

OPEN ACCESS



The Journal of Threatened Taxa (JoTT) is dedicated to building evidence for conservation globally by publishing peer-reviewed articles online every month at a reasonably rapid rate at [www.threatenedtaxa.org](http://www.threatenedtaxa.org). All articles published in JoTT are registered under [Creative Commons Attribution 4.0 International License](https://creativecommons.org/licenses/by/4.0/) unless otherwise mentioned. JoTT allows unrestricted use, reproduction, and distribution of articles in any medium by providing adequate credit to the author(s) and the source of publication.

# Journal of Threatened Taxa

Building evidence for conservation globally

[www.threatenedtaxa.org](http://www.threatenedtaxa.org)

ISSN 0974-7907 (Online) | ISSN 0974-7893 (Print)

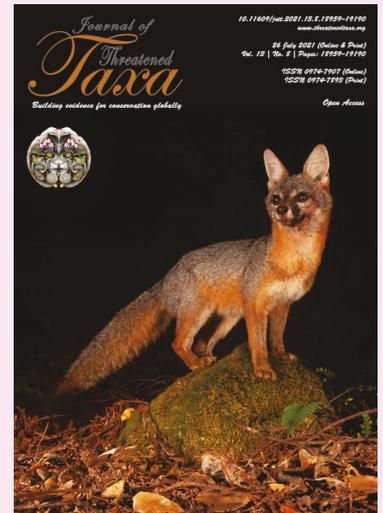
## COMMUNICATION

### ON THE DIVERSITY AND ABUNDANCE OF RIPARIAN ODONATE FAUNA (INSECTA) OF THE MIDSTREAM CHALAKKUDY RIVER, KERALA, INDIA

C. Nitha Bose, C.F. Binoy & Francy K. Kakkassery

26 July 2021 | Vol. 13 | No. 8 | Pages: 19053–19059

DOI: [10.11609/jott.7328.13.8.19053-19059](https://doi.org/10.11609/jott.7328.13.8.19053-19059)



For Focus, Scope, Aims, and Policies, visit [https://threatenedtaxa.org/index.php/JoTT/aims\\_scope](https://threatenedtaxa.org/index.php/JoTT/aims_scope)

For Article Submission Guidelines, visit <https://threatenedtaxa.org/index.php/JoTT/about/submissions>

For Policies against Scientific Misconduct, visit [https://threatenedtaxa.org/index.php/JoTT/policies\\_various](https://threatenedtaxa.org/index.php/JoTT/policies_various)

For reprints, contact [<ravi@threatenedtaxa.org>](mailto:ravi@threatenedtaxa.org)

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.

Publisher & Host







## On the diversity and abundance of riparian odonate fauna (Insecta) of the midstream Chalakkudy River, Kerala, India

C. Nitha Bose<sup>1</sup> , C.F. Binoy<sup>2</sup>  & Francy K. Kakkassery<sup>3</sup> 

<sup>1</sup>Research and Postgraduate Department of Zoology,, St. Thomas' College (Autonomous), Thrissur, Kerala 680001, India.

<sup>1</sup>nithabose123@gmail.com, <sup>2</sup>drcfbinoy@gmail.com, <sup>3</sup>fkakkassery@gmail.com (corresponding author)

**Abstract:** The riparian Odonate insect diversity of the midstream Chalakkudy River at six locations assessed from February 2018 to January 2019 has revealed the occurrence of 25 species of odonates. Among them, 10 species are dragonflies belonging to seven genera of the family Libellulidae and the remaining 15 species are damselflies belonging to six families and 11 genera. Five endemic damselfly species have been recorded. *Pseudagrion indicum* is endemic to the Western Ghats, while the remaining four species, *Vestalis apicalis*, *Libellago indica*, *Dysphaea ethela*, and *Heliocypha bisignata*, are endemic to India. Diversity indices of the odonates in all the six locations were analyzed and it showed less abundance at sites where tourist activities are more and with thin native riparian vegetation. Further, the study has unequivocally revealed that thick native riparian vegetation is essential for their perching and existence. By and large, the uncontrolled tourism activities and habitat alteration interfere with the density and diversity of these endemic species.

**Keywords:** Damselflies, dragonflies, endemism, odonates, tourism, Western Ghats.

**Editor:** Ashish D. Tiple, Vidyabharati college, Seloo, Wardha, India.

**Date of publication:** 26 July 2021 (online & print)

**Citation:** Bose, C.N., C.F. Binoy & F. Kakkassery (2021). On the diversity and abundance of riparian odonate fauna (Insecta) of the midstream Chalakkudy River, Kerala, India. *Journal of Threatened Taxa* 13(8): 19053–19059. <https://doi.org/10.11609/jott.7328.13.8.19053-19059>

**Copyright:** © Bose et al. 2021. Creative Commons Attribution 4.0 International License. JoTT allows unrestricted use, reproduction, and distribution of this article in any medium by providing adequate credit to the author(s) and the source of publication.

**Funding:** Human Resource Development Group - Council of Scientific and Industrial Research (CSIR).

**Competing interests:** The authors declare no competing interests.

**Author details:** NITHA BOSE C, is a research scholar under the guidance of Dr. Francy K. Kakkassery and the co guidance of Dr. C.F. Binoy at the Department of Zoology, St.Thomas' College (Autonomous). Her research work is based on taxonomy and molecular phylogeny of odonates of Kerala. DR. C.F. BINOY, has been working as Assistant Professor (Selection Grade) in the Research and Post Graduate Department of Zoology, St.Thomas' College (Autonomous). He is a research guide under the University of Calicut, guiding four doctoral students and as co-guide of three. Entomology, especially biodiversity conservation related to insects, insect ecology, pollination biology of mangrove ecosystem are the fields of interest. DR. FRANCY K. KAKKASSERY has been working as Associate Professor and Head in the Research and Post Graduate Department of Zoology, St.Thomas' College (Autonomous). He retired from service last year after a long 30 years. He has been doing research in field Entomology, specializing in dragonflies and damselflies, and also in aquatic biology. Six students are doing doctoral research work under his guidance.

**Author contributions:** NBC— data collection, data analysis and interpretation, drafting the article, editing; CFB—final approval of the version; FKK—conception or design of the work, critical revision of article, editing, final approval of the version.

**Acknowledgements:** The authors are grateful to the Council of Scientific and Industrial Research (CSIR) for financial support. The authors express indebtedness to Dr. K.H. Amitha Bachan, assistant professor & research guide, Research Department of Botany, MES Asmabi College, Kodungallur. The authors are thankful to the principal, St. Thomas' College (Autonomous), Thrissur for facilities provided.



## INTRODUCTION

Kerala has a comprehensively documented odonate fauna. The relevant works among them include that of Rao & Lahiri (1982), Mathavan & Miller (1989), Radhakrishnan (1997), Emiliyamma & Radhakrishnan (2002), Emiliyamma (2005), Palot et al. (2005), Adarsh et al. (2014), Varghese et al. (2014), Nair (2017), and Susanth & Anooj (2020). Recent works further added up the rich odonate diversity of Kerala to 174 species (Emiliyamma et al. 2020; Joshi et al. 2020). The seasonal and habitat distribution of Odonata diversity of riparian habitats such as Mula and Mutha river basins in Maharashtra was studied by Kulkarni & Subramanian (2013). Species turn over and abundance of the odonates of riparian zones depends on season and land use types. Endemics and habitat specialists are restricted to undisturbed riverine ecosystems as they possess a narrow range of habitat tolerance. Conservation of riparian zone results in the conservation of endemics of odonates (Subramanian 2007; Subramanian et al. 2008). The present study investigated the odonate diversity and abundance of midstream Chalakkudy river giving special reference to endemics.

## METHODS

The survey was conducted once a month from February 2018 to January 2019 by conventional random sampling. Six locations of midstream Chalakkudy River were randomly selected for the observation of odonates. The river is 13.5 km (approximately) long from the first location to last one (Bachan 2003). The details of the study localities are given in Table 1. All the six locations are with rocky river bed and evergreen and semi evergreen forest vegetation. *Madhuca neriifolia*, *Syzigium occidentale*, *Humboldtia vahliana*, *Elaeocarpus*, and *Homonoia riparia* are the dominant species of flowering plants in these locations (Bachan 2010). The selected locations have been confronted with anthropogenic disturbances such as habitat alteration due to tourism activities including resorts & commercial establishments, oil palm plantations, and activities of local people. The odonates were documented and identified with the help of photographs, keys, and descriptions given in the literature (Fraser 1933, 1934, 1936; Kiran & Raju 2013). The species richness and abundance were recorded and Simpson & Shannon diversity indices and evenness values were calculated using PAST software. The observed species of odonates were categorized as VC—Very

**Table 1. Odonate collection localities.**

	Sample collection sites	Latitude	Longitude	Altitude (m)
L1	Ezhattumugham	10.295	76.451	39
L2	Chiklayi	10.294	76.470	46
L3	Ayyampuzha	10.292	76.478	47
L4	Vettilappara	10.289	76.512	64
L5	Athirappilly	10.285	76.558	86
L6	Athirappilly waterfalls	10.284	76.569	116

common (180–240 sightings), CO—Common (120–180 sightings), OC—Occasional (60–120 sightings), and RA—Rare (1–60 sightings)) depending upon their occurrence during the survey (Palot et al. 2005; Tiple et al. 2012).

## RESULTS

During the study period, 2,186 individuals of 25 species were observed. Out of these, 10 species were dragonflies of the suborder Anisoptera, belonging to seven genera and the family Libellulidae. The remaining 15 species were damselflies under the suborder Zygoptera and they come under 11 genera in six families (Tables 1, 2). Libellulidae is the only anisopteran family, which has been observed among the odonates in the present survey. *Orthetrum sabina* a well-known cannibalistic dragonfly, has been found to be very common. On the other hand, *Onychothemis testacea* was encountered very rarely during the present survey. Members of the family Coenagrionidae (6 species) were dominating in the order Zygoptera succeeded by Calopterigidae (3 species) and Platycnemididae (3 species). *Vestalis apicalis* and *Prodasineura verticalis* were common but *Aciagrion occidentale* was observed only sporadically in this region. Out of the 25 species recorded, five species are endemics and they belong to the suborder Zygoptera. But *Pseudagrion indicum* is endemic to Western Ghats, while *Vestalis apicalis* is endemic to southern and central India, *Libellago indica* is endemic to peninsular India, whereas *Dysphaea ethela* and *Heliocypha bisignata* are endemic to India (Kalkman et al. 2020). The most dominant endemic species observed in the present survey was *Dysphaea ethela* and *Heliocypha bisignata*, which exhibited a minimum level of occurrence. The percentage distribution of each endemic species is as follows: *Pseudagrion indicum* 9%, *Vestalis apicalis* 26%, *Libellago indica* 28%, *Dysphaea ethela* 34%, and *Heliocypha bisignata* 3%. The first location Ezhattumugham (L1) harboured as many as 536

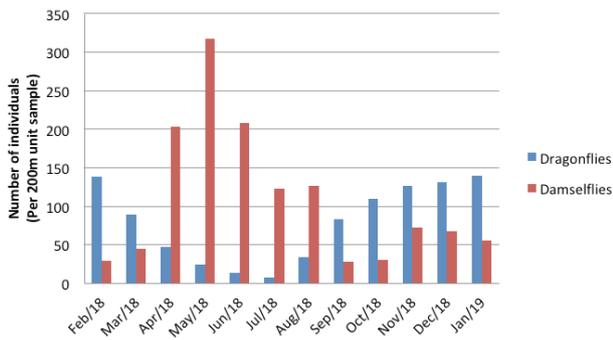


Figure 1. Abundance of dragonflies and damselflies in the Chalakkudy River.

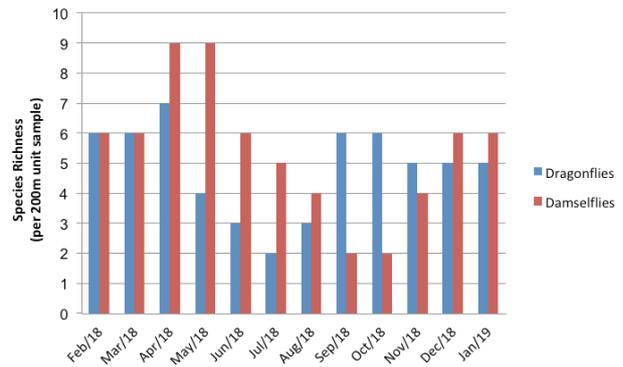


Figure 2. Species richness of dragonflies and damselflies in the Chalakkudy River.

individuals in 21 species. *Vestalis apicalis* was the most abundant, and endemic species. *Onychothemis testacea* and *Zygonyx iris* were recorded only from this location. The highest number of endemics were also recorded from here. In spite of the disturbances from tourists, this location showed a good quantity of native vegetation including emergent vegetation and shade cover and that perhaps resulted in the collection of a maximum number of individuals. The second location, Chiklayi (L2) yielded a maximum observation of 363 individuals of 17 species. *Orthetrum sabina* was the common species but *Libellago indica* was the prevalent endemic of this location. The habitat is rocky in nature with moderate shade cover and prominent emergent vegetation. Tourists' activities are appreciably low and the native vegetation is limited by oil palm plantation. Maximum value of diversity indices was shown by location. The third location, Ayyampuzha (L3) was polluted by the activities of local people and tourists to some extent. But the oil palm plantation ousted the native vegetation. From this location having traces of shoreline plants, limited shade cover, boulders and rocks, 284 individuals of 15 species were recorded of which, *Trithemis aurora* was dominant with the endemic species *Libellago indica*. Vettilappara (L4) is yet another location having least human interference with appreciable shade cover and riparian vegetation. But the native riparian vegetation is narrowed into a thin belt by the plantation crops. *Libellago indica* (endemic) and *Pseudagrion rubriceps* were the commonly found species during the study period. A total of 501 individuals belonging to 17 species were encountered in Vettilappara. Athirappilly (L5) is slightly polluted by human activities (tourism and nearby construction works) with minimum shade cover and moderate emergent vegetation. Eighteen species were recorded during the survey. *Orthetrum sabina* and *Prodasineura verticalis* were the common species

Table 2. List of dragonflies recorded from Chalakkudy River.

	Scientific name (Family: Libellulidae)	Abundance	IUCN status
1	<i>Diplacodes trivialis</i> (Rambur, 1842)	O	LC
2	<i>Neurothemis tullia</i> (Drury, 1773)	O	LC
3	<i>Onychothemis testacea</i> (Laidlaw, 1902)	R	LC
4	<i>Orthetrum chrysis</i> (Selys, 1891)	R	LC
5	<i>Orthetrum pruinosum</i> (Burmeister, 1839)	R	LC
6	<i>Orthetrum sabina</i> (Drury, 1770)	VC	LC
7	<i>Pantala flavescens</i> (Fabricius, 1798)	O	LC
8	<i>Trithemis aurora</i> (Burmeister, 1839)	VC	LC
9	<i>Trithemis festiva</i> (Rambur, 1842)	C	LC
10	<i>Zygonyx iris</i> (Selys, 1869)	R	LC

VC—Very common | CO—Common | OC—Occasional | RA—Rare | EN—Endemic.

found along with the frequently encountered endemic damselfly, *Libellago indica*. Athirappilly waterfalls (L6) is another beautiful location where the tourists activities are significantly high and endowed with rocky habitat and riparian vegetation. But the presence of macrophytes and overhanging vegetation is scanty due to tourists disturbances. As a result, the numerical abundance of species recorded from this location was very less. However, the endemic dragonflies, *Dysphaea ethela* and *Vestalis apicalis* were the dominating species of this location.

**Effect of flood**

During the month of August of the study period, heavy down pour at Kerala led to a deluge and it badly affected the study areas. Riparian vegetation was totally destroyed. Natural soil texture was lost, soil accumulation could be found in river and river banks. As a consequence, a sudden drop in damselfly diversity

**Table 3. List of damselflies recorded from Chalakkudy River.**

	Scientific name (Suborder: Zygoptera)	Abundance	IUCN Red List status
	<b>Family: Calopterygidae</b>		
1	<i>Neurobasis chinensis</i> (Linnaeus, 1758)	R	LC
2	<i>Vestalis apicalis</i> (Selys, 1873)	VC & EN	LC
3	<i>Vestalis gracilis</i> (Rambur, 1842)	C	LC
	<b>Family: Chlorocyphidae</b>		
4	<i>Libellago indica</i> (Fraser, 1928)	C & EN	LC
5	<i>Heliocypha bisignata</i> (Hagen in Selys, 1853)	R & EN	LC
	<b>Family: Coenagrionidae</b>		
6	<i>Aciagrion occidentale</i> (Laidlaw, 1919)	R	LC
7	<i>Agriocnemis pieris</i> (Laidlaw, 1919)	R	LC
8	<i>Agriocnemis pygmaea</i> (Rambur, 1842)	R	LC
9	<i>Ischnura rubilio</i> (Brauer, 1865)	R	LC
10	<i>Pseudagrion indicum</i> (Fraser, 1924)	O & EN	DD
11	<i>Pseudagrion rubriceps</i> (Selys, 1876)	C	LC
	<b>Family: Euphaeidae</b>		
12	<i>Dysphaea ethela</i> (Fraser, 1924)	VC & EN	LC
	<b>Family: Platycnemididae</b>		
13	<i>Copera marginipes</i> (Rambur, 1842)	R	LC
14	<i>Copera vittata</i> (Selys, 1863)	R	LC
15	<i>Prodasineura verticalis</i> (Selys, 1860)	VC	LC

was noticed just after the flood. Only two species of damselflies were recorded in the first two months after the flood, i.e., September and October 2018. But dragonfly diversity was not much affected. In the succeeding months the species richness and abundance were observed to have rebounded.

Simpson & Shannon diversity indices and evenness values of the six locations were calculated (Table 4). Maximum species richness and abundance were found

at Location 1. Simpson and Shannon diversity indices (0.9197 and 2.628, respectively) were found to be equally high for location 2, while the least values were shown by Location 6 (0.8694 and 2.191, respectively). Maximum value of evenness (0.8257) was recorded at Location 3 and a minimum at Location 1.

## DISCUSSION

The current study points out the role of native riparian vegetation and the impact of human interference such as habitat alteration by tourism, construction works and plantations on the density and diversity of odonate fauna. Studies revealed that riparian vegetation promotes the occurrence of invertebrates including insects and facilitates suitable habitat for insects by providing food, resting and hiding places for emergent adults and substratum for egg laying. Also the shade cover regulates water temperature and overall quality of the stream (Knight & Bottorff 1981; Ober & Hayes 2008). Moreover, the prey insects are attracted by flowering plants, which in turn form ideal food for odonates. Therefore, these conditions become more pertinent for the carnivorous odonates. The hanging plants and emergent macrophytes furnish perching sites and structures for egg laying and emergence of adults. Literature delineates the role of macrophytes and shoreline structures in oviposition, formation of larval microhabitat, emergence support and adult perching site (Samways & Steytler 1996; Schindler et al. 2003).

In the present study 15 species of damselflies and 10 dragonflies were recorded. As the damselflies are weak fliers, they may depend on their own microhabitat for food and reproduction. But the agile fliers, dragonflies are free to move to more extensive habitats according to their preferences. This is a factor of variation in species richness between the two suborders. The most commonly encountered dragonfly was *Orthetrum*

**Table 4. Community structure of odonates.**

Parameters/ Indices	L1 Ezhattumugham	L2 Chiklayi	L3 Ayyampuzha	L4 Vettilappara	L5 Athirappilly	L6 Athirappilly waterfall
Species richness	21	17	15	17	18	12
No. of individuals (per 200m unit sample)	536	363	284	501	377	125
Simpson 1-D	0.8983	0.9197	0.9091	0.9121	0.9064	0.8694
Shannon H	2.518	2.628	2.517	2.561	2.545	2.191
Evenness	0.5907	0.8142	0.8257	0.7617	0.7079	0.7456



Image 1. *Dysphaea ethela*



Image 2. *Pseudagrion indicum*



Image 3. *Libellago indica* (male)



Image 4. *Libellago indica* (female)



Image 5. *Vestalis apicalis*



Image 6. *Heliocypha bisignata*

*sabina*, which predate on other insects and exhibits cannibalistic behavior too (Iswardaru 2018). Further, adequate quantities of reeds support the occurrence of damselflies than dragonflies (Fulan et al. 2008). In the present study, L1, L2, L4 and L5 locations showed the maximum species richness, abundance and diversity. Despite the human disturbances, L1 showed the highest value of species richness and abundance. Presence of comparatively abundant native vegetation including emergent macrophytes supported the diversity in L1. Moreover, in L2, L3 and L4 sites, the native riparian vegetation is narrowed by the plantation crops. Vegetation in location L5 was destroyed as a result of resort construction. Pristine habitat loss results in the loss of odonate diversity (Rodrigues et al. 2016). But the presence of a modest percentage of riparian vegetation could hold up the diversity in these locations to some extent. Although L6 is devoid of plantation crops, the prominent disturbances from tourists have destroyed the emergent macrophytes and overhanging vegetation. This has led to the least diversity indices on species richness and abundance in L6. Another observation noticed in the present study was on the high abundance of endemic species in L1 and minimum distribution at L6. *Dysphaea ethela* and *Heliocypha bisignata* were reported to be respectively the common and rarely occurring endemic species.

As per the literature, undisturbed riparian forests are typically rich with the presence of endemics (Subramanian et al. 2008). Destruction of riparian flora and fauna could be attributed to damming, tourists activities, construction works and expanding the area for agricultural plantations leading to the declined number of species. For instance, it is evident that the fish fauna of Chalakkudy river is highly threatened by damming, deforestation and pesticide pollution (Raghavan et al. 2008). Habitat alteration interferes with the abundance of endemic odonates and supports the occurrence of generalist species like libellulids (Kalkman et al. 2008; Subramanian et al. 2008), and that is evident in the present study. Research work delineates the resilience capacity of organisms to flood (Death 2008; Golab & Sniegula 2012; Raghavan 2019). In spite of the destructive flood during the current study, odonates showed a tendency to bounce back to pre-flood conditions within a very short time. Further studies are required to authenticate the same.

## REFERENCES

- Adarsh, C.K., K.S. Aneesh & P.O. Nameer (2014). A preliminary checklist of odonates in Kerala Agricultural University (KAU) campus, Thrissur District, Kerala, southern India. *Journal of Threatened Taxa* 6(8): 6127–6137. <https://doi.org/10.11609/JoTT.o3491.6127-37>
- Bachan, A.K.H (2003). Riparian vegetation along the middle and lower zones of the Chalakkudy river, Kerala, India. Project 26/2000 Sponsored by Kerala Research Programme on Local Level Development, CDS, Thiruvananthapuram
- Bachan, A.K.H. (2010). Riparian flora of the Chalakkudy river basin and its ecological significance. Ph D Thesis. Department of Botany, University of Calicut, xii+882pp.
- Death, R.G. (2008). The Effect of Floods on Aquatic Invertebrate Communities, pp. 113-121. *Proceedings of the Royal Entomological Society's 24<sup>th</sup> Symposium*. Royal Entomological Society of London. Cromwell Press, Trowbridge, UK.
- Emiliyamma, K.G. (2005). On the Odonata (Insect) Fauna of Kottayam District, Kerala, India. *Zoo's Print Journal* 20(12): 2108–2110. <https://doi.org/10.11609/JoTT.ZPJ.1338.2108-10>
- Emiliyamma, K.G. & C. Radhakrishnan (2002). Additions to the Odonata of (Insecta) of Thiruvananthapuram District, Kerala. *Zoo's Print Journal* 17(10): 914–917. <https://doi.org/10.11609/JoTT.ZPJ.17.10.914-7>
- Emiliyamma, K.G., M.J. Palot & C. Charesh (2020). A new species of *Platylestes* Selys (Odonata: Zygoptera: Lestidae) from the coastal area of Kannur District, Kerala, India. *Journal of Threatened Taxa* 12(13): 16854–16860. <https://doi.org/10.11609/jott.5209.12.13.16854-16860>
- Fraser, F.C. (1933). *The Fauna of British India including Ceylon and Burma. Odonata – Vol. I*. Taylor and Francis Ltd, London, 423pp.
- Fraser, F.C. (1934). *The Fauna of British India including Ceylon and Burma. Odonata – Vol. II*. Taylor and Francis Ltd, London, 398pp.
- Fraser, F.C. (1936). *The Fauna of British India including Ceylon and Burma. Odonata – Vol. III*. Taylor and Francis Ltd, London, 461pp.
- Fulan, J.A., R. Raimundo & D. Figueiredo (2008). Habitat characteristics and dragonflies (Odonata) diversity and abundance in the Guadiana River, eastern of the Alentejo, Portugal. *Boletín de la Asociación española de Entomología* 32(3-4): 327–340.
- Golab, M.J. & S. Sniegula (2012). Changes in reproductive behavior in adult damselfly *Calopteryx splendens* (Odonata: Calopterygidae) in response to flood. *Entomological Science* 15(3): 280–287. <https://doi.org/10.1111/j.1479-8298.2012.00516.x>
- Iswardaru, D. (2018). Diversity of dragonflies (Odonata) in swamp ecosystem University of Lampung. *Agricultura* 105(1–2): 101–109.
- Joshi, S., K.A. Subramanian, R. Babu, D. Sawant & K. Kunte (2020). Three new species of *Protosticta* Selys, 1885 (Odonata: Zygoptera: Platystictidae) from the Western Ghats, India, with taxonomic notes on *P. mortoni* Fraser, 1922 and rediscovery of *P. rufostigma* Kimmins, 1958. *Zootaxa* 4858(2): 151–185. <https://doi.org/10.11646/zootaxa.4858.2.1>
- Kalkman, V.J., R. Babu, M. Bedjanic, 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>
- Kalkman, V.J., V. Clausnitzer, K.D.B. Dijkstra, A.G. Orr, D.R. Paulson & J.V. Tol (2008). Global diversity of dragonflies (Odonata) in freshwater. *Hydrobiologia*. 595: 351–363. <https://doi.org/10.1007/s10750-007-9029-x>
- Kiran, C.G. & D. Raju (2013). *Dragonflies and Damselflies of Kerala*. Tropical Institute of Ecological Sciences, Greenleaf Publications, Kottayam, Kerala, India.
- Knight, A.W. & R. Bottorff (1981). The importance of riparian vegetation to stream ecosystems. In: Warner & K.M. Hendrix (eds.). *California Riparian Systems Conference: Ecology, Conservation, and Productive Management*. University of California Press.
- Kulkarni, A.S. & K.A. Subramanian (2013). Habitat and seasonal



- distribution of Odonata (Insecta) of Mula and Mutha river basins, Maharashtra, India. *Journal of Threatened Taxa* 5(7): 4084–4095. <https://doi.org/10.11609/JoTT.o3253.4084-95>
- Mathavan, S. & P.L. Miller (1989).** A Collection of Dragonflies (Odonata) made in the Periyar National Park, Kerala, South India, in January 1988. *International Odonatological Society, Bilthoven, Rapid communications (supplements)* 10: 1–10
- Nair, V.P. (2017).** Dragonflies: Additions to the Odonata (Insecta) fauna of Varadoor, Kannur, Kerala, South India. Bugs R All #164. In: *Zoo's Print* 32(11): 24–30.
- Ober, H.K. & J.P. Hayes (2008).** Influence of forest riparian vegetation on abundance and biomass of nocturnal flying insects. *Forest Ecology and Management* 256(5): 1124–1132. <https://doi.org/10.1016/j.foreco.2008.06.010>
- Palot, M.J., C. Radhakrishnan & V.P. Soniya (2005).** Odonata (Insecta) diversity of rice field habitat in Palakkad district, Kerala. *Record of Zoological Survey of India* 104(Part 1-2): 71–77.
- Radhakrishnan, C. (1997).** Ecology and conservation status of entomofauna of Malabar. *Zoos' Print* 11: 2–5.
- Raghavan, R. (2019).** Impact of 2018 Kerala floods on aquatic biodiversity with special reference to single location endemic species. Report submitted to the Kerala State Biodiversity Board.
- Raghavan, R, G. Prasad, P.H.A. Ali & B. Pereira (2008).** Fish fauna of Chalakkudy River, part of Western Ghats biodiversity hotspot, Kerala, India: patterns of distribution, threats and conservation needs. *Biodiversity and Conservation* 17: 3119–3131. <https://doi.org/10.1007/s10531-007-9293-0>
- Rao, R. & A.R. Lahiri (1982).** First records of odonates (Arthropoda: Insecta) from the Silent Valley and New Amarambalam Reserved Forests. *Journal of the Bombay Natural History Society* 79(3): 557–562.
- Rodrigues, M.E., F.O. Roque, J.M.O. Quintero, J.C.C. Pena, D.C. Sousa & P.D.M. Junior (2016).** Nonlinear responses in damselfly community along a gradient of habitat loss in a savanna landscape. *Biological Conservation* 194: 113–120. <https://doi.org/10.1016/j.biocon.2015.12.001>
- Samways, M.J. & N.S. Steytler (1996).** Dragonfly (Odonata) distribution patterns in urban and forest landscapes, and recommendations for riparian management. *Biological Conservation* 78(3): 279–288. [https://doi.org/10.1016/S0006-3207\(96\)00032-8](https://doi.org/10.1016/S0006-3207(96)00032-8)
- Schindler, M., C. Fesl & A. Chovanec (2003).** Dragonfly associations (Insecta: Odonata) in relation to habitat variables: A multivariate approach. *Hydrobiologia* 497(1):169–180. <https://doi.org/10.1023/A:1025476220081>
- Subramanian, K.A. (2007).** Endemic Odonates of the Western Ghats: Habitat distribution and conservation. *Odonata: Biology of Dragonflies*. Scientific Publishers.
- Subramanian, K.A., S. Ali & T.V. Ramachandra (2008).** Odonata as indicators of riparian ecosystem health a case study from south western Karnataka, India. *Fraseria (N.S.)* 7 :83–95.
- Susanth, C. & S.S. Anooj (2020).** Checklist of Odonata of Wayanad district, Kerala. *Indian Journal of Entomology* 82(2): 315–323. <https://doi.org/10.5958/0974-8172.2020.00072.3>
- Tiple A.D., S. Paunika & S.S. Talmale (2012).** Dragonflies and Damselflies (Odonata: Insecta) of Tropical Forest Research Institute, Jabalpur, Madhya Pradesh, Central India. *Journal of Threatened Taxa* 4(4): 2529–2533. <https://doi.org/10.11609/JoTT.o2657.2529-33>
- Varghese, A.P., P.R. Nikesh & J. Mathew (2014).** Odonata (Insecta) diversity of Salim Ali Bird Sanctuary and its adjacent areas in Thattakkad, Kerala, India. *Journal of Threatened Taxa* 6(6): 5887–5893. <https://doi.org/10.11609/JoTT.o3395.5887-93>





www.threatenedtaxa.org

OPEN ACCESS



The Journal of Threatened Taxa (JoTT) is dedicated to building evidence for conservation globally by publishing peer-reviewed articles online every month at a reasonably rapid rate at [www.threatenedtaxa.org](http://www.threatenedtaxa.org). All articles published in JoTT are registered under [Creative Commons Attribution 4.0 International License](https://creativecommons.org/licenses/by/4.0/) unless otherwise mentioned. JoTT allows unrestricted use, reproduction, and distribution of articles in any medium by providing adequate credit to the author(s) and the source of publication.

ISSN 0974-7907 (Online) | ISSN 0974-7893 (Print)

July 2021 | Vol. 13 | No. 8 | Pages: 18959–19190

Date of Publication: 26 July 2021 (Online & Print)

DOI: 10.11609/jott.2021.13.8.18959-19190

#### Communications

##### Distribution and habitat preferences of the Chinese Pangolin *Manis pentadactyla* (Mammalia: Manidae) in the mid-hills of Nepal

– Suman Acharya, Hari Prasad Sharma, Rajeev Bhattarai, Beeju Poudyal, Sonia Sharma & Suraj Upadhaya, Pp. 18959–18966

##### On the occurrence of the Himalayan Wolf *Canis lupus*, L. 1758 (Mammalia: Carnivora: Canidae) in the Gaurishankar Conservation Area, Nepal; its existence confirmed through sign and visual evidence in Rolwaling Valley

– Bishnu Prasad Pandey, Shankar Man Thami, Rabin Shrestha & Mukesh Kumar Chalise, Pp. 18967–18974

##### Group size, crowding, and age class composition of the threatened Sambar *Rusa unicolor* (Kerr, 1792) (Mammalia: Cetartiodactyla: Cervidae) in the semi-arid regions of northeastern Rajasthan, India

– Deepak Rai & Kalpana, Pp. 18975–18985

##### Study on the impacts of LULC change on the wildlife habitat and the livelihood of people in and around Dampa Tiger Reserve, Mizoram, India

– Sushanto Gouda, Janmejey Sethy, Netrapal Singh Chauhan & Harendra Singh Bargali, Pp. 18986–18992

##### Characterisation of breeding habitat of Grizzled Giant Squirrel *Ratufa macroura* (Mammalia: Sciuridae) in Chinnar Wildlife Sanctuary, Western Ghats, India

– Kiran Thomas & P.O. Nameer, Pp. 18993–19001

##### Seasonal prey availability and diet composition of Lesser Asiatic Yellow House Bat *Scotophilus kuhlii* Leach, 1821

– Shani Kumar Bharti & Vadmalalai Elangovan, Pp. 19002–19010

##### Bird composition, diversity and foraging guilds in agricultural landscapes: a case study from eastern Uttar Pradesh, India

– Yashmita-Ulman & Manoj Singh, Pp. 19011–19028

##### Identification of a unique barb from the dorsal body contour feathers of the Indian Pitta *Pitta brachyura* (Aves: Passeriformes: Pittidae)

– Prateek Dey, Swapna Devi Ray, Sanjeev Kumar Sharma, Padmanabhan Pramod & Ram Pratap Singh, Pp. 19029–19039

##### Moths of the superfamily Gelechioidea (Microlepidoptera) from the Western Ghats of India

– Amit Katewa & Prakash Chand Pathania, Pp. 19040–19052

##### On the diversity and abundance of riparian odonate fauna (Insecta) of the midstream Chalakkudy River, Kerala, India

– C. Nitha Bose, C.F. Binoy & Franci K. Kakkassery, Pp. 19053–19059

##### Species diversity and abundance patterns of epiphytic orchids in Aralam Wildlife Sanctuary in Kerala, India

– Jis Sebastian, Durairaj Kathiresan & Giby Kuriakose, Pp. 19060–19069

##### Status and conservation needs of *Cycas pectinata* Buch.-Ham. in its natural habitat at Baroiyadhala National Park, Bangladesh

– M.K. Hossain, M.A. Hossain, S. Hossen, M.R. Rahman, M.I. Hossain, S.K. Nath & M.B.N. Siddiqui, Pp. 19070–19078

#### Review

##### Limitations of current knowledge about the ecology of Grey Foxes hamper conservation efforts

– Maximilian L. Allen, Alexandra C. Avrin, Morgan J. Farmer, Laura S. Whipple, Emmarie P. Alexander, Alyson M. Cervantes & Javan M. Bauder, Pp. 19079–19092

#### Short Communications

##### On the freshwater fish fauna of Krishna River, Sangli District, Maharashtra, India

– Suresh M. Kumbhar, Shrikant S. Jadhav, Swapnali B. Lad, Abhijit B. Ghadage, Satyawan S. Patil & C. Shiva Shankar, Pp. 19093–19101

##### Diversity and distribution of the large centipedes (Chilopoda: Scolopendromorpha) in the Phia Oac - Phia Den National Park, Vietnam

– Le Xuan Son, Nguyen Thi Tu Anh, Tran Thi Thanh Binh, Thu Anh T. Nguyen & Anh D. Nguyen, Pp. 19102–19107

##### Diversity of ants in Aarey Milk Colony, Mumbai, India

– Akshay Gawade & Amol P. Patwardhan, Pp. 19108–19117

##### First record of ghost shrimp *Corallianassa coutierei* (Nobili, 1904) (Decapoda: Axideidae: Callichiridae) from Indian waters

– Piyyush Vadher, Hitesh Kardani, Prakash Bambhaniya & Imtiaz Beleem, Pp. 19118–19124

##### A preliminary checklist of dragonflies and damselflies (Insecta: Odonata) of Vakkom Grama Panchayath, Thiruvananthapuram District, Kerala, India

– J. Arunima & P.O. Nameer, Pp. 19125–19136

##### Diversity pattern of butterfly communities (Lepidoptera) in different habitat types of Nahan, Himachal Pradesh, India

– Suveena Thakur, Suneet Bahrdwaj & Amar Paul Singh, Pp. 19137–19143

##### Descriptions of the early stages of *Vagrans egista sinha* (Lepidoptera: Nymphalidae) with notes on its host plant *Xylosma longifolia* Clos from the western Himalaya of India

– Pranav Gokhale & M.A. Yathumon, Pp. 19144–19148

#### Notes

##### First photographic record of Mishmi Takin *Budorcus taxicolor taxicolor* and Red Goral *Nemorhaedus baileyi* from Kamlang Tiger Reserve, Arunachal Pradesh, India

– Cheshta Singh & Deepti Gupta, Pp. 19149–19152

##### Utilisation of honey trap method to ensnare a dispersing sub-adult Bengal Tiger *Panthera tigris tigris* L. in a human dominated landscape

– Gobind Sagar Bhardwaj, Balaji Kari & Arvind Mathur, Pp. 19153–19155

##### First camera trap photographs of Indian Pangolin *Manis crassicaudata* (Mammalia: Pholidota: Manidae) from Pakistan

– Misbah Bint Riaz, Faraz Akrim, Siddiq Qasim, Syed Afaq Bukhari, Asad Aslam, Muhammad Waseem, Rizwana Imtiaz & Tariq Mahmood, Pp. 19156–19158

##### Photographic record of Lesser Flamingo *Phoeniconaias minor* (Aves: Phoenicopteridae) in Ramganga river, Bareilly, India

– Pichaimuthu Gangaikaran, Aftab A. Usmani, G.V. Gopi, S.A. Hussain & Khursid A. Khan, Pp. 19159–19161

##### Total length and head length relationship in Mugger Crocodiles *Crocodylus palustris* (Reptilia: Crocodylia: Crocodylidae) in Iran

– Asghar Mobaraki, Elham Abtin, Malihe Erfani & Colin Stevenson, Pp. 19162–19164

##### First record of the hoverfly genus *Spilomyia* Meigen (Diptera: Syrphidae) for Pakistan

– Muhammad Asghar Hassan, Imran Bodlah, Riaz Hussain, Azan Karam, Fazlullah & Azaz Ahmad, Pp. 19165–19167

##### Rediscovery of Watson's Demon *Stimula swinhoei swinhoei* (Elwes & Edwards, 1897) (Lepidoptera: Hesperidae: Hesperinae) in Meghalaya, India after 60 years

– Suman Bhowmik & Atanu Bora, Pp. 19168–19170

##### A record of *Ouraapteryx dierli* Inoue, 1994 (Lepidoptera: Geometridae: Ennominae) from the Garhwal Himalaya, India

– Arun P. Singh & Lekhendra, Pp. 19171–19172

##### Report of *Bradynopyga konkanensis* Joshi & Sawant, 2020 (Insecta: Odonata) from Kerala, India

– Muhammed Haneef, B. Raju Stiven Crasta & A. Vivek Chandran, Pp. 19173–19176

##### A new distribution record of *Bianor angulosus* (Karsch, 1879) (Araneae: Salticidae) from Kerala, India

– Nishi Babu, John T.D. Caleb & G. Prasad, Pp. 19177–19180

##### Notes on lectotypification of the Assam Ironwood *Mesua assamica* (King & Prain) Kosterm. (Calophyllaceae)

– Prantik Sharma Baruah, Sachin Kumar Borthakur & Bhaben Tanti, Pp. 19181–19184

##### On the rediscovery of a rare root parasite *Gleadovia ruborum* Gamble & Prain (Orobanchaceae) from Uttarakhand, western Himalaya, India

– Amit Kumar, Navendu V. Page, Bhupendra S. Adhikari, Manoj V. Nair & Gopal S. Rawat, Pp. 19185–19188

##### Occurrence of vivipary in *Ophiorrhiza rugosa* Wall. (Rubiaceae)

– Birina Bhuyan & Sanjib Baruah, Pp. 19189–19190

Publisher & Host

