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PJBS

ISSN 1028-8880

Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences 6 (8): 762-765, 2003
ISSN 1028-8880

Relationship Between Zooplankton Abundance and Physico-Chemical Parameters in Sundarban Ecosystem During Monsoon

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Abstract: Studies on relationship between zooplankton abundance and physico-chemical parameters in Sundarban mangrove ecosystem during monsoon were made for a period of July, 2001. In the present study, impact of different physico-chemical parameters on zooplankton population was found. The relationship between zooplankton and water quality parameters was varied from place to place depending upon the condition of the water body.

Key words: Abundance, zooplankton, physico-chemical parameters, sundarban mangrove

Introduction

Different environmental factors that determine the characters of water have great importance upon the growth and abundance of zooplankton. The physico-chemical factors and nutrient status of water play the most important role in governing the production of planktonic biomass. But little information is available on the seasonal variation of zooplankton and their relationship with the physico-chemical parameters of water in Sundarban mangrove forest. The physico-chemical parameters are water temperature, pH, dissolve oxygen (DO), salinity, free carbon dioxide and total alkalinity. Some of the works which have been done in Bangladesh include those of Das and Bhuiyan (1974), 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).

Materials and Methods

Zooplankton sampling: Zooplankton samples were collected from 28 stations of Baleswar-Supati, Passure-Sibsa, Arpangasia-Balta and Jamuna-Malancha River System by using simple conical tow-net, which mesh size, is 90 μm. and the samples were kept in the plastic container.

Preservation: Borax buffered formalin was used at amount 1.5 ml per 250 ml samples and samples were taken 250 ml each and every occasion.

Counting: For zooplankton counting, the Sedgewick-Rafter (S-R) cell was used which is 50 mm. long, 20 mm. wide and 1 mm. deep. Number of zooplankton in the S-R cell was derived from the following formula:

$$\text{No. ml}^{-1} = \frac{C \times 1000\ \text{mm}^3}{L \times D \times W \times S}$$

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

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

Measurement of water quality parameters

Methods which were used for measuring the water quality parameter are given in the following table

Parameters	Method
Water temperature	Simple thermometer
pH	Electrometric
Salinity	Volumetric
Dissolve oxygen	Volumetric
Total alkalinity	Volumetric
Free CO_2	Volumetric

Results and Discussion

Relationship between Zooplankton abundance and different water quality parameters in Baleshwar- Selang river system during monsoon.

Water body of the Sundarban mangrove forest is an ecosystem with a network of various physico-chemical parameters and its biota. The physico-chemical parameters and plankton communities together form a comprehensive ecosystem and as in any ecosystem, there are interactions between the plankton and also between the plankton and the physico-chemical parameters. These interactions are directly or indirectly subjected to the complex influences, some of which results in quantitative changes. e.g. Increases or decreases of size of the population. (Welch, P. S. 1952).

Table 1: Net Zooplankton Abundance and different water quality parameters in Baleshwar-Selang river system during study period

Net Zooplankton Abundance	Water Temperature (°C)	pH	Salinity (ppt)	Dissolve oxygen (ppm)	Total alkalinity (mg $CaCO_3$)	Free CO_2 ($mgO_2 L^{-1}$)
2500	29.50	8.40	0.5	4.95	168.52	1.74
1250	29.25	8.45	0	6.05	121.32	1.47
2500	29.75	8.40	0.5	5.90	121.29	1.26
1667	29.00	8.35	2.0	6.20	106.65	1.43

Table 2: Correlation (r), regression equation (y), net Zooplankton Abundance and different water quality parameters in Baleshwar-Selang river system during study period

Relationship	Regression equation (y)	Correlation "r" *	Calculated 't'	df
Zooplankton Abundance Vs water temp.	Y= - 42071.5+1499.6* X	0.774	6.24	3
Zooplankton Abundance Vs pH	Y= 37007.25 - 4170 * X	-0.272	6.31	3
Zooplankton Abundance Vs Salinity	Y= 2534.58 - 555.33 * X	-0.0628	6.33	3
Zooplankton Abundance Vs DO	Y= 6209.85 -732.57 *X	-0.661	6.31	3
Zooplankton Abundance Vs Total alkalinity	Y= 247.65+13.376 * X	0.577	6.07	3
Zooplankton Abundance Vs Free CO_2	Y= 1355.28+423.064 *X	0.135	6.33	3

*At 5% level of significance at 3 degree of freedom

Table 3: Net Zooplankton Abundance and different water quality parameters in Pasur-Sibsa river system during study period

Net Zooplankton Abundance	Water Temperature (°C)	pH	Salinity (ppt)	DO (ppm)	Total alkalinity (mg $CaCO_3$)	Free CO_2 ($mgO_2 L^{-1}$)
2083	20.00	7.85	3	6.65	128.25	4.19
2078	22.25	7.75	2	6.20	125.50	2.81
2500	29.55	7.70	5	5.90	159.45	2.43
2489	27.50	7.55	3	5.30	140.40	4.50

Table 4: Correlation (r), regression equation (y), net Zooplankton Abundance and different water quality parameters in Pasur-Sibsa river system during study period

Relationship	Regression equation (y)	Correlation "r" *	Calculated 't'	df
Zooplankton Abundance Vs water temp.	Y= 1004.61 + 51.68 * X	0.962	19.27	3
Zooplankton Abundance Vs pH	Y= 14031.07 B 1522.67 *X	-0.796	19.06	3
Zooplankton Abundance Vs Salinity	Y= 1853.37 + 1335.79 * X	0.703	19.14	3
Zooplankton Abundance Vs DO	Y= 4394.81 B 350.49 * X	-0.830	19.04	3
Zooplankton Abundance Vs Total alkalinity	Y= 422.75 + 13.47 * X	0.871	19.04	3
Zooplankton Abundance Vs Free CO_2	Y= 2313.68 B 7.52 * X	-0.032	19.10	3

*At 5% level of significance at 3 degree of freedom

Table 5: Net Zooplankton Abundance and different water quality parameters in Arpangasia-Balta river system during study period

Net Zooplankton Abundance	Water Temperature (°C)	pH	Salinity (ppt)	DO (ppm)	Total alkalinity (mg $CaCO_3$)	Free CO_2 ($mgO_2 L^{-1}$)
513	29.75	7.75	10.5	9.25	183.3	0.255
1112	28.5	8.05	12	10.05	156.9	0.54
705	29.5	8.3	11.5	10.15	146.5	0.55
898	29.5	8.6	11	10.2	317.5	0.34
417	28.5	8.35	12.5	9.7	324	0.255

Table 6: Correlation (r), regression equation (y), net Zooplankton Abundance and different water quality parameters in Arpangasia-Balta river system during study period

Relationship	Regression equation (y)	Correlation "r" *	Calculated 't'	df
Zooplankton Abundance Vs water temp.	Y= 3240.62 + 135.95* X	-0.184	5.54	4
Zooplankton Abundance Vs pH	Y= - 415.872 + 139.448 *X	0.159	5.70	4
Zooplankton Abundance Vs Salinity	Y= 678.4 + 4.4 * X	0.012	5.67	4
Zooplankton Abundance Vs DO	Y= 4025.907 + 481.753 * X	0.678	5.69	4
Zooplankton Abundance Vs Total alkalinity	Y= 951.37 B 0. 98* X	-0.306	3.51	4
Zooplankton Abundance Vs Free CO_2	Y= 209.88 + 1337.93* X	0.698	5.76	4

*At 5% level of significance at 4 degree of freedom

Table 7: Net Zooplankton Abundance and different water quality parameters in Jamuna-Malancha river system during study period

Net Zooplankton Abundance	Water Temperature (°C)	pH	Salinity (ppt)	DO (ppm)	Total alkalinity (mg $CaCO_3$)	Free CO_2 ($mgO_2 L^{-1}$)
250	29.5	7.4	14.5	7.85	116.5	1.89
389	29.75	7.5	14.5	5.6	115.75	2.33
445	30.3	7.5	14	5.2	106.5	3.234
385	30.3	7.6	11	5.45	98.25	2.53
445	30.4	7.55	8	6.45	107.5	2.86

Table 8: Correlation (r), regression equation (y), net Zooplankton Abundance and different water quality parameters in Jamuna-Malancha river system during study period

Relationship	Regression equation (y)	Correlation "r" *	Calculated 't'	df
Zooplankton Abundance Vs water temp.	Y= - 4669.07+168.09* X	0.855	9.94	4
Zooplankton Abundance Vs pH	Y= -4695.25+675 *X	0.702	10.53	4
Zooplankton Abundance Vs Salinity	Y= 550.83B 13.55 * X	-0.486	10.21	4
Zooplankton Abundance Vs DO	Y= 763.69B 65.80 * X	-0.787	10.45	4
Zooplankton Abundance Vs Total alkalinity	Y= 913.93B 5.01 X	-0.512	7.31	4
Zooplankton Abundance Vs Free CO_2	Y= 34.41 + 133.35*X	0.908	10.79	4

*At 5% level of significance at 4 degree of freedom

Relationship between zooplankton abundance and water quality parameters: Zooplankton abundance showed inverse relationship with water temperature in Arpangasia-Balta river system (r = - 0.184) which is poorly negative correlated (Table 6). Such finding resembles the works of Chowdhury *et al.,* 1987, Patra and Azadi (1987) and Islam M. N. *et al.,* 2000. But zooplankton showed direct relationship with water temperature in Baleswar-Selangang river system (r = 0.774) (Table 3) and Jamuna-Malancha river system (r = 0.855) (Table 8). Both are moderately correlated. And in Pasur-Sibsa river system (r=0.962) it showed highly direct correlation with zooplankton abundance (Table 4). This direct relation is first found in the present study. It is found in the present study that free CO_2 is inversely related (Table 4) in the Pasur-Sibsa river system (r = - 0.032) with zooplankton abundance which is poorly correlated. This result supports the result of Alam *et al.,* 1987, Patra and Azadi 1987 and Islam M. N. *et al.,* 2000.But zooplankton abundance showed direct relationship with free CO_2 in Jamuna-Malancha river system (r = 0.908) which is highly correlated (Table 8), Arpangasia-Balta river system (r = - 0.698) which is moderately correlated (Table 6) and in Baleswar- Selangang river system (r = 0.135) which is poorly correlated (Table 2). The direct relationship of zooplankton with free CO_2 is found in this study.

Zooplankton abundance also showed inverse relationship with pH in Baleswar- Selangang river system (r = - 0.272) which is poorly correlated (Table 2) and in Pasur-Sibsa river system (r = - 0.796) which is moderately correlated (Table 4) (Alam *et al.,* 1987, Patra and Azadi, 1987; Chowdhury *et al.,* 1987 and Islam *et al.,* 2000). But zooplankton showed direct relationship with pH in Jamuna-Malancha river system (r = 0.702) which is moderately correlated (Table 8) and in Arpangasia-Batula river system (r = - 0.159) which is poorly correlated (Table 6). This direct relationship is found in the present study.

It is found in the present study that salinity may be inversely related in the Baleswar- Selangang river system (r = - 0.628) and in Jamuna-Malancha river system (r = - 0.486) with zooplankton abundance which are moderately correlated (Table 2 and 8). But in the Arpangasia-Balta river system (r = 0.012) and in the Pasur-Sibsa river system (r = 0.703) zooplankton may be directly correlated with the salinity (Table 6 and 4).

Zooplankton abundance showed inverse relationship with dissolve oxygen in Baleswar- Selangang river system (r = - 0.661), in Pasur-Sibsa river system (r = - 0.830) and in Jamuna-Malancha river system (r = - 0.787) which all are moderately correlated (Table 2, 4 and 8). These observations are found for the first time .On the other hand zooplankton showed direct relationship with dissolve oxygen in the Arpangasia-Balta river system (r = 0.678) of which is moderately correlated (Table 6). Such finding resembles the works of Miah *et al.,* 1981 and Alam *et al.,* 1987.

Total alkalinity showed direct relationship with zooplankton abundance in the Baleswar- Selangang river system (r = 0.577) and in Pasur-Sibsa river system (r = 0.871) both of them are moderately correlated (Table 2 and 4). These results have similarity with the findings of Miah *et al.,* 1981 and Alam *et al.,* 1987. But in the Arpangasia-Balta river system (r = - 0.306) and in the Jamuna-Malancha river system (r = - 0.512) zooplankton showed inverse relationship (Table 6 and 8). This inverse relationship is found in the present study.

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