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Diversity of Odonata Fauna in Lentic and Lotic Ecosystem in Raigarh District of Chhattisgarh, India

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ABSTRACT

From December 2021 to November 2022, survey was conducted on the diversity of Odonates revealed a total of 42 species, which were collected from the study area of Raigarh district, Chhattisgarh state in India. These include 23 species under three families of Anisoptera and 19 species under 5 families of Zygoptera were recorded in both lentic and lotic sites of the selected research area. 4 species were recorded only in lentic site whereas 6 species reported only in lotic site. 32 species were commonly found in both sites. The most abundant Anisoptera species in both the lentic and the lotic systems was *Diplocodes trivilis*. Among the Zygoptera, the most abundant species in the lentic system was *Ceriagrion coromandelianum* and *Ischnura aurora* in the lotic system. Libellulidae was the most common species observed in all sites and family *Coenogrionidae* was prevalently observed in and around the pond ecosystem. Darners, Clubtail and Spreadwings were also pond-preferring species. Stream gliders and Darts were frequently seen in lotic ecosystem. The Shannon-Weiner index(H') was 3.315 in lentic system and 3.249 in lotic system. Species richness or Margalef's richness (D_{Mg}) index was found to be 5.700 in lentic and 6.14 in lotic system. The Jaccard's similarity index (C_j) was 0.808 between lentic and lotic systems. In the lentic ecosystem rich species diversity of Dragonflies was present whereas in the lotic ecosystem Damselflies were dominant. Different environmental factors affected Odonates diversely in lentic and lotic systems.

Key words: *Odonata, Diversity, Lentic, lotic, Shannon-Weiner index, Margalef's index, Jaccard's index.*

Introduction

Odonates are ecologically conspicuous and one of the ancient insects that invade in all types of habitats. Taxonomically Odonata includes dragonflies (Anisoptera) and damselflies (Zygoptera). Adult dragonflies are robust insects with stouter abdomen and they are strong agile fliers, often flying fast. (Nair, 2011). Adult damselflies are delicate insects with slimy built abdomen and are comparatively weak flier, flying close to the ground or water (Nair, 2011). The life history of odonates is closely linked with water bodies. They use a wide range of flowing and stagnant water bodies (Subramanian, 2005). The term lentic refers to standing water such as lakes, ponds swamps and marshes while lotic refers to running water habitat such as rivers and streams. Marsh and (Fairbridge, 1999). Adults may be found in particularly high numbers near water because they may be egg laying or mate guarding while a female is laying, defending a territory, or may have just emerged. (Corbet, 1980, 1999). Many species of odonata are restricted to specific habitats. Adult odonates feed on mosquitoes, blackflies and other blood sucking flies and act as an important biocontrol agent of these harmful insects (Subramanian, 2005). Their sensitivity to environmental change makes dragonflies and damselflies some of the most visible indicators of wetland health and diversity. Klym and Quin (2003). Odonata serve

as an umbrella species in biodiversity conservation (Bried *et al.*, 2007). The objective of the present study is to accomplish the extensive study on Odonata diversity and their habitat preference in Raigarh district, Chhattisgarh.

Materials and Methods

Sampling sites: The present study was performed in the Raigarh district of Chhattisgarh, India. The district is situated at 21°23′00′′ N and 83°10′00′′ E, in the easternmost part of Chhattisgarh. The mean minimum temperature is 17.7°C and mean maximum temperature is 31.8°C and the humidity is 50.39%. There is a significant number of complex and diverse freshwater bodies in the Raigarh district. In the present study, we selected three different lotic sites along the banks of three major rivers (Kelo, Kurket, Mahanadi) and 3 different lentic sites along three ponds (Vijaypur Talab, Ganesh Talab, Budha Talab).

Sampling Method: Only adult odonates were sampled by frequent visits to selected sites from December 2021 to November 2022. Line transect technique was used to study the abundance and diversity of odonatan fauna. 150-meter-long line transacts were laid along the riverbank and pondside. Sampling was done in every site by moving along the transect by direct count (Sutherland, 1996). Data collection performed in all seasons between 10:00 am to 1:00 pm on sunny days. Each sampling site is visited by us twice a month**.** Photographs of the adult Odonates were taken with the help of a digital camera canon 700D (EFS55-250mm, macro1.1m/3.6ft). Most of the time species of odonates were identified visually and with the help of photographs but in case of any confusion to identify species 'capture, identify and release method' was used (Rai and Raj, 2015, b). Odonates were captured by sweep net and after identification released without any harm. Odonates were identified by using keys provided by Fraser (1934, 1936), Subramanian, (2005), Mitra (1995), Andrew *et al.*, (2009), and Nair (2011). A field guide note book as discussed by K.A. Subramanian (2009) was also prepared.

Data analysis: Shannon Wiener Index (H') is an information statistic which is used here to determine diversity of species in diverse habitat. This index is represented by this formula:

$$H' = -\sum_{i=1}^{s} Pi \ ln \ Pi$$

Where S= No. of species in the sample, Pi= proportion of individuals that belong to species i.

Marglef's richness index (D_{Mg}) indicates species richness in particular area and is calculated by this formula:

$$D_{Mg} = \frac{(S-1)}{\ln N}$$

Where **S**= number of species, **N** =Total number of individuals in the area

The Jaccard's similarity index (C_j) is used to find similarity of species in two different areas:

$$C_j = \frac{a}{a+b+c}$$

Where a= total no. of species presents in both sample, b = no. of species observed in the first sample but not in the second sample, c= no. of species presents in second sample but not in first sample.

Results and Discussion

Abundance: While carrying out biodiversity surveys, 876 individuals of odonates belonging to 42 species were documented in the study period. 36 species were documented from lentic sites, whereas 38 species were from lotic sites. 4 species were observed in only lentic sites and 6 species were found in only lotic sites. 32 species were commonly listed on both sites. Suborder Anisoptera comprises 23 species under three families and 19 species under 5 families of Zygoptera were recorded. Coenagrionidae in zygoptera and libelludae in anisoptera were the families where the maximum number of species were listed.

In lentic sites the most abundant species was *Diplocodes trivialis* and 40 individuals were recorded during the study period. *Brachithemis cotaminata* was the second largest species in lentic sites and 34 individuals were recorded. The least common species was *Orthetrum glaucum*, and only one individual was recorded throughout the year of study time. The most abundant Zygoptera species in the lentic system was *Ceriagrion coromandelianum*. Lestidae were also seen in the lentic site. Four species *Brachydiplax farinose, Diplacodes nebulosa, Orthetrum glaucum, Paragomphus lineatus* were found only in

lentic sites. *Pantala flavescense* was the most abundant species in rainy season. In all lotic sites, Libellulidae was the most common family under Anisoptera. Six species- *Pseudogrion microcephalum, Pseudagrion spencei, Copera marginipes, Elattonera nigerrima, Disproneura quadrimaculata, Libellago indica* were reported only in lotic sites. The most abundant Anisopteran species in the lotic system was *Diplocodes trivilis*. Among the Zygoptera, the most frequent species were *Psudogrion decorum*, and *Ishneura arora*.

In lotic sites, reed beds and many submerged vegetations provide good breeding sites for endophytic oviposition, so in these sites more zygopteran species were found. The distribution and abundance of Zygoptera species were most affected by reeds. (Fulan *et al.*, 2008). Most of the dragonfly oviposit exophytically. Skimmers (Libellulidae), Darners (Ashinidae), clubtails (Gomphidae) were pond-preferring species. Libellulidae are less common in lotic sites than lentic site because of the waterways tends to be fast running and generally unsuitable for the usually weed or mud inhabiting Libellulidae larvae (Samways,1989).

Species diversity, richness and similarity indices:

Shannon-Weiner diversity index(H') takes the number of each species living in an area and the evenness of their relative abundance. The Shannon-Weiner diversity index of lentic area (3.315) was greater than diversity index of lotic area (3.249). It showed that lentic area has more Odonate diversity present as compared to lotic area. The higher value of H', the greater the diversity and supposedly the cleaner the environment. Margalef's richness Index (D_{Mg}) of Odonata was 5.7 measured in lentic area and 6.14 in lotic area. It means lotic area has more species richness than lentic area. The Jaccard's similarity index (C_j) between lentic and lotic sites was calculated 0.808. It indicates that there were many similar species present in both the sites.

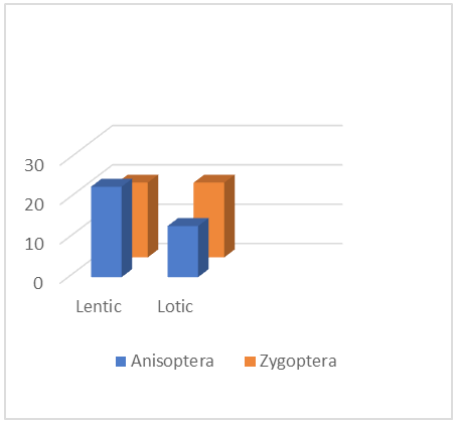


Fig. 1. Distribution of Anisoptera and zygoptera

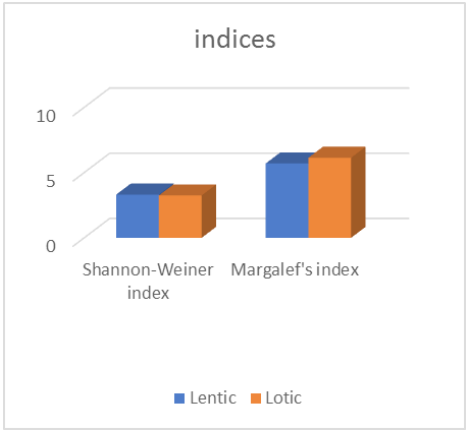


Fig. 2. Indices in lentic and lotic systems

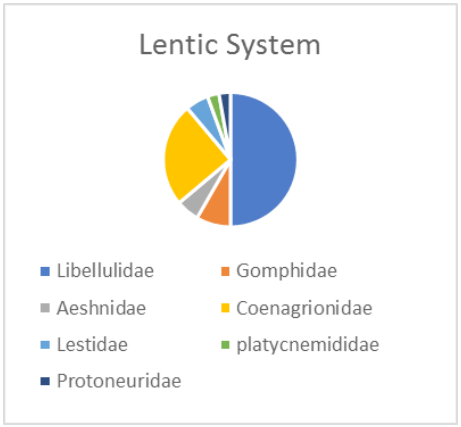


Fig. 3. Family composition in lentic system

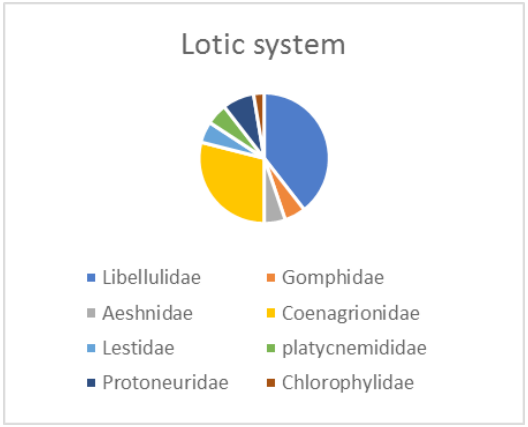


Fig. 4. Family composition in lentic system

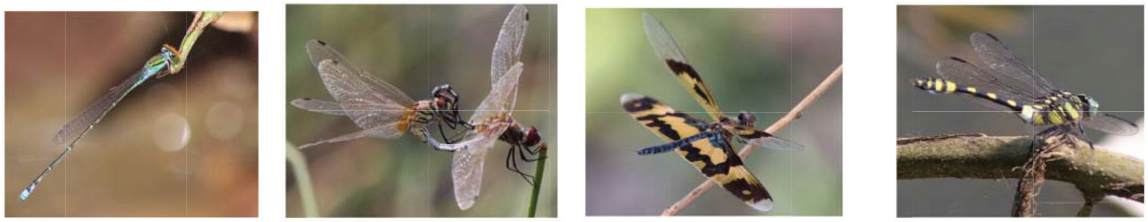
Conclusion

The findings of the present study reveal that the Raigarh district is rich in Odonata biodiversity. In lentic and lotic habitats water flow rate, water temperature, turbidity morphometry, width and depth of water bodies, and stability are the major factors affecting the composition of Odonata species. The presence of various types of vegetation, perching areas, and shades also act as a major role in the distribution and abundance of Odonata fauna. The findings of the present study provide baseline data for further studies in this area. The study also recommends the need to improve the lentic and lotic

Table 1. Composition and distribution of Odonates in Lentic and Lotic sites

Sub-order	Family	S.N.	Species	No. of individuals encountered	
				Lentic Sites	Lotic Sites
Anisoptera	Libellulidae	I.	*Acisoma panorpoides*	12	2
		II.	*Brachythemis contaminata*	34	14
		III.	*Brachydiplax chalebea*	9	4
		IV.	*Brachydiplax farinosa*	8	0
		V.	*Crocothemis servilia*	22	13
		VI.	*Diplocodes trivilis*	40	23
		VII.	*Diplacodes nebulosa*	8	0
		VIII.	*Neurithemis intermedia*	8	2
		IX.	*Orthetrum glaucum*	1	0
		X.	*Orthetrum pruinosum*	2	1
		XI.	*Orthetrum Sabina*	16	20
		XII.	*Pantala flavescense*	30	13
		XIII.	*Potamarch congener*	15	5
		XIV.	*Rhyothemis variegata*	30	12
		XV.	*Tramea limbata*	6	8
		XVI.	*Trithemis aurora*	10	8
		XVII.	*Trithemis festiva*	2	20
		XVIII.	*Trithemis pallidinervis*	13	18
	Gomphidae	XIX.	*Ictinogamphus rapax*	18	8
		XX.	*Onychogamphus forcipatus*	4	6
		XXI.	*Paragomphus lineatus*	14	0
	Aeshnidae	XXII.	*Anax guttatus*	5	2
		XXIII.	*Anax immaculiforns*	4	1
Zygoptera	Coenagrionidae	XXIV.	*Agriocnemis femina*	14	16
		XXV.	*Agriocnemis lacteola*	2	1
		XXVI.	*Agriocnemis pygmaea*	18	14
		XXVII.	*Ceriagrion coromandelian*	20	16
		XXVIII.	*Ceriagrion olivaceum*	13	16
		XXIX.	*Ischnura aurora*	21	26
		XXX.	*Ischnura senegalansis*	13	17
		XXXI.	*Psudogrion decorum*	21	26
		XXXII.	*Pseudogrion microcephalum*	0	8
		XXXIII.	*Pseudagrion rubriceps*	15	19
		XXXIV.	*Pseudagrion spencei*	0	4
	Lestidae	XXXV.	*Lestes umbrinus*	8	4
		XXXVI.	*Lestes viridulus*	3	3
	platycnemididae	XXXVII.	*Copera marginipes*	0	5
		XXXVIII.	*Copera vittata*	4	18
	Protoneuridae	XXXIX.	*Elattonera nigerrima*	0	6
		XL.	*Disproneura quadrimaculata*	0	16
		XLI.	*Prodasineura verticalis*	2	5
	Chlorocyphidae	XLII.	*Libellago indica*	0	12
		TOTAL		465	411

(a)*Acisoma panorpoides* (b) *Trithemis aurora* (c) *Crocothemis servilia* (d) *Ischnura senegalansis*



(e) *Pseudagrion rubriceps* (f) *Rhyothemis variegata* (g) *Ictinogamphus rapax* (h) *Trithemis pallidinervis*

(i) *Trithemis festiva* (j) *Copera marginipes* (k) *Agriocnemis pygmaea* (l) *Ischnura aurora*

functional status for conserving Odonatan biodiversity.

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