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Water Quality Evaluation by Monitoring Zooplankton Distribution in Wild Ponds, Noakhali, Bangladesh

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ABSTRACT

Pond water quality was evaluated by identifying and estimating zooplankton during monsoon in Noakhali, Bangladesh. Three wild ponds were chosen for monitoring zooplankton distribution which are not used for fish culture or any other commercial purposes. In this study, the Wetland Zooplankton Index (WZI) was employed to engage the zooplankton genera according to their specific WZI values. Two of the sampling ponds were found to have moderate water quality. Additionally, another pond was found with nearly good water quality. Total zooplankton was observed as 5541.67±176.77 ind/L, 9608.34±271 ind/L and 9541.67±176 ind/L in three different sampling ponds. There were four groups of zooplankton as Rotifera (6 genera), Copepoda (4 genera) and Cladocera (6 genera) identified in all the sampling ponds. The physicochemical water parameters as water temperature, water pH, total alkalinity, free CO_2, ammonia, nitrate and nitrite were also evaluated in sampling ponds.

INTRODUCTION

The earthen ponds are recognized as most traditional living essentials in our society. In the southern part of Bangladesh, the ponds are used for drinking purposes and fish culture. Unfortunately, many household or roadside ponds and seasonal wetlands are not properly treated due to some misconceptions. In many cases, ponds and wetlands are used as local waste depositing points and it is very disastrous for us. The Noakhali district is consecrated with a lot of ponds and wetlands. In Noakhali, ponds and wetlands are used for aquaculture and daily household uses. Therefore, the potentiality of many ponds is deteriorated because of the misuse and mismanagement. Zooplankton are very sensitive to environmental changes in aquatic bodies. The prime environmental factor temperature initiates the growth and survival performance of zooplankton through seasonal change. Aquatic nitrogenous and phosphorus nutrients control the distribution and diversity of zooplankton (Rajkumar et al. 2014). The capability of aquaculture is determined by zooplankton assemblages in a pond. Zooplankton represents themselves as an obvious trophic connecting agents between fishes and phytoplankton. Recently, the biological assessment of water quality by using zooplankton was very well accepted and practised by scientists. Zooplanktons are proficient in quick response to even slight environmental changes (Sládeček 1973, Gannon & Sternberger 1978, Sinha & Sinha 1993, Joseph et al. 2011, Patra et al. 2011) Thus, the Wetland Zooplankton Index (WZI) was designed to evaluate the lake water quality in North America (Lougheed & Chow-Fraser 2002). This index was suggested as a scale from bad (0) to good (5) of water quality.

The present study was attempted to evaluate the contribution of zooplankton as a bioindicator to wild pond water quality.

MATERIALS AND METHODS

A total of three mistreated wild ponds at Sonapur, Noakhali in Bangladesh were chosen for zooplankton sampling and water quality analysis. These ponds were ignored or not properly used by local people. This study was conducted from July 2018 to September 2018 and aimed at the analysis of the physicochemical water quality (water temperature, total alkalinity, total suspended solids, free CO_2, ammonia, nitrate, nitrite and phosphorus) and zooplankton assemblages in these three ponds. The water temperature and pH were measured directly on spot by thermometer and pH meter (HANNA-HI96107) respectively. While conducting the study, the total alkalinity (mg/L), total suspended solids (mg/L), free CO_2 (mg/L), ammonia (mg/L), nitrate (mg/L), nitrite (mg/L) and phosphorus (mg/L) were determined according to guidelines from the American Public Health Association (APHA 1995).

Zooplankton were collected from surface water through plankton net (mesh size: 25 µm) and preserved in 250 mL plastic containers with 5 % buffered formalin. Furthermore, zooplankton were observed at 16×10 and 16×40 magnification using a light microscope in a Sedgewick-Rafter counting cell. The density and diversity of zooplankton were determined by following Tonapi (1980) and Battish (1992). For ranking water quality by using zooplankton, Wetland Zooplankton Index: WZI = ČYiTiUi/ČYiTi (Yi = Individual/liter, Ti = Tolerance, Ui = Optimum) was employed (Lougheed & Chow-Fraser 2002).

RESULTS AND DISCUSSION

The groups of zooplankton as Rotifera, Copepoda and Cladocera were represented with their genera specific abundance (Table 1). There are six genera of Rotifera and Cladocera and four genera of Copepoda listed from three sampling ponds (Table 1, Fig. 1). A total of 5541.67±176.77 ind/L, 9608.34±271 ind/L and 9541.67±176 ind/L of zooplankton were recorded in Pond A, Pond B and Pond C, respectively (Table 1, Fig.1). In the present study, Pond A, Pond B and Pond C were dominated by Cladocera, Copepoda and Rotifera respectively (Fig. 1). Many scientists have observed the density and distribution of zooplankton in wild, fish culture, seasonal and unused ponds. Hossain et al. (2015) reported Rotifera (6 genera), Cladocera (3 genera), Crustacean (3 genera) and Copepoda (2 genera) in different cultures, households and unused ponds. The groups of zooplankton as Rotifera, Crustacea, Cladocera were also studied by (Morris & Mischke 1999, Beaugrand et al. 2000, Mahar et al. 2000, Begum et al. 2007, Dirican et al. 2009, Jakhar 2013, Saha et al. 2017, Khan & Bari 2019). Wetland zooplankton index (WZI) was established as a water quality indicator by monitoring zooplankton distribution (Lougheed & Chow-Fraser 2002). In the present study, Pond A and Pond B were found with moderate water quality (Table 1). Furthermore, Pond C was found to have nearly good water quality (Table 1). Khalifa et al. (2015) studied the seasonal water quality of different lakes and found spring water quality is better than other seasons followed by autumn, winter and summer.

Table 1: Spatial distribution and wetland zooplankton index (Lougheed & Chow-Fraser 2002) of zooplankton during sampling periods.

Zooplankton	Pond A Yi (ind/L)	Pond B Yi (ind/L)	Pond C Yi (ind/L)	Optimum Ui	Tolerance Ti
Rotifera	-	-	-	-	-
Amuraeopsis	-	666.67	791.67	3	1
Ascomarpha	-	1166.67	-	1	1
Brachionus	500.00	666.67	-	2	1
Lepadella	-	1125.00	-	4	2
Plationus	958.34	-	-	-	-
Polyarthura	-	958.34	541.67	3	1
Copepoda	-	-	-	-	-
Heliodiaptomus	791.67	-	1208.34	-	-
Mesocyclops	-	-	1458.34	-	-
Neodiaptomus	1208.34	-	958.34	-	-
Thermocyclops	958.34	958.04	958.34	-	-
Cladocera	-	-	-	-	-
Alona	-	1125.00	-	-	-
Alonella	666.67	1458.34	-	-	-
Chydorus	458.34	-	666.67	4	2
Macrothrix		1458.34	1041.67	5	3
Scapholeberis	-	-	958.34	-	-
Sinocephalus	-	-	958.34	5	3
Total Zooplankton (Average ± Standard Error)	5541.67±176	9608.34±271	9541.67±176		
WZI (Scale: 0-5) = ČYiTiUi/ČYiTi	3.29	3.79	4.54		
Water Quality	Moderate	Moderate	Nearly good		

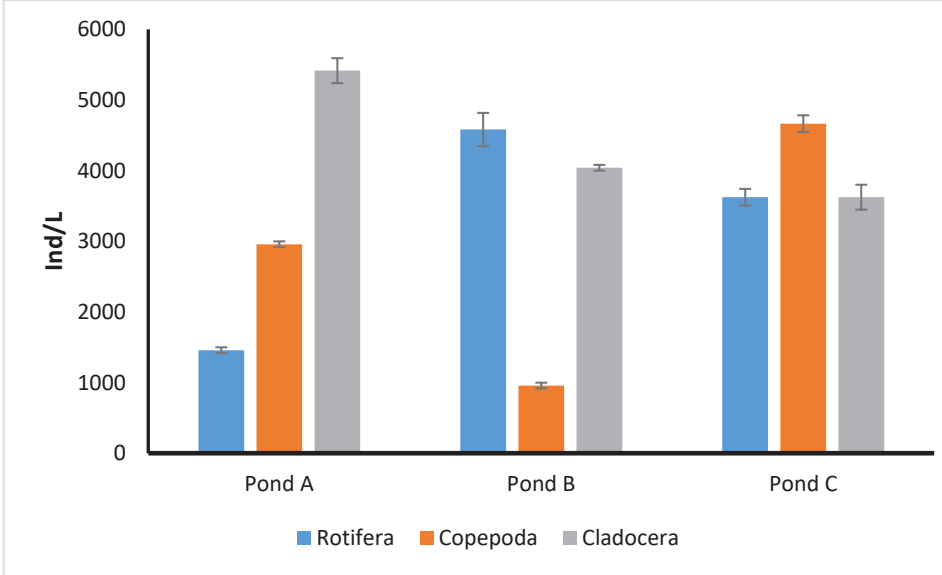

Fig.1: Group-wise zooplankton distribution in sampling ponds.

Several important physicochemical water quality parameters were also estimated in all the sampling ponds (Table 2). In the present study, the temperature was recorded from 29.05 to 30.03°C. The water temperature is the most important factor in the zooplankton distribution and diversity in ponds (Wetzel & Likens 2000). The fertility of pond water is indicated by pH (Sreenivasan 1976). The pH range (7.4-8.2) specifies the well buffering of water quality in sampling ponds which is favourable to the zooplankton growth. The total alkalinity and free CO_2 were recorded as 9.00- 18.16 mg/L and 4.90-12.05 mg/L respectively (Table 2). Rotifers showed a negative relationship with total alkalinity in fish culture ponds (Khan & Bari 2019). The water quality parameters recorded in this study were in agreement with many workers (Hegde & Bharti 1985, Boyd & Tucker 1998, Pulle & Khan 2003, Chowdhury & Mamun 2006, Joseph & Yamakanamardi 2011, Rashed-un-Nabi et al. 2011, Khan et al. 2020, Khan et al. 2019, Khan & Islam 2019, Waseeh et al. 2020).

The present study also focussed on to estimate dissolved phosphorus, dissolved inorganic nitrogen composed of ammonia (NH_3), nitrite (NO_2) and nitrate (NO_3) in the sampling ponds. The pond water quality was ranked with the concentrations of ammonia, nitrate, nitrite and phosphorus according to (Sládeček 1973) as in Table 3. In this study, all sampling ponds were found with moderate to poor water quality (Table 3).

Table 2: Physicochemical water quality of sampling ponds.

Water Quality Parameters	Pond A	Pond B	Pond C
Temperature (°C)	29.05-30.01	29.06-30.03	29.05-30.01
pH	8.1-8.2	7.4-7.6	7.8-8
Total Alkalinity	18.00-18.16	9.00-9.08	13.50-13.62
FCO_2	11.09-12.05	4.90-7.99	7.99-8.05

Table 3: Dissolved inorganic nitrogen and phosphorus of sampling ponds.

Water Quality Parameters	Pond A	Pond B	Pond C
NH_4 (mg/L)	0.7-0.9	0.8-1.0	0.4-0.6
Nitrate (mg/L)	0.08-0.1	0.03-0.05	0.04-0.05
Nitrite (mg/L)	0.05	0.05	0.05
PO_4 (mg/L)	0.09-0.10	0.10-0.13	0.08-0.11
Water quality rank (Sládeček 1973)	Moderate to Poor	Moderate to Poor	Moderate to Poor

The chemical water quality determines the favourable conditions for life survival in ponds, lakes, rivers or any aquatic body (Khalifa et al. 2015). The chemical components of water, to evaluate the suitability of aquatic ecosystems, were studied by Fisher et al. (2008), Heikal (2010), Patra et al. (2011) and Belal (2012).

CONCLUSION

This study was conducted to inaugurate preliminary water quality of wild ponds in Noakhali by using zooplankton as a bioindicator. The findings of this base study will be used for further comprehensive research on zooplankton distribution and physicochemical properties of water in freshwater wetlands.

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