BIODIVERSITY AND SYNECOLOGY OF ZOOPLANKTON IN FLOODPLAIN LAKES OF LOWER ASSAM (N.E. INDIA)

ABSTRACT

By

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ABSTRACT

Freshwater ecosystems include diversified biotopes ranging from ephemeral tree-holes and pools to large natural lakes and man-made reservoirs and the mighty riverine systems. Of these, the floodplain lakes comprise an integral component of the rural landscape in the different river basins. These environs, often, combine salient characteristics of lentic and lotic habitats and, hence, are unique and interesting ecotones. They deserve special mention because of their rich aquatic biodiversity and are considered to be one of the most productive ecosystems in the world (Odum, 1978; Mitsch and Gosselink, 1986). The floodplain lakes or beels deserve special mention in the state of Assam; they cover around 1,00,000 ha area, which in turn, comprise about 93% of total lentic fish prone area and about 81% of total lentic area of this state. They exhibit greatest scope for fish production through proper management; the traditional methods of fish farming yield production of only 200 kg/ha/year, which can be increased to about 1000 kg/ha/year through the practice of scientific fish farming (Sugunan, 1997). The studies on different aspects of limnology including temporal variations in water quality and plankton production of the floodplain lakes are, therefore, essential to understand their nature, dynamics and trophic status and also to assess fishery potential.

The present study assumes special significance in view of the mentioned lacunae and it deals with (i) to provide an account of zooplankton biodiversity in the floodplain lakes of lower Assam with reference to the interesting elements on faunal diversity of Rotifera and Cladocera and (ii) to undertake observations on synecology of zooplankton in selected floodplain lakes of lower Assam with special reference to their abundance, community structure, seasonal succession, dominance, species diversity, evenness and limnological correlations between various abiotic and biotic factors. Certain abiotic factors are recorded for the sampled biotopes to provide basic information on their water quality. The examined taxa are suitably illustrated. On the other hand, the synecology of zooplankton deals with investigations on temporal variations, at regular monthly intervals, in different parameters of water quality as well as on qualitative and quantitative composition of net plankton, zooplankton and phytoplankton in two floodplain lakes located in lower Assam.

STUDY SITES

Two floodplain lakes namely Deepor and Ghorajan beel were selected for the detailed limnological studies on temporal variations of water quality and qualitative as well as quantitative composition of net plankton, zooplankton and phytoplankton.
Along with the above, two other floodplain lakes were also sampled for the study of biodiversity of zooplankton.

Methods of study:

For the synecology of zooplankton, investigations on temporal variations, at monthly intervals, in different parameters of water quality namely water temperature, transparency, pH, specific conductivity, dissolved oxygen, free carbon dioxide, total alkalinity, total hardness, calcium, magnesium, chloride, sodium, potassium, sulphate, phosphate, nitrate, silicate, total dissolved solids, dissolved organic matter and biological oxygen demand (BOD) as well as qualitative and quantitative composition of net plankton, zooplankton and phytoplankton were carried out in Deepor and

Ghorajan beel during the period August, 1999 - July, 2001. Besides the above, qualitative plankton and water samples were collected seasonally (autumn, winter, monsoon and summer) from two more floodplain lakes for the study of biodiversity of zooplankton during the same period with the study of synecology of zooplankton.

Air and water temperatures were recorded. Light penetration was measured with a Secchi disc method. pH and specific conductivity were measured. The estimation of dissolved oxygen was done by the modified Wrinkler's method. Various other chemical parameters were analyzed following A.P.H.A. (1992). The rainfall data was obtained from the Guwahati Meteorological Centre. The plankton samples were collected by nylobolt plankton net (No.25) and preserved in 5% formalin. Qualitative samples were obtained by towing the net in the water bodies and quantitative samples were collected from the sampling stations by filtering 25 litres of water and each sample was concentrated to 25 ml. Quantitative enumeration of planktonic communities was done using the Sedgwick-Rafter counting cell. Important and interesting zooplankton taxa were isolated and mounted in polyvinyl alcohol-lactophenol mixture for detailed study. Different plankton taxa were identified following the important works of Edmondson (1959), Kutikova (1970) Needham and Needham (1972), Koste (1978), Smirnov (1971, 1976), Michael and Sharma (1988), Battish (1992), Segers (1995), Sharma and Sharma (1999, 2000). The examined taxa were suitably illustrated. The general nature and composition of the examined taxocoenosis were discussed. The observations were made on population densities of net plankton, zooplankton and their constituent groups, percentage composition of different planktonic taxa and temporal variations in qualitative and quantitative diversity.

Percentage similarities of zooplankton between monthly collections was calculated *vide* Sorensen's index (Sorensen, 1948). Species diversity was calculated using Shannan's and Menhinick's indices. Dominance and evenness were calculated by Berger-Parker's and E_1 indices.

Two-way Analysis of Variance (ANOVA) was performed to detect significance of quantitative variations of plankton between the months and between the sampling stations in the sampled beels.

Ecological relationships between plankton and various abiotic and biotic factors were computed by simple correlation coefficient (r_1 and r_2) at two sampling stations of each beel and by multiple correlation regression (R_1^2 and R_2^2). Statistical significance of the stated correlations was ascertained by application of 't-test'.

The results obtained are summarized below:-

1. ABIOTIC FACTORS:

Monthly rainfall ranged between 0.18-384.6 mm (155.2 ±141.3) during the course of this study. Maximum rainfall (384.6mm) was experienced during June-August in both the years. Its peak was recorded during August in the first year of the study period. However, low rainfall was noticed during December (0.18mm) in the first year and in the same month (0.6mm) in the same year. A very low precipitation was recorded from November to February (1.7mm – 0.18mm) during the study period.

The recorded air temperature ranged between 22.3-38.2 (30.7 ±4.3) at station I and 22.4-38.1 (30.6 ±4.2) at station II in Deepor beel. Water temperature of the beel varied from a winter low of 17.9°C (December-February) to a summer high of 33.6° C (May-July) and ranged between 17.9-

33.6°C (28.4 ±4.3) at station I. A minor peak during September-October occurred when the weather was moderately hot. Station II recorded 18.2-32.9°C (28.1 ±3.9) with a minor peak during April-May. However, air temperature fluctuated between 21.9-37.1 (30.4 ±4.0) at station I and 21.9-38.1 (30.6 ±4.2) at station II in Ghorajan beel. Water temperature varied between 19.7-33.2°C (28.0 ±3.7) and 19.8-32.8°C (28.1 ±3.8) at station I and II respectively in this beel. Seasonal variations of water temperature were observed in Siligurijan and Fingua beel, which ranged between 17.9-31.7°C (27.1 ±5.5) and 23.2-33.5°C (28.8 ±4.0) respectively. The recorded air temperature ranged between 20.4-34.8°C (29.7 ±5.5) in the former, while the later depicted 24.8-36.6°C (30.8 ±4.5). The recorded variations and mean values exerted tropical nature and the temporal changes in the water temperature followed nearly an identical pattern in the sampled beels. Further, it followed a trend identical to that of atmospheric temperature. Water temperature exhibited significant positive relationships with rainfall (r_1= 0.716, p<.001; r_2= 0.705, p<.001) and total alkalinity (r_1= 0.476, p<.05) in Deepor beel. It also depicted significant positive relationship with rainfall (r_1= 0.714, p<.001; r_2= 0.674, p<.001) in Ghorajan beel, which resulted due to concentration of precipitation during summer months.

The present study registered low transparency i.e between 17.0-82.0 cm (55.8 ±20.9) at station I and 15.0-81.0 cm (55.2 ±22.2) at station II in Deepor beel. Ghorajan beel also depicted low transparency (16.0-82.0 cm; 53.3 ±20.9) at station I and (16.0-83.0 cm; 55.1 ±21.6) at station II. Transparency ranged between 16.0-82.0(53.3 ±20.9) cm and 16.0-83.0 (55.1 ±21.6) cm at station I and II respectively in Ghorajan beel. Transparency varied between 21.0-68.0 cm (44.5 ±20.3) in Siligurijan beel and between 36.0-78.0 cm (60.0 ±17.0) in Fingua beel. Transparency showed clear seasonality during the present study with minima recorded in rainy season (inorganic turbidity) and maxima in winter in the sampled beels. Reduced transparency during the rainy season may be attributed to increased load of silt and suspended particles brought into the beels by run-off. Correlation analysis among the abiotic factors revealed that transparency and sodium were significantly correlated (r_1= 0.587, p<.01) at station I but it negatively correlated with phosphate (r_1= -0.419, p<.05) in Deepor beel. Correlation analysis revealed that transparency, total alkalinity (r_1= –0.438, p<.05; r_2= –0.455, p<.05) and BOD (r_1= –0.492, p<.05; r_2= –0.459, p<.05) were negatively correlated in Ghorajan beel indicating inverse relationships between them.

In the present observations, water of Deepor beel depicted their marginal acidic to alkaline character as pH varied between 6.5-9.5 (7.3 ±0.6) at station I and 6.6-9.2 (7.3 ±0.5) at station II. On the other hand, pH fluctuated between 6.7-8.4 (7.1 ±0.6) at station I and between 6.6-8.3 (7.1 ±0.5) at station II in Ghorajan beel. pH varied between 6.8-7.4(7.2 ±0.23) in Siligurijan beel and 6.9-8.4(7.6 ±0.56) in Fingua beel. However, correlation analysis among abiotic factors established that pH depicted significant direct relationships with specific conductivity (r_1= 0.512, p<.01; r_2= 0.547, p<.01), total hardness (r_1= 0.499, p<.05; r_2= 0.415, p<.05), chloride (r_1= 0.576, p<.01; r_2= 0.597, p<.01), which concurred with the result of Samuajan beel of upper Assam (Sharma and Hussain, 1999) and significant negative correlation with free carbon dioxide (r_1= –0.485, p<.05; r_2= –0.455, p<.05) and nitrate (r_1= –0.487, p<.05; r_2= –0.461, p<.05) in Deepor beel. Besides, it shared significant direct relationships with several factors namely, specific conductivity (r_1= 0.479, p<.05; r_2= 0.410, p<.05), total hardness (r_2= 0.644, p<.001), chloride r_1= 0.588, p<.01; r_2= 0.569, p<.01) and significant inverse relationships with sulphate (r_1= –0.598, p<.01; r_2= –0.564, p<.01) and nitrate (r_1= –0.424, p<.05; r_2= –0.462, p<.05) in Ghorajan beel, which agreed with the remarks of Sharma and Hussain (1999).

The present investigation registered specific conductivity ranging between 94.0-199.0 µS/cm (162.2 ±34.6) at station I and 102.0-198.0 µS/cm (162.6 ±33.0) at station II in Deepor beel. F ratio of ANOVA ($F_{11, 23}$ = 106.87, p>0.05) showed significant difference between the months in the

first year and the second year ($F_{11,23}$ = 84.73, p>0.05). Specific conductivity ranged between 50.0-193.0(128.0 ±40.0) at station I and between 49.0-198.0(133.2 ±45.9) at station II in Ghorajan beel. However, ANOVA ($F_{11,23}$ = 489.38, p>0.05) reflected significant difference between the months in the first year. The variations in conductivity with seasons and sites were significant. Low conductivity values were recorded at all stations of both the beels. Seasonal variations of specific conductivity fluctuated between 130.0-189.0 µS/cm (157.0 ±25.1) in Siligurijan beel and 89.0-173.0 µS/cm (135.5 ±30.8) in Fingua beel. They, however, differed notably in their specific conductivity values- Deepor (162.2 ±34.6µS/cm) at station I and 162.6 ±33.0µS/cm) at station II > Siligurijan (157.0 ±25.1µS/cm) > Fingua (135.5 ±30.8µS/cm) > Ghorajan beel 128.0 ±40.0µS/cm at station I and (133.2 ±45.9µS/cm) at station II. On the other hand, specific conductivity registered inverse correlation with sulphate (r_1= -0.501; p<.05) and sodium (r_1= -0.640, p<.01) and direct relationships with pH (r_1= 0.512, p<.01), hardness (r_1= 0.513; *p*<.01), calcium (r_1= 0.464; *p*<.05), chloride (r_1= 0.616, *p*<.01) and BOD (r_1= 0.447; *p*<.05) in the present study, which coincided with the report of Sharma and Hussain (1999). However, specific conductivity recorded an inverse correlation with sulphate (r_1= -0.615; *p*<.01) and direct correlation with pH (r_1= 0.479, p<.05; r_2= 0.410; p<.05), hardness (r_1= 0.857, *p*<.001; r_2= 0.748; *p*<.001), calcium (r_1= 0.796, p<.001; r_2= 0.687; *p*<.001), phosphate (r_2= 0.408, *p*<.05) and BOD (r_1= 0.484, *p*<.05; r_2= 0.494, *p*<.05) in the present study of Ghorajan beel, thereby, indicating contributory role of these factors in ionic content of the sampled water body.

The present study depicted nearly identical ranges and mean values of dissolved oxygen, which fluctuated between 3.2-12 mg/l (6.1 ±2.5) at station I and 2.4-12.8 mg/l (5.9 ±2.4) at station II in Deepor beel. It depicted 62.4-120.2% saturation at station I and 59.4-121.2% at station II in this beel, which concurred with the Samuajan beel (Sharma and Hussain, 1999). ANOVA ($F_{11,23}$ = 36.76, p>0.05 in the first year; $F_{11,23}$ = 36.86, p>0.05 in the second year) depicted significant difference between the months in both the years. During the whole study period, in Ghorajan beel relatively moderate dissolved oxygen was observed as it ranged between 2.4-10.2 mg/l (5.7 ±1.7) at station I and 3.2-12.4 mg/l (5.6 ±2.0) at station II. It showed 56.8-112.4% saturation at station I and 62.0-119.8% at station II. On the other hand, ANOVA ($F_{11,23}$ = 5.64, p>0.05) showed significant difference between the months in the second year. During the study period, seasonal variations of dissolved oxygen of the surface water ranged between 4.4-9.8 mg/l (6.5 ±2.1) in Siligurijan beel depicting 65.4-106.4% saturation and 3.6-12.4 mg/l (6.8 ±3.5) in Fingua beel and also exhibited 63.6-122.6% saturation. In addition, dissolved oxygen registered direct correlation with BOD (r_2= 0.424, p<.05) and FCO_2 (r_2= 0.448, *p*<.05) in Deepar beel. On the other hand, it also exhibited direct correlation with FCO_2 (r_1= 0.538, *p*<.01; r_2= 0.642, *p*<.001) and BOD (r_1= 0.466, *p*<.05; r_2= 0.462, *p*<.05) in Ghorajan beel.

Free carbon dioxide varied between 0-30.0 mg/l (11.1 ±7.7) at station I and 0-38.0 mg/l (10.7 ±8.2) at station II in Deepor beel. However, ANOVA ($F_{11,23}$ = 61.73, p>0.05 in the first year; $F_{11,23}$ = 63.57, p>0.05 in the second year) showed significant difference between the months in both the years. Free carbon dioxide was detected throughout the study period with concentrations fluctuating between 4.0-30.0 mg/l (8.7 ±5.8) and between 2.0-30.0 mg/l (8.3 ±5.3) at stations I and II respectively in Ghorajan beel, thereby, reflecting its poor autotrophic uptake in the ecosystem. ANOVA ($F_{11,23}$ = 9.65, p>0.05 in the first year; $F_{1,23}$ =17.39, p>0.05 in the second year) showed significant difference between the months in both the years in Ghorajan beel. In this present observation, free carbon dioxide exhibited direct correlation with total alkalinity (r_1= 0.659, *p*<.001; r_2= 0.45, *p*<.05), dissolved oxygen (r_2= 0.448, *p*<.05), nitrate (r_2= 0.433, *p*<.05) in Deepor beel. On the other hand, Ghorajan beel registered positive relationships with total alkalinity (r_1= 0.444, *p*<.05; r_2= 0.434, *p*<.05), dissolved oxygen (r_1= 0.538, <.01; r_2= 0.642, *p*<.001) and BOD (r_1= 0.592, *p*<.01; r_2= 0.663, *p*<.001) indicating positive relationships among them.

The present study exhibited ranges 32.0-96.0 mg/l (70.0 ±16.4) at station I and 30.0-93.0 mg/l (70.7 ±17.4) at station II in Deepor beel. However, ANOVA ($F_{1, 23}$ = 94.1, p>0.05 in the first year; $F_{1, 23}$ = 100.71, p>0.05 in the second year) exhibited significant difference between the months in both the years. Ghorajan beel, on the other hand, recorded 30.0-112.0 mg/l (66.0 ±20.1) at station I and 38.0-116.0 mg/l (66.7 ±19.5) at station II. Both the beels depicted almost an identical concentration, which was low. Low concentration in tropical water bodies is supported by other workers of this region (Sharma and Hussain, 1999; Sharma and Lyngdoh, 1999 and Sharma and Hussain, 2001). ANOVA ($F_{11, 23}$ = 98.97, p>0.05 in the first year; $F_{11, 23}$ = 21.031, p>0.05 in the second year) showed significant difference between the months in both the years. Total alkalinity ranged between 45.0-84.0 mg/l (61.4 ±14.1) in Siligurijan beel and 62.0-84.0 mg/l (71.7 ±8.5) in Fingua beel. Total alkalinity exerted significant positive relationships with water temperature (r_1= 0.476, p<.05), free carbon dioxide (r_1= 0.659, p<.001; r_2= 0.450, p<.05), nitrate (r_1= 0.528, p<.01) and silicate (r_1= 0.407, p<.05) in Deepor beel, which in turn, reflected interdependence of these attributes. The recorded values concurred with the reports of Bhattarai (2004). On the other hand, it registered direct correlation with specific conductivity (r_1= 0.517, p<.01; r_2= 0.532, p<.01), hardness (r_1= 0.576, p<.01, r_2= 0.562, p<.01), calcium (r_1= 0.488, p<.05; r_2= 0.458, p<.05) in Ghorajan beel; these relationships agreed with Sharma (1995) and Sharma and Hussain (1999).

Total hardness fluctuated between 46.0-82.0 mg/l (60.9 ±11.2) at station I and 40.0-80.0 mg/l (60.9 ±12.1) at station II in Deepor beel. In this beel, ANOVA ($F_{11, 23}$ = 218.61, p>0.05 in the first year; $F_{11, 23}$ = 199.29, p>0.05 in the second year) depicted significant difference between the months; in case of stations ($F_{1, 23}$ =16.83, p>0.05 in the first year; $F_{1, 23}$ = 16.79, p>0.05 in the second year) also, it showed significant difference in both the years. However, Ghorajan beel exhibited 20.0-84.0 mg/l (54.4 ±15.7) at station I 20.0-80.0 mg/l (52.6 ±15.1) at station II. ANOVA ($F_{11, 23}$ = 116.76, p>0.05 in the first year; $F_{11, 23}$ = 8.948, p>0.05 in the second year) showed significant difference between the months at both the stations. Total hardness varied between 40.0-76.0 mg/l (60.0 ±14.1) in Siligurijan beel and between 52.0-76.0 mg/l (63.2 ±9.4) in Fingua beel. The role of calcium and magnesium in controlling the total hardness is clearly indicated by significant positive correlations with calcium r_1= 0.866, p<.001; r_2= 0.868, p<.001) and magnesium (r_2= 0.461, p<.05) in Deepor and also showed positive relationships with calcium (r_1= 0.807, p<.001; r_2= 0.807, p<.001) magnesium (r_1= 0.495, p<.05; r_2= 0.524, p<.01) in Ghorajan beel. Positive correlation of total hardness also existed with other abiotic factors including chloride (r_1= 0.587, p<.01) and BOD (r_1= 0.462, p<.05; r_2= 0.458, p<.05) and it established inverse correlation with sulphate (r_1= -0.738, p<.001; r_2= -0.679, p<.001), nitrate (r_1= -0.540, p<.01; r_2= -0.427, p<.05) in Deepor beel. However, it showed direct relationships with chloride (r_2= 0.424, p<.05) and BOD (r_1= 0.479, p<.05; r_2= 0.489, p<.05) and inverse relationship with sulphate (r_1= -0.585, p<.01; r_2= -0.488, p<.05) in Ghorajan beel, which coincided with the result of Samuajan beel indicating dilution impact of rainfall (Sharma and Hussain, 1999).

The calcium content of the surface water ranged between 23.1-56.7 mg/l (36.2 ±8.2) at station I and 21.0-52.5 mg/l (35.2 ±8.6) at station II in Deepor beel. ANOVA ($F_{1, 23}$ =37.59 p>0.05 in the first year; $F_{1, 23}$ =37.41, p>0.05 in the second year) showed significant difference between the months and no significant difference between the stations in the years. On the other hand, it recorded 8.4-46.2 mg/l (31.3 ±10.5) at station I and 10.5-44.1 mg/l (29.1 ±9.8) at station II in Ghorajan beel. However, ANOVA ($F_{11, 23}$ = 36.49, p>0.05 in the first year; $F_{11, 23}$ =19.09, p>0.05 in the second year) exhibited significant difference between the months in both the years, while in case of stations ($F_{1, 23}$ =27.44, p>0.05 in the second year) it showed significant difference in the second year. The ranges and mean values of Deepor beel were relatively higher than the values of Ghorajan beel. Calcium ranged between 26.1-43.6 mg/l (33.4 ±6.4) in Siligurijan beel and between 29.4-

38.3 mg/l (32.9 ±3.3) in Fingua beel. The former showed peak calcium concentration during summer and lowest during autumn, while maximum value was observed during monsoon season in Fingua beel. Correlation analysis revealed that calcium depicted direct relationship with total hardness (r_1= 0.866, p<.001; r_2= 0.868, p<.001) in Deepor beel, on the other hand, it showed the identical relationship in Ghorajan beel, where total hardness (r_1= 0.807, p<.001; r_2= 0.807, p<.001), which confirmed that calcium in contributing to total hardness across the two study sites was more pronounced than any other ion and apparently agreed with the reports of floodplain lakes of Assam by Sharma and Hussain (1999). On the other hand, calcium showed inverse relationships with sulphate (r_1= -0.519, p<.01; r_2= -0.599, p<.01) at station II in Deepor beel, while it depicted inverse relationships with sulphate (r_1= -0.640, p<.001; r_2= -0.516, p<.01) in Ghorajan beel.

Magnesium fluctuated between 0.8-8.9 mg/l (5.6 ±1.7) at station I and station II recorded 0.8-9.3 mg/l (5.9 ±1.9) in Deepor beel. The present study registered Calcium > Magnesium, which is a general trend in most of the water bodies. Ghorajan beel depicted no definite pattern of monthly variations. The values ranged between 0.9-9.6 mg/l (5.2 ±2.4) and between 0.7-9.4 mg/l (5.3 ±2.3) at station I and II respectively. However, it depicted positive relationship with phosphate (r_2=0.462, p<.05) in this beel. Magnesium concentration varied between 3.3-9.1 mg/l (6.4 ±2.2) in Siligurijan beel and between 5.5-10.8 mg/l (7.4 ±2.1) in Fingua beel. It registered maxima during monsoon and minima during autumn season in Siligurijan beel. Fingua beel showed peak concentration during winter and lowest value was noticed during monsoon season. The mean values of Siligurijan and Fingua beel showed slightly higher than that of Deepor and Ghorajan beel.

The present study registered a narrow range of fluctuations of chloride i.e. between 14.9-35.9 mg/l (23.8 ±6.5) at station I and 12.9-35.9 mg/l (23.3 ±6.7) at station II in Deepor beel. On the other hand, it ranged between 8.9-42.9 mg/l (21.8 ±8.4) at station I and 9.9-43.9 mg/l (22.6 ±7.5) at station II in Ghorajan beel. maximum value was observed in July (42.9 mg/l at station I & 43.9 mg/l at station II) in Ghorajan beel, high chloride values in the beel could be due to animal waste from cattle grazing during the season. In general, chloride concentration agreed with the ranges noticed in natural water, thereby indicating lack of organic pollution in the studied beels. Chloride registered significant inverse correlation with sulphate (r_1= -0.419; p<.05, r_2= -0.583; p<.01) in Deepor beel. On the other hand, it showed significant positive correlation with BOD (r_1= 0.625; p<.001) at station I in Ghorajan beel indicating interdependence between them.

Dissolved organic matter ranged between 0.3-3.2 mg/l (2.3 ±0.7) and 0.5-3.8 mg/l (2.1 ±0.7) at station I and II in Deepor beel respectively. DOM content of Ghorajan beel fluctuated between 0.9-3.8 mg/l (2.3 ±0.7) at station I and between 0.8-3.8 mg/l (2.2 ±0.7) at station II. The concentrations of DOM in both the beels were relatively low. On the other hand, the mean values of both the beels were slightly higher than the report of Zafar (1964).

The water of the two floodplains indicated relatively low concentration of dissolved solids, i.e. between 0.4-2.6 mg/l (1.6 ±0.6) at station I and 0.3-3.2 mg/l (1.5 ±0.6) at station II in Deepor beel. Ghorajan beel showed ranges of TDS 0.8-2.9 mg/l (1.9 ±0.6) at station I and 1.1-2.9 mg/l (1.8 ±0.5) at station II. Both the beels depicted low concentration of TDS during the whole study period. Low TDS at these sampled beels corresponded with low ionic concentrations in general, which supported the results of Bhattarai (2004).

The concentration of inorganic phosphorus estimated as phosphate ranged between 0.01-0.9 mg/l (0.3 ±0.3) at station I and between 0.02-1.2 mg/l (0.3 ±0.3) at station II in Deepor beel. Ghorajan beel depicted phosphate content ranging between 0.02-1.4 mg/l (0.5 ±0.4) at station I and between 0.04-2.4 mg/l (0.87 ±0.8) at station II. In addition, it depicted inverse correlation with

transparency (r_1= -0.419; p<.05) in Deepor beel, which coincided with the reports of floodplain lakes of Assam by Sharma and Hussain (1999). In general, lower phosphate content in water column of Deepor beel, during most part of present study period, was attributed to its uptake by luxuriant growth of aquatic macrophytes, which agreed with the findings of Sharma and Hussain (1999). It exhibited significant inverse correlation with potassium (r_2= -0.410, p<.05) at station I in this beel. On the other hand, annual ranges and mean values of both the beels (excepting Ghorajan station II) concurred with the results of Yusuf *et al.* (1986), Yadava *et al.* (1987), Vass (1989) and Sinha *et al.* (1994), Sharma and Hussain (2001).

The present observation indicated sulphate content ranging between 5.1-28.2 mg/l (14.9 ±6.3) at station I and between 4.9-24.5 mg/l (15.8 ±5.3) at station II in Deepor beel. On the other hand, sulphate content in Ghorajan beel depicted bimodal pattern of monthly variations and fluctuated between 3.6-30.3 mg/l (17.4 ±6.8) at station I and between 4.2-27.0 mg/l (16.5 ±5.9) at station II during the study period. Further, it registered inverse correlations with specific conductivity (r_1= -0.501, p<.05; r_2= -0.524, p<.01) and total hardness (r_1= -0.738, p<.001; r_2= -0.679, p<.001) in Deepor beel, and it recorded an identical relationships with pH (r_1= -0.598, p<.01; r_2= -0.564, p<.01), specific conductivity (r_1= -0.615, p<.01) and total hardness (r_1= -0.585, p<.01; r_2= -0.488, p<.05) in Ghorajan beel, which coincided with the reports of floodplain lakes of Assam by Sharma and Hussain (1999), while direct relationship was noticed with nitrate (r_2= 0.534, p<.01) in Ghorajan beel, which agreed with the reports by Sharma and Hussain (1999). Mean values of both the beels corresponded with the reports of Yousuf *et al.* (1986) and Sharma and Hussain (2001).

Nitrate concentration was low during the study period in Deepor beel and it ranged between 0.1-1.9 mg/l (1.2 ±0.5) at station I and between 0.2-2.3 (1.4 ±0.6) at station II. The concentration of this nutrient fluctuated between 0.09-2.1 mg/l (1.1 ±0.6) at station I and between 0.09-2.1 mg/l (1.2 ±0.6) at station II in Ghorajan beel. Nitrate registered inverse relationship with total hardness (r_1= -0.540, p<.01; r_2= -0.427, p<.05) in Deepor beel. Both the beels depicted almost identical findings with the report of Samuajan beel (Sharma and Hussain, 1999). This micronutrient exhibited peak during monsoon, which supported by significant positive correlation with rainfall (r_1= 411; p<.05) in Deepor beel. It depicted positive correlation with rainfall (r_2= 0.442; p<.05) in Ghorajan beel also. The impact of rainfall is also supported by Goswami (1985), Yadava (1987) and Sharma and Hussain (1999). Annual range and mean values of both the beels are almost similar with the reports of Sharma and Hussain (1999) and Sharma and Hussain (2001) from the state of Assam.

In the present study, silicate content ranged between 0.1-4.6 mg/l (2.1 ±0.9) at station I and station II 0.3-4.1 mg/l (1.9 ±0.8) in Deepor beel. On the contrary, Ghorajan beel exhibited 0.04-4.1 mg/l (1.8 ±0.8) at station I and 0.1-4.3 mg/l (1.9 ±0.9) at station II. Its concentration was lower than the reports by Dey (1981), Yousuf *et al.* (1986), Yadava *et al.* (1987) and Singh and Roy (1990), on the other hand, its mean values of both the beels were lower than the reports of Sharma and Hussain (1999). It, however, registered positive relationship with total alkalinity (r_1= 0.407, p<.05) in Deepor beel. Silicate also exhibited positive relationship with sodium (r_1= 0.643, p<.01; r_2= 0.474, p<.05) in Ghorajan beel. Both the beels corroborated the relationships with the reports of Sharma and Hussain (1999) from the state of Assam.

BOD fluctuated between 0.6-4.8 mg/l (2.09 ±0.9) at station I and between 0.4-5.1 mg/l (2.8 ±1.5) at station II in Deepor beel. BOD values ranged between 0.1-4.4 mg/l (1.8 ±1.0) at station I and between 0.1-4.8 mg/l (1.7 ±1.1) at station II in Ghorajan beel. However, BOD registered direct correlation with dissolved oxygen (r_2= 0.424, p<.05) and calcium (r_1= 0.529, p<.01; r_2= 0.483, p<.05) in Deepor beel. On the contrary, Ghorajan beel depicted direct relationships with

dissolved oxygen (r_1= 0.466, p<.05; r_2= 0.462, p<.05) and calcium (r_1= 0.442, p<.05; r_2= 0.514, p<.01) indicating positive relationship among them and also exhibited significant inverse correlation with transparency (r_1= -0.492, p<.05; r_2= -0.459, p<.05). In the present study, Deepor beel and Ghorajan beel did not cross the polluted range of BOD (lower level 6 mg/l).

The concentration of this alkaline earth metal ranged between 12.4-31.0 mg/l (19.6 ±4.7) at station I and between 11.1-28.0 mg/l (18.8 ±4.2) at station II in Deepor beel. However, sodium fluctuated between 6.1-27.0 mg/l (18.6 ±5.4) at station I and between 7.3-29.0 mg/l (19.9 ±5.4) at station II in Ghorajan beel. It exhibited significant inverse correlation with specific conductivity (r_1= -0.64, p<.01) and pH (r_1= -0.428 p<.05) and BOD (r_1= -0.446 p<.05) at station I in Deepor beel, which did not depict the identical trend with the records of Ghorajan beel. However, sodium exhibited significant positive relationships with transparency (r_1= 0.587, p<.01) and silicate (r_1= 0.474, p<.05) at station I in Deepor beel and at station II in Ghorajan beel respectively. The minimum values of Deepor beel were apparently higher than that of Ghorajan beel. On the other hand, the mean values of both the beels were lower than the earlier report of floodplain lakes of Assam (Sharma and Hussain, 2001) and apparently higher than the lakes of high altitude (Zutshi and Vass, 1978).

The present observations showed a wide range of fluctuations in the potassium content of the water, i.e. between 3.2-9.0 mg/l (6.06 ±1.6) at station I, while station II exhibited 4.2-10.2 mg/l (6.6 ±1.5) in Deepor beel. Ghorajan beel depicted wide range of potassium fluctuations. It ranged between 3.7-10.0 mg/l (6.4 ±1.7) at station I and between 3.2-9.8 mg/l (6.1 ±1.7) at station II. It depicted significant inverse correlation with BOD (r_1= -0.464, p<.05) at station I Deepor beel. The mean values were observed to be higher than the report of other beels from the state of Assam (Sharma and Hussain, 2001). On the other hand, the values of potassium of both the sampled floodplain lakes were apparently higher than the values of high altitude lakes, which compared with the results of Dal lake, Srinagar (Zutshi and Vass, 1978).

2. BIOTIC FACTORS:

A. BIODIVERSITY OF ZOOPLANKTON

Seasonal variations for the study of biodiversity of zooplankton were observed in four beels, namely Siligurijan, Fingua, Deepor and Ghorajan beel. The zooplankton taxocoenosis of the sampled beels included two major groups namely, Rotifera and Cladocera. Species richness of zooplankton ranged between 46-68 species in Siligurijan beel. Species richness of Rotifera fluctuated between 30-50 species in this beel. A total of 104 zooplankton taxa were identified from Siligurijan beel out of which 72 species of Rotifera and 32 species of Cladocera. Species richness of zooplankton varied between 59-80, the maximum was observed during autumn and the minimum during the monsoon season in Fingua beel. Species richness of Rotifera fluctuated between 35-57 in this beel. A total of 105 zooplankton taxa were identified from this beel. 75 species of Rotifera and 30 species of Cladocera were identified during the study period. 122 zooplankton taxa were identified from Deepor beel, out of which Rotifera registered 87 species and 35 species of Cladocera. On the other hand, Ghorajan beel registered a total of 120 taxa, 86 species belonging to Rotifera and 34 species belonging to Cladocera during the study period, which apparently higher in comparison to the reports of subtropical lakes from this region (Sharma, 1995) and also floodplain lakes of Assam. Lecanidae and Brachionidae together, comprised a notable component of rotifer biodiversity in the sampled beels. In the present investigation, Siligurijan beel registered 72 species of Rotifera, out of which 18 species belonging to Lecanidae family followed by 17 species to Brachionidae. On the other hand, Fingua registered 75 species of Rotifera, a total of 20 species belonging to Lecanidae

family, while 17 species belonging to Brachionidae. Rotifera accounted for 69.2% of total zooplankton richness in Siligurijan beel and 71.4% in Fingua beel. Lecanidae (24 species) and Brachionidae (19 species) together, comprised a notable component of rotifer biodiversity in Deepor beel. In the present study, Ghorajan beel registered 86 species of Rotifera, out of which 24 species belonging to Lecanidae family followed by 19 species belonging to Brachionidae, 9 species belonging to Colurellidae, 7 species belonging to Trichocercidae. The proportion of widely distributed *Lecane* amounts to 25% of the total rotifers in Siligurijan, on the other hand, 26.7% in Fingua beel. This is apparently higher than the result of Samuajan beel of upper Assam (Sharma and Hussain, 2001) but the distribution percentages of *Lecane* are definitely lower than the reports of Deepor (27.6%) and Ghorajan beel (27.9%). Among the rotifers, *Brachionus mirabilis*, *Lecane thienemanni*, *Lecane ohioensis*, *Lecane decipiens*, *L. inopinata*, *L. crepida*, *Filinia camascela*, and *Trochosphaera aequatorialis* were totally absent in Siligurijan beel during the study period. On the other hand, *Keratella tropica*, *Beauchampiella eudactylota*, *Lecane pyriformis, Lecane decipiens* and *L. inopinata* were also not registered in Fingua beel. The rotifer fauna exhibited dominance of monogonont taxa. Five eurotatorian families namely Lecanidae>Brachionidae>Colurellidae>Trichocercidae included 68.9% of the total rotifers in Deepor beel, 68.6% in Ghorajan beel, 68.1% in Siligurijan beel and 68% in Fingua beel, the spectrum of dominance apparently agreed with the report of Sharma (1996).

The other dominant group Cladocera exhibited the ranges of species richness 16-25 in Siligurijan beel. Maximum species richness was observed during winter and the minimum during monsoon season. Cladocera depicted the ranges of species richness 20-24 in Fingua beel. A total of 32 species documented from Siligurijan beel, while Fingua beel registered 30 species. The number of both the beels was lower as compared to reports of Deepor and Ghorajan beel, which registered 35 and 34 species respectively. *Bosmina longirostris*, *Biapertura karua, Moina micrura, Scapholeberis kingi* contributed to maximum richness in Siligurijan beel, on the other hand, *Bosmina longirostris* recorded maximum during monsoon season in the sampled beels and *Biapertura karua* and *Chydorus sphaericus* were found to be common in Fingua beel. The cladocerans comprised subdominant component of zooplankton in the sampled beels.

Percentage similarity of Rotifera of Deepor and Ghorajan beel exhibited ranges 24.2-84.7% in the first year with highest between December and January and lowest between April and June, while it showed ranges 32.7-71.1% in the second year with highest between January and June and lowest between February and May. In Deepor and Ghorajan beel, only instance of higher community similarity (more than 80%) of rotifera was observed between December and January (84.7%) in the first year.

B. SYNECOLOGY OF ZOOPLANKTON

(I) NET PLANKTON:

Net plankton in Deepor and Ghorajan beel appeared to be diversified. Higher species richness was observed in both the beels. Recorded 208 species including 149 species of zooplankton and 59 species of phytoplankton in Deepor beel, on the other hand, a total of 202 species were recorded in Ghorajan beel out of which 147 zooplankton species and 55 phytoplankton species at all. Zooplankton comprised an important component and constituted dominant group to the planktonic communities in both the beels. This dominant group, on the other hand, included six major groups namely, Rotifera, Cladocera, Copepoda, Rhizopoda, Ostracoda and Conchostraca. Species richness in both the beels was higher than the reports of Sharma (1995), Sharma and Hussain (1999) and Sharma (2001). The population density of net plankton at station I ranged between 475-

969 ind/l (703.0 ±124.0) and 431-1036 ind/l (618.0 ±147.0) at station II in Deepor beel. The quantitative abundance of net plankton in Ghorajan beel fluctuated between 414-1134 ind/l (647.0 ±179.0) at station I and 335-804 ind/l (522.0 ±130.0) at station II. In the present investigations, net plankton densities were significantly influenced by phytoplankton (r_1= 0.626, p<.01; r_2= 0.878, p<.001), Chlorophyta (r_1= 0.619, p<.01; r_2= 0.798, p<.001), Bacillariophyta (r_1= 0.598, , p<.01; r_2= 0.736, p<.001) and also showed significant correlation with zooplankton (r_1= 0.501, p<.05; r_2= 0.584, p<.01) and Rotifera (r_1= 0.456, p<.05; r_2= 0.56, p<.01) in Deepor beel, thereby, exhibited contributory role in the population. Further, it exhibited significant direct correlation with phosphate (r_2= 0.423, p<.05) in this beel indicating positive relationship between them. In addition, net plankton showed positive correlation with phytoplankton (r_1= 0.759, p<.001; r_2= 0.621, p<.01), Chlorophyta (r_1= 0.746, p<.01; r_2= 0.526, p<.01), Bacillariophyta (r_1= 0.315, r_2= 0.644, p<.001), zooplankton (r_1= 0.647, p<.001; r_2= 0.76, p<.001) and Rotifera (r_1= 0.474, p<.05; r_2= 0.751, p<.01) in Ghorajan beel indicating interdependence among the attributes. On the other hand, it showed significant positive relationships with specific conductivity (r_1= 0.423, p<.05), total alkalinity (r_1= 0.596, p<.01; r_2= 0.416, p<.05), calcium (r_1= 0.409, p<.05), phosphate (r_1= 0.517, p<.01; r_2= 0.432, p<.05) and silicate (r_1= 0.476, p<.05). The multiple regression indicated that sixteen ecological variables together accounted for 69.6% (station I) and 72.3% (station II) of variations of net plankton indicating importance of combined influence of various factors in Deepor beel, while it accounted for 82.2% at station I and 77.8% at station II in Ghorajan beel.

(II) ZOOPLANKTON:

The zooplankton taxocoenosis of both the beels included six major groups namely, Rotifera, Cladocera, Copepoda, Rhizopoda, Ostracoda and Conchostraca. 149 zooplankton taxa were identified from Deepor beel, which included 149 species at station I and 147 species at station II, on the other hand, Ghorajan beel registered a total of 147 taxa, indicated 147 species at station I and 146 species at station II during the study period, which apparently higher compared to the reports of Sharma, 1995 and also floodplain lakes of Assam. Of these, Rotifera registered 88 species at station I and 87 species at station II with spectrum of dominance as Rotifera > Cladocera with 48 species (st.I) > 43 species (st.II) and 12 species (st. I) > Rhizopoda > 11 species (st. II) > Copepoda (3 species at both the stations) > Ostracoda (2 species at both the stations) > Conchostraca (1 species at both the stations) in Deepor beel. On the other hand, Ghorajan beel registered 87 species at both stations of Rotifera with spectrum of dominance as Rotifera > Cladocera (42 species at station I, 42 species at station II) > Rhizopoda (12 species at station I, 11 species at station II) > Copepoda (3 species at both the stations) > Ostracoda (2 species at both the stations) > Conchostraca (1 species at both the stations).

Zooplankton comprised an important component, which ranged between 172-565 (361.0 ±103.0) at station I and 146-382 (256.0 ±71.0) at station II in Deepor beel and significantly influenced their monthly abundance (r_1= 0.501, p<.05; r_2= 0.584, p<.01). On the contrary, Ghorajan beel exhibited 133-487 (327.0 ±117.0) at station I and 152-464 (300.0 ±102.0) at station II and also positively correlated with net plankton (r_1= 0.647, p<.01; r_2= 0.76, p<.001). The observed densities were also higher than in the floodplain lakes of Bihar (Rai and Dutta Munshi, loc cit.; Sanjer and Sharma, loc cit.), Kashmir (Khan, 1987) and West Bengal (Vass, 1989). Zooplankton exhibited significant positive correlation with Rotifera (r_1= 0.843, p<.001; r_2= 0.787, p<.001), Cladocera (r_1= 0.818, p<.001; r_2= 0.892, p<.001), Copepoda (r_1= 0.427, p<.05), Rhizopoda (r_1= 0.597, p<.01; r_2= 0.762, p<.001) and Ostracoda (r_1= 0.443, p<.05) in Deepor beel indicating interdependence among the attributes. On the other hand, zooplankton exhibited significant positive relationships with magnesium (r_1= 0.423, p<.05) at station I and inversely correlated with water temperature (r_1= -0.465, p<.05) at station I in this beel, thereby, exhibited relatively low temperature is favourable

for zooplankton production. ANOVA showed no significant differences between the months ($F_{11, 23}$ = 2.413, p>.001) as well as between the stations ($F_{1, 23}$ = 4.673, p>.001) in first and second year ($F_{11, 23}$ = 0.036, p>.001 between months; $F_{1, 23}$ = 0.004, p>.001 between stations) in Deepor beel. However, ANOVA showed significant differences between the months ($F_{11, 23}$ = 4.35, p>.001) as well as between the stations ($F_{1, 23}$ = 6.69, p>.001) in first and in second year, it exhibited significant differences between the months ($F_{11, 23}$ = 10.24, p>.001) and no significant differences between the stations ($F_{1, 23}$ = 0.198, p>.001) in Ghorajan beel. The present observation registered inverse correlation between zooplankton vs. transparency (r_1= -0.513, p<.01) in Ghorajan beel. It exhibited significant positive correlation with Rotifera (r_1= 0.958, p<.001; r_2= 0.933, p<.001), Cladocera (r_1= 0.919, p<.001; r_2= 0.808, p<.001), Copepoda (r_1= 0.859, p<.001; r_2= 0.599, p<.01)), Rhizopoda (r_1= 0.472, p<.05; r_2= 0.576, p<.01) and Ostracoda (r_1= 0.439, p<.05) in this beel. The correlation revealed that the abundance of zooplankton is chiefly dependent on its major groups i.e. Rotifera, Cladocera, Copepoda and Rhizopoda. On the other hand, zooplankton exhibited significant correlation with total alkalinity (r_1= 0.524, p<.01; r_2= 0.558, p<.01), phosphate (r_1= 0.45, p<.05; r_2= 0.413, p<.05), BOD (r_1= 0.612, p<.01), specific conductivity (r_2= 0.428, p<.05), total hardness (r_2= 0.525, p<.01), calcium (r_2= 0.472, p<.05), magnesium (r_2= 0.419, p<.05) and phosphate (r_2= 0.413, p<.05) in this beel. Alkalinity and pH are often found as variables predicting the zooplankton community composition, based on data from a large number of different water bodies (Berzins & Pejler, 1987). Zooplankton positively correlated with total alkalinity (r_1= 0.524, p<.01; r_2= 0.558, p<.01) in Ghorajan beel.

During the present study, zooplankton communities depicted higher species diversity computed *vide* Shannan's index and ranged between 2.532-3.634 (3.264 ±0.3) and 2.215-3.869 (3.234 ±0.35) at station I and II respectively in Deepor beel. Similarly, Menhinick's index varied with their narrow ranges and higher mean values i.e. between 2.003-3.977 (3.316 ±0.5) at station I and 2.092-4.373 (3.372 ±0.6) at station II. On the other hand, Ghorajan beel indicated relatively higher species diversity among the stations and it ranged between 3.007-3.978 (3.458 ±0.25) at station I and 2.943-3.784 (3.344 ±0.22) at station II using Shannan's index and it fluctuated between 3.015-4.536 (3.525 ±0.4) at station I and 2.919-4.002 (3.348 ±0.3) using Menhinick's index. Mean values of species diversity in both the beels exhibited almost identical and the recorded zooplankton diversity was higher than the reports of Sharma (1995), Sharma and Hussain (1999), Wanswett (2001) and Sharma and Lyngdoh (2004).

Zooplankton dominance (*vide* Berger-Parker's index) at both the stations was generally low and ranged between 0.069-0.236 (0.168 ±0.04) and 0.085-0.284 (0.163 ±0.04) at station I and II respectively. Dominance of zooplankton fluctuated between 0.123-0.251 (0.184 ±0.03) at station I and 0.135-0.297 (0.197 ±0.03) at station II in Ghorajan beel. It registered peak in March and minima in July in the second year at station I, while station II exhibited maxima in September and minima in August in the first year. The present study showed relatively low overall dominance due to fewer quantitatively important species. Mean values indicated low dominance in both the beel, which broadly coincided with the findings of the beels of upper Assam reported by Sharma and Hussain (2001

Evenness (E_1) indicated high equitability of zooplankton and fluctuated with narrow ranges i.e. between 0.853-0.956 (0.891 ±0.03) at station I and 0.876-0.984 (0.939 ±0.03) at station II in Deepor beel. On the other hand, evenness of Ghorajan beel showed ranges 0.895-0.976 (0.924 ±0.02) at station I and 0.886-0.987 (0.927 ±0.02) at station II. However, zooplankton evenness did not depict significant monthly variations and exhibited almost identical annual ranges between the beels. Further, high evenness at all the stations in the beels indicated greater equitability of species

abundance in the community, which concurred with the report of Washington (1984). The mean value of station I in Deepor beel exhibited marginally lower than that of other stations of the sampled beels. The multiple regression indicated that sixteen abiotic factors accounted for 90.9% (station I) and 81.5% (station II) of variations of zooplankton indicating importance of combined influence of various factors in Deepor beel, while Ghorajan beel stated 71.5% and 92.2% at station I and station II respectively.

Rotifera accounted for the highest share of the abundance of zooplankton. The present study did not depict any definite periodicity of overall rotifer abundance or of individual species. In general, a greater number of taxa were recorded in the sampled beels but numerical abundances were considerably lower. A total of 88 and 87 species at both the stations of Deepor beel and 87 species in Ghorajan beel represented it. The documented 88 rotifer species from both the beels accounted for 75.86% of the total reported rotifers from the floodplain lakes of Assam (116 reported species), 60.27% of the total reported rotifers from the N.E. India (146 reported species) and only 26.35% of the total rotifers from whole of the country (334 reported species). Lecanidae and Brachionidae were the dominant families of Rotifera in the sampled beels. The rotifer fauna exhibited dominance of monogonont taxa. Five eurotatorian families namely Lecanidae> Brachionidae> Colurellidae> Trichocercidae included 66.6% of the total rotifers, the spectrum of dominance apparently agreed with the report of Sharma (1996). Various non-planktonic taxa of the Epiphanidae, Trichotridae, Synchaetidae, Dicranophoridae and Floscularidae were poorly observed. Lecanidae (24 species at both the stations) and Brachionidae (19 species at both the stations) together, comprised a notable component of rotifer biodiversity in Deepor beel. In the present study, Ghorajan beel registered 87 species of Rotifera at both the stations, out of which 24 species belonging to Lecanidae family followed by 19 species belonging to Brachionidae, 9 species belonging to Colurellidae, 6 species belonging to Trichocercidae. This is apparently higher than the report of Samuajan beel of upper Assam (Sharma and Hussain, 2001). The predominance of Lecane species is in agreement with reports on the rotifer fauna of other tropical floodplain lakes (e.g. Africa: Segers *et al.*, 1993c; Asia: Segers, 1994: South America: Jose De Paggi, 1993).

Altogether 24 species belonging to Lecanidae family documented from both the beels, which accounted 52.17% of the total recorded Lecane species from N.E. India (reported 46 species), 75% of Sri Lanka (reported 32 species) and 51.06% of Thailand (reported 47 species). On the other hand, Lecanidae accounted for 27.3% of total rotifer richness in Deepor beel and 27.6% in Ghorajan beel, hence, broadly corresponded with its contribution (26.9%) in the floodplain lakes of upper Assam (Sharma, 2000) and also (28.5%) in tropical floodplain lakes of the river Niger, Africa (Segers *et al.* 1993). As a result of this study, a total of 19 species belonging to Brachionidae documented from both the beels, which accounted for 82.61% of the total of N.E. India (23 reported species). Most species of Brachionus, reported from India, are pantropical or cosmopolitan forms of alkaline waters. However, both the beels registered 12 species belonging to genus Brachionus, which accounted for 85.71% of the total reported species from N.E. India (14 reported species). Rotifera ranged between 94-265 ind/l (183.5 ±55.1) at station I and 62-187 ind/l (117.0 ±37.0) at station II in Deepor beel. The dominant component contributed significantly to net plankton (r_1= 0.456, p<.05; r_2= 0.560, p<.01) and Zooplankton production (r_1= 0.843, p<.001; r_2= 0.787, p<.001) in this beel. On the other hand, Ghorajan beel registered Rotifera abundance 56-245 (167.0 ±60.0) at station I and 92-267 ind/l, (159.0 ±56.0) at station II, which contributed significantly to net plankton (r_1= 0.474, p<.05; r_2= 0.751, p<.001) and zooplankton (r_1= 0.958, p<.001; r_2= 0.933, p<.001) in Ghorajan beel. The Rotifera abundance is apparently higher than the reports of Lahon (1983), Kar (1984), Yadava *et al.* (1987), Baruah *et al.* (1993), Sinha *et al.* (1994) and Sharma and Hussain (2001).

Deepor beel registered species diversity of Rotifera using Shannon's index was 2.528-3.594 (3.208 ±0.3) at station I and 2.585-3.657 (3.224 ±0.25) at station II exhibiting narrow range. While using Menhinick's index it ranged between 1.617-3.899 (3.117 ±0.6) at station I and between 1.94-4.545 (3.346 ±0.7) at station II, which showed wide range. Ghorajan beel exhibited species diversity of rotifers using Shannon's index 2.851-3.679 (3.301 ±0.2) at station I and 2.647-3.628 (3.194 ±0.26) at station II. While using Menhinick's index it ranged between 2.091-4.796 (3.319 ±0.8) at station I and between 1.909-3.992 (2.979 ±0.5) at station II. The species diversity of both the beels concurred with the report of Samuajan beel by Sharma and Hussain, 2001. During the course of study, Berger-parker's index of dominance registered 0.075-0.206 (0.124 ±0.04) at station I and 0.071-0.183 (0.114 ±0.03) at station II in Deepor beel. On the other hand, Berger-Parker index of dominance ranged between 0.08-0.208 (0.124 ±0.04) at station I and 0.068-0.326 (0.125 ±0.06) at station II in Ghorajan beel. The present study showed relatively low overall dominance due to fewer quantitatively important species and apparently agreed with the results of some floodplain lakes of Assam reported by Sharma and Hussain (2001).

During the whole study period, evenness of rotifers using E_1 ranged between 0.81-0.919 (0.867 ±0.03) at station I and 0.864-0.947 (0.911 ±0.02) at station II of Deepor beel. Ghorajan beel exhibited evenness using E_1 ranged between 0.853-0.969 (0.894 ±0.02) at station I and 0.855-0.925 (0.892 ±0.027) at station II.

In the present investigations, cladocerans comprised subdominant component of zooplankton in Deepor beel. The quantitative abundance of Cladocera ranged between 29-195 ind/l (105.0 ±43.0 ind/l) at station I of Deepor beel, while station II recorded 44-134 ind/l (82.0 ±28.0 ind/l). A total of 48 species at station I and 43 species at station II belonging to 6 families were identified during the study period in Deepor beel. Out of 48 species 52.1% at station I and 58.1% at station II belonging to Chydoridae family. The quantitative abundance of cladocera ranged between 47-160 ind/l (99.4 ±34.3 ind/l) at station I of Ghorajan beel, while station II recorded 28-155 ind/l (81.1 ±28.8 ind/l). The recorded abundance is higher than the reports of Khan (1987), Sinha *et al.* (1994), Sanjer and Sharma (1995) and Sharma and Hussain (2001). On the other hand, Ghorajan beel registered 42 species at both the stations of which 25 species belonging to Chydoridae family (59.5% of total Cladocera). The figures from both the beels were apparently higher than the findings of Sharma (1985) from West Bengal. The Cladocera comprised an important component 31.2% at station I and 29.3% at station II of zooplankton in Deepor beel. On the other hand, Ghoranjan beel exhibited 28.6% at station I and 28.8% at station II of the total recorded zooplankton. Deepor beel registered species diversity of Cladocera using Shannon's index were 2.151-3.178 (2.803 ±0.3) at station I and 2.164-3.251 (2.828 ±0.2) at station II; while using Menhinick' index ranged between 1.414-3.549 (2.414 ±0.5) at station I and 1.51-3.81 (2.519 ±0.6) at station II. In the present study, Ghorajan beel recorded species diversity of Cladocera using Shannon's index were 2.468-3.201 (2.851 ±0.2) at station I and station II exhibited 2.231-3.128 (2.743 ±0.24); while using Menhinick' index ranged between 1.811-3.444 (2.419 ±0.5) at station I and 1.395-3.618 (2.372 ±0.5) at station II depicting wide range. Berger-Parker's index of dominance in Deepor beel indicated 0.08-0.25 (0.147 ±0.04) at station I and 0.091-0.243 (0.161 ±0.04) at station. During the whole study period, Berger-Parker's index of dominance in Ghorajan beel recorded 0.08-0.25 (0.147 ±0.04) at station I and 0.091-0.243 (0.161 ±0.04) at station II. The present study showed relatively low overall dominance due to fewer quantitatively important species. In this investigation, evenness index (E_1) reflected 0.836-0.975 (0.895 ±0.03) at station I and 0.733-0.951 (0.913 ±0.05) at station II in Deepor beel. Evenness reflected maximum value during April in the first year and minimum value was noticed during January in the first year at station I and station II exhibited maxima during August in the first year and minima during October in the first year. However, evenness recorded 0.844 –0.963 (0.909 ±0.03) at station I and 0.84 –0.955 (0.914 ±0.029) at station

II in Ghorajan beel. In general, evenness registered inverse relationship with dominance. Coefficient correlation of water temperature (r_1= -0.691, p<.001) showed significant inverse relationship with Cladocera in Deepor beel, thereby, exhibited low temperature for their growth of population. On the other hand, it depicted direct correlation with total alkalinity (r_1= 0.478, p<.05), total hardness (r_1= 0.437, p<.05), magnesium (r_1= 0.495, p<.05) and BOD (r_1= 0.562, p<.01) in Ghorajan beel. Correlation between biotic factors revealed that Cladocera and phytoplankton (r_1= -0.523, p<.01) were inversely correlated but positively correlated with zooplankton (r_1= 0.818, p<.001; r_2= 0.892, p<.001) in Deepor beel, while the same relationships were noticed with zooplankton (r_1= 0.919, p<.001; r_2= 0.808, p<.001) in Ghorajan beel indicating interdependence between them.

Meso cyclops sp., Helio diaptomus sp. and Nauplius larvae were the only representatives of this group at both the sampled beels. Copepoda registered relatively low qualitative diversity in Deepor beel. Diversity of this group in this beel though low, abundance among zooplankton population was quite high especially during summer months. It formed quantitatively most important group and ranged between 10-122 ind/l (40.0 ±26.0); but did not depict any definite monthly pattern at station I, while station II recorded 7-77 ind/l (27.0 ±16.0) in Deepor beel. Maximum and minimum abundance were observed during July in the second year (122 ind/l) and during October in the first year (10 ind/l) at station I in Deepor beel. A peak of nauplii was observed during April and May at both the stations, indicating a reproductive increment. On the contrary, Copepoda was represented by three species at both the stations in Ghorajan beel. The population density of Copepoda ranged between 6-81 ind/l (35.0 ±22.0); but did not depict any definite monthly pattern at station I, on the other hand station II recorded 4-93 ind/l (34.0 ±25.0). In addition, the density of copepod corresponded with higher concentrations in a number of abiotic factors. Positive relationships with total alkalinity (r_1= 0.418, p<.05; r_2= 0.427, p<.05) and BOD (r_1= 0.571, p<.01; r_2= 0.423, p<.05) in Ghorajan beel. Among the biotic factors, copepod exhibited a distinct influence on zooplankton (r_1= 0.427, p<.05) and net plankton (r_1= 0.463, p<.05) in Deepor beel, while it showed positive relationships with zooplankton (r_1= 0.859, p<.001; r_2= 0.599, p<.01) and net plankton (r_1= 0.698, p<.001; r_2= 0.445, p<.05) in Ghorajan beel.

The Rhizopoda formed the third qualitative important group in both the beels. The population density of this group, however, ranged between 5-43 ind/l (14.2 ±11.1) at station I and 5-42 ind/l (22.4 ±12.5) at station II in Deepor beel. On the contrary, Ghorajan beel showed between 4-47 ind/l (10.8 ±9.4) at station I and 4-70 ind/l (21.8 ±16.3) at station II. The mean values of Deepor beel were marginally higher than that of Ghorajan beel. On the other hand, the mean values of both the beels established definitely higher values than the reports of Samuajan beel of Assam by Sharma and Hussain (2001). The Rhizopoda were represented by 12 species at both the sampled beels This group registered significant direct correlations with specific conductivity (r_1=0.493, p<.05), total alkalinity (r_1=0.452, p<.05) and total hardness (r_1= 0.514, p<.01; r_2= 0.485, p<.05) in Ghorajan beel, which agreed with the results of Sharma and Hussain (2001). Rhizopoda depicted direct correlations with net plankton (r_1= 0.417, p<.05), zooplankton (r_1= 0.597, p<.01; r_2= 0.762, p<.001), Rotifera (r_1= 0.426, p<.05; r_2= 0.668, p<.01), Cladocera (r_2= 0.513, p<.01) and Copepoda (r_1= 0.558, p<.01) in Deepor beel indicating interdependence among them. Similarly, it also shared direct correlations with net plankton (r_1= 0.572, p<.01; r_2= 0.546, p<.01), zooplankton (r_1= 0.472, p<.05; r_2= 0.576, p<.01), Rotifera (r_2= 0.627, p<.01), Cladocera (r_1= 0.427, p<.05) and Copepoda (r_1= 0.468, p<.05) in Ghorajan beel. *Arcella discoides* occurred throughout the study period and mainly contributed to their maximum density in both the sampled beels, which agreed with reports of Sharma and Hussain (2001).

Two planktonic ostracods were occasionally very abundant. They were present most of the months dominated by Cypricercus sp. and Cypris sp. at both the stations in Deepor beel. Popula-

tion density of Cypricercus sp. ranged between 0-33 ind/l at station I and station II exhibited 0-14 ind/l, while Cypris sp. showed 0-7 ind/l and 0-6 ind/l at station I and II respectively. On the other hand, Ghorajan beel exhibited Ostracods dominated by the same species Cypricercus sp. and Cypris sp. at both the stations. Population density of Cypricercus sp. ranged between 0-16 ind/l at station I and station II exhibited 0-6 ind/l, while Cypris sp. showed 0-8 ind/l and 0-4 ind/l at station I and II respectively. During the zooplankton peak they became less abundant perhaps due to competition by the large numbers of other herbivorous zooplankton. Ostracods depicted direct correlations with zooplankton (r_1=0.443, p<.05) and Copepoda (r_1=0.634, p<.01) in Deepor beel indicating interdependence among the attributes. However, it depicted direct correlations with zooplankton (r_1=0.439, p<.05), Rotifera (r_1=0.427, p<.05) and Cladocera (r_1=0.513, p<.05) in Ghorajan beel. Conchostraca sp. was found at both the stations in Deepor beel in a very negligible quantity.

(III) PHYTOPLANKTON:

Phytoplankton taxa recorded in the present study of Deepor beel belonged to five groups namely Chlorophyta, Bacillariophyta, Cyanophyta, Euglenophyta, Dinophyta and Chrysophyta. These, in turn, were represented by 59 species at station I and also the same number of species at station II. The species richness of phytoplankton fluctuated between 16-34 species (18.0 ±4.0) and 20-35 species (20.0 ±5.0) at station I and II respectively. The maximum and minimum number of species were noticed in the month of June in the first year at station I and in November in the first year. The abundance of phytoplankton ranged between 219-682 ind/l (342.0 ±114.0) at station I and 221-654 ind/l (362.0 ±119.0) at station II of Deepor beel. Phytoplankton of this beel are represented by 55 species at station I and 54 species at station II in Ghorajan beel. In the present study, population density of phytoplankton in this beel fluctuated between 220-727 ind/l (320.0 ±136.0) at station I and 130-486 ind/l (222.0 ±84.0) at station II. However, station I exhibited 46.1-70.38% of net plankton, while station II showed 33.08-64.5% in Deepor beel. On the other hand, Ghorajan depicted 53.14-64.11% at station I and 38.8-60.44% at station II. Phytoplankton comprised a dominant composition of net plankton. This was also ascertained by significant positive correlation with net plankton (r_1=0.626, p<.01; r_2=0.878, p<.001) in Deepor beel, while correlation analysis revealed that phytoplankton and net plankton were significantly correlated (r_1=0.759, p<.001; r_2=0.621, p<.01) in Ghorajan beel. Quantitative abundance of the sampled floodplain lakes is distinctly higher than the reports from reservoirs, which concurred with the report of Sharma, (1995).

In the present observation, Chlorophyta were represented by 23 species at both the stations in Deepor beel, while Ghorajan beel registered 21 species. Chlorophyta exhibited a positive and significant relationships with net plankton (r_1=0.619, p<.01; r_2=0.798, p<.001), phytoplankton (r_1=0.963, p<.001; r_2=0.949, p<.001), Bacillariophyta (r_1=0.861, p<.001; r_2=0.793, p<.001), Cyanophyta (r_1=0.697, p<.001; r_2=0.787, p<.001), Chrysophyta (r_1=0.704, p<.001) and specific conductivity (r_2=0.428, p<.05) indicating interdependence with each other. On the other hand, significant inverse correlation with Cladocera (r_1=-0.477, p<.01) at station I in Deepor beel. Similarly, it exhibited significant positive correlation with net plankton (r_1=0.746, p<.001; r_2=0.526, p<.01), phytoplankton (r_1=0.982, p<.001; r_2=0.962, p<.001), Bacillariophyta (r_1=0.633, p<.001; r_2=0.924, p<.001), Cyanophyta (r_1=0.912, p<.001; r_2=0.696, p<.001), Chrysophyta (r_1=0.505, p<.01; r_2=0.603, p<.01) and total alkalinity (r_2=0.432, p<.05). This group showed inverse but insignificant impact of pH in Deepor beel but no specific trend was evident in Ghorajan beel. The Bacillariophyta were represented by 20 and 19 species in Deepor and Ghorajan beel respectively. Bacillariophyta showed significant positive correlation with net plankton (r_1=0.598, p<.01; r_2=0.736, p<.001), phytoplankton (r_1=0.701, p<.001; r_2=0.892, p<.001), Chlorophyta (r_1=0.861, p<.001; r_2=0.793, p<.001), Chrysophyta (r_1=0.704, p<.001), calcium (r_1=0.419, p<.05) and BOD (r_2=0.426, p<.05). On the

other hand, significant inverse correlation with Cladocera (r_1=-0.552, p<.01) at station I in Deepor beel. This group registered significant positive correlation with phytoplankton (r_1=0.674, p<.001; r_2=0.938, p<.001), Chlorophyta (r_1=0.633, p<.001; r_2=0.924, p<.001) and Chrysophyta (r_1=0.546, p<.01; r_2=0.652, p<.001) and significant inverse correlation with zooplankton (r_1=-0.624, p<.01) at station I in Ghorajan beel indicating negative impact on the population pattern. The Cyanophyta was represented by 8 and 7 taxa in Deepor and Ghorajan beel respectively. Cyanophyta showed significant positive correlation with phytoplankton (r_1=0.782, p<.001; r_2=0.907, p<.001), Chlorophyta (r_1=0.697, p<.001; r_2=0.787, p<.001), Chrysophyta (r_1=0.516, p<.01), transparency (r_2=0.462, p<.05), specific conductivity (r_2=0.409, p<.05) and BOD (r_1=0.454, p<.05). On the other hand, significant inverse correlation with zooplankton (r_1=-0.545, p<.01), Cladocera (r_1=-0.488, p<.05), magnesium (r_1=-0.416, p<.05) and silicate (r_1=-0.439, p<.05) at station I in Deepor beel. However, Cyanophyta exhibited significant positive correlation with net plankton (r_1=0.717, p<.001; r_2=0.508, p<.01), phytoplankton (r_1=0.949, p<.001; r_2=0.820, p<.001), Chlorophyta (r_1=0.912, p<.001; r_2=0.696, p<.001), Chrysophyta (r_1=0.416, p<.05; r_2=0.604, p<.01) and calcium (r_2=0.411, p<.05) in Ghorajan beel. In the present investigation, Euglenophyta was qualitatively less important and poorly represented by only 3 species in Deepor and Ghorajan beel. This group exhibited positive correlation with specific conductivity (r_1=0.431, p<.05) in Ghorajan beel. Euglenophyta showed significant positive correlation with net plankton (r_2=0.609, p<.01), phytoplankton (r_1=0.802, p<.001; r_2=0.695, p<.001), Chlorophyta (r_1=0.738, p<.001; r_2=0.581, p<.01), Cyanophyta (r_1=0.553, p<.01; r_2=0.645, p<.001) and Chrysophyta (r_1=0.606, p<.01) in Deepor beel and significant inverse correlation with Cladocera (r_1=-0.619, p<.01) at station I in this beel. On the contrary, it showed significant positive correlation with net plankton (r_1=0.599, p<.01), phytoplankton (r_1=0.678, p<.001), Chlorophyta (r_1=0.631, p<.001), Cyanophyta (r_1=0.589, p<.01), Rhizopoda (r_1=0.672, p<.001), specific conductivity (r_1=0.431, p<.05) and phosphate (r_1=0.595, p<.01) at station I in Ghorajan beel. The Dinophyta were represented only by some motile algae Gonyaulax sp., Peridinium sp. and Ceratium sp. in both the sampled beels. It showed significant positive correlation with net plankton (r_1=0.622, p<.01; r_2=0.499, p<.05), phytoplankton (r_1=0.442, p<.05; r_2=0.414, p<.05), Chlorophyta (r_1=0.421, p<.05) and Cyanophyta (r_2=0.409, p<.05) in Deepor beel, while it exhibited significant inverse relationship with specific conductivity (r_1=-0.431, p<.05) at station I in this beel. On the other hand, it showed significant positive correlation with net plankton (r_2=0.508, p<.01), phytoplankton (r_2=0.665, p<.001), Chlorophyta (r_2=0.542, p<.01), Bacillariophyta (r_2=0.514, p<.01), Cyanophyta (r_2=0.498, p<.05), Rhizopoda (r_1=0.468, p<.05), free carbon dioxide (r_1=0.457, p<.05) and total alkalinity (r_1=0.495, p<.05) in Ghorajan beel. The Chrysophyta was represented by only two species in both the beels. Chrysophyta showed significant positive correlation with phytoplankton (r_1=0.737, p<.001), Chlorophyta (r_1=0.729, p<.001), Bacillariophyta (r_1=0.704, p<.001), Cyanophyta (r_1=0.516, p<.01) and Euglenophyta (r_1=0.606, p<.01). It exhibited significant inverse relationships with zooplankton (r_1=-0.591, p<.01), Cladocera (r_1=-522, p<.01) and dissolved oxygen (r_1=-408, p<.05) in Deepor beel. On the other hand, it showed significant positive correlation with net plankton (r_2=0.411, p<.05), phytoplankton (r_1=0.511, p<.01; r_2=0.628, p<.01), Chlorophyta (r_1=0.505, p<.01; r_2=0.603, p<.01), Bacillariophyta (r_1=0.546, p<.01; r_2=0.652, p<.001), Cyanophyta (r_1=0.416, p<.05; r_2=0.604, p<.01) and calcium (r_1=0.412, p<.05), while it depicted significant inverse relationship with zooplankton (r_1=-0.617, p<.01) in Ghorajan beel. The multiple correlation of phytoplankton with sixteen abiotic factors was computed and registered 76.5% at station I and 72.4% at station II in Deepor beel, while Ghorajan beel accounted for 72.9% at station I and 59.0% at station II.

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BIODIVERSITY AND SYNECOLOGY OF ZOOPLANKTON IN FLOODPLAIN LAKES OF LOWER ASSAM (N.E. INDIA)

Forwarded

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A THESIS

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Declaration

I, **Pradip Thakuria**, hereby declare that the subject matter of the thesis is the record of work done by me, that the contents of this thesis did not form basis of the award of any previous degree to me or to the best of my knowledge to anybody else and that the thesis has not been submitted by me for any research degree in any other university/institute.

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Dedicated

to loving memory of my beloved uncle

(Bhal Dewta),

Late Girish Chandra Thakuria

who left for heaven.

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(Pradip Thakuria)

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Chapter I

INTRODUCTION

Water is the prime necessity of human life. All human civilizations have developed around some natural sources of water. In his quest for water, man has not only endeavoured to explore new sources of water but also to improve its quality and quantity. Water is one of nature's greatest gifts to mankind. Freshwater amounts to about 2.53% of the global water balance and three quarter of it is trapped in the polar ice and glaciers. The scarcity of accessible freshwater is of great interest as well as concern since water is an indispensable liquid required for several purposes including drinking, sanitation, irrigation, navigation and recreation. In recognition of the importance of water resources to our planet's future, the year 2003 was proclaimed as the 'International Year of Freshwater' by the General Assembly of the United Nations with the main objective of raising awareness of the importance of protecting and managing the same in a sustainable way. Moreover, 2005-2015 is proclaimed as 'Decade of water for life'. The significance of harvesting, conservation and management of freshwater resources is being rated as highest priority for global attention and action. Demand upon freshwater resources has rapidly escalated due to radical increase in world population, industrialization, urbanization and expansion of agriculture poses a great environmental stress for the survival of mankind.

Man's interest in water around him is certainly as old as man himself. To survive in the wild, early man had to become, in his way a naturalist, a full time ecologist and this required knowledge of the water. This source of nature, its motion and changing condition as it flows to the sea and the life it supports along these are now subject of limnology, the science of inland water (Reid and Wood, 1976). The subject came of age when the three-volume monograph, mainly the outcome of research done on Lac Leman (Lake Geneva), was published by Forel (1901). Further, prominent earlier scientific development in this field included the study on distribution and ecology of crustacean zooplankton in Danish lakes by Muller (1867), recognition of lakes as functioning units or 'microscosms' by Forbes (1887) and development of the widely used Wrinkler technique for dissolved oxygen determination by Wrinkler (1888). Various important subsequent limnological developments have been indicated by Kalf (2002). The period between 1970-2000, on the other hand, saw a rapid development in several dimensions of limnology mainly characterized by significant progress in quantifying links between community structure and functioning and role of fish therein, greater integration of fish ecology in limnology and growing interest in wetlands as systems (Kalff, loc. sit). However, limnology is a young branch of science in India, barely around one century old and it is only recently that experimental ecology of freshwaters has started in the country. In the wake of ecological exploration of lentic water habitats, the limnological perspectives draw a serious attention in Indian freshwater bodies especially in the lakes and

reservoirs. Pruthi (1933) and Sewell (1934) initiated the studies on hydrology and hydrobiology of a pond in Indian Museum Compound, Kolkota and which could be considered as one of the earliest works in India. However, it took some time for the tempo of work on limnology to catch up in the country. A review of limnological literature from India exhibits limited information on abiotic environment and planktonic communities of these biotopes. Some useful contributions related to the mentioned aspects are those by Gulati and Wartz-Shulz (1980), Michael (1980), Sharma 2000 and Sharma *et al.* 2000. In the North-east India, reports representing water quality of the sub-tropical environs are mostly from Meghalaya and Assam, which include works by Alfred and Thapa (1995), Sharma (1995, 1999), Sharma and Lyngdoh (1999), Sharma and Wanswett (1999), Sharma and Hussain (1999), Sharma (2000), Sharma *et al.* (2000) and Sharma and Lyngskor (2003). Similarly, major contributions to the Zooplankton diversity in this region are by Sharma and Sharma (1987, 1990, 1997, 1999, 2001); Sharma and Hussain (1999); Sharma *et al.* (2000) and Sharma (2000, 2005).

It has been established that wetlands provide food, fodder and many forms of medicinal plants apart from their beneficial ecological effects that include sanitation, self-purification, cultural and aesthetic satisfaction. Wetlands, being major components of the freshwater resource and regarded as biologically sensitive ecosystems, playing also a vital role in the inland fish production. Freshwater ecosystems include diversified biotopes ranging from ephemeral tree-holes and pools to large natural lakes and man-made reservoirs and the mighty riverine systems. Of these, the floodplain lakes comprise an integral component of the rural landscape in the different river basins. These environs, often, combine salient characteristics of lentic and lotic habitats and, hence, are unique and interesting ecotones. They deserve special mention because of their rich aquatic biodiversity and are considered to be one of the most productive ecosystems in the world (Odum, 1978; Mitsch and Gosselink, 1986). The floodplain lakes comprise an important component of inland aquatic resources of India (0.20 million ha) and North – Eastern region (0.12 million ha). They represent one of the lucrative sources of fisheries in eastern Uttar Pradesh, northern Bihar, West Bengal, Assam, valley districts of Manipur and foothills of Arunachal Pradesh and Meghalaya. Further, they are invariably termed as "beels", "Jheels" "mauns", "chaurs", "hoars", "pats" and "bheries" in different parts of India. The floodplain lakes or beels deserve special mention in the state of Assam; they cover around 1,00,000 ha area, which in turn, comprise about 93% of total lentic fish prone area and about 81% of total lentic area of this state. According to Goswami (1997), the state has 1392 beels, which include around 423 (30.4%) registered and 969 (69.6%) unregistered beels. On the other hand, a recent report of the Assam Remote Sensing Application Centre indicates total 3536 beels in Assam. They exhibit greatest scope for fish production through proper management; the traditional methods of fish farming yield production of only 200 kg/ha/year, which can be increased to about 1000 kg/ha/year through the practice of scientific fish farming (Sugunan, 1997). A proper understanding of the complex ecological rela-

tionships in the floodplain lakes is imperative for their scientific management as well as in formulating strategies for stock manipulation and optimum exploitation of the biological productivity (Jhingran 1989). The studies on different aspects of limnology including temporal variations in water quality and plankton production of the floodplain lakes are, therefore, essential to understand their nature, dynamics and trophic status and also to assess fishery potential. A review of limnological literature from India, however, exhibits limited information on abiotic environment and planktonic communities of these biotopes. Some useful contributions related to the mentioned aspects are those by Pandit (1980), Pandit and Kaul (1982), Khan (1987), Yousuf *et al.* (1986), Rai and Dutta Munshi (1988), Vass (1989), Vyas (1989), Baruah *et al.* (1993), Sinha *et al.* (1994) and Sanjer and Sharma (1995). On the other hand, investigations from N.E. India are restricted to few published reports (Yadava *et al.*, 1987; Yadava and Dey, 1990; Dutta *et al.*, 1995; Sharma and Hussain, 1999; Sharma, 2000; Sharma *et al.* 2000) and a number of unpublished works (Lahon, 1983; Kar, 1984; Goswami, 1985; Yadava, 1987 and Goswami, 1997) from the floodplain lakes of Assam. The magnitude of the indicated literature may even provide a misleading picture since a number of the stated works contains limited information on composition and ecology of plankton in general and zooplankton in particular.

The present study assumes special significance in view of the mentioned lacunae and it deals with (i) to provide an account of zooplankton biodiversity in the floodplain lakes of lower Assam with reference to the interesting elements on faunal diversity of Rotifera and Cladocera and (ii) to undertake observations on synecology of zooplankton in selected floodplain lakes of lower Assam with special reference to their abundance, community structure, seasonal succession, dominance, species diversity, evenness and limnological correlations between various abiotic and biotic factors. The biodiversity of zooplankton is based on extensive qualitative plankton samples collected in different seasons from various floodplain lakes of lower Assam. Certain abiotic factors namely water temperature, pH, transparency, specific conductivity, total alkalinity, total hardness are recorded for the sampled biotopes to provide basic information on their water quality. The examined taxa are suitably illustrated. The general nature and composition of the examined taxocoenosis are discussed. Comments are made on the distribution and ecology of various interesting elements. On the other hand, the synecology of zooplankton deals with investigations on temporal variations, at regular monthly intervals, in different parameters of water quality as well as on qualitative and quantitative composition of net plankton, zooplankton and phytoplankton in two floodplain lakes namely Deepor beel and Ghorajan beel located in lower Assam. The observations are made on population densities of net plankton, zooplankton, phytoplankton and their constituent groups. An attempt is made to compute limnological correlations between the recorded abiotic and biotic parameters.

Chapter II

MATERIALS AND METHODS

STUDY SITES

The following floodplain lakes were selected for the detailed limnological studies on temporal variations of water quality and qualitative as well as quantitative composition of net plankton, zooplankton and phytoplankton.

Deepor beel: It is located (Latitude: 26° 03′ 26″ N; Longitude: 90° 36′ 39″ E; Area: 443 ha) in Kamrup district of Assam, near Guwahati city. This beel is of riverine origin and is an oval floodplain **(Fig.1-A).** The Khanajan river in the north is working as the main outlet/inlet channel which connects the river Brahmaputra while another redundant canal connects it with the Kalmoni river in the west. The river Basistha is the main inlet for the beel, which carries stream water from Basistha hill stream. This beel is bordered by the National Highway No. 37, which passes at a little distance from the eastern margin while the Assam Engineering College road passes in the northern side of the beel. The Chakardoi Hill Range connecting the Meghalaya Hill Range borders the southern part. It has recently been recognized as 'Ramsar site'. Several macrophytes that are commonly found in this beel which include *Hydrilla verticillata,. Naias indica,. Euryale ferox, Vallisnaria spiralis, Salvinia cucullata, Utricularia flexuosa, Trapa bispinos, Eichhornia crassipes, Monochoria hastaefolia, Xanthium strumarium, Ipomea fistulosa, Croton bonplandianum, Hygrorhiza aristata, Polygonum hydropiper, Limnophila sp., Chara sp., Nymphaea sp., Lemna sp., Azolla sp.* and *Pistia sp.* The fish fauna of the beel includes *Labeo rohita, Catla catla, cirrhina mrigala, Wallago attu, Labeo gonius, Labeo bata, Labeo calbasu, Cirrhina reba, Notopterus chitala, Notopterus notopterus, Mystus seenghala, M. cavassius, M. vittatus, Channa striatus, C. marulius, C. gachua, C. punctatus, Puntius sophore, P. ticto. P. sarana, Colisa fasciatus, Heteropneustes fossilis, Clarias batrachus, Chanda nama, C. ranga, Eutropichthyes vacha, Callichrous pabda, Nandus nandus, Amphipnous cuchia, Mastacembelus sp.* and *Anabas testudineus.*

Ghorajan beel: It is a perrenial beel located (Latitude: 26° 09′ 26″ N; Longitude: 90° 41′ 25″, Area: 117ha) in Kamrup district of Assam and at a distance of 2 km.from the National Highway No. 31 and about 20 km from Guwahati city **(Fig.1-B).** It is of a riverine origin connecting with the river Brahmaputra with a 1 km. channel. The Agiathuri railway station borders the west - southern part of the beel. Several macrophytes are found in this beel, which include *Hydrilla verticillata, Naias indica, Euryale ferox, Vallisnaria spiralis, Salvinia cucullata, Utricularia flexuosa, Trapa bispinosa, Monochoria hastaefolia, Xanthium strumarium, Ipomea fistulosa, Croton bonplandianum, Hygrorhiza aristata, Polygonum hydropiper, Limnophila sp., Chara sp., Lemna sp.* and *Azolla sp.* The fish fauna of this beel is composed of *Labeo rohita, Catla catla, cirrhina mrigala, Wallago attu, Labeo gonius, Labeo*

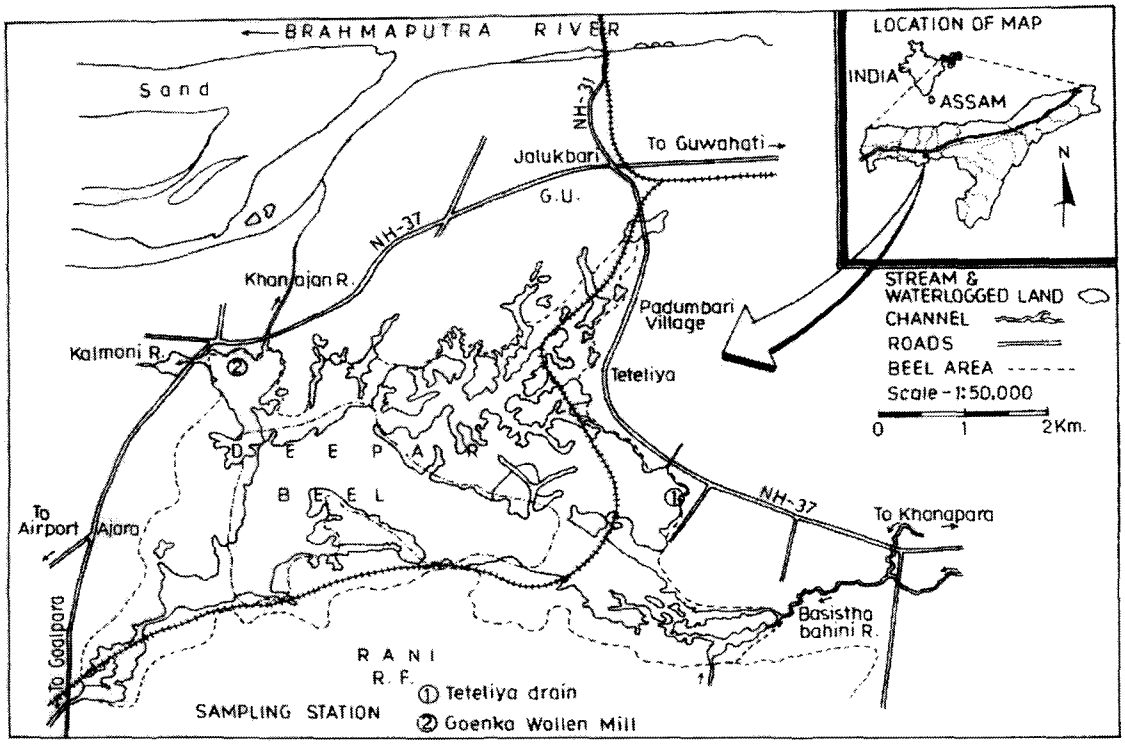


***Fig. 1* (A) : MAP OF DEEPOR BEEL**

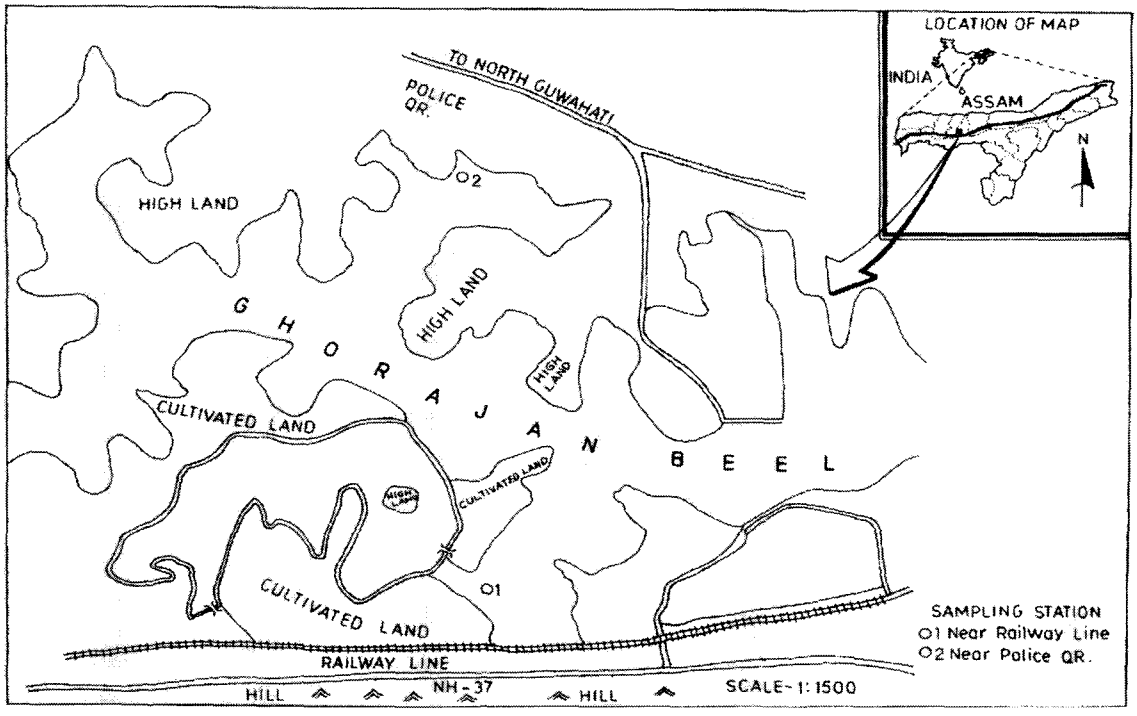


***Fig. 1* (B) : MAP OF GHORAJAN BEEL**

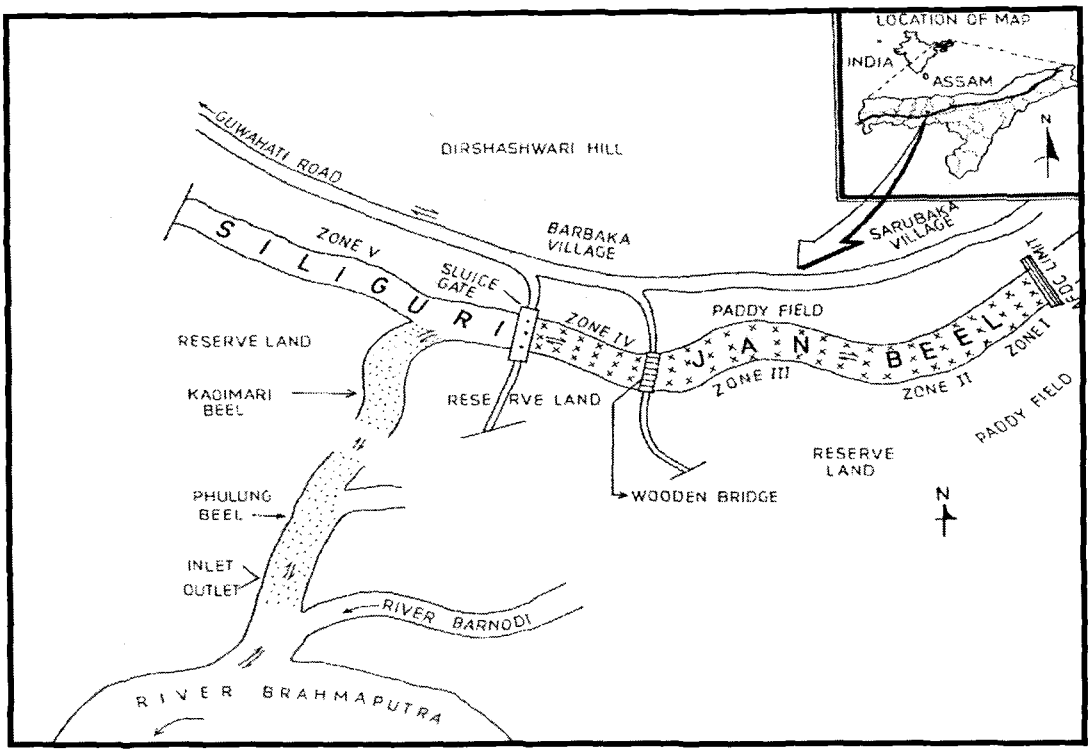


***Fig. 1* (C) : MAP OF SILIGURIJAN BEEL**

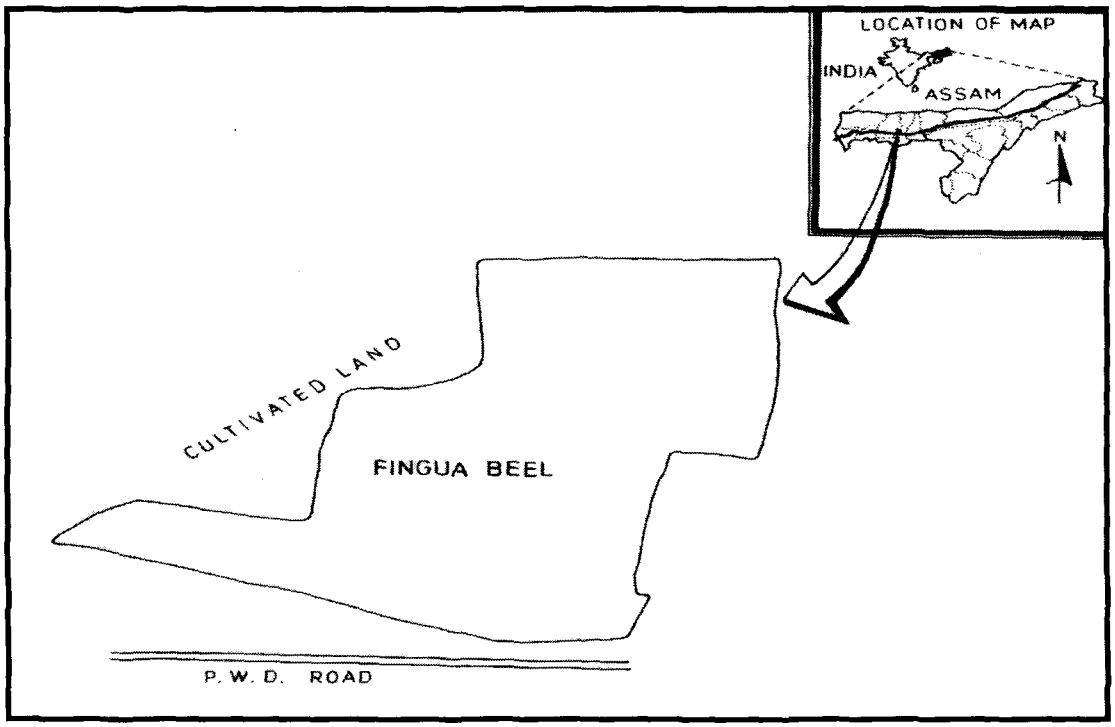


***Fig. 1* (D) : MAP OF FINGUA BEEL**

bata, Labeo calbasu, Cirrhina reba, Notopterus chitala, Notopterus notopterus, Channa striatus, C. marulius, C. gachua, C. punctatus, Puntius sophore, P. ticto. P. sarana, Colisa fasciatus, Heteropneustes fossilis, Clarias batrachus, Chanda nama, C. ranga, Eutropichthyes vacha, Callichrous pabda, Nandus nandus, Amphipnous cuchia, Mastacembelus sp. and *Anabas testudineus.*

Besides the above, the following floodplain lakes were also sampled for the study of biodiversity of zooplankton.

Siligurijan beel: It is located (Latitude: 26° 13′ 26″ N; Longitude 91° 22′ 51″ E; Area 20 ha) in Kamrup district of Assam and at the foothill of Dirgheswari hill, near North Guwahati. This beel is characterised as a channel type and is connected with Kawoimari beel, which acts as a seasonal inlet and finally connected with the river Brahmaputra **(Fig.1-C)**. Since the beel is located in the shoreline of river Brahmaputra, during the monsoon season its surrounding area is submerged with flood. However, there is luxuriant growth of aquatic plants such as *Hydrilla verticillata,. Naias indica,. Euryale ferox, Vallisnaria spiralis, Salvinia cucullata, Trapa bispinos, Eichhornia crassipes, Ipomea fistulosa, Polygonum hydropiper, Limnophila sp., Chara sp., Nymphaea sp., Lemna sp., Azolla sp.* and *Pistia sp.* Its fish fauna includes *Labeo rohita, Catla catla, cirrhina mrigala, Wallago attu, Labeo gonius, Labeo bata, Labeo calbasu, Cirrhina reba, Notopterus chitala, Notopterus notopterus, Mystus seenghala, M. cavassius, M. vittatus, Tor tor, Tor putitora, Channa striatus, C. marulius, C. gachua, C. punctatus, Puntius sophore, P. ticto, P. sarana, Colisa fasciatus, Heteropneustes fossilis, Clarias batrachus, Chanda nama, C. ranga, Eutropichthyes vacha, Callichrous pabda, Nandus nandus, Amphipnous cuchia, Mastacembelus sp. , Anabas testudineus* and *Bagarius bagarius.*

Fingua beel: This beel is located at Maikuchi village about 3 km north to the district headquarter town of Barpeta district. It is a flat type beel surrounded by Maikuchi village and Gharpur village on the north, Gharpur village on the east, Dhakua and Maikuchi on the south and the Kahibari and Patbausi village on the west **(Fig.1-D)**. The area of the beel is 112 ha which increases upto 140 to 150 ha during monsoon and as small as only 1.5 ha, restricting to two small 'Kur' (deeper area) in the winter. It is a floodplain lake and is connected with the river Chaukhowa through a seasonal channel. However, due to flat nature of the beel, paddy is cultivated at the low-lying marginal areas on the eastern part of the beel (about 8 to 10 ha). There is luxuriant growth of aquatic plants in this beel such as *Hydrilla verticillata, Naias indica, Euryale ferox, Vallisnaria spiralis, Salvinia cucullata, Utricularia flexuosa, Trapa bispinosa, Monochoria hastaefolia, Xanthium strumarium, Ipomea fistulosa, Croton bonplandianum, Hygrorhiza aristata, Polygonum hydropiper, Limnophila sp., Chara sp., Lemna sp.* and *Azolla sp.* The fish fauna of the beel includes *Labeo rohita, Catla catla, cirrhina mrigala, Wallago attu, Labeo gonius, Labeo bata, Labeo calbasu, Cirrhina reba, Mystus seenghala, M. cavassius, M. vittatus, Channa striatus, C. marulius, C. gachua, C. punctatus, Puntius sophore, P. ticto. P. sarana, Colisa fasciatus, Heteropneustes fossilis, Clarias batrachus, Chanda nama, C. ranga, Eutropichthyes vacha, Callichrous pabda, Nandus nandus, Amphipnous cuchia, Mastacembelus sp. , Anabas testudineus* and *Rasbora sp.*

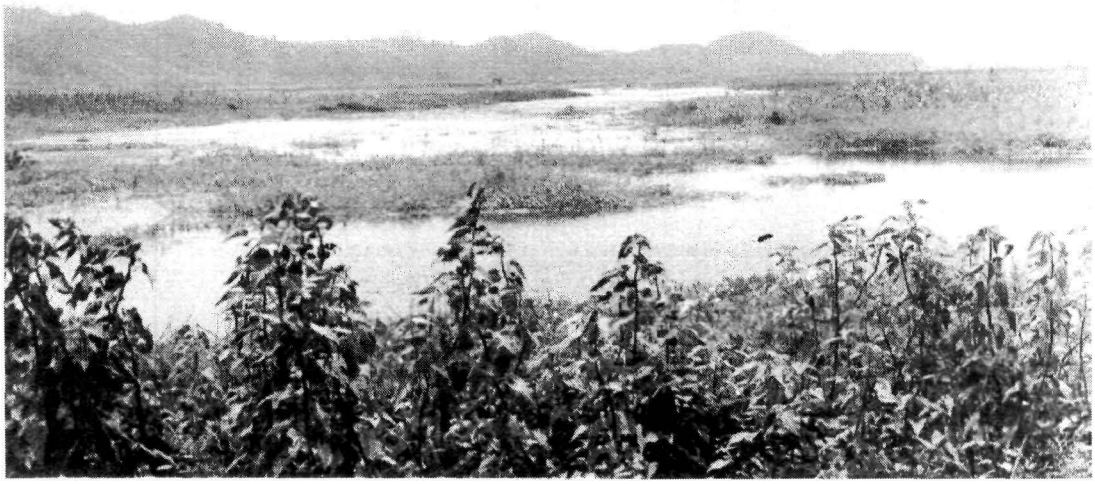


Fig. 2 (A) Deepor Beel (Station - I)

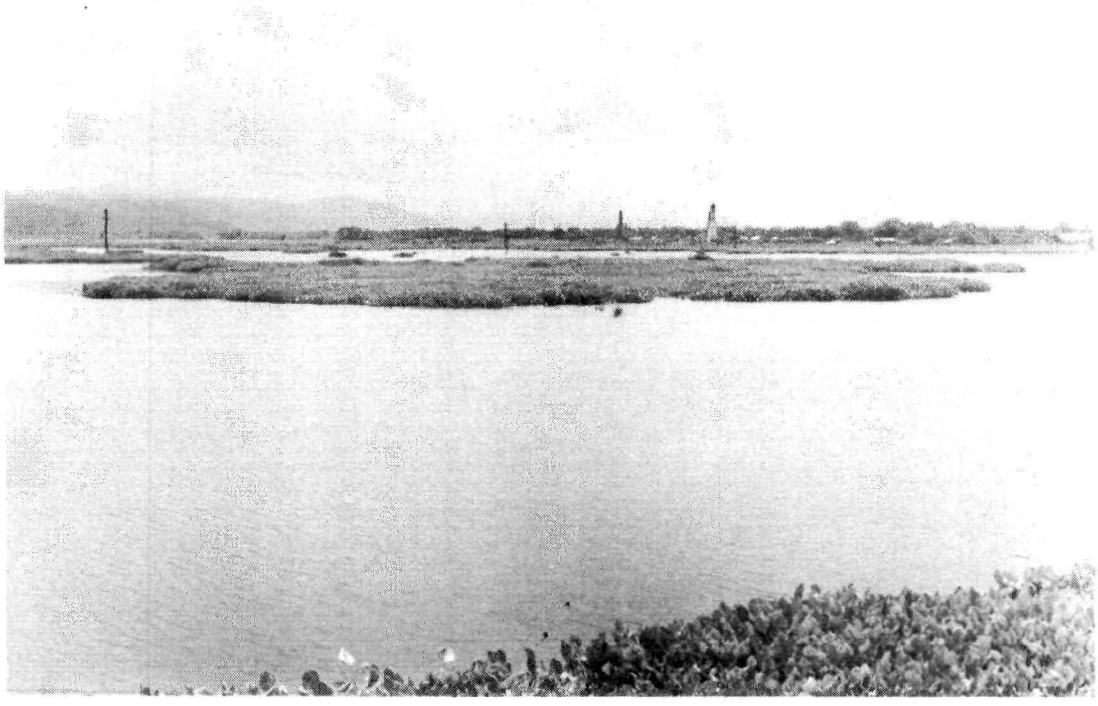


Fig. 2 (B) Deepor Beel (Station - II)

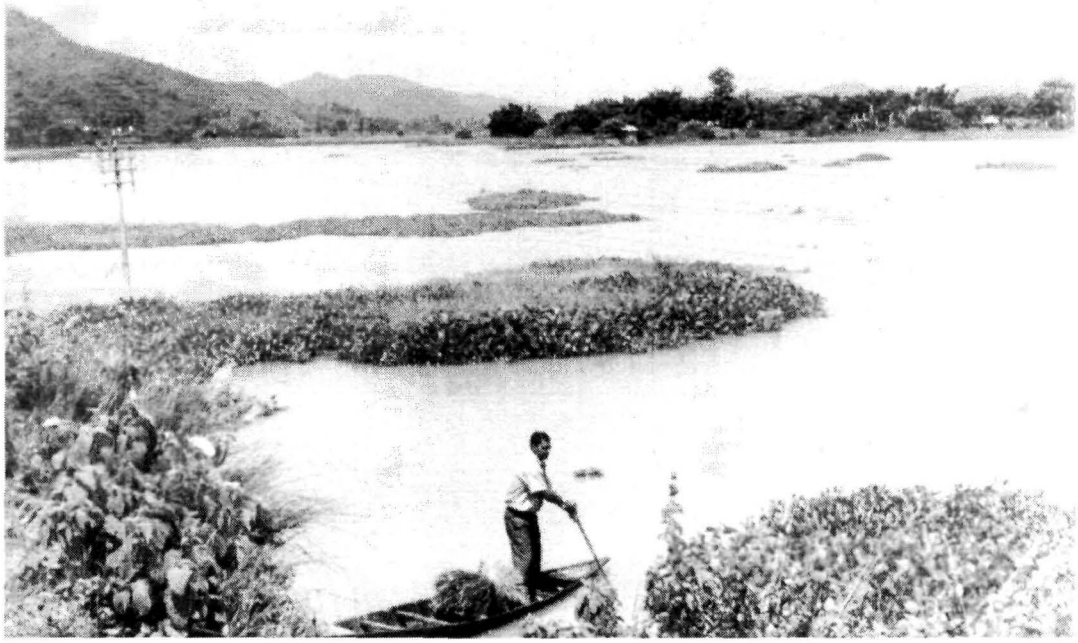


Fig. 2 (C) Ghorajan Beel (Station - I)

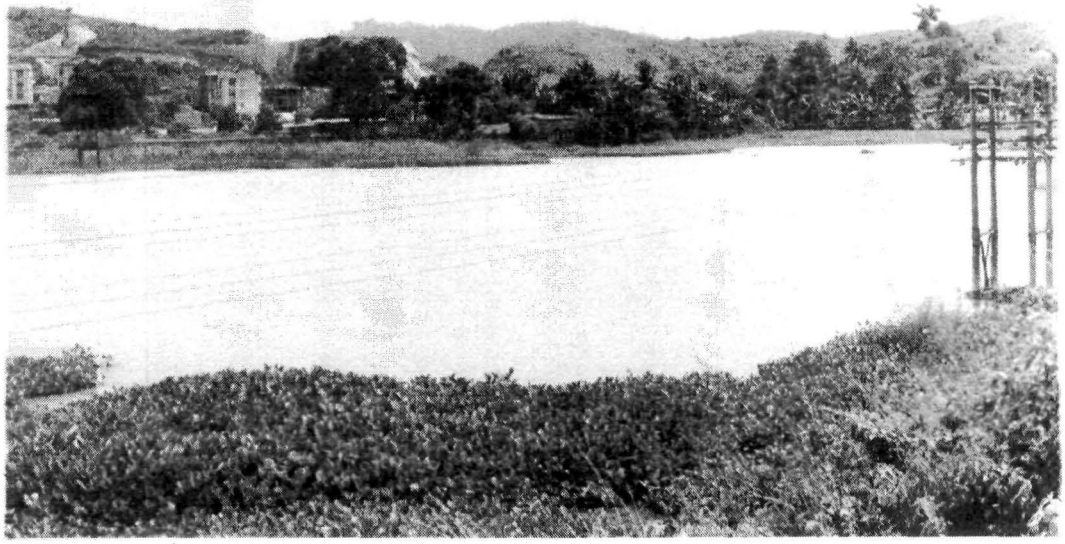


Fig. 2 (D) Ghorajan Beel (Station - II)

Methods of study:

For the synecology of zooplankton, investigations on temporal variations, at monthly intervals, in different parameters of water quality namely water temperature, transparency, pH, specific conductivity, dissolved oxygen, free carbon dioxide, total alkalinity, total hardness, calcium, magnesium, chloride, sodium, potassium, sulphate, phosphate, nitrate, silicate, total dissolved solids, dissolved organic matter and biological oxygen demand (BOD) as well as qualitative and quantitative composition of net plankton, zooplankton and phytoplankton were carried out in Deepor and Ghorajan beel during the period August, 1999 - July, 2001. Besides the above, qualitative plankton and water samples were collected seasonally (autumn, winter, monsoon and summer) from two more floodplain lakes for the study of biodiversity of zooplankton during the same period with the study of synecology of zooplankton.

Air and water temperatures were recorded. Light penetration was measured with a Secchi disc method. pH and specific conductivity were measured with digital pH meter and conductivity bridge meter respectively. The estimation of dissolved oxygen was done by the modified Wrinkler's method. Various other chemical parameters were analyzed following A.P.H.A. (1992). The rainfall data was obtained from the Guwahati Meteorological Centre. The plankton samples were collected by nylobolt plankton net (No.25) and preserved in 5% formalin. Qualitative samples were obtained by towing the net in the water bodies and quantitative samples were collected from the sampling stations by filtering 25 litres of water and each sample was concentrated to 25 ml. Quantitative enumeration of planktonic communities was done using the Sedgwick-Rafter counting cell. Important and interesting zooplankton taxa were isolated and mounted in polyvinyl alcohol-lactophenol mixture for detailed study. Different plankton taxa were identified following the important works of Edmondson (1959), Kutikova (1970) Needham and Needham (1972), Koste (1978), Smirnov (1971, 1976), Michael and Sharma (1988), Battish (1992), Segers (1995), Sharma and Sharma (1999, 2000). The examined taxa were suitably illustrated. The general nature and composition of the examined taxocoenosis were discussed. The observations were made on population densities of net plankton, zooplankton and their constituent groups, percentage composition of different planktonic taxa and temporal variations in qualitative and quantitative diversity.

Percentage similarities of zooplankton between monthly collections was calculated *vide* Sorensen's index (Sorensen, 1948):

$$S=\frac{2c}{a+b}x100$$

Where as, S= Percentage community similarity,
a= Number of species of a community in a monthly collection,
b= Number of species of the same community in another monthly collection,
c= Number of species common to both the monthly collections.

The structure of the zooplankton community was expressed through the following diversity, evenness and dominance indices:

Species diversity:

Shannon's index:

$H' = -\sum pi \ln pi$ (Ludwig and Reynolds, 1988)

Where as, pi = n/N
n= density of individual species
N= total density

Menhinick's index:

$D_{Mn}= \frac{S}{\sqrt{N}}$ (Menhinick, 1964)

Where as, S = total number of species
N = total density

Dominance:

Berger-Parker's index:

$d = \frac{N\max}{N}$ (Berger-Parker, 1970)

Where as, N max = density of most abundant species
N = total density

Evenness:

$E_1= \frac{H'}{\ln S}$ (Pielou, 1975)

Where as, E=evenness
H' = species diversity
S = species richness

Analysis of Variance (ANOVA):

Two-way Analysis of Variance (ANOVA) was performed to detect significance of quantitative variations of plankton between the months and between the sampling stations in the sampled beels.

Ecological Relationships:

Ecological relationships between plankton and various abiotic and biotic factors were computed by simple correlation coefficient (r_1 and r_2) at two sampling stations of each beel and by multiple correlation regression (R_1^2 and R_2^2). Statistical significance of the stated correlations was ascertained by application of 't-test'.

Chapter III

OBSERVATIONS

1. ABIOTIC FACTORS:

The monthly and seasonal variations in the recorded abiotic parameters during the present study, in addition, annual ranges and mean values (±SD) for two years are presented in Tables 1-7. F values of analysis of variance (ANOVA) were computed for some important abiotic factors are indicated in Tables 12-15. Correlation co-efficients between abiotic, between biotic and between abiotic and biotic parameters are shown in Tables 8-11 and 35-42. Some important features of the observed parameters are described below:-

RAINFALL: Monthly rainfall ranged between 0.18-384.6 mm (155.2 ±141.3) during the course of this study. Maximum rainfall (384.6mm) was experienced during June-August in both the years. Its peak was recorded during August in the first year of the study period. However, low rainfall was noticed during December (0.18mm) in the first year and in the same month (0.6mm) in the same year. A very low precipitation was recorded from November to February (1.7mm – 0.18mm) during the study period. However, bimodal pattern of monthly variations, with three maxima was observed in the whole study period with primary maxima (384.6 mm) during August in the first year and secondary maxima during August again (373.3 mm) in the second year and tertiary maxima during June next (343.0 mm). The quantity of rainfall was higher in the first year in comparison to second year. During the investigation, total monthly rainfall 0.18-384.6 mm (155.2 ±141.3) is directly influenced by southwest monsoons. Although the study area experienced fairly extended monsoon season, the period of maximum rainfall coincided with the periods of high air and water temperatures. The study areas received monsoon rain from May to August.

This study period experienced heavy rains during April-August (220.2-384.6mm and 257.2mm-240.3mm) in two years respectively with normal rains during the rest of the wet season. It registered a significant direct correlation with water temperature (r_1=0.716, p<.001) at station I in Deepor beel. Further, it exerted an inverse correlation with transparency (r_1=-0.615, significant p<.01) at station I. Rainfall showed negative correlation with transparency (r_1=-0.633, significant p<.001) at station I in Ghorajan beel.

TEMPERATURE: Water temperature at station I of Deepor beel varied sinusoidally from a winter low of 17.9°C (December-February) to a summer high of 33.6° C (May-July) and showed mean value 28.4 ±4.3°C. Station II recorded 18.2-32.9°C (28.1±3.9) with a minor peak during April-May. The recorded air temperature ranged between 22.3-38.2°C (30.7 ±4.3) at station I and 22.4-38.1°C (30.6 ±4.2) at station II. Maximum water temperature was observed during June in the second year, where as air temperature was recorded highest in the same month (38.2°C) and minimum water temperature was noticed during December in the second year, where

Table:1 Monthly variations in abiotic parameters of Deepor beel (Station 1)

Factors	1999					2000												2001						
	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J
Rainfall(mm)	384.6	189.0	129.8	44.3	0.18	4.6	22.8	45.3	220.2	367.1	365.0	201.2	373.3	159.5	43.2	1.7	0.6	2.1	16.4	19.4	257.2	293.1	343.0	240.3
Air temperature(°C)	31.0	33.0	30.0	28.2	22.3	24.1	28.2	31.3	33.4	34.6	36.4	32.8	30.2	32.1	31.6	26.9	23.1	24.6	27.2	33.2	32.7	34.9	38.2	36.8
Water temperature(°C)	31.0	32.0	29.0	28.0	20.9	21.8	26.7	28.4	31.3	31.9	32.8	30.2	28.6	29.5	29.1	23.4	17.9	20.7	26.4	32.4	31.2	32.6	33.6	31.3
pH	6.8	7.0	6.7	6.5	7.3	7.5	9.5	7.5	7.3	7.3	7.4	7.9	6.9	7.3	7.3	7.5	6.9	8.3	7.9	7.5	7.1	7.2	7.4	7.2
Transparency(cm)	35.0	75.0	78.0	81.0	80.0	48.0	53.0	67.0	79.0	46.0	36.0	19.0	17.0	70.0	73.0	75.0	82.0	52.0	56.0	62.0	66.0	42.0	31.0	18.0
Sp. conductivity(μS/c)	106.0	123.0	130.0	149.0	134.0	178.0	199.0	198.0	199.0	188.0	175.0	199.0	124.0	94.0	127.0	108.0	150.0	197.0	199.0	176.0	172.0	180.0	196.0	192.0
Dissolved oxygen(mg/l)	5.2	7.2	4.0	6.4	6.4	3.2	9.6	12.0	4.0	6.4	5.6	6.4	12.0	4.0	3.2	6.4	9.6	4.0	4.8	3.2	4.6	4.8	7.2	6.6
Free carbon - dioxide(mg/l)	8.0	8.0	10.0	26.0	8.0	2.0	Nil	6.0	28.0	8.0	12.0	6.0	30.0	10.0	22.0	8.0	4.0	4.0	4.0	14.0	10.0	12.0	10.0	6.0
Total alkalinity(mg/l)	64.0	70.0	64.0	94.0	72.0	38.0	70.0	32.0	90.0	82.0	80.0	80.0	78.0	76.0	96.0	72.0	60.0	42.0	44.0	80.0	74.0	68.0	72.0	82.0
Total hardness(mg/l)	46.0	46.0	48.0	50.0	58.0	82.0	80.0	76.0	82.0	78.0	62.0	52.0	52.0	66.0	56.0	56.0	62.0	62.0	64.0	60.0	56.0	46.0	58.0	64.0
Calcium(mg/l)	27.3	29.4	29.4	23.1	31.5	52.5	48.3	44.1	56.7	44.1	36.3	35.7	33.6	33.6	37.8	33.6	37.8	25.2	42.0	31.5	35.3	28.5	32.2	40.2
Magnesium(mg/l)	4.5	4.0	4.5	6.5	6.4	7.2	7.7	0.8	6.1	8.2	6.2	3.9	4.5	7.9	4.4	5.4	5.9	8.9	5.3	6.9	5.0	4.2	6.3	5.8
Chloride(mg/l)	19.9	21.9	19.9	24.9	27.9	30.9	34.9	29.9	35.9	24.9	19.9	30.9	19.9	15.9	18.9	15.9	16.9	31.9	34.9	19.9	20.9	14.9	18.9	21.9
Dissolved organic matter(mg/l)	2.1	2.6	1.2	2.7	2.5	0.4	3.0	2.9	2.7	1.6	2.7	1.9	2.4	1.4	2.9	2.6	2.3	1.3	2.7	3.2	3.0	2.2	2.8	2.5
Total dissolved solids(mg/l)	0.4	0.4	1.0	2.3	2.6	1.6	1.9	1.7	2.1	1.5	2.2	2.1	1.1	1.7	0.8	0.9	1.8	2.1	2.0	1.4	1.9	0.8	1.4	1.8
Phosphate(mg/l)	0.3	0.3	0.1	0.1	0.1	0.2	0.01	0.05	0.07	0.1	0.1	0.3	0.4	0.8	0.06	0.04	0.1	0.9	0.7	0.2	0.6	0.8	0.6	0.9
Sulphate(mg/l)	22.0	26.2	18.6	13.4	19.6	5.7	7.8	5.1	8.3	6.9	11.8	28.2	20.0	16.0	14.2	18.6	22.2	9.4	12.2	11.8	8.2	17.6	14.8	18.4
Nitrate(mg/l)	1.9	1.5	1.4	1.3	1.7	0.2	0.1	0.3	1.2	1.6	1.8	1.9	1.5	0.2	1.2	1.6	1.3	0.6	0.9	1.7	1.4	0.8	1.2	1.6
Silicate(mg/l)	1.7	1.5	1.6	3.9	4.6	0.3	2.4	0.1	1.4	1.9	2.8	2.1	1.4	2.6	1.9	1.5	2.9	1.8	3.1	2.7	2.2	1.9	2.1	2.4
BOD(mg/l)	2.8	0.8	0.9	0.8	1.2	1.6	2.8	3.2	3.8	2.1	2.7	2.1	4.8	0.6	1.2	2.4	3.2	1.8	1.6	1.8	1.6	1.8	2.2	2.4
Sodium(mg/l)	18.0	22.0	26.0	21.0	31.0	17.2	12.4	16.1	18.0	20.0	24.0	14.0	15.0	24.4	27.3	26.2	19.3	14.2	18.7	16.4	20.6	18.2	14.8	16.2
Potassium(mg/l)	4.2	5.8	8.0	7.0	6.0	6.9	3.2	5.7	4.1	5.8	6.8	8.0	4.2	9.0	6.7	4.6	6.1	4.2	4.8	7.8	8.2	4.3	6.2	7.8

Table: 2 Monthly variations in abiotic parameters of Deepor beel (Station II)

Factors	1999					2000												2001						
	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J
Rainfall(mm)	384.6	189.0	129.8	44.3	0.18	4.6	22.8	45.3	220.2	367.1	365.0	201.2	373.3	159.5	43.2	1.7	0.6	2.1	16.4	19.4	257.2	293.1	343.0	240.3
Air temperature(°C)	30.0	33.1	30.0	28.3	22.4	23.5	28.4	31.1	33.6	34.8	36.4	32.7	30.3	32.3	31.2	27.2	23.4	24.2	27.8	33.4	32.0	34.2	38.1	36.4
Water temperature(°C)	29.0	32.0	29.5	27.9	20.7	21.6	26.0	28.2	31.1	32.1	32.9	29.6	28.9	30.6	28.5	24.1	18.2	22.4	25.4	31.7	30.2	30.7	32.8	30.6
pH	6.7	6.9	7.0	6.6	7.2	7.4	9.2	7.6	7.1	7.2	7.4	7.6	6.9	7.1	6.8	6.9	7.2	7.4	7.6	7.2	7.7	7.1	7.4	7.2
Transparency(cm)	36.0	78.0	80.0	81.0	80.0	52.0	58.0	69.0	77.0	44.0	34.0	15.0	15.0	75.0	77.0	76.0	79.0	49.0	52.0	57.0	60.0	40.0	27.0	15.0
Sp. conductivity(μs/cm)	108.0	100.0	120.0	152.0	137.0	175.0	195.0	197.0	198.0	186.0	178.0	196.0	128.0	98.0	142.0	124.0	169.0	174.0	178.0	196.0	192.0	186.0	179.0	193.0
Dissolved oxygen(mg/l)	4.8	6.4	4.8	7.2	7.2	4.0	10.4	11.2	4.8	5.6	5.6	5.6	12.8	4.8	4.6	5.8	8.4	3.2	4.0	2.4	4.8	5.4	5.2	4.6
Free carbon - dioxide(mg/l)	6.0	10.0	10.0	25.0	6.0	4.0	-	4.0	24.0	10.0	14.0	4.0	38.0	10.0	18.0	6.0	9.0	6.0	6.0	10.0	12.0	4.0	6.0	4.0
Total alkalinity(mg/l)	54.0	62.0	62.0	92.0	68.0	36.0	72.0	30.0	86.0	84.0	82.0	82.0	82.0	74.0	87.0	93.0	79.0	38.0	48.0	76.0	78.0	83.0	76.0	74.0
Total hardness(mg/l)	40.0	40.0	46.0	48.0	54.0	80.0	78.0	74.0	80.0	76.0	64.0	50.0	56.0	76.0	64.0	72.0	68.0	58.0	60.0	58.0	62.0	52.0	56.0	50.0
Calcium(mg/l)	21.0	21.0	25.2	25.2	33.6	50.4	46.2	42.0	52.5	42.0	38.4	37.8	31.6	37.8	32.7	42.2	39.9	21.0	39.9	35.7	39.3	27.4	30.2	32.4
Magnesium(mg/l)	4.6	4.1	5.0	5.5	4.9	7.2	7.7	0.8	6.7	8.3	6.2	2.9	5.9	9.3	7.6	7.2	6.8	8.9	4.9	5.4	5.5	5.9	6.3	4.3
Chloride(mg/l)	14.9	14.9	18.9	25.9	29.9	29.9	35.9	30.9	33.9	23.9	21.9	31.9	20.9	17.9	14.9	19.9	12.9	28.9	32.9	20.9	22.9	16.9	18.9	19.9
Dissolved organic matter(mg/l)	2.4	3.1	1.1	2.7	2.9	0.5	3.0	2.6	3.8	1.9	2.2	1.7	2.6	0.9	1.8	2.2	1.9	2.4	2.6	2.2	2.0	0.9	1.6	1.8
Total dissolved solids(mg/l)	0.3	1.2	0.8	3.2	2.5	1.5	1.9	2.1	1.8	1.7	2.4	1.9	1.0	0.8	1.4	1.7	0.7	1.2	1.8	1.2	1.4	1.2	0.8	1.4
Phosphate(mg/l)	0.3	0.3	0.1	0.1	0.2	0.2	0.02	0.08	0.09	0.2	0.06	0.2	0.5	0.07	0.8	0.2	0.06	0.3	0.2	1.1	0.9	0.4	1.2	0.2
Sulphate(mg/l)	21.0	24.5	19.2	11.6	16.7	4.9	8.2	6.2	9.8	7.6	14.2	22.7	21.0	22.3	19.2	14.6	17.2	14.6	16.2	18.4	15.8	14.4	19.2	20.4
Nitrate(mg/l)	1.4	1.7	1.5	2.3	2.1	0.3	0.2	0.4	1.9	2.2	1.6	1.7	1.8	1.3	1.6	0.5	0.8	1.6	1.9	0.8	1.2	0.9	1.3	1.6
Silicate(mg/l)	1.8	1.6	1.9	4.1	3.9	0.3	2.5	0.9	1.3	2.4	2.9	1.9	1.6	1.8	2.1	1.2	1.4	2.2	2.6	1.7	1.4	1.2	1.4	1.8
BOD(mg/l)	3.4	0.7	0.7	1.3	1.6	1.9	4.8	4.7	4.1	4.6	5.1	4.6	2.8	1.6	2.4	3.6	4.2	1.8	1.6	0.4	2.2	3.2	2.6	1.8
Sodium(mg/l)	14.6	12.4	17.2	19.0	28.0	15.9	11.1	17.2	17.9	21.2	24.6	16.3	16.0	22.2	18.4	24.6	20.2	12.4	22.6	25.2	18.6	20.3	18.5	16.7
Potassium(mg/l)	7.6	5.2	5.6	9.0	5.0	6.3	4.2	6.1	5.6	6.3	7.2	7.0	6.4	9.2	6.8	6.2	10.2	8.4	8.6	5.4	4.8	6.7	5.6	5.2

Table: 3 Monthly variations in abiotic parameters of Ghorajan beel (Station I)

Factors	1999					2000											2001						
	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J
Rainfall(mm)	384.6	189.0	129.8	44.3	0.18	4.6	22.8	45.3	220.2	367.1	365.0	201.2	373.3	350.5	43.2	1.7	0.6	2.1	16.4	19.4	257.2	2.3.1	343.0	240.3
Air temperature(^{0}C)	32.0	32.0	30.5	28.6	25.5	24.2	28.3	31.4	33.3	34.5	36.6	32.6	29.4	32.3	31.0	26.9	22.2	24.0	28.4	32.8	32.6	3.8	37.1	32.8
Water temperature(^{0}C)	31.0	31.5	29.0	27.5	21.5	21.8	26.4	29.1	31.6	31.8	33.2	29.4	27.6	30.1	28.8	23.8	19.7	22.1	27.0	30.2	29.7	30.1	31.8	29.0
PH	6.9	7.2	6.9	6.8	7.4	7.6	8.4	8.2	8.3	7.9	7.6	7.5	6.8	7.8	7.4	6.9	6.7	7.6	7.9	7.2	7.1	7.3	7.6	7.2
Transparency(cm)	32.0	80.0	82.0	78.0	80.0	51.0	56.0	67.0	76.0	42.0	31.0	16.0	19.0	58.0	65.0	75.0	76.0	52.0	50.0	54.0	56.0	38.0	29.0	17.0
Sp. conductivity(µs/cm)	75.0	50.0	54.0	102.0	76.0	314.0	346.0	182.0	193.0	162.0	164.0	112.0	112.0	99.0	153.0	122.0	129.0	128.0	179.0	163.0	186.0	198.0	128.0	150.0
Dissolved oxygen(mg/l)	4.2	4.8	6.4	4.0	7.2	2.4	8.0	7.2	5.6	4.8	4.0	7.2	10.2	5.6	7.2	7.2	8.0	4.8	4.8	5.6	5.8	4.5	3.4	3.8
Free carbon - dioxide(mg/l)	4.0	6.0	6.0	8.0	4.0	4.0	4.0	8.0	10.0	6.0	10.0	8.0	30.0	12.0	16.0	12.0	6.0	6.0	4.0	10.0	18.0	4.0	6.0	8.0
Total alkalinity(mg/l)	50.0	38.0	30.0	40.0	52.0	54.0	56.0	42.0	82.0	78.0	86.0	76.0	82.0	82.0	82.0	56.0	50.0	74.0	42.0	112.0	89.0	82.0	76.0	73.0
Total hardness(mg/l)	38.0	20.0	22.0	36.0	38.0	56.0	52.0	80.0	58.0	58.0	72.0	46.0	48.0	56.0	52.0	52.0	60.0	66.0	68.0	84.0	72.0	68.0	52.0	56.0
Calcium(mg/l)	25.2	16.0	8.4	16.8	16.8	34.1	21.0	42.0	39.9	46.2	34.3	16.8	29.4	36.4	33.6	35.7	31.5	27.3	44.1	44.1	40.2	39.4	33.2	29.7
Magnesium(mg/l)	3.1	0.9	3.3	4.7	5.1	2.8	7.8	0.9	4.4	2.8	9.1	7.1	4.5	4.7	3.4	3.9	6.9	9.4	5.8	9.6	7.7	6.2	4.6	6.4
Chloride(mg/l)	10.9	10.9	23.9	16.9	18.9	28.9	31.9	28.9	36.9	21.9	28.9	42.9	21.9	16.9	13.9	16.9	18.9	24.9	28.9	24.9	16.9	17.9	8.9	13.9
Dissovled organic matter(mg/l)	2.2	1.9	1.3	1.6	2.1	0.0	3.7	2.3	2.1	3.6	3.8	2.9	2.6	1.5	2.2	3.5	2.8	1.8	1.6	2.2	2.6	3.0	2.1	2.4
Total dissolved solids(mg/l)	2.4	1.1	0.8	1.2	1.8	1.2	1.6	1.9	2.2	2.9	2.6	2.1	2.2	1.1	1.8	1.6	2.4	2.3	2.1	2.8	1.5	1.1	2.4	2.2
Phosphate(mg/l)	0.2	0.2	0.1	0.2	0.2	0.2	0.02	0.1	0.1	0.05	0.1	0.3	0.4	0.6	1.1	0.9	0.08	0.7	0.8	1.2	1.4	0.9	1.2	0.7
Sulphate(mg/l)	30.0	27.2	25.6	18.3	16.9	9.7	11.8	3.6	6.3	14.6	18.4	30.3	24.0	18.2	14.6	16.2	22.5	20.7	16.4	12.6	16.7	14.2	18.4	12.9
Nitrate(mg/l)	1.9	1.5	1.3	2.1	1.9	0.2	0.4	0.8	0.9	1.2	1.4	1.6	1.4	1.7	1.3	0.8	0.7	0.09	1.1	1.8	1.4	0.8	0.06	1.2
Silicate(mg/l)	1.6	1.8	1.4	3.7	4.1	0.7	9.6	0.04	1.8	2.3	2.6	1.9	1.1	1.4	1.9	2.2	2.6	2.4	1.7	1.9	1.2	1.8	2.1	1.7
BOD(mg/l)	0.4	0.3	0.2	0.3	0.1	1.6	2.2	2.4	1.8	3.4	2.8	3.2	4.4	1.8	2.2	2.6	2.4	1.6	1.4	1.8	2.2	1.6	1.4	1.8
Sodium(mg/l)	14.3	12.2	18.5	24.0	22.7	9.3	6.1	19.5	20.3	22.5	26.9	16.5	18.0	14.6	16.2	22.4	26.2	22.6	16.8	24.3	22.7	18.2	15.3	12.9
Potassium(mg/l)	7.4	4.2	6.0	8.0	6.9	8.1	7.2	16.0	4.5	8.2	9.3	7.4	4.2	3.8	6.7	5.9	7.5	5.4	8.2	3.7	5.6	6.9	5.5	4.6

Table: 4 Monthly variations in abiotic parameters of Ghorajan beel (Station II)

Factors	1999					2000											2001						
	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J
Rainfall(mm)	384.6	189.0	129.8	44.3	0.18	4.6	22.8	45.3	220.2	367.1	365.0	201.2	373.3	159.5	43.2	1.7	0.6	2.1	16.4	10.4	257.2	293.1	343.0	240.3
Air temperature (^{0}C)	31.0	32.0	30.5	28.3	21.9	24.6	28.3	31.2	33.5	34.6	36.8	32.6	30.1	32.1	31.8	27.2	22.9	23.9	28.0	33.1	32.6	35.1	38.7	33.2
Water temperature (^{0}C)	29.0	31.0	29.5	28.1	19.8	21.3	26.5	28.5	29.6	31.7	32.7	30.1	28.3	29.8	30.1	25.4	20.2	21.4	27.2	30.8	30.9	31.2	32.8	29.1
pH	6.7	7.1	6.6	7.1	7.2	7.5	8.3	8.2	8.1	7.8	7.6	7.5	6.9	7.6	7.1	6.7	6.9	7.8	7.7	7.9	7.1	6.8	7.2	7.4
Transparency (cm)	33.0	83.0	81.0	79.0	79.0	68.0	58.0	65.0	77.0	40.0	32.0	17.0	20.0	67.0	70.0	72.0	79.0	48.0	55.0	58.0	61.0	37.0	28.0	16.0
Sp. conductivity (µs/cm)	71.0	49.0	56.0	99.0	67.0	108.0	118.0	176.0	190.0	166.0	165.0	114.0	115.0	92.0	124.0	112.0	135.0	125.0	183.0	178.0	172.0	198.0	196.0	187.0
Dissolved oxygen (mg/l)	4.4	4.0	5.6	4.8	8.0	3.2	7.2	6.4	4.8	4.0	4.0	8.0	12.4	6.4	6.4	8.2	3.6	4.0	4.8	4.8	5.6	3.6	4.0	6.6
Free carbon –dioxide (mg/l)	4.0	6.0	4.0	6.0	6.0	2.0	2.0	10.0	12.0	8.0	10.0	8.0	30.0	10.0	12.0	8.0	10.0	6.0	3.0	8.0	10.0	6.0	8.0	10.0
Total alkalinity (mg/l)	46.0	40.0	38.0	38.0	54.0	52.0	58.0	44.0	78.0	74.0	84.0	78.0	84.0	84.0	75.0	67.0	62.0	64.0	40.0	116.0	78.0	82.0	86.0	79.0
Total hardness (mg/l)	30.0	22.0	20.0	38.0	40.0	56.0	50.0	76.0	62.0	56.0	74.0	48.0	46.0	62.0	58.0	46.0	48.0	62.0	66.0	80.0	62.0	56.0	58.0	46.0
Calcium (mg/l)	22.0	18.9	10.5	14.7	14.7	42.0	18.9	39.9	37.8	44.1	39.2	18.9	27.3	37.3	28.6	26.4	25.7	23.1	39.9	42.0	36.4	32.6	30.2	27.4
Magnesium (mg/l)	1.9	0.7	2.3	5.6	6.1	3.4	7.5	0.8	5.8	2.8	8.4	7.1	4.5	6.0	7.1	4.8	5.4	9.4	6.3	9.2	6.2	5.7	6.7	4.5
Chloride (mg/l)	12.9	6.9	21.9	12.9	19.9	21.9	32.9	27.9	34.9	22.9	26.9	43.9	22.9	17.9	18.9	23.9	16.9	20.9	30.9	26.9	22.9	16.9	18.9	15.9
Dissolved organic matter (mg/l)	2.1	1.8	1.4	1.5	2.3	0.8	3.8	2.5	2.2	3.1	3.6	2.6	2.3	2.1	1.6	2.2	1.8	2.4	3.2	1.7	1.2	2.1	1.8	2.4
Total dissolved solids (mg/l)	2.0	1.3	1.4	1.5	1.8	1.1	1.7	1.9	2.3	2.9	2.7	1.8	2.1	1.7	1.4	2.4	2.1	1.3	1.6	1.8	1.3	1.6	2.4	1.3
Phosphate (mg/l)	0.3	0.4	0.3	0.1	0.1	0.2	0.04	0.08	1.1	0.07	0.09	0.2	0.5	0.9	1.2	1.1	2.2	2.4	2.1	1.9	2.4	0.9	1.2	1.1
Sulphate (mg/l)	27.0	24.1	21.3	12.6	14.3	4.8	13.4	4.2	7.9	9.8	14.3	26.3	22.0	14.6	18.2	16.5	20.4	18.4	15.2	18.3	22.4	14.4	16.2	19.2
Nitrate(mg/l)	1.7	1.9	1.4	1.3	2.1	0.2	0.4	0.09	1.2	1.6	1.8	1.9	1.3	0.9	0.7	1.4	1.2	0.6	0.4	1.4	1.8	1.3	1.1	0.7
Silicate (mg/l)	1.5	1.7	1.3	3.7	4.3	0.8	0.7	0.1	1.3	1.6	1.9	1.7	1.2	2.6	2.2	2.4	1.8	1.6	2.4	2.2	1.6	2.2	1.8	2.4
BOD (mg/l)	0.6	0.2	0.1	0.3	0.1	1.4	2.0	2.2	3.6	2.9	2.7	2.9	1.8	1.4	1.6	2.2	0.8	1.2	2.4	1.8	2.6	1.2	1.4	1.6
Sodium (mg/l)	20.2	19.4	12.6	27.0	29.0	12.6	7.3	20.2	22.1	24.3	25.4	18.4	22.0	16.4	14.2	12.8	18.2	24.2	28.4	25.6	23.2	18.4	20.2	19.3
Potassium(mg/l)	6.3	4.4	4.6	7.0	5.0	6.2	8.1	9.8	5.9	7.2	8.4	6.2	6.3	4.6	3.2	7.2	7.9	4.4	5.4	7.9	6.8	5.6	3.4	3.8

as air temperature was recorded as 23.1°C at station I, on the other hand, minimum air temperature was observed during December (22.3°C) in the first year. However, station II showed maximum during June in the first year, but the maximum air temperature was noticed during June (38.1°C) in the second year, on the other hand, minimum water temperature was recorded during December (18.2°C) in the second year at station II in Deepor beel. Correlation analysis among abiotic variables revealed that water temperature exhibited significant relationships with rainfall (r_1=0.716, p<.001; r_2=0.705, p<.001) and total alkalinity (r_1=0.476, p<.05) in this beel.

Water temperature varied between 19.7-33.2°C (28.0 ±3.7) and 19.8-32.8°C(28.1 ±3.8) at station I and II respectively in Ghorajan beel (Table 9, 10 & 11). However, air temperature fluctuated between 21.9-37.1 (30.4 ±4.0) at station I and 21.9-38.1 (30.6 ±4.2) at station II in this beel. Maximum water temperature was observed during June in the first year and a minimum during December in the first year at station I, on the other hand, maximum water temperature was observed during June in the second year and minimum was observed during December in the first year at station II. On the other hand, maximum air temperature was recorded during June in the second year and a minimum during December (21.9°C) in the first year at station I, while station II showed maximum during June in the second year and a minimum during December at station II in Ghorajan beel. The temporal changes in the water temperature followed nearly an identical pattern in both the sampled beels. Further, it followed an identical trend to that of atmospheric temperature. There was a marginal decline in mid-monsoon and minor fluctuations were seen till October. Temperature dropped sharply from the month of November onwards and minima was registered during December in both the beels. Water temperature showed significant relationship with rainfall (r_1=0.714, p<.001; r_2=0.674, p<.001) in this sampled beel. Seasonal variations of water temperature were observed in two more beels, which ranged between 17.9-31.7°C(27.1 ±5.5) in Siligurijan beel and 23.2-33.5°C(28.8 ±4.0) in Fingua beel (Table 7). The recorded air temperature ranged between 20.4-34.8°C (29.7 ±5.5) in the former, while the later depicted 24.8-36.6°C (30.8 ±4.5). Maximum water temperature was recorded during autumn season and a secondary maxima was noticed during monsoon season in Siligurijan beel, on the other hand, it exhibited maxima during monsoon and a secondary maxima was observed during summer season in Fingua beel.

TRANSPARENCY: Transparency showed clear seasonality with the minimum value of 17.0 cm recorded during rainy season and maxima (82.0 cm) during winter at station I in Deepor beel, while the station II exhibited the minimum of 15.0 cm and the maximum of 81.0 cm. In this beel mean and transparency ranges were identical at both the stations during both the years where as peak transparency was recorded during December in the second year and minima during August in the same year, while station II showed peak during November in the first year and minima during August in the second year. The water of the beel remained clear during the spring months but exhibited a high turbidity during the months of high rainfall (April-August) depicting unimodal pattern of variations at both the stations in Deepor beel. It depicted significant inverse relationships with rainfall (r_1=-0.615, p<.01; r_2=-0.621, p<.01) and phosphate (r_1=-0.419, p<.05) in this beel.

Table: 5 Annual Ranges and Mean values (±SD) of abiotic parameters of Deepor beel

FACTORS	STATION I		STATION II	
	RANGE	MEAN ±SD	RANGE	MEAN ±SD
Rainfall(mm)	.18-384.6	155.2±141.3	.18-384.6	155.2±141.3
Air temperature(^{0}C)	22.3-38.2	30.7 ±4.3	22.4-38.1	30.6 ±4.2
Water temperature(^{0}C)	17.9-33.6	28.4 ±4.3	18.2-32.9	28.1 ±3.9
pH	6.5-9.5	7.3 ±0.6	6.6-9.2	7.3 ±0.5
Transparency(cm)	17.0-82.0	55.8 ±20.9	15.0-81.0	55.2 ±22.2
Sp. conductivity(µS/cm)	94.0-199.0	162.2 ±34.6	102.0-198.0	162.6 ±33.0
Dissolved oxygen(mg/l)	3.2-12.0	6.1 ±2.5	2.4-12.8	5.9 ±2.4
Free carbon - dioxide(mg/l)	0-30.0	11.1 ±7.7	0-38.0	10.7 ±8.2
Total alkalinity(mg/l)	32.0-96.0	70.0 ±16.4	30.0-93.0	70.7 ±17.4
Total hardness(mg/l)	46.0-82.0	60.9 ±11.2	40.0-80.0	60.9 ±12.1
Calcium(mg/l)	23.1-56.7	36.2 ±8.2	21.0-52.5	35.2 ±8.6
Magnesium(mg/l)	0.8-8.9	5.6 ±1.7	0.8-9.3	5.9 ±1.9
Chloride(mg/l)	14.9-35.9	23.8 ±6.5	12.9-35.9	23.3 ±6.7
Dissolved Organic Matter(mg/l)	0.4-3.2	2.3 ±0.7	0.5-3.8	2.1 ±0.7
Total Dissolved Solids(mg/l)	0.4-2.6	1.6 ±0.6	0.3-3.2	1.5 ±0.6
Phosphate(mg/l)	0.01-0.9	0.3 ±0.3	0.02-1.2	0.3 ±0.3
Sulphate(mg/l)	5.1-28.2	14.9 ±6.3	4.9-24.5	15.8 ±5.3
Nitrate(mg/l)	0.1-1.9	1.2 ±0.5	0.2-2.3	1.4 ±0.6
Silicate(mg/l)	0.1-4.6	2.1 ±0.9	0.3-4.1	1.9 ±0.8
BOD(mg/l)	0.6-4.8	2.09 ±0.9	0.4-5.2	2.8 ±1.5
Sodium(mg/l)	12.4-31.0	19.6 ±4.7	11.1-28.0	18.8 ±4.2
Potassium(mg/l)	3.2-9.0	6.06 ±1.6	4.2-10.2	6.6 ±1.5

Table: 6 Annual Ranges and Mean values (±SD) of abiotic parameters of Ghorajan beel

FACTORS	STATION I		STATION II	
	RANGE	MEAN ±SD	RANGE	MEAN ±SD
Rainfall(mm)	.18-384.6	155.2±141.3	.18-384.6	155.2±141.3
Air temperature(^{0}C)	21.9-37.1	30.4 ±4.0	21.9-38.1	30.6 ±4.2
Water temperature(^{0}C)	19.7-33.2	28.0 ±3.7	19.8-32.8	28.1 ±3.8
pH	6.7-8.4	7.4 ±0.5	6.6-8.3	7.4 ±0.5
Transparency(cm)	16.0-82.0	53.3 ±20.9	16.0-83.0	55.1 ±21.6
Sp. conductivity(μS/cm)	50.0-193.0	128.0 ±40.0	49.0-198.0	133.2±45.9
Dissolved oxygen(mg/l)	2.4-10.2	5.7 ±1.7	3.2-12.4	5.6 ±2.0
Free carbon - dioxide(mg/l)	4.0-30.0	8.7 ±5.8	2.0-30.0	8.3 ±5.3
Total alkalinity(mg/l)	30.0-112.0	66.0 ±20.1	38.0-116.0	66.7 ±19.5
Total hardness(mg/l)	20.0-84.0	54.4 ±15.7	20.0-80.0	52.6 ±15.1
Calcium(mg/l)	8.4-46.2	31.3 ±10.5	10.5-44.1	29.1 ±9.8
Magnesium(mg/l)	0.9-9.6	5.2 ±2.4	0.7-9.4	5.3 ±2.3
Chloride(mg/l)	8.9-42.9	21.8 ±8.4	9.9-43.9	22.6 ±7.5
Dissolved Organic Matter(mg/l)	0.9-3.8	2.3 ±0.7	0.8-3.8	2.2 ±0.7
Total Dissolved Solids(mg/l)	0.8-2.9	1.9 ±0.6	1.1-2.9	1.8 ±0.5
Phosphate(mg/l)	0.02-1.4	0.5 ±0.4	0.04-2.4	0.87 ±0.8
Sulphate(mg/l)	3.6-30.3	17.4 ±6.8	4.2-27.0	16.5 ±5.9
Nitrate(mg/l)	0.09-2.1	1.1 ±0.6	0.09-2.1	1.2±0.6
Silicate(mg/l)	0.04-4.1	1.8 ±0.8	0.1-4.3	1.9 ±0.9
BOD(mg/l)	0.1-4.4	1.8 ±1.0	0.1-4.8	1.7 ±1.1
Sodium(mg/l)	6.1-27.0	18.6 ±5.4	7.3-29.0	19.9 ±5.4
Potassium(mg/l)	3.7-10.0	6.4 ±1.7	3.2-9.8	6.1 ±1.7

Table: 7 Seasonal variations in some abiotic parameters of Siligurijan and Fingua beel

Siligurijan beel						
	Winter	Summer	Monsoon	Autumn	Range	Mean ±SD
Air temperature (^{0}C)	20.4	31.4	34.8	32.5	20.4-34.8	29.7 ±5.5
Water temperature (^{0}C)	17.9	27.9	30.9	31.7	17.9-31.7	27.1 ±5.5
pH	6.8	7.4	7.2	7.3	6.8-7.4	7.2 ±0.23
Transparency (cm)	61.0	68.0	28.0	21.0	21.0-68.0	44.5 ±20.3
Sp. conductivity (µS/cm)	135.0	174.0	189.0	130.0	130.0-189.0	157.0 ±25.1
Dissolved oxygen (mg/l)	6.8	9.8	4.4	5.2	4.4-9.8	6.5 ±2.1
Total alkalinity (mg/l)	73.0	45.0	84.0	55.0	45.0-84.0	61.4 ±14.1
Total hardness (mg/l)	54.0	76.0	70.0	40.0	40.0-76.0	60.0 ±14.1
Calcium (mg/l)	31.6	43.6	32.4	26.1	26.1-43.6	33.4 ±6.4
Magnesium (mg/l)	5.4	7.8	9.1	3.3	3.3-9.1	6.4 ±2.2
Fingua beel						
	Winter	Summer	Monsoon	Autumn	Range	Mean ±SD
Air temperature (^{0}C)	24.8	33.3	36.6	28.7	24.8-36.6	30.8 ±4.5
Water temperature (^{0}C)	23.2	31.6	33.5	26.9	23.2-33.5	28.8 ±4.0
pH	6.9	8.4	7.3	7.8	6.9-8.4	7.6 ±0.56
Transparency (cm)	52.0	74.0	36.0	78.0	36.0-78.0	60.0 ±17.0
Sp. conductivity (µS/cm)	89.0	150.0	173.0	130.0	89.0-173.0	135.5 ±30.8
Dissolved oxygen (mg/l)	4.2	7.2	12.4	3.6	3.6-12.4	6.8 ±3.5
Total alkalinity (mg/l)	62.0	84.0	75.0	66.0	62.0-84.0	71.7 ±8.5
Total hardness (mg/l)	57.0	76.0	68.0	52.0	52.0-76.0	63.2 ±9.4
Calcium (mg/l)	32.3	31.5	38.3	29.4	29.4-38.3	32.9 ±3.3
Magnesium (mg/l)	6.0	10.8	7.2	5.5	5.5-10.8	7.4 ±2.1

Transparency ranged between 16.0-82.0(53.3 ±20.9) cm and 16.0-83.0 (55.1 ±21.6) cm at station I and II respectively in Ghorajan beel. It registered peak during October in the first year and minima during July in the same year at station I, while station II recorded peak during September in the first year and minima during July in the second year. However, the period between May-August depicted continuous decline and September-January a steady increase in penetration of light. It exhibited inverse correlations with rainfall (r_1=-0.633, p<.001; r_2=-0.657, p<.001), total alkalinity (r_1=–0.438, p<.05; r_2=–0.455, p<.05) and BOD (r_1=–0.492, p<.05; r_2=–0.459, p<.05) in this beel. Seasonal variations of transparency were noticed between 21.0-68.0 cm (44.5 ±20.3) in Siligurijan beel and between 36.0-78.0 cm (60.0 ±17.0) in Fingua beel (Table 7). The former exhibited minima during autumn and peak during summer, while the later showed minima during summer and maxima during monsoon season. The transparency secondary maxima (61.0 cm.) during winter season in Siligurijan beel, on the other hand, Fingua beel depicted secondary maxima during summer season.

pH: During the present study period, pH varied between 6.5-9.5 (7.3 ±0.6) and 6.6-9.2 (7.3 ±0.5) at stations I and II respectively in Deepor beel. Lowest pH was recorded during October and November in the first year at station I, while it was noticed during November in the same year at station II in the beel. Highest pH was noticed during February in the first year at station I in this beel and during February in the same year at station II. Further, hydrogen ion concentration showed little variation till September in the first year. A relative higher values were recorded in the month of February in the first year followed by the same month in the second year at station I, while station II also recorded maxima in the same month. pH broadly depicted a unimodal pattern of variations during the study period in this beel. From the month of December (February recorded 9.5 at station I and 9.2 at station II) onwards in the first year, water was moderately alkaline in nature but pH regulated marginal fluctuations during the rest part of the study period at both the stations. pH depicted significant direct relationships with specific conductivity (r_1=0.512, p<.01; r_2=0.547, p<.01), total hardness (r_1=0.499, p<.05; r_2=0.415, p<.05), chloride (r_1=0.576, p<.01; r_2=0.597, p<.01) and significant inverse relationships with free carbon dioxide (r_1=–0.485, p<.05; r_2=–0.455, p<.05) and nitrate (r_1=–0.487, p<.05; r_2=–0.461, p<.05) in this beel.

pH fluctuated between 6.7-8.4 (7.1 ±0.6) at station I and between 6.6-8.3 (7.1 ±0.5) at station II in Ghorajan beel. Station I of this beel exhibited peak pH during February in the first year followed by April in the same year; while station II recorded during February in the first year followed by March of the same year. However, lowest pH was observed during December at station I and station II recorded lowest pH during October in the first annual cycle. This beel depicted maximum pH values during pre-monsoon season and slightly lower during the monsoon season of the year at both the stations. A narrow range of monthly fluctuations of pH was observed during the study period in this beel. During the second year, pH exhibited moderately alkaline in nature except an alkaline condition in the month of February in the first year, which recorded 8.4 at station I and 8.3 at station II. pH of the surface waters registered narrow fluctuations during the study period. It established signifi-

cant direct relationships with specific conductivity (r_1=0.479, p<.05; r_2=0.41, p<.05), total hardness (r_2=0.644, p<.001), chloride r_1=0.588, p<.01; r_2=0.569, p<.01) and significant inverse relationships with sulphate (r_1=–0.598, p<.01; r_2=–0.564, p<.01) and nitrate (r_1=–0.424, p<.05; r_2=–0.462, p<.05) in this beel. pH varied between 6.8-7.4(7.2 ±0.23) in Siligurijan beel and 6.9-8.4(7.6 ±0.56) in Fingua beel. It registered relatively lower fluctuation in both the beels except during winter in Fingua beel, which was slightly higher value. Siligurijan beel exhibited maximum value during summer and minima during winter season. However, the range exhibited slightly acidic to slightly alkaline nature but the mean value indicated alkaline condition of the water in the studied beel. On the other hand, Fingua beel depicted the identical but slightly higher mean value. However, secondary maxima was observed during autumn in Siligurijan beel, while Fingua beel exhibited a secondary maxima during the same season.

SPECIFIC CONDUCTIVITY: The sampled beels are characterised by a very low specific conductivity in general with relatively wide ranges between 94.0-199.0 (162.2 ±34.6) µS/cm at station I and 102.0-198.0 (162.6 ±33.0) µS/cm at station II in Deepor beel. The lowest value was recorded during September in the first year at station I and during September in the same year at station II. Peak concentration was observed during February and July in the first year and during February in the second year at station I as well as during April in the first year at station II. However, it showed secondary maxima during March (198.0 µS/cm) in the first year at station I and during the same month (197.0 µS/cm) in the same year at station II. Specific conductivity remained relatively constant throughout the summer season in the first and second year in this beel. Further, it depicted a bimodal pattern of monthly variations at both the stations. Specific conductivity registered inverse correlation with sulphate (r_1=-0.501; p<.05) and direct relationships with pH (r_1=0.512; p<.01), hardness (r_1=0.513; p<.01), calcium (r_1=0.464; p<.05), chloride (r_1=0.616, p<.01) and BOD (r_1=0.447; p<.05) in the present study.

Specific conductivity ranged between 50.0-193.0 (128.0 ±40.0) µS/cm at station I and between 49.0-198.0 (133.2 ±45.9) µS/cm at station II in Ghorajan beel. Both the stations, however, depicted lowest specific conductivity during September in the first year. Station I depicted peak concentration during April in the first year while ionic peak was observed during May in the second year at station II. On the other hand, it exhibited secondary maxima during April in the second year at station I and during June in the same year at station II. It declined gradually during July during both the years at station I and in the first year at station II. Specific conductivity recorded an inverse correlation with sulphate (r_1=-0.615; p<.01; r_2=-0.361) and direct correlation with pH (r_1=0.479, r_2=0.41; p<.05), hardness (r_1=0.857, p<.001; r_2=0.748; p<.001), calcium (r_1=0.796, r_2=0.687; p<.001), phosphate (r_1=0.346, r_2=0.408; p<.05) and BOD (r_1=0.484, p<.05; r_2=0.494, p<.05) in this study.

Specific conductivity ranged between 130.0-189.0 (157.0 ±25.1) µS/cm in Siligurijan beel and 89.0-173.0 (135.5 ±30.8) µS/cm in Fingua beel. The lowest specific conductivity value (89.0 µS/cm) was recorded during autumn in Fingua beel, while Siligurijan beel depicted peak value (189.0 µS/cm) during monsoon sea-

Table: 8 Correlation co-efficient (r_1) between abiotic factors of Deepor beel (Station I)

	Water temp'	Transparency	pH	Sp. conductivity	DO	FCO_2	T. alkalinity	T. hardness	Calcium	Magnesium	Chloride	Phosphate	Sulphate	Nitrate	Silicate	BOD	Sodium	Potassium
Rainfall(mm)	0.716©	-0.615Δ	-0.331	-0.008	0.095	0.276	0.351	-0.225	0.089	-0.124	-0.328	0.232	0.174	0.411*	-0.155	0.161	-0.172	-0.018
Water temperature (^{0}C)	-	-0.367	-0.191	0.121	-0.126	0.333	0.476*	-0.193	-0.057	-0.245	-0.238	0.149	0.01	0.286	-0.135	-0.015	-0.146	0.206
Transparency (cm)		-	-0.174	-0.33	-0.186	0.085	-0.003	0.06	-0.013	0.019	0.003	-0.419*	-0.145	-0.175	0.191	-0.205	0.587Δ	0.076
pH			-	0.512Δ	0.082	-0.485*	-0.266	0.498*	0.377	0.323	0.576Δ	0.039	-0.349	-0.487*	-0.044	0.257	-0.428*	-0.367
Sp. conductivity (µS/cm)				-	0.052	-0.191	-0.231	0.513Δ	0.464*	0.099	0.616Δ	0.155	-0.501*	-0.224	-0.1	0.447*	-0.64	-0.135
DO (mg/l)					-	0.075	-0.157	0.071	0.079	-0.377	0.039	-0.219	0.131	-0.056	-0.116	0.366	-0.317	-0.338
FCO_2 (mg/l)						-	0.659©	-0.126	-0.013	-0.059	-0.083	-0.249	-0.051	0.178	0.081	-0.029	0.061	-0.159
T. alkalinity (mg/l)							-	-0.241	-0.125	0.149	-0.323	-0.182	0.249	0.528Δ	0.407*	-0.124	0.273	0.235
T. hardness (mg/l)								-	0.866©	0.363	0.587Δ	-0.207	-0.738©	-0.54Δ	-0.257	0.462*	-0.275	-0.141
Calcium (mg/l)									-	0.056	0.549Δ	-0.286	-0.519Δ	-0.362	-0.369	0.529Δ	-0.237	-0.158
Magnesium (mg/l)										-	0.135	0.163	-0.31	-0.167	0.375	-0.134	-0.039	0.002
Chloride (mg/l)											-	-0.128	-0.419*	-0.336	-0.067	0.253	-0.382	-0.322
Phosphate (mg/l)												-	0.088	-0.189	0.055	-0.251	-0.296	0.105
Sulphate (mg/l)													-	0.55	0.231	-0.215	0.193	0.116
Nitrate(mg/l)														-	0.318	0.033	0.272	0.17
Silicate (mg/l)															-	-0.288	0.355	0.188
BOD (mg/l)																-	-0.446*	-0.464*
Sodium (mg/l)																	-	0.296

Level of Significance: p*< 05, p∆< 01, p© < 001

Table: 9 Correlation co-efficient (r_2) between abiotic factors of Deepor beel (Station II)

	Water temp'	Transparency	pH	Sp. conductivity	DO	FCO_2	T. alkalinity	T. hardness	Calcium	Magnesium	Chloride	Phosphate	Sulphate	Nitrate	Silicate	BOD	Sodium	Potassium
Rainfall(mm)	0.705©	-0.621Δ	-0.193	-0.03	0.042	0.233	0.297	-0.261	-0.202	-0.062	-0.323	0.188	0.257	0.338	-0.108	0.286	-0.115	-0.155
Water temperature (^{0}C)	-	-0.354	-0.125	0.066	-0.161	0.198	0.326	-0.217	-0.163	-0.167	-0.216	0.336	0.248	0.264	-0.061	0.012	-0.036	-0.329
Transparency (cm)		-	-0.147	-0.333	-0.014	0.046	-0.009	0.237	0.102	0.15	-0.029	-0.218	-0.194	-0.086	0.144	-0.261	0.203	0.102
pH			-	0.547Δ	0.242	-0.455*	-0.216	0.415*	0.462*	0.039	0.597Δ	-0.1	-0.379	-0.461*	-0.017	0.376	-0.264	-0.341
Sp. conductivity (µs/cm)				-	-0.062	-0.186	-0.024	0.346	0.489*	-0.145	0.53Δ	0.136	-0.524Δ	-0.194	-0.117	0.394	0.003	-0.213
DO (mg/l)					-	0.448*	0.038	0.131	0.116	-0.261	0.134	-0.287	-0.169	-0.152	0.052	0.424*	-0.225	-0.081
FCO_2(mg/l)						-	0.45*	0.033	0.002	0.182	-0.029	0.058	0.045	0.433*	0.218	-0.011	-0.081	0.052
T. alkalinity (mg/l)							-	-0.015	0.069	0.269	-0.305	0.171	0.231	0.279	0.255	0.18	0.346	-0.036
T. hardness (mg/l)								-	0.868©	0.461*	0.399	-0.209	-0.679©	-0.427*	-0.288	0.458*	0.144	-0.001
Calcium (mg/l)									-	0.149	0.522Δ	-0.209	-0.599Δ	-0.371	-0.284	0.483*	0.223	-0.164
Magnesium (mg/l)										-	-0.118	0.025	-0.138	-0.01	0.053	-0.019	0.054	0.244
Chloride (mg/l)											-	-0.321	-0.583Δ	-0.002	0.202	0.235	-0.101	-0.208
Phosphate (mg/l)												-	0.302	-0.046	-0.209	-0.333	0.119	-0.303
Sulphate (mg/l)													-	0.327	0.062	-0.406*	0.011	0.115
Nitrate(mg/l)														-	0.629Δ	-0.22	0.132	0.179
Silicate (mg/l)															-	-0.126	0.287	0.162
BOD (mg/l)																-	-0.077	0.032
Sodium (mg/l)																	-	0.116

Level of Significance: p*< 05, p∆< 01, p© < 001

Table: 10 Correlation co-efficient (r_1) between abiotic factors of Ghorajan beel (Station I)

	Water temperature	Transparency	pH	Sp. conductivity	DO	FCO_2	T. alkalinity	T. hardness	Calcium	Magnesium	Chloride	Phosphate	Sulphate	Nitrate	Silicate	BOD	Sodium	Potassium
Rainfall(mm)	0.714©	-0.633©	-0.078	0.049	-0.177	0.268	0.352	-0.246	0.068	-0.088	-0.168	-0.005	0.307	0.174	-0.089	0.268	-0.059	-0.086
Water temperature (°C)	-	-0.344	0.189	0.207	-0.269	0.145	0.351	0.033	0.126	-0.123	-0.041	0.116	0.062	0.312	-0.226	0.079	-0.144	-0.085
Transparency (cm)		-	-0.039	-0.137	0.123	-0.192	-0.438*	-0.249	-0.187	-0.299	-0.125	-0.189	-0.191	0.063	0.215	-0.492*	0.258	-0.03
pH			-	0.479*	-0.111	-0.307	0.088	0.371	0.341	-0.018	0.588\	-0.199	-0.598Δ	-0.424*	-0.337	0.158	-0.284	0.283
Sp. conductivity (µs/cm)				-	-0.034	0.169	0.517Δ	0.857©	0.796	0.32	0.344	0.346	-0.615Δ	-0.259	-0.181	0.484*	0.308	0.261
DO (mg/l)					-	0.538\	0.005	-0.052	-0.228	0.039	0.214	-0.11	0.134	0.117	-0.136	0.466*	0.116	-0.153
FCO_2 (mg/l)						-	0.444*	0.114	0.131	0.06	-0.061	0.298	0.074	0.227	-0.185	0.592\	0.143	-0.368
T. alkalinity (mg/l)							-	0.576Δ	0.488*	0.571Δ	0.135	0.532\	-0.179	0.034	-0.144	0.517\	0.195	-0.389
T. hardness (mg/l)								-	0.807©	0.495*	0.325	0.389	-0.585Δ	-0.287	-0.249	0.479*	0.282	0.192
Calcium (mg/l)									-	0.063	0.129	0.376	-0.64Δ	-0.302	-0.312	0.442*	0.1	0.128
Magnesium (mg/l)										-	0.262	0.352	0.053	-0.046	0.256	0.213	0.322	-0.133
Chloride (mg/l)											-	-0.348	-0.232	-0.182	-0.307	0.399	-0.041	0.248
Phosphate (mg/l)												-	-0.086	-0.082	-0.029	0.055	0.056	-0.41*
Sulphate (mg/l)													-	0.384	0.279	-0.128	0.038	-0.175
Nitrate(mg/l)														-	0.361	-0.203	0.289	-0.124
Silicate (mg/l)															-	-0.315	0.643	-0.036
BOD (mg/l)																-	0.076	0.097
Sodium (mg/l)																	-	0.102

Level of Significance: p*<.05; pΔ<.01; p©<.001

Table: 11 Correlation co-efficient (r_2) between abiotic factors of Ghorajan beel (Station II)

	Water temperature	Transparency	pH	Sp. conductivity	DO	FCO_2	T. alkalinity	T. hardness	Calcium	Magnesium	Chloride	Phosphate	Sulphate	Nitrate	Silicate	BOD	Sodium	Potassium
Rainfall(mm)	0.674©	-0.657©	-0.209	0.217	0.016	0.378	0.325	-0.085	0.167	-0.196	-0.101	-0.238	0.269	0.442*	-0.175	0.364	0.152	-0.098
Water temperature (°C)	-	-0.377	0 025	0.339	-0.062	0.179	0.377	0.139	0 261	-0.062	0.072	-0.155	0.157	0.253	-0.15	0.289	0.032	-0.059
Transparency (cm)		-	-0.032	-0.397	-0 205	-0.311	-0.455*	-0.183	-0.161	-0.188	-0.197	0.064	-0.282	-0.06	0.163	-0.459*	-0.155	0.067
pH			-	0.41*	-0.101	-0.122	0.169	0.644©	0.469*	0.283	0.569Δ	-0.025	-0.564Δ	-0.462*	-0.319	0.358	0.126	0.336
Sp. conductivity (µs/cm)				-	-0.225	0.154	0.532Δ	0.748©	0.687©	0.339	0.315	0.408*	-0.361	-0.289	-0.172	0.494*	0.305	0.183
DO (mg/l)					-	0.642©	0.133	-0.142	-0.281	0.011	0.277	-0.214	0.222	0.078	0.054	0.462*	-0 1	0.024
FCO_2 (mg/l)						-	0.434*	0.141	0.146	0.027	0.044	0.067	0.154	0.108	-0.096	0.663©	0.175	0.025
T. alkalinity (mg/l)							-	0.562Δ	0.458*	0.579Δ	0.229	0.31	0.082	0.17	0.039	0.481*	0.123	-0.008
T. hardness (mg/l)								-	0.807©	0.524Δ	0.424*	0.366	-0.488*	-0.385	-0.172	0.489*	0.313	0.353
Calcium (mg/l)									-	0.091	0.223	0.248	-0.516Δ	-0.309	-0.289	0.514Δ	0.224	0.293
Magnesium (mg/l)										-	0.355	0.462*	0.058	-0.013	0.314	0.187	0.249	-0.063
Chloride (mg/l)											-	-0.035	-0.171	-0.108	-0.331	0.625©	-0.011	0.356
Phosphate (mg/l)												-	0.244	-0.153	0.078	0.054	0.225	-0.194
Sulphate (mg/l)													-	0.534Δ	0.134	-0.134	-0.039	-0.318
Nitrate(mg/l)														-	0.411*	-0.077	0.312	-0.016
Silicate (mg/l)															-	-0.391	0.474*	-0.333
BOD (mg/l)																-	0.121	0.303
Sodium (mg/l)																	-	0.08

Level of Significance: p*<.05; pΔ<.01; p©<.001

son. However, secondary maxima (174.0 μS/cm) was observed during summer in Siligurijan beel and Fingua beel exhibited a secondary maxima (150.0 μS/cm) during summer season. The ranges and the mean values of Siligurijan beel were higher than that of Fingua beel.

DISSOLVED OXYGEN: Dissolved oxygen concentration fluctuated between 3.2-12.0 (6.1 ±2.5) mg/l at station I and between 2.4-12.8 (5.9 ±2.4) mg/l at station II in Deepor beel. Further, minimum dissolved oxygen values were recorded during January and October in the first year and also during March in the second year at station I and it showed during March in the second year at station II. Its peak value was attained during August in the first year at station I and during the same month in the same year at station II. It depicted 62.4-120.2% saturation at station I and 59.4-121.2% at station II in this beel. It exhibited secondary maxima during February (9.6 mg/l) in the first year and during December in the second year at station I, while station II showed secondary maxima during March (11.2 mg/l) at station II. After it attained maxima during March in the first year, a gradual decline in concentration was noticed till its second peak during August in the second year. Again from the secondary maxima during December in the second year, a gradual decline was observed till June of the same year at station I. On the other hand, after it attained peak during August in the second year, this gas remained low and almost constant till the end of the study period except during December (8.4 mg/l) at station II in this beel. However, bimodal pattern of monthly variations of dissolved oxygen concentration during the study period with two equal maxima (12.0 mg/l) was observed at station I and bimodal pattern was noticed at station II. In addition, dissolved oxygen registered direct significant correlation with BOD (r_2= 0.424, p<.05) and interestingly with free Co_2 (r_2= 0.448, p<.05) in this beel.

Dissolved oxygen fluctuated between 2.4-10.2 (5.7 ±1.7) mg/l at station I and between 3.2-12.4 (5.6 ±2.0) mg/l at station II in Ghorajan beel. Maximum concentration was recorded during August in the first year at station I and during the same month in the first year at station II. On the other hand, its minimum value was observed during January in the first year at station I and during the same month in the first year at station II. It exhibited secondary maxima during February (8.0 mg/l) in first year at station I and during November (8.2 mg/l) in the second year at station II. A very irregular trend was observed at station I but after it attained the secondary maxima during November in the second year at station II, it gradually declined till the end of the study period, however, a bimodal pattern of variations was noticed at station II. It showed 56.8-112.4% saturation at station I and 62.0-119.8% at station II. It exhibited significant positive relationships with free Co_2 (r_1= 0.538, p<.01; r_2= 0.642, p<.001) and BOD (r_1= 0.466, p<.05; r_2= 0.462, p<.05) in this beel.

Dissolved oxygen varied between 4.4-9.8 (6.5 ±2.1) mg/l in Siligurijan beel and 3.6-12.4 (6.8 ±3.5) mg/l in Fingua beel. Maximum concentrations of dissolved oxygen were recorded during summer and minimum during monsoon in both the beels. However, secondary maxima (6.8 mg/l) was noticed during winter in Siligurijan beel. On the other hand, Fingua beel showed the secondary maxima (7.2 mg/l) during summer season.

FREE CARBON DIOXIDE: The present observations recorded occurrence of free carbon dioxide throughout the study period at both the stations in Deepor beel and it varied between 0-30.0 (11.1 ±7.7) mg/l and between 0-38.0 (10.7 ±8.2) mg/l respectively. Its minimum concentration was noted during February in the first year and maximum concentration was recorded during August in the same year. This gas recorded secondary maxima (28.0 mg/l) during April in the first year followed by a tertiary maxima (26.0 mg/l) during November in the same year and depicted trimodal pattern of monthly variations at station I, while an identical pattern of variations was observed at station II, where secondary maxima (25.0 mg/l) was recorded during November in the first year followed by a tertiary maxima (24.0 mg/l) during April in the same year. After attaining maxima during August in the second year, a gradual decline was observed till the end of the study period at station I. Station II also followed the identical trend of variations during the study period. During the whole study period, a sharp decline was noticed during January and February in both the years. After the tertiary maxima in November (26.0 mg/l) in the first year, it recorded sharp decline to 8.0 mg/l in December and subsequently to 2.0 mg/l in January. It experienced the same trend in the second year of observation. In this present observation, free carbon dioxide exhibited positive correlation with total alkalinity (r_1= 0.659, p<.001; r_2= 0.45, significant p<.05), dissolved oxygen (r_2= 0.448, p<.05), nitrate (r_2= 0.433, p<.05) in this beel.

It was detected throughout the study period with concentrations fluctuating between 4.0-30.0 (8.7 ±5.8) mg/l and between 2.0-30.0 (8.3 ±5.3) mg/l at stations I and II respectively in Ghorajan beel. Maximum concentration of this gas was recorded during August in the first year and minimum concentrations were noticed during August, December, January and February in the first year and during February and May in the second year at station I. On the other hand, station II depicted maxima during August in the first year and a minimum value was observed during January and February in the same year of the study period. This beel exhibited wider ranges with a unimodal pattern of monthly variations at both the sampled stations. Secondary maxima (18.0 mg/l) was observed during April in the second year at station I and during April (12.0 mg/l) in the first year, while it was noticed during October (12.0 mg/l) in the second year at station II. In addition, the present observations indicated lower values of this gas during dry season, i.e. during December–February and relatively higher values during the rest of the study period. This beel depicted relatively low free carbon dioxide concentration (2.0 mg/l) in the month of January and February in the first year followed by the second year during the same season. Free Co_2 registered positive relationships with total alkalinity (r_1= 0.444, p<.05; r_2= 0.434, p<.05), dissolved oxygen (r_1= 0.538, <.01; r_2= 0.642, p<.001) and BOD (r_1= 0.592, p<.01; r_2= 0.663, p<.001).

TOTAL ALKALINITY: In the present observations, total alkalinity was exclusively represented by methyl orange alkalinity. This vital parameter varied considerably from month to month and from one sampling station to another. This study evidently registered low total alkalinity, the value fluctuated between 32.0-96.0 (70.0 ±16.4) mg/l and 30.0-93.0 (70.7 ±17.4) mg/l at stations I and II respectively in Deepor beel. At station I, maximum value was observed during the month of October in the

Table: 12 ANOVA OF SOME IMPORTANT ABIOTIC PARAMETERS OF DEEPOR BEEL, 1999-2000

Sources of variance	Sum of squares	Degree of freedom (d f)	Mean sum of squares	Variance ratio (F ratio)
Specific conductivity				
Between the months	27555.83	11	2505.07	106.87*
Between the stations	48.16	1	48.16	2.05
Error	257.84	11	23.44	
Total	27861.83	23		
Dissolved oxygen				
Between the months	118.47	11	10.77	36.76*
Between the stations	0.057	1	0.057	0.19
Error	3.22	11	0.29	
Total	121.75	23		
Free carbon dioxide				
Between the months	1448.46	11	131.68	61.73*
Between the stations	1.04	1	1.04	0.49
Error	23.46	11	2.13	
Total	1472.96	23		
Total alkalinity				
Between the months	8073.83	11	733.98	94.1*
Between the stations	28.16	1	28.16	3.61
Error	85.84	11	7.8	
Total	8187.83	23		
Total hardness				
Between the months	5357.83	11	487.07	218.61*
Between the stations	37.49	1	37.49	16.83*
Error	24.51	11	2.23	
Total	5419.83	23		
Calcium				
Between the months	2559.43	11	232.67	37.59*
Between the stations	22.24	1	22.24	3.59
Error	68.17	11	6.19	
Total	2649.84	23		

*Significant at 0.05 level

Table: 13 ANOVA OF SOME IMPORTANT ABIOTIC PARAMETERS OF DEEPOR BEEL, 2000-2001

Sources of variance	Sum of squares	Degree of freedom (d f)	Mean sum of squares	Variance ratio (F ratio)
Specific conductivity				
Between the months	30672.73	11	2788.36	84.73*
Between the stations	69.24	1	69.24	2.1
Error	362.68	11	32.91	
Total	31104.65	23		
Dissolved oxygen				
Between the months	170.36	11	15.49	36.86*
Between the stations	0.087	1	0.087	0.207
Error	4.58	11	0.42	
Total	175.02	23		
Free carbon dioxide				
Between the months	1580.38	11	143.67	63.57*
Between the stations	2.06	1	2.06	0.91
Error	24.87	11	2.26	
Total	1607.31	23		
Total alkalinity				
Between the months	9283.61	11	843.96	100.71*
Between the stations	36.32	1	36.32	4.33
Error	92.19	11	8.38	
Total	9412.12	23		
Total hardness				
Between the months	5436.72	11	494.24	199.29*
Between the stations	41.64	1	41.64	16.79*
Error	27.35	11	2.48	
Total	5505.71	23		
Calcium				
Between the months	2720.37	11	247.3	37.41*
Between the stations	25.42	1	25.42	3.84
Error	72.76	11	6.61	
Total	2818.55	23		

*Significant at 0.05 level

Table: 14 ANOVA OF SOME IMPORTANT ABIOTIC PARAMETERS OF GHORAJAN BEEL, 1999-2000

Sources of variance	Sum of squares	Degree of freedom (d f)	Mean sum of squares	Variance ratio (F ratio)
Specific conductivity				
Between the months	52917.46	11	4810.68	489.38*
Between the stations	18.38	1	18.38	1.87
Error	108.12	11	9.83	
Total	53043.96	23		
Dissolved oxygen				
Between the months	102.81	11	9.35	2.57
Between the stations	0.087	1	0.087	0.024
Error	40.06	11	3.64	
Total	142.95	23		
Free carbon dioxide				
Between the months	154	11	14.00	9.65*
Between the stations	0	1	0	0
Error	16	11	1.45	
Total	170	23		
Total alkalinity				
Between the months	7120	11	647.27	98.97*
Between the stations	0	1	0	0
Error	72	11	6.54	
Total	7192	23		
Total hardness				
Between the months	7359.33	11	669.03	116.76*
Between the stations	0.66	1	0.66	0.12
Error	63.01	11	5.73	
Total	7423.00			
Calcium				
Between the months	3363.81	11	305.8	36.49*
Between the stations	1.45	1	1.45	0.17
Error	92.18	11		
Total	3457.44	23		

*Significant at 0.05 level

Table: 15 ANOVA OF SOME IMPORTANT PARAMETERS OF GHORAJAN BEEL, 2000-2001

Sources of variance	Sum of squares	Degree of freedom (d f)	Mean sum of squares	Variance ratio (F ratio)
Specific conductivity				
Between the months	15571	11	1415.54	1.678
Between the stations	840.17	1	840.17	0.996
Error	9276.83	11	843.35	
Total	25688	23		
Dissolved oxygen				
Between the months	90.65	11	8.24	5.64*
Between the stations	0.103	1	0.103	0.071
Error	16.1	11	1.46	
Total	106.85	23		
Free carbon dioxide				
Between the months	1041.83	11	97.71	17.39*
Between the stations	4.16	1	4.16	0.74
Error	61.84	11	5.62	
Total	1107.83	23		
Total alkalinity				
Between the months	7097.46	11	645.22	21.031*
Between the stations	12.04	1	12.04	0.392
Error	337.46	11	30.68	
Total	7446.96	23		
Total hardness				
Between the months	2097.46	11	190.68	8.948*
Between the stations	70.04	1	70.04	3.287
Error	234.46	11	21.31	
Total	2401.96	23		
Calcium				
Between the months	725.52	11	65.96	19.09*
Between the stations	94.8	1	94.8	27.44*
Error	38.01	11	3.455	
Total	858.33	23		

*Significant at 0.05 level

second year and minimum during March in the same year at station I. While the maxima was noticed during November in the second year and the minimum during March in the first year at station II. On the other hand, alkalinity exhibited secondary maxima during November in first year at station I, while it was registered during the same month in the same year at station II. A tertiary maxima was noticed during April in the first year at station I and gradually decreased till October, where it attained maxima, while a tertiary maxima was noticed during October in the second year at station II. In this beel, the ranges and mean values of total alkalinity were identical during the both annual cycles and depicted trimodal pattern of monthly variations. It attained the maximum value during the pre-winter season at both the stations.

Total alkalinity ranged between 30.0-112.0 (66.0 ±20.1) mg/l and between 38.0-116.0 (66.7 ±19.5) mg/l at station I and II respectively in Ghorajan beel. Maximum value was noticed during March in the second year at station I, while minimum alkalinity was noticed during October in the first year. On the other hand, secondary maxima was observed during April in the second year at station I and during June in the second year at station II. It depicted bimodal pattern of monthly variations and exhibited gradual fluctuations till monsoon and it increased during April in the first year followed by its narrow monthly variations till pre-winter season, subsequently during the pre-monsoon season it attained the peak at station I. On the other hand, a bimodal pattern of monthly variations was noticed with similar ranges and mean values till pre-monsoon season in the first year, while with the peak during pre-monsoon season in the second year it showed gradual decline till the end of the study period. It registered direct correlations with specific conductivity (r_1= 0.517, p<.01; r_2= 0.532, p<.01), hardness (r_1= 0.576, p<.01, r_2= 0.562, p<.01) and calcium (r_1= 0.488, p<.05; r_2= 0.458, p<.05) in this beel.

Total alkalinity ranged between 45.0-84.0 (61.4 ±14.1) mg/l in Siligurijan beel and 62.0-84.0 (71.7 ±8.5) mg/l in Fingua beel. Maximum value was noticed during monsoon and a minimum during summer in Siligurijan, while Fingua beel showed maximum during winter and minimum during autumn season. On the other hand, secondary maxima (73.0 mg/l) was noticed during winter in Siligurijan beel, while Fingua beel showed second maximum value (75.0 mg/l) during monsoon season. The mean value of Siligurijan exhibited higher than that of Fingua beel.

TOTAL HARDNESS: Total hardness ranged between 46.0-82.0 (60.9 ±11.2) mg/l and 40.0-80.0 (60.9 ±12.4) mg/l at station I and II respectively in Deepor beel. It registered peak during January and April in the first year at station I, while station II exhibited the same season in the same year in the beel. Minimum values were recorded August and September in the first year at station I and station II depicted the lowest values during the same months in the same year. Further, monthly variations of total hardness depicted a clear unimodal pattern of fluctuations during the whole study period with a secondary maxima (80.0 mg/l) during February in the first year at station I and during the same month (78.0 mg/l) in the same year at station II in this beel. Total hardness increased sharply from the post-winter season, which remained without more monthly fluctuations till monsoon season, on the other hand, it declined during the summer and winter seasons till the end of the study period

with a narrow range of monthly variations at station I. Station II of the studied beel also depicted the same trend of monthly fluctuations. Hardness exhibited direct relationships with calcium (r_1= 0.866, p<.001; r_2= 0.868, p<.001), magnesium (r_2= 0.461, p<.05), chloride (r_1= 0.587, p<.01) and BOD (r_1= 0.462, p<.05; r_2= 0.458, p<.05) and it established inverse correlation with sulphate (r_1= -0.738, p<.001; r_2= -0.679, p<.001), nitrate (r_1= -0.540, p<.01; r_2= -0.427, p<.05) in this beel.

Ghorajan beel recorded 20.0-84 (54.4 ±15.7) mg/l station I and 20.0-80.0 (52.6 ±15.1) mg/l at station II. It registered lowest concentration during September in the first year at station I and during October in the same year at station II. However, it depicted bimodal pattern of monthly fluctuations with gradual increase from the winter season to pre-monsoon season in the first year and attained the peak during March in the second year. It exhibited identical trend of fluctuations in the first year and attained the secondary maxima (80.0 mg/l) during March in the first annual cycle at station I. However, station II exhibited gradual increase to attain the peak during March in the second annual cycle. Total hardness of this beel declined during August-February and increased once again to attain the second maxima (76.0 mg/l) during March in the first annual cycle. It showed direct relationships with calcium (r_1= 0.807, p<.001; r_2= 0.807, p<.001) magnesium (r_1= 0.495, p<.05; r_2= 0.524, p<.01), chloride (r_1= 0.325, r_2= 0.424, p<.05), BOD (r_1= 0.479, p<.05; r_2= 0.489, p<.05), and inverse relationships with sulphate (r_1= -0.585, p<.01; r_2= -0.488, p<.05) in this beel.

Total hardness varied between 40.0-76.0 (60.0 ±14.1) mg/l in Siligurijan beel and between 52.0-76.0 (63.2 ±9.4) mg/l in Fingua beel. It registered maxima during summer and minima during autumn in Siligurijan beel. Fingua beel showed peak hardness during winter and minima during monsoon season. It exhibited secondary maxima (70.0 mg/l) during monsoon in the former, however, it showed secondary maxima (68.0 mg/l) during the same season i.e. monsoon in the later.

CALCIUM: The present study indicated relatively lower concentration of calcium, which in turn, fluctuated between 23.1-56.7 (36.2 ±8.2) mg/l at station I and 21.0-52.5 (35.2 ±8.6) mg/l at station II of Deepor beel respectively. The lowest value of calcium was observed during November in the first year at station I and three distinct minima were noticed during August and September in the first year and during January in the second year at station II in this beel. Its peak concentrations were, however, noted during April in the first year at station I and station II registered during the same month. With annual ranges and mean values remaining a narrow fluctuations during the study period, calcium content in this beel depicted a bimodal pattern of monthly variations at station I. Station II of the beel exhibited almost identical trend of variations in the whole study period. There was a sharp decline during winter season till December followed by a rise in their monthly variations to attain primary maxima during April in the first annual cycle at station I. At this station, calcium content registered secondary maxima (52.5 mg/l) during January in the same cycle. On the other hand, secondary maxima (50.4 mg/l) was noticed during January in the first year at station II. Calcium depicted significant direct relationship with total hardness (r_1= 0.866, p<.001; r_2= 0.868, p<.001) and it showed significant inverse relationship with sulphate (r_1= -0.519, p<.01; r_2= -0.599, p<.01) at station II in this beel.

Calcium varied between 8.4-46.2 (31.3 ±10.5) mg/l at station I and between 10.5-44.1 (29.1 ±9.8) mg/l at station II respectively in Ghorajan beel. Minimum concentration was observed during October in the second year at station I and station II also exhibited minima in the same month. Maximum values were recorded during May in the first year at station I and station II recorded during the same month in this beel. However, the calcium content exhibited wide ranges in the monthly variations till secondary maxima (42.0 mg/l) was attained during March in first year followed by tertiary maxima (41.1 mg/l) during February and March in the second year at station I. Station II of this beel also exhibited secondary maxima (42.0 mg/l) during March in the second year. It showed the positive relationship with total hardness (r_1= 0.807, p<.001; r_2= 0.807, p<.001), while it depicted inverse relationship with sulphate (r_1= -0.640, p<.001; r_2= -0.516, p<.01) in this beel.

Calcium ranged between 26.1-43.6 (33.4 ±6.4) mg/l in Siligurijan beel and between 29.4-38.3 (32.9 ±3.3) mg/l in Fingua beel. The former showed peak calcium concentration during summer and lowest during autumn, while maximum value was observed during monsoon season in Fingua beel. Siligurijan beel depicted a secondary maxima (32.4 mg/l) during monsoon, while secondary maxima (32.3 mg/l) was observed during winter season in Fingua beel.

MAGNESIUM: It ranged between 0.8-8.9 (5.6 ±1.7) mg/l at station I and between 0.8-9.3 (5.9 ±1.9) mg/l at station II in Deepor beel. This beel was characterised by trimodal pattern of variations with a relatively narrow range and after remaining generally low till December, it showed peak during January in the second year at station I, while the station II showed maxima during September in the first year. Further, lowest hardness was noticed during March in the first year at both the stations in Deepor beel. However, a secondary maxima (8.2 mg/l) was recorded during May in the first year at station I, on the other hand, station II showed secondary maxima (8.9 mg/l) during January in the second year. During the winter season a gradual increase was noticed until it attained a tertiary maxima (7.7 mg/l) during February in the first year at station I. Further, very irregular monthly variations were observed during the summer and winter seasons till it attained a tertiary maxima (8.3 mg/l) during May in the first year at station II.

Ghorajan beel depicted trimodal pattern of monthly variations. The values ranged between 0.9-9.6 (5.2 ±2.4) mg/l and between 0.7-9.4 (5.3 ±2.3) mg/l at station I and II respectively. This beel exhibited peak magnesium hardness during March in the second year at station I and at station II it was noticed during January in the same year, while the lowest value was observed during September in the first year at both the stations in the beel. However, in the second year at station I, there was a sharp decline during winter season till December followed by an increase to secondary maxima (9.4 mg/l) during January. On the other hand, station II exhibited a gradual decline after it attained secondary maxima (9.2 mg/l) during March in the second annual cycle. Again during winter and monsoon seasons a very irregular fluctuations in monthly variations was observed till it attained a tertiary maxima (9.1 mg/l) during June in the first year at station I. However, almost identical trend was noticed at station II also and it attained tertiary maxima (8.4 mg/l) during the

same month in the same year. Magnesium concentration further, exhibited different trends of ranges in monthly variations but it was observed that the concentration attained peak during the same season in both the beels. However, it depicted positive relationship with phosphate (r_1= 0.352, r_2= 0.462, p<.05) in this beel.

Magnesium concentration varied between 3.3-9.1 (6.4 ±2.2) mg/l in Siligurijan beel and between 5.5-10.8 (7.4 ±2.1) mg/l in Fingua beel. It registered maxima during monsoon and minima during autumn season in Siligurijan beel. Fingua beel showed peak concentration during winter and lowest value was noticed during monsoon season. Secondary maxima (7.8 mg/l) was noticed during summer in Siligurijan beel, while Fingua beel exhibited secondary maxima (7.2 mg/l) during monsoon season.

CHLORIDE: The chloride content ranged between 14.9-35.9 (23.8 ±6.5) mg/l at station I and between 12.9-35.9 (23.3 ±6.7) mg/l at station II in Deepor beel. Maximum value was recorded during April in the first year at station I and during February in the same year at station II of the beel. On the other hand, minimum value was registered during May in the second year at station I and during December in the first year at station II. It, however, depicted a bimodal pattern of monthly variations. Chloride content showed secondary maxima (34.9 mg/l) during February in both annual cycles at station I, however, station II exhibited secondary maxima (33.9 mg/l) during April in the first annual cycle. In the second year, there was sharp decline in monthly variations till it attained tertiary maxima (31.9 mg/l) during January at station I, it clearly showed an identical trend of variations at station II and attained tertiary maxima (32.9 mg/l) during February. Chloride registered significant inverse correlation with sulphate (r_1= -0.419; p<.05, r_2= -0.583; p<.01) in this beel.

Chloride content in Ghorajan beel ranged between 8.9-42.9 (21.8 ±8.4) mg/l and between 9.9-43.9 (22.6 ±7.5) mg/l at station I and station II respectively. The beel exhibited distinct maxima during July in the first year at station I and during the same month at station II. While it exhibited lowest value during June in the second year at station I and it showed minima during September at station II in the first year. This beel depicted a bimodal pattern of monthly variations with slightly higher ranges and mean values in the second year at both the stations. It gradually declined from maxima in July to the end of the study period with minima in June at station I. A trend of gradual increase was observed from the beginning of the study period till the second maxima (36.9 mg/l) during April in the first year at station I. The content showed the same trend of fluctuations till it attained the secondary maxima (32.9 mg/l) during February in the first year at station II in the beel. It showed significant positive correlation with BOD (r_1= 0.625; p<.001) at station I in this beel.

DISSOLVED ORGANIC MATTER: It ranged between 0.3-3.2 (2.3 ±0.7) mg/l and between 0.5-3.8 (2.1 ±0.7) mg/l at station I and II respectively of Deepor beel. It showed maxima during March in the second year and minima was observed during January in the first year at station I. It registered maximum value during April in the first year and minima during January in the same year at station II. DOM attained a secondary maxima (3.0 mg/l) during February in the first year and during

April in the second year at station I and also during February (3.0 mg/l) in the first year at station II in this beel. On the contrary, maximum value was observed during April in the first year and minimum during January in the same year at station II. It depicted a bimodal pattern of monthly variations with narrow ranges and mean values at both the stations. At station I, DOM exhibited a gradual increase during the winter season but sharply declined in the month of January in the first annual cycle and in the next month it again increased and attained the second maxima.

DOM content of Ghorajan beel fluctuated between 0.9-3.8 (2.3 ±0.7) mg/l at station I and between 0.8-3.8 (2.2 ±0.7) mg/l at station II. It exhibited peak value during June in the first year and minima during January in the same year at station I while it reached maxima during February in the first year and minima during January in the same year at station II. However, a secondary maxima was observed during February in the first year at station I and during June in the same year at station II. DOM showed bimodal pattern of their monthly variations during the whole study period in the beel. It gradually decreased from the month of August and sharply declined in January, which attained the second maxima in the next month at station I; on the other hand, station II depicted the identical trend of variations.

TOTAL DISSOLVED SOLIDS: Total dissolved solids ranged between 0.4-2.6 (1.6 ±0.6) mg/l at station I and between 0.3-3.2 (1.5 ±0.6) mg/l at station II in Deepor beel. The lowest concentration was observed during August and September in the first year and maximal value was noticed during December in the same year at station I, while the lowest value during August in the first year and maxima was observed during November in the same year at station II. In this beel, there was a marginal difference in annual ranges of monthly TDS values with bimodal patterns of fluctuations. Relatively less fluctuation was observed till October in the first year, the period from August-October exhibited generally a low content (0.4-1.0 mg/l) but it increased sharply and depicted the secondary maxima (2.3 mg/l) in November at station I. Almost an identical trend of variations was observed during the period of August-October but sharply increased to attain the maxima in November followed by a secondary maxima (2.5 mg/l) in the next month at station II. TDS depicted higher values during the winter season at both the stations of Deepor beel.

TDS of Ghorajan beel ranged between 0.8-2.9 (1.9 ±0.6) mg/l at station I and 1.1-2.9 (1.8 ±0.5) mg/l at station II. However, station I depicted maximum TDS value during May in the first year and minima during October in the same year. On the other hand, station II registered maximum during May in the first year and minimum during January in the same year. This beel also depicted bimodal pattern of monthly variations with a secondary maxima (2.8 mg/l) during March in the second annual cycle at station I and station II showed the secondary maxima (2.7 mg/l) during June in the first annual cycle. From the month of October in the first year, there was a gradual increase in monthly variations till it attained the primary maxima in May at station I. On the other hand, starting with a high value in August, it declined gradually till it attained the primary maxima in May followed by its secondary maxima in the next month at station II.

PHOSPHATE: The concentration of inorganic phosphorus estimated as phosphate ranged between 0.01-0.9 (0.3 ±0.3) mg/l at station I and between 0.02-1.2 (0.3 ±0.3) mg/l at station II in Deepor beel. The lowest concentration was observed during February in the first year, it subsequently registered a gradual increase and culminated in peak during January in the second year at station I. On the other hand, station II exhibited minima during January and maxima during June in the second year. Phosphate content exhibited secondary maxima (0.8 mg/l) during September in the second year at station I, while it showed almost an identical trend of variations and exhibited secondary maxima (1.1 mg/l) during March in the second year at station II in the studied beel. This beel depicted unimodal pattern of monthly phosphate variations at station I but it also exhibited unimodal pattern at station II. Compared to first year monthly fluctuations, second year exhibited marginally higher mean values with a peak during the period at station I. However, a higher value was observed during the winter in the first year but on the other hand, relatively higher values with narrow ranges were noticed during the post-monsoon and summer seasons in the second year at station II.

Ghorajan beel depicted phosphate content ranging between 0.02-1.4 (0.5 ±0.4) mg/l at station I and between 0.04-2.4 (0.87 ±0.8) mg/l at station II. Minima was observed during February in the first year and a maxima during April in the second year at station I, while station II showed the lowest concentration during February in the first year and its peak concentration was noticed during January in the second year. This beel depicted unimodal pattern of monthly variations with secondary maxima (1.1 mg/l) during October in the second year at station I while station II exhibited relatively higher mean values followed by a secondary maxima (2.2 mg/l) during December in the second year. Both the stations showed relatively higher mean values during the second annual cycle and the trend of monthly variations was broadly corresponded with that ranges recorded in Deepor beel. It exhibited significant inverse correlation with potassium (r_2= -0.410, p<.05) at station I in this beel.

SULPHATE: The present observations indicated sulphate content ranging between 5.1-28.2 (14.9 ±6.3) mg/l at station I and between 4.9-24.5 (15.8 ±5.3) mg/l at station II of Deepor beel. During the winter season, its values were lower than that of summer and lowest value was noticed during March in the first year and its peak was noticed during July in the same year at station I, while station II registered a minima during January in the first year and a maxima during September in the same year. It showed a secondary maxima (26.2 mg/l) during September in the first year at station I, while it exhibited secondary maxima (22.7 mg/l) during July in first year at station II. Sulphate content depicted a trimodal pattern of variations and the content gradually decreased during the winter and monsoon seasons (October-June) and sharply increased to attain the maxima in July at station I. With distinct variations during the winter in the second year, it was found to be increase from the post-monsoon season. On the other hand, an identical trend of variations was observed at station II with maxima in September during the first annual cycle and subsequently it gradually decreased from winter season upto monsoon season and again relatively higher values were noticed from July onwards. In the second year, a gradual decline

was observed with narrow ranges till the end of the study period. Further, it registered inverse correlations with specific conductivity (r_1= -0.501, p<.05; r_2= -0.524, p<.01) and total hardness (r_1= -0.738, p<.001; r_2= -0.679, p<.001) in this beel.

Sulphate content of Ghorajan beel depicted bimodal pattern of monthly variations and fluctuated between 3.6-30.3 (17.4 ±6.8) mg/l at station I and between 4.2-27.0 (16.5 ±5.9) mg/l at station II during the study period. The lowest concentration was observed during March in the first year and its peak was noticed during July in the same year at station I, while station II depicted minima during the same month of the same year with station I and a maxima during August in the first year. This beel exhibited secondary maxima (30.0 mg/l) during August in first year at station I, while station II showed a secondary maxima (26.3 mg/l) during July in the same year. During the winter and monsoon seasons, the content was found to be lower and sharply increased to attain maxima in July at station I and again it showed gradual decline during the winter and monsoon seasons till the end of the study period in the second annual cycle. Almost an identical trend of variations was noticed at station II of the sampled beel. It recorded inverse relationships with pH (r_1= -0.598, p<.01; r_2= -0.564, p<.01), specific conductivity (r_1= -0.615, p<.01)and total hardness (r_1= -0.585, p<.01; r_2= -0.488, p<.05), while direct relationship was observed with nitrate (r_2= 0.534, p<.01) in this beel.

NITRATE: Nitrate concentration was low during the study period in Deepor beel and it ranged between 0.1-1.9 (1.2 ±0.5) mg/l at station I and between 0.2-2.3 (1.4 ±0.6) mg/l at station II. However, it did not follow any definite trend in the beel. Its minimum nitrate concentration was observed during February in the first year and minima during September in the first year and also during July in the same year at station I. On the other hand, station II exhibited minimum concentration during February in the first year and maxima during December in the first year. A relatively narrow range was observed during the whole study period with secondary maxima (1.8 mg/l) in June in the first annual cycle at station I, while station II exhibited secondary maxima (2.1 mg/l) in December during the same annual cycle. The nitrate concentration remained low during monsoon season and indicated sharp increase in July (peak). However, nitrate remained generally low during the second year with a minor fluctuations depicting irregular monthly variations at station I. Station II of the studied beel exhibited less fluctuations and showed relatively low concentration during the second year. A sudden drop of nitrate occurred during January-March in the first year followed by a sharp increase again culminating into second maxima at station II. Nitrate registered inverse relationship with total hardness (r_1= -0.540, p<.01; r_2= -0.427, p<.05) and positive correlation with rainfall (r_1= 411, p<.05) in this beel.

The concentration of this nutrient fluctuated between 0.09-2.1 (1.1 ±0.6) mg/l at station I and between 0.09-2.1 (1.2 ±0.6) mg/l at station II of Ghorajan beel. It attained peak during November in the first year and minimum concentration was observed during January in the second year at station I; while station II depicted maxima during December in the first year and a minima during March in the same year. This beel exhibited a secondary maxima (1.9 mg/l) during August and December in the first year at station I, while station II showed a secondary maxima (1.9 mg/

l) during two months i.e. September and July in the first year. Both the stations of the sampled beel did not follow any definite trend of variations during the study period. After it attained the peak, the concentration decreased sharply remaining low during the post-winter and pre-monsoon seasons, thereafter gradually increased to a certain extent and maintained the low range of variations till the end of the study period at both the stations. Both the sampled stations exhibited maxima and minima during the pre-winter and post winter seasons respectively of the same year. It depicted positive correlation only with rainfall (r_2= 0.442, p<.05) in this beel.

SILICATE: Silicate concentration ranged between 0.1-4.6 (2.1 ±0.9) mg/l at station I and between 0.3-4.1 (1.9 ±0.8) mg/l at station II in Deepor beel. Station I showed maxima during December in the first year and minima during March in the same year. On the other hand, it attained peak during November in the first year and minima during January in the same year at station II. After the peak during winter season, it decreased gradually remaining low during monsoon and summer seasons and once again it increased from the month of February in the second year at station I, while it exhibited second maxima (3.9 mg/l) during November in the first year at station I. On the other hand, station II exhibited almost identical monthly variations but secondary maxima (3.9 mg/l) was noticed during December in the first year while it gradually declined during the monsoon and increased during the summer season showing a tertiary maxima (2.9 mg/l) in June at station II. In the second year, the concentration decreased during the winter and it increased during February. Silicate content depicted bimodal pattern of variations at station I, while it showed trimodal pattern at station II. It, however, registered positive relationship with total alkalinity (r_1= 0.407, p<.05) in this sampled beel.

Ghorajan beel registered silicate values ranging between 0.04-4.1 (1.8 ±0.8) mg/l at station I and between 0.08-4.3 (1.9 ±0.9) mg/l at station II. Maximum concentration was observed during December in the first year and minima during March in the same year at station I; while station II exhibited maxima during December in the first year and minima during March in the first year. However, it depicted trimodal pattern of monthly variations at station I with a secondary maxima (3.7 mg/l) during November in the first year and a tertiary maxima (2.6 mg/l) during summer season in the month of June and during winter season in the next year in December. On the other hand, station II depicted bimodal pattern of monthly silicate variations with secondary maxima (3.7 mg/l) during winter season in the month of November and tertiary maxima during autumn in the month of September in the next year. Silicate content continued to remain low during January-April in the first year at both the stations and the monthly variations observed in the second year showed slightly higher concentration than the first year. Silicate exhibited positive relationship with sodium (r_1= 0.643, p<.01; r_2= 0.474, p<.05) in this beel.

BIOCHEMICAL OXYGEN DEMAND: It fluctuated between 0.6-4.8 (2.09 ±0.9) mg/l at station I and between 0.4-5.1 (2.8 ±1.5) mg/l at station II in Deepor beel. BOD attained a peak during August in the first year and minimum value was observed during September in the second year at station I, while station II exhibited maximum value during June in the first year and minima was noticed during March

in the second year. It exhibited secondary maxima (3.8 mg/l) during April in the first year at station I, while station II showed secondary maxima (4.8 mg/l) during February in the first year. Further, it remained relatively low during winter season in the first year but increased sharply from February at both the stations. However, station II exhibited relatively higher concentrations during monsoon and summer seasons but gradually decreased in the second year. BOD registered positive correlation with dissolved oxygen (r_2= 0.424, p<.05) and calcium (r_1= 0.529, p<.01; r_2= 0.483, p<.05) in this beel.

BOD values ranged between 0.1-4.4 (1.8 ±1.0) mg/l at station I and between 0.1-4.8 (1.7 ±1.1) mg/l at station II in Ghorajan beel. Station I depicted maximum value during August in the second year and minima during December in the first year. On the other hand, maximum value was noticed during October and December in the first year and minima during August in the second year at station II. This beel depicted bimodal pattern of variations and showed relatively higher concentrations during summer in the first year and during winter season in the second year at both the stations. It exhibited secondary maxima (3.4 mg/l) during May in the first year at station I and during April (3.6 mg/l) in the same year at station II. Further, the second year exhibited relatively higher BOD concentrations than the first year. This beel depicted direct relationships with dissolved oxygen (r_1= 0.466, p<.05; r_2= 0.462, p<.05) and calcium (r_1= 0.442, p<.05; r_2= 0.514, p<.01) and also exhibited significant inverse correlation with transparency (r_1= -0.492, p<.05; r_2= -0.459, p<.05).

SODIUM: Sodium ranged between 12.4-31.0 (19.6 ±4.7) mg/l at station I and between 11.1-28.0 (18.8 ±4.2) mg/l at station II of Deepor beel. Higher sodium concentration was observed during December in the first year and lower was noted during February in the same year at station I, while maxima was observed during December and minima during February in the first year at station II. However, secondary maxima (27.3 mg/l) was observed during October in the second year at station I, while secondary maxima (26.2 mg/l) was noticed during March in the next year at station II. A distinct bimodal pattern of monthly variations was observed with higher concentrations during pre-monsoon and winter seasons in different years at station I. The sodium content remained relatively high from September-December in the first annual cycle with its peak in December; thereafter it gradually decreased till August with a secondary maxima in October in the next cycle at station I. However, station II depicted bimodal pattern of variations with two relatively higher values in two different seasons during the study period. Relatively higher values were found during winter in the first annual cycle with a peak, again the values increased during monsoon in the second annual cycle. However, sodium exhibited significant positive relationships with transparency (r_1= 0.282, p<.01) at station I. On the other hand, it showed significant negative relationships with pH (r_1= -0.428, p<.05) and BOD (r_1= -0.446, p<.05) at station I in this beel.

However, sodium fluctuated between 6.1-27.0 (18.6 ±5.4) mg/l at station I and between 7.3-29.0 (19.9 ±5.4) mg/l at station II in Ghorajan beel. On the contrary, maximum sodium concentration was noticed during December in the first year at station I and station II registered maxima during December in the first year and

minima during February in the same year. However, secondary maxima (26.9 mg/l) was observed during June in the first year at station I, while secondary maxima (28.4 mg/l) was noticed during February in the next year at station II. A trimodal pattern of monthly variations was observed with higher concentrations during the three seasons in different years at both the stations. The sodium content remained relatively high from August-December in the first annual cycle with its peak in December; thereafter it sharply decreased during January and February. This was followed by an increase till secondary maxima in June was attained in the first year at station I. A third maxima was observed during the winter in the second year. However, station II depicted almost an identical pattern of variations with three relatively higher values in three different seasons during the study period. Station II exhibited a relatively higher values during winter in the first annual cycle, again the value increased during post-monsoon and summer seasons followed by again a high value during post-winter and pre-monsoon seasons in the second annual cycle. It showed significant positive correlation with silicate (r_1= 0.643, p<.01; r_2= 0.474, p<.05) in Ghorajan beel.

POTASSIUM: In the present observations, potassium content ranged between 3.2-9.0 (6.06 ±1.6) mg/l at station I, while station II exhibited 4.2-10.2 (6.6 ±1.5) mg/l in Deepor beel. Peak concentration of potassium was recorded during September in the second year and minima was noted during February in the first year at station I. Station II depicted maxima during December in the second year and minima during February in the same year. A trimodal pattern of monthly variations was observed at station I with secondary maxima (8.2 mg/l) during April in the second year at station I. On the other hand, station II exhibited secondary maxima (9.2 mg/l) during September in the second year. After it attained a relatively high value in October in the first year, potassium content gradually declined during winter and monsoon seasons till the peak in September. However, there was a decline during the winter in the next cycle till it attained the second maxima in April. It depicted significant inverse correlation with BOD (r_1= -0.464, p<.05) at station I.

Potassium fluctuated between 3.7-10.0 (6.4 ±1.7) mg/l at station I and between 3.2-9.8 (6.1 ±1.7) mg/l at station II of Ghorajan beel. Maximum concentration was noticed during February in the first year and minima was registered during March in the second year at station I and station II exhibited maxima during March in the first year and minima during October in the second year. A secondary maxima (9.3 mg/l) was noticed during June in the first year at station I, while station II showed secondary maxima during the same month (8.4 mg/l) in the same annual cycle. It was consistently low during winter with a very narrow range till it attained maximum value in March during the first annual cycle. In the second year, after it attained tertiary maxima (8.2 mg/l) in February, then dropped again during monsoon season till the end of the study period. A trimodal pattern of variations was observed during the whole study at both the stations of the beel. It exhibited significant inverse relationship with phosphate (r_1= -0.410, p<.05) at station I.

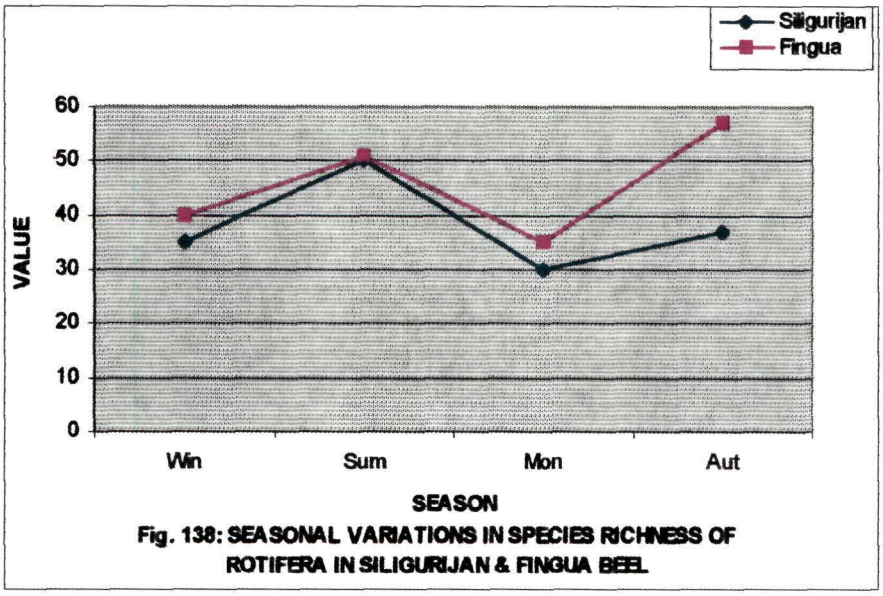


Fig. 138: SEASONAL VARIATIONS IN SPECIES RICHNESS OF ROTIFERA IN SILIGURIJAN & FINGUA BEEL

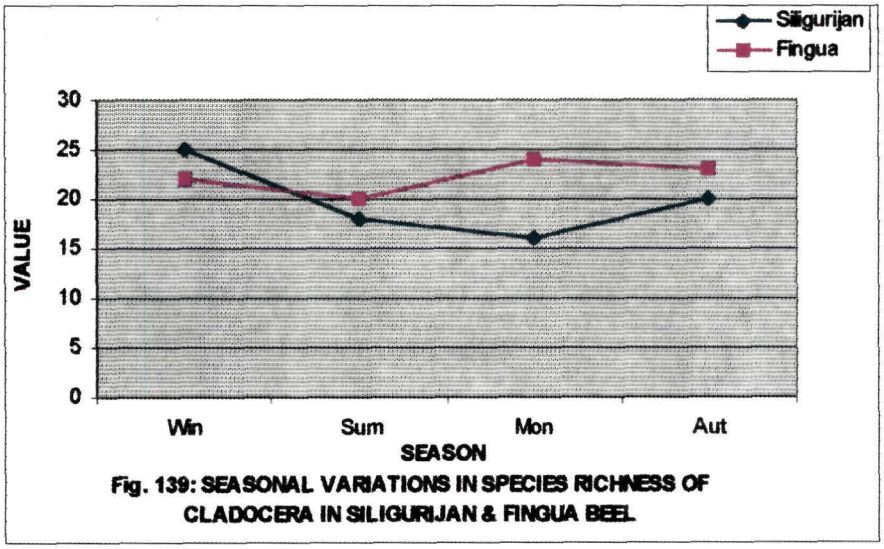


Fig. 139: SEASONAL VARIATIONS IN SPECIES RICHNESS OF CLADOCERA IN SILIGURIJAN & FINGUA BEEL

2. BIOTIC FACTORS:

The biotic factors included in the present observations deal with composition of net plankton, zooplankton and phytoplankton, succession of various planktonic taxa as well as population densities of the stated communities. Their important features are explained below:-

A. BIODIVERSITY OF ZOOPLANKTON

During the present study, along with regular limnological investigations in two beels, qualitative plankton samples were collected from few beels of lower Assam. The samples were screened for identification of zooplankton particularly rotifers and cladocerans. Species composition of the recorded taxa in the sampled beels is presented in Tables: 8 (a) and 8 (b) and also illustrated (Rotifera, Figs. 3-90; Cladocera, Figs. 91-125). Seasonal variations in species richness of Rotifera and Cladocera of Siligurijan and Fingua beel are presented in Figures 138-139.

Systematic list of documented Rotifera and Cladocera

ROTIFERA

Family: Brachionidae

Brachionus falcatus Zacharias
B.bidentatus Anderson
B.quadridentatus(Hermann)
B.caudatus(Barrois& Daday)
B.rubens Ehrenberg
B.patulus(Muller)
Platyias quadricornis(Ehrenberg)
K.quadrata(Muller)
K.tropica(Apstein)
Anuraeopsis fissa (Gosse)
B.angularis Gosse
B.diversicornis(Daday)
B.calyciflorus(Pallas)
B.forficula Wierzejski
B.mirabilis(Daday)
B.patulus macracanthus(Daday)
Keratella cochlearis Gosse
K.lenzi Hauer
K.procurva(Thorpe)

Family : Euchlanidae

Euchlanis dilatata Ehrenberg
Dipleuchlanis propatula(Gosse)
Euchlanis triquetra Ehrenberg
Beauchampiella endactylota(Gosse)

Family : Mytilinidae

Mytilina ventralis(Ehrenberg)
M.bisulcata(Lucks)

Family : Trichotridae

Macrochaetus sericus(Thorpe)
Trichotria tetractis(Ehrenberg)

Family: Colurellidae

Colurella obtusa(Gosse)
Lepadella ovalis(Muller)
L.patella(Muller)
L.ehrenbergi(Perty)
L.apsicora Myers
C.uncinata(Muller)
Lepadella ovalis larga (Sharma)
L.heterostyla(Murray)
L.rhomboides(Gosse)
Squatinella mutica(Ehrenberg)

Family : Lecanidae

Lecane curvicornis(Murray)
L.ploenensis(Voigt)
L.ludwigi(Eckstein)
L.leontina(Turner)
L.luna(Muller)
L.quadridentata(Ehrenberg)
L.bulla(Gosse)
L.aculeata(Jakubski)
L.hamata(Stokes)
L.hornemanni(Ehrenberg)
L.ohioensis(Herrick)
L.inopinata(Harring & Myers)
L.ungulata(Gosse)
L.hastata (Murray)
L.lateralis Sharma
L.papuana(Murray)
L.pyriformis(Daday)
L.closterocerca(Schmarda)
L.lunaris(Ehrenberg)
L.unguitata(Fadeev)
L.thienemanni(Hauer)
L.stenroosi(Meissner)
L.decipiens(Murray)
L.crepida(Harring)

Family : Notommatidae

Cephalodella forficula(Ehrenberg)
Scaridium longicaudum(Muller)
Monommata longiseta(Muller)

Family : Gastropodidae

Ascomorpha saltans Bartsch

Family: Trichocercidae

Trichocerca cylindrica(Imhof)
T.porcellus(Gosse)
T.rattus (O.F. Muller)
Trichocerca pusilla (Lauterborn)
T.similis(Wierzejski)
T.elongata(Gosse)
T.longiseta(Schrank)

Family: Asplanchnidae

Asplanchna priodonta Gosse

Family: Synchaetidae

Polyarthra vulgaris Carlin

Family: Floscularidae

Sinantherina socialis Bory de st. Vincent
S. spinosa(Thorpe)

Family: Conochilidae

Conochilus unicornis Rousselet

Family: Hexarthridae

Hexarthra mira(Hudson)

Family: Filiniidae

Filinia camascela Myers
F.pejleri Hutchinson
F.longiseta(Ehrenberg)
F.opoliensis Zacharias

Family : Testudinellidae

Testudinella patina(Hermann)
T.emarginula(Stenroos)
Trochosphaera aequatorialis Semper
T.greeni Koste
T.brevicaudata Yamammoto

Family: Philodinidae

Rotaria neptunia(Ehrenberg)

Cladocera

Family: Sididae

Sida crystallina (O.F.Muller)
Diaphanosoma excisum Sars

Family: Daphnidae

Ceriodaphnia cornuta Sars
Scapholeberis kingi Sars
S.serrulatus (Koch)
C.quadrangula (O.F.Muller)
Simocephalus vetulus (O.F.Muller)
Daphnia lumholtzi Sars

Family: Moinidae

Moina micrura Kurz
Moinodaphnia macleayi (King)

Family: Bosminidae

Bosmina longirostris (O.F.Muller)
Bosminopsis deitersi Richard

Family: Macrothricidae

Macrothrix goeldii Richard
Ilyocryptus spinifer Herrick
Macrothrix laticornis (Jurine)

Family: Chydoridae

Pleuroxus similis Vavra
Chydorus sphaericus (O.F.Muller)
Dadaya macrops (Daday)
Alona intermedia Sars
A.costata Sars
A.guttata Sars
Biapertura karua (King)
Graptoleberis testudinaria (Fischer)
Kurzia longirostris (Daday)
Euryalona orientalis (Daday)
Alonella exisa (Fischer)
C.barroisi Richard
Dunhevedia serrata Daday
A.quadrangularis (O.F.Muller)
A.rectangula Sars
Acroperus harpae (Baird)
Camptocercus rectirostris Schoedler
Leydigia acanthocercoides (Fischer)
Oxyurella singalensis (Daday)
Notalona globulosa (Daday)

Table: 16 (a) Species composition of Rotifera and Cladocera in Deepor, Ghorajan, Siligurijan and Fingua beel

Species	Deepor beel	Ghorajan beel	Siligurijan beel	Fingua beel
ROTIFERA				
Family: Brachionidae				
Brachionus falcatus Zacharias	+	+	+	+
B.angularis Gosse	+	+	+	+
B.bidentatus Anderson	+	+	+	+
B.diversicornis(Daday)	+	+	+	+
B.quadridentatus(Hermann)	+	+	+	+
B.calyciflorus(Pallas)	+	+	+	+
B.caudatus(Barrois& Daday)	+	+	+	+
B.forficula Wierzejski	+	+	+	+
B.rubens Ehrenberg	+	+	+	+
B.mirabilis(Daday)	+	+	-	-
B.patulus(Muller)	+	+	+	+
B.patulus macracanthus(Daday)	+	+	+	+
Platyias quadricornis(Ehrenberg)	+	+	+	+
Keratella cochlearis Gosse	+	+	+	+
K.quadrata(Muller)	+	+	+	+
K.lenzi Hauer	+	+	+	+
K.tropica(Apstein)	+	+	+	-
K.procurva(Thorpe)	+	+	-	+
Anuraeopsis fissa(Gosse)	+	+	+	+
Family : Euchlanidae				
Euchlanis dilatata Ehrenberg	+	+	+	+
Euchlanis triquetra Ehrenberg	-	-	+	+
Dipleuchlanis propatula(Gosse)	+	+	+	+
Beauchampiella eudactylota(Gosse)	+	+	-	-
Family : Mytilinidae				
Mytilina ventralis(Ehrenberg)	+	+	+	+
M.bisulcata(Lucks)	+	+	+	+
Family : Trichotridae				
Macrochaetus sericus(Thorpe)	+	+	+	+
Trichotria tetractis(Ehrenberg)	+	+	+	+
Family: Colurellidae				
Colurella obtusa(Gosse)	+	+	+	+
C.uncinata(Muller)	+	+	+	+
Lepadella ovalis ovalis(Muller)	+	+	+	+
Lepadella ovalis larga (Sharma)	+	-	-	-
L.patella(Muller)	+	+	+	+

L.heterostyla(Murray)	+	+	+	+
L.ehrenbergi(Perty)	+	+	+	+
L.rhomboides(Gosse)	+	+	-	+
L.apsicora Myers	+	+	-	-
Squatinella mutica(Ehrenberg)	+	+	+	+
Family : Lecanidae				
Lecane curvicornis(Murray)	+	+	+	+
L.ungulata(Gosse)	+	+	+	+
L.ploenensis(Voigt)	+	+	+	+
L.hastata (Murray)	+	+	-	-
L.ludwigi(Eckstein)	+	+	+	+
L.lateralis Sharma	+	+	+	+
L.leontina(Turner)	+	+	+	+
L.papuana(Murray)	+	+	+	+
L.luna(Muller)	+	+	+	+
L.pyriformis(Daday)	+	+	+	-
L.quadridentata(Ehrenberg)	+	+	+	+
L.closterocerca(Schmarda)	+	+	+	+
L.bulla(Gosse)	+	+	+	+
L.lunaris(Ehrenberg)	+	+	+	+
L.aculeata(Jakubski)	+	+	+	+
L.unguitata(Fadeev)	+	+	+	+
L.hamata(Stokes)	+	+	+	+
L.thienemanni(Hauer)	+	+	-	+
L.hornemanni(Ehrenberg)	+	+	+	+
L.stenroosi(Meissner)	+	+	+	+
L.ohioensis(Herrick)	+	+	+	+
L.decipiens(Murray)	+	+	-	-
L.inopinata(Harring & Myers)	+	+	-	-
L.crepida(Harring)	+	+	-	+
Family : Notommatidae				
Cephalodella forficula(Ehrenberg)	+	+	-	-
Monommata longiseta(Muller)	+	+	+	+
Scaridium longicaudum(Muller)	+	+	+	+
Family : Gastropodidae				
Ascomorpha saltans Bartsch	+	+	+	-
Family: Trichocercidae				
Trichocerca cylindrica(Imhof)	+	+	+	+
T.similis(Wierzejski)	+	+	+	+
T.porcellus(Gosse)	+	+	+	+
T.elongata(Gosse)	+	+	+	+
T.capucina(Wierzejsk& Zacharias)	+	+	+	+
T.longiseta(Schrank)	+	+	+	+
Trichocerca pusilla (Lauterborn)	+	+	+	-
Family: Asplanchnidae				

Asplanchna priodonta Gosse	+	+	+	+
Family: Synchaetidae				
Polyarthra vulgaris Carlin	+	+	+	+
Family : Flosculariidae				
Sinantherina socialis Bory de st. Vincent	+	+	+	+
S. spinosa Thorpe)	+	+	+	-
Family: Conochilidae				
Conochilus unicornis Rousselet	+	+	+	+
Family: Hexarthridae				
Hexarthra mira(Hudson)	+	+	+	+
Family: Filiniidae				
Filinia camascela Myers	+	+	-	+
F.longiseta(Ehrenberg)	+	+	+	+
F.pejleri Hutchinson	+	+	+	+
F.opoliensis Zacharias	+	+	+	+
Family : Testudinellidae				
Testudinella patina(Hermann)	+	+	+	+
T.greeni Koste	+	+	-	+
T.emarginula(Stenroos)	+	+	+	+
T.brevicaudata Yamamoto	+	+	-	-
Trochosphaera aequatorialis Semper	+	+	-	+
Family: Philodinidae				
Rotaria neptunia(Ehrenberg)	+	+	+	+
Total No of Species	**87**	**86**	**72**	**75**
Cladocera				
Family: Sididae				
Sida crystallina (O.F.Muller)	+	+	+	+
Diaphanosoma excisum Sars	+	+	+	+
Family: Daphnidae				
Ceriodaphnia cornuta Sars	+	+	+	+
C.quadrangula (O.F.Muller)	+	+	+	+
Scapholeberis kingi Sars	+	+	+	+
Simocephalus vetulus (O.F.Muller)	+	+	+	+
S.serrulatus (Koch)	+	+	+	+
Daphnia lumholtzi Sars	+	-	-	-
Family : Moinidae				
Moina micrura Kurz	+	+	+	+
Moinodaphnia macleayi (King)	+	+	+	+
Family : Bosminidae				
Bosmina longirostris (O.F.Muller)	+	+	+	+
Bosminopsis deitersi Richard	+	+	+	+
Family : Macrothricidae				
Macrothrix goeldii Richard	+	+	+	+
Grimaldina brazzai Richard	+	+	-	-
Ilyocryptus spinifer Herrick	+	+	+	+

Family: Chydoridae				
Pleuroxus similis Vavra	+	+	+	+
Alonella exisa (Fischer)	+	+	+	+
Chydorus sphaericus (O.F.Muller)	+	+	+	+
C.barroisi Richard	+	+	+	+
Dadaya macrops (Daday)	+	+	+	+
Dunhevedia serrata Daday	+	+	+	+
Alona intermedia Sars	+	+	-	-
A.quadrangularis (O.F.Muller)	+	+	+	+
A.costata Sars	+	+	+	+
A.rectangula Sars	+	+	-	-
A.guttata Sars	+	+	-	-
Acroperus harpae (Baird)	+	+	+	+
Biapertura karua (King)	+	+	+	+
Camptocercus rectirostris Schoedler	+	+	+	+
Graptoleberis testudinaria (Fischer)	+	+	+	+
Leydigia acanthocercoides (Fischer)	+	+	+	+
Kurzia longirostris (Daday)	+	+	+	+
Oxyurella singalensis (Daday)	+	+	+	+
Euryalona orientalis (Daday)	+	+	+	+
Notalona globulosa (Daday)	+	+	+	+
Total No of Species	**35**	**34**	**32**	**30**

Table:16 (b) Seasonal variations of zooplankton in selected floodplain lakes

ROTIFERA	Siliguri jan beel				Fingen beel			
Family: Brachionidae	Win	Sum	Mon	Aut	Win	Sum	Mon	Aut
Brachionus falcatus Zacharias	-	+	-	-	+	+	+	+
B.angularis Gosse	+	+	-	-	+	-	+	+
B.bidentatus Anderson	-	+	-	+	-	+	-	+
B.diversicornis (Daday)	-	+	-	+	-	-	+	-
B.quadridentatus(Hermann)	+	+	-	-	+	-	-	+
B.calyciflorus(Pallas)	+	-	-	+	-	+	+	-
B.caudatus(Barrois & Daday)	-	+	-	+	-	+	-	+
B.forficula Wierzejski	-	+	-	-	-	+	-	+
B.rubens Ehrenberg	-	-	+	-	+	-	-	-
B.patulus(Muller)	+	+	-	+	-	+	+	+
B.patulus macracanthus(Daday)	+	+	-	+	+	+	-	+
Platyias quadricornis(Ehrenberg)	+	-	+	+	+	+	-	+
Keratella cochlearis Gosse	+	+	-	+	+	-	+	-
K.quadrata(Muller)	-	+	+	-	-	+	-	+
K.lenzi Hauer	+	-	-	-	-	+	+	-
K.tropica(Apstein)	+	-	-	-	-	-	-	-
K. procurva(Thorpe)	-	-	-	-	+	-	-	-
Anuraeopsis fissa(Gosse)	-	+	+	-	+	-	+	-
Family : Euchlanidae								
Euchlanis dilatata Ehrenberg	+	+	-	+	+	+	+	+
Euchlanis triquetra Ehrenberg	-	+	-	-	-	+	-	+
Dipleuchlanis propatula(Gosse)	-	+	+	-	-	+	-	+
Family : Mytilinidae								
Mytilina ventralis(Ehrenberg)	-	+	-	+	-	+	+	-
M.bisulcata(Lucks)	-	-	+	-	-	+	-	+
Family : Trichotridae								
Macrochaetus sericus(Thorpe)	-	+	+	+	+	+	-	-
Trichotria tetractis(Ehrenberg)	+	-	+	+	-	-	-	+
Family: Colurellidae								
Colurella obtusa(Gosse)	-	-	-	+	-	+	+	
C.uncinata(Muller)	+	+	+	-	+	+	-	-
Lepadella ovalis(Muller)	+	+	-	+	-	+	+	-
L.patella(Muller)	-	-	+	+	+	-	+	+
L.heterostyla(Murray)	+	-	+	-	-	+	+	-
L.ehrenbergi(Perty)	-	+	-	-	+	+	-	+
L.rhomboides(Gosse)	-	-	+	+	-	+	+	-
Squatinella mutica	-	-	+	-	+	-	-	+
Family : Lecanidae								
Lecane curvicornis(Murray)	-	+	-	+	+	+	+	-
L.ungulata(Gosse)	+	+	-	-	+	+	-	+
L.ploenensis(Voigt)	+	+	-	-	-	-	+	+
L.pertica(Harring & Myers)	+	-	-	-	-	+	-	-

L.ludwigi(Eckstein)	-	+	+	+	+	+	+	+
L.lateralis Sharma	-	-	+	-	+	-	-	+
L.leontina(Turner)	+	+	-	+	+	+	+	+
L.papuana(Murray)	+	-	-	-	-	+	-	+
L.luna(Muller)	-	+	+	+	+	+	-	-
L.pyriformis(Daday)	+	-	-	+	+	+	+	+
L.quadridentata(Ehrenberg)	+	-	-	+	+	-	+	+
L.closterocerca(Schmarda)	+	+	-	-	+	+	-	+
L.bulla(Gosse)	+	+	-	+	+	+	+	+
L.lunaris(Ehrenberg)	+	-	+	-	+	-	-	+
L.aculeata(Jakubski)	+	+	-	+	+	+	-	+
L.unguitata(Fadeev)	-	+	-	-	-	+	+	-
L.hamata(Stokes)	-	+	-	-	-	+	-	+
L.thienemanni(Hauer)	-	+	-	-	-	-	-	-
L.hornemanni(Ehrenberg)	-	+	-	-	-	-	+	-
L.stenroosi(Meissner)	+	-	-	-	-	-	-	+
L.ohioensis(Herrick)	-	-	-	-	+	-	-	+
L.crepida(Harring)	-	+	-	-	-	-	-	-
Family : Notommatidae								
Cephalodella forficula(Ehrenberg)	-	-	-	+	-	+	-	+
Monommata longiseta(Muller)	-	+	+	+	+	+	-	+
Scaridium longicaudum(Muller)	-	+	+	-	-	+	-	+
Family : Gastropodidae								
Ascomorpha saltans Bartsch	+	-	-	+	-	-	+	+
Family: Trichocercidae								
Trichocerca cylindrica(Imhof)	-	-	+	+	-	+	-	-
T.similis(Wierzejski)	+	-	-	-	-	+	+	-
T.porcellus(Gosse)	-	+	-	-	-	+	-	
T.elongata(Gosse)	-	-	-	+	-	+	-	
T.capucina(Wierzejski & Zacharias)	-	+	-	+	+	-	+	+
T.longiseta(Schrank)	+	+	-	-	-	+	-	+
Trichocerca pusilla (Lauterborn)	-	+	+	-	-	-	-	-
Family: Asplanchnidae								
Asplanchna priodonta Gosse	+	+	+	+	+	+	+	+
Family: Synchaetidae								
Polyarthra vulgaris Carlin	-	+	+	+	+	+	+	+
Family : Floscularidae								
Sinantherina socialis Bory de st. Vincent	-	-	+	+	+	+	+	+
S. spinosa(Thorpe)	-	+	-	-	+	-	+	+
Family: Conochilidae								
Conochilus unicornis Rousselet	-	+	-	-	-	+	-	+
Family: Hexarthridae								
Hexarthra mira(Hudson)	+	-	-	-	-	+	-	+
Family: Filiniidae								

Filinia camascela Myers	-	-	-	-	-	-	-	+
F.longiseta(Ehrenberg)	-	-	-	+	-	+	+	-
F.pejleri(Hutchinson)	+	-	-	-	+	+	-	+
F.opoliensis(Zacharias)	+	+	+	-	+	-	+	
Family : Testudinellidae								
Testudinella patina(Hermann)	-	+	+	-	+	+		
T.greeni Koste	+	-	-	-	-	-	-	+
T.emarginula(Stenroos)	-	+	-	-	+	-	-	+
Trochosphaera aequatorialis Semper	-	-	-	-	-	-	-	+
Family: Philodinidae								
Rotaria neptunia(Ehrenberg)	-	+	-	+	-	-	+	-
Species richness	***35***	***50***	***30***	***37***	***40***	***51***	***35***	***57***
Cladocera								
Family: Sididae								
Sida crystallina (O.F.Muller)	-	-	+	+	+	-	-	+
Diaphanosoma excisum Sars	-	+	-	+	+	+	+	-
Family: Daphnidae								
Ceriodaphnia cornuta Sars	+	-	-	+	+	-	+	-
C.quadrangula (O.F.Muller)	-	+	-	-	+	+	-	-
Scapholeberis kingi Sars	+	+	+	+	+	+	+	+
Simocephalus vetulus (O.F.Muller)	+	+	+	+	+	+	+	+
S.serrulatus (Koch)	+	+	-	+	+	+	+	+
Family : Moinidae								
Moina micrura Kurz	+	-	+	-	+	+	-	+
Moinodaphnia macleayi (King)	-	-	-	+	-	+	-	-
Family : Bosminidae								
Bosmina longirostris (O.F.Muller)	+	+	+	-	+	-	+	+
Bosminopsis deitersi Richard	+	+	+	-	+	-	+	+
Family : Macrothricidae								
Macrothrix goeldii Richard	+	-	-	+	-	+	+	
Ilyocryptus spinifer Herrick	+	+	+	+	-	+	+	
Family: Chydoridae								
Pleuroxus similis Vavra	+	+	+	+	+	-	+	+
Alonella exisa (Fischer)	+	+	-	+	+	+	+	+
Chydorus sphaericus (O.F.Muller)	+	+	-	+	+	+	+	+
C.barroisi Richard	+	-	+	+	+	+	+	-
Dadaya macrops (Daday)	-	-	+	-	-	-	-	+
Dunhevedia serrata Daday	+	-	-	-	-	-	+	-
Alona intermedia Sars	+	+	-	-	-	+	+	+
A.quadrangularis (O.F.Muller)	+	-	+	+	+	+	+	+
A.costata Sars	-	+	-	-	-	+	+	-
Acroperus harpae (Baird)	+	-	-	-	+	-	+	-

Biapertura karua (King)	+	+	+	+	+	+	+	+
Camptocercus rectirostris Schoedler	+	+	+	-	+	+	+	+
Graptoleberis testudinaria (Fischer)	+	-	-	-	-	+	+	+
Leydigia acanthocercoides (Fischer)	+	-	-	-	+	-	+	-
Kurzia longirostris (Daday)	+	+	-	+	-	-	+	+
Oxyurella singalensis (Daday)	+	+	-	+	+	+	-	-
Euryalona orientalis (Daday)	+	-	+	+	+	-	-	+
Notalona globulosa (Daday)	+	+	+	+	+	+	+	+
Species richness	*25*	*18*	*16*	*20*	*22*	*20*	*24*	*23*

Systematic Account of Rotifera

The systematic account is briefly described below:

Phylum: Rotifera
Class: Eurotatoria Bartos, 1959
Superorder: Monogononta Wesenberg-Lund, 1889
Order: Ploimida Delage, 1897
Family: Brachionidae Wesenberg-Lund, 1889

1. Brachionus falcatus Zacharias, 1898
(Fig. 3)

Characters: Occipital margin with six spines; intermediates much longer and curved ventrally; medians and laterals shorter and of almost equal length. Posterior spines long, incurved and with widely separated at their bases.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India-Meghalaya, Assam, West Bengal, Andra Pradesh, Nagpur, Gujarat. Elsewhere-Cosmopolitan

2. Brachionus angularis Gosse, 1851
(Fig. 4)

Characters: Lorica rigid, usually stippled and dorsoventrally compressed. Anterior occipital margin with two median spines flanked by a U-shaped sinus. Posterior spines lacking. Large foot opening and flanked laterally by cuticular protuberances.
Distribution: Assam-Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Assam, Jammu and Kashmir, West Bengal, Orissa, Bihar, Andhra Pradesh, Maharashtra, Madhya Pradesh, Delhi, Punjab and Haryana. Elsewhere-Cosmopolitan.

3. Brachionus bidentatus Anderson, 1889
(Fig. 5)

Characters: Lorica firm and elongated. Anterior margin with longer lateral and median spines than intermediate ones. Postero-lateral spines almost parallel sided. Foot opening with a symmetrically projecting sheath.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Meghalaya, Assam, West Bengal, Andhra Pradesh, Orissa, Punjab and Haryana. Elsewhere- tropics and sub-tropics.

4. Brachionus diversicornis (Daday, 1883)
(Fig. 6)

Characters: Lorica elongated, rigid, and compressed dorsoventrally. Anterior occipital margin with four occipital spines; medians short and laterals longer. Posterior spines two, unequal and divergent; the right posterior spines usually long.

Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- West Bengal, Assam and Orissa. Elsewhere-Tropics and sub-tropical.

5. Brachionus quadridentatus Hermann, 1783
(Fig. 7)

Characters: Lorica rigid, stippled and moderately compressed dorso-ventrally. Anterior margin with six occipital spines; median spines longest and ventrally curved, laterals longer than intermediates. Postero-lateral spines well developed. Ventro-posterior spines prolonged to form a foot-sheath around the retractile foot.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Assam, West Bengal, Orissa, Andhra Pradesh, Madhya Pradesh, Kerala, Rajasthan Punjab and Kashmir. Elsewhere- Cosmopolitan.

6. Brachionus calyciflorus Pallas, 1766
(Fig. 8)

Characters: Lorica flexible and broadly oval in outline. Anterior occipital margin with four spines of variable lengths; median slightly longer than laterals. Postero-lateral spines present.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Meghalaya, Assam, West Bengal, Bihar, Orissa, Madhya Pradesh, Punjab and Jammu. Elsewhere- Cosmopolitan.

7. Brachionus caudatus Barrois and Daday, 1894
(Fig. 9)

Characters : Lateral occipital spines longer than the medians. Posterior spines in the plane of the axis of the body.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel
India-Assam, Gujarat, Rajasthan. Elsewhere- Cosmopolitan.

8. Brachionus forficula forficula Wierzejski, 1891
(Fig. 10)

Characters: Lorica rigid, finely stippled and compressed dorso-ventrally. Anterior margin with four occipital spines, laterals longer than medians. Posterior spines stout, inwardly directed and widely separated at their bases; each with a knee-like swelling on inner side near the base.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- West Bengal, Orissa, Andhra Pradesh, Gujarat and Punjab. Elsewhere-Subtropicopolitan.

9. Brachionus rubens Ehrenberg, 1838
(Fig. 11)

Characters: Lorica oval, dorsoventrally compressed. Anterior margins with short six occipital spines; median and occipital spines with peculiar asymmetrical shape-

each spine resulting into a narrow anterior part, then rounding out to form a broad base; median occipitals slightly longer than others; four inner occipital spines with short ridges. Posterior spines absent; foot opening sub-square.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Meghalaya, Assam, West Bengal, Orissa, Rajasthan, Punjab and Jammu. Elsewhere- Cosmopolitan.

10. Brachionus mirabilis Daday, 1897
(Fig. 12)

Characters: Lorica firm and stippled. Anterior occipital margin with six spines; medians longest and curved outwards. Ventral plate of lorica terminating into two long posterior spines extending backwards from lorica at an angle of 45^0. foot-opening situated between the bases of ventral spines and surrounded by a sheath.
Distribution: Deepor and Ghorajan beel.
India- West Bengal, Assam and Orissa. Elsewhere-Tropics and sub-tropics

11. Brachionus patulus patulus (O.F. Muller, 1786)
(Fig. 13)

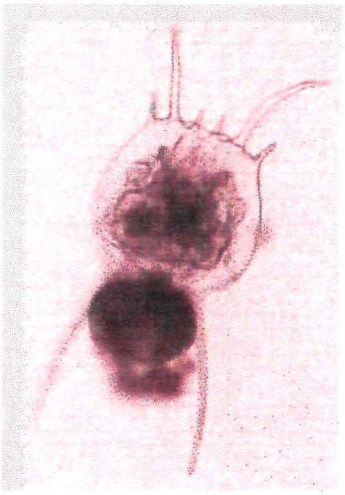
Characters: Lorica rigid, sub-rectangular and moderately compressed dorsoventrally; dorsum with reticulate areolation. Both occipital margins with short, blunt spines with median larger than the laterals. Posterior spines short. Foot opening flanked by asymmetrical spines.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Meghalaya, Assam, West Bengal, Orissa, Andhra Pradesh, Gujarat, Tamil Nadu, Kerala, Rajasthan, Punjab and Kashmir. Elsewhere- Cosmopolitan.

12. Brachionus patulus macracanthus (Daday, 1905)
(Fig. 14)

Characters: Differentiated by its distinctly elongated posterior spines; lateral antennae situated on postero-lateral spines.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Meghalaya, Assam, West Bengal. Elsewhere- Neotropical.

13. Platyias quadricornis (Ehrenberg, 1838)
(Fig. 15)

Characters: Lorica firm, almost circular, tuberculated and pattern of pentagonal facets on dorsal plate. Anterior margin wide, 3/5 of lorica width. Occipital margins with two stout median spines tapering but little and bluntly rounded to nearly truncate at their tips, usually bending somewhat ventrally. External angles of anterior margin terminating in triangular cusps with small and pointed spines. Anteroventral margin concave, serrate. Posterior margin of lorica with two short, stout parallel spines. Foot opening more or less elliptical. Above foot opening, several concentric circular folds present. Foot of 3 sections with two long, pointed conical toes.



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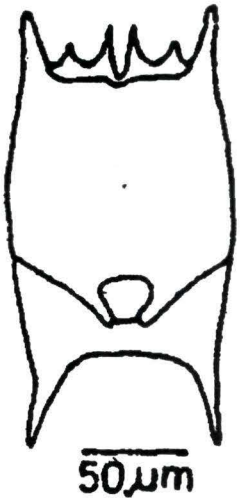

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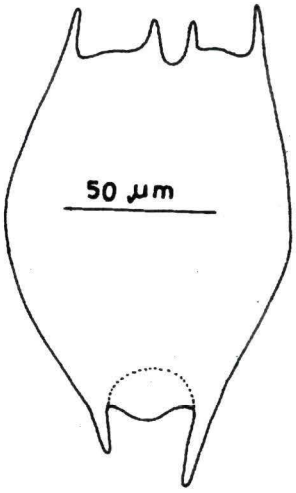

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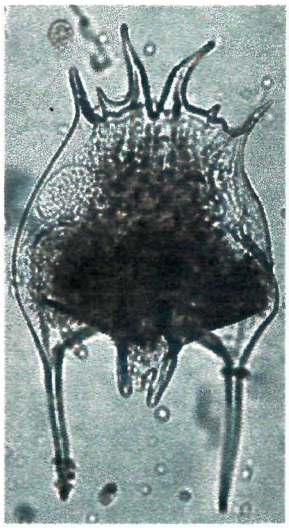

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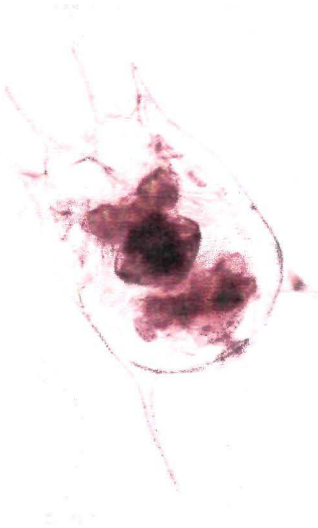

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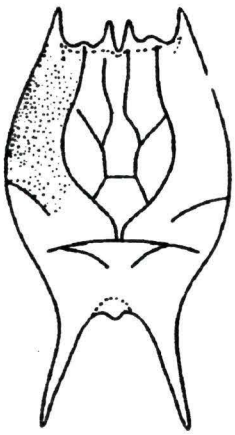
Fig. 3, *Brachionus falcatus* Zacharias, ***Fig. 4,*** *B.angularis* Gosse,
Fig. 5, *B.bidentatus* Anderson, ***Fig. 6,*** *B.diversicornis*(Daday),
Fig. 7, *B.quadridentatus* (Hermann), ***Fig. 8,*** *B.calyciflorus* (Pallas)



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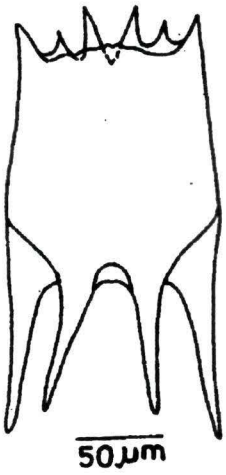

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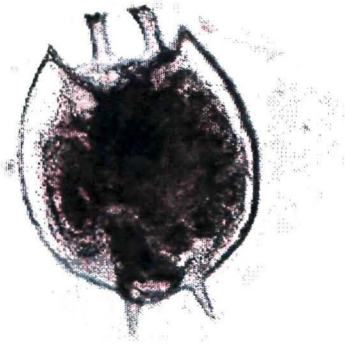
Fig. 9, *B.caudatus*(Barrois& Daday), ***Fig. 10,*** *B.forficula* Wierzejski,
Fig. 11, *B.rubens* Ehrenberg, ***Fig. 12,*** *B.mirabilis*(Daday),
Fig. 13, *B.patulus*(Muller), ***Fig. 14,*** *B.patulus macracanthus*(Daday)



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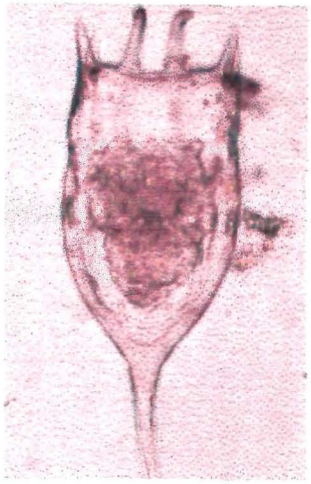

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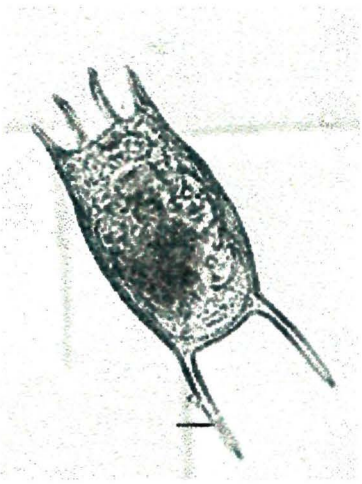

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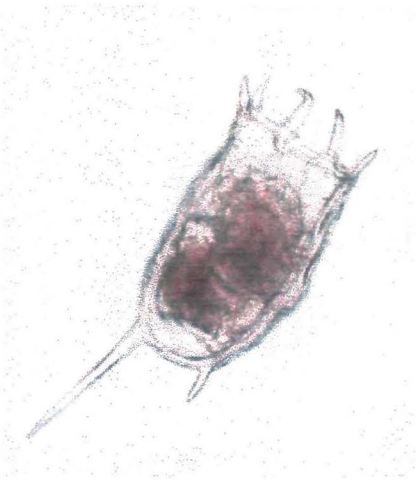

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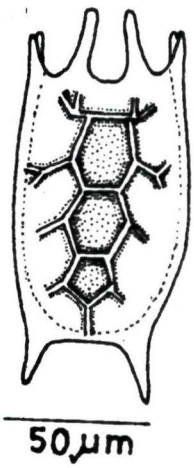

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Fig. 15, *Platyias quadricornis*(Ehrenberg), ***Fig. 16,*** *Keratella cochlearis* Gosse,
Fig. 17, *K.quadrata*(Muller), ***Fig. 18,*** *K.lenzi* Hauer,
Fig. 19, *K.tropica*(Apstein), ***Fig. 20,*** *K.procurva*(Thorpe)

Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Meghalaya, Assam, West Bengal, Bihar, Orissa, Andhra Pradesh, Kerala, Rajasthan, Punjab, Haryana and Kashmir.
Elsewhere- Tropics and sub-tropics.

14. Keratella cochlearis (Gosse, 1851)
(Fig. 16)

Characters: Lorica elongated-oval and with a median posterior spine of variable length. Dorsal plate with characteristic facets and granulated. Anterior margin with six occipital spines; median longest and ventrally curved, intermediate divergent and shorter than laterals. Single median posterior spines.

Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.

India- Meghalaya, Assam, West Bengal, Orissa, Kerala, Rajasthan, Punjab and Jammu. Elsewhere- Cosmopolitan.

15. Keratella quadrata (O.P. Muller, 1786)
(Fig. 17)

Characters: Lorica almost rectangular in outline and with six anterior occipital spines; medians spines longest and curved. Dorsal plate with three median hexagonal plaques behind anterior median area; lateral plaques arranged symmetrically on either side of median plaques. Posterior spines long, sub equal, widely separated at their bases and parallel or divergent.

Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.

India- Assam, West Bengal, Tamil Nadu, Kerala, Kashmir and Ladakh. Elsewhere- Cosmopolitan.

16. Keratella lenzi Hauer, 1953
(Fig. 18)

Characters: Lorica elongate-oval, with maximum width behind its middle region, rounded posteriorly and without any posterior spine. Anterior margin with six occipital spines; medians longest and ventrally curved. Dorsal plate with three median plaques, the ultimate plaque elongated and its arms running towards the posterior margin in form of a divergent crest.

Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.

India- Assam, West Bengal and Punjab. Elsewhere- Pantropical.

17. Keratella tropica (Apstein, 1907)
(Fig. 19)

Characters: Lorica elongate-oval and with six occipital spines; medians occipital longest, pointed and out-curved. Dorsal plate with three median hexagonal plaques and a small squarish area between the last median plaque and the posterior margin of lorica. Posterior spines unequal and variable in length.

Distribution: Deepor, Ghorajan and Siligurijan beel.
India- Meghalaya, Assam, West Bengal, Bihar, Orissa, Andhra Pradesh, Madhya Pradesh Kerala, Gujarat, Rajasthan, Punjab, Haryana and Kashmir. Elsewhere- Tropics and sub-tropics.

18. Keratella procurva (Thorpe, 1891)
(Fig. 20)

Characters: Lorica elongated and with six anterior occipital spines; median spines longest and curved. Dorsal plate with three median plaques; posteriormost plaque pentagonal and terminating in a short median line extending upto posterior margin of lorica. Posterior spines small and sub equal.

Distribution: Deepor, Ghorajan and Fingua beel.

India- West Bengal, Orissa, Kerala, Kashmir and Ladakh. Elsewhere- Pantropical.

19. Anuraeopsis fissa (Gosse, 1951)
(Fig. 21)

Characters: Lorica ovate finely stippled, obtusely pointed posterioly and without markings on the surface; anterior dorsal margin of lorica with a shallow sinus. Ventral plate projecting a little laterally beyond the dorsal plate anteriorly. Foot absent.

Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.

India- Meghalaya, Assam, West Bengal, Bihar, Orissa, Kerala, Rajasthan, Gujarat, Punjab and Haryana. Elsewhere-Cosmopolitan.

Family: Euchlanidae Bartos, 1959
20. Euchlanis dilatata Ehrenberg, 1832
(Fig. 22)

Characters: Lorica oval, flexible, truncate anteriorly and rounded posteriorly. Dorsal plate with a shallow notch at its posterior end. Ventral plate flat, smaller and narrower than dorsal plat. Toes parallel and with pointed tips.

Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.

India- Meghalaya, Assam, West Bengal, Bihar, Orissa, Gujarat, Punjab and Kashmir. Elsewhere-Cosmopolitan.

21. Euchlanis triquetra Ehrenberg, 1838
(Fig. 23)

Characters: Lorica elliptical, truncate posteriorly and with lateral flanges; with a strong dorsal keel extending from anterior posterior end of lorica. Dorsal plate longer than ventral plate. Toes slender, rod-shaped and with pointed tips.

Distribution: Siligurijan and Fingua beel.

India- Meghalaya and West Bengal. Elsewhere-Cosmopolitan.

22. Dipleuchlanis propatula (Gosse, 1886)
(Fig. 24)

Characters: Lorica oval in outline, truncate in front and rounded posteriorly. Dorsal plate concave and smaller than ventral one all around; posterior portion gradually narrowing, obtusely pointed at posterior end; with width about 2/3 of ventral one. Ventral plate convex. Dorsal and ventral plates connected with deep sulci. Inner margins of sulci gradually narrowing, tapering abruptly at posterior portion and making spine like shape. Lateral edges of two plates almost parallel and somewhat elevated. Head connected with anterior margin of lorica by a cuticular membrane. Two cylindrical toes very long, slender, parallel sided and tapering to short points, without swelling before tips.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Assam, West Bengal, Orissa and Kerela. Elsewhere-Cosmopolitan.

23. Beauchampiella eudactylota (Gosse, 1886)
(Fig. 25)

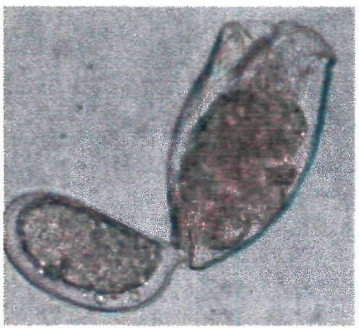
Characters: Body transparent, pear-shaped, thin, flexible and with a distinct dorsal bulge. Muscle bands supporting body and foot distinct. Foot two-segmented; toes very long and baton-shaped.
Distribution: Deepor and Ghorajan beel.
India- West Bengal, Andhra Pradesh and Madhya Pradesh. Elsewhere-Cosmopolitan.

Family: Mytilinidae Bartos, 1959
24. Mytilina ventralis (Ehrenberg, 1959)
(Fig. 26)

Characters: Lorica rigid and laterally compressed; antero-ventral corner with a spine each. Postero-dorsal and postero-ventral spines short and variable. Two moderately long toes.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Meghalaya, Assam, West Bengal, Bihar, Orissa, Andhra Pradesh, Madhya Pradesh, Gujarat, Kerala, Punjab and Kashmir. Elsewhere-Cosmopolitan.

25. Mytilina bisulcata (Lucks, 1912)
(Fig. 27)

Characters: Lorica transparent and its anterior end with two folds; almost rounded in cross section and dorsal keel with three stumps. Dorsal sulcus indistinct. Toes long and slender; produced into distinct slender spines. Anterior end as wide as posterior end or narrower.



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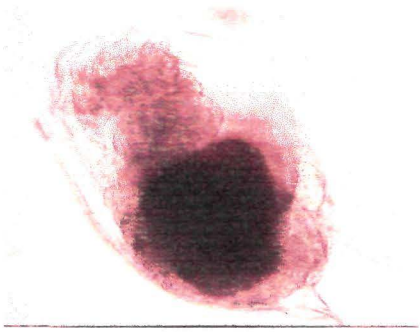

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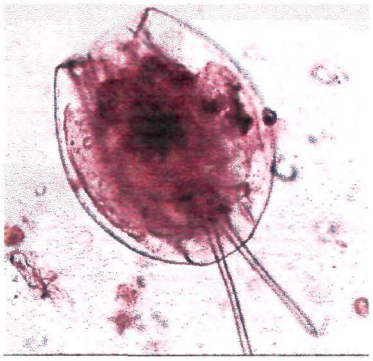

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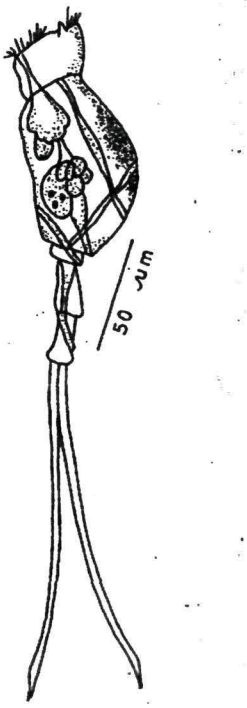

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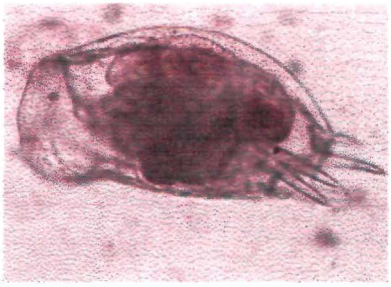

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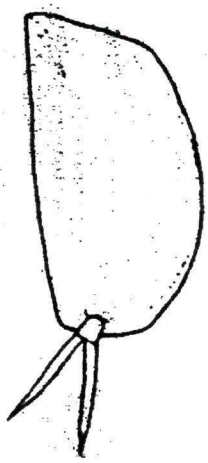
Fig. 21, *Anuraeopsis fissa*(Gosse), ***Fig. 22,*** *Euchlanis dilatata* Ehrenberg, ***Fig. 23,*** *Euchlanis triquetra* Ehrenberg, ***Fig. 24,*** *Dipleuchlanis propatula*(Gosse), ***Fig. 25,*** *Beauchampiella endactylota*(Gosse), ***Fig. 26,*** *Mytilina ventralis*(Ehrenberg)



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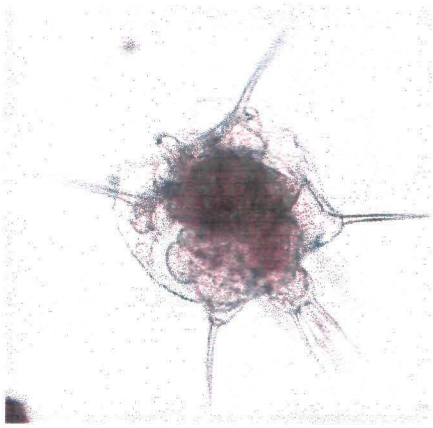

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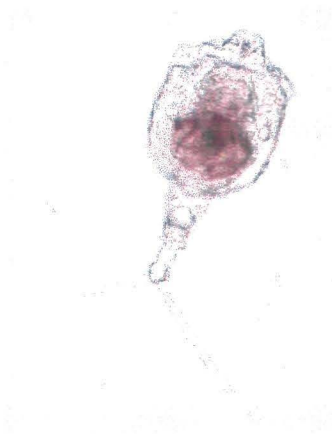

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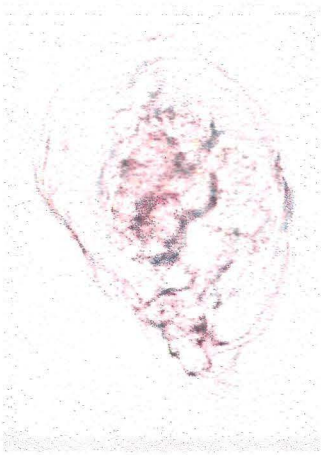

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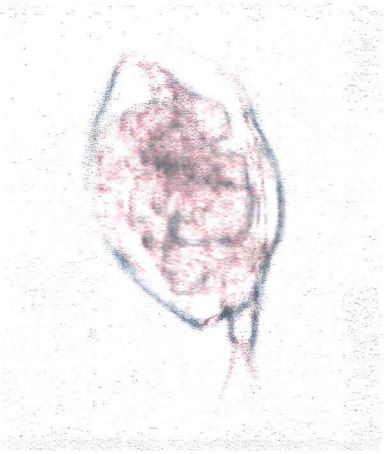

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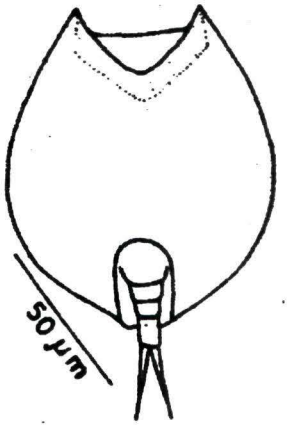

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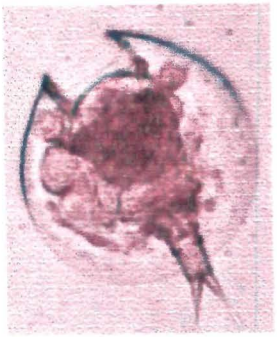
Fig. 27, *M.bisulcata*(Lucks), ***Fig. 28,*** *Macrochaetus sericus*(Thorpe), ***Fig. 29,*** *Trichotria tetractis*(Ehrenberg), ***Fig. 30,*** *Colurella obtusa*(Gosse), ***Fig. 31,*** *C.uncinata*(Muller), ***Fig. 32,*** *Lepadella ovalis ovalis*(Muller)



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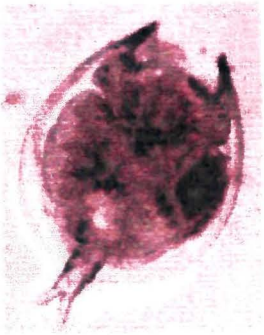

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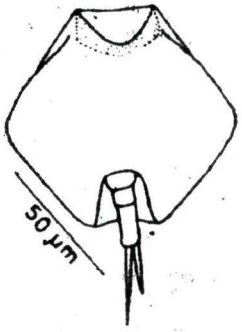

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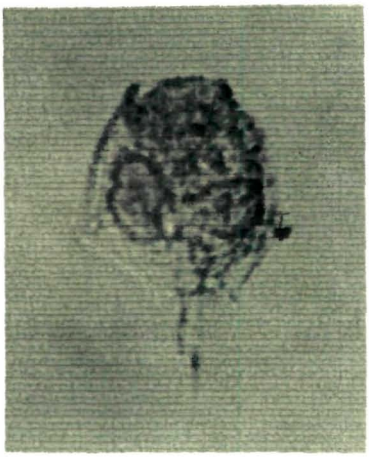

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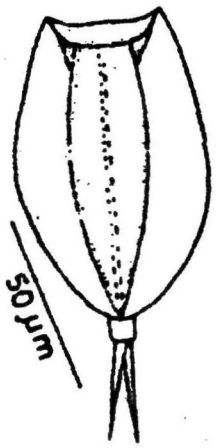

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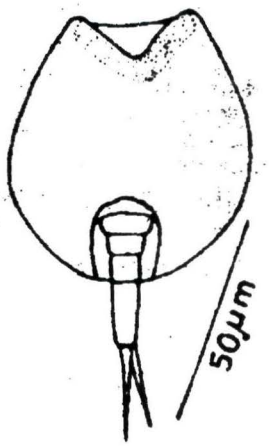

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Fig. 33, *Lepadella ovalis larga* (Sharma), ***Fig. 34,*** *L.patella*(Muller), ***Fig. 35,*** *L.heterostyla*(Murray), ***Fig. 36,*** *L.ehrenbergi*(Perty), ***Fig. 37,*** *L.rhomboides*(Gosse), ***Fig. 38,*** *L.apsicora* Myers

Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- West Bengal and Orissa. Elsewhere-Cosmopolitan.

Family: Trichotridae Bartos, 1959

26. Macrochaetus sericus (Thorpe, 1893)

(Fig. 28)

Characters: Lorica horse-shoe shaped and granulated with small spines at its external angles. Dorsum with 8 spines arranged symmetrically along its midline; median caudal spines deeply inserted. Foot two segmented. Toes short and spindle-shaped.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Meghalaya, West Bengal, Orissa, Andhra Pradesh, Madhya Pradesh. Elsewhere-Tropics and sub-tropics.

27. Trichotria tetractis (Ehrenberg, 1830)

(Fig. 29)

Characters: Lorica stippled and longer than its width; antero-dorsal corners with small spines. Dorsum with distinct pattern of carinal plates and ridges. Toes long, cylindrical and ending in acute points.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Meghalaya, Assam, West Bengal, Orissa, Andhra Pradesh, Madhya Pradesh, Tamil Nadu, Gujarat, Kerala, Punjab and Kashmir. Elsewhere-Cosmopolitan.

Family: Colurellidae Bartos, 1959

28. Colurella obtusa (Gosse, 1886)

(Fig. 30)

Characters: Lorica small and laterally compressed; oval with obtuse posterior angles. Foot opening relatively broad. Toes small, slender and pointed.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Meghalaya, West Bengal and Punjab. Elsewhere-Cosmopolitan.

29. Colurella uncinata (O.F. Muller, 1773)

(Fig. 31)

Characters: Lorica ovate and laterally compressed. Posterior angles of lorica downwardly directed, edges drawn closer. Foot small and stout. Toes two, slender and pointed.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Meghalaya and West Bengal. Elsewhere-Cosmopolitan.

30. Lepadella ovalis ovalis (Muller, 1786)

(Fig. 32)

Characters: Lorica almost circular in outline. Dorsal plate convex and ventral plate nearly flat. Anterior margin of lorica U-shaped dorsally, V-shaped ventrally; ventral margin somewhat large and deeper than that of dorsal margin. Stippled collar present on anterior margin dorsally and ventrally; ventral collar rounded with constant width along anterior margin; dorsal collar rather angled, wider than ventral collar but tapered narrower laterally. Two toes sharp and pointed, tapering straightly and about 1/5 of lorica length.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Meghalaya, Assam, West Bengal, Orissa, Bihar, Punjab, Haryana and Jammu and Kashmir. Elsewhere-Cosmopolitan

31. Lepadella ovalis larga (Sharma, 1978)

(Fig. 33)

Characters: Differ from typical *L. ovalis* in (i) lorica broader than its length; (ii) dorsal plate more arched; (iii) shape of posterior margins of lorica; (iv) shape of foot-groove.
Distribution: Deepor beel.
India- Endemic, reported from West Bengal. Elsewhere-Tropics.

32. Lepadella patella (O.F. Muller, 1773)

(Fig. 34)

Characters: Lorica oval and dorsal plate strongly arched; anterior dorsal and ventral sinus with stippled collars. Foot-groove parallel-sided to semicircular and its edges projecting at the posterior end. Toes pointed.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- North-Eastern states, West Bengal, Orissa, Bihar, Rajasthan, Gujarat, Punjab and Kashmir. Elsewhere-Cosmopolitan.

33. Lepadella heterostyla (Murray, 1913)

(Fig. 35)

Characters: Lorica rhomboidal, with its edges curving upwards from the blunt lateral angles. Dorsal plate strongly convex in its median region. Posterior angles of lorica with semicircular emarginations. Toes unequal and pointed.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Meghalaya, Mizoram, Assam, West Bengal, Orissa. Elsewhere- Cosmopolitan.

34. Lepadella ehrenbergi (Perty, 1850)

(Fig. 36)

Characters: Lorica broadly rhomboidal in outline. Dorsal plate moderately convex

in central region and relatively flat laterally. Lateral angles with median spurs curving outwards and forwards. Posterior angles pointed and posterior margin of lorica slightly concave. Foot-groove broader posteriorly; toes unequal and pointed.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Meghalaya, Nagaland, Assam, West Bengal and Orissa. Elsewhere-Cosmopolitan.

35. Lepadella rhomboides (Gosse, 1884)
(Fig. 37)

Characters : Lorica rhomboid-ovate; dorsal plate with a wide and moderately high median keel, sides of keel strongly convex and meet centrally at an obtuse angle forming a faint ridge. Dorsal sinus shallow. Foot- groove variable: toes pointed.
Distribution: Deepor, Ghorajan and Fingua beel.
India-West Bengal, Assam, Orissa, Gujarat, Nilgiri Hills and Punjab. Elsewhere-Cosmopolitan.

36.*Lepadella aspicora* Myers, 1934
(Fig. 38)

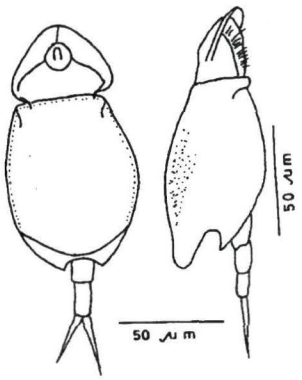
Characters: Lorica elongate-oval in outline. Anterior dorsal sinus broad, slightly concave. Toes moderately long and acutely pointed.
Distribution: Deepor and Ghorajan beel.
India- Meghalaya, Nagaland, Assam, West Bengal and Orissa. Elsewhere-Cosmopolitan.

36. Squatinella mutica (Ehrenberg, 1832)
(Fig. 39)

Characters: Body oblong-ovate and transparent. Trunk with oblong-ovate lorica; posterior end of trunk lorica with a notch. First foot segment covered by a projection of dorsal plate. Toes long, slender and acutely pointed.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Meghalaya, West Bengal and Ladak. Elsewhere-Cosmopolitan

Family: Lecanidae Bartos, 1959
37. Lecane curvicornis (Murray, 1913)
(Fig. 40)

Characters: Lorica pyriform, anterior margins coincident with a broad v-shaped sinus; external edges with prominent spines. Dorsal plate narrower than ventral plate and without any surface marking. Posterior segment of ventral plate with transverse fold. Toes long and straight. Claws small with spicule at outer side of its base.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Meghalaya, West Bengal, Bihar, Andhra Pradesh, Madhya Pradesh. Elsewhere-Tropics and sub-tropics.



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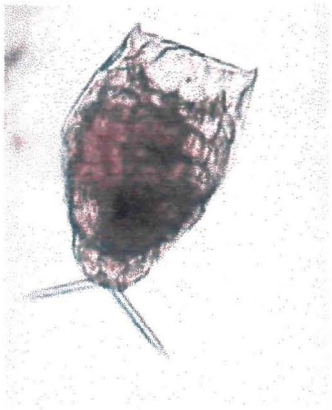

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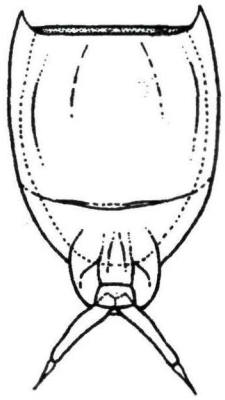

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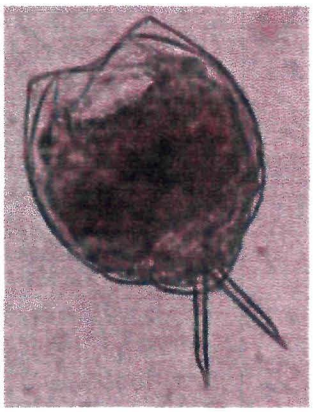
Fig. 39, *Squatinella mutica (Ehrenberg),* ***Fig. 40,*** *Lecane curvicornis*(Murray),
Fig. 41, *L.ungulata*(Gosse), ***Fig. 42,*** *L.ploenensis*(Voigt),
Fig. 43, *L.hastata* (Murray), ***Fig. 44,*** *L.ludwigi*(Eckstein)



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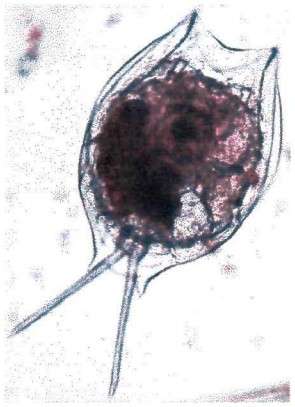

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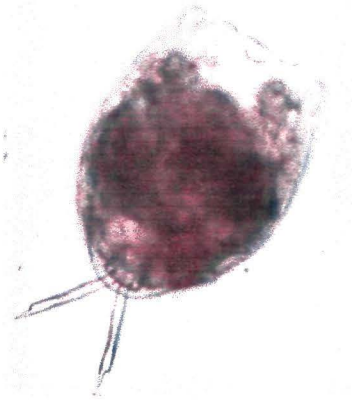

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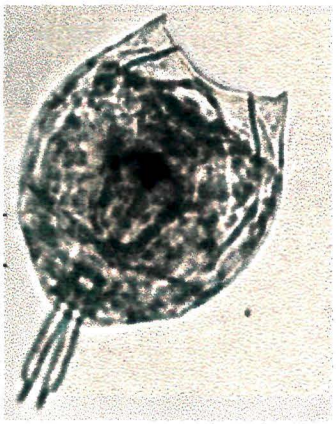

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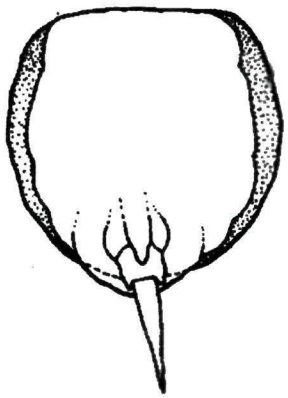

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Fig. 45, *L.lateralis* Sharma, ***Fig. 46,*** *L.leontina*(Turner), ***Fig. 47,*** *L.papuana* (Murray),
Fig. 48, *L.luna*(Muller), ***Fig. 49,*** *L.pyriformis*(Daday),
Fig. 50, *L.quadridentata*(Ehrenberg)

39.*Lecane ungulata* (Gosse, 1887)

(Fig. 41)

Characters: Lorica large, broadly ovate; anterior margins almost straight and with distinct triangular cuspidate spines at external angles. Dorsal plate narrower than ventral plate. Toes parallel-sided and with long stout claws; each claw with a prominent basal spicule.

Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.

India- Meghalaya, Nagaland, Mizoram, Assam, West Bengal, Orissa, Andhra Pradesh, Gujarat and Punjab. Elsewhere-Cosmopolitan.

40. *Lecane ploenensis* (Voigt, 1902)

(Fig. 42)

Characters: Lorica elongate-oval; spines at anterior external angles relatively longer. Dorasal plate truncate posteriorly and with distinct surface markings. Toes relatively elongated and terminating into acute points.

Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.

India- Meghalaya, Mizoram, West Bengal, Gujarat and Punjab. Elsewhere-Cosmopolitan.

41. *Lecane hastata* (Murray, 1913)

(Fig. 43)

Characters: Lorica almost oval in outline, with coincident anterior margins. Dorsal plate smaller than ventral plate and obtuse posteriorly. Anterior external angles of ventral plate with small spines. Posterior segment broad and semicircular. Toes almost parallel-sided and slightly swollen at their free ends; claws distinct, pointed and with swollen bases.

Distribution: Deepor and Ghorajan beel.

India-Assam, West Bengal. Elsewhere: Europe, Eastern Asia and South America. Elsewhere-Cosmopolitan.

42. *Lecane ludwigi*(Eckstein, 1883)

(Fig. 44)

Characters: Lorica oval, anterior margins coincident, slightly concave and with prominent spines at external angles of ventral margin. Dorsal plate truncate posteriorly and broader than ventral plate. Posterior segment produced into long triangular spines. Toes long, slender, parallel-sided and ending into distinct conical points.

Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.

India- Meghalaya, Mizoram, West Bengal, Gujarat and Punjab. Elsewhere-Cosmopolitan.

43. *Lecane lateralis* Sharma, 1978
(Fig. 45)

Characters: Lorica broadly ovate; anterior dorsal margin concave, anterior ventral margin undulating and with a transverse fold in its posterior regions; its ventro-lateral angles produced into small extensions. Toes long, parallel-sided about ¾ of the length and with stout claws; each claw with a distinct basal spicule.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- West Bengal, Tripura. Elsewhere-Paleotropical.

44. *Lecane leontina* (Turner, 1892)
(Fig. 46)

Characters: Lorica oblong-ovate; anterior dorsal and ventral sinus broadly v-shaped. Ventral plate broader and with triangular spines at anterio external angles. Posterior segment projecting over foot. Toes long, parallel-sided and terminating into claws; each claw with a basal spicule.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel
India- North Eastern states, West Bengal, Orissa, Bihar, Andhra Pradesh, Madhya Pradesh and Punjab. Elsewhere-Tropics and sub-tropics.

45. *Lecane papuana* (Murray, 1913)
(Fig. 47)

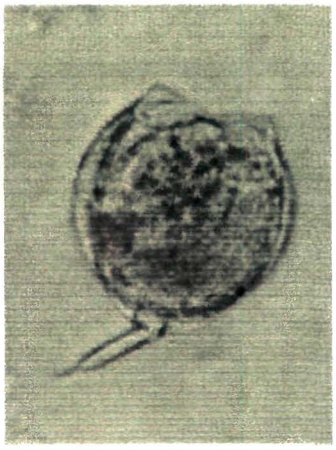
Characters: Lorica oval to circular; anterior dorsal margin straight, anterior ventral margin undulating with a shallow median sinus. Ventral plate slightly narrower than dorsal plate. Posterior segment small and rounded. Toes moderately long, parallel-sided and terminating into claws.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- North Eastern states, West Bengal, Orissa, Bihar, Tamil Nadu and Kashmir. Elsewhere-Tropics and sub-tropics.

46. *Lecane luna* (Miller, 1773)
(Fig. 48)

Characters: Lorica ovate to sub-circular in outline. Dorsal plate broader than ventral plate. Anterior ventral sinus v-shaped with cusp-shaped external angles. Toes stout, parallel sided and slightly swollen at their bases; claws with basal spicule.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- North Eastern states, West Bengal, Orissa, Bihar, Gujarat, Rajasthan, Punjab and Jammu and Kashmir. Elsewhere-Tropics and sub-tropics.

47. *Lecane pyriformis* (Daday, 1905)
(Fig. 49)

Characters: Lorica pyriform, anterior margins straight or slightly convex with rounded external angles. Ventral plate narrower than dorsal plate. Second foot-joint



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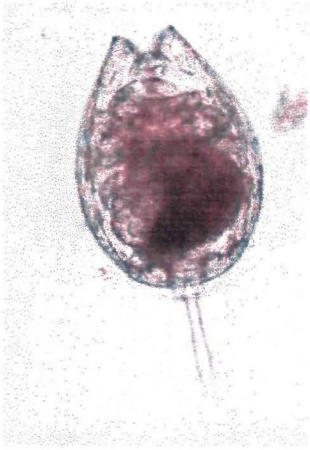

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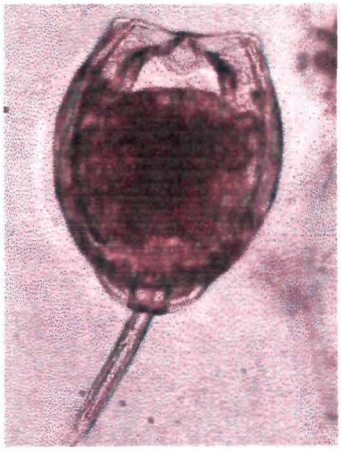

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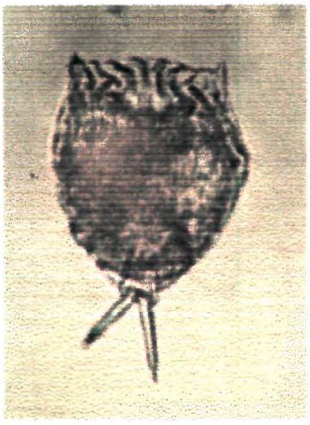

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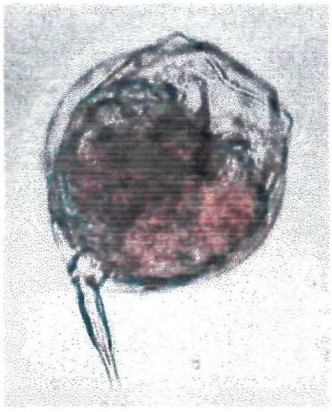

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Fig. 51, *L.closterocerca*(Schmarda), ***Fig. 52,*** *L.bulla*(Gosse),
Fig. 53, *L.lunaris*(Ehrenberg), ***Fig. 54,*** *L.aculeata*(Jakubski),
Fig. 55, *L.unguitata*(Fadeev), ***Fig. 56,*** *L.hamata*(Stokes)

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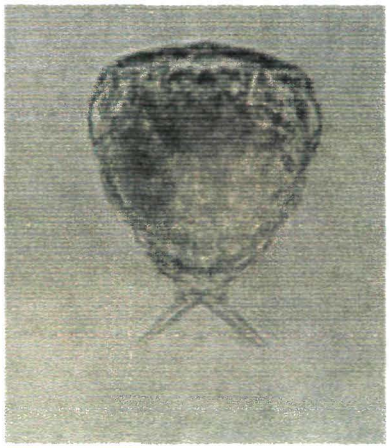

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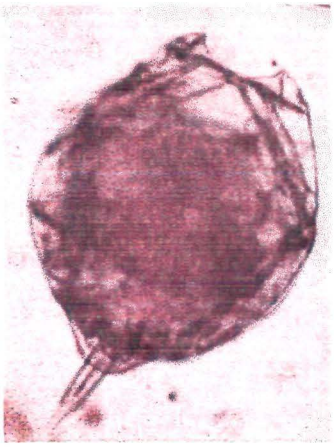

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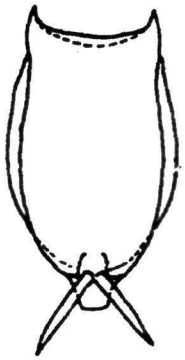

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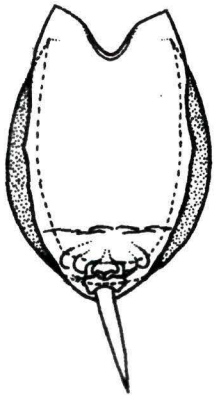

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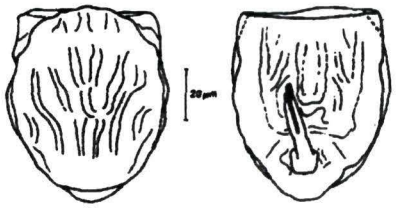

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Fig. 57, *L.thienemanni*(Hauer), ***Fig. 58,*** *L.hornemanni*(Ehrenberg),
Fig. 59, *L.stenroosi*(Meissner), ***Fig. 60,*** *L.ohioensis*(Herrick),
Fig. 61, *L.decipiens*(Murray), ***Fig. 62,*** *L.inopinata*(Harring & Myers) (Dorsal & Ventral)

sub-square. Toe pararrel sided almost up to half and then tapering to a slender tip.
Distribution: Deepor and Ghorajan and Siligurijan beel.
India- Meghalaya, West Bengal, Assam, Orissa, Bihar and Punjab. Elsewhere-Cosmopolitan.

48. *Lecane (Monostyla) quadridentata* (Ehrenbarg, 1832)
(Fig. 50)

Characters: Lorica broadly ovate to pyriform. Anterior dorsal margin with two out-curved spines; ventral margin with v-shaped sinus and its external angles produced into minute frontal spines. Toe long and parallel sided; claw pointed with two basal spicules without median line.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Meghalaya, Manipur, Mizoram, Assam, Orissa, Andhra Pradesh, Tamil Nadu, Gujarat, Rajasthan, Punjab, Haryana and Kashmir. Elsewhere-Cosmopolitan

49. *Lecane closterocerca* (Schmarda, 1859)
(Fig. 51)

Characters: Lorica broadly oval with concave anterior margins; anterior external angles rounded. Ventral plate narrower than dorsal plate. Toes parallel sided up to half of its length then tapering to a slender point.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- North Eastern states, Orissa, Tamil Nadu, Gujarat, Rajasthan, Punjab and Jammu and Kashmir. Elsewhere-Cosmopolitan.

50. *Lecane bulla* (Gosse, 1851)
(Fig. 52)

Characters: Lorica oblong-ovate; anterodorsal margin with a shallow, V-shaped sinus having median notch. Anteroventral margin with deep sinus. Ventral plate equally broad or slightly narrower than dorsal plate. Toes long and terminating into a long and pointer claw; claw with a distinct median line but undivided.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- North Eastern states, West Bengal, Orissa, Bihar, Andhra Pradesh, Tamil Nadu, Gujarat, Rajasthan, Punjab and Jammu and Kashmir. Elsewhere-Cosmopolitan.

51. *Lecane (Monostyla) lunaris* (Ehrenberg, 1832)
(Fig. 53)

Characters: Lorica broadly ovate; anterior margin with a shallow lunate sinus. Dorsal plate semi-circular to pear-shaped and ventral plate broadly oval and narrower than dorsal plate. Toe long and parallel sided; claw with a median furrow and two basal spicules.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- North Eastern states, West Bengal, Orissa, Bihar, Gujarat, and Kashmir. Elsewhere-Cosmopolitan.

52. *Lecane aculeata* (Jakubski, 1912)
(Fig. 54)

Characters: Lorica elongate and oval with straight and coincident anterior margins. Dorsal plate with margins. Ventral plate narrower than dorsal plate and with large spines curving out at its external edge. Posterior segment broader and semi-circular. Toes parallel sided and end into slender claws.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Meghalaya, West Bengal and Orissa. Elsewhere-Tropics and sub-tropics.

53. *Lecane (Monostyla) unguitata* (Fadeev, 1925)
(Fig. 55)

Characters: Lorica broadly circular with relatively small anterior opening. Anterior dorsal margin straight and anterior ventral margin undulating with deep median sinus and rounded external angles. Dorsal plate pyriform, truncate posteriorly and smaller than ventral plate. Claw pointed with indistinct furrow and with two basal spicules.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Meghalaya, Assam, West Bengal, Orissa, Bihar and Gujarat. Elsewhere-Paleotropical.

54. *Lecane hamata* (Stokes, 1859)
(Fig. 56)

Characters: Lorica elongate-oval. Anterior dorsal margin with a shallow lunate sinus; anterior ventral margin with a deep V-shaped sinus and with acute angled distinct cusps at its external angles. Toe parallel-sided for about half of its length and then tapering to an acute point. Posterior segment slightly broader and semi-circular.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- West Bengal, Orissa and Rajasthan. Elsewhere-Tropics and sub-tropics.

55. *Lecane thienemanni*(Hauer, 1938)
(Fig. 57)

Characters: Lorica elongate oval, anterior dorsal margin straight and narrower; anterior ventral margin with a shallow sinus and its external angles produced into two strongly built triangular spines. Dorsal plate slightly truncate posteriorly and broader than ventral plate. Toe parallel-sided for about half of its length and the tapering to an acute point.
Distribution: Deepor, Ghorajan and Fingua beel.
India- West Bengal, Orissa and Rajasthan. Elsewhere-Tropics and sub-tropics.

56. *Lecane hornemanni* (Ehrenbarg, 1834)
(Fig. 58)

Characters: Lorica broadly ovate, slightly convex and without any spines at exter-

nal angles. Dorsal plate semi-circular and broader than ventral plate. Toes stout, tapering gradually and with slightly curved points.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Meghalaya, West Bengal, Andhra Pradesh, Tamil Nadu, Gujarat and Kashmir. Elsewhere-Tropics and sub-tropics.

57. *Lecane stenroosi* (Meissner, 1908)
(Fig. 59)

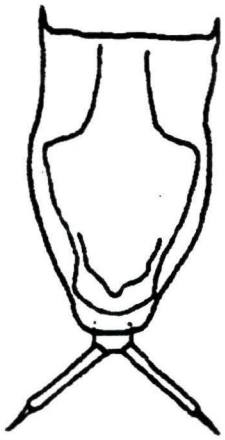
Characters: Lorica oval about 1.3 times as long as broad; densely granulated. Ventral plate of lorica rather flat and dorsal plate rather convex. Lorica laterally sulcate, appearing divided into dorsal and ventral plate. Anterior margin of lorica wide, reaching 3/5 of lorica width. Anterior margin of ventral plate shallowly concave but somewhat domed laterally and rather deeply grooved centrally, where getting lower than anterodorsal margin. Two anterolateral edges with small stout, strongly incurved triangular spines. Ventral plate somewhat narrower laterally than dorsal plate and slightly extended over dorsal margin posteriorly. Foot short, not retractable. Toe trident-shaped terminally.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Meghalaya, Mizoram, West Bengal, Gujarat and Punjab. Elsewhere-Cosmopolitan.

58. *Lecane ohioensis* (Herrick, 1885)
(Fig. 60)

Characters: Lorica broadly oval; anterior margins concave, external angles with inwardly directed distinct and stout spines. Dorsal plate truncate posteriorly and with four transverse rows of tesselations. Ventral plate narrower than dorsal plate and with a few folds. Posterior segment broad and with a spade-shaped posterior process. Toes long, parallel-sided and terminating into short and pointed tips.
Distribution: Deepor, Ghorajan and Fingua beel.
India- Meghalaya, Mizoram, West Bengal, Gujarat and Punjab. Elsewhere-Cosmopolitan.

59. *Lecane decipiens* (Murray, 1913)
(Fig. 61)

Characters: Lorica elongate-oval; anterior margins coincident and with a deep U-shaped sinus flanked by two acute triangular cusps at the external angles. Toe parallel-sided for about half of its length and then tapering to an acute point.
Distribution: Deepor and Ghorajan beel.
India- Meghalaya, Mizoram, Assam, West Bengal, Orissa, Gujarat and Punjab. Elsewhere-Cosmopolitan.



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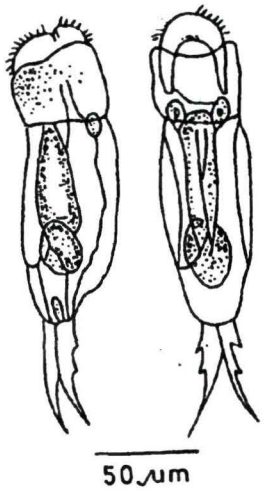

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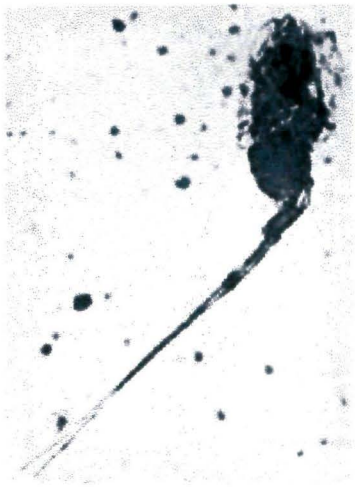

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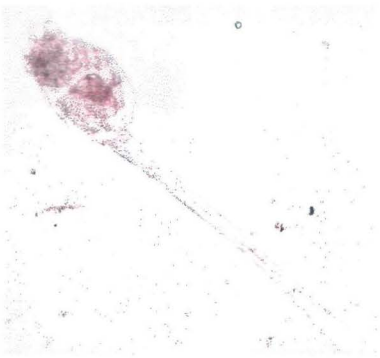

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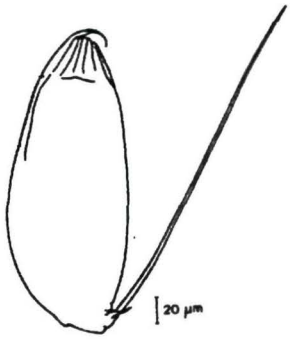

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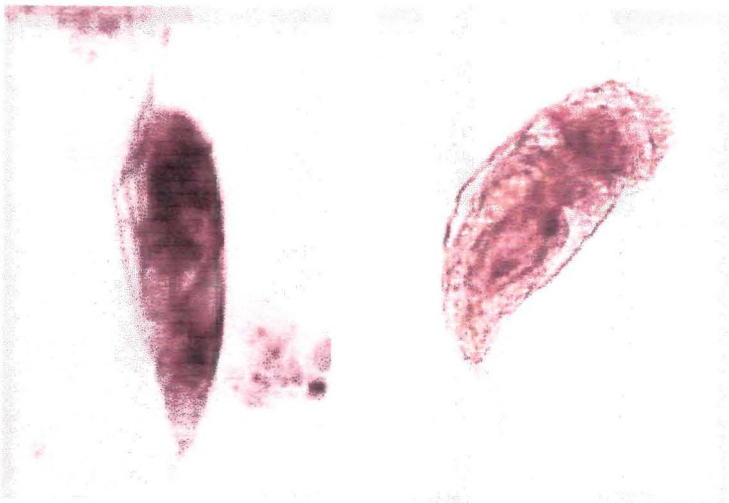
Fig. 63, *L.crepida*(Harring), ***Fig. 64,*** *Cephalodella forficula*(Ehrenberg) (Lateral & Dorsal), ***Fig. 65,*** *Monommata longiseta*(Muller), ***Fig. 66,*** *Scaridium longicaudum*(Muller), ***Fig. 67,*** *Ascomorpha saltans* Bartsch, ***Fig. 68,*** *Trichocerca cylindrica*(Imhof)



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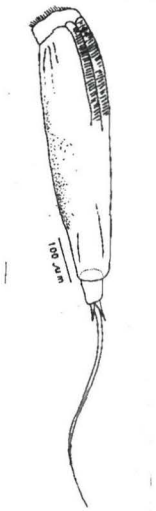

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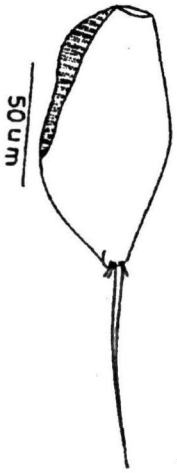

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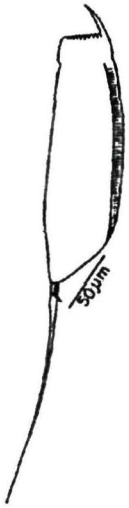

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Fig. 69, *T.similis*(Wierzejski), ***Fig. 70,*** *T.porcellus*(Gosse), ***Fig. 71,*** *T. elongata*(Gosse), ***Fig. 72,*** *T. rattus* (Ehrenberg), ***Fig. 73,*** *T.longiseta*(Schrank), ***Fig. 74,*** *Trichocerca pusilla* (Lauterborn)

60. *Lecane inopinata* Harring & Myers, 1926
(Fig. 62)

Characters: Absence of an ornamentation on the dorsal plate of the lorica. Toes fused in their basal third. Absence of hooks on the anterior edges of the lorica.
Distribution: Deepor and Ghorajan beel.
India- Meghalaya, Mizoram, Assam, West Bengal, Gujarat and Punjab. Elsewhere-Cosmopolitan.

61. *Lecane crepida* Harring, 1914
(Fig. 63)

Characters: Lorica elongated, parallel-sided and with anterior margins almost straight. External angles of ventral plate with anteriorly directed spines. Dorsal plate smaller than ventral plate. Second foot joint broadly square and projecting beyond lorica. Toes parallel sided and each with a pointed claw.
Distribution: Deepor, Ghorajan and Fingua beel.
India- Meghalaya, Assam, West Bengal, Tamil Nadu, Gujarat, Punjab. Elsewhere-Tropics and sub-tropics.

Family: Notommatidae Remane, 1933
62. *Cephalodella forficula* (Ehrenberg, 1832)
(Fig. 64)

Characters: Body elongated and slightly curved; body short and stout with thin dorsal and ventral plate. Foot ventrally directed; toes slightly bent and pointed.
Distribution: Deepor and Ghorajan beel.
India- Meghalaya, Assam, West Bengal, Gujarat, Kashmir and Ladak. Elsewhere-Cosmopolitan.

63. *Monommata longiseta* (Muller, 1786)
(Fig. 65)

Characters: Lorica thin transparent and almost cylindrical. Foot distinctly segmented; Toes long and unequal.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Meghalaya, Assam, West Bengal. Elsewhere-Cosmopolitan.

64. *Scaridium longicaudum* (Muller, 1786)
(Fig. 66)

Characters: Large animal, second foot pseudosegment and toes relatively short. Lorica thin and somewhat cylindrical. Fulcrum with high midventral crest, basal plate well developed. Rami teeth large. Basal part of unci triangular. Uncus tooth robust, strongly curved, acutely pointed, with subapical accessory tooth. No posterior lamella. Foot three segmented, distal segment longest; foot segment with stri-

ated muscles. Toes long, almost parallel-sided and with blunt tips. Alulae rounded.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Meghalaya, Mizoram, Nagaland, Assam, West Bengal, Orissa, Bihar, Gujarat and Punjab. Elsewhere-Cosmopolitan.

Family : Gastropodidae Remane, 1933

65. *Ascomorpha saltans* Bartsch, 1870

(Fig. 67)

Characters: Body oval; thin lorica; corona with apical ring of cilia; apical tied with stiff tentacle and tufts of cilia. Stomach with 1-4 blind sacs; trophy elements sometimes united; intestine obliterated; foot small or lacking; cuticle approaching loricate condition.
Distribution: Deepor, Ghorajan and Siligurijan beel.
India- Meghalaya, Assam, West Bengal, Jammu and Ladakh. Elsewhere-Cosmopolitan.

Family: Trichocercidae Remane, 1933

66. *Trichocerca cylindrica* (Inshof, 1891)

(Fig. 68)

Characters: Body long and cylindrical. Anterior end with a median dorsal spine and a number of longitudinal folds. Lorica thin, with a striated area. Left toe almost as long as lorica; right toe reduced to a scaly spine. Lateral antennae located in the middle of the dorsal crest.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Meghalaya, West Bengal, Orissa and Kashmir. Elsewhere-Palaearctic and Nearctic regions and Sri Lanka.

67. *Trichocerca similis* (Wierzejski, 1893)

(Fig. 69)

Characters: Body long, slender and tapering posteriorly. Anterior end with two long spines dorsally separated by a small hump. Dorsal keel extending from base of anterior spines up to one-third of the body length. Foot two segmented. Toes short and unequal.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Meghalaya, West Bengal, Orissa, Bihar and Gujarat. Elsewhere-Cosmopolitan

68.*Trichocerca porcellus* (Gosse, 1851)

(Fig. 70)

Characters: Lorica oval, anterior end broader than posterior. Body short and slender; a distinct head without any crest for striated area. Anterior end straight. Toes unequal and ventrally directed ; right toe very small.

Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- West Bengal. Elsewhere: South America and Sri Lanka. Elsewhere-South America and Sri Lanka.

69. *Trichocerca elongata* (Gosse, 1886)
(Fig. 71)

Characters: Body cylindrical, with two small keels extending upto 1/3 of the body length. Left toe longer than body, right toe reduced. Trophi asymmetrical; fulcrum expanded at the distal end, right manubrium large and inwardly directed at its free end and left manubrium reduced.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- West Bengal. Elsewhere: South America and Sri Lanka. Elsewhere-South America and Sri Lanka.

70.*Trichocerca (Trichocerca) rattus* (O.F. Muller, 1776)
(Fig. 72)

Characters: Body spindle-shaped and with a broad striated keel extending upto ½ the body length. Lateral antennae situated in the anterior portion of the body. Left toe smaller than body; right toe reduced. Right manubrium slightly reduced than left. Right ramus obtuse, left ramus strong, plank-shaped and with broad free end.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Assam, West Bengal, Gujarat, Punjab, Kashmir, Ladakh. Elsewhere- Cosmopolitan.

71. *Trichocerca longiseta* (Schrank, 1802)
(Fig. 73)

Characters: Lorica long and slender; anterior margin with a long spine, a shorter spine and two small projections. Striated area up to middle of trunk. Left toe equal to about half of the body length or more and right toe small; substyli present.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India-Meghalaya, Jammu and Kashmir and Ladakh. Elsewhere-Palaeartic and Neartic regions.

72. *Trichocerca pusilla* (Lauterborn, 1898)
(Fig. 74)

Characters: Lorica oval, anterior end broader than posterior. Body short, slender and cylindrical; a distinct head without any crest for striated area. Anterior end straight. Toes unequal; left toe moderately long and ventrally directed; right toe very small.
Distribution: Deepor, Ghorajan and Siligurijan beel.
India- Meghalaya and Assam. Elsewhere-Cosmopolitan.

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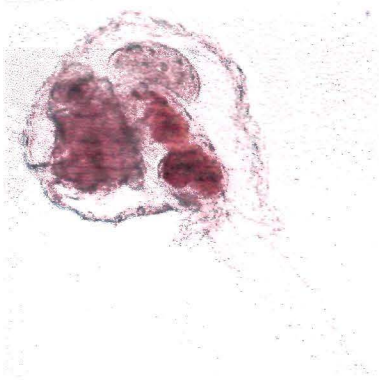

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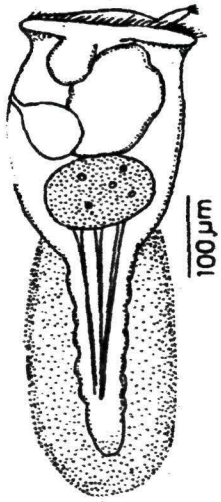

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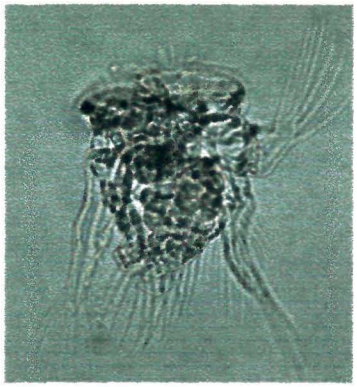

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Fig. 75, *Asplanchna priodonta* Gosse, ***Fig. 76,*** *Polyarthra vulgaris* Carlin, ***Fig. 77,*** *Sinantherina socialis* Bory de st. Vincent, ***Fig. 78,*** *S. spinosa*(Thorpe), ***Fig. 79,*** *Conochilus unicornis* Rousselet, ***Fig. 80,*** *Hexarthra mira*(Hudson)

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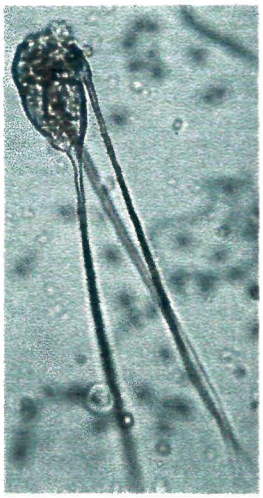

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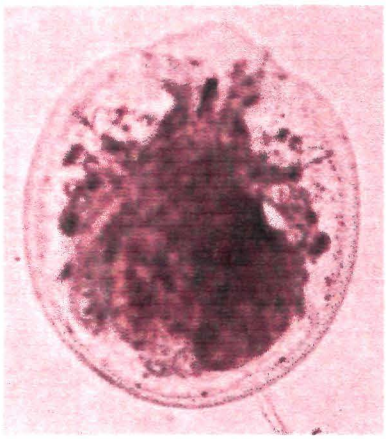

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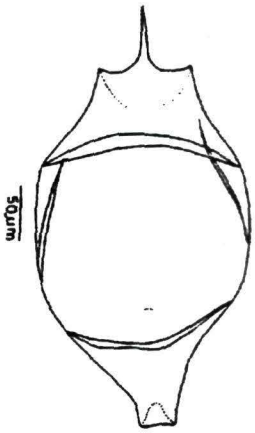

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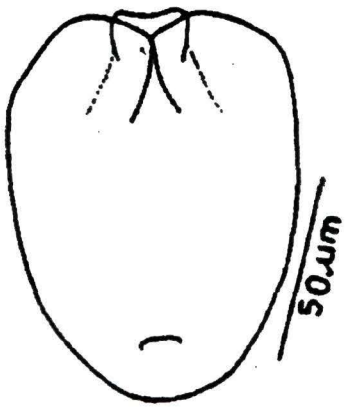
Fig. 81, *Filinia camascela* Myers, ***Fig. 82,*** *F.longiseta*(Ehrenberg), ***Fig. 83,*** *F.pejleri* Hutchinson, ***Fig. 84,*** *F.opoliensis* Zacharias, ***Fig. 85,*** *Testudinella patina*(Hermann), ***Fig. 86,*** *T.greeni* Koste



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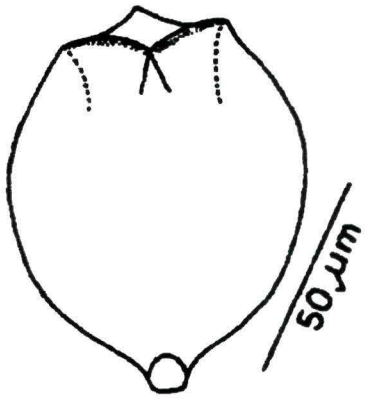

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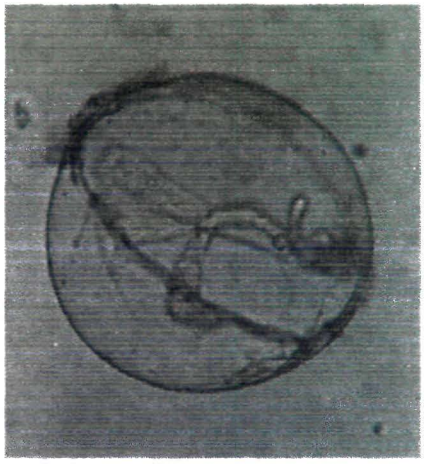

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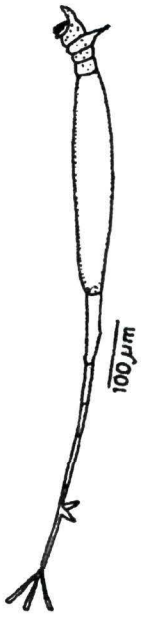

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Fig. 87, *T.emarginula*(Stenroos), ***Fig. 88,*** *T.brevicaudata* Yamammoto,

Fig. 89, *Trochosphaera aequatorialis* Semper,

Fig. 90, *Rotaria neptunia*(Ehrenberg)

Family: Asplanchnidae Harring & Myers, 1926

73. *Asplanchna priodonta* Gosse, 1850

(Fig. 75)

Characters: Body illoricate, transparent and sacciform. Contractile vesicle small and rounded. Gastric glands rounded. Vitellarium rounded. Rami serrate on inner side, broad at free ends. Foot absent.

Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.

India- Meghalaya, West Bengal, Bihar, Gujarat and Jammu and Kashmir. Elsewhere-Cosmopolitan.

Family: Synchaetidae Remane, 1933

74. *Polyarthra vulgaris* Carlin, 1943

(Fig. 76)

Characters: Body broadly cyndrical, with ventral appendages. Apical field with two ciliated antennae, lateral antennae located in the poterior third part of the body. Serrate paddles feather-shaped and slightly longer than the body; each blade with a distinct mid-rib and lateral ribs.

Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.

India- Meghalaya, Assam, West Bengal, Orissa, Bihar, Punjab and Kashmir. Elsewhere-Cosmopolitan.

75. *Sinantherina socialis* Bory de st. Vincent

(Fig. 77)

Characters: Colonial; foot short or medium. They may be distinguished by the presence of 4 warts on the venter; the larvae do not carry eggs.

Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.

India-Assam, West Bengal. Elsewhere-Cosmopolitan.

76. *Sinantherina spinosa* (Thorpe, 1893)

(Fig. 78)

Characters: Ventral side of trunk spinulated; Colonial. Foot short. They may be distinguished by the presence of many fine spines on the venter.

Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.

India- Assam, West Bengal. Elsewhere-Cosmopolitan.

Family: Conochilidae Bartos, 1959

77. *Conochilus unicornis* Rousselet, 1892

(Fig. 79)

Characters: Body transparent, vase-shaped with long, contractile and unsegmented foot. Colonial and with gelatinous case. Digestive system U-shaped, anus situated dorsally.

Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.

India- Meghalaya, Assam, West Bengal, Jammu. Elsewhere-Cosmopolitan.

Family: Hexrthridae Schmarda

78. *Hexerthra mira* (Hudson, 1871)

(Fig. 80)

Characters: Appendages are hollow outgrowths of body wall, containing striated muscles and bearing setae. Three pairs of strong hooks present.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Meghalaya, West Bengal. Elsewhere-Cosmopolitan.

Family: Filinidae Bartos, 1959

79. *Filinia camascela* Myers, 1938

(Fig. 81)

Characters : Distinguished from all other known species of the genus Filinia by distinct shape of lorica as well as by its broad based and stout setae.
Distribution: Deepor, Ghorajan and Fingua beel.
India- Meghalaya, Tripura, Assam. Elsewhere- Oriental and restricted to N.E. India.

80. *Filinia longiseta* (Ehrenberg, 1834)

(Fig. 82)

Characters: Body barrel-shaped with two antero-lateral and long posterior setae. Anterior setae usually folded ventrally. Posterior seta inserted usually 25 ìm away from caudal end of body.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Meghalaya, Assam, West Bengal, Orissa, Bihar, Madhya Pradesh, Gujarat, Rajasthan, Punjab, Haryana and Jammu. Elsewhere-Cosmopolitan.

81. *Filinia pejleri* Hutchinson, 1964

(Fig. 83)

Characters: Body relatively small, transparent fusiform and with three setae; width 1/3 or ¼ of body length. Posterior seta with a broad oblique base and inserted terminally at posterior end of the body.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India-Assam, West Bengal, Tamil Nadu, Rajasthan and Punjab. Elsewhere-tropics and Subtropics.

82. *Filinia opoliensis* Zacharias, 1898

(Fig. 84)

Characters : Body firm, rigid cuticle of elongated ovoid shape ; lateral anterior setae of different lengths, arising from broad paddle-like bases, commonly held directed forward; two caudal seta.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Meghalaya, Assam, West Bengal. Elsewhere-Cosmopolitan

Family: Testudinellidae Bartos, 1959

83. *Testudinella patina* (Hermann, 1783)

(Fig. 85)

Characters: Lorica almost circular, transparent and dorso-ventrally flattened. Dorsal plate slightly convex and anterior dorsal margin rounded. Lateral antennae situated anterior to middle region of lorica. Foot opening circular and located in the middle part on the ventral side; foot annulated projecting with a terminal ciliated cap.

Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.

India- Meghalaya, Assam, West Bengal, Orissa, Bihar, Andhra Pradesh, Gujarat, Punjab and Kashmir. Elsewhere-Cosmopolitan.

84. *Testudinella greeni* Koste, 1981

(Fig. 86)

Characters: Lorica elongate-oval, strongly curved dorsally, maximum width in its middle region, produced posteriorly into a tubular angulated end. Anterior dorsal margin with distinct, long, median spine and produced external angles; ventral margin with median notch, bounded by two spines. Foot-opening inverted v-shaped, situated at posterior end of lorica.

Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.

India-Assam. Elsewhere-Palaeotropical.

85. *Testudinella emarginula* (Stenroos, 1898)

(Fig. 87)

Characters: Lorica elliptical and with maximum width slightly behind its anterior region; dorsal surface convex and ventral surface with distinct median keel. Foot-opening slit shaped, located ventrally some distance from posterior end of lorica. Body ovoid to pyriform, head aperture not flared; median indentation in posterior dorsal rim.

Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.

India- Meghalaya, Assam, West Bengal. Elsewhere-Cosmotropical.

86. *Testudinella brevicaudata* (Yamamoto, 1951)

(Fig. 88)

Characters: Lorica broadly oval, with maximum width in its middle and produced posteriorly into a rectangular projection. Anterior dorsal margin broadly conical; ventral margin with sloping sides and a median spine. Foot-opening almost semi-circular and ventrally located at posterior projection of lorica.

Distribution: Deepor and Ghorajan beel.

India-Assam

87. *Trochosphaera aequatorialis* Semper
(Fig. 89)

Characters: Spherical body to 1mm; equatorial ciliary band; vitellarium ribbon or sickle-shaped, multinucleate.
Distribution: Deepor, Ghorajan and Fingua beel.
India-Assam and West Bengal. Elsewhere-Cosmopolitan.

88. *Rotaria neptunia* (Ehrenberg, 1832)
(Fig. 90)

Characters: Body long, slender and fusiform. Palp-like antennae on first neck segment. Trunk long. Slender and telescopic with a pair of spurs; last foot-segment with slender toes.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Meghalaya, Assam, West Bengal, Bihar, Orissa and Andhra Pradesh. Elsewhere-Cosmopolitan.

Systematic Account of Cladocera

Class: Crustacea
Sub-Class: Branchiopoda
Order: Cladocera

Family: Sididae Baird, 1850
1. Sida crystallina (O.F.Muller, 1776)
(Fig. 91)

Characters : Carapace transparent or yellowish. Body slightly oblong. Head very large, quadrate and clearly separable from the body by a cervical depression. A large dorsal gland present in littoral forms. Eye small, located in the ventral region of head, rostrum small and pointed. Antennules short, truncate, with short flagellum; attached to side of rostrum. Post-abdomen with about 14 lateral anal spines; groups of lateral setae arranged almost in a single row. Claw with four basal spines; with a row of setae distal to the basal spines.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Kashmir. Elsewhere- Holarctic and neotropical.

2. Diaphanosoma excisum Sars, 1885
(Fig. 92)

Characters: Carapace almost onlong in outline, posterior end abruptly truncate. Posterodorsal corner of valves almost ending in a right angle. Posteroventral corner with variable number of denticles followed by delicate cilia; number of denticles sometimes differing even on the two valves. Duplicature joining ventral shell margin at nearly right angle. Head large, oblong-quadrate and obtusely truncate anteriorly. Eye relatively large with numerous crystalline lenses; located in the frontal

portion of head, close to the ventral margin. Reflexed antennae not reaching posterior margin of valves. Postabdomen narrow with fine setules. Claw with three basal spines, decreasing in size proximally.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Meghalaya, Assam, West Bengal, Bihar, Rajasthan. Elsewhere-Common in tropics and subtropics.

Family: Daphnidae straus, 1820

3. Ceriodaphnia cornuta Sars, 1885
(Fig. 93)

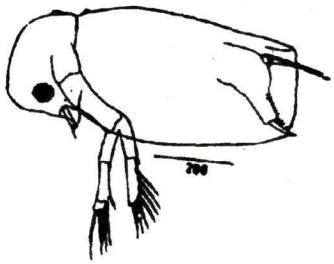
Characters: Carapace of female rather tumid, broadly oval in outline; produced posteriorly into a short projection, lying slightly above the longitudinal axis. Head with short spine or horn over eye on anterior margin in some specimens. Eye large, ocellus small and punctiform. Antennules small, fusiform not extending to tip of rostrum. Postabdomen moderately broad, with 5-6 anal spines.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Meghalaya, Assam, West Bengal, Bihar, Rajasthan. Elsewhere-Cosmotropical.

4. Ceriodaphnia quadrangula (O.F.Muller, 1776)
(Fig. 94)

Characters: Carapace rounded quadrangular in outline, posterior protuberance distinctly produced and far above the axis of the body. Valves reticulated, often not plainly marked. Head angulate but not inflated in front of antennules. Antennules small, sensory seta near the apex. Eye of moderate size. Postabdomen slightly narrowing towards apex, sinuate above anal spines; with 7-9 anal spines. Claw large and finely setulate.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Kashmir, Ladakh and Nilgiri Hills, South India. Elsewhere- Throughout Europe, Central Asia, Greenland.

5. Scapholeberis kingi Sars 1903b
(Fig. 95)

Characters: Body color usually dark, often nearly black. Posterio and ventral margins straight; at almost their junction a spine often short, but often very long. Rostrum short and blunt. Antennules very small, almost immovable, set behind beak. Postabdomen short and broad, rounded at posterior end. Claw moderately long, stout and with setae on its concave margin.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Meghalaya, Assam, West Bengal, Orissa, Bihar, Rajasthan, Punjab, Jammu and Kashmir. Elsewhere-Cosmopolitan.



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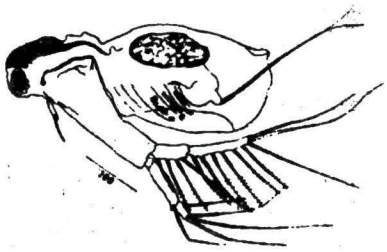

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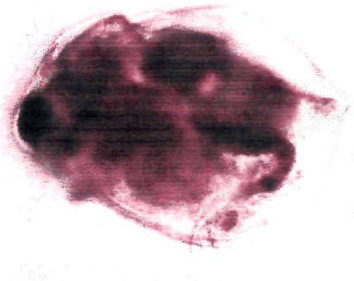

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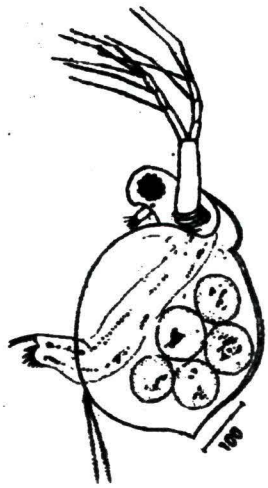

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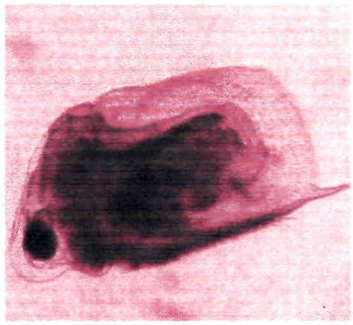

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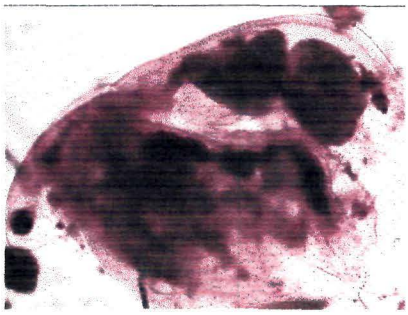
Fig. 91, *Sida crystallina* (O.F.Muller), ***Fig. 92,*** *Diaphanosoma excisum* Sars, ***Fig. 93,*** *Ceriodaphnia cornuta* Sars, ***Fig. 94,*** *C.quadrangula* (O.F.Muller), ***Fig. 95,*** *Scapholeberis kingi* Sars, ***Fig. 96,*** *Simocephalus vetulus* (O.F.Muller)



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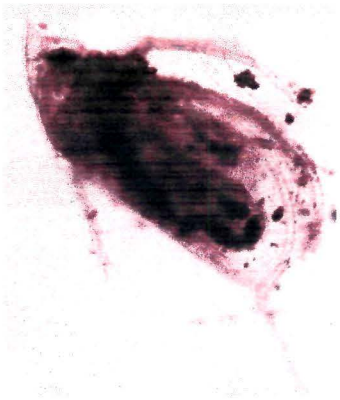

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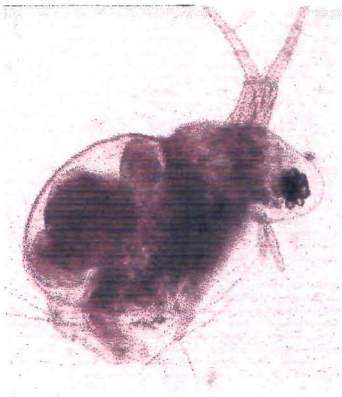

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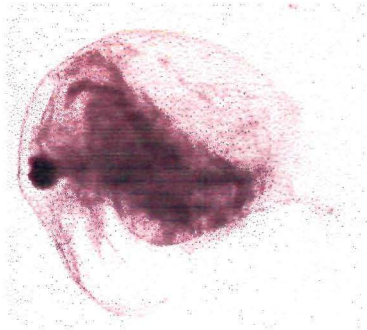

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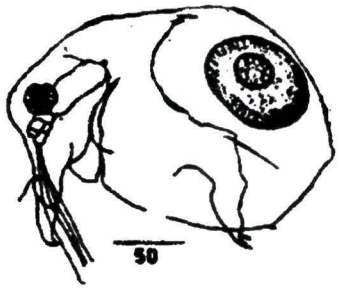

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Fig. 97, *S.serrulatus* (Koch), ***Fig. 98,*** *Daphnia lumholtzi* Sars,
Fig. 99, *Moina micrura* Kurz, ***Fig. 100,*** *Moinodaphnia macleayi* (King),
Fig. 101, *Bosmina longirostris* (O.F.Muller), ***Fig. 102,*** *Bosminopsis deitersi* Richard

6. Simocephalus vetulus (O.F. Muller, 1776)
(Fig. 96)

Characters: Ocellus large, elongated, rarely rhomboidal. No spine on valves, though there may a blunt posterior angle. Postabdomen very broad, deeply emarginate; anal spines about 10, decreasing from the claws; the larger bent and ciliate at the base. Claws long, slender, nearly straight, with fine teeth along entire length.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Meghalaya, Assam, West Bengal, Orissa, Bihar, Punjab, Jammu and Kashmir. Elsewhere-Cosmopolitan.

7. Simocephalus serrulatus (Koch, 1841)
(Fig. 97)

Characters: Carapace oval or trigonal in outline, dorsal and ventral margins evenly arched; posterior protuberance obtuse and produced, situated in the longitudinal axis of body. Posterior region of dorsal surface and posterior prominence marked distantly with denticles. Head small and produced anteriorly into an acute projection, ventral surface of head almost straight. Rostrum small and pointed. Eye comparatively small; ocellus small and punctiform. Postabdomen very broad, its posterior end forming an expansion in front of anal sinus. Claw long and slender.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Assam, West Bengal, Andhra Pradesh. Elsewhere-Cosmopolitan.

8. Daphnia lumholtzi Sars, 1885
(Fig. 98)

Characters: Carapace broadly oval, narrowed posteriorly and continued into a considerably long posterior spine. Dorsal surface of valves moderately arched and armed with elongated and distant spicules, which continue to posterior spine. Head of distinct dorsal depression above heart; produced anteriorly in the form of a helmet of variable length. Eye large; ocellus small.
Distribution: Deepor beel.
India- Meghalaya, Assam, West Bengal, Orissa, Bihar, Punjab and Haryana. Elsewhere-Cosmopolitan.

Family: Moinidae Goulden, 1968
9. Moina micrura Kurz, 1874
(Fig. 99)

Characters : Head large, extended in anteroventral direction and with well developed supraocular depression. Anterior and ventral margins of head evenly rounded. Eye large. Valves oblong or rotund in shape. No setules either on head or valves. Antennules originating well behind the eye; antennules large, thin and with a long basal seta.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Meghalaya, Assam, West Bengal, Orissa, Bihar, Punjab. Elsewhere-Africa, Syria, USSR, France, Philippines.

10. Moinodaphnia macleayi (King, 1853)
(Fig. 100)

Characters: Head small, rounded and trigonal in shape. Eye large, filling up anterior part of head. Very slight supraocular depression. Antennules long and thin and arising from the ventral margin just behind eye. Abdominal process large, horseshoe shaped. Postabdomen with an elongated distal end, with 7-11 feathered teeth. Claw with fine setae on concave margin.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- West Bengal, Orissa, Bihar. Elsewhere-Widely distributed in tropics.

Family: Bosminidae Sars, 1865
11. Bosmina longirostris (O.F. Muller, 1776)
(Fig. 101)

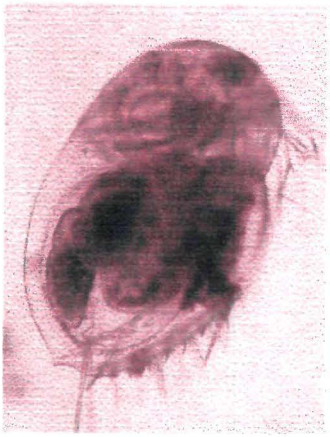
Characters : Body almost oval in outline. Posterodorsal corner of valves distinctly angular, posteroventral corner produced into backwardly directly spine. Head large, more or less arched in front of eye. Eye usually large. A small sensory hair situated nearer to eye than to base of antennule. Postabdomen almost quadrate. Clawwith proximal pectin of 3-6 spinules and distal pectin of 7-10 spines continued distally into minute spinules.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Meghalaya, Assam, West Bengal, Kashmir. Elsewhere-Cosmopolitan.

12. Bosmina deitersi Richard, 1895
(Fig. 102)

Characters: Body almost oval in outline. Posterodorsal corner of valves distinct; posteroventral corner with a small mucro-like process and with a few spinules before it. Head very large, with a long rostrum; head with supraocular depression. Antennules long, united with each other at basal part and with about 5-6 sensory setae on the ventral side near apex. Postabdomen broad and tapering distally; with about 7 small spines on the postanal edge followed by a row of setae proximally. Claw large and with one large basal spine.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Meghalaya, Assam, West Bengal, Jamuna river, Delhi. Elsewhere-Cosmopolitan.

13. Macrothrix goeldii Richard, 1897
(Fig. 103)

Characters: Body almost oval in outline, with maximum width slightly before middle; dorsal margin almost evenly arched, ventral margin arched anteriorly and ascending posteriorly. Shell markings reticulate and cause minute serrations on dorsal margin of head and body. Head subtriangular and almost evenly arched. Postabdomen with small notch on dorsal margin in the proximal side of anal opening. Anal region with sharp teeth and groups of bristles. Claw with setae on concave margin.



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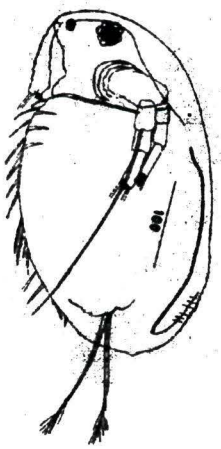

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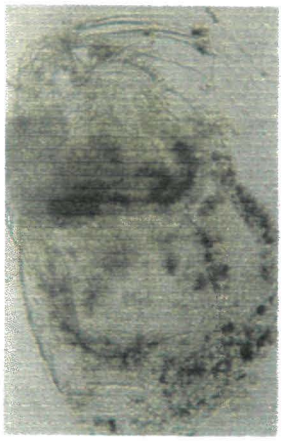

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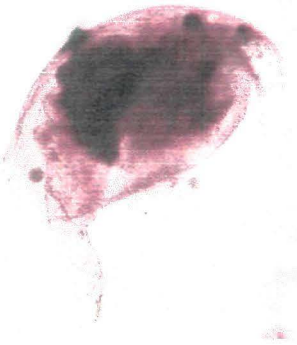

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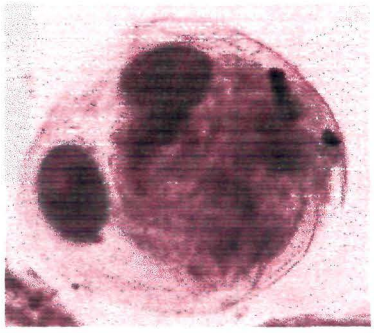
Fig. 103, *Macrothrix goeldii* Richard, ***Fig. 104,*** *Macrothrix laticornis* (Fischer), ***Fig. 105,*** *Ilyocryptus spinifer* Herrick, ***Fig. 106,*** *Pleuroxus similis* Vavra, ***Fig. 107,*** *Alonella exisa* (Fischer), ***Fig. 108,*** *Chydorus sphaericus* (O.F.Muller)



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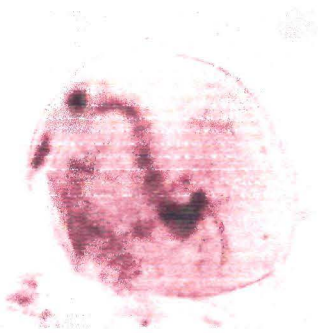

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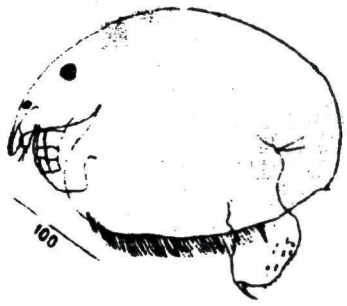

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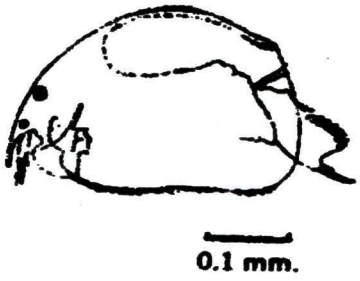

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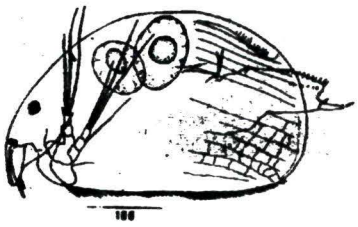

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Fig. 109, *C.barroisi* Richard, ***Fig. 110,*** *Dadaya macrops* (Daday),
Fig. 111, *Dunhevedia serrata* Daday, ***Fig. 112,*** *Alona intermedia* Sars,
Fig. 113, *A.quadrangularis* (O.F.Muller), ***Fig. 114,*** *A.costata* Sars

Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- West Bengal, Rajasthan. Elsewhere-Cosmopolitan.

14. Macrothrix laticornis (Jurine, 1820)
(Fig. 104)

Characters: Body almost oval in outline, with very small protuberance at the posterior end. Valves crested, reticulated; serrations on the dorsal edge distinct only in posterodorsal region. Head evenly arched. Head shield widening gently from tip of rostrum onwards; headpore large. In lateral view, a ridge departs from tip of rostrum, distal to level of ocellus and runs towards base of head shield in continuous concave arch. Antennules broadening apically with distinct ventral angulation, anterior margin with several fine incisions and clusters or rows of setules; olfactory setae conspicuously unequal. Labrum with large triangular process. Eye very near margin of the head.Posabdomen broad, not bilobed, with numerous fine spines and setules. Claw small, with setae on the concave margin.
Distribution: Deepor and Ghorajan beel.
India-Ladakh, Nilgiri Hills. Elsewhere-Holarctic, Neotropical and Oriental.

15. Ilyocryptus spinifer Herrick, 1882
(Fig. 105)

Characters: Body form oval-triangular in outline. Posterior and ventral edge of valves rounded into each other and bearing long, usually branched and feathered setae. Head keel starting from anterior rim of head and extending upto back of head. Antennules long, biarticulated and attached to the ventral side of head behind vertex. Postabdomen large, broad and anus opening in the depression on the dorsal margin of postabdomen. Claw long, slightly curved and with two basal spines of unequal length.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Meghalaya, West Bengal, Rajasthan. Elsewhere-Pantropical, also recorded from North America, China, Australia and Cuba.

Family: Chydoridae Stebbing, 1902
16. Pleuroxus similis Vavra, 1900
(Fig. 106)

Characters : Body with uniformly curved dorsal margin. Postero-ventral corner of the valves with 1-3 denticles; variation noticed even on valves of same animal. Rostrum long and pointed downwards, reaching level of ventral margin of valve. Antennuales terminating far from apex of rostrum. Plate of labrum with convex anterior margin. Postabdomen elongated, tapering slightly to distal end; dorsal distal corner of postabdomen situated slightly behind base of claws. Anal spines 10-13 and increase gradually in size distally. Claw with two basal spines.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel
India- Meghalaya, West Bengal, Kashmir. Elsewhere-Cosmopolitan.

17. Alonella excisa (Fischer, 1854)
(Fig. 107)

Character : Body oval in outline ; posterior margin of valve straight. Posterodorsal corner distinct; posteroventral corner with one blunt denticle. Head shield with rounded posterior margin. Plate of labrum with convex anterior margin and blunt apex. Ocellus slightly nearer to eye than to apex of rostrum. Postabdomen short. Preanal corner blunt.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel
India- Meghalaya, West Bengal, Madhya Pradesh, Kashmir. Elsewhere-Cosmopolitan.

18. Chydorus sphaericus (O.F. Muller, 1776)
(Fig. 108)

Character: Body almost sphaerical in outline, length slightly more than height. Posterodorsal corner of valves distinct. Posteroventral corner rounded, without denticles. Rostrum pointed and emarginated. Posterior margin of head shield rounded, head pores typical for this subfamily. Plate of labrum with smooth, convex anterior margin and with produced, pointed apex. Ocellus nearer to eye than to apex of rostrum. Postabdomen short, with 7-10 anal denticles. Claw with two basal spines and setae on the concave margin.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Meghalaya, West Bengal, Bihar, Kashmir, Ladakh. Elsewhere-Cosmopolitan.

19. Chydorus barroisi Richard, 1894b
(Fig. 109)

Characters : Body broadly elliptical in outline, maximum height in middle. Dorsal and ventral margins similarly convex, posterior margin almost straight. Posterodorsal corner of valves rounded. Posteroventral corner of each valve with denticle. Antennules short, conical and not reaching apex of rostrum. Ocellus smaller than eye, situated halfway between eye and apex of rostrum. Postabdomen short, with 9 unequal anal spines. Claw with two basal spines and setae on concave margin.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Meghalaya, West Bengal, Gujarat, Kashmir. Elsewhere-Cosmotropical.

20. Dadaya microps (Daday, 1898)
(Fig. 110)

Characters: Body oval in outline. Dorsal and ventral margin of valves convex. Posteroventral corner of valve rounded, with a denticle. Valves marked with a pattern of hexagons. Rostrum long, directed backwards. Posterior margin of head shield round, head pore single. Antennules distinctly projecting beyond apex of rostrum. Ocellus and eye unusually large. Postabdomen with a projecting preanal corner. Claw with a basal spine.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India-Meghalaya, West Bengal, Kashmir. Elsewhere-Indo-Malayan, Australian and Neotropical regions.

21. Dunhevedia serrata Daday, 1898
(Fig. 111)

Characters: Body almost oval in outline; maximum height just before middle. Posterodorsal corner of valves not very distinct. Posteroventral corner with two dentacles; dorsal denticle smaller than ventral. Valves with longitudinal lines and dots. Rostrum blunt. Plate of labrum with serrated anterior margin with 10-15 denticles, apical denticles directed downward. Ocellus smaller than eye and situated halfway between eye and apex of rostrum. Postabdomen oval; with 13-15 anal denticles and numerous lateral groups of setae. Claw with basal spine and with setae on the concave margin.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India-Assam, West Bengal, Tamil Nadu. Elsewhere-Africa, Sri Lanka, New Guinea and North America.

22. Alona intermedia Sars
(Fig. 112)

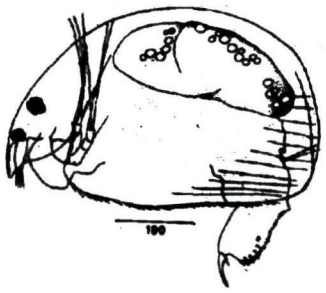
Characters: Body evenly arched but not very high. Postabdomen long, broad, enlarged toward apex, with rounded angle; the 8-9 marginal denticles rather small and thick; the lateral denticles or fascicles much more conspicuous, consisting of bundles of fine setae. The distal seta in each bundle is the largest and the size of setae increases toward apex of postabdomen. The distal bundles project beyond margin of postabdomen.
Distribution: Deepor and Ghorajan beel.
India- Assam, West Bengal and South India. Elsewhere- Cosmopolitan.

23. Alona quadrangularis (O.F. Muller, 1776)
(Fig. 113)

Characters: Body almost rectangular in outline with maximum height near posterior end. Posterodorsal and posteroventral corners of valves rounded. Valves marked with longitudinal lines, connected by transverse lines thus forming cells. Head shield with pointed posterior margin; three main connected head pores. Antennules distally with sensory setae and sensory papilla on posterior margin. Postabdomen broadened distally. Claw with basal spine and without row of setae on its concave margin.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Meghalaya, West Bengal and South India. Elsewhere-Cosmopolitan.

24. Alona costata Sars, 1862b
(Fig. 114)

Characters: Body almost obovate in outline. Posterodorsal and posteroventral corners of valves rounded. Posterior margin of valves with a row of spinules on its inner margin. Valves marked with longitudinal lines with interconnections. Head shield with rounded posterior margin. Three main connected head pores, lateral pores with chitinous thickenings. Antennules not reaching apex of rostrum. Antennal setae: 0-



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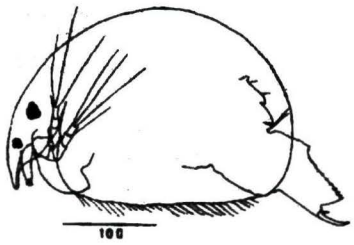

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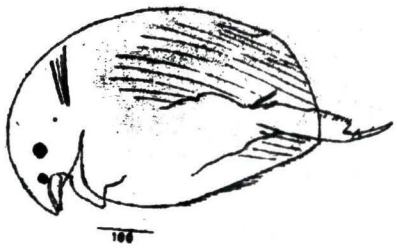

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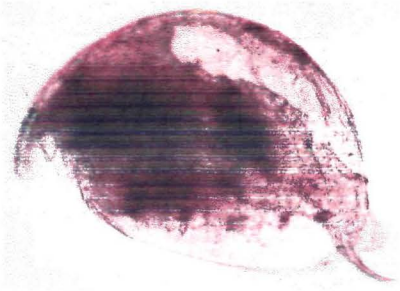

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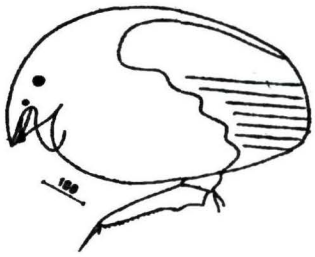

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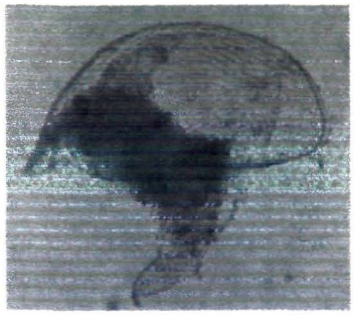

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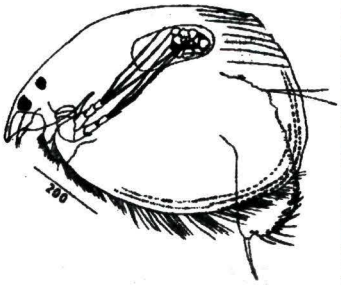
Fig. 115, *A.rectangula* Sars, ***Fig. 116,*** *A.guttata* Sars, ***Fig. 117,*** *Acroperus harpae* (Baird), ***Fig. 118,*** *Biapertura karua* (King), ***Fig. 119,*** *Camptocercus rectirostris* Schoedler, ***Fig. 120,*** *Graptoleberis testudinaria* (Fischer)



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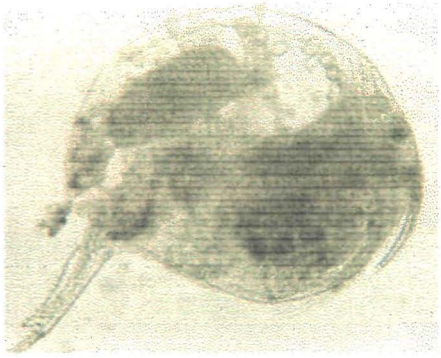

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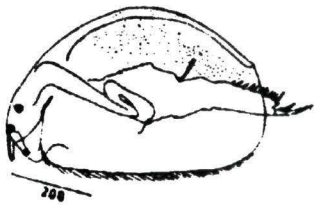

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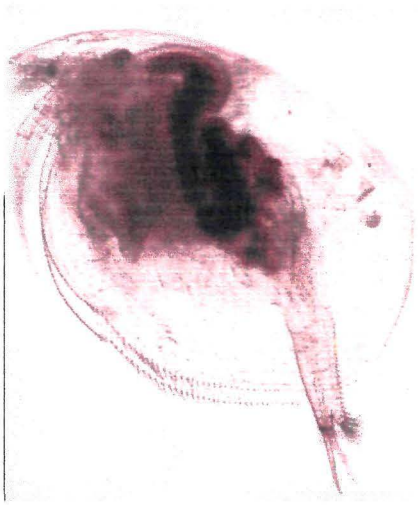

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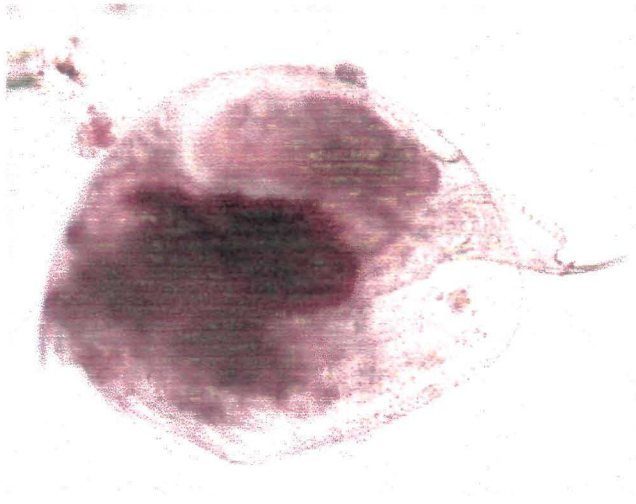

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Fig. 121, *Leydigia acanthocercoides* (Fischer), ***Fig. 122,*** *Kurzia longirostris* (Daday), ***Fig. 123,*** *Oxyurella singalensis* (Daday), ***Fig. 124,*** *Euryalona orientalis* (Daday), ***Fig. 125,*** *Notalona globulosa* (Daday)

0-3/1-1-3; spines on proximal segment of endopodite and on both distal segments. Plate of labrum rounded. Ocellus much smaller than eye and situated halfway between eye and apex of rostrum. Postabdomen short and tapering distally, dorsal margin almost straight and preanal corner only slightly projecting beyond base of claws. Anal spines 11-12, decreasing in size proximally. Groups of lateral setae present in a row, the distal setae being longest in each groups. Anal margin almost straight. Claw with basal spine.

Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.

India- Meghalaya, Assam, West Bengal, South India. Elsewhere-Cosmopolitan.

25. Alona rectangula (Stingelin, 1895)

(Fig. 115)

Characters: Posteroventral corner of valves rounded, without denticles. Antennules almost reaching apex of rostrum. Plate of labrum rounded. Ocellus slightly smaller than eye. Postabdomen slightly widening distally; with 6-9 lateral groups of setae, 2-3 spines and setae in each group. Claw with basal spine.

Distribution: Deepor and Ghorajan beel.

India-West Bengal. Elsewhere- New Zealand, USSR.

26. Alona guttata, Sars, 1862b

(Fig. 116)

Characters : Body almost oval in outline, with rounded posterodorsal and posteroventral corners of valves. In some cases, valves with longitudinal lines, with patterns of polygons, posteriorly. Head shield with rounded posterior margin. Three main head pores, with narrow connection between them. Antennules not reaching apex of rostrum. Antennae with spine on proximal segment of exopodite and on both distal segments. Plate of labrum rounded. Ocellus smaller than eye, situated halfway between eye and apex of rostrum. Postabdomen wide, with 9 anal spines and lateral groups of setae. Distal dorsal end of postabdomen pointed and projecting beyond base of claws. Preanal corner projecting. Anal margin slightly concave. Claws with basal spine.

Distribution: Deepor and Ghorajan beel.

India- Assam, West Bengal,Ladakh and Nilgiri Hills. Elsewhere-Cosmopolitan.

27. Acroperus harpae (Baird, 1834)

(Fig. 117)

Characters: Body almost oval in outline. Posterodorsal corner of valves slightly lower than highest point of dorsal margin. Posteroventral corner of valves with 2-5 denticles. Dorsal crest and head keel present. Head shield with 3 connected main head pore. Antennules not reaching apex of rostrum; anterior margin of antennules with incisions and setae. Plate of labrum triangular, with convex anterior margin and blunt apex. Postabdomen with very small anal spines. Claws with basal spine and setae on proximal margin, distal most seta larger than others.

Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.

India- Meghalaya, West Bengal and Kashmir. Elsewhere-Cosmopolitan.

28. Biapertura karua (King, 1853)
(Fig. 118)

Characters: Body oval in outline, maximum height slightly before middle. Posteroventral corner of valves with 3-5 denticles, separated from each other by margin of valve. Valves striated with occasional polygons. Head shield with rounded anterior and posterior margins. Two connected main head pores and two small lateral pores. Plate of labrum rounded. Ocellus smaller than eye and situated nearer to eye than to apex of rostrum. Lateral setae in groups, first seta of some of the distal groups projecting beyond margin of postabdomen. Claws with very small basal spine.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Meghalaya, West Bengal. Elsewhere-Cosmopolitan.

29. Camptocercus rectirostris Schoedler, 1862
(Fig. 119)

Characters: Body oval in outline; maximum height in front of middle. Posterodorsal corner of valves rounded; posteroventral corner with 3-5 denticles. Valves marked with curved stripes. Head keel present, passing into dorsal keel. Head with generally sloping dorsal keel. Rostrum pointed and directed anteriorly. Head shield with three connected main head pores, lateral pores situated opposite to median main pore. Antennules not reaching apex of rostrum. Plate of labrum with rounded apex. Ocellus smaller than eye, situated nearer to eye than to apex of rostrum. Postabdomen long, narrow; with 15-17 anal denticles, lateral setae small and in groups. Claw long, with basal spine and row of setae which become longer distally.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India-Kashmir, Gujarat and West Bengal Elsewhere-Holarctic, Ethiopian, Indo-Malayan, New Zealand and European USSR regions.

30. Graptoleberis testudinaria (Fischer, 1851)
(Fig. 120)

Characters: Dorsal margin of body convex ventral margin almost straight. Ventral margin of valves with setose setae decreasing in size towards posterventral corner but not reaching it. Posteroventral corner of valves with variable number of denticles. Head shield and valves marked with tetragonal, pentagonal or hexagonal cells. Head shield with angular posterior margin. Three connected main head pores, lateral pores at level of median main pore and surrounded by chitinous ring. Rostral margin very wide, its ventral margin almost at level of ventral margin of valve. Antennules with a sensory seta at the distal end of anterior margin; distal end with esthetases of differing length. Plate of labrum with rounded apex. Ocellus smaller than eye and situated nearer to eye than to apex of rostrum. Postabdomen tapering with row of anal spines increasing in size distally. Eight groups of lateral setae. Claw with a small basal spine and with row of fine setae on the concave margin.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India-Kashmir, and Kumaon, Western Himalayas. Elsewhere-Cosmopolitan.

31. Leydigia acanthocercoides (Fischer, 1854)
(Fig. 121)

Characters: Body roughly oblong and compressed. Valves with longitudinal lines, running parallel to the anterior margin. Head shield and intervals between lines with fine striations. Head shield with rounded posterior margin. Three connected main head pores, lateral pores situated near median main pore. Distance from posterior main pore to posterir margin of head shield about four times longer than distance between marginal main pores. Rostrum short, blunt, directed anteriorly and slightly ventrally. Plate of labrum with setae on anterior margin. Ocellus larger than eye. Postabdomen broadly rounded and margin concave. Lateral part of anus with several rows of setae. Lateral groups consist of 2 setae each. Anal spines very small. Two small terminal groups near claws. Claws without basal spine.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India-West Bengal, Rajasthan, Gujarat. Elsewhere-Holarctic, Ethiopian, Indo-Malayan, New Zealand and European USSR regions.

32. Kurzia longirostris (Daday, 1898)
(Fig. 122)

Characters: Posterodorsal and posteroventral corners of valves rounded. Valves marked with longitudinal lines. Rostrum relatively long and slightly curved ventrally, apex or rostrum in line with median line of body. Head shield with rounded posterior margin. Three main head pores, connected by open channel transversely expanded at anterior region. Antennules reaching middle of rostrum. Plate of labrum with pointed apex. Ocellus smaller than eye, its distance from eye half as much as from rostrum. Postabdomen tapering distally distal corner produced. Claw with a basal spine and row of setae on concave margin.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- Meghalaya, West Bengal. Elsewhere-Cosmotropical.

33. Oxyurella singalensis (Daday, 1898)
(Fig. 123)

Characters: Valves with dots and with lines parallel to the ventral margin. Antennules almost reaching apex of rostrum. Two separate main head pores, situated behind each other in median line main pores. Distance between small lateral pores about equal to that between the main pores. Plate of labrum with blunt apex. Ocellus smaller than eye. Postabdomen slightly narrowing distally; with 11-13 anal spines decreasing in size proximally. Distal anal spines longest, followed by short denticle at extreme distal end. Lateral setae in groups and arranged in a row. Claw large, with basal spine some distance from base and with one additional small spine at base of claw.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India-West Bengal. Elsewhere- Ethiopian and Indo-Malayan regions and from Northeast China.

34. Euryalona orientalis (Daday, 1898)
(Fig. 124)

Characters: Posteroventral corner of valves rounded, without denticles. Ventral margin of valves with a blunt process before middle; middle region of ventral margin with setae arising some distance from the margin. Margin of valves with several concentric rows of weak dots. Head shield with blunt anterior and rounded posterior margin. A single median head pore. Plate of labrum with convex anterior margin and blunt apex. Ocellus smaller than eye and situated halfway between eye and apex of rostrum. Postabdomen narrow and slightly curved; with about 20 anal denticles, decreasing in size proximally.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India-Meghalaya, West Bengal, Kashmir. Elsewhere- Indo-Malayan, Ethiopian and Neotropical regions.

35. Notalona globulosa (Daday, 1898)
(Fig. 125)

Characters: Body oval and rounded in outline. Posterodorsal corner of valves distinct, posteroventral corner rounded and without denticles. Valves with distinct lines. Rostrum blunt. Posterior margin of head shield angular. A single head pore. Antennules not reaching apex of rostrum. Plate of labrum with bluntly denticulate pointed apex, though broad in some cases. Ocellus smaller than eye and situated slightly nearer to eye than to apex of rostrum. Postabdomen broadest near anus, with distinct preanal corner. Claw with single basal spine.
Distribution: Deepor, Ghorajan, Siligurijan and Fingua beel.
India- West Bengal. Elsewhere- Indo-Malayan, Neotropical and Nearctic regions.

B. SYNECOLOGY OF ZOOPLANKTON

Annual variations of zooplankton, phytoplankton and their various groups are presented in Tables 27-30 (zooplankton) and in Tables 67-70 (phytoplankton) and abundance of net plankton in Tables 31-34. The ranges and mean values of different components of zooplankton, species diversity, dominance and evenness are presented in Tables 59-60. Species richness and abundance of Rotifera and Cladocera of both the beels are presented in Figures 126-133. Monthly and total abundance of net plankton, zooplankton and phytoplankton of both the sampled beels are presented in Figures 134-137 and 156-159 respectively.

(I) NET PLANKTON:

Net plankton (208 taxa) included zooplankton (149 taxa) >phytoplankton (59 taxa) at station I, while station II exhibited 206 taxa of net plankton, which included zooplankton (147 taxa)> phytoplankton (59 taxa) in Deepor beel. The abundance of net plankton at station I ranged between 475-969 (703.0 ±123.0) ind/l and between 431-1036 (618.0 ±146.0) ind/l at station II of Deepor beel. Peak net plankton abundance was observed during April in the second year, while minimum den-

TABLE : 17 PERCENTAGE SIMILARITIES BETWEEN ROTIFERA OF DEEPOR BEEL (STATION I), 1999-2000

	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
AUG	-	66.7	62.3	66.7	68.1	73.1	70.6	48.7	29.0	61.2	61.5	57.1
SEP		-	51.3	62.1	70.4	64.4	66.7	53.3	27.1	48.8	59.1	54.3
OCT			-	65.1	66.7	67.4	67.4	45.1	32.7	56.4	47.6	51.9
NOV				-	63.9	74.7	79.6	57.1	26.5	68.1	59.8	57.8
DEC					-	74.0	78.9	58.8	26.1	56.5	67.3	54.9
JAN						-	45.9	55.2	33.8	58.3	66.0	60.2
FEB							-	64.6	27.5	66.0	67.9	62.7
MAR								-	32.1	48.1	63.5	58.9
APR									-	22.2	31.9	35.5
MAY										-	45.6	65.9
JUN											-	52.7
JUL												-

TABLE : 18 PERCENTAGE SIMILARITIES BETWEEN ROTIFERA OF DEEPOR BEEL (STATION I), 2000-2001

	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
AUG	-	58.2	56.8	64.6	66.7	67.3	36.6	42.7	51.9	58.4	56.5	51.2
SEP		-	53.1	66.7	62.6	**72.9**	32.4	38.5	47.5	47.8	61.1	53.9
OCT			-	48.9	46.1	62.6	39.4	48.6	47.2	54.8	55.2	46.9
NOV				-	65.3	64.1	37.1	45.9	52.6	54.5	61.5	54.1
DEC					-	62.0	29.8	47.9	49.3	58.8	52.3	56.1
JAN						-	26.7	40.5	44.4	55.9	60.4	53.3
FEB							-	45.5	45.8	43.3	31.7	39.1
MAR								-	50.8	50.0	41.8	45.9
APR									-	30.3	46.4	60.3
MAY										-	35.6	44.7
JUN											-	58.6
JUL												-

TABLE : 19 PERCENTAGE SIMILARITIES BETWEEN ROTIFERA OF DEEPOR BEEL (STATION II), 1999-2000

	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
AUG	-	50.0	48.6	50.7	57.1	57.9	66.6	64.4	33.9	28.6	40.7	59.8
SEP		-	47.0	31.9	52.9	70.3	49.3	61.4	31.4	33.3	23.1	54.1
OCT			-	44.8	51.5	58.3	56.3	**69.8**	32.6	23.1	40.0	72.3
NOV				-	38.8	43.8	52.8	54.0	32.0	30.2	35.3	52.4
DEC					-	52.8	45.1	65.1	28.6	34.6	36.0	55.4
JAN						-	51.9	63.0	36.4	34.8	30.3	71.3
FEB							-	57.1	29.6	35.1	29.1	63.6
MAR								-	23.2	30.5	34.3	75.7
APR									-	17.1	24.2	30.3
MAY											15.9	33.8
JUN											-	32.6
JUL												-

TABLE : 20 PERCENTAGE SIMILARITIES BETWEEN ROTIFERA OF DEEPOR BEEL (STATION II), 2000-2001

	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
AUG	-	44.7	40.0	56.0	48.6	53.2	55.1	48.0	53.8	53.8	47.4	60.5
SEP		-	37.9	50.0	62.6	54.8	31.0	66.7	59.8	58.2	61.2	49.4
OCT			-	37.7	29.4	54.8	57.1	49.3	55.5	47.2	37.1	54.3
NOV				-	35.6	53.8	38.2	56.7	51.9	46.7	50.7	42.7
DEC					-	51.2	41.6	40.6	52.6	47.4	62.2	51.5
JAN						-	41.7	51.3	41.1	51.3	43.0	50.6
FEB							-	41.2	47.9	47.9	37.7	63.8
MAR								-	49.3	**28.6**	56.0	48.0
APR									-	52.5	41.0	48.7
MAY										-	30.8	48.7
JUN											-	39.5
JUL												-

TABLE : 21 PERCENTAGE SIMILARITIES BETWEEN ROTIFERA OF GHORAJAN BEEL (STATION I), 1999-2000

	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
AUG	-	58.9	45.3	68.9	72.5	64.4	68.8	78.4	52.4	51.2	55.9	68.2
SEP		-	57.6	48.6	58.7	62.2	57.1	62.8	47.0	39.4	46.7	52.8
OCT			-	50.7	38.9	64.8	54.0	55.4	40.0	**31.7**	48.6	49.3
NOV				-	62.1	65.1	69.7	73.5	50.0	41.0	51.7	69.0
DEC					-	52.0	66.7	**78.8**	49.4	55.7	55.6	61.2
JAN						-	51.7	57.5	42.5	41.0	60.7	52.4
FEB							-	65.3	48.2	49.4	52.2	71.3
MAR								-	50.0	51.1	65.3	62.5
APR									-	52.8	36.1	64.1
MAY										-	49.4	52.3
JUN											-	57.5
JUL												-

TABLE : 22 PERCENTAGE SIMILARITIES BETWEEN ROTIFERA OF GHORAJAN BEEL (STATION I), 2000-2001

	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
AUG	-	52.4	58.6	65.3	69.4	50.7	46.9	50.0	53.3	51.2	62.4	62.7
SEP		-	56.6	58.8	**74.3**	38.5	59.1	45.8	56.1	53.9	64.0	69.7
OCT			-	42.8	69.3	35.1	40.5	50.6	35.9	58.8	64.6	55.2
NOV				-	45.4	40.0	50.0	42.7	51.3	44.4	63.6	65.3
DEC					-	38.3	60.6	48.7	51.5	54.8	61.0	67.3
JAN						-	32.1	35.3	48.0	42.1	47.0	41.3
FEB							-	29.5	36.7	20.9	53.8	52.9
MAR								-	**29.1**	35.5	43.8	43.9
APR									-	36.1	41.7	56.8
MAY										-	32.9	59.1
JUN											-	40.4
JUL												-

TABLE : 23 PERCENTAGE SIMILARITIES BETWEEN ROTIFERA OF GHORAJAN BEEL (STATION II), 1999-2000

	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
AUG	-	53.1	38.1	48.5	59.7	59.1	59.1	64.5	40.0	62.9	51.2	73.1
SEP		-	31.1	25.0	47.4	56.6	49.0	36.4	29.8	42.2	50.0	56.0
OCT			-	29.8	41.4	57.7	53.8	40.0	34.8	42.8	38.1	35.1
NOV				-	32.8	39.1	45.9	55.9	36.7	41.1	35.5	46.2
DEC					-	42.4	48.5	63.3	26.7	54.8	51.5	61.1
JAN						-	40.0	49.3	40.7	51.3	39.4	58.5
FEB							-	41.1	33.3	48.7	50.7	53.6
MAR								-	29.8	63.7	54.8	69.5
APR									-	**19.4**	30.8	42.1
MAY										-	49.4	60.0
JUN											-	64.5
JUL												-

TABLE : 24 PERCENTAGE SIMILARITIES BETWEEN ROTIFERA OF GHORAJAN BEEL (STATION II), 2000-2001

	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
AUG	-	37.4	54.3	56.7	47.7	45.1	52.2	58.9	48.1	64.3	50.0	58.5
SEP		-	44.4	45.8	**70.1**	52.5	51.3	55.2	54.5	64.6	44.7	61.5
OCT			-	41.1	48.3	45.7	52.9	44.1	53.8	48.8	50.7	61.7
NOV				-	37.5	44.4	49.2	51.4	39.4	60.7	47.0	48.6
DEC					-	51.9	40.0	59.5	49.4	55.9	46.3	52.3
JAN						-	57.9	50.7	52.9	55.2	43.1	56.3
FEB							-	**30.8**	33.3	48.6	53.9	52.2
MAR								-	40.0	53.0	44.4	58.9
APR									-	42.8	35.6	50.6
MAY										-	39.5	50.6
JUN											-	42.1
JUL												-

TABLE : 25 PERCENTAGE SIMILARITIES BETWEEN ROTIFERA OF DEEPOR AND GHORAJAN BEEL, 1999-2000

	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
AUG	-	65.7	48.7	63.5	62.8	70.6	59.1	72.2	53.2	54.5	52.3	62.6
SEP		-	53.7	48.7	60.2	60.9	54.1	68.1	50.0	45.9	51.7	62.5
OCT			-	64.1	60.7	53.8	66.6	66.6	41.6	42.8	46.9	52.6
NOV				-	67.4	61.5	70.2	79.6	56.4	45.7	55.3	65.1
DEC					-	**84.7**	71.5	80.7	48.8	45.2	58.9	66.6
JAN						-	68.0	77.3	56.8	46.5	53.6	60.8
FEB							-	34.8	55.7	52.6	62.3	65.3
MAR								-	43.8	53.5	53.6	51.9
APR									-	32.7	**24.2**	36.1
MAY										-	62.9	52.1
JUN											-	59.8
JUL												-

TABLE : 26 PERCENTAGE SIMILARITIES BETWEEN ROTIFERA OF DEEPOR AND GHORAJAN BEEL, 2000-2001

	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
AUG	-	55.2	51.5	65.9	66.0	41.1	43.4	53.8	57.1	54.8	58.9	69.2
SEP		-	63.5	60.0	69.9	42.1	58.1	44.4	40.9	59.8	63.3	61.7
OCT			-	54.3	63.1	41.2	51.3	41.2	52.8	48.1	64.4	58.6
NOV				-	70.7	47.2	58.5	54.5	44.7	45.8	63.8	69.9
DEC					-	40.6	50.6	43.2	49.3	57.5	57.1	68.0
JAN						-	52.9	43.9	51.8	50.0	**71.1**	62.9
FEB							-	44.9	41.7	**32.7**	42.4	37.3
MAR								-	50.0	37.3	45.7	50.6
APR									-	42.6	47.2	54.3
MAY										-	54.8	47.3
JUN											-	60.4
JUL												-

sity was observed during October in the first year at station I. The maximum and minimum densities were noticed during May in the second year and November in the first year respectively at station II of Deepor beel. However, net plankton depicted a trimodal annual pattern at station I with primary maxima during monsoon (April-May) in the second year followed by secondary maxima during winter (November-January) in the first year and tertiary maxima during pre-monsoon season (February-April) in the first year, while it exhibited bimodal pattern of abundance with primary maxima during monsoon (May-April) in the second year and a secondary maxima during pre-monsoon season (March-April) in the first year at station II in this beel. Net plankton exhibited significant positive relationship with phosphate (r_2=0.423, p<.05) in this beel. On the other hand, it showed significant positive correlation with phytoplankton (r_1=0.626, p<.01; r_2=0.878, p<.001), Chlorophyta (r_1=0.619, p<.01; r_2=0.798, p<.001), Bacillariophyta (r_1=0.598, p<.01; r_2=0.736, p<.001) and also showed significant correlation with zooplankton (r_1=0.501, p<.05; r_2=0.584, p<.01) and Rotifera (r_1=0.456, p<.05; r_2=0.56, p<.01) in this beel.

Net plankton were represented by 202 taxa including zooplankton (147 taxa)> phytoplankton (55 taxa) at station I and 200 taxa with zooplankton (146 taxa) >phytoplankton (54 taxa) at station II of Ghorajan beel. Quantitative abundance of net plankton in Ghorajan beel fluctuated between 414-1134 (647.0 ±179.0) ind/l at station I and between 335-804 (522.0 ±130.0) ind/l at station II. The minimum and peak densities were observed during February in the first year and April in the second year respectively at station I. On the other hand, station II depicted minimum value during February in the first year and maxima during May in the second year (Tables 21 and 22). On the contrary, Ghorajan beel depicted bimodal pattern of abundance at both the stations with primary maxima during monsoon (April-May) in the second year and a secondary maxima during post monsoon (April-July) in the first year at station I, however, station II showed primary maxima during monsoon (April-May) in the second year and a secondary maxima during summer season (June-July) in the first year. In addition, net plankton exhibited significant positive relationships with specific conductivity (r_1= 0.423, p<.05), total alkalinity (r_1= 0.596, p<.01; r_2= 0.416, p<.05), calcium (r_1= 0.409, p<.05), phosphate (r_1= 0.517, p<.01; r_2= 0.432, p<.05) and silicate (r_1= 0.476, p<.05). However, net plankton showed positive correlation with phytoplankton (r_1= 0.759, p<.001; r_2= 0.621, p<.01), Chlorophyta (r_1= 0.746, p<.01; r_2= 0.526, p<.01), Bacillariophyta (r_2= 0.644, p<.001), zooplankton (r_1= 0.647, p<.001; r_2= 0.76, p<.001) and Rotifera (r_1= 0.474, p<.05; r_2= 0.751, p<.01).

The cumulative effects of the abiotic factors namely rainfall (X1), water temperature (X2), pH (X3), transparency (X4), specific conductivity (X5), dissolved oxygen (X6), free carbon dioxide (X7), alkalinity (X8), hardness (X9), calcium (X10), chloride (X11), dissolved oxygen matter (X12), phosphate (X13), sulphate (X14), nitrate (X15), biochemical oxygen demand (X16) on the abundance of net plankton were computed by multiple regression method (Tables 61 & 62).

Table: 27 Monthly variations in population density of zooplankton in Deepor beel (Station I)

ROTIFERA	1999					2000												2001						
Family: Brachionidae	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J
Brachionus falcatus Zacharias	-	-	-	19	15	11	-	13	-	8	23	7	6	-	8	-	10	14	-	-	32	-	12	-
B.angularis Gosse	4	6	-	7	5	3	2	-	-	-	-	2	-	8	-	3	6	2	-	-	-	2	-	-
B.bidentatus Anderson	-	-	-	6	8	4	7	3	-	-	4	-	-	4	-	6	-	3	-	-	-	-	-	4
B.diversicornis(Daday)	-	-	2	-	4	3	2	-	4	-	-	-	3	-	-	-	2	2	-	-	-	-	3	2
B.quadridentatus(Hermann)	2	-	5	3	2	-	2	1	-	19	28	-	-	2	4	-	-	-	-	2	3	4	-	-
B.calyciflorus(Pallas)	-	4	-	-	3	5	3	2	-	-	-	2	4	-	6	-	-	2	-	-	42	-	-	8
B.caudatus(Barrois& Daday)	3	-	-	2	4	2	5	11	-	-	4	3	-	7	-	5	-	-	-	-	-	-	4	-
B.forficula Wierzejski	-	-	3	-	2	1	4	2	-	-	-	-	2	-	-	3	-	-	-	2	-	2	3	-
B.rubens Ehrenberg	-	-	-	-	-	-	-	-	1	4	-	-	-	-	-	-	3	-	-	-	2	-	-	3
B.mirabilis(Daday)	-	-	-	-	-	-	-	-	-	-	4	2	4	-	2	3	-	-	2	-	-	-	-	-
B.patulus(Muller)	2	1	2	1	3	1	21	11	-	5	6	4	4	3	2	5	8	20	12	16	8	6	4	10
B.patulus macracanthus(Daday)	-	2	1	1	1	4	4	3	2	-	3	-	2	4	3	3	2	4	-	4	2	-	3	-
Platyias quadricornis(Ehrenberg)	3	2	5	3	21	4	13	-	-	3	14	6	6	10	14	28	6	8	3	-	12	4	-	6
Keratella cochlearis Gosse	4	2	5	11	8	13	7	3	-	3	4	2	-	4	-	5	3	2	4	8	14	10	8	6
K.quadrata(Muller)	-	3	-	2	1	-	3	1	-	-	3	-	3	-	4	3	6	4	-	-	-	2	-	-
K.lenzi Hauer	-	3	-	1	3	2	1	-	-	-	3	4	-	2	3	-	-	4	-	-	-	-	2	-
K.tropica(Apstein)	2	4	-	-	2	5	12	10	-	-	6	-	-	4	6	-	-	3	-	28	-	-	-	3
K.procurva(Thorpe)	-	-	-	-	-	-	-	-	3	-	4	-	2	-	-	-	-	3	-	-	-	-	2	-
Anuraeopsis fissa(Gosse)	-	2	-	-	4	-	-	2	-	3	-	6	6	3	-	4	3	2	4	12	-	3	-	4
Family : Euchlanidae																								
Euchlanis dilatata Ehrenberg	8	14	6	9	12	7	25	24	18	5	6	9	14	18	32	16	42	15	8	20	12	14	6	4
Dipleuchlanis propatula(Gosse)	-	-	2	1	1	-	1	-	-	2	-	3	2	3	-	4	4	2	-	-	2	-	3	-
Beauchampiella endactylota(Gosse)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	3	-	-	1
Family : Mytilinidae																								
Mytilina ventralis(Ehrenberg)	2	1	1	2	1	3	1	-	-	2	1	-	4	7	-	3	-	-	-	-	4	-	2	3
M.bisulcata(Lucks)	2	-	-	1	-	1	-	-	-	-	2	-	-	-	2	-	-	2	-	2	-	-	-	1
Family : Trichotridae																								
Macrochaetus sericus(Thorpe)	3	2	1	1	4	1	2	2	3	-	1	2	3	4	2	6	3	-	-	-	-	4	-	-
Trichotria tetractis(Ehrenberg)	2	1	2	1	1	3	1	-	-	2	2	1	4	3	-	2	2	1	-	-	2	4	3	-
Family: Colurellidae																								
Colurella obtusa(Gosse)	1	-	-	2	-	1	1	-	-	2	-	-	-	2	2	-	1	2	-	-	-	2	1	-
C.uncinata(Muller)	-	1	-	-	1	2	1	-	-	-	3	-	-	1	2	-	-	2	-	-	-	-	-	2
Lepadella ovalis(Muller)	2	1	1	-	1	2	2	3	-	-	2	3	4	-	3	3	2	1	-	4	-	3	6	-
Lepadella ovalis larga (Sharma)	2	-	1	-	1	1	1	-	-	2	2	-	1	3	-	3	2	2	-	-	-	2	-	-
L.patella(Muller)	-	2	2	1	-	-	2	1	-	1	-	2	-	3	2	2	-	4	-	-	-	-	2	-

L.heterostyla(Murray)	-	-	-	1	-	1	-	-	-	-	2	-	2	-	-	-	3	2	-	-	-	6	-	4
L.ehrenbergi(Perty)	1	-	-	1	-	-	2	1	-	2	-	-	-	-	3	-	-	2	-	-	1	-	4	-
L.rhomboides(Gosse)	-	-	-	1	-	2	1	2	2	-	4	2	4	3	-	-	-	2	-	-	-	2	-	-
L.apsicora Myers	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	2	-	-	-	1	-
Squatinella mutica(Ehrenberg)	1	-	-	-	1	-	1	-	-	5	1	3	2	-	-	2	2	-	-	3	-	-	-	4
Family : Lecanidae																								
Lecane curvicornis(Murray)	2	1	-	2	1	2	4	1	-	3	2	-	4	2	4	2	-	3	-	-	-	-	2	-
L.ungulata(Gosse)	3	2	3	1	14	5	1	-	-	4	-	2	2	3	-	8	4	6	-	-	-	3	-	2
L.ploenensis(Voigt)	-	-	1	2	-	1	2	-	-	-	2	-	1	-	2	-	2	-	-	2	-	-	-	1
L.hastata (Murray)	-	-	1	1	1	-	-	-	-	2	-	-	-	2	-	-	-	1	-	-	-	-	1	-
L.ludwigi(Eckstein)	1	1	-	-	-	1	-	2	2	-	-	3	4	-	3	3	-	2	1	-	-	4	3	-
L.lateralis Sharma	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-
L.leontina(Turner)	6	3	5	12	29	21	4	-	-	4	5	10	16	8	6	10	7	20	-	47	8	10	6	3
L.papuana(Murray)	-	4	-	-	2	1	-	1	-	-	1	3	2	3	-	-	2	1	-	-	-	-	2	-
L.luna(Muller)	-	-	2	-	1	-	1	1	-	-	2	-	3	-	3	-	2	-	4	-	2	-	-	2
L.pyriformis(Daday)	1	-	1	-	-	1	-	-	3	-	-	2	-	2	2	-	-	4	-	-	-	-	-	1
L.quadridentata(Ehrenberg)	1	3	2	1	1	1	2	-	-	3	-	-	3	4	4	2	-	-	-	-	3	-	4	2
L.closterocerca(Schmarda)	2	1	-	-	1	-	3	-	-	2	2	1	1	2	3	-	4	4	-	2	-	1	-	-
L.bulla(Gosse)	10	2	2	12	4	3	5	12	4	-	5	3	6	12	15	9	14	10	6	8	12	4	3	2
L.lunaris(Ehrenberg)	1	-	3	-	1	1	1	-	-	-	-	-	2	2	-	1	2	-	-	-	4	-	-	2
L.aculeata(Jakubski)	1	1	-	2	-	-	1	2	-	2	-	1	-	2	3	-	4	-	-	2	-	-	1	-
L.unguitata(Fadeev)	3	-	2	1	4	1	2	3	10	2	2	3	2	4	4	6	5	3	-	-	-	2	3	2
L.hamata(Stokes)	-	-	-	2	1	1	1	-	-	3	-	-	-	2	-	3	1	1	-	-	-	-	-	1
L.thienemanni(Hauer)	-	-	-	-	-	-	1	2	-	-	3	2	3	-	-	2	-	-	-	1	-	-	1	-
L.hornemanni(Ehrenberg)	-	-	-	2	-	-	1	-	-	4	-	-	2	-	-	1	1	3	-	-	-	2	-	-
L.stenroosi(Meissner)	-	-	-	-	-	-	-	-	3	-	1	-	-	2	-	-	-	-	-	-	-	-	-	-
L.ohioensis(Herrick)	-	-	-	-	-	-	-	-	1	1	-	2	2	-	2	-	-	4	-	-	-	3	-	-
L.decipiens(Murray)	-	-	-	-	-	-	-	3	-	2	2	-	-	3	-	2	2	-	1	-	-	-	-	2
L.inopinata(Harring & Myers)	-	-	-	-	-	-	-	-	-	3	-	1	-	1	-	1	-	2	-	-	-	-	1	-
L.crepida(Harring)	-	-	-	-	-	-	-	-	1	-	2	-	-	-	-	2	-	1	-	-	2	-	-	2
Family : Notommatidae																								
Cephalodella forficula(Ehrenberg)	1	-	1	2	-	1	1	-	-	2	-	3	2	2	-	1	-	-	2	-	-	-	1	-
Monommata longiseta(Muller)	2	1	2	3	1	1	2	-	-	3	-	-	4	2	3	3	2	2	-	1	-	4	-	-
Scaridium longicaudum(Muller)	-	-	1	-	1	1	1	2	-	3	4	2	-	1	-	2	-	-	-	-	-	-	3	-
Family : Gastropodidae																								
Ascomorpha saltans Bartsch	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	3	-	7	-	-
Family: Trichocercidae																								
Trichocerca cylindrica(Imhof)	1	2	-	1	1	-	1	-	-	-	2	-	3	-	2	2	-	4	-	2	-	-	1	-
T.similis(Wierzejski)	-	-	2	1	-	1	1	-	-	4	-	2	-	2	-	1	1	2	-	-	2	-	-	1
T.porcellus(Gosse)	-	1	-	1	-	-	11	2	-	2	-	3	4	-	6	-	-	-	4	-	2	2	-	-
T.elongata(Gosse)	1	2	1	4	3	1	1	-	3	-	-	-	3	-	4	2	-	1	-	-	-	-	-	2
T.rattus (O.F. Muller)	-	1	-	1	-	2	1	-	-	2	-	3	-	-	2	-	2	-	-	-	-	2	-	-

T.longiseta(Schrank)	1	2	1	5	1	3	2	-	-	-	1	-	4	6	-	3	3	-	-	-	1	-	-	-
Trichocerca pusilla (Lauterborn)	-	1	-	-	1	-	1	-	2	-	-	-	-	-	1	2	-	-	-	-	-	2	-	-
Family: Asplanchnidae																								
Asplanchna priodonta Gosse	13	20	10	4	6	12	3	12	-	4	5	8	10	24	16	12	27	18	8	14	12	6	10	12
Family: Synchaetidae																								
Polyarthra vulgaris Carlin	2	3	12	6	3	12	18	3	2	4	3	6	7	13	22	20	16	27	10	6	8	3	5	8
Family : Floscularidae																								
Sinantherina socialis Bory de st. Vincent	4	6	-	-	8	11	-	-	-	14	18	-	10	14	17	-	-	9	-	-	-	-	2	-
S. spinosa(Thorpe)	-	-	-	-	-	-	-	-	17	10	-	12	-	-	-	8	4	-	-	6	-	8	10	-
Family: Conochilidae																								
Conochilus unicornis Rousselet	7	5	-	8	-	10	12	8	-	-	6	-	12	16	-	-	-	8	-	-	-	16	-	-
Family: Hexarthridae																								
Hexarthra mira(Hudson)	1	1	-	-	-	1	-	-	-	-	1	-	-	-	2	-	-	-	-	-	-	2	3	-
Family: Filiniidae																								
Filinia camascela Myers	-	16	-	-	-	-	13	-	-	-	9	-	6	-	-	-	4	-	-	-	-	8	-	-
F.longiseta(Ehrenberg)	2	-	1	1	-	2	1	-	-	2	-	3	3	2	-	1	2	-	-	-	-	-	3	-
F.pejleri Hutchinson	1	-	-	-	1	-	4	2	-	1	2	1	-	4	3	-	-	-	4	-	-	2	-	3
F.opoliensis Zacharias	-	-	2	10	-	-	3	1	-	-	2	-	-	2	-	-	3	1	-	-	-	-	4	-
Family : Testudinellidae																								
Testudinella patina(Hermann)	2	-	-	3	-	12	5	14	6	4	5	3	8	12	7	18	15	9	14	38	6	-	10	2
T.greeni Koste	3	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	3	-
T.emarginula(Stenroos)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	6	-	4	-	2
T.brevicaudata Yamammoto	-	-	-	-	-	-	-	-	1	-	-	-	-	2	-	-	-	1	-	-	-	-	-	-
Trochosphaera aequatorialis Semper	-	-	-	-	-	-	-	-	-	-	17	-	-	-	4	-	-	-	-	-	-	2	-	-
Family: Philodinidae																								
Rotaria neptunia(Ehrenberg)	-	-	-	4	1	1	1	2	-	2	-	-	-	2	-	2	4	6	-	-	-	2	-	-
Family: Epiphanidae																								
Epiphanes sp.	-	-	-	-	-	-	-	-	-	-	-	2	2	4	3	3	7	2	-	-	2	-	3	4
Species richness	***42***	***39***	***35***	***48***	***49***	***51***	***60***	***36***	***20***	***43***	***49***	***42***	***50***	***53***	***45***	***49***	***46***	***54***	***21***	***25***	***27***	***39***	***42***	***36***
Abundance(ind/l)	***116***	***130***	***94***	***169***	***198***	***192***	***238***	***168***	***88***	***160***	***236***	***144***	***213***	***260***	***245***	***241***	***254***	***265***	***107***	***239***	***203***	***169***	***154***	***121***
Cladocera																								
Family: Sididae																								
Pseudosida bidentata Herrick	2	3	-	-	-	1	2	-	-	-	1	-	-	-	-	2	-	1	-	-	-	-	2	-
Sida crystallina (O.F.Muller)	1	-	-	2	1	-	1	-	-	2	-	2	-	-	1	-	3	-	-	-	-	3	-	-
Diaphanosoma excisum Sars	6	3	4	8	12	4	5	-	3	-	4	6	4	8	12	7	5	16	-	2	4	-	8	5
D.senegal Gauthier	2	3	2	4	3	5	3	2	-	2	3	4	2	2	5	4	2	3	2	-	-	4	3	-
Family: Daphnidae																								
Ceriodaphnia cornuta Sars	2	3	-	1	-	4	3	-	-	3	4	3	4	-	8	-	3	2	-	-	-	3	6	-
C.quadrangula (O.F.Muller)	-	-	-	1	2	-	1	-	-	2	-	2	2	2	-	-	-	3	-	-	-	-	2	-
Scapholeberis kingi Sars	3	5	4	6	3	2	4	1	2	2	3	4	3	5	7	3	14	16	-	6	4	5	-	4

Simocephalus vetulus (O.F.Muller)	2	3	3	4	2	6	2	2	-	1	2	3	6	2	3	8	4	4	8	6	2	-	4	3
S.serrulatus (Koch)	1	2	2	1	3	2	1	1	2	-	1	4	2	4	-	3	2	2	4	-	-	2	-	1
Daphnia lumholtzi Sars	-	-	-	-	-	33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-
Family : Moinidae																								
Moina micrura Kurz	5	6	-	-	3	-	2	-	-	1	-	6	4	3	6	-	10	22	-	-	12	-	4	-
Moinodaphnia macleayi (King)	1	-	-	-	-	1	1	-	-	-	-	-	-	2	-	3	-	-	-	-	2	3	-	2
Family : Bosminidae																								
Bosmina longirostris (O.F.Muller)	-	-	3	4	12	9	2	4	-	16	14	10	-	-	-	14	18	16	10	-	-	-	8	12
Bosminopsis deitersi Richard	-	-	3	3	7	10	2	2	4	12	5	14	-	-	-	4	7	3	-	16	-	-	10	8
Family : Macrothricidae																								
Macrothrix goeldii Richard	5	4	4	3	6	9	12	-	-	2	2	-	-	7	4	6	3	4	-	-	2	-	3	-
M.laticornis (Jurine)	6	3	2	2	3	4	3	2	2	1	-	2	-	-	6	-	8	10	-	2	-	-	4	2
Grimaldina brazzai Richard	-	-	-	2	-	-	1	-	-	-	-	1	-	-	4	-	-	-	-	-	1	-	-	-
Ilyocryptus spinifer Herrick	2	1	-	-	1	1	1	-	-	2	-	3	2	3	-	2	1	2	-	-	-	2	-	3
Family: Chydoridae																								
Pleuroxus similis Vavra	-	-	4	3	-	2	3	10	-	2	4	3	8	10	-	6	5	12	-	4	-	3	-	6
Notalona globulosa (Daday)	2	6	5	11	3	4	3	-	-	-	2	4	14	16	8	12	6	10	2	-	-	4	6	3
Alonella exisa (Fischer)	2	3	2	4	4	3	5	2	-	-	3	6	-	-	12	8	9	4	-	3	-	-	4	-
Chydorus sphaericus (O.F.Muller)	14	12	8	10	15	9	18	6	3	4	3	10	24	8	18	22	16	12	8	10	6	8	16	22
C.faviformis Birge	-	1	-	2	1	1	1	-	-	-	1	2	-	-	3	-	-	1	-	-	-	-	-	1
C.ovalis Kurz	-	2	1	2	1	1	1	-	-	2	-	-	2	1	-	-	-	3	-	-	-	-	-	2
C.barroisi Richard	3	2	4	2	3	2	2	1	4	2	2	4	4	6	7	12	10	16	-	-	-	4	6	4
C.reticulatus Daday	-	-	-	1	-	-	1	-	-	-	1	-	-	-	-	2	-	-	-	-	1	-	-	-
Alona intermedia Sars	2	3	2	4	7	2	3	-	-	2	-	1	3	2	2	4	-	2	-	2	-	1	-	3
A.quadrangularis (O.F.Muller)	2	1	2	1	1	2	1	-	-	1	1	2	4	2	3	3	2	1	-	-	6	3	-	2
A.costata Sars	-	-	4	3	6	2	3	-	3	2	2	-	2	-	-	4	3	3	-	-	-	2	2	-
A.rectangula Sars	-	-	-	1	3	2	-	-	-	1	-	-	-	2	1	1	-	2	-	-	-	-	-	1
A.guttata Sars	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	2	1	-	-	2	-	2	-	4
Biapertura karua (King)	14	9	7	15	8	12	6	4	2	-	2	6	22	20	15	18	24	14	-	-	8	10	4	4
B.affinis (Leydig)	3	2	3	1	2	2	3	-	-	-	1	-	-	3	6	4	-	3	2	-	-	-	-	1
Acroperus harpae (Baird)	3	2	-	4	2	1	2	2	-	-	3	2	3	4	4	-	2	2	-	2	-	3	-	-
Camptocercus rectirostris Schoedler	2	1	2	4	3	3	2	-	-	2	-	2	4	-	3	3	1	1	-	-	-	-	4	-
Leydigia acanthocercoides (Fischer)	-	-	-	2	1	1	-	-	-	2	-	4	3	2	2	-	3	-	4	-	-	-	1	-
Leydigiopsis sp.	-	-	6	-	-	9	14	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
Graptoleberis testudinaria (Fischer)	-	-	-	-	1	-	2	-	4	-	-	3	-	2	-	3	1	1	-	2	-	4	-	2
Oxyurella singalensis (Daday)	2	1	2	3	2	1	1	-	-	-	2	6	4	3	3	2	-	2	4	-	6	-	2	-
Kurzia longirostris (Daday)	1	1	3	2	1	4	3	1	-	-	3	2	-	-	2	1	-	-	-	-	3	-	-	4
Euryalona orientalis (Daday)	-	2	1	2	2	1	-	-	-	3	-	2	2	-	4	3	6	-	-	-	-	2	-	3

Dunhevedia serrata Daday	-	-	-	-	-	-	4	5	-	-	2	-	-	3	2	-	-	-	6	-	-	-	2	-
Dadaya macrops (Daday)	-	-	-	-	-	-	-	-	-	-	-	6	-	-	3	4	-	-	-	4	-	-	-	6
Species richness	*25*	*26*	*25*	*33*	*32*	*34*	*37*	*15*	*10*	*23*	*25*	*31*	*24*	*25*	*28*	*30*	*27*	*32*	*10*	*13*	*14*	*19*	*21*	*25*
Abundance(ind/l)	*88*	*84*	*83*	*118*	*124*	*155*	*124*	*45*	*29*	*69*	*71*	*129*	*130*	*122*	*154*	*170*	*169*	*195*	*50*	*61*	*61*	*68*	*101*	*108*
Copepoda																								
Meso cyclops sp.	14	12	8	19	6	16	15	9	38	42	28	17	25	32	18	22	28	48	14	20	8	14	24	12
Helio diaptomus sp.	3	-	-	-	4	-	12	3	-	16	-	10	6	8	10	4	-	14	-	8	-	-	18	9
Nauplius larvae	6	4	2	-	-	3	-	2	3	-	2	6	8	16	9	7	14	4	-	6	58	60	25	20
Species richness	*3*	*2*	*2*	*1*	*2*	*2*	*2*	*3*	*2*	*2*	*2*	*3*	*3*	*3*	*3*	*3*	*2*	*3*	*1*	*3*	*2*	*2*	*3*	*3*
Abundance(ind/l)	*23*	*16*	*10*	*19*	*10*	*19*	*27*	*14*	*41*	*58*	*30*	*33*	*39*	*56*	*37*	*33*	*42*	*66*	*14*	*34*	*66*	*74*	*67*	*122*
Rhizopoda																								
Arcella discoides Ehrenberg	10	7	6	8	12	9	10	4	-	2	6	4	8	10	7	12	6	5	-	-	-	6	10	4
A.megastoma Penard	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	2	7	3	-	2
A.dentata Ehrenberg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	5	3	-	-	-
A.vulgaris Ehrenberg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	4	-	3	-
Centropyxis hemisphaerica (Barnard)	3	-	4	1	-	4	2	3	2	3	-	2	4	5	8	-	3	3	-	4	-	14	-	18
C.aculeata (Ehrenberg)	-	2	-	-	4	3	3	2	3	-	2	1	-	3	2	2	-	4	4	-	-	-	8	-
C.arcelloides Penard	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	3	3	-	-
Difflugia lebes Penard	4	2	-	-	2	3	-	2	-	3	-	3	7	14	12	5	16	3	-	-	6	10	-	14
D.urceolata Carter	-	-	3	2	6	-	-	3	-	-	3	2	3	-	4	4	3	4	-	10	4	-	6	-
D.oblonga Ehrenberg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	3	-	2	-	3
Euglypha ciliata Ehrenberg	2	-	-	-	2	1	-	1	-	2	-	6	-	3	4	8	6	-	2	-	-	2	4	-
Actinosphaerium eichhorni Ehrenberg	-	-	2	-	-	1	-	1	-	3	-	3	4	2	-	-	2	1	-	2	-	3	-	-
Species richness	*4*	*3*	*3*	*3*	*5*	*6*	*3*	*7*	*1*	*5*	*3*	*7*	*5*	*6*	*6*	*5*	*6*	*6*	*7*	*6*	*6*	*8*	*5*	*5*
Abundance(ind/l)	*19*	*11*	*15*	*11*	*26*	*21*	*15*	*16*	*5*	*13*	*11*	*21*	*26*	*37*	*37*	*31*	*36*	*20*	*24*	*26*	*27*	*43*	*31*	*41*
Ostracoda																								
Cypricercus sp.	4	-	2	3	3	5	9	4	2	-	2	2	6	4	7	10	18	12	-	8	-	-	22	33
Cypris sp.	-	3	2	2	-	-	4	6	5	7	-	-	2	2	-	1	3	2	-	-	2	-	3	4
Species richness	*1*	*1*	*2*	*2*	*1*	*1*	*2*	*2*	*2*	*1*	*1*	*1*	*2*	*2*	*1*	*2*	*2*	*2*	-	*1*	*1*	-	*2*	*2*
Abundance(ind/l)	*4*	*3*	*4*	*5*	*3*	*5*	*13*	*10*	*7*	*7*	*2*	*2*	*8*	*6*	*7*	*11*	*21*	*14*	-	*8*	*2*	-	*25*	*37*
Conchostraca sp.	-	-	2	1	-	-	-	2	2	-	1	3	2	4	3	3	1	5	-	-	-	4	-	3

Table: 28 Monthly variations in population density of zooplankton in Deepor beel [Station II]

ROTIFERA	1999					2000												2001						
Family: Brachionidae	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J
Brachionus falcatus Zacharias	-	18	-	-	4	12	-	13	-	-	-	10	-	-	-	4	7	16	-	-	-	6	-	-
B.angularis Gosse	2	-	3	1	1	-	-	1	-	-	-	2	3	-	-	2	-	1	-	2	-	-	-	6
B.bidentatus Anderson	-	-	2	-	1	1	-	10	-	3	-	2	-	-	4	-	-	6	4	-	-	-	-	2
B.diversicornis(Daday)	2	-	-	-	3	-	-	4	-	-	-	-	-	2	-	-	3	-	-	-	2	-	3	-
B.quadridentatus(Hermann)	1	1	-	-	-	2	1	3	4	-	-	-	4	10	-	2	-	-	-	4	-	8	-	-
B.calyciflorus(Pallas)	-	-	2	-	4	10	2	1	-	-	2	3	-	-	3	-	-	-	5	-	4	-	-	-
B.caudatus(Barrois & Daday)	-	3	-	2	-	-	-	10	-	-	-	-	2	-	6	-	-	4	-	-	-	-	4	3
B.forficula Wierzejski	-	1	1	-	-	3	-	2	-	-	-	2	-	3	-	4	6	2	-	2	-	-	1	-
B.rubens Ehrenberg	-	-	-	-	-	-	-	-	-	2	-	-	-	-	3	-	-	-	-	-	-	2	-	-
B.mirabilis(Daday)	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	4	-	-	-	-	4	-	2
B.patulus(Muller)	1	-	-	3	2	2	1	-	-	2	2	4	2	3	2	3	-	6	10	2	4	-	12	14
B.patulus macracanthus(Daday)	3	-	2	-	-	1	1	-	-	-	-	1	-	1	2	-	-	2	2	4	6	2	-	2
Platyias quadricornis(Ehrenberg)	2	3	3	-	-	4	12	2	-	3	-	2	4	2	3	-	2	-	4	6	3	-	6	2
Keratella cochlearis Gosse	3	4	3	-	1	2	2	11	4	-	-	4	7	4	8	-	5	3	4	6	-	2	-	2
K.quadrata(Muller)	2	1	-	-	2	-	-	1	3	-	-	-	-	2	-	3	3	6	-	4	6	-	2	-
K.lenzi Hauer	-	-	1	1	-	-	1	2	-	-	-	3	-	-	-	2	-	-	-	4	3	-	-	-
K.tropica(Apstein)	1	1	1	-	12	1	-	1	-	-	3	2	2	-	-	-	1	-	2	-	4	2	-	1
K.procurva(Thorpe)	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	2	-	-	-	2	-	-
Anuraeopsis fissa(Gosse)	-	-	3	2	-	1	12	1	-	4	-	3	4	3	6	2	2	-	8	6	4	-	7	-
Family : Euchlanidae																								
Euchlanis dilatata Ehrenberg	6	2	3	3	10	4	3	2	-	-	3	8	7	9	6	10	6	5	-	6	8	16	14	17
Dipleuchlanis propatula(Gosse)	-	-	1	-	-	1	-	1	-	-	4	2	-	2	-	-	3	-	-	-	2	-	-	1
Beauchampiella endactylota(Gosse)																								
Family : Mytilinidae																								
Mytilina ventralis(Ehrenberg)	2	4	-	1	1	2	1	1	-	-	-	3	4	2	-	3	-	2	-	-	3	2	-	-
M.bisulcata(Lucks)	-	-	-	2	-	-	-	1	-	-	-	-	2	-	-	-	1	-	-	2	-	-	-	3
Family : Trichotridae																								
Macrochaetus sericus(Thorpe)	3	1	-	1	-	2	2	1	-	4	-	-	3	-	-	2	-	-	4	-	-	-	-	8
Trichotria tetractis(Ehrenberg)	1	2	1	-	1	3	1	2	2	-	-	4	-	1	2	-	-	4	-	4	2	3	-	-
Family: Colurellidae																								
Colurella obtusa(Gosse)	-	2	-	1	-	1	2	-	-	-	-	1	-	-	2	-	-	1	-	-	3	2	-	2
C.uncinata(Muller)	-	-	1	-	-	-	1	-	2	-	-	1	-	1	-	1	-	-	-	3	-	-	2	-
Lepadella ovalis(Muller)	3	-	2	-	-	2	1	3	-	-	-	2	4	-	-	3	-	2	1	-	2	2	-	6
Lepadella ovalis larga (Sharma)	-	-	1	1	1	-	-	1	-	-	2	-	-	2	-	1	2	-	-	2	-	-	3	-
L.patella(Muller)	-	1	1	2	4	-	-	2	-	2	-	3	-	2	-	-	4	-	-	-	3	-	4	-
L.heterostyla(Murray)	-	1	-	-	-	1	-	-	-	-	-	-	-	-	2	-	-	-	2	-	-	-	-	3

L.ehrenbergi(Perty)	-	2	-	-	-	1	-	-	3	-	-	-	-	1	-	-	-	1	-	2	-	-	-	-
L.rhomboides(Gosse)	-	-	-	-	2	-	-	1	-	-	-	3	2	-	-	1	-	-	-	-	2	-	-	-
L.apsicora Myers	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	3	-	-	-	1	-
Squatinella mutica	-	1	-	1	-	1	-	-	-	2	-	4	-	2	3	-	-	2	4	6	3	8	-	-
Family : Lecanidae																								
Lecane curvicornis(Murray)	2	-	1	3	2	-	1	2	-	-	3	-	2	1	-	1	3	-	-	-	4	2	-	-
L.ungulata (Gosse)	3	1	-	-	2	-	1	-	-	-	-	2	1	-	2	2	-	1	3	3	-	-	-	6
L.ploenensis (Voigt)	-	1	-	-	-	1	-	4	-	2	-	2	-	2	-	-	4	-	2	2	-	-	4	-
L.hastata (Murray)	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	3	-	-	2	2	-	-
L.ludwigi(Eckstein)	2	-	-	1	-	-	-	1	-	-	-	3	-	2	-	-	1	-	4	6	3	-	2	2
L.lateralis Sharma	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
L.leontina(Turner)	4	3	3	-	2	2	1	2	-	-	4	2	4	3	14	-	2	6	5	12	18	10	8	12
L.papuana(Murray)	-	-	2	1	-	-	1	-	4	3	-	3	-	-	2	-	3	-	-	-	-	2	-	-
L.luna(Muller)	-	-	-	1	-	-	1	1	-	-	-	-	2	1	-	-	-	1	-	2	-	-	-	1
L.pyriformis(Daday)	-	1	-	-	-	1	1	-	-	-	-	2	4	-	-	3	-	-	2	-	2	1	-	-
L.quadridentata(Ehrenberg)	3	1	-	-	2	-	-	1	-	2	-	-	-	3	4	6	-	-	3	-	6	8	-	4
L.closterocerca(Schmarda)	-	-	4	-	3	-	1	3	-	-	-	1	-	2	-	-	2	-	-	3	-	2	2	-
L.bulla(Gosse)	2	5	1	2	3	3	2	4	4	-	-	4	6	4	-	8	5	3	8	6	4	10	4	3
L.lunaris(Ehrenberg)	1	-	-	1	-	-	2	1	-	-	2	-	-	3	-	2	-	-	-	3	-	2	4	2
L.aculeata(Jakubski)	-	-	1	4	1	2	-	1	-	-	-	2	1	-	-	-	3	-	2	-	2	-	4	2
L.unguitata(Fadeev)	4	2	-	-	3	1	1	2	-	3	-	2	4	3	2	2	-	2	1	1	3	1	-	2
L.hamata(Stokes)	-	1	-	1	-	-	-	1	-	-	-	-	-	-	-	1	-	1	-	2	-	-	1	-
L.thienemanni(Hauer)	-	-	-	-	-	-	-	3	-	-	6	1	2	-	-	-	1	-	-	-	-	2	1	-
L.hornemanni(Ehrenberg)	2	-	-	1	-	-	3	-	-	2	-	-	-	3	-	-	2	-	-	-	-	-	2	2
L.stenroosi(Meissner)	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	2	-	-	-	-	-
L.ohioensis(Herrick)	-	-	-	-	-	-	-	-	-	-	-	-	2	3	-	-	2	-	-	4	-	-	2	-
L.decipiens(Murray)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	1	-	-	2	-	-	-
L.inopinata(Harring & Myers)	-	-	-	-	-	-	2	-	-	-	-	1	-	2	-	-	-	-	-	-	-	3	-	-
L.crepida(Harring)	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	1	-	1	-	2	-	-	3	-
Family : Notommatidae																								
Cephalodella forficula(Ehrenberg)	1	-	-	2	1	-	1	4	-	-	-	2	-	1	-	2	-	1	-	3	-	-	6	-
Monommata longiseta(Muller)	2	-	-	1	2	3	-	3	-	-	-	2	-	2	-	-	2	-	4	-	-	2	-	-
Scaridium longicaudum(Muller)	-	1	-	-	1	-	1	2	-	1	-	-	1	-	2	-	-	-	-	3	-	-	2	-
Family: Trichocercidae																								
Trichocerca cylindrica(Imhof)	2	1	2	-	-	2	-	1	-	-	-	2	-	1	-	1	2	-	-	-	2	-	-	2
T.similis(Wierzejski)	1	-	1	1	-	-	2	-	-	-	-	1	-	-	2	-	-	1	4	-	-	4	-	1
T.porcellus(Gosse)	-	-	-	1	1	-	1	-	2	2	-	-	-	2	-	-	3	-	-	2	3	-	-	-
T.elongata(Gosse)	-	4	2	-	1	-	-	2	-	-	-	-	2	-	-	1	-	-	1	-	-	2	-	2
T.rattus (O.F. Muller)	1	-	-	1	-	1	-	-	4	-	3	1	1	1	-	-	2	-	-	-	2	1	1	-
T.longiseta(Schrank)	3	1	2	-	-	1	4	2	-	-	-	2	-	2	-	3	-	2	-	-	-	-	2	-
Trichocerca pusilla (Lauterborn)	-	2	-	-	1	1	-	-	2	-	-	-	2	-	-	-	1	-	-	-	-	4	-	3
Family: Asplanchnidae																								

Asplanchna priodonta Gosse	4	6	2	-	3	2	4	3	-	8	9	7	4	7	10	5	3	12	6	8	14	12	4	22
Family: Synchaetidae																								
Polyarthra vulgaris Carlin	3	2	1	2	-	2	3	3	4	-	4	3	10	6	4	5	9	7	8	12	6	10	16	7
Family : Flosculariidae																								
Sinantherina socialis Bory de st. Vincent	10	-	-	8	14	6	-	-	13	-	12	-	7	10	-	8	-	4	-	-	-	14	12	-
S. spinosa(Thorpe)	-	-	-	-	-	-	-	-	-	7	6	-	-	-	4	3	-	-	-	6	8	-	-	-
Family: Conochilidae																								
Conochilus unicornis Rousselet	-	12	9	7	-	7	5	5	-	-	-	10	-	-	8	7	-	6	-	-	-	10	8	-
Family: Hexarthridae																								
Hexarthra mira(Hudson)	1	-	-	-	-	-	1	-	-	-	-	-	3	-	-	-	-	2	-	-	2	-	-	-
Family: Filiniidae																								
Filinia camascela Myers	-	4	-	-	-	-	-	-	-	-	8	-	-	4	-	-	-	3	-	-	-	-	10	-
F.longiseta(Ehrenberg)	-	2	2	-	1	1	-	1	-	-	-	2	-	3	2	-	-	-	-	4	3	-	-	4
F.pejleri Hutchinson	-	-	3	1	-	-	-	2	4	-	-	3	3	-	2	2	-	1	-	-	2	2	-	-
F.opoliensis Zacharias	2	-	1	-	1	-	-	2	-	3	-	2	1	-	-	-	3	-	3	-	-	-	2	2
Family : Testudinellidae																								
Testudinella patina(Hermann)	3	-	2	1	-	2	-	1	4	-	4	3	4	3	3	5	12	8	4	-	8	6	10	4
T.greeni Koste	4	-	-	-	-	-	3	-	-	-	-	-	-	-	2	-	-	-	-	-	-	4	-	-
T.emarginula(Stenroos)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	-	-	6	-	4
T.brevicaudata Yamammoto	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	2	-
Trochosphaera aequatorialis Semper	-	-	-	-	-	-	-	-	9	7	-	4	-	3	-	-	-	2	-	-	-	-	-	8
Family: Philodinidae																								
Rotaria neptunia(Ehrenberg)	2	-	-	1	-	-	1	1	-	-	-	2	1	2	-	-	2	3	-	-	6	4	-	-
Family: Epiphanidae																								
Epiphanes sp.	-	-	-	-	-	-	-	-	-	-	-	-	2	-	3	3	2	1	-	2	3	-	4	2
Species richness	***37***	***35***	***33***	***34***	***33***	***39***	***38***	***53***	***16***	***19***	***17***	***50***	***38***	***47***	***32***	***37***	***36***	***41***	***31***	***37***	***40***	***40***	***38***	***38***
Abundance(ind/l)	***94***	***98***	***70***	***63***	***93***	***96***	***86***	***136***	***68***	***62***	***77***	***141***	***120***	***136***	***122***	***116***	***118***	***138***	***125***	***151***	***169***	***187***	***178***	***171***
Cladocera																								
Family: Sididae																								
Pseudosida bidentata Herrick	2	-	-	-	1	-	2	1	-	3	-	-	1	-	2	-	-	-	-	-	2	-	-	-
Sida crystallina (O.F.Muller)	1	-	1	2	-	-	-	1	3	-	-	2	2	-	-	-	2	-	2	-	-	4	2	-
Diaphanosoma excisum Sars	4	3	2	3	3	2	-	3	2	-	8	4	4	3	6	4	5	2	-	-	4	6	10	12
D.senegal Gauthier	3	-	2	3	2	1	1	1	-	14	-	6	-	2	-	2	-	3	-	4	-	-	-	-
Family: Daphnidae																								
Ceriodaphnia cornuta Sars	3	-	2	1	-	-	1	3	-	4	5	4	-	3	4	6	-	-	-	-	-	4	3	4
C.quadrangula (O.F.Muller)	-	2	1	-	-	1	-	2	-	-	-	2	-	-	1	4	-	2	-	2	-	2	1	-
Scapholeberis kingi Sars	4	2	3	3	2	5	1	3	9	-	8	3	6	4	5	7	10	12	6	-	4	8	6	-
Simocephalus vetulus (O.F.Muller)	2	1	-	4	3	1	1	2	4	6	3	2	3	4	4	2	4	3	-	3	6	-	10	12
S.serrulatus (Koch)	1	-	1	1	1	2	-	1	-	-	5	2	-	1	2	-	3	2	-	-	2	4	2	2
Daphnia lumholtzi Sars	-	-	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-

Family : Moinidae																									
Moina micrura Kurz	3	2	1	-	-	-	1	2	-	-	6	3	2	-	3	5	-	4	-	-	3	6	-	-
Moinodaphnia macleayi (King)	1	-	-	-	-	-	-	1	-	-	-	2	2	-	-	1	-	-	2	-	-	3	-	2
Family : Bosminidae																									
Bosmina longirostris (O.F.Muller)	-	-	8	-	6	5	3	4	-	-	12	10	-	10	-	8	7	-	-	-	-	12	10	-
Bosminopsis deitersi Richard	-	3	-	2	4	3	1	-	-	-	8	6	-	6	3	-	5	-	-	-	4	6	-	4
Family : Macrothricidae																									
Macrothrix goeldii Richard	2	4	1	3	-	2	1	2	-	6	7	-	2	-	4	3	2	4	-	-	3	4	-	2
M.laticornis (Jurine)	-	3	2	-	-	1	2	1	-	-	3	2	3	2	-	2	4	2	-	-	-	2	3	-
Grimaldina brazzai Richard	-	-	-	-	3	-	-	2	-	-	-	4	-	3	-	-	-	1	-	-	4	-	-	-
Ilyocryptus spinifer Herrick	1	-	1	-	-	1	4	2	-	3	4	2	3	4	-	6	2	2	3	-	2	-	-	-
Family: Chydoridae																									
Pleuroxus similis Vavra	-	3	-	2	4	-	-	1	-	3	8	-	6	4	2	-	3	7	-	10	8	4	-	7
Notalona globulosa (Daday)	3	-	-	5	-	3	2	4	4	2	3	4	8	7	6	18	8	5	-	-	4	6	12	6
Alonella exisa (Fischer)	7	3	4	-	4	9	3	6	-	-	4	6	4	3	2	-	7	3	4	2	10	3	-	4
Chydorus sphaericus (O.F.Muller)	4	8	3	4	5	6	4	4	14	8	12	14	16	8	10	14	18	9	12	7	18	10	5	-
C.faviformis Birge	3	-	4	2	-	-	1	1	-	-	-	-	2	-	-	3	-	-	-	-	2	-	-	-
C.ovalis Kurz	1	-	-	1	2	-	-	-	-	3	-	-	-	2	-	4	-	1	-	-	-	-	3	-
C.barroisi Richard	3	4	3	2	2	1	3	5	6	4	7	6	8	10	6	3	3	7	4	-	3	14	9	5
C.reticulatus Daday	-	2	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	2	-	-
Alona intermedia Sars	2	1	-	-	1	1	-	1	-	3	-	2	2	-	3	2	-	2	1	-	-	-	2	-
A.quadrangularis (O.F.Muller)	2	1	1	1	-	3	1	-	-	-	2	3	3	2	-	2	4	1	-	-	-	8	3	4
A.costata Sars	-	-	3	-	2	2	1	3	2	2	4	3	-	1	2	-	2	-	3	4	3	-	-	2
A.rectangula Sars	2	-	-	-	1	-	-	1	-	-	-	2	2	2	-	-	-	1	-	-	-	1	-	-
A.guttata Sars	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	2	-	-	2	-	-	-	1
Biapertura karua (King)	3	2	3	4	3	2	2	6	4	-	4	10	10	8	7	14	5	12	-	6	8	12	4	10
B.affinis (Leydig)	1	-	-	1	2	1	-	1	-	2	-	2	2	3	-	-	2	2	-	4	6	-	-	-
Acroperus harpae (Baird)	-	4	-	-	-	3	-	1	-	3	-	2	2	3	3	-	3	-	4	6	3	-	-	2
Camptocercus rectirostris Schoedler	3	-	-	2	-	1	-	2	3	-	-	3	-	2	2	4	-	2	-	-	-	2	-	-
Leydigia acanthocercoides (Fischer)	-	-	-	3	-	2	2	-	-	-	2	-	3	4	-	-	4	2	-	-	-	4	-	-
Leydigiopsis sp.	-	-	6	-	-	-	4	-	-	-	-	-	-	2	2	3	-	-	-	-	-	-	-	-
Graptoleberis testudinaria (Fischer)	-	-	2	-	-	-	1	-	-	-	3	-	-	1	-	2	2	-	-	-	3	-	-	-
Oxyurella singalensis (Daday)	2	3	-	-	1	1	2	1	-	2	-	3	-	-	3	4	-	2	-	-	-	4	2	-
Kurzia longirostris (Daday)	3	-	1	2	1	-	1	4	2	3	-	2	4	-	-	2	2	-	2	3	-	-	-	-
Euryalona orientalis (Daday)	-	-	-	1	3	-	2	2	-	-	-	1	-	2	1	-	-	3	1	1	-	-	2	-
Dunhevedia serrata Daday	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	2	-	-	-	-	-	3	-	-
Dadaya macrops (Daday)	-	-	-	-	-	-	-	-	-	-	-	7	-	2	2	-	-	3	-	-	-	-	4	-
Species richness	***26***	***18***	***22***	***22***	***22***	***25***	***25***	***33***	***11***	***17***	***21***	***31***	***25***	***30***	***25***	***26***	***24***	***27***	***12***	***13***	***22***	***25***	***19***	***16***
Abundance(ind/l)	***66***	***51***	***55***	***52***	***56***	***65***	***47***	***75***	***53***	***71***	***118***	***124***	***103***	***109***	***87***	***127***	***109***	***99***	***44***	***54***	***105***	***134***	***93***	***79***
Copepoda																									
Meso cyclops sp.	12	16	8	21	9	11	6	7	28	42	63	24	16	22	10	17	37	24	12	6	8	4	5	7
Helio diaptomus sp.	3	6	4	5	3	2	2	4	12	9	8	6	4	7	-	8	6	4	-	-	4	10	2	-

Nauplius larvae	2	-	-	2	1	-	1	4	-	-	6	4	10	12	6	7	4	6	3	12	10	22	-	-
Species richness	*3*	*2*	*2*	*3*	*3*	*2*	*3*	*3*	*2*	*2*	*3*	*3*	*3*	*3*	*2*	*3*	*3*	*3*	*2*	*2*	*3*	*3*	*2*	*1*
Abundance(ind/l)	*17*	*22*	*12*	*28*	*13*	*13*	*9*	*15*	*40*	*51*	*77*	*34*	*30*	*41*	*16*	*32*	*47*	*34*	*15*	*18*	*22*	*36*	*7*	*7*
Rhizopoda																								
Arcella discoides Ehrenberg	4	3	3	5	2	1	2	3	-	-	4	3	4	3	3	2	5	2	-	-	-	6	8	10
A.megastoma Penard	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	10	-	3	8
A.vulgaris Ehrenberg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	5	-	4	-	-
Centropyxis hemisphaerica (Barnard)	2	1	-	3	1	-	1	4	-	3	-	-	2	-	3	6	4	3	-	8	4	-	6	4
C.aculeata (Ehrenberg)	3	2	1	-	4	1	3	4	3	-	-	2	10	4	6	5	7	6	4	-	-	4	-	2
C.arcelloides Penard	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	7	4	-	-	2
Difflugia lebes Penard	1	1	2	2	-	-	1	2	2	4	6	3	12	16	10	8	13	20	-	12	-	8	4	-
D.urceolata Carter	-	1	-	3	3	2	-	1	-	-	3	3	4	6	5	10	4	3	-	-	8	-	-	5
D.oblonga Ehrenberg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	8	5	-	4	-
Euglypha ciliata Ehrenberg	1	-	-	2	1	-	4	1	-	-	-	4	3	4	2	2	3	5	3	2	-	2	-	-
Actinosphaerium eichhorni Ehrenberg	-	1	-	-	-	2	-	4	-	3	-	2	2	2	3	4	4	2	-	-	3	-	2	2
Species richness	*5*	*6*	*3*	*5*	*5*	*4*	*5*	*7*	*2*	*3*	*3*	*6*	*7*	*6*	*7*	*7*	*7*	*7*	*6*	*6*	*6*	*5*	*6*	*7*
Abundance(ind/l)	*11*	*9*	*6*	*15*	*11*	*6*	*11*	*19*	*5*	*10*	*13*	*17*	*37*	*35*	*32*	*37*	*40*	*41*	*22*	*42*	*34*	*24*	*27*	*33*
Ostracoda																								
Cypricercus sp.	4	3	3	-	2	3	4	4	6	-	8	6	4	3	9	4	12	14	-	4	-	-	10	8
Cypris sp.	-	-	-	2	4	4	-	-	3	-	-	2	3	-	-	2	2	4	-	-	-	-	3	6
Species richness	*1*	*1*	*1*	*1*	*2*	*2*	*1*	*2*	*2*	-	*1*	*2*	*2*	*1*	*1*	*2*	*2*	*2*	-	*1*	-	-	*2*	*2*
Abundance(ind/l)	*4*	*3*	*3*	*2*	*6*	*7*	*4*	*4*	*9*	-	*8*	*8*	*7*	*3*	*9*	*6*	*14*	*18*	-	*4*	-	-	*13*	*14*
Conchostraca sp.	-	-	-	-	3	2	2	-	-	3	4	3	3	2	2	1	3	2	-	-	2	1	-	2

Table: 29 Monthly variations in population density of zooplankton in Ghorajan beel [Station I]

ROTIFERA	1999					2000												2001						
Family: Brachionidae	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J
Brachionus falcatus Zacharias	6	-	-	8	12	-	5	7	-	17	19	14	-	7	14	-	8	-	-	-	20	12	-	8
B.angularis Gosse	-	2	-	-	-	1	-	3	2	-	-	2	3	-	-	6	-	5	-	-	-	2	-	-
B.bidentatus Anderson	-	-	-	3	7	-	2	1	-	-	4	-	-	3	6	-	4	-	8	7	-	-	-	4
B.diversicornis(Daday)	-	1	-	2	1	1	1	3	-	-	-	-	2	-	4	3	-	-	-	-	-	2	2	-
B.quadridentatus(Hermann)	2	1	1	-	1	2	1	2	-	4	-	-	4	2	2	-	3	-	6	-	4	-	6	10
B.calyciflorus(Pallas)	-	2	-	2	4	1	1	3	-	-	-	-	6	12	-	4	-	8	-	-	10	-	-	-
B.caudatus(Barrois & Daday)	4	-	-	1	3	2	2	13	3	-	-	4	-	3	-	14	8	-	-	-	-	4	3	-
B.forficula Wierzejski	-	-	-	2	2	-	1	3	-	-	3	2	2	2	-	3	-	-	-	3	-	-	-	6
B.rubens Ehrenberg	-	-	-	-	-	-	-	-	2	2	-	-	-	2	-	-	1	-	-	-	-	-	-	2
B.mirabilis(Daday)	-	-	-	-	-	-	-	-	-	3	2	-	-	-	2	-	1	-	4	-	-	-	-	3
B.patulus(Muller)	1	1	2	1	3	1	1	2	-	-	3	4	6	4	2	2	4	6	-	4	14	8	18	6
B.patulus macracanthus(Daday)	3	-	-	1	2	-	3	1	5	-	-	3	3	9	-	5	7	2	3	-	6	-	5	6
Platyias quadricornis(Ehrenberg)	3	2	-	1	4	3	1	2	6	9	7	12	-	3	2	6	16	-	10	8	-	-	4	-
Keratella cochlearis Gosse	6	2	1	2	1	7	2	4	6	4	-	7	8	6	10	7	4	12	-	-	4	6	8	10
K.quadrata(Muller)	1	1	-	2	1	-	1	1	-	-	3	4	-	-	4	2	-	-	-	3	-	-	5	2
K.lenzi Hauer	2	-	-	-	3	1	1	-	4	-	-	-	-	2	3	-	2	-	-	-	-	2	-	4
K.tropica(Apstein)	-	1	1	-	2	1	-	1	-	-	4	-	2	-	4	3	-	-	2	-	-	-	3	2
K.procurva(Thorpe)	-	-	-	-	-	-	-	-	2	3	4	-	-	-	-	2	-	-	-	-	4	-	-	2
Anuraeopsis fissa(Gosse)	1	-	-	1	1	2	-	1	-	3	4	-	3	4	-	2	2	5	3	4	4	-	8	5
Family : Euchlanidae																								
Euchlanis dilatata Ehrenberg	18	3	5	2	11	4	13	9	14	9	7	10	14	8	10	16	22	10	-	6	12	24	20	28
Dipleuchlanis propatula(Gosse)	3	-	-	1	1	-	2	1	-	-	4	3	4	2	-	3	2	-	-	-	2	-	-	4
Beauchampiella endactylota(Gosse)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	2	-	-	-	2	1
Family : Mytilinidae																								
Mytilina ventralis(Ehrenberg)	1	-	1	3	-	2	1	4	-	-	3	4	2	4	-	-	6	-	4	8	-	4	-	3
M.bisulcata(Lucks)	2	-	-	-	-	3	-	1	-	-	2	-	-	2	-	3	-	-	-	-	2	-	-	1
Family : Trichotridae																								
Macrochaetus sericus(Thorpe)	3	4	-	1	1	-	2	1	2	-	-	3	5	4	2	-	3	-	-	-	-	2	3	-
Trichotria tetractis(Ehrenberg)	2	-	1	1	-	1	2	1	-	2	-	3	2	3	-	-	2	-	4	3	6	-	4	2
Family: Colurellidae																								
Colurella obtusa(Gosse)	2	-	-	1	-	1	-	2	-	-	4	-	-	2	3	-	2	1	-	-	-	2	3	-
C.uncinata(Muller)	-	1	1	1	-	2	-	-	3	-	-	2	2	3	-	1	1	-	2	-	-	-	2	1
Lepadella ovalis(Muller)	1	1	-	-	2	1	1	1	-	3	-	-	4	-	3	4	2	-	-	-	3	-	4	-
Lepadella ovalis larga (Sharma)	1	-	-	2	-	1	-	1	3	-	-	-	2	2	-	3	2	-	3	-	2	-	-	1
L.patella(Muller)	1	1	2	-	-	1	-	2	-	-	3	-	2	2	-	3	-	-	2	-	-	-	-	4
L.heterostyla(Murray)	-	-	1	1	-	1	-	-	2	-	-	2	-	1	4	-	3	-	-	1	-	-	2	-
L.ehrenbergi(Perty)	-	-	-	2	-	1	-	1	-	2	3	-	1	-	2	-	2	2	-	-	-	1	-	3

L.rhomboides(Gosse)	-	-	-	1	1	-	-	1	4	3	-	-	-	2	1	-	-	-	-	-	-	3	-	6
L.apsicora Myers	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	3	-	-	-	1	-
Squatinella mutica	-	-	-	2	1	-	1	-	-	4	3	1	-	3	-	-	2	-	-	2	-	2	-	4
Family : Lecanidae																								
Lecane curvicornis(Murray)	4	6	-	-	3	2	-	8	2	4	4	3	2	8	6	4	3	-	-	2	-	-	2	-
L.ungulata(Gosse)	3	2	1	4	-	1	2	1	-	-	6	4	-	6	4	-	5	-	-	-	-	1	4	6
L.ploenensis(Voigt)	2	-	-	1	2	-	4	1	-	-	-	-	-	2	3	-	1	-	2	-	1	-	-	2
L.hastata (Murray)	-	-	-	-	1	-	2	-	-	2	-	-	-	-	2	-	-	-	-	-	-	-	1	-
L.ludwigi(Eckstein)	3	-	-	-	2	-	-	1	3	2	-	2	2	4	3	-	2	4	-	-	2	-	3	2
L.lateralis Sharma													-	-	-	-	-	3	-	5	-	-	-	-
L.leontina(Turner)	9	4	11	3	4	2	2	3	4	-	5	8	12	7	4	6	5	-	14	8	-	5	10	5
L.papuana(Murray)	-	-	1	-	2	-	-	1	-	-	3	-	-	2	-	2	-	2	-	-	-	1	-	2
L.luna(Muller)	-	-	-	1	-	1	-	-	-	-	2	3	2	-	1	3	-	-	-	1	-	4	-	3
L.pyriformis(Daday)	-	2	1	-	-	-	1	-	2	1	-	-	-	1	2	-	1	-	2	-	-	-	-	-
L.quadridentata(Ehrenberg)	3	1	-	-	2	2	-	1	-	-	3	-	6	4	-	3	5	-	3	-	2	-	4	-
L.closterocerca(Schmarda)	1	-	-	1	-	1	1	1	3	2	-	2	2	3	3	-	2	-	-	-	4	3	-	6
L.bulla(Gosse)	4	2	2	1	5	6	1	1	4	4	5	6	10	8	16	23	12	10	6	8	5	14	12	7
L.lunaris(Ehrenberg)	-	-	1	2	-	1	1	-	-	-	3	-	2	-	3	2	-	-	-	3	-	-	4	2
L.aculeata(Jakubski)	1	-	-	-	1	-	-	2	3	3	-	-	-	1	2	-	-	-	2	-	-	1	-	3
L.unguitata(Fadeev)	3	2	2	-	1	2	1	2	4	2	3	4	3	2	3	6	2	4	-	3	5	4	2	2
L.hamata(Stokes)	-	1	1	1	-	1	2	1	-	-	-	-	-	2	-	-	-	-	3	-	-	-	4	-
L.thienemanni(Hauer)	-	-	-	-	-	-	2	-	3	-	4	2	2	-	-	1	-	-	-	-	-	1	-	2
L.hornemanni(Ehrenberg)	-	-	-	-	-	3	-	1	-	-	2	-	-	4	-	2	-	-	2	-	-	-	2	-
L.stenroosi(Meissner)	-	-	-	-	-	-	-	-	1	-	4	-	-	-	2	-	-	-	-	-	-	1	-	-
L.ohioensis(Herrick)	-	-	-	-	-	-	-	-	3	-	-	-	-	-	2	4	6	-	-	-	-	-	3	-
L.decipiens(Murray)	-	-	-	-	-	-	3	-	-	2	-	-	2	-	3	-	1	-	2	-	-	-	-	-
L.inopinata(Harring & Myers)	-	-	-	-	-	-	-	-	2	-	1	-	-	2	-	1	-	-	-	-	-	2	-	2
L.crepida(Harring)	-	-	-	-	-	-	-	-	-	1	-	2	-	-	2	-	-	-	-	2	-	-	-	-
Family : Notommatidae																								
Cephalodella forficula(Ehrenberg)	1	-	-	1	-	-	2	-	-	2	-	3	2	-	2	-	1	-	-	2	-	-	2	-
Monommata longiseta(Muller)	3	1	-	1	1	-	1	2	4	2	-	2	4	-	2	2	-	4	2	-	-	-	1	-
Scaridium longicaudum(Muller)	-	-	-	-	1	1	-	2	-	6	5	-	2	-	1	4	2	-	-	3	-	-	-	2
Family: Trichocercidae																								
Trichocerca cylindrica(Imhof)	3	4	2	3	-	1	2	1	3	-	-	2	2	6	5	-	2	-	-	2	-	-	2	-
T.similis(Wierzejski)	-	-	1	-	-	1	3	1	-	-	2	-	-	4	3	1	-	-	2	-	-	-	3	-
T.porcellus(Gosse)	2	-	-	-	1	-	1	1	-	4	2	3	3	-	2	-	1	-	-	-	-	4	-	2
T.elongata(Gosse)	1	2	-	1	1	-	-	4	2	-	-	-	2	-	-	2	-	2	3	-	-	-	-	1
T.rattus (O.F. Muller)	-	-	2	-	-	-	1	-	3	2	3	2	-	2	2	-	-	-	-	2	-	-	3	-
T.longiseta(Schrank)	2	-	2	3	-	1	-	1	-	-	3	-	3	2	4	2	6	-	-	3	-	2	-	1
Trichocerca pusilla (Lauterborn)	-	1	3	-	-	1	-	1	-	-	3	-	-	2	1	-	-	-	-	-	-	1	-	3
Family: Asplanchnidae																								
Asplanchna priodonta Gosse	9	6	4	3	3	-	1	7	8	14	23	28	32	24	18	26	13	20	18	28	14	16	20	12

Family: Synchaetidae																								
Polyarthra vulgaris Carlin	3	2	2	4	3	6	2	3	11	4	3	14	4	14	6	16	9	4	10	8	12	14	8	6
Family : Floscularidae																								
Sinantherina socialis Bory de st. Vincent	14	16	-	-	12	17	-	9	-	14	18	12	20	-	14	-	10	-	-	-	8	7	-	10
S. spinosa(Thorpe)	-	-	-	-	-	-	-	-	7	6	12	30	-	12	6	12	-	-	12	-	-	-	14	-
Family: Conochilidae																								
Conochilus unicornis Rousselet	7	4	-	-	6	-	5	-	-	-	8	12	14	10	16	-	8	4	-	-	-	-	6	-
Family: Hexarthridae																								
Hexarthra mira(Hudson)	2	-	-	-	-	-	1	-	-	-	-	-	-	1	-	2	-	-	-	-	4	-	2	-
Family: Filiniidae																								
Filinia camascela Myers	8	7	-	-	-	-	4	-	-	-	8	-	-	-	-	8	6	-	-	-	-	-	-	10
F.longiseta(Ehrenberg)	2	-	1	2	2	1	-	1	-	-	-	-	-	4	-	3	-	-	3	-	2	-	-	4
F.pejleri Hutchinson	1	-	1	1	4	1	1	1	-	-	3	2	2	-	2	-	-	4	-	2	-	-	3	-
F.opoliensis Zacharias	-	-	2	-	1	-	1	1	2	-	-	3	3	-	1	-	2	-	-	-	-	2	-	-
Family : Testudinellidae																								
Testudinella patina(Hermann)	3	-	-	4	2	2	-	4	3	3	6	14	4	6	-	8	5	4	10	-	6	14	8	4
T.greeni Koste	4	-	-	-	3	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	2	-	3
T.emarginula(Stenroos)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	3	-	-	4
T.brevicaudata Yamammoto	-	-	-	-	-	-	-	-	3	-	-	-	2	-	-	-	-	-	-	3	-	-	-	-
Trochosphaera aequatorialis Semper	-	-	-	-	-	-	-	-	-	4	6	-	10	-	-	-	-	-	-	-	-	-	6	-
Family: Philodinidae																								
Rotaria neptunia(Ehrenberg)	3	-	-	1	-	-	1	-	2	-	-	2	-	3	-	-	2	-	3	-	-	-	-	2
Family: Epiphanidae																								
Epiphanes sp.	-	-	-	-	-	-	-	-	-	-	-	-	3	2	-	4	2	-	3	-	-	-	4	2
Species richness	***47***	***31***	***28***	***43***	***44***	***43***	***46***	***55***	***37***	***35***	***46***	***41***	***48***	***55***	***51***	***47***	***50***	***23***	***33***	***28***	***27***	***34***	***45***	***54***
Abundance(ind/l)	***164***	***86***	***56***	***82***	***127***	***94***	***92***	***135***	***140***	***152***	***232***	***245***	***234***	***245***	***224***	***244***	***223***	***121***	***158***	***134***	***161***	***173***	***236***	***238***
Cladocera																								
Family: Sididae																								
Pseudosida bidentata Herrick	2	-	-	2	1	-	-	1	-	-	4	-	-	2	3	-	-	-	2	-	-	-	-	-
Sida crystallina (O.F.Muller)	-	4	-	-	2	-	1	-	-	3	4	-	6	-	-	4	-	-	-	-	3	-	-	2
Diaphanosoma excisum Sars	3	5	1	4	2	1	1	1	4	3	2	4	8	4	6	3	3	4	-	6	10	14	8	-
D.senegal Gauthier	2	1	2	3	2	1	3	2	3	3	2	3	4	2	3	2	2	-	4	2	-	3	-	4
Family: Daphnidae																								
Ceriodaphnia cornuta Sars	-	3	-	2	1	-	2	2	-	-	4	4	6	3	2	3	-	-	3	-	2	-	-	-
C.quadrangula (O.F.Muller)	-	-	-	-	2	-	-	1	-	-	-	3	-	2	-	1	-	-	2	2	-	-	-	-
Scapholeberis kingi Sars	3	2	1	6	4	3	1	6	4	2	3	7	4	3	3	5	4	6	8	4	10	3	6	8
Simocephalus vetulus (O.F.Muller)	4	1	1	3	7	1	2	2	3	4	4	5	2	-	4	4	2	4	-	2	3	6	4	10
S.serrulatus (Koch)	1	1	2	1	1	1	2	1	2	2	3	3	2	2	-	3	2	-	2	-	4	-	-	4
Family : Moinidae																								
Moina micrura Kurz	-	-	4	7	-	-	3	3	-	-	8	7	8	-	-	6	8	-	-	10	8	-	6	-

Moinodaphnia macleayi (King)	1	-	-	-	-	-	-	-	-	-	-	2	2	-	2	-	-	-	-	-	-	1	-	2
Family : Bosminidae																								
Bosmina longirostris (O.F.Muller)	-	-	6	7	-	4	-	8	-	14	19	24	-	-	-	14	17	-	-	16	4	-	-	10
Bosminopsis deitersi Richard	-	-	3	-	4	3	-	-	2	12	16	19	-	-	4	10	12	-	8	10	-	-	-	8
Family : Macrothricidae																								
Macrothrix goeldii Richard	2	4	2	1	6	3	3	1	-	-	4	-	3	2	2	4	3	4	-	-	2	-	-	4
M.laticornis (Jurine)	1	2	1	3	2	1	1	3	4	-	-	3	2	3	2	1	2	-	3	-	-	2	4	-
Grimaldina brazzai Richard	-	-	-	-	3	-	-	-	-	2	3	-	-	4	-	-	2	-	-	-	-	-	-	-
Ilyocryptus spinifer Herrick	2	-	-	2	-	-	1	3	-	-	8	4	-	3	2	2	-	2	-	4	-	-	4	2
Family: Chydoridae																								
Pleuroxus similis Vavra	9	7	-	-	3	-	2	-	-	-	4	3	8	10	7	-	4	-	3	-	6	-	-	4
Notalona globulosa (Daday)	3	-	-	2	2	-	4	3	7	4	-	7	12	14	-	8	7	2	-	4	4	-	2	-
Alonella exisa (Fischer)	4	-	-	6	-	3	-	7	-	-	3	4	-	5	8	-	6	-	10	12	5	7	5	8
Chydorus sphaericus (O.F.Muller)	12	9	14	5	7	8	3	4	9	7	18	10	8	16	22	12	32	18	14	10	16	17	10	4
C.faviformis Birge	-	2	-	-	1	-	-	3	-	-	4	-	-	-	3	-	-	-	-	2	-	-	-	-
C.ovalis Kurz	3	-	-	-	2	1	2	2	-	4	-	-	-	2	-	2	-	-	1	-	-	2	-	3
C.barroisi Richard	4	2	1	3	3	7	2	3	7	12	4	6	8	6	5	12	17	4	10	8	6	12	14	22
C.reticulatus Daday	-	-	-	1	-	-	-	2	-	-	-	-	-	4	2	-	-	-	-	1	-	-	2	-
Alona intermedia Sars	3	-	2	1	1	3	-	3	4	3	-	2	4	3	-	2	4	-	3	-	2	2	-	2
A.quadrangularis (O.F.Muller)	2	-	2	1	-	-	3	3	-	3	3	2	4	-	3	2	3	-	4	2	2	3	-	4
A.costata Sars	-	-	2	-	1	-	4	2	3	2	-	3	-	3	2	-	4	6	-	10	3	2	-	3
A.rectangula Sars	-	-	-	2	1	-	1	-	-	-	2	-	2	-	-	-	1	-	-	-	1	-	2	-
A.guttata Sars	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	5	-	-	4	-	2	-	-	4
Biapertura karua (King)	6	2	7	5	2	2	3	2	3	4	4	8	10	7	6	9	12	10	4	6	14	8	6	15
B.affinis (Leydig)	3	-	-	1	-	3	-	4	-	-	2	-	-	4	-	2	-	-	1	-	-	-	2	-
Acroperus harpae (Baird)	3	-	-	2	-	2	-	1	-	3	8	3	-	4	-	2	2	3	-	2	2	4	5	8
Camptocercus rectirostris Schoedler	1	-	2	-	1	1	-	3	-	-	3	2	2	1	2	-	-	4	3	-	2	-	-	4
Leydigia acanthocercoides (Fischer)	-	-	-	-	2	1	1	-	-	-	4	-	4	-	3	-	-	-	-	2	-	-	2	-
Leydigiopsis sp.	-	-	-	6	-	4	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	3	-
Graptoleberis testudinaria (Fischer)	-	-	-	-	-	3	-	1	-	2	1	-	2	-	2	-	-	3	-	4	2	2	-	4
Oxyurella singalensis (Daday)	1	-	2	1	-	1	3	1	2	-	-	3	-	3	-	4	-	-	6	-	10	3	2	6
Kurzia longirostris (Daday)	-	2	1	1	3	2	-	1	-	3	2	3	4	-	3	2	1	-	3	-	2	-	-	8
Euryalona orientalis (Daday)	1	-	-	3	2	1	2	-	-	-	6	2	-	2	-	-	4	2	-	3	-	-	6	-
Dunhevedia serrata Daday	-	-	-	-	-	-	-	2	-	3	4	-	-	-	-	2	-	2	-	-	3	1	4	3
Dadaya macrops (Daday)	-	-	-	-	-	-	-	-	-	-	-	-	8	6	-	-	-	4	6	-	-	2	-	4
Species richness	***24***	***15***	***19***	***27***	***27***	***24***	***23***	***31***	***14***	***21***	***30***	***27***	***24***	***27***	***25***	***27***	***24***	***16***	***23***	***22***	***26***	***19***	***20***	***27***
Abundance(ind/l)	***76***	***47***	***56***	***81***	***68***	***60***	***50***	***81***	***57***	***95***	***156***	***146***	***123***	***120***	***10 5***	***12 6***	***15 4***	***78***	***10 6***	***12 2***	***12 8***	***94***	***97***	***16 0***
Copepoda																								
Meso cyclops sp.	7	9	6	14	12	8	9	7	32	28	16	52	38	27	22	53	59	12	16	20	48	34	52	38
Helio diaptomus sp.	-	4	-	-	-	3	-	2	-	-	6	7	16	7	5	12	10	6	-	4	14	8	7	-
Nauplius larvae	-	1	-	2	-	1	-	2	4	3	3	4	8	10	12	7	12	10	8	-	-	7	-	10

Species richness	*1*	*3*	*1*	*2*	*1*	*3*	*1*	*3*	*2*	*2*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*3*	*2*	*2*	*2*	*3*	*2*	*2*
Abundance(ind/l)	*7*	*14*	*6*	*16*	*12*	*12*	*9*	*11*	*36*	*31*	*25*	*63*	*62*	*44*	*39*	*72*	*81*	*28*	*24*	*24*	*62*	*49*	*59*	*48*
Rhizopoda																								
Arcella discoides Ehrenberg	-	3	-	1	2	1	4	6	-	-	4	3	2	-	3	13	2	-	6	4	10	-	7	12
A.megastoma Penard	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	4	-	6	2	-	3
A.dentata Ehrenberg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	6	-	8	-	3	-
A.vulgaris Ehrenberg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	3	3	-	4	2	-
Centropyxis hemisphaerica (Barnard)	-	-	4	2	-	1	4	1	-	3	-	4	4	3	2	1	2	4	-	8	5	4	-	4
C.aculeata (Ehrenberg)	2	-	2	-	-	2	3	-	4	-	-	-	2	1	3	3	1	-	-	3	-	6	4	-
C.arcelloides Penard	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	5	-	-	5	2
Difflugia lebes Penard	-	1	1	-	2	1	-	1	-	-	3	-	4	2	2	1	1	3	10	-	6	-	8	-
D.urceolata Carter	3	-	2	1	4	1	-	-	-	-	4	7	2	3	3	2	2	-	2	4	-	-	4	-
D.oblonga Ehrenberg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	2	2	4	7	-	4
Euglypha ciliata Ehrenberg	-	2	-	-	1	-	1	1	6	2	-	4	-	2	-	3	2	3	-	-	8	4	-	3
Actinosphaerium eichhorni Ehrenberg	1	-	2	-	-	1	-	2	3	3	2	3	1	1	2	2	1	-	2	3	-	-	2	-
Species richness	*3*	*3*	*5*	*3*	*4*	*6*	*4*	*5*	*3*	*3*	*4*	*5*	*6*	*6*	*6*	*7*	*7*	*7*	*9*	*8*	*7*	*6*	*8*	*6*
Abundance(ind/l)	*6*	*6*	*11*	*4*	*9*	*7*	*12*	*11*	*13*	*8*	*13*	*21*	*15*	*12*	*15*	*25*	*11*	*24*	*38*	*32*	*47*	*27*	*35*	*28*
Ostracoda																								
Cypricercus sp.	-	3	-	4	3	2	-	2	6	8	16	9	-	-	4	3	3	-	4	6	2	-	3	2
Cypris sp.	6	8	4	-	1	6	-	3	-	4	4	-	6	7	5	8	8	2	-	4	3	2	-	3
Species richness	*1*	*2*	*1*	*1*	*2*	*2*	-	*2*	*1*	*2*	*2*	*1*	*1*	*1*	*2*	*2*	*2*	*1*	*1*	*2*	*2*	*1*	*3*	*2*
Abundance(ind/l)	*6*	*11*	*4*	*4*	*4*	*8*	-	*5*	*6*	*12*	*20*	*9*	*6*	*7*	*9*	*11*	*11*	*2*	*4*	*10*	*5*	*2*	*3*	*5*
Conchostraca sp.	-	1	-	-	2	-	-	1	-	3	4	3	3	4	2	2	6	-	3	-	4	3	-	2

Table:30 Monthly variations in population density of zooplankton in Ghorajan beel [Station II]

ROTIFERA	1999					2000												2001						
Family: Brachionidae	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J
Brachionus falcatus Zacharias	8	4	-	-	7	6	-	5	-	12	19	14	12	9	-	14	-	-	10	-	-	-	12	6
B.angularis Gosse	-	-	3	-	-	1	-	-	4	-	-	3	2	-	3	-	2	-	-	8	-	-	-	-
B.bidentatus Anderson	-	-	-	-	1	-	-	3	-	4	7	-	-	4	-	2	-	3	-	-	-	2	-	-
B.diversicornis(Daday)	-	4	-	-	-	-	2	-	-	2	-	3	-	-	3	-	2	-	-	-	-	-	2	-
B.quadridentatus(Hermann)	3	-	-	2	2	-	4	1	-	6	7	2	-	4	2	-	3	-	-	2	3	-	-	-
B.calyciflorus(Pallas)	-	-	3	-	5	4	-	2	-	-	-	6	7	-	6	4	-	-	2	-	-	-	4	6
B.caudatus(Barrois & Daday)	-	-	2	4	-	-	-	9	-	2	-	-	-	5	-	6	-	-	-	-	-	4	-	-
B.forficula Wierzejski	-	-	-	-	1	-	-	2	-	4	2	4	-	-	4	-	2	1	-	-	4	-	-	-
B.rubens Ehrenberg	-	-	-	-	-	-	-	-	-	3	3	-	3	-	-	-	1	-	-	1	-	-	2	-
B.mirabilis(Daday)	-	-	-	-	-	-	-	-	-	-	2	3	-	2	-	-	3	-	-	-	5	-	-	2
B.patulus(Muller)	3	2	2	1	1	1	2	1	-	6	4	3	6	3	4	10	12	6	-	-	4	12	14	-
B.patulus macracanthus(Daday)	1	-	-	-	1	-	-	1	6	-	3	2	3	6	-	4	6	-	3	-	-	4	-	2
Platyias quadricornis(Ehrenberg)	2	-	1	-	4	1	2	2	-	12	-	4	4	4	10	14	6	8	12	5	-	9	-	10
Keratella cochlearis Gosse	4	3	-	-	4	4	5	-	6	3	7	6	6	8	5	10	14	-	18	25	8	10	-	12
K.quadrata(Muller)	1	-	-	-	-	2	-	1	-	4	-	-	-	-	3	4	-	-	-	-	-	5	4	-
K.lenzi Hauer	2	-	-	-	-	1	-	-	3	-	-	3	-	3	4	-	-	-	-	-	2	-	4	-
K.tropica(Apstein)	2	-	-	-	1	-	1	-	-	4	-	-	-	2	2	-	-	4	-	-	6	8	-	3
K.procurva(Thorpe)	-	-	-	-	-	-	-	-	4	-	8	-	3	-	-	-	4	-	-	-	-	2	-	-
Anuraeopsis fissa(Gosse)	-	2	-	-	1	-	1	1	4	-	3	2	4	2	4	-	6	-	-	2	8	6	-	4
Family : Euchlanidae																								
Euchlanis dilatata Ehrenberg	9	4	2	2	1	1	5	3	-	6	7	8	-	3	8	6	4	14	22	18	10	12	8	15
Dipleuchlanis propatula(Gosse)	2	-	-	1	-	-	-	-	4	4	-	3	-	2	-	1	-	-	-	2	-	3	-	-
Beauchampiella endactylota(Gosse)																								
Family : Mytilinidae																								
Mytilina ventralis(Ehrenberg)	1	-	1	-	-	-	2	1	6	-	3	2	-	3	-	2	4	6	8	14	-	-	4	3
M.bisulcata(Lucks)	2	-	-	-	-	-	1	-	-	2	-	1	2	-	-	-	1	-	-	-	2	3	-	-
Family: Trichotridae																								
Macrochaetus sericus (Thorpe)	2	-	-	4	-	-	-	1	5	3	-	3	2	3	-	4	2	-	-	3	-	4	-	3
Trichotria tetractis (Ehrenberg)	1	-	-	4	-	1	4	3	-	-	2	4	-	2	2	-	-	8	6	-	2	-	-	4
Family: Colurellidae																								
Colurella obtusa(Gosse)	1	-	4	-	-	2	-	1	-	3	-	-	2	-	1	-	-	2	-	-	4	-	3	3
C.uncinata(Muller)	-	-	-	2	4	-	-	1	-	-	1	2	-	1	-	-	2	-	-	-	-	2	-	1
Lepadella ovalis(Muller)	3	4	-	-	-	1	1	-	-	4	-	3	2	-	4	3	-	-	6	3	-	3	-	1
Lepadella ovalis larga (Sharma)	1	1	-	-	1	-	-	-	2	-	3	2	-	2	-	-	3	-	4	-	-	2	-	-
L.patella(Muller)	4	-	-	2	2	-	-	1	3	-	-	2	-	2	-	-	4	3	-	2	1	1	-	-
L.heterostyla(Murray)	-	-	-	-	1	-	-	1	-	2	-	-	-	-	2	1	-	-	-	-	-	-	3	2
L.ehrenbergi(Perty)	-	-	-	1	-	-	2	-	-	-	3	-	1	3	-	-	-	-	-	1	2	-	-	1
L.rhomboides(Gosse)	-	-	-	-	1	-	-	1	-	2	-	3	-	-	2	-	3	-	-	2	-	3	-	-

L.apsicora Myers	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	-	-	4	2	-	-
Squatinella mutica	-	-	1	-	-	1	2	-	4	-	2	-	-	3	-	-	2	-	4	-	-	-	2	-
Family : Lecanidae																								
Lecane curvicornis(Murray)	2	-	-	1	-	-	-	2	-	4	3	4	-	3	-	2	1	6	-	4	-	3	2	-
L.ungulata(Gosse)	3	-	-	4	2	-	1	1	-	5	6	3	2	4	6	-	-	-	8	-	3	-	-	4
L.ploenensis(Voigt)	-	1	-	-	-	4	-	1	2	-	-	3	-	1	-	2	-	-	-	2	-	4	-	3
L.hastata (Murray)	-	-	-	1	-	-	-	-	-	2	-	-	2	-	-	-	-	-	-	3	-	-	1	-
L.ludwigi(Eckstein)	1	-	-	-	2	-	-	1	-	2	-	-	-	2	-	-	4	2	-	-	4	6	-	-
L.lateralis Sharma																								
L.leontina(Turner)	2	4	1	-	1	2	2	3	-	5	14	8	6	-	10	7	12	6	14	16	-	8	15	7
L.papuana(Murray)	-	-	-	1	-	4	-	1	2	-	-	4	-	1	-	-	2	-	-	3	2	-	4	-
L.luna(Muller)	-	-	-	-	1	-	-	-	-	-	3	2	3	-	2	-	-	-	-	-	1	-	3	-
L.pyriformis(Daday)	-	-	4	-	-	-	2	-	3	-	-	-	2	1	3	2	-	-	1	-	-	2	2	-
L.quadridentata(Ehrenberg)	3	-	-	2	4	-	-	2	-	8	-	2	-	3	4	-	-	6	-	-	3	-	-	4
L.closterocerca(Schmarda)	-	2	-	-	2	-	-	1	-	-	2	4	2	1	1	-	2	4	3	3	-	2	4	2
L.bulla(Gosse)	1	4	3	-	4	2	1	3	-	5	6	4	10	3	6	-	4	12	16	22	10	15	8	6
L.lunaris(Ehrenberg)	-	-	1	4	2	-	1	-	4	-	-	-	3	-	-	2	-	-	-	-	2	-	-	3
L.aculeata(Jakubski)	-	4	-	-	-	-	2	-	-	2	3	3	-	2	1	-	1	-	2	-	-	-	-	1
L.unguitata(Fadeev)	2	1	3	1	4	4	3	2	-	7	-	8	4	3	-	2	2	4	10	6	4	3	3	2
L.hamata(Stokes)	-	1	-	-	-	1	-	-	-	-	4	2	-	-	2	-	-	-	-	-	2	-	-	1
L.thienemanni(Hauer)	-	-	-	-	-	-	-	1	-	4	2	-	3	-	-	2	-	1	-	-	-	2	-	-
L.hornemanni(Ehrenberg)	-	-	-	-	-	-	-	3	-	2	-	-	-	4	-	-	1	-	2	-	4	-	2	-
L.stenroosi(Meissner)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	1	-	-
L.ohioensis(Herrick)	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	4	-	2	-	4	-	2	-	-
L.decipiens(Murray)	-	-	-	-	-	4	-	-	-	2	-	2	-	3	-	-	2	-	-	1	-	-	1	-
L.inopinata(Harring & Myers)	-	-	-	-	-	-	-	3	-	1	-	-	-	-	-	-	2	-	-	-	-	-	-	2
L.crepida(Harring)	-	-	-	-	-	-	-	-	2	-	1	-	-	-	1	-	-	-	2	-	-	-	4	-
Family : Notommatidae																								
Cephalodella forficula(Ehrenberg)	1	-	-	-	1	-	1	1	-	-	3	2	1	1	-	-	1	4	-	2	-	2	-	1
Monommata longiseta(Muller)	3	1	-	2	-	1	-	-	4	-	-	-	2	-	3	1	-	-	-	2	1	-	-	2
Scaridium longicaudum(Muller)	-	-	1	-	-	1	-	-	3	5	-	-	1	1	-	-	4	2	-	-	2	2	-	-
Family: Trichocercidae																								
Trichocerca cylindrica(Imhof)	3	2	-	-	1	1	-	-	4	-	-	2	-	3	-	2	2	-	-	-	1	-	-	-
T.similis(Wierzejski)	-	-	2	-	1	-	1	-	-	-	3	-	1	2	-	-	-	-	-	4	-	2	-	1
T.porcellus(Gosse)	1	-	-	2	-	4	1	3	-	2	-	3	-	4	3	-	1	6	-	-	3	3	-	2
T.elongata(Gosse)	-	-	3	4	-	-	2	-	2	2	-	-	-	-	2	-	-	-	-	2	-	-	-	-
T.rattus (O.F. Muller)	-	-	-	1	-	-	-	2	-	-	4	3	2	-	-	1	-	-	4	-	2	3	1	-
T.longiseta(Schrank)	2	2	-	-	1	-	3	-	-	3	-	2	-	1	1	-	2	-	-	-	-	-	-	2
Trichocerca pusilla (Lauterborn)	-	-	-	1	-	-	-	2	-	4	-	-	-	2	-	-	-	-	3	-	-	1	1	-
Family: Asplanchnidae																								
Asplanchna priodonta Gosse	15	30	12	-	14	16	-	14	-	12	19	16	10	22	14	9	25	16	12	22	-	15	8	5
Family: Synchaetidae																								

Polyarthra vulgaris Carlin	20	6	13	14	5	8	20	13	8	14	7	6	8	6	10	7	4	32	29	18	4	9	7	4
Family : Floscularidae																								
Sinantherina socialis Bory de st. Vincent	12	-	14	-	-	-	9	-	-	12	7	16	-	10	-	12	14	-	-	18	10	-	-	-
S. spinosa(Thorpe)	-	-	-	-	-	-	-	-	-	18	19	12	8	-	9	-	4	-	6	-	-	12	6	-
Family: Conochilidae																								
Conochilus unicornis Rousselet	-	-	4	-	6	8	-	-	-	14	8	-	7	-	-	-	10	22	-	14	-	-	8	12
Family: Hexarthridae																								
Hexarthra mira(Hudson)	-	-	-	-	1	-	-	-	-	2	-	-	-	2	-	-	-	-	1	-	-	4	-	-
Family: Filiniidae																								
Filinia camascela Myers	8	5	-	-	-	-	6	-	-	-	4	-	-	7	-	-	4	-	-	-	-	-	6	-
F.longiseta(Ehrenberg)	3	-	-	-	1	1	-	2	-	3	-	3	2	-	3	-	2	-	1	-	2	-	-	-
F.pejleri Hutchinson	1	-	-	1	-	-	4	3	4	-	-	4	-	2	-	-	1	6	-	4	-	-	-	1
F.opoliensis Zacharias	1	2	-	1	-	-	-	1	-	-	3	2	3	-	-	1	-	-	-	3	2	4	-	-
Family : Testudinellidae																								
Testudinella patina(Hermann)	2	-	12	-	-	4	-	10	8	6	4	8	7	4	6	10	8	20	-	14	9	6	8	5
T.greeni Koste	2	-	-	-	1	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	2	-	-	-
T.emarginula(Stenroos)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	-	10	4	-	2	3
T.brevicaudata Yamammoto	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-
Trochosphaera aequatorialis Semper	-	-	-	-	-	-	-	-	-	5	4	-	4	-	-	-	-	-	-	-	-	-	6	-
Family: Philodinidae																								
Rotaria neptunia(Ehrenberg)	2	3	-	-	-	1	-	-	-	3	7	2	2	-	3	-	-	-	-	2	-	4	2	5
Family: Epiphanidae																								
Epiphanes sp.	-	-	-	-	-	-	-	-	-	-	-	2	4	-	6	8	-	4	6	-	3	2	-	2
Species richness	***41***	***23***	***22***	***25***	***36***	***30***	***30***	***43***	***24***	***48***	***41***	***52***	***41***	***50***	***40***	***33***	***47***	***30***	***28***	***37***	***38***	***46***	***35***	***41***
Abundance(ind/l)	***142***	***92***	***92***	***63***	***92***	***92***	***93***	***116***	***97***	***242***	***222***	***220***	***161***	***175***	***167***	***163***	***202***	***220***	***215***	***267***	***145***	***215***	***166***	***158***
Cladocera																								
Family: Sididae																								
Pseudosida bidentata Herrick	2	1	-	-	1	-	-	-	-	2	3	-	-	2	3	-	-	-	-	-	-	-	-	-
Sida crystallina (O.F.Muller)	-	-	3	4	-	-	1	-	-	2	-	2	1	-	-	2	-	-	-	-	-	-	3	2
Diaphanosoma excisum Sars	3	4	-	2	3	-	5	6	-	4	6	3	4	3	8	-	4	-	6	16	-	6	10	8
D.senegal Gauthier	2	-	1	2	1	4	-	-	5	-	3	3	2	4	1	3	-	4	-	-	2	3	6	4
Family: Daphnidae																								
Ceriodaphnia cornuta Sars	-	-	2	-	1	-	-	1	-	6	9	4	4	-	3	1	-	-	-	2	3	-	2	-
C.quadrangula (O.F.Muller)	-	2	-	-	-	1	1	-	-	-	3	-	2	-	-	-	3	-	-	-	-	2	-	1
Scapholeberis kingi Sars	2	3	2	4	-	2	1	1	4	4	9	6	7	4	6	9	4	10	-	3	2	-	4	6
Simocephalus vetulus (O.F.Muller)	1	2	1	4	3	1	1	2	-	7	3	3	-	3	3	-	5	6	8	-	4	6	12	2
S.serrulatus (Koch)	1	1	1	2	2	1	1	1	-	-	4	2	2	2	-	3	2	2	4	-	-	3	2	-
Family : Moinidae																								
Moina micrura Kurz	-	-	3	-	-	2	-	14	12	-	6	-	4	-	4	-	-	-	-	-	3	-	-	4
Moinodaphnia macleayi (King)	-	1	-	-	-	-	-	-	2	-	-	1	-	3	2	-	2	-	-	-	-	1	-	-

Family : Bosminidae																								
Bosmina longirostris (O.F.Muller)	-	-	10	12	-	18	-	17	-	14	22	16	-	-	16	18	10	-	14	-	-	8	-	12
Bosminopsis deitersi Richard	-	-	3	-	4	4	-	16	-	8	6	12	-	4	8	10	7	-	-	4	5	-	-	6
Family : Macrothricidae																								
Macrothrix goeldii Richard	2	-	-	4	3	1	-	1	-	6	9	-	3	4	-	2	5	-	-	4	-	3	-	2
M.laticornis (Jurine)	1	1	-	3	-	2	3	4	4	-	3	2	2	1	1	-	-	-	2	-	3	-	-	1
Grimaldina brazzai Richard	-	-	-	-	2	-	-	-	-	4	-	2	-	2	-	-	-	-	-	3	2	-	-	-
Ilyocryptus spinifer Herrick	2	-	-	2	1	-	-	2	-	4	3	3	-	3	-	4	2	6	-	-	4	3	-	-
Family: Chydoridae																								
Pleuroxus similis Vavra	2	1	-	2	-	-	2	-	-	7	4	4	-	3	4	-	3	10	6	-	4	3	-	-
Notalona globulosa (Daday)	3	-	-	1	2	11	4	3	5	-	6	3	14	8	6	10	4	-	8	4	-	-	6	4
Alonella exisa (Fischer)	4	3	3	2	4	4	2	2	-	-	12	8	2	4	3	6	7	-	12	6	-	-	4	2
Chydorus sphaericus(O.F.Muller)	3	2	12	4	3	2	5	3	-	14	10	9	3	12	4	7	14	12	8	16	6	12	3	4
C.faviformis Birge	-	-	1	-	-	1	-	2	-	-	3	2	1	1	-	-	2	-	-	-	1	-	-	-
C.ovalis Kurz	-	1	-	-	-	1	-	-	4	-	-	1	-	-	1	-	1	-	-	2	-	-	-	1
C.barroisi Richard	2	3	2	2	1	2	2	1	-	6	3	4	4	3	3	-	6	5	4	-	3	6	-	4
C.reticulatus Daday	1	-	-	-	-	-	-	-	2	-	-	-	-	1	-	-	-	-	2	-	-	-	1	-
Alona intermedia Sars	1	-	-	2	4	1	-	2	-	-	4	-	2	-	-	3	-	-	-	-	-	2	-	-
A.quadrangularis (O.F.Muller)	2	-	3	2	4	2	-	1	-	4	3	4	-	3	-	2	2	-	-	-	3	-	-	1
A.costata Sars	-	-	-	1	-	2	-	1	-	2	-	3	3	2	-	2	-	-	4	-	3	3	-	2
A.rectangula Sars	1	-	-	1	-	-	-	4	2	-	-	-	2	-	-	-	-	4	-	-	-	-	2	-
A.guttata Sars	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	3	-	2	-	-	1
Biapertura karua (King)	2	1	3	-	8	2	4	3	5	6	9	3	4	6	9	12	4	8	18	-	10	6	-	4
B.affinis (Leydig)	1	-	-	-	2	-	2	2	-	2	-	-	2	-	4	-	2	-	-	-	-	-	4	-
Acroperus harpae (Baird)	2	-	-	2	-	-	-	1	-	-	4	3	-	-	3	-	2	-	-	6	-	2	4	-
Camptocercus rectirostris Schoedler	1	2	2	-	-	1	6	2	-	3	-	4	2	-	-	3	-	-	-	14	-	-	2	-
Leydigia acanthocercoides (Fischer)	-	-	-	-	1	6	-	-	-	4	-	2	-	2	-	-	4	-	-	-	2	-	-	3
Leydigiopsis sp.	-	-	-	6	-	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-
Graptoleberis testudinaria (Fischer)	-	-	-	-	1	-	1	-	-	-	4	3	-	-	2	1	-	-	-	-	-	4	3	-
Oxyurella singalensis (Daday)	2	-	1	2	2	-	-	4	3	-	2	5	-	3	-	-	2	-	2	-	1	-	2	3
Kurzia longirostris (Daday)	1	-	1	-	-	1	1	2	-	2	2	-	4	-	-	3	-	3	-	-	-	2	-	-
Euryalona orientalis (Daday)	-	-	-	-	4	2	-	1	-	3	-	2	-	2	-	2	-	4	-	-	3	-	-	-
Dunhevedia serrata Daday	-	-	-	-	-	-	-	4	-	6	-	3	-	-	-	-	2	-	-	2	-	-	-	2
Dadaya macrops (Daday)	-	-	-	-	-	-	-	-	-	-	-	9	-	-	-	4	-	-	2	-	-	4	-	-
Species richness	***24***	***15***	***18***	***22***	***22***	***24***	***18***	***28***	***11***	***23***	***27***	***31***	***22***	***26***	***22***	***21***	***24***	***12***	***16***	***13***	***21***	***19***	***17***	***23***
Abundance(ind/l)	***44***	***28***	***54***	***66***	***57***	***74***	***50***	***103***	***48***	***120***	***155***	***131***	***74***	***87***	***95***	***10 7***	***99***	***74***	***10 3***	***82***	***68***	***79***	***70***	***79***
Copepoda																								
Meso cyclops sp.	18	60	11	17	6	9	5	14	24	30	70	43	27	48	18	62	70	-	12	8	6	10	3	4
Helio diaptomus sp.	4	-	3	-	-	2	3	-	-	6	4	12	6	3	8	10	18	4	10	7	12	6	2	3
Nauplius larvae	2	1	-	-	2	-	1	1	-	3	2	8	10	7	6	8	5	-	-	14	34	12	2	2
Species richness	***3***	***2***	***2***	***1***	***2***	***2***	***3***	***2***	***1***	***3***	***3***	***3***	***3***	***3***	***3***	***3***	***3***	***1***	***2***	***3***	***3***	***3***	***3***	***3***

Abundance(ind/l)	*24*	*61*	*14*	*17*	*8*	*11*	*9*	*15*	*24*	*39*	*76*	*63*	*43*	*58*	*32*	*80*	*93*	*4*	*22*	*29*	*52*	*28*	*7*	*9*
Rhizopoda																								
Arcella discoides Ehrenberg	2	2	-	1	-	4	3	-	-	4	4	-	3	14	4	2	13	-	-	8	-	6	4	-
A.megastoma Penard	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	8	-	6	4
A.vulgaris Ehrenberg-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	3	-	5	4	-	-
Centropyxis hemisphaerica (Barnard)	-	1	2	1	-	-	4	3	-	2	-	4	4	3	3	2	6	4	3	-	-	-	6	4
C.aculeata (Ehrenberg)	3	-	-	2	1	2	-	-	2	-	-	3	2	3	2	1	2	6	12	4	2	3	-	3
C.arcelloides Penard	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	-	-	8	6
Difflugia lebes Penard	1	-	2	-	-	1	-	-	3	4	-	2	8	10	7	6	5	18	24	12	6	4	10	-
D.urceolata Carter	-	2	-	-	-	2	-	1	-	2	-	-	4	2	4	3	3	10	8	7	-	5	2	3
D.oblonga Ehrenberg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	6	2	3	-	5
Euglypha ciliata Ehrenberg	-	1	-	-	2	-	-	-	-	-	2	-	2	2	1	3	2	-	14	6	-	4	-	2
Actinosphaerium eichhorni Ehrenberg	3	-	-	2	-	-	-	4	3	-	-	4	3	2	3	8	4	2	-	4	3	2	-	-
Species richness	*4*	*4*	*2*	*4*	*2*	*4*	*2*	*3*	*3*	*4*	*2*	*4*	*7*	*7*	*7*	*7*	*7*	*7*	*8*	*8*	*6*	*8*	*6*	*7*
Abundance(ind/l)	*9*	*6*	*4*	*6*	*13*	*9*	*7*	*8*	*8*	*10*	*6*	*13*	*26*	*36*	*24*	*25*	*35*	*40*	*70*	*49*	*26*	*31*	*36*	*26*
Ostracoda																								
Cypricercus sp.	3	4	-	-	-	4	1	-	3	4	2	6	2	2	6	3	2	-	-	4	-	3	4	-
Cypris sp.	-	-	3	-	-	2	-	4	-	-	-	3	1	2	2	4	1	-	2	-	1	-	2	-
Species richness	*1*	*1*	*1*	-	-	*2*	*1*	*1*	*1*	*1*	*1*	*2*	*2*	*2*	*2*	*2*	*2*	-	*1*	*1*	*1*	*1*	*2*	-
Abundance(ind/l)	*3*	*4*	*3*	-	-	*6*	*1*	*4*	*3*	*4*	*2*	*9*	*3*	*4*	*8*	*7*	*3*	-	*2*	*4*	*1*	*3*	*6*	-
Conchostraca sp.	-	2	-	-	-	-	-	1	-	-	3	4	2	3	2	1	4	-	-	-	2	-	-	1

Table: 61 Multiple Regression (R_1^2 and R_2^2) of Net Plankton in Deepor beel

Step-wise regression	Station I	Station II
$(X_1 - X_{16})$	R^2=0.696152	R^2=0.723027
$(X_1 - X_{15})$	R^2=0.549806	R^2=0.709872
$(X_1 - X_{14})$	R^2=0.549748	R^2=0.457652
$(X_1 - X_{13})$	R^2=0.547304	R^2=0.379506
$(X_1 - X_{12})$	R^2=0.448066	R^2=0.376546
$(X_1 - X_{11})$	R^2=0.43344	R^2=0.373532
$(X_1 - X_{10})$	R^2=0.161424	R^2=0.367951
$(X_1 - X_9)$	R^2=0.160849	R^2=0.362092
$(X_1 - X_8)$	R^2=0.160512	R^2=0.361437
$(X_1 - X_7)$	R^2=0.16017	R^2=0.354245
$(X_1 - X_6)$	R^2=0.112759	R^2=0.334983
$(X_1 - X_5)$	R^2=0.108582	R^2=0.314565
$(X_1 - X_4)$	R^2=0.102065	R^2=0.072094
$(X_1 - X_3)$	R^2=0.055545	R^2=0.06657
$(X_1 - X_2)$	R^2=0.048215	R^2=0.066512

Table: 62 Multiple Regression (R_1^2 and R_2^2) of Net plankton in Ghorajan beel

Step-wise regression	Station I	Station II
$(X_1 - X_{16})$	R^2=0.822773	R^2=0.778657
$(X_1 - X_{15})$	R^2=0.817147	R^2=0.776905
$(X_1 - X_{14})$	R^2=0.815328	R^2=0.764068
$(X_1 - X_{13})$	R^2=0.804697	R^2=0.747739
$(X_1 - X_{12})$	R^2=0.732793	R^2=0.643556
$(X_1 - X_{11})$	R^2=0.71359	R^2=0.611116
$(X_1 - X_{10})$	R^2=0.713112	R^2=0.553185
$(X_1 - X_9)$	R^2=0.712835	R^2=0.552975
$(X_1 - X_8)$	R^2=0.69619	R^2=0.482191
$(X_1 - X_7)$	R^2=0.653152	R^2=0.360873
$(X_1 - X_6)$	R^2=0.649769	R^2=0.339052
$(X_1 - X_5)$	R^2=0.645848	R^2=0.3348
$(X_1 - X_4)$	R^2=0.255945	R^2=0.114817
$(X_1 - X_3)$	R^2=0.249869	R^2=0.067414
$(X_1 - X_2)$	R^2=0.238374	R^2=0.057253

ZOOPLANKTON

The zooplankton of both the beels included six major groups namely, Rotifera, Cladocera, Copepoda, Rhizopoda, Ostracoda and Conchostraca. Of these, Rotifera showed qualitative abundance in their species composition and indicated 88 species at station I and 87 species at station II (Fig.-126) with spectrum of dominance as Rotifera > Cladocera (48 species at station I; 43 species at station II) > Rhizopoda (12 species at station I, 11 species at station II) > Copepoda (3 species at both the stations) > Ostracoda (2 species at both the stations) > Conchostraca (1 species at both the stations) in Deepor beel. 149 zooplankton taxa were identified from Deepor beel, which observed 149 species at station I and 147 species at station II. Zooplankton comprised an important component, which ranged between 172-565 (361.0 ±103.0) ind/l at station I and 146-382 (256.0 ±71.0) ind/l at station II of net plankton in Deepor beel (Tables 27 & 28) and significantly influenced their monthly abundance (r_1= 0.501, p<.05; r_2= 0.584, p<.01). However, ANOVA showed no significant differences between the months ($F_{1, 23}$ = 2.413, p>.001) as well as between the stations ($F_{1, 23}$ =4.673, p>.001) in first and second year ($F_{1, 23}$ =0.036, p>.001 between months; $F_{1, 23}$ = 0.004, p>.001 between stations). Its density exhibited a slightly different seasonal trend during the study period. However, January and May was found zooplankton with peak density of 565 ind/l at station I and 382 ind/l at station II. Relatively low zooplankton density was observed during monsoon season at station I. Most of the time, total zooplankton density showed a considerable temporal variation in both the years. Relatively low density of zooplankton was occurred from July to early November in the first year, only interrupted by the sudden peak in October at station I. It exhibited bimodal pattern of distribution, which showed a primary maxima during winter (December-January) and secondary maxima during summer season (July). Zooplankton exhibited significant positive correlations with Rotifera (r_1= 0.843, p<.001; r_2= 0.787, p<.001), Cladocera (r_1= 0.818, p<.001; r_2= 0.892, p<.001), Copepoda (r_1= 0.427, p<.05), Rhizopoda (r_1= 0.597, p<.01; r_2= 0.762, p<.001) and Ostracoda (r_1= 0.443, p<.05) in this beel. In addition, they exhibited significant positive relationships with magnesium (r_1= 0.423, p<.05) at station I and inversely correlated with water temperature (r_1= -0.465, p<.05) at station I in this beel. Species diversity using Shannan's index ranged between 2.532-3.634 (3.264 ±0.3) and 2.215-3.869 (3.234 ±0.35) at station I and II respectively in Deepor beel, while using Menhinick's index it fluctuated between 2.003-3.977 (3.316 ±0.5) and 2.092-4.373 (3.372 ±0.6) at station I and station II respectively (Tables 43 and 44). Dominance of zooplankton ranged between 0.069-0.236 (0.168 ±0.04) and 0.085-0.284 (0.163 ±0.04) at station I and II respectively (Tables 45 and 46). In addition, evenness showed the ranges 0.853-0.956 (0.891 ±0.03) at station I and 0.876-0.984 (0.939 ±0.03) at station II of Deepor beel (Tables 47 and 48).

On the other hand, Ghorajan beel registered 87 species at both stations of Rotifera (Fig.-127) with spectrum of dominance as Rotifera > Cladocera (42 species at station I, 42 species at station II) > Rhizopoda (12 species at station I, 11 species at station II) > Copepoda (3 species at both the stations) > Ostracoda (2species at both the stations) > Conchostraca (1 species at both the stations). Zooplankton also comprised an important component of net plankton in Ghorajan beel, abundance

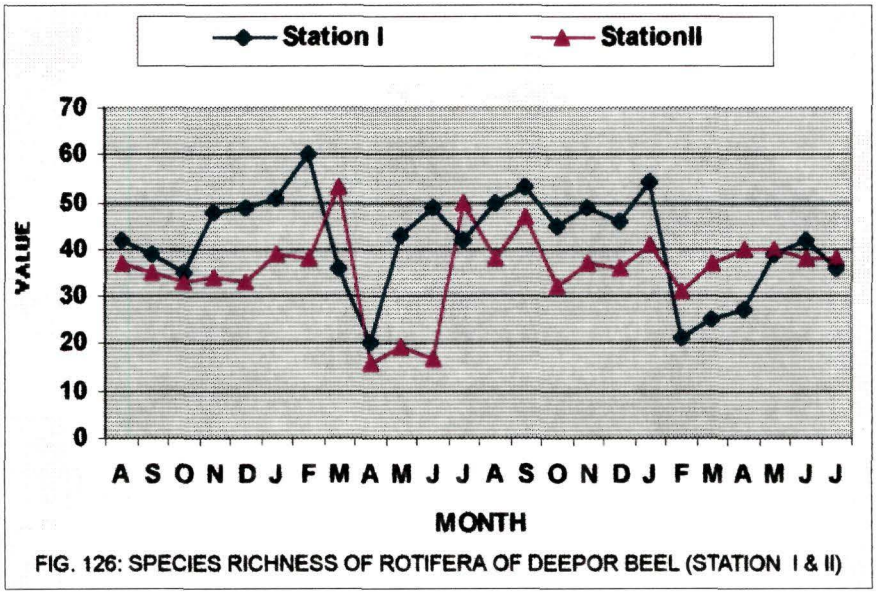


FIG. 126: SPECIES RICHNESS OF ROTIFERA OF DEEPOR BEEL (STATION I & II)

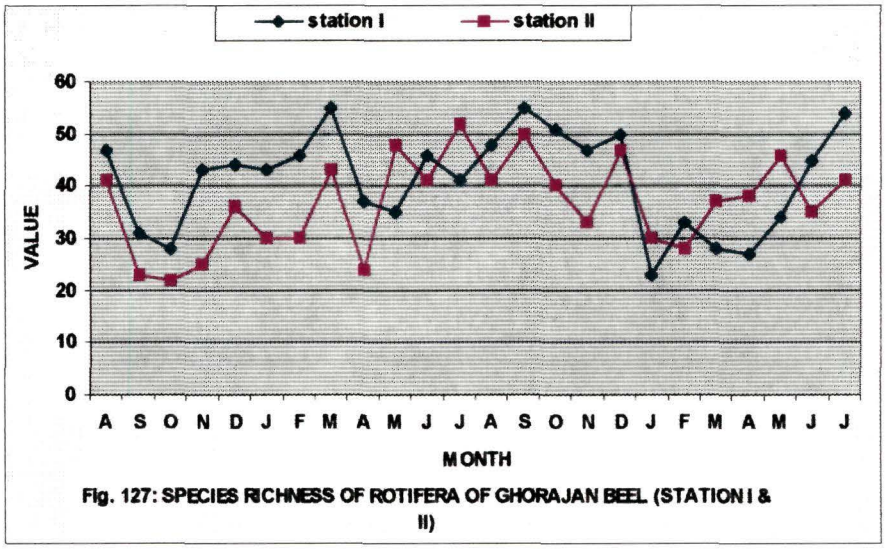


Fig. 127: SPECIES RICHNESS OF ROTIFERA OF GHORAJAN BEEL (STATION I & II)

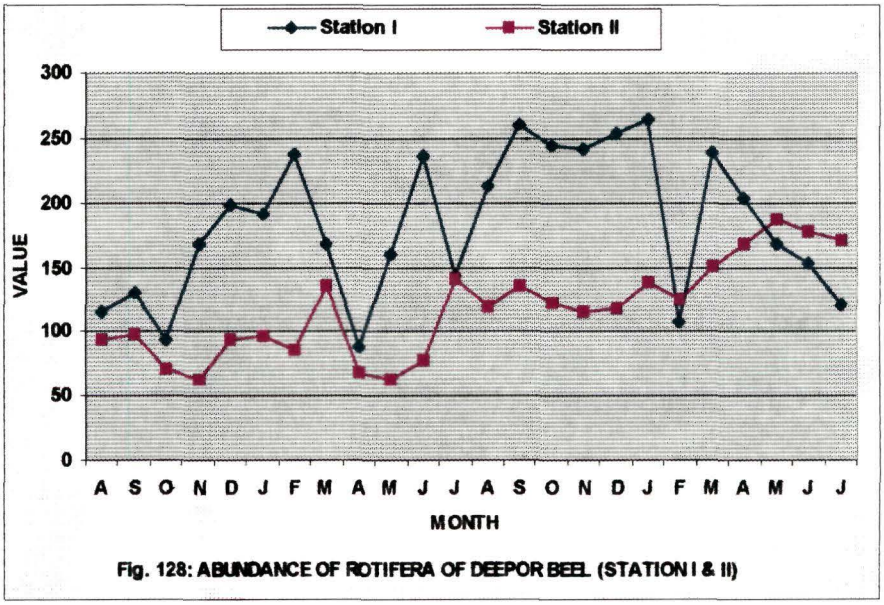


Fig. 128: ABUNDANCE OF ROTIFERA OF DEEPOR BEEL (STATION I & II)

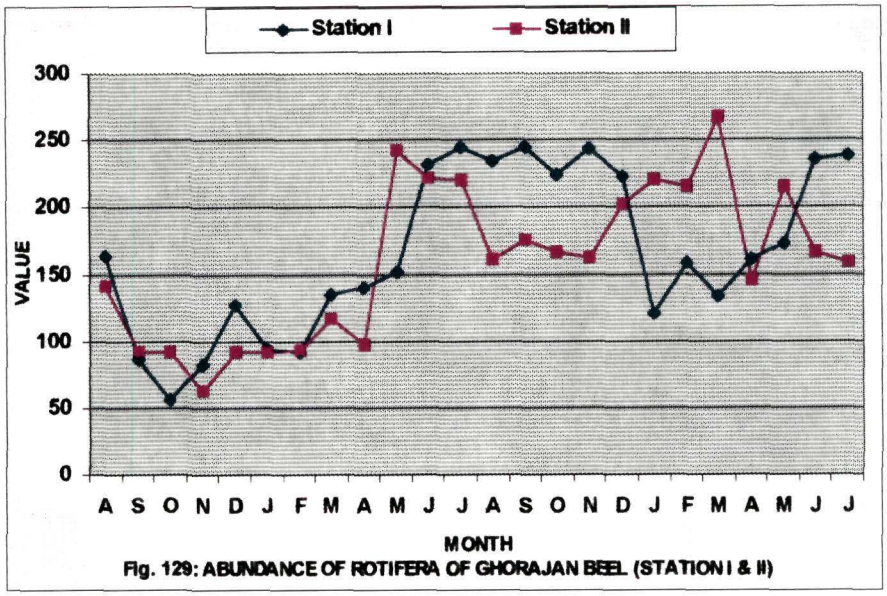


Fig. 129: ABUNDANCE OF ROTIFERA OF GHORAJAN BEEL (STATION I & II)

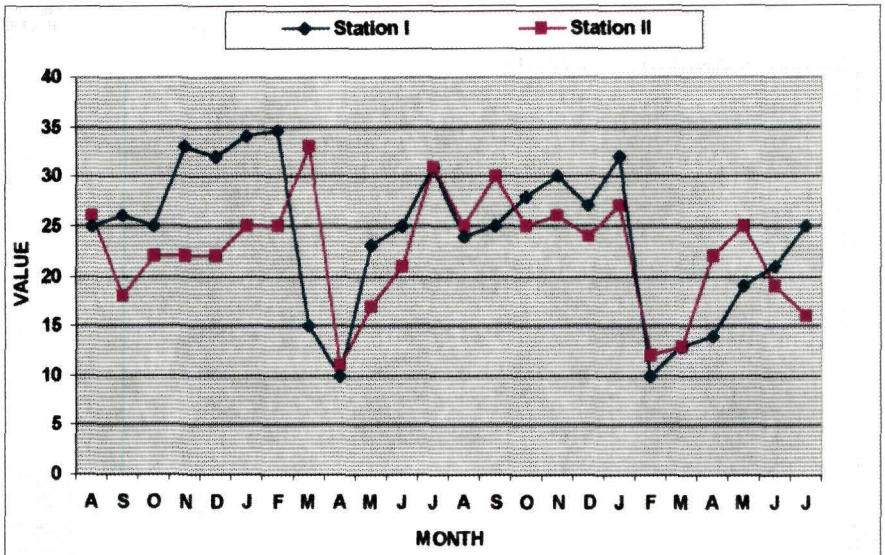


Fig. 130: SPECIES RICHNESS OF CLADOCERA OF DEEPOR BEEL (STATION I & II)

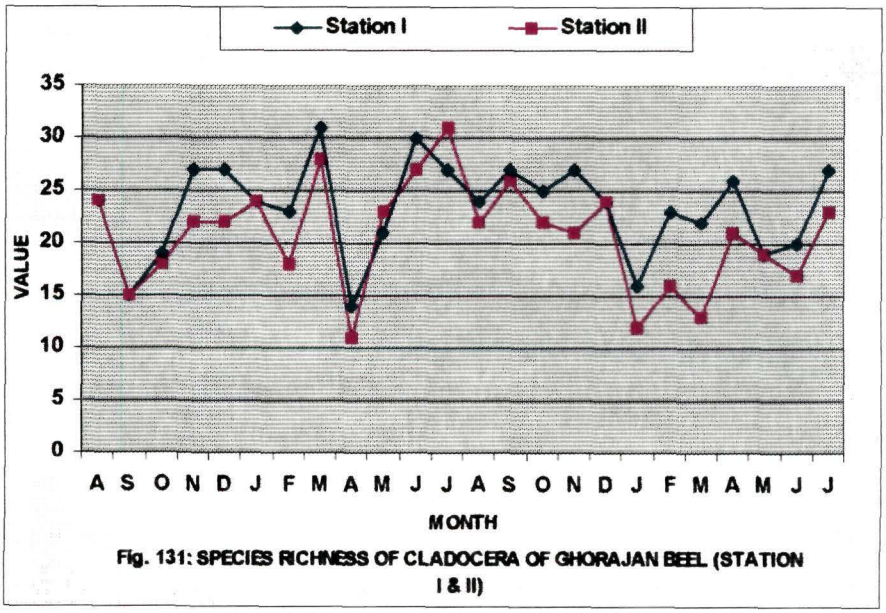


Fig. 131: SPECIES RICHNESS OF CLADOCERA OF GHORAJAN BEEL (STATION I & II)

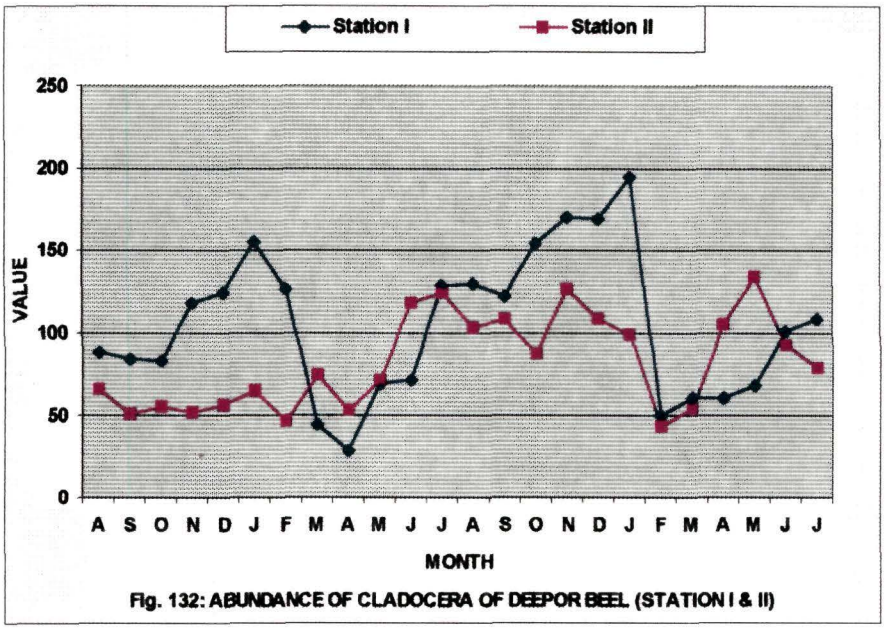


Fig. 132: ABUNDANCE OF CLADOCERA OF DEEPOR BEEL (STATION I & II)

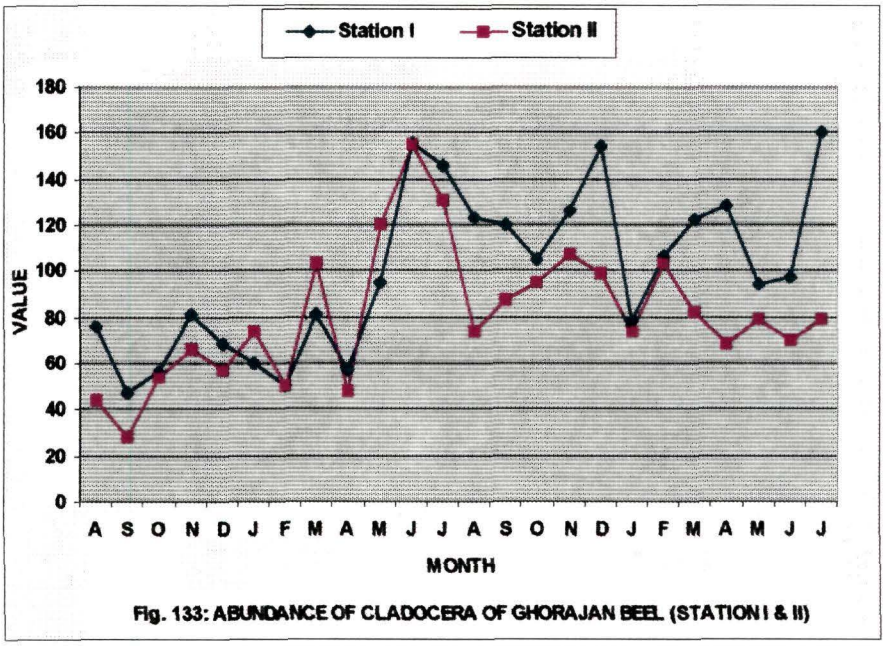
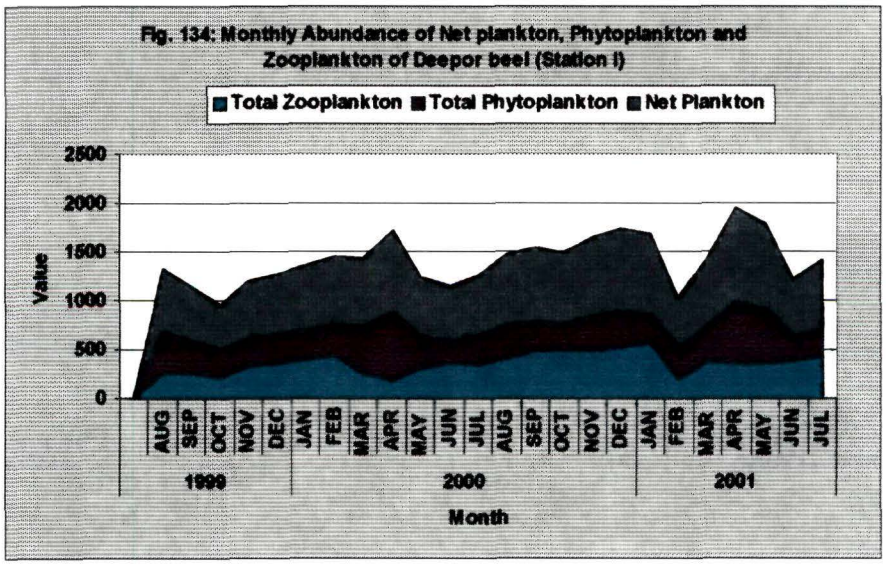


Fig. 133: ABUNDANCE OF CLADOCERA OF GHORAJAN BEEL (STATION I & II)



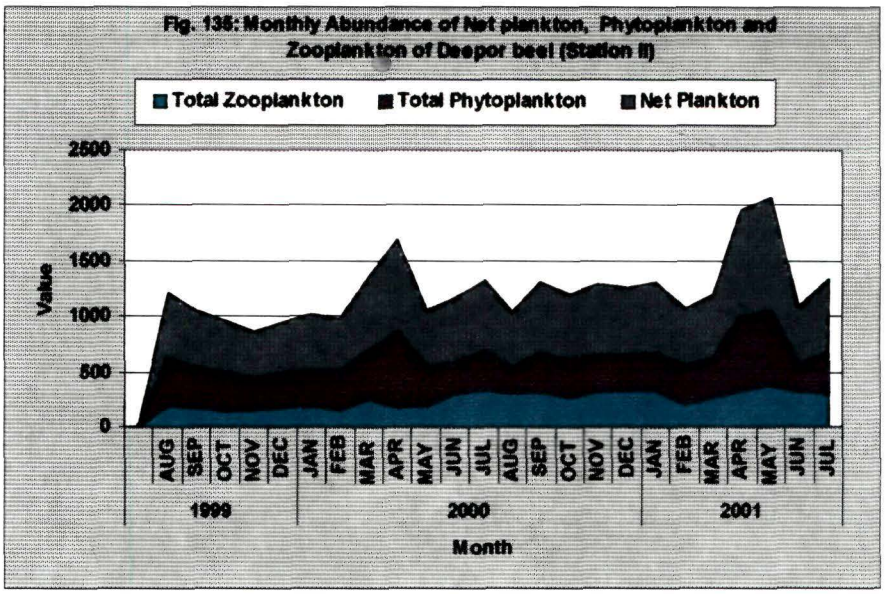


Fig. 135: Monthly Abundance of Net plankton, Phytoplankton and Zooplankton of Deepor beel (Station II)

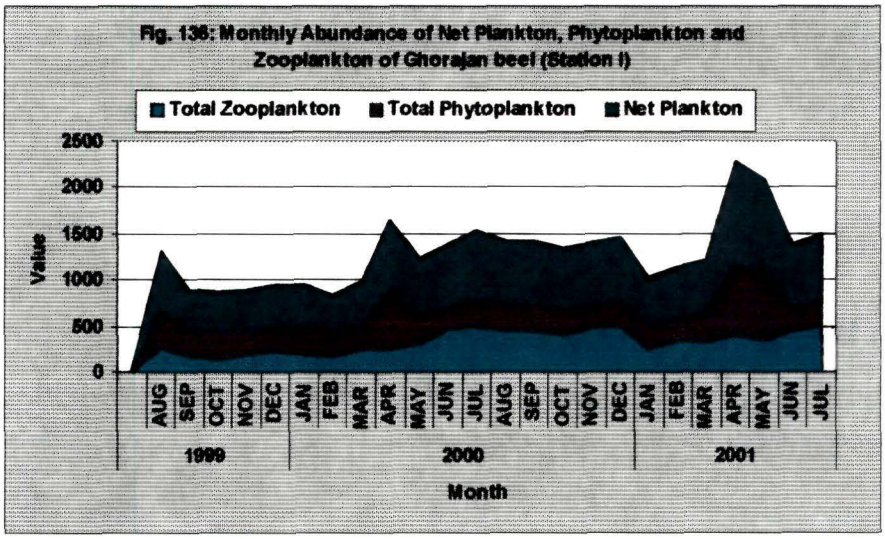


Fig. 136: Monthly Abundance of Net Plankton, Phytoplankton and Zooplankton of Ghorajan beel (Station I)

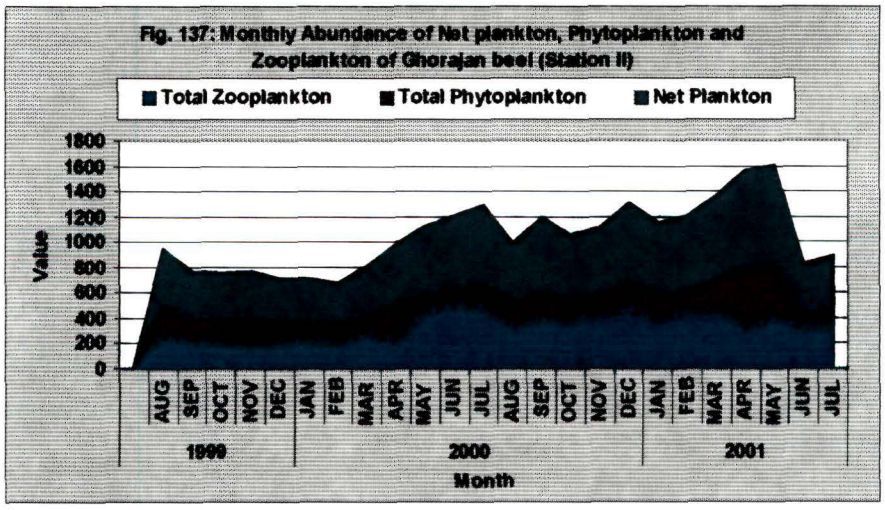


Fig. 137: Monthly Abundance of Net plankton, Phytoplankton and Zooplankton of Ghorajan beel (Station II)

Table: 31 Abundance of Zooplankton, Phytoplankton and Net plankton of Deepor beel (Station I)

	1999					2000											2001								
	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	RANGE	MEAN ±SD
Zooplankton	250	244	208	323	361	392	420	255	172	307	351	332	418	485	483	489	523	565	195	368	359	358	378	432	172-565	361.0 ±103.0
Phytoplankton	412	323	267	272	276	287	306	455	682	307	219	294	315	282	258	333	347	275	310	347	610	539	230	270	219-682	342.0 ±115.0
Net Plankton	662	567	475	595	637	679	726	710	854	614	570	626	733	767	741	822	870	840	505	715	969	897	608	702	475-969	703.0 ±124.0

Table: 32 Abundance of Zooplankton, Phytoplankton and Net plankton of Deepor beel (Station II)

	1999					2000												2001								
	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	RANGE	MEAN ±SD
Zooplankton	192	183	146	160	182	189	159	249	175	197	297	327	300	326	268	319	331	332	206	269	332	382	318	306	146-382	256.0± 71.0
Phytoplankton	412	340	332	271	291	319	329	425	668	331	281	334	221	328	328	324	299	324	331	332	650	654	222	363	221-668	362.0 ±120.0
Net Plankton	604	523	478	431	473	508	488	674	843	528	578	661	521	654	596	643	630	656	537	601	982	1036	540	669	431-1036	618.0 ±146.5

Table: 33 Abundance of Zooplankton, Phytoplankton and Net plankton of Ghorajan beel (Station I)

	1999					2000												2001								
	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	RANGE	MEAN ±SD
Zooplankton	259	165	133	187	222	181	163	244	252	301	450	487	443	432	394	480	486	253	333	322	407	349	433	483	133-487	327.0 ±117.0
Phytoplankton	392	283	298	254	248	293	251	249	576	313	239	278	270	282	275	220	246	255	238	281	727	697	256	267	220-727	320.0 ±137.0
Net Plankton	651	448	431	441	470	474	414	493	828	614	689	765	713	714	669	700	732	508	571	603	1134	1046	689	750	414-1134	647.0 ±179.0

Table: 34 Abundance of Zooplankton, Phytoplankton and Net plankton of Ghorajan beel (Station II)

	1999					2000												2001								
	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	RANGE	MEAN ±SD
Zooplankton	222	193	167	152	160	192	160	247	180	415	464	440	309	363	328	383	436	338	412	431	294	356	285	273	152-464	300.0 ±102.0
Phytoplankton	255	195	212	235	200	167	175	157	318	145	138	204	188	234	200	174	220	240	194	250	486	449	130	172	130-486	222.0 ±85.0
Net Plankton	477	388	379	387	360	359	335	404	498	560	602	644	497	597	528	557	656	578	606	681	780	804	415	445	335-804	522.0 ±130.0

ranged between 133-487 (327.0 ±117.0) ind/l at station I and between 152-464 (300.0 ±102.0) ind/l at station II (Tables 29 & 30) and was positively correlated with net plankton (r_1= 0.647, p<.01; r_2= 0.76, p<.001). This study depicted a bimodal pattern of zooplankton abundance, with a peak during summer (July), and another a maxima during winter (November-December) in this beel. The present observations registered inverse correlations between zooplankton vs. transparency (r_1= -0.513, p<.01; r_2= -0.404, p<.05) in this beel. They exhibited significant positive correlations with Rotifera (r_1= 0.958, p<.001; r_2= 0.933, p<.001), Cladocera (r_1= 0.919, p<.001; r_2= 0.808, p<.001), Copepoda (r_1= 0.859, p<.001; r_2= 0.599, p<.01)), Rhizopoda (r_1= 0.472, p<.05; r_2 = 0.576, p<.01) and Ostracoda (r_1= 0.439, p<.05) in this beel. Zooplankton registered significant correlations with total alkalinity (r_1= 0.524, p<.01; r_2= 0.558, p<.01), phosphate (r_1= 0.45, p<.05; r_2= 0.413, p<.05), BOD (r_1= 0.612, p<.01), specific conductivity (r_2= 0.428, p<.05), total hardness (r_2= 0.525, p<.01), calcium (r_2= 0.472, p<.05), magnesium (r_2= 0.419, p<.05) and phosphate (r_2= 0.413, p<.05) in this beel. However, ANOVA showed significant differences between the months ($F_{1, 23}$ = 4.35, p>.001) as well as between the stations ($F_{1, 23}$ = 6.69, p>.001) in first and in second year, it exhibited significant differences between the months ($F_{1, 23}$ =10.24, p>.001) and no significant differences between the stations ($F_{1, 23}$ = 0.198, p>.001). In Ghorajan beel, species diversity ranged between 3.007-3.978 (3.458 ±0.25) at station I and 2.943-3.784 (3.344 ±0.22) at station II using Shannan's index and it fluctuated between 3.015-4.536 (3.525 ±0.4) at station I and 2.919-4.002 (3.348 ±0.3) using Menhinick's index (Tables 49 and 50). Dominance of zooplankton fluctuated between 0.123-0.251 (0.184 ±0.03) at station I and 0.135-0.297 (0.197 ±0.03) at station II (Tables 51 and 52). On the other hand, evenness of this beel showed ranges 0.895-0.976 (0.924 ±0.02) at station I and 0.886-0.987 (0.927 ±0.02) at station II (Tables 53 and 54).

The numerical abundance of Rotifera was apparently high; it ranged between 94-265 (183.0 ±55.0) ind/l at station I and 62-187 (117.0 ±36.0) ind/l at station II in Deepor beel (Fig.-128). ANOVA showed significant differences between the stations ($F_{1, 23}$ = 5.318, p>.001) and no significant differences between the months ($F_{1, 23}$ = 1.509, p>.001) in first year and in second year, it exhibited no significant differences between the months ($F_{1, 23}$ = 1.82, p>.001) and between the stations ($F_{1, 23}$ = 0.84, p>.001). The beel registered species diversity of Rotifera using Shannon's index was 2.528-3.594 (3.208 ±0.3) at station I and 2.585-3.657 (3.224 ±0.25) at station II. While using Menhinick's index ranged between 1.617-3.899 (3.117 ±0.6) at station I and between 1.94-4.545 (3.346 ±0.7) at station II. Among various documented species of rotifers *Lecane leontina* (47 ind/l) achieved highly pronounced peak during March in the second year followed by *Euchlanis dilatata* (42 ind/l) during December in the first year; *Brachionus calyciflorus* (42 ind/l) during April in the second year; *Testudinella patina* (38 ind/l), during March in the second year; *Brachionus falcatus* (32 ind/l) in the second year at station I. On the other hand, *Asplanchna priodonta* (22 ind/l) attained peak during July in the second year followed by *lecane leontina* (18 ind/l) during April in the second year; *Euchlanis dilatata* (17 ind/l) during July in the second year; *Brachionus falcatus* (16 ind/l) at station II in Deepor beel. The dominant component contributed significantly to net plankton (r_1=0.456, p<.05; r_2= 0.56, p<.01) and zooplankton (r_1= 0.843, p<.001; r_2= 0.787,

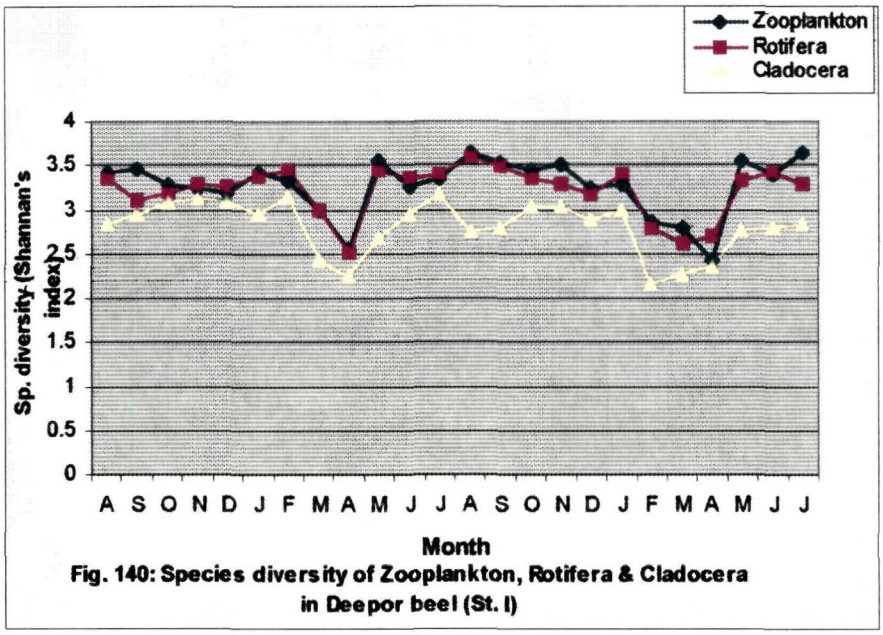


Fig. 140: Species diversity of Zooplankton, Rotifera & Cladocera in Deepor beel (St. I)

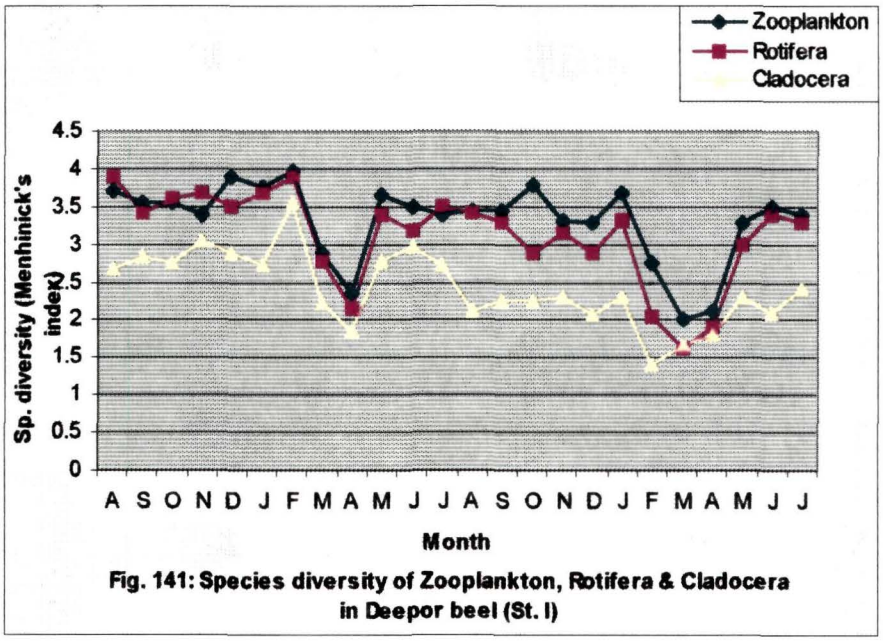


Fig. 141: Species diversity of Zooplankton, Rotifera & Cladocera in Deepor beel (St. I)

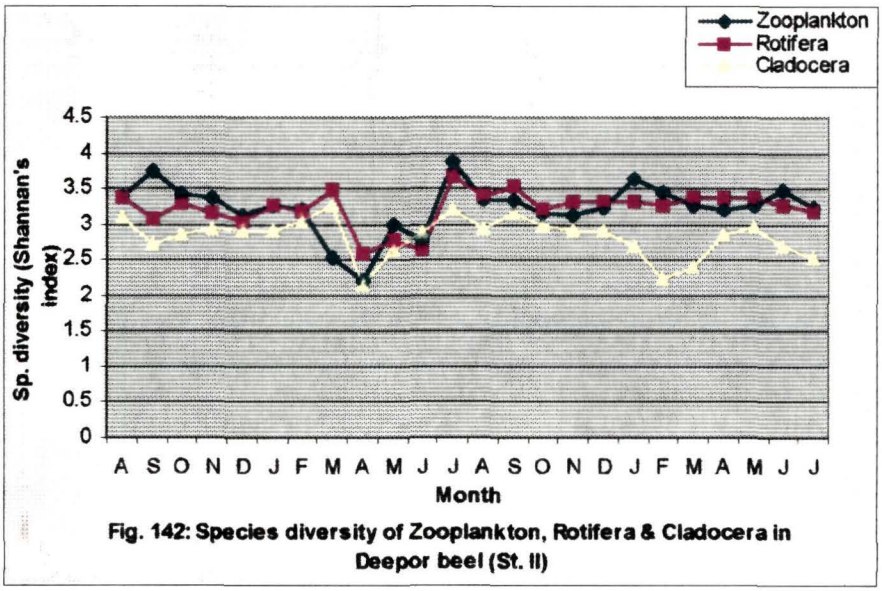


Fig. 142: Species diversity of Zooplankton, Rotifera & Cladocera in Deepor beel (St. II)

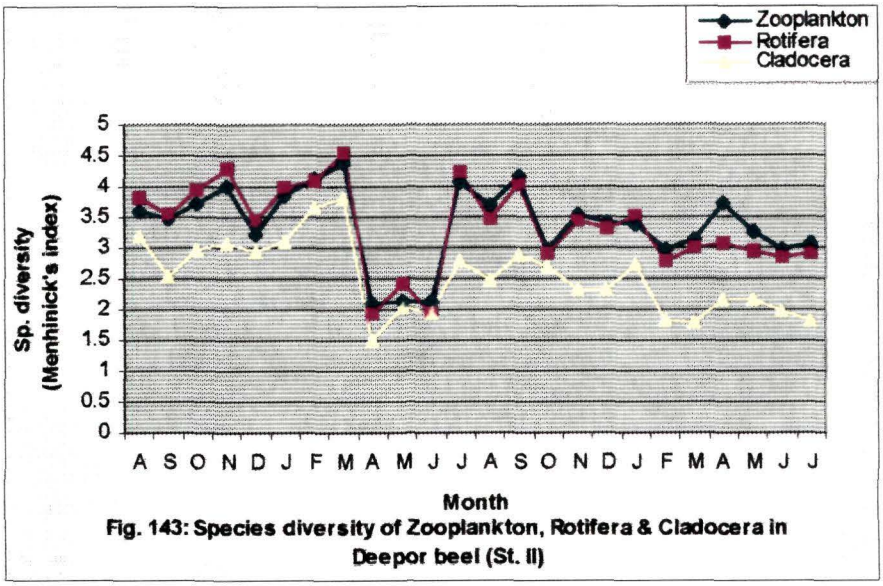


Fig. 143: Species diversity of Zooplankton, Rotifera & Cladocera in Deepor beel (St. II)

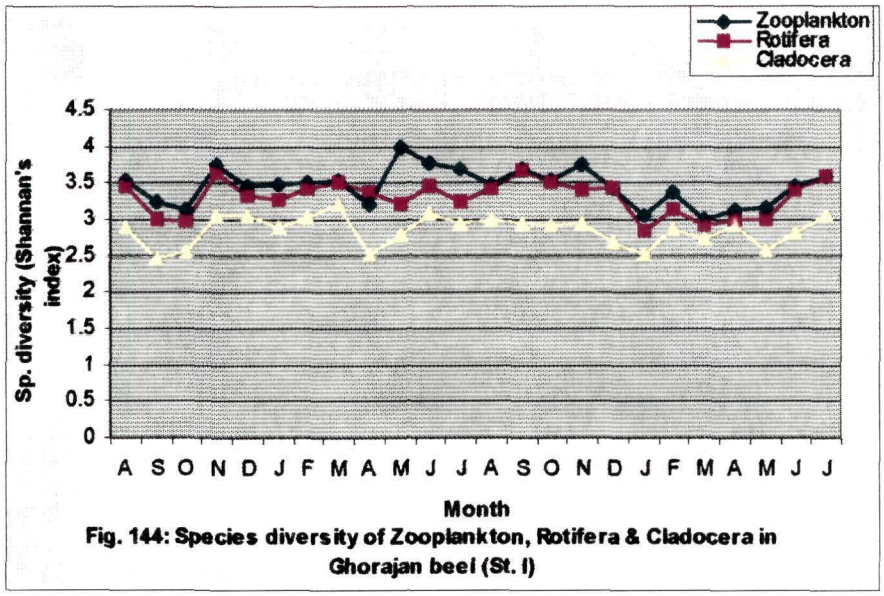


Fig. 144: Species diversity of Zooplankton, Rotifera & Cladocera in Ghorajan beel (St. I)

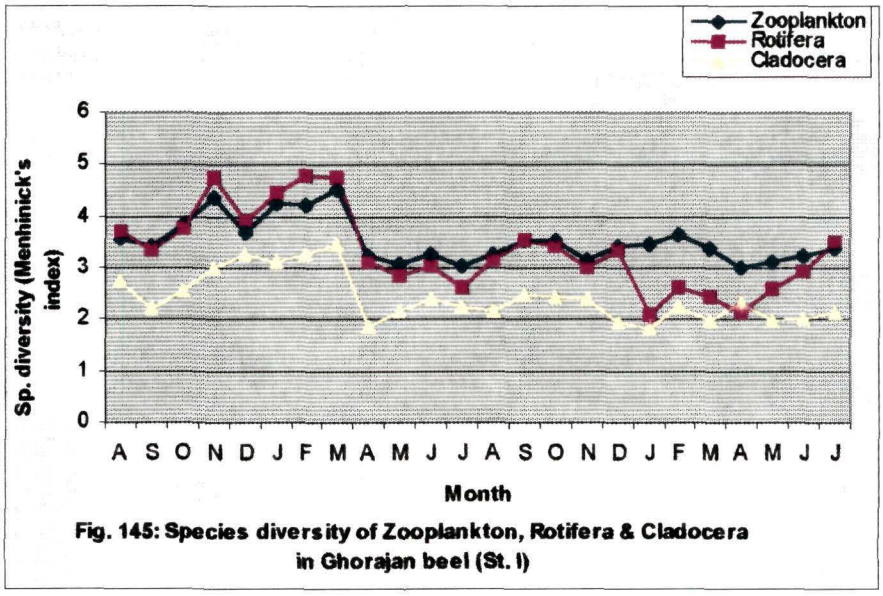


Fig. 145: Species diversity of Zooplankton, Rotifera & Cladocera in Ghorajan beel (St. I)

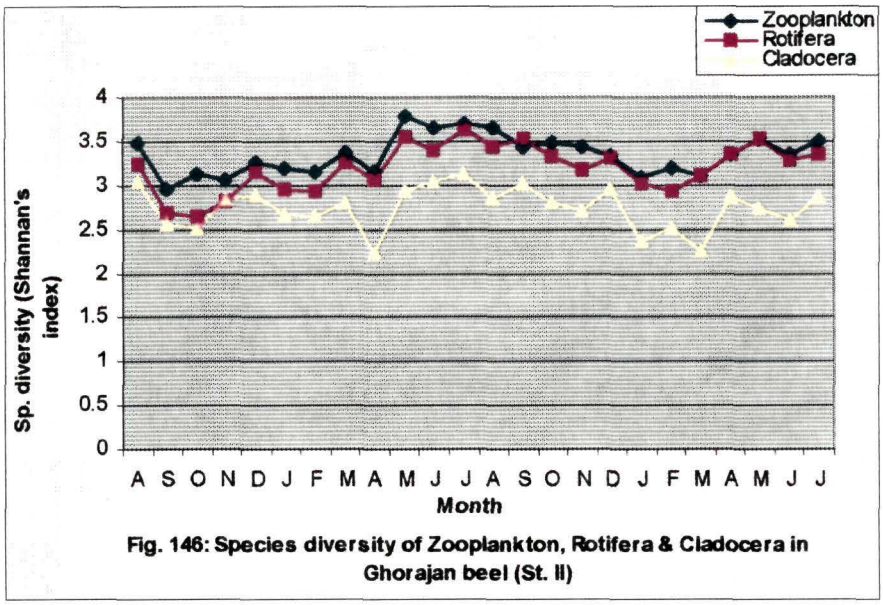


Fig. 146: Species diversity of Zooplankton, Rotifera & Cladocera in Ghorajan beel (St. II)

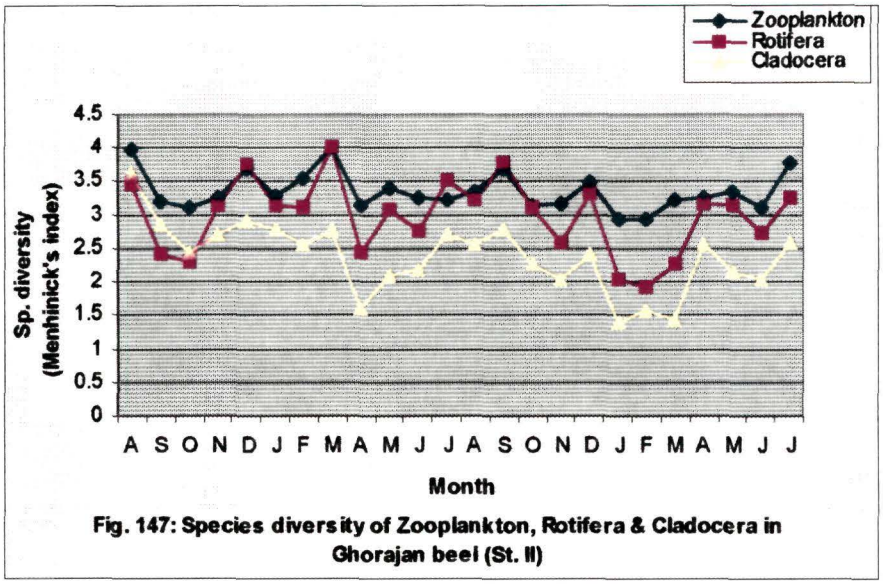


Fig. 147: Species diversity of Zooplankton, Rotifera & Cladocera in Ghorajan beel (St. II)

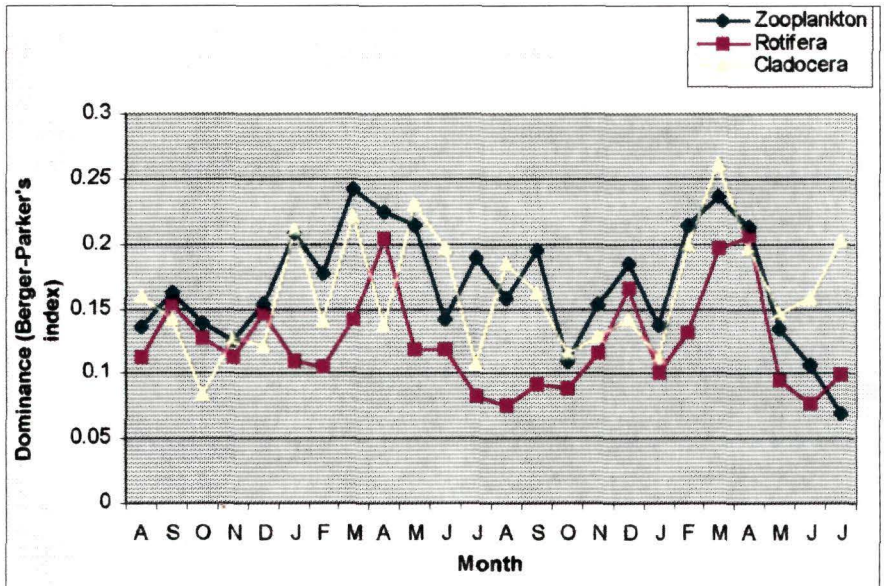


Fig. 148: Dominance of Zooplankton, Rotifera & Cladocera in Deepor beel (St. I)

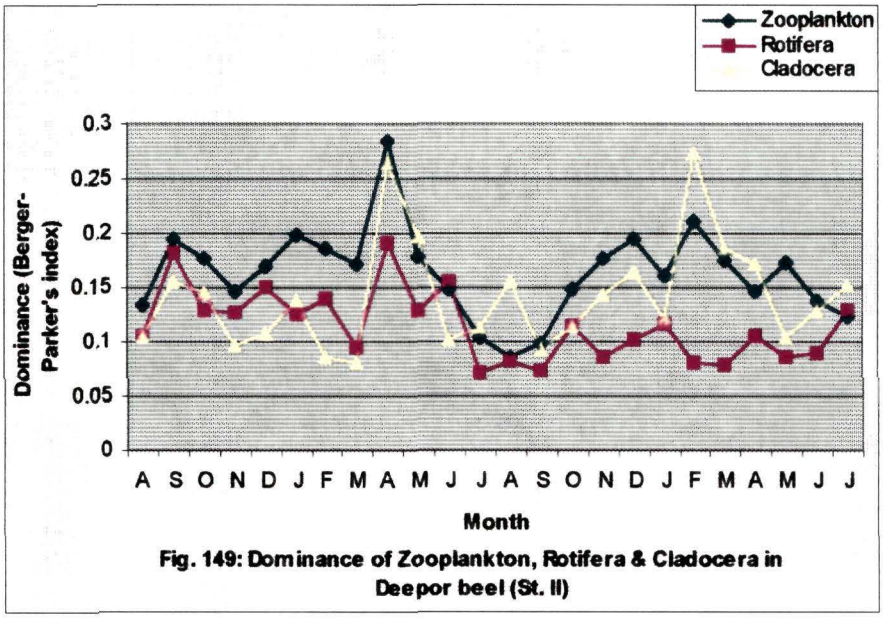


Fig. 149: Dominance of Zooplankton, Rotifera & Cladocera in Deepor beel (St. II)

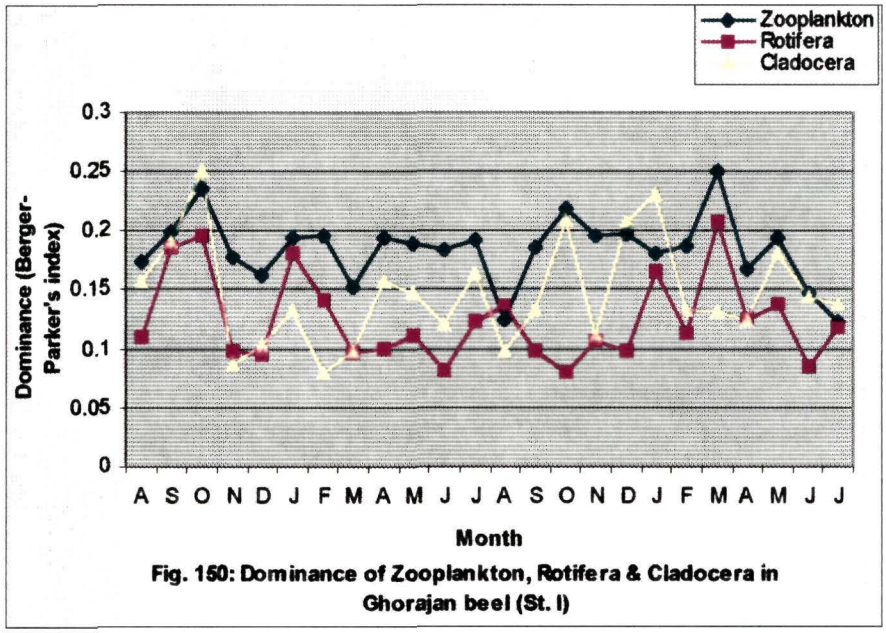


Fig. 150: Dominance of Zooplankton, Rotifera & Cladocera in Ghorajan beel (St. I)

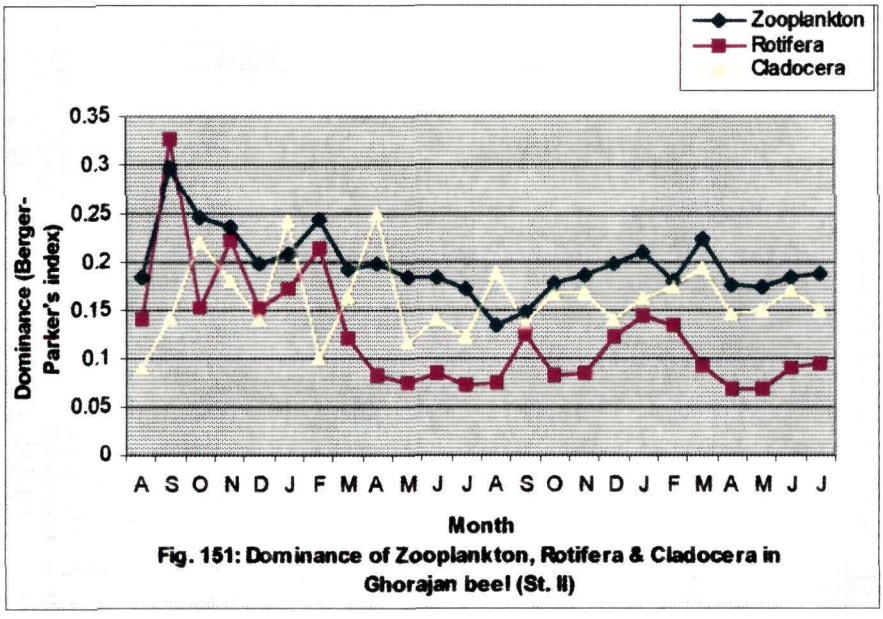


Fig. 151: Dominance of Zooplankton, Rotifera & Cladocera in Ghorajan beel (St. II)

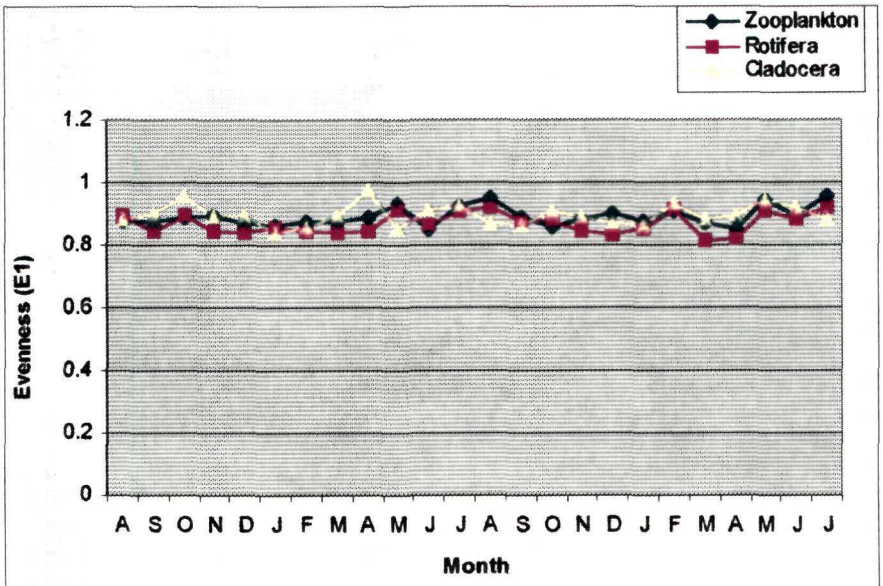


Fig. 152: Evenness of Zooplankton, Rotifera & Cladocera in Deepor beel (St. I)

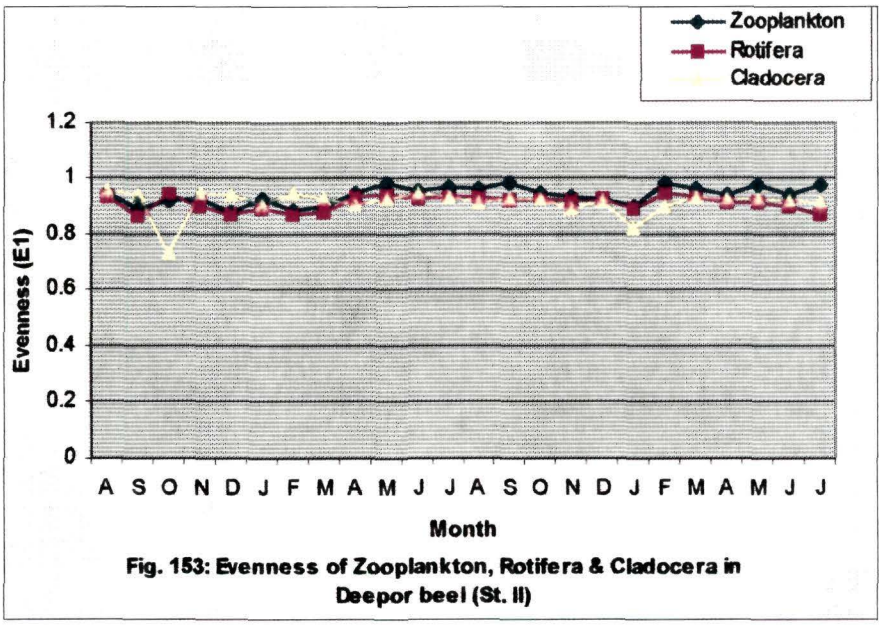


Fig. 153: Evenness of Zooplankton, Rotifera & Cladocera in Deepor beel (St. II)

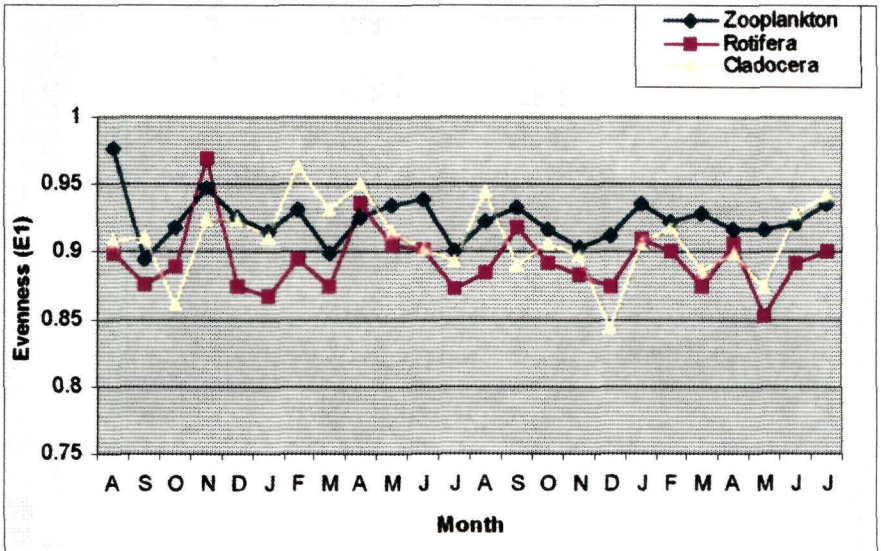


Fig. 154: Evenness of Zooplankton, Rotifera & Cladocera in Ghorajan beel (St. I)

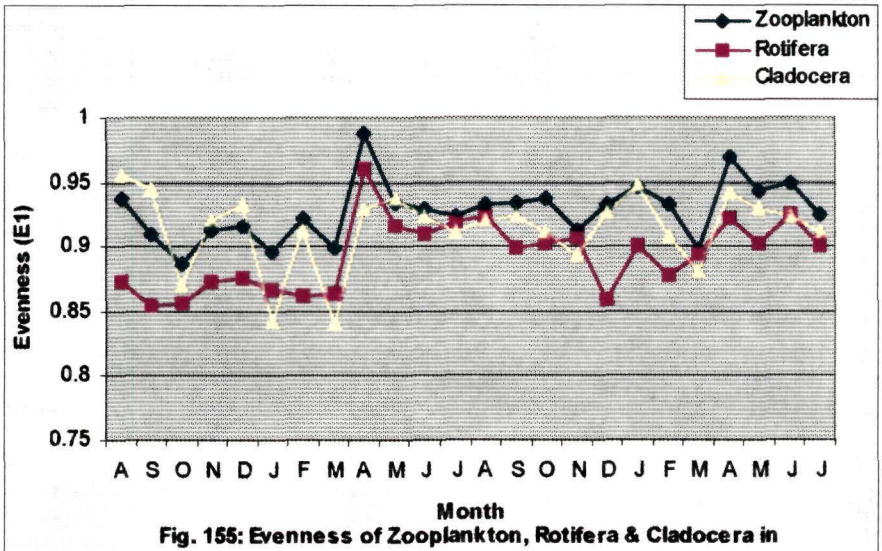


Fig. 155: Evenness of Zooplankton, Rotifera & Cladocera in Ghorajan beel (St. II)

$p<.001$). It depicted significant positive relationships with Cladocera ($r_1= 0.597$, $p<.01$; $r_2= 0.502$, $p<.01$) and Rhizopoda ($r_1= 0.426$, $p<.05$; $r_2= 0.668$, $p<.001$) and also with phosphate ($r_2= 0.57$, $p<.01$) and inversely correlated with water temperature ($r_1= 0.415$, $p<.05$), free carbon dioxide ($r_2= 0.57$, $p<.01$) and silicate ($r_2= 0.417$, $p<.05$) in this beel. During the course of study, Berger-parker's index of dominance registered 0.075-0.206 (0.124 ±0.04) at station I and 0.071-0.183 (0.114 ±0.03) at station II in Deepor beel. Evenness of rotifers using E1 ranged between 0.81-0.919 (0.867 ±0.03) at station I and 0.864 –0.947 (0.911 ±0.02) at station II of Deepor beel.

On the other hand, Ghorajan beel registered Rotifera abundance 56-245 (166.0 ±60.0) ind/l at station I and 92-267 ind/l (159.0 ±56.0) at station II (Fig.-129), which contributed significantly to net plankton ($r_1= 0.474$, $p<.05$; $r_2=0.751$, $p<.001$) and zooplankton ($r_1= 0.958$, $p<.001$; $r_2= 0.933$, $p<.001$). ANOVA showed significant differences between the stations ($F_{1, 23} =5.838$, $p>.001$) and insignificant differences between the months ($F_{11, 23} = 2.485$, $p>.001$) in first year and in second year, they exhibited insignificant differences both between the months ($F_{1, 23} = 2.485$, $p>.001$) and between the stations ($F_{1, 23} = 0.688$, $p>.001$). Ghorajan beel exhibited species diversity of rotifers using Shannon's index 2.851-3.679 (3.301 ±0.2) at station I and 2.647-3.628 (3.194 ±0.26) at station II. While using Menhinick's index it ranged between 2.091-4.796 (3.319 ±0.8) at station I and 1.909-3.992 (2.979 ±0.5) at station II. *Sinantherina spinosa* (30 ind/l) achieved maximum density during July in the first year followed by *Asplanchna priodonta* (28 ind/l) during July in the same year; *Euchlanis dilatata* (28 ind/l) during July in the second year and *Brachionus falcatus* (20 ind/l) during April in the second year at station I, while *Polyarthra vulgaris* (32 ind/l) attained peak during January in the second year followed by *Asplanchna priodonta* (30 ind/l) during September in the first year, *Lecane bulla* (22 ind/l) during March in the second year and *Euchlanis dilatata* (22 ind/l) during February in the second year at station II in Ghorajan beel. It depicted significant positive relationships with free carbon dioxide ($r_1= 0.425$, $p<.05$), total alkalinity ($r_1= 0.48$, $p<.05$) and BOD ($r_1= 0.586$, $p<.01$) in this beel. Berger-Parker's index of dominance ranged between 0.08-0.208 (0.124 ±0.04) at station I and 0.068-0.326 (0.125 ±0.06) at station II in Ghorajan beel. The beel exhibited evenness using E1 ranged between 0.853-0.969 (0.894 ±0.02) at station I and 0.855-0.925 (0.892 ±0.027) at station II.

In the present investigation, cladocerans comprised another important component of zooplankton in Deepor beel. The quantitative abundance of Cladocera ranged between 29-195 ind/l (104.0 ±43.0) at station I this beel, while station II recorded 44-134 ind/l (82.0 ±28.0) (Fig.-132). They, however, depicted a multimodal annual pattern and recorded lowest abundance in April in the first year but maximum cladocerans density was noticed during January in the second year with a secondary maxima in November in the second year followed by a tertiary maxima during January in the first year at station I, while this group showed minimum density in April in the first year. On the other hand, station II depicted peak density in May in the second year with secondary maxima in July in the first year and a minimum density in February in the second year. Cladocera had their peak during February in the first year when they were represented by 40 species but number of species was

Table: 35 Correlation co-efficient (r_1) between abiotic and biotic factors of Deepor beel (station I)

	Water temperature	pH	Transparency	Sp. conductivity	Dissolved oxygen	Free carbon dioxide	Total alkalinity	Total hardness	Calcium	Magnesium	Chloride	Phosphate	Sulphate	Nitrate	Silicate	BOD	Sodium	Potassium
Net plankton	-0.193	0.089	0.127	0.027	-0.008	0.096	0.027	0.128	0.108	0.071	-0.172	0.226	-0.181	-0.227	-0.166	0.289	-0.153	-0.176
Phytoplankton	0.211	-0.119	0.206	0.182	-0.054	0.237	-0.002	0.107	0.289	-0.305	0.117	0.029	-0.229	-0.062	-0.286	0.309	-0.158	-0.247
Chlorophyta	0.212	-0.193	0.165	0.173	-0.053	0.238	-0.003	0.021	0.192	-0.267	0.064	0.203	-0.128	-0.057	-0.253	0.243	-0.191	-0.199
Bacillariophyta	0.263	0.023	0.164	0.306	-0.059	0.193	0.081	0.273	0.419*	-0.264	0.184	-0.142	-0.17	-0.098	-0.251	0.288	-0.141	-0.214
Cyanophyta	0.168	-0.004	0.115	0.244	0.122	0.304	-0.15	0.254	0.397	-0.416*	0.458*	-0.187	-0.317	-0.138	-0.439*	0.454*	-0.233	-0.455*
Euglenophyta	0.32	0.067	0.071	0.367	-0.205	0.026	0.057	0.217	0.338	-0.18	0.215	-0.315	-0.355	-0.013	-0.124	0.048	-0.146	-0.074
Dinophyta	-0.141	-0.312	0.304	-0.431*	0.009	0.069	0.111	-0.214	-0.151	-0.066	-0.563Δ	-0.033	0.196	0.196	0.092	0.156	0.204	0.073
Chrysophyta	0.245	-0.037	0.126	0.271	-0.408*	0.024	-0.171	0.061	0.068	-0.043	0.123	0.226	-0.313	-0.201	-0.14	-0.116	-0.174	-0.086
Zooplankton	-0.465*	0.238	-0.076	-0.169	0.049	-0.148	0.036	0.011	-0.193	0.423*	-0.336	0.243	0.038	-0.199	0.119	0.003	-0.006	0.054
Rotifera	-0.415*	0.301	0.139	-0.205	0.065	-0.075	0.006	0.1	-0.147	0.384	-0.277	-0.041	-0.167	-0.257	0.158	-0.003	0.112	0.042
Cladocera	-0.691©	0.185	0.102	-0.3	0.06	-0.182	-0.077	-0.095	-0.224	0.347	-0.077	0.028	0.249	-0.139	0.065	-0.079	0.061	-0.043
Copepoda	0.266	0.003	-0.448*	0.274	-0.089	-0.027	0.235	0.036	-0.019	0.253	-0.284	0.679©	-0.034	0.022	-0.005	0.106	-0.302	0.141
Rhizopoda	-0.115	-0.091	-0.169	-0.197	-0.068	-0.126	0.038	-0.261	-0.215	-0.036	-0.569Δ	0.521Δ	0.279	-0.065	0.141	-0.105	0.092	0.211

Level of Significance: p*<.05; pΔ<.01; p©<.001

Table: 36 Correlation co-efficient (r_2) between abiotic and biotic factors of Deepor beel (station II)

	Water temperature	pH	Transparency	Sp. conductivity	Dissolved oxygen	Free carbon dioxide	Total alkalinity	Total hardness	Calcium	Magnesium	Chloride	Phosphate	Sulphate	Nitrate	Silicate	BOD	Sodium	Potassium
Net plankton	0.068	0.123	0.083	-0.226	0.052	0.062	-0.003	0.207	0.087	-0.024	0.188	0.423*	-0.093	0.116	0.157	0.138	-0.018	-0.162
Phytoplankton	0.177	0.024	0.129	0.322	-0.153	0.368	0.149	0.004	0.334	0.043	-0.309	0.033	0.421*	-0.036	-0.064	0.207	-0.148	0.096
Chlorophyta	0.122	-0.203	0.067	0.428*	-0.092	-0.149	0.233	0.141	-0.023	-0.142	0.136	-0.327	-0.172	-0.166	0.125	0.332	0.207	-0.112
Bacillariophyta	-0.092	0.163	0.243	0.101	0.115	0.262	0.139	0.296	0.208	0.321	0.008	0.162	0.263	0.041	-0.039	0.426*	0.172	-0.097
Cyanophyta	0.147	-0.028	0.462*	0.409*	0.262	0.107	-0.042	0.122	-0.146	0.136	-0.182	0.278	0.176	-0.129	0.267	0.137	-0.062	0.242
Euglenophyta	0.325	0.283	-0.086	0.096	0.073	-0.008	-0.048	0.087	-0.032	0.203	0.326	-0.126	-0.042	-0.202	0.028	-0.204	0.028	0.329
Dinophyta	-0.121	0.188	0.157	0.238	0.164	0.372	0.163	-0.143	0.327	0.197	-0.131	-0.162	0.232	0.109	-0.122	0.043	-0.156	0.203
Chrysophyta	0.309	0.046	0.202	0.124	0.006	0.168	0.216	0.023	0.202	-0.148	0.148	0.261	0.149	0.223	-0.056	-0.191	0.032	0.126
Zooplankton	0.059	-0.022	-0.399	0.179	-0.086	-0.076	0.231	0.007	-0.077	0.122	-0.359	0.338	0.317	-0.212	-0.344	0.199	0.167	0.245
Rotifera	0.127	0.093	-0.404	0.277	-0.167	-0.57Δ	-0.043	-0.162	-0.155	-0.156	-0.233	0.57Δ	0.341	-0.299	-0.417*	-0.151	0.029	-0.056
Cladocera	0.063	0.124	0.052	-0.306	0.261	0.207	0.122	0.366	0.128	0.269	0.129	0.361	-0.163	0.268	0.178	0.007	-0.146	0.117
Copepoda	0.159	-0.193	0.166	0.317	0.152	-0.142	0.294	0.152	0.241	-0.126	0.062	-0.146	0.209	-0.176	-0.202	-0.112	0.271	-0.232
Rhizopoda	-0.092	0.322	-0.029	0.052	-0.193	-0.097	-0.056	-0.102	0.067	0.008	-0.103	0.203	-0.122	0.047	-0.066	0.223	-0.133	0.006

Level of Significance: p*<.05; pΔ<.01; p©<.001

Table: 37 Correlation co-efficient (r_1) between abiotic and biotic factors of Ghorajan beel (station I)

	Water temperature	pH	Transparency	Sp. conductivity	Dissolved oxygen	Free carbon dioxide	Total alkalinity	Total hardness	Calcium	Magnesium	Chloride	Phosphate	Sulphate	Nitrate	Silicate	BOD	Sodium	Potassium
Net plankton	0.287	-0.165	-0.358	0.423*	0.033	0.373	0.596Δ	0.385	0.409*	0.306	-0.05	0.517Δ	-0.008	0.019	0.476*	0.375	0.183	-0.2
Phytoplankton	0.308	0.013	-0.032	0.289	-0.151	0.109	0.335	0.189	0.271	0.088	-0.019	0.294	-0.143	0.016	-0.168	-0.034	0.049	-0.146
Chlorophyta	0.305	-0.012	-0.033	0.392	-0.166	0.087	0.289	0.147	0.241	0.056	-0.009	0.222	-0.127	0.05	-0.071	-0.032	0.131	-0.092
Bacillariophyta	0.189	0.219	0.102	0.195	-0.185	-0.315	0.113	0.119	0.033	0.159	0.277	-0.151	-0.079	0.109	-0.158	-0.165	-0.026	0.163
Cyanophyta	0.203	-0.028	-0.021	0.299	0.003	0.182	0.226	0.116	0.218	-0.001	0.014	0.184	-0.114	-0.07	-0.298	0.018	-0.051	-0.2
Euglenophyta	0.101	0.044	-0.082	0.431*	-0.209	-0.053	0.269	0.391	0.382	0.291	-0.167	0.595Δ	-0.204	-0.188	-0.192	-0.013	-0.072	-0.104
Dinophyta	0.287	-0.077	-0.138	0.22	-0.051	0.457*	0.495*	0.184	0.273	0.099	-0.321	0.729©	-0.047	-0.001	-0.119	0.042	-0.09	-0.465*
Chrysophyta	0.055	0.205	0.093	0.401	-0.231	-0.145	0.171	0.402	0.412*	0.059	0.039	0.095	-0.187	-0.232	-0.117	0.082	0.131	0.328
Zooplankton	0.079	-0.271	-0.513Δ	0.305	0.227	0.279	0.524Δ	0.371	0.31	0.366	-0.054	0.45*	0.155	0.011	0.206	0.612Δ	0.223	-0.137
Rotifera	0.128	-0.186	-0.574Δ	0.219	0.229	0.425*	0.48*	0.274	0.271	0.225	-0.073	0.357	0.158	0.008	0.049	0.586Δ	0.105	-0.121
Cladocera	0.051	-0.355	-0.489*	0.295	0.179	0.383	0.478*	0.437*	0.263	0.495*	0.005	0.349	0.155	0.169	0.129	0.562Δ	0.347	-0.013
Copepoda	-0.103	-0.338	-0.279	0.261	0.331	0.459*	0.418*	0.223	0.23	0.269	-0.087	0.439*	0.159	-0.172	-0.261	0.571Δ	0.222	-0.271
Rhizopoda	0.109	-0.002	-0.317	0.493*	-0.072	0.176	0.452*	0.514Δ	0.408*	0.504Δ	-0.023	0.843©	-0.094	-0.205	-0.119	0.166	0.089	-0.262

Level of Significance: p*<.05; pΔ<.01; p©<.001

Table: 38 Correlation co-efficient (r_2) between abiotic and biotic factors of Ghorajan beel (station II)

	Water temperature	pH	Transparency	Sp. conductivity	Dissolved oxygen	Free carbon dioxide	Total alkalinity	Total hardness	Calcium	Magnesium	Chloride	Phosphate	Sulphate	Nitrate	Silicate	BOD	Sodium	Potassium
Net plankton	0.308	-0.263	-0.107	0.362	0.165	0.461*	0.416*	0.372	0.312	-0.052	0.272	0.432*	-0.009	0.025	0.396	-0.092	0.142	-0.153
Phytoplankton	0.106	-0.223	0.163	0.428*	-0.124	0.029	0.267	0.229	0.242	0.046	-0.168	0.348	0.162	0.143	0.232	0.097	0.147	0.346
Chlorophyta	0.068	0.172	0.126	0.293	-0.036	0.062	0.432*	0.116	0.176	0.142	-0.263	0.243	-0.062	0.124	-0.163	0.036	0.142	-0.082
Bacillariophyta	0.172	-0.093	0.163	0.176	0.166	-0.326	0.164	0.328	0.214	0.062	0.241	0.164	-0.073	0.106	-0.283	-0.083	-0.053	0.129
Cyanophyta	0.324	0.074	-0.092	0.246	-0.177	0.242	0.249	0.125	0.411*	0.054	-0.046	0.386	0.127	0.067	0.204	-0.029	-0.124	0.237
Euglenophyta	0.073	-0.142	0.238	0.169	-0.107	0.246	0.158	0.328	0.092	-0.128	0.327	0.276	-0.065	0.076	0.152	0.076	0.226	0.206
Dinophyta	0.166	-0.029	-0.174	0.422*	-0.133	0.186	0.328	0.118	0.392	0.186	-0.306	-0.262	-0.208	-0.186	-0.142	0.089	0.163	-0.302
Chrysophyta	0.162	0.322	0.072	0.377	-0.208	-0.176	0.256	0.262	0.297	0.324	-0.108	0.176	-0.086	0.228	0.363	0.362	-0.066	0.327
Zooplankton	0.187	0.046	-0.404	0.428*	-0.053	0.22	0.558Δ	0.525Δ	0.472*	0.419*	0.265	0.413*	0.186	0.113	-0.263	0.383	0.229	0.188
Rotifera	0.246	0.122	-0.093	0.387	0.142	0.057	0.267	0.238	0.168	0.204	0.124	0.272	0.225	0.296	-0.072	0.052	-0.176	0.245
Cladocera	0.098	-0.203	0.147	0.289	-0.185	-0.042	0.238	0.295	0.315	-0.065	-0.057	0.148	0.092	0.128	-0.167	0.209	0.146	0.029
Copepoda	0.198	-0.286	-0.167	0.278	0.147	0.169	0.427*	0.363	0.328	0.175	-0.078	0.214	0.166	0.296	-0.302	0.423*	-0.168	0.278
Rhizopoda	0.292	0.062	-0.082	0.326	0.228	-0.209	0.202	0.485*	0.278	0.233	-0.122	0.329	0.044	0.173	-0.092	0.283	0.243	0.397

Level of Significance: p*<.05; pΔ<.01; p©<.001

Table: 39 Correlation coefficient (r_1) between biotic factors of Deepor beel (Station I)

	Total phytoplankton	chlorophyta	Bacillariophyta	Cyanophyta	Euglenophyta	Dinophyta	Chrysophyta	Zooplankton	Rotifera	Cladocera	Copepoda	Rhizopoda	Ostracoda
Net plankton	0.626Δ	0.619Δ	0.598Δ	0.271	0.397	0.622Δ	0.39	0.501*	0.456*	0.198	0.463*	0.417*	0.151
Phytoplankton	-	0.963©	0.701©	0.782©	0.802©	0.442*	0.737©	-0.361	-0.267	-0.523Δ	0.114	-0.089	-0.236
Chlorophyta		-	0.861©	0.697©	0.738©	0.421*	0.729©	-0.328	-0.268	-0.477*	0.234	-0.024	-0.149
Bacillariophyta			-	0.74©	0.837©	0.345	0.704©	-0.337	-0.165	-0.552Δ	0.148	-0.077	-0.236
Cyanophyta				-	0.553Δ	-0.045	0.516Δ	-0.545Δ	-0.4	-0.488*	-0.208	-0.455*	-0.311
Euglenophyta					-	0.279	0.606Δ	-0.416*	-0.296	-0.619Δ	0.126	-0.124	-0.192
Dinophyta						-	0.194	0.253	0.312	0.054	0.108	0.387	-0.013
Chrysophyta							-	-0.591Δ	-0.209	-0.522Δ	0.068	-0.047	-0.394
Zooplankton								-	0.843©	0.818©	0.427*	0.597Δ	0.443*
Rotifera									-	0.597Δ	0.069	0.426*	0.07
Cladocera										-	0.068	0.397	0.301
Copepoda											-	0.558Δ	0.634©
Rhizopoda												-	0.404

Level of Significance: p*<.05; pΔ<.01; p©<.001

Table: 40 Correlation coefficient (r_2) between biotic factors of Deepor beel (Station II)

	Total phytoplankton	chlorophyta	Bacillariophyta	Cyanophyta	Euglenophyta	Dinophyta	Chrysophyta	Zooplankton	Rotifera	Cladocera	Copepoda	Rhizopoda	Ostracoda
Net plankton	0.878©	0.798©	0.736©	0.851©	0.609Δ	0.499*	0.031	0.584Δ	0.56Δ	0.514Δ	0.2	0.275	-0.345
Phytoplankton	-	0.949©	0.892©	0.907©	0.695©	0.414*	0.08	0.124	0.104	-0.07	0.059	-0.113	-0.298
Chlorophyta		-	0.793©	0.787©	0.581Δ	0.225	0.033	-0.099	0.149	0.092	0.032	-0.207	-0.353
Bacillariophyta			-	0.769©	0.677©	0.3	0.037	0.028	0.172	-0.045	0.029	-0.119	-0.338
Cyanophyta				-	0.645©	0.409*	0.006	0.227	0.29	0.188	0.095	0.019	-0.323
Euglenophyta					-	0.319	-0.184	0.083	-0.005	-0.049	-0.057	-0.014	-0.051
Dinophyta						-	0.373	0.333	0.275	0.225	0.183	0.183	0.39
Chrysophyta							-	-0.071	0.052	-0.169	-0.135	-0.037	0.135
Zooplankton								-	0.787©	0.892©	0.316	0.762©	0.346
Rotifera									-	0.502Δ	-0.264	0.668©	0.2
Cladocera										-	0.511Δ	0.513Δ	0.244
Copepoda											-	0.035	0.037
Rhizopoda												-	0.361

Level of Significance: p*<.05; pΔ<.01; p©<.001

Table: 41 Correlation coefficient (r_1) between biotic factors of Ghorajan beel (Station I)

	Total phytoplankton	chlorophyta	Bacillariophyta	Cyanophyta	Euglenophyta	Dinophyta	Chrysophyta	Zooplankton	Rotifera	Cladocera	Copepoda	Rhizopoda	Ostracoda
Net plankton	0.759©	0.746©	0.315	0.717©	0.599Δ	0.319	0.265	0.647©	0.474*	0.535Δ	0.698©	0.572Δ	0.109
Phytoplankton	-	0.982©	0.674©	0.949©	0.678©	0.152	0.511Δ	-0.005	-0.082	-0.082	0.178	0.347	-0.232
Chlorophyta		-	0.633©	0.912©	0.631©	0.044	0.505Δ	-0.005	-0.083	-0.074	0.183	0.298	-0.198
Bacillariophyta			-	0.575Δ	0.297	-0.254	0.546Δ	-0.624Δ	-0.371	-0.222	-0.232	-0.026	-0.078
Cyanophyta				-	0.589Δ	0.271	0.416*	-0.012	-0.071	-0.122	0.225	0.269	-0.307
Euglenophyta					-	0.153	0.534Δ	0.126	-0.021	0.113	0.229	0.672©	-0.246
Dinophyta						-	-0.201	0.312	0.336	0.156	0.267	0.468*	-0.078
Chrysophyta							-	-0.617Δ	-0.285	-0.124	-0.075	0.109	-0.073
Zooplankton								-	0.958©	0.919©	0.859©	0.472*	0.439*
Rotifera									-	0.814©	0.775©	0.315	0.427*
Cladocera										-	0.71©	0.427*	0.513Δ
Copepoda											-	0.468*	0.222
Rhizopoda												-	-0.151

Level of Significance: p*<.05; pΔ<.01; p©<.001

Table: 42 Correlation coefficient (r_2) between biotic factors of Ghorajan beel (Station II)

	Total phytoplankton	chlorophyta	Bacillariophyta	Cyanophyta	Euglenophyta	Dinophyta	Chrysophyta	Zooplankton	Rotifera	Cladocera	Copepoda	Rhizopoda	Ostracoda
Net plankton	0.621Δ	0.526Δ	0.644©	0.508Δ	0.183	0.508Δ	0.411*	0.76©	0.751©	0.446*	0.445*	0.546Δ	0.099
Phytoplankton	-	0.962©	0.938©	0.82©	0.195	0.665©	0.628Δ	-0.035	0.032	-0.287	0.043	0.146	-0.238
Chlorophyta		-	0.924©	0.696©	0.116	0.542Δ	0.603Δ	-0.126	-0.025	-0.351	-0.117	0.151	-0.268
Bacillariophyta			-	0.663©	0.211	0.514Δ	0.652©	0.044	0.124	-0.189	-0.016	0.254	-0.273
Cyanophyta				-	0.074	0.498*	0.604Δ	-0.029	-0.034	-0.186	0.231	-0.126	0.032
Euglenophyta					-	0.123	0.139	0.071	-0.065	-0.035	0.335	0.216	-0.16
Dinophyta						-	0.083	0.101	0.119	-0.189	0.215	0.21	-0.272
Chrysophyta							-	0.003	0.04	-0.126	0.073	0.021	-0.104
Zooplankto								-	0.933©	0.808©	0.599Δ	0.576Δ	0.324
Rotifera									-	0.657©	0.345	0.627Δ	0.208
Cladocera										-	0.475*	0.194	0.337
Copepoda											-	0.047	0.341
Rhizopoda												-	0.004

Level of Significance: p*<.05; pΔ<.01; p©<.001

TABLE: 43 SPECIES DIVERSITY OF ZOOPLANKTON, ROTIFERA AND CLADOCERA OF DEEPOR BEEL(STATION I)

Shannan's index																									
	1999					2000											2001								
	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	RANGE	MEAN ±SD
ZOOPLANKTON	3.422	3.467	3.288	3.239	3.189	3.412	3.337	2.987	2.532	3.542	3.265	3.342	3.634	3.534	3.447	3.511	3.242	3.286	2.844	2.797	2.421	3.552	3.398	3.639	2.532-3.634	3.264 ±0.3
ROTIFERA	3.348	3.092	3.184	3.270	3.252	3.364	3.444	2.996	2.528	3.428	3.348	3.398	3.594	3.478	3.341	3.275	3.174	3.390	2.779	2.608	2.691	3.321	3.409	3.288	2.528-3.594	3.208 ±0.3
CLADOCERA	2.835	2.945	3.072	3.124	3.100	2.951	3.157	2.426	2.246	2.669	2.941	3.178	2.751	2.785	3.023	3.024	2.871	3.000	2.151	2.261	2.356	2.774	2.794	2.836	2.151-3.178	2.803 ±0.3
MENHINICK'S INDEX																										
ZOOPLANKTON	3.699	3.557	3.545	3.391	3.895	3.752	3.977	2.884	2.352	3.646	3.496	3.376	3.453	3.429	3.796	3.316	3.282	3.686	2.742	2.003	2.121	3.287	3.498	3.394	2.003-3.977	3.316 ±0.5
ROTIFERA	3.899	3.420	3.610	3.692	3.482	3.68	3.889	2.777	2.132	3.399	3.189	3.500	3.426	3.287	2.875	3.156	2.886	3.317	2.03	1.617	1.895	3.000	3.384	3.272	1.617-3.899	3.117 ±0.6
CLADOCERA	2.665	2.836	2.744	3.038	2.873	2.731	3.549	2.236	1.857	2.769	2.967	2.729	2.105	2.263	2.256	2.301	2.076	2.291	1.414	1.664	1.792	2.304	2.089	2.405	1.414-3.549	2.414 ±0.5

TABLE: 44 SPECIES DIVERSITY OF ZOOPLANKTON, ROTIFERA AND CLADOCERA OF DEEPOR BEEL (STATION II)

SHANNON'S INDEX																										
	1999					2000												2001								
	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	RANGE	MEAN ±SD
ZOOPLANKTON	3.385	3.758	3.426	3.376	3.116	3.248	3.215	2.536	2.215	2.978	2.765	3.869	3.348	3.334	3.154	3.117	3.243	3.646	3.438	3.267	3.215	3.252	3.485	3.239	2.215-3.869	3.234 ±0.35
ROTIFERA	3.373	3.074	3.283	3.159	3.034	3.261	3.168	3.489	2.585	2.775	2.633	3.657	3.396	3.543	3.209	3.326	3.306	3.304	3.252	3.372	3.368	3.373	3.269	3.172	2.585-3.657	3.224 ±0.25
CLADOCERA	3.099	2.728	2.854	2.937	2.906	2.915	3.052	3.251	2.164	2.634	2.881	3.194	2.939	3.145	2.990	2.912	2.913	2.697	2.226	2.393	2.861	2.970	2.699	2.529	2.164-3.251	2.828 ±0.27
MENHINICK'S INDEX																										
ZOOPLANKTON	3.586	3.465	3.728	4.004	3.217	3.836	4.121	4.373	2.092	2.137	2.132	4.047	3.692	4.147	2.973	3.539	3.418	3.375	2.964	3.116	3.704	3.254	2.956	3.064	2.092-4.373	3.372 ±0.6
ROTIFERA	3.816	3.535	3.944	4.283	3.422	3.980	4.097	4.545	1.940	2.413	1.937	4.210	3.469	4.030	2.897	3.435	3.314	3.490	2.773	3.011	3.077	2.925	2.848	2.906	1.94-4.545	3.346 ±0.7
CLADOCERA	3.2	2.52	2.966	3.05	2.939	3.100	3.646	3.81	1.510	2.017	1.933	2.784	2.463	2.873	2.68	2.307	2.299	2.714	1.809	1.769	2.147	2.159	1.970	1.800	1.51-3.81	2.519 ±0.6

TABLE: 45 DOMINANCE OF ZOOPLANKTON, ROTIFERA AND CLADOCERA OF DEEPOR BEEL (STATION I)

Berger-Parker's index																									
	1999					2000											2001								
	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	RANGE	MEAN ±SD
ZOOPLANKTON	0.136	0.163	0.139	0.126	0.154	0.209	0.178	0.242	0.224	0.215	0.142	0.189	0.158	0.195	0.109	0.154	0.185	0.138	0.215	0.236	0.213	0.134	0.107	0.069	0.069-0.236	0.168 ±0.04
ROTIFERA	0.112	0.153	0.127	0.112	0.146	0.109	0.105	0.142	0.204	0.118	0.118	0.083	0.075	0.092	0.089	0.116	0.165	0.101	0.131	0.196	0.206	0.094	0.077	0.099	0.075-0.206	0.124 ±0.04
CLADOCERA	0.159	0.142	0.084	0.127	0.121	0.212	0.141	0.222	0.137	0.231	0.197	0.108	0.184	0.163	0.116	0.129	0.142	0.112	0.2	0.262	0.196	0.147	0.158	0.203	0.084-0.262	0.162 ±0.04

TABLE: 46 DOMINANCE OF ZOOPLANKTON, ROTIFERA AND CLADOCERA OF DEEPOR BEEL (STATION II)

Berger-Parker's index																									
	1999					2000											2001								
	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	RANGE	MEAN ±SD
ZOOPLANKTON	0.134	0.194	0.176	0.147	0.169	0.199	0.185	0.172	0.284	0.178	0.148	0.103	0.085	0.098	0.149	0.176	0.195	0.161	0.211	0.175	0.146	0.174	0.137	0.124	0.085-0.284	0.163 ±0.04
ROTIFERA	0.106	0.183	0.128	0.126	0.15	0.125	0.139	0.095	0.191	0.129	0.155	0.071	0.083	0.073	0.115	0.086	0.102	0.116	0.08	0.079	0.106	0.085	0.089	0.129	0.071-0.183	0.114 ±0.03
CLADOCERA	0.106	0.156	0.145	0.096	0.107	0.138	0.085	0.08	0.264	0.197	0.101	0.112	0.155	0.092	0.115	0.142	0.165	0.121	0.273	0.185	0.171	0.104	0.129	0.152	0.08-0.273	0.141 ±0.05

TABLE: 47 EVENNESS OF ZOOPLANKTON, ROTIFERA AND CLADOCERA OF DEEPOR BEEL (STATION I)

$$E_1 = \frac{H'}{\ln S}$$

	1999					2000												2001								
	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	RANGE	MEAN ±SD
ZOOPLANKTON	0.878	0.874	0.889	0.896	0.868	0.865	0.875	0.876	0.886	0.932	0.853	0.927	0.953	0.885	0.857	0.884	0.897	0.872	0.905	0.869	0.849	0.945	0.891	0.956	0.853-0.956	0.891 ±0.03
ROTIFERA	0.895	0.844	0.895	0.844	0.835	0.855	0.841	0.836	0.844	0.911	0.86	0.909	0.919	0.876	0.877	0.841	0.829	0.85	0.913	0.81	0.816	0.907	0.877	0.918	0.81-0.919	0.867 ±0.03
CLADOCERA	0.88	0.903	0.954	0.893	0.894	0.836	0.856	0.895	0.975	0.851	0.913	0.925	0.866	0.865	0.907	0.889	0.871	0.865	0.934	0.881	0.893	0.942	0.918	0.881	0.836-0.975	0.895 ±0.03

TABLE: 48 EVENNESS OF ZOOPLANKTON, ROTIFERA AND CLADOCERA DEEPOR BEEL (STATION II)

$$E_t = \frac{H'}{\ln S}$$

	1999					2000											2001								
	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	RANGE	MEAN ±SD
ZOOPLANKTON	0.947	0.889	0.916	0.924	0.876	0.925	0.882	0.895	0.946	0.984	0.955	0.971	0.963	0.983	0.947	0.934	0.929	0.896	0.982	0.959	0.939	0.973	0.941	0.976	0.876-0.984	0.939 ±0.03
ROTIFERA	0.934	0.864	0.939	0.895	0.867	0.89	0.871	0.878	0.932	0.942	0.929	0.934	0.934	0.92	0.926	0.921	0.923	0.889	0.947	0.934	0.913	0.914	0.899	0.872	0.864-0.947	0.911 ±0.02
CLADOCERA	0.951	0.943	0.733	0.95	0.94	0.905	0.948	0.929	0.902	0.929	0.946	0.93	0.913	0.924	0.929	0.894	0.917	0.818	0.896	0.933	0.925	0.923	0.917	0.912	0.733-0.951	0.913 ±0.05

TABLE: 49 SPECIES DIVERSITY OF ZOOPLANKTON, ROTIFERA AND CLADOCERA OF GHORAJAN BEEL (STATION I)

SHANNON'S INDEX																										
	1999					2000												2001								
	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	RANGE	MEAN ±SD
ZOOPLANKTON	3.548	3.247	3.126	3.763	3.465	3.482	3.515	3.536	3.215	3.978	3.765	3.693	3.486	3.684	3.547	3.743	3.432	3.046	3.386	3.007	3.135	3.152	3.445	3.598	3.007-3.978	3.458 ±0.25
ROTIFERA	3.462	3.009	2.964	3.646	3.31	3.262	3.428	3.507	3.378	3.219	3.455	3.243	3.421	3.679	3.509	3.400	3.418	2.851	3.147	2.916	2.987	3.008	3.398	3.591	2.851-3.679	3.301 ±0.2
CLADOCERA	2.887	2.468	2.536	3.046	3.047	2.897	3.022	3.201	2.509	2.787	3.069	2.943	3.004	2.935	2.921	2.958	2.683	2.513	2.877	2.739	2.931	2.573	2.821	3.051	2.468-3.201	2.851 ±0.2
MENHINICK'S INDEX																										
ZOOPLANKTON	3.586	3.428	3.826	4.376	3.686	4.248	4.215	4.536	3.215	3.078	3.265	3.029	3.248	3.534	3.542	3.147	3.432	3.463	3.638	3.367	3.015	3.112	3.215	3.394	3.015-4.536	3.525 ±0.4
ROTIFERA	3.670	3.343	3.741	4.748	3.904	4.435	4.796	4.734	3.127	2.839	3.020	2.619	3.137	3.513	3.407	3.008	3.348	2.091	2.625	2.419	2.127	2.585	2.929	3.500	2.091-4.796	3.319 ±0.8
CLADOCERA	2.753	2.188	2.539	3.000	3.274	3.098	3.252	3.444	1.854	2.154	2.402	2.234	2.164	2.464	2.439	2.405	1.934	1.811	2.234	1.991	2.298	1.959	2.031	2.134	1.811-3.444	2.419 ±0.5

TABLE: 50 SPECIES DIVERSITY OF ZOOPLANKTON, ROTIFERA AND CLADOCERA OF GHORAJAN BEEL (STATION II)

SHANNON'S INDEX																									
	1999					2000												2001								
	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	RANGE	MEAN ±SD
ZOOPLANKTON	3.483	2.943	3.115	3.063	3.265	3.182	3.153	3.362	3.153	3.784	3.651	3.696	3.648	3.439	3.473	3.433	3.328	3.087	3.186	3.107	3.353	3.517	3.345	3.498	2.943-3.784	3.344 ±0.22
ROTIFERA	3.238	2.681	2.647	2.809	3.142	2.948	2.934	3.25	3.051	3.545	3.382	3.628	3.432	3.517	3.328	3.17	3.308	3.009	2.924	3.098	3.355	3.522	3.287	3.347	2.647-3.628	3.194 ±0.26
CLADOCERA	3.038	2.561	2.516	2.845	2.885	2.676	2.637	2.8	2.231	2.938	3.045	3.128	2.847	3.007	2.805	2.718	2.948	2.355	2.518	2.26	2.869	2.737	2.607	2.857	2.231-3.128	2.743 ±0.24
MENHINICK'S INDEX																										
ZOOPLANKTON	3.981	3.198	3.113	3.245	3.693	3.275	3.538	4.002	3.143	3.385	3.251	3.215	3.341	3.679	3.145	3.158	3.487	2.922	2.919	3.214	3.243	3.327	3.116	3.761	2.919-4.002	3.348 ±0.3
ROTIFERA	3.441	2.398	2.293	3.149	3.753	3.127	3.111	3.992	2.437	3.085	2.751	3.505	3.231	3.779	3.095	2.584	3.307	2.022	1.909	2.264	3.155	3.137	2.716	3.261	1.909-3.992	2.979 ±0.5
CLADOCERA	3.618	2.835	2.449	2.708	2.914	2.79	2.545	2.759	1.587	2.099	2.168	2.708	2.557	2.787	2.257	2.03	2.412	1.395	1.576	1.435	2.546	2.137	2.032	2.587	1.395-3.618	2.372 ±0.5

TABLE: 51 DOMINANCE OF ZOOPLANKTON, ROTIFERA AND CLADOCERA OF GHORAJAN BEEL (STATION I)

Berger-Parker's index																									
	1999					2000												2001								
	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	RANGE	MEAN ±SD
ZOOPLANKTON	0.174	0.199	0.236	0.178	0.162	0.194	0.195	0.152	0.194	0.189	0.184	0.193	0.125	0.186	0.219	0.196	0.198	0.181	0.188	0.251	0.168	0.194	0.147	0.123	0.123-0.251	0.184 ±0.03
ROTIFERA	0.109	0.186	0.196	0.097	0.094	0.181	0.141	0.096	0.1	0.111	0.081	0.122	0.136	0.097	0.08	0.106	0.098	0.165	0.113	0.208	0.124	0.138	0.084	0.117	0.08-0.208	0.124 ±0.04
CLADOCERA	0.157	0.191	0.25	0.086	0.102	0.133	0.08	0.098	0.157	0.147	0.121	0.164	0.097	0.133	0.209	0.111	0.207	0.231	0.132	0.131	0.125	0.181	0.144	0.137	0.08-0.25	0.147 ±0.04

TABLE: 52 DOMINANCE OF ZOOPLANKTON, ROTIFERA AND CLADOCERA OF GHORAJAN BEEL (STATION II)

Berger-Parker's index																										
	1999					2000												2001								
	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	RANGE	MEAN ±SD
ZOOPLANKTON	0.185	0.297	0.246	0.237	0.198	0.209	0.245	0.192	0.198	0.185	0.184	0.173	0.135	0.149	0.179	0.186	0.199	0.211	0.181	0.225	0.176	0.174	0.185	0.189	0.135-0.297	0.197 ±0.03
ROTIFERA	0.141	0.326	0.152	0.222	0.152	0.173	0.215	0.121	0.082	0.074	0.085	0.072	0.074	0.125	0.083	0.085	0.123	0.145	0.134	0.093	0.068	0.069	0.09	0.094	0.068-0.326	0.125 ±0.06
CLADOCERA	0.091	0.142	0.222	0.181	0.14	0.243	0.1	0.165	0.25	0.116	0.141	0.122	0.189	0.137	0.168	0.168	0.141	0.162	0.174	0.195	0.147	0.151	0.171	0.151	0.091-0.243	0.161 ±0.04

TABLE: 53 EVENNESS OF ZOOPLANKTON, ROTIFERA AND CLADOCERA OF GHORAJAN BEEL (STATION I)

$$E_1 = \frac{H'}{\ln S}$$

	1999					2000												2001								
	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	RANGE	MEAN ±SD
ZOOPLANKTON	0.976	0.895	0.918	0.948	0.926	0.915	0.932	0.899	0.926	0.934	0.938	0.901	0.923	0.933	0.917	0.904	0.912	0.935	0.922	0.929	0.916	0.917	0.921	0.936	0.895-0.976	0.924 ±0.02
ROTIFERA	0.899	0.876	0.889	0.969	0.874	0.867	0.895	0.875	0.935	0.905	0.902	0.873	0.884	0.918	0.892	0.883	0.874	0.909	0.901	0.875	0.906	0.853	0.892	0.901	0.853-0.969	0.894 ±0.02
CLADOCERA	0.908	0.911	0.861	0.924	0.924	0.911	0.963	0.932	0.95	0.915	0.902	0.893	0.945	0.89	0.907	0.897	0.844	0.906	0.918	0.886	0.899	0.874	0.928	0.942	0.844-0.963	0.909 ±0.03

TABLE: 54 EVENNESS OF ZOOPLANKTON, ROTIFERA AND CLADOCERA OF GHORAJAN BEEL (STATION II)

$$E_1 = \frac{H'}{\ln S}$$

	1999					2000												2001								
	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	RANGE	MEAN ±SD
ZOOPLANKTON	0.937	0.909	0.886	0.912	0.916	0.895	0.922	0.899	0.987	0.934	0.929	0.923	0.933	0.934	0.937	0.913	0.932	0.946	0.932	0.898	0.969	0.943	0.949	0.925	0.886-0.987	0.927 ±0.02
ROTIFERA	0.872	0.855	0.856	0.872	0.876	0.866	0.862	0.864	0.96	0.915	0.91	0.918	0.924	0.899	0.902	0.907	0.859	0.9	0.877	0.894	0.922	0.902	0.925	0.901	0.855-0.925	0.892 ±0.03
CLADOCERA	0.955	0.945	0.87	0.92	0.933	0.842	0.912	0.84	0.93	0.937	0.924	0.911	0.921	0.923	0.911	0.893	0.926	0.948	0.908	0.88	0.942	0.929	0.923	0.911	0.84-0.955	0.914 ±0.03

Table: 55 ANOVA OF BIOTIC FACTORS OF DEEPOR BEEL, 1999-2000

Sources of variance	Sum of squares	Degree of freedom (d f)	Mean sum of squares	Variance ratio (F ratio)
ZOOPLANKTON				
Between the months	5255.46	11	477.77	2.413
Between the stations	925.04	1	925.04	4.673
Error	2177.46	11	197.95	
Total	8357.96	23		
ROTIFERA				
Between the months	1573.5	11	143.04	1.509
Between the stations	504.16	1	504.16	5.318*
Error	1042.84	11	94.8	
Total	3120.5	23		

*Significant at 0.05 level

Table: 56 ANOVA OF BIOTIC FACTORS OF DEEPOR BEEL, 2000-2001

Sources of variance	Sum of squares	Degree of freedom (d f)	Mean sum of squares	Variance ratio (F ratio)
ZOOPLANKTON				
Between the months	4110.33	11	373.67	0.036
Between the stations	42.67	1	42.67	0.004
Error	112860.33	11	10260.03	
Total	117013.33	23		
ROTIFERA				
Between the months	1012.5	11	92.04	1.82
Between the stations	42.67	1	42.67	0.84
Error	555.33	11	50.48	
Total	1610.5	23		

*Significant at 0.05 level

Table: 57 ANOVA OF BIOTIC FACTORS OF GHORAJAN BEEL, 1999-2000

Sources of variance	Sum of squares	Degree of freedom (d f)	Mean sum of squares	Variance ratio (F ratio)
ZOOPLANKTON				
Between the months	3936.46	11	357086	4.35*
Between the stations	551.04	1	551.04	6.69*
Error	905.46	11	82.31	
Total	5392.96	23		
ROTIFERA				
Between the months	1280.46	11	116.4	2.485
Between the stations	273.38	1	273.38	5.838*
Error	515.12	11	46.83	
Total	2068.96	23		

*Significant at 0.05 level

Table: 58 ANOVA OF BIOTIC FACTORS OF GHORAJAN BEEL, 2000-2001

Sources of variance	Sum of squares	Degree of freedom (d f)	Mean sum of squares	Variance ratio (F ratio)
ZOOPLANKTON				
Between the months	134654.83	11	12241.35	10.24*
Between the stations	228.16	1	228.16	0.198
Error	13149.16	11	1195.38	
Total	148032.15	23		
ROTIFERA				
Between the months	1390.46	11	126.41	2.485
Between the stations	35.04	1	35.04	0.688
Error	559.46	11	50.86	
Total	1984.96	23		

*Significant at 0.05 level

decreased to 10 species in the next year during the same month at station I; while station II recorded maximum number of 33 species during March in the first year and it exhibited minimum of 11 species during April of the same year. Among the reported species, *Chydorus sphaericus* appeared to be the common cladoceran in the beel. It achieved peak during August in the second year (24 ind/l) followed by 22 ind/l during July in the first year at station I in Deepor beel. The group of small-bodied cladocerans was dominated by three species *Chydorus sphaericus*, *Biapertura karua*, *Chydorus barroisii*, whereas the large-bodied cladocerans was dominated by *Scapholeberis kingi* and *Simocephalus vetulus* in this beel. Of the species recorded in the present study, the most abundant species in the whole sequence was *Chydorus sphaericus*, which was observed throughout the twenty-four months in this beel. Maximum population density of *Bosmina longirostris* was observed during December in the first year (18 ind/l) in Deepor beel. *Daphnia lumholtzi* was recorded during January in the first year & during April in the second year throughout the study period. Coefficient correlation of water temperature (r_1= -0.691, p<.001) showed significant inverse relationship with Cladocera. Correlations between biotic factors revealed that Cladocera and phytoplankton (r_1= -0.523, p<.01) were inversely correlated but this group was positively correlated with zooplankton (r_1= 0.818, p<.001; r_2= 0.892, p<.001).

The quantitative abundance of Cladocera ranged between 47-160 (99.0 ±34.0) ind/l at station I of Ghorajan beel, while station II recorded 28-155 (81.0 ±28.0) ind/l (Fig.-133). It exhibited peak density in July in the second year and lowest density in September in the first year at station I, while station II exhibited maximum abundance in June in the first year and minimum in September in the first year. In all the collections obtained from the sampled beel, Maximum (30 ind/l) was observed during June in the first year and minimum (14 ind/l) during April in the first year. On the other hand, *C. sphaericus* attained highest density during December in the second year at station I and during March in the same year at station II in Ghorajan beel. *Simocephalus vetulus* was maximum (10 ind/l) in July in the second year at station I, while peak (12 ind/l) was noticed in June in the same year at station II. *Ceriodaphnia cornuta*, *Moina micrura* and *Diaphanosoma excisum* was observed in various monthly collections with low density at both the year. However, *Chydorus sphaericus* was observed abundantly except in April in the first year at station II. Maximum population density of *Bosmina longirostris* was observed during July in the first year (24 ind/l) in this beel. Cladocera exhibited positive relationships with total alkalinity (r_1= 0.478, p<.05), total hardness (r_1= 0.437, p<.05), magnesium (r_1= 0.495, p<.05) and BOD (r_1= 0.562, p<.01) but they inversely correlated with transparency (r_1= -0.489, p<.05). It showed significant inverse correlation with zooplankton (r_1= 0.919, p<.001; r_2= 0.808, p<.001) in this beel.

The Copepoda was represented by three species at both the stations in Deepor beel. The abundance of this group ranged between 10-122 ind/l (39.0 ±25.0); but did not depict any definite monthly pattern at station I while station II recorded 7-77 ind/l (26.0 ±16.0) in Deepor beel. Meso cyclops sp., Helio diaptomus sp. and Nauplius larvae were the only representatives. Maximum and minimum abundance were observed during July in the second year (122 ind/l) and during October in the first year

(10 ind/l) at station I in the beel. A peak of nauplii was observed during April and May at both the stations. The copepod showed significant positive correlation with phosphate (r_1= 0.679, p<.001) and inversely correlated with transparency (r_1= -0.448, p<.05) in this beel. Among the biotic factors, they exhibited significant correlations with zooplankton (r_1= 0.427, p<.05), Cladocera (r_2= 0.511, p<.01) and net plankton (r_1= 0.463, p<.05) in this beel.

On the contrary, Copepoda was represented by three species at both the stations in Ghorajan beel. The abundance of Copepoda ranged between 6-81 ind/l (34.0 ±22.0); but did not depict any definite monthly pattern at station I, on the other hand station II recorded 4-93 ind/l (34.0 ±25.0). Maximum and minimum abundance were observed during December in the first year and during October in the same year respectively at station I, while station II depicted peak during December in the second year and minima during January of the same year. Meso cyclops sp., Helio diaptomus sp. and Nauplius larvae were the only representatives of this group. Among the reported members of this group, Meso cyclops sp. was quantitatively important and was observed in all collections. Throughout the study period, the densities of Helio diaptomus sp. were not high enough to show any significant occurrence. However, copepods indicated positive relationships with free carbon dioxide (r_1 = 0.459, p<.05), total alkalinity (r_1 = 0.418, p<.05; r_2= 0.427, p<.05), phosphate (r_1 = 0.439, p<.05) and BOD (r_1= 0.571, p<.01; r_2 = 0.423, p<.05) in this beel. On the other hand, they exhibited significant positive correlation with Rhizopoda (r_1 = 0.468, p<.05) at station I in this beel.

The abundance of Rhizopoda ranged between 5-43 ind/l (14.0 ±11.0) at station I and between 5-42 ind/l (22.0 ±12.0) at station II in Deepor beel. This group were represented by 12 species at station I and 11 species at station II in Deepor beel. However, their peak densities were observed during May in the second year at station I and during March in the second year at station II in Deepor beel. Lowest density was noticed during April in the first year at station I and station II showed lowest density during the same month with station I. Rhizopoda depicted direct correlations with net plankton (r_1 = 0.417, p<.05), zooplankton (r_1 = 0.597, p<.01; r_2= 0.762, p<.001), Rotifera (r_1 = 0.426, p<.05; r_2 = 0.668, p<.001), Cladocera (r_2 = 0.513, p<.01) and Copepoda (r_1= 0.558, p<.01) in this beel.

The abundance of Rhizopoda of Ghorajan beel ranged between 4-47 ind/l (10.0 ±9.0) at station I and 4-70 ind/l (21.0 ±16.0) at station II. On the other hand, this beel registered 12 and 11 species at station I and at station II respectively. They exhibited maximum densities during April in the second year at station I and during February in the second year at station II. This beel registered minimum density during November in the first year at station I and during October in the first year at station II. *Dufflugia sp.* was common planktonic protozoans at both the stations. Other protozoans, which occurred with low density, were *Centropyxis hemisphaerica, C. aculeata, Euglypha ciliata and Actinosphaerium eichhorni. Arcella discoides* occurred throughout the study period and mainly contributed to their maximum density at both the stations of the sampled beel. This group registered significant direct correlations with specific conductivity (r_1= 0.493, p<.05), total alkalinity (r_1= 0.452,

Fig. 156: Percentage of Abundance of Net plankton, Zooplankton & Phytoplankton in Deepor beel (St. I)

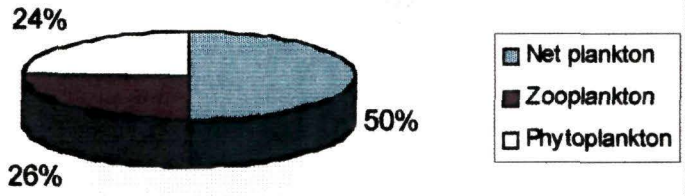


Fig. 157: Percentage of Abundance of Net plankton, Zooplankton & Phytoplankton in Deepor beel (St. II)

Fig. 158: Percentage of Abundance of Net plankton, Zooplankton & Phytoplankton in Ghorajan beel (St. I)

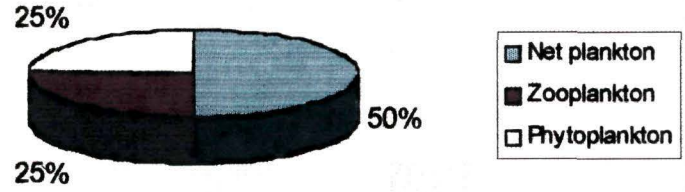
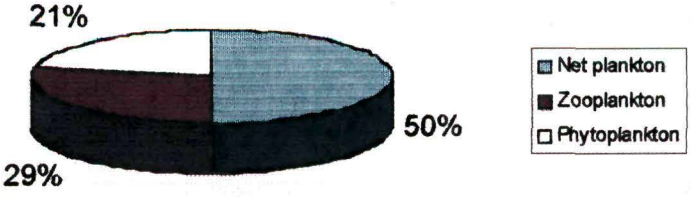


Fig. 159: Percentage of Abundance of Net plankton, Zooplankton & Phytoplankton in Ghorajan beel (St. II)



$p<.05$) and total hardness ($r_1= 0.514, p<.01$; $r_2= 0.485, p<.05$). However, it registered direct correlations with net plankton ($r_1= 0.572, p<.01$ $r_2= 0.546, p<.01$), zooplankton ($r_1= 0.472, p<.05$ $r_2= 0.576, p<.01$), Rotifera ($r_2= 0.627, p<.01$), Cladocera ($r_1= 0.427, p<.05$) and Copepoda ($r_1= 0.468, p<.01$) in this beel.

Ostracods were dominated by Cypricercus sp. and Cypris sp. at both the stations in Deepor beel. Abundance of Cypricercus sp. ranged between 0-33 ind/l at station I and station II exhibited 0-14 ind/l, while Cypris sp. showed 0-7 ind/l and 0-6 ind/l at station I and II respectively in this beel. The former attained maxima during July in the second year at station I and station II exhibited maximum density during January in the same year and the later showed peak density during May in the first year at station I and station II depicted maxima during July in the second year. Ostracods depicted direct correlations with zooplankton ($r_1= 0.443, p<.05$) and Copepoda ($r_1= 0.634, p<.01$) in this beel.

On the other hand, Ghorajan beel exhibited two species i.e. Cypricercus sp. and Cypris sp. at both the stations. Abundance of Cypricercus sp. ranged between 0-16 ind/l at station I and station II exhibited 0-6 ind/l, while Cypris sp. showed 0-8 ind/l and 0-4 ind/l at station I and II respectively. The former attained peak density during June in the first year at station I, while station II exhibited maximum density during July and October in the second year. On the other hand, the later showed peak density during September in the first year and during November and December in the second year at station I, however, station II depicted maxima during March in the first year and also during November in the second year. This group exhibited significant correlations with zooplankton ($r_1= 0.439, p<.05$), Rotifera ($r_1= 0.427, p<.05$) and Cladocera ($r_1= 0.513, p<.01$) at station I in this beel.

Conchostraca sp. was registered at both the stations in Deepor beel in very low densities. The species was observed from early summer to early winter season. It was observed that population density ranged between 0-5 ind/l at station I, while station II showed 0-4 ind/l. This species was represented continuously from May to December in the study period but in relatively smaller number in the collected sample from both the stations of Ghorajan beel. In the present survey, population density fluctuated between 0-6 ind/l at station I, while station II registered 0-4 ind/l.

The cumulative effects of the abiotic factors namely rainfall (X1), water temperature (X2), pH (X3), transparency (X4), specific conductivity (X5), dissolved oxygen (X6), free carbon dioxide (X7), alkalinity (X8), hardness (X9), calcium (X10), chloride (X11), dissolved oxygen matter (X12), phosphate (X13), sulphate (X14), nitrate (X15), biochemical oxygen demand (X16) on the abundance of zooplankton communities were computed by multiple regression method (Tables 63 & 64).

Table: 59 Range and Mean values of different component of zooplankton, species diversity, evenness and dominance of Deepor Beel

	Station I	**Station II**
Net plankton	475-969 (703.0±124.0)	431-1036 (618.0±141.0)
No. of species	149	147
Zooplankton Abundance (ind/l)	172-565 (361.0 ±103.0)	146-382 (256.0 ±71.0)
Rotifera (ind/l)	88-265 (183.0 ±55.0)	62-187 (117.0 ±37.0)
Cladocera (ind/l)	29-195 (105.0 ±43.0)	44-134 (82.0 ±28.0)
Rhizopoda (ind/l)	5-43 (14.0 ±11.0)	5-42 (22.0 ±13.0)
Copepoda (ind/l)	10-122 (40.0 ±26.0)	7-77 (27.0 ±16.0)
Rotifera		
Species diversity		
Shannan's index	2.528-3.594 (3.208 ±0.3)	2.585-3.657 (3.224 ±0.25)
Menhinick's index	1.617-3.899 (3.117 ±0.6)	1.94-4.545 (3.346 ±0.7)
Evenness		
E_1	0.81-0.919 (0.867 ±0.03)	0.864-0.947 (0.911 ±0.02)
Dominance		
Berger-Parker's index	0.075-0.206 (0.124 ±0.04)	0.071-0.183 (0.114 ±0.03)
Cladocera		
Species diversity		
Shannan's index	2.151-3.178 (2.803 ±0.3)	2.164-3.251 (2.828 ±0.27)
Menhinick's index	1.414-3.549 (2.414 ±0.5)	1.51-3.81 (2.519 ±0.6)
Evenness		
E_1	0.836-0.975 (0.895 ±0.03)	0.733-0.951 (0.913 ±0.05)
Dominance		
Berger-Parker's index	0.084-0.262 (0.162 ±0.04)	0.08-0.273 (0.141 ±0.05)

Table: 60 Range and mean values of different component of zooplankton, species diversity, evenness and dominance zooplankton of Ghorajan Beel

	Station I	Station II
Net plankton	414-1134 (647.0 ±179.0)	335-804 (522.0 ±130.0)
No. of species	147	146
Zooplankton Abundance (ind/l)	133-487 (327.0 ±117.0)	152-464 (300.0 ±102.0)
Rotifera (ind/l)	56-245 (167.0 ±60.0)	92-267 (159.0 ±56.0)
Cladocera (ind/l)	47-160 (99.0 ±34.0)	28-155 (81.0 ±29.0)
Rhizopoda (ind/l)	4-47 (11.0 ±9.0)	4-70 (22.0 ±16.0)
Copepoda (ind/l)	6-81 (35.0 ±22.0)	4-93 (34.0 ±25.0)
Rotifera		
Species diversity		
Shannan's index	2.851-3.679 (3.301 ±0.2)	2.647-3.628 (3.194 ±0.26)
Menhinick's index	2.091-4.796 (3.319 ±0.8)	1.909-3.992 (2.979 ±0.5)
Evenness		
E_1	0.853-0.969 (0.894 ±0.02)	0.855-0.925 (0.892 ±0.027)
Dominance		
Berger-Parker's index	0.08-0.208 (0.124 ±0.04)	0.068-0.326 (0.125 ±0.06)
Cladocera		
Species diversity		
Shannan's index	2.468-3.201 (2.851 ±0.2)	2.231-3.128 (2.743 ±0.24)
Menhinick's index	1.811-3.444 (2.419 ±0.5)	1.395-3.618 (2.372 ±0.5)
Evenness		
E_1	0.844-0.963 (0.909 ±0.03)	0.84-0.955 (0.914 ±0.029)
Dominance		
Berger-Parker's index	0.08-0.25 (0.147 ±0.04)	0.091-0.243 (0.161 ±0.04)

Table: 63 Multiple Regression (R_1^2 and R_2^2) of Zooplankton in Deepor beel

Step-wise regression	Station I	Station II
$(X_1 - X_{16})$	R^2=0.909173	R^2=0.814876
$(X_1 - X_{15})$	R^2=0.909083	R^2=0.814873
$(X_1 - X_{14})$	R^2=0.90811	R^2=0.744177
$(X_1 - X_{13})$	R^2=0.9056	R^2=0.576864
$(X_1 - X_{12})$	R^2=0.876126	R^2=0.565775
$(X_1 - X_{11})$	R^2=0.875786	R^2=0.561168
$(X_1 - X_{10})$	R^2=0.599891	R^2=0.495315
$(X_1 - X_9)$	R^2=0.490493	R^2=0.37235
$(X_1 - X_8)$	R^2=0.490359	R^2=0.347107
$(X_1 - X_7)$	R^2=0.401186	R^2=0.245399
$(X_1 - X_6)$	R^2=0.387702	R^2=0.230302
$(X_1 - X_5)$	R^2=0.383094	R^2=0.230296
$(X_1 - X_4)$	R^2=0.294993	R^2=0.205499
$(X_1 - X_3)$	R^2=0.258457	R^2=0.05704
$(X_1 - X_2)$	R^2=0.224422	R^2=0.051726

Table: 64 Multiple Regression (R_1^2 and R_2^2) of Zooplankton in Ghorajan beel

Step-wise regression	Station I	Station II
$(X_1 - X_{16})$	R^2=0.715507	R^2=0.922294
$(X_1 - X_{15})$	R^2=0.69304	R^2=0.913729
$(X_1 - X_{14})$	R^2=0.691577	R^2=0.8913
$(X_1 - X_{13})$	R^2=0.687276	R^2=0.88658
$(X_1 - X_{12})$	R^2=0.666513	R^2=0.870203
$(X_1 - X_{11})$	R^2=0.627267	R^2=0.659518
$(X_1 - X_{10})$	R^2=0.623292	R^2=0.589057
$(X_1 - X_9)$	R^2=0.611278	R^2=0.571789
$(X_1 - X_8)$	R^2=0.611258	R^2=0.48715
$(X_1 - X_7)$	R^2=0.594643	R^2=0.414376
$(X_1 - X_6)$	R^2=0.594547	R^2=0.319744
$(X_1 - X_5)$	R^2=0.540179	R^2=0.312757
$(X_1 - X_4)$	R^2=0.354521	R^2=0.232553
$(X_1 - X_3)$	R^2=0.160663	R^2=0.037239
$(X_1 - X_2)$	R^2=0.122494	R^2=0.035091

PHYTOPLANKTON:

Temporal variations in species richness and abundance of phytoplankton taxa of Deepor and Ghorajan beel are indicated in Tables 67-70 and in Figures 160-167. Various phytoplankton recorded from Deepor beel belonged to five groups namely Chlorophyta, Bacillariophyta, Cyanophyta, Euglenophyta, Dinophyta and Chrysophyta. These, in turn, were represented by 59 species at both the sampled stations. The species richness of phytoplankton fluctuated between 16-34 species (18.0 ±4.0) and 20-35 species (20.0 ±5.0) at station I and II respectively. The maximum and minimum number of species were noticed in the month of June in the first year at station I and in November in the first year. The abundance of phytoplankton ranged between 219-682 (342.0 ±114.0) ind/l at station I and 221-654 (362.0 ±119.0) ind/l at station II of Deepor beel. The present observation registered a sharp decline in phytoplankton abundance from September to January in the first year and maxima was subsequently noticed in April in the first year at station I and minima was observed in June of the same year. However, station II showed peak density during April in the first year and lowest during August of the same year. Phytoplankton exhibited significant positive correlation with net plankton (r_1= 0.626, p<.01; r_2= 0.878, p<.001) in this beel.

In the present study, the abundance of phytoplankton in Ghorajan beel fluctuated between 220-727 (320.0 ±136.0) ind/l at station I and 130-486 (222.0 ±84.0) ind/l at station II. Peak density was observed during April in the second year at station I and minima was noticed during November in the first year. On the other hand, station II exhibited maximum during April in the second year and minima during June of the same year. Among the different groups of phytoplankton documented in this study, followed the spectrum of dominance as Chlorophyta> Bacillariophyta> Cyanophyta> Euglenophyta> Dinophyta> Chrysophyta in Ghorajan beel. Phytoplankton of this beel are represented by 55 species at station I and 54 species at station II. Correlation analysis revealed that phytoplankton and net plankton were significantly correlated (r_1= 0.759, p<.001; r_2= 0.621, p<.01) in this beel.

The abundance of Chlorophyta at station I fluctuated between 85-274 ind/l (141.0 ±46.0) at station I in Deepor beel. The minimum density was noticed during June in the first year. This group, however, recorded primary maxima (274 ind/l) in April in the first year; secondary maxima (254 ind/l) in April in the second year and still another was observed during May in the second year, thereby indicating trimodal pattern of temporal variations. The population density of this group was distinctly lower from November in the second year to January in the same year and subsequently during March and April in the same year respectively. The abundance of Chlorophyta at station II in this beel was relatively lower and fluctuated between 112-346 ind/l (171.0 ±63.0). The green algae registered maximum density in this ecosystem during April in the first year and lowest abundance was noticed in August in the second year and June in the same year. Further, this group recorded secondary maxima in May in the second year and tertiary maxima in April in the second year and hence, exhibited bimodal pattern of annual variations. In addition, their population indicated almost equal magnitude of abundance from January in the second

year. The Chlorophyta was the most dominant quantitative group, which comprised of 38.9% of the total phytoplankton at station I. A maximum density was observed during May in the first year and minima was observed during April in the same year at station II. Chlorophyta established a positive and significant relationships with net plankton (r_1= 0.619, p<.01; r_2= 0.798, p<.001), Phytoplankton (r_1= 0.963, p<.001; r_2= 0.949, p<.001), Bacillariophyta (r_1= 0.861, p<.001; r_2= 0.793, p<.001), Cyanophyta (r_1= 0.697, p<.001; r_2= 0.787, p<.001), Chrysophyta (r_1= 0.704, p<.001) and specific conductivity (r_2= 0.428, p<.05). On the other hand, significant inverse correlation with Cladocera (r_1= -0.477, p<.01) at station I in Deepor beel.

The Chlorophyta abundance ranged between 86-407 ind/l (155.0 ±84.0) at station II, which depicted peak density during May in the second year and lowest during February in the first year in Ghorajan beel. Station II of this beel fluctuated between 67-222 ind/l (109.0 ±38.0), density of which exhibited maximum during May in the second year and minima during June in the first year. On the contrary, it exhibited significant positive correlation with net plankton (r_1= 0.746, p<.001; r_2= 0.526, p<.01), phytoplankton (r_1= 0.982, p<.001; r_2= 0.962, p<.001), Bacillariophyta (r_1= 0.633, p<.001; r_2= 0.924, p<.001), Cyanophyta (r_1= 0.912, p<.001; r_2= 0.696, p<.001), Chrysophyta (r_1= 0.505, p<.01; r_2= 0.603, p<.01) and total alkalinity (r_2= 0.432, p<.05) in Ghorajan beel.

The Bacillariophyta were represented by 20 species at both the stations in Deepor beel and their species richness in the monthly collections ranged between 9-18 (14.0 ±3.0) and maximum number of species were found during April and May in second year; while lower richness of the diatoms was observed in June in the second year at station I. On the other hand, station II registered 9-18 (13.0 ±3.0) and peak during April in the first year and minima during August in the first year. The population densities of Bacillariophyta at station I in Deepor beel fluctuated between 53-181 (89.0 ±32.0) ind/l, which followed a bimodal pattern of temporal variations. The minimum density of these diatoms was noticed during June in the second year. This group, however, recorded primary maxima in April in the first year and secondary maxima in April in the second year. On the other hand, the quantitative abundance of the Bacillariophyta at station II fluctuated between 39-147 (86.0 ±25.0) ind/l. The diatoms density was higher in April in the second year and again at the end of this study period May in the second year but during the rest of the study period, it exhibited bimodal pattern; primary maxima of lesser magnitude was noticed in April in the first year, on the other hand, the lowest density of this group was observed in August in the second year. Bacillariophyta showed significant positive correlations with net plankton (r_1= 0.598, p<.01; r_2= 0.736, p<.001), phytoplankton (r_1= 0.701, p<.001; r_2= 0.892, p<.001), Chlorophyta (r_1= 0.861, p<.001; r_2= 0.793, p<.001), Chrysophyta (r_1= 0.704, p<.001), calcium (r_1= 0.419, p<.05) and BOD (r_2= 0.426, p<.05). In addition, they showed significant inverse correlation with Cladocera (r_1= -0.552, p<.01) at station I in Deepor beel.

The Bacillariophyta were represented by 19 species at both the stations in Ghorajan beel and their species richness in the monthly collections ranged between 6-17 (12.0 ±3.0) and maximum number of species were found shortly after winter

Table: 67 Monthly variations in population density of phytoplankton in Deepor beel [Station I]

	1999					2000												2001						
Chlorophyta	**A**	**S**	**O**	**N**	**D**	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**	**J**	**F**	**M**	**A**	**M**	**J**	**J**
Chlamydomonas sp.	6	5	7	-	12	7	4	14	18	10	3	-	-	-	12	10	-	4	8	-	28	12	9	-
Gonium sp.	8	14	10	14	6	5	12	9	15	7	6	10	4	-	8	-	-	10	12	14	10	14	-	10
Pandorina morum	10	4	6	9	-	8	-	6	9	3	-	12	6	14	-	9	15	-	-	6	4	6	-	-
Volvox sp.	3	-	4	6	3	2	4	-	7	-	9	3	10	16	-	-	-	12	5	-	6	-	14	16
Eudorina sp.	-	5	10	8	6	-	-	2	6	4	-	4	-	-	12	18	10	-	14	-	32	24	4	-
Pleodorina sp.	4	6	-	-	4	8	10	7	-	2	5	-	-	-	6	4	-	-	-	10	-	16	8	12
Pediastrum simplex	8	3	5	4	-	-	6	3	10	6	4	3	12	4	-	-	8	6	-	-	14	8	-	6
P.duplex	-	2	3	-	4	4	7	2	5	-	-	-	6	-	-	-	2	-	10	-	12	14	6	-
Hydrodictyon sp.	6	9	8	5	-	12	10	8	22	3	-	6	-	8	14	12	-	-	4	3	10	5	-	4
Closterium sp.	15	14	17	10	8	14	4	15	33	18	12	8	22	18	-	-	28	-	-	14	30	38	-	10
Coelastrum sp.	2	4	-	2	-	3	3	2	4	-	1	3	-	-	6	10	-	12	4	-	6	-	8	2
Cosmarium granatun	18	15	10	8	14	-	-	16	28	12	3	14	28	14	-	-	32	4	-	6	-	8	-	4
C.monomazum	2	-	2	-	6	4	3	-	-	2	3	3	4	-	-	3	6	-	4	2	3	-	18	-
Spirogyra spiralis	32	24	14	15	18	24	18	28	42	14	20	24	18	15	-	24	-	14	26	8	12	6	16	22
Ulothrix sp.	10	7	3	4	-	-	2	4	6	2	-	3	-	6	10	-	-	20	15	-	16	18	-	14
Euastrum sp.	-	5	3	7	2	5	-	6	-	-	2	4	5	-	8	6	4	-	-	17	14	9	4	6
Xanthidium sp.	4	-	-	5	3	4	2	-	7	4	-	2	3	-	-	4	12	16	-	-	8	4	3	-
Sirogonium sp.	14	16	10	-	8	-	4	9	14	10	8	-	6	10	-	7	-	-	12	-	4	10	-	12
Desmidium sp.	7	8	-	4	3	6	10	12	15	8	-	3	-	8	12	-	4	3	-	8	-	6	-	4
Chlorella sp.	-	3	2	3	-	7	-	6	10	4	3	-	-	-	4	6	20	22	-	15	8	-	12	3
Zygnema sp.	5	3	4	6	7	-	9	4	8	-	2	6	4	3	-	7	-	-	10	18	16	20	-	8
Gonatozygon sp.	3	4	-	8	2	3	6	4	3	3	4	4	-	6	3	-	6	8	-	-	15	4	6	-
Microspora sp.	2	6	5	3	-	4	-	5	12	-	-	6	10	-	-	4	5	-	8	10	6	9	-	4
Species richness	***19***	***20***	***18***	***18***	***16***	***17***	***17***	***20***	***20***	***17***	***15***	***18***	***14***	***12***	***11***	***14***	***13***	***12***	***13***	***13***	***20***	***19***	***12***	***16***
Abundance(ind/l)	***159***	***157***	***123***	***121***	***106***	***120***	***114***	***162***	***274***	***112***	***85***	***118***	***138***	***122***	***95***	***124***	***152***	***131***	***132***	***131***	***254***	***231***	***108***	***137***
Bacillariophyta																								
Amphora sp.	12	7	5	8	9	-	4	8	10	-	4	6	-	8	10	-	4	6	3	-	12	8	6	-
Caloneis sp.	4	6	4	7	4	8	-	4	8	7	-	-	3	4	-	4	3	-	6	8	10	4	-	4
Cymbella sp.	3	4	2	-	5	4	7	-	3	2	5	4	-	-	6	5	8	10	-	6	4	16	8	-
Diatoma sp.	2	-	7	4	10	-	7	12	7	4	8	2	-	4	8	-	-	3	7	24	22	14	-	10
Diploneis sp.	7	4	-	8	-	-	-	16	22	16	7	9	6	-	-	4	3	-	-	10	6	4	7	-
Eunotia sp.	-	3	2	-	4	6	10	14	18	12	-	4	-	7	4	-	-	9	-	4	13	15	-	12
Flagillaria sp.	10	4	6	4	-	12	8	-	10	7	3	12	18	6	-	14	12	-	13	-	6	-	8	4
Frustulia sp.	6	-	5	2	3	-	7	4	-	-	8	4	-	-	26	18	-	4	-	6	8	10	12	-
Gomphonema sp.	4	6	-	3	4	2	5	4	8	2	-	-	4	3	-	-	16	8	-	4	6	4	-	8
Gyrosigma sp.	-	3	4	-	-	3	7	6	4	-	4	6	3	-	8	6	-	-	7	-	4	12	-	-
Melosira sp.	12	-	-	10	7	6	5	8	14	6	-	3	10	8	-	4	3	-	-	7	14	8	4	-
Navicula sp.	4	2	2	-	3	2	-	2	6	3	2	-	-	-	4	3	-	2	2	-	-	3	-	4
Nitzschia sp.	-	7	5	4	2	-	4	-	-	8	-	6	4	2	2	-	-	3	-	3	4	6	2	-
Pinnularia sp.	2	4	-	3	3	6	2	4	4	-	2	3	-	-	-	6	5	-	4	8	10	7	-	10

Pleurosigma sp.	6	5	4	-	4	8	7	6	12	4	-	10	3	2	-	4	-	4	14	-	7	16	-	4
Rhopalodia sp.	2	-	-	4	2	4	-	-	4	3	3	-	-	4	4	-	-	6	4	3	-	3	2	-
Surirella sp.	7	4	8	-	10	-	12	16	20	12	10	6	14	8	-	9	12	-	-	-	6	4	-	12
Synedra sp.	8	4	-	3	4	8	-	6	5	6	-	3	-	12	7	4	-	-	4	5	4	3	-	-
Spephanodiscus sp.	2	-	-	-	3	-	4	8	10	3	2	-	-	-	-	8	10	-	14	-	12	-	4	3
Tabellaria sp.	1	4	5	7	-	4	6	10	16	7	5	10	3	4	-	-	2	4	-	6	8	12	-	4
Species richness	***17***	***15***	***13***	***13***	***16***	***13***	***15***	***16***	***18***	***16***	***13***	***15***	***10***	***13***	***10***	***13***	***11***	***11***	***11***	***13***	***18***	***18***	***9***	***11***
Abundance(ind/l)	***92***	***67***	***59***	***67***	***77***	***73***	***95***	***128***	***181***	***102***	***63***	***88***	***68***	***72***	***79***	***89***	***78***	***59***	***78***	***94***	***156***	***149***	***53***	***75***
Cyanophyta																								
Anabaena sp.	4	7	3	3	-	2	8	12	16	10	4	-	-	3	8	-	6	7	12	-	14	4	-	-
Anabaenopsis sp.	5	2	4	-	8	14	7	9	14	8	2	4	-	2	-	8	-	-	-	14	7	3	-	2
Mycrocystis sp.	-	4	8	10	13	9	-	18	20	6	-	8	18	-	12	-	-	16	7	2	8	10	4	-
Nostoc sp.	18	-	14	9	6	-	8	10	9	-	12	14	-	4	-	7	10	-	16	8	24	22	-	12
Oscillatoria sp.	44	28	16	14	19	22	14	28	38	16	14	22	48	-	25	8	4	7	-	-	20	16	28	-
Phormidium sp.	15	12	-	6	-	10	15	20	24	-	8	-	-	16	8	-	-	28	21	-	8	12	-	10
Rivularia sp.	6	-	4	3	6	-	8	12	20	-	4	7	8	-	-	12	16	-	-	14	-	8	4	3
Raphidiopsis sp.	4	7	-	5	4	3	4	10	8	12	3	2	-	3	4	2	-	2	4	-	6	-	5	2
Species richness	***7***	***6***	***6***	***7***	***6***	***6***	***7***	***8***	***8***	***5***	***7***	***6***	***3***	***5***	***5***	***5***	***4***	***5***	***5***	***4***	***7***	***7***	***4***	***5***
Abundance(ind/l)	***96***	***60***	***49***	***50***	***56***	***60***	***64***	***119***	***149***	***52***	***47***	***57***	***74***	***28***	***57***	***37***	***36***	***60***	***60***	***38***	***87***	***75***	***41***	***29***
Euglenophyta																								
Euglena sp.	8	5	6	6	4	-	9	10	14	7	3	4	-	6	4	5	2	-	-	4	6	4	-	-
Phacus sp.	4	3	2	-	3	5	4	4	6	5	4	-	3	-	5	8	-	10	14	-	18	16	-	8
Trachelomonas sp.	4	6	3	5	-	2	3	6	10	9	-	10	-	4	6	-	12	-	8	16	9	-	10	4
Species richness	***3***	***3***	***3***	***2***	***2***	***2***	***3***	***3***	***3***	***3***	***2***	***2***	***1***	***2***	***3***	***2***	***2***	***1***	***2***	***2***	***3***	***2***	***1***	***2***
Abundance(ind/l)	***16***	***14***	***11***	***11***	***7***	***7***	***16***	***20***	***30***	***21***	***7***	***14***	***3***	***10***	***15***	***13***	***14***	***10***	***22***	***20***	***33***	***20***	***10***	***12***
Dinophyta																								
Gonyaulax sp.	4	8	3	4	6	-	-	10	17	7	-	4	-	3	4	-	8	2	-	10	12	17	-	9
Peridinium sp.	7	5	5	3	-	4	8	2	6	3	6	-	-	4	3	2	-	-	6	-	8	-	10	2
Ceratium sp.	22	-	8	6	12	6	-	-	3	-	4	5	28	32	-	64	53	-	-	33	38	18	-	-
Species richness	***3***	***2***	***3***	***3***	***2***	***2***	***1***	***2***	***3***	***2***	***2***	***2***	***1***	***3***	***2***	***2***	***2***	***1***	***1***	***2***	***3***	***2***	***1***	***2***
Abundance(ind/l)	***33***	***13***	***16***	***13***	***18***	***10***	***8***	***12***	***26***	***10***	***10***	***9***	***28***	***39***	***7***	***66***	***61***	***2***	***6***	***43***	***58***	***35***	***10***	***11***
Chrysophyta																								
Dinobryon sp.	10	8	6	-	12	14	-	8	12	4	-	8	-	4	3	-	6	3	-	14	8	12	-	6
Hyalobryon sp.	6	4	3	10	-	3	9	6	10	6	7	-	4	7	2	4	-	10	12	7	14	17	8	-
Species richness	***2***	***2***	***2***	***1***	***1***	***2***	***1***	***2***	***2***	***2***	***1***	***1***	***1***	***2***	***2***	***1***	***1***	***2***	***1***	***2***	***2***	***2***	***1***	***1***
Abundance(ind/l)	***16***	***12***	***9***	***10***	***12***	***17***	***9***	***14***	***22***	***10***	***7***	***8***	***4***	***11***	***5***	***4***	***6***	***13***	***12***	***21***	***22***	***29***	***8***	***6***

Table: 68 Monthly variations in population density of phytoplankton in Deepor beel [Station II]

	1999					2000												2001						
Chlorophyta	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J
Chlamydomonas sp.	10	8	4	16	12	18	9	11	24	12	-	7	-	-	12	14	-	8	4	2	-	14	6	-
Gonium sp.	7	17	8	-	10	6	5	8	14	-	10	4	3	-	4	8	10	-	-	8	10	-	3	14
Pandorina morum	12	-	14	4	6	3	15	4	5	4	3	-	-	14	9	-	6	4	-	-	-	18	12	3
Volvox sp.	-	4	-	-	-	6	-	3	7	2	-	4	18	20	-	14	-	-	28	-	16	-	-	22
Eudorina sp.	8	6	5	8	3	-	5	-	11	4	9	5	-	-	12	3	18	14	6	-	22	28	-	-
Pleodorina sp.	5	3	3	12	8	10	6	4	20	14	4	10	-	14	16	6	-	8	-	24	15	9	4	-
Pediastrum simplex	4	-	6	8	7	14	7	-	12	8	10	6	10	8	-	15	4	-	3	-	8	10	3	6
P.duplex	-	-	-	3	-	-	4	-	-	2	1	-	-	-	3	-	-	4	2	-	2	-	-	-
Hydrodictyon sp.	8	14	10	6	8	17	24	6	32	-	4	12	-	18	24	27	-	8	-	7	14	12	-	4
Closterium sp.	22	18	24	14	10	14	18	15	43	24	13	15	28	-	32	16	8	-	38	43	58	53	17	22
Coelastrum sp.	4	3	2	-	2	4	3	-	-	5	3	-	3	-	4	6	-	10	-	-	7	24	-	12
Cosmarium granatun	25	19	22	6	16	12	20	28	46	10	28	21	-	34	19	-	14	22	-	24	37	20	14	-
C.monomazum	-	5	3	-	10	-	4	6	4	5	-	8	14	6	-	-	8	-	7	6	15	-	3	-
Spirogyra spiralis	52	32	18	20	14	17	22	16	62	17	24	28	27	22	33	36	-	24	20	-	56	72	30	27
Ulothrix sp.	4	3	3	6	12	-	-	10	4	6	-	14	-	6	4	-	16	-	24	8	-	14	-	8
Euastrum sp.	6	8	-	4	-	6	4	5	10	3	2	-	4	3	-	6	-	3	-	-	14	22	-	6
Xanthidium sp.	-	-	4	3	8	5	-	12	4	6	-	5	-	-	-	10	8	-	-	13	-	-	8	-
Sirogonium sp.	10	12	17	-	14	7	4	18	20	10	6	2	-	4	3	-	-	6	5	-	-	10	-	7
Desmidium sp.	6	3	2	4	8	6	5	9	4	3	3	1	-	-	3	-	4	2	2	-	6	4	-	-
Chlorella sp.	2	1	3	-	-	4	3	3	2	-	7	2	3	-	-	4	2	-	-	4	3	7	-	6
Zygnema sp.	5	7	-	4	6	-	-	5	7	2	2	-	2	2	-	5	4	-	6	-	-	8	4	-
Gonatozygon sp.	4	3	4	6	-	8	5	4	5	4	-	4	-	4	3	4	-	2	-	-	10	4	-	3
Microspora sp.	3	2	3	-	4	4	6	8	10	-	5	3	-	-	8	10	3	-	2	3	-	6	8	-
Species richness	***19***	***19***	***19***	***16***	***18***	***18***	***19***	***19***	***21***	***19***	***17***	***18***	***10***	***13***	***16***	***16***	***13***	***13***	***13***	***11***	***16***	***18***	***12***	***13***
Abundance(ind/l)	***197***	***168***	***155***	***124***	***158***	***161***	***169***	***175***	***346***	***141***	***134***	***151***	***112***	***155***	***189***	***184***	***105***	***115***	***147***	***142***	***293***	***335***	***112***	***140***
Bacillariophyta																								
Amphora sp.	8	6	4	3	-	10	6	9	8	2	-	2	-	4	3	-	8	12	-	-	6	14	-	-
Caloneis sp.	7	4	3	8	12	-	4	6	5	14	9	4	3	-	-	6	4	-	-	4	3	5	-	4
Cymbella sp.	4	3	-	6	5	4	-	7	14	10	8	-	6	3	-	12	6	4	8	-	-	7	4	-
Diatoma sp.	-	2	4	-	4	8	9	16	15	9	6	-	4	-	8	7	-	10	16	22	28	6	12	16
Diploneis sp.	12	14	7	8	-	6	6	3	7	-	14	20	-	18	14	-	-	4	-	-	9	7	-	6
Eunotia sp.	4	3	-	2	6	8	3	-	4	2	-	10	-	-	4	3	5	-	-	-	-	2	-	4
Flagillaria sp.	8	6	14	-	1	2	-	4	-	7	3	4	2	-	-	4	-	-	6	2	14	12	-	-
Frustulia sp.	3	-	8	4	3	5	7	6	4	3	-	7	-	4	3	-	-	8	5	-	-	-	4	2
Gomphonema sp.	-	8	6	12	9	-	3	14	18	4	3	-	4	-	-	12	16	-	-	14	8	6	-	-

Gyrosigma sp.	2	3	3	-	-	4	2	3	6	2	-	3	-	4	6	-	-	7	4	-	4	2	-	4
Melosira sp.	4	-	6	4	3	10	9	7	8	-	4	5	-	-	-	2	4	-	-	6	5	14	6	-
Navicula sp.	1	3	-	2	2	3	-	-	-	5	2	4	8	14	-	-	32	-	-	24	27	-	8	3
Nitzschia sp.	6	7	2	-	-	2	4	3	12	6	-	8	-	6	4	-	-	6	8	4	-	16	-	18
Pinnularia sp.	-	-	4	6	8	-	3	4	7	3	-	4	-	-	3	5	-	-	4	-	-	-	14	-
Pleurosigma sp.	4	3	7	2	-	5	7	4	8	2	6	-	4	8	-	-	6	-	-	4	7	-	-	-
Rhopalodia sp.	-	2	3	-	4	12	-	-	4	3	-	-	3	2	4	-	-	8	6	-	-	4	3	-
Surirella sp.	6	3	-	7	5	2	1	1	3	-	4	5	-	-	10	12	-	-	-	14	17	-	4	2
Synedra sp.	14	-	4	12	-	-	14	9	8	2	-	6	5	-	-	4	3	-	8	-	16	12	-	-
Spephanodiscus sp.	-	4	3	2	2	2	-	5	3	-	3	3	-	-	6	3	-	4	-	2	3	-	6	3
Tabellaria sp.	2	10	4	4	3	-	2	7	8	10	4	6	-	4	2	-	-	12	14	18	-	22	-	8
Species richness	***15***	***16***	***16***	***15***	***14***	***15***	***15***	***17***	***18***	***16***	***12***	***15***	***9***	***10***	***12***	***11***	***9***	***10***	***10***	***11***	***13***	***14***	***9***	***11***
Abundance(ind/l)	***85***	***81***	***82***	***82***	***67***	***83***	***80***	***108***	***142***	***84***	***66***	***91***	***39***	***67***	***67***	***70***	***84***	***75***	***79***	***114***	***147***	***129***	***61***	***70***
Cyanophyta																								
Anabaena sp.	10	14	-	6	9	12	18	22	20	16	-	14	-	12	18	-	-	24	16	10	22	8	-	-
Anabaenopsis sp.	6	3	12	8	14	7	13	15	12	8	10	3	14	-	6	17	8	-	-	-	15	28	12	4
Mycrocystis sp.	3	-	6	10	6	8	10	14	15	-	14	8	-	4	-	12	10	20	38	-	42	46	-	25
Nostoc sp.	14	6	8	5	-	6	-	8	7	18	8	10	6	-	12	-	22	8	-	16	-	-	-	-
Oscillatoria sp.	32	24	28	18	14	12	17	25	44	15	19	27	42	38	-	18	-	-	30	14	62	54	-	52
Phormidium sp.	12	9	6	3	3	4	6	4	12	10	8	4	-	12	15	-	14	16	-	8	16	-	10	8
Rivularia sp.	6	-	8	-	-	-	3	-	-	2	4	3	-	-	4	-	6	8	-	-	2	3	-	-
Raphidiopsis sp.	-	2	3	2	2	-	-	4	7	-	-	1	-	-	-	6	-	-	-	4	7	-	-	-
Species richness	***7***	***6***	***7***	***7***	***6***	***6***	***6***	***7***	***7***	***6***	***6***	***8***	***3***	***4***	***5***	***4***	***5***	***5***	***3***	***5***	***7***	***5***	***2***	***4***
Abundance(ind/l)	***83***	***58***	***71***	***52***	***48***	***49***	***67***	***92***	***117***	***69***	***63***	***70***	***62***	***66***	***55***	***53***	***60***	***76***	***84***	***52***	***166***	***139***	***22***	***89***
Euglenophyta																								
Euglena sp.	4	6	3	2	-	7	-	12	14	3	2	2	-	5	6	-	-	18	9	-	20	14	-	8
Phacus sp.	3	2	-	4	3	2	4	3	5	9	-	4	2	3	-	4	2	-	-	-	8	-	7	4
Trachelomonas sp.	1	2	-	3	4	2	2	7	6	4	3	-	-	-	4	3	-	2	2	8	-	-	6	-
Species richness	***3***	***3***	***1***	***3***	***2***	***3***	***2***	***3***	***3***	***3***	***2***	***2***	***1***	***2***	***2***	***2***	***1***	***2***	***2***	***1***	***2***	***1***	***2***	***2***
Abundance(ind/l)	***8***	***10***	***3***	***9***	***7***	***11***	***6***	***22***	***25***	***16***	***5***	***6***	***2***	***8***	***10***	***7***	***2***	***20***	***11***	***8***	***28***	***14***	***13***	***12***
Dinophyta																								
Gonyaulax sp.	9	4	6	-	-	3	2	5	6	-	4	3	-	4	2	-	4	7	-	3	10	-	-	2
Peridinium sp.	4	3	-	2	3	2	-	4	3	6	1	2	2	-	-	4	-	3	2	6	4	7	10	-
Ceratium sp.	19	8	7	-	-	4	3	12	20	10	4	6	-	22	-	-	32	28	-	-	-	24	-	36
Species richness	***3***	***3***	***2***	***1***	***1***	***3***	***2***	***3***	***3***	***2***	***3***	***3***	***1***	***2***	***1***	***1***	***2***	***3***	***1***	***2***	***2***	***2***	***1***	***2***
Abundance(ind/l)	***32***	***15***	***13***	***2***	***3***	***9***	***5***	***21***	***29***	***16***	***9***	***11***	***2***	***26***	***2***	***4***	***36***	***38***	***2***	***9***	***14***	***31***	***10***	***38***
Chrysophyta																								
Dinobryon sp.	3	4	3	2	6	2	2	4	5	2	-	3	-	6	2	-	12	-	-	4	2	-	-	14
Hyalobryon sp.	4	4	5	-	2	4	-	3	4	3	4	2	4	-	3	6	-	-	8	3	-	6	4	-
Species richness	***2***	***2***	***2***	***1***	***2***	***2***	***1***	***2***	***2***	***2***	***1***	***2***	***1***	***1***	***2***	***1***	***1***	-	***1***	***2***	***1***	***1***	***1***	***1***
Abundance(ind/l)	***7***	***8***	***8***	***2***	***8***	***6***	***2***	***7***	***9***	***5***	***4***	***5***	***4***	***6***	***5***	***6***	***12***	-	***8***	***7***	***2***	***6***	***4***	***14***

Table: 69 Monthly variations in population density of phytoplankton in Ghorajan beel [Station I]

	1999					2000												2001						
Chlorophyta	**A**	**S**	**O**	**N**	**D**	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**	**J**	**F**	**M**	**A**	**M**	**J**	**J**
Chlamydomonas sp.	12	6	-	18	9	15	7	5	20	4	8	3	20	10	15	7	14	8	-	-	6	12	16	-
Gonium sp.	6	14	9	5	8	-	4	6	16	10	7	12	-	18	12	10	24	20	15	18	-	8	12	10
Pandorina morum	5	4	13	-	-	8	3	5	9	-	3	6	8	12	7	-	6	-	9	12	10	25	8	-
Volvox sp.	-	6	4	4	3	7	-	-	3	2	-	-	12	8	-	6	4	-	-	10	24	28	-	15
Eudorina sp.	4	3	7	12	10	6	8	14	18	6	-	4	6	4	10	14	6	12	24	-	32	24	6	-
Pleodorina sp.	7	-	15	4	6	12	6	7	11	7	5	-	8	-	-	4	-	10	6	8	22	48	10	18
Pediastrum simplex	-	4	3	7	-	9	3	2	2	4	3	4	4	-	-	6	8	3	8	5	14	12	4	6
Hydrodictyon sp.	2	6	-	-	14	5	9	5	-	15	8	12	6	10	4	-	-	-	4	6	12	10	-	4
Closterium sp.	18	14	22	9	12	7	6	15	38	27	16	8	-	6	12	10	-	14	8	4	42	54	18	-
Coelastrum sp.	-	-	3	-	5	4	2	3	7	2	3	3	4	-	-	5	7	-	-	12	14	10	-	8
Cosmarium sp.	36	26	17	12	4	8	14	8	67	31	23	25	22	14	8	16	12	-	-	10	52	37	9	12
Spirogyra spiralis	67	23	14	26	15	10	5	7	73	24	18	13	28	20	16	12	-	8	10	6	87	64	14	24
Ulothrix sp.	5	-	-	4	3	7	-	6	12	3	-	5	2	4	-	-	8	-	3	10	12	14	4	-
Euastrum sp.	-	4	3	3	6	12	-	4	6	-	5	6	4	-	8	-	-	2	6	-	8	6	-	10
Xanthidium sp.	7	2	6	6	10	-	3	-	4	3	7	14	-	2	3	-	-	14	-	-	10	8	-	-
Sirogonium sp.	4	6	3	5	-	7	4	5	5	9	-	4	-	-	4	8	-	-	5	4	6	10	4	-
Desmidium sp.	3	2	4	7	6	8	2	2	6	3	9	-	4	-	-	-	6	-	-	-	8	7	-	3
Chlorella sp.	-	-	9	3	3	-	4	3	14	8	-	7	-	6	-	-	-	8	4	-	2	6	-	4
Zygnema sp.	5	6	6	9	8	2	3	2	4	7	3	6	-	-	-	8	10	-	-	-	-	4	-	-
Gonatozygon sp.	4	3	4	6	-	4	3	5	-	2	2	4	6	-	4	-	-	10	8	6	10	12	3	-
Microspora sp.	2	-	7	3	6	-	-	6	4	3	3	2	-	-	-	4	-	-	-	-	6	8	-	10
Species richness	***16***	***16***	***18***	***18***	***17***	***17***	***17***	***19***	***19***	***19***	***16***	***18***	***14***	***12***	***12***	***13***	***11***	***11***	***13***	***13***	***19***	***21***	***12***	***12***
Abundance(ind/l)	***187***	***129***	***149***	***143***	***128***	***131***	***86***	***110***	***319***	***170***	***123***	***138***	***134***	***114***	***103***	***110***	***105***	***109***	***110***	***111***	***377***	***407***	***108***	***124***
Bacillariophyta																								
Amphora sp.	10	8	7	-	4	4	5	2	7	-	5	6	-	4	-	8	6	3	-	-	10	14	-	-
Caloneis sp.	7	4	3	5	3	7	8	9	14	12	6	4	3	-	-	4	-	-	8	3	8	6	-	7
Cymbella sp.	-	-	2	4	4	9	3	4	3	6	2	4	6	-	-	-	4	6	-	5	4	-	8	-
Diatoma sp.	6	2	12	3	3	-	2	5	8	3	-	2	-	-	8	-	-	3	2	-	3	-	-	-
Diploneis sp.	4	3	4	6	9	-	3	3	5	-	12	14	-	5	6	-	-	-	8	10	12	7	-	-
Flagillaria sp.	3	4	7	3	-	8	8	-	4	3	5	2	4	-	-	3	-	5	-	-	8	-	-	4
Frustulia sp.	-	-	-	2	2	4	-	7	2	-	4	3	-	8	2	-	3	-	-	6	10	12	5	-
Gomphonema sp.	6	3	4	-	3	10	13	3	15	4	-	-	2	-	-	4	-	8	-	-	-	6	-	4
Gyrosigma sp.	3	-	-	5	6	-	4	4	2	7	3	-	-	4	3	-	-	-	6	10	14	18	-	5
Melosira sp.	12	4	3	-	-	8	14	4	-	-	5	9	-	12	-	-	10	7	-	6	-	8	4	-

Navicula sp.	-	10	2	2	1	3	2	3	2	1	3	-	2	-	16	14	-	-	3	-	6	2	-	6
Nitzschia sp.	5	3	3	7	9	-	4	-	6	10	4	16	-	14	-	-	7	-	-	2	4	-	-	-
Pinnularia sp.	4	4	-	6	3	2	2	5	3	4	6	2	-	-	12	-	18	9	-	14	5	6	4	-
Pleurosigma sp.	14	6	4	3	10	7	4	-	-	3	3	6	2	-	4	3	-	-	12	-	4	-	-	14
Rhopalodia sp.	3	3	2	-	-	4	-	6	8	2	-	-	3	4	-	-	-	15	-	4	8	6	-	2
Surirella sp.	-	-	4	3	2	2	3	4	2	-	5	4	-	2	-	4	3	-	-	-	-	5	2	-
Synedra sp.	6	8	3	4	4	3	6	2	4	6	-	7	-	-	3	-	8	4	-	10	12	-	-	6
Spephanodiscus sp.	-	4	2	-	1	2	3	2	6	9	3	4	-	-	-	2	-	-	6	-	2	-	5	4
Tabellaria sp.	10	7	4	3	-	-	4	3	2	4	4	-	-	2	-	-	6	3	-	3	-	4	-	2
Species richness	***14***	***15***	***16***	***14***	***15***	***14***	***17***	***16***	***17***	***14***	***15***	***14***	***7***	***9***	***8***	***8***	***9***	***10***	***7***	***11***	***15***	***12***	***6***	***10***
Abundance(ind/l)	***93***	***73***	***66***	***56***	***64***	***73***	***88***	***66***	***93***	***74***	***70***	***83***	***22***	***55***	***54***	***42***	***65***	***63***	***45***	***73***	***110***	***94***	***28***	***54***
Cyanophyta																								
Anabaena sp.	4	6	8	-	6	9	14	7	17	12	8	12	-	8	10	-	5	7	-	-	18	16	-	4
Anabaenopsis sp.	-	4	3	6	2	-	-	8	10	4	3	-	4	-	6	3	8	-	6	10	7	-	12	-
Mycrocystis sp.	3	-	4	3	7	12	4	6	16	10	9	7	-	10	12	-	14	5	-	-	18	20	-	6
Nostoc sp.	14	7	10	4	3	14	5	3	8	4	-	4	3	-	-	6	-	8	10	24	22	28	14	-
Oscillatoria sp.	43	27	32	17	15	22	28	19	62	9	7	14	64	34	-	28	22	14	18	-	68	65	-	25
Phormidium sp.	9	3	7	2	2	4	3	-	7	-	-	-	6	2	-	4	8	-	3	2	7	14	12	6
Rivularia sp.	4	7	-	-	5	-	-	6	4	3	3	6	-	3	5	-	-	4	2	2	6	8	5	4
Species richness	***6***	***6***	***6***	***5***	***7***	***5***	***5***	***6***	***7***	***6***	***5***	***5***	***4***	***5***	***4***	***4***	***5***	***5***	***5***	***4***	***7***	***6***	***4***	***5***
Abundance(ind/l)	***77***	***54***	***64***	***32***	***40***	***61***	***54***	***49***	***124***	***42***	***30***	***43***	***77***	***57***	***33***	***41***	***57***	***38***	***39***	***38***	***146***	***151***	***43***	***45***
Euglenophyta																								
Euglena sp.	6	8	3	4	-	6	12	4	3	-	2	4	-	5	8	-	6	14	17	-	22	16	6	10
Phacus sp.	-	3	2	2	4	3	3	5	6	9	2	3	4	6	-	10	4	-	3	6	8	10	-	8
Trachelomonas sp.	2	4	1	1	2	1	-	-	-	4	3	-	-	-	4	3	-	2	-	8	4	6	4	-
Species richness	***2***	***3***	***3***	***3***	***2***	***3***	***2***	***2***	***2***	***2***	***3***	***2***	***1***	***2***	***2***	***2***	***2***	***2***	***2***	***2***	***3***	***3***	***2***	***2***
Abundance(ind/l)	***8***	***15***	***6***	***7***	***6***	***10***	***15***	***9***	***9***	***13***	***7***	***7***	***4***	***11***	***12***	***13***	***10***	***16***	***20***	***14***	***34***	***32***	***10***	***18***
Dinophyta																								
Gonyaulax sp.	4	3	-	-	4	2	2	-	1	2	1	1	-	2	4	3	-	2	2	6	4	-	2	3
Peridinium sp.	3	2	4	6	-	3	-	1	4	3	-	-	3	4	-	6	5	-	3	2	8	4	-	4
Ceratium sp.	17	4	6	5	-	4	-	7	22	1	3	3	28	36	65	-	-	22	17	32	38	-	62	15
Species richness	***3***	***3***	***2***	***2***	***1***	***3***	***1***	***2***	***3***	***3***	***2***	***2***	***2***	***3***	***2***	***2***	***1***	***2***	***3***	***3***	***3***	***1***	***2***	***3***
Abundance(ind/l)	***24***	***9***	***10***	***11***	***4***	***9***	***2***	***8***	***27***	***6***	***4***	***4***	***31***	***42***	***69***	***9***	***5***	***24***	***22***	***40***	***50***	***4***	***64***	***22***
Chrysophyta																								
Dinobryon sp.	1	2	2	4	3	7	2	4	-	6	1	3	2	-	4	3	-	2	2	1	4	6	2	-
Hyalobryon sp.	2	1	1	1	3	2	4	3	4	2	4	-	-	3	-	2	4	3	-	4	6	3	1	4
Species richness	***2***	***2***	***2***	***2***	***2***	***2***	***2***	***2***	***1***	***2***	***2***	***1***	***1***	***1***	***1***	***2***	***1***	***2***	***1***	***2***	***2***	***2***	***2***	***1***
Abundance(ind/l)	***3***	***3***	***3***	***5***	***6***	***9***	***6***	***7***	***4***	***8***	***5***	***3***	***2***	***3***	***4***	***5***	***4***	***5***	***2***	***5***	***10***	***9***	***3***	***4***

Table: 70 Monthly variations in population density of phytoplankton in Ghorajan beel [Station II]

	1999					2000												2001						
Chlorophyta	**A**	**S**	**O**	**N**	**D**	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**	**J**	**F**	**M**	**A**	**M**	**J**	**J**
Chlamydomonas sp.	7	9	12	6	14	8	6	4	7	3	6	4	10	12	-	-	8	14	-	6	18	14	7	-
Gonium sp.	3	8	7	11	5	7	9	5	12	4	4	5	-	6	4	10	3	2	4	-	8	10	-	6
Pandorina morum	4	2	-	-	3	6	-	-	6	2	5	2	3	-	6	4	8	4	-	10	12	8	-	10
Volvox sp.	3	-	-	-	4	-	3	7	5	-	-	3	-	4	10	-	3	-	12	14	18	12	15	-
Eudorina sp.	-	-	3	4	-	3	-	4	11	3	-	-	2	-	-	4	-	4	3	-	8	-	10	2
Pleodorina sp.	2	6	14	9	-	-	7	-	-	6	4	5	-	3	2	-	-	-	4	6	10	14	-	4
Pediastrum simplex	-	2	6	4	3	12	-	3	2	-	-	-	5	-	4	3	6	-	4	3	5	8	4	-
Hydrodictyon sp.	18	6	-	8	-	14	-	16	14	6	4	3	-	6	10	14	-	8	12	-	4	14	-	8
Closterium sp.	6	8	10	12	5	7	9	-	6	-	12	14	8	-	6	-	-	15	-	10	12	9	6	4
Coelastrum sp.	-	-	4	-	3	-	6	10	19	6	-	-	4	3	-	4	10	-	8	14	18	16	-	-
Cosmarium sp.	22	14	12	34	20	4	10	4	4	-	6	8	-	14	20	12	-	6	10	18	22	42	12	16
Spirogyra spiralis	36	24	18	16	32	12	15	20	39	25	8	12	24	32	18	-	22	28	12	16	26	30	15	17
Ulothrix sp.	-	6	7	11	-	-	5	6	6	-	5	3	4	-	8	6	-	-	14	8	10	6	-	4
Euastrum sp.	3	-	-	-	4	2	-	3	3	4	-	-	3	6	-	-	-	4	2	-	8	4	3	-
Xanthidium sp.	-	2	3	-	-	4	3	-	-	10	2	4	-	-	4	3	-	-	3	14	-	6	-	3
Sirogonium sp.	2	4	4	3	2	-	2	-	4	-	-	-	12	-	6	-	8	10	-	4	3	-	-	6
Desmidium sp.	3	6	-	-	4	2	-	-	-	3	3	2	-	4	10	-	6	4	4	-	8	3	2	-
Chlorella sp.	-	-	2	2	3	-	4	4	6	-	5	3	4	-	3	7	-	-	3	6	-	4	-	4
Zygnema sp.	4	3	-	-	-	2	3	2	4	-	-	3	-	12	-	-	14	8	-	-	10	12	4	-
Gonatozygon sp.	6	-	8	7	2	-	-	3	-	-	3	8	-	10	6	-	-	-	8	4	12	6	-	4
Microspora sp.	-	2	2	4	3	2	-	-	5	3	-	-	2	3	-	4	6	5	-	-	-	4	-	2
Species richness	***14***	***15***	***15***	***14***	***15***	***14***	***13***	***14***	***17***	***12***	***13***	***15***	***12***	***13***	***15***	***11***	***11***	***13***	***15***	***14***	***18***	***19***	***10***	***14***
Abundance(ind/l)	***119***	***102***	***112***	***131***	***107***	***85***	***82***	***91***	***153***	***75***	***67***	***79***	***81***	***115***	***117***	***71***	***94***	***112***	***103***	***133***	***212***	***222***	***78***	***90***
Bacillariophyta																								
Amphora sp.	4	6	-	3	3	-	4	4	8	2	-	2	3	8	-	-	4	2	3	-	4	2	-	3
Caloneis sp.	12	-	8	4	5	2	-	-	3	-	4	-	-	10	2	6	-	4	-	-	6	8	3	-
Cymbella sp.	-	2	-	4	-	-	5	2	2	4	3	3	-	-	8	-	-	10	4	6	4	3	-	2
Diatoma sp.	3	3	4	3	2	6	2	-	4	3	-	-	4	4	-	2	3	-	-	4	10	8	-	4
Diploneis sp.	-	-	2	-	-	5	2	3	3	-	4	2	2	-	-	4	2	-	-	3	8	6	4	-
Flagillaria sp.	8	13	5	-	6	2	-	-	16	3	-	4	-	3	6	-	4	8	4	-	-	3	-	2
Frustulia sp.	2	2	-	4	3	-	4	6	7	-	3	-	-	4	3	2	-	-	2	5	4	-	3	-
Gomphonema sp.	-	-	3	3	5	3	-	-	2	2	-	8	4	2	-	4	-	-	3	-	6	8	-	8
Gyrosigma sp.	3	4	-	-	-	-	3	-	-	4	3	3	-	4	3	-	6	3	-	2	2	3	2	-
Melosira sp.	-	2	4	7	-	3	4	7	3	-	5	4	2	-	-	2	4	-	-	7	10	12	-	-
Navicula sp.	-	-	-	2	3	-	-	-	-	4	2	-	6	8	10	-	-	12	24	32	30	16	-	10
Nitzschia sp.	4	3	2	-	-	6	3	2	2	-	-	3	-	2	-	4	3	-	-	-	3	-	2	-

Pinnularia sp.	2	-	7	9	-	5	-	3	8	2	-	-	4	3	-	-	-	2	-	-	10	12	-	7
Pleurosigma sp.	6	4	2	-	7	-	-	4	3	-	4	4	-	-	4	3	-	-	6	5	4	2	2	-
Rhopalodia sp.	-	-	3	4	-	4	6	-	2	3	-	2	3	-	2	2	-	-	3	10	6	-	-	5
Surirella sp.	2	1	4	3	2	-	-	3	4	-	3	-	-	-	3	-	5	2	-	2	-	4	3	-
Synedra sp.	-	-	-	-	4	3	4	-	-	2	6	7	4	-	2	-	-	6	4	-	-	2	-	3
Spephanodiscus sp.	3	2	2	-	3	4	2	7	6	-	2	3	-	4	3	2	-	-	6	4	-	4	-	4
Tabellaria sp.	-	-	3	4	-	-	3	-	-	3	-	-	6	-	-	4	10	2	-	-	12	8	3	-
Species richness	***11***	***11***	***13***	***12***	***11***	***11***	***12***	***10***	***15***	***11***	***11***	***12***	***10***	***11***	***11***	***11***	***9***	***10***	***10***	***11***	***15***	***16***	***8***	***10***
Abundance(ind/d)	***49***	***42***	***49***	***50***	***43***	***43***	***42***	***41***	***73***	***32***	***39***	***45***	***38***	***52***	***43***	***35***	***41***	***51***	***59***	***80***	***119***	***101***	***22***	***48***
Cyanophyta																								
Anabaena sp.	-	3	2	-	6	-	14	3	18	5	-	6	4	-	3	2	-	-	-	2	4	6	-	2
Anabaenopsis sp.	2	2	-	4	2	-	-	2	5	3	2	2	-	3	-	4	2	-	3	-	8	12	4	-
Mycrocystis sp.	8	10	-	15	4	7	2	-	14	3	-	2	4	3	-	-	6	10	-	-	12	14	-	6
Nostoc sp.	3	4	7	3	-	2	3	3	-	2	6	4	-	6	10	5	-	2	-	3	8	6	4	-
Oscillatoria sp.	33	19	8	16	22	12	4	7	30	14	9	52	25	14	8	32	28	18	10	14	42	33	14	12
Phormidium sp.	4	-	6	-	-	-	5	3	4	-	3	-	-	4	3	-	-	6	4	-	2	5	-	-
Rivularia sp.	-	-	3	2	-	2	3	-	-	-	-	3	6	-	4	2	-	-	-	3	2	4	-	2
Species richness	***5***	***5***	***5***	***5***	***4***	***4***	***6***	***5***	***5***	***5***	***4***	***6***	***4***	***5***	***5***	***5***	***3***	***4***	***3***	***4***	***7***	***7***	***3***	***4***
Abundance(ind/l)	***50***	***38***	***26***	***40***	***34***	***23***	***31***	***18***	***71***	***27***	***20***	***69***	***39***	***30***	***28***	***45***	***36***	***36***	***17***	***22***	***85***	***80***	***22***	***22***
Euglenophyta																								
Euglena sp.	2	4	-	4	3	-	7	2	2	-	-	4	-	4	3	-	2	4	-	-	2	3	-	2
Phacus sp.	-	-	4	3	-	2	2	-	4	3	3	-	4	6	-	8	4	-	7	5	4	-	-	-
Species richness	***1***	***1***	***1***	***2***	***1***	***1***	***2***	***1***	***2***	***1***	***1***	***1***	***1***	***2***	***1***	***1***	***2***	***1***	***1***	***1***	***2***	***1***	***-***	***1***
Abundance(ind/l)	***2***	***4***	***4***	***7***	***3***	***2***	***9***	***2***	***6***	***3***	***3***	***4***	***4***	***10***	***3***	***8***	***6***	***4***	***7***	***5***	***6***	***3***	***-***	***2***
Dinophyta																								
Gonyaulax sp.	-	2	-	-	-	3	-	-	-	2	2	-	4	3	-	-	6	-	4	3	8	2	-	4
Peridinium sp.	4	3	3	4	6	7	4	2	2	-	-	3	-	2	4	-	-	4	-	-	3	3	-	2
Ceratium sp.	26	-	18	-	-	4	-	-	7	3	4	-	20	22	-	8	35	33	-	-	42	28	6	-
Species richness	***2***	***2***	***2***	***1***	***1***	***3***	***1***	***1***	***2***	***2***	***2***	***1***	***2***	***3***	***1***	***1***	***2***	***2***	***1***	***1***	***3***	***3***	***1***	***2***
Abundance(ind/l)	***30***	***5***	***21***	***4***	***6***	***14***	***4***	***2***	***9***	***5***	***6***	***3***	***24***	***27***	***4***	***8***	***41***	***37***	***4***	***3***	***53***	***33***	***6***	***6***
Chrysophyta																								
Dinobryon sp.	3	4	-	-	5	-	7	3	2	-	-	4	-	-	2	3	-	-	4	2	8	6	-	4
Hyalobryon sp.	2	-	-	3	2	-	-	-	4	3	3	-	2	-	3	4	2	-	-	5	3	4	2	-
Species richness	*2*	*1*	-	*1*	*2*	-	*1*	*1*	*2*	*1*	*1*	*1*	*1*	-	*2*	*2*	*1*	-	*1*	*2*	*2*	*2*	*1*	*1*
Abundance(ind/l)	*5*	*4*	-	*3*	*7*	-	*7*	*3*	*6*	*3*	*3*	*4*	*2*	-	*5*	*7*	*2*	-	*4*	*7*	*11*	*10*	*2*	*4*

viz. during February and April in first year; while lower richness of the diatoms was observed in June in the second year at station I. On the other hand, station II registered 8-16 (11.0 ±2.0) and peak during May in the second year and minima during June in the second year. However, they exhibited 34.5% of the total phytoplankton station I. The number of this community appeared to be quantitatively more at station II and, in turn, comprised 35.2% of phytoplankton abundance. However, population density varied between 22-110 (67.0 ±21.0) ind/l at station I and station II showed between 22-119 (52.0 ±21.0) ind/l in the beel. The diatoms exhibited significant positive correlations with phytoplankton (r_1= 0.674, p<.001; r_2= 0.938, p<.001), Chlorophyta (r_1= 0.633, p<.001; r_2= 0.924, p<.001) and Chrysophyta (r_1= 0.546, p<.01; r_2= 0.652, p<.001). On the other hand, they reflected significant inverse correlation with zooplankton (r_1= -0.624, p<.01) at station I in Ghorajan beel.

The Cyanophyta was represented by 8 species at both the stations in Deepor beel. Their species richness in the monthly collection ranged between 3-8 (6.0 ±1.0) at station I, which exhibited maximum number of species during March and April in the first year; on the other hand, minimum was noticed during August of the same year. However, station II depicted the range 2-8 (5.0 ±2.0), which registered maximum number during July in the first year and a minimum during June in the second year. Abundance of Cyanophyta ranged between 28-149 (61.0 ±27.0) ind/l at station I, which recorded peak density during April in the first year and minima during September in the second year. Further, the abundance ranged between 22-166 (73.0 ±30.0) ind/l at station II, which exhibited maximum density during April in the second year and minimum during June of the same year in Deepor beel. Cyanophyta showed significant positive correlation with phytoplankton (r_1= 0.782, p<.001; r_2= 0.907, p<.001), Chlorophyta (r_1= 0.697, p<.001; r_2= 0.787, p<.001), Chrysophyta (r_1= 0.516, p<.01), transparency (r_2= 0.462, p<.05), specific conductivity (r_2= 0.409, p<.05) and BOD (r_1= 0.454, p<.05) . On the other hand, significant inverse correlation with zooplankton (r_1=-0.545, p<.01), Cladocera (r_1= -0.488, p<.05), magnesium (r_1= -0.416, p<.05) and silicate (r_1= -0.439, p<.05) at station I in Deepor beel.

The Cyanophyta was represented by 7 species at both the stations in Ghorajan beel. The species richness ranged between 4-7 (5.0 ±1.0) at station I, which recorded maximum number of species during December, April in the first year and again during April in the second year; on the other hand, minimum value was registered during August, October, November, March, June in the second year. Station II depicted composition range 3-7 (5.0 ±1.0), which experienced maximum during April and May in the second year and a minima during December, February and June in the second of the study period. However, the abundance of Cyanophyta ranged between 30-151 (59.0 ±33.0) ind/l at station I in Ghorajan beel, which exhibited maximum density during May in the second year and minimum during June in the first year. Station II fluctuated the density range between 17-85 (37.0 ±19.0) ind/l, which showed peak during April in the second year and lowest during February of the same year. Cyanophyta exhibited significant positive correlation with net plankton (r_1= 0.717, p<.001; r_2= 0.508, p<.01), phytoplankton (r_1= 0.949, p<.001; r_2= 0.82, p<.001), Chlorophyta (r_1= 0.912, p<.001; r_2= 0.696, p<.001), Chrysophyta (r_1= 0.416, p<.05; r_2= 0.604, p<.01) and calcium (r_2= 0.411, p<.05) in this beel.

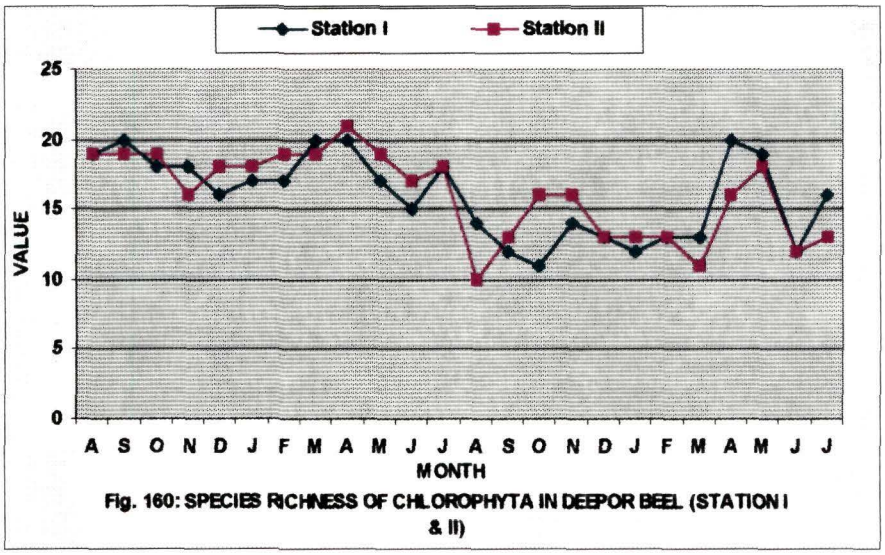


Fig. 160: SPECIES RICHNESS OF CHLOROPHYTA IN DEEPOR BEEL (STATION I & II)

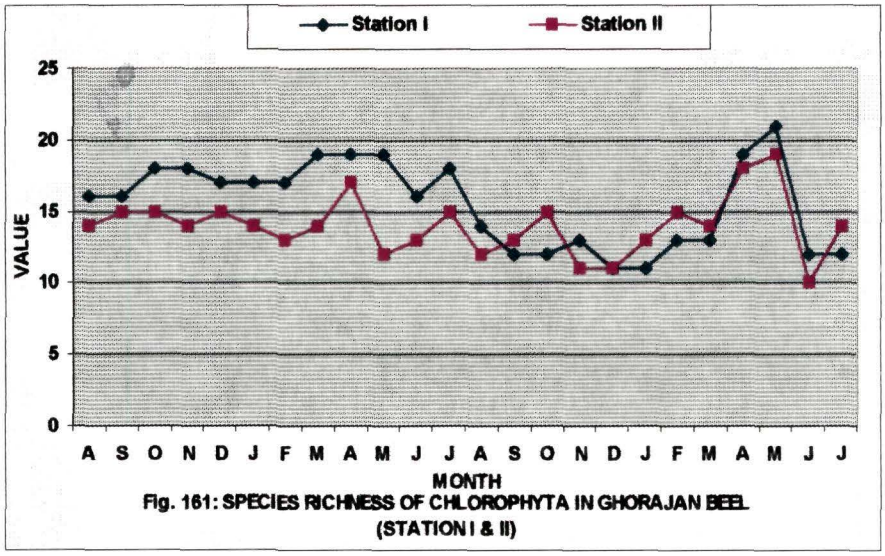


Fig. 161: SPECIES RICHNESS OF CHLOROPHYTA IN GHORAJAN BEEL (STATION I & II)

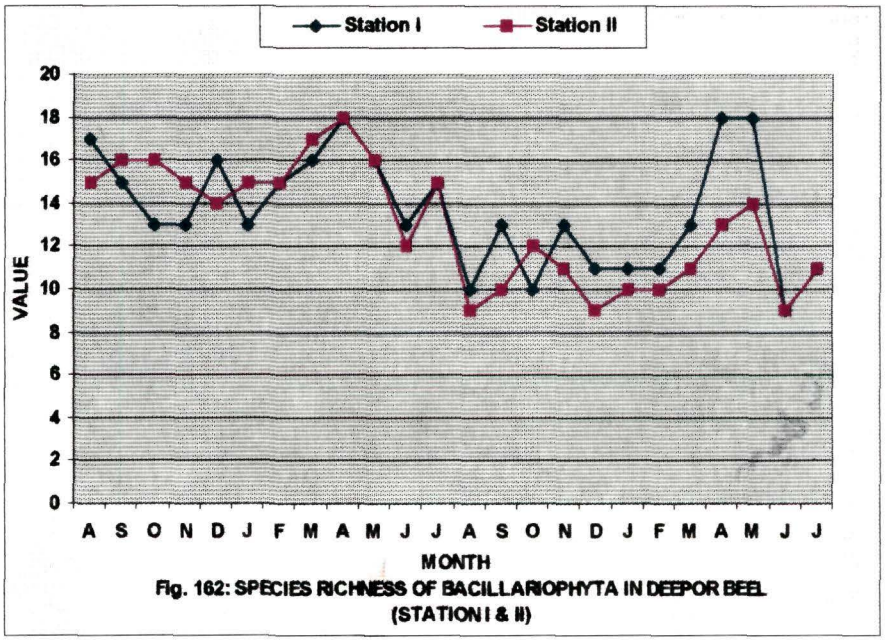


Fig. 162: SPECIES RICHNESS OF BACILLARIOPHYTA IN DEEPOR BEEL (STATION I & II)

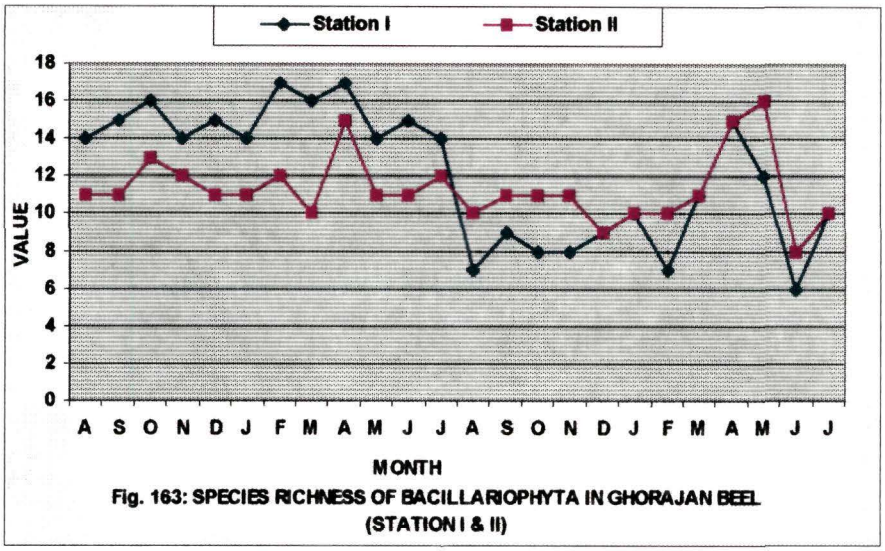


Fig. 163: SPECIES RICHNESS OF BACILLARIOPHYTA IN GHORAJAN BEEL (STATION I & II)

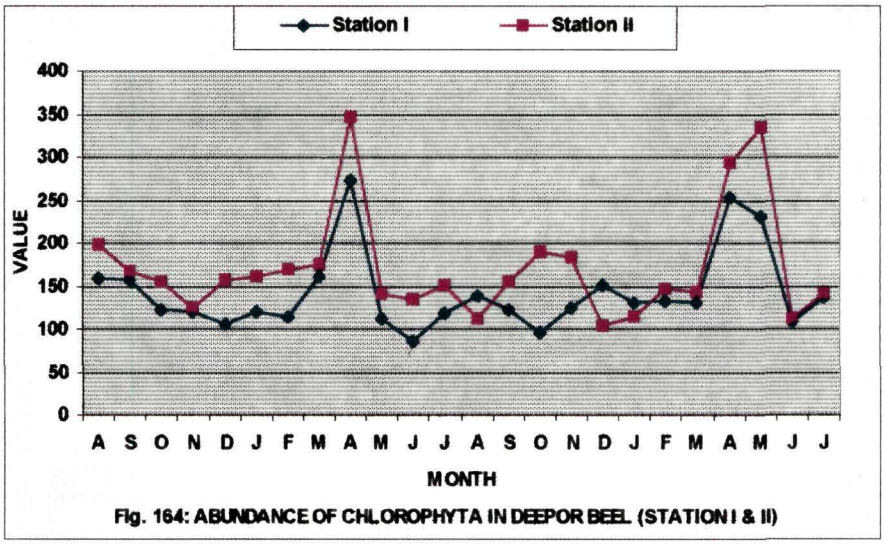


Fig. 164: ABUNDANCE OF CHLOROPHYTA IN DEEPOR BEEL (STATION I & II)

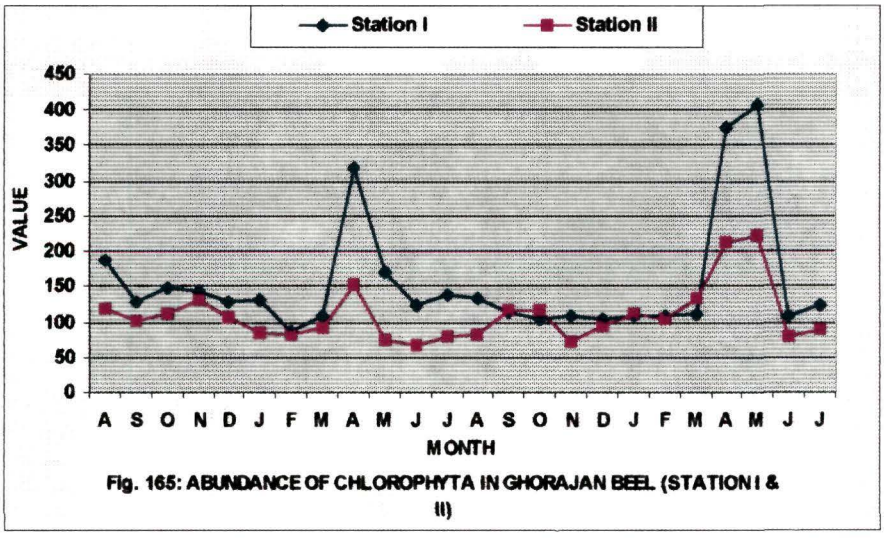


Fig. 165: ABUNDANCE OF CHLOROPHYTA IN GHORAJAN BEEL (STATION I & II)

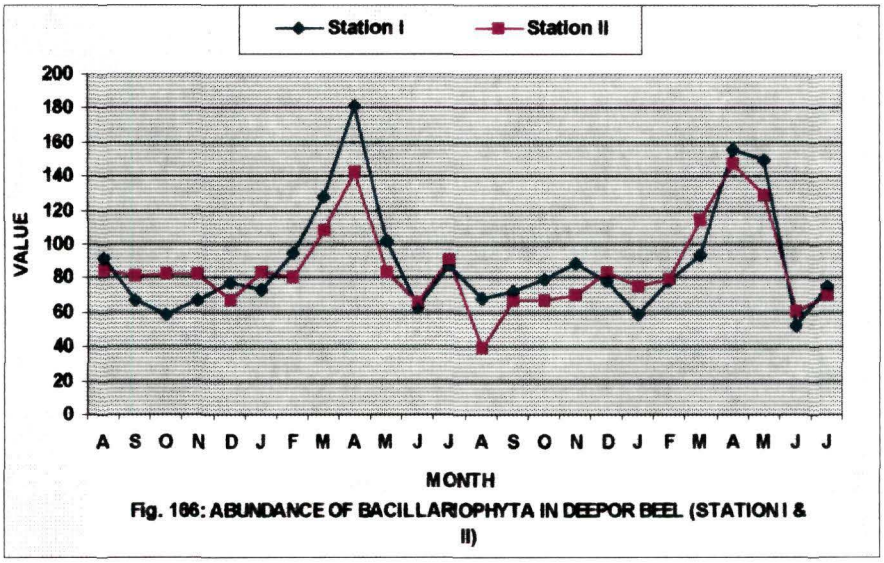


Fig. 166: ABUNDANCE OF BACILLARIOPHYTA IN DEEPOR BEEL (STATION I & II)

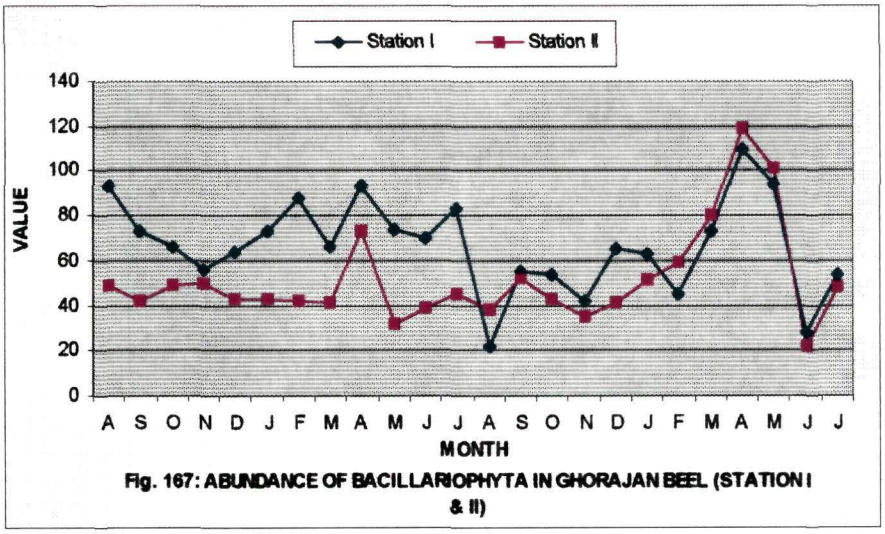


Fig. 167: ABUNDANCE OF BACILLARIOPHYTA IN GHORAJAN BEEL (STATION I & II)

In the present investigation, Euglenophyta was qualitatively less important and represented by only 3 species in Deepor and Ghorajan beel. However, the abundance of Euglenophyta ranged between 3-33 ind/l (14.0 ±6.0) at station I and between 2-28 ind/l (10.0 ±6.0) at station II in Deepor beel. Maximum abundance (30 ind/l) was observed in April at station I in the first year and station II showed maxima (28 ind/l) in April in the second year. Euglenophyta showed significant positive correlation with net plankton (r_2= 0.609, p<.01), phytoplankton (r_1= 0.802, p<.001; r_2= 0.695, p<.001), Chlorophyta (r_1= 0.738, p<.001; r_2= 0.581, p<.01), Cyanophyta (r_1= 0.553, p<.01; r_2= 0.645, p<.001) and Chrysophyta (r_1= 0.606, p<.01) in Deepor beel and significant inverse correlation with Cladocera (r_1= -0.619, p<.01) at station I in this beel.

Euglenophyta density fluctuated between 4-34 ind/l (12.0 ±7.0) at station I and between 0-10 ind/l (4.0 ±2.0) at station II of Ghorajan beel. It exhibited maxima (20 ind/l) in February at station I in the second year and in September at station II (10 ind/l) in the same year It showed significant positive correlation with net plankton (r_1= 0.599, p<.01), phytoplankton (r_1= 0.678, p<.001), Chlorophyta (r_1= 0.631, p<.001), Cyanophyta (r_1= 0.589, p<.01), Rhizopoda (r_1= 0.672, p<.001) and specific conductivity (r_1= 0.431, p<.05) at station I in Ghorajan beel. Euglenophyta were common and were ubiquitous at all stations in the sampled beels.

The Dinophyta were represented only by some motile algae in both the sampled beels. The abundance of Dinophyta fluctuated between 2-66 (23.0 ±18.0) ind/l at station I and between 2-38 (16.0 ±12.0) ind/l at station II in Deepor beel. It exhibited maxima in November in the second year and minima in January in the same year at station I, while it showed maxima in January and July in the second year and minima in November in the first year and August and February in the second year at station II. Dinophyta showed significant positive correlation with net plankton (r_1= 0.622, p<.01; r_2= 0.499, p<.05), phytoplankton (r_1= 0.442, p<.05; r_2= 0.414, p<.05), Chlorophyta (r_1= 0.421, p<.05) and Cyanophyta (r_2= 0.409, p<.05) in Deepor beel, while it exhibited significant inverse relationship with specific conductivity (r_1= -0.431, p<.05) at station I in this beel.

The abundance of Dinophyta ranged between 2-69 (21.0 ±19.0) ind/l at station I and between 2-53 (15.0 ±14.0) ind/l at station II in Ghorajan beel. It exhibited maxima in October in the second year and minima in February in the first year at station I, while maxima was observed in April in the second year and minima in March in the first year at station II. They showed significant positive correlations with net plankton (r_2= 0.508, p<.01), phytoplankton (r_2= 0.665, p<.001), Chlorophyta (r_2= 0.542, p<.01), Bacillariophyta (r_2= 0.514, p<.01), Cyanophyta (r_2= 0.498, p<.05), Rhizopoda (r_1= 0.468, p<.05), free carbon dioxide (r_1= 0.457, p<.05) and total alkalinity (r_1= 0.495, p<.05) in this beel.

The abundance of Chrysophyta fluctuated between 4-29 ind/l at station I and between 0-14 ind/l at station II in Deepor beel. It showed maximum density in May in the second year and minima was recorded in August in the first year at

station I, while station II depicted maximum in July in the second year and no species was noticed in August in the first year; in January in the second year and also in March in the second year. Chrysophyta showed significant positive correlation with phytoplankton (r_1= 0.737, p<.001), Chlorophyta (r_1= 0.729, p<.001), Bacillariophyta (r_1= 0.704, p<.001), Cyanophyta (r_1= 0.516, p<.01) and Euglenophyta (r_1= 0.606, p<.01). It exhibited significant inverse relationships with zooplankton (r_1= -0.591, p<.01), Cladocera (r_1= -522, p<.01) and dissolved oxygen (r_1= -408, p<.05) in this beel.

Chrysophyta ranged between 2-10 ind/l at station I and between 0-11 ind/l at station II in Ghorajan beel. However, this group exhibited maximum density in April in the second year and minima was noticed August in the first year at station I, while maximum density in April in the second year and no species was observed in October in first year; in January in the first year; in August in the first year and in December in the second year at station II in Ghorajan beel. This group showed significant positive correlation with net plankton (r_2= 0.411, p<.05), phytoplankton (r_1= 0.511, p<.01; r_2= 0.628, p<.01), Chlorophyta (r_1= 0.505, p<.01; r_2= 0.603, p<.01), Bacillariophyta (r_1= 0.546, p<.01; r_2= 0.652, p<.001), Cyanophyta (r_1= 0.416, p<.05; r_2= 0.604, p<.01) and calcium (r_1= 0.412, p<.05), while they depicted significant inverse relationship with zooplankton (r_1= -0.617, p<.01) in this beel.

The cumulative effects of the abiotic factors namely rainfall (X1), water temperature (X2), pH (X3), transparency (X4), specific conductivity (X5), dissolved oxygen (X6), free carbon dioxide (X7), alkalinity (X8), hardness (X9), calcium (X10), chloride (X11), dissolved oxygen matter (X12), phosphate (X13), sulphate (X14), nitrate (X15), biochemical oxygen demand (X16) on the abundance of phytoplankton communities were computed by multiple regression method (Tables 65 & 66).

Table: 65 Multiple Regression (R_1^2 and R_2^2) of Phytoplankton in Deepor beel

Step-wise regression	Station I	Station II
(X_1- X_{16})	R^2=0.765673	R^2=0.724398
(X_1- X_{15})	R^2=0.588712	R^2=0.70448
(X_1- X_{14})	R^2=0.588317	R^2=0.485406
(X_1- X_{13})	R^2=0.58825	R^2=0.485387
(X_1- X_{12})	R^2=0.554105	R^2=0.485387
(X_1- X_{11})	R^2=0.532527	R^2=0.484653
(X_1- X_{10})	R^2=0.524616	R^2=0.48105
(X_1- X_9)	R^2=0.419896	R^2=0.468222
(X_1- X_8)	R^2=0.418986	R^2=0.464325
(X_1- X_7)	R^2=0.357037	R^2=0.457197
(X_1- X_6)	R^2=0.340134	R^2=0.44775
(X_1- X_5)	R^2=0.340062	R^2=0.417729
(X_1- X_4)	R^2=0.214622	R^2=0.158541
(X_1- X_3)	R^2=0.051071	R^2=0.057332
(X_1- X_2)	R^2=0.045616	R^2=0.054598

Table: 66 Multiple Regression (R_1^2 and R_2^2) of Phytoplankton in Ghorajan beel

Step-wise regression	Station I	Station II
$(X_1 - X_{16})$	R^2=0.729592	R^2=0.590487
$(X_1 - X_{15})$	R^2=0.728722	R^2=0.559618
$(X_1 - X_{14})$	R^2=0.720887	R^2=0.559577
$(X_1 - X_{13})$	R^2=0.684374	R^2=0.546702
$(X_1 - X_{12})$	R^2=0.632094	R^2=0.430122
$(X_1 - X_{11})$	R^2=0.50919	R^2=0.354161
$(X_1 - X_{10})$	R^2=0.502393	R^2=0.351647
$(X_1 - X_9)$	R^2=0.497257	R^2=0.319009
$(X_1 - X_8)$	R^2=0.46993	R^2=0.315568
$(X_1 - X_7)$	R^2=0.443672	R^2=0.271156
$(X_1 - X_6)$	R^2=0.439066	R^2=0.250482
$(X_1 - X_5)$	R^2=0.425437	R^2=0.250482
$(X_1 - X_4)$	R^2=0.221908	R^2=0.105476
$(X_1 - X_3)$	R^2=0.147241	R^2=0.066593
$(X_1 - X_2)$	R^2=0.146563	R^2=0.021961

Chapter IV

DISCUSSION

Wetzel (1975) implied that most important goal of limnology is to study the circulation of materials. Biotic and abiotic phenomena are interrelated and the concept of balance is a major part of this interrelationship. Thus, the aim of limnology is to comprehend and circulate the whole productive and destructive processes that are involved in the energy flow. Role of water in nature is unique not only from the point of human consideration but also for those numerous organisms living in it. The studies on different aspects of limnology including temporal variations in water quality and plankton production of the floodplain lakes are essential to understand their nature, trophic status and also to assess the fishery potential. The detailed limnological investigations in two selected floodplain lakes along with biodiversity and synecology of zooplankton were undertaken and the results are discussed below:-

1. ABIOTIC FACTORS:

RAINFALL:

Rainfall was scattered throughout the study period but monsoon contributed a large part of total rainfall in the area. During the present study, total monthly rainfall (0.18-384.6 mm; 155.2 ±141.3) with most of the precipitation occurring between April to August and is directly influenced by southwest monsoons. The period of maximum rainfall coincided with the periods of high air and water temperatures. Rainfall exerted its influence on various abiotic factors in the sampled beels with variable degree as indicated by their correlation values. It registered a significant direct correlation with water temperature (r_1= 0.716, p<.001; r_2= 0.705, p<.001) in Deepor beel and in Ghorajan beel (r_1= 0.714, p<.001; r_2= 0.674, p<.001), which resulted due to concentration of precipitation during summer months. Further, it exhibited significant inverse correlation with transparency (r_1= -0.615, p<.01; r_2= -0.621, p<.01) in Deepor beel and also significant negative relationship in Ghorajan beel (r_1= -0.633, p<.001; r_2= -0.657, p<.001). This fact could be due to increased runoff entering into water bodies from catchments along with surface soil and debris during rainy seasons. Such a generalization concurred with reports by Sharma and Lyngdoh (1999) and Sharma and Wanswett (1999). The recorded results corroborated with Samuajan beel of Assam (Sharma and Hussain, 1999). However, total annual rainfall was higher during the first year in the sampled beels.

The rainfall had a direct relationship with the abundance and distribution of Phytoplankton and indirect relationship through increase in the turbidity and lowering of the temperature and pH. During the present study, rainfall appeared to play a significant role as it controlled the water level fluctuation in the beels. Apart from dilution effect, rainfall has direct role in drying and reflooding of the water bodies.

TEMPERATURE:

Atmospheric temperature in the sampled beels was consistently high and varied slightly in the annual cycle. From February, temperature begins to increase steadily. The recorded air temperature ranged between 22.3-38.2 (30.7 ±4.3) at station I and 22.4-38.1 (30.6 ±4.2) at station II in Deepor beel. Water temperature of the beel varied from a winter low of 17.9°C (December-February) to a summer high of 33.6° C (May-July) and ranged between 17.9-33.6° C (28.4 ±4.3) at station I. A minor peak during September-October occurred when the weather was moderately hot. Station II recorded 18.2-32.9°C (28.1 ±3.9) with a minor peak during April-May. However, air temperature fluctuated between 21.9-37.1 (30.4 ±4.0) at station I and 21.9-38.1 (30.6 ±4.2) at station II in Ghorajan beel. Water temperature varied between 19.7-33.2°C (28.0 ±3.7) and 19.8-32.8°C (28.1 ±3.8) at station I and II respectively in this beel. Water temperature was the lowest in December corresponding with the lowest atmospheric temperature and thereafter it showed a gradual upward trend till June and July when it touched the peak in both the beels. Seasonal variations of water temperature were observed in Siligurijan and Fingua beel, which ranged between 17.9-31.7°C (27.1 ±5.5) and 23.2-33.5°C (28.8 ±4.0) respectively. The recorded air temperature ranged between 20.4-34.8°C (29.7 ±5.5) in the former, while the later depicted 24.8-36.6°C (30.8 ±4.5). The recorded variations and mean values exerted tropical nature and the temporal changes in the water temperature followed nearly an identical pattern in the sampled beels. Further, it followed a trend identical to that of atmospheric temperature. The recorded ranges corroborated with other Indian floodplain lakes (Dey, 1981; Dey and Kar, 1987; Vass, 1989; Yadava and Dey, 1990; Sing and Roy, 1990; Sinha *et al.* 1994; Sharma and Hussain, 1999). December was the coldest month during the study period. Mean air temperature was noticed to be higher than the mean water temperature in both the sampled beels, which disagreed with the report of Sharma and Hussain (1999). Both the beels exhibited tropical range of water temperature, which coincided with the reports of Sharma (2000) from Assam.

Water temperature exhibited significant positive relationships with rainfall ($r_1 = 0.716, p<.001$; $r_2 = 0.705, p<.001$) and total alkalinity ($r_1 = 0.476, p<.05$) in Deepor beel. It also depicted significant positive relationship with rainfall ($r_1 = 0.714, p<.001$; $r_2 = 0.674, p<.001$) in Ghorajan beel, which resulted due to concentration of precipitation during summer months.

TRANSPARENCY:

The present study registered low transparency i.e between 17.0-82.0 cm (55.8 ±20.9) at station I and 15.0-81.0 cm (55.2 ±22.2) at station II in Deepor beel. Transparency showed clear seasonality with the minimum value of 17.0cm recorded during rainy season and maxima (82.0cm) during winter at station I in Deepor beel, while the station II exhibited the minimum of 15.0cm and the maximum of 81.0 cm. In Deepor beel mean and ranges were identical at both the stations during both the years where peak transparency was recorded during December in the second year and minima during August in the same year, while station II showed peak during

November in the first year and minima during August in the second year. The water of the beel remained clear during the spring months but exhibited a high turbidity during the months of high rainfall (April-August) depicting unimodal pattern of variations at both the stations in Deepor beel. Ghorajan beel also depicted low transparency (16.0-82.0 cm; 53.3 ±20.9) at station I and (16.0-83.0 cm; 55.1 ±21.6) at station II. Transparency ranged between 16.0-82.0(53.3 ±20.9) cm and 16.0-83.0 (55.1 ±21.6) cm at station I and II respectively in Ghorajan beel. It registered peak during October in the first year and minima during July in the same year at station I, while station II recorded peak during September in the first year and minima during July in the second year. However, the period between May-August depicted continuous decline and September-January a steady increase in penetration of light.

Transparency varied between 21.0-68.0 cm (44.5 ±20.3) in Siligurijan beel and between 36.0-78.0 cm (60.0 ±17.0) in Fingua beel. Maximum value (68.0 cm) was noticed during the summer and minima (21.0 cm) during the autumn season in the former, while maximum value (78.0 cm) was observed during the autumn and minima (36.0 cm) during the monsoon season in the later. The mean value of Siligurijan beel exhibited lower than all other three beels, on the other hand, it showed vice-versa in Fingua beel i.e. higher than all the sampled beels. However, it corresponded with the earlier reports of the floodplain lakes of upper Assam by Sharma and Hussain (1999) but the annual ranges remained lower than other beels of Assam (Lahon, 1983; Goswami, 1985; Dey and Kar, 1987; Yadava and Dey, 1990). The marked seasonal variation of transparency was controlled by varying amounts of sediments, algae, illumination and suspended organic matter. Wet season variability in transparency was higher than that of the dry season in Deepor beel. However, Fingua beel showed the highest turbidity in rainy season.

Transparency showed clear seasonality during the present study with minima recorded in rainy season (inorganic turbidity) and maxima in winter. However, comparatively higher values were recorded during winter (November and December) and lower during rainy seasons (July and August), which corroborated by its general significant inverse relationship with rainfall in Deepor beel (r_1= -0.615, $p<.01$; r_2= -0.621, $p<.01$) and also in Ghorajan beel (r_1= -0.633, $p<.001$; r_2= -0.657, $p<.001$). Similarly, the inverse relationship with rainfall concurred with the report of Samuajan beel of upper Assam. Reduced transparency during the rainy season may be attributed to increased load of silt and suspended particles brought into the beels by run-off. Correlation analysis among the abiotic factors revealed that transparency and sodium were significantly correlated (r_1= 0.587, $p<.01$) at station I but it negatively correlated with phosphate (r_1= -0.419, $p<.05$) in Deepor beel. The determination of Secchi disc visibility affords a practical estimate of plankton density provided plankton is the primary source of turbidity (Almazan and Boyd, 1978).

Correlation analysis revealed that transparency, total alkalinity (r_1= –0.438, $p<.05$; r_2= –0.455, $p<.05$) and BOD (r_1= –0.492, $p<.05$; r_2= –0.459, $p<.05$) were negatively correlated in Ghorajan beel indicating inverse relationships between them. However, there were no significant variations in transparency between two years in the sampled beels. It was observed that transparency suddenly decreased during January in both the years in the studied beels.

pH:

In the present observations, water of Deepor beel depicted their marginal acidic to alkaline character as pH varied between 6.5-9.5 (7.3 ±0.6) at station I and 6.6-9.2 (7.3 ±0.5) at station II. Lowest pH was recorded during October and November in the first year at station I, while it showed during November in the first year at station II in the beel. Peak pH was noticed during February in the first year at station I in Deepor beel and during February in the first year at station II. Further, hydrogen ion concentration showed little variation till September in the first year in Deepor beel and therefore it exhibited distinct changes during the study period. A relative higher values were recorded in the month of February in the first year followed by February in the second year at station I in Deepor beel, while station II also recorded maximum in February. Apparently, overall pH in the second year was higher than the first year. However, pH broadly depicted a unimodal pattern of variations during the study period in this beel. From the month of December (February recorded 9.5 at station I and 9.2 at station II) onwards in the first year, water was moderately alkaline in nature but pH maintained marginal fluctuations during the rest part of the study period at both the stations.

On the other hand, pH fluctuated between 6.7-8.4 (7.1 ±0.6) at station I and between 6.6-8.3 (7.1 ±0.5) at station II in Ghorajan beel. Station I of this beel exhibited maximum pH during February in the first year followed by April in the same year; while station II recorded during February in the first year followed by March of the same year. However, lowest pH was observed during December at station I and station II recorded lowest pH during October in the first annual cycle. On the contrary, this parameter registered relatively lower fluctuation in this sampled beel. This beel depicted peak pH during pre-monsoon season and slightly lower during the monsoon season of the year at both the stations. A narrow range of monthly fluctuations of pH was observed during the study period in this beel. During the second year, pH exhibited moderately alkaline in nature and also an alkaline condition in the month of February in the first year, which recorded 8.4 at station I and 8.3 at station II. pH of the surface waters registered narrow fluctuations during the study period. pH of the surface waters registered narrow fluctuations during the study period in the sampled beels. Narrow fluctuation in pH indicates the good buffering capacity of the water, which is supported by monthly fluctuations during the study period. Mean and maximum values were slightly higher than the works of Dey and Kar (1987), Yadava *et al.* (1987) and Sharma and Hussain (1999). Relatively, overall pH in the second year was higher than the first year in the sampled beels. Acidic nature of both the beels from August-October in the first year (later part of monsoon) can be assigned to influx of carbonic acid with rainwater while the pH values were observed to be acidic to circumneutral during the remaining part of the study period, which coincided with the findings of Sharma and Hussain (1999).

pH varied between 6.8-7.4(7.2 ±0.23) in Siligurijan beel and 6.9-8.4(7.6 ±0.56) in Fingua beel. It registered relatively lower fluctuation in both the beels except during winter in Fingua beel, which was slightly higher value. Siligurijan beel exhibited maximum value during summer and minima during winter season.

However, the range exhibited slightly acidic to slightly alkaline nature but the mean value indicated alkaline condition of the water in the studied beel. On the other hand, Fingua beel depicted the identical but slightly higher mean value was observed. However, secondary maxima (7.3) was observed during autumn in Siligurijan beel, while Fingua beel exhibited a secondary maxima (7.8) during the same season. High hydrogen ion concentrations during summer are probably due to higher photosynthetic activity. The mean values of these beels showed almost identical results with the Deepor and Ghorajan beel. The ranges and mean values are confirmed the earlier reports of Goswami (1997), Sharma (2000) and Sharma and Sharma (2001). However, in the present study, pH of all the sampled beels depicted their marginal acidic to alkaline character.

However, correlation analysis among abiotic factors established that pH depicted significant direct relationships with specific conductivity (r_1= 0.512, p<.01; r_2= 0.547, p<.01), total hardness (r_1= 0.499, p<.05; r_2= 0.415, p<.05), chloride (r_1= 0.576, p<.01; r_2= 0.597, p<.01), which concurred with the result of Samuajan beel of upper Assam (Sharma and Hussain, 1999) and significant negative correlation with free carbon dioxide (r_1= –0.485, p<.05; r_2= –0.455, p<.05) and nitrate (r_1= –0.487, p<.05; r_2= –0.461, p<.05) in Deepor beel. Besides, it shared significant direct relationships with several factors namely, specific conductivity (r_1= 0.479, p<.05; r_2= 0.410, p<.05), total hardness (r_2= 0.644, p<.001), chloride r_1= 0.588, p<.01; r_2= 0.569, p<.01) and significant inverse relationships with sulphate (r_1= –0.598, p<.01; r_2= –0.564, p<.01) and nitrate (r_1= –0.424, p<.05; r_2= –0.462, p<.05) in Ghorajan beel, which agreed with the remarks of Sharma and Hussain (1999).

SPECIFIC CONDUCTIVITY:

The present investigation registered specific conductivity ranging between 94.0-199.0 µS/cm (162.2 ±34.6) at station I and 102.0-198.0 µS/cm (162.6 ±33.0) at station II in Deepor beel. The lowest value was recorded during September in the first year at station I and during September in the same year at station II. Peak concentration was observed during February and July in the first year and during February in the second year at station I as well as during April in the first year at station II. However, it showed secondary maxima during March (198.0µs/cm) in the first year at station I and during the same month (197.0µs/cm) in the same year at station II. Specific conductivity remained relatively constant throughout the summer season in the first and second year in this beel. Further, it depicted a bimodal pattern of monthly variations at both the stations. Further, mean conductivity value is notably lower than the floodplains from Kashmir (Khan, 1987), West Bengal (Vass, 1989) and Bihar (Singh and Roy, 1990) but agreed with the reports from Deepor beel (Dey, 1981), Sone beel (Dey and Kar, 1987) and Samuajan beel (Sharma and Hussain, 1999) of Assam. On the other hand, F ratio of ANOVA ($F_{11, 23}$ = 106.87, p>0.05) showed significant difference between the months in the first year and the second year ($F_{11, 23}$ = 84.73, p>0.05).

Specific conductivity ranged between 50.0-193.0(128.0 ±40.0) at station I and between 49.0-198.0(133.2 ±45.9) at station II in Ghorajan beel. Both the sta-

tions of Ghorajan beel depicted lowest specific conductivity during September in the first year. Station I depicted peak concentration during April in the first year and peak was observed during May in the second year at station II. On the other hand, it exhibited secondary maxima during April in the second year at station I and during June in the same year at station II. It declined gradually during July during both the years at station I and in the first year at station II. However, ANOVA ($F_{11, 23} = 489.38$, $p>0.05$) reflected significant difference between the months in the first year. The variations in conductivity with seasons and sites were significant. Low conductivity values were recorded at all stations of both the beels. The pattern of fluctuation was also similar. The seasonal mean was higher in the dry period. The present values are broadly identical to water bodies of Meghalaya (Sharma, 2001). Gradual increase in conductivity during the rainy season may be attributed to greater ionic concentration of the inlet flow and run-off from the watershed.

Seasonal variations of specific conductivity fluctuated between 130.0-189.0 µS/cm (157.0 ±25.1) in Siligurijan beel and 89.0-173.0 µS/cm (135.5 ±30.8) in Fingua beel. The highest value was observed during the monsoon and the lowest value during the autumn season in Siligurijan beel; on the contrary, the highest value was noticed during the monsoon and the lowest during the winter in Fingua beel. They, however, differed notably in their specific conductivity values- Deepor (162.2 ±34.6µS/cm) at station I and 162.6 ±33.0µS/cm) at station II > Siligurijan (157.0 ±25.1µS/cm) > Fingua (135.5 ±30.8µS/cm) > Ghorajan beel 128.0 ±40.0µS/cm at station I and (133.2 ±45.9µS/cm) at station II can be assigned to 'Class I' category *vide* Talling & Talling, (1965) and Payne (1986) and also supported by the reports of Sharma (2000) from the floodplains of Assam. This characteristic feature is attributed to leached and weathered nature of rocks and soils (Rai and Hill, 1978) due to high rainfall in N.E. region (Sharma, 1995, 1999; Sharma and Hussain, 1999) as well as to the lowered buffering capacity of the demineralized waters (Steinitz-Kannan *et al.* 1983). Mean conductivity values of all the studied beels are, however, relatively higher than the reported floodplains of upper Assam by Sharma & Hussain (1999) and Sharma (2000).

On the other hand, specific conductivity registered inverse correlation with sulphate ($r_1 = -0.501$; $p<.05$) and sodium ($r_1 = -0.640$, $p<.01$) and direct relationships with pH ($r_1 = 0.512$, $p<.01$), hardness ($r_1 = 0.513$; $p<.01$), calcium ($r_1 = 0.464$; $p<.05$), chloride ($r_1 = 0.616$, $p<.01$) and BOD ($r_1 = 0.447$; $p<.05$) in the present study, which coincided with the report of Sharma and Hussain (1999). However, specific conductivity recorded an inverse correlation with sulphate ($r_1 = -0.615$; $p<.01$) and direct correlation with pH ($r_1 = 0.479$, $p<.05$; $r_2 = 0.410$; $p<.05$), hardness ($r_1 = 0.857$, $p<.001$; $r_2 = 0.748$; $p<.001$), calcium ($r_1 = 0.796$, $p<.001$; $r_2 = 0.687$; $p<.001$), phosphate ($r_2 = 0.408$, $p<.05$) and BOD ($r_1 = 0.484$, $p<.05$; $r_2 = 0.494$, $p<.05$) in the present study of Ghorajan beel, thereby, indicating contributory role of these factors in ionic content of the sampled water body. This beel also depicted almost an identical trend with Deepor beel, excepting relationships with FCo_2, alkalinity, sodium and potassium.

DISSOLVED OXYGEN:

The present study depicted nearly identical ranges and mean values of dissolved oxygen, which fluctuated between 3.2-12 mg/l (6.1 ±2.5) at station I and 2.4-12.8 mg/l (5.9 ±2.4) at station II in Deepor beel. It depicted 62.4-120.2% saturation at station I and 59.4-121.2% at station II in this beel, which concurred with the Samuajan beel (Sharma and Hussain, 1999). Maximum value was observed in March in the first year and minima in January at station I, while maximum concentration was noticed in August and minima was recorded in March in the second year at station II. However, ANOVA ($F_{11, 23} = 36.76$, $p>0.05$ in the first year; $F_{11, 23} = 36.86$, $p>0.05$ in the second year) depicted significant difference between the months in both the years. During the whole study period, in Ghorajan beel relatively moderate dissolved oxygen was observed as it ranged between 2.4-10.2 mg/l (5.7 ±1.7) at station I and 3.2-12.4 mg/l (5.6 ±2.0) at station II. It showed 56.8-112.4% saturation at station I and 62.0-119.8% at station II. It depicted maximum value in February in first year and minima in June in the second year at station I, on the other hand, maximum value was observed in August and minima in January in the first year at station II. On the other hand, ANOVA ($F_{11, 23} = 5.64$, $p>0.05$) showed significant difference between the months in the second year. During the study period, seasonal variations of dissolved oxygen of the surface water ranged between 4.4-9.8 mg/l (6.5 ±2.1) in Siligurijan beel depicting 65.4-106.4% saturation and 3.6-12.4 mg/l (6.8 ±3.5) in Fingua beel and also exhibited 63.6-122.6% saturation. It registered maximum value during summer and minima during monsoon season in the former, on the contrary, maximum value was observed during monsoon and minima during autumn season in the later. Siligurijan beel depicted identical trend of range with the reports from Assam by Sharma (2000), but Fingua beel exhibited the highest value of range slightly higher than that of the report of Sharma (2000). Mean values of Deepor and Ghorajan beel are slightly lower than the results of floodplains of upper Assam (Sharma and Hussain, 1999; Sharma, 2000).

The recorded annual DO ranges broadly concurred with the findings of Lahon (1983), Yadava *et al.* (1987), Vass (1989), Yadava and Dey (1990), Sing and Roy (1990), Sinha *et al.* (1994) and Sharma and Hussain (1999). Sarma (2000), Sharma (2000) and Sharma and Sharma (2001); these also broadly agreed with the results of Goswami (1997), while its minimum values are slightly lower in Deepor and Ghorajan beel than the reports of the aforesaid authors. The solubility of oxygen is known to be influenced by water temperature (Wetzel, 1983) and many workers namely Ohle (1952), Mortimer (1956, 57, 81), Sikander and Tripathi (1984), Sukla (1989), Lahon (1983), Goswami (1985) Dey and Kar (1987), Sharma and Wanswett (1999), Sharma and Hussain (1999) have shown higher dissolved oxygen at low temperatures. Such a pattern is evident in the present study, which depicted higher dissolved oxygen concentration during winter and lower during summer months. In addition, dissolved oxygen registered direct correlation with BOD ($r_2 = 0.424$, $p<.05$) and FCO_2 ($r_2 = 0.448$, $p<.05$) in Deepar beel. On the other hand, it also exhibited direct correlation with FCO_2 ($r_1 = 0.538$, $p<.01$; $r_2 = 0.642$, $p<.001$) and BOD ($r_1 = 0.466$, $p<.05$; $r_2 = 0.462$, $p<.05$) in Ghorajan beel.

FREE CARBON DIOXIDE:

Free carbon dioxide varied between 0-30.0 mg/l (11.1 ±7.7) at station I and 0-38.0 mg/l (10.7 ±8.2) at station II in Deepor beel. Its concentration was noted 0 mg/l during February in the first year and maximum concentration was recorded during August in the same year. This gas recorded secondary maxima (28.0 mg/l) during April in the first year followed by a tertiary maxima (26.0 mg/l) during November in the same year and depicted trimodal pattern of monthly variations at station I, while the identical pattern of variations was observed at station II, where secondary maxima (25.0 mg/l) was recorded during November in the first year followed by a tertiary maxima (24.0 mg/l) during April in the same year. After attained maxima during August in the second year, a gradual decline was observed till the end of the study period at station I. Station II also followed the identical trend of variations during the study period. During the whole study period, a sharp decline was noticed during January and February in both the years. After the tertiary maxima in November (26.0 mg/l) in the first year, it recorded sharp decline to 8.0 mg/l in December and subsequently to 2.0 mg/l in January and even nil in February. It experienced the same trend in the second year of observation. However, ANOVA ($F_{11, 23}$ = 61.73, $p>0.05$ in the first year; $F_{11, 23}$ = 63.57, $p>0.05$ in the second year) showed significant difference between the months in both the years.

Free carbon dioxide was detected throughout the study period with concentrations fluctuating between 4.0-30.0 mg/l (8.7 ±5.8) and between 2.0-30.0 mg/l (8.3 ±5.3) at stations I and II respectively in Ghorajan beel, thereby, reflecting its poor autotrophic uptake in the ecosystem. Maximum concentration of this gas was recorded during August in the first year and minimum concentrations were noticed during August, December, January and February in the first year and during February and May in the second year at station I, on the other hand, station II depicted maxima during August in the first year and a minimum value was observed during January and February in the same year of the study period. This beel exhibited wider ranges with a unimodal pattern of monthly variations at both the sampled stations. In addition, the present observations indicated lower values of this gas during dry season, i.e. during December– February and relatively higher values during the rest of the study period. This beel depicted relatively low free carbon dioxide concentration (2.0 mg/l) in the month of January and February in the first year followed by the second year during the same season. Secondary maxima (18.0 mg/l) was observed during April in the second year at station I and during April (12.0 mg/l) in the first year, while it was noticed during October (12.0 mg/l) in the second year at station II. month of January and February in the first year followed by the second year during the same In addition, the present observations indicated lower values of this gas during dry season, i.e. season. It occurred throughout the present study period in high concentration but there was no consistent seasonal trend in both the beels. The stated ranges of both the beels were slightly higher than the reports of Lahon (1983), Goswami (1985), Dey and Kar (1987), Sharma (1995) and Sharma and Hussain (1999). But in comparison to the ranges of Ghorajan beel, it showed higher values of concentration in Deepor beel. ANOVA ($F_{11, 23}$ = 9.65, $p>0.05$ in the first year; $F_{1, 23}$ =17.39, $p>0.05$ in the second year) showed significant difference between the months

in both the years in Ghorajan beel.

In this present observation, free carbon dioxide exhibited direct correlation with total alkalinity (r_1= 0.659, p<.001; r_2= 0.45, p<.05), dissolved oxygen (r_2= 0.448, p<.05), nitrate (r_2= 0.433, p<.05) in Deepor beel. On the other hand, Ghorajan beel registered positive relationships with total alkalinity (r_1= 0.444, p<.05; r_2= 0.434, p<.05), dissolved oxygen (r_1= 0.538, <.01; r_2= 0.642, p<.001) and BOD (r_1= 0.592, p<.01; r_2= 0.663, p<.001) indicating positive relationships among them.

TOTAL ALKALINITY:

The present study exhibited ranges 32.0-96.0 mg/l (70.0 ±16.4) at station I and 30.0-93.0 mg/l (70.7 ±17.4) at station II in Deepor beel. However, ANOVA ($F_{1, 23}$ = 94.1, p>0.05 in the first year; $F_{1, 23}$ = 100.71, p>0.05 in the second year) exhibited significant difference between the months in both the years. Ghorajan beel, on the other hand, recorded 30.0-112.0 mg/l (66.0 ±20.1) at station I and 38.0-116.0 mg/l (66.7 ±19.5) at station II. Both the beels depicted almost an identical concentration, which was low. Low concentration in tropical water bodies is supported by other workers of this region (Sharma and Hussain, 1999; Sharma and Lyngdoh, 1999 and Sharma and Hussain, 2001). ANOVA ($F_{11, 23}$ = 98.97, p>0.05 in the first year; $F_{11, 23}$ = 21.031, p>0.05 in the second year) showed significant difference between the months in both the years. The mean values of both the beels reflected marginally hard water nature and alkalinity was exclusively attributed to bicarbonate ions in this study, which agreed with the report of Samuajan beel by Sharma and Hussain (1999). The observed ranges and mean values were apparently higher than the reports of Lahon (1983), Dey and Kar (1987), Yadava *et al.* (1987) and Yadava and Dey (1990). At station I, maximum value was observed during the month of October in the second year and minimum during March in the same year at station I. While the maxima was noticed during November in the second year and the minima during March in the first year at station II. On the other hand, alkalinity exhibited secondary maxima during November in first year at station I, while it was registered during the same month in the same year at station II. A tertiary maxima was noticed during April in the first year at station I and gradually decreased till October, where it attained the maximum, while a tertiary maxima was noticed during October in the second year at station II. In this beel, the ranges and mean values of total alkalinity were identical during the both annual cycles and depicted trimodal pattern of monthly variations. It attained the maximum value during the pre-winter season at both the stations.

On the other hand, maximum value was noticed during March in the second year at station I, while the minimum during October in the first year. On the other hand, secondary maxima was observed during April in the second year at station I and during June in the second year at station II in Ghorajan beel. It depicted bimodal pattern of monthly variations and exhibited gradual fluctuations till monsoon and it increased during April in the first year followed by its narrow monthly variations till pre-winter season, subsequently during the pre-monsoon season it attained the peak at station I. On the other hand, a bimodal pattern of monthly variations was noticed

with identical ranges and mean values till pre-monsoon season in the first year, while with the peak during pre-monsoon season in the second year it showed gradual decline till the end of the study period.

Total alkalinity ranged between 45.0-84.0 mg/l (61.4 ±14.1) in Siligurijan beel and 62.0-84.0 mg/l (71.7 ±8.5) in Fingua beel. Maximum value was noticed during monsoon and a minimum during summer in Siligurijan, while Fingua beel showed maximum during winter and minimum during autumn season. On the other hand, secondary maxima (73.0 mg/l) was noticed during winter in Siligurijan beel, while Fingua beel showed second maximum value (75.0 mg/l) during monsoon season. The mean value of Siligurijan exhibited higher than that of Fingua beel. Similarly, alkalinity of the sampled beels is considerably higher than waters from Meghalaya (Sharma, 2001).

Total alkalinity exerted significant positive relationships with water temperature (r_1= 0.476, p<.05), free carbon dioxide (r_1= 0.659, p<.001; r_2= 0.450, p<.05), nitrate (r_1= 0.528, p<.01) and silicate (r_1= 0.407, p<.05) in Deepor beel, which in turn, reflected interdependence of these attributes. The recorded values concurred with the reports of Bhattarai (2004). On the other hand, it registered direct correlation with specific conductivity (r_1= 0.517, p<.01; r_2= 0.532, p<.01), hardness (r_1= 0.576, p<.01, r_2= 0.562, p<.01), calcium (r_1= 0.488, p<.05; r_2= 0.458, p<.05) in Ghorajan beel; these relationships agreed with Sharma (1995) and Sharma and Hussain (1999). Alkalinity was lowest in the rainy season at all stations of both the beels, because of higher rates of photosynthesis, which agreed with the findings of Jain *et al.* (1999).

TOTAL HARDNESS:

Total hardness fluctuated between 46.0-82.0 mg/l (60.9 ±11.2) at station I and 40.0-80.0 mg/l (60.9 ±12.1) at station II in Deepor beel. In this beel, ANOVA ($F_{11,23}$ = 218.61, p>0.05 in the first year; $F_{11,23}$ = 199.29, p>0.05 in the second year) depicted significant difference between the months; in case of stations ($F_{1,23}$ =16.83, p>0.05 in the first year; $F_{1,23}$ = 16.79, p>0.05 in the second year) also, it showed significant difference in both the years. However, Ghorajan beel exhibited 20.0-84.0 mg/l (54.4 ±15.7) at station I 20.0-80.0 mg/l (52.6 ±15.1) at station II. It registered peak during January in the first year at station I and during January and April in the same year at station II of the former and during March in the second year at station I and during March in the second year at station II of the later. Two distinct minima of hardness were recorded during August and September in the first year at station I in Deepar and station II depicted the same trend during the same months. On the other hand, Ghorajan beel registered lowest concentration during September in the first year at station I and during October in the same year at station II. The recorded values of both the beels are, however, slightly lower than the report of floodplain lakes of upper Assam (Sharma and Hussain, 1999; 2001). ANOVA ($F_{11,23}$ = 116.76, p>0.05 in the first year; $F_{11,23}$ = 8.948, p>0.05 in the second year) showed significant difference between the months at both the stations. Total hardness varied between 40.0-76.0 mg/l (60.0 ±14.1) in Siligurijan beel and between 52.0-76.0 mg/l (63.2 ±9.4) in Fingua beel. It registered maxima during summer and minima during au-

tumn in Siligurijan beel. Fingua beel showed maximum during winter and minimum during monsoon season. It exhibited secondary maxima (70.0 mg/l) during monsoon in the former, however, it showed secondary maxima (68.0 mg/l) during the same season i.e. monsoon in the later. The present study reaffirmed hard water character of all the sampled beels, the recorded values were, however, lower than the reports of Samuajan beel by Sharma and Hussain (1999).

The role of calcium and magnesium in controlling the total hardness is clearly indicated by significant positive correlations with calcium r_1= 0.866, p<.001; r_2= 0.868, p<.001) and magnesium (r_2= 0.461, p<.05) in Deepor and also showed positive relationships with calcium (r_1= 0.807, p<.001; r_2= 0.807, p<.001) magnesium (r_1= 0.495, p<.05; r_2= 0.524, p<.01) in Ghorajan beel. Positive correlation of total hardness also existed with other abiotic factors including chloride (r_1= 0.587, p<.01) and BOD (r_1= 0.462, p<.05; r_2= 0.458, p<.05) and it established inverse correlation with sulphate (r_1= -0.738, p<.001; r_2= -0.679, p<.001), nitrate (r_1= -0.540, p<.01; r_2= -0.427, p<.05) in Deepor beel. However, it showed direct relationships with chloride (r_2= 0.424, p<.05) and BOD (r_1= 0.479, p<.05; r_2= 0.489, p<.05) and inverse relationship with sulphate (r_1= -0.585, p<.01; r_2= -0.488, p<.05) in Ghorajan beel, which coincided with the result of Samuajan beel indicating dilution impact of rainfall (Sharma and Hussain, 1999).

CALCIUM AND MAGNESIUM:

The calcium content of the surface water ranged between 23.1-56.7 mg/l (36.2 ±8.2) at station I and 21.0-52.5 mg/l (35.2 ±8.6) at station II in Deepor beel. ANOVA ($F_{1, 23}$ =37.59 p>0.05 in the first year; $F_{1, 23}$ =37.41, p>0.05 in the second year) showed significant difference between the months and no significant difference between the stations in the years. On the other hand, it recorded 8.4-46.2 mg/l (31.3 ±10.5) at station I and 10.5-44.1 mg/l (29.1 ±9.8) at station II in Ghorajan beel. However, ANOVA ($F_{11, 23}$ = 36.49, p>0.05 in the first year; $F_{11, 23}$ =19.09, p>0.05 in the second year) exhibited significant difference between the months in both the years, while in case of stations ($F_{1, 23}$ =27.44, p>0.05 in the second year) it showed significant difference in the second year. The ranges and mean values of Deepor beel were relatively higher than the values of Ghorajan beel. On the other hand, the recorded values of both the beels are lower than the reports of Samuajan beel from Assam by Sharma and Hussain (1999). The lowest values of calcium were observed during November in the first year at station I and three distinct minima were noticed during August and September in the first year and during January in the second year at station II in Deepor beel. Its peak concentrations were, however, noted during April in the first year at station I and station II registered during the same month. With annual ranges and mean values remaining a narrow fluctuations during the study period, calcium content in this beel depicted a bimodal pattern of monthly variations at station I. Station II of the beel exhibited almost identical trend of variations in the whole study period. There was a sharp decline during winter season till December followed by a rise in their monthly variations to attain the primary maxima during April in the first annual cycle at station I. At this station, calcium content registered secondary maxima (52.5 mg/l) during January in the same cycle. On the

other hand, secondary maxima (50.4 mg/l) was noticed during January in the first year at station II.

However, minimum calcium content was observed during October in the second year at station I and station II also exhibited minima in the same month. Maximum values were recorded during May in the first year at station I and station II recorded during the same month in Ghorajan beel. However, the calcium content exhibited wide ranges in the monthly variations till secondary maxima (42.0 mg/l) was attained during March in first year followed by tertiary maxima (41.1 mg/l) during February and March in the second year at station I. Station II of this beel also exhibited secondary maxima (42.0 mg/l) during March in the second year. Calcium ranged between 26.1-43.6 mg/l (33.4 ±6.4) in Siligurijan beel and between 29.4-38.3 mg/l (32.9 ±3.3) in Fingua beel. The former showed peak calcium concentration during summer and lowest during autumn, while maximum value was observed during monsoon season in Fingua beel. Siligurijan beel depicted a secondary maxima (32.4 mg/l) during monsoon, while secondary maxima (32.3 mg/l) was observed during winter season in Fingua beel. However, slightly higher value was observed during summer than the other seasons in Fingua beel. Calcium content of all the sampled beels concurred with the results of other floodplain lakes of Assam (Lahon, 1983; Goswami, 1985; Dey and Kar, 1987; Yadava and Dey, 1990; Goswami, 1997) but slightly lower than the result of Samuajan beel (Sharma and Hussain, 1999).

Correlation analysis revealed that calcium depicted direct relationship with total hardness (r_1= 0.866, p<.001; r_2= 0.868, p<.001) in Deepor beel, on the other hand, it showed the identical relationship in Ghorajan beel, where total hardness (r_1= 0.807, p<.001; r_2= 0.807, p<.001), which confirmed that calcium in contributing to total hardness across the two study sites was more pronounced than any other ion and apparently agreed with the reports of floodplain lakes of Assam by Sharma and Hussain (1999). Calcium is mainly responsible for imparting hardness to water; this fact is supported by its significant positive correlation, which is in concurrence with the results from N.E. region (Sharma and Wanswett, 1999). On the other hand, calcium showed inverse relationships with sulphate (r_1= -0.519, p<.01; r_2= -0.599, p<.01) at station II in Deepor beel, while it depicted inverse relationships with sulphate (r_1= -0.640, p<.001; r_2= -0.516, p<.01) in Ghorajan beel.

Magnesium fluctuated between 0.8-8.9 mg/l (5.6 ±1.7) at station I and station II recorded 0.8-9.3 mg/l (5.9 ±1.9) in Deepor beel. The present study registered Calcium > Magnesium, which is a general trend in most of the water bodies. Almost identical dominance is observed by Zutshi (1981), Jhingran (1982), Vass *et al.* (1989), Sharma (1995) and Sharma and Wanswett (1999). This beel was characterised by trimodal pattern of variations with a relatively narrow range and after remaining generally low till December, it showed a peak of concentration during January in the second year at station I, while the station II showed maxima during September in the first year. Further, lowest hardness was noticed during March in the first year at both the stations in Deepor beel. However, a secondary maxima (8.2 mg/l) was recorded during May in the first year at station I, on the other hand, station II showed secondary maxima (8.9 mg/l) during January in the second year. During the winter season a

gradual increase was noticed until it attained a tertiary maxima (7.7 mg/l) during February in the first year at station I. Further, very irregular monthly variations were observed during the summer and winter seasons till it attained a tertiary maxima (8.3 mg/l) during May in the first year at station II.

Ghorajan beel depicted no definite pattern of monthly variations. The values ranged between 0.9-9.6 mg/l (5.2 ±2.4) and between 0.7-9.4 mg/l (5.3 ±2.3) at station I and II respectively. This beel exhibited peak magnesium hardness during March in the second year at station I and at station II it was noticed during January in the same year, while the lowest value was observed during September in the first year at both the stations in the beel. However, in the second year at station I, there was a sharp decline during winter season till December followed by an increase to secondary maxima (9.4 mg/l) during January. On the other hand, station II exhibited a gradual decline after it attained secondary maxima (9.2 mg/l) during March in the second annual cycle. Again during winter and monsoon seasons a very irregular fluctuations in monthly variations was observed till it attained a tertiary maxima (9.1 mg/l) during June in the first year at station I. However, almost identical trend was noticed at station II also and it attained tertiary maxima (8.4 mg/l) during the same month in the same year. Magnesium concentration further, exhibited different trends of ranges in variations but it was observed that the concentration attained peak during the same season in both the beels. However, it depicted positive relationship with phosphate (r_2=0.462, p<.05) in this beel.

Magnesium concentration varied between 3.3-9.1 mg/l (6.4 ±2.2) in Siligurijan beel and between 5.5-10.8 mg/l (7.4 ±2.1) in Fingua beel. It registered maxima during monsoon and minima during autumn season in Siligurijan beel. Fingua beel showed peak concentration during winter and lowest value was noticed during monsoon season. However, secondary maxima (7.8 mg/l) was noticed during summer in Siligurijan beel, while Fingua beel exhibited secondary maxima (7.2 mg/l) during monsoon season. The mean values of Siligurijan and Fingua beel showed slightly higher than that of Deepor and Ghorajan beel.

CHLORIDE:

The present study registered a narrow range of fluctuations of chloride i.e. between 14.9-35.9 mg/l (23.8 ±6.5) at station I and 12.9-35.9 mg/l (23.3 ±6.7) at station II in Deepor beel. On the other hand, it ranged between 8.9-42.9 mg/l (21.8 ±8.4) at station I and 9.9-43.9 mg/l (22.6 ±7.5) at station II in Ghorajan beel. Maximum value was recorded during April in the first year at station I and during February in the same year at station II in Deepor beel. On the other hand, minimum value was registered during May in the second year at station I and during December in the first year at station II. It, however, depicted a bimodal pattern of monthly variations. Chloride content showed secondary maxima (34.9 mg/l) during February in both annual cycles at station I, however, station II exhibited secondary maxima (33.9 mg/l) during April in the first annual cycle. In the second year, there was sharp decline in monthly variations till it attained a tertiary maxima (31.9 mg/l) during January at station I, it clearly showed the identical trend of variations at station II and attained

a tertiary maxima (32.9 mg/l) during February. The chloride reached a maximum concentration in winter, decreasing in the rainy season and lowest during the summer months in Deepor beel. Less water flowing from and to the lakes in winter season may be one of the causes of accumulation of chloride released from debris. On the other hand, maximum value was observed in July (42.9 mg/l at station I & 43.9 mg/l at station II) in Ghorajan beel, high chloride values in the beel could be due to animal waste from cattle grazing during the season. In general, chloride concentration agreed with the ranges noticed in natural water, thereby indicating lack of organic pollution in the studied beels. The observations agreed with the results of Sharma (1995) and Sharma & Wanswett (1999). The ranges and mean values of both the beels were slightly higher than the reports of Sharma and Hussain (1999). Sharma and Lyngdoh (1999) and Sharma & Wanswett (1999) from this region.

Chloride registered significant inverse correlation with sulphate (r_1= -0.419; p<.05, r_2= -0.583; p<.01) in Deepor beel. On the other hand, it showed significant positive correlation with BOD (r_1= 0.625; p<.001) at station I in Ghorajan beel indicating interdependence between them.

DISSOLVED ORGANIC MATTER:

Dissolved organic matter ranged between 0.3-3.2 mg/l (2.3 ±0.7) and 0.5-3.8 mg/l (2.1 ±0.7) at station I and II in Deepor beel respectively. It showed maxima during March in the second year and minima was observed during January in the first year at station I. It registered maximum value during April in the first year and minima during January in the same year at station II. DOM attained a secondary maxima (3.0 mg/l) during February in the first year and during April in the second year at station I and also during February (3.0 mg/l) in the first year at station II in this beel. On the contrary, maximum value was observed during April in the first year and minimum during January in the same year at station II. It depicted a bimodal pattern of monthly variations with narrow ranges and mean values at both the stations. At station I, DOM exhibited a gradual increase during the winter season but sharply declined in the month of January in the first annual cycle and in the next month it again increased and attained the second maxima. During the second annual cycle, ranges and mean values relatively declined during winter season. DOM content of Ghorajan beel fluctuated between 0.9-3.8 mg/l (2.3 ±0.7) at station I and between 0.8-3.8 mg/l (2.2 ±0.7) at station II. It exhibited maximum value during June in the first year and minima during January in the same year at station I while it reached maxima during February in the first year and minima during January in the same year at station II. However, a secondary maxima was observed during February in the first year at station I and during June in the same year at station II. DOM showed bimodal pattern of their monthly variations during the whole study period in the beel. It gradually decreased from the month of August and sharply declined in January, which attained the second maxima in the next month at station I, on the other hand, station II depicted the identical trend of variations. The concentrations of DOM in both the beels were relatively low. On the other hand, the mean values of both the beels were slightly higher than the report of Zafar (1964).

TOTAL DISSOLVED SOLIDS:

The water of the two floodplains indicated relatively low concentration of dissolved solids, i.e. between 0.4-2.6 mg/l (1.6 ±0.6) at station I and 0.3-3.2 mg/l (1.5 ±0.6) at station II in Deepor beel. The lowest concentration was observed during August and September in the first year and maximal value was noticed during December in the same year at station I, while the lowest value during August in the first year and the maximal value was observed during November in the same year at station II. In this beel, there was a marginal difference in annual ranges of monthly TDS values with bimodal patterns of fluctuations. Relatively less fluctuation was observed till October in the first year, the period August-October exhibited generally a low content (0.4-1.0 mg/l) but it increased sharply and depicted the secondary maxima (2.3 mg/l) in November at station I. Almost an identical trend of variations was observed during the period of August-October but sharply increased to attain the maxima in November followed by a secondary maxima (2.5 mg/l) in the next month at station II. TDS content experienced maximum values during the winter season at both the stations in Deepor beel.

Ghorajan beel showed ranges of TDS 0.8-2.9 mg/l (1.9 ±0.6) at station I and 1.1-2.9 mg/l (1.8 ±0.5) at station II. However, station I depicted maximum TDS value during May in the first year and minima during October in the same year, on the other hand, station II registered maximum during May in the first year and minimum during January in the same year. This beel also depicted bimodal pattern of monthly variations with a secondary maxima (2.8 mg/l) during March in the second annual cycle at station I and station II showed the secondary maxima (2.7 mg/l) during June in the first annual cycle. From the month of October in the first year, there was a gradual increase in monthly variations till it attained the primary maxima in May at station I. On the other hand, starting with a high value in August, it declined gradually with narrow ranges till it attained the primary maxima in May followed by its secondary maxima in the next month at station II. Both the beels depicted low concentration of TDS during the whole study period. Low TDS at these sampled beels corresponded with low ionic concentrations in general, which supported the results of Bhattarai (2004).

PHOSPHATE:

The concentration of inorganic phosphorus estimated as phosphate ranged between 0.01-0.9 mg/l (0.3 ±0.3) at station I and between 0.02-1.2 mg/l (0.3 ±0.3) at station II in Deepor beel. The lowest concentration was observed during February in the first year, it subsequently registered a gradual increase and culminated in peak during January in the second year at station I. On the other hand, station II exhibited a minima during January and maxima during June in the second year. Phosphate content was generally low with very narrow ranges and low mean values during the winter and monsoon seasons and it attained secondary maxima (0.8 mg/l) during September in the second year at station I, while it showed almost an identical trend of variations and exhibited secondary maxima (1.1 mg/l) during March in the second year at station II in the studied beel. This beel depicted unimodal pattern of

monthly phosphate variations at station I but it also exhibited unimodal pattern at station II. Ghorajan beel depicted phosphate content ranging between 0.02-1.4 mg/l (0.5 ±0.4) at station I and between 0.04-2.4 mg/l (0.87 ±0.8) at station II. The beel did not exhibit any definite pattern of variations; minima was observed during February in the first year and a maxima during April in the second year at station I, while station II showed the lowest concentration during February in the first year and its peak concentration was noticed during January in the second year. This beel depicted unimodal pattern of monthly variations with a second maxima (1.1 mg/l) during October in the second year at station I while station II exhibited relatively higher mean values followed by a secondary maxima (2.2 mg/l) during December in the second year. Both the stations showed relatively higher mean values during the second annual cycle and the trend of monthly variations was broadly corresponded with that ranges recorded in Deepor beel. In the present study, phosphate concentration was found to be relatively low in the sampled beels. The mean values of Ghorajan beel were slightly higher than the values of Deepor beel. On the other hand, annual ranges and mean values of both the beels (excepting Ghorajan station II) concurred with the results of Yusuf *et al.* (1986), Yadava *et al.* (1987), Vass (1989) and Sinha *et al.* (1994), Sharma and Hussain (2001). In comparison to other stations of both the beels, station II of Ghorajan beel recorded slightly higher phosphate concentration, which may be due to lack of aquatic macrophytes.

In addition, it depicted inverse correlation with transparency (r_1= -0.419; p<.05) in Deepor beel, which coincided with the reports of floodplain lakes of Assam by Sharma and Hussain (1999). In general, lower phosphate content in water column of Deepor beel, during most part of present study period, was attributed to its uptake by luxuriant growth of aquatic macrophytes, which agreed with the findings of Sharma and Hussain (1999). It exhibited significant inverse correlation with potassium (r_2= -0.410, p<.05) at station I in this beel.

SULPHATE:

The present observation indicated sulphate content ranging between 5.1-28.2 mg/l (14.9 ±6.3) at station I and between 4.9-24.5 mg/l (15.8 ±5.3) at station II in Deepor beel. During the winter season, its values were lower than that of summer and lowest value was noticed during March in the first year and its peak was noticed during July in the same year at station I, while station II registered a minima during January in the first year and a maxima during September in the same year. It showed secondary maxima (26.2 mg/l) during September in the first year at station I, while it exhibited secondary maxima (22.7 mg/l) during July in first year at station II. Sulphate content depicted a trimodal pattern of variations and the content gradually decreased during the winter and monsoon seasons (October-June) and sharply increased to attain the maxima in July at station I. With distinct variations during the winter in the second year, it was found to be increase from the post-monsoon season. On the other hand, the identical trend of variations were observed at station II with maxima in September during the first annual cycle and subsequently it gradually decrease from winter season upto monsoon season and again relatively higher values were noticed from July onwards. This fact could be attributed to influx of sur-

face debris into the beel along with rainwater. In the second year, a gradual decline was observed with narrow ranges till the end of the study period.

On the other hand, sulphate content in Ghorajan beel depicted bimodal pattern of monthly variations and fluctuated between 3.6-30.3 mg/l (17.4 ±6.8) at station I and between 4.2-27.0 mg/l (16.5 ±5.9) at station II during the study period. The lowest concentration was observed during March in the first year and its peak was noticed during July in the same year at station I, while station II depicted minima during the same month of the same year with station I and a maxima during August in the first year. This beel exhibited secondary maxima (30.0 mg/l) during August in first year at station I, while station II showed a secondary maxima (26.3 mg/l) during July in the same year. During the winter and monsoon seasons, the content was found to be lower and sharply increased to attain maxima in July at station I and again it showed gradual decline during the winter and monsoon seasons till the end of the study period in the second annual cycle. Almost an identical trend of variations was noticed at station II of the sampled beel. Recorded ranges and mean values at all sites fall within the normal range of 1-30 mg/l reported to occur in freshwater (Wetzel, 1983); similarly mean values corresponded with the reports of Yousuf *et al.* (1986) and Sharma and Hussain (2001). Further, it registered inverse correlations with specific conductivity (r_1= -0.501, p<.05; r_2= -0.524, p<.01) and total hardness (r_1= -0.738, p<.001; r_2= -0.679, p<.001) in Deepor beel, and it recorded an identical relationships with pH (r_1= -0.598, p<.01; r_2= -0.564, p<.01), specific conductivity (r_1= -0.615, p<.01) and total hardness (r_1= -0.585, p<.01; r_2= -0.488, p<.05) in Ghorajan beel, which coincided with the reports of floodplain lakes of Assam by Sharma and Hussain (1999), while direct relationship was noticed with nitrate (r_2= 0.534, p<.01) in Ghorajan beel, which agreed with the reports by Sharma and Hussain (1999).

NITRATE:

Nitrate concentration was low during the study period in Deepor beel and it ranged between 0.1-1.9 mg/l (1.2 ±0.5) at station I and between 0.2-2.3 (1.4 ±0.6) at station II. However, it did not contribute any definite trend in the beel. Its minimum nitrate concentration was observed during February in the first year and minima during September in the first year and also during July in the same year at station I. Relatively lower concentration during dry months could be due to low rainfall. On the other hand, station II exhibited minimum concentration during February in the first year and maxima during December in the first year. A relatively narrow range was observed during the whole study period with secondary maxima (1.8 mg/l) in June in the first annual cycle at station I, while station II exhibited secondary maxima (2.1 mg/l) in December during the same annual cycle. The nitrate concentration remained low during monsoon season and indicated sharp increase in July (peak). However, nitrate remained generally low during the second year with minor fluctuations depicting irregular monthly variations at station I. Generally low nitrate content in this beel depicted low usage of nitrogenous fertilizers in the catchment area (White, 1983 and Sharma, 1995). Station II of the studied beel exhibited less fluctuations and showed relatively low concentration during the second year. A sudden drop of nitrate occurred during January-March in the first year followed by a sharp

increase again culminating into second maxima at station II. According to Reid and Wood (1976) under the influence of edaphic factors, particularly during flood season, nitrate may be expected to increase significantly. In the present study, such an increase was noted during post-monsoon (July-September). On the other hand, station II exhibited minimum concentration during the same month with station I and maximum value was observed during December in the first year. The concentration of this nutrient fluctuated between 0.09-2.1 mg/l (1.1 ±0.6) at station I and between 0.09-2.1 mg/l (1.2 ±0.6) at station II in Ghorajan beel. It attained peak during November in the first year and minimum concentration was observed during January in the second year at station I; while station II depicted maxima during December in the first year and a minima during March in the same year. This beel exhibited a secondary maxima (1.9 mg/l) during August and December in the first year at station I, while station II showed a secondary maxima (1.9 mg/l) during two months i.e. September and July in the first year. Both the stations of the sampled beel did not follow any definite trend of variations during the study period. After it attained the peak, the concentration decreased sharply remaining low during the post-winter and pre-monsoon seasons, thereafter gradually increased to a certain extent and maintained the low range of variations till the end of the study period at both the stations. Both the sampled stations exhibited peculiar variations, where maxima and minima was noticed during the pre-winter and post winter seasons of the same year. Annual range and mean values of both the beels are almost similar with the reports of Sharma and Hussain (1999) and Sharma and Hussain (2001) from the state of Assam.

Nitrate registered inverse relationship with total hardness (r_1= -0.540, $p<.01$; r_2= -0.427, $p<.05$) in Deepor beel. Both the beels depicted almost identical findings with the report of Samuajan beel (Sharma and Hussain, 1999). This micronutrient exhibited peak during monsoon, which supported by significant positive correlation with rainfall (r_1= 411; $p<.05$) in Deepor beel. It depicted positive correlation with rainfall (r_2= 0.442; $p<.05$) in Ghorajan beel also. The impact of rainfall is also supported by Goswami (1985), Yadava (1987) and Sharma and Hussain (1999).

SILICATE:

In the present study, silicate content ranged between 0.1-4.6 mg/l (2.1 ±0.9) at station I and station II 0.3-4.1 mg/l (1.9 ±0.8) in Deepor beel. Its concentration was lower than the reports by Dey (1981), Yousuf *et al.* (1986), Yadava *et al.* (1987) and Singh and Roy (1990), on the other hand, its mean values of both the beels were lower than the reports of Sharma and Hussain (1999). Station I showed maxima during December in the first year and minima during March in the same year. On the other hand, this content attained peak during November in the first year and minima during January in the same year at station II. After it attained the peak during winter season, it decreased gradually remaining low during monsoon and summer seasons and once again it increased from the month of February in the second year at station I, while it exhibited second maxima (3.9 mg/l) during November in the first year at station I. On the other hand, station II exhibited almost identical monthly variations but secondary maxima (3.9 mg/l) was noticed during December in the first year while it gradually declined during the monsoon and increased during the summer

season showing tertiary maxima (2.9 mg/l) in June at station II. In the second year, the concentration decreased during the winter and it increased during February. This fact could be attributed to influx of silt and sediment rich rainwater during monsoon and summer months. Silicate content depicted bimodal pattern of variations at station I, while it showed trimodal pattern at station II. It, however, registered positive relationship with total alkalinity (r_1= 0.407, p<.05) in this sampled beel.

Ghorajan beel registered silicate values ranging between 0.04-4.1 mg/l (1.8 ±0.8) at station I and between 0.08-4.3 mg/l (1.9 ±0.9) at station II. Maximum concentration was observed during December in the first year and minima during March in the same year at station I; while station II exhibited maxima during December in the first year and minima during March in the first year. However, it depicted trimodal pattern of monthly variations at station I with a secondary maxima (3.7 mg/l) during November in the first year and a tertiary maxima (2.6 mg/l) during summer season in the month of June and during winter season in the next year in December. On the other hand, station II depicted bimodal pattern of monthly silicate variations with secondary maxima (3.7 mg/l) during winter season in the month of November and tertiary maxima during autumn in the month of September in the next year. Silicate content continued to remain low during January-April in the first year at both the stations and the monthly variations observed in the second year showed slightly higher concentration than the first year. All observed values are lower than the reports by Zutshi *et al.* (1980), Vass *et al.* (1989) and Sharma (2001). Silicate correlated positively with sodium (r_1= 0.643, p<.01; r_2= 0.474, p<.05) in this beel.

It, however, registered positive relationship with total alkalinity (r_1= 0.407, p<.05) in Deepor beel. Silicate also exhibited positive relationship with sodium (r_1= 0.643, p<.01; r_2= 0.474, p<.05) in Ghorajan beel. Both the beels corroborated the relationships with the reports of Sharma and Hussain (1999) from the state of Assam. The low silica content is probably responsible for low diatom population (Zutshi and Vass, 1978). Though in contrast to desmids, diatom had high representation in the studied beels, yet it showed low population, which in confirmity with the remark of Zutshi and Vass (1978). In addition, the period of low concentration of this nutrient corresponded with high rainfall, which diluted it in these biotopes.

BIOCHEMICAL OXYGEN DEMAND:

BOD fluctuated between 0.6-4.8 mg/l (2.09 ±0.9) at station I and between 0.4-5.1 mg/l (2.8 ±1.5) at station II in Deepor beel. It attained a peak during August in the first year and minimum value was observed during September in the second year at station I, while station II exhibited maximum value during June in the first year and minima was noticed during March in the second year. BOD attained maximum in the wet season and minimum in the dry season of a tropical freshwater water body of Nigeria reported by A.W. Akpan (1995). It was also observed that BOD was high and increased during the rainy season with greater variability during the season. Akpan reported that high BOD in the water body during the wet season is attributed to municipal effluents made up of sewage and other domestic and industrial wastes brought into the water body by run-off, station II of the studied beel corre-

sponded the report of the aforesaid author. BOD exhibited secondary maxima (3.8 mg/l) during April in the first year at station I, while station II showed secondary maxima (4.8 mg/l) during February in the first year. Further, it remained relatively low during winter season in the first year but increased sharply from February at both the stations. However, station II exhibited relatively higher concentrations during monsoon and summer seasons but gradually decreased in the second year. BOD values ranged between 0.1-4.4 mg/l (1.8 ±1.0) at station I and between 0.1-4.8 mg/l (1.7 ±1.1) at station II in Ghorajan beel. However, station I depicted maximum value during August in the second year and minima during December in the first year. On the other hand, maximum value was noticed during October and December in the first year and minima during August in the second year at station II. This beel depicted bimodal pattern of variations and showed relatively higher concentrations during summer in the first year and during winter season in the second year at both the stations. It exhibited secondary maxima (3.4 mg/l) during May in the first year at station I and during April (3.6 mg/l) in the same year at station II. Further, the second year exhibited relatively higher concentrations than the first year, on the other hand, Deepor beel depicted totally opposite pattern of variations. On the other hand, BOD level ranged between 50-90 mg/l in Elenga beel from the state of Assam and considered being polluted water (Baruah and Das, 2001). In the present study, Deepor beel and Ghorajan beel did not cross the polluted range of BOD (lower level 6 mg/l).

However, BOD registered direct correlation with dissolved oxygen (r_2= 0.424, p<.05) and calcium (r_1= 0.529, p<.01; r_2= 0.483, p<.05) in Deepor beel. On the contrary, Ghorajan beel depicted direct relationships with dissolved oxygen (r_1= 0.466, p<.05; r_2= 0.462, p<.05) and calcium (r_1= 0.442, p<.05; r_2= 0.514, p<.01) indicating positive relationship among them and also exhibited significant inverse correlation with transparency (r_1= -0.492, p<.05; r_2= -0.459, p<.05).

SODIUM:

The concentration of this alkaline earth metal ranged between 12.4-31.0 mg/l (19.6 ±4.7) at station I and between 11.1-28.0 mg/l (18.8 ±4.2) at station II in Deepor beel. Maximum sodium concentration was observed during December in the first year and minima was noted during February in the same year at station I, while maxima was observed during December and minima during February in the first year at station II. However, secondary maxima (27.3 mg/l) was observed during October in the second year at station I, while secondary maxima (26.2 mg/l) was noticed during March in the next year at station II. A distinct bimodal pattern of monthly variations was observed with higher concentrations during pre-monsoon and winter seasons in different years at station I. The sodium content remained relatively high from September-December in the first annual cycle with its peak in December, thereafter it gradually decreased till August with a secondary maxima in October in the next cycle at Station I. However, Station II depicted bimodal pattern of variations with two relatively higher values in two different seasons during the study period. Relatively higher values were found during winter in the first annual cycle with a peak, again the values increased during monsoon in the second annual cycle. However, sodium exhibited significant positive relationships with transpar-

ency (r_1= 0.282, p<.01) at station I. On the other hand, it showed significant negative relationships with pH (r_1= -0.428, p<.05) and BOD (r_1= -0.446, p<.05) at station I in this beel.

However, sodium fluctuated between 6.1-27.0 mg/l (18.6 ±5.4) at station I and between 7.3-29.0 mg/l (19.9 ±5.4) at station II in Ghorajan beel. On the contrary, maximum sodium concentration was noticed during December in the first year at station I and station II registered maxima during December in the first year and minima during February in the same year. However, secondary maxima (26.9 mg/l) was observed during June in the first year at station I, while secondary maxima (28.4 mg/l) was noticed during February in the next year at station II. A trimodal pattern of monthly variations was observed with higher concentrations during the three seasons in different years at both the stations. The sodium content remained relatively high from August-December in the first annual cycle with its peak in December; thereafter it sharply decreased during January and February. This was followed an increase till secondary maxima in June was attained in the first year at station I. A third peak was observed during the winter season in the second year. However, station II depicted almost an identical pattern of variations with three relatively higher values in three different seasons during the study period. Station II exhibited a relatively higher values during winter in the first annual cycle with a peak, again the value increased during post-monsoon and summer seasons followed by again a high value during post-winter and pre-monsoon seasons in the second annual cycle. It showed significant positive correlation with silicate (r_1= 0.643, p<.01; r_2= 0.474, p<.05) in Ghorajan beel. The minimum values of Deepor beel were apparently higher than that of Ghorajan beel. On the other hand, the mean values of both the beels were lower than the earlier report of floodplain lakes of Assam (Sharma and Hussain, 2001) and apparently higher than the lakes of high altitude (Zutshi and Vass, 1978). It followed a general trend indicating higher concentration during winter and lower during monsoon season in both the beels. Though the highest values were noticed during December in the first year but its concentrations registered a marginal increase during the second year of study period in both the beels. It exhibited significant inverse correlation with specific conductivity (r_1= -0.64, p<.01) and pH (r_1= -0.428 p<.05) and BOD (r_1= -0.446 p<.05) at station I in Deepor beel, which did not depict the identical trend with the records of Ghorajan beel. However, sodium exhibited significant positive relationships with transparency (r_1= 0.587, p<.01) and silicate (r_1= 0.474, p<.05) at station I in Deepor beel and at station II in Ghorajan beel respectively.

POTASSIUM:

The present observations showed a wide range of fluctuations in the potassium content of the water, i.e. between 3.2-9.0 mg/l (6.06 ±1.6) at station I, while station II exhibited 4.2-10.2 mg/l (6.6 ±1.5) in Deepor beel. Peak concentration of potassium was recorded during September in the second year and minima was noted during February in the first year at station I. Station II depicted maxima during December in the second year and minima during February in the same year. A wide ranges as well as mean values of potassium were recorded between two annual cycles

in the sampled beel. A distinct trimodal pattern of monthly variations was observed at station I with secondary maxima (8.2 mg/l) during April in the second year at station I. On the other hand, station II exhibited secondary maxima (9.2 mg/l) during September in the second year. After it attained a relatively high value in October in the first year, potassium content gradually declined during winter and monsoon seasons till the peak in September. However, there was a decline during the winter in the next cycle till it attained the second maxima in April. It depicted significant inverse correlation with BOD (r_1= -0.464, p<.05) at station I.

Ghorajan beel depicted wide range of potassium fluctuations. It ranged between 3.7-10.0 mg/l (6.4 ±1.7) at station I and between 3.2-9.8 mg/l (6.1 ±1.7) at station II. Maximum concentration was noticed during February in the first year and minima was registered during March in the second year at station I and station II exhibited maxima during March in the first year and minima during October in the second year. A secondary maxima (9.3 mg/l) was noticed during June in the first year at station I, while station II showed secondary maxima during the same month (8.4 mg/l) in the same annual cycle. It was consistently low during winter with a very narrow range till it attained maximum value in March during the first annual cycle. In the second year, after it attained tertiary maxima (8.2 mg/l) in February, then dropped again during monsoon season till the end of the study period. A trimodal pattern of variations was observed during the whole study at both the stations of the beel. It exhibited significant inverse relationship with phosphate (r_1= -0.41, p<.05) at station I. The mean values were observed to be higher than the report of other beels from the state of Assam (Sharma and Hussain, 2001). On the other hand, the values of potassium of both the sampled floodplain lakes were apparently higher than the values of high altitude lakes, which compared with the results of Dal lake, Srinagar (Zutshi and Vass, 1978).

2. BIOTIC FACTORS:

A. BIODIVERSITY OF ZOOPLANKTON

Seasonal variations for the study of biodiversity of zooplankton were observed in four beels, namely Siligurijan, Fingua, Deepor and Ghorajan beel. The zooplankton taxocoenosis of the sampled beels included two major groups namely, Rotifera and Cladocera. Species richness of zooplankton ranged between 46-68 species in Siligurijan beel. Maximum species richness was observed during summer and the minimum during monsoon season. Species richness of Rotifera fluctuated between 30-50 species in this beel. However, maximum species richness was noticed during summer and the minimum during monsoon season. A slightly depression of rotifera was evident in the monsoon months but peaks occurred more irregularly in Siligurijan beel. A total of 104 zooplankton taxa were identified from Siligurijan beel out of which 72 species of Rotifera and 32 species of Cladocera. Species richness of zooplankton varied between 59-80, the maximum was observed during autumn and the minimum during the monsoon season in Fingua beel. Species richness of Rotifera fluctuated between 35-57 in this beel. However, autumn was found to be the most conducive to rotifers growth with peak density and the

minimum during winter season in Fingua beel. A total of 105 zooplankton taxa were identified from this beel. 75 species of Rotifera and 30 species of Cladocera were identified during the study period. 122 zooplankton taxa were identified from Deepor beel, out of which Rotifera registered 87 species and 35 species of Cladocera. On the other hand, Ghorajan beel registered a total of 120 taxa, 86 species belonging to Rotifera and 34 species belonging to Cladocera during the study period, which apparently higher in comparison to the reports of subtropical lakes from this region (Sharma, 1995) and also floodplain lakes of Assam i.e. 42 species from Dora beel (Lahon, 1983), 33 species from Chandubi beel (Yadava, 1987), 50 species from Samuajan beel (Sharma and Hussain, 1999). However, the present study revealed higher species richness compared to other water bodies of the country i.e. 40 species from floodplain lake of Kashmir (Khan, 1987) and 57 species from Pichhola-Fatehsagar (Vyas, 1989).

Lecanidae and Brachionidae together, comprised a notable component of rotifer biodiversity in the sampled beels. In the present investigation. Siligurijan beel registered 72 species of Rotifera, out of which 18 species belonging to Lecanidae family followed by 17 species to Brachionidae. On the other hand, Fingua registered 75 species of Rotifera, a total of 20 species belonging to Lecanidae family, while 17 species belonging to Brachionidae. Rotifera accounted for 69.2% of total zooplankton richness in Siligurijan beel and 71.4% in Fingua beel. Lecanidae (24 species) and Brachionidae (19 species) together, comprised a notable component of rotifer biodiversity in Deepor beel. In the present study, Ghorajan beel registered 86 species of Rotifera, out of which 24 species belonging to Lecanidae family followed by 19 species belonging to Brachionidae, 9 species belonging to Colurellidae, 7 species belonging to Trichocercidae. The proportion of widely distributed *Lecane* amounts to 25% of the total rotifers in Siligurijan, on the other hand, 26.7% in Fingua beel. This is apparently higher than the result of Samuajan beel of upper Assam (Sharma and Hussain, 2001) but the distribution percentages of *Lecane* are definitely lower than the reports of Deepor (27.6%) and Ghorajan beel (27.9%). Among the rotifers, *Brachionus mirabilis*, *Lecane thienemanni*, *Lecane ohioensis*, *Lecane decipiens*, *L. inopinata*, *L. crepida*, *Filinia camascela*, and *Trochosphaera aequatorialis* were totally absent in Siligurijan beel during the study period. On the other hand, *Keratella tropica*, *Beauchampiella eudactylota*, *Lecane pyriformis*, *Lecane decipiens* and *L. inopinata* were also not registered in Fingua beel.

The rotifer fauna exhibited dominance of monogonont taxa. Five eurotatorian families namely Lecanidae>Brachionidae>Colurellidae>Trichocercidae included 68.9% of the total rotifers in Deepor beel, 68.6% in Ghorajan beel, 68.1% in Siligurijan beel and 68% in Fingua beel, the spectrum of dominance apparently agreed with the report of Sharma (1996). Various non-planktonic taxa of the Trichotridae, Synchaetidae and Flosculariadae were poorly observed. This is apparently higher than the report of Samuajan beel of upper Assam (Sharma and Hussain, 2001). The predominance of Lecane species is in agreement with reports on the rotifer fauna of other tropical floodplain lakes (Segers *et al.*, 1993c; Segers, 1994 and Jose De Paggi, 1993). Lecane and Brachionus imparted a general tropical character to the studied fauna; such a generalization is in confirmity with the reports by Green (1972), Pejler

(1977), Fernando (1980), Dumont (1983), Sharma (1987, 1991, 1996, 1999), Sharma and Naik (1996) and Segers (1996) though they were widespread but less dominant.

Brachionus angularis, Brachionus calyciflorus, B. bidentata, B. falcatus, B. rubens, B. caudatus, Brachionus patulus macracanthus, Keratella tropica, Mytilina ventralis, Lecane curvicornis, L. leontina, Trichocerca similis, Conochilus unicornis, Sinantherina spinosa, Filinia longiseta, Filinia opoliensis, Rotaria neptunia, Anuraeopsis fissa, B. mirabilis, Keratella lenzi, K. procurva, Macrochaetus sericus, Lepadella ovalis larga, L. patella, Lepadella rhomboides, L. aspicora, Lecane lateralis, L. quadridentata, L. ohioensis, Testudinella patina, Dipleuchlanis propatula, Mytilina bisulcata, Testudinella emarginula, Trochosphaera aequatorialis etc. were uncommon rotifers documented from the sampled beels. So far as the biogeography of rotifers is concerned, some species occur in tropical and subtropical latitudes, but can occasionally be found in suitable habitats in temperate regions (Segers, 1996). The following species *Lecane aculeata, L. crepida, L. curvicornis, L. hastata, L. hornemanni, L. inopinata, L. leontina, L. papuana* are considered to be under this group. On the other hand, *Lecane bulla, L. closterocerca, L. hamata, L. ludwigii, L. luna, L. lunaris, L. ungulata* are under cosmopolitan taxa. *Lecane decipiens, L. thienemanni* species are considered to be under pantropical. The aforesaid species were documented from the sampled beels. The family Brachionidae illustrate the high level of endemicity found in Australia and South America, while the Indian subcontinent and Africa have a predominantly cosmopolitan fauna. Keratella shows the widest latitudinal range. Endemism in this genus is concentrated near both poles, with no endemism in the tropics and little in subtropics except Australia and South America (Dumont, 1983). Likewise, all the Indian species of Keratella are also known from elsewhere. Amongst about 37 known species of Keratella, only seven have so far been recorded from India Sharma (1987). The sampled beels documented only five species of it. This study found the rare rotifers, occurrence of widely distributed warm-water Eastern Hemisphere taxa in the floodplain lakes, *Lecane lateralis* and *L. unguitata* were interesting, which in concurrence with the works of Segers and Baribwegure (2000) from the floodplain lakes of river Rusizi, Northwest Burundi. A number of Testudinella species are quite common in tropical waters, especially *Testudinella patina* and its varieties (Fernando and Zankai, 1981). The present observation agreed with the remarks of Fernando and Zankai. The cosmotropical species *Filinia camascela* is an interesting addition to the Indian rotifera is restricted only to N.E India (Sharma and Sharma, 2000). Occurrence of this species in the sampled beels agreed with the aforesaid report.

As a result of this study, a total of 19 species belonging to Brachionidae documented from Deepor and Ghorajan beel, which accounted for 82.61% of the total of N.E. India (23 reported species). Most species of Brachionus, reported from India, are pantropical or cosmopolitan forms of alkaline waters. However, both the beels registered 12 species belonging to genus Brachionus, which accounted for 85.71% of the total reported species from N.E. India (14 reported species). *Brachionus calyciflorus, B. caudatus, B. angularis, B. forficula, B. diversicornis* and *B. rubens* were found to be important elements of zooplankton in the studied beels. Brachionidae contributed 21.6% in Deepor beel, Ghorajan beel depicted 21.8%, Siligurijan beel

showed 26.6% and 25.7% in Fingua beel of total species richness. The rotifer fauna of the sampled beels was distinctly tropical as indicated by the common occurrence of Brachionus sp. and absence of Notholca sp. (Sharma and Sharma, 1984). Abundance of Brachionus sp. was indicative of alkaline nature of Deepor beel. The species *Brachionus patulus* is very common, and occurs in all types of water bodies. It is considered cosmopolitan (Chengalath *et al.*, 1973). Occurrence of *Brachionus patulus macracanthus* was observed throughout the study period in all the sampled beels with small populations. Its presence in the floodplain lakes of Assam is noteworthy and it was documented from Meghalaya for the first time (Sharma, 1987). *Keratella tropica* appeared to be most widely distributed in the sampled beels.

Anuraeopsis fissa and *Brachionus forficula* in Ghorajan beel occurred only during warmer months and, hence, the present observations reaffirmed their warm-stenothermal nature (Koste, 1978). *Anuraeopsis fissa* shows a wide distribution in India, as compared to *A. coelata* (Sharma, 1987a). The rotifer *Sinantherina socialis* occurred during summer season and *Polyarthra vulgaris* and *Brachionus falcatus* recorded very common in Siligurijan beel. On the other hand, *Asplanchna priodonta* showed autumn occurrence and *Euchlanis dilatata, Brachionus falcatus and Lecane bulla* were found common in Fingua beel. *Euchlanis triquetra* was not observed in Deepor and Ghorajan beel.

The other dominant group Cladocera exhibited the ranges of species richness 16-25 in Siligurijan beel. Maximum species richness was observed during winter and the minimum during monsoon season. Cladocera depicted the ranges of species richness 20-24 in Fingua beel. A total of 32 species documented from Siligurijan beel, while Fingua beel registered 30 species. The number of both the beels was lower as compared to reports of Deepor and Ghorajan beel, which registered 35 and 34 species respectively. *Bosmina longirostris, Biapertura karua, Moina micrura, Scapholeberis kingi* contributed to maximum richness in Siligurijan beel, on the other hand, *Bosmina longirostris* recorded maximum during monsoon season in the sampled beels and *Biapertura karua* and *Chydorus sphaericus* were found to be common in Fingua beel. The cladocerans comprised subdominant component of zooplankton in the sampled beels.

On the other hand, *Chydorus sphaericus, Biapertura karua, Chydorus barroisi Scapholeberis kingi* and *Simocephalus vetulus* were present in substantial numbers in all the sampled beels during the whole study period. Among the reported species, *Chydorus sphaericus* appeared to be the commonest and most widely distributed cladoceran in the beels. *Simocephalus vetulus* is a weedy species but it is not restricted to this habitat, it can be found in open water, which observed during the study period. *Ceriodaphnia cornuta, Moina micrura, Moinodaphnia* sp. and *Diaphanosoma excisum* are considered to be typically tropical species, which were recorded in all the beels. On the other hand, *Leydigia acanthocercoides* is considered to be temperate in origin but occurrence of the aforesaid species in the beels was note-worthy. A few species had relatively consistent seasonal patterns in all the sampled beels. Occurrence of *Daphnia lumholtzi* only in two months (during January and April) throughout the study period in Deepor beel and its total absence in all

the three beels was note-worthy. *Dadaya macrops* was not present throughout the study period in the beels, the species was observed during July, October and November in the study period in Deepor beel. Almost same trend was noticed in Ghorajan beel also.

Ilyocryptus spinifer represented a typical benthic form recorded from all the sampled beels. On the other hand, *Diaphanosoma excisum* was a dominant species in the limnetic regions as observed in all the beels, but presence of this species in Deepor and Ghorajan beel was noteworthy. In the present investigations, *Bosmina longirostris* and *Bosminopsis deitersi* of the family Bosminidae were well distributed over the whole of the sampled beels. Both the species showed identical seasonal trend. Similarly, *Chydorus barroisi* and *Alonella exisa* were also important contributors to species richness of the beels. *Graptoleberis testudinaria* is a rare form in the tropics, which was documented for the first time in the state of Tripura in N.E. India.

Percentage similarity of rotifers followed an almost identical ranges between 22.2-79.6% in the first year at station I and between 16.7-75.7% in the first year at station II in Deepor beel; while it showed 26.7-72.9% in the second year at station I and 28.6-66.7% in the second year at station II. However, this exhibited community similarities 72.7% instances during the first year study at station I and during the second year study it depicted 50% were above 50% similarity, on the other hand, 42.4% instances during the first year and 45.4% during the second year were 50% similarity at station II. It distinctly depicted less variability at station I and more at station II. Percentage similarity between Rotifera exhibited highest between November-February and lowest between April-May in the first year at station I in Deepor beel while it showed it showed highest between September-January and lowest between January-February in the second year in this beel. On the other hand, it exhibited highest value between October-March and lowest similarity between April and May in the first year at station II and it showed highest between September and March and lowest between March May in the second year in this station of Deepor beel. Further, in Deepor beel similarity less than 30% exhibited between few months (6 instances), which showed maximum instances in April during the first year, while it exhibited less tan 30% similarity in two instances in February during the second year at station I, while it showed 10 instances at station II in the first year and only one instance in May (28.6%) in the second year.

On the other hand, it was observed that 31.7-78.8% in the first year at station I and 19.4-73.1% in the first year at station II in Ghorajan beel and it depicted 20.9-69.4% in the second year at station I and 30.8-64.6% in the same year. However, this beel registered 72.7% instances during the first year and 54.5% during the second year were 50% similarity at station I. While 40.9% instances during the first year and 53.0% during the second year were above 50% similarity at station II. The beel registered less variability at station I and more at station II. Overall species richness in sampled floodplain lakes exhibited high community similarities. Percentage similarity between Rotifera exhibited highest between December and March and lowest between October and May in the first year at station I in this beel while it

showed highest between September-December and lowest between March-April in the second year. On the other hand, it exhibited highest value between August-July and lowest similarity was observed between April and May in the first year at station II and it showed highest between September and December and lowest between February and March in the second year in this station of Ghorajan beel. Percentage similarity less than 30% showed between two months i.e. in March (29.1%) and April (29.5%) during the second year at station I in this beel. On the other hand, it showed between two months i.e. in April (29.8%) and May (19.4%) in the first year at station II.

Percentage similarity of Rotifera of Deepor and Ghorajan beel exhibited ranges 24.2-84.7% in the first year with highest between December and January and lowest between April and June, while it showed ranges 32.7-71.1% in the second year with highest between January and June and lowest between February and May. In Deepor and Ghorajan beel, only instance of higher community similarity (more than 80%) of rotifera was observed between December and January (84.7%) in the first year.

B. SYNECOLOGY OF ZOOPLANKTON

(I) NET PLANKTON:

Net plankton in Deepor and Ghorajan beel appeared to be diversified. Higher species richness was observed in both the beels. Recorded 208 species including 149 species of zooplankton and 59 species of phytoplankton in Deepor beel, on the other hand, a total of 202 species were recorded in Ghorajan beel out of which 147 zooplankton species and 55 phytoplankton species at all. Zooplankton comprised an important component and constituted dominant group to the planktonic communities in both the beels. This dominant group, on the other hand, included six major groups namely, Rotifera, Cladocera, Copepoda, Rhizopoda, Ostracoda and Conchostraca. Species richness in both the beels was higher than the reports of Sharma (1995), Sharma and Hussain (1999) and Sharma (2001).

The population density of net plankton at station I ranged between 475-969 ind/l (703.0 ±124.0) and 431-1036 ind/l (618.0 ±147.0) at station II in Deepor beel. Their peak abundance was observed during April in the second year, while minimum density was observed during October in the first year at station I. The maximum and minimum densities were noticed during May in the second year and during November in the first year respectively at station II in Deepor beel. The quantitative abundance of net plankton in Ghorajan beel fluctuated between 414-1134 ind/l (647.0 ±179.0) at station I and 335-804 ind/l (522.0 ±130.0) at station II. The minimum and peak densities were observed during February in the first year and April in the second year respectively at station I. On the other hand, station II depicted minimum value during February in the first year and a maxim during May in the second year. The present study indicated high net plankton abundance, which apparently higher than the other reported floodplain lakes of Assam (Lahon, 1983; Sharma and Hussain, 2001) and elsewhere in India (Pandit, 1980; Rai and Dutta Munshi, 1982;

Sugunan, 1989; Vass, 1989; Baruah *et al.*, 1993; Sinha, *et al.*, 1994). On the other hand, net plankton depicted maximum density during April, which broadly corresponded with the result of Sharma and Hussain, 2001 from upper Assam.

Further, net plankton depicted a trimodal annual pattern at station I with primary maxima during monsoon (April-May) followed by a secondary maxima during winter (November-January) and tertiary maxima during pre-monsoon season (February-April), while it exhibited bimodal pattern of abundance with primary maxima during monsoon (May-April) and a secondary maxima during pre-monsoon season (March-April) at station II in Deepor beel. On the contrary, Ghorajan depicted a bimodal pattern of abundance at both the stations with primary maxima during monsoon (April-May) and a secondary maxima during post monsoon (April-July) at station I, however, station II showed primary maxima during monsoon (April-May) and a secondary maxima during summer (June-July). In the present investigations, net plankton densities were significantly influenced by phytoplankton (r_1= 0.626, p<.01; r_2= 0.878, p<.001), Chlorophyta (r_1= 0.619, p<.01; r_2= 0.798, p<.001), Bacillariophyta (r_1= 0.598, , p<.01; r_2= 0.736, p<.001) and also showed significant correlation with zooplankton (r_1= 0.501, p<.05; r_2= 0.584, p<.01) and Rotifera (r_1= 0.456, p<.05; r_2= 0.56, p<.01) in Deepor beel, thereby, exhibited contributory role in the population. Further, it exhibited significant direct correlation with phosphate (r_2= 0.423, p<.05) in this beel indicating positive relationship between them. In addition, net plankton showed positive correlation with phytoplankton (r_1= 0.759, p<.001; r_2= 0.621, p<.01), Chlorophyta (r_1= 0.746, p<.01; r_2= 0.526, p<.01), Bacillariophyta (r_1= 0.315, r_2= 0.644, p<.001), zooplankton (r_1= 0.647, p<.001; r_2= 0.76, p<.001) and Rotifera (r_1= 0.474, p<.05; r_2= 0.751, p<.01) in Ghorajan beel indicating interdependence among the attributes. On the other hand, it showed significant positive relationships with specific conductivity (r_1= 0.423, p<.05), total alkalinity (r_1= 0.596, p<.01; r_2= 0.416, p<.05), calcium (r_1= 0.409, p<.05), phosphate (r_1= 0.517, p<.01; r_2= 0.432, p<.05) and silicate (r_1= 0.476, p<.05). However, the positive correlations with some important abiotic factors of both the sampled beels nearly corresponded with the results from N.E. region (Sharma, 1995).

The multiple regression indicated that sixteen ecological variables namely rainfall, water temperature, pH, transparency, specific conductivity, dissolved oxygen, free carbon dioxide, alkalinity, hardness, calcium, chloride, dissolved oxygen matter, phosphate, sulphate, nitrate and biochemical oxygen demand together accounted for 69.6% (station I) and 72.3% (station II) of variations of net plankton indicating importance of combined influence of various factors in Deepor beel, while it accounted for 82.2% at station I and 77.8% at station II in Ghorajan beel. With the deletion of rainfall (X_1) fifteen abiotic factors accounted for 54.9% of the variations in net plankton densities at station I and 70.9% at station II in Deepor beel, on the other hand, fifteen abiotic factors accounted for 81.7% of the variations in net plankton densities at station I and 77.6% at station II in Ghorajan beel. With the removal of water temperature (X_2) fourteen abiotic factors accounted for 54.9% at station I and 45.7% at station II in Deepor beel, however, it accounted for 81.5% at station I and 76.4% at station II in Ghorajan beel. On the other hand, with the deletion pH (X_3) thirteen abiotic factors accounted for 54.7% at station I and 37.9% at station II

in Deepor beel and 80.4% at station I and 74.7% at station II in Ghorajan beel. Therefore, the stated variables rainfall at both the stations, water temperature and pH at station I appeared to be significant and accounted for a high cumulative impact of net plankton variations in Deepor beel. The step-wise regression of recorded ten abiotic factors (X_1-X_{10}) explained for 71.3% and 51.3% at station I and station II respectively in Ghorajan beel. The generalization broadly differed with results of Sharma (1995) and Sharma and Hussain (2001) stating that 10 variables explained for about 97% and 99% respectively. On the other hand, it also differed from the conclusions of Yadava and Dey (1990) who indicated 10 variables to explain for only 61% of net plankton density variations while 17 variables accounted for 94%. However, the combined impact of sixteen variables accounted for 82.2% at station I in Ghorajan beel appeared to be more than that of 69.6% registered at station I in Deepor beel. High cumulative impact of abiotic factors on net plankton abundance in both the beels concurred with the earlier reports of Sharma (1995), Jyrwa (1996) and Sharma and Lyngdoh (2003).

(II) ZOOPLANKTON:

The zooplankton taxocoenosis of both the beels included six major groups namely, Rotifera, Cladocera, Copepoda, Rhizopoda, Ostracoda and Conchostraca. 149 zooplankton taxa were identified from Deepor beel, which included 149 species at station I and 147 species at station II, on the other hand, Ghorajan beel registered a total of 147 taxa, indicated 147 species at station I and 146 species at station II during the study period, which apparently higher compared to the reports of Sharma, 1995 and also floodplain lakes of Assam i.e. 42 species from Dora beel (Lahon, 1983), 33 species from Chandubi beel (Yadava, 1987), 50 species from Samuajan beel (Sharma and Hussain, 1999). However, the present study revealed higher species richness compared to other water bodies of the country i.e. 40 species from floodplain lake of Kashmir (Khan, 1987) and 57 species from Pichhola-Fatehsagar (Vyas, 1989). Of these, Rotifera registered 88 species at station I and 87 species at station II with spectrum of dominance as Rotifera > Cladocera with 48 species (st.I) > 43 species (st.II) and 12 species (st. I) > Rhizopoda > 11 species (st. II) > Copepoda (3 species at both the stations) > Ostracoda (2 species at both the stations) > Conchostraca (1 species at both the stations) in Deepor beel. On the other hand, Ghorajan beel registered 87 species at both stations of Rotifera with spectrum of dominance as Rotifera > Cladocera (42 species at station I, 42 species at station II) > Rhizopoda (12 species at station I, 11 species at station II) > Copepoda (3 species at both the stations) > Ostracoda (2 species at both the stations) > Conchostraca (1 species at both the stations).

Zooplankton comprised an important component, which ranged between 172-565 (361.0 ±103.0) at station I and 146-382 (256.0 ±71.0) at station II in Deepor beel and significantly influenced their monthly abundance (r_1= 0.501, $p<.05$; r_2= 0.584, $p<.01$). On the contrary, Ghorajan beel exhibited 133-487 (327.0 ±117.0) at station I and 152-464 (300.0 ±102.0) at station II and also positively correlated with net plankton (r_1= 0.647, $p<.01$; r_2= 0.76, $p<.001$). The recorded zooplankton densities were, however, higher than the results of Kar (1984), Kolekar *et al.* (1989) and

Baruah *et al.* (1993). The observed densities were also higher than in the floodplain lakes of Bihar (Rai and Dutta Munshi, loc cit.; Sanjer and Sharma, loc cit.), Kashmir (Khan, 1987) and West Bengal (Vass, 1989). Zooplankton exhibited significant positive correlation with Rotifera (r_1= 0.843, p<.001; r_2= 0.787, p<.001), Cladocera (r_1= 0.818, p<.001; r_2= 0.892, p<.001), Copepoda (r_1= 0.427, p<.05), Rhizopoda (r_1= 0.597, p<.01; r_2= 0.762, p<.001) and Ostracoda (r_1= 0.443, p<.05) in Deepor beel indicating interdependence among the attributes. On the other hand, zooplankton exhibited significant positive relationships with magnesium (r_1= 0.423, p<.05) at station I and inversely correlated with water temperature (r_1= -0.465, p<.05) at station I in this beel, thereby, exhibited relatively low temperature is favourable for zooplankton production.

The density of zooplankton exhibited a slightly different seasonal trend with alternating increases and decreases within the study period in Deepor beel. However, January and May was found to be most conducive to zooplankton growth with peak density of 565 ind/l at station I and 382 ind/l at station II. ANOVA showed no significant differences between the months ($F_{11, 23}$ = 2.413, p>.001) as well as between the stations ($F_{1, 23}$ = 4.673, p>.001) in first and second year ($F_{11, 23}$ = 0.036, p>.001 between months; $F_{1, 23}$ = 0.004, p>.001 between stations). On the other hand, Ghorajan beel depicted a trimodal pattern of abundance i.e. June-July in the first year; November-December in the same year and June-July in the second year with a peak density in July (487 ind/l) at station I and a bimodal pattern was observed June-July in first year and February-March in the second year with a peak density in June (464 ind/l) at station II. The summer maxima of zooplankton were in concurrence with those findings reported by Das & Srivastava (1956), Michael (1968) and Sharma (1992, 1995). However, ANOVA showed significant differences between the months ($F_{11, 23}$ = 4.35, p>.001) as well as between the stations ($F_{1, 23}$ = 6.69, p>.001) in first and in second year, it exhibited significant differences between the months ($F_{11, 23}$ = 10.24, p>.001) and no significant differences between the stations ($F_{1, 23}$ = 0.198, p>.001).

This study depicted a bimodal pattern of zooplankton abundance, with a peak during summer (July), and another a maxima during winter (November-December) in Ghorajan beel. The stated trend is in agreement with the bimodal pattern of distribution observed by Lahon (1983), Yadava *et al.* (1987) and Sanjer and Sharma (1995). It was observed that Deepor beel also exhibited a bimodal pattern of distribution, which showed primary maxima during winter (December-January) and a secondary maximum during summer (July). The present observation registered inverse correlation between zooplankton vs. transparency (r_1= -0.513, p<.01) in Ghorajan beel. It exhibited significant positive correlation with Rotifera (r_1= 0.958, p<.001; r_2= 0.933, p<.001), Cladocera (r_1= 0.919, p<.001; r_2= 0.808, p<.001), Copepoda (r_1= 0.859, p<.001; r_2= 0.599, p<.01)), Rhizopoda (r_1= 0.472, p<.05; r_2= 0.576, p<.01) and Ostracoda (r_1= 0.439, p<.05) in this beel. The correlation revealed that the abundance of zooplankton is chiefly dependent on its major groups i.e. Rotifera, Cladocera, Copepoda and Rhizopoda. On the other hand, zooplankton exhibited significant correlation with total alkalinity (r_1= 0.524, p<.01; r_2= 0.558, p<.01), phosphate (r_1= 0.45, p<.05; r_2= 0.413, p<.05), BOD (r_1= 0.612, p<.01), specific con-

ductivity (r_2= 0.428, p<.05), total hardness (r_2= 0.525, p<.01), calcium (r_2= 0.472, p<.05), magnesium (r_2= 0.419, p<.05) and phosphate (r_2= 0.413, p<.05) in this beel. Alkalinity and pH are often found as variables predicting the zooplankton community composition, based on data from a large number of different water bodies (Berzins & Pejler, 1987). Zooplankton positively correlated with total alkalinity (r_1= 0.524, p<.01; r_2= 0.558, p<.01) in Ghorajan beel.

During the present study, zooplankton communities depicted higher species diversity computed *vide* Shannan's index and ranged between 2.532-3.634 (3.264 ±0.3) and 2.215-3.869 (3.234 ±0.35) at station I and II respectively in Deepor beel. Similarly, Menhinick's index varied with their narrow ranges and higher mean values i.e. between 2.003-3.977 (3.316 ±0.5) at station I and 2.092-4.373 (3.372 ±0.6) at station II. Shannan's index depicted a narrow range of diversity during the pre-monsoon period and the highest diversity was registered in August, while the lowest value was recorded in April in the first year. On the other hand, Menhinick's index exhibited highest diversity in February in the first year and the lowest in March in the second year at station I. Shannan's index exhibited maxima during July and minima was noticed during April in the first year at station II. Diversity was relatively low during February, March and April in the second year at station I but low diversity was observed during March, April, May and June in the first year at station II. On the other hand, Ghorajan beel indicated relatively higher species diversity among the stations and it ranged between 3.007-3.978 (3.458 ±0.25) at station I and 2.943-3.784 (3.344 ±0.22) at station II using Shannan's index and it fluctuated between 3.015-4.536 (3.525 ±0.4) at station I and 2.919-4.002 (3.348 ±0.3) using Menhinick's index. Shannan's index indicated maxima during May in the first year, while minima during March in the second year. On the other hand, Menhinick's index depicted highest value during March in the second year and the lowest value during April in the second year at station I. Shannan's index depicted maxima during May, while minima was observed during September in the first year at station II. On the contrary, Menhinick's index exhibited highest diversity during March in the first year and the lowest value was observed during February in the second year. Mean values of species diversity in both the beels exhibited almost identical and the recorded zooplankton diversity was higher than the reports of Sharma (1995), Sharma and Hussain (1999), Wanswett (2001) and Sharma and Lyngdoh (2004).

Zooplankton dominance (*vide* Berger-Parker's index) at both the stations was generally low and ranged between 0.069-0.236 (0.168 ±0.04) and 0.085-0.284 (0.163 ±0.04) at station I and II respectively. A narrow range was observed during the first year, while relatively higher values were observed during February, March (maxima) and April and gradually it decreased up to minima during July in the second year at station I. Dominance of zooplankton fluctuated between 0.123-0.251 (0.184 ±0.03) at station I and 0.135-0.297 (0.197 ±0.03) at station II in Ghorajan beel. It registered peak in March and minima in July in the second year at station I, while station II exhibited maxima in September and minima in August in the first year. The present study showed relatively low overall dominance due to fewer quantitatively important species. Mean values indicated low dominance in both the beel, which broadly coincided with the findings of the beels of upper Assam reported by

Sharma and Hussain (2001). In addition, monthly variations indicated narrow fluctuation in the sampled beels.

Evenness (E_1) indicated high equitability of zooplankton and fluctuated with narrow ranges i.e. between 0.853-0.956 (0.891 ±0.03) at station I and 0.876-0.984 (0.939 ±0.03) at station II in Deepor beel. On the other hand, evenness of Ghorajan beel showed ranges 0.895-0.976 (0.924 ±0.02) at station I and 0.886-0.987 (0.927 ±0.02) at station II. However, zooplankton evenness did not depict significant monthly variations and exhibited almost identical annual ranges between the beels. Further, high evenness at all the stations in the beels indicated greater equitability of species abundance in the community, which concurred with the report of Washington (1984). The mean value of station I in Deepor beel exhibited marginally lower than that of other stations of the sampled beels. The recorded values of both the beels coincided with the reports of Sharma and Hussain (2001) of Assam.

The multiple regression indicated that sixteen abiotic factors accounted for 90.9% (station I) and 81.5% (station II) of variations of zooplankton indicating importance of combined influence of various factors in Deepor beel, while Ghorajan beel stated 71.5% and 92.2% at station I and station II respectively. However, the step-wise regression of ten factors accounted for 59.9% at station I and 49.5% at station II in the former, while the later accounted for 62.3% at station I and 58.9% at station II and further regression substantially decreased the cumulative impact below 50%. While just only five abiotic factors (X_1-X_5) i.e. rainfall, water temperature, pH, transparency and specific conductivity accounted 87.5% at station I and 56.1% at station II in Deepor beel, however it registered for 65.9% at station I and 87.0% at station II in Ghorajan beel after removal of four parameters, thereby indicating the most profound impact of these five factors on zooplankton in both the beels. Overall high cumulative impact of abiotic factors on zooplankton abundance broadly concurred with the reports of Sharma (1995) and Sharma and Hussain (2001).

ROTIFERA:

Phylum Rotifera represents one of the oldest groups of invertebrates, which are presumed to be a product of the aerobic phase in the development of our planet (Sladecek, 1983). Segers *et al.* (1993) postulated (sub)tropical floodplain lakes to be the richest rotifer habitats of the world. Investigations in floodplain lakes of the Brahmaputra river basin of Assam state reflected richest rotifer biodiversity in the Indian subcontinent (Sharma and Hussain, 1999; Sharma, 2000; Sharma and Sharma, 2001).

Rotifera accounted for the highest share of the abundance of zooplankton. The present study did not depict any definite periodicity of overall rotifer abundance or of individual species. In general, a greater number of taxa were recorded in the sampled beels but numerical abundances were considerably lower. A total of 88 and

87 species at both the stations of Deepor beel and 87 species in Ghorajan beel represented it. The documented 88 rotifer species from both the beels accounted for 75.86% of the total reported rotifers from the floodplain lakes of Assam (116 reported species), 60.27% of the total reported rotifers from the N.E. India (146 reported species) and only 26.35% of the total rotifers from whole of the country (334 reported species).

Lecanidae and Brachionidae were the dominant families of Rotifera in the sampled beels. The rotifer fauna exhibited dominance of monogonont taxa. Five eurotatorian families namely Lecanidae> Brachionidae> Colurellidae> Trichocercidae included 66.6% of the total rotifers, the spectrum of dominance apparently agreed with the report of Sharma (1996). Various non-planktonic taxa of the Epiphanidae, Trichotridae, Synchaetidae, Dicranophoridae and Floscularidae were poorly observed. Lecanidae (24 species at both the stations) and Brachionidae (19 species at both the stations) together, comprised a notable component of rotifer biodiversity in Deepor beel. In the present study, Ghorajan beel registered 87 species of Rotifera at both the stations, out of which 24 species belonging to Lecanidae family followed by 19 species belonging to Brachionidae, 9 species belonging to Colurellidae, 6 species belonging to Trichocercidae. This is apparently higher than the report of Samuajan beel of upper Assam (Sharma and Hussain, 2001). The predominance of Lecane species is in agreement with reports on the rotifer fauna of other tropical floodplain lakes (e.g. Africa: Segers *et al.*, 1993c; Asia: Segers, 1994: South America: Jose De Paggi, 1993).

The extremely unequal distribution of rotifers in the same beel from one station to another and from year to year was remarkable. Of the 167 Lecane species recognized, 77 species or 46% are confined to (sub)tropical regions, as compared to 50 species (30%) that occur in temperate or arctic regions (Segers, 1996). It had already been noticed that Lecane is dominant in terms of species diversity in tropical acid waters (Fernando, 1980; Dussart *et al.*, 1984; Segars & Dumont, 1995), where over 40 taxa can be found in a single locality (Segers *et al.*, 1993a). The proportion of widely distributed Lecane amounts to 41.3% of the total. There are, however, only 21 species true cosmopolitans. There are relatively fewer widely distributed taxa in Lecane than in the pelagic Brachionidae (Dumont, 1983; Pejler, 1977b). The genus Lecane generally constitutes the most diverse group of rotifers in many types of tropical freshwater body (Dussart *et al.* 1984, Segers *et al.* 1993). Altogether 24 species belonging to Lecanidae family documented from both the beels, which accounted 52.17% of the total recorded Lecane species from N.E. India (reported 46 species), 75% of Sri Lanka (reported 32 species) and 51.06% of Thailand (reported 47 species). On the other hand, Lecanidae accounted for 27.3% of total rotifer richness in Deepor beel and 27.6% in Ghorajan beel, hence, broadly corresponded with its contribution (26.9%) in the floodplain lakes of upper Assam (Sharma, 2000) and also (28.5%) in tropical floodplain lakes of the river Niger, Africa (Segers *et al.* 1993). This number is low, compared to reports like Segers *et al.* (1993), in which 59 Lecane species are reported in a single survey. Further, the documented number is lower than the report of Burundi (34 species), a floodplain lake (Segers and Baribwegure, 2000).

Peak rotifer density during December in the first year (winter) was, however, primarily due to the lecanids-dominant *Lecane leontina* followed by sub-dominant *L. papuana* > *L. hastata* > *L. inopinata*. In addition, *Brachionus angularis*, *Keratella cochliaris*, *Euchlanis dilatata* and *Mytilina ventralis* indicated maximum densities during November, January, February and September respectively at station I. Station II exhibited peak rotifer density during July in the first year (monsoon) was due to *Euchlanis dilatata* followed by *Lecane leontina* indicated numerical importance. This study found the rare rotifers, occurrence of widely distributed warm-water Eastern Hemisphere taxa in the floodplain lakes, *Lecane lateralis* and *L. unguitata* were interesting, which in concurrence with the works of Segers and Baribwegure (2000) from the floodplain lakes of river Rusizi, Northwest Burundi.

As a result of this study, a total of 19 species belonging to Brachionidae documented from both the beels, which accounted for 82.61% of the total of N.E. India (23 reported species). Most species of Brachionus, reported from India, are pantropical or cosmopolitan forms of alkaline waters. However, both the beels registered 12 species belonging to genus Brachionus, which accounted for 85.71% of the total reported species from N.E. India (14 reported species). *Brachionus calyciflorus*, *B. caudatus*, *B. angularis*, *B. forficula*, *B. diversicornis* and *B. rubens* were found to be important elements in the zooplankton of Deepor and Ghorajan beel. Marked change was observed in the time of occurrence and abundance of *Brachionus falcatus* during the two years. It was present in the samples almost throughout the first year with a single peak in April in the second year. In the next year it was present only in June, August, October and December in Deepor beel. Ghorajan beel also showed almost identical trend, which depicted peak density in the same month of the same year. Ability for co-existence of Brachionus species with blue-green algae is considered a pre-supposition for survival in tropical lakes (Pejler 1977 b). The rotifer fauna of the sampled beels was distinctly tropical as indicated by the common occurrence of Brachionus sp. and absence of Notholca sp. (Sharma and Sharma, 1984). Abundance of Brachionus sp. was indicative of alkaline nature of the water bodies of Deepor beel. The species *Brachionus patulus* is very common, and occurs in all types of water bodies. It is considered cosmopolitan (Chengalath *et al.*, 1973), which concurred with the result of the sampled beels. Occurrence of *Brachionus patulus macracanthus* was observed throughout the study period in all the studied beels with small populations. Its presence in the floodplain lakes of Assam is noteworthy because it was documented from Meghalaya for the first time, which was a new record for India (Sharma, 1987a). All the Indian species of Keratella are also known from elsewhere. Amongst about 37 known species of Keratella, only seven have so far been recorded from India (Sharma, 1987). The sampled beels documented only five species of it. *Keratella tropica* appeared to be most widely distributed in the sampled beels. *Keratella procurva* was registered from the sampled beels and it was a new report from the N.E. region of the country.

However, a substantial number of taxa with restricted occurrence were recorded in both the beels. Those of the rotifers which are provided with well-developed lorica (e.g.; Brachionus, Keratella and Anuraeopsis) usually have their maxi-

mum intensity during the summer months and that of illoricates during winter (George, 1961; Laal, 1984 and Sharma, 1992). The beel did not depict such definite pattern but coincided the report by Sharma (2000) in Samuajan beel of Assam. *Anuraeopsis fissa* (maximum in April and July), *Brachionus forficula* (maximum in July) in Ghorajan beel occurred only during warmer months and, hence, the present observations reaffirmed their warm-stenothermal nature (Koste, 1978). *Anuraeopsis fissa* shows a wide distribution in India, as compared to *A. coelata* (Sharma, 1987a). *A. coelata* was totally absent in the sample of the studied beels. Brachionidae contributed 21.6% in Deepor beel; however, Ghorajan beel depicted 21.8% of total species richness. Lecane and Brachionus imparted a general tropical character to the studied fauna; such a generalization is in confirmity with the reports by Green (1972), Pejler (1977), Fernando (1980), Dumont (1983), Sharma (1987, 1991, 1996, 1999), Sharma and Naik (1996) and Segers (1996) though they were widespread but less dominant.

Occurrence of *Testudinella greeni*, an interesting palaeotropical element, in both the beels was restricted to some months in less abundance during the study period but apparently higher than the reports of a tectonic lake (Sone beel) in Barrak valley of Assam (Sharma, 1990) and floodplain lakes of upper Assam (Sharma and Sharma, 2000). It is so far apparently restricted to the floodplain lakes of N.E. region (Sharma and Sharma, 2000). Some of the taxa encountered were particularly noteworthy. *Testudinella brevicaudata* was observed only in three months during the whole study period in both the beels (2 times in Deepor and 3 times in Ghorajan beel), which was earlier reported three species from a nursery tank in Guwahati city of Assam (Sharma, 1990). A number of Testudinella species are quite common in tropical waters, especially *Testudinella patina* and its varieties (Fernando and Zankai, 1981). The cosmotropical species *Filinia camascela* is an interesting addition to the Indian Rotifera is restricted only to N.E India (Sharma and Sharma, 2000). Occurrence of this species in both the beels agreed with the aforesaid report. During the entire survey period, *Ascomorpha saltans* were observed 3 times in Deepor and not even a single species was found in Ghorajan beel.

On the other hand, very little is known about the distribution of Indian species of the genus Lepadella. The only significant previous contributions to this field are those of Edmondson & Hutchinson (1934), Wulfert (1966), Vasisht & Battish (1971a & 1971b) and Sharma (1978). Six species of genus Lepadella were documented from both the beels and it distinctly agreed with the report of Sharma and Sharma (1987). North-East India revealed ten species, majority of which showed cosmopolitan distribution and comprised an important component of the periphytic rotifers (Sharma and Sharma, 1987). It was observed that the colonies of *Conochilus unicornis* became numerically important. The maximum densities attained in May at station I in the second year, while station II depicted the same trend of distribution. This study, therefore, showed fairly rich and diversified rotifer taxocoenosis. In addition, overall species richness in the beels from lower Assam presented a distinct contrast to only 29 species registered from six beels of lower Assam (Goswami, 1997) and 64 species from five beels of upper Assam (Sharma, 2000).

Rotifers are considered as good indicators of water quality (Fuller *et al.*,

1977; Pejler, 1981, Sladecek, 1983 and Sharma, 1996). The observations on Indian indicator species were first made by Arora (1961, 1966). This aspect has subsequently drawn attention of several other workers (Sharma, 1983, 1986, 1992b, 1996). Sladecek (1935, 1983) considered 82 rotifers as good indicators and he contributed a lot in assessing the water quality. However, *Brachionus angularis, Brachionus calyciflorus, B. bidentata, B. falcatus, B. rubens, Keratella tropica, Mytilina ventralis, Lecane curvicornis, L. bulla, L. leontina, Asplanchna priodonta, Trichocerca similis, Polyarthra vulgaris, Ascomorpha ovalis, Conochilus unicornis, Sinantherina spinosa, Filinia longiseta, F. opoliensis, Rotaria neptunia* are often reported to occur under eutrophic conditions. *Anuraeopsis fissa, B. bidentata, B. falcatus, B. forficula, B. mirabilis, Keratella tropica, Macrochaetus sericus, Lecane ludwigi, L. quadridentata, Sinantherina spinosa, F. opoliensis* occurred during warmer months and, hence, the present observations reaffirmed their warm-stenothermal nature (Koste, 1978). On the other hand, *Brachionus angularis, Brachionus calyciflorus, B. rubens, Euchlanis dilatata, Lepadella ovalis, L. patella, Polyarthra vulgaris* and *Testudinella patina* are considered to be eurythermal species. Slightly alkaline and slightly acidic nature of water of both the beels are characterised by various acidophilic and alkalophilic species. Acidophilic elements are *Brachionus patulus macracanthus, B. mirabilis, Dipleuchlanis propatula, Mytilina bisulcata, Testudinella emarginula.* Alkalophilic species are considered to be *Anuraeopsis fissa, Brachionus angularis, B. caudatus, Brachionus calyciflorus, B. rubens, B. falcatus, Keratella tropica, Polyarthra vulgaris, Filinia longiseta, F. opoliensis.* Such an affinity is in conformity with earlier reports from upper Assam (Sharma, 2000). However, *Keratella lenzi* prefers special water.

In two years of study period, percentage similarity of rotifers followed an almost identical ranges between 22.2-79.6% in the first year at station I and 16.7-75.7% in the same year at station II in Deepor beel; while it showed 26.7-72.9% in the second year at station I and 28.6-66.7% in the same year at station II of the aforesaid beel. On the other hand, it was observed that 31.7-78.8% in the first year at station I and 19.4-73.1% in the same first year at station II in Ghorajan beel and it depicted 20.9-69.4% in the second year at station I and 30.8-64.6% in the same year in the same beel. However, Deepor beel exhibited community similarities 72.7% instances during the first year study at station I and during the second year study it depicted 50% were above 50% similarity, on the other hand, 42.4% instances during the first year and 45.4% during the second year were 50% similarity at station II. It distinctly depicted less variability at station I and more at station II. However, Ghorajan beel registered 72.7% instances during the first year and 54.5% during the second year were 50% similarity at station I. While 40.9% instances during the first year and 53.0% during the second year were above 50% similarity at station II of the same beel. The beel registered less variability at station I and more at station II. Overall species richness in both the floodplain lakes exhibited high community similarities in comparison with the earlier reports from the floodplain lakes of Assam (Goswami, 1985; Goswami, 1997; Sharma, 2000).

Rotifera ranged between 94-265 ind/l (183.5 ±55.1) at station I and 62-187 ind/l (117.0 ±37.0) at station II in Deepor beel. The dominant component contrib-

uted significantly to net plankton (r_1= 0.456, p<.05; r_2= 0.560, p<.01) and Zooplankton production (r_1= 0.843, p<.001; r_2= 0.787, p<.001) in this beel. On the other hand, Ghorajan beel registered Rotifera abundance 56-245 (167.0 ±60.0) at station I and 92-267 ind/l, (159.0 ±56.0) at station II, which contributed significantly to net plankton (r_1= 0.474, p<.05; r_2= 0.751, p<.001) and zooplankton (r_1= 0.958, p<.001; r_2= 0.933, p<.001) in Ghorajan beel. The Rotifera abundance is apparently higher than the reports of Lahon (1983), Kar (1984), Yadava *et al.* (1987), Baruah *et al.* (1993), Sinha *et al.* (1994) and Sharma and Hussain (2001). However, it exhibited direct correlation with total alkalinity in Ghorajan beel (r_1=0.480, p<.05) was in concurrence with the remarks on plankton Rotifera by Michael (1968), Nayar (1970) and Vasisht and Sharma (1976). Rotifers depicted significant direct correlation with zooplankton (r_1= 0.843, p<.001; r_2= 0.787, p<.001) and Cladocera (r_1= 0.597, p<.01; r_2= 0.502, p<.01) indicating positive relationships between them. Coefficient correlation of FCO_2 (r_2= -0.570, P<.01) showed inverse relationships with rotifers in Deepor beel, while it exhibited positive relationship at station I (r_1= 0.425, p<.05) in Ghorajan beel. Significant inverse relationship between rotifers and water temperature (r_1= -0.415, p<.05) at station I in Deepor beel indicated lower temperature to be favourable for their population. Station I of the beel corroborated the report by Sharma (2000).

Among various documented species of rotifers *Lecane leontina* (47 ind/l) achieved highly pronounced peak during March in the second year followed by *Euchlanis dilatata* (42 ind/l) during December in the first year; *Brachionus calyciflorus* (42 ind/l) during April in the second year; *Testudinella patina* (38 ind/l), during March in the second year; *Brachionus falcatus* (32 ind/l) in the second year at station I. On the other hand, *Asplanchna priodonta* (22 ind/l) attained peak during July in the second year followed by *lecane leontina* (18 ind/l) during April in the second year; *Euchlanis dilatata* (17 ind/l) during July in the second year; *Brachionus falcatus* (16 ind/l) at station II in Deepor beel. However, *Sinantherina spinosa* (30 ind/l) achieved maximum density during July in the first year followed by *Asplanchna priodonta* (28 ind/l) during July in the same year; *Euchlanis dilatata* (28 ind/l) during July in the second year and *Brachionus falcatus* (20 ind/l) during April in the second year at station I, while *Polyarthra vulgaris* (32 ind/l) attained peak during January in the second year followed by *Asplanchna priodonta* (30 ind/l) during September in the first year, *Lecane bulla* (22 ind/l) during March in the second year and *Euchlanis dilatata* (22 ind/l) during February in the second year at station II in Ghorajan beel. Out of 25 families of Eurotatoria so far known from India, 19 families were recorded from Deepor and 17 families from Ghorajan beel.

Shannon's and Menhinick's indices were grouped together, followed nearly identical ranges as well as patterns in both the beels. Deepor beel registered species diversity of Rotifera using Shannon's index was 2.528-3.594 (3.208 ±0.3) at station I and 2.585-3.657 (3.224 ±0.25) at station II exhibiting narrow range. While using Menhinick's index it ranged between 1.617-3.899 (3.117 ±0.6) at station I and between 1.94-4.545 (3.346 ±0.7) at station II, which showed wide range. Ghorajan beel exhibited species diversity of rotifers using Shannon's index 2.851-3.679 (3.301 ±0.2) at station I and 2.647-3.628 (3.194 ±0.26) at station II. While using Menhinick's index it ranged between 2.091-4.796 (3.319 ±0.8) at station I and between 1.909-

3.992 (2.979 ±0.5) at station II. The species diversity of both the beels concurred with the report of Samuajan beel by Sharma and Hussain, 2001.

Shannon's index registered maximum diversity during August in the second year and a minima during April in the same year at station I; while maximum diversity during July in the first year and minimum during April in the same year at station II in Deepor beel. However, Menhinick's index recorded maximum diversity during August in the first year and a minima during March in the second year at station I; on the other hand, station II registered maximum value during March in the first year and a minima during April in the same year. In the present study, Shannon's index depicted maximum diversity during September in the second year and a minima during January in the second year at station I; while maximum diversity during July in the first year and a minima during October in the first year at station II of Ghorajan beel. Menhinick's index exhibited maximum during February in the first year and a minima during January in the second year at station I; however station II registered maximum during March in the first year and a minima during February in the second year. Shannon's and Menhinick's indices of species diversity followed nearly identical ranges and patterns showed relatively small differences in both the beels. Diversity indices revealed that species diversity is apparently higher than the reports of Sharma and Hussain (2001). The response of H′ is mostly a function of changes in species richness rather than in the relative species abundance (Boyle *et al.*, 1990). F values of Analysis of Variance (ANOVA) were computed, where two-way interactions were observed. ANOVA exhibited no significant difference between the months in both the years and in case of stations, it showed significant difference between the stations ($F_{1, 23}$ = 5.318, p>.05) in the first year in Deepor beel, while it exhibited significant differences between the stations ($F_{1, 23}$ = 5.838, p>.05) in the first year in Ghorajan beel.

During the course of study, Berger-parker's index of dominance registered 0.075-0.206 (0.124 ±0.04) at station I and 0.071-0.183 (0.114 ±0.03) at station II in Deepor beel. On the other hand, Berger-Parker index of dominance ranged between 0.08-0.208 (0.124 ±0.04) at station I and 0.068-0.326 (0.125 ±0.06) at station II in Ghorajan beel. In the present study, Berger-Parker index of dominance observed maximum during April in the second year and a minima during August in the same year at station I in Deepor beel and station II depicted maximum during September in the first year and a minima during July in the first year. On the contrary, Berger-Parker index of dominance observed maximum during March in the second year and a minima during October in the second year at station I in Ghorajan beel and station II depicted maximum during September in the first year and a minima during April in the second year. The present study showed relatively low overall dominance due to fewer quantitatively important species and apparently agreed with the results of some floodplain lakes of Assam reported by Sharma and Hussain (2001).

During the whole study period, evenness of rotifers using E_1 ranged between 0.81-0.919 (0.867 ±0.03) at station I and 0.864-0.947 (0.911 ±0.02) at station II of Deepor beel. Ghorajan beel exhibited evenness using E_1 ranged between 0.853-0.969 (0.894 ±0.02) at station I and 0.855-0.925 (0.892 ±0.027) at station II. Even-

ness index (E_1) reflected maximum degree of evenness in August in the second year and a minimum value in March and February in the second year at station I of Deepor beel and station II depicted a maxima in September in the first year and a minima in February in the second year. During the whole study period, in Ghorajan beel, E_1 depicted maximum during November in the first year and a minima during May in the second year at station I, while station II reflected maximum during June in the second year and a minima during September in the first year. Among the sampled beels, low mean evenness of rotifers was recorded at station I in Deepor beel, while high mean value was noticed at station II in the same beel. In both the beels, evenness registered inverse relationship with dominance, which broadly coincided with the findings of some beels of Assam reported by Sharma and Hussain (2001). However, in the second year evenness was relatively high (0.919 in August at station I; 0.947 in February at station II) in Deepor and Ghorajan beel (0.969 in November at station I; 0.925 in June at station II).

In the present study, diversity was found to be related to evenness or equitability. Furthermore, the equitability component was inversely related to density changes. Thus increased density contributed by one or two taxa appear to have disturbed the community equilibrium by depressing equitability. Available information from similar studies in both temperate and subtropical lakes (Ryan, 1984; Schmid-Araya & Zuniga, 1992) indicate that the nature of relationships among diversity, equitability, species richness and density could vary widely even between lakes from the same geographic area, with diversity found to be related only to equitability in certain lakes and to both equitability and species richness or density in certain others. However, in periods of extreme of conditions where diversity was low, evenness might show high values. This is due to the fact that in these periods there is a reduced number of well-adapted species, and the community must not be regarded as an immature stage but as a successional stage induced by the extreme environmental conditions (Mezquita and Miracle, 1997). This generalization is corroborated with the fact that species diversity depicted 2.585 in April in the first year where evenness was 0.932 at station II in Deepor beel, on the other hand, species diversity exhibited 2.851 in January in the first year where evenness was 0.909 at station I in Ghorajan beel.

CLADOCERA:

Cladocera comprise one of the important components of the zooplankton community in lentic ecosystem. In many inland water bodies there are the most abundant crustacean plankters and comprise a major food item of fishes. The systematic studies on Indian freshwater Cladocera were initiated by Baird (1860) and their status was lastly reviewed by Sharma (1991). The Cladocera are dominant micro-crustaceans in freshwater habitats of lower Assam, but they are not known taxonomically and ecologically as compared to those in the surrounding regions (Michael and Sharma, 1988). Although Cladocera are among the commonest freshwater microcrustaceans, a perusal of literature of this group shows that they are poorly known taxonomically throughout India (Biswas, 1971; Nayar 1971; Venkataraman, 1983; Michael and Sharma, 1988). In the Indian context, the studies

on cladocera usually form a part of general limnological investigations in lakes, ponds, floodplain lakes and reservoirs where from several genera and species are reported from time to time.

In the present investigations, cladocerans comprised subdominant component of zooplankton in Deepor beel. The quantitative abundance of Cladocera ranged between 29-195 ind/l (105.0 ±43.0 ind/l) at station I of Deepor beel, while station II recorded 44-134 ind/l (82.0 ±28.0 ind/l). Cladocera, however, depicted a multimodal annual pattern and recorded lowest abundance in April in the first year but maximum cladocerans density was noticed during January in the second year with secondary maxima in November in the first year followed by a tertiary maxima during January in the first year at station I, while it showed a minimum density in April in the first year. On the other hand, station II depicted peak density in May in the second year with secondary maxima in July in the first year and a minimum density in February in the second year. A total of 48 species at station I and 43 species at station II belonging to 6 families were identified during the study period in Deepor beel. Out of 48 species 52.1% at station I and 58.1% at station II belonging to Chydoridae family. The quantitative abundance of cladocera ranged between 47-160 ind/l (99.4 ±34.3 ind/l) at station I of Ghorajan beel, while station II recorded 28-155 ind/l (81.1 ±28.8 ind/l). It exhibited peak density in July in the second year and lowest density in September in the first year at station I, while station II established maximum abundance in June in the first year and minimum in September in the first year. The recorded abundance is higher than the reports of Khan (1987), Sinha *et al.* (1994), Sanjer and Sharma (1995) and Sharma and Hussain (2001). On the other hand, Ghorajan beel registered 42 species at both the stations of which 25 species belonging to Chydoridae family (59.5% of total Cladocera). The figures from both the beels were apparently higher than the findings of Sharma (1985) from West Bengal.

The Cladocera comprised an important component 31.2% at station I and 29.3% at station II of zooplankton in Deepor beel. Cladocera recorded their peak during February in the first year when they were represented in maximum number of 40 species but interestingly, in the next year during the same month, number of species was decreased to 10 species at station I; while station II recorded maximum number of 33 species during March in the first year and it exhibited minimum of 11 species during April of the same year. However, Ghoranjan beel exhibited 28.6% at station I and 28.8% at station II of the total recorded zooplankton. In all the collections obtained from the sampled beel, 30 species was observed maximum during June in the first year and a minimum of 14 species during April of the same year.

Deepor beel registered species diversity of Cladocera using Shannon's index were 2.151-3.178 (2.803 ±0.3) at station I and 2.164-3.251 (2.828 ±0.2) at station II; while using Menhinick' index ranged between 1.414-3.549 (2.414 ±0.5) at station I and 1.51-3.81 (2.519 ±0.6) at station II. Shannon's index depicted maximum diversity during July in the first year and minima during February in the second year at station I and station II exhibited maxima during March in the first year and minima during April in the first year in Deepor beel. On the other hand, Menhinick's index recorded maxima during February in the first year and minima

during February in the second year at station I and station II exhibited maximum during March in the first year and a minima during April in the same year. Menhinick's index showed relatively lower diversity values during the February, March and April in the second year at station I and also during February and March at station II. In the present study, Ghorajan beel recorded species diversity of Cladocera using Shannon's index were 2.468-3.201 (2.851 ±0.2) at station I and station II exhibited 2.231-3.128 (2.743 ±0.24); while using Menhinick' index ranged between 1.811-3.444 (2.419 ±0.5) at station I and 1.395-3.618 (2.372 ±0.5) at station II depicting wide range. During the whole study, Shannon's index recorded peak diversity during March in the first year and lowest value of diversity was observed during September in the first year in the beel, while station II registered maxima during July in the first year and a minima during April in the first year. On the other hand, Menhinick's index showed maxima during the same month with Shannon's index but minimum value was noticed during January in the second year at station I and station II exhibited peak diversity during August in the first year and lowest value was noticed during January in the second year

Berger-Parker's index of dominance in Deepor beel indicated 0.08-0.25 (0.147 ±0.04) at station I and 0.091-0.243 (0.161 ±0.04) at station II. In the present study, Berger-Parker's index of dominance indicated a maxima during March in the second year and a minima during October in the first year at station I and station II registered maximum during February in the second year and a minima March in the first year in Deepor beel. During the whole study period, Berger-Parker's index of dominance in Ghorajan beel recorded 0.08-0.25 (0.147 ±0.04) at station I and 0.091-0.243 (0.161 ±0.04) at station II. Berger-Parker's index of dominance in this beel registered maximum value during October in the first year and it noted minimum value during February in the first year at station I and station II indicated maximum value during January in the first year and it showed a minima value during August in the first year at station II in this beel. The present study showed relatively low overall dominance due to fewer quantitatively important species.

In this investigation, evenness index (E_1) reflected 0.836-0.975 (0.895 ±0.03) at station I and 0.733-0.951 (0.913 ±0.05) at station II in Deepor beel. Evenness reflected maximum value during April in the first year and minimum value was noticed during January in the first year at station I and station II exhibited maxima during August in the first year and minima during October in the first year. However, evenness recorded 0.844 –0.963 (0.909 ±0.03) at station I and 0.84 –0.955 (0.914 ±0.029) at station II in Ghorajan beel. In general, evenness registered inverse relationship with dominance.

Coefficient correlation of water temperature (r_1= -0.691, p<.001) showed significant inverse relationship with Cladocera in Deepor beel, thereby, exhibited low temperature for their growth of population. On the other hand, it depicted direct correlation with total alkalinity (r_1= 0.478, p<.05), total hardness (r_1= 0.437, p<.05), magnesium (r_1= 0.495, p<.05) and BOD (r_1= 0.562, p<.01) in Ghorajan beel. Correlation between biotic factors revealed that Cladocera and phytoplankton (r_1= -0.523, p<.01) were inversely correlated but positively correlated with zooplankton (r_1= 0.818,

$p<.001$; $r_2 = 0.892$, $p<.001$) in Deepor beel, while the same relationships were noticed with zooplankton ($r_1 = 0.919$, $p<.001$; $r_2 = 0.808$, $p<.001$) in Ghorajan beel indicating interdependence between them. Cladocera hatching and growth rate is controlled by temperature (Venkataraman, 2000); positive relationship with water temperature in Ghorajan beel established the confirmity with the stated fact.

During the whole study period, small-bodied cladocerans were present in substantial numbers. The group of small-bodied cladocerans was dominated by three species *Chydorus sphaericus*, *Biapertura karua*, *Chydorus barroisi*, whereas the large-bodied cladocerans was dominated by *Scapholeberis kingi* and *Simocephalus vetulus* in Deepor beel. Among the reported species, *Chydorus sphaericus* appeared to be the commonest and most widely distributed cladoceran in the beel. It achieved peak during August in the second year (24 ind/l) followed by 22 ind/l during July, 2001 at station I in Deepor beel. On the other hand, *C. sphaericus* attained highest density during December in the second year at station I and during March in the same year at station II in Ghorajan beel. In the present investigation, 25 species of the family Chydoridae were found in Deepor and Ghorajan beel. Of the species recorded in the present study, the most abundant species in the whole sequence was *Chydorus sphaericus*, which was observed throughout the twenty-four months in both the beels excepting April in the first year at station II in Ghorajan beel. Interestingly, 52.1% Chydorids of total Cladocera were registered at station I and 58.1% at station II in Deepor beel, on the contrary, both the stations in Ghorajan beel registered 59.5%, which showed slightly higher than the former. In all these periods, small species of Alona or Chydorus had high relative abundance in comparison to large species. The peak abundance of *Chydorus sphaericus* during August in the second year with the increasing phytoplankton biomass, which was dominated by filamentous Oscillatoria sp. during the same month in the sampled beel.

Simocephalus vetulus is a weedy species but it is not restricted to this habitat, it can be found in open water (Smyly, 1958). Presence of this species at station II in Ghorajan beel agreed with the aforesaid comment, since station II of the beel was almost open water body. *S. vetulus* is more littoral form of the Cladocera, they spend much time fixed to solid substrates feeding (Hutchinson, 1967). Occurrence of *Ceriodaphnia cornuta*, *Moina micrura*, *Moina daphnia* and *Diaphanosoma excisum*, *Macrothrix laticornis* and *Leydigia acanthocercoides* in both the beels was noteworthy. *Leydigia acanthocercoides* is a widely distributed species in India (Nayar, 1971; Sharma, 1978; Michael and Sharma, 1988) and Sri Lanka (Rajapaksa and Fernando, 1982).

The cladoceran was composed primarily of commonly occurring species. Occurrence of *Daphnia lumholtzi* only in two months (during January in the first year & during April in the second year) throughout the study period in Deepor beel and its total absence in Ghorajan beel was note-worthy. On the other hand, occurrence of Leydigiopsis sp. was a new appearance in both the beels and also for the state of Assam as well as N.E. India. *Dadaya macrops* was not present throughout the study period in both the beels, the species was observed during July, October and November in the second year of the study period in Deepor beel, and again reap-

peared during July in the next year. The almost same trend was noticed in Ghorajan beel. It was observed during August and September in the second year and reappeared again during July in the next year. Most of the other cladocerans occurred in low abundance in both the sampled floodplain lakes.

Reported species of the genera Daphnia, Diaphanosoma, Ceriodaphnia and Moina from West Bengal comprised truly planktonic forms. A majority of other taxa, particularly Chydorids were associated with weedy habitats. *Ilyocryptus spinifer* represented a typical benthic form (Sharma and Sharma, 1985). Population density of this species was very meager with the maximum 8 ind/l during June in the first year in Ghorajan beel. *Diaphanosoma excisum* was a dominant species in the limnetic regions as observed in other tropical regions like Sri Lanka, South-East Asia (Fernando, 1980). Though the samples were not collected from limnetic and littoral zones separately in both the beels, but presence of this species in high abundance (16 ind/l in Deepor and Ghorajan beel) apparently agreed with the remarks of Fernando. However, occurrence of *Pseudosida bidentata* in both the beels was noteworthy.

In the present study, *Bosmina longirostris* and *Bosminopsis deitersi* of the family Bosminidae were well distributed in the sampled beels. Both the species showed identical seasonal trend in the sampled beels. Maximum population density *Bosmina longirostris* was observed during December in the first year (18 ind/l) in Deepor beel and during July in the same year (24 ind/l) in Ghorajan beel. Similarly, *Chydorus barroisi* and *Alonella exisa* were never numerically dominant but important contributors to zooplankton of both the beels. Daday (1898) recorded *Graptoleberis testudinaria* from Sri Lanka and this species is a rare form in the tropics (Fernando, 1980a). However, it documented from the state of Tripura.

COPEPODA:

Meso cyclops sp., Helio diaptomus sp. and Nauplius larvae were the only representatives of this group at both the stations in Deepor beel. Copepoda registered relatively low qualitative diversity in Deepor beel. Diversity of this group in this beel though low, abundance among zooplankton population was quite high especially during summer months. It formed quantitatively most important group and ranged between 10-122 ind/l (40.0 ±26.0); but did not depict any definite monthly pattern at station I, while station II recorded 7-77 ind/l (27.0 ±16.0) in Deepor beel. Maximum and minimum abundance were observed during July in the second year (122 ind/l) and during October in the first year (10 ind/l) at station I in Deepor beel. A peak of nauplii was observed during April and May at both the stations, indicating a reproductive increment. On the contrary, Copepoda was represented by three species at both the stations in Ghorajan beel. The population density of Copepoda ranged between 6-81 ind/l (35.0 ±22.0); but did not depict any definite monthly pattern at station I, on the other hand station II recorded 4-93 ind/l (34.0 ±25.0). Maximum and minimum abundance were observed during December in the first year (81 ind/l) and during October in the same year (6 ind/l) respectively at station I, while station II depicted maximum during December in the second year and minimum during

January of the same year. The number of species recorded in the present study is marginally higher than the reports of Yousuf *et al.* (1983) but it is higher than the reports by Sharma (1995) and Lyngdoh (2002). However, copepods indicated positive relationships with phosphate (r_1= 0.439, p<.05) in Ghorajan beel and Deepor beel (r_1= 0.679, p<.001), which, in turn, corresponded with the result of Sharma and Hussain (2001). Among the reported species of this group, Meso cyclops sp. was quantitatively important and observed in all collections. The dominance of this species among the copepods confirmed the previous works in the floodplain lakes of Assam.

High copepod production was observed during the period of low carbon dioxide content in Deepor beel. In addition, the density of copepod corresponded with higher concentrations in a number of abiotic factors. Positive relationships with total alkalinity (r_1= 0.418, p<.05; r_2= 0.427, p<.05) and BOD (r_1= 0.571, p<.01; r_2= 0.423, p<.05) in Ghorajan beel. Among the biotic factors, copepod exhibited a distinct influence on zooplankton (r_1= 0.427, p<.05) and net plankton (r_1= 0.463, p<.05) in Deepor beel, while it showed positive relationships with zooplankton (r_1= 0.859, p<.001; r_2= 0.599, p<.01) and net plankton (r_1= 0.698, p<.001; r_2= 0.445, p<.05) in Ghorajan beel.

RHIZOPODA:

The Rhizopoda formed the third qualitative important group in both the beels. The population density of this group, however, ranged between 5-43 ind/l (14.2 ±11.1) at station I and 5-42 ind/l (22.4 ±12.5) at station II in Deepor beel. On the contrary, Ghorajan beel showed between 4-47 ind/l (10.8 ±9.4) at station I and 4-70 ind/l (21.8 ±16.3) at station II. The mean values of Deepor beel were marginally higher than that of Ghorajan beel. On the other hand, the mean values of both the beels established definitely higher values than the reports of Samuajan beel of Assam by Sharma and Hussain (2001).

The Rhizopoda were represented by 12 species at station I and 11 species at station II in Deepor beel. On the other hand, Ghorajan beel registered 12 species at station I and 11 species at station II. However, their peak densities were observed during May in the second year at station I and during March in the same year at station II in Deepor beel, on the other hand. Ghorajan exhibited maximum densities during April in the second year at station I and during February in the second year at station II. Lowest density was noticed during April in the first year at station I and station II showed lowest density during the same month with station I in Deepor beel. Ghorajan beel registered minimum density during November in the first year at station I and during October in the same year at station II. Difflugia sp. was one of the commonest planktonic protozoans in the sampled beels. Other protozoans, which occurred as few individuals per litre, were *Centropyxis hemisphaerica, C. aculeata, Euglypha ciliata and Actinosphaerium eichhorni*. The present study indicated higher overall qualitative as well as quantitative abundance of rhizopods than the reports of Sharma (1995), Das *et al.* (1996) and Lyngdoh (2002).

This group registered significant direct correlations with specific conductivity (r_1=0.493, p<.05), total alkalinity (r_1=0.452, p<.05) and total hardness (r_1= 0.514, p<.01; r_2= 0.485, p<.05) in Ghorajan beel, which agreed with the results of Sharma and Hussain (2001). Rhizopoda depicted direct correlations with net plankton (r_1= 0.417, p<.05), zooplankton (r_1= 0.597, p<.01; r_2= 0.762, p<.001), Rotifera (r_1= 0.426, p<.05; r_2= 0.668, p<.01), Cladocera (r_2= 0.513, p<.01) and Copepoda (r_1= 0.558, p<.01) in Deepor beel indicating interdependence among them. Similarly, it also shared direct correlations with net plankton (r_1= 0.572, p<.01; r_2= 0.546, p<.01), zooplankton (r_1= 0.472, p<.05; r_2= 0.576, p<.01), Rotifera (r_2= 0.627, p<.01), Cladocera (r_1= 0.427, p<.05) and Copepoda (r_1= 0.468, p<.05) in Ghorajan beel. *Arcella discoides* occurred throughout the study period and mainly contributed to their maximum density in both the sampled beels, which agreed with reports of Sharma and Hussain (2001).

OSTRACODA:

Two planktonic ostracods were occasionally very abundant. They were present most of the months dominated by Cypricercus sp. and Cypris sp. at both the stations in Deepor beel. Population density of Cypricercus sp. ranged between 0-33 ind/l at station I and station II exhibited 0-14 ind/l, while Cypris sp. showed 0-7 ind/l and 0-6 ind/l at station I and II respectively. The former attained maximum during July in the second year at station I and station II exhibited maximum density during January in the same year and the later showed peak density during May in the first year at station I and station II depicted maximum during July in the second year. On the other hand, Ghorajan beel exhibited Ostracods dominated by the same species Cypricercus sp. and Cypris sp. at both the stations. Population density of Cypricercus sp. ranged between 0-16 ind/l at station I and station II exhibited 0-6 ind/l, while Cypris sp. showed 0-8 ind/l and 0-4 ind/l at station I and II respectively. The former attained peak density during June in the first year at station I, while station II exhibited maximum density during July and October in the second year, on the other hand, the later showed peak density during September in the first year and during November and December in the second year at station I, however, station II depicted maximum during March in the first year and also during November in the second year. During the zooplankton peak they became less abundant perhaps due to competition by the large numbers of other herbivorous zooplankton. Ostracods depicted direct correlations with zooplankton (r_1=0.443, p<.05) and Copepoda (r_1=0.634, p<.01) in Deepor beel indicating interdependence among the attributes. However, it depicted direct correlations with zooplankton (r_1=0.439, p<.05), Rotifera (r_1=0.427, p<.05) and Cladocera (r_1=0.513, p<.05) in Ghorajan beel.

Conchostraca sp. was found at both the stations in Deepor beel in a very negligible quantity. The species was observed continuously from early summer to early winter season. It was observed that population density ranged between 0-5 ind/l at station I, while station II showed 0-4 ind/l. This species was represented continuously from May to December in the study period but in relatively smaller number in the collected sample from both the stations of Ghorajan beel. In the present survey, population density fluctuated between 0-6 ind/l at station I, while station II regis-

tered 0-4 ind/l. Interestingly, the observation established that conchostraca sp. was found in a very small quantity but they represented in a common period of study.

(III) PHYTOPLANKTON:

Phytoplankton taxa recorded in the present study of Deepor beel belonged to five groups namely Chlorophyta, Bacillariophyta, Cyanophyta, Euglenophyta, Dinophyta and Chrysophyta. These, in turn, were represented by 59 species at station I and also the same number of species at station II. The species richness of phytoplankton fluctuated between 16-34 species (18.0 ±4.0) and 20-35 species (20.0 ±5.0) at station I and II respectively. The maximum and minimum number of species were noticed in the month of June in the first year at station I and in November in the first year. The abundance of phytoplankton ranged between 219-682 ind/l (342.0 ±114.0) at station I and 221-654 ind/l (362.0 ±119.0) at station II of Deepor beel. It, however, increased from the lowest initial density to 78 ind/l in June in the first year at station I. The present observation registered a sharp decline in phytoplankton abundance from September to January in the first year and maxima was subsequently noticed in April in the first year at station I and minima was observed in June of the same year. However, station II showed peak density during April in the first year and lowest during August of the same year.

Ghorajan beel depicted an identical spectrum of dominance with Deepor beel i.e. followed the spectrum of dominance as Chlorophyta> Bacillariophyta> Cyanophyta> Euglenophyta> Dinophyta> Chrysophyta. Phytoplankton of this beel are represented by 55 species at station I and 54 species at station II. This general group-wise composition differed from those by Sharma (1995), Sehdave (1996) and the report of Dey and Kar from Sone beel of Assam. In the present study, population density of phytoplankton in this beel fluctuated between 220-727 ind/l (320.0 ±136.0) at station I and 130-486 ind/l (222.0 ±84.0) at station II. Maximum density was observed during April in the second year at station I and minima during November in the first year. On the other hand, station II exhibited maxima during April in the second year and minima during June of the same year. However, station I exhibited 46.1-70.38% of net plankton, while station II showed 33.08-64.5% in Deepor beel. On the other hand, Ghorajan depicted 53.14-64.11% at station I and 38.8-60.44% at station II. Phytoplankton comprised a dominant composition of net plankton. This was also ascertained by significant positive correlation with net plankton (r_1=0.626, p<.01; r_2=0.878, p<.001) in Deepor beel, while correlation analysis revealed that phytoplankton and net plankton were significantly correlated (r_1=0.759, p<.001; r_2=0.621, p<.01) in Ghorajan beel. Quantitative abundance of the sampled flood-plain lakes is distinctly higher than the reports from reservoirs, which concurred with the report of Sharma, (1995).

In the present observation, Chlorophyta were represented by 23 species at both the stations in Deepor beel, while Ghorajan beel registered 21 species. Further, their species richness ranged between 11-20 (16.0 ±2.9) at station I and 10-21 (16.0 ±3.0) at station II in Deepor beel but it did not depict any definite monthly pattern. The minimum number of species was noticed during September in the first year and

October in the second year; while peak qualitative diversity was recorded during September in the first year. In general, the species richness of this group was relatively higher at both the stations from August-November in the second year. The species richness of Chlorophyta ranged between 11-21 (15.0 ±3.0) at station I and 10-19 (14.0 ±2.0) at station II in Ghorajan beel. Station I registered maximum density during May in the second year and a minima during February in the same year; while station II depicted maximum during May in the second year and a minima during June in the first year. The number of species of Chlorophyta documented from both the sampled beels registered higher than the report of Sone beel by Dey and Kar (op. cit.), Sharma (1995) Sharma and Lyngdoh (2003). The population density of Chlorophyta at station I fluctuated between 85-274 ind/l (142.0 ±46.0 ind/l) in Deepor beel. The minimum density was noticed during June in the first year. This group, however, recorded a primary maxima (274 ind/l) in April in the first year; a secondary maxima (254 ind/l) in April in the second year and still another was observed during May in the second year, thereby indicating a trimodal pattern of temporal variations. The population density of this group was distinctly lower from November in the second year to January in the same year and subsequently during March and April in the same year respectively. The population density of Chlorophyta at station II in Deepor beel was relatively lower and fluctuated between 112-346 ind/l (171.0 ±63.0 ind/l). The green algae registered maximum density in this ecosystem during April in the first year and lowest abundance was noticed in August in the second year and June in the same year. Further, this group recorded secondary maxima in May in the second year and another maxima in April in the second year and hence, exhibited a trimodal pattern of annual variations. In addition, their population indicated almost equal magnitude of abundance from January in the second year. The Chlorophyta was the most dominant quantitative groups, which comprised of 38.9% of the total phytoplankton at station I. A maximum percentage of this group noticed in the stated water body during May in the first year and lowest percentage composition was observed during April in the same year. Further, the percentage composition did not follow any definite pattern of temporal variations. The green algae comprised between 37.4% of the total phytoplankton at station II. This group represented the most dominant fraction of the phytoplankton (76%) in October in the second year and lowest contribution was noticed during January in the same year (22%) in Deepor beel. On the other hand, population density varied between 86-407 ind/l (155.0 ±84.0) which depicted peak density during May in the second year and lowest during February in the first year at station I in Ghorajan beel, while station II showed between 67-222 ind/l (110.0 ±39.0), which exhibited maximum during May in the second year and minima during June in the first year. However, station I exhibited 38.2% of the total phytoplankton, while station II showed 38.8%.

Chlorophyta exhibited a positive and significant relationships with net plankton (r_1=0.619, p<.01; r_2=0.798, p<.001), phytoplankton (r_1=0.963, p<.001; r_2=0.949, p<.001), Bacillariophyta (r_1=0.861, p<.001; r_2=0.793, p<.001), Cyanophyta (r_1=0.697, p<.001; r_2=0.787, p<.001), Chrysophyta (r_1=0.704, p<.001) and specific conductivity (r_2=0.428, p<.05) indicating interdependence with each other. On the other hand, significant inverse correlation with Cladocera (r_1=-0.477, p<.01) at station I in Deepor beel. Similarly, it exhibited significant positive correlation with net plankton (r_1=0.746,

$p<.001$; $r_2=0.526$, $p<.01$), phytoplankton ($r_1=0.982$, $p<.001$; $r_2=0.962$, $p<.001$), Bacillariophyta ($r_1=0.633$, $p<.001$; $r_2=0.924$, $p<.001$), Cyanophyta ($r_1=0.912$, $p<.001$; $r_2=0.696$, $p<.001$), Chrysophyta ($r_1=0.505$, $p<.01$; $r_2=0.603$, $p<.01$) and total alkalinity ($r_2=0.432$, $p<.05$). This group showed inverse but insignificant impact of pH in Deepor beel but no specific trend was evident in Ghorajan beel.

According to Strom (1924) acidic waters support thick population of desmids. In contrast to this Gonzalves and Joshi (1946) and Zafar (1967) have recorded thicker population of desmids in moderately alkaline waters. Rao (1955) concluded that certain species of desmids were favoured by high pH, others by low pH and still others were indifferent to the pH. Deepor beel exhibited peak density of desmids in April in the first year, where pH value was 7.3 at station I, while station II registered peak density in the same month, where pH value was 7.1. On the other hand, desmids reached its peak in May in the second year at station I, where it showed pH value 7.3 and station II registered peak density in the same month, where pH value was 6.8. The findings suggest that the desmids were dominant at a pH of 6.8 to 7.3 in the sampled beels. It was noticed that their representation both qualitatively and quantitatively during the summer months was meager in both the sampled beels. Deepor beel registered a minimum density (85 ind/l) in June in the first year at station I and station II showed minimum density (112 ind/l) in June in the second year. On the contrary, Ghorajan beel exhibited minimum abundance (67 ind/l) in June in the first year at station II. There was a decline with the increase in temperature during the summer suggesting that the desmids preferred moderate temperatures of early summer and winter, which corroborated the remark of Kant and Anand (1978). Despite low dissolved nutrient concentrations, high algal biomass implies internal cycling of nutrients (Rao *et al.*, 1999). This is in concurrence with the result of both beels, which registered low nutrient concentration during the study period.

The Bacillariophyta were represented by 20 species at both the stations in Deepor beel and their species richness in the monthly collections ranged between 9-18 (14.0 ±3.0) at station I and between 9-18 (13.0 ±3.0) at station II. Maximum number of species was noticed during April in the first year and April and May in the second year; while lower richness of the diatoms was observed in June in the second year at station I. On the other hand, station II registered peak during April in the first year and a minima during August in the second year. The population densities of Bacillariophyta at station I in Deepor beel fluctuated between 53-181 ind/l (89.0 ±32.1), which followed a multidimensional pattern of temporal variations. The minimum density of the diatoms was noticed during June in the second year. This group, however, recorded primary maxima in April in the first year and secondary maxima in April in the second year. On the other hand, the quantitative abundance of the Bacillariophyta at station II fluctuated between 39-147 ind/l (85.0 ±25.0). The diatoms density was higher in April in the second year and again at the end of this study period May in the second year but during the rest of the study period, it exhibited a broadly bimodal pattern; a primary maxima of lesser magnitude was noticed in April in the first year, on the other hand, the lowest density of this group was observed in August in the second year. The recorded low diatom density during warm months may be due to decomposition and sedimentation. On the contrary, the Bacillariophyta

were represented by 19 species at both the stations in Ghorajan beel and their species richness in the monthly collections ranged between 6-17 (12.0 ±3.0) and maximum number of species were found shortly after winter viz. during February and April in first year; while lower richness of the diatoms was observed in June in the second year at station I. On the other hand, station II registered 8-16 (11.0 ±1.8) and peak during May in the second year and minima during June in the second year. However, station I exhibited 34.5% of the total phytoplankton, The number of this community appeared to be quantitatively more at station II and, in turn, comprised 35.2% of phytoplankton abundance. However, abundance varied between 22-110 ind/l (67.0±21.0) at station I and station II showed between 22-119 ind/l (51.0 ±21.0) in the beel. Maximum density was observed in April in the second year and minima in August in the first year. Recorded density of both the beels concurred with the reports of Goel *et al.* (1988), Das *et al.* (1996) and Sharma and Lyngskor (2003).

Bacillariophyta showed significant positive correlation with net plankton (r_1=0.598, p<.01; r_2=0.736, p<.001), phytoplankton (r_1=0.701, p<.001; r_2=0.892, p<.001), Chlorophyta (r_1=0.861, p<.001; r_2=0.793, p<.001), Chrysophyta (r_1=0.704, p<.001), calcium (r_1=0.419, p<.05) and BOD (r_2=0.426, p<.05). On the other hand, significant inverse correlation with Cladocera (r_1=-0.552, p<.01) at station I in Deepor beel. This group registered significant positive correlation with phytoplankton (r_1=0.674, p<.001; r_2=0.938, p<.001), Chlorophyta (r_1=0.633, p<.001; r_2=0.924, p<.001) and Chrysophyta (r_1=0.546, p<.01; r_2=0.652, p<.001) and significant inverse correlation with zooplankton (r_1=-0.624, p<.01) at station I in Ghorajan beel indicating negative impact on the population pattern.

The Cyanophyta was represented by 8 taxa at all at both the stations in Deepor beel. Their species richness in the monthly collection ranged between 3-8 (6.0 ±1.3) at station I, which exhibited maximum number of species during March and April in the first year; on the other hand, minimum was noticed during August of the same year. However, station II depicted the range 2-8 (5.0 ±2.0), which registered maximum number during July in the first year and a minimum during June in the second year. Population density was noticed 28-149 ind/l (62.0 ±28.0) at station I, which recorded peak density during April in the first year and a minima during September in the second year. On the contrary, it ranged between 22-166 ind/l (73.0 ±30.2) at station II, which exhibited maximum density during April in the second year and a minima during June of the same year. However, the Cyanophyta was represented by 7 species at both the stations in Ghorajan beel. The species richness ranged between 4-7 (5.0 ±0.9) at station I, which recorded maximum number of species during December, April in the first year and again during April in the second year; on the other hand, minimum value was registered during August, October, November, March, June in the second year. Station II depicted composition range 3-7 (5.0 ±1.0), which experienced maximum during April and May in the second year and a minima during December, February and June in the second of the study period. However, population density of the beel ranged between 30-151 ind/l (60.0 ±33.0) at station I, which exhibited maximum density during May in the second year and minimum during June in the first year. Station II fluctuated the density range between 17-85 ind/l (38.0 ±19.0), which showed peak during April in the second

year and lowest during February of the same month. Relatively low species richness of the blue-green algae in the present study broadly concurred with reports of Zutshi *et al.* (1980) and Singh *et al.* (1982). However, the recorded richness was marginally higher than the reports of Khan and Zutshi (1980) and Sharma and Lyngdoh (2003).

Cyanophyta showed significant positive correlation with phytoplankton (r_1=0.782, p<.001; r_2=0.907, p<.001), Chlorophyta (r_1=0.697, p<.001; r_2=0.787, p<.001), Chrysophyta (r_1=0.516, p<.01), transparency (r_2=0.462, p<.05), specific conductivity (r_2=0.409, p<.05) and BOD (r_1=0.454, p<.05). On the other hand, significant inverse correlation with zooplankton (r_1=-0.545, p<.01), Cladocera (r_1=-0.488, p<.05), magnesium (r_1=-0.416, p<.05) and silicate (r_1=-0.439, p<.05) at station I in Deepor beel. However, Cyanophyta exhibited significant positive correlation with net plankton (r_1=0.717, p<.001; r_2=0.508, p<.01), phytoplankton (r_1=0.949, p<.001; r_2=0.820, p<.001), Chlorophyta (r_1=0.912, p<.001; r_2=0.696, p<.001), Chrysophyta (r_1=0.416, p<.05; r_2=0.604, p<.01) and calcium (r_2=0.411, p<.05) in Ghorajan beel.

In the present investigation, Euglenophyta was qualitatively less important and poorly represented by only 3 species in Deepor and Ghorajan beel. However, the population density ranged between 3-33 ind/l (15.0 ±7.0) at station I and 2-28 ind/l (11.0 ±7.0) at station II in Deepor beel. On the other hand, population density fluctuated between 4-34 ind/l (13.0 ±7.0) at station I and 0-10 ind/l (4.0 ±2.0) at station II in Ghorajan beel. Euglena Sp. was recorded at all stations in the sampled beels. Euglenophyta were common and were ubiquitous at all stations in the sampled beels. This group exhibited positive correlation with specific conductivity (r_1=0.431, p<.05) in Ghorajan beel. Euglenophyta showed significant positive correlation with net plankton (r_2=0.609, p<.01), phytoplankton (r_1=0.802, p<.001; r_2=0.695, p<.001), Chlorophyta (r_1=0.738, p<.001; r_2=0.581, p<.01), Cyanophyta (r_1=0.553, p<.01; r_2=0.645, p<.001) and Chrysophyta (r_1=0.606, p<.01) in Deepor beel and significant inverse correlation with Cladocera (r_1=-0.619, p<.01) at station I in this beel. Euglenophyta did not show any significant correlation with either of any of the abiotic factors in this beel. On the contrary, it showed significant positive correlation with net plankton (r_1=0.599, p<.01), phytoplankton (r_1=0.678, p<.001), Chlorophyta (r_1=0.631, p<.001), Cyanophyta (r_1=0.589, p<.01), Rhizopoda (r_1=0.672, p<.001), specific conductivity (r_1=0.431, p<.05) and phosphate (r_1=0.595, p<.01) at station I in Ghorajan beel.

The Dinophyta were represented only by some motile algae Gonyaulax sp., Peridinium sp. and Ceratium sp. in both the sampled beels. The abundance of this group in Deepor beel fluctuated between 2-66 ind/l (23.0 ±18.0) at station I and 2-38 ind/l (16.0 ±12.0) at station II. However, the abundance ranged between 2-69 ind/l (21.0 ±19.1) at station I and 2-53 ind/l (15.0 ±14.0) at station II in Ghorajan beel. Ceratium sp. dominated the assemblages of the sampled beels. It showed significant positive correlation with net plankton (r_1=0.622, p<.01; r_2=0.499, p<.05), phytoplankton (r_1=0.442, p<.05; r_2=0.414, p<.05), Chlorophyta (r_1=0.421, p<.05) and Cyanophyta (r_2=0.409, p<.05) in Deepor beel, while it exhibited significant inverse relationship with specific conductivity (r_1=-0.431, p<.05) at station I in this beel. On the other hand, it showed significant positive correlation with net plankton (r_2=0.508, p<.01),

phytoplankton (r_2=0.665, p<.001), Chlorophyta (r_2=0.542, p<.01), Bacillariophyta (r_2=0.514, p<.01), Cyanophyta (r_2=0.498, p<.05), Rhizopoda (r_1=0.468, p<.05), free carbon dioxide (r_1=0.457, p<.05) and total alkalinity (r_1=0.495, p<.05) in Ghorajan beel.

The Chrysophyta was represented by only two species in both the beels. Their species richness in the monthly collection ranged between 1-2 species and abundance fluctuated between 4-29 ind/l at station I and 0-14 ind/l at station II in Deepor beel. It showed maximum density in May in the second year and a minima in August in the second year at station I, while station II depicted maximum in July in the second year and no species was noticed in August in the first year; January in the second year and March in the second year. On the other hand, Ghorajan beel depicted 2-10 ind/l at station I and 0-11 ind/l at station II. However, this group exhibited maximum density in April in the second year and a minima was noticed August in the same year at station I, while maximum density in April in the second year and no species was observed in October in the first year; January in the first year; August in the second year and December in the second year at station II in Ghorajan beel. Chrysophyta showed significant positive correlation with phytoplankton (r_1=0.737, p<.001), Chlorophyta (r_1=0.729, p<.001), Bacillariophyta (r_1=0.704, p<.001), Cyanophyta (r_1=0.516, p<.01) and Euglenophyta (r_1=0.606, p<.01). It exhibited significant inverse relationships with zooplankton (r_1=-0.591, p<.01), Cladocera (r_1=-522, p<.01) and dissolved oxygen (r_1=-408, p<.05) in Deepor beel. On the other hand, it showed significant positive correlation with net plankton (r_2=0.411, p<.05), phytoplankton (r_1=0.511, p<.01; r_2=0.628, p<.01), Chlorophyta (r_1=0.505, p<.01; r_2=0.603, p<.01), Bacillariophyta (r_1=0.546, p<.01; r_2=0.652, p<.001), Cyanophyta (r_1=0.416, p<.05; r_2=0.604, p<.01) and calcium (r_1=0.412, p<.05), while it depicted significant inverse relationship with zooplankton (r_1=-0.617, p<.01) in Ghorajan beel.

The multiple correlation of phytoplankton with sixteen abiotic factors was computed and registered 76.5% at station I and 72.4% at station II in Deepor beel, while Ghorajan beel accounted for 72.9% at station I and 59.0% at station II. On the other hand, the step-wise regression of recorded ten abiotic factors (X_1-X_{10}) explained for 52.4% at station I and 48.1% at station II in Deepor beel, while in Ghorajan beel the stated factors explained for 50.2% at station I and 35.1% at station II. After deletion of rainfall (X_1), fifteen abiotic factors resulted for 58.8% at station I and 70.4% at station II. On the other hand, after removal of water temperature (X_2) the fourteen abiotic factors resulted 58.8% at station I and 48.5% at station II in Deepor beel. In case of station II of the beel water temperature depicted significant cumulative impact on phytoplankton. High cumulative impact of abiotic factors on phytoplankton was observed, which concurred with the reports of Sharma and Lyngskor (2003) and Sharma and Lyngdoh (2003).

Chapter V

CONCLUSION

Four floodplain lakes were selected for the biodiversity of zooplankton out of which two were selected for the study of synecology of zooplankton, which included detailed limnological studies on temporal variations of water quality and qualitative as well as quantitative composition of net plankton, zooplankton and phytoplankton. To sum up, all the sampled beels depicted (sub)tropical nature, their water ranging from slightly acidic to circum-neutral to slightly alkaline and with poor to moderate mineral contents. Further, the waters were mostly well oxygenated and moderately hard to soft confirmed by methyl orange alkalinity and total hardness. In addition, free carbon dioxide registered slightly higher concentration compared to other reported works of the region but it registered 0 mg/l in the month of February in Deepor beel, on the other hand, the sampled beels registered low silicate concentration. The present study registered Calcium > Magnesium, which is a general trend in most of the water bodies. Maximum value was observed in July (42.9 mg/l at station I & 43.9 mg/l at station II) in Ghorajan beel, high chloride values in the beel could be due to animal waste from cattle grazing during the season. In general, chloride concentration agreed with the ranges noticed in natural water, thereby indicating lack of organic pollution in the studied beels. Low Total Dissolved Solids (TDS) at these sampled beels corresponded with low ionic concentrations in general. In the present study, Deepor beel and Ghorajan beel did not cross the polluted range of BOD (lower level 6 mg/l).

Seasonal variations for the study of biodiversity of zooplankton were observed in four beels, namely Siligurijan, Fingua, Deepor and Ghorajan beel. The zooplankton taxocoenosis of the sampled beels included two major groups namely, Rotifera and Cladocera. Species richness of zooplankton ranged between 46-68 species in Siligurijan beel. Species richness of Rotifera fluctuated between 30-50 species in this beel. A slightly depression of rotifera was evident in the monsoon months but peaks occurred more irregularly in Siligurijan beel. A total of 104 zooplankton taxa were identified from Siligurijan beel out of which 72 species of Rotifera and 32 species of Cladocera. Species richness of zooplankton varied between 59-80, the maximum was observed during autumn and the minimum during the monsoon season in Fingua beel. Species richness of Rotifera fluctuated between 35-57 in this beel. However, autumn was found to be the most conducive to rotifers growth with peak density and the minimum during winter season in Fingua beel. A total of 105 zooplankton taxa were identified from this beel. 75 species of Rotifera and 30 species of Cladocera were identified during the study period. 122 zooplankton taxa were identified from Deepor beel, out of which Rotifera registered 87 species and 35 species of Cladocera. On the other hand, Ghorajan beel registered a total of 120 taxa, 86 species belonging to Rotifera and 34 species belonging to Cladocera during the study period, which apparently higher in comparison to the reports of subtropical lakes from this region (Sharma, 1995) and also floodplain lakes of Assam.

Lecanidae and Brachionidae together, comprised a notable component of rotifer biodiversity in the sampled beels. In the present investigation, Siligurijan beel registered 72 species of Rotifera, out of which 17 species belonging to 18 species belonging to Lecanidae family followed by 17 species to Brachionidae. On the other hand, Fingua registered 75 species of Rotifera, a total of 20 species belonging to Lecanidae family, while 17 species belonging to Brachionidae. Rotifera accounted for 69.2% of total zooplankton richness in Siligurijan beel and 71.4% in Fingua beel. Lecanidae (24 species) and Brachionidae (19 species) together, comprised a notable component of rotifer biodiversity in Deepor beel. In the present study, Ghorajan beel registered 86 species of Rotifera, out of which 24 species belonging to Lecanidae family followed by 19 species belonging to Brachionidae, 9 species belonging to Colurellidae, 7 species belonging to Trichocercidae. The proportion of widely distributed *Lecane* amounts to 25% of the total rotifers in Siligurijan, on the other hand, 26.7% in Fingua beel. This is apparently higher than the result of Samuajan beel of upper Assam (Sharma and Hussain, 2001) but the distribution percentages of *Lecane* are definitely lower than the reports of Deepor (27.6%) and Ghorajan beel (27.9%). Among the rotifers, *Brachionus mirabilis*, *Lecane thienemanni*, *Lecane ohioensis*, *Lecane decipiens*, *L. inopinata*, *L. crepida*, *Filinia camascela*, and *Trochosphaera aequatorialis* were totally absent in Siligurijan beel during the study period. On the other hand, *Keratella tropica*, *Beauchampiella eudactylota*, *Lecane pyriformis*, *Lecane decipiens* and *L. inopinata* were also not registered in Fingua beel.

The rotifer fauna exhibited dominance of monogonont taxa. Five eurotatorian families namely Lecanidae>Brachionidae>Colurellidae>Trichocercidae included 68.9% of the total rotifers in Deepor beel, 68.6% in Ghorajan beel, 68.1% in Siligurijan beel and 68% in Fingua beel, the spectrum of dominance apparently agreed with the report of Sharma (1996). Various non-planktonic taxa of the Trichotridae, Synchaetidae and Flosculariadae were poorly observed. This is apparently higher than the report of Samuajan beel of upper Assam (Sharma and Hussain, 2001). The predominance of Lecane species is in agreement with reports on the rotifer fauna of other tropical floodplain lakes (Segers *et al.*, 1993c; Segers, 1994 and Jose De Paggi, 1993). Lecane and Brachionus imparted a general tropical character to the studied fauna; such a generalization is in confirmity with the reports by Green (1972), Pejler (1977), Fernando (1980), Dumont (1983), Sharma (1987, 1991, 1996, 1999), Sharma and Naik (1996) and Segers (1996) though they were widespread but less dominant.

The other dominant group Cladocera exhibited the ranges of species richness 16-25 in Siligurijan beel. Maximum species richness was observed during winter and the minimum during monsoon season. Cladocera depicted the ranges of species richness 20-24 in Fingua beel. A total of 32 species documented from Siligurijan beel, while Fingua beel registered 30 species. The number of both the beels was lower as compared to Deepor and Ghorajan beel, which registered 35 and 34 species respectively. *Bosmina longirostris*, *Biapertura karua*, *Moina micrura*, *Scapholeberis kingi* contributed to maximum richness in Siligurijan beel, on the other hand, *Bosmina longirostris* recorded maximum during monsoon season in the sampled beels and *Biapertura karua* and *Chydorus sphaericus* were found to be common in Fingua beel. The cladocerans comprised subdominant component of zooplankton in the sampled beels.

On the other hand, *Chydorus sphaericus*, *Biapertura karua*, *Chydorus barroisi Scapholeberis kingi* and *Simocephalus vetulus* were present in substantial numbers in all the sampled beels during the whole study period. Among the reported species, *Chydorus sphaericus* appeared to be the commonest and most widely distributed cladoceran in the beels. *Simocephalus vetulus* is a weedy species but it is not restricted to this habitat, it can be found in open water, which observed during the study period. *Ceriodaphnia cornuta*, *Moina micrura*, *Moinodaphnia* sp. and *Diaphanosoma excisum* are considered to be typically tropical species, which were recorded in all the beels. On the other hand, *Leydigia acanthocercoides* is considered to be temperate in origin but occurrence of the aforesaid species in the beels was note-worthy. A few species had relatively consistent seasonal patterns in all the sampled beels. Occurrence of *Daphnia lumholtzi* only in two months (during January and April) throughout the study period in Deepor beel and its total absence in all the three beels was note-worthy. *Dadaya macrops* was not present throughout the study period in the beels, the species was observed during July, October and November in the study period in Deepor beel. Almost same trend was noticed in Ghorajan beel also.

Ilyocryptus spinifer represented a typical benthic form recorded from all the sampled beels. On the other hand, *Diaphanosoma excisum* was a dominant species in the limnetic regions as observed in all the beels, but presence of this species in Deepor and Ghorajan beel was noteworthy. In the present investigations, *Bosmina longirostris* and *Bosminopsis deitersi* of the family Bosminidae were well distributed over the whole of the sampled beels. Both the species showed identical seasonal trend. Similarly, *Chydorus barroisi* and *Alonella exisa* were also important contributors to species richness of the beels. *Graptoleberis testudinaria* is a rare form in the tropics, which was documented for the first time in the state of Tripura in N.E. India.

Percentage similarity of Rotifera of Deepor and Ghorajan beel exhibited ranges 24.2-84.7% in the first year with highest between December and January and lowest between April and June, while it showed ranges 32.7-71.1% in the second year with highest between January and June and lowest between February and May. In Deepor and Ghorajan beel, only instance of higher community similarity (more than 80%) of rotifera was observed between December and January (84.7%) in the first year.

For the synecology of zooplankton, investigations on temporal variations, at monthly intervals, in different parameters of water quality as well as qualitative and quantitative composition of net plankton, zooplankton and phytoplankton were carried out in Deepor and Ghorajan beel during the period August, 1999 - July, 2001. Net plankton in Deepor and Ghorajan beel appeared to be diversified. Higher species richness was observed in both the beels. Recorded 208 species including 149 species of zooplankton and 59 species of phytoplankton in Deepor beel, on the other hand, a total of 202 species were recorded in Ghorajan beel out of which 147 zooplankton species and 55 phytoplankton species at all. Zooplankton comprised an important component and constituted dominant group to the planktonic communities in both the beels. This dominant group, on the other hand, included six major groups namely, Rotifera, Cladocera, Copepoda, Rhizopoda, Ostracoda and Conchostraca.

Species richness in both the beels was higher than the reports of Sharma (1995), Sharma and Hussain (1999) and Sharma (2001). The present study indicated high net plankton abundance, which apparently higher than the other reported floodplain lakes of Assam (Lahon, 1983; Sharma and Hussain, 2001) and elsewhere in India (Pandit, 1980; Rai and Dutta Munshi, 1982; Sugunan, 1989; Vass, 1989; Baruah *et al.*, 1993; Sinha, *et al.*, 1994). On the other hand, net plankton depicted maximum density during April, which broadly corresponded with the result of Sharma and Hussain, 2001 from upper Assam. High cumulative impact of abiotic factors on net plankton abundance in both the beels concurred with the earlier reports of Sharma (1995), Jyrwa (1996) and Sharma and Lyngdoh (2003).

The zooplankton taxocoenosis of both the beels included six major groups namely, Rotifera, Cladocera, Copepoda, Rhizopoda, Ostracoda and Conchostraca. 149 zooplankton taxa were identified from Deepor beel, which included 149 species at station I and 147 species at station II, on the other hand, Ghorajan beel registered a total of 147 taxa, indicated 147 species at station I and 146 species at station II during the study period, which apparently higher compared to the reports of Sharma, 1995 and also floodplain lakes of Assam. During the present study, zooplankton communities depicted higher species diversity computed *vide* Shannan's index and ranged between 2.532-3.634 (3.264 ±0.3) and 2.215-3.869 (3.234 ±0.35) at station I and II respectively in Deepor beel. Similarly, Menhinick's index varied with their narrow ranges and higher mean values i.e. between 2.003-3.977 (3.316 ±0.5) at station I and 2.092-4.373 (3.372 ±0.6) at station II. On the other hand, Ghorajan beel indicated relatively higher species diversity among the stations and it ranged between 3.007-3.978 (3.458 ±0.25) at station I and 2.943-3.784 (3.344 ±0.22) at station II using Shannan's index and it fluctuated between 3.015-4.536 (3.525 ±0.4) at station I and 2.919-4.002 (3.348 ±0.3) using Menhinick's index. Zooplankton dominance (*vide* Berger-Parker's index) at both the beels was generally low and ranged between 0.069-0.236 (0.168 ±0.04) and 0.085-0.284 (0.163 ±0.04) at station I and II respectively in Deepor beel. Dominance of zooplankton fluctuated between 0.123-0.251 (0.184 ±0.03) at station I and 0.135-0.297 (0.197 ±0.03) at station II in Ghorajan beel. Mean values indicated low dominance in both the beel, which broadly coincided with the findings of the beels of upper Assam reported by Sharma and Hussain (2001). In addition, monthly variations indicated narrow fluctuation in the sampled beels. However, zooplankton evenness did not depict significant monthly variations and exhibited almost identical annual ranges between the beels. Further, high evenness at all the stations in the beels indicated greater equitability of species abundance in the community, which concurred with the report of Washington (1984). The mean value of station I in Deepor beel exhibited marginally lower than that of other stations of the sampled beels. The recorded values of both the beels coincided with the reports of Sharma and Hussain (2001) of Assam. Overall high cumulative impact of abiotic factors on zooplankton abundance broadly concurred with the reports of Sharma (1995) and Sharma and Hussain (2001).

Rotifera accounted for the highest share of the abundance of zooplankton. The present study did not depict any definite periodicity of overall rotifer abundance or of individual species. In general, a greater number of taxa were recorded in the sampled beels but numerical abundances were considerably lower. A total of 88 and 87 species at both the stations of Deepor beel and 87 species in Ghorajan beel represented it. The documented 88 rotifer species from both the beels accounted for 75.86% of the total reported rotifers from the floodplain lakes of Assam (116 reported species), 60.27% of the total reported rotifers from the N.E. India (146 reported species) and only 26.35% of the total rotifers from whole of the country (334 reported species).

Lecanidae and Brachionidae were the dominant families of Rotifera in the sampled beels. The rotifer fauna exhibited dominance of monogonont taxa. Five eurotatorian families namely Lecanidae> Brachionidae> Colurellidae> Trichocercidae included 66.6% of the total rotifers, the spectrum of dominance apparently agreed with the report of Sharma (1996). Various non-planktonic taxa of the Epiphanidae, Trichotridae, Synchaetidae, Dicranophoridae and Floscularidae were poorly observed. Lecanidae (24 species at both the stations) and Brachionidae (19 species at both the stations) together, comprised a notable component of rotifer biodiversity in Deepor beel. In the present study, Ghorajan beel registered 87 species of Rotifera at both the stations, out of which 24 species belonging to Lecanidae family followed by 19 species belonging to Brachionidae, 9 species belonging to Colurellidae, 6 species belonging to Trichocercidae. This is apparently higher than the report of Samuajan beel of upper Assam (Sharma and Hussain, 2001). The predominance of Lecane species is in agreement with reports on the rotifer fauna of other tropical floodplain lakes (e.g. Africa: Segers *et al.*, 1993c; Asia: Segers, 1994; South America: Jose De Paggi, 1993). As a result of this study, a total of 19 species belonging to Brachionidae documented from both the beels, which accounted for 82.61% of the total of N.E. India (23 reported species). Most species of Brachionus, reported from India, are pantropical or cosmopolitan forms of alkaline waters. However, both the beels registered 12 species belonging to genus Brachionus, which accounted for 85.71% of the total reported species from N.E. India (14 reported species). Occurrence of *Brachionus patulus macracanthus* was observed throughout the study period in all the studied beels with small populations. Its presence in the floodplain lakes of Assam is noteworthy because it was documented from Meghalaya for the first time, which was a new record for India (Sharma, 1987a). All the Indian species of Keratella are also known from elsewhere. Amongst about 37 known species of Keratella, only seven have so far been recorded from India (Sharma, 1987). The sampled beels documented only five species of it. *Keratella tropica* appeared to be most widely distributed in the sampled beels. *Keratella procurva* was registered from the sampled beels and it was a new report from the N.E. region of the country. Occurrence of *Testudinella greeni*, an interesting palaeotropical element, in both the beels was restricted to some months in less abundance during the study period but apparently higher than the reports of a tectonic lake (Sone beel) in Barrak valley of Assam (Sharma, 1990) and floodplain lakes of upper Assam (Sharma and Sharma, 2000). It is so far apparently restricted to the floodplain lakes of N.E. region (Sharma and Sharma, 2000). Some of the taxa encountered were particularly noteworthy.

Testudinella brevicaudata was observed only in three months during the whole study period in both the beels (2 times in Deepor and 3 times in Ghorajan beel), which was earlier reported three species from a nursery tank in Guwahati city of Assam (Sharma, 1990). A number of Testudinella species are quite common in tropical waters, especially *Testudinella patina* and its varieties (Fernando and Zankai, 1981). The cosmotropical species *Filinia camascela* is an interesting addition to the Indian Rotifera is restricted only to N.E India (Sharma and Sharma, 2000). Occurrence of this species in both the beels agreed with the aforesaid report. Diversity indices revealed that species diversity is apparently higher than the reports of Sharma and Hussain (2001). The present study showed relatively low overall dominance due to fewer quantitatively important species and apparently agreed with the results of some floodplain lakes of Assam reported by Sharma and Hussain (2001). In both the beels, evenness registered inverse relationship with dominance, which broadly coincided with the findings of some beels of Assam reported by Sharma and Hussain (2001). F values of Analysis of Variance (ANOVA) were computed, where two-way interactions were observed. ANOVA exhibited no significant difference between the months in both the years and in case of stations, it showed significant difference between the stations ($F_{1, 23}$ = 5.318, p>.05) in the first year in Deepor beel, while it exhibited significant differences between the stations ($F_{1, 23}$ = 5.838, p>.05) in the first year in Ghorajan beel.

A total of 48 species at station I and 43 species at station II belonging to 6 families were identified during the study period in Deepor beel. Out of 48 species 52.1% at station I and 58.1% at station II belonging to Chydoridae family. On the other hand, Ghorajan beel registered 42 species at both the stations of which 25 species belonging to Chydoridae family (59.5% of total Cladocera). The figures from both the beels were apparently higher than the findings of Sharma (1985) from West Bengal. Occurrence of *Daphnia lumholtzi* only in two months (during January in the first year & during April in the second year) throughout the study period in Deepor beel and its total absence in Ghorajan beel was note-worthy. On the other hand, occurrence of Leydigiopsis sp. was a new appearance in both the beels and also for the state of Assam as well as N.E. India.

Meso cyclops sp., Helio diaptomus sp. and Nauplius larvae were the only representatives of this group. Among the reported species of this group, Meso cyclops sp. was quantitatively important and observed in the sampled beels. The dominance of this species among the copepods confirmed the previous works in the floodplain lakes of Assam.

The Rhizopoda formed the third qualitative important group in both the beels. The Rhizopoda were represented by 12 species in Deepor and Ghorajan beel. Dufflugia sp. was one of the commonest planktonic protozoans in the sampled beels. Other protozoans, which occurred as few individuals per litre, were *Centropyxis hemisphaerica, C. aculeata, Euglypha ciliata and Actinosphaerium eichhorni*. The present study indicated higher overall qualitative as well as quantitative abundance of rhizopods than the reports of Sharma (1995), Das *et al.* (1996) and Lyngdoh (2002).

Two planktonic ostracods were occasionally very abundant. They were present most of the months dominated by Cypricercus sp. and Cypris sp. in both the beels. Conchostraca sp. was found at all the stations in both the beels in a very negligible quantity.

Phytoplankton taxa recorded in the present study of Deepor and Ghorajan beel belonged to five groups namely Chlorophyta, Bacillariophyta, Cyanophyta, Euglenophyta, Dinophyta and Chrysophyta. These, in turn, were represented by 59 species in the former and 55 in the later. Ghorajan beel depicted an identical spectrum of dominance with Deepor beel i.e. followed the spectrum of dominance as Chlorophyta> Bacillariophyta> Cyanophyta> Euglenophyta> Dinophyta> Chrysophyta. The multiple correlation of phytoplankton with sixteen abiotic factors was computed and registered 76.5% at station I and 72.4% at station II in Deepor beel, while Ghorajan beel accounted for 72.9% at station I and 59.0% at station II.

Chapter VI

SUMMARY

Freshwater ecosystems include diversified biotopes ranging from ephemeral tree-holes and pools to large natural lakes and man-made reservoirs and the mighty riverine systems. Of these, the floodplain lakes comprise an integral component of the rural landscape in the different river basins. These environs, often, combine salient characteristics of lentic and lotic habitats and, hence, are unique and interesting ecotones. They deserve special mention because of their rich aquatic biodiversity and are considered to be one of the most productive ecosystems in the world (Odum, 1978; Mitsch and Gosselink, 1986). The floodplain lakes or beels deserve special mention in the state of Assam; they cover around 1,00,000 ha area, which in turn, comprise about 93% of total lentic fish prone area and about 81% of total lentic area of this state. They exhibit greatest scope for fish production through proper management; the traditional methods of fish farming yield production of only 200 kg/ha/year, which can be increased to about 1000 kg/ha/year through the practice of scientific fish farming (Sugunan, 1997). The studies on different aspects of limnology including temporal variations in water quality and plankton production of the floodplain lakes are, therefore, essential to understand their nature, dynamics and trophic status and also to assess fishery potential.

The present study assumes special significance in view of the mentioned lacunae and it deals with (i) to provide an account of zooplankton biodiversity in the floodplain lakes of lower Assam with reference to the interesting elements on faunal diversity of Rotifera and Cladocera and (ii) to undertake observations on synecology of zooplankton in selected floodplain lakes of lower Assam with special reference to their abundance, community structure, seasonal succession, dominance, species diversity, evenness and limnological correlations between various abiotic and biotic factors. Certain abiotic factors are recorded for the sampled biotopes to provide basic information on their water quality. The examined taxa are suitably illustrated. On the other hand, the synecology of zooplankton deals with investigations on temporal variations, at regular monthly intervals, in different parameters of water quality as well as on qualitative and quantitative composition of net plankton, zooplankton and phytoplankton in two floodplain lakes namely Deepor beel and Ghorajan beel located in lower Assam. The results obtained are summarized below:-

1. ABIOTIC FACTORS:

Monthly rainfall ranged between 0.18-384.6 mm (155.2 ±141.3) during the course of this study. Maximum rainfall (384.6mm) was experienced during June-August in both the years. Its peak was recorded during August in the first year of the study period. However, low rainfall was noticed during December (0.18mm) in the first year and in the same month (0.6mm) in the same year. A very low precipitation was recorded from November to February (1.7mm – 0.18mm) during the study period.

The recorded air temperature ranged between 22.3-38.2 (30.7 ±4.3) at station I and 22.4-38.1 (30.6 ±4.2) at station II in Deepor beel. Water temperature of the beel varied from a winter low of 17.9°C (December-February) to a summer high of 33.6°C (May-July) and ranged between 17.9-33.6°C (28.4 ±4.3) at station I. A minor peak during September-October occurred when the weather was moderately hot. Station II recorded 18.2-32.9°C (28.1 ±3.9) with a minor peak during April-May. However, air temperature fluctuated between 21.9-37.1 (30.4 ±4.0) at station I and 21.9-38.1 (30.6 ±4.2) at station II in Ghorajan beel. Water temperature varied between 19.7-33.2°C (28.0 ±3.7) and 19.8-32.8°C (28.1 ±3.8) at station I and II respectively in this beel. Seasonal variations of water temperature were observed in Siligurijan and Fingua beel, which ranged between 17.9-31.7°C (27.1 ±5.5) and 23.2-33.5°C (28.8 ±4.0) respectively. The recorded air temperature ranged between 20.4-34.8°C (29.7 ±5.5) in the former, while the later depicted 24.8-36.6°C (30.8 ±4.5). The recorded variations and mean values exerted tropical nature and the temporal changes in the water temperature followed nearly an identical pattern in the sampled beels. Further, it followed a trend identical to that of atmospheric temperature. Water temperature exhibited significant positive relationships with rainfall (r_1= 0.716, p<.001; r_2= 0.705, p<.001) and total alkalinity (r_1= 0.476, p<.05) in Deepor beel. It also depicted significant positive relationship with rainfall (r_1= 0.714, p<.001; r_2= 0.674, p<.001) in Ghorajan beel, which resulted due to concentration of precipitation during summer months.

The present study registered low transparency i.e between 17.0-82.0 cm (55.8 ±20.9) at station I and 15.0-81.0 cm (55.2 ±22.2) at station II in Deepor beel. Ghorajan beel also depicted low transparency (16.0-82.0 cm; 53.3 ±20.9) at station I and (16.0-83.0 cm; 55.1 ±21.6) at station II. Transparency ranged between 16.0-82.0(53.3 ±20.9) cm and 16.0-83.0 (55.1 ±21.6) cm at station I and II respectively in Ghorajan beel. Transparency varied between 21.0-68.0 cm (44.5 ±20.3) in Siligurijan beel and between 36.0-78.0 cm (60.0 ±17.0) in Fingua beel. Transparency showed clear seasonality during the present study with minima recorded in rainy season (inorganic turbidity) and maxima in winter in the sampled beels. Reduced transparency during the rainy season may be attributed to increased load of silt and suspended particles brought into the beels by run-off. Correlation analysis among the abiotic factors revealed that transparency and sodium were significantly correlated (r_1= 0.587, p<.01) at station I but it negatively correlated with phosphate (r_1= -0.419, p<.05) in Deepor beel. Correlation analysis revealed that transparency, total alkalinity (r_1= –0.438, p<.05; r_2= –0.455, p<.05) and BOD (r_1= –0.492, p<.05; r_2= –0.459, p<.05) were negatively correlated in Ghorajan beel indicating inverse relationships between them.

In the present observations, water of Deepor beel depicted their marginal acidic to alkaline character as pH varied between 6.5-9.5 (7.3 ±0.6) at station I and 6.6-9.2 (7.3 ±0.5) at station II. On the other hand, pH fluctuated between 6.7-8.4 (7.1 ±0.6) at station I and between 6.6-8.3 (7.1 ±0.5) at station II in Ghorajan beel. pH varied between 6.8-7.4(7.2 ±0.23) in Siligurijan beel and 6.9-8.4(7.6 ±0.56) in Fingua beel. However, correlation analysis among abiotic factors established that pH depicted significant direct relationships with specific conductivity (r_1= 0.512, p<.01; r_2= 0.547, p<.01), total hardness (r_1= 0.499, p<.05; r_2= 0.415, p<.05), chloride (r_1= 0.576, p<.01; r_2= 0.597, p<.01), which concurred with the result of Samuajan beel of

upper Assam (Sharma and Hussain, 1999) and significant negative correlation with free carbon dioxide (r_1= –0.485, p<.05; r_2= –0.455, p<.05) and nitrate (r_1= –0.487, p<.05; r_2= –0.461, p<.05) in Deepor beel. Besides, it shared significant direct relationships with several factors namely, specific conductivity (r_1= 0.479, p<.05; r_2= 0.410, p<.05), total hardness (r_2= 0.644, p<.001), chloride r_1= 0.588, p<.01; r_2= 0.569, p<.01) and significant inverse relationships with sulphate (r_1= –0.598, p<.01; r_2= –0.564, p<.01) and nitrate (r_1= –0.424, p<.05; r_2= –0.462, p<.05) in Ghorajan beel, which agreed with the remarks of Sharma and Hussain (1999).

The present investigation registered specific conductivity ranging between 94.0-199.0 µS/cm (162.2 ±34.6) at station I and 102.0-198.0 µS/cm (162.6 ±33.0) at station II in Deepor beel. F ratio of ANOVA ($F_{11, 23}$ = 106.87, p>0.05) showed significant difference between the months in the first year and the second year ($F_{11, 23}$ = 84.73, p>0.05). Specific conductivity ranged between 50.0-193.0(128.0 ±40.0) at station I and between 49.0-198.0(133.2 ±45.9) at station II in Ghorajan beel. However, ANOVA ($F_{11, 23}$ = 489.38, p>0.05) reflected significant difference between the months in the first year. The variations in conductivity with seasons and sites were significant. Low conductivity values were recorded at all stations of both the beels. Seasonal variations of specific conductivity fluctuated between 130.0-189.0 µS/cm (157.0 ±25.1) in Siligurijan beel and 89.0-173.0 µS/cm (135.5 ±30.8) in Fingua beel. They, however, differed notably in their specific conductivity values- Deepor (162.2 ±34.6µS/cm) at station I and 162.6 ±33.0µS/cm) at station II > Siligurijan (157.0 ±25.1µS/cm) > Fingua (135.5 ±30.8µS/cm) > Ghorajan beel 128.0 ±40.0µS/cm at station I and (133.2 ±45.9µS/cm) at station II. On the other hand, specific conductivity registered inverse correlation with sulphate (r_1= -0.501; p<.05) and sodium (r_1= -0.640, p<.01) and direct relationships with pH (r_1= 0.512, p<.01), hardness (r_1= 0.513; p<.01), calcium (r_1= 0.464; p<.05), chloride (r_1= 0.616, p<.01) and BOD (r_1= 0.447; p<.05) in the present study, which coincided with the report of Sharma and Hussain (1999). However, specific conductivity recorded an inverse correlation with sulphate (r_1= -0.615; p<.01) and direct correlation with pH (r_1= 0.479, p<.05; r_2= 0.410; p<.05), hardness (r_1= 0.857, p<.001; r_2= 0.748; p<.001), calcium (r_1= 0.796, p<.001; r_2= 0.687; p<.001), phosphate (r_2= 0.408, p<.05) and BOD (r_1= 0.484, p<.05; r_2= 0.494, p<.05) in the present study of Ghorajan beel, thereby, indicating contributory role of these factors in ionic content of the sampled water body.

The present study depicted nearly identical ranges and mean values of dissolved oxygen, which fluctuated between 3.2-12 mg/l (6.1 ±2.5) at station I and 2.4-12.8 mg/l (5.9 ±2.4) at station II in Deepor beel. It depicted 62.4-120.2% saturation at station I and 59.4-121.2% at station II in this beel, which concurred with the Samuajan beel (Sharma and Hussain, 1999). ANOVA ($F_{11, 23}$ = 36.76, p>0.05 in the first year; $F_{11, 23}$ = 36.86, p>0.05 in the second year) depicted significant difference between the months in both the years. During the whole study period, in Ghorajan beel relatively moderate dissolved oxygen was observed as it ranged between 2.4-10.2 mg/l (5.7 ±1.7) at station I and 3.2-12.4 mg/l (5.6 ±2.0) at station II. It showed 56.8-112.4% saturation at station I and 62.0-119.8% at station II. On the other hand, ANOVA ($F_{11, 23}$ = 5.64, p>0.05) showed significant difference between the months in the second year. During the study period, seasonal variations of dissolved oxygen of the surface water ranged between 4.4-9.8 mg/l (6.5 ±2.1) in Siligurijan beel de-

picting 65.4-106.4% saturation and 3.6-12.4 mg/l (6.8 ±3.5) in Fingua beel and also exhibited 63.6-122.6% saturation. In addition, dissolved oxygen registered direct correlation with BOD (r_2= 0.424, p<.05) and FCO_2 (r_2= 0.448, p<.05) in Deepar beel. On the other hand, it also exhibited direct correlation with FCO_2 (r_1= 0.538, p<.01; r_2= 0.642, p<.001) and BOD (r_1= 0.466, p<.05; r_2= 0.462, p<.05) in Ghorajan beel.

Free carbon dioxide varied between 0-30.0 mg/l (11.1 ±7.7) at station I and 0-38.0 mg/l (10.7 ±8.2) at station II in Deepor beel. However, ANOVA ($F_{11, 23}$ = 61.73, p>0.05 in the first year; $F_{11, 23}$ = 63.57, p>0.05 in the second year) showed significant difference between the months in both the years. Free carbon dioxide was detected throughout the study period with concentrations fluctuating between 4.0-30.0 mg/l (8.7 ±5.8) and between 2.0-30.0 mg/l (8.3 ±5.3) at stations I and II respectively in Ghorajan beel, thereby, reflecting its poor autotrophic uptake in the ecosystem. ANOVA ($F_{11, 23}$ = 9.65, p>0.05 in the first year; $F_{1, 23}$ =17.39, p>0.05 in the second year) showed significant difference between the months in both the years in Ghorajan beel. In this present observation, free carbon dioxide exhibited direct correlation with total alkalinity (r_1= 0.659, p<.001; r_2= 0.45, p<.05), dissolved oxygen (r_2= 0.448, p<.05), nitrate (r_2= 0.433, p<.05) in Deepor beel. On the other hand, Ghorajan beel registered positive relationships with total alkalinity (r_1= 0.444, p<.05; r_2= 0.434, p<.05), dissolved oxygen (r_1= 0.538, <.01; r_2= 0.642, p<.001) and BOD (r_1= 0.592, p<.01; r_2= 0.663, p<.001) indicating positive relationships among them.

The present study exhibited ranges 32.0-96.0 mg/l (70.0 ±16.4) at station I and 30.0-93.0 mg/l (70.7 ±17.4) at station II in Deepor beel. However, ANOVA ($F_{1, 23}$ = 94.1, p>0.05 in the first year; $F_{1, 23}$ = 100.71, p>0.05 in the second year) exhibited significant difference between the months in both the years. Ghorajan beel, on the other hand, recorded 30.0-112.0 mg/l (66.0 ±20.1) at station I and 38.0-116.0 mg/l (66.7 ±19.5) at station II. Both the beels depicted almost an identical concentration, which was low. Low concentration in tropical water bodies is supported by other workers of this region (Sharma and Hussain, 1999; Sharma and Lyngdoh, 1999 and Sharma and Hussain, 2001). ANOVA ($F_{11, 23}$ = 98.97, p>0.05 in the first year; $F_{11, 23}$ = 21.031, p>0.05 in the second year) showed significant difference between the months in both the years. Total alkalinity ranged between 45.0-84.0 mg/l (61.4 ±14.1) in Siligurijan beel and 62.0-84.0 mg/l (71.7 ±8.5) in Fingua beel. Total alkalinity exerted significant positive relationships with water temperature (r_1= 0.476, p<.05), free carbon dioxide (r_1= 0.659, p<.001; r_2= 0.450, p<.05), nitrate (r_1= 0.528, p<.01) and silicate (r_1= 0.407, p<.05) in Deepor beel, which in turn, reflected interdependence of these attributes. The recorded values concurred with the reports of Bhattarai (2004). On the other hand, it registered direct correlation with specific conductivity (r_1= 0.517, p<.01; r_2= 0.532, p<.01), hardness (r_1= 0.576, p<.01, r_2= 0.562, p<.01), calcium (r_1= 0.488, p<.05; r_2= 0.458, p<.05) in Ghorajan beel; these relationships agreed with Sharma (1995) and Sharma and Hussain (1999).

Total hardness fluctuated between 46.0-82.0 mg/l (60.9 ±11.2) at station I and 40.0-80.0 mg/l (60.9 ±12.1) at station II in Deepor beel. In this beel, ANOVA ($F_{11, 23}$ = 218.61, p>0.05 in the first year; $F_{11, 23}$ = 199.29, p>0.05 in the second year)

depicted significant difference between the months: in case of stations ($F_{1,23}$ =16.83, p>0.05 in the first year; $F_{1,23}$ = 16.79, p>0.05 in the second year) also, it showed significant difference in both the years. However, Ghorajan beel exhibited 20.0-84.0 mg/l (54.4 ±15.7) at station I 20.0-80.0 mg/l (52.6 ±15.1) at station II. ANOVA ($F_{11,23}$ = 116.76, p>0.05 in the first year; $F_{11,23}$ = 8.948, p>0.05 in the second year) showed significant difference between the months at both the stations. Total hardness varied between 40.0-76.0 mg/l (60.0 ±14.1) in Siligurijan beel and between 52.0-76.0 mg/l (63.2 ±9.4) in Fingua beel. The role of calcium and magnesium in controlling the total hardness is clearly indicated by significant positive correlations with calcium (r_1= 0.866, p<.001; r_2= 0.868, p<.001) and magnesium (r_2= 0.461, p<.05) in Deepor and also showed positive relationships with calcium (r_1= 0.807, p<.001; r_2= 0.807, p<.001) magnesium (r_1= 0.495, p<.05; r_2= 0.524, p<.01) in Ghorajan beel. Positive correlation of total hardness also existed with other abiotic factors including chloride (r_1= 0.587, p<.01) and BOD (r_1= 0.462, p<.05; r_2= 0.458, p<.05) and it established inverse correlation with sulphate (r_1= -0.738, p<.001; r_2= -0.679, p<.001), nitrate (r_1= -0.540, p<.01; r_2= -0.427, p<.05) in Deepor beel. However, it showed direct relationships with chloride (r_2= 0.424, p<.05) and BOD (r_1= 0.479, p<.05; r_2= 0.489, p<.05) and inverse relationship with sulphate (r_1= -0.585, p<.01; r_2= -0.488, p<.05) in Ghorajan beel, which coincided with the result of Samuajan beel indicating dilution impact of rainfall (Sharma and Hussain, 1999).

The calcium content of the surface water ranged between 23.1-56.7 mg/l (36.2 ±8.2) at station I and 21.0-52.5 mg/l (35.2 ±8.6) at station II in Deepor beel. ANOVA ($F_{1,23}$ =37.59 p>0.05 in the first year; $F_{1,23}$ =37.41, p>0.05 in the second year) showed significant difference between the months and no significant difference between the stations in the years. On the other hand, it recorded 8.4-46.2 mg/l (31.3 ±10.5) at station I and 10.5-44.1 mg/l (29.1 ±9.8) at station II in Ghorajan beel. However, ANOVA ($F_{11,23}$ = 36.49, p>0.05 in the first year; $F_{11,23}$ =19.09, p>0.05 in the second year) exhibited significant difference between the months in both the years, while in case of stations ($F_{1,23}$ =27.44, p>0.05 in the second year) it showed significant difference in the second year. The ranges and mean values of Deepor beel were relatively higher than the values of Ghorajan beel. Calcium ranged between 26.1-43.6 mg/l (33.4 ±6.4) in Siligurijan beel and between 29.4-38.3 mg/l (32.9 ±3.3) in Fingua beel. The former showed peak calcium concentration during summer and lowest during autumn, while maximum value was observed during monsoon season in Fingua beel. Correlation analysis revealed that calcium depicted direct relationship with total hardness (r_1= 0.866, p<.001; r_2= 0.868, p<.001) in Deepor beel, on the other hand, it showed the identical relationship in Ghorajan beel, where total hardness (r_1= 0.807, p<.001; r_2= 0.807, p<.001), which confirmed that calcium in contributing to total hardness across the two study sites was more pronounced than any other ion and apparently agreed with the reports of floodplain lakes of Assam by Sharma and Hussain (1999). On the other hand, calcium showed inverse relationships with sulphate (r_1= -0.519, p<.01; r_2= -0.599, p<.01) at station II in Deepor beel, while it depicted inverse relationships with sulphate (r_1= -0.640, p<.001; r_2= -0.516, p<.01) in Ghorajan beel.

Magnesium fluctuated between 0.8-8.9 mg/l (5.6 ±1.7) at station I and station II recorded 0.8-9.3 mg/l (5.9 ±1.9) in Deepor beel. The present study registered

Calcium > Magnesium, which is a general trend in most of the water bodies. Ghorajan beel depicted no definite pattern of monthly variations. The values ranged between 0.9-9.6 mg/l (5.2 ±2.4) and between 0.7-9.4 mg/l (5.3 ±2.3) at station I and II respectively. However, it depicted positive relationship with phosphate (r_2=0.462, p<.05) in this beel. Magnesium concentration varied between 3.3-9.1 mg/l (6.4 ±2.2) in Siligurijan beel and between 5.5-10.8 mg/l (7.4 ±2.1) in Fingua beel. It registered maxima during monsoon and minima during autumn season in Siligurijan beel. Fingua beel showed peak concentration during winter and lowest value was noticed during monsoon season. The mean values of Siligurijan and Fingua beel showed slightly higher than that of Deepor and Ghorajan beel.

The present study registered a narrow range of fluctuations of chloride i.e. between 14.9-35.9 mg/l (23.8 ±6.5) at station I and 12.9-35.9 mg/l (23.3 ±6.7) at station II in Deepor beel. On the other hand, it ranged between 8.9-42.9 mg/l (21.8 ±8.4) at station I and 9.9-43.9 mg/l (22.6 ±7.5) at station II in Ghorajan beel. maximum value was observed in July (42.9 mg/l at station I & 43.9 mg/l at station II) in Ghorajan beel, high chloride values in the beel could be due to animal waste from cattle grazing during the season. In general, chloride concentration agreed with the ranges noticed in natural water, thereby indicating lack of organic pollution in the studied beels. Chloride registered significant inverse correlation with sulphate (r_1= -0.419; p<.05, r_2= -0.583; p<.01) in Deepor beel. On the other hand, it showed significant positive correlation with BOD (r_1= 0.625; p<.001) at station I in Ghorajan beel indicating interdependence between them.

Dissolved organic matter ranged between 0.3-3.2 mg/l (2.3 ±0.7) and 0.5-3.8 mg/l (2.1 ±0.7) at station I and II in Deepor beel respectively. DOM content of Ghorajan beel fluctuated between 0.9-3.8 mg/l (2.3 ±0.7) at station I and between 0.8-3.8 mg/l (2.2 ±0.7) at station II. The concentrations of DOM in both the beels were relatively low. On the other hand, the mean values of both the beels were slightly higher than the report of Zafar (1964).

The water of the two floodplains indicated relatively low concentration of dissolved solids, i.e. between 0.4-2.6 mg/l (1.6 ±0.6) at station I and 0.3-3.2 mg/l (1.5 ±0.6) at station II in Deepor beel. Ghorajan beel showed ranges of TDS 0.8-2.9 mg/l (1.9 ±0.6) at station I and 1.1-2.9 mg/l (1.8 ±0.5) at station II. Both the beels depicted low concentration of TDS during the whole study period. Low TDS at these sampled beels corresponded with low ionic concentrations in general, which supported the results of Bhattarai (2004).

The concentration of inorganic phosphorus estimated as phosphate ranged between 0.01-0.9 mg/l (0.3 ±0.3) at station I and between 0.02-1.2 mg/l (0.3 ±0.3) at station II in Deepor beel. Ghorajan beel depicted phosphate content ranging between 0.02-1.4 mg/l (0.5 ±0.4) at station I and between 0.04-2.4 mg/l (0.87 ±0.8) at station II. In addition, it depicted inverse correlation with transparency (r_1= -0.419, p<.05) in Deepor beel, which coincided with the reports of floodplain lakes of Assam by Sharma and Hussain (1999). In general, lower phosphate content in water column of Deepor beel, during most part of present study period, was attributed to its uptake by luxuriant growth of aquatic macrophytes, which agreed with the findings

of Sharma and Hussain (1999). It exhibited significant inverse correlation with potassium (r_2= -0.410, p<.05) at station I in this beel. On the other hand, annual ranges and mean values of both the beels (excepting Ghorajan station II) concurred with the results of Yusuf *et al.* (1986), Yadava *et al.* (1987), Vass (1989) and Sinha *et al.* (1994), Sharma and Hussain (2001).

The present observation indicated sulphate content ranging between 5.1-28.2 mg/l (14.9 ±6.3) at station I and between 4.9-24.5 mg/l (15.8 ±5.3) at station II in Deepor beel. On the other hand, sulphate content in Ghorajan beel depicted bimodal pattern of monthly variations and fluctuated between 3.6-30.3 mg/l (17.4 ±6.8) at station I and between 4.2-27.0 mg/l (16.5 ±5.9) at station II during the study period. Further, it registered inverse correlations with specific conductivity (r_1= -0.501, p<.05; r_2= -0.524, p<.01) and total hardness (r_1= -0.738, p<.001; r_2= -0.679, p<.001) in Deepor beel, and it recorded an identical relationships with pH (r_1= -0.598, p<.01; r_2= -0.564, p<.01), specific conductivity (r_1= -0.615, p<.01) and total hardness (r_1= -0.585, p<.01; r_2= -0.488, p<.05) in Ghorajan beel, which coincided with the reports of floodplain lakes of Assam by Sharma and Hussain (1999), while direct relationship was noticed with nitrate (r_2= 0.534, p<.01) in Ghorajan beel, which agreed with the reports by Sharma and Hussain (1999). Mean values of both the beels corresponded with the reports of Yousuf *et al.* (1986) and Sharma and Hussain (2001).

Nitrate concentration was low during the study period in Deepor beel and it ranged between 0.1-1.9 mg/l (1.2 ±0.5) at station I and between 0.2-2.3 (1.4 ±0.6) at station II. The concentration of this nutrient fluctuated between 0.09-2.1 mg/l (1.1 ±0.6) at station I and between 0.09-2.1 mg/l (1.2 ±0.6) at station II in Ghorajan beel. Nitrate registered inverse relationship with total hardness (r_1= -0.540, p<.01; r_2= -0.427, p<.05) in Deepor beel. Both the beels depicted almost identical findings with the report of Samuajan beel (Sharma and Hussain, 1999). This micronutrient exhibited peak during monsoon, which supported by significant positive correlation with rainfall (r_1= 411; p<.05) in Deepor beel. It depicted positive correlation with rainfall (r_2= 0.442; p<.05) in Ghorajan beel also. The impact of rainfall is also supported by Goswami (1985), Yadava (1987) and Sharma and Hussain (1999). Annual range and mean values of both the beels are almost similar with the reports of Sharma and Hussain (1999) and Sharma and Hussain (2001) from the state of Assam.

In the present study, silicate content ranged between 0.1-4.6 mg/l (2.1 ±0.9) at station I and station II 0.3-4.1 mg/l (1.9 ±0.8) in Deepor beel. On the contrary, Ghorajan beel exhibited 0.04-4.1 mg/l (1.8 ±0.8) at station I and 0.1-4.3 mg/l (1.9 ±0.9) at station II. Its concentration was lower than the reports by Dey (1981), Yousuf *et al.* (1986), Yadava *et al.* (1987) and Singh and Roy (1990), on the other hand, its mean values of both the beels were lower than the reports of Sharma and Hussain (1999). It, however, registered positive relationship with total alkalinity (r_1= 0.407, p<.05) in Deepor beel. Silicate also exhibited positive relationship with sodium (r_1= 0.643, p<.01; r_2= 0.474, p<.05) in Ghorajan beel. Both the beels corroborated the relationships with the reports of Sharma and Hussain (1999) from the state of Assam.

BOD fluctuated between 0.6-4.8 mg/l (2.09 ±0.9) at station I and between 0.4-5.1 mg/l (2.8 ±1.5) at station II in Deepor beel. BOD values ranged between 0.1-

4.4 mg/l (1.8 ±1.0) at station I and between 0.1-4.8 mg/l (1.7 ±1.1) at station II in Ghorajan beel. However, BOD registered direct correlation with dissolved oxygen (r_2= 0.424, p<.05) and calcium (r_1= 0.529, p<.01; r_2= 0.483, p<.05) in Deepor beel. On the contrary, Ghorajan beel depicted direct relationships with dissolved oxygen (r_1= 0.466, p<.05; r_2= 0.462, p<.05) and calcium (r_1= 0.442, p<.05; r_2= 0.514, p<.01) indicating positive relationship among them and also exhibited significant inverse correlation with transparency (r_1= -0.492, p<.05; r_2= -0.459, p<.05). In the present study, Deepor beel and Ghorajan beel did not cross the polluted range of BOD (lower level 6 mg/l).

The concentration of this alkaline earth metal ranged between 12.4-31.0 mg/l (19.6 ±4.7) at station I and between 11.1-28.0 mg/l (18.8 ±4.2) at station II in Deepor beel. However, sodium fluctuated between 6.1-27.0 mg/l (18.6 ±5.4) at station I and between 7.3-29.0 mg/l (19.9 ±5.4) at station II in Ghorajan beel. It exhibited significant inverse correlation with specific conductivity (r_1= -0.64, p<.01) and pH (r_1= -0.428 p<.05) and BOD (r_1= -0.446 p<.05) at station I in Deepor beel, which did not depict the identical trend with the records of Ghorajan beel. However, sodium exhibited significant positive relationships with transparency (r_1= 0.587, p<.01) and silicate (r_1= 0.474, p<.05) at station I in Deepor beel and at station II in Ghorajan beel respectively. The minimum values of Deepor beel were apparently higher than that of Ghorajan beel. On the other hand, the mean values of both the beels were lower than the earlier report of floodplain lakes of Assam (Sharma and Hussain, 2001) and apparently higher than the lakes of high altitude (Zutshi and Vass, 1978).

The present observations showed a wide range of fluctuations in the potassium content of the water, i.e. between 3.2-9.0 mg/l (6.06 ±1.6) at station I, while station II exhibited 4.2-10.2 mg/l (6.6 ±1.5) in Deepor beel. Ghorajan beel depicted wide range of potassium fluctuations. It ranged between 3.7-10.0 mg/l (6.4 ±1.7) at station I and between 3.2-9.8 mg/l (6.1 ±1.7) at station II. It depicted significant inverse correlation with BOD (r_1= -0.464, p<.05) at station I Deepor beel. The mean values were observed to be higher than the report of other beels from the state of Assam (Sharma and Hussain, 2001). On the other hand, the values of potassium of both the sampled floodplain lakes were apparently higher than the values of high altitude lakes, which compared with the results of Dal lake, Srinagar (Zutshi and Vass, 1978).

2. BIOTIC FACTORS:

A. BIODIVERSITY OF ZOOPLANKTON

Seasonal variations for the study of biodiversity of zooplankton were observed in four beels, namely Siligurijan, Fingua, Deepor and Ghorajan beel. The zooplankton taxocoenosis of the sampled beels included two major groups namely, Rotifera and Cladocera. Species richness of zooplankton ranged between 46-68 species in Siligurijan beel. Species richness of Rotifera fluctuated between 30-50 species in this beel. A total of 104 zooplankton taxa were identified from Siligurijan beel out of which 72 species of Rotifera and 32 species of Cladocera. Species richness of zooplankton varied between 59-80, the maximum was observed during au-

tumn and the minimum during the monsoon season in Fingua beel. Species richness of Rotifera fluctuated between 35-57 in this beel. A total of 105 zooplankton taxa were identified from this beel. 75 species of Rotifera and 30 species of Cladocera were identified during the study period. 122 zooplankton taxa were identified from Deepor beel, out of which Rotifera registered 87 species and 35 species of Cladocera. On the other hand, Ghorajan beel registered a total of 120 taxa, 86 species belonging to Rotifera and 34 species belonging to Cladocera during the study period, which apparently higher in comparison to the reports of subtropical lakes from this region (Sharma, 1995) and also floodplain lakes of Assam. Lecanidae and Brachionidae together, comprised a notable component of rotifer biodiversity in the sampled beels. In the present investigation, Siligurijan beel registered 72 species of Rotifera, out of which 18 species belonging to Lecanidae family followed by 17 species to Brachionidae. On the other hand, Fingua registered 75 species of Rotifera, a total of 20 species belonging to Lecanidae family, while 17 species belonging to Brachionidae. Rotifera accounted for 69.2% of total zooplankton richness in Siligurijan beel and 71.4% in Fingua beel. Lecanidae (24 species) and Brachionidae (19 species) together, comprised a notable component of rotifer biodiversity in Deepor beel. In the present study, Ghorajan beel registered 86 species of Rotifera, out of which 24 species belonging to Lecanidae family followed by 19 species belonging to Brachionidae, 9 species belonging to Colurellidae, 7 species belonging to Trichocercidae. The proportion of widely distributed *Lecane* amounts to 25% of the total rotifers in Siligurijan, on the other hand, 26.7% in Fingua beel. This is apparently higher than the result of Samuajan beel of upper Assam (Sharma and Hussain, 2001) but the distribution percentages of *Lecane* are definitely lower than the reports of Deepor (27.6%) and Ghorajan beel (27.9%). Among the rotifers, *Brachionus mirabilis*, *Lecane thienemanni*, *Lecane ohioensis*, *Lecane decipiens*, *L. inopinata*, *L. crepida*, *Filinia camascela*, and *Trochosphaera aequatorialis* were totally absent in Siligurijan beel during the study period. On the other hand, *Keratella tropica*, *Beauchampiella eudactylota*, *Lecane pyriformis*, *Lecane decipiens* and *L. inopinata* were also not registered in Fingua beel. The rotifer fauna exhibited dominance of monogonont taxa. Five eurotatorian families namely Lecanidae> Brachionidae> Colurellidae> Trichocercidae included 68.9% of the total rotifers in Deepor beel, 68.6% in Ghorajan beel, 68.1% in Siligurijan beel and 68% in Fingua beel, the spectrum of dominance apparently agreed with the report of Sharma (1996).

The other dominant group Cladocera exhibited the ranges of species richness 16-25 in Siligurijan beel. Maximum species richness was observed during winter and the minimum during monsoon season. Cladocera depicted the ranges of species richness 20-24 in Fingua beel. A total of 32 species documented from Siligurijan beel, while Fingua beel registered 30 species. The number of both the beels was lower as compared to reports of Deepor and Ghorajan beel, which registered 35 and 34 species respectively. *Bosmina longirostris*, *Biapertura karua*, *Moina micrura*, *Scapholeberis kingi* contributed to maximum richness in Siligurijan beel, on the other hand, *Bosmina longirostris* recorded maximum during monsoon season in the sampled beels and *Biapertura karua* and *Chydorus sphaericus* were found to be common in Fingua beel. The cladocerans comprised subdominant component of zooplankton in the sampled beels.

Percentage similarity of Rotifera of Deepor and Ghorajan beel exhibited ranges 24.2-84.7% in the first year with highest between December and January and lowest between April and June, while it showed ranges 32.7-71.1% in the second year with highest between January and June and lowest between February and May. In Deepor and Ghorajan beel, only instance of higher community similarity (more than 80%) of rotifera was observed between December and January (84.7%) in the first year.

B. SYNECOLOGY OF ZOOPLANKTON

(I) NET PLANKTON:

Net plankton in Deepor and Ghorajan beel appeared to be diversified. Higher species richness was observed in both the beels. Recorded 208 species including 149 species of zooplankton and 59 species of phytoplankton in Deepor beel, on the other hand, a total of 202 species were recorded in Ghorajan beel out of which 147 zooplankton species and 55 phytoplankton species at all. Zooplankton comprised an important component and constituted dominant group to the planktonic communities in both the beels. This dominant group, on the other hand, included six major groups namely, Rotifera, Cladocera, Copepoda, Rhizopoda, Ostracoda and Conchostraca. Species richness in both the beels was higher than the reports of Sharma (1995), Sharma and Hussain (1999) and Sharma (2001). The population density of net plankton at station I ranged between 475-969 ind/l (703.0 ±124.0) and 431-1036 ind/l (618.0 ±147.0) at station II in Deepor beel. The quantitative abundance of net plankton in Ghorajan beel fluctuated between 414-1134 ind/l (647.0 ±179.0) at station I and 335-804 ind/l (522.0 ±130.0) at station II. In the present investigations, net plankton densities were significantly influenced by phytoplankton (r_1= 0.626, p<.01; r_2= 0.878, p<.001), Chlorophyta (r_1= 0.619, p<.01; r_2= 0.798, p<.001), Bacillariophyta (r_1= 0.598, , p<.01; r_2= 0.736, p<.001) and also showed significant correlation with zooplankton (r_1= 0.501, p<.05; r_2= 0.584, p<.01) and Rotifera (r_1= 0.456, p<.05; r_2= 0.56, p<.01) in Deepor beel, thereby, exhibited contributory role in the population. Further, it exhibited significant direct correlation with phosphate (r_2= 0.423, p<.05) in this beel indicating positive relationship between them. In addition, net plankton showed positive correlation with phytoplankton (r_1= 0.759, p<.001; r_2= 0.621, p<.01), Chlorophyta (r_1= 0.746, p<.01; r_2= 0.526, p<.01), Bacillariophyta (r_1= 0.315, r_2= 0.644, p<.001), zooplankton (r_1= 0.647, p<.001; r_2= 0.76, p<.001) and Rotifera (r_1= 0.474, p<.05; r_2= 0.751, p<.01) in Ghorajan beel indicating interdependence among the attributes. On the other hand, it showed significant positive relationships with specific conductivity (r_1= 0.423, p<.05), total alkalinity (r_1= 0.596, p<.01; r_2= 0.416, p<.05), calcium (r_1= 0.409, p<.05), phosphate (r_1= 0.517, p<.01; r_2= 0.432, p<.05) and silicate (r_1= 0.476, p<.05). The multiple regression indicated that sixteen ecological variables together accounted for 69.6% (station I) and 72.3% (station II) of variations of net plankton indicating importance of combined influence of various factors in Deepor beel, while it accounted for 82.2% at station I and 77.8% at station II in Ghorajan beel.

(II) ZOOPLANKTON:

The zooplankton taxocoenosis of both the beels included six major groups namely, Rotifera, Cladocera, Copepoda, Rhizopoda, Ostracoda and Conchostraca. 149 zooplankton taxa were identified from Deepor beel, which included 149 species at station I and 147 species at station II, on the other hand, Ghorajan beel registered a total of 147 taxa, indicated 147 species at station I and 146 species at station II during the study period, which apparently higher compared to the reports of Sharma, 1995 and also floodplain lakes of Assam. Of these, Rotifera registered 88 species at station I and 87 species at station II with spectrum of dominance as Rotifera > Cladocera with 48 species (st.I) > 43 species (st.II) and 12 species (st. I) > Rhizopoda > 11 species (st. II) > Copepoda (3 species at both the stations) > Ostracoda (2 species at both the stations) > Conchostraca (1 species at both the stations) in Deepor beel. On the other hand, Ghorajan beel registered 87 species at both stations of Rotifera with spectrum of dominance as Rotifera > Cladocera (42 species at station I, 42 species at station II) > Rhizopoda (12 species at station I, 11 species at station II) > Copepoda (3 species at both the stations) > Ostracoda (2 species at both the stations) > Conchostraca (1 species at both the stations).

Zooplankton comprised an important component, which ranged between 172-565 (361.0 ±103.0) at station I and 146-382 (256.0 ±71.0) at station II in Deepor beel and significantly influenced their monthly abundance (r_1= 0.501, p<.05; r_2= 0.584, p<.01). On the contrary, Ghorajan beel exhibited 133-487 (327.0 ±117.0) at station I and 152-464 (300.0 ±102.0) at station II and also positively correlated with net plankton (r_1= 0.647, p<.01; r_2= 0.76, p<.001). The observed densities were also higher than in the floodplain lakes of Bihar (Rai and Dutta Munshi, loc cit.; Sanjer and Sharma, loc cit.), Kashmir (Khan, 1987) and West Bengal (Vass, 1989). Zooplankton exhibited significant positive correlation with Rotifera (r_1= 0.843, p<.001; r_2= 0.787, p<.001), Cladocera (r_1= 0.818, p<.001; r_2= 0.892, p<.001), Copepoda (r_1= 0.427, p<.05), Rhizopoda (r_1= 0.597, p<.01; r_2= 0.762, p<.001) and Ostracoda (r_1= 0.443, p<.05) in Deepor beel indicating interdependence among the attributes. On the other hand, zooplankton exhibited significant positive relationships with magnesium (r_1= 0.423, p<.05) at station I and inversely correlated with water temperature (r_1= -0.465, p<.05) at station I in this beel, thereby, exhibited relatively low temperature is favourable for zooplankton production. ANOVA showed no significant differences between the months ($F_{11, 23}$ = 2.413, p>.001) as well as between the stations ($F_{1, 23}$ = 4.673, p>.001) in first and second year ($F_{11, 23}$ = 0.036, p>.001 between months; $F_{1, 23}$ = 0.004, p>.001 between stations) in Deepor beel. However, ANOVA showed significant differences between the months ($F_{11, 23}$ = 4.35, p>.001) as well as between the stations ($F_{1, 23}$ = 6.69, p>.001) in first and in second year, it exhibited significant differences between the months ($F_{11, 23}$ = 10.24, p>.001) and no significant differences between the stations ($F_{1, 23}$ = 0.198, p>.001) in Ghorajan beel. The present observation registered inverse correlation between zooplankton vs. transparency (r_1= -0.513, p<.01) in Ghorajan beel. It exhibited significant positive correlation with Rotifera (r_1= 0.958, p<.001; r_2= 0.933, p<.001), Cladocera (r_1= 0.919, p<.001; r_2= 0.808, p<.001), Copepoda (r_1= 0.859, p<.001; r_2= 0.599, p<.01)), Rhizopoda (r_1= 0.472, p<.05; r_2= 0.576, p<.01) and Ostracoda (r_1= 0.439, p<.05) in

this beel. The correlation revealed that the abundance of zooplankton is chiefly dependent on its major groups i.e. Rotifera, Cladocera, Copepoda and Rhizopoda. On the other hand, zooplankton exhibited significant correlation with total alkalinity (r_1= 0.524, p<.01; r_2= 0.558, p<.01), phosphate (r_1= 0.45, p<.05; r_2= 0.413, p<.05), BOD (r_1= 0.612, p<.01), specific conductivity (r_2= 0.428, p<.05), total hardness (r_2= 0.525, p<.01), calcium (r_2= 0.472, p<.05), magnesium (r_2= 0.419, p<.05) and phosphate (r_2= 0.413, p<.05) in this beel. Alkalinity and pH are often found as variables predicting the zooplankton community composition, based on data from a large number of different water bodies (Berzins & Pejler, 1987). Zooplankton positively correlated with total alkalinity (r_1= 0.524, p<.01; r_2= 0.558, p<.01) in Ghorajan beel.

During the present study, zooplankton communities depicted higher species diversity computed *vide* Shannan's index and ranged between 2.532-3.634 (3.264 ±0.3) and 2.215-3.869 (3.234 ±0.35) at station I and II respectively in Deepor beel. Similarly, Menhinick's index varied with their narrow ranges and higher mean values i.e. between 2.003-3.977 (3.316 ±0.5) at station I and 2.092-4.373 (3.372 ±0.6) at station II. On the other hand, Ghorajan beel indicated relatively higher species diversity among the stations and it ranged between 3.007-3.978 (3.458 ±0.25) at station I and 2.943-3.784 (3.344 ±0.22) at station II using Shannan's index and it fluctuated between 3.015-4.536 (3.525 ±0.4) at station I and 2.919-4.002 (3.348 ±0.3) using Menhinick's index. Mean values of species diversity in both the beels exhibited almost identical and the recorded zooplankton diversity was higher than the reports of Sharma (1995), Sharma and Hussain (1999), Wanswett (2001) and Sharma and Lyngdoh (2004).

Zooplankton dominance (*vide* Berger-Parker's index) at both the stations was generally low and ranged between 0.069-0.236 (0.168 ±0.04) and 0.085-0.284 (0.163 ±0.04) at station I and II respectively. Dominance of zooplankton fluctuated between 0.123-0.251 (0.184 ±0.03) at station I and 0.135-0.297 (0.197 ±0.03) at station II in Ghorajan beel. It registered peak in March and minima in July in the second year at station I, while station II exhibited maxima in September and minima in August in the first year. The present study showed relatively low overall dominance due to fewer quantitatively important species. Mean values indicated low dominance in both the beel, which broadly coincided with the findings of the beels of upper Assam reported by Sharma and Hussain (2001

Evenness (E_1) indicated high equitability of zooplankton and fluctuated with narrow ranges i.e. between 0.853-0.956 (0.891 ±0.03) at station I and 0.876-0.984 (0.939 ±0.03) at station II in Deepor beel. On the other hand, evenness of Ghorajan beel showed ranges 0.895-0.976 (0.924 ±0.02) at station I and 0.886-0.987 (0.927 ±0.02) at station II. However, zooplankton evenness did not depict significant monthly variations and exhibited almost identical annual ranges between the beels. Further, high evenness at all the stations in the beels indicated greater equitability of species abundance in the community, which concurred with the report of Washington (1984). The mean value of station I in Deepor beel exhibited marginally lower than that of other stations of the sampled beels. The multiple regression indicated that sixteen abiotic factors accounted for 90.9% (station I) and 81.5% (station II) of variations of

zooplankton indicating importance of combined influence of various factors in Deepor beel, while Ghorajan beel stated 71.5% and 92.2% at station I and station II respectively.

Rotifera accounted for the highest share of the abundance of zooplankton. The present study did not depict any definite periodicity of overall rotifer abundance or of individual species. In general, a greater number of taxa were recorded in the sampled beels but numerical abundances were considerably lower. A total of 88 and 87 species at both the stations of Deepor beel and 87 species in Ghorajan beel represented it. The documented 88 rotifer species from both the beels accounted for 75.86% of the total reported rotifers from the floodplain lakes of Assam (116 reported species), 60.27% of the total reported rotifers from the N.E. India (146 reported species) and only 26.35% of the total rotifers from whole of the country (334 reported species). Lecanidae and Brachionidae were the dominant families of Rotifera in the sampled beels. The rotifer fauna exhibited dominance of monogonont taxa. Five eurotatorian families namely Lecanidae> Brachionidae> Colurellidae> Trichocercidae included 66.6% of the total rotifers, the spectrum of dominance apparently agreed with the report of Sharma (1996). Various non-planktonic taxa of the Epiphanidae, Trichotridae, Synchaetidae, Dicranophoridae and Floscularidae were poorly observed. Lecanidae (24 species at both the stations) and Brachionidae (19 species at both the stations) together, comprised a notable component of rotifer biodiversity in Deepor beel. In the present study, Ghorajan beel registered 87 species of Rotifera at both the stations, out of which 24 species belonging to Lecanidae family followed by 19 species belonging to Brachionidae, 9 species belonging to Colurellidae, 6 species belonging to Trichocercidae. This is apparently higher than the report of Samuajan beel of upper Assam (Sharma and Hussain, 2001). The predominance of Lecane species is in agreement with reports on the rotifer fauna of other tropical floodplain lakes (e.g. Africa: Segers *et al.*, 1993c; Asia: Segers, 1994: South America: Jose De Paggi, 1993).

Altogether 24 species belonging to Lecanidae family documented from both the beels, which accounted 52.17% of the total recorded Lecane species from N.E. India (reported 46 species), 75% of Sri Lanka (reported 32 species) and 51.06% of Thailand (reported 47 species). On the other hand, Lecanidae accounted for 27.3% of total rotifer richness in Deepor beel and 27.6% in Ghorajan beel, hence, broadly corresponded with its contribution (26.9%) in the floodplain lakes of upper Assam (Sharma, 2000) and also (28.5%) in tropical floodplain lakes of the river Niger, Africa (Segers *et al.* 1993). As a result of this study, a total of 19 species belonging to Brachionidae documented from both the beels, which accounted for 82.61% of the total of N.E. India (23 reported species). Most species of Brachionus, reported from India, are pantropical or cosmopolitan forms of alkaline waters. However, both the beels registered 12 species belonging to genus Brachionus, which accounted for 85.71% of the total reported species from N.E. India (14 reported species). Rotifera ranged between 94-265 ind/l (183.5 ±55.1) at station I and 62-187 ind/l (117.0 ±37.0) at station II in Deepor beel. The dominant component contributed significantly to net plankton (r_1= 0.456, p<.05; r_2= 0.560, p<.01) and Zooplankton production (r_1= 0.843, p<.001; r_2= 0.787, p<.001) in this beel. On the other hand, Ghorajan beel

registered Rotifera abundance 56-245 (167.0 ±60.0) at station I and 92-267 ind/l, (159.0 ±56.0) at station II, which contributed significantly to net plankton (r_1= 0.474, p<.05; r_2= 0.751, p<.001) and zooplankton (r_1= 0.958, p<.001; r_2= 0.933, p<.001) in Ghorajan beel. The Rotifera abundance is apparently higher than the reports of Lahon (1983), Kar (1984), Yadava *et al.* (1987), Baruah *et al.* (1993), Sinha *et al.* (1994) and Sharma and Hussain (2001).

Deepor beel registered species diversity of Rotifera using Shannon's index was 2.528-3.594 (3.208 ±0.3) at station I and 2.585-3.657 (3.224 ±0.25) at station II exhibiting narrow range. While using Menhinick's index it ranged between 1.617-3.899 (3.117 ±0.6) at station I and between 1.94-4.545 (3.346 ±0.7) at station II, which showed wide range. Ghorajan beel exhibited species diversity of rotifers using Shannon's index 2.851-3.679 (3.301 ±0.2) at station I and 2.647-3.628 (3.194 ±0.26) at station II. While using Menhinick's index it ranged between 2.091-4.796 (3.319 ±0.8) at station I and between 1.909-3.992 (2.979 ±0.5) at station II. The species diversity of both the beels concurred with the report of Samuajan beel by Sharma and Hussain, 2001. During the course of study, Berger-parker's index of dominance registered 0.075-0.206 (0.124 ±0.04) at station I and 0.071-0.183 (0.114 ±0.03) at station II in Deepor beel. On the other hand, Berger-Parker index of dominance ranged between 0.08-0.208 (0.124 ±0.04) at station I and 0.068-0.326 (0.125 ±0.06) at station II in Ghorajan beel. The present study showed relatively low overall dominance due to fewer quantitatively important species and apparently agreed with the results of some floodplain lakes of Assam reported by Sharma and Hussain (2001).

During the whole study period, evenness of rotifers using E_1 ranged between 0.81-0.919 (0.867 ±0.03) at station I and 0.864-0.947 (0.911 ±0.02) at station II of Deepor beel. Ghorajan beel exhibited evenness using E_1 ranged between 0.853-0.969 (0.894 ±0.02) at station I and 0.855-0.925 (0.892 ±0.027) at station II.

In the present investigations, cladocerans comprised subdominant component of zooplankton in Deepor beel. The quantitative abundance of Cladocera ranged between 29-195 ind/l (105.0 ±43.0 ind/l) at station I of Deepor beel, while station II recorded 44-134 ind/l (82.0 ±28.0 ind/l). A total of 48 species at station I and 43 species at station II belonging to 6 families were identified during the study period in Deepor beel. Out of 48 species 52.1% at station I and 58.1% at station II belonging to Chydoridae family. The quantitative abundance of cladocera ranged between 47-160 ind/l (99.4 ±34.3 ind/l) at station I of Ghorajan beel, while station II recorded 28-155 ind/l (81.1 ±28.8 ind/l). The recorded abundance is higher than the reports of Khan (1987), Sinha *et al.* (1994), Sanjer and Sharma (1995) and Sharma and Hussain (2001). On the other hand, Ghorajan beel registered 42 species at both the stations of which 25 species belonging to Chydoridae family (59.5% of total Cladocera). The figures from both the beels were apparently higher than the findings of Sharma (1985) from West Bengal. The Cladocera comprised an important component 31.2% at station I and 29.3% at station II of zooplankton in Deepor beel. On the other hand, Ghoranjan beel exhibited 28.6% at station I and 28.8% at station II of the total recorded zooplankton. Deepor beel registered species diversity of Cladocera using Shannon's index were 2.151-3.178 (2.803 ±0.3) at station I and 2.164-3.251 (2.828

±0.2) at station II; while using Menhinick' index ranged between 1.414-3.549 (2.414 ±0.5) at station I and 1.51-3.81 (2.519 ±0.6) at station II. In the present study, Ghorajan beel recorded species diversity of Cladocera using Shannon's index were 2.468-3.201 (2.851 ±0.2) at station I and station II exhibited 2.231-3.128 (2.743 ±0.24); while using Menhinick' index ranged between 1.811-3.444 (2.419 ±0.5) at station I and 1.395-3.618 (2.372 ±0.5) at station II depicting wide range. Berger-Parker's index of dominance in Deepor beel indicated 0.08-0.25 (0.147 ±0.04) at station I and 0.091-0.243 (0.161 ±0.04) at station. During the whole study period, Berger-Parker's index of dominance in Ghorajan beel recorded 0.08-0.25 (0.147 ±0.04) at station I and 0.091-0.243 (0.161 ±0.04) at station II. The present study showed relatively low overall dominance due to fewer quantitatively important species. In this investigation, evenness index (E_1) reflected 0.836-0.975 (0.895 ±0.03) at station I and 0.733-0.951 (0.913 ±0.05) at station II in Deepor beel. Evenness reflected maximum value during April in the first year and minimum value was noticed during January in the first year at station I and station II exhibited maxima during August in the first year and minima during October in the first year. However, evenness recorded 0.844 –0.963 (0.909 ±0.03) at station I and 0.84 –0.955 (0.914 ±0.029) at station II in Ghorajan beel. In general, evenness registered inverse relationship with dominance. Coefficient correlation of water temperature (r_1= -0.691, p<.001) showed significant inverse relationship with Cladocera in Deepor beel, thereby, exhibited low temperature for their growth of population. On the other hand, it depicted direct correlation with total alkalinity (r_1= 0.478, p<.05), total hardness (r_1= 0.437, p<.05), magnesium (r_1= 0.495, p<.05) and BOD (r_1= 0.562, p<.01) in Ghorajan beel. Correlation between biotic factors revealed that Cladocera and phytoplankton (r_1= -0.523, p<.01) were inversely correlated but positively correlated with zooplankton (r_1= 0.818, p<.001; r_2= 0.892, p<.001) in Deepor beel, while the same relationships were noticed with zooplankton (r_1= 0.919, p<.001; r_2= 0.808, p<.001) in Ghorajan beel indicating interdependence between them.

Meso cyclops sp., Helio diaptomus sp. and Nauplius larvae were the only representatives of this group at both the sampled beels. Copepoda registered relatively low qualitative diversity in Deepor beel. Diversity of this group in this beel though low, abundance among zooplankton population was quite high especially during summer months. It formed quantitatively most important group and ranged between 10-122 ind/l (40.0 ±26.0); but did not depict any definite monthly pattern at station I, while station II recorded 7-77 ind/l (27.0 ±16.0) in Deepor beel. Maximum and minimum abundance were observed during July in the second year (122 ind/l) and during October in the first year (10 ind/l) at station I in Deepor beel. A peak of nauplii was observed during April and May at both the stations, indicating a reproductive increment. On the contrary, Copepoda was represented by three species at both the stations in Ghorajan beel. The population density of Copepoda ranged between 6-81 ind/l (35.0 ±22.0); but did not depict any definite monthly pattern at station I, on the other hand station II recorded 4-93 ind/l (34.0 ±25.0). In addition, the density of copepod corresponded with higher concentrations in a number of abiotic factors. Positive relationships with total alkalinity (r_1= 0.418, p<.05; r_2= 0.427, p<.05) and BOD (r_1= 0.571, p<.01; r_2= 0.423, p<.05) in Ghorajan beel. Among the biotic factors, copepod exhibited a distinct influence on zooplankton (r_1= 0.427, p<.05) and net plankton (r_1= 0.463, p<.05) in Deepor beel, while it showed positive

relationships with zooplankton (r_1= 0.859, p<.001; r_2= 0.599, p<.01) and net plankton (r_1= 0.698, p<.001; r_2= 0.445, p<.05) in Ghorajan beel.

The Rhizopoda formed the third qualitative important group in both the beels. The population density of this group, however, ranged between 5-43 ind/l (14.2 ±11.1) at station I and 5-42 ind/l (22.4 ±12.5) at station II in Deepor beel. On the contrary, Ghorajan beel showed between 4-47 ind/l (10.8 ±9.4) at station I and 4-70 ind/l (21.8 ±16.3) at station II. The mean values of Deepor beel were marginally higher than that of Ghorajan beel. On the other hand, the mean values of both the beels established definitely higher values than the reports of Samuajan beel of Assam by Sharma and Hussain (2001). The Rhizopoda were represented by 12 species at both the sampled beels This group registered significant direct correlations with specific conductivity (r_1=0.493, p<.05), total alkalinity (r_1=0.452, p<.05) and total hardness (r_1= 0.514, p<.01; r_2= 0.485, p<.05) in Ghorajan beel, which agreed with the results of Sharma and Hussain (2001). Rhizopoda depicted direct correlations with net plankton (r_1= 0.417, p<.05), zooplankton (r_1= 0.597, p<.01; r_2= 0.762, p<.001), Rotifera (r_1= 0.426, p<.05; r_2= 0.668, p<.01), Cladocera (r_2= 0.513, p<.01) and Copepoda (r_1= 0.558, p<.01) in Deepor beel indicating interdependence among them. Similarly, it also shared direct correlations with net plankton (r_1= 0.572, p<.01; r_2= 0.546, p<.01), zooplankton (r_1= 0.472, p<.05; r_2= 0.576, p<.01), Rotifera (r_2= 0.627, p<.01), Cladocera (r_1= 0.427, p<.05) and Copepoda (r_1= 0.468, p<.05) in Ghorajan beel. *Arcella discoides* occurred throughout the study period and mainly contributed to their maximum density in both the sampled beels, which agreed with reports of Sharma and Hussain (2001).

Two planktonic ostracods were occasionally very abundant. They were present most of the months dominated by Cypricercus sp. and Cypris sp. at both the stations in Deepor beel. Population density of Cypricercus sp. ranged between 0-33 ind/l at station I and station II exhibited 0-14 ind/l, while Cypris sp. showed 0-7 ind/l and 0-6 ind/l at station I and II respectively. On the other hand, Ghorajan beel exhibited Ostracods dominated by the same species Cypricercus sp. and Cypris sp. at both the stations. Population density of Cypricercus sp. ranged between 0-16 ind/l at station I and station II exhibited 0-6 ind/l, while Cypris sp. showed 0-8 ind/l and 0-4 ind/l at station I and II respectively. During the zooplankton peak they became less abundant perhaps due to competition by the large numbers of other herbivorous zooplankton. Ostracods depicted direct correlations with zooplankton (r_1=0.443, p<.05) and Copepoda (r_1=0.634, p<.01) in Deepor beel indicating interdependence among the attributes. However, it depicted direct correlations with zooplankton (r_1=0.439, p<.05). Rotifera (r_1=0.427, p<.05) and Cladocera (r_1=0.513, p<.05) in Ghorajan beel. Conchostraca sp. was found at both the stations in Deepor beel in a very negligible quantity.

(III) PHYTOPLANKTON:

Phytoplankton taxa recorded in the present study of Deepor beel belonged to five groups namely Chlorophyta, Bacillariophyta, Cyanophyta, Euglenophyta, Dinophyta and Chrysophyta. These, in turn, were represented by 59 species at sta-

tion I and also the same number of species at station II. The species richness of phytoplankton fluctuated between 16-34 species (18.0 ±4.0) and 20-35 species (20.0 ±5.0) at station I and II respectively. The maximum and minimum number of species were noticed in the month of June in the first year at station I and in November in the first year. The abundance of phytoplankton ranged between 219-682 ind/l (342.0 ±114.0) at station I and 221-654 ind/l (362.0 ±119.0) at station II of Deepor beel. Phytoplankton of this beel are represented by 55 species at station I and 54 species at station II in Ghorajan beel. In the present study, population density of phytoplankton in this beel fluctuated between 220-727 ind/l (320.0 ±136.0) at station I and 130-486 ind/l (222.0 ±84.0) at station II. However, station I exhibited 46.1-70.38% of net plankton, while station II showed 33.08-64.5% in Deepor beel. On the other hand, Ghorajan depicted 53.14-64.11% at station I and 38.8-60.44% at station II. Phytoplankton comprised a dominant composition of net plankton. This was also ascertained by significant positive correlation with net plankton (r_1=0.626, p<.01; r_2=0.878, p<.001) in Deepor beel, while correlation analysis revealed that phytoplankton and net plankton were significantly correlated (r_1=0.759, p<.001; r_2=0.621, p<.01) in Ghorajan beel. Quantitative abundance of the sampled floodplain lakes is distinctly higher than the reports from reservoirs, which concurred with the report of Sharma, (1995).

In the present observation, Chlorophyta were represented by 23 species at both the stations in Deepor beel, while Ghorajan beel registered 21 species. Chlorophyta exhibited a positive and significant relationships with net plankton (r_1=0.619, p<.01; r_2=0.798, p<.001), phytoplankton (r_1=0.963, p<.001; r_2=0.949, p<.001), Bacillariophyta (r_1=0.861, p<.001; r_2=0.793, p<.001), Cyanophyta (r_1=0.697, p<.001; r_2=0.787, p<.001), Chrysophyta (r_1=0.704, p<.001) and specific conductivity (r_2=0.428, p<.05) indicating interdependence with each other. On the other hand, significant inverse correlation with Cladocera (r_1=-0.477, p<.01) at station I in Deepor beel. Similarly, it exhibited significant positive correlation with net plankton (r_1=0.746, p<.001; r_2=0.526, p<.01), phytoplankton (r_1=0.982, p<.001; r_2=0.962, p<.001), Bacillariophyta (r_1=0.633, p<.001; r_2=0.924, p<.001), Cyanophyta (r_1=0.912, p<.001; r_2=0.696, p<.001), Chrysophyta (r_1=0.505, p<.01; r_2=0.603, p<.01) and total alkalinity (r_2=0.432, p<.05). This group showed inverse but insignificant impact of pH in Deepor beel but no specific trend was evident in Ghorajan beel. The Bacillariophyta were represented by 20 and 19 species in Deepor and Ghorajan beel respectively. Bacillariophyta showed significant positive correlation with net plankton (r_1=0.598, p<.01; r_2=0.736, p<.001), phytoplankton (r_1=0.701, p<.001; r_2=0.892, p<.001), Chlorophyta (r_1=0.861, p<.001; r_2=0.793, p<.001), Chrysophyta (r_1=0.704, p<.001), calcium (r_1=0.419, p<.05) and BOD (r_2=0.426, p<.05). On the other hand, significant inverse correlation with Cladocera (r_1=-0.552, p<.01) at station I in Deepor beel. This group registered significant positive correlation with phytoplankton (r_1=0.674, p<.001; r_2=0.938, p<.001), Chlorophyta (r_1=0.633, p<.001; r_2=0.924, p<.001) and Chrysophyta (r_1=0.546, p<.01; r_2=0.652, p<.001) and significant inverse correlation with zooplankton (r_1=-0.624, p<.01) at station I in Ghorajan beel indicating negative impact on the population pattern. The Cyanophyta was represented by 8 and 7 taxa in Deepor and Ghorajan beel respectively. Cyanophyta showed significant positive correlation with phytoplankton (r_1=0.782, p<.001; r_2=0.907, p<.001), Chlorophyta (r_1=0.697, p<.001; r_2=0.787, p<.001), Chrysophyta (r_1=0.516,

$p<.01$), transparency ($r_2=0.462$, $p<.05$), specific conductivity ($r_2=0.409$, $p<.05$) and BOD ($r_1=0.454$, $p<.05$). On the other hand, significant inverse correlation with zooplankton ($r_1=-0.545$, $p<.01$), Cladocera ($r_1=-0.488$, $p<.05$), magnesium ($r_1=-0.416$, $p<.05$) and silicate ($r_1=-0.439$, $p<.05$) at station I in Deepor beel. However, Cyanophyta exhibited significant positive correlation with net plankton ($r_1=0.717$, $p<.001$; $r_2=0.508$, $p<.01$), phytoplankton ($r_1=0.949$, $p<.001$; $r_2=0.820$, $p<.001$), Chlorophyta ($r_1=0.912$, $p<.001$; $r_2=0.696$, $p<.001$), Chrysophyta ($r_1=0.416$, $p<.05$; $r_2=0.604$, $p<.01$) and calcium ($r_2=0.411$, $p<.05$) in Ghorajan beel. In the present investigation, Euglenophyta was qualitatively less important and poorly represented by only 3 species in Deepor and Ghorajan beel. This group exhibited positive correlation with specific conductivity ($r_1=0.431$, $p<.05$) in Ghorajan beel. Euglenophyta showed significant positive correlation with net plankton ($r_2=0.609$, $p<.01$), phytoplankton ($r_1=0.802$, $p<.001$; $r_2=0.695$, $p<.001$), Chlorophyta ($r_1=0.738$, $p<.001$; $r_2=0.581$, $p<.01$), Cyanophyta ($r_1=0.553$, $p<.01$; $r_2=0.645$, $p<.001$) and Chrysophyta ($r_1=0.606$, $p<.01$) in Deepor beel and significant inverse correlation with Cladocera ($r_1=-0.619$, $p<.01$) at station I in this beel. On the contrary, it showed significant positive correlation with net plankton ($r_1=0.599$, $p<.01$), phytoplankton ($r_1=0.678$, $p<.001$), Chlorophyta ($r_1=0.631$, $p<.001$), Cyanophyta ($r_1=0.589$, $p<.01$), Rhizopoda ($r_1=0.672$, $p<.001$), specific conductivity ($r_1=0.431$, $p<.05$) and phosphate ($r_1=0.595$, $p<.01$) at station I in Ghorajan beel. The Dinophyta were represented only by some motile algae Gonyaulax sp., Peridinium sp. and Ceratium sp. in both the sampled beels. It showed significant positive correlation with net plankton ($r_1=0.622$, $p<.01$; $r_2=0.499$, $p<.05$), phytoplankton ($r_1=0.442$, $p<.05$; $r_2=0.414$, $p<.05$), Chlorophyta ($r_1=0.421$, $p<.05$) and Cyanophyta ($r_2=0.409$, $p<.05$) in Deepor beel, while it exhibited significant inverse relationship with specific conductivity ($r_1=-0.431$, $p<.05$) at station I in this beel. On the other hand, it showed significant positive correlation with net plankton ($r_2=0.508$, $p<.01$), phytoplankton ($r_2=0.665$, $p<.001$), Chlorophyta ($r_2=0.542$, $p<.01$), Bacillariophyta ($r_2=0.514$, $p<.01$), Cyanophyta ($r_2=0.498$, $p<.05$), Rhizopoda ($r_1=0.468$, $p<.05$), free carbon dioxide ($r_1=0.457$, $p<.05$) and total alkalinity ($r_1=0.495$, $p<.05$) in Ghorajan beel. The Chrysophyta was represented by only two species in both the beels. Chrysophyta showed significant positive correlation with phytoplankton ($r_1=0.737$, $p<.001$), Chlorophyta ($r_1=0.729$, $p<.001$), Bacillariophyta ($r_1=0.704$, $p<.001$), Cyanophyta ($r_1=0.516$, $p<.01$) and Euglenophyta ($r_1=0.606$, $p<.01$). It exhibited significant inverse relationships with zooplankton ($r_1=-0.591$, $p<.01$), Cladocera ($r_1=-522$, $p<.01$) and dissolved oxygen ($r_1=-408$, $p<.05$) in Deepor beel. On the other hand, it showed significant positive correlation with net plankton ($r_2=0.411$, $p<.05$), phytoplankton ($r_1=0.511$, $p<.01$; $r_2=0.628$, $p<.01$), Chlorophyta ($r_1=0.505$, $p<.01$; $r_2=0.603$, $p<.01$), Bacillariophyta ($r_1=0.546$, $p<.01$; $r_2=0.652$, $p<.001$), Cyanophyta ($r_1=0.416$, $p<.05$; $r_2=0.604$, $p<.01$) and calcium ($r_1=0.412$, $p<.05$), while it depicted significant inverse relationship with zooplankton ($r_1=-0.617$, $p<.01$) in Ghorajan beel. The multiple correlation of phytoplankton with sixteen abiotic factors was computed and registered 76.5% at station I and 72.4% at station II in Deepor beel, while Ghorajan beel accounted for 72.9% at station I and 59.0% at station II.

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BIO-DATA

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