ABUNDANCE AND DISTRIBUTION OF PLANKTON IN THE SUNDERBANS MANGROVE FOREST

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ABSTRACT

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The present study conducted at the coastal belt of Bay of Bengal during April 1 to December 1, 2005 to identify and quantify the abundance, taxonomy and relative ratio of phytoplankton and zooplankton, plankton samples were collected from four main streams of the Sundarbans mangrove ecosystems. A total of 15 genera of phytoplankton were recorded. The number of genera under the class Chlorophyceae, Myxophyceae and Bacillriophyceae were identified at 5, 7 and 3 respectively. *Cosciodiscus sp.* and *Microcystis sp.* were the most dominant genera in phytoplankton community. The average overall phytoplankton cell abundance was varied from 275 to 5680 individual per liter in summer, 125 to 6250 individual/l in monsoon and 267 to 7707 individual/l in winter. The study revealed the average phytoplankton abundance was 2510, 1786 and 2550 individuals/l in summer, monsoon and winter respectively. Among the three class of phytoplankton Myxophyceae (54 percents) is the most dominant in summer in the sunderbans mangrove forest. The abundance of Myxophyceae was 58 percents and 55 percents in monsoon and winter respectively. The abundance of Chlorophyceae was 23 percents 16 percents and 22 percents in summer, monsoon and winter respectively.A total of 11 genera of zooplankton were recorded. The number of genera of zooplankton under the class Crustacea was identified The average overall zooplankton cell abundance was varied from 370 to 4420 individual/l in summer, 250 to 2550 individual/l in monsoon and 260 to 2835 individual/l in winter. The study revealed the average zooplankton abundance was 2038, 1260 and 1206 individuals/l in summer, monsoon and winter respectively.

Keywords: Phytoplankton, Zooplankton, and Mangrove Forest

INTRODUCTION

Sundarban, the world largest mangrove forest located on the south slope of the world highest mountain Himalayan and along the northern extremity of Bay of Bengal and sandwiched with India on the western. Its abundance of tidal rivers, flora, fauna make it an ecologically interested site. There is many endangered species, the highly interwoven river system and large trucks of wetlands with their rich avifauna are matter of great significance. They are covered to some extent, along with other mangrove forests of the Indian subcontinent.

Phytoplankton has the great importance in the aquatic ecology. Phytoplanktons have been used as indicators of water quality. They strongly influence certain non-biological aspects of water quality (such as pH, color, taste and odor). In a practical sense, they are a part of water quality. Moreover their relationship with nutrient cycle, carbon cycles and oxygen cycles is undividable. Phytoplankton is globally the most important amongst the primary producers, which form the base line of many food webs in the aquatic environment. Phytoplankton production is a determinant of fish production and act as a remarkable biological factor in fluctuation of stock. Primary production is also dependent on Phytoplankton production.

Passur, Sibsha, Arpangasia, Ramnarayan, Raimongol, Bangra, Haringhata, Pathuria, Balesher river systems are criss-crossed in the Sundarban area. This aquatic reign is heavily abundant with phytoplankton and zooplankton. *Diaptomas* species and *Mysis* species of copepod, rotifers, cladocerons, protozoans, nematodes, oligochaetes and crustaceans.

George (1966), Krishnamurthy (1966) and Michael (1968a) worked in detail on the ecology and zooplankton population from different waters of India. Some of the works, which have been done in Bangladesh, include those of Islam and Aziz (1975), Islam and Mendes (1976), Khan *et al.* (1978), Miah *et al.* (1981), Ali *et al.* (1980), Patra and Azadi (1987), Bhuiyan *et al.* (1997), Bhuiyan and Nesa (1998a, 1998b).

Phytoplankton has also economic importance. Some blue green algae are capable to form sheaths of $CaCO_3$, which may build up quite extensive lime deposit. In Java and Equador *Nostoc commences* is eaten as food. Diatomaceous earth formed by fossil diatom has great industrial value. They are used in light and heat resistant bricks, powder and toothpaste, polishing materials, pharmaceutical jellies, lotion etc. they are also used in whisky chaser for a cold cure. However, for broader economic object, estimation of phytoplankton is essential for proper exploitation of mangrove resources that leads to

economic benefits, employment and balance of ecosystem. To provide sustainable utilization, management and conservation, the basic knowledge of exploitation level is essential. Lack of the basic knowledge and information of the management lead to unexpected detrimental effects on the resources and ecosystem. For this reason, proper understanding of the phytoplankton and primary productivity is necessary. This knowledge can help for the future management and planning issues of the fishery resources of the Sundarbans. But the basic data on the primary productivity and phytoplankton of the ecosystem are insufficient for management of aqua resources.

Thus the objective of the present study was to know about the present status of abundance, taxonomy, relative ratio of phytoplankton and zooplankton in the Sundarbans Mangrove Ecosystem.

MATERIALS AND METHODS

Sampling area

The study area lies 300 km southwest of Dhaka, Bangladesh on the coastal plain at the apex of the Bay of Bengal and covers approximately 14,000 km2. The area lies between $21^{o}30'$ and $23^{o}15'$ North and $89^{o}00'$ and $90^{o}00'$ East and includes the world's largest continuous mangrove forest, the Sundarbans, estuarine marshlands and numerous rivers, canals and their tributaries (Giri and Shrestha, 1996; Viju, 1995). The terrain is relatively flat; the elevation ranges from sea level to 5 m above mean sea level (Castro- Ortiz, 1994).

Sources of data

Raw data in the present study were collected from three trips report entitled Fisheries Research and Stock Assessment in the Sundarbans (FRSAS) by the Fisheries and Marine Resources Technology Dicsipline, Khulna University under Sunderbans Biodiversity Conservation Project (SBCP). The collected samples of the project were also used for further analysis.

Plankton Collection

Phytoplankton samples were collected from the Sundarbans mangrove water is divided into four main rivers at sampling stations. Each stream was also divided into seven stations depending on longitudinal (1^{0}) difference. Sampling was done at 18 stations from April to December 2001.

Phytoplankton and zooplankton samples were collected both qualitatively and quantitatively from 18 stations by using simple conical tow-net oblique or horizontal tows, which mesh size, is 90µm. and the samples were kept in the plastic container. Water within container was taken from the representative area to analysis physiochemical parameters.

Preservation

Two-preserved sample for phytoplankton abundance evaluation, Lugol's solution was used at amount 1.5ml per 250-ml samples and samples were taken 250 ml each and every occasion (Boyd, 1979).

Two-preserved sample for zooplankton abundance evaluation, Borax buffered formalin was used at amount 1.5ml per 250 ml samples and samples were taken 250 ml each and every occasion (Boyd, 1979).

Identification

Phytoplankton cells were enumerated under a light microscope by using Sedwick-Rafter cell. A series of pencil and ink drawing on postcards of the species of the observed were prepared to identify the organisms. Identification was done by the help of following book: Division of Chlorophyceae-Chlorophyta (Arnold, 1989).

Counting

For phytoplankton counting, the Sedgwick-Rafter (S-R) cell was used which is 50 mm. long, 20mm. wide and 1 mm. deep. Before filling the S-R cell with sample, the cover glasses were diagonally placed across the cell and then samples were transferred with a large bore pipette so that no air bubbles in the cell covers were formed. The S-R cell was let standed for at least 15 minute to settle plankton. Then phytoplankton on the bottom of the S-R cell was counted inumerated by compound microscope. By moving the mechanical stage, the entire bottom of the slide area was examined carefully. Organisms lying between two parallel cross hairs were counted as they passed a vertical line. Number of phytoplankton in the S-R cell was derived from the following formula-

$$\text{No /ml} = \frac{C \times 1000\ mm^3}{L \times D \times W \times S}$$

Where,

C = Number of Organisms Counted

L = Length of each strip (S-R cell length) in mm.

D = Depth of a strip (whipple grid image width) in mm.
S = Number of strips counted
W = Width of the strip (whipple grid image width) in mm.

Number of cells per mm. was multiplied by a correction factor to adjust the number of organisms per liter.

Data analysis and map building

GIS software consisted of an interface from MAPINFO and digitized maps from ArcView3.2v. An alternative software system is produced by ARCINFO and MAPINFO is computable with that system. The GIS software was used to view the statistical results and map of Sunderbans mangrove forest.

RESULTS

Phytoplankton Abundance

The abundance of different group of phytoplankton in different station of sunderbans mangrove forest in three seasons has been shown in the Table: 1, 2, 3 and 4.

Table 2. Phytoplankton abundance (individuals/l) in different season abundance for the Baleswar-Supati river system

Sampling area	**Station**	**Summer**	Monsoon	**Winter**
Unabunia	A1	3220	1563	1820
Talubulbania	A2	3865	1875	2145
Horintana	A3	4240	1875	1910
Supati	A4	5280	2188	2470

Table 3. Phytoplankton abundance (individuals/l) in different season abundance for the Passur-Sibsa river system

Sampling area	**Station**	**Summer**	Monsoon	**Winter**
Nandabala	B1	4500	5000	6600
Velmari	B2	3765	6250	7706
Mochrashing	B3	5680	5625	6260
Sibsa	B4	4225	4375	6760

Table 4. Phytoplankton abundance (individuals/l) in different season abundance for the Arpangasia-Batla river system

Sampling area	**Station**	**Summer**	Monsoon	**Winter**
Andharmanik	C1	452	370	510
Gewakhali	C2	600	476	267
Jhaliakhal	C3	525	521	347
Kagadobeki	C4	380	552	1029
Nilkamal	C5	550	412	375

Table 5. Phytoplankton abundance (individuals/l) in different season abundance for the Jamuna-Malancha river system

Sampling area	**Station**	**Summer**	Monsoon	**Winter**
Kalaghachia	D1	275	334	1700
Dobeki	D2	750	205	900
Notabeki	D3	1000	167	2400
Dingimari	D4	2250	125	1900
Pushpakati	D5	3625	250	800

Among the collected phytoplankton 17 genera and 23 species were identified. The Table-2 shows that diatoms constituted the dominant flora. The maximum and minimum abundance of phytoplankton cells were recorded at 5280 Individuals/l and 3220 Individuals/l in summer, 1563 Individuals/l and 2188 Individuals/l in monsoon and 2470 Individuals/l and 1820 Individuals/l in winterfrom Urubunia and Supati river system respectively.

The Table 3 shows that diatoms constituted the dominant flora. The maximum and minimum abundance of phytoplankton cells were recorded at 5680 Individuals/l and 3765 Individuals/l in summer, 6250 Individuals/l and 4375 Individuals/l in monsoon and 7706 Individuals/l and 6250 Individuals/l in winter from Passur-Sibsa river system respectively.

The Table 4 shows that diatoms constituted the dominant flora. The maximum and minimum abundance of phytoplankton cells were recorded at 600 Individuals/l and 380 Individuals/l in summer, 552 Individuals/l and 370 Individuals/l in monsoon and 1029 Individuals/l and 267 Individuals/l in winter from Arpangasia-Balta river system respectively.

The Table 5 shows that diatoms constituted the dominant flora. The minimum and maximum abundance of phytoplankton cells were recorded at 3625 Individuals/l and 275 Individuals/l in summer, 334 Individuals/l and 125 Individuals/l in monsoon and 2400 Individuals/l and 900 Individuals/l in winter from Jamuna-Malancha river system respectively.

Seasonal variation of the Phytoplankton Abundance

Among the four river system maximum phytoplankton abundance was found in 5680 individuals/l in station B3 of Passur-Sibsa river system and minimum was 275 individuals/l in station D1 of Jamuna-Malancha river system during summer. In case of monsoon the maximum phytoplankton abundance was 6250 individuals/l in station B2 of Passur-Sibsa river system and minimum was 125 individuals/l in station D4 of Jamuna-Malancha river system (Figure 1). On the other hand the maximum phytoplankton abundance was found in 7707 individuals/l in station B2 of Passur-Sibsa river system and minimum was 267 individuals/l in station C2 of Arpangasia-Balta river system during winter (Figure 1).

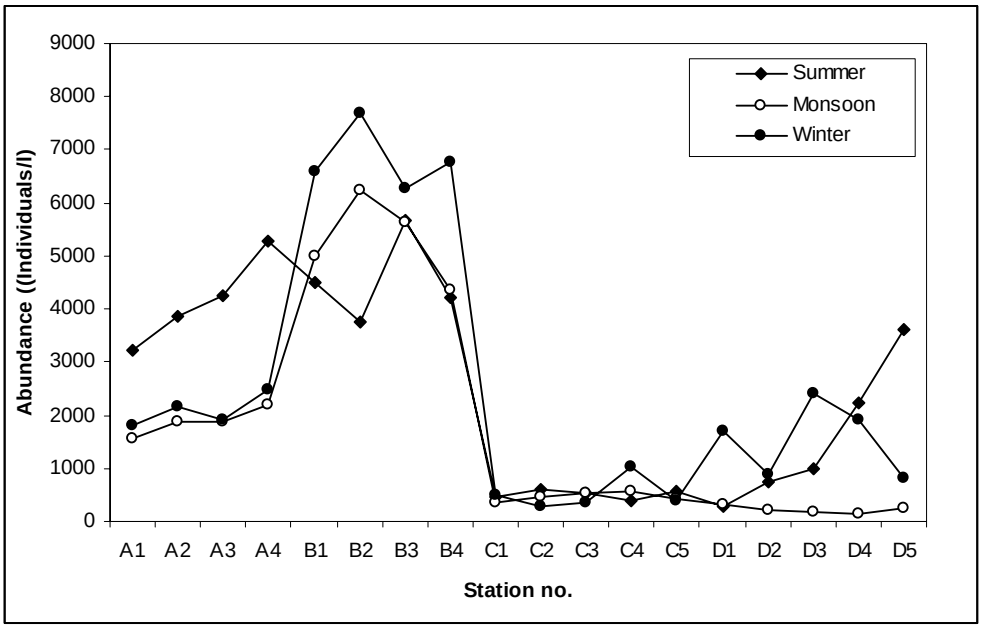

Figure 1. Seasonal variation of the phytoplankton Abundance at different sampling points

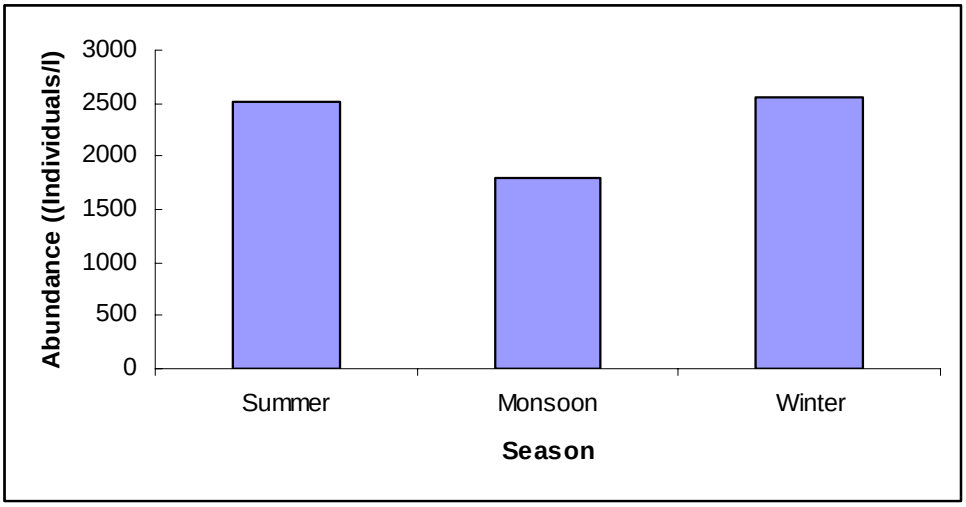

Figure 2. Seasonal variation of phytoplankton

Class wise phytoplankton abundance

Table 6. Class wise phytoplankton abundance for the Baleswar – Supati river system

Station no.	Class	Summer		Monsoon		Winter	
		Abundance (Individuals/l)	(%)	Abundance (Individuals/l)	(%)	Abundance (Individuals/l)	(%)
A1	Chlorophyceae	515	16	328	21	346	19
	Myxophyceae	2447	76	1094	70	1201	66
	Bacillariophyceae	258	8	141	9	273	15
A2	Chlorophyceae	1275	33	600	32	622	29
	Myxophyceae	1623	42	844	45	1030	48
	Bacillariophyceae	966	25	431	23	493	23
A3	Chlorophyceae	594	14	150	8	210	11
	Myxophyceae	1781	42	788	42	974	51
	Bacillariophyceae	1866	44	938	50	917	48
A4	Chlorophyceae	1003	19	328	15	420	17
	Myxophyceae	3485	66	1532	70	1531	62
	Bacillariophyceae	792	15	328	15	519	21

Class wise net phytoplankton abundance were within range of 3485 individuals/l to 515 individuals/l in summer, 1532 individuals/l to 141 individuals/l in monsoon and 1531 to 210 individuals/l in winter respectively for the Baleswar – Supati river system. Most dominant class of phytoplankton was Myxophyceae and Bacillariophyceae was found the less dominate class.

Table 7. Class wise phytoplankton abundance in different season for the Passure – Sibsa river system

Station no.	Class	Summer		Monsoon		Winter	
		Abundance (Individuals/l)	(%)	Abundance (Individuals/l)	(%)	Abundance (Individuals/l)	(%)
B1	Chlorophyceae	945	21	800	16	1188	18
	Myxophyceae	2160	48	2450	49	3366	51
	Bacillariophyceae	1395	31	1750	35	2046	31
B2	Chlorophyceae	527	14	508	8	771	10
	Myxophyceae	2598	69	5080	80	5857	76
	Bacillariophyceae	640	17	762	12	1079	14
B3	Chlorophyceae	1193	21	619	11	814	13
	Myxophyceae	2670	47	3263	58	3255	52
	Bacillariophyceae	1818	32	1744	31	2191	35
B4	Chlorophyceae	1056	25	1313	30	1622	24
	Myxophyceae	2155	51	1794	41	3110	46
	Bacillariophyceae	1014	24	1269	29	2028	30

Class wise net phytoplankton abundance were within range of 2670 individuals/l to 640 individuals/l in summer, 5080 individuals/l to 508 individuals/l in monsoon and 5857 individuals/l to 771 individuals/l in winter respectively for the Passure – Sibsa river system. Most dominant class of phytoplankton was Myxophyceae and Bacillariophyceae was the less dominant class.

Table 8. Class wise phytoplankton abundance in different season for the Arpangasia - Batla river system

Station no.	Class	Summer		Monsoon		Winter	
		Abundance (Individuals/l)	(%)	Abundance (Individuals/l)	(%)	Abundance (Individuals/l)	(%)
C1	Chlorophyceae	36	8	78	21	77	15
	Myxophyceae	362	80	211	57	286	56
	Bacillariophyceae	54	12	81	22	148	29
C2	Chlorophyceae	66	11	19	4	21	8
	Myxophyceae	492	82	390	82	198	74
	Bacillariophyceae	42	7	67	14	48	18
C3	Chlorophyceae	53	10	130	25	66	19
	Myxophyceae	305	58	240	46	187	54
	Bacillariophyceae	168	32	151	29	94	27
C4	Chlorophyceae	27	7	50	9	226	18
	Myxophyceae	308	81	359	65	504	69
	Bacillariophyceae	46	12	144	26	298	13
C5	Chlorophyceae	99	18	58	14	83	22
	Myxophyceae	325	59	239	58	184	49
	Bacillariophyceae	127	23	115	28	109	29

Class wise net phytoplankton abundance were within range of 492 individuals/l to 27individuals/l in summer, 359 individuals/l to 19 individuals/l in monsoon and 286 individuals/l to 48 individuals/l in winter respectively for the Arpangasia - Batla river system. Most dominant class of phytoplankton was Myxophyceae and Bacillariophyceae was the less dominant class.

Table 9. Class wise phytoplankton abundance in different season for the Jamuna – Malancha river system

Station no.	Class	Summer		Monsoon		Winter	
		Abundance (Individuals/l)	(%)	Abundance (Individuals/l)	(%)	Abundance (Individuals/l)	(%)
D1	Chlorophyceae	36	13	40	12	323	19
	Myxophyceae	44	16	40	12	782	46
	Bacillariophyceae	195	71	254	76	595	35
D2	Chlorophyceae	83	11	10	5	108	12
	Myxophyceae	435	58	103	50	378	42
	Bacillariophyceae	233	31	92	45	414	46
D3	Chlorophyceae	710	71	132	79	1248	52
	Myxophyceae	160	16	35	21	936	39
	Bacillariophyceae	130	13	0	0	216	9
D4	Chlorophyceae	1395	62	73	58	836	44
	Myxophyceae	810	36	53	42	931	49
	Bacillariophyceae	45	2	0	0	133	7
D5	Chlorophyceae	761	21	38	15	248	31
	Myxophyceae	2248	62	153	61	408	51
	Bacillariophyceae	616	17	60	24	144	18

Class wise net phytoplankton abundance were within range of 2248 individuals/l to 36 individuals/l in summer, 254 individuals/l to 10 individuals/l during monsoon and 1248 individuals/l to 108 individuals/l in winter respectively for the Jamuna – Malancha river system. Most dominant class of phytoplankton was Myxophyceae and less dominent was Bacillariophyceae.

Among the three class of phytoplankton Myxophyceae (54 percents) is the most dominant in summer in the sunderbans mangrove forest. The abundance of Myxophyceae was 58 percents and 55 percents in monsoon and winter respectively. The abundance of Chlorophyceae was 23 percents 16 percents and 22 percents in summer, monsoon and winter respectively (Figure 3, Figure 4 and Figure 5).

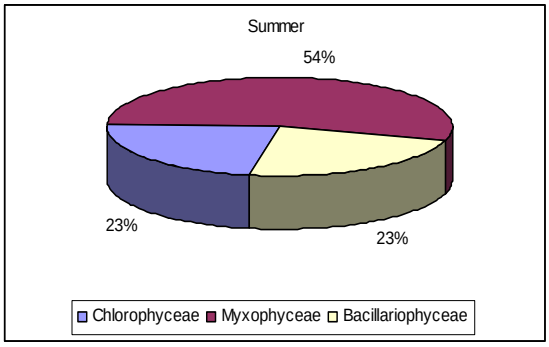

Figure 3 Seasonal variation of Class wise phytoplankton abundance during summer

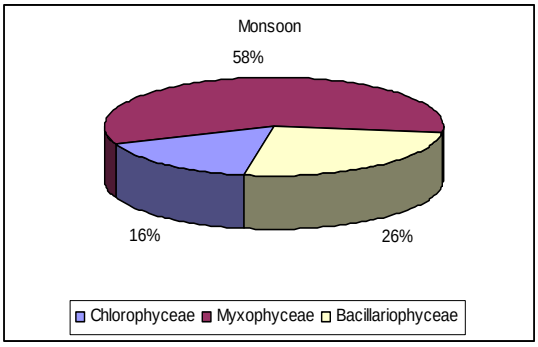

Figure 4. Seasonal variation of Class wise phytoplankton abundance during monsoon

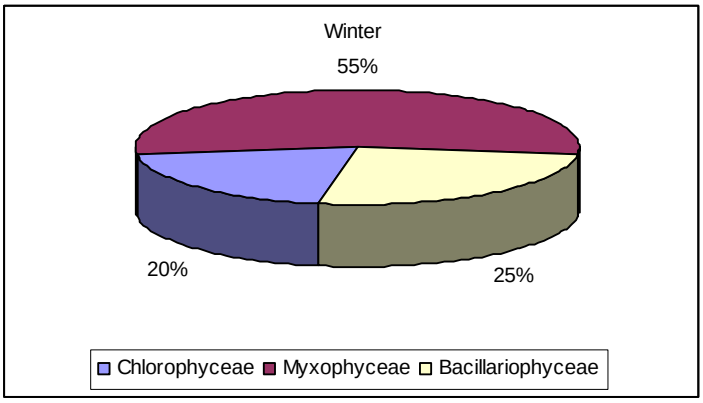

Figure 5. Seasonal variation of Class wise phytoplankton abundance during winter

Zooplankton abundance

The abundance of different group of zooplankton in different station of sunderbans mangrove forest in three seasons has been shown in Table10, 11 and 12.

Table 10. Zoolankton abundance (individuals/l) in different season abundance for the Baleswar – Supati river system

Sampling area	**Station**	**Summer**	Monsoon	**Winter**
Unabunia	A1	2320	2500	1435
Talubulbania	A2	2755	1250	1980
Horintana	A3	3415	2500	1750
Supati	A4	4250	1667	2360

Table 11. Zoolankton abundance (individuals/l) in different season abundance for the Passur- Sibsa river system

Sampling area	**Station**	**Summer**	Monsoon	**Winter**
Nandabala	B1	3935	2083	2124
Velmari	B2	3170	2127	2280
Mochrashing	B3	4420	2500	2310
Sibsa	B4	3560	2484	2835

Table-12: Zoolankton abundance (individuals/l) in different season abundance for the Arpangasia-Batla river system

Sampling area	**Station**	**Summer**	Monsoon	**Winter**
Andharmanik	C1	415	513	278
Gewakhali	C2	520	1112	350
Jhaliakhal	C3	455	705	300
Kagadobeki	C4	370	898	300
Andharmanik	C1	460	417	260

Table-13: Zoolankton abundance (individuals/l) in different season abundance for the Jamuna-Malancha river system

Sampling area	**Station**	**Summer**	Monsoon	**Winter**
Kalaghachia	D1	1375	250	350
Dobeki	D2	625	389	1200
Notabeki	D3	1250	445	600
Dingimari	D4	1625	394	600
Pushpakati	D5	1760	467	400

Among the collected zooplankton 11 species were identified. The Table-10 shows that *Cladoceron* eg. *Bosmina* sp.and *Praunus* sp. was the dominant species. The maximum and minimum abundance of zooplankton cells were recorded at 4250 Individuals/l and 2320 Individuals/l in summer, 2500 Individuals/l and 1250 Individuals/l during monsoon and 2360 Individuals/l and 1435 Individuals/l from Urubunia and Supati river system during winter respectively.

The Table 11 shows that diatoms constituted the dominant flora. The maximum and minimum abundance of zooplankton cells were recorded at 4420 Individuals/l and 3170 Individuals/l in summer, 2500 Individuals/l and 1250 Individuals/l in monsoon and 2360 Individuals/l and 1435 Individuals/l from Passur-Sibsa river system in winter respectively

The Table 12 shows that diatoms constituted the dominant flora. The maximum and minimum abundance of zooplankton cells were recorded at 520 Individuals/l and 370 Individuals/l during summer, 1112 Individuals/l and 417 Individuals/l in monsoon and 350 Individuals/l and 260 Individuals/l from Arpangasia-Balta river system during winter respectively

The Table 13 shows that diatoms constituted the dominant flora. The maximum and minimum abundance of zooplankton cells were recorded at 1760 Individuals/l and 625 Individuals/l during summer, 467 Individuals/l and 250 Individuals/l in monsoon and 1200 Individuals/l and 350 Individuals/l from Jamuna-Malancha river system during winter respectively

Seasonal variation of the Zooplankton Abundance

Among the four river system maximum zooplankton abundance was found in 4420 individuals/l in station B3 of Passur-Sibsa river system and minimum was 370 individuals/l in station C4 of Arpangasia-

Balta Jamuna-Malancha river system during summer . In case of monsoon the maximum zooplankton abundance was found in 2550 individuals/l in station B3 of Passur-Sibsa river system and minimum was 250 individuals/l in station D1 of Jamuna-Malancha river system . On the other hand the maximum zooplankton abundance was found in 2835 individuals/l in station B4 of Passur-Sibsa river system and minimum was 260 individuals/l in station C5 of Arpangasia-Balta river system during winter (Figure 6).

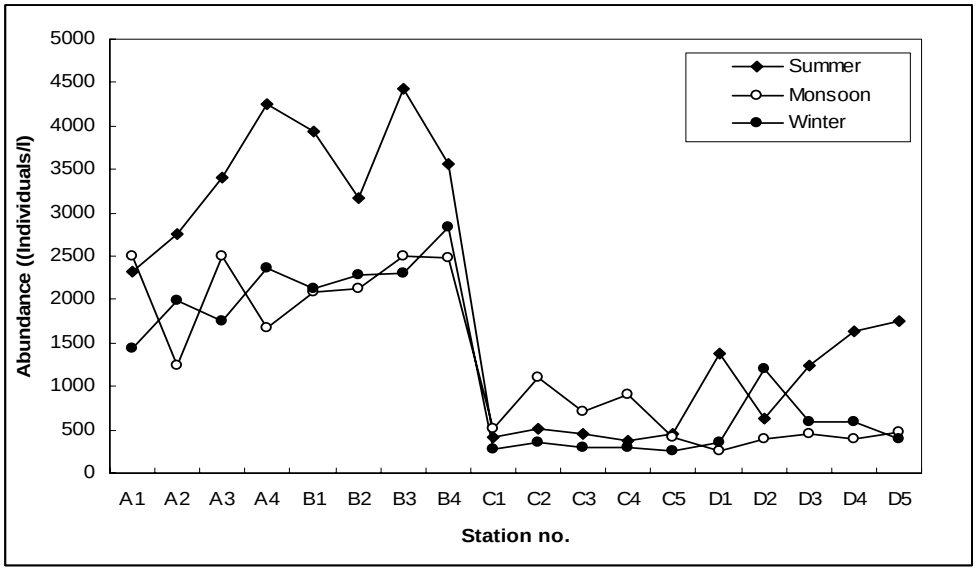

Figure 6. Seasonal variation of the Zooplankton Abundance at different sampling points

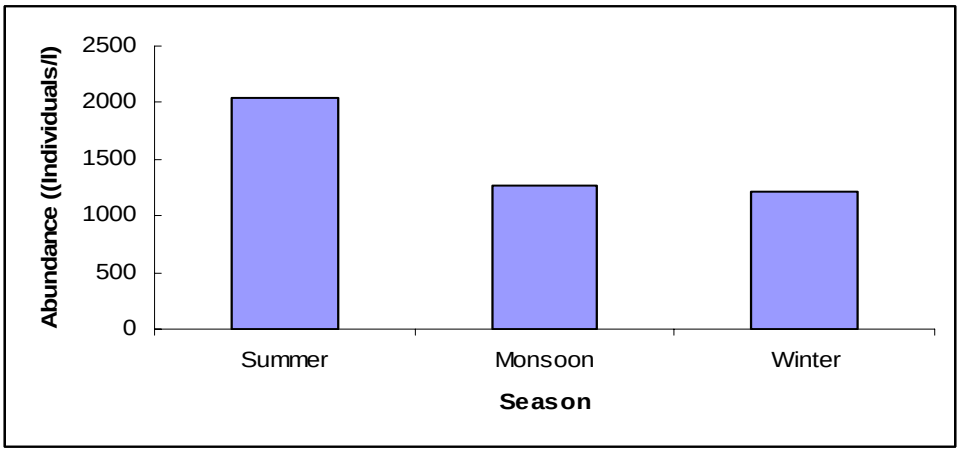

Figure 7. Seasonal variation of zooplankton

DISCUSSION

The Sundarban, an enormous tract of mangrove forest in the world, is a dynamic, fragile, complex ecosystem in delicate balance with the soil, water and environment. This extensive mangrove ecosystem excluding India part, situation on the western region of Bangladesh Sundarban area occupies 1777 km^2 of water with highly interwoven four river system i.e. Baleswar- Selagang, Pasur-Sibsa Arpangasia-Balta, Jamuna-Malancha. Of the representative river systems, during monsoon phytoplankton was examined both qualitatively and quantitatively with regard to standard methods for the examination of water and wastewater.

Phytoplankton plays an important role in the water of mangrove ecosystem as primary producer and is an important source of food for the fish. There have been relatively a few studies of phytoplankton species diversity in the Sundarban ecosystem.

From the different river systems, *Coscinodicus spp.* and *Microcystis spp.* were the common species. The study data showed an indication of low diversity of phytoplankton. *Coscinodiscus was* the most diversity species. Other dominant species were *Microcystis sp, Rhizosolenia sp, Ankistrodesmus spp, Gonatozygon spp Gloeotrichia pisum, G. echinulata, Dactyolococcopsis spp., Cyclotella sp, Chroococcus dispersus.* Similar species composition is also found in some areas. C.P.Gopinathan and J.X.Radrigo shows that

Coscinodiscus sp. and *Rhizosolenia sp.* are dominate ones in inshore waters of Tuticorin. Islam and Aziz have found *Coscinodicus granii*, *Rhizosolenia imbricata* and *Planktonilla spp.* in the northern-estern Bay of Bangel, Bangladesh.

Echinosphaerella limnetica was olso found in Harintana of Baleswar-selagang river system and also *Treubaria setgerum* in Nandada of Pasur –Sibsa river system. G.M. Smith characterizes these two species i.e. *E. limnetica* and *T. setgerum* as rare species.

In Belshwar- Selagang river system nine genera of Zooplankton were identified. Dominant species was Copepod of which four genera are-. *Merocyclops* sp., *diaptomus* sp., *Cyclops* sp., *Mesocyclops* sp. And second dominant species were Cladoceron eg. *Bosmina* sp., *Praunus* sp.

In Passur-Sibsa river system ten genera were identified. Dominant species in this region was Copepod of which four species were-. *Merocyclops* sp., *diaptomus* sp., *Cyclops* sp., *Mesocyclops* sp. And second dominant species were Cladoceron eg. *Bosmina* sp., *Praunus* sp., *Daphnia* sp.

In Arpangasia- Balta nine genera were identified. Common genera of zooplankton were *Copepod, Mysids, Lucifer* and *Daphnia*. Among them most common genera was Copepod of which four species were-. *Merocyclops* sp., *diaptomus* sp., *Cyclops* sp., *Mesocyclops* sp. And second dominant species were-*Bosmina* sp., *Praunus* sp., *Daphnia* sp. and others were *Mysidella* sp., crab zoea.

In Jamuna- Malancha river system Dominant species was Copepod of which four species were-. Merocyclops sp., diaptomus sp., Mesocyclops sp. And second dominant species were Cladoceron eg. *Bosmina* sp., *Daphnia* sp. and *Lucifer* sp.

During this study a distinct fluctuation of zooplankton population in the 28 selected stations of the Sundarban mangrove forest from July 20 to 25, 2001 was observed. This fluctuation was the impact of different physico-chemical parameters on zooplankton population. Harvey (1934) and Tranter (1962) in the area between the north-east coast of Australia and Indonesia both were similar observed in zooplankton population. Similar observations were noted by Krisnomoorthi and Visvesvara (1966), Michel (1968b), Mathew (1975), Islam et al. (1975), Ali et al. (1980) and Islam *et al.* (2000) in different working areas. The study of Patra and Azadi (1997) in Halda river in Bangladesh showed similar plankton composition.

A total of 11 genera of different group of zooplankton were identified from the study area. Todd *et al.* (1991) reported six genera, Charles, 1955 reported four genera and Islam and Aziz (1980) reported single genera of different zooplankton from different water bodies.

Table 14. Class wise percentage of phytoplankton in different ecosystem in Bangladesh

Ecosystem	Location	Species composition	Abundance (%)	Reference
Pond	Shahidullah Hall, Dhaka University	Cyanophyceae	37.19	Khondker and Chowdhury, 1993
		Chlorophyceae	32.15	
		Bacillariophyceae	11.66	
		Euglenophyceae	19.0	
River	Buriganga	Chlorophyceae	26.26	Mirza *et al.* 1985
		Myxophyceae	41.36	
		Bacillario phyceae	32.14	
		Euglenophyceae	0.24	
Lake	Kaptai lake	Diatom	-	Chowdhury and Mazumder, 1981., Khondker and parveen, 1993
		Chlorophyceae	-	
		Euglenophyceae	25.80	
		Cyanophyceae	40.03	
Mangrove	Sunderbans mangrove forest	Chlorophyceae	23	Current study (Summer)
		Myxophyceae	54	
		Bacillariophyceae	23	
Mangrove	Sunderbans mangrove forest	Chlorophyceae	16	Current study (Monsoon)
		Myxophyceae	58	
		Bacillariophyceae	26	
Mangrove	Sunderbans mangrove forest	Chlorophyceae	20	Current study (Winter)
		Myxophyceae	54	
		Bacillariophyceae	25	

Phytoplankton abundance varies from one river system to another. Table.4.1 provides mean abundance of species composition of phytoplankton cell for different river system where Chlorophyceae was found to vary from 16% to 23%. Myxophyceae and Bacillariophyceae were also within range of 54% to 58% and 23% to 26% in summer, monsoon and winter respectively. The highest mean abundance of phytoplankton was 62% and the lowest was 9%. The species composition of the Mangrove ecosystem shows that Myxophyceae >Bacillariophyceae >Chlorophyceae, which is similar to species composition of Buriganga river given by Mirza et.al, 1985.

Subrahmanyan (1946) provided an account of 170 forms of diatoms from the Madras coast in the southern part of the Bay of Bengal. Subrahmanyan (1958) has also listed 52 species of phytoplankton from the Arabian Sea, off the coast of India and reported Bacilliriphyta is the dominant group. Henedy (1954) has described 176 forms of marine diatoms from Galapagos and those of some other tropical waters. A total of 15 genera and 21 species of phytoplankton belonging to different classes were encountered during the present study, namely Bacillariophyceae (4 genera and 9 species), Chlorophyceae (5 genera and 5 species) and Myxophyceae (8 genera and 9 species) of which Myxophyceae was the dominant group.

Brunel (1962) reported that the genus *Chaetoceros* is known to be most diversified and the main constituent genus of spring Diatom plankton in temperate waters. Islam and Aziz (1985) also noted that *Chaetoceros* contributed most both in numbers of species and in their relative abundance in tropical water of Bangladesh. Pahaw and Mehrotra (1966) in the Ganga River found two peaks phytoplankton, one during the summer and other during the winter or spring.

CONCLUSION

The collection and analysis of data on phytoplankton and zooplankton from the different river systems i.e Baleswar- Selagong, Pasur- Sibsa, Arpangasia- Batula and Jamuna- Malancha are the important components of the Sundarban mangrove ecosystem, Bangladesh as well as the world mangrove ecosystem. Efforts were mode to retrieve data on the records of phytoplankton abundance, primary productivity and water quality parameters eg. Water temperature, transparency, pH salinity, dissolve oxygen, totals hardness, totals alkalinity and free Co_2 from the representative area. The abundance of plankton was varied widely from one river system to another. The abundance of plankton was also varied according to the water temperature, pH and other water quality parameters. These findings will be helpful for the management and conservation of the Sundarbans mangrove ecosystem. But a few works have been conducted on the ecology of the mangrove forest.

However, more research should be conducted to develop basic knowledge of the ecosystem that may be help to balance the ecology of mangroves through proper management and conservation of the Sundarbans mangrove ecosystem.

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