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Plankton population and physico-chemical properties of a lake of Jahangirnagar University campus, Bangladesh at various lunar rhythms

Most Fahima Ahmed Anny* and Ismot Ara[1]
Department of Botany, Jahangirnagar University, Savar, Dhaka-1342, Bangladesh

Abstract

Planktonic biomass and physico-chemical properties of water from a lake at Jahangirnagar University, Bangladesh were studied during new moon, first quarter, full moon and last quarter phases from 16th June to 15th July 2015. Twenty four species of phytoplankton belonging to Chlorophyceae, Bacillariophyceae and Euglenophyceae were recorded. Maximum abundance (162-301 unit/l) of Chlorophyceae was recorded in first quarter phase followed by full moon phase (112-224 unit/l), new moon phase (85-222unit/l) and last quarter phase (60-125 unit/l), respectively. *Chlorella vulgaris* and *Biddulphia aurita* were the most abundant phytoplankton throughout the lunar period. Among the zooplankton, 5 species of Protozoa, 2 species of Rotifer, 3 species of Cladocera and 1 species of Ostracoda were recorded. Highest zooplankton was recorded in full moon phase (54-105 unit/l) and *Daphnia cephalata* was the most abundant species throughout the lunar cycle. Physico-chemical parameters indicate that the water temperature, colour, odour and pH were almost similar throughout the lunar cycle, whereas maximum dissolved oxygen (7.16 mg/l) and minimum (4.43 mg/l) were found during the last quarter and the full moon phase, respectively. The highest content of free carbon dioxide (4.36 mg/l) and chloride (22.8 mg/l) were recorded during first quarter and full moon phase accordingly.

Key words: Lunar rhythm, planktonic biomass, Jahangirnagar University lake.

INTRODUCTION

The movement of moon on its orbit around the earth produces tidal rhythms that flows twice a day and rhythmic variation of the height of the tides, which are of the considerable importance on plants and animals. Phytoplankton and zooplankton are the important biological indicators of the water quality of a lentic water body and serve as food for aquatic animals and also play an important role in maintaining the biological balance (Perumal *et al.*, 2009). Phytoplankton species diversity responds rapidly to changes in the aquatic environment particularly in relation to nutrients. Many factors reducing phytoplankton diversity may have direct detrimental effects on the amount and predictability of aquatic primary production (Rajkumar *et al.*, 2009). Darkness in the earth's natural photoperiod, and has played a vital role in biological history of all living organisms, be they plants or animals (Moharana & Patra, 2014).

Lunar rhythm is a phenomenon associated with the life processes of the plankton showing a specific response to light in term of phototaxis. Those which are positive to phototaxis report their maximum rhythmic activities during day light and others being negative in phototaxis are more active in dark (Dhua & Patra, 2006). It has been recognized that

[1] Department of Zoology, Jahangirnagar University, Savar, Dhaka-1342, Bangladesh
*Corresponding author. E-mail: mfa.anny81@gmail.com

zooplankton biomass and abundance assessments produce a higher variability. The zooplankton abundance can vary in relation to illumination by the moon in subtropical waters (Hernández-León *et al*., 2001). Many researches (Chowdhury & Mamun, 2005; Chowdhury & Zaman, 1999; Chowdhury *et al*., 1998; Chowdhury & Zaman, 2000; Fakruzzaman *et al*., 2001; Islam & Chowdhury, 2013; Islam & Shaha, 1975) were conducted on the plankton population and diversity in relation to physico-chemical conditions of different water bodies in Bangladesh. But the effects of lunar cycle on the ethological pattern of plankton communities in any lake of Bangladesh have not been studied. Therefore, the present research work was undertaken to investigate the physic-chemical properties and planktonic biomass of a lake on the basis of lunar rhythm at Jahangirnagar University in Bangladesh.

MATERIALS AND METHODS

Plankton (phyto and zooplankton) samplings were made from a lake of Jahangirnagar University (Latitudes of 23º04′00″N to 23º04′15″N and longitudes of 90º45′10″E to 90º47′50″E with an average elevation of approximately 12 meter from the sea level) in Bangladesh during a lunar period i.e., 16th June to 15th July, 2015 at 8.00 p.m. Collections were made from 100 litres water sample by a plastic bucket of 10 litres capacity and transferring into a plankton net made of bolting silk cloth (No.25, mesh size 64µ). 100 litre of water sample reduced to 50 ml of concentrated sample by filtration through the plankton net and was preserved in 3% formaldehyde. During the operation, a subsample of 1ml from the stock was drawn on to the plankton counting cell (1ml capacity). Plankton per litre of water was calculated using formulae as suggested by Edmonson (1995). Qualitative and quantitative estimations of the plankton were made by a Sedgewick-Rafter counting cell as per Fritsch (1965) and Tilden (1968). All the planktons encountered were represented in absolute number. Water temperature of the surface water was measured by using a degree centigrade thermometer, electric conductivity was measured by using an EC meter (Portable EC meter, Sension 5, HACH Company, USA), pH and Eh (Redox Potential) were measured by using a pH meter (Portable pH meter, Sension 1, HACH Company, USA), dissolved oxygen was determined by using the DO meter (Portable DO meter, Sension 6, HACH Company, USA).

RESULTS AND DISCUSSION

The phytoplankton abundance of the studied water body has been presented in Table 1. Fourteen species of Chlorophyceae i.e. *Actinastrum hantzschii*, *Chlamydomonas cylindrica*, *Chlamydomonas angulosa*, *Chlorococcum infusionum*, *Chlorella vulgaris*, *Diacanthos belenophorus*, *Dictyosphaerium pulchellum*, *Eudoina elegans*, *Kirchneriella irregularis*, *Pediastrum tetras*, *Schroederia spiralis*, *Scenedesmus dimorphus*, *Tetraedron bifurcatum* and *Tetraedron minimum*; 1 species of Baccilariophyceae i.e. *Biddulphia aurita* and 9 species of Euglenophyceae such as *Euglena chlamydophora*, *Euglena clavata*, *Euglena deses*, *Euglena exilis*, *Euglena flava*, *Euglena oxyuris*, *Euglena sanguine*, *Trachelomonas globularis* and *Trachelomonas oblonga* were recorded. The maximum abundance of Chlorophyceae (162-301 unit/l) was recorded during the first quarter phase followed by full moon phase (112-224 unit/l), new moon phase (85-222 unit/l) and last quarter phase (60-125 unit/l) respectively. Similar results (highest and lowest abundance in different phases) also found in Baccilariophyceae and Euglenophyceae. The results indicate that *Chlorella vulgaris* and *Biddulphia aurita* were the most abundant phytoplankton throughout the lunar period. It is pertinent to mention here the findings the of Dhua & Patra (2006) where they mentioned that the lunar cycle imparts certain stimulatory effects on the rhythmic behaviour of plankton and their life processes by which they actively migrate to the surface and gradually sink as the moon fades.

Table 1. Phytoplankton abundance (units/l) of a lake of Jahangirnagar University campus at various lunar rhythms

Phytoplankton	Lunar Period			
	New moon phase (16-23 June, 2015)	First quarter phase (24 June-1st July, 2015)	Full-moon phase (2-7 July, 2015)	Last quarter phase (8-15 July, 2015)
Chlorophyceae				
Actinastrum hantzschii Lagerheim	4-8	7-11	5-9	0-6
Chlamydomonas cylindrica Chod.	2-9	8-17	5-14	4-10
Chlamydomonas angulosa Nyg.	2-12	5-14	6-10	0-4
Chlorococcum infusionum (Schrank) Meneghini	2-10	5-13	5-10	0-5
Chlorella vulgaris Beyerinck	33-80	60-91	19-66	14-25
Diacanthos belenophorus	3-8	4-11	5-14	1-5
Dictyosphaerium pulchellum	4-16	10-18	10-14	6-15
Eudoina elegans	2-11	6-10	4-8	2-9
Kirchneriella irregularis (G. M. Smith) Korsikov	2-4	5-10	4-9	2-4
Pediastrum tetras (Ehrenberg) Ralfs	1-3	4-8	5-7	2-5
Schroederia spiralis (Printz) Korsikov	3-9	5-11	4-5	1-5
Scenedesmus dimorphus (Turp) Kutz	20-35	27-60	25-40	13-31
Tetraedron bifurcatum (Wille) Lagerheim	4-9	6-12	5-9	0-5
Tetraedron minimum (A. Br.) Hangsgirg	3-8	10-15	6-13	3-8
Total	85-222	162-301	112-224	60-125
Baccilariophyceae				
Biddulphia aurita	33-81	61-90	19-66	14-25
Euglenophyceae				
Euglena chlamydophora Mainx	7-18	10-20	5-14	5-7
Euglena clavata Skuja	19-35	22-39	25-30	9-18
Euglena deses Ehrenberg	15-26	21-42	22-27	4-16
Euglena exilis Gojdics	11-14	8-25	17-21	3-11
Euglena flava Dangeard	8-18	9-20	5-15	4-6
Euglena oxyuris Schmarda	4-16	10-18	10-14	6-16
Euglena sanguinea Ehrenberg	20-33	24-41	25-28	10-17
Trachelomonas globularis (Awerinzew) Lemmermann	2-7	10-15	5-13	0-4
Trachelomonas oblonga	2-10	11-17	5-13	0-6
Total	88-177	125-237	119-175	45-97

Zooplankton groups consisted of 5 species of Protozoa i.e. *Entamoeba histilytica*, *Entamoeba coli*, *Paramecium caudatum*, *Paramecium buarsaria* and *Pleuronema chrysalis*, 2 species of Rotifer i. e. *Brachionus angularis* and *Brachionus forficula*, 3 species of Cladocera i. e. *Daphnia carinata*, *Daphnia cephalata* and *Moina micrura* and 1 species of Ostracoda such as *Eucypris virens*. Cladocera was the dominant organisms among the zooplankton (Table 2). The number of zooplanktons increased during full moon phase reaching the population maxima (54-105). The result revealed that the *Daphnia cephalata* was the most abundant zooplankton throughout the lunar cycle.

Table 2. Zooplankton abundance (units/l) of a lake of Jahangirnagar University campus at various lunar rhythms

Zooplankton	Lunar Period			
	New moon phase (16-23 June, 2015)	First quarter phase (24 June-1st July, 2015)	Full-moon phase (2-7 July, 2015)	Last quarter phase (8-15 July, 2015)
Protozoa				
Entamoeba histolytica Schaudinn	1-4	3-5	2-8	0-4
Entamoeba coli (Grassi)	0-3	5-7	3-5	3-5
Paramecium caudatum Ehrenberg	6-11	3-7	8-14	2-3
Paramecium buarsaria (Ehrenberg)	5-8	5-7	9-13	1-3
Pleuronema chrysalis (Muller)	0-5	2-8	3-8	1-5
Total	12-31	20-32	35-38	13-14
Rotifera				
Brachionus angularis Gosse	5-8	3-8	8-14	5-9
Brachionus forficula Wierzejski	3-9	7-13	10-16	7-12
Total	8-17	15-16	18-30	16-17
Cladocera				
Daphnia carinata King	10-35	5-13	20-42	23-31
Daphnia cephalata (King)	12-32	4-11	23-45	17-28
Moina micrura Kurz	3-16	6-16	11-18	9-13
Total	25-83	15-40	54-105	49-72
Ostracoda				
Eucypris virens	0-6	3-7	3-8	0-4

Physico-chemical parameters i.e. temperature, colour, odour, transparency, pH, EC, Eh, dissolved oxygen, free carbon dioxide and chloride during new moon, first quarter, full moon and last quarter phases from 16th June to 15th July 2015 presented in Table 3. The results indicate that the water temperature, colour, odour and pH were almost similar throughout the lunar cycle; whereas maximum dissolved oxygen (7.16 mg/l) and minimum (4.43 mg/l) were found during the last quarter and the full moon phase, respectively. On the other hand highest amount of free carbon dioxide (4.36 mg/l) and chloride (22.8 mg/l) were recorded during first quarter and full moon phase accordingly.

Table 3. Physico-chemical parameters of a lake of Jahangirnagar University campus at various lunar rhythms

Parameters	Lunar Period			
	New moon phase (16-23 June, 2015)	First quarter phase (24 June-1st July, 2015)	Full-moon phase (2-7 July, 2015)	Last quarter phase (8-15 July, 2015)
Water temperature(°C)	25.0	26.0	26.0	26.0
Weather	Sunny	Sunny	Sunny	Sunny
Colour	Greenish	Greenish	Greenish	Greenish
Odour	Stagnant	Stagnant	Stagnant	Stagnant
Transparency (cm)	14.0	14.5	15.75	15.5
pH	7.5	7.4	7.3	7.2
EC (μS/cm)	287	288	287	284
Eh (mv)	32.1	29.0	31.5	28.7
DO (mg/l)	6.83	6.90	4.43	7.16
Free CO_2 (mg/l)	1.73	4.36	2.43	2.33
Chloride (mg/l)	21.07	22.19	22.80	21.46

EC = Electrolytic Conductivity, **Eh** = Redox Potential, **DO** = Dissolved Oxygen

The physico-chemical parameters during a lunar cycle followed the same trend in fresh water ecosystem. Different rhythmicity in fresh water planktons of both lentic and lotic ecosystems and correlated it with the variations in light intensity, temperature, transparency and feeding spectrums were reported previously (Patra *et al*. (1986), Nayak & Gochhait (1990), Choudhury *et al*. (1992), Singh & Srivastava (1993). The favourable physico-chemical parameters of a lake during monsoon provide a suitable back ground to enhance the planktonic population. It can be concluded from the present study that the lunar cycle imparts a stimulating effect on the plankton life processes by which they actively migrate to the surface and then gradually decrease as the phase of the moon decreases. This is a continual cyclic process from one lunar period to another and their maximum and minimum migration is governed ultimately by lunar rhythm. Further study is required to establish planktonic lunar cycle which is important to maintain aquatic ecosystem.

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