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A Survey of the Odonate Diversity of the Palni Hills, Western Ghats, India

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Abstract

The odonates recorded during four brief surveys conducted in the Lower Palni Hills, Western Ghats, India in 2022 and 2024 are reported. Thirty-seven species were recorded, including a gomphid that does not match the description of any known species. Fourteen of the species recorded represent additions to the odonate fauna of the Palnis. Remarks are made on the habitats that were surveyed. The updated checklist is presented.

Key words: Odonata, Western Ghats, Palni Hills, India, Gomphidae, *Anisogomphus*, endemism

Introduction

The Western Ghats (Figure 1) are one of the global biodiversity hotspots (Myers et al. 2000). Some 200 dragonfly species have been recorded from the Western Ghats, of which 74 species are endemic to these mountains (Subramanian et al. 2018). Several new Western Ghats species have been described since 2018 (e.g. Babu & Subramanian 2019; Chandran et al. (2024a, b, c); Dalvi et al. 2024; Anooj et al. 2025; Chandran et al. 2025), enhancing the number of endemic species significantly.

Within the Western Ghats, the hills south of latitude 13°N have been identified as having high levels of endemism. The Anamalai–Palani–Kodaikanal complex, located in the southern part of the Western Ghats, is one of the sections that have been identified as high-priority areas for conservation of dragonflies (Subramanian et al. 2018). This work was conducted in the Palni Hills, which fall in this complex.

The Palni Hills, or Palnis (Figure 2), are a spur of the Western Ghats running roughly in the north-easterly direction. They are located between latitudes 10° 1′ N and 10° 26′ N and between longitudes 77° 14′ E and 77° 52′ E. The Palnis are about 86 km long, and their width is about 24 km. The total area of the Palni Hills is around 2050 km^2. Two sections can be distinguished in the Palnis: the higher Upper Palnis (average altitude 2100 m), in the west, and the Lower Palnis (900–1200 m high), in the east. The popular tourist destination Kodaikanal, a hill station, is located in the central portion of the Palni Hills (Imperial Gazetteer of India, 1908).

F.C. Fraser (1923) made collections of dragonflies in these hills in 1908. The Palnis were subsequently explored for dragonflies in 1922 and 1923 by T. Bainbigge Fletcher, A.G. Frere and S. Kemp. They made collections of dragonflies, which they sent to Fraser. He referred to this material in various publications (Fraser (1923, 1924, 1931, 1933, 1934, 1936)).

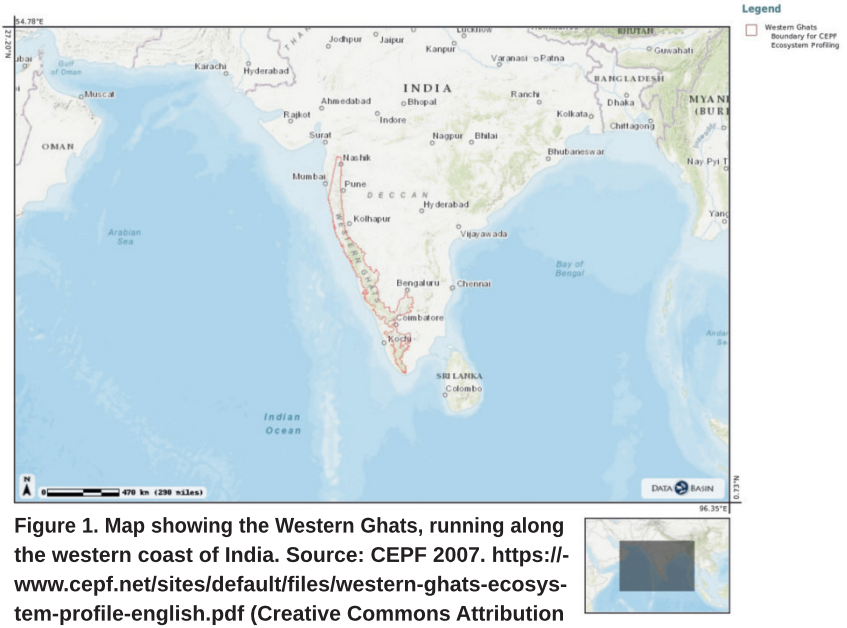

Figure 1. Map showing the Western Ghats, running along the western coast of India. Source: CEPF 2007. https://-www.cepf.net/sites/default/files/western-ghats-ecosystem-profile-english.pdf (Creative Commons Attribution 3.0 License)

The collections of Fraser and his associates were made at altitudes above 5000 feet (1500 m) and, to use Fraser's (1923) words, 'cannot be said to be truly representative of the whole of the Palnis'. Since the initial efforts, made around 100 years back, no systematic documentation of the dragonflies of the Palni Hills has been published. Thus, relatively little is known about the dragonflies of the Palnis.

Material and methods

Surveys

Previously, we carried out a survey of the Upper Palnis (in 2015) and made incidental observations in the Lower Palnis (in Perumbarai (in 2011, 2012 and 2014) and in Pethuparai (2017)). Our findings will be published in a work under preparation.

It was not evident from our previous experience what the best time of the year was for studying dragonflies in the Palnis. So we chose to conduct the initial surveys of the present work at the earliest opportunity. First we carried out two surveys in 2022 (one each in September and October).

It was rainy during this period, more so in October, and the streams were all in full spate. Though we found dragonflies, the conditions were not ideal, and so we decided to continue the surveys only in summer (the following March and later). However, because of a setback, we were able to conduct two more surveys only in 2024.

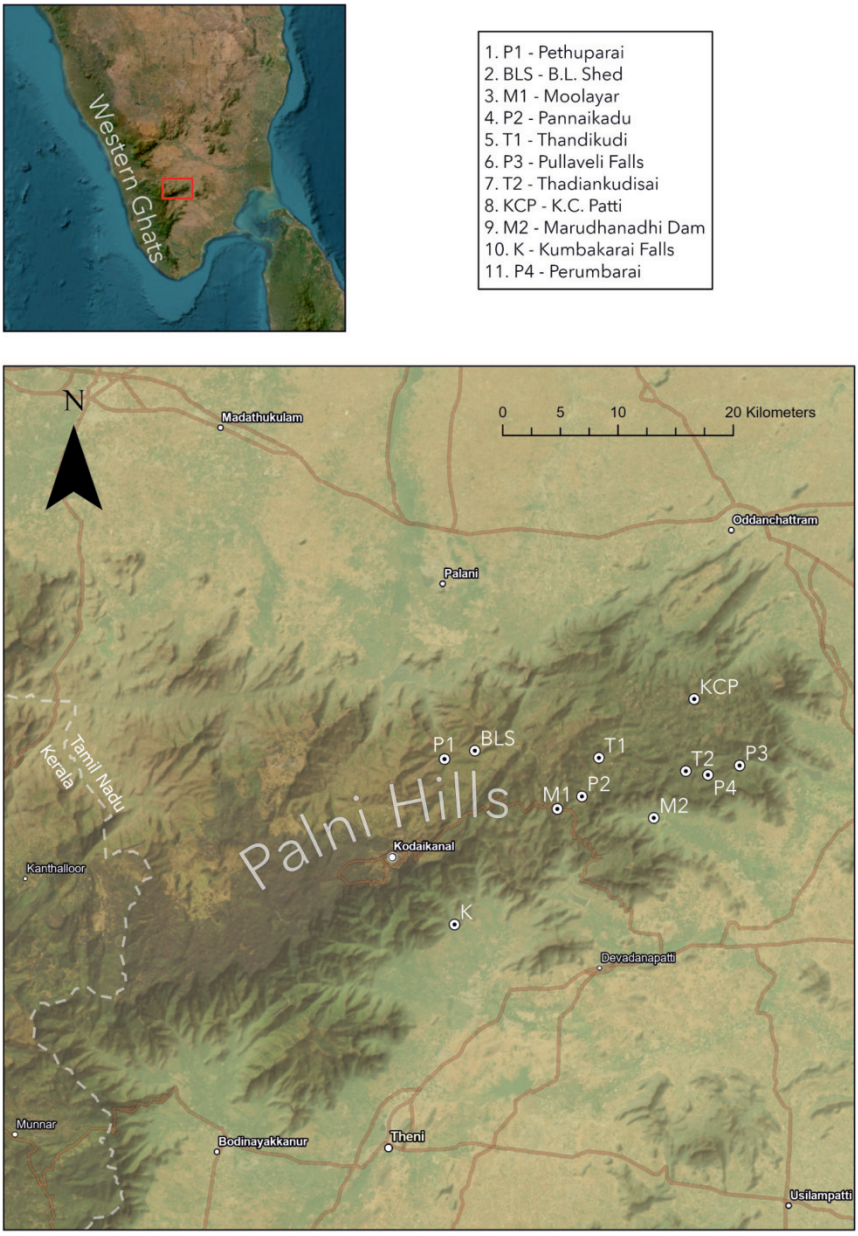

Figure 2. Overview of survey sites of 2022 and 2024. Image made by Kedaravindan Bhaskar using ArcGIS Pro. Data layers — (1) Digital elevation model (source: United States Geological Survey), (2) Basemap (Earthstar Geographics)

Localities

In this section, we have described briefly the locations we surveyed, indicating their approximate altitudes and coordinates. We have referred to the locations using the names of settlements and habitations close to them. The locations surveyed are indicated in Figure 2.

P1. Pethuparai (10°18'29.13" N, 77°31'22.88" E; 1500 m): Pethuparai is around 12 km from Kodaikanal. Two major streams meet close to Pethuparai before winding along to a waterfall. These streams flow through a mosaic of forest and plantations, primarily coffee and orange plantations. In wet weather, numerous rivulets come alive and feed into the two perennial streams. At the locations surveyed, the two large streams are broad and open. The banks are either rocky and devoid of vegetation or are sandy and support emergent plants, sometimes opposite banks at one point being of different types (Figure 3).

BLS. B.L. Shed (10°18'52.60"N, 77°32'48.11"E; 1700 m): B.L. Shed is situated in a valley adjacent to Pethuparai. The survey location was below a bridge across a stream. The stream is open to the sky at this point. Upstream, it flows through a boulder-filled sloping course bordered by dense shrubbery that discourages exploration (Figure 4). In the other direction, the stream grows broader and flows through a level stretch covered by the canopy of tall trees.

M1. Moolayar (10°16'9.93"N, 77°36'39.48"E; 1200 m): There is a relatively narrow stream at Moolayar. It passes under a bridge on the main road up the hills to Kodaikanal. There is a short open section on the upstream side of the bridge. Downstream, access is difficult. There is considerable evidence of human use of the stream at this point in the form of various discarded objects, packaging, et cetera.

P2. Pannaikadu (10°16'44.81"N, 77°37'48.40"E; 1370 m): Rivulets near Pannaikadu that pass through forest or cultivated lands. The beds and banks are correspondingly clean or cluttered with debris, respectively. These rivulets are covered by the canopy (Figure 5).

T1. Thandikudi (10°18'32.54"N, 77°38'36.11"E; 1340 m): Thandikudi is the name of a village surrounded by coffee estates. One boggy area fed by a rivulet was surveyed (Figure 6). We noted dragonflies opportunistically at a coffee estate in Thandikudi.

P3. Pullaveli Falls (10° 18' 11.11" N, 77° 45' 10.74" E; 850 m): The stream at Pullaveli is broad and open in general, but it is constricted at one point. A track running along this stream for some distance affords access to the water all along (Figure 7). There are plantations on either side of the stream on this stretch.

T2. Thadiankudisai (10°17'55.51"N, 77°42'39.95"E; 1080 m): We surveyed a stream adjoining the Horticultural Research Station, near Perumbarai. It is open at the point where it flows below a small bridge, and it is covered by the canopy both upstream and downstream (Figure 8). The vegetation on the banks includes both tall forest trees and lower shrubs. The access provided by the road appears to be the source of pollution in the form of various objects found in the water.

KCP. K.C. Patti (10°21'16.62"N, 77°43'3.41"E; 1220 m): We surveyed this location once. There is a promising stream here, within private land. The water was high in the stream

Figure 3. View of the merged stream at Pethuparai above the waterfall.

Figure 4. Upstream section of stream at B.L. Shed.

Figure 5. Pool in drying stream bed at Pannaikadu.

Figure 6. Boggy patch adjoining rivulet at Thandikudi.

Figure 7. View of narrow section of stream at Pullaveli Falls.

Figure 8. Downstream view of the stream at Thadiankudisai.

Figure 9. View of reservoir at Marudhanadhi.

Figure 10. Signboard at Kumbakarai Falls.

and the current was rapid when we visited the place. There were few dragonflies in evidence then.

M2. Marudhanadhi Dam (10°15'44.70"N, 77°41'10.07"E; 340 m): Marudhanadhi is located at the foothills, where a stream feeds a reservoir (Figure 9). The water comes down a forested slope and passes through coconut plantations on its way to the reservoir. Thus, at this location there were both dragonflies that breed in running water and those that breed in still water. We visited Marudhanadhi Dam once. A survey conducted when the inflow is moderate and the weather is sunny is likely to provide records of more species.

K. Kumbakarai Falls (10°10'47.23"N, 77°31'51.05"E; 380 m): Our survey was in summer, and the level of the stream was low. According to local people, the water flow in the stream is considerably greater at certain times. Kumbakarai is at the foothills, and tourists visit the stream to bathe in it when there is a good flow of water (Figure 10). The Tamil Nadu Forest Department are taking efforts to prevent pollution of the water arising from the tourism.

P4. Perumbarai (10°17'44.91"N, 77°43'41.88"E; 1030 m): This is a location that we had visited only previously. Access was not available during the surveys of 2022 and 2024. There is a manmade pool in a private property (Perumbarai Environmental Centre) at Perumbarai. In the course of our previous surveys, we found species here, such as *Tetrathemis platyptera* Selys, 1878 (Figure 11) and *Zyxomma petiolatum* Rambur, 1842, that we did not encounter in the present work.

Figure 11. *Tetrathemis platyptera* (male) at Perumbarai.

Results

Recorded species

We recorded thirty-seven odonate species, including one form that did not match the description of any known species and two species whose identity we could not confirm. Fourteen species are additions to the regional fauna, and these are each indicated in the following list with an asterisk.

Zygoptera

Calopterygidae

1. *Neurobasis chinensis* — **BLS**, ♂♀ breeding, 11.9.2022; **M2**, ♂, 17.10.2022; **P3**, 12.9.2022; **K**, ♂, 21.4.2024; **T2**, ♂♀, 30.4.2024, 1.5.2024; **P1**, ♂♀, 1.5.2024; **P3**, ♂♀, 2.5.2024
2. **Vestalis apicalis* — **K**, ♂♀, 21.4.2024. This species is endemic to India and Sri Lanka (Dow 2009a); (Figure 12).

Figure 12. *Vestalis apicalis*, Kumbakarai Falls.

Chlorocyphidae

3. *Heliocypha bisignata* — **BLS**, ♂, 11.9.2022; **M2**, ♂, 17.10.2022; **T2**, ♂, 12.9.2022; **K**, ♂♀, 21.4.2024; **P2**, ♂♀, 1.5.2024; **P1**, ♂♀, 1.5.2024; **T2**, 1.5.2024; **P3**, ♂♀ breeding, 2.5.2024

Coenagrionidae

4. **Aciagrion approximans* — **T1**, ♂♀ , 12.9.2022, ♀ , 13.9.2022. The subspecies *Aciagrion approximans krishna* is endemic to the Western Ghats (Joshi et al. 2016).
5. **Agriocnemis pygmaea* — **K**, ♂ , 21.4.2024; **T1**, ♂ , 2.5.2024
6. **Ceriagrion coromandelianum* — **M2**, 17.10.2022
7. **Ischnura rubilio* — **M1**, ♂ , 1.5.2024
8. *Pseudagrion decorum* — **M2**, ♂ , 17.10.2022
9. **Pseudagrion rubriceps* (Figure 13) — **M2**, ♂ , 17.10.2022; **M1**, ♂♀ breeding, 1.5.2024; **P1**, ♂ , 1.5.2024; **P3**, ♂♀ breeding, 2.5.2024

Figure 13. Pair of *Pseudagrion rubriceps* at Pethuparai.

Euphaeidae

10. *Euphaea cardinalis* — **P1**, ♂ , 10.9.2022; **BLS**, ♂ , 11.9.2022; **T2**, ♂ , 12.9.2022; This species is endemic to India (Mitra 2002).

Lestidae

11. *Indolestes gracilis* — **P1**, ♂ , 26.12.2017. We found the subspecies *Indolestes gracilis davenporti*, which is endemic to the southern Western Ghats (Subramanian et al. 2018).

Platycnemididae

12. *Esme cyaneovittata* — **P1**, ♂♀ breeding, 10.9.2022; **BLS**, ♂♀ breeding, 11.9.2022; **P2** [**T1**-road forest stream], ♂ , 11.9.2022, 1.5.2024; **P3**, 2.5.2024. *Esme cyaneovittata* is endemic to the southern Western Ghats (Kakkassery 2011a; Emiliyamma et al. 2007).

13. *Esme mudiensis* Fraser, 1931 — **P3**, ♂, 12.9.2022; **P2**, ♂, 1.5.2024; **P1** ♂, 1.5.2024 (not confirmed). This species is endemic to the southern Western Ghats (Kakkassery 2011b).
14. *Copera marginipes* — **P3**, ♂ (pale form), 2.5.2024
15. **Copera vittata* — **P3**, ♂♀, 12.9.2022; **P1**, ♂, 1.5.2024

Unidentified *Copera* species — **M2**, ♂, 17.10.2022; **K**, 21.4.2024. The species involved were probably *Copera marginipes* or *Copera vittata*.

16. *Prodasineura verticalis* — **P3**, ♂♀, 12.9.2022; **K**, ♂♀ breeding, 21.4.2024; **P1**, ♂, 1.5.2024; **P3**, ♂♀ breeding, 2.5.2024

Platystictidae

17. **Protosticta gravelyi* (Figure 14) — **P3**, ♂♀, 12.9.2022. This species is endemic to the Western Ghats and adjoining areas (Subramanian 2011).

Figure 14. *Protosticta gravelyi* at Pullaveli Falls.

Anisoptera

Aeshnidae

18. *Anax immaculifrons* — **M1**, ♂, 11.9.2022; **P3**, 12.9.2022. An *Anax* dragonfly observed flying rapidly at **BLS**, 11.9.2022 was tentatively identified as belonging to this species. However, *Anax guttatus* and *A. indicus* have also been recorded in the Palni Hills (Table 1), and these species cannot be excluded.

Gomphidae

19. **Anisogomphus* (?) species (Figure 15) — **P2**, ♂, 1.5. 2024. A single male gomphid dragonfly that does not match the description of any known species was found.
20. **Paragomphus lineatus* — **K**, ♂, 21.4.2024

Libellulidae

21. *Brachythemis contaminata* — **M2**, ♀, 17.10.2022; **P3**, ♀, 12.9.2022, ♂♀, 2.5.2024; **K**, ♂♀, 21.4.2024; **T2**, ♂, 30.4.2024; **M1**, ♂, 1.5.2024; **P1**, ♂, 1.5.2024

Figure 15. Unidentified male gomphid at Pannaikadu, possibly of a hitherto undescribed species.

22. *Diplacodes trivialis* — **P1**, ♀ , 11.9.2022; **K**, ♂♀ , 21.4.2024; **P3**, ♀ , 2.5.2024
23. *Hylaeothemis apicalis* — **T2**, ♂ , 12.9.2022. *Hylaeothemis apicalis* is endemic to India (Dow 2009b).
24. **Lathrecista asiatica* — **T1**, ♂ , 30.4.2024, 1.5.2024
25. *Orthetrum chrysis* — **M1**, ♂ , 26.12.2017; **P3**, ♂ , 12.9.2022, ♂ , 2.5.2024; **M1**, ♂ , 1.5.2024
26. *Orthetrum glaucum* — **P1**, ♀ , 11.9.2022; **M2**, ♂ , 17.10.2022; **P3**, ♂ , 12.9.2022; **M1**, ♂ , 1.5.2024
27. *Orthetrum luzonicum* — **P1**, ♂♀ , 1.5.2024
28. *Orthetrum pruinosum* — **T1**, ♂ , 12.9.2022; KCP, 13.9.2022; **M1**, ♂ , 1.5.2024; **P2**, ♂ , 2.5.2024
29. **Orthetrum sabina* — **P1**, 11.9.2022, 1.5.2024; **K**, 21.4.2024; **M1**, ♂♀ breeding, 1.5.2024
30. *Orthetrum triangulare* — **P2**, ♂ , 1.5.2024
31. *Palpopleura sexmaculata* — **P1**, ♂♀ , 1.5.2024 (not confirmed). The insects were restless and flew away swiftly. Hence they could not be observed clearly.
32. *Pantala flavescens* — **K**, ♂♀ , 21.4.2024; **P1**, 1.5.2024
33. **Potamarcha congener* — **K**, ♀ , 21.4.2024
34. **Tholymis tillarga* — **T2**, 1.5.2024
35. *Trithemis aurora* — **M2**, ♂ , 17.10.2022; **K**, ♂ , 21.4.2024; **P1**, ♂ , 1.5.2024; **P3**, ♂ , 2.5.2024

36. *Trithemis festiva* — **P3**, ♂, 12.9.2022; **K**, ♂, 21.4.2024; **P1**, ♂, 1.5.2024; **P3**, ♂, 2.5.2024
37. *Zygonyx iris* — **P3**, 12.9.2022; K, 21.4.2024; **P1**, 1.5.2024; **P3**, 2.5.2024

Discussion

A total of 38 species are mentioned explicitly by Fraser (1923, 1924, 1931, 1933, 1934, 1936) as being found in the Palnis. Manikandan et al. (2023) recorded 10 species at Thadiankudisai (Lower Palnis), of which four are additions to those recorded by Fraser. Thus what is known about the dragonflies of the Palni Hills owes mostly to Fraser's efforts. The information available about dragonflies in the Palni Hills must be considered limited in light of the rich dragonfly diversity of the Western Ghats as a whole and in light of Fraser's description of the altitudinal scope of his work in the Palnis: As stated previously, the Palnis are among the highest ranges of the Western Ghats. Thus it is reasonable to expect that the Palnis support a wide range of the dragonfly habitats of the Western Ghats. Whereas Fraser (1923) stated that the Palni Hills collections which he referred to in his publications were extensive, he said that they had been made only at the highest elevations.

Given the part of the Palnis that Fraser had concentrated on, as well as our survey in 2015, we chose to focus on the Lower Palnis and thereby complement his work. We anticipated that we would find a great diversity of odonate forms, including endemic species and forms that had not been described.

During our surveys, we recorded 37 dragonfly species, including one form that has possibly not been described as a species so far. Fourteen of the taxa, including the possible new form, documented by us are first records for the Palni Hills. The checklist of the Palni Hills presently has 55 taxa (Table 1).

We have identified a new gomphid (Figure 15), tentatively as belonging to the genus *Anisogomphus*, and we intend to describe the new taxon subsequently.

Other significant records include *Vestalis apicalis* (Figure 12), *Protosticta gravelyi* (Figure 14) and *Hylaeothemis apicalis*. The first two of these species are known to be endemic to the Western Ghats; the third has been reported only from eastern India apart from the Western Ghats.

We came across species that Fraser had stated were not found in his Palnis collections. These include *Lathrecista asiatica, Potamarcha congener* and *Pseudagrion rubriceps* (Figure 13).

We believe that the Palnis reveal their odonate wealth but slowly and that further surveys will be very productive.

Acknowledgement

We thank Mr. Rameshwaran for his companionship, guidance and support during the 2022 surveys. It was thanks to his sharp observation that we spotted the *Protosticta gravelyi* damselflies and photographed them. Our surveys were supported by the International Dragonfly Fund.

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Appendix 1

Table 1: Checklist of odonate species of the Palni Hills. *, species added to the checklist by the present work; †, species added to Fraser's list by Manikandan et al. (1922); ?, not confirmed.

Serial number	Species	Source					
		Fraser				Manikandan et al, 2022	Present survey
		1923	1924	1931	1933, 1934, 1936		
1	*Neurobasis chinensis* (Linnaeus, 1758)			Yes	Yes		Yes
2	*Vestalis apicalis* Selys, 1873						Yes*
3	*Heliocypha bisignata* (Hagen in Selys, 1853)				Yes	Yes	Yes
4	*Aciagrion approximans* (Selys, 1876)						Yes*
5	*Agriocnemis pygmaea* (Rambur, 1842)						Yes*
6	*Ceriagrion coromandelianum* (Fabricius, 1798)						Yes*
7	*Ischnura rubilio* Selys, 1876						Yes*
8	*Pseudagrion australasiae* Selys, 1876	Yes					
9	*Pseudagrion decorum* (Rambur, 1842)		Yes				Yes
10	*Pseudagrion malabaricum* Fraser, 1924		Yes	Yes	Yes		
11	*Pseudagrion rubriceps* Selys, 1876						Yes*
12	*Euphaea cardinalis* (Fraser, 1924)			Yes	Yes	Yes	Yes
13	*Euphaea fraseri* (Laidlaw, 1920)					Yes†	
14	*Indolestes gracilis* (Hagen in Selys, 1862)	Yes	Yes	Yes	Yes		Yes
15	*Esme cyaneovittata* Fraser, 1922	Yes	Yes		Yes		Yes
16	*Esme mudiensis* Fraser, 1931					Yes†	?
17	*Copera marginipes* (Rambur, 1842)		Yes				Yes
18	*Copera vittata* (Selys, 1863)						Yes*
19	*Prodasineura verticalis* (Selys, 1860)		Yes				Yes
20	*Protosticta gravelyi* Laidlaw, 1915						Yes*
21	*Anaciaeschna martini* Selys, 1897	Yes	Yes	Yes	Yes		
22	*Anax guttatus* (Burmeister, 1839)	Yes					
23	*Anax immaculifrons* Rambur, 1842	Yes	Yes	Yes			Yes
24	*Anax indicus* Lieftinck, 1942					Yes†	
25	*Anisogomphus*(?) species						Yes*
26	*Asiagomphus nilgiricus* (Laidlaw, 1922)		Yes	Yes	Yes		
27	*Lamelligomphus nilgiriensis* (Fraser, 1922)				Yes		
28	*Paragomphus lineatus* (Selys, 1850)						Yes*
29	*Epophthalmia frontalis* Selys, 1871		Yes				
30	*Acisoma panorpoides* Rambur, 1842	Yes	Yes				
31	*Brachythemis contaminata* (Fabricius, 1793)	Yes	Yes			Yes	Yes
32	*Crocothemis servilia* (Drury, 1773)	Yes					
33	*Diplacodes trivialis* (Rambur, 1842)	Yes				Yes	Yes
34	*Hemicordulia asiatica* Selys, 1878	Yes	Yes		Yes		
35	*Hylaeothemis apicalis* Fraser, 1924		Yes			Yes	Yes
36	*Indothemis carnatica* (Fabricius, 1798)	Yes	Yes				
37	*Lathrecista asiatica* (Fabricius, 1798)						Yes*
38	*Neurothemis intermedia* (Rambur, 1842)		Yes				
39	*Orthetrum chrysis* (Selys, 1891)					Yes†	Yes
40	*Orthetrum glaucum* (Brauer, 1865)	Yes		Yes			Yes
41	*Orthetrum luzonicum* (Brauer, 1868)	Yes	Yes	Yes			Yes
42	*Orthetrum pruinosum* (Burmeister, 1839)	Yes		Yes			Yes
43	*Orthetrum sabina* (Drury, 1773)	Yes		Yes			Yes
44	*Orthetrum taeniolatum* (Schneider, 1845)			Yes			
45	*Orthetrum triangulare* (Selys, 1878)	Yes	Yes	Yes			Yes
46	*Palpopleura sexmaculata* (Fabricius, 1787)	Yes	Yes				?*
47	*Pantala flavescens* (Fabricius, 1798)	Yes		Yes		Yes	Yes
48	*Potamarcha congener* (Rambur, 1842)						Yes*
49	*Sympetrum fonscolombii* (Selys, 1840)	Yes	Yes	Yes	Yes		
50	*Tholymis tillarga* (Fabricius, 1798)						Yes*
51	*Tramea limbata* (Desjardins, 1835)	Yes					
52	*Trithemis aurora* (Burmeister, 1839)	Yes	Yes				Yes
53	*Trithemis festiva* (Rambur, 1842)	Yes	Yes	Yes			Yes
54	*Trithemis pallidinervis* (Kirby, 1889)	Yes	Yes				
55	*Zygonyx iris* Selys, 1869				Yes		Yes

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