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Diversity and abundance of aquatic insects of Bhagda Taal, Balrampur

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Abstract
Wetlands are among the world's most productive ecosystems and provide numerous benefits to human beings directly or indirectly. An inventory was carried out to investigate the diversity, relative abundance and distribution of aquatic insects in three different sites of Bhagda Taal, a wetland of Balrampur district during July, 2024 to November, 2024. A total 215 individuals representing 19 genera, 15 families and 4 orders were recorded. Maximum 19 genera and 121 individuals belonging to 15 families and 4 orders of aquatic insects were recorded in vegetation rich marginal site and minimum 11genera and 29 individuals belonging to 9 families and 3 orders of aquatic insects were recorded from central middle area of the wetland.

Keywords: Biodiversity, entomofauna, relative abundance, wetland, bioindicators

Introduction

Among freshwater organisms, aquatic insects are the most numerous and widespread. Globally, approximately 45,000 species have been described, accounting for about 3 percent of all insect species (Balaram, 2005) [2]. In India alone, an estimated 5,000 species of aquatic insects inhabit diverse inland freshwater habitats (Subramanian and Sivaramakrishnan,2007) [22]. Aquatic insects play a crucial role in maintaining the stability and functioning of aquatic ecosystems. They significantly contribute to nutrient cycling, energy transfer, and the dynamics of food webs within these environments (Prakash and Yadav, 2016) [17]. Functioning as herbivores, detritus feeders, and predators, they help regulate ecosystem processes (Dijkstra *et al*., 2014) [12]. Their high abundance is attributed to their prolific reproductive capacity, short generation time, high turnover rate, and ability to rapidly colonize various habitats. As a result, they dominate the fauna of lentic waterbodies (Roy *et al*., 1988) [20]. The diversity and abundance of aquatic insects serve as indicators of the ecological health of aquatic habitats, making them essential subjects for ecological studies and biomonitoring efforts. Consequently, they are widely utilized as model organisms in various biomonitoring assessments to analyze human impacts on freshwater ecosystems (Bonada *et al*., 2006; Balachandran *et al*., 2012; Prakash and Verma, 2018) [3, 8, 18]. The presence or absence of certain families and or orders of aquatic insects can indicate whether a particular water body is healthy or polluted. Notably, the insect orders Ephemeroptera, Plecoptera, and Trichoptera are considered pollution-sensitive groups and are extensively employed in aquatic insect biomonitoring programs. Understanding the composition, distribution, and abundance patterns of aquatic insects is therefore crucial for effective ecosystem management and conservation initiatives (Dudgeon *et al*., 2006) [14].

In India, recent biomonitoring studies have demonstrated that the community structure of aquatic insects specifically reflects the prevailing environmental conditions of aquatic habitats (Barman *et al*., 2014; Prommi and Payakka, 2015; Barman and Gupta, 2015; Chakravarty and Gupta, 2021) [6, 7, 9, 19]. However, there is limited information on the abundance and diversity of aquatic insects in the freshwater bodies of eastern Uttar Pradesh. To address this gap, the present study was conducted to examine the diversity of aquatic insects in Bhagda Taal, a wetland located in the Balrampur district of eastern Uttar Pradesh.

Materials and Methods

The Bhagda Taal, a wetland, currently under exploration, is located approximately 16 km southeast of M.L.K.P.G. College, Balrampur. It lies between the latitudes 27°25'48" N to 27°43'08" N and longitudes 82°18'48" E to 82°30'18" E**.** This primarily rainfed wetland originally had a catchment area of about 21 ha. However, due to encroachment by villagers, the area has now been reduced to approximately 15 hectares. During the summer season, the water spread area further shrinks to about 7.0–8.0 ha. Bhagda Taal supports a diverse range of aquatic plants, including Nymphaea, Nelumbo, and Nymphya. It also provides a habitat for various aquatic birds such as ducks, Saras (Sarus crane), and Bagula (egret)**.** The abundant food supply attracts hundreds of resident and migratory birds, particularly during the winter season. The wetland's water is utilized for agriculture and fish culture, making it an essential ecological and economic resource for the local community.

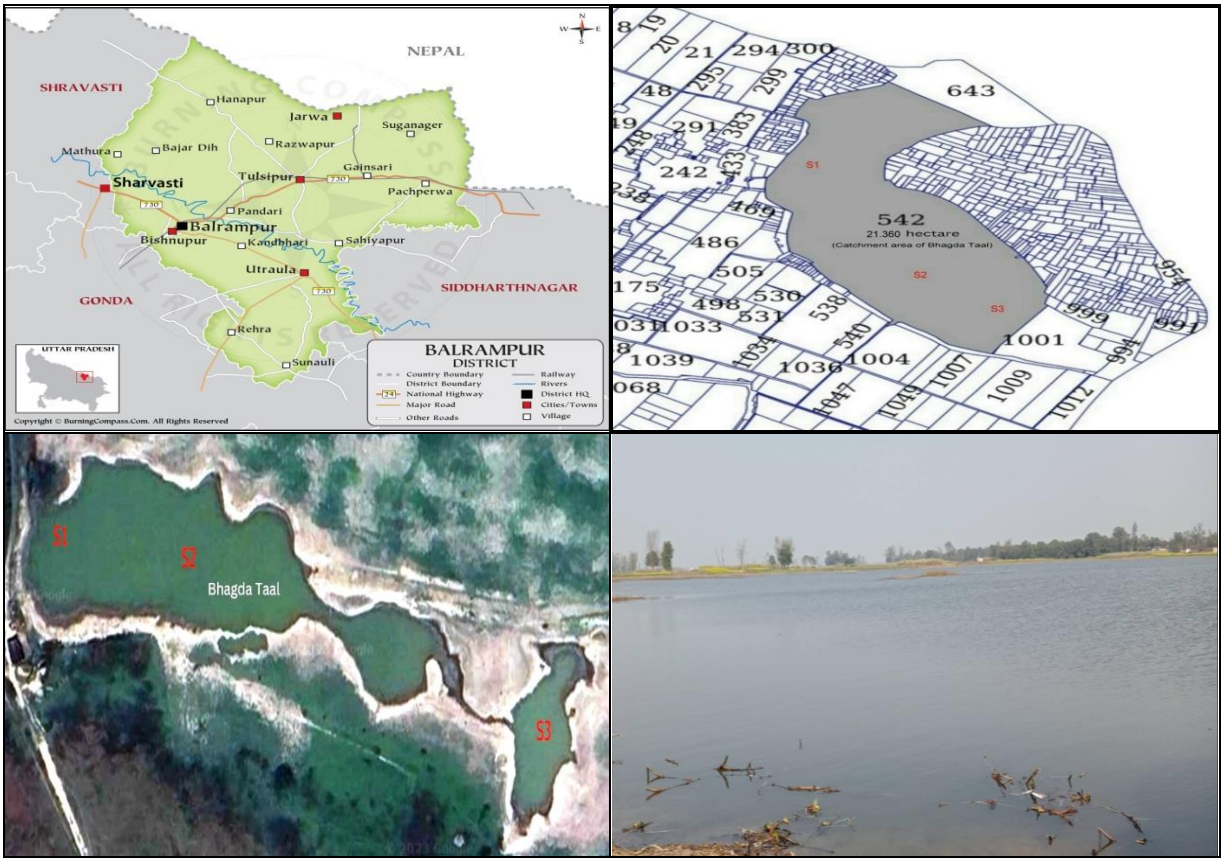
The samples were collected monthly from July 2024 to November 2024 during early morning and afternoon hours by using aquatic net, hand net and hand-picking methods. Collected samples were washed by tap water then transferred to white trays for picking the aquatic insects using foreceps and brush. The collected insects were preserved in 4% formalin and brought to the laboratory for further analyzed the species diversity. Before preserving natural colour of insects were noted. The collected samples were examined under a dissecting microscope and identified with the help of Book entitled "Aquatic insect of India- A field Guide" and "A guide to the study of fresh water biology" written by Subramanian & Sivaramakrishnan (2007) [22] and Needham and Needham (1962) [16] and other standard literature (Vazirani, 1970; Tonapi, 1980; Douwe *et*

al., 2014; Choudhary and Ahi, 2015; Chauhan and Verma, 2016) [10, 11, 13, 24, 25] and other standard taxonomic keys.

Relative abundance of a species refers to how common or rare species is relative to other species in a given location or community which was calculated by the formula:

$$\text{Relative Abundance (RA\%)} = \frac{\text{Number of individuals of a particular species}}{\text{Total Number of individuals of all the species at the same place at the same time}} \times 100$$

The dominance status of insects was determined from Engelmann's scale (Engelmann, 1973) [15].



Location, Google Map and Photograph of Bhagda Taal of Uttar Pradesh

Result and discussion

In the present study total 19 genera of aquatic insects belonging to 15 families and representing 4 orders, *viz.* Hemiptera, Coleoptera, Odonata and Diptera were recorded (Table1). The order of dominance order is Hemiptera> Coleoptera> Odonata >Diptera (Fig.1) and families Corixidae > Hydrophilidae > Hydrometridae > Micronectidae > Coenagrionidae > Chironomidae > Libellulidae = Gerridae > Mesoveliidae> Notonectidae = Gyrinidae= Syrphidae > Nepidae = Hygobiidae = Dytiscide (Fig. 2). Maximum 19 genera and 121 individuals of aquatic insects were recorded in site S1 (Marginal shallow site) and minimum 11 genera and 26 individuals were recorded in site S2 (central deepest site). Among the three sites, site S1 and site S3 showed significant differences with site S2 in terms of species compositions. (Table1). The relative abundance of aquatic insects and their dominance status were depicted in Table 1.

Among these the order Hemiptera was most abundant representing 53.95% of the total fauna as shown in the Figure 1. The Hemiptera had 9 species from 7 families *viz. Gerris sp., Limnogonnus sp.* and *Velia sp.* (Gerridae), *Corixa sp.*. (Corixidae), *Hydrometra sp.* (Hydrometridae), *Mesovelia sp.* (Mesoveliidae), *Micronecta sp.* (Micronectidae), *Notonecta sp.* (Notonectidae) and *Ranatra sp.* (Nepidae). The freshwater Hemiptera commonly known as 'aquatic bugs' are secondarily adapted to aquatic ecosystems (Basu and Subramanian, 2017) [4] due to their absorbing capacity of atmospheric oxygen by using different respiratory organs (plastron, syphon, etc.), enabling them to minimize their dependence on dissolved oxygen in water (Thorpe, 1950) [23]. Several workers have reported the dominance of Hemiptera in lentic water bodies (Barman and Baruah, 2013; Prakash and Yadav, 2016; Prakash and Verma, 2018) [5, 17, 18].

Table 1: Number of species and relative abundance of aquatic insects recorded in three sites of Bhagda Taal, Balrampur, U.P.

Family	Species (Common Name)	Number of Individual / Insect at different sites				RA (%)	Dominance status
		S1	S2	S3	Total		
Order: Hemiptera							
Corixidae	*Corixa sp.* (Water Boatman)	24	8	12	44	20.47	**Dominant**
Hydrometridae	*Hydrometra sp.* (Water measure)	11	3	7	21	9.77	Subdominant
Mesoveliidae	*Mesovelia sp.* (Water treader)	6	0	4	10	4.65	Subdominant
Micronectidae	*Micronecta sp.* (Lesser water boatman)	8	2	7	17	7.91	Subdominant
Notonectidae	*Notonecta sp.* (Back swimmer)	4	1	2	7	3.26	Subdominant

Nepidae	*Ranatra sp.* (Water Scorpion)	3	1	2	6	2.79	Recedent;
Gerridae	*Gerris sp* (water striders)	3	1	2	6	2.79	Recedent;
	Limnogonnus sp. (water striders)	2	0	1	3	1.40	Recedent;
	Velia sp. (water cricket)	2	0	0	2	0.93	**Subrecedent**
Total number of individuals		**63**	**16**	**37**	**116**	**53.95**	
Order: Coleoptera							
Hydrophilidae	*Hydrophilus sp.* (Aquatic beetle)	12	4	6	22	10.23	**Dominant**
	Berosus sp. (Scavenger beetles)	8	2	3	13	6.05	Subdominant
Gyrinidae	*Dineutus sp.* (Whirligig beetles)	4	1	2	7	3.26	Subdominant
Hygobiidae	*Hygrobia sp.* (Screech Beetles)	5	0	1	6	2.79	Recedent;
Dytiscidae (Laccophilina)	*Laccophilus sp.* (water beetles)	4	0	2	6	2.79	Recedent;
Total number of individuals		**33**	**7**	**14**	**54**	**25.12**	
Order: Odonata							
Coenagrionidae	*Ischnura. sp.* (Damselfly)	7	2	5	14	6.51	Subdominant
Libellulidae	Diplocodes sp. (Dragonflies)	4	1	2	7	3.26	Subdominant
	Sympetrum sp. (Dragonflies)	2	0	2	4	1.86	Recedent;
Total number of individuals		**13**	**3**	**9**	**25**	**11.63**	
Order: Diptera							
Chironomidae	*Chironomus Larvae* (Non-Biting Midges)	8	0	5	13	6.05	Subdominant
Syrphidae	*Eristalis* (Droneflies)	4	0	3	7	3.26	Subdominant
Total number of individuals		**12**	**0**	**8**	**20**	**9.30**	
Total Number of Aquatic Insect		**121**	**26**	**68**	**215**		
RA<1= Subrecedent; 1.1-3.1=Recedent; 3.2-10 =Subdominant; 10.1-31.6= Dominant; >31.7%= Eddominant							

Coleoptera was the second dominant order in terms of relative abundance and number of genera and accounted for 25.12% of the total fauna, with 5 genera belonging to 4 families, *viz.*, *Hydrophilus sp* and *Berosus sp.* (Hydrophilidae), *Dineutus sp.* (Gyrinidae), *Hygrobia sp.* (Hygobiidae) and *Laccophilus sp.* (*Dytiscidae* / *Laccophilina*). Order Odonata was third dominant order in terms of relative abundance 11.63% of total fauna and represented by 3 genera *Ischnura. sp.* (Coenagrionidae), Diplocodes sp. and *Sympetrum sp.* (Libellulidae) with. The order Diptera had 2 genera belonging to 2 family and 2 genera with relative abundance 9.30%. Dominance of Hemipteran and Coleoptera insects suggested that the wetland ecosystem is non-polluted (Prakash and Verma, 2018) [18]. Odonates are characterized as an excellent bioindicator of water pollution in aquatic habitats. In the present study, the absence of pollution sensitive groups (Ephemeroptera and Trichoptera) indicates healthy status of wetland (Prakash and Verma, 2018; Arumugam and Athikesavan, 2021) [1, 18]. It was found that among the 19 genera *Corixa* sp. and *Hydrophilus sp.* were dominant and the remaining 10 genera were subdominant and 6 genera Recedent and one genera Recedent status.

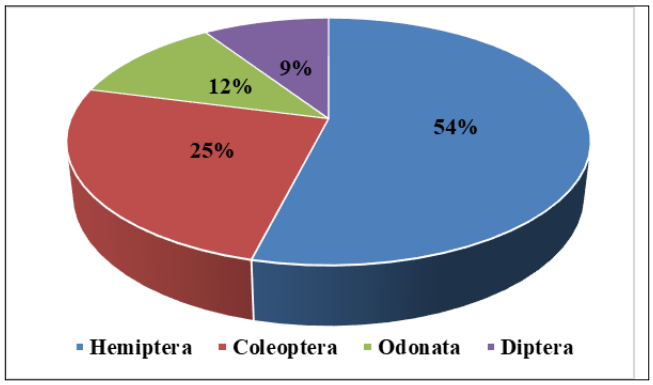


Fig 1: Percentage composition of Aquatic insect order collected from Bhagda Taal

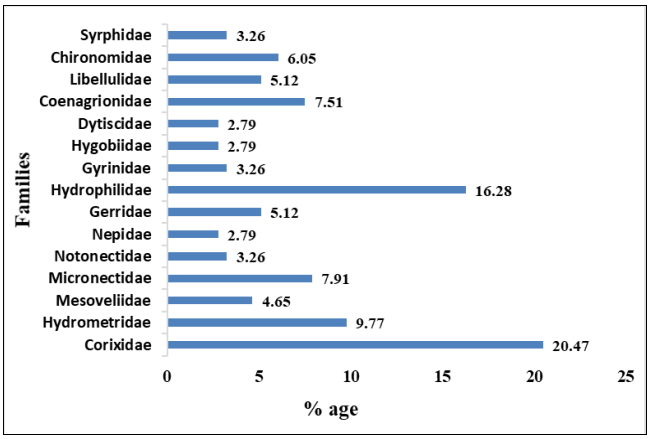


Fig 2: Percentage composition of Aquatic insect families collected from Bhagda Taal

Conclusion

The absence of pollution sensitive genera and dominance of hemipteran and coleopteran insects in the present investigation suggested that this rural wetland is relatively less polluted. Since short-term sampling (five month and five sample) does not cover all the species which are active in different seasons of the years, therefore, the true number of species estimated for the three sites of the wetland might be higher than the present predicted value. This investigation highlights the importance of wetland in supporting the biodiversity of insects and their usage in biomonitoring programmes, which can be incorporated into long-term water quality studies to evaluate the health of the water bodies.

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