

Abundance and Biodiversity of Phytoplankton in the Halda River during Monsoon and Post Monsoon period

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Research Article

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Abstract

*Abundance of phytoplankton in the Halda river was studied during monsoon (July) & post monsoon (February). Samples were collected from three sampling stations- Station 01 (Moduna Ghat), Station 02 (Sattar Ghat), Station 03 (Najirbat). Total 20 species were identified. The highest number were recorded for *Coscinodiscus Sp* (600 cells/liter) during post monsoon at station 03.*

The average number of phytoplankton in station 01, station 02 and station 03 were found 2985 cells/liter, 3470 cells/liter, 3870 cells/liter. The most abundance of phytoplankton was found in post monsoon.

The physio chemical parameter varied from as, temperature 27° to 29° during monsoon, 25° to 28° during post monsoon, PH 5.5 to 6 during monsoon and 5.5 to 5.9 during post monsoon, dissolve oxygen 4.285 mg/l to 5mg/l during monsoon, 4.285mg/l to 5.71 mg/l during post monsoon and transparency 26.5 to 32 cm during monsoon, 27 to 31 cm during post monsoon. The Shannon diversity index was ranged between 2.345 to 2.6 during monsoon and 2.59 to 2.62 during post monsoon. The richness of study areas ranges between 2 to 2.3 during monsoon and 1.99 to 2.28 during post monsoon. The evenness was found in range of 0.81 to 0.92 during monsoon and 0.87 to 0.92 during post monsoon.

Keywords: Phytoplankton, Monsoon, Post Monsoon, Biotic, pH Dissolved Oxygen, Biodiversity Index

Introduction

Plankton is suspended particulate organic matter in aquatic environment. They can be range in 1 μm to 500 μm . Their movement depends on tide, current, wind etc. Generally, plankton are two types, zooplankton and phytoplankton. Phytoplankton, the names come from two Greek word, "Phyton" means plant and "Planktos" means drifter. They are the autotrophic components of the plankton community and key part of ocean, sea and fresh water basin ecosystem. Phytoplankton are extremely diverse, varying from photosynthesizing bacteria to plant like diatoms. They are microscopic, biotic organisms that inhabit the upper sunlit layer of almost all ocean and bodies of fresh water. They are agents for primary production. They absorb energy from the Sun and nutrients from the water to produce their own food. It is estimated that between 50% to 85% of the world oxygen is produced via phytoplankton. Bangladesh is a country of river and canals. The studies on phytoplankton of river have prime importance. The study of Yamazi (1972) mentioned that marine plants are important source upon which all the fauna depends for the energy necessary for the existence. Another study by Wickstead (1965) mentioned that phytoplankton forms a very important constituents and generally considered as the best index of the aquatic habitat. Halda river originates from

Badnatali Hill Ranges in Ramgarh Upazila in the Chittagong Hill Tracts and located in the south eastern part of Bangladesh. It flows through Fatikchari Upazila, Hathazari Upazila, Raozan Upazila and Chittagong Kotwali Thana and falls into the Karnafully river at Kalir Ghat. The length of this river is almost 1000 Km and it has a very turbulent tributary. To understand about an aquatic ecosystem, first of all we should know about phytoplankton, as it is the primary producer. Phytoplankton includes all the floating plants of sea, river, estuary and lake. In comparison to other biological organism, phytoplankton is mixed with the water column. They optimize their residence in the photic zone by a number of mechanism, controlling buoyancy using gas vacuoles, migration using flagella, area / volume ratio to from resistance and metabolic processes.

Phytoplankton constitutes 95% of total marine production. Temperature is the most important factor in controlling the growth of phytoplankton was approved by many workers. In open ocean, these primary productions eaten entirely by zooplankton while 10% of plant material is eaten by herbivores. Variations of phytoplankton community depends also on some factors such as nutrient, light intensity etc.

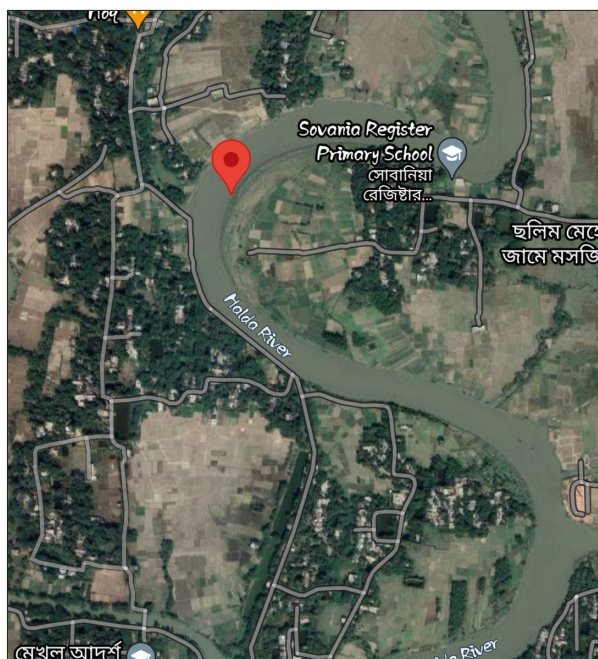
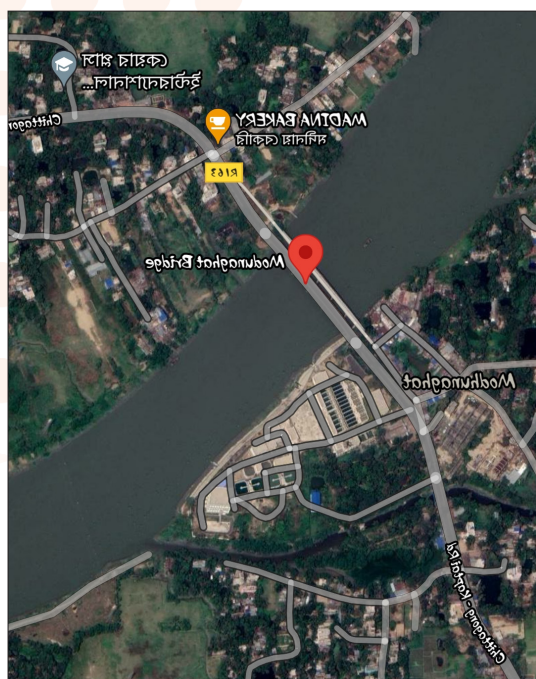
Materials and Methods

Investigated period

Investigation in Halda river was carried out during monsoon (July) and post monsoon (February) period. Samples are collected from three selected stations.

Station No.	Station Name	Latitude	Longitude
1	Moduna ghat	22°43'41"	91°87'28"
2	Sattar ghat	22°39'57"	91°89'88"
3	Najirhat	22°32'46"	91°85'31"

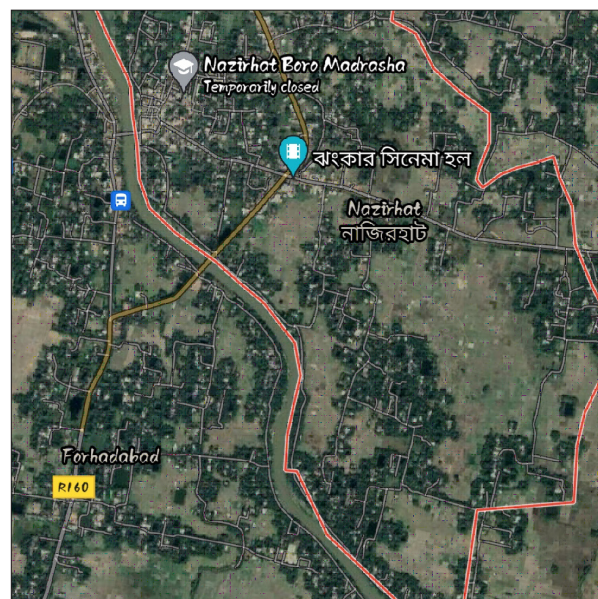
Sampling station with geographic location



Sampling Design

A Sampling design was formulated by selecting three stations and to collect samples were collected from the surface water by bottle to determine water temperature and dissolved. Samples are collected during monsoon and post monsoon. From sampling stations, water sample oxygen, PH was determined by PH paper and water transparency was measured by secchi disk. Phytoplankton samples were collected by plastic bottle of IL. These samples are preserved with 2% formalin and brought to observation.

Sample Collection



Method to determine water parameter

Water temperature

Water temperature was measured by using a thermometer.

PH

PH of surface water is measured by PH test paper.

Dissolved Oxygen

Dissolved oxygen in water was determined by Winkler method.

Equipment: DO bottle, Pipette, Burette, Stand, Conical flask.

Reagents: $MnSO_4$, KI, H_2SO_4 , Starch solution $Na_2S_2O_3$.

Method

- Add 1ml $MnSO_4$
- Add 1ml KI.
- Sample are taken into a specific volume of DO bottle.
- Invert the bottle for mixing at least 15 times.
- Add 1ml H_2SO_4
- Take 10 ml sample in conical flask, add 1-2 drops of starch solution.
- A pale bluish color can be seen.
- Titrate against 0,025N $Na_2S_2O_3$ solution.
- Disappear the color.

Figure: Three sampling stations of Halda River (Google Map)

Calculation

$$DO = V \times N \times 5.6 \times 1000 / S \times B(B-A)$$

Here,

V=Volume of Na₂S₂O₃ needed

N=0.025 N

S= Sample taken

B=Bottle volume

A=2

Water transparency

Water transparency is determined by secchi disk.

Phytoplankton

Collection

The collection of phytoplankton was done from each station by using 1L plastic bottles. After collecting this, these bottles were labeled by permanent marker. These labels indicate station number

Preservation

Collected samples were preserved with 2% formalin and brought to lab for analysis.

Siphoning

In lab, phytoplankton's concentration in sample were increased by decreasing water volume from different size of measuring cylinder, with settlement at least for 24 hours. The whole procedure was done by siphoning with medical saline pipe. At the end of last phase 100 ml measuring cylinder was remained.

Identification and Enumeration

The concentrated samples were shaken before taking into rafter cell. A cover slip was placed process was performed twice for each sample. carefully to avoid air bubbles. Then rafter cell was placed under the microscope and counting. This Identification was done by following several works such as Davis (1955), Islam and Aziz (1977), Haque (1999), Rahman (1997), Zafar (2000), Sarif (2001) etc.

Observation and Result

Phytoplankton composition

The number of phytoplankton ranges 2950 cells/l to 3650 cells during monsoon. Highest number of phytoplankton were found in Station 3 and lowest was in Station 1. Same was in post monsoon where the number ranges 3020 cells/l to 4090 cells/l.

Stations	Numbers cells/l(Monsoon)	Numbers cells/l(Post Monsoon)
Station-01	2950	3020
Station-02	3320	3620
Station-03	3650	4090

Environmental parameters

Water temperature

During monsoon, the temperature ranges between 27°C to 29°C. Highest temperature was collected from station 02.

During 2nd sampling in post monsoon, temperature ranges between 25°C to 28°C. Highest temperature was recorded in Station 02 and Station 01.

Stations	Monsoon(°C)	Post Monsoon(°C)
Station-01	27	28
Station-02	29	28
Station-03	28	25

PH

PH was ranges between 5.5 to 6 during monsoon. Highest PH was recorded in Station 03. In post monsoon, PH was recorded between 5.5 to 5.9. Highest value was found again in Station 03.

Stations	Monsoon	Post Monsoon
Station-01	5.5	5.5
Station-02	5.5	5.7
Station-03	6	5.9

Water Transparency

Water depth that measured in different stations were recorded.

Stations	Monsoon(cm)	Post Monsoon(cm)
Station-01	26.5	27
Station-02	32	31
Station-03	27	28

Dissolved Oxygen

Dissolve oxygen 4.285 mg/l to 5 mg/l during monsoon, 4.285 mg/l to 5.71 mg/l during post monsoon.

Stations	Monsoon(mg/l)	Post monsoon(mg/l)
Station-01	5	4.285
Station-02	5	4.285
Station-03	4.285	5.71

Total Number of species in Station-01 during post monsoon with percentage (%)

Species number	Name of the species	Total cell/l	(%)
01	Coscinodiscus sp.	440	14.56
02	Chlorella sp.	270	8.94
03	Cyclotella sp.	140	4.63
04	Climocospheonia sp.	200	6.62
05	Biddulphia sp.	100	3.31
06	Euglena sp.	170	6.62
07	Fragilaria sp.	170	5.63
08	Nitzschia sp.	270	8.94
09	Navicula sp.	170	5.63
10	Nostoc sp.	70	2.31
11	Peridinium sp.	240	7.94
12	Pleurosigma sp.	300	9.93
13	Rhizosolenia sp.	70	2.31
14	Synedra sp.	70	2.31
15	Thalassiosira sp.	140	4.63
16	Unidentified	70	2.31
17	Unidentified	100	3.31
		Total=3020	

Total number of species in station-02 during post monsoon with percentage (%)

Species number	Name of the species	Total cell/l	(%)
01	Coscinodiscus sp.	540	14.91
02	Chlorella sp.	300	8.28
03	Cyclotella sp.	240	6.62
04	Climocospheonia sp.	100	2.76
05	Biddulphia sp.	270	7.45
06	Euglena sp.	270	7.45
07	Fragilaria sp.	240	6.62
08	Nitzschia sp.	200	5.52
09	Navicula sp.	170	4.69
10	Nostoc sp.	100	2.76
11	Peridinium sp.	200	5.52
12	Pleurosigma sp.	240	6.62
13	Rhizosolenia sp.	170	4.69
14	Synedra sp.	140	3.86
15	Thalassiosira sp.	200	5.52
16	Unidentified	70	1.93
17	Unidentified	170	4.69
		Total=3620	

Species number	Name of the species	Total cell/l	(%)
01	Coscinodiscus sp.	600	14.66
02	Chlorella sp.	300	7.33
03	Cyclotella sp.	340	8.31
04	Climocospheonia sp.	200	4.88
05	Biddulphia sp.	240	5.86
06	Euglena sp.	200	4.88
07	Fragilaria sp.	270	6.60
08	Nitzschia sp.	340	8.31
09	Navicula sp.	170	4.15
10	Nostoc sp.	70	1.71
11	Peridinium sp.	240	5.86
12	Pleurosigma sp.	100	2.44
13	Chaetoceros sp.	170	4.15
14	Rhizosolenia sp.	200	4.88
15	Synedra sp.	70	1.71
16	Thalassiosira sp.	140	3.42
17	Unidentified	100	2.44
18	Unidentified	140	3.42
19	Unidentified	100	2.44
		Total=4090	

Total number of species in station-03 during post monsoon with percentage (%)

Biodiversity Index

The Shannon-wiener index

The Shannon-wiener index (H) was used to summarize the information on the relative abundance of zooplankton species found within study area.

The Shannon-wiener index, $H = -\sum [P_i \times \ln(P_i)]$

Where, P_i is the proportional abundance of the species- $[n_i/N]$
 n_i =Number of individual species, N =Total number of species.

Stations	Monsoon	Post Monsoon
Station-01	2.345	2.59
Station-02	2.6	2.59
Station-03	2.44	2.62

Pielou's Evenness index

The evenness index, $J' = [H(S)/H_{max}]$

Where, $H(S)$ =Shannon diversity index

$H_{max} = \ln S$

Stations	Monsoon	Post Monsoon
Station-01	0.83	0.92
Station-02	0.92	0.91
Station-03	0.81	0.87

Margalef Richness index

The formula of Margalef richness is, $d=(S-1)/\log N$

Where, S = total number of species,

N=number of individual

Stations	Monsoon	Post Monsoon
Station-01	2	1.99
Station-02	1.97	1.95
Station-03	2.3	2.28

Discussion

Hydrological parameters

Temperature

Water temperature is very important for aquatic organism. During study, water temperature ranged from 25°C to 29°C.

Hague (1983) observed the temperature of Matamuhuri estuary to be 28°C during October. Md.

Enamul Haque (2006) observed temperature 18°C to 31°C at pagla river.

Dissolved Oxygen

Dissolved oxygen is one of the essential factors for aquatic organism such as phytoplankton. The highest DO was recorded 5.71mg/l and lowest was recorded 4.285 mg/l.

Chowdhury (1995) recorded DO 4.63 mg/l in Moheshkhali channel during October.

Rahman (1997) reported that DO in Naf river was 4.5 mg/l.

PH

PH is one of the major factor for aquatic environment. The highest value was found 6 and lowest was recorded 5.5.

Fatema (2017) found PH in the range of 7.61 to 8.97 in Buriganga river.

Water transparency

The highest transparency of water was highest recorded 32 cm and lowest was 26.5cm.

Md. Enamul Haque recorded 205 cm water transparency in March in Pagla river and 46cm in May.

Phytoplankton composition

During the study period, 20 species was identified in Halda river. The highest abundance found in station 03 and lowest was found in station 01.

The highest number of species was found during post monsoon in February. *Coscinodiscus* sp were most dominant species in all station.

The study of Sharif (2002) recorded 22 genera of phytoplankton Chandpur, Barisal, Bhola, Hatiya and Sandip during post monsoon.

Haque (2006) found 28 genera of phytoplankton from Pagla river during study period

Compared with them, the concentration and abundance of phytoplankton was lower.

Biodiversity Index (Shanon Index)

Shanon index is one of the popular index to determine biodiversity. The higher the value of Shanon index, the higher it is diversified.

In Halda river, the highest value of Shanon index was found in Station 03 (2.62) during post monsoon and lowest value was found in Station 01 (2.345).

It can be said that, most of the stations are well diversified.

Pielou's Evenness index

The evenness was ranges between 0.81 to 0.92 during monsoon and 0.87 to 0.92 at post monsoon.

The highest value was found in Station 01 during post monsoon. Analyzing most of values, it can be said that evenness index is good for the study area.

Margalef Richness index

The richness of study areas ranges between 2 to 2.3 during monsoon and 1.99 to 2.28 during post monsoon.

The highest value was found in Station 03 during monsoon.

Limitation

It was not possible to collect samples not more than two times for lacking of time. More study is required to have a concrete conclusion.

Conclusion and Recommendation

The study narrated that Halda is well diversified 20 species phytoplankton were identified which play a vital role in river ecosystem.

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