Dragonflies and Damselflies (Insecta: Odonata) of Aryanad Grama Panchayat, Kerala, India

Reji Chandran 1 & A. Vivek Chandran 2

1,2 Society for Odonate Studies, Vellooparampil, Kuzhimattom PO, Kottayam, Kerala 686533, India.
2 Department of Geology and Environmental Science, Christ College, Irinjalakuda, Thrissur, Kerala 680125, India.
1 itsreji.chandran@gmail.com, 2 avivekchandran2@gmail.com (corresponding author)

Abstract: A year-long study to document the diversity and seasonality of odonates was conducted at Aryanad Grama Panchayat, Thiruvananthapuram district, Kerala, southern India. A total of 93 species (56 dragonflies and 37 damselflies) belonging to 12 families were recorded. Twenty-four species of odonates recorded are endemic to the Western Ghats, three to peninsular India and one to India. Small streams showed the highest species richness, hosting 69 species and ponds the lowest with 59 species. Species richness showed a peak during the southwest monsoon season and a dip in winter. The study highlights the importance of biodiversity documentation at regional level.

Keywords: Endemic, seasonality, southern India, species richness, Western Ghats.
INTRODUCTION

Protected areas are the cornerstones of global biodiversity conservation efforts. India has established a network of protected areas covering approximately 4.8% of its geographical area, but it is impossible to bring the entire range of biodiversity under this network (Mathur & Sinha 2008). It is therefore, imperative that we take measures to document and conserve biodiversity outside protected areas. Under the Biological Diversity Act of 2002, the Grama Panchayats in India are mandated to form Biodiversity Management Committees (BMCs) for the documentation, conservation and sustainable use of bioresources. Kerala is the first state in India to form BMCs in all its local bodies (Kerala State Biodiversity Board 2021). However, the documentation of insect biodiversity is incomplete in most of the People’s Biodiversity Registers (PBRs) prepared by the BMCs.

Dragonflies and damselflies, which together form the insect Order Odonata are considered as important components of freshwater ecosystems as well as good indicators of ecosystem health because of their amphibious life history, relatively short generation time, high trophic position and diversity (Corbet 1993; Clark & Samways 1996). Biodiversity of insects is threatened worldwide (Sánchez-Bayo & Wyckhuys 2019) and one in 10 species of dragonflies and damselflies is threatened with extinction (Clausnitzer et al. 2009). This global decline of insect populations is feared to cause a catastrophic collapse of earth’s ecosystems (May 2010). The endemic species of odonates have a narrow distribution across the Western Ghats, occurring in only small patches of suitable habitats (Subramanian et al. 2011; Koparde et al. 2014). Aryanad (8.556–8.677 °N & 77.071–77.224 °E) is an agricultural village under the foothills of Agasthyamalai of southern Western Ghats in Thiruvananthapuram district, Kerala (Figure 1). The predominant crops grown here are coconut, rubber, banana, and vegetables (Government of Kerala 2021). Aryanad lies adjacent to the Peppara Wildlife Sanctuary and the Karamana River that originates in the Western Ghats flows through the village.

MATERIALS AND METHODS

Four ponds (with area less than 30 m²), three small streams (with width approximately 0.5 m), five large streams (with width approximately 2 m) and the Karamana River having a width of approximately 6 m were selected in Aryanad Grama Panchayat for sampling odonates (Image 1). Each habitat was visited once every month from 1 December 2019 to 30 November 2020. Visual encounter surveys (VES) were done to...
document the odonates, where the observer walked along the edge of each waterbody for 20 minutes and recorded all the odonate species encountered. All the field visits were made between 0900 h and 1100 h. The odonates were photographed using a Nikon Z6 mirror-less camera and Nikon 105 mm macro lens. The individual odonates were identified to the species level referring to taxonomic monographs (Fraser 1933, 1934, 1936) and field guides (Subramanian 2005, 2009; Kiran & Raju 2013). A checklist was prepared using systematic arrangement and taxonomy according to Kalkman et al. 2020. The study period was divided into four seasons for data analysis—winter (December–February), summer (March–May), south-west monsoon (June–August), and north-east monsoon (September–November).

RESULTS AND DISCUSSION

A total of 93 species of odonates (56 dragonflies and 37 damselflies) from 12 families were recorded from Aryanad Grama Panchayat (Table 1, Images 2–6). This accounts for more than half (53%) of the odonate species recorded from the state of Kerala till date (Society for Odonate Studies 2021). In comparable studies, only 82 species of odonates were recorded from Thattekad Bird Sanctuary (Varghese et al. 2014) and 48 from Chinmar Wildlife Sanctuary (Adarsh et al. 2015). The high odonate diversity documented from Aryanad Grama Panchayat is probably due to the diverse habitats it sustains and its proximity to forests including those of Peppara Wildlife Sanctuary. Out of the 93 species recorded from Aryanad, 24 are endemic to the Western Ghats, three to Peninsular India and one to India. Small streams had the highest species count and ponds the least (Figure 2). The species richness showed a peak during the south-west monsoon when 90 species were recorded and a dip in winter, when only 30 species could be seen (Figure 3).

The records of the following species are significant considering their endemicity, rarity and threat status (Subramanian et al. 2018; IUCN 2021):

**Protosticta sanguinostigma** Fraser, 1922

This species, easily identified by the reddish brown equatorial band in its eyes and the peculiar shape of anal appendages is categorized as ‘Vulnerable’ by the International Union for Conservation of Nature and Natural Resources (IUCN) in its Red List of Threatened Species. It was recorded only from the lotic habitats of Aryanad and was unrecorded during winter.

**Calocypha laidlawi** (Fraser, 1924)

This small damselfly brightly coloured with sky blue, black and vermilion is the only extant species of the genus. It is endemic to the southern Western Ghats and has so far been recorded only from a few locations in Kerala and Karnataka. It was recorded from all three lotic habitat types of Aryanad Grama Panchayat and was sighted in all the seasons. An extensive search of literature and websites failed to produce even a single photograph of the female of this species. Hence, this is most probably the first photographic record of the female from the wild (Image 7). It remains a ‘Data Deficient’ species in the IUCN Red List.

**Elattoneura souteri** (Fraser, 1924)

This damselfly coloured brightly with red and black is a ‘Data Deficient’ species in the IUCN Red List and has so far been recorded only from a few locations in Kerala and Karnataka. It was recorded from all three lotic habitat types of Aryanad and could not be seen in winter.

**Esme longistyla** Fraser, 1931

This species was identified referring to characters like complete anal bridge vein, blue annules on abdomen, blue stripes on legs and structure of anal appendages. Even though it is classified as a ‘Least Concern’ species in the IUCN Red List, only very scarce reports of this species exist from Kerala and Karnataka. In Aryanad, it was recorded from both small and large streams. It could not be seen in winter.

**Melanoneura bilineata** Fraser, 1922

This rare and relatively large damselfly species is the sole representative of the genus and has so far been recorded only from a few locations in Kerala and Karnataka. It is coloured blue and black and can be distinguished by the absence of the anal bridge vein in its wings. This species, classified as ‘Near Threatened’ in the IUCN Red List was recorded from Aryanad in all four seasons. It could be seen only in the small streams and hence appears to show high habitat specificity.

**Burmagomphus laidlawi** Fraser, 1924

This medium-sized clubtail dragonfly has till now been recorded only from montane forest streams of Kerala, Karnataka and Tamil Nadu. It can be easily separated from other clubtail species by the structure of its anal appendages. It was recorded only during the southwest monsoon season and could be seen only in large streams. Hence, this species is highly seasonal and has specific habitat requirements. It remains a ‘Data
Table 1. Checklist of Odonata recorded from Aryanad Grama Panchayat, Kerala, southern India.

*Endemity:* EN WG—Endemic to the Western Ghats | EN P—Endemic to peninsular India | EN I—Endemic to India.

*IUCN Red list status:* NE—Not Evaluated | DD—Data Deficient | LC—Least Concern | NT—Near Threatened | VU—Vulnerable.

*Habitats:* P—Ponds | SS—Small streams | LS—Large streams | R—River.

*Seasons:* M1—Southwest Monsoon | M2—Northeast Monsoon | W—Winter | S—Summer.

| Species | Endemcity | IUCN Red List status | Habitats recorded | Seasons recorded |
|---------|------------|----------------------|-------------------|-----------------|
| **Zygoptera (Damselflies)** | | | | |
| Family: Lestidae | | | | |
| 1 Lestes elatus Hagen in Selys, 1862 | LC | P, SS | M1 |
| 2 Lestes praemorsus Hagen in Selys, 1862 | LC | P | M1, M2 |
| **Family: Platystictidae** | | | | |
| 3 Protosticta gravelyi Laidlaw, 1915 | EN WG | LC | P, SS, LS, R | M1, M2, W, S |
| 4 Protosticta sanguinostigma Fraser, 1922 | EN WG | VU | SS, LS, R | M1, M2, S |
| **Family: Calopterygidae** | | | | |
| 5 Neurobasis chinensis (Linnaeus, 1758) | LC | SS, LS, R | M1, M2, W, S |
| 6 Vestalis apicalis Selys, 1873 | LC | P, SS, LS, R | M1, M2, W, S |
| 7 Vestalis gracilis (Rambur, 1842) | LC | P, SS, LS, R | M1, M2, S |
| 8 Vestalis submontana Fraser, 1934 | EN WG | NE | P, SS, LS, R | M1, M2, S |
| **Family: Chlorocyphidae** | | | | |
| 9 Calocypha laidlawi (Fraser, 1924) | EN WG | DD | SS, LS, R | M1, M2, W, S |
| 10 Helio cyna bignata (Hagen in Selys, 1853) | EN P | LC | SS, LS, R | M1, M2, W, S |
| 11 Libellago indica (Fraser, 1928) | EN P | NE | SS, LS, R | M1, M2, W, S |
| **Family: Euphaeidae** | | | | |
| 12 Euphaea ethelo Fraser, 1924 | EN P | LC | SS, LS, R | M1, M2, S |
| 13 Euphaea fraseri (Laidlaw, 1920) | EN WG | LC | SS, LS | M1, M2, S |
| **Family: Platycnemididae** | | | | |
| 14 Coconeura risi (Fraser, 1931) | EN WG | DD | P, SS, LS | M1, M2, W, S |
| 15 Copera marginipes (Rambur, 1842) | LC | P, SS, LS, R | M1, M2, W, S |
| 16 Copera vittata (Selys, 1863) | LC | P, SS, LS, R | M1, M2, W, S |
| 17 Elattoneura souteri (Fraser, 1924) | EN WG | DD | SS, LS, R | M1, M2, S |
| 18 Elattoneura tetrico (Laidlaw, 1917) | EN WG | LC | SS, LS, R | M1, M2, S |
| 19 Esmie longistylo Fraser, 1931 | EN WG | LC | SS, LS | M1, M2, S |
| 20 Melanoneura bilineata Fraser, 1922 | EN WG | NT | SS | M1, M2, W, S |
| 21 Onychargia atrocyana Selys, 1865 | LC | P, SS | M1, M2, S |
| 22 Prodasineura verticalis (Selys, 1860) | LC | P, SS, LS, R | M1, M2, W, S |
| **Family: Coenagrionidae** | | | | |
| 23 Aciagrion occidentale Laidlaw, 1919 | LC | LS, R | M1, M2, S |
| 24 Agriocnemis pieris Laidlaw, 1919 | LC | P, SS, LS, R | M1, M2, W, S |
| 25 Agriocnemis pygmaea (Rambur, 1842) | LC | P | M1, M2 |
| 26 Agriocnemis splendissima Laidlaw, 1919 | LC | P, R | M1, M2 |
| 27 Archibasis oscillans (Selys, 1877) | LC | SS, LS, R | M1, M2, S |
| 28 Ceriagrion cinerobellulum (Brauer, 1865) | LC | P | M1, M2, W, S |
| 29 Ceriagrion coronandelanum (Fabricius, 1798) | LC | P | M1, M2 |
| 30 Ceriagrion rubicorne Laidlaw, 1916 | LC | SS, R | M1, S |
| 31 Ischnura rubilio Selys, 1876 | NE | P, R | M1, M2 |
| 32 Ischnura senegalensis (Rambur, 1842) | LC | P | M2, S |
| 33 Pseudagrion decorum (Rambur, 1842) | LC | P, LS, R | M1, S |
| Species                        | Endemicity | IUCN Red List status | Habitats recorded from | Seasons recorded in |
|-------------------------------|------------|----------------------|------------------------|--------------------|
| 34 Pseudagrion indicum Fraser, 1924 | EN WG      | LC                   | P, LS, R               | M1, M2, S          |
| 35 Pseudagrion malabaricum Fraser, 1924 | LC         | LS, R                | M1, S                  |
| 36 Pseudagrion microcephalum (Rambur, 1842) | LC         | P, SS, LS, R         | M1, M2, S              |
| 37 Pseudagrion rubriceps Selys, 1876    | LC         | P, SS, LS, R         | M1, M2, W, S           |
| Anisoptera (Dragonflies)        |            |                      |                        |
| 38 Anax immaculifrons Rambur, 1842 | DD         | P, SS, LS, R         | M1, M2, S              |
| 39 Gynacantha dravida Liefvink, 1960 | DD         | P, SS, SS, LS, R     | M1, M2, S              |
| Family: Aeshnidae               |            |                      |                        |
| 40 Burmagomphus laidlawi Fraser, 1924 | DD         | LS                   | M1                     |
| 41 Gomphidia kodaguensis Fraser, 1923 | EN WG      | DD                   | P, SS, LS, R           | M1, M2, W, S       |
| 42 Heliothemis promelas (Selys, 1873) | EN WG      | LC                   | P, SS, LS, R           | M1, M2             |
| 43 Ictinogomphus rapax (Rambur, 1842) | LC         | P, SS, LS, R         | M1, M2, W, S           |
| 44 Macrothemis wynoedicus Fraser, 1924 | EN WG      | DD                   | P, SS, LS, R           | M1, M2             |
| 45 Metallagomphus aconaces (Laidlaw, 1822) | DD         | LS                   | M1, M2                 |
| 46 Megagomphus tamarachiriensis Fraser, 1931 | EN WG      | NE                   | P, SS, LS, R           | M1, M2, S          |
| 47 Microgomphus souteri Fraser, 1924 | DD         | P, SS, LS, R         | M1, M2, S              |
| 48 Nychogomphus striatus (Fraser, 1924) | DD         | P, SS, LS, R         | M1, M2, S              |
| 49 Paragomphus lineatus (Selys, 1850) | LC         | P, SS, LS, R         | M1, M2, W, S           |
| Family: Gomphidae               |            |                      |                        |
| 50 Epicallathemis frontalis Selys, 1871 | LC         | LS, R                | M1, M2, S              |
| 51 Epophthalmia vittata Burmeister, 1839 | LC         | LS, R                | M1, M2                 |
| 52 Macromia bellica Fraser, 1924 | LC         | SS, LS, R            | M1                     |
| 53 Macromia cingulata Rambur, 1842 | EN WG      | LC                   | SS, LS                 | M1, S              |
| 54 Macromia flavocolorata Fraser, 1922 | LC         | SS, LS, R            | M1, M2, S              |
| 55 Macromia ida Fraser, 1924 | LC         | SS, LS               | M1                     |
| 56 Macromia irata Fraser, 1924 | LC         | SS, LS               | S                      |
| Family: Libellulidae            |            |                      |                        |
| 57 Acisoma panorpoides Rambur, 1842 | LC         | P, SS                | M1, M2                 |
| 58 Aethriamanta brevipennis (Rambur, 1842) | LC         | P, SS                | M1, M2                 |
| 59 Brachydiplax chalybea Brauer, 1868 | LC         | P, SS, LS, R         | M1, M2, W, S           |
| 60 Brachydiplax sobrina (Rambur, 1842) | LC         | P, SS                | M1, M2                 |
| 61 Brachythemis contaminata (Fabricius, 1793) | LC         | P, SS, LS, R         | M1, M2, W, S           |
| 62 Bradinopyga geminata (Rambur, 1842) | LC         | SS                   | M1, M2                 |
| 63 Crotonia lineata (Brauer, 1878) | LC         | SS, LS, R            | M1, M2, S              |
| 64 Crocothemis servilia (Drury, 1773) | LC         | P, SS, LS, R         | M1, M2, S              |
| 65 Diplacodes triviolis (Rambur, 1842) | LC         | P, SS, LS, R         | M1, M2, W, S           |
| 66 Hydrobasileus croceus (Brauer, 1867) | LC         | P, SS, LS, R         | M1, M2, S              |
| 67 Hylaethemis apicalis Fraser, 1924 | EN I       | DD                   | P, SS                  | M1, M2, S          |
| 68 Lathrecista asiatica (Fabricius, 1798) | LC         | P, SS, LS, R         | M1, M2, S              |
| 69 Neurothemis fulvia (Drury, 1773) | LC         | P, SS                | M1, M2, S              |
| 70 Neurothemis tulio (Drury, 1773) | LC         | P, SS, LS, R         | M1, M2, W, S           |
| 71 Orthoneurus testaceus Laidlaw, 1902 | LC         | LS, R                | M1, M2                 |
| 72 Orthetrum chrysis (Selys, 1891) | LC         | P, SS, LS, R         | M1, M2, W, S           |
| 73 Orthetrum glaucum (Brauer, 1865) | LC         | P, SS, LS, R         | M1, M2, W, S           |
Deficient’ species in the IUCN Red List.

**Nychogomphus striatus (Fraser, 1924)**

This medium-sized clubtail dragonfly has very few previous records from Kerala and Tamil Nadu. The record from Nepal requires validation. It has peculiar claw-shaped anal appendages that help to distinguish it easily from other clubtail species. It is a ‘Data Deficient’ species in the IUCN Red List and was recorded from all four habitat types sampled in Aryanad. It could be seen in both southwest monsoon and northeast monsoon seasons.

**Epophthalmia frontalis Selys, 1871**

Fraser (1924) described *Macromia binocellata* based on a single male specimen collected by C.M. Inglis from Palni hills, Western Ghats. Subsequently, more specimens were obtained from Tamaracherry, Calicut and Walayar in the Western Ghats after which he treated it as *Epophthalmia frontalis malabarensis* (Fraser 1935) and later, as *Epophthalmia frontalis binocellata* (Fraser 1936). According to the last source, within Indian limits, *E. frontalis frontalis* occurs in Assam and *E. frontalis binocellata* is confined to the Western Ghats. The taxon in the Western Ghats is described as a much darker insect compared to its congeners. Its abdominal segments 4 to 6 have paired isolated sub-basal spots instead of rings. Also, its inferior anal appendage is distinctly longer and curves up between the apices of superiors. According to Lieftinck (1931) and Fraser (1936) *E. frontalis* and *E. vittata* can be separated from each other based on their facial markings, but Asahina (1987) disagrees and states that these markings vary depending on maturity and individuals. A large Macromiid was seen in the large streams and Karamana River in Aryanad, but its markings seem to match more with *E. frontalis frontalis* as described by Fraser (1936) and Asahina (1987). Its terminal abdominal segments, including the anal appendages were predominantly yellow. The inferior anal appendage was longer than the superiors whose apices it covered by curving in. A comparative analysis using the available resources and photographs lets us place the taxon encountered as *Epophthalmia frontalis* (Image 8), but taxonomic resolution beyond this level was impossible without examining specimens. Tiple & Payra (2020) while reporting *E. frontalis* from Central India encountered a similar problem and suggested a taxonomic revision of South and Southeast Asian

| Species | Endemicity | IUCN Red List status | Habitats recorded from | Seasons recorded in |
|---------|------------|----------------------|------------------------|---------------------|
| Orthetrum luzonicum (Brauer, 1868) | LC | P, SS, LS, R | M1, M2, W, S |
| Orthetrum pruinorum (Burmeister, 1839) | LC | P, SS, LS, R | M1, M2, W, S |
| Orthetrum sabina (Drury, 1770) | LC | P, SS, LS, R | M1, M2, W, S |
| Poliothemis sexmaculata (Fabricius, 1787) | LC | SS | M2 |
| Pantala flavescens (Fabricius, 1798) | LC | P, SS, LS, R | M1, M2, W, S |
| Potamarcha congener (Rambur, 1842) | LC | P, SS, LS, R | M1, M2 |
| Rhodotheres rufa (Rambur, 1842) | LC | P, LS, R | M1, M2, W, S |
| Rhyothemis triangularis Kirby, 1889 | LC | P | M1, M2, W, S |
| Rhyothemis vanegata (Linnaeus, 1763) | LC | P, LS, R | M1, M2 |
| Tetrothemis platytera Selys, 1878 | LC | P, SS | M1, M2, S |
| Tholymis tillarga (Fabricius, 1798) | LC | P, LS, R | M1, M2 |
| Tramea limbata (Desjardins, 1832) | LC | P, LS, R | M1, M2 |
| Thrinethis aurora (Burmeister, 1839) | LC | P, SS, LS, R | M1, M2, W, S |
| Thrinethis festiva (Rambur, 1842) | LC | P, SS | M1, M2, S |
| Urothemis signata (Rambur, 1842) | LC | P, SS | M1, M2, S |
| Zygonyx irisi Selys, 1869 | LC | SS, LS, R | M1, M2 |
| Zyxomma petiolatum Rambur, 1842 | LC | P, SS | M1, M2, S |
| Idionyx gomantakensis Subramanian, Rangnekar & Naik, 2013 | EN WG | NE | SS | M1, S |
| Idionyx saffronata Fraser, 1924 | EN WG | DD | SS | M1, S |
| Macromidia donaldi (Fraser, 1924) | LC | SS, LS, R | M1, M2, S |
Figure 2. Odonate species richness in each habitat type of Aryanad Grama Panchayat.

Figure 3. Odonate species richness in different seasons at Aryanad Grama Panchayat.

Image 1. The different habitat types sampled for odonates in Aryanad Grama Panchayat: A—Pond | B—Small stream | C—Large stream | D—Karamana River. © Reji Chandran.

*Epophthalmia* species, particularly *E. frontalis* and *E. vittata*.

Another large Macromiid with its superior and inferior anal appendages of almost the same length was identified as *E. vittata*. Its last segments including the anal appendages were reddish brown with restricted yellow markings (Image 9).
Macromia ida Fraser, 1924
It is a rare species recorded only from a few locations in Kerala, Karnataka and Tamil Nadu. A single female of this species was sighted near the Karamana River in the southwest monsoon season. It was identified referring to its facial markings and paired dorsal spots on its second abdominal segment.

Idionyx gomantakensis Subramanian, Rangnekar & Naik, 2013
This species was described based on specimens collected from Goa and it remains ‘Not Evaluated’ in the IUCN Red List. Only very few records of this species are available, all of them from Goa and Kerala. It was
recorded only from the small streams of Aryanad in summer and southwest monsoon seasons.

Our study has unveiled crucial information regarding the distribution, habitat preference and seasonality of a large number of odonate species in the Western Ghats landscape. While the five Orthetrum species were recorded from all the sampled habitats and in all four seasons, many of the endemic species showed high habitat specificity and definite seasonality. The former can be called eurytopic or generalist species and the latter are stenotopic or specialist species. The peak in
species richness during the southwest monsoon season was expected because most odonate species in India are known to emerge and breed during the monsoon (Subramanian 2005). Odonate diversity dips in winter coinciding with a fall in water level in their habitats and picks up in summer with the pre-monsoon showers. The small streams support the highest number of species probably because they have different microhabitats in the form of pools, marshes and slow flowing stretches. Aryanad village, with its plantations, home gardens and forests at the fringes probably functions as an ecotone, hosting rich biodiversity. Ecotones are ecological
transition zones characterised by high species turnover rates and local biodiversity peaks (Risser 1995; Odum & Barrett 2005). This calls for effective conservation measures to protect the microhabitats of odonates by the local administration of Aryanad.

REFERENCES

Adarsh, C.K., R. Arunraj & P.O. Nameer (2015). Odonata (Insecta) diversity of Chinnar Wildlife Sanctuary, the Southern Western Ghats, India. Journal of Threatened Taxa: 7(2): 6910–6919. https://doi.org/10.11609/JoTT.o3771.6910-9

Asahina, S. (1987). A list of the Odonata recorded from Thailand. Part XVIII. Cordulidae 2 Kontyu 55(4): 699–720
Clark, T.E. & M.J. Samways (1996). Dragonflies (Odonata) as indicators of biotope quality in the Kruger National Park, South Africa. *Journal of Applied Ecology* 33(5): 1001–1012.

Clausnitzer V., V.J. Kalkman, M. Ram, B. Collen, J.E.M. Baillie, M. Bedjanič, W.R.T. Darwall, K.B. Dijkstra, R. Dow, J. Hawking, H. Karube, E. Malikova, D. Paulson, K. Schütte, F. Suhling, R.J. Villanueva, N. Ellenrieder & K. Wislon (2009). Odonata enter the biodiversity crisis debate: The first global assessment of an insect group. *Biological Conservation* 142: 1864–1869.

Corbet, P.S. (1993). Are Odonata useful as bioindicators? *Libelula* 12(3–4): 91–102.

Fraser, F.C. (1924). A Survey of the Odonata Fauna of Western India with special remarks on the genera Macromia and Idionyx and descriptions of thirty new species. *Records of the Indian Museum* 26(5): 423–522.

Fraser, F.C. (1933). The Fauna of British-India including Ceylon and
Image 7. *Calocypha laidlawi* female (left) and mating pair (right). © Reji Chandran.

Image 8. *Epophthalmia frontalis*: 1—Accessory genitalia of *E. frontalis frontalis* redrawn from Asahina (1987) | 2—Accessory genitalia of *E. frontalis* photographed from Aryanad | 3 & 5—dorsal & right lateral views of anal appendages of *E. frontalis binocellata* redrawn from Fraser (1936) | 4 & 6—dorsal & right lateral views of *E. frontalis* photographed from Aryanad. © Images—Reji Chandran; Drawings—A. Vivek Chandran.
Image 9. *Epophthalmia vittata* in flight; inset—right lateral view of anal appendages of *Epophthalmia vittata vittata* redrawn from Fraser (1936). © Image—Reji Chandran; Drawing—A. Vivek Chandran.

Burma, Odonata. Vol. I. Taylor and Francis Ltd., London, 436 pp.

Fraser, F.C. (1934). The Fauna of British-India including Ceylon and Burma, Odonata. Vol. II. Taylor and Francis Ltd., London, 442 pp.

Fraser, F.C. (1935). New Oriental Dragonflies (Order Odonata). Records of the Indian Museum 37(3): 321–333.

Fraser, F.C. (1936). The Fauna of British-India including Ceylon and Burma, Odonata. Vol. III. Taylor and Francis Ltd., London, 461 pp.

Government of Kerala (2021). https://lsgkerala.gov.in/en/lbelection/electdmemberdet/2010/255 Accessed on 16 April 2021.

IUCN (2021). Red List of Threatened Species. International Union for Conservation of Nature https://www.iucnredlist.org/ Accessed on 15 April 2021.

Kalkman, V.J., R. Babu, M. Bedjanič, K. Conniff, T. Gyeltshen, M.K. Khan, K.A. Subramanian, A. Zia & A.G. Orr (2020). Checklist of the dragonflies and damselflies (Insecta: Odonata) of Bangladesh, Bhutan, India, Nepal, Pakistan and Sri Lanka. Zootaxa 4849(1): 001–084. https://doi.org/10.11646/zootaxa.4849.1.1

Kerala State Biodiversity Board (2021). https://www.keralabiodiversity.org/ Accessed on 16 April 2021.

Kiran, C.G. & D.V. Raju (2013). Dragonflies and damselflies of Kerala (Keralathile Thumbikal). Tropical Institute of Ecological Sciences, 156pp.

Koparde P., P. Mhaske & A. Patwardhan (2014). New records of dragonflies and damselflies of Kerala (Keralathile Thumbikal). Tropical Institute of Ecological Sciences, 156pp.

Lieftinck, M.A. (1931). A revision of genus *Epophthalmia* Burmeister (Odonata: Corduliinae) with notes on habits and larvae. Treubia 13: 21–80.

Mathur, P.K. & P.R. Sinha (2008). Looking Beyond Protected Area Networks: A Paradigm Shift in Approach for Biodiversity Conservation. International Forestry Review 10(2): 305–314.

May, R.M. (2010). Ecological science and tomorrow’s world. Philosophical Transactions of the Royal Society: Biological Sciences. 365: 41–47.

Oдум, E.P. & G.W. Barrett (2005). Fundamentals of Ecology, 5th edition, Thomson Brooks/Cole, Belmont, California, 598pp.

Risser, P.G. (1995). The Status of the Science Examining Ecotones: A dynamic aspect of landscape is the area of steep gradients between more homogeneous vegetation associations. *BioScience* 45(5): 318–325. https://doi.org/10.2307/1312492

Sánchez-Bayo, F. & K.A.G. Wyckhuys (2019). Worldwide decline of the entomofauna: A review of its drivers. *Biological Conservation* 232: 8–27.

Society for Odonate Studies (2021). List of odonates of Kerala. https://odonatesociety.org/list-of-odonates-of-kerala/ Electronic version accessed on 15 April 2021.

Subramanian, K.A. (2005). India-A Lifescape, Dragonflies of India – A Field Guide. Vigyan Prasar, India Offset Press, New Delhi, 118pp.

Subramanian, K.A. (2009). Dragonflies and Damselflies of Peninsular India – A Field Guide. Vigyan Prasar, Noida, India, 168pp.

Subramanian, K.A., F. Kakassery & M.V. Nair (2011). The status and distribution of dragonflies and damselflies (Odonata) of the Western Ghats, pp. 63–72. In: Molur, S., K.G. Smith, B.A. Daniel & W.R.T. Darwall (comp.), The Status and Distribution of Freshwater Biodiversity in the Western Ghats, India. IUCN, Cambridge, UK and Glad, Switzerland and Zoo Outreach Organization, Coimbatore, India, 116 pp.

Subramanian, K.A., K.G. Emiliyamma, R. Babu, C. Radhakrishnan & S.S. Talmale (2018). Atlas of Odonata (Insecta) of the Western Ghats, India. Zoological Survey of India, Kolkata, 417 pp.

Tiple, A.D & A. Payra (2020). First Record of *Epophthalmia frontalis* from Central India (Insecta: Odonata: Macromiidae). *Travaux du Museum National d’Histoire Naturelle “Grigore Antipa”* 63(2): 127–130. https://doi.org/10.3897/travaux.63.652897

Varghese, A.P., P.R. Nikes & J. Mathew (2014). Odonata (Insecta) diversity of Salim Ali Bird Sanctuary and its adjacent areas in Thattekad, Kerala, India. *Journal of Threatened Taxa* 6(6): 5887–5893. https://doi.org/10.11609/JoTT.o3395.5887-93
Birds

Dr. Hem Sagar Baral, Charles Sturt University, NSW Australia
Dr. Chris Bowden, Royal Society for the Protection of Birds, Sandy, UK
Dr. Priya Davidar, Pondicherry University, Kalapet, Puducherry, India
J.W. Dukworth, IUCN SSC, Bath, UK
Dr. Rajiv Jayapal, SACON, Coimbatore, Tamil Nadu, India
Rajiv S. Kalsi, M.L.N. College, Yamuna Nagar, Haryana, India
V. Santharan, Rishi Valley Education Centre, Chittoor Dt., Andhra Pradesh, India
D. Balachandran, Bombay Natural History Society, Mumbai, India
M.J. Praween, Bengaluru, India
C. Srinivasulu, Osmania University, Hyderabad, India
K.S. Gopi Sundar, International Crane Foundation, Baraboo, USA
Dr. Gommbatactor Sundar, Professor of Ornithology, Ilan, Israel
R. Rajendran, Wildlife Society of South Asia, Mumbai, India
M. Zafar-ul Islam, Prince Saud Al Faisal Wildlife Research Center, Taif, Saudi Arabia

Mammals

Dr. Giovanni Amori, CNR - Institute of Ecosystem Studies, Rome, Italy
Dr. Anwaruddin Chowdhury, Guwahati, Assam, India
Dr. David Mallon, Zoological Society of London, UK
Shomita Mukherjee, SACON, Coimbatore, Tamil Nadu, India
Dr. Angie Appell, Wild Cat Network, Germany
Dr. P. G. Nams, Smithsonian Institution, London, UK
Dr. Heidi S. Riddle, Riddle's Elephant and Wildlife Sanctuary, Karnataka, USA
Dr. Karin Schwartz, George Mason University, Fairfax, Virginia, USA
Lala A. K. Singh, Bhabhanwire, Orissa, India
Dr. Mewa Singh, Myore University, Myore, India
Paul Racey, University of Exeter, Devon, UK
Dr. Honnava N. Kumar, SACON, Anakati P.O., Coimbatore, Tamil Nadu, India
Dr. Nishith Dharayya, HNG University, Panat, Gujarat, India
Dr. Spataco Gippoliti, Socio Onorario Societa Italiana per la Storia della Fauna "Giuseppe Altobello", Rome, Italy
Justus Joshua, Green Future Foundation, Tiruchirapalli, Tamil Nadu, India
Dr. R. Sundararajan, Professor of Ornithology, Ilan, Israel
Dr. Brian L. Cypster, California State University-Stanislaus, Bakersfield, CA
Dr. S.S. Talmale, Zoological Survey of India, Pune, Maharashtra, India
Dr. Piccardo-Jonker, Endangered Wildlife Trust, Gauteng, South Africa
Dr. Shruti K. Mathur, National College, Tiruchirappalli, Tamil Nadu, India
Dr. Reuven Yosef, International Birding & Research Centre, Eilat, Israel
Dr. Gombobaatar Sundev, Professor of Ornithology, Ulaanbaatar, Mongolia
Dr. Simon Dowell, Science Director, Chester Zoo, UK
Dr. David Mallon, Zoological Society of London, UK
Dr. Anwaruddin Chowdhury, Guwahati, Assam, India
Dr. John T. Dood, Wildlife Society of South Asia, Mumbai, India
Dr. A. V. Wolfe, Wildlife Information Liaison Development Society, Thiruvananthapuram, Kerala, India
Dr. S. Balachandran, Bombay Natural History Society, Mumbai, India
Dr. Tim Inskipp, Bishop Auckland Co., Durham, UK
Dr. Gombobaatar Sundev, Professor of Ornithology, Ulaanbaatar, Mongolia
Dr. Shomita Mukherjee, SACON, Coimbatore, Tamil Nadu, India
Dr. Rajasekhar G. Jani, Anand Agricultural University, Anand, Gujarat, India
Dr. G.N. Tiwari, Senior Scientist, ICRISAT, Indian Agricultural Research Institute (IARI), New Delhi, India
Dr. D.I. Singh, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, India
Dr. Rupika S. Rajakaruna, University of Peradeniya, Peradeniya, Sri Lanka
Dr. Bahar Baviskar, Wild-CER, Nagpur, Maharashtra 440013, India

The opinions expressed by the authors do not reflect the views of the Journal of Threatened Taxa, Wildlife Information Liaison Development Society, Zoo Outreach Organization, or any of the partners. The journal, the publisher, the host, and the partners are not responsible for the accuracy of the political boundaries shown in the maps by the authors.
Communications

Updated distribution of seven Trichosanthes L. (Cucurbitales: Cucurbitaceae) taxa in India, along with taxonomic notes
Kanakasabapathi Pradheep, Soymichiten, Ganjalagattha Dasaiah Harish, Muhammed Abdul Nizar, Kailash Chandra Bhatt, Anjula Pandey & Sudhir Pal Ahlawat, Pp. 20143–20152

Dragonflies and Damselflies (Insecta: Odonata) of Aryanad Grama Panchayat, Kerala, India
– Reji Chandran & A. Vivek Chandran, Pp. 20153–20166

Checklist of Odonata (Insecta) of Doon Valley, Uttarakhand, India
– British De, Sarika Bhatt, Amar Paul Singh, Manisha Uniyal & Virendra Prasad Uniyal, Pp. 20167–20173

Diversity of moths from the urban set-up of Valmiki Nagar, Chennai, India
– Vikas Madhay Nagarajan, Rohith Srinivasan & Mahathi Narayanaswamy, Pp. 20174–20189

Icthyofaunal diversity with relation to environmental variables in the snow-fed Tamor River of eastern Nepal
– Jawan Tumbahangfe, Jash Hang Limbu, Archana Prasad, Bhararat Raj Subba & Dil Kumar Limbu, Pp. 20190–20200

Observations on the foraging behavior of Tricoloured Munia Lonchura malacca (Linnaeus, 1766) and its interaction with pearl millet fields in Vellupuram District, Tamil Nadu, India
– M. Pandian, Pp. 20201–20208

Roosting patterns of House Sparrow Passer domesticus Linn., 1758 (Aves: Passeridae) in Bhavnagar, Gujarat, India
– Foram P. Patel & Pravin Prashant P. Dodia, Pp. 20209–20217

Review

Comprehensive checklist of algal class Chlorophyceae (sensu Fritsch, 1935) for the flora of Kerala, India, with updated taxonomic status
– Sushma Verma, Kiran Toppo & Sanjeeva Nayaka, Pp. 20218–20248

View Point

Wildlife managers ignore previous knowledge at great risk: the case of Rivaldo, the iconic wild Asian Elephant Elephas maximus L. of the Sigur Region, Nilgiri Biosphere Reserve, India
– Jean-Philippe Puyravaud & Priya Davidar, Pp. 20249–20252

Short Communications

Diversity and distribution of macro lichens from Kalpetta Municipality of Wayanad District, Kerala, India
– Greeshma Balu, A.R. Rasm, Stephen Sequeira & Biju Haridas, Pp. 20253–20257

Extended distribution of two endemic epiphytes from the Western Ghats to the Deccan Plateau
– Sonal Vishnu Deore, Mangala Dala Sonawane & Sharad Suresh Kambale, Pp. 20258–20260

Nomenclatural notes and report of Boehmeria pendulliflora Wedd. ex D.G. Long from the Terai region of Uttar Pradesh, India
– Anil Gupta, Imtiyaz Ahmad Hurrah, Aparna Shukla & Vijay V. Wagh, Pp. 20261–20265

New distribution record of a true coral species, Psammocora contigua (Esper, 1794) from Gulf of Kachchh Marine National Park & Sanctuary, India
– R. Chandran, R. Senthil Kumaran, D.T. Vasavada, N.N. Joshi & Osman G. Husen, Pp. 20266–20271

A new species of flat-headed mayfly Afronurus meenmutti (Ephemeroptera: Heptageniidae: Ecdyonurinae) from Kerala, India
– Marimuthu Muthukatturaju & Chellaiah Balasubramanian, Pp. 20272–20277

Photographic record of Dholes preying on a young Banteng in southwestern Java, Indonesia
– Dede Aulia Rahman, Mohamad Syamsudin, Asep Yayus Firdaus, Herry Trisna Afriandi & Anggodo, Pp. 20278–20283

Latrine site and its use pattern by Large Indian Civet Viverra zibetha Linnaeus, 1758: record from camera trap
– Bhuvan Singh Bist, Prashant Ghimire, Basant Sharma, Chiranjeevi Khanal & Anoj Subedi, Pp. 20284–20287

Notes

Two additions to the flora of Kerala, India
– P. Murugan, Basil Paul & M. Sulaiman, Pp. 20288–20291

Pentatropis R.Br. ex Wight & Arn. (Apocynaceae), a new generic record for Kerala, India
– V. Ambika, Jose Sojan & V. Suresh, Pp. 20292–20294

New record of Kashmir Birch Mouse Sicista concolor leathemi (Pandit: Sminthidae) in the Indian Himalaya
– S.S. Talmale, Avtar Kaur Siddhu & Uttam Saikia, Pp. 20295–20298

Breeding record of Black-headed Ibis Threskiornis melanocephalus (Aves: Threskiornithidae) at Mavoor wetland, Kozhikode District, Kerala, India
– C.T. Shifa, Pp. 20299–20301

Response

Crop and property damage caused by Purple-faced Langurs Trachypithecus vetulus (Mammalia: Primates: Cercopithecidae)
– Vincent Nijman, Pp. 20302–20306

Reply

If habitat heterogeneity is effective for conservation of butterflies in urban landscapes of Delhi, India? Unethical publication based on data manipulation: Response of original authors
– Monalisa Paul & Aisha Sultana, Pp. 20307–20308

Book Review

Freshwater fishes of the Arabian Peninsula
– Rajeev Raghavan, Pp. 20309–20310