



Odonate Diversity in Paddy Fields and Environs of Madakkathara Grama Panchayath, Thrissur, Kerala, India

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Abstract: The diversity of odonates was documented from Madakkathara Grama Panchayath in the Thrissur District of Kerala state in southern India. Field surveys which were conducted from December 2018 to November 2019 recorded 47 odonates, including 32 species of dragonflies (Anisoptera) and 15 species of damselflies (Zygoptera). Among dragonflies, the family Libellulidae dominated with 30 species, while Coenagrionidae with 9 species were dominant among damselflies. The 25.68% of the odonates in Kerala and 22.49% of the odonates in the Western Ghats were represented in the odonate diversity of the Madakkathara Grama Panchayath. The migratory species *Pantala flavescens* dominated the count, especially around the monsoons.

Keywords: Anisoptera, Zygoptera, Western Ghats, Endemic, Species inventory

The order Odonata, which comprises dragonflies and damselflies, is one of the most fascinating insect groups due to their amphibious life history, relatively short generation time, high trophic position, and diversity. They are composed of primitive predatory insects, whose origins date back to the Permian period (Grimaldi et al 2005). Globally, there are over 6376 identified odonate species (Paulson et al 2022), of which 493 species are seen in India, 209 in the Western Ghats, and 183 in Kerala. These 183 species of odonates include 70 Western Ghats endemics, belonging to 87 genera under 2 suborders and 14 families (Nair et al 2021, Sadasivan et al 2021, Vijayakumaran et al 2022).

The order Odonata forms the apex predators in the freshwater ecosystems, and hence their diversity in rice fields from different parts of the country has been studied. Some notable works on paddy fields odonates in India include: Anbalagan et al (2013) have recorded 23 species of dragonflies and 12 species of damselflies from rice and vegetable fields in Tiruvallur district of Tamil Nadu, India; Arulprakash et al (2017) have recorded 19 species of odonates from rice fields of five major rice-growing areas of Pattukkottai, Thanjavur district in Tamil Nadu; A total of 44 species (30 dragonflies and 14 damselflies) belonging to 33 genera and eight families were recorded from the Kole Wetlands, central Kerala, India by Chandran et al (2021); 66 species were documented from Kattampally wetlands, Kannur, Kerala (Rodrigues et al 2022); Gunathilagaraj et al (1999) studied the odonate diversity in the rice fields of Coimbatore and recorded 16 species of odonates from the

study area; A total of 12 species of Odonata under three families and 12 genera were collected and identified during the survey in the irrigated rice ecosystem of Madurai, Tamil Nadu by Kandibane et al (2005); Palot et al (2005) studied the odonate diversity of rice field habitat in Palakkad district, Kerala and recorded 21 species under 18 genera of 5 families; Rohmare et al (2016) investigated the diversity and population dynamics of odonata in the rice-growing area of Central Gujarat; and Talmale and Kulkarni (2003) collected 19 taxa from 17 genera and 5 families from the paddy fields of Bhandara district, Maharashtra.

This study focuses on the paddy fields of Madakkathara Grama Panchayath (MGP). Madakkathara village is in the Thrissur taluk of Thrissur district in Kerala, India. The area is located between 10° 33' 0.00" N- 10° 36' 0.00" N and 76° 15' 0.00" E- 76° 18' 0.00" E and has an area of 21.59 sq. km (Fig. 1). Even with its proximity to the city, MGP is an agriculturally intense place with a good area of land under cultivation. The intricate system of irrigation canals and related tanks, village ponds, and paddy fields in MGP offers promising odonate habitats. But the changes in land use practices, which mainly include the turning of agroecosystems like paddy fields into nurseries, housing plots, and fields for growing other crops like coconut, mixed cropping, etc, are seen inferred as a threat to local odonate diversity.

MATERIAL AND METHODS

Field surveys were conducted from December 2018 to November 2019 in the paddy field agroecosystems of

Madakkathara Panchayath, Thrissur from December to February (winter- W), March to May (summer- S), June to August (southwest monsoon- M1), and September to November (northeast monsoon- M2). Visual encounter surveys (VES) were done for adult odonates between 0900 and 1300 hrs to document them from the paddy fields and their adjoining irrigational canals. Odonates were not collected but were photographed using a Nikon COOLPIX P900 and a Nikon D5600 DSLR camera with a 70-300mm lens. Species identification was done using field guides (Subramanian 2009, Kiran and Raju 2013). The scientific names are adopted from the revised nomenclature by Kalkman et al (2020). The odonates observed during the study period were categorised into four groups based on their relative abundance modified from Adarsh et al (2014). Accordingly, those species which were sighted 75-100% of the survey days were categorised as 'Very Common' (VC), 50-74% as 'Common' (CO), 25-49% as 'Not Rare' (NR), and 'Rare' (RA) for those that were sighted less than 25% of the field days. The data analysis was done with the help of PAST software (Sivaruban et al 2020).

RESULTS AND DISCUSSION

In the study, we documented 47 species of odonates (Table 1), which included 32 species of Anisoptera (Dragonflies) and 15 species of Zygoptera (Damselflies) belonging to 8 families. The family Libellulidae was the most speciose in Anisoptera with 30 species, followed by Aeshnidae and Gomphidae. Among Zygoptera, Coenagrionidae with 9 species was the most dominant family, followed by Platycnemididae, Calopterygidae, Chlorocyphidae, and Lestidae.

The relative abundance analysis shows that 28 species out of the 47 species of odonates were very common, 10 common, 5 not rare, and 4 rare (Fig. 2). The most abundant species were *Pantala flavescens* (25.57 %), followed by *Brachythemis contaminata*, *Crocothemis servilia*, and *Trithemis pallidinervis* (Fig. 3). Libellulidae was the most

abundant family (63.83 %), followed by Coenagrionidae. *Pantala flavescens* (63.83 %) and *Agriocnemis pygmaea* (2.95 %) were the most abundant species in the respective dragonfly and damselfly categories.

The diversity study across the four seasons showed that the maximum species richness and diversity were observed during the northeast monsoon season and the minimum during the summer season. Species richness observed in four different seasons in the paddy fields is summarised in Figure 4. Members of odonate families such as Gomphidae, Libellulidae, Coenagrionidae, and Platycnemididae were observed throughout the seasons (Table 2), whereas Aeshnidae, Calopterygidae, and Chlorocyphidae family members were observed only during the monsoon months. There were seasonal variation in dragonfly and odonate abundance, whereas damselfly abundance was essentially constant throughout the study period.

The present study recorded two endemic species of odonates, one each for the Western Ghats and Peninsular India. The taxon *Agriocnemis keralensis* is endemic to the Western Ghats, and *Libellago indica* is endemic to peninsular India. Out of the 209 species of odonates recorded from the

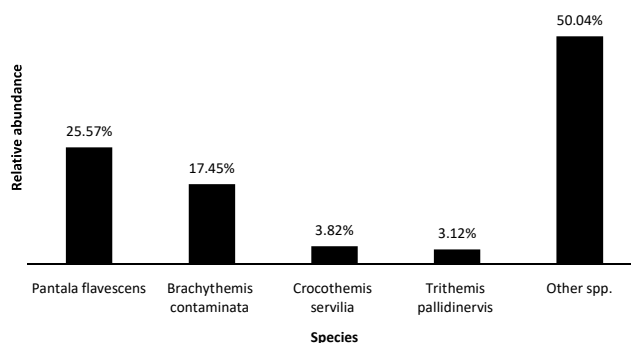


Fig. 2. Relative abundance of the most dominant species in comparison with the rest of the species

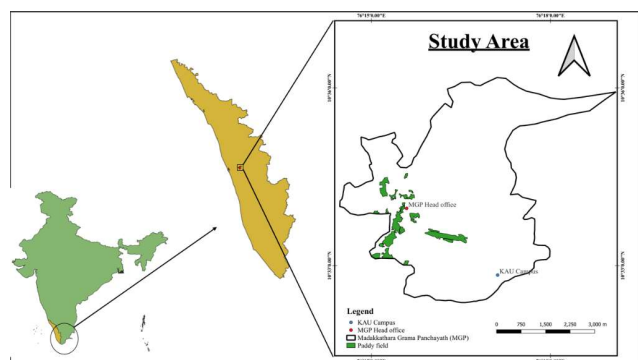


Fig. 1. Study location

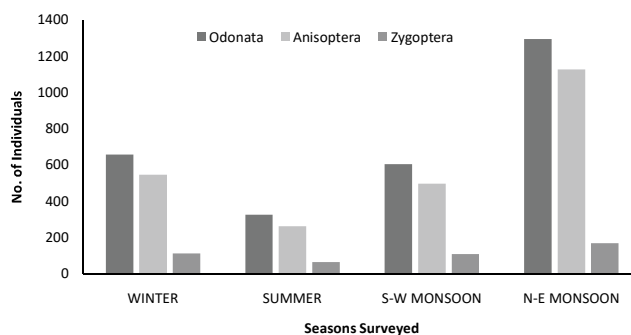


Fig. 3. Species richness observed in four different seasons in the paddy fields of MGP, Thrissur, Kerala

Table 1. Checklist of odonates from the paddy fields of Madakkathara Grama Panchayath, Thrissur, Kerala

Family/Scientific name	IUCN status	Abundance	Seasons recorded in
Anisoptera (Dragonflies)			
Family - Aeshnidae (Darners) – RA: 2.13%			
<i>Gynacantha dravida</i> Lieftinck 1960	DD	RA	M2
Family - Gomphidae (Clubtails) – RA: 2.13%			
<i>Ictinogomphus rapax</i> (Rambur 1842)	LC	VC	W, S, M1, M2
Family - Libellulidae (Skimmers) – RA: 63.83%			
<i>Acisoma panorpoides</i> Rambur 1842	LC	VC	W, S, M1, M2
<i>Aethriamanta brevipennis</i> (Rambur 1842)	LC	VC	W, S, M1, M2
<i>Brachydiplax chalybea</i> Brauer 1868	LC	VC	W, S, M1, M2
<i>B.sobrina</i> (Rambur 1842)	LC	VC	W, S, M1, M2
<i>Brachythemis contaminata</i> (Fabricius 1793)	LC	VC	W, S, M1, M2
<i>Bradinopyga geminate</i> (Rambur 1842)	LC	VC	W, S, M1, M2
<i>Crocothemis servilia</i> (Drury 1770)	LC	VC	W, S, M1, M2
<i>Diplacodes nebulosa</i> (Fabricius 1793)	LC	VC	W, S, M1, M2
<i>D.trivialis</i> (Rambur 1842)	LC	VC	W, S, M1, M2
<i>Hydrobasileus croceus</i> (Brauer 1867)	LC	VC	W, S, M1, M2
<i>Lathrecista asiatica</i> (Fabricius 1798)	LC	NR	S, M1, M2
<i>Neurothemis fulvia</i> (Drury 1773)	LC	CO	W, S, M1, M2
<i>N.intermedia</i> (Rambur 1842)	LC	CO	W, M1, M2
<i>N.tullia</i> (Drury 1773)	LC	VC	W, S, M1, M2
<i>Orthetrum chrysis</i> (Selys 1892)	LC	CO	W, S, M1, M2
<i>O.luzonicum</i> (Brauer 1868)	LC	VC	W, S, M1, M2
<i>O.pruinosum</i> (Burmeister 1839)	LC	CO	W, S, M1, M2
<i>O.sabina</i> (Drury 1770)	LC	VC	W, S, M1, M2
<i>Pantala flavescens</i> (Fabricius 1798)	LC	VC	W, S, M1, M2
<i>Potamarcha congener</i> (Rambur 1842)	LC	CO	W, M1, M2
<i>Rhodothermis rufa</i> (Rambur 1842)	LC	VC	W, S, M1, M2
<i>Rhyothemis variegata</i> (Linnaeus 1763)	LC	VC	W, S, M1, M2
<i>Tetrathemis platyptera</i> Selys 1878	LC	NR	W, S, M1, M2
<i>Tholymis tillarga</i> (Fabricius 1798)	LC	VC	W, S, M1, M2
<i>Tramea limbata</i> (Rambur 1842)	LC	NR	S, M1, M2
<i>Trithemis aurora</i> (Burmeister 1839)	LC	CO	S, M1, M2
<i>T.festiva</i> (Rambur 1842)	LC	CO	W, M1, M2
<i>T.pallidinervis</i> (Kirby 1889)	LC	VC	W, S, M1, M2
<i>Urothemis signata</i> (Rambur 1842)	LC	VC	W, S, M1, M2
<i>Zyxomma petiolatum</i> Rambur 1842	LC	RA	M2
Zygoptera (Damsel flies)			
Family - Coenagrionidae (Narrow-wings) – RA: 19.15%			
<i>Agriocnemis keralensis</i> Peters 1981*	LC	VC	W, S, M1, M2
<i>A.pieris</i> Laidlaw 1919	LC	VC	W, S, M1, M2
<i>A.pygmaea</i> (Rambur 1842)	LC	VC	W, S, M1, M2
<i>Ceragrion cerinorubellum</i> (Brauer 1865)	LC	VC	W, S, M1, M2
<i>C.coromandelianum</i> (Fabricius 1798)	LC	VC	W, S, M1, M2
<i>Ischnura rubilio</i> Selys 1876	LC	VC	W, S, M1, M2
<i>I.senegalensis</i> (Rambur 1842)	LC	CO	W, S, M1, M2
<i>Pseudagrion microcephalum</i> (Rambur 1842)	LC	VC	W, S, M1, M2
<i>P.rubriceps</i> Selys 1876	LC	VC	W, S, M1, M2
Family - Platycnemididae (White-legs) – RA: 4.26%			
<i>Copera marginipes</i> (Rambur 1842)	LC	NR	M1, M2
<i>Prodasineura verticalis</i> (Selys 1860)	LC	CO	W, S, M1, M2
Family - Lestidae (Spread-wings) – RA: 2.13%			
<i>Lestes praemorsus</i> Hagen in Selys 1862	LC	CO	S, M1, M2
Family - Calopterygidae (Broad-wings) – RA: 4.26%			
<i>Vestalis apicalis</i> Selys 1873	LC	RA	M1
<i>V.gracilis</i> (Rambur 1842)	LC	RA	M1
Family - Chlorocyphidae (Stream jewels) – RA: 2.13%			
<i>Libellago indica</i> (Fraser 1928) **	NE	NR	M1, M2



Image 1: *Vestalis gracilis*



Image 2: *Vestalis apicalis*



Image 11: *Brachidiplax chalybea*



Image 12: *Hydrobasileus croceus*



Image 3: *Libellago indica*



Image 4: *Ischnura senagalensis*



Image 13: *Brachythemis contaminata*



Image 14: *Neurothemis tullia*



Image 5: *Agriocnemis pieris*



Image 6: *Ischnura rubilio*



Image 15: *Rhyothemis variegata*



Image 16: *Diplacodes trivialis*



Image 7: *Copera marginipes*



Image 8: *Ceriagrion coromandelianum*



Image 17: *Trithemis festiva*



Image 18: *Tholymis tillarga*



Image 9: *Agriocnemis keralensis*



Image 10: *Pseudagrion microcephalum*



Image 19: *Orthetrum sabina*

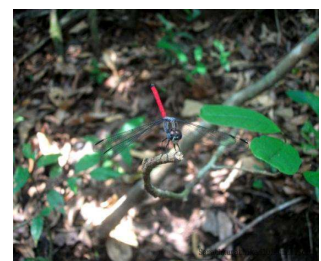


Image 20: *Lathrecista asiatica*



Image 21: *Trithemis aurora*



Image 22: *Neurothemis fulvia*



Image 23: *Acisoma panorpoides*



Image 24: *Ictinogomphus rapax*



Image 25: *Orthetrum luzonicum*



Image 26: *Crocothemis servilia*



Image 27: *Orthetrum chrysis*



Image 28: *Orthetrum pruinosum*



Image 29: *Pantala flavescens*



Image 30: *Brachydiplax sobrina*



Image 31: *Urothemis signata*



Image 32: *Potamarcha congener*

Western Ghats and 183 species of odonates from Kerala, the present study has accounted for 25.68 % of the odonates in Kerala and 22.49 % of the odonates in the Western Ghats. None of the odonate species from the study area was listed under the Indian Wildlife Protection Act (WPA) of 1972 or the appendices of CITES. Except for *Gynacantha dravida*, which is staged under the 'Data Deficient' category and *Ischnura rubilio* and *Libellago indica*, which are staged under the 'Not Evaluated' category, the rest of the species are listed under the 'Least Concern' category of the IUCN Red List 2022.

One of the most crucial habitats for odonates is paddy fields, where several species primarily reproduce. They hatch when the paddy fields are irrigated, grow swiftly while the water is still in the fields, and emerge before the fields are emptied. This is because their life cycle is synchronised with human activities on the rice crop. The diversity and abundance of these species in paddy fields, however, are less documented in many parts of the world.

A comparable study by Chandran et al (2021) from the Kole wetlands in Central Kerala, located approximately 13 km from the present study location, found a total of 44 species of odonates, including 30 dragonflies and 14 damselflies from eight families. Since the paddy fields serve as ephemeral wetlands, 12 new species that were not listed in Chandran et al (2021) as in the current investigation.

The MGP is also close to the Kerala Agricultural University, Vellanikkara, Thrissur from where 52 species of odonates have been recorded by Adarsh et al (2014), possibly because of the heterogeneity of habitats there. Five new species that had not been previously identified by Adarsh et al (2014), have been reported in this study. The present study has also added three new species, namely *Agriocnemis keralensis*, *Lestes praemorsus*, and *Orthetrum pruinosum*, to the checklist of odonates in Indian paddy fields enlisted in Pavithran et al (2020), thus bringing the total number of odonates recorded from paddy fields to 130.

In the Libellulidae family of Anisoptera and the Coenagrionidae family of Zygoptera, higher species diversity was observed. Ghahari et al (2009) revealed that the Libellulidae and Coenagrionidae families dominated in terms of the number of species in Iranian rice fields. Kumar and Mitra (1998) noted that the family Libellulidae was represented by a high number of species (18 species) out of a total collection of 42 species from Sahstradhara, Dehradun. The current study has shown that the diversity and abundance of odonate fauna show a rise during the Northeast monsoon period. Talmale and Kulkarni (2003) also showed that the odonate population peaks during October and November. This is because paddy fields act as temporary wetlands and remain inundated for more than

Table 2. Family-wise distribution of odonate species in different seasons

Seasons	Aeshnidae	Gomphidae	Libellulidae	Coenagrionidae	Platycnemididae	Lestidae	Calopterygidae	Chlorocyphidae
Winter	0	1	26	9	1	0	0	0
Summer	0	1	27	9	1	1	0	0
Southwest Monsoon	0	1	29	9	2	1	2	1
Northeast Monsoon	1	1	30	9	2	1	0	1

three months, providing ideal breeding conditions for odonates.

CONCLUSION

The study focused on the paddy fields in Madakkathara Grama Panchayath, which are an agriculturally intense area with a good area of land under cultivation. The system of irrigation canals and related tanks, village ponds, and paddy fields in the region provide suitable habitats for odonates. However, changes in land use practices, such as turning paddy fields into nurseries or other crop fields, threaten the local odonate diversity. The study can also be used to show the effects of anthropogenic disturbance on agrobiodiversity, and their significance as indicators of the quality of the biotope. Overall, the study provides important insights into the diversity of odonates in Madakkathara Grama Panchayath and highlights the importance of conserving their habitats to ensure their continued presence in the region.

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