhance local interest and capacity for the implementation of dragonfly surveys and research.

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Appendix: Checklist of Odonata recorded from Central Kalimantan

The list below is based on records from Dow (2010b), Dow *et al.* (2007), Dumont (2013), Lieftinck (1932, 1937, 1950a, 1950b, 1951, 1953a, 1953b, 1954, 1964, 1965), Orr (2002), Orr & Hämäläinen (2013), Ris (1911) and van Tol & Norma-Rashid (1995) as well as the results of the 2012 survey.

* - First record for Central Kalimantan made during the 2012 survey.

Zygoptera

Argiolestidae

1. *Podolestes atomarius* Lieftinck, 1950
2. *Podolestes furcifer* Lieftinck, 1950

Calopterygidae

3. *Neurobasis longipes* Hagen, 1887
4. *Vestalis amaryllis* Lieftinck, 1965
5. *Vestalis amoena* Hagen in Selys, 1853

Chlorocyphidae

6. *Heliocypha biseriata* (Selys, 1859)
7. *Libellago aurantiaca* Selys, 1859
8. *Libellago dorsocyana* Lieftinck, 1937
9. *Libellago hyalina* Selys, 1859
10. *Libellago lineata* (Burmeister, 1839)
11. *Libellago semiopaca* (Selys, 1873)
12. *Pachycypha aurea* Lieftinck, 1950
13. *Rhinocypha spinifer* Laidlaw, 1931
14. *Rhinocypha viola* Orr, 2002
15. *Sundacypha petiolata* (Selys, 1859)

Euphaeidae

16. *Dysphaea dimidata* (Selys, 1853)
17. *Dysphaea lugens* (Selys, 1873)
18. *Euphaea impar* Selys, 1859
19. *Euphaea subcostalis* (Selys, 1873)

Philosinidae

20. *Rhinagrion borneense* (Selys, 1886)

Platycnemididae

21. *Coeliccia* species *borneensis*-group
22. *Coeliccia nigrohamata* Laidlaw 1918 (note 1)
23. *Coeliccia* new species *membranipes*-group*
24. *Coeliccia* species *membranipes*-group 2* (note 1)
25. *Copera vittata* (Selys, 1863)
26. *Elattoneura analis* (Selys, 1860)
27. *Elattoneura aurantiaca* (Selys, 1886)
28. *Elattoneura coomansi* Lieftinck, 1937*
29. *Elattoneura erythromma* Lieftinck, 1953
30. *Elattoneura longispina* Lieftinck, 1937*
31. *Prodasineura abbreviata* Lieftinck, 1951
32. *Prodasineura interrupta* (Selys, 1860)
33. *Prodasineura quadristigma* Lieftinck, 1951
34. *Prodasineura tenebricosa* Lieftinck, 1937
35. *Prodasineura* new species*

Coenagrionidae

36. *Aciagrion borneense* (Ris, 1911)*
37. *Agriocnemis femina femina* (Brauer, 1868)
38. *Agriocnemis minima* (Selys, 1877)*
39. *Amphicnemis dactylostyla* Lieftinck, 1953
40. *Amphicnemis erminea* Lieftinck, 1953
41. *Amphicnemis pandanicola* Lieftinck, 1953
42. *Amphicnemis platystyla* Lieftinck, 1953
43. *Amphicnemis* new sp 1*
44. *Amphicnemis* new sp 2*
45. *Archibasis incisura* Lieftinck, 1949
46. *Archibasis melanocyana* (Selys, 1877)
47. *Archibasis tenella* Lieftinck, 1949
48. *Archibasis viola* Lieftinck, 1948
49. *Ceriagrion cerinorubellum* (Brauer, 1865)
50. *Ischnura senegalensis* (Rambur, 1842)
51. *Mortonagrion aboreense* (Laidlaw, 1914)*
52. *Mortonagrion falcatum* Lieftinck, 1934*
53. *Mortonagrion forficulatum* Lieftinck, 1953
54. *Onychargia atrocyana* (Selys, 1865)
55. *Pericnemis ?kiautarum* Orr & Hämäläinen, 2013 (note 2)
56. *Pseudagrion coomansi* Lieftinck, 1937
57. *Teinobasis suavis* Lieftinck, 1953



Anisoptera**Aeshnidae**

58. *Gynacantha dohrni* Krüger, 1899
59. *Heliaeschna uninervulata* Martin, 1909
60. *Tetracanthagyna plagiata* (Waterhouse, 1877)

Gomphidae

61. *Burmagomphus plagiatus* Lieftinck, 1964
62. *Ictinogomphus acutus* (Laidlaw, 1914)
63. *Ictinogomphus decoratus melaenops* (Selys, 1858)
64. *Macrogomphus decemlineatus* (Selys, 1878)
65. *Macrogomphus parallelogramma albardae* (Selys, 1878)
66. *Microgomphus chelififer* (Selys, 1858)

Macromiidae

67. *Epophthalmia vittigera* (Rambur, 1842)
68. *Macromia arachnomima* Lieftinck, 1953
69. *Macromia cincta* Rambur, 1842
70. *Macromia cydippe* Laidlaw, 1922
71. *Macromia mnemosyne* Lieftinck, 1935

Libellulidae

72. *Acisoma panorpoides* Rambur, 1842
73. *Brachydiplax chalybea* Brauer, 1868
74. *Brachydiplax farinosa* Krüger, 1902
75. *Brachygonia oculata* (Brauer, 1878)
76. *Brachygonia ophelia* Ris, 1910
77. *Brachygonia puella* Lieftinck, 1937
78. *Chalybeothemis fluviatilis* Lieftinck, 1933
79. *Cratilla lineata* (Brauer, 1878)
80. *Cratilla metallica* (Brauer, 1878)
81. *Crocothemis servilia* (Drury, 1773)
82. *Diplacodes trivialis* (Rambur, 1842)
83. *Lyriothemis biappendiculata* (Selys, 1878)
84. *Lyriothemis cleis* Brauer, 1868
85. *Nannophya pygmaea* Rambur, 1842
86. *Nannophyopsis chalcosoma* Lieftinck, 1935
87. *Neurothemis fluctuans* (Fabricius, 1793)
88. *Onychothemis coccinea* Lieftinck, 1953
89. *Onychothemis culminicola* Förster, 1904
90. *Orchithemis pruinans* (Selys, 1878)

91. *Orchithemis pulcherrima* Brauer, 1878
92. *Orchithemis xanthosoma* Laidlaw, 1911
93. *Orthetrum chrysis* (Selys, 1891)
94. *Orthetrum glaucum* (Brauer, 1865)
95. *Orthetrum pruinosum schneideri* Förster, 1903
96. *Orthetrum sabina* (Drury, 1773)
97. *Orthetrum testaceum* (Burmeister, 1839)
98. *Pantala flavescens* (Fabricius, 1798)
99. *Pornothemis serrata* Krüger, 1902
100. *Pornothemis starrei* Lieftinck, 1948
101. *Raphismia inermis* Ris, 1910
102. *Rhodothemis rufa* (Rambur, 1842)
103. *Rhyothemis aterrima* Selys, 1891
104. *Rhyothemis fulgens* Kirby, 1889
105. *Rhyothemis obsolescens* Kirby, 1889
106. *Rhyothemis phyllis* (Sulzer, 1776)
107. *Rhyothemis triangularis* Kirby, 1889
108. *Risiophlebia dohrni* (Krüger, 1902)*
109. *Tholymis tillarga* (Fabricius, 1798)
110. *Tyriobapta laidlawi* Ris, 1919
111. *Tyriobapta torrida* Kirby, 1889
112. *Urothemis signata insignata* (Selys, 1872)
113. *Zygonyx iris errans* Lieftinck, 1953
114. *Zyxomma petiolatum* Rambur, 1842

Notes

Note 1: Lieftinck (1953b) recorded *C. resecta* Lieftinck, 1953 from the Sampit area, or inland from that area, of Central Kalimantan. Orr (2003) treated *C. resecta* as a synonym of *C. nigrohamata* and we follow the same course here, pending the completion of a revision of the *membranipes*-group by the first author. As noted in the species found section of this paper, *C.* species from location 4.a (Bereng Rambang) is morphologically very close to *C. nigrohamata* but differs in the markings of the male; the two species are provisionally considered as separate here.

Note 2: Orr & Hämäläinen (2013) state that a specimen very like *P. kiautarum* from Central Kalimantan is in collection R.A. Dow; this is incorrect, the specimen is in the collections of the Naturalis Biodiversity Centre.



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