PHYTOPLANKTON FLORA OF TANGUAR HAOR ECOSYSTEM OF BANGLADESH: CHLOROPHYTA

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Abstract

The qualitative and quantitative aspects of phytoplankton population belonging to the green algae (Chlorophyta) from Watch Tower and Rauar Station of Tanguar Haor, Sunamganj were studied. In the study, a total of 39 species of three Orders under the algal Division Chlorophyta was worked out. Their photomicrographs and individual densities in the pelagic community of phytoplankton over a study year of 2016 and 2017 are discussed. In Volvocales, *Volvox carteri* Stein, in Chlorococcales, *Coelastrum microporum* Nägeli and in Zygnematales, *Staurastrum paradoxum* Meyen represented the highest number of population in the community. Rauar Station was found to contain the lesser number of phytoplankton densities compared to Watch Tower Station.

Key words: Phytoplankton; Flora; Tanguar Haor; Chlorophyta.

INTRODUCTION

Algal Divisions from the Kingdom Eukaryota representing the flora of pelagic phytoplankton are very big. There are six such Divisions, namely Cryptophyta, Pyrrhophyta, Raphidiophyta, Chrysophyta, Euglenophyta and Chlorophyta (Reynolds 1984). Species belonging to the above mentioned divisions are most common in occurrence as phytoplankton in the lentic and lotic freshwater ecosystems of Bangladesh. Though, Islam and Paul (1978) studied the aquatic macrophytes and phytoplankton flora of the Haor Hakaluki of Maulvi Bazar District, there exists few information on the floristic composition of phytoplankton for Tanguar Haor of Sunamganj District. Recently, Bhuiyan *et al*. (2019) published the phytoplankton flora of Tanguar Haor ecosystem covering the species of phytoplankton belonging to the divisions Cyanophyta, Pyrrhophyta, Chrysophyta and Euglenophyta.

According to Reynolds (1978), phytoplanktonic genera from the Division Chlorophyta, are relatively higher in the Order Volvocales (7 genera), Chlorococcales (21 genera) and Zygnematles (8 genera). So, the Division Chlorophyta is important compared to the other algal divisions. Analysis on the samples of phytoplankton collected from Tanguar Haor showed a significant occurrence of the members of phytoplankton belonging to the green algae in the pelagic community (Bhuiyan *et al*. 2019). So, the present paper has been aimed to represent a qualitative and quantitative account of the phytoplankton of Tanguar Haor belonging to the green algae.

MATERIAL AND METHODS

The samples of the present investigation were collected bimonthly for the year 2017 and 2018 following the procedure as described in Bhuiyan *et al*. (2018, 2019). The qualitative study was performed with the help of an Olympus Phase Contrast Microscope under magnification varied from 200-400x. Photomicrographs of most of the dominant phytoplankton from the studied sample were taken along with their measurements. The taxa were later on identified with the help of Ahmed *et al*. (2008), Ling and Tyler (2000), Dillard (1989) and Prescott (1982).

After the identification of the dominant green planktonic taxa in the samples, the population of individual species was quantified with the help of a Microplankton Counting Chamber (Helber Counting

Chamber, Thoma, UK). The quantification was carried out at 400x under a Nikon Students Microscope (Japan).The population density of individual species thus counted was transferred to their presence at unit volume of Haor water and presented in Table 1. Some species of plankton whose population were too low to be counted were shown just as present (-) in Table 1.

RESULTS AND DISCUSSION

Species of phytoplankton recorded from Chlorophyta from the two study stations of Tanguar Haor have been listed in Table 1 along with their densities (index×10^3/l). Photomicrographs of two species namely, *Pandorina morum* and *Closterium kuetzingii* could not be provided in the illustration. However, their counting data are presented in Table 1. In the planktonic sample, two tychoplankton were found to occur, namely *Stigeoclonium* sp. (Fig. 2b) and *Bulbochaete* sp. (Fig. 2g).

Table 1. Qualitative (taxonomic diversity) and quantitative accounts of phytoplankton belonging to Chlorophyta collected from two study stations of Tanguar Haor (counting data represents, ind.×10^3/l).

Order	Species	Stations*		Fig.	References
		Watch Tower	Rauar		
Volvocales	*Eudorina elegans* Ehrenberg	22.5	23	Figs. 1a-b	Islam (2008)a
	Pandorina morum (Müll.) Bory	27.5	15.5	-	Islam (2008)b
	Pleudorina sphaerica Iyenger	25	-	Figs. 1c-d	Islam (1974)
	Volvox carteri Stein	81.5	49.5	Figs. 1e & l	Islam (1974)
Chlorococcales	*Dictyosphaerium pulchellum* Wood	5	9.5	Figs.1 h-i	Islam and Aziz (1977)
	Kentrosphaeria gloeophilum (Bohlin) Brunnthaler	37.5	-	Fig. 2a	Prescott (1982)
	Coelastrum microporum Nägeli	197.5	44	Fig. 2j	Ling and Tyler (2000)
	C. indicum W.B. Turner	15	-	Fig. 2k	Dillard (1989)
	Kirchneriella diane var. *diane* (Bohl.) Comas	20	-	Fig. 2d	Islam and Khatun (1966)
	Ankistrodesmus falcatus (Corda) Ralfs	20	47	-	Dillard (1989)
	Oocystis eliptica W. West	5	-	Fig. 1f	Islam (1973)
	Pediastrum simplex Meyen	42.5	17	Figs. 4a-c	Islam and Zaman (1975)
	P. duplex Meyen	129	75	Fig. 4d	Islam and Zaman (1975)
	Scenedesmus acuminatus (Lager.) Chodat	2.5	4.5	Fig. 2e	Ling and Tyler (2000)
Zygnematales	*Spondylosium planum* (Wolle) W. & W.	17.5	9.5	Fig. 2e	Islam and Zaman (1975)
	Desmidium bailyei (Ralfs) Nordstedt	19	5	Fig. 2j	Islam and Zaman (1975)
	Phymatodocis irregular Schm. var. *intermedia* Gutw.	9	3	Fig. 2i	Islam (1970)
	Closterium kuetzingii var. kuetzingii Brebisson	10	12.5	-	Islam and Haroon (1980)
	Triploceras gracile var. *gracile* Bailey	-	3	Fig. 2h	Islam and Akter (2005)
	Cosmarium pardalis Chon	10.5	10	Fig. 2o	Islam and Zaman (1975)
	Xanthidium bengalicum Turner	5	4	Fig. 3b	Islam (1970)
	Staurastrum paradoxum Meyen	161.5	34.5	Figs. 3i-k	Islam and Chowdhury (1979)
	St. chaetoceros (Schröder) G.M. Smith	-	50	Fig. 3h	Islam and Aziz (1977)
	St. bifidum Breb. *ex* Ralfs	136.5	47	Fig. 3a	Islam and Akter (2006)
	St. pinnatum Turner	112.5	-	Fig. 3g	Islam and Haroon (1980)
	St. leptocanthum Nordstedt	6.5	-	Fig. 3c	Islam and Akter (2006)
	Arthrodesmus curvatus var. *latus* Turner	-	4.5	Fig. 3l	Islam and Irfanullah (2006)

* Count as mean value (ind×10^3/l)

In true sense, those two are the occupants of benthic filamentous algae but started growing as plankton after detaching from the habitat. Including these two members of tychoplankton, other members of phytoplankton whose density could not be counted because of their poor abundance in the community are: *Spirogyra* sp., *Mougeotia* sp., *Pleurotaenium subcoronulatum* (Turner) W. & W.,

Schroederia spiralis (Printz) Koršikov, *Cosmarium subcostatum* Nordst., *C. impressulum* Elfving, *C. contractum* Kirschner var. *cracoviense* Raciborski, *Closterium dianae* var. *dianae* Ehrenberg ex Ralfs, *C. dianae* Ehrenberg ex Ralfs var. *arcuatum* (Bréb.) Rabenhorst, *Micrasterias apiculata* var. *apiculata* (Ehrenberg) Menegh. ex Ralfs.

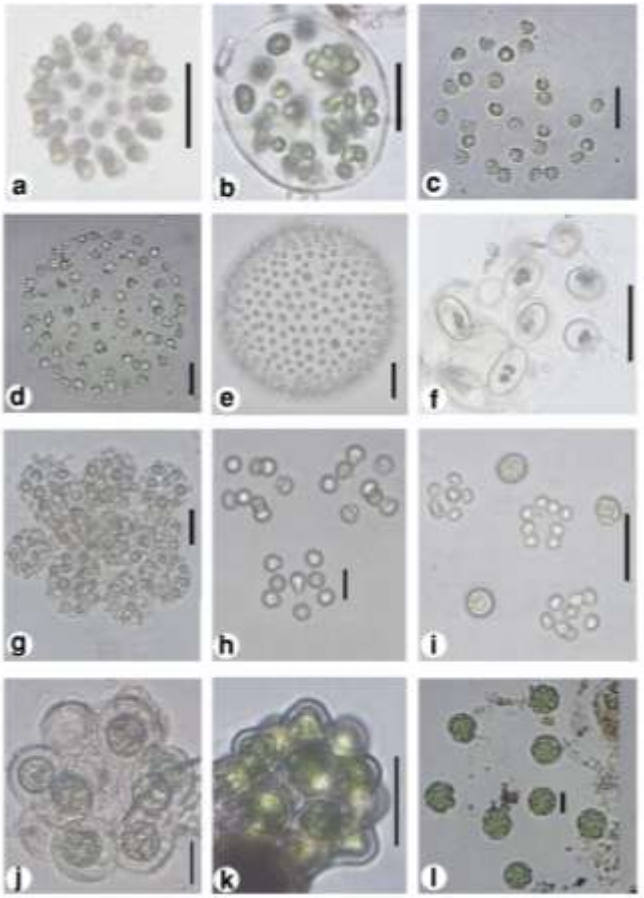

Fig. 1. Photomicrographs of phytoplankton from Tanguar Haor: **a, b**. *Eudorina elegans*; **c, d**. *Pleodorina sphaerica*; **e** and **l** (enlarged part of colony) *Volvox carteri*; **f**. *Oocystis eliptica*; **g.** (colony complex) and **j**. *Coelastrum microporum*; **h, i**. *Dictyosphaericum pulchelum*; **k**. *Coelastrum indicum.* (In figs. a, b, c, d, e, f, i, k; Scales = 40 µm) and (In figs. g, h, j and l, Scales = 20 µm).

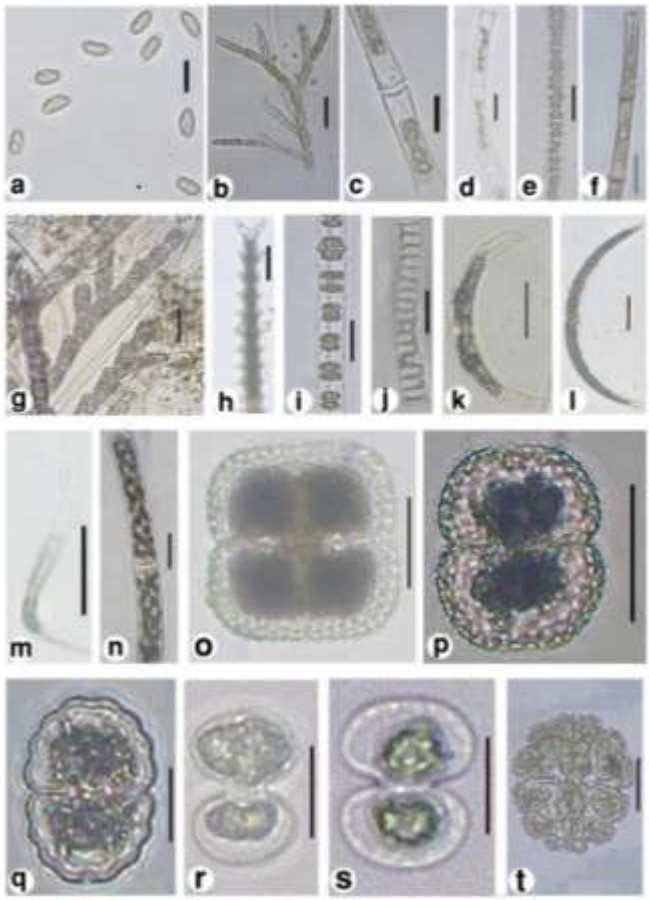

Fig. 2. Photomicrographs of phytoplankton from Tanguar Haor: **a**. *Kentosphaera gloeophila*; **b**. (tychoplankton) *Stigeoclonium* sp.; **c, d** (vegetative) *Mougeotia* sp.; **e**. *Spondylosium planum*; **f**. *Pleurotaenium subcoronulatum*; **g** (tychoplankton). *Bulbochaete* sp.; **h**. *Triploceros gracile* var. *gracile*; **i**. *Phymatodocis irregular* var. *intermedia*; **j**. *Desmidium baileyi*; **k**. *Closterium diane* var. *diane*; **l**. *Cl. diane* var. *arcuatum*; **m**. *Shroederia spiralis*; **n**. (vegetative). *Spirogyra* sp.; **o**. *Cosmarium pardalis*; **p**. *C. subcostatum*; **q**. *C. impressulum*; **r-s**. *C. contractum* var. *cracoviense* fa. *angulatum* and **t**. *Micrasterias apiculata* var. *apiculata* (In figs. c, d, e, f, g, h, k, l, m, n, o, p, r, s and t; Scales = 40 µm) and (In figs. a, b, i, j and q; Scales = 20 µm).

In the present investigation total 27 species of Chlorophyta have been counted (Table 1). Order Volvocales was represented by 4 species. Their occurrence in both the studied stations, namely Watch Tower and Rauar Stations were almost same except *Pleudorina sphaerica* which was absent in the

Rauar Station. *Volvox carteri* showed highest number of density among Volvocales. Its density varied 81.5 $\times 10^3$ ind/l and 49.5 $\times 10^3$ ind/l in Watch Tower and Rauar Stations, respectively. The density of *Eudorina elegans* was almost the same in both the studied stations (Table 1).

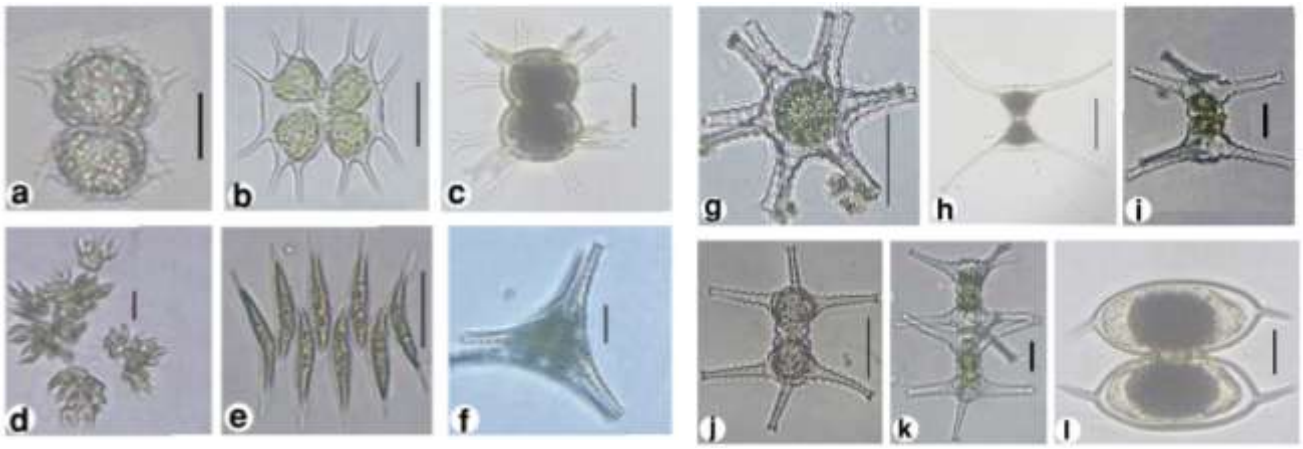

Fig. 3. Photomicrographs of phytoplankton from Tanguar Haor: **a**. *Staurastrum bifidum* Breb. *ex* Ralfs; **b**. *Xanthidium bengalicum* Turner; **c**. *St. leptacanthum*; **d**. *Kirschneriell diane* var. *diane*; **e**. *Scenedesmus acuminatus*; **f** (top view), **i** (face view), **j** (dividing stage) and **k** (two celled colony), *Staurastrum paradoxum*; **g** (top view). *Staurastrum pinnatum*, **h**. *St. chaetoceros*, **l**. *Arthrodesmus curvaus* var. *latus.* (In figs. a, b, c, d, e, f, g, h and j; Scales = 40 µm) and (In figs. i, k and l; Scales = 20 µm).

The population density of *Pandorina morum* was lower in the Rauar Station (15.5×10^3 ind/l) compared to the Watch Tower Station (27.5 ×10^3 ind/l). Chlorococcales was represented by 11 species of which most abundant were *Coelastrum microporum* (197.5×10^3 ind/l) and *Pediastrum duplex* (129×10^3 ind/l). For others the density ranged from 5-47×10^3 ind/l. On the otherhand, *Kentrosphaeria gloeophilum, C. indicum, Kirchneriella diane* var. *diane* and *Oocystis eliptica* were absent in the Rauar Station. The order Zygnematales was represented by 22 species, of which 3 species of the Genus *Staurastrum* showed the highest abundance in the community. These are *Staurastrum paradoxum, St. bifidum* and *St. pinnatum* with cell densities of 161.5, 136.5 and 112.5×10^3 ind/l, respectively (Table 1). *Triploceras gracile* var. *gracile, St. chaetoceros* and *Arthrodesmus curvatus* var. *latus* were absent in the Watch Tower Station while *St. pinnatum* and *St. leptocanthum* were absent from the Rauar Station.

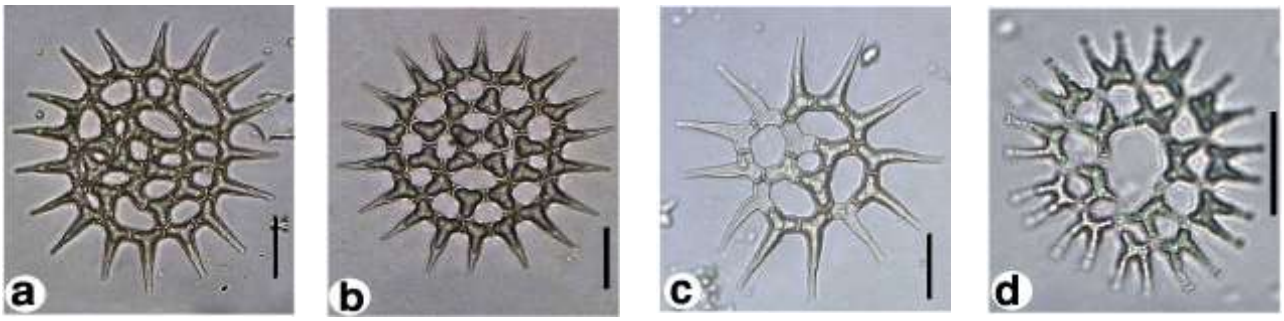

Fig. 4. Photomicrographs of phytoplankton from Tanguar Haor: **a-c**. *Pediastrum simplex*; **b**. *Pediastrum duplex*. (In figs. a, b, c and d; Scales = 40 µm)

Islam and Paul (1978) studied the algal flora of the Hakaluki Haor of Maulvi Bazar district. A comparison has been made between their results and the results from the present investigation on the Tanguar Haor (Table 2). From Table 2 it has been seen that the number of species recorded by Islam and

Paul (1978) for the orders Chlorococcales and Zygnematales were almost the same for the Tanguar Haor. This gives some insight that the pelagic area of Haor waters are predominantly occupied by the population of chlorococcoid and desmid algae. Regarding the occurrence of Volvocales, though Islam (1978) did not show any record in their collection but in case of Tanguar Haor at least 4 species could be recorded with a highest population density of *Volvox carteri*. This species was previously recorded from Dhaka, Khulna and Jhenidaha districts of Bangladesh (Islam 1974). Islam and Zaman (1975) recorded *V. carteri* in rainy season from the river Buriganga near Dhaka. Regarding the occurrence of chlorococcoid and desmids in the Hoar water very little could be inferred on the chemical factors. For Tanguar Haor there is no previous record on phosphate and nitrate concentration of water.

Table 2. A comparison of phytoplankton quality from green algae (Chlorophyta) between Tanguar Haor and Hakaluki Haor.

Order	Species number	
	Tanguar Haor (Present study)	Hakaluki Haor (Islam 1978)
Chaetophorales	1	-
Oedogoniales	1	3
Volvocales	4	-
Chlorococcales	11	11
Zygnematales	22	28

Recently, Bhuiyan *et al*. (2017) reported the mean concentration of soluble reactive phosphorus (SRP) for the Haor as 16.3 µg/l and nitrate-nitrogen as 180 µg/l. Mamun *et al*. (2013) reported water temperature, pH and dissolved oxygen (DO) as 28.0°C, 7.32 and 5.03 mg/l, respectively which is quite consistent with the findings of Bhuiyan *et al*. (2017). The water of Tanguar Haor could be classified as alkaline with moderate concentrations of SRP and nitrate-nitrogen. Bhuiyan *et al*. (2019) stated a mesotrophic status of the Haor. Since altogether 39 species of phytoplankton were recorded from the haor water, the diversity seems to be higher and shows that the water of the haor is not eutrophic, i.e., rich in nitrogen and phosphorus compounds. Moreover, the occurrence of *Volvox carteri* shows the action of some flowing rivers across the Haor basin.

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