

ABUNDANCE OF AQUATIC INSECTS IN RELATION TO PHYSICO-CHEMICAL PARAMETERS OF TWO HIGHLY POLLUTED RIVERS SITALAKHYA AND THE BURIGANGA

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Abstract: Diversity of aquatic insects in relation to the physicochemical parameters of the river Buriganga and Shitalakhya were studied from January to December 2013. A total of 9,891 individuals of aquatic insects representing 22 families under 6 orders were collected and identified. Higher number of insects were recorded from the river Shitalakhya (5,493) than the river Buriganga (4,398). Representatives of the family Culicidae were found to be dominant in the river Buriganga (23.28%) than Shitalakhya (20.70%). Specimens under the order Ephemeroptera and Trichoptera were found only in the river Shitalakhya. The highest diversity of Shannon Weiner Index (2.98), Evenness (0.98) and Taxa Richness (0.98) were recorded in the river Shitalakhya than the river Buriganga. This indicated the less pollution and presence of higher diversity of aquatic insects in the Shitalakhya river. The highest temperature, pH, EC, TDS, COD was observed in Buriganga in dry season and highest DO was observed in Shitalakhya in monsoon. From the present investigation it may be concluded here that the river Buriganga was more polluted than the river Shitalakhya.

Key words: Aquatic insect, physicochemical parameters, River Buriganga River Shitalakhya

INTRODUCTION

Aquatic ecosystems are being continually polluted by anthropogenic activities especially by industrial effluents. Aquatic insects play very important role in the ecosystem, not only do they serve as food for fish, amphibians, and aquatic birds, but also they are involved in the breakdown of organic matter and nutrients (Mohiuddin *et al.* 2011). Most of the rivers in the urban areas of the developing world are the end points of effluents discharged from the industries (Suthar *et al.* 2010). It has been reported that the water pollution in the two important rivers of Bangladesh namely the Buriganga and the Shitalakhya is now reaching to the highest level (Ahmad *et al.* 2010). Aquatic insects are used to assess the “health” of a river (Antonio and Barros 2001). A more favorable water quality index would be characterized by finding sensitive as well as tolerant organisms (Zakir *et al.* 2006).

The use of aquatic insects for assessing water quality provides information to environmental managers and decisions makers to take justifiable actions in regards to the state and quality of water bodies. The river Buriganga running by

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the side of the Dhaka City, the capital of Bangladesh, is one of the most important rivers in Bangladesh (Islam *et al.* 2006). The river Shitalakhya is one of the most prominent rivers in the flood plain region of Bangladesh. It is located in Narayanganj City, the second most vital industrial zone of the country. Moreover, the river is the route of the communication with Chandpur, Chittagong as the port of cargo. Besides these, the people live on and around these two rivers utilizing water for their household washing, bathing and other necessary daily works. The risks of pollution impact are rising upwards sequentially (WARPO, 2000). The present study was conducted to investigate the composition, diversity, and distribution of aquatic insects in relation to the physicochemical properties of the rivers Buriganga and Shitalakhya. This may also help to evaluate the pollution status of the two important rivers of Bangladesh.

MATERIAL AND METHODS

Water samples and aquatic insects were collected from the river Buriganga and the Shitalakhya January to December, 2013 during. Three sampling sites were selected for each of the river and the names of the sampling location for their latitudes and longitudes are shown in the Table 1.

Table 1. Description of the sampling sites of two rivers

Name of the rivers	Sampling locations	Description of the locations	GPS position	
			Latitude	Longitude
Buriganga	B1	Char Saiyedpur, Kathpotti, Narayanganj	23°34'54.1"N	90°30'04.0"E
	B2	Fatulla Launch Terminal, Narayanganj	23°38'27.5"N	90°28'21.2"E
	B3	Hazaribagh, Dhaka	23°42'00"N	90°25'00"E
Shitalakhya	S1	Hajiganj Launch Ghat, Narayanganj	23°38'00.8"N	90°30'56.2" E
	S2	Launch Terminal, Narayanganj	23°36'57.3"N	90°30'21.1"E
	S3	Kachpur Bridge, Narayanganj	23°42'12.8"N	90°30'57.0"E

Collection of water samples and analysis: Water samples were collected fortnightly from each sampling location with 200 ml plastic containers. The containers were pre-washed with nitric acid each time to remove any form of contaminants. The water samples were brought to the Soil and Environment Section of BCSIR lab of Dhaka and preserved in refrigerator temporarily until analysis. Water pH was determined by glass electrode using pH meter (Sense Ion, 156; HACH, USA). The EC of water samples was directly determined by EC meter (Sense Ion, 156; HACH, USA) in $\mu\text{s}/\text{cm}$. The total dissolved solid (TDS) was determined directly by TDS meter (2100 Q; HACH, USA). Dissolved oxygen

of water samples was determined in the field by DO meter (HQ 30 D; HACH, USA). COD was determined with COD kit (Cat. 21259-15; HACH, USA). Average values of each parameter were recorded and presented in the form of their seasonal variations.

Collection of aquatic insects and identification: Adult insects were collected from the water surface of each sampling location using a dip-net. Insects collected were preserved in 70% ethanol in jars. All samples collected were taken to the Entomology laboratory of the Department of Zoology in Jahangirnagar University for identification. The insects were identified using microscope. The specimens were identified on the basis of the external morphology. Identification of the various taxa were done following available keys (Ameen *et al.* 1982; Ameen and Nessa 1985, Khan *et al.* 1997).

Analysis of data: Data were analysed using Microsoft Excel. Diversity and other indices were calculated using the following formulas:

Taxa richness (R): The taxa richness was based solely on the number of taxa found in the given area and does not reflect the relative dominance of species. The formula is: $R = s$ (s = the number of taxa).

Shannon-wiener index (H): This index was determined by both the number of species and the even distribution of individuals among those species (Niklaus *et al.* 2001). The formula is

$$H = -\sum_{i=1}^n p_i \ln p_i$$

Pi, relative abundance = n_i/N

n_i = number of individuals in species i

N = total number of individuals in all species H

Evenness (E): Using species richness (R) and the Shannon-Wiener index (H), evenness of a taxa was computed using following formula:

$$E = H/\ln(R)$$

RESULTS AND DISCUSSION

A total of, 9891 individuals of aquatic insects having representatives from 22 families under 6 orders were identified (Table 2).

Culicidae was found as the dominant family in both the rivers (Buriganga 23.28% and Shitalakhya 20.70%). In the river Buriganga, the abundance

Table 2. Number and seasonal abundance of aquatic insect communities in the river Buriganga (B) and Shitalakhya (S)

Order Name	Family Name	Dry Season		Pre Monsoon		Monsoon		Post Monsoon		Percentage (%)	
		B	S	B	S	B	S	B	S	B	S
Ephemeroptera	Ephemeridae	0	0	0	25	0	0	0	0	-	0.43
Odonata	Aeshnidae	5	14	71	90	44	57	19	26	2.98	3.19
	Libellulidae	23	26	49	63	35	48	23	32	2.79	2.88
	Calopterygidae	26	21	48	62	29	41	20	28	2.64	2.59
	Lestidae	13	23	63	77	39	47	11	17	2.70	2.80
	Coenagrionidae	31	24	50	64	35	50	10	16	2.70	2.63
Hemiptera	Corixidae	65	63	38	51	81	99	74	91	5.53	5.19
	Notonectidae	31	30	30	41	66	79	58	70	3.97	3.75
	Belostomatidae	36	35	41	51	97	118	85	101	5.55	5.20
	Gerridae	40	41	83	97	160	209	129	174	8.83	8.89
Coleoptera	Haliplidae	27	44	25	34	48	59	32	39	2.83	3.00
	Dytiscidae	41	59	45	51	49	68	38	52	3.71	3.92
	Noteridae	33	58	38	52	69	87	35	49	3.75	4.20
	Gyrinidae	40	57	52	63	75	93	48	59	4.61	4.64
	Coccinellidae	18	49	63	81	68	83	26	35	3.75	4.23
	Curculionidae	18	38	40	54	57	70	18	28	2.85	3.24
Trichoptera	Rhyacophilidae	0	4	0	13	0	19	0	25	-	1.04
Diptera	Culicidae	106	105	222	227	147	184	314	357	17.94	15.89
	Chironomidae	155	128	134	130	86	108	104	124	10.89	8.92
	Simuliidae	61	81	20	28	21	34	44	55	3.13	3.38
	Tabanidae	16	10	0	0	33	49	47	60	2.06	2.03
	Syrphidae	10	20	45	64	48	62	24	43	2.72	3.23

was followed by Chironomidae (9.62%), Gerridae (8.83%), Corixidae (5.53%), Gyridae (4.61%) and the least dominant family was Tabanidae (2.06%). In contrast, the Shitalakhya supported a slightly different aquatic insect community. The abundance of the family Gerridae was 8.89%, followed by Chironomidae 8.82%, Belostomatidae 5.20%, Corixidae 5.19%, Gyridae 4.64%. The least dominant families in the river Shitalakhya were Ephemeroidea 0.43% and Rhyacophilidae 1.04%. Ohiokhioya *et al.* (2009) studied the aquatic insects inhabiting in the river Okhuo of Africa and reported their abundance as Ephemeroidea > Odonata > Coleoptera > Diptera > Plecoptera > Trichoptera.

Ameen and Nessa (1985) described twenty three species of aquatic Hemiptera from ponds and lakes in and around Dhaka city. Khan *et al.* (1997) identified larvae of thirty Chironomidae species of order Diptera from central east and south-east of Bangladesh. Armitage (1983) considered the members of Ephemeroidea, Plecoptera, Trichoptera as sensitive to environmental stress. So it is assumed that the condition of river Shitalakhya is cleaner than the river Buriganga as the representatives of order Ephemeroidea and Trichoptera were found only in the river Shitalakhya. Dinakar and Anbalagan (2006) showed anthropogenic impacts on aquatic insects in six streams of South Western Ghats of India. Thani and Phalaraksh (2008) also studied the aquatic insect's diversity and water quality of Mekong river of Thailand. They found that highest number of aquatic insects were from the order Ephemeroidea. In the present study the order Ephemeroidea and Trichoptera were found only in river Shitalakhya but not in the river Buriganga. So, it can be said that the water quality of river Shitalakhya is much better than the river Buriganga and is less affected with anthropogenic activities.

Wahizatul *et al.* (2011), discovered that Culicidae was probably the most diverse and abundant group among all stream macroinvertebrates. The number of Chironomidae was higher in the Buriganga than the Shitalakhya. In dry season, the highest numbers of aquatic insects were recorded from the order Diptera under the family Chironomidae (72) in the river Buriganga. Pinder (1986) also described the family Chironomidae as the most abundant group in freshwater communities in Thailand. In pre-monsoon, the order Ephemeroidea emerged in river Shitalakhya and highest numbers of individuals were recorded from the family Ephemeroidea (16) at sampling location S1. In monsoon, all the orders except Ephemeroidea emerged enormously and a large number of individuals under the order Odonata, Hemiptera, Coleoptera, Trichoptera and Diptera were recorded from both the rivers. According to Ohiokhioya *et al.* (2009) community composition varied seasonally, with a trend toward a declining proportion during the rainy season and increasing proportion during the dry season. The reason may be that they worked with pollution free river.

In post-monsoon, Dipteran family Tabanidae (37) and Trichopteran family Rhyacophilidae (27) showed increased numbers of individuals at sampling location S1 in the river Shitalakhya. Antonio and Barros (2001) reported that the

number of Tabanidae increased in October, coincided with the beginning of the rainy season. The daily abundance of the total adults of the order Trichoptera reached a maximum on September (Ghosh and Singh, 2005). These results of their works were similar with the findings of present study.

Seasonal diversity and quality indices of the aquatic insects from different sampling locations of the river Buriganga and Shitalakhya are presented in the Table 3. The highest values of Shannon Weiner Index (2.98), Evenness (0.98) and Taxa Richness (0.98) were recorded in the river Shitalakhya and lowest values of all those indices were found in the river Buriganga indicated the presence of higher diversity of aquatic insects in the river Shitalakhya than the river Buriganga.

Abhijna *et al.* (2013) declared Vellayani lake of India which maintained better quality with the highest values of same diversity indices. The seasonal variation in the physicochemical properties of the water samples collected from the river Buriganga and Shitalakhya are shown in Table 4.

Temperature of river Buriganga and Shitalakhya was found to vary from 25.26°C to 29.27 °C and 24.91°C to 29.65°C respectively throughout the year. Ahmad *et al.* (2010) found that temperature varied from 22.9°C to 36.0°C along the river Shitalakhya in dry season. Such high temperature in these rivers may be due to outfalls of the thermal effluent of cement factories, dyeing factories etc. standing beside the bank of the rivers. The highest pH (7.59) was recorded during pre-monsoon in the river Buriganga and the lowest pH (7.01) was recorded in post monsoon in the river Shitalakhya. Similar type of investigation

Table 3. Seasonal diversity and quality indices of aquatic insects from different sampling locations of the river Buriganga (B) and Shitalakhya (S)

Season	Sampling Locations	Shannon-Wiener's Diversity Index	Evenness	Taxa Richness
Dry Season	B1	2.58	0.86	20
	B2	2.42	0.81	20
	B3	0.89	0.50	6
	S1	2.71	0.89	21
	S2	2.56	0.85	20
	S3	1.06	0.51	8
Pre-Monsoon	B1	2.80	0.95	19
	B2	2.74	0.93	19
	B3	1.66	0.72	10
	S1	2.98	0.98	21
	S2	2.86	0.95	20
	S3	2.66	0.89	20

Monsoon	B1	2.88	0.96	20
	B2	2.84	0.95	20
	B3	2.06	0.83	12
	S1	2.95	0.97	21
	S2	2.86	0.96	20
	S3	2.01	0.81	12
Post-Monsoon	B1	2.71	0.91	20
	B2	2.54	0.86	19
	B3	1.42	0.65	9
	S1	2.85	0.94	21
	S2	2.63	0.88	20
	S3	1.54	0.67	10

was carried out by Dubey *et al.* (2006) with the river Yamuna of India and recorded low pH value during monsoon period. According to the findings of Rahman *et al.* (2012) EC values increased in pre-monsoon in the river Buriganga and the Shitalakhya. In the river Buriganga the highest EC (661.67 $\mu\text{s}/\text{cm}$) was recorded in pre-monsoon, and the lowest (198 $\mu\text{s}/\text{cm}$) was recorded in post-monsoon in the river Shitalakhya. Ahmad *et al.* (2011) found TDS values were higher in winter season than that of rainy season in the river Shitalakhya. This may be because, in rainy season the polluted water was diluted with the rain water, thus reduce TDS values. In present study, the highest DO (6.15 mg/l) was observed in post-monsoon in the river Shitalakhya and the lowest (3.37 mg/l) was recorded in dry season in the river Buriganga. Because in dry season the flow of water in the river was very low and concentration of pollutants was very high. Industrial wastes may also caused depletion of DO by chemical reaction, (Chakraborty *et al.* 2013). It was evident from the results of the present investigation that the pollution of both the rivers were deadly hazardous upon the status of aquatic biodiversity. So awareness should be developed to stop over pollution in the rivers through unplanned industrialization and urbanization because rivers are one of the most potential natural resources that enrich our poor country from various aspects and this information may help Government and Non-Government organizations to plan long term strategies to save our aquatic ecosystem.

Table 4. Seasonal variation in the physicochemical parameters of water samples collected from different sampling locations of the river Buriganga (B) and Shitalakhya (S)

Parameters	Name of the seasons							
	Dry season		Pre monsoon		Monsoon		Post monsoon	
	B	S	B	S	B	S	B	S
Temperature oC	25.26±0.60	24.91±0.79	28.77±0.93	28.92±0.67	29.27±0.43	29.65±0.28	26.80±0.25	26.34±0.67
pH	7.33±0.09	7.12±7.02	7.587±0.03	7.39±0.04	7.37±0.04	7.33±0.13	7.30±0.01	7.01±0.05
Electrical Conductivity (EC)µs/cm	564.33±49.09	455.67±47.19	661.67±45.32	610.67±14.52	378.67±60.97	380.33±96.31	217.33±30.43	198.00±31.94
Total Dissolved Oxygen (TDS) mg/l	279.00±55.97	193.33±35.27	390.67±26.41	380.33±10.40	106.33±11.57	124.00±36.01	125.33±16.76	100.67±9.56
Chemical Oxygen Demand (COD) mg/l	3.37±0.45	4.26±0.32	3.80±0.32	4.20±0.23	5.38±0.36	6.15±0.15	5.96±0.46	6.03±0.41
Dissilved Oxygen (DO)	419.79±33.5	261.94±36.25	345.66±27.67	245.67±27.67	164.36±35.89	101.65±18.00	235.45±38.82	146.45±21.36

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