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Distribution and Abundance of Plankton and Periphyton in Some Water Bodies in Relation to Anthropogenic Stress

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Abstract: The present investigation was carried out in two different anthropogenic stress prevailing water bodies namely 4 No. Bhery (Station A) at Kolkata, West Bengal, India and Mathura Beel (Station B) at KAPA, Kanchrapara, West Bengal, India. After analyzing the plankton data of different spots of the Station A, it is revealed that in all the spots are dominating by phytoplankton groups in order *viz.* Cyanophyceae > Chlorophyceae > Bacillariophyceae > Euglenophyceae > Xanthophyceae. This indicates the high organic load in all the spots. But comparatively very high in Main Bhery and Channel which leads to the algal bloom formation (surface algal scum) and this ultimately deplete the oxygen level in the water which was confirm by the dark green color and the presence of dead fishes (*L. rohita, C. mrigala*) in the surface of both the spots. All the water bodies were under various anthropogenic stresses that were mainly organic in origin.

Key words: Plankton · Periphyton · Anthropogenic Stress · Bhery · Beel

INTRODUCTION

Aquatic organisms have preferred habitats, which are regulated by physical, chemical and other biological features. Variation in one or more of these can lead to stress on individual or community and may inflict reduction in the abundance of organisms. On the other hand, water quality affects the abundance, species composition, stability, productivity and physiological conditions of population of aquatic organisms. Therefore, the nature and health of aquatic community are an expression of the quality of water. Biological methods used for assessing the water quality including collection, counting and identification of aquatic organisms, particularly plankton and periphyton are the important tools in biomonitoring studies [1, 2].

According to Chapman [2], when biological methods are carried out by trained personnel it can be very quick and cheap and integrated into others studies. Compared with physicochemical analysis, much less equipment is necessary and a large area can be surveyed very intensively in a short time, resulting in a large amount of information for later assessment.

Keeping these in mind, the present short term investigation has been carried out in two contrasting sites *viz.* fresh water sewage- fed Bhery and Beel with following objectives:

- To study the presence or absence of certain plankton and periphyton genera or families and plankton abundance as a means of measuring environmental status.
- To document the texture (spectrum) of phytoplankton and algal periphyton for the biological assessment of selected water bodies.
- To investigate the role of biological communities (plankton and periphyton) as bio-indicators of anthropogenic stress.

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MATERIALS AND METHODS

Study Site: Two different anthropogenic stress prevailing water bodies/sites of present investigation are namely, 4 No. Bhery- Station A (Fresh water sewage-fed fisheries) at Kolkata, West Bengal, India and Mathura Beel- Station B (wetland fisheries) at KAPA, Kanchrapara, West Bengal, India. The freshwater sewage-fed Bhery is solely managed with the use of city sewage. The beel, though it is not subjected to sewage pollution but frequent human intervention *viz*. pen and cage culture, jute rating, bathing and other household activities causing serious stress to the aquatic environment leading to change in the biotic profile of the ecosystem. Besides this, siltation is a serious and perennial problem affecting the production and productivity of the ecosystem.

The sampling stations and other details of the study area have been discussed below:

For Plankton: Four different spots of beel were sampled for plankton analysis.

For Periphyton: Periphyton samples were collected from different substratum, *viz.* bamboo pole, tree trunk, plant stems, snails, water hyacinth and other aquatic plants.

Collection and Identification of Plankton and Periphyton:
Plankton: Plankton samples were collected from the different above-mentioned spots with the help of conical bolting silk plankton net (No.0.25) by filtering 50 liters of water. The samples were preserved in 4% formalin solution and brought into the laboratory and kept in dark for further analysis. Qualitative assessments of plankton were done following the standard keys *viz.* APHA [1], Edmondson [3], Khan [4], Korinek *et al,*[5], Michael [6], Michael and Sharma [7], Sharma and Sharma [8], Venkataraman and Das [9], Quantitative evaluations of plankton were done following the standard method [1].

Periphyton: Periphyton samples were collected with the help of knife or blade by scrapping from different submerged substrates from various spots. The collected periphyton were preserved in 4% formalin solution [10]. The preservation was done spot wise and substrate wise in separate plastic sample bottles and brought into the laboratory for further analysis. Only qualitative assessment was done following the key of Edmondson [3] and APHA [1].

Interpretation of Results: For interpreting the observed data, phytoplankton genera and algal periphyton genera were used for categorization of the water bodies following APHA [1]:

Taste and Odor Algae: *Asterionella, Anabaena, Hydrodictyon, Anacystis, Uroglenopsis, Synedra, Peridinium, Mallomonas, Ceratium, Staurastrum, Aphanizomenon, Dinobryon, Volvox, Nitella, Tabellaria, Gomphosphaeria, Synura, Panorina.*

Filter Clogging Algae: *Dinobryon, Anacystis, Cymbella, Chlorella, Rivularia, Tribonema, Closterium, Synedra, Melosira, Closterium, Tabellaria, Navicula, Cyclotella, Spirogyra, Oscillatoria, Asterionella, Palmella, Diatoma, Anabaena, Flagilaria*.

High Organic Load (Polluted Water) Algae: *Phormidium, Agmenellum, Carteria, Nitzschia, Pyrobotrys, Lepocinclis, Tetraedron, Euglena, Anabaena, Spirogyra, Oscillatoria, Phacus, Chlorococcum, Chlorogonium, Chlorella, Stigeoclonium, Anacystis, Chlamydomonas, Gomphonema, Spirulina (Arthrospira), Lyngbya.*

Clear Water Algae: *Rhizoclonium, Pinnularia, Cladophora, Surirella, Cyclotella, Rhodomonas, Coccochloris, Chrysococcus, Ankistrodesmus, Agmenellum, Meridion, Lemanea, Cocconeis, Microcoleus, Hildenbrandia, Phacotus, Chromulina, Entophysalis, Micrasterias, Calothrix, Navicula, Ulothrix.*

Plankton and Other Surface Water Algae: *Nodularia, Coelastrum, Fragilaria, Euglena, Micractinium, Gomphosphaeria, Oocytis, Botryococcus, Mougeotia, Euastrum, Scenedesmus, Cylindrospermum, Actinastrum, Phacus, Gonium, Desmidium, Stephanodiscus, Sphaerocystis, Stauroneis, Zygnema, Eudorina, Pediastrum*.

Algae Growing on Reservoir Walls: *Phormidium, Ulothrix, Cladophora, Gomphonema, Achnanthes, Stigeoclonium,Vaucheria, Tetraspora, Audouinella, Tolypothrix, Chara, Lyngbya, Compsopogon, Microspora, Bulbochaete, Batrachospermum, Cymbella, Chaetophora, Phytoconis, Oedogonium, Draparnaldia.*

RESULTS AND DISCUSSION

The distribution of different genera of plankton and periphyton and abundance of plankton of both the stations are computed and presented in the Tables 1 to 5.

After analyzing the plankton data of different spots of the Station A (Table 1), it was revealed that in all the spots were dominating by phytoplankton groups in order *viz.* Cyanophyceae> Chlorophyceae> Bacillariophyceae> Euglenophyceae> Xanthophyceae. This was indicated the high organic load in all the spots. But comparatively very high in Main Bhery and Channel which was leaded to the algal bloom formation (surface algal scum) and this was ultimately depleted the oxygen level in the water which was confirm by the dark green color and the presence of dead fishes (*L. rohita* and *C. mrigala*) in the surface of both the spots.

Present observation was also tally with the findings of Chapman [2] that due to some stress in the aquatic environment and some kind of damage was clearly visible, such as unusual color in the water was increased turbidity or the presence of dead fishes. However, many forms of damage was scanned or detected without detailed examination of all the aquatic biota.

In case of Station B (Table 2) out of two groups of Cyanophyceae population was dominated with a high peak and was eliminated all others groups except very few Bacillariophyceae representatives, but among the zooplankton rotifers were contributed to a great extent in the system. This was also a reflection of high organic load.

From the above observations it was found that Cyanophyceae (mainly *Anacystis* and *Anabaena*) blooms were found in the spots of Channel and Main Bhery of Station A and in the Beel of Station B. This was a very common phenomenon in the Indian waters which indicates high nutrient load and leads to eutrophication i.e. the super saturation of DO in day time and depletion of that in night hours. The Blue-green algae was secreted toxin commonly known as cyanotoxins like hepato, neuro and cytotoxin.

Table 1: Abundance & Percentage Composition of Plankton Groups in 4 No. Bhery (Station A)

		1		2		3		4		5		6	
Plankton Group		No/L	%	No/L	%	No/L	%	No/L	%	No/L	%	No/L	%
Phytoplankton	Cyanophyceae•	200	56.5	4050	57.2	556	100	20504	100	10404	93.2	25255	94.2
	Chlorophyceae••	102	28.8	1750	24.7							1000	3.7
	Bacillariophyceae			525	7.4					500	4.5	555	2.1
	Xanthophyceae	52	14.7										
	Euglenophyceae			755	10.7					255	2.3		
Sub Total		354	73.9*	7080	98.2*	556	59.4*	20504	100*	11159	98.7	26805	96.6*
Zooplankton	Protozoa									150	100		
	Rotifera			105		155	40.8					560	59.2
	Caldocera	100	80	25		100	26.3					130	13.8
	Copepoda					125	32.9					255	27
	Nemotoda	25	20										
Sub Total		125	26.1*	130	1.8*	380	40.6*			150	1.3*	945	3.4*
Total Plankton		479		7210		936		20504		11309		27750	

*% Abundance of total plankton. • First abundant group, •• Second abundant group

Table 2: Abundance & Percentage Composition of Plankton Groups in Mathura Beel (Station B)

		1		2		3		4	
Plankton Group		No/L	%	No/L	%	No/L	%	No/L	%
Phytoplankton	Cyanophyceae•	74606	100	6552	100	12409	99.8	9475	99.6
	Bacillariophyceae					27	0.2	35	0.7
Sub Total		74606	99.8*	6552	80.2*	12436	66.4*	9510	71.4*
Zooplankton	Rotifera•	79	59.8	1538	95.4	5709	90.6	3552	93.3
	Copepoda	53	40.2	75	4.6	589	9.7	255	6.7
Sub Total		132	0.2*	1613	19.8*	6298	33.6*	3807	28.6*
Total Plankton		74738		8165		187354		13317	

*% Abundance of total plankton.,• First abundant group

Table 3: Occurrence of Phytoplankton Taxa in 4 No. Bheri (Station A) & Mathura Beel (Station B)

			Station A						
Plankton Taxa			1	2	3	4	5	6	Station B
Phytoplankton									
I Cynophyceae (Myxophyceae)									
Chroococcales	Chroococcaceae	1. *Anacystis*	+	-	+	+*	-	+*	+*
		2. *Agmenllum*	-		+		+		
Nostocales	Nostocaceae	1.*Anabaena*	-	+	-	-	+	+	
		2.*Nostoc*	-	+	-	-	-		
	Oscillatoriaceae	1.*Oscillatoria.*	+	-	+	+	-	+	+
		2.*Spirulina*	+	+	+	-	-	+	+
		3.*Anabaenopsis*	-	-	-	-	-	-	+
Sub Total			3	4	3	2	2	4	4
II Chlorophyceae									
Volvocales	Volvocaceae	1.*Eudorina*	-	+	-				+
Chlorococcales	Scenedesmaceae	1.*Scenedesmus*	-		+	-	-	-	+
	Occystaceae	1.*Chlorella.*	+	+	+			+	
		2.*Selanastrum*	-	+					
		3.*Kirchneriella*	-	+					
	Hydrodictyaceae	1.*Pediastrum*	+	-					
Zygnematales	Desmidiaceae	1.*Closterium*	-	+					
Ulotrichales	Protococcaceae	1.*Protococcus*	-	+					
Sub Total			2	7				2	2
III. Bacillariophyceae									
	Pennate	1.*Navicula*	-	+	-	-	-	+	
		2.*Nitzschia*							
		3.*Synedra*	-	-	-	-	+		
Sub Total			1			1	1		
IV. Euglenophyceae									
Euglenales	Euglenaceae	1.*Euglena*	-	+	-	-	-		
		2.*Phacus*	-	+	-	-	-		
		3.*Lepocynclis*	-	-	-	-	+		
Sub Total				2			1		
V. Xanthophyceac			-						
Heterocapsales	Chlorotheciaceae	1.*Ophiocytium*	+		-				
Sub Total			1						
Total			6	14	3	2	4	7	6

Table 4: Occurrence (O) & Frequency (F) of Zooplankton Taxa in 4 No. Bheri, (Station A) & Mathura Beel (Station B)

		Station A						
Plankton Taxa		1	2	3	4	5	6	Station B
Zooplankton								
I. Rotifera	1. *Brachionus calyciflorus*	-	+	-	-	+	+	+
	2. *B. forficula*	-	+	+	-	-	+	+
	3. *Keratella tropica*	-	-	-	-	-	+	
	4. *Filinia longiseta*	-	-	+	-	-	+	+
	5. *Asplanchua*	-	-	-	-	-	+	+
	6. *Trichocera*							+
	7. *K. cochlearis*							+
Sub Total		0	2	1	0	1	5	7

Table 4: Continue

Plankton Taxa		Station A 1	2	3	4	5	6	Station B
II. Crustacea.								
C l a d o c e r a	1 . *Moina micrura*		+	+	+	-	-	+
	2. *Diaphanosoma excisum*	-		+	-			
Sub Total		1	1	2	0	0	1	0
Copepoda.								
Cyclopoida	1. *Tropocyclops*	-	-	+	-	-	+	+
Calanoida	1. *Neodiaptomus schamakari*	-	-	+	-	-	+	+
Sub Total			2		-	2	2	
Nauplius & Metanauplius -		-	+	-	-	+		
Copepodite					-			
Nematoda		+	-	-	-	-	-	
Sub Total		1						
Total		2	3	5		1	8	9

Table 5: Occurrence (O) & Frequency (F) of Periphyton Taxa in 4 No. Bheri (Station A) & Mathura Beel (Station B)

Periphyton Taxa			Station A 3		4		5		6		Station B	
Plant origin			O	F	O	F	O	F	O	F	O	F
\I Cynophyceae (Myxophyceae)												
Chroococcales	Chroococcaceae	*1. Anacystis*					+		+		+	
		2. Agmenllum					+				+	
Nostocales												
\	Nostocaceae	*1.Anabaena*									+	
		2.Lyngbya	+*		+*		+*		+*		+*	
		3.Calothrix									+	
	Oscillatoriaceae	*1.Oscillatora*			+				+			
		2.Spirulina			+		+				+	
		3.Anabaenopsis									+	
Sub Total			1		3		4		3		7	
II Chlorophyceae												
Chlorococcales	Scenedesmaceae	*1.Scenedesmus*					+				+	
	Occystaceae	*1.Ankistrodesmus*							+			
		2.Chlorella					+					
		3.Selanastrum										
		4.Kirchneriella										
		5.Dactylococcus							+			
Zygnematales	Desmidiaceae	*1.Cosmarium*					+				+	
Ulotrichales	Ulotrichasceae	*1.Ulothrix*	+									
	Chactoploraceae	*1.Stigeoclonium*	+									
		2.Chactophora	+		+				+			
		3.Protoderma	+									
	Coeleochaetaceae	*1.Coleochaete*	+									
	Cylnidrocapsaceae	*1.Leptosira*									+	
Sub Total			5		1		3		3		3	
III. Bacillariophyceae	Centric	*1.Melosira*							+			
		2.Skeletonema							+			
	Pennate	*1.Navicula*					+					
		2.Nitzschia					+				+	
		3.Synedra ***					+		+			
		4.Gomphonema			+**		+**		+**		+	
Sub Total					1		4		4		2	
Total			6		5		11		10		12	

Table 5: Continue

Periphyton Taxa		Station A 3	4	5	6	Station B
Animal Origin						
I.Protozoa	*1.Zoothumnium*			+*	+*	
Sub Total		1	1			
II.Rotifera	*1.Lapedela*			+		
	2.Lacane					+
	3.Asplanchna					+
Sub Total					1	2
Total				1	2	2

Again the decomposition of high algal mass was resulted to the anaerobic conditions which were indicated as the main causative factor for mass mortality of fishes.

Further, it was again confirmed by the analysis of phytoplankton and algal periphyton genera of station A and B as per APHA [1] as mentioned in the methodology, the sampling stations were categorized under the high organic load (polluted) water algae as per the maximum number of genera was recorded in all the water bodies (Tables 3 to 5). This means all the water bodies were under various anthropogenic stresses that were mainly organic in origin.

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