



DIVERSITY OF ODONATA IN HOKERSAR WETLAND- A RAMSAR SITE OF KASHMIR HIMALAYA, INDIA

MOHD HUSSAIN², ALTAF HUSSAIN MIR¹, NISAR AHMAD PARAY¹ AND TANVEER AHMAD DAR^{1*}

¹Entomology Research Laboratory, Department of Zoology, University of Kashmir, Srinagar 190006, J&K, India

²Department of Zoology, University of Ladakh, UT Ladakh, India

*Email: dardanvi8@gmail.com (corresponding author): ORCID ID 0000-0001-5693-955X

ABSTRACT

The present study was carried out from 2021 to 2023 to assess the diversity and seasonal distribution of odonates in the Hokersar wetland. A total of 18 species under 11 genera and four families were observed of which a high diversity of dragonflies were seen compared to damselflies. Libellulidae was found to be the most species-rich family followed by Aeshnidae. The most abundant species were *Pantala flavescens* (F) (11.98%), *Crocothemis servilia* (Drury) (11.35%) and *Ischnura inarmata* Calvert (11.09%). A change in diversity and abundance across seasons was observed with the highest being in summer followed by autumn, while absence during spring and autumn was seen, except for *Sympecma paedisca* (Brauer) found throughout the year.

Key words: Bioindicators, conservation, dragonflies, Hokersar, Libellulidae, Ramsar site, abundance, *Crocothemis servilia*, *Sympecma paedisca*, season

Odonata which includes damselflies (Zygoptera) and dragonflies (Anisoptera) is a small but well-known insect order due to their large body size, colorful bodies, and conspicuous behavior. Being predators both at the larval and the adult stage, they play an important role in nutrient cycling in aquatic and terrestrial ecosystems (Tiple et al., 2012). Odonates have a worldwide distribution except for Antarctica and globally represented by 6,407 described species belonging to 693 genera and 18 families (Schorr and Paulson 2023), while Indian fauna is represented by 498 species under 154 genera and 18 families (Subramanian and Babu 2020). Early contributions to the studies on Odonata fauna of Kashmir Himalaya include Calvert (1898), who reported 15 species; Fraser (1933, 1934, 1936) updated the list to 21 species. Singh and Bajjal (1954), Chowdhary and Das (1975) and Asahina (1978) also reviewed the odonates of Kashmir Himalaya. Recent studies by Riyaz and Sivasankaran (2021) reported 10 species from Hirpora Wildlife Sanctuary, Shopian, Kashmir; Qureshi et al. (2022) recorded 12 species from district of Pulwama, Kashmir. Paray and Mir (2023) gave a list of 24 species of odonates including four new records from Kashmir Himalaya; Gazanfar and Khaleel (2023); Qureshi et al. (2023) added new records to the Odonate fauna of Kashmir Himalaya. Sharma et al. (2023) prepared a checklist of 63 Odonata species including 24 new records to Jammu

and Kashmir. Keeping in view the scarce study of the region and the importance of this insect group, it was imperative to explore their diversity and distribution from the study area and this study will pay the way to understand the ecology of this group better and help for its conservation.

MATERIALS AND METHODS

Hokersar wetland, a Ramsar site and a protected wildlife reserve in Jammu and Kashmir, India lies between the coordinates of 34° 06' N latitude to 74° 05' E longitude. The area of the wetland has shrunk from 19.5 km² to 13.26 km² due to encroachment along all sides of its circumference. The wetland is perennial, permanent in nature with fluvial origin, and attains a maximum depth of 2.5 m in spring and a minimum of 0.7 m during the autumn season. The area of wetland is differentiated into three varied zones-marshy and exposed zone extending from north to northwest, the central deep area having mostly free expanse of water, southeastern zone mostly covering the silted area.

Field surveys were carried out seasonally (Spring, Summer, Autumn, and Winter) from 2021-2023 in four zones (East, West, North, and South) of the wetland. Sampling sites were selected randomly to cover all the microhabitats (marshes, canals, terrestrial zone and agricultural fields) of the wetland. Collecting transects

of 250 x 10 m were laid down. Data collection was done using a combination of direct searching techniques and the opportunistic sighting method. Specimens were collected using the aerial net and preserved for further examination. Photographs of the species in the field were taken using Canon EOS 200D with a 250 mm lens camera. Identification of the specimens was done by consulting the taxonomic literature of Fraser (1933, 1934, 1936), and the field guide of Subramanian (2009). For nomenclature and hierarchy of taxa, the World Odonata list by Schorr and Paulson (2023) and the checklist of Odonata of South Asian countries by Kalkman et al. (2020) were followed. Specimens collected during the study were deposited in the Museum of the Department of Zoology, University of Kashmir, India

RESULTS AND DISCUSSION

A total of 784 adult odonates were collected during the survey which belong to 18 species under eleven genera and four families (Fig. 1; Table 1). Out of 18 species, 15 species under eight genera and two families belong to the suborder Anisoptera, while three species under three genera and two families belong to the suborder Zygoptera. Based on the species richness of families, Libellulidae was found highly diverse with twelve species followed by Aeshnidae with three species, while Coenagrionidae and Lestidae were represented by two and a single species respectively. Based on the relative abundance, *Pantala flavescens* (Fabricius, 1798) *Ischnura inarmata* Calvert, 1898 and *Crocothemis servilia* (Drury, 1770) were recorded

as the dominant species. The diversity of Odonata of Hokersar wetland accounts 66.66% of the total diversity of Kashmir Himalaya. The diversity of Odonata varied according to the season. The highest diversity was recorded during the summer and Autumn period in the case of dragonflies whereas in the case of damselflies, it was from early spring to autumn. Adults of *Sympetma paedisca* were recorded throughout the year i.e. in all seasons (winter, spring, summer, and autumn).

Odonata fauna of the wetland is dominated by Family Libellulidae which accounts 44.44% of the total species account. Species of this family show wide geographical distribution, shorter life cycle, and high tolerance to changing environment (Gentry et al., 1975; Samways 1989). Subramanian et al. (2008) also recorded high species richness of the family Libellulidae in the lentic ecosystem. *Pantala flavescens* (Fabricius) as one of the abundant species and migratory in nature was seen to congregate in large numbers in the wetland. Similar pattern about *Pantala favescens* (Fabricius) was observed in Kole Wetlands of Central Kerela, India (Chandran et al., 2021). Less diversity of damselflies may be attributed by their less dispersal ability, changing environment, partial shade cover in the wetland (Weir 1974; Williams 1997). Comparatively, species of the family Aeshnidae are larger in size; these were observed to fly strongly and high above the wetland and its associated landscape.

As Kashmir Himalaya has a temperate climate and shows different seasons, the diversity and species abundance vary during different seasons of the year.



Fig. 1. A- *Ischnura inarmata*; B- *Sympetma paedisca*; C- *Enallagma cyathigerum*; D- *Pantala flavescens*; E- *Palpopleura sexmaculata*; F- *Crocothemis servilia*; G- *Orthetrum brunneum*; H- *Orthetrum glaucum*; I- *Orthetrum luzonicum*; J- *Orthetrum triangulare*; K- *Orthetrum sabina*; L- *Sympetrum commixtum*; M- *Sympetrum fonscolombii*; N- *Sympetrum striolatum*; O- *Aeshna mixta*; P- *Aeshna juncea*; Q- *Anax parthenope*; R- *Trithemis aurora*

Table 1. Checklist of Odonata -Hokersar wetland with their relative abundance

S.No.	Family/Scientific Name	IUCN status	Relative abundance (%)	Seasonal abundance
	Lestidae			
01	<i>Sympecma paedisca</i> (Brauer, 1877)	LC	4.59	All the four seasons
	Coenagrionidae			
02	<i>Ischnura inarmata</i> Calvert, 1898	DD	11.09	Absent during winter
03	<i>Enallagma cyathigerum</i> (Charpentier, 1840)	LC	3.95	Absent during winter
	Libellulidae			
04	<i>Orthetrum sabina</i> (Drury, 1770)	LC	9.05	Absent during winter and spring
05	<i>Orthetrum triangulare</i> (Selys, 1878)	LC	3.44	Absent during winter and spring
06	<i>Orthetrum glaucum</i> (Brauer, 1865)	LC	4.33	Absent during winter and spring
07	<i>Orthetrum luzonicum</i> (Brauer, 1868)	LC	3.95	Absent during winter and spring
08	<i>Orthetrum brunneum</i> (Fonscolombe, 1837)	LC	3.18	Absent during winter and spring
09	<i>Crocothemis servilia</i> (Drury, 1770)	LC	11.35	Absent during winter and spring
10	<i>Palpopleura sexmaculata</i> (Fabricius, 1787)	LC	1.78	Absent during winter and spring
11	<i>Sympetrum commixtum</i> Selys, 1884	LC	7.52	Absent during winter and spring
12	<i>Sympetrum striolatum</i> (Charpentier, 1840)	LC	6.63	Absent during winter and spring
13	<i>Sympetrum fonscolombii</i> (Selys, 1840)	LC	7.01	Absent during winter and spring
14	<i>Pantala flavescens</i> (Fabricius, 1798)	LC	11.98	Absent during winter and spring
15	<i>Trithemis aurora</i> (Burmeister, 1839)	LC	1.91	Absent during winter and spring
	Aeshnidae			Absent during winter and spring
16	<i>Anax parthenope</i> (Selys, 1839)	LC	2.29	Absent during winter and spring
17	<i>Aeshna mixta</i> Latreille, 1805	LC	3.06	Absent during winter and spring
18	<i>Aeshna juncea</i> (Linnaeus, 1758)	LC	2.80	Absent during winter and spring

LS-Least Concern; DD-Data Deficient

There occur changes in ecology of the wetland in different seasons due to variations in environmental variables like temperature and precipitation that in turn affect the seasonal distribution of species. As observed by Thakuria and Kalita (2021), changes in physical attributes of the habitat with changes in season are responsible for changes in species diversity. The abundance and flight period of Odonata species are determined by two factors, duration and synchronization in emergence and adult life span (Khrokalo and Sheshurak 2006). The present study demonstrates high diversity during the summer and Autumn season. *Sympecma paedisca* was the only species recorded throughout the year as adults, as *Sympecma paedisca* (Brauer) and *Sympecma fusca* undergo hibernation at the adult stage during the winter in the temperate region (Ruiter and Manger 2007; Stalder 2014). Most of the species recorded during the survey are widespread generalists. Species like *Lestes barbarous* (Fabricius), *Megalestes major* Selys, 1862 *Orthetrum internum* McLachlan, 1894, *Libellula quadrimaculata* Linnaeus, 1758 were not reported in the present study, probably these species are habitat specific and are restricted to habitats of forest landscape and higher altitude (Bitupan

et al., 2015). Many species of Odonates are specialist/stenotypic species and are narrowly distributed and found in small patches in specific habitats (Koparde et al. 2014)

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AUTHOR CONTRIBUTION STATEMENT

Study conception and design by Mohd Hussain; Data Collection by Nisar Ahmad Paray, Tanveer Ahmad Dar; Analysis and interpretation of results by Altaf Hussain Mir; all authors reviewed the results and approved the final version of the manuscript.

CONFLICT OF INTEREST

No conflict of interest.

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