



DIVERSITY OF ODONATA IN A COFFEE ECOSYSTEM

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ABSTRACT

A total of 419 individuals under 5 families, 10 genera and 10 species of Odonata were observed in the present study on the Odonata from a coffee ecosystem at the lower Palni Hills, Tamil Nadu, India. Among these, the family Libellulidae included six species followed by Euphaeidae (2), and Chlorocyphidae, Coenagrionidae and Aeshnidae (1 each). The dominant species were: *Pantala flavescens* (44.40%) > *Diplacodes trivialis* (22.70%) > *Orthetrum chrysis* (7.40%). *Pantala flavescens* was maximum during northeast monsoon season (50.0%) followed by summer and winter (43.8% each). Margalef index of species richness was maximum (2.00) during winter, and that of Simpson index was maximum (0.75) during south west monsoon. Shannon-Wiener index of dominance was maximum (1.75) during summer. The species were evenly distributed during summer with Pielou's evenness index value of 0.76.

Key words: Odonata, diversity indices, coffee ecosystem, Southern Western Ghats, lower Palni Hills, seasonal abundance, numerical abundance

Western Ghats, one of the mega hotspot centres of the world is endowed with rich biodiversity with its flora and fauna being largely endemic (<https://whc.unesco.org/en/list/1342/>). The Palni Hills in Tamil Nadu, which are the eastern extension of the Western Ghats, have invertebrate richness and endemism yet to be explored. The present study on the insect diversity in this region (10.12-10.15°N, 77.26-77.33°E), an inventory of Odonata was undertaken during January, 2018 to 2019, covering an area of 2068 km². Odonata are known as ecological indicators, and many studies show that certain species exhibit high association with particular habitats (Smith et al., 2007), especially of freshwater habitats (Subramanian and Sivaramakrishnan 2005). These insectivorous insects are biocontrol agents against mosquitoes (Andrew et al., 2008). Indiscriminate usage of pesticides causes the loss of biodiversity of beneficial organisms. Recently, biodiversity in agricultural land has received growing attention (Dudley et al., 2005). Coffee is the most important perennial beverage, especially in Tamil Nadu (Central Coffee Research Institute CCRI, 2018). In the study area of Thadiyankudisai, coffee is cultivated in an area of 13,436 ha, and insect pests are a major constraint. Basic study on Odonata diversity is a prerequisite for the success of any biological control and IPM measure, and hence the present study.

MATERIALS AND METHODS

The present study was carried out at the Horticultural

Research Station, Thadiyankudisai (10.29°N, 77.71°E, 1098 masl) from January, 2018 to January, 2019. Survey sites were chosen based on accessibility, covering the Lower Palni hills where coffee is intercropped with silver oak, pepper, avocado, mandarin orange, macadamia nut, Indian coral tree, silk cotton, jack and banana. The research plot's location is in the northern region of Kodavan river and southern region of Thathampara canals. Collection of specimens was done with a specially designed insect net (30 cm dia of the hoop and collection bag length 60 cm) at weekly intervals. Species were photographed with a Canon camera, and identification was done following the taxonomic keys (Fraser, 1933, 1934 and 1936). Expertise of Dr K Gunathilagaraj, Dr Subramanian (Zoological Survey of India, SRC, Chennai), Dr R. Arulprakash and Suhirtha Muhil was availed. Identified collections were deposited at the Tamil Nadu Agricultural University (TNAU), Insect Museum, Coimbatore. Relative abundance was calculated by the formula- relative density (%) = (no. of individuals of one species/ no. of individuals of all species) x 100. Species or alpha diversity was quantified using Simpson's diversity index (SDI- Simpson, 1949) and Shannon-Wiener index (Shannon and Weaver, 1949). Margalef index of species richness was calculated (Margalef, 1958) as $\alpha = (S - 1) / \ln(N)$; S = total no. of species, N = total no. of individuals in the sample. Species evenness was calculated using the Pielou's evenness index ($E1 = H' / \ln(S)$); H' = Shannon-Wiener diversity index, S = total number of species in

the sample (Pielou, 1966) with biodiversity calculator. <https://www.alyoung.com/labs/biodiversity-calculator.html>.

RESULTS AND DISCUSSION

A total of 419 specimens of Odonata under 5 families, 10 genera and 10 species was observed, with Libellulidae being more speciose (6 species) followed by Euphaeidae (2), Chlorocyphidae, Coenagrionidae and Aeshnidae (1 each). The most dominant were- *Pantala flavescens* (44.40%) > *Diplacodes trivialis* (22.70%) > *Orthetrum chrysis* (7.40%). *Pantala flavescens* was the maximum during north east monsoon (50.00%) while *Diplacodes trivialis* (26.90%) was in the south west monsoon (Table 1). Margalef Index (2.00) was the highest during winter, and the Simpson index (0.75) was the highest during south west monsoon; Shannon-Wiener Index of dominance (1.75) was maximum during summer. The species were evenly distributed during summer with Pielou's index

being 0.76 (Table 2). The dominance of Libellulidae has been previously reported from other parts of the Western Ghats (Subramanian et al., 2008; Koparde et al., 2015). Libellulidae occur commonly in the plains, semi evergreen forests, moist deciduous forests, coastal swamps (Subramanian et al., 2008). *Pantala flavescens* and *D. trivialis* commonly occur in the agroecosystems such as rice (Gunathilagaraj et al., 1999; Arulprakash et al., 2017) and pulses cultivated under dry irrigated conditions (Chitra et al., 2000). Among Zygoptera, *Esme mudiensis* (Coenagrionidae) is the most common in the wetlands (Subramanian et al., 2008) and from rice fields of Coimbatore (Gunathilagaraj et al., 1999), Pattukottai (Arulprakash et al., 2017). Higher diversity and even species distribution during summer may be attributed emergence of 2-3 generations during summer months (Michael and Norma, 2010).

Libellulidae and Gomphidae are well-distributed Anisopterans across Indian subcontinent, with few species restricted to Western Ghats and/or northeast

Table 1. Seasonal abundance of Odonata in coffee ecosystem at Thadiyankudisai

S. No.	Family/ Scientific name	Seasonal abundance				Numerical abundance (Nos.)
		Winter	Summer	SWM	NEM	
1.	Aeshnidae <i>Anax indicus</i>	2	1	3	2	8
2.	Chlorocyphidae <i>Heliocypha bisignata</i>	2	6	2	6	16
3.	Coenagrionidae <i>Esme mudiensis</i>	3	2	1	5	11
4.	Euphaeidae <i>Euphaea fraseri</i> <i>Euphaea cardinalis</i>	1 3	2 3	3 4	0 3	6 13
5.	Libellulidae <i>Brachythemis contaminata</i> <i>Diplacodes trivialis</i> <i>Hylaeothemis indica</i> <i>Orthetrum chrysis</i> <i>Pantala flavescens</i>	7 19 5 8 39	4 21 8 7 42	7 28 6 10 40	6 27 10 6 65	24 95 29 31 186
Total		89	96	104	130	419

No- Total number of individuals collected, SWM- South west monsoon, NEM- North east monsoon

Table 2. Diversity indices of Odonata in coffee ecosystem at Thadiyankudisai

Season	Diversity indices			
	Margalef index (α)	Simpson's index	Shannon-Wiener index	Pielou's index
Winter	2.00	0.74	1.71	0.74
Summer	1.97	0.74	1.75	0.76
South west monsoon	1.93	0.75	1.74	0.75
North east monsoon	1.65	0.67	1.50	0.68

India (Fraser, 1934; 1936; Subramanian, 2005). Two species belonging to Libellulidae and 18 species belonging to Gomphidae are known to be endemic to Western Ghats (Subramanian, 2007). A review by Subramanian et al. (2011) points agricultural pollution and urban and industrial development as major threats to Odonata fauna of Western Ghats.

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AUTHOR CONTRIBUTION STATEMENT

Conceptualization: KRM and NC; Experimentation and data collection: KRM, MM and MA; Data curation: KRM and NC; Formal analysis: KRM and NC; Writing-original draft preparation: KRM, MM, NC and MA; Writing: KRM; Review and editing: KRM, MM and NC; Supervision: KRM, MM, NC and MA; Funding acquisition: KRM and MM; Project administration: MM, NC and MA; All authors read and approved the manuscript.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCES

- Andrew R J, Subramaniam K. A, Tiple A D. 2008. A handbook on common odonates of Central India. South Asian Council of Odonatology, Nagpur.
- Arulprakash R, Chitra N, Gunathilagaraj K. 2017. Biodiversity of Odonata in rice at Pattukkottai in Tamil Nadu. Indian Journal of Entomology 79 (4): 498-502.
- Chitra N, Soundararajan R P, Gunathilagaraj K. 2000. Orthoptera in rice fields of Coimbatore. Zoos' Print Journal 15 (8): 308-311.
- Central Coffee Research Centre. 2018. Database on coffee. Market Research and Intelligence Unit, Central Coffee Research Institute, Coffee Research Station, Chikmagalur. 119 pp.
- Dudley N, Baldock D, Nasi R, Stolton S. 2005. Measuring biodiversity and sustainable management in forests and agricultural landscapes. Philosophical Transactions of the Royal Society of London B: Biological Sciences 360 (1454): 457-470.
- Fraser F C. 1933. The fauna of British India including Ceylon and Burma. Odonata Vol. I. Taylor and Francis Ltd., London.
- Fraser F C. 1934. The fauna of British India including Ceylon and Burma. Odonata Vol. II. Taylor and Francis Ltd., London.
- Fraser F C. 1936. The fauna of British India including Ceylon and Burma. Odonata Vol. III. Taylor and Francis Ltd., London.
- Gunathilagaraj K, Soundarajan R P, Chitra N, Swamiappan M. 1999. Odonata in the rice fields of Coimbatore. Zoos' Print Journal 14 (6): 43-44.
- Koparde P, Mhaske P, Patwardhan A. 2015. Habitat correlates of Odonata species diversity in the northern Western Ghats, India. Odonatologica 44 (1): 21-43. <https://whc.unesco.org/en/list/1342>
- Margalef R. 1958. Temporal succession and spatial heterogeneity in phytoplankton. Perspectives in Marine Biology. pp. 323-349.
- Michael J S, Norma J S. 2010. Recovery of endemic dragonflies after removal of invasive alien trees. Conservation Biology 24 (1): 267-277.
- Pielou E C. 1966. The measurement of diversity in different types of biological collections. Journal of Theoretical Biology 13: 131-144.
- Shannon C E, Warren W. 1949. The mathematical theory of communication. University of Illinois Press, Urbana. 177 pp.
- Simpson E H. 1949. Measurement of species diversity. Nature 163: 688.
- Smith J, Samways M J, Taylor S. 2007. Assessing riparian quality using two complementary sets of bioindicators. Biodiversity and Conservation 16: 2695-2713.
- Subramanian K A. 2005. Dragonflies and damselflies of Peninsular India- a field guide. Project Lifescape. Centre for Ecological Sciences, Indian Institute of Bangalore and Indian Academy of Sciences, Bangalore.
- Subramanian K A, Sivaramkrishnan K G. 2005. Habitat and microhabitat distribution of stream insect communities of Western Ghats. Current Science. 89: 976-987.
- Subramanian K A. 2007. Endemic Odonates of the Western Ghats: habitat distribution and conservation. Odonata: Biology of dragonflies. Scientific Publishers, Jodhpur, India. pp.257-271.
- Subramanian K A, Ali S, Ramchandra T V. 2008. Odonata as indicators of riparian ecosystem health a case study from south western Karnataka, India. Fraseria (NS). 7: 83-95.
- Subramanian K A, Kakkassery F, Nair M V. 2011. The status and distribution of dragonflies and damselflies (Odonata) of the Western Ghats. Molur S, Smith K G, Daniel B A, Darwall W R T (Compilers). The status and distribution of freshwater biodiversity in the Western Ghats, India. Cambridge, UK, and Gland, Switzerland: IUCN, and Coimbatore, India: Zoo Outreach Organization. pp. 63-71.

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