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State the organic pollution level in rain fed ponds, Noakhali, Bangladesh

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Abstract

The present study has been conducted to assay the water quality of rain fed ponds by determining the organic pollution level according to Palmer's algal pollution index. A total three genera (*Ankistrodesmus*, *Chlorella*, *Scenedesmus*) of Chlorophyceae, four genera (*Cyclostella*, *Navicula*, *Synedra*, *Melosira*) of Bacillariophyceae, two genera (*Euglena*, *Phacus*) of Euglenophyceae and only one genera (*Oscillatoria*) of Cyanophyceae were identified for determination of Palmer's algal pollution index. *Chlorella* and *Euglena* were most dominant phytoplankton in all observed rain fed ponds during sampling. Algal pollution index of pond A, B, C, D, E and F was 16, 23, 21, 13, 10 and 17 respectively. According to the index value pond A and F were found probable high organic pollution. On the other hand pond B and C were observed confirmed high organic pollution. More over pond D had moderate pollution and pond E was detected as lack of organic pollution. Some physico-chemical water quality parameters (water temperature, transparency, total suspended solids, P^H , total alkalinity, free CO_2 and ammonia) were also estimated as a supporting water quality analysis during sampling periods.

Keywords: Organic pollution, palmer's algal pollution index, rain fed pond, water quality

1. Introduction

Noakhali is a district in Bangladesh blessed with lot of freshwater ponds and rain fed wetlands. These water bodies are used as main source of drinking water and fish culture. In present days, many of water bodies are vulnerable because of urbanization and surface nutrients run off. Water organic pollution is most important existing issue. Phytoplankton plays a core role in primary production in fertile water bodies. Some species of phytoplankton are used as bio-indicator for evaluating water quality. The physico-chemical water qualities influence the primary production through controlling the species composition and abundance of phytoplankton. Biological evaluation is comparatively preferable way to assay the pollution level of water body [1, 2, 3, 4, 5]. The rain water conducted organic load through surface runoff to the ponds and reduced dissolved oxygen level in water body [6, 7, 8]. Aquatic living organisms are the consequence of incorporation and interaction of several physico-chemical and geomorphological features of any aquatic system [9, 10]. Furthermore, in aquatic ecosystem species are sensitive to many physico-chemical variables as acidification (p^H level), eutrophication and organic pollution [11, 12]. Algae are found responsible for water pollution in many important ways. Several nitrogenous and phosphorus nutrients enhance the algal growth in the water body [13]. Phytoplankton alone reflects the whole ecological conditions of water body. Phytoplankton are commonly found in any type of water bodies and well known indicator to evaluate degree of pollution [14, 15, 16, 17, 18, 19, 20]. There were 60 genera and 80 species of phytoplankton tolerant to organic pollution listed by Palmer (1969). This classic algal index is used in rating water quality in aquatic bodies based on organic pollution (Palmer, 1969) [20]. The present study is a preliminary step to evaluate the organic pollution level by using Palmer's algal pollution index (1969) and some physico-chemical water quality parameters in rain fed ponds.

2. Materials & Methods

2.1 Sampling site

There are total six rain fed ponds were selected for phytoplankton sampling and water quality analysis in Sonapur, Noakhali district, Bangladesh (Table 1). The present study conducted from 16 August 2019 to 7 September 2019 during monsoon.

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Table 1: Geographical conditions of sampling ponds in Noakhali, Bangladesh.

Sampling ponds	Pond A	Pond B	Pond C	Pond D	Pond E	Pond F
	22°48'3.7" N	22°48'09.4" N	22°48'21.8" N	22°48'53.2" N	22°48'54.1" N	22°49'27.9" N
	91°06'12.1" E	91°06'12.6" E	91°06'12.5" E	91°06'12.1" E	91°06'13.2" E	91°06'02.2" E

2.2 Plankton collection and estimation

Phytoplankton were collected through plankton net (mesh size: 25 µm) and preserved in 5% buffered formalin. Specific species of phytoplankton according to Palmer's algal pollution index ^[12] were identified by using a light binocular microscope (Labomed, model: CXL-181085030) at 16×10 and 16×40 magnification level. The phytoplankton genera were identified up to genus level by ^[1, 21, 22, 23].

2.3 Water quality analysis

Some important physico-chemical water quality parameters as temperature, water transparency, p^H, total suspended solids, total alkalinity, free Carbon-di oxide and ammonia were determined. Water temperature, p^H and transparency were determined on spot by thermometer, p^H meter (HANNA- HI-98107) and secchi disc respectively. Total suspended solids, total alkalinity, free Carbon-di oxide and ammonia were measured by following guidelines of the American Public Health Association ^[24].

2.4 Statistical Analysis

ANOVA (One-way analysis of variance) through Microsoft EXCEL were used for data analysis.

3. Results & Discussion

A total ten organic pollution indicator genera belong to four

groups phytoplankton as Chlorophyceae, Bacillariophyceae, Cyanophyceae and Euglenophyceae were identified (Table 2). Jose and Kumar (2011) listed 20 algal species in four Kerala temple ponds which were responsible for organic pollution according to Palmer's algal index ^[25]. Singh (2018) also found ten pollution indicator algal species for water quality analysis in high latitude wetland, India ^[26]. Bordoloi and Baruah (2014) also reported five genera of Bacillariophyceae, three genera of Chlorophyceae, two genera of Cyanophyceae and Euglenophyceae in historical pond of Upper Assam according to Palmer's algal pollution index ^[9]. The phytoplankton group: Chlorophyceae was dominated by *Chlorella* (Table 2). Furthermore, Bacillariophyceae, Cyanophyceae and Euglenophyceae were dominated by *Cyclostella*, *Oscillatoria* and *Euglena* respectively (Table 2). *Chlorella* and *Euglena* also found dominated by ^[27, 28]. In the present study Pond A and Pond F was found probable high organic pollution (Table 2). On the other hand, Pond B and Pond C found certain high organic pollution (Table 2). Furthermore, moderate organic pollution was observed in Pond C and no organic pollution was occurred in Pond D (Table 2). The conducting study revealed the organic pollution level in several rain fed ponds which in agreements with ^[25, 26, 29, 30, 31, 32].

Table 2: Organic pollution index according to Palmer (1969) of six rain ponds in Noakhali, Bangladesh.

Phytoplankton	Pond A	Pond B	Pond C	Pond D	Pond E	Pond F
Chlorophyceae						
<i>Ankistrodesmus</i>	2	-	2	-	-	-
<i>Chlorella</i>	3	3	3	3	3	3
<i>Scenedesmus</i>	-	4	-	-	-	-
Bacillariophyceae						
<i>Cyclostella</i>	1	1	1	1	-	1
<i>Navicula</i>	3	3	-	-	-	3
<i>Synedra</i>	-	2	2	2	-	-
<i>Melosira</i>	-	-	1	-	-	-
Cyanophyceae						
<i>Oscillatoria</i>	-	5	5	-	-	5
Euglenophyceae						
<i>Euglena</i>	5	5	5	5	5	5
<i>Phacus</i>	2	-	2	2	2	-
Total score	16	23	21	13	10	17
Pollution level	Probable high organic pollution	Confirms high organic pollution	Confirms high organic pollution	Moderate pollution	Lack of organic pollution	Probable high organic pollution

In all sampling rain ponds water temperature (°C), transparency (cm), total suspended solids(mg/l), P^H, total alkalinity (mg/l), free CO₂ (mg/l) and ammonia (mg/l) were 28.95-29.3, 7.45-11.5, 1.145×10⁻³-6.5×10⁻⁴, 7.2-8.5, 9.0-21,

5.99-9.98, 0.35-1.25 recorded respectively (Table 3). The physico-chemical water quality parameters were also conducted to evaluate physical and chemical status of water body by ^[1, 33, 34, 35, 36, 37, 38, 39].

Table 3: Physico-chemical water qualities of six rain fed ponds in Noakhali, Bangladesh.

Parameters	Pond A	Pond B	Pond C	Pond D	Pond E	Pond F
Temperature (°C)	28.95±0.05	29.05±0.05	29.01±0.0	29.05±0.05	29.2±0.09	29.3±0.19
Transparency (cm)	11.5±0.50	9.9±0.0	9.1±0.0	8.1±0.0	7.45±0.50	10.45±0.50
Total suspended solids (mg/l)	1.145×10 ⁻³ ± 5.014×10 ⁻⁶	4.5×10 ⁻⁴ ± 5.014×10 ⁻⁶	2.5×10 ⁻⁴ ± 5.014×10 ⁻⁶	4.5×10 ⁻⁴ ± 5.014×10 ⁻⁶	6.5×10 ⁻⁴ ± 5.014×10 ⁻⁶	1.5×10 ⁻⁴ ± 5.014×10 ⁻⁶
P ^H	8.0-8.5	7.2-7.5	8.0-8.1	7.3-7.5	7.2-7.4	7.8-8.0
Total Alkalinity (mg/l)	9.0±1.0	13.0±1.0	21.0±1.0	9.0±1.0	9.0±1.0	13.0±1.0

Free CO ₂ (mg/l)	9.98±2.0	5.99±2.0	5.99±2.0	9.98±2.0	7.98±4.0	9.98±2.0
Ammonia (mg/l)	0.35±0.05	0.95±0.05	0.35±0.05	0.85±0.05	1.25±0.05	0.55±0.05

The prime factor temperature controls the algae production by influencing photosynthesis [40]. The negative relationship between water transparency and total phytoplankton production were found by [1, 41]. The p^H value states the productivity of water body [39]. The photosynthesis is maintained by alkalinity as the buffering capability of water body [42]. Free CO₂ in water increase the organic production [35]. The most favorable nitrogenous nutrient as ammonia plays a potential role in phytoplankton production [43].

4. Conclusion

This study provides preliminary statement of the organic pollution index values of rain fed ponds in Noakhali, Bangladesh during monsoon. Rain fed ponds play an important role in local economics by monsoonal fish trapping through native fish traps. The aquatic chemistry and algal composition ensures the availability and abundance of native fishes in rain fed ponds.

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