CHAPTER – 4

RESULTS

4.1 PHYSICO-CHEMICAL ANALYSIS OF WATER

The Physico-chemical analysis of water in Urpod beel during the period of study were Water Temperature, Transparency, p^H, DO, BOD, Free CO_2, Total Alkalinity, Total Hardness, Ca, Mg, Cl, Bicarbonate, Total Dissolved Solids, Total Suspended Solids, Na, K, SO_4, NO_3, PO_4, N, Zn, Cu, Cr and Cd. The results of physico-chemical analysis of the beel water have been depicted in tables (Table 2.1 - 2.9) and are described as follows:

i) Water Temperature (˚C)

The mean water temperature for the study period has been depicted in the Table 2.1 to 2.9. The mean highest temperature recorded for the study period was 27.62 ± 0.69 (Table 2.2) during monsoon season and the lowest value was 14.02 ± 0.55 (Table 2.4) during the winter season in the year 2014-15. While the next year (2015 – 16) showed 12.64˚ ± 1.06 in winter season (Table 2.8) and 26.5 ± 1.18 in monsoon season (Table 2.6), the lowest and highest valuaes. The overall lowest temperature for the period was 13.3˚C ± 1.28 in winter season and the highest 26.92˚C ± 2.07 in monsoon season recorded (Table 2.9) during the whole study period. Water temperature was showed significant positive correlation with N in pre-monsoon (Table 2.10b) and with Na in monsoon season (Table 2.11b) while negative significant correlation with PO_4 in monsoon season (Table 2.11b). Water temperature showed the significant positive correlation with DO, BOD, FCO_2, TA, TDS, TSS, Cl, BIC, Ca, Mg, Na, SO_4 and negative significant correlation with TRN, TH, PO_4, and N in post-monsoon season (Table2.12a and 2.12b) .Water Temperature also showed the significant positive correlation with FCO_2, TA, TSS, Cl, BIC, Mg, SO_4 and negative significant correlation with TRN and BOD in winter season during the study period (Table2.13a, 2.13b).

ii) Transparency (cm)

In the first year the water transparency varies from 41.2 ±0.16 in winter period (Table 2.4) to 56.7 ± 0.18 in monsoon period (Table 2.2). In the second year, the transparency ranges from 43.2 ± 0.17 in winter season (Table 2.8) to 58.8 ± 0.26 in monsoon season (Table 2.6). Transparency showed the significant positive correlation with N and negative correlation with TA, TH, TDS, TSS, Cl, BIC, Ca, Mg, Na, K and SO_4 in pre-monsoon season (Table2.10a and 2.10b). Transparency showed positive significant correlation with BOD and PO_4 and negative significant correlation with FCO_2, TA, TH, TDS, TSS, Cl, Ca, Mg, Na, SO_4 and NO_3 in monsoon season (Table2.11a and 2.11b). Transparency was positively significantly correlated with PO_4 and N and negatively significantly correlated with DO, BOD, FCO_2, TA, TH, TDS, TSS, Cl, BIC, Ca, Mg, , Na, K and SO_4 in post-monsoon season (Table2.12a and 2.12b). Transparency also showed the significant positive correlation with TH and negative significant correlation with FCO_2, TA, TDS, TSS, Cl, BIC, Ca, Mg, Na, K and SO_4 in winter season (Table2.13a and 2.13b).

iii) P^H

The overall data for P^H showed a range between the ranges 6.5 – 7.2 demonstrating a mean value of 7.1. Most of the individual data obtained during the study period from within acidic range showing a range variation between marginally acidic to alkaline range (Table 2.1-2.8). P^H showed significant positive correlation with DO, TA, TH, TDS, TSS, Cl, BIC, Ca, SO_4 in pre-monsoon season (Table 2.10a and 2.10b). P^H showed positive significant correlation with BIC in monsoon season (Table 2.11b). P^H also showed significant negative correlation with N in winter season (Table 2.13b).

iv) Dissolved Oxygen (mgl^{-1})

The minimal DO value 6.3 ± 0.41 was recorded (Table 2.5) in pre-monsoon season in the year of 2015-16 and maximum value 10.2 ± 0.09 was in post-monsoon season in the year 2014 – 15 (Table 2.3). Most of the values were noticed

approximately between 8.0 – 10 mg/l. DO showed significant positive correlation with TA, TH, TDS, TSS, Cl, BIC, Ca, Mg, Na, K, SO_4 and PO_4 in pre-monsoon season (Table 2.10a and 2.10b). DO showed positive significamt correlation with PO_4 and negative correlation with Ca in monsoon season (Table 2.11b). DO showed the significant positive correlation with BOD, FCO_2, TA, TDS, TSS, Cl, BIC, Ca, Mg, Na, and negative significant correlation with TH, PO_4 and N in post-monsoon season(Table 2.12a and 2.12b). DO also presented negative significant correlations with Na in winter season (Table 2.13b).

v) Biochemical Oxygen Demand (mgl^{-1})

During the study period BOD concentration ranges from 5.7 ±0.05 – 7.1±0.18 mg/l. Low concentration of BOD was observed during monsoon period, 2014 – 15 (Table 2.2) and maximum values were found in pre-monsoon of 2014 – 15 (Table 2.1). BOD had prented significant positive correlation with BIC, Na and K in pre-monsoon season (Table 2.10b). BOD showed positive correlation with BIC and negative correlation with FCO_2, TA, TH, TDS, TSS, Cl, Ca, Mg, Na, SO_4, and NO_3 in monsoon season (Table 2.11a and 2.11b). BOD showed the significant positive correlation with FCO_2,TA, TDS, TSS, Cl, BIC, Ca, Mg, Na, NO_3 and negative significant with TH and N in post-monsoon season (Table 2.12a and 2.12b). BOD also exhibited the significant positive correlation with TH and negative significant correlation with TA, Cl, Ca, Mg and K in winter season (Table2.13a and 2.13b).

vi) Free CO_2 (mgl^{-1})

This factor was ranged from of 6.6 ±0.29 (pre-monsoon) (Table 2.1) to 6.9±0.16 mg/l (post-monsoon) (Table 2.3) during the year 2014-15. In the next year the values were ranges from 5.7±0.05 (Table 2.6) to 6.4±0.24 in monsoon and pre-monsoon (Table 2.5) seasons respectively. FCO_2 showed positive significant correlation with TA, TH, TDS, TSS, Cl, Ca, Mg, Na, SO_4, NO_3 and negative correlation with PO_4 in monsoon season (Table 2.11a and 2.11b). FCO_2 showed the significant positive correlation with TA, TDS, TSS, Cl, BIC, Mg, Na, K, SO_4 and negative significant correlation with TH in post-monsoon season (Table 2.12a and

2.12b). FCO_2 also showed the significant positive correlation with TA, TDS, TSS, Cl, BIC,Ca, Mg, Na, K, SO_4 and negative correlation with ($P<0.05$) TH in winter season (Table 2.13a and 2.13b).

vii) Total Alkalinity (mgl^{-1})

The total alkalinity ranges from 30.2 ± 0.17 in monsoon season (Table 2.2) and 40.4 ± 0.18 in pre-monsoon season (Table 2.1) during the first year of observation 2014 – 15. In the next year the values ranges from 28.6 ± 0.11 in monsoon season (Table 2.6) to 31.9 ± 0.89 in pre-monsoon season (Table 2.5). TA is showed significant positive correlation with TH, TDS, TSS, Cl, BIC, Ca, Mg, Na, K, SO_4 and PO_4 in pre-monsoon season (Table 2.10a and 2.10b). TA showed positive correlation with TH, TDS, TSS, Cl, Ca, Mg, Na, SO_4, NO_3 and negative significant correlation with BIC and PO_4 in monsoon season (Table 2.11a and 2.11b). TA showed the significant positive correlation with TDS, TSS, Cl, BIC, Ca, Mg, Na, K, SO_4 and negative significant correlation with TH, PO_4 and N in post-monsoon season (Table 2.12a and 2.12b). TA also showed the significant positive correlation with TDS, TSS, Cl, BIC, Ca, Mg, Na, K, SO_4 and negative significant correlation with TH in winter season (Table 2.13a and 2.13b).

viii) Total Hardness (mgl^{-1})

This parameter in the lake water ranged between 26.2 ± 0.23 in post monsoon season (Table 2.3) to 37.4 ± 0.40 in pre-monsoon in the year 2014 – 15 (Table 2.1). In the year 2015 – 16 the values ranges from 28.0 ± 0.17 in post-monsoon (Table 2.7) to 33.8 ± 0.67 in pre-monsoon season (Table 2.5). TH was positively significantly correlated with TDS, TSS, Cl, BIC, Ca, Mg, Na, K, SO_4, and PO_4 in pre-monsoon season (Table 2.10a and 2.10b). TH showed the positive significant correlation with TDS, TSS, Cl, Ca, Mg, Na, SO_4, NO_3 and negative correlation with BIC and PO_4 in monsoon season (Table 2.11a and 2.11b). TH showed the significant positive correlation with PO_4 and N and negative correlation with TDS, TSS, Cl, BIC, Ca, Mg, Na, K and SO_4 in post-monsoon season (Table 2.12a and 2.12b). TH has been able to

project significantly negative correlation with TDS, TSS, Cl, BIC, Ca, Mg, Na, K, and SO_4 in winter season (Table 2.13a and 2.13b).

ix) Calcium (mgl^{-1})

During the two years of study period, the mean values of Ca ranged from 15.7± 0.36 – 18.98 ± 0.08 mg/l. Its minimal values was noticed in post monsoon in the year 2015 -16 (Table 2.7) whereas its maximum value was noticed in pre-monsoon in the year 2014 – 15 (Table 2.1). The pre-monsoon values of the whole lake in the first year were found to be higher than the second year. In general the higher values of calcium may due to the decomposition of organic materials that releases the CO_2 which brings calcium in to the system. Ca showed significant positive correlation with Mg, Na, K, SO_4 and PO_4 in pre-monsoon season (Table 2.10c). Ca showed positive significant correlation with Mg, Na, SO_4, NO_3 and negative correlation with PO_4 in monsoon season (Table 2.11c). Ca showed the significant positive correlation with Mg, Na, K, SO_4 and negative correlation with PO_4 and N in post-monsoon season (Table 2.12c). Ca was found positively correlated with Mg, Na, K, SO_4, and N in winter season (Table 2.13c).

x) Magnesium (mgl^{-1})

The concentration of magnesium in the beel was found in minimum (12.0 ± 0.04) in post-monsoon season, 2015 – 16 (Table 2.7) and the maximum (17.9 ± 0.05) in pre-monsoon season, 2014 -15 (Table 2.1). Mg showed significant positive correlation with Na, K, SO_4, PO_4 in pre-monsoon season (Table 2.10c). Mg showed positive correlation with Na, SO_4, NO_3 and negative correlation with PO_4 in monsoon season (Table 2.11c). Mg showed the significant positive correlation with Na, K, SO_4, NO_3 and negative correlation with PO_4 and N in post-monsoon season (Table 2.12c). Mg demonstrated the positive correlation with those of Na, K and SO_4 during the winter season (Table 2.13c).

xi) Chloride (mgl^{-1}):

Chloride content of the beel water ranged from 1.9 ± 0.1 – 11.0 ± 0.05 mg/l. The minimum values were noticed in post-monsoon season, 2015 – 16 (Table 2.7) and the maximum values noticed in pre-monsoon season, in the year 2014 -15 (Table 2.1). Cl was showed significant positive correlation with BIC, Ca, Mg, Na, K, SO_4 and PO_4 in pre-monsoon season (Table 2.10c). Cl showed positive correlation with Ca, Mg, Na, SO_4, NO_3 and negative correlation with BIC and PO_4 in monsoon season (Table 2.11c). Cl showed the significant positive correlation with BIC, Ca, Mg, Na, K, SO_4 and negative correlation with PO_4 and N in post-monsoon season (Table 2.12c). Cl also presented significant positive correlation with BIC, Ca, Mg, Na, K, SO_4 and N in winter season (Table 2.13c).

xii) Bicarbonate (mgl^{-1})

Bicarbonate values ranged between 29.0 ±0.05– 36.0±0.05 mg/l in the first year of observation 2014-2015. The minimum value was found in monsoon season (Table 2.2) and the maximum was found in pre-monsoon season (Table 2.1). In the second year the values ranges between 29.6 ± 0.49 in monsoon season (Table 2.6) to 32.6 ± 0.73 in pre-monsoon season (Table 2.5). BIC showed the significant positive correlation with Ca, Mg, Na, K, SO_4 and PO_4 in pre-monsoon season (Table 2.10c). BIC showed significant negative correlation with Ca, Mg, SO_4 and NO_3 in monsoon season (Table 2.11c). BIC showed the significant positive correlation with Ca, Mg, Na, K, SO_4 and negative correlation with PO_4 and N in post-monsoon season (Table 2.12c). BIC showed positive correlation with Ca, Mg, Na, K, SO_4 and N in winter season (Table 2.13c).

xiii) Total Dissolved Solids (mgl^{-1})

Total Dissolved Solids (TDS) plays an important role in community structure due to its limiting impart or primary production and trophodynamics. TDS of the beel water during the survey period was found to be ranged between 11.9 ± 0.27 in monsoon of 2015 -16 (Table 2.6) to 22.0 ± 0.17 in pre-monsoon, 2014 – 15 (Table 2.1). TDS showed significant positive correlation with TSS, Cl, BIC, Ca, Mg, Na, K,

SO_4 and PO_4 in pre-monsoon season (Table 2.10a and 2.10b). TDS exhibited significant positive correlation with those of TSS, Cl, Ca, Mg, Na, SO_4 and NO_3 and significant negative correlation with BIC, K and PO_4 during monsoon (Table 2.11a and 2.11b). TDS showed significant positive correlation with TSS, Cl, BIC, Ca, Mg Na, SO_4 and negative correlation with PO_4 and N in post-monsoon season (Table 2.12a and 2.12b). TDS also showed significant positive correlation with those of TSS, Cl, BIC, Ca, Mg Na, K, SO_4, NO_3, PO_4 and N during winter season (Table 2.13a and 2.13b).

xiv) Total Suspended Solids (mgl^{-1})

The Total Suspended Solids of the water sample was 72.0 ±0.12 which was maximum in monsoon (Table 2.2) whereas, minimum value 64.0 ± 0.15 was observed in pre-monsoon period during the year 2014 -15 (Table 2.1). The TSS value observed was 64.1±0.42 as the maximum in post-monsoon (Table 2.7) and minimum 60.0±0.11 during pre-monsoon period (Table 2.5) during the year 2015 – 16. TSS value showed significant positive correlation with those of Cl, BIC, Ca, Mg, Na, K, SO_4 and PO_4 in pre-monsoon season (Table 2.10b). TSS presented significant positive correlation with Cl, Ca, Mg, Na, SO_4 and NO_3 and negative correlation with BIC and PO_4 in monsoon season (Table 2.11b). TSS exhibited significant positive correlation with those of Cl, BIC, Ca, Mg, Na, K, SO_4, NO_3 and negative correlation with only PO_4 and N in post-monsoon season (Table 2.12b). TSS also showed the significant positive correlation with Cl, BIC, Ca, Mg, Na, K and SO_4 in winter season (Table 2.13b).

xv) Sodium (mgl^{-1})

Sodium (Na) concentration in the beel water ranged between 0.60 mg/l in pre-monsoon, 2015 -2016 (Table 2.5) to 0.70 mg/l in post-monsoon and winter season 2014 – 2015 (Table 2.3 and 2.4). The first year values were higher than the second year during the study period. Na showed significant positive correlation with K, SO_4 and PO_4 in pre-monsoon season (Table 2.10c). Na presented positive significant correlation with SO_4 and NO_3 while significant negative significant correlation with PO_4 in monsoon season (Table 2.11c) was demonstrated. Na showed the significant

positive significant correlation with K and SO_4 and negative correlation with PO_4 and N in post-monsoon season (Table 2.12c). Na suggested the significant positive correlation with those of K, SO_4 and N in winter season (Table 2.13c).

xvi) Potassium (mgl^{-1})

The quantity of potassium in the beel water ranged from 1.31 ± 0.01 – 1.48 ± 0.04 mg/l where in the minimum was noticed in pre-monsoon (Table 2.5) in the year 2015 – 16 and the maximum was found in the winter season of the year 2014 -15 (Table 2.4). Comparatively the first year values were found to be higher than the second year. K showed the significant positive correlation only with SO_4 in pre-monsoon (Table 2.10c) and with N in monsoon season (Table 2.11c). In post-monsoon period the K showed the significant positive correlation with that of SO_4 and negative correlation with PO_4 and N (Table 2.12c). K also showed the significant positive correlation with PO_4 and N in winter season (Table 2.13c).

xvii) Sulphate (mgl^{-1})

Sulphates (SO_4) of beel water was observed to be ranged between 4.4 – 6.8 mg/l, wherein the minimum was noticed in winter season, 2015 – 16 (Table 2.8) and the maximum was noticed in pre-monsoon and monsoon season, 2014 -15 (Table 2.1 and 2.2). SO_4 showed significant positive correlation with that of PO_4 in pre-monsoon season (Table 2.10c). In monsoon season SO_4 presented significant positive correlation with NO_3 and negative correlation with PO_4 (Table 2.11c). SO_4 significantly negatively correlated with PO_4 in post-monsoon season $p<0.05$ (Table 2.12c).

xviii) Nitrate (mgl^{-1}):

The quality of nitrate of beel water ranged from 0.8 – 1.0 mg/l. The minimal values were noticed in most of the localities in winter season on both the year (Table 2.4 and 2.8). No specific seasonal pattern was observed in both the years. NO_3 showed significant negative correlation with N in post-monsoon season (Table 2.12c).

xix) Phosphate (mgl^{-1})

During the course of study on Urpod beel the PO_4 had been found to be ranged between 0.1 – 0.17 mg/l. The minimal value was noticed in monsoon and post – monsoon (2014 -15), Table 2.2 and 2.3. The maximum value was noticed in pre-monsoon during the year 2014 – 15 (Table 2.1). PO_4 showed the significant positive correlation with N in post-monsoon season (Table 2.12c) and winter season (Table 2.13c).

xx) Nitrogen (mgl^{-1})

Nitrogen (N) values have been between from 1.5 – 1.9 mg/l in the first year of observation. The minimum values were found in pre-monsoon and post-monsoon seasons (Table 2.1 and 2.3) and the maximum values in winter season (Table 2.4). In the second year of observation the values were found between the ranges of 1.7 – 1.8 mg/l respectively in the whole season. No specific seasonwise trend was noticed of this factor during the study period on Urpod beel (Table 2.5-2.8).

xxi) Zinc (mgl^{-1})

The concentration of zinc (Zn) in the study has been found to be ranged between 0.24 – 0.27 mg/l. Most of the values were noticed approximately between 0.24 – 0.26 mg/l in both the study years (Table 2.1-2.8).

xxii) Copper (mgl^{-1})

The low concentration of Cu values was found in the study period. In pre-monsoon season a very low concentration of Cu was observed (0.001mg/l) (Table 2.1) in the first year of observation. In pre-monsoon and post-monsoon season Cu was observed (0.002mgl) in the second year of observation (Table 2.5 and 2.7).

xxiii) Chromium (mgl^{-1})

The chromium (Cr) concentrations were found in the bellow detectable level in both the years (Table 2.1-2.8)

xxiv) Cadmium (mgl^{-1})

The values of cadmium (Cd) were also found in very low concentration (0.002 – 0.003 mg/l) in both the years (Table 2.1-2.8).

Table 2.1: - Assay of physico-chemical parameters of Urpod beel water during Pre-monsoon period, 2014-15 (S-1, S-2, S-3, S-4, S-5-indicate different sampling and study sites).

Site → Parameters ↓	S-1	S-2	S-3	S-4	S-5	Mean ±SD
Water Temp (˚C)	20.3 ±0.63	20.0 ±0.56	20.9 ±0.08	20.9 ±0.08	20.8 ±0.22	20.6 ± 0.39
Transparncy (cm)	43.4 ±0.47	43.6 ±0.52	43.8 ±0.43	44.0 ±0.34	44.3 ±0.60	43.8 ± 0.35
pH	7.1 ±0.18	7.2 ±0.17	7.0 ±0.13	7.3 ±0.25	7.3 ±0.19	7.2 ± 0.13
DO (mg./l)	6.9 ±0.08	7.4 ±0.18	7.1 ±0.11	7.1 ±0.1	7.2 ±0.18	6.7 ± 0.15
BOD (mg./l)	6.9 ±0.1	6.7 ±0.2	6.7 ±0.22	6.8 ±0.26	6.5 ±0.15	7.1 ± 0.18
Free CO_2 (mg./l)	6.2 ±0.02	6.8 ±0.08	6.5 ±0.16	6.5 ±0.16	6.9 ±0.1	6.6 ± 0.29
Total Alkalinity (mg./l)	40.6 ±0.89	40.6 ±1.14	40.2 ±0.21	40.5 ±0.43	40.3 ±0.37	40.4 ± 0.18
Total Hardness (mg./l)	37.0 ±0.15	37.6 ±0.57	37.9 ±0.30	37.6 ±0.39	37.0 ±0.18	37.4 ± 0.40
Calcium (Ca) (mg./l)	18.9 ±0.08	19.08 ±0.14	18.90 ±0.11	19.0 ±0.1	19.04 ±0.08	18.98 ± 0.08
Magnesium (Mg) (mg./l)	17.9 ±0.04	17.9 ±0.1	18.0 ±0.10	18.0 ±0.15	17.9 ±0.30	17.9 ± 0.05
Chloride (Cl) (mg./l)	10.9 ±0.13	10.9 ±0.08	11.0 ±0.15	11.0 ±0.25	11.0 ±0.16	11.0 ± 0.05
Bicarbonate (mg./l)	36.0 ±0.13	36.0 ±0.16	35.9 ±0.08	36.0 ±0.10	36.0 ±0.13	36.0 ± 0.05
Total Dissolved Solids (mg./l)	21.9 ±0.08	21.8 ±0.15	22.1 ±0.16	22.2 ±0.19	21.9 ±0.50	22.0 ± 0.17
Total Suspended Solids (mg./l)	64.3 ±0.18	64.0 ±0.10	63.8 ±0.05	63.9 ±0.15	64.1 ±0.15	64.0 ± 0.15
Sodium (Na) (mg./l)	0.63 ±0.008	0.64 ±0.01	0.62 ±0.007	0.62 ±0.007	0.61 ±0.01	0.62 ± 0.01
Potassium (K) (mg./l)	1.35 ±0.007	1.35 ±0.01	1.35 ±0.012	1.35 ±0.012	1.34 ±0.013	1.34 ± 0.004
Sulphate (SO_4) (mg./l)	6.6 ±0.18	6.5 ±0.2	6.8 ±0.08	7.0 ±0.15	6.9 ±0.11	6.8 ± 0.21
Nitrate (NO_3) (mg./l)	0.9 ±0.05	1.0 ±0.05	1.0 ±0.10	1.0 ±0.1	1.0 ±0.1	0.98 ± 0.03
Phosphate (PO_4) (mg./l)	0.17 ±0.005	0.17 ±0.005	0.18 ±0.004	0.18 ±0.005	0.17 ±0.005	0.17 ± 0.005

Nitrogen(N) (mg./l)	1.5 ±0.11	1.5 ±0.07	1.6 ±0.05	1.6 ±0.05	1.5 ±0.05	1.5 ± 0.05
Zinc(Zn) (mg./l)	0.260 ±0.01	0.263 ±0.01	0.262 ±0.01	0.262 ±0.01	0.261 ±0.01	0.261 ± 0.01
Copper(Cu) (mg./l)	0.001 ±0.01	0.001 ±0.01	0.002 ±0.01	0.001 ±0.01	0.001 ±0.01	0.001 ± ND
Chromium (Cr) (mg./l)	BDL	BDL	BDL	BDL	BDL	----
Cadmium (Cd) (mg./l)	0.002 ±0.001	0.002 ±0.001	0.002 ±0.001	0.002 ±0.001	0.001 ±0.001	0.002 ± 0.001

Table 2.2: - Assay of physico-chemical parameters of Urpod beel water during Monsoon period, 2014-15 (S-1, S-2, S-3, S-4, S-5-indicate different sampling and study sites).

Sites → Parameters ↓	S-1	S-2	S-3	S-4	S-5	Mean ±SD
Water Temp (˚C)	26.5 ±0.09	27.4 ±0.11	28.0 ±0.04	28.0 ±0.16	28.2 ±0.18	27.62 ± 0.69
Transparncy (cm)	56.8 ±0.89	56.8 ±0.09	56.4 ±0.22	56.6 ±0.27	56.7 ±0.39	56.7 ± 0.18
pH	6.8 ±0.70	6.9 ±0.8	6.9 ±0.12	6.8 ±0.89	6.9 ±0.54	6.9 ± 0.08
DO (mg./l)	8.0 ±0.17	8.0 ±0.07	8.3 ±0.10	8.1 ±0.11	8.0 ±0.05	8.1 ± 0.13
BOD (mg./l)	5.8 ±0.13	5.7 ±0.08	5.7 ±0.07	5.7 ±0.05	5.8 ±0.10	5.7 ± 0.05
Free CO_2 (mg./l)	6.9 ±0.05	6.9 ±0.08	6.9 ±0.13	6.3 ±0.08	6.8 ±0.07	6.8 ± 0.26
Total Alkalinity (mg./l)	30.1 ±0.10	30.2 ±0.07	30.3 ±0.55	30.3 ±30	29.9 ±0.10	30.2 ± 0.17
Total Hardness (mg./l)	34.0 ±0.55	34.6 ±0.09	34.7 ±0.13	34.4 ±0.25	34.6 ±0.24	34.5 ± 0.28
Calcium (Ca) (mg./l)	18.06 ±0.09	18.08 ±0.13	17.08 ±0.05	17.24 ±0.05	17.14 ±0.10	17.52 ± 0.50
Magnesium (Mg) (mg./l)	16.0 ±0.08	16.1 ±0.09	15.9 ±0.08	16.0 ±0.08	15.9 ±0.08	16.0 ± 0.10
Chloride (Cl) (mg./l)	9.7 ±0.18	9.5 ±0.10	9.8 ±0.08	9.5 ±0.10	9.6 ±0.05	9.6 ± 0.13
Bicarbonate (mg./l)	29.0 ±0.15	29.0 ±0.16	29.1 ±0.19	29.0 ±0.12	29.1 ±0.13	29.0 ± 0.05
Total Dissolved Solids (mg./l)	18.0 ±0.13	17.9 ±0.10	17.8 ±0.04	18.2 ±0.15	18.1 ±0.08	18.0 ± 0.15
Total Suspended Solids (mg./l)	72.0 ±0.07	71.8 ±0.48	72.1 ±0.13	72.1 ±0.10	72.0 ±0.05	72.0 ± 0.12
Sodium (Na) (mg./l)	0.67 ±0.008	0.68 ±0.01	0.66 ±0.10	0.68 ±0.01	0.68 ±0.008	0.67 ± 0.008
Potassium (K) (mg./l)	1.37 ±0.007	1.37 ±0.01	1.39 ±0.01	1.40 ±0.01	1.39 ±0.01	1.37 ± 0.04

Sulphate (SO_4) (mg./l)	6.3 ±0.13	6.8 ±0.11	6.8 ±0.08	7.0 ±0.08	6.9 ±0.15	6.8 ± 0.29
Nitrate (NO_3) (mg./l)	0.96 ±0.55	0.98 ±0.08	1.0 ±0.05	1.0 ±0.08	0.98 ±0.11	0.98 ± 0.02
Phosphate (PO_4) (mg./l)	0.1 ±0.004	0.09 ±0.009	0.1 ±0.004	0.1 ±0.005	0.09 ±0.01	0.1 ± 0.003
Nitrogen(N) (mg./l)	1.7 ±0.15	1.5 ±0.04	1.8 ±0.09	1.8 ±0.08	1.8 ±0.09	1.8 ± 0.04
Zinc(Zn) (mg./l)	0.263 ±0.008	0.260 ±0.005	0.260 ±0.003	0.261 ±0.003	0.260 ±0.002	0.260 ± 0.01
Copper(Cu) (mg./l)	BDL	BDL	BDL	BDL	BDL	------
Chromium (Cr) (mg./l)	BDL	BDL	BDL	BDL	BDL	------
Cadmium (Cd) (mg./l)	0.003 ±0.001	0.003 ±0.001	0.002 ±0.001	0.003 ±0.002	0.003 ±0.002	0.003 ± 0.001

Table 2.3: -Assay of physico-chemical parameters of Urpod beel water during Post-monsoon period, 2014-15 (S-1, S-2, S-3, S-4, S-5 indicate different sampling and study sites).

Sites → Parameters ↓	S-1	S-2	S-3	S-4	S-5	Mean ±SD
Water Temp (˚C)	25.3 ± 0.21	25.6 ±0.09	25.0 ±0.05	25.0 ±0.25	25.4 ±0.19	25.26 ± 0.26
Transparncy (cm)	45.2 ±0.18	45.1 ±0.13	45.0 ±0.04	45.4 ±0.15	45.2 ±0.24	45.2 ± 0.18
pH	6.6 ±0.13	6.7 ±0.13	6.6 ±0.11	6.7 ±0.11	6.6 ±0.11	6.7 ± 0.05
DO (mg./l)	10.2 ±0.17	10.4 ±0.17	10.2 ±0.17	10.2 ±0.14	10.2 ±0.12	10.2 ± 0.09
BOD (mg./l)	6.2 ±0.17	6.4 ±0.12	6.0 ±0.04	6.3 ±0.13	6.3 ±0.14	6.2 ± 0.15
Free CO_2 (mg./l)	6.9 ±0.16	6.6 ±0.16	7.0 ±0.61	7.0 ±0.08	6.9 ±0.08	6.9 ± 0.16
Total Alkalinity (mg./l)	32.0 0.20	32.2 ±0.02	32.2 ±0.21	32.1 0.11	31.9 0.1	32.0 ± 0.13
Total Hardness (mg./l)	26.3 ±0.20	26.0 ±0.18	26.0 ±0.11	26.4 ±0.21	26.5 0.04	26.2 ± 0.23
Calcium (Ca) (mg./l)	17.02 ±0.11	17.0 ±0.12	16.22 ±0.04	16.04 ±0.04	16.68 ±0.12	16.59 ± 0.44
Magnesium (Mg) (mg./l)	13.0 ±0.10	13.0 ±0.11	12.9 ±0.55	13.2 ±0.11	13.2 ±0.07	13.0 ± 0.11
Chloride (Cl) (mg./l)	8.3 ±0.15	8.0 ±0.1	8.3 ±0.08	8.3 ±0.13	8.4 ±0.13	8.3 ± 0.15
Bicarbonate (mg./l)	31.0 ±0.08	31.0 ±0.13	31.0 ±0.11	31.0 ±0.05	31.0 ±0.05	31.0 ± 0.02

Total Dissolved Solids (mg./l)	12.9 ±0.11	13.0 ±0.13	13.1 ±0.11	13.0 ±0.08	13.2 ±0.08	13.0 ± 0.11
Total Suspended Solids (mg/l)	69.0 ±0.23	69.1 ±0.07	68.5 ±0.48	68.8 ±0.47	69.2 ±0.12	68.9 ± 0.28
Sodium (Na) (mg./l)	0.70 ±0.01	0.68 ±0.007	0.70 ±0.02	0.72 ±0.01	0.71 ±0.007	0.70 ± 0.01
Potassium (K) (mg./l)	1.43 ±0.02	1.40 ±0.007	1.42 ±0.01	1.44 ±0.005	1.44 ±0.005	1.43 ± 0.02
Sulphate (SO_4) (mg./l)	5.4 ±0.08	5.3 ±0.11	5.4 ±0.11	5.5 ±0.15	5.4 ±0.08	5.4 ± 0.05
Nitrate (NO_3) (mg./l)	0.9 ±0.05	0.9 ±0.04	0.8 ±0.04	0.9 ±0.05	0.9 ±0.04	0.9 ± 0.04
Phosphate (PO_4) (mg./l)	0.1 ±0.004	0.1 ±0.008	0.1 ±0.004	0.1 ±0.005	0.09 ±0.01	0.1 ± 0.01
Nitrogen (N) (mg./l)	1.5 ±0.08	1.4 ±0.09	1.5 ±0.08	1.5 ±0.05	1.5 ±0.05	1.5 ± 0.04
Zinc(Zn) (mg./l)	0.250 ±0.008	0.249 ±0.004	0.251 ±0.001	0.252 ±0.008	0.251 ±0.003	0.250 ± 0.01
Copper (Cu) (mg./l)	BDL	BDL	BDL	BDL	BDL	-----
Chromium (Cr) (mg./l)	BDL	BDL	BDL	BDL	BDL	------
Cadmium (Cd) (mg./l)	0.003 ±0.001	0.003 ±0.001	0.003 ±0.001	0.003 ±0.001	0.002 ±0.001	0.003 ± 0.001

Table 2.4: - Assay of physico-chemical parameters of Urpod beel water during Winter period, 2014 to 2015 (S-1, S-2, S-3, S-4, S-5 indicate different sampling and study sites).

Sites → Parameters ↓	S-1	S-2	S-3	S-4	S-5	Mean ±SD
Water Temp (˚C)	13.2 ±1.30	14.4 ±0.55	14.6 ±0.55	13.8 ±0.84	14.1 ±0.74	14.02 ± 0.55
Transparncy (cm)	41.3 ±0.07	41.4 ±0.08	41.3 ±0.27	41.2 ±0.08	41.0 ±0.08	41.2 ± 0.16
pH	6.5 ±0.23	6.7 ±0.15	6.7 ±0.15	6.3 ±0.15	6.5 ±0.15	6.5 ± 0.17
DO (mg./l)	8.2 ±0.82	8.7 ±0.08	8.6 ±0.15	8.6 ±0.18	8.6 ±0.13	8.5 ± 0.19
BOD (mg./l)	6.0 ±0.12	5.9 ±0.11	5.9 ±0.07	6.6 ±0.13	6.1 ±0.08	6.1 ± 0.34
Free CO_2 (mg./l)	6.7 ±0.16	6.6 ±0.07	6.6 ±0.08	7.0 ±0.12	7.0 ±0.11	6.8 ± 0.20
Total Alkalinity (mg./l)	32.1 ±0.17	32.3 ±0.19	32.2 ±0.14	32.3 ±0.04	32.2 ±0.17	32.2 ± 0.08
Total Hardness (mg./l)	29.3 ±0.21	29.0 ±0.05	29.2 ±0.11	29.4 ±0.1	29.4 ±0.09	29.2 ± 0.18
Calcium (Ca) (mg./l)	16.67 ±0.15	16.38 ±0.13	16.52 ±0.15	16.16 ±0.15	16.44 ±0.10	16.43 ± 0.19

Magnesium (Mg) (mg./l)	16.0 ±0.16	16.3 ±0.04	16.0 ±0.09	15.9 ±0.07	16.0 ±0.09	16.0 ± 0.04
Chloride (Cl) (mg./l)	8.0 ±0.09	8.2 ±0.12	8.3 ±0.05	8.3 ±0.08	8.3 ±0.05	8.2 ± 0.13
Bicarbonate (mg./l)	31.0 ±0.07	31.0 ±0.05	31.1 ±0.04	31.1 ±0.05	31.1 ±0.07	31.0 ± 0.04
Total Dissolved Solids (mg./l)	15.0 ±0.15	14.8 ±0.04	14.9 ±0.08	15.1 ±0.09	15.2 ±0.05	15.0 ± 0.13
Total Suspended Solids (mg./l)	65.0 ±0.29	65.2 ±0.31	65.6 ±0.37	65.3 ±0.23	65.1 ±0.21	65.2 ± 0.22
Sodium (Na) (mg./l)	0.70 ±0.01	0.68 ±0.01	0.70 ±0.008	0.70 ±0.008	0.69 ±0.007	0.70 ± 0.005
Potassium (K) (mg./l)	1.47 ±0.03	1.44 ±0.02	1.48 ±0.03	1.46 ±0.02	1.48 ±0.004	1.48 ± 0.04
Sulphate (SO_4) (mg./l)	4.7 ±0.09	4.8 ±0.08	4.7 ±0.07	4.8 ±0.13	4.9 ±0.09	4.7 ± 0.15
Nitrate (NO_3) (mg./l)	0.8 ±0.84	0.8 ±0.08	0.9 ±0.04	0.8 ±0.07	0.8 ±0.07	0.8 ± 0.05
Phosphate (PO_4) (mg./l)	0.13 ±0.01	0.11 ±0.004	0.14 ±0.004	0.13 ±0.01	0.14 ±0.005	0.13 ± 0.12
Nitrogen (N) (mg./l)	1.9 ±0.09	1.8 ±0.05	1.9 ±0.04	1.9 ±0.08	2.0 ±0.05	1.9 ± 0.07
Zinc(Zn) (mg/l)	0.247 ±0.01	0.248 ±0.01	0.248 ±0.01	0.248 ±0.01	0.249 ±0.01	0.248 ± 0.01
Copper (Cu) (mg./l)	BDL	BDL	BDL	BDL	BDL	----
Chromium (Cr) (mg./l)	BDL	BDL	BDL	BDL	BDL	----
Cadmium (Cd) (mg./l)	0.003 ±0.001	0.002 ±0.001	0.003 ±0.001	0.003 ±0.001	0.003 ±0.001	0.003 ±0.001

Table 2.5: - Assay of physico-chemical parameters of Urpod beel water during Pre-monsoon period, 2015-16 (S-1, S-2, S-3, S-4, S-5 -indicate different sampling and study sites).

Sites → Parameters↓	S-1	S-2	S-3	S-4	S-5	Mean ±SD
Water Temp (˚C)	20.4 ±1.14	20.6 ±2.07	20.8 ±1.30	21.2 ±1.48	21.2 ±1.48	20.8 ±0.36
Transparncy (cm)	44.6 ±2.01	44.6 ±2.07	46.6 ±1.14	45.2 ±2.58	46.6 ±1.40	45.5 ±1.10
pH	6.9 ±0.27	6.9 ±0.13	6.9 ±0.11	7.1 ±0.16	7.1 ±0.16	7.0 ±0.10
DO (mg./l)	6.2 ±0.24	5.9 ±0.15	5.9 ±0.19	6.4 ±0.16	6.9 ±0.15	6.3 ±0.41
BOD (mg./l)	6.3 ±0.16	6.5 ±0.14	6.3 ±0.16	6.8 ±0.08	6.6 ±0.13	6.5 ±0.21

Free CO_2 (mg./l)	6.5 ±0.29	6.5 ±0.31	6.1 ±0.20	6.7 ±0.30	6.2 ±0.19	6.4 ±0.24
Total Alkalinity (mg./l)	31.1 ±1.08	31 ±1.58	32.6 ±0.91	33 ±1.48	32 ±1.58	31.9 ±0.89
Total Hardness (mg./l)	33.2 ±0.82	33 ±1.54	34.2 ±1.48	34.6 ±1.14	33.8 ±1.64	33.8 ±0.67
Calcium (Ca) (mg./l)	17.8 ±0.58	18.2 ±0.52	18.2 ±0.52	18.0 ±0.48	18.0 ±0.48	18.0 ±0.17
Magnesium (Mg) (mg./l)	16.0 ±0.25	16.0 ±0.22	16.2 ±0.27	15.8 ±0.18	15.8 ±0.15	16.0 ±0.17
Chloride (Cl) (mg./l)	4.0 ±0.18	4.1 ±0.16	4.2 ±0.25	4.0 ±0.20	3.9 0.22	4.0 ±0.11
Bicarbonate (mg./l)	32.8 ±1.11	32.7 ±1.29	31.3 ±0.97	33.2 ±1.31	32.8 ±1.30	32.6 ±0.73
Total Dissolved Solids (mg./l)	18.0 ±0.31	18.0 ±0.24	17.7 ±0.24	18.0 ±0.31	18.0 ±0.24	17.9 ±0.13
Total Suspended Solids (mg./l)	59.9 ±0.16	59.9 ±0.13	60.1 ±0.1	60.1 ±0.01	60.1 ±0.49	60.0 ±0.11
Sodium (Na) (mg./l)	0.60 ±0.01	0.58 ±0.01	0.59 ±0.01	0.62 ±0.02	0.59 ±0.01	0.60 ±0.01
Potassium (K) (mg./l)	1.31 ±0.01	1.33 ±0.01	1.30 ±0.01	1.32 ±0.01	1.31 ±0.01	1.31 ±0.01
Sulphate (SO_4) (mg./l)	6.0 ±0.11	5.9 ±0.15	5.8 ±0.17	6.2 ±0.15	6.1 ±0.11	6.0 ±0.16
Nitrate (NO_3) (mg./l)	0.99 ±0.13	0.97 ±0.43	1.0 ±0.08	0.97 ±0.04	0.98 ±0.84	0.98 ±0.01
Phosphate (PO_4) (mg./l)	0.15 ±0.007	0.13 ±0.011	0.16 ±0.012	0.15 ±0.007	0.16 ±0.007	0.15 ±0.01
Nitrogen(N) (mg./l)	1.6 ±0.07	1.4 ±0.08	1.7 ±0.14	1.9 ±0.16	1.8 ±0.13	1.7 ±0.17
Zinc(Zn) (mg/l)	0.256 ±0.001	0.258 ±0.001	0.257 ±0.001	0.258 ±0.001	0.261 ±0.001	0.258 ±0.001
Copper(Cu) (mg./l)	0.002 ±0.001	0.002 ±0.001	0.002 ±0.001	0.002 ±0.001	0.002 ±0.001	0.002 ±ND
Chromium (Cr) (mg./l)	BDL	BDL	BDL	BDL	BDL	------
Cadmium (Cd) (mg./l)	0.002 ±0.001	0.002 ±0.001	0.002 ±0.001	0.002 ±0.001	0.002 ±0.001	0.002 ±ND

Table 2.6:- Assay of physico-chemical parameters of Urpod beel water during Monsoon period,2015-16 (S-1, S-2, S-3, S-4, S-5-indicate different sampling and study sites).

Sites → Parameters ↓	S-1	S-2	S-3	S-4	S-5	Mean ±SD
Water Temp (˚C)	26.6 ±2.19	25.8 ±2.58	26.2 ±2.58	25.3 ±1.71	28.4 ±0.89	26.5 ±1.18
Transparncy (cm)	58.4 ±2.88	59.0 ±1.58	59.0 ±1.58	58.8 ±1.48	59.0 ±1.58	58.8 ±0.26

p^H	7.0 ±0.54	6.9 ±0.21	6.7 ±0.16	6.9 ±0.13	7.0 ±0.13	6.9 ±0.12
DO (mg./l)	8.3 ±0.23	8.2 ±0.23	8.1 ±0.15	8.4 ±0.17	8.2 ±0.11	8.2 ±0.11
BOD (mg./l)	6.3 ±0.38	6.0 ±0.16	5.9 ±0.18	5.9 ±0.11	6.0 ±0.18	6.0 ±0.16
Free CO_2 (mg./l)	5.7 ±0.15	5.6 ±0.21	5.6 ±0.18	5.7 ±0.09	5.7 ±0.13	5.7 ±0.05
Total Alkalinity (mg./l)	28.6 ±0.55	28.5 ±0.68	28.6 ±0.54	28.7 ±0.51	28.4 ±0.39	28.6 ±0.11
Total Hardness (mg./l)	28.1 ±0.52	28.3 ±0.50	28.2 ±0.41	28.4 ±0.36	28.7 ±0.45	28.3 ±0.23
Calcium (Ca) (mg./l)	15.5 ±0.22	15.9 ±0.21	16.0 ±0.55	16.0 ±0.31	16.0 ±0.31	16.0 ±0.28
Magnesium (Mg) (mg./l)	11.9 ±0.72	12.3 ±0.52	12.1 ±0.35	12.9 ±0.19	12.9 ±0.15	12.5 ±0.41
Chloride (Cl) (mg./l)	2.0 ±0.35	2.1 ±0.18	2.0 ±0.14	1.9 ±0.15	2.0 ±0.11	2.0 ±0.007
Bicarbonate (mg./l)	30.1 ±0.90	29.7 ±1.11	29.1 ±0.66	29.0 ±0.61	29.9 ±0.36	29.6 ±0.49
Total Dissolved Solids (mg./l)	11.5 ±0.73	12.2 ±0.30	12.1 ±0.22	11.9 ±0.15	11.9 ±0.11	11.9 ±0.27
Total Suspended Solids (mg./l)	63.6 ±1.82	64.8 ±0.43	64.2 ±0.57	64.1 ±1.20	65.0 ±0.14	63.3 ±0.56
Sodium (Na) (mg./l)	0.61 ±0.01	0.59 ±0.01	0.60 ±0.02	0.63 ±0.01	0.64 ±0.01	0.61 ±0.02
Potassium (K) (mg./l)	1.40 ±0.02	1.39 ±0.01	1.39 ±0.01	1.39 ±0.01	1.39 ±0.01	1.39 ±0.004
Sulphate (SO_4) (mg/l)	5.0 ±0.26	5.1 ±0.18	5.1 ±0.20	5.3 ±0.11	5.2 ±0.08	5.1 ±0.13
Nitrate (NO_3) (mg./l)	0.8 ±0.08	0.8 ±0.70	0.9 ±0.70	1.0 ±0.05	0.9 ±0.01	0.9 ±0.08
Phosphate (PO_4) (mg./l)	0.11 ±0.01	0.12 ±0.01	0.11 ±0.01	0.12 ±0.01	0.1 ±0.005	0.12 ±0.004
Nitrogen(N) (mg./l)	1.8 ±0.11	1.7 ±0.05	1.9 ±0.05	1.9 ±0.03	1.8 ±0.09	1.8 ±0.08
Zinc(Zn) (mg/l)	0.28 ±0.01	0.27 ±0.01	0.26 ±0.01	0.26 ±0.01	0.27 ±0.01	0.267 ±0.007
Copper(Cu) (mg./l)	BDL	BDL	BDL	BDL	BDL	------
Chromium (Cr) (mg./l)	BDL	BDL	BDL	BDL	BDL	------
Cadmium (Cd) (mg./l)	0.002 ±0.001	0.002 ±0.001	0.002 ±0.001	0.002 ±0.001	0.002 ±0.001	0.002 ±ND

Table 2.7:- Assay of physico-chemical parameters of Urpod beel water during Post-monsoon period, 2015-16 (S-1, S-2, S-3, S-4, S-5 indicate different sampling and study sites).

Sites → Parameters ↓	S-1	S-2	S-3	S-4	S-5	Mean ±SD
Water Temp (˚C)	24.1 ±0.75	24.1 ±0.85	24.7 ±1.09	24.3 ±1.30	24.4 ±1.19	24.3 ±0.25
Transparncy (cm)	47 ±0.79	46.3 ±1.20	47.1 ±0.74	46.6 ±1.14	47.2 ±0.84	47.0 ±0.38
pH	6.5 ±0.14	6.8 ±0.08	6.6 ±0.13	6.3 0.15	6.3 0.16	6.5 ±0.21
DO (mg./l)	9.9 ±0.42	10.0 ±0.30	9.9 ±0.64	9.7 ±0.67	9.9 ±0.19	9.9 ±0.19
BOD (mg./l)	6.0 ±0.30	6.1 ±0.18	6.0 ±0.14	5.9 ±0.2	6.0 ±0.14	6.0 ±0.08
Free CO_2 (mg./l)	6.0 ±0.16	6.3 ±0.38	5.9 ±0.18	5.9 ±0.11	5.9 ±0.11	6.0 ±0.16
Total Alkalinity (mg./l)	29.8 ±0.38	29.5 ±0.40	29.7 ±0.48	30.1 ±0.83	30.0 ±0.2	29.8 ±0.24
Total Hardness (mg./l)	27.7 ±0.48	28.1 ±0.18	28.1 ±0.23	28.0 ±0.20	27.9 ±0.56	28.0 ±0.17
Calcium (Ca) (mg./l)	15.3 ±0.36	15.4 ±0.43	15.6 ±0.40	16.0 ±0.92	16.1 ±0.36	15.7 ±0.36
Magnesium (Mg) (mg./l)	12.0 ±0.1	12.0 ±0.12	11.9 ±0.15	11.8 ±0.21	12.0 ±0.18	12.0 ±0.04
Chloride (Cl) (mg./l)	2.0 ±0.15	1.8 ±0.04	1.9 ±0.11	2.0 ±0.16	1.9 ±0.13	1.9 ±0.1
Bicarbonate (mg./l)	30.0 ±0.16	29.8 ±0.12	30.0 ±0.19	29.9 ±0.11	30.0 ±0.11	29.9 ±0.09
Total Dissolved Solids (mg./l)	11.8 ±0.09	12.0 ±0.12	12.2 ±0.28	12.0 ±0.08	11.9 ±0.1	12.0 ±0.14
Total Suspended Solids (mg./l)	64.1 ±0.14	64.0 ±0.13	64.1 ±0.23	63.9 ±0.05	63.8 ±0.05	64.1 ±0.42
Sodium (Na) (mg./l)	0.64 ±0.007	0.64 ±0.01	0.62 ±0.02	0.65 ±0.01	0.65 ±0.01	0.64 ±0.01
Potassium (K) (mg./l)	1.40 ±0.01	1.39 ±0.01	1.38 ±0.017	1.39 ±0.014	1.40 ±0.012	1.39 ±0.008
Sulphate (SO_4) (mg./l)	4.8 ±0.11	4.8 ±0.1	4.9 ±0.16	5.2 ±0.19	5.2 ±0.21	5.0 ±0.20
Nitrate (NO_3) (mg./l)	0.9 ±0.04	0.8 ±0.04	0.8 ±0.09	0.8 ±0.08	0.8 ±0.08	0.8 ±0.04
Phosphate (PO_4) (mg./l)	0.12 ±0.007	0.13 ±0.008	0.12 ±0.005	0.11 ±0.011	0.12 ±0.005	0.12 ±0.004
Nitrogen(N) (mg./l)	1.6 ±0.11	1.8 ±0.08	1.9 ±0.04	1.9 ±0.05	1.8 ±0.07	1.8 ±0.13
Zinc(Zn) (mg./l)	0.243 ±0.01	0.242 ±0.01	0.243 ±0.01	0.244 ±0.01	0.240 ±0.01	0.242 ±0.001
Copper(Cu) (mg./l)	0.002 ±0.001	0.002 ±0.001	0.002 ±0.001	0.002 ±0.001	0.002 ±0.001	0.002 ±0.001

Chromium (Cr) (mg./l)	BDL	BDL	BDL	BDL	BDL	-----
Cadmium (Cd) (mg./l)	0.003 ±0.001	0.003 ±0.001	0.003 ±0.001	0.003 ±0.001	0.003 ±0.001	0.003 ±0.001

Table 2.8: - Assay of physico-chemical parameters of Urpod beel water during Winter period, 2015 to 2016 (S-1, S-2, S-3, S-4, S-5 -indicate different sampling and study sites).

Sites → Parameters ↓	S-1	S-2	S-3	S-4	S-5	Mean ±SD
Water Temp (˚C)	14.4 ±0.55	12.6 ±0.54	11.8 ±0.84	12.6 ±0.89	11.8 ±0.84	12.64 ±1.06
Transparncy (cm)	43.0 ±0.04	43.0 ±0.09	43.2 ±0.19	43.2 ±0.17	43.4 ±0.13	43.2 ±0.17
pH	6.6 ±0.12	6.9 ±0.05	6.7 ±0.16	6.5 ±0.11	6.6 ±0.19	6.7 ±0.15
DO (mg./l)	8.7 ±0.27	8.5 ±0.17	9.0 ±0.19	9.0 ±0.15	8.7 ±0.11	8.8 ±0.21
BOD (mg/l)	6.3 ±0.25	6.8 ±0.08	6.6 ±0.13	6.3 ±0.15	6.5 ±0.14	6.5 ±0.21
Free CO_2 (mg./l)	6.1 ±0.30	6.1 ±0.18	5.9 ±0.2	6.0 ±0.14	6.0 ±0.14	6.0 ±0.08
Total Alkalinity (mg./l)	30.1 ±0.21	30.0 ±0.20	30.0 ±0.20	30.1 ±0.17	29.9 ±0.19	30.0 ±0.08
Total Hardness (mg./l)	30.0 ±0.10	30.0 ±0.19	30.0 ±0.21	30.0 ±0.19	30.0 ±0.16	30.0 ±0.04
Calcium (Ca) (mg./l)	16.0 ±0.13	15.9 ±0.08	16.2 ±0.16	16.0 ±0.16	16.0 ±0.19	16.0 ±0.07
Magnesium (Mg) (mg./l)	13.8 ±0.09	14.2 ±0.12	14.0 ±0.09	14.2 ±0.12	13.9 ±0.05	14.0 ±0.18
Chloride (Cl) (mg./l)	3.9 ±0.05	3.8 ±0.09	3.9 ±0.01	4.2 ±0.09	4.0 ±0.16	4.0 ±0.15
Bicarbonate (mg./l)	30 ±0.12	29.9 ±0.08	30.2 ±0.51	29.9 ±0.08	30.0 ±0.05	30.0 ±0.08
Total Dissolved Solids (mg./l)	13.9 ±0.1	14.0 ±0.15	14.0 ±0.11	13.8 ±0.19	14.3 ±0.07	14.0 ±0.16
Total Suspended Solids (mg./l)	61.6 ±0.95	62.6 ±1.02	62.0 ±0.08	62.3 ±1.24	61.6 ±0.95	61.6 ±0.32
Sodium (Na) (mg./l)	0.64 ±0.01	0.64 ±0.01	0.62 ±0.01	0.63 ±0.008	0.66 ±0.005	0.64 ±0.014
Potassium (K) (mg./l)	1.43 ±0.008	1.42 ±0.016	1.40 ±0.015	1.44 ±0.005	1.44 ±0.008	1.43 ±0.016
Sulphate (SO_4) (mg./l)	4.5 ±0.12	4.5 ±0.19	4.5 ±0.23	4.4 ±0.08	4.3 ±0.07	4.4 ±0.09
Nitrate (NO_3) (mg./l)	0.8 ±0.07	0.8 ±0.08	0.8 ±0.11	0.8 ±0.08	0.9 ±0.05	0.8 ±0.04

Phosphate (PO_4) (mg./l)	0.12 ±0.008	0.12 ±0.008	0.12 ±0.007	0.12 ±0.008	0.12 ±0.008	0.12 ±0.004
Nitrogen(N) (mg./l)	1.7 ±0.13	1.6 ±0.04	1.8 ±0.08	1.8 ±0.08	1.9 ±0.04	1.8 ±0.11
Zinc(Zn) (mg./l)	0.240 ±0.01	0.239 ±0.01	0.241 ±0.01	0.240 ±0.01	0.240 ±0.01	0.240 ±0.007
Copper(Cu) (mg./l)	BDL	BDL	BDL	BDL	BDL	----
Chromium (Cr) (mg./l)	BDL	BDL	BDL	BDL	BDL	----
Cadmium (Cd) (mg./l)	0.001 ±ND	0.001 ±ND	0.001 ±0.01	0.001 ±ND	0.001 ±ND	0.001 ±ND

Table 2.9: - Means of physico-chemical parameters of Urpod beel during March, 2014 to February, 2016. (n=50/season in 5 different sites; ± = Standard deviation)

Parameters	PR-MON	MON	PO-MON	WIN
	Mean ± SD	Mean ±SD	Mean ±SD	Mean ±SD
Water Temp (˚C)	20.12 ± 1.54	26.92 ± 2.07	24.74 ± 0.98	13.3 ± 1.28
Transparency (cm)	44.6 ± 0.12	57.7 ± 0.2	46.1 ± 0.21	42.2 ±0.17
pH	7.1 ± 0.15	6.9 ± 0.13	6.6 ± 0.21	6.6 ± 0.22
Dissolved Oxygen (DO) (mg./l)	6.5 ± 0.25	8.1 ± 0.19	9.8 ± 0.16	8.6 ± 0.18
Biochemical Oxygen Demand (BOD) (mg/l)	6.8 ± 0.15	5.8 ± 0.20	6.1 ± 0.16	6.3 ± 0.25
Free CO_2 (mg./l)	6.5 ± 0.19	6.1 ± 0.2	6.4 ± 0.13	6.4 ± 0.13
Total Alkalinity (mg./l)	36.1 ± 0.22	29.4 ± 0.12	30.9 ± 0.20	31.1 ± 0.49
Total Hardness (TH) (mg./l)	35.6 ± 0.23	29.2 ± 0.20	27.1 ± 0.16	29.6 ± 0.18
Calcium (Ca) (mg./l)	18.52 ± 0.61	16.69 ± 0.90	16.05 ± 0.68	15.69 ± 2.24
Magnesium (Mg) (mg./l)	16.9 ± 0.15	14.2 ± 0.11	12.5 ± 0.12	15.0 ± 0.16
Chloride (Cl) (mg./l)	7.5 ± 0.08	5.8 ± 0.12	5.1 ± 0.34	5.1 ± 0.13
Bicarbonate (BIC) (mg./l)	34.3 ± 0.12	29.3 ± 0.12	30.4 ± 0.09	30.5 ± 0.1
Total Dissolved Solids (TDS) (mg./l)	19.9 ± 0.13	14.9 ± 0.97	12.5 ± 0.25	14.5 ± 0.16
Total Suspended Solids (TSS)(mg./l)	62.0 ± 0.15	67.6 ± 0.16	66.5 ± 0.31	63.4 ± 0.09
Sodium (Na) (mg./l)	0.61 ± 0.01	0.64 ± 0.01	0.67 ± 0.01	0.67 ± 0.01

Potassium (K) (mg./l)	1.32 ± 0.01	1.38 ± 0.01	1.41 ± 0.01	1.45 ± 0.01
Sulphate (SO_4) (mg./l)	6.4 ± 0.14	5.9 ±0.20	5.2 ± 0.20	4.5 ± 0.11
Nitrate (NO_3) (mg./l)	0.98 ± 0.19	0.94 ±0.19	0.85 ± 0.4	0.80 ± 0.44
Phosphate (PO_4) (mg./l)	0.16 ± 0.01	0.11 ±0.01	0.11 ± 0.01	0.12 ± 0.01
Nitrogen(N) (mg./l)	1.6 ± 0.08	1.8 ±0.07	1.7 ± 0.07	1.7 ± 0.09
Zinc(Zn) (mg./l)	0.26 ± 0.01	0.26 ±0.01	0.25 ± 0.01	0.24 ± 0.01
Copper(Cu) (mg./l)	0.001 ± 0.01	BDL	0.001 ± ND	BDL
Chromium (Cr) (mg./l)	BDL	BDL	BDL	BDL
Cadmium (Cd) (mg./l)	0.002 ±0.005	0.002 ±0.005	0.003 ±0.001	0.002 ±0.001

Table 2.10(a): - Correlation coefficient matrix among certain physico-chemical parameters of Urpod beel in Pre-monsoon season during March, 2014 – Feb, 2016.

	WT	TRN	p^H	DO	BOD	FCO_2	TA	TH	TDS	TSS
WT	1	.591	.059	-.135	.040	-.151	-.303	-.218	-.322	-.356
TRN		1	-.366	-.530	-.520	-.488	-.733*	-.685*	-.791*	-.767*
pH			1	.816*	.559	.510	.714*	.692*	.686*	.694*
DO				1	.589	.417	.845*	.848*	.842*	.838*
BOD					1	.123	.603	.618	.577	.574
FCO_2						1	.344	.345	.364	.338
TA							1	.985*	.986*	.994*
TH								1	.963*	.963*
TDS									1	.993*
TSS										1

Table 2.10(b): - Correlation coefficient matrix among certain physico-chemical parameters of Urpod beel in Pre-monsoon season during March, 2014 – Feb, 2016.

	Cl	BIC	Ca	Mg	Na	K	SO_4	NO_3	PO_4	N
WT	-.352	-.312	-.349	-.376	-.384	-.366	-.025	.212	-.022	.714*
TRN	-.799*	-.840*	-.708*	-.769*	-.708*	-.894*	-.682*	.235	-.378	.650*
p^H	.674*	.731*	.683*	.628	.590	.590	.798*	.097	.620	-.038
DO	.828*	.877*	.781*	.787*	.733*	.734*	.845*	.090	.803*	-.145
BOD	.548	.659*	.514	.496	.715*	.703*	.602	-.483	.442	.067
FCO_2	.357	.474	.362	.318	.411	.429	.441	.380	.060	-.218
TA	.991*	.951*	.968*	.982*	.802*	.885*	.915*	-.043	.848*	-.389
TH	.966*	.923*	.941*	.985*	.821*	.859*	.909*	.047	.884*	-.277
TDS	.973*	.906*	.961*	.969*	.684*	.890*	859*	.023	.755*	.-531
TSS	.996*	.935*	.990*	.989*	.724*	.889*	.894*	.002	.820*	-.517

Table 2.10 (c): - Correlation coefficient matrix among certain physico-chemical parameters of Urpod beel in Pre-monsoon season during March, 2014 – Feb, 2016.

	Cl	BIC	Ca	Mg	Na	K	SO_4	NO_3	PO_4	N
Cl	1	.961*	.973*	.906*	.752*	.908*	.916*	-.025	.816*	-.490
BIC		1	.906*	.935*	.796*	.944*	.938*	-.095	.736*	-.436
Ca			1	.973*	.753*	.921*	.935*	-.029	.816*	-.474
Mg				1	.768*	.899*	.910*	-.080	.817*	.-470
Na					1	.726*	.681*	-.166	.664*	-.075
K						1	.843*	-.165	.575	.-559
SO_4							1	.059	.811*	-.264
NO_3								1	.157	.115
PO_4									1	.-009
N										1

Table 2.11(a): - Correlation coefficient matrix among certain physico-chemical parameters of Urpod beel in Monsoon season during March, 2014 – Feb, 2016.

	WT	TRN	p^H	DO	BOD	FCO_2	TA	TH	TDS	TSS
WT	1	-.558	.239	-.355	-.367	.498	.498	.594	.547	.584
TRN		1	.155	.479	.711*	-.941*	-.984*	-.980*	-.974*	-.969*
p^H			1	.440	.490	-.116	-.266	-.194	-.267	-.041
DO				1	.464	-.546	-.506	-.572	-.614	-.560
BOD					1	-.722*	-.804*	-803*	-.810*	-832*
FCO_2						1	.932*	.956*	.944*	.947*
TA							1	.983*	.983*	.977*
TH								1	.995*	.996*
TDS									1	.997*
TSS										1

Table 2.11(b): - Correlation coefficient matrix among certain physico-chemical parameters of Urpod beel in Monsoon season during March, 2014 – Feb, 2016.

	Cl	BIC	Ca	Mg	Na	K	SO_4	NO_3	PO_4	N
WT	.555	.000	.379	.566	.685*	.086	.615	.351	-.822*	-.164
TRN	-.985*	.580	-.858*	-.968*	-.880*	.304	-.962*	-.665*	.753*	.398
p^H	-.228	.680*	-.309	-.191	-.041	.187	-.193	-.003	-.022	-.167
DO	-.585	.382	-.697*	-.560	-.519	.542	-.523	-.209	.649*	.523
BOD	-.785*	.875*	-.802*	-.832*	-.731*	.436	-.826*	-.853*	.541	.276
FCO_2	.959*	-.592	.918*	.947*	.861*	-.564	.901*	.656*	-.791*	-.517
TA	.987*	-.680*	.905*	.973*	.879*	-.375	.968*	.723*	-719*	-.429
TH	.997*	-636*	.911*	.990*	.914*	-.396	.984*	.712*	-.802*	-.453
TDS	.918*	-693*	.923*	.921*	.858*	-.704*	.858*	.673*	-.740*	-.623
TSS	.985*	-.671*	.986*	.990*	.942*	-.447	.974*	.766*	-783*	-.453

Table 2.11(c): - Correlation coefficient matrix among certain physico-chemical parameters of Urpod beel in Monsoon season during March, 2014 – Feb, 2016.

	Cl	BIC	Ca	Mg	Na	K	SO_4	NO_3	PO_4	N
Cl	1	-.636*	.918*	.985*	.896*	-.409	.972*	.687*	-.781*	-.452
BIC		1	-.693*	-.671*	-.580	.428	-.660*	-.850*	.315	.026
Ca			1	.934*	.897*	-.408	.976*	.698*	-.774*	-.445
Mg				1	.902*	-.413	.974*	.694*	-.787*	-.452
Na					1	-.375	.916*	.800*	-.844*	-.376
K						1	-.282	-.294	.380	.687*
SO_4							1	.755*	-.779*	-.388
NO_3								1	-.508	-.005
PO_4									1	.464
N										1

Table 2.12 (a): - Correlation coefficient matrix among certain physico-chemical parameters of Urpod beel in post-Monsoon season during March, 2014 – Feb, 2016.

	WT	TRN	p^H	DO	BOD	FCO_2	TA	TH	TDS	TSS
WT	1	-.819*	.366	.853*	.780*	.742*	.892*	-.869*	.917*	.916*
TRN		1	-.539	-.868*	-.706*	-.946*	-.934*	-.934*	-.939*	-.951*
p^H			1	.667	.628	.571	.341	-.403	.478	.469
DO				1	.864*	.841*	.857*	-.900*	.865*	.904*
BOD					1	.674*	.700*	-697*	.723*	.785*
FCO_2						1	.906*	-.903*	.925*	.935*
TA							1	-.984*	.956*	.980*
TH								1	-.933*	-.971*
TDS									1	.975*
TSS										1

Table 2.12(b): - Correlation coefficient matrix among certain physico-chemical parameters of Urpod beel in Post-monsoon season during March, 2014 – Feb, 2016.

	Cl	BIC	Ca	Mg	Na	K	SO_4	NO_3	PO_4	N
WT	.894*	.911*	.868*	.874*	.736*	.609	.755*	.555	-.864*	-.751*
TRN	-.952*	-.921*	-.735*	-.922*	-.882*	-.733*	-.752*	-.495	.831*	.835*
p^H	.436	.400	.072	.487	.269	.239	-.008	.322	-.121	-.458
DO	.882*	.885*	.693*	.900*	.738*	.615	.585	.597	-.668*	-.896*
BOD	.737*	.734*	.641*	.813*	.653*	.579	.503	.750*	-.604	-.757*
FCO_2	.948*	.920*	.606	.948*	.933*	.866*	.749*	.516	.569	-.592
TA	.988*	.989*	.807*	.959*	.929*	.769*	.884*	.569	-.921*	-.875*
TH	-.976*	-.980*	-.769*	-.946*	-.885*	-.753*	-.799*	-.592	.867*	.929*
TDS	.778*	.787*	.751*	.794*	.681*	.544	.788*	.467	-.803*	-.640*
TSS	.984*	.979*	.985*	.986*	.944*	.874*	.813*	.668*	-.878*	-.898*

Table 2.12(c): - Correlation coefficient matrix among certain physico-chemical parameters of Urpod beel in Post-monsoon season during March, 2014 – Feb, 2016.

	Cl	BIC	Ca	Mg	Na	K	SO_4	NO_3	PO_4	N
Cl	1	.995*	.778*	.984*	.938*	.835*	.843*	.602	-.909*	-.886*
BIC		1	.787*	.979*	.920*	.822*	.843*	.619	-.911*	-.894*
Ca			1	.737*	.890*	.774*	.816*	.497	-.904*	-.802*
Mg				1	.918*	.816*	.815*	.642*	-.904*	-.895*
Na					1	.944*	.899*	.571	-.883*	-.807*
K						1	.787*	.628	-.795*	-.740*
SO_4							1	.359	-.885*	-.611
NO_3								1	-.573	-.778*
PO_4									1	.746*
N										1

Table 2.13(a): - Correlation coefficient matrix among certain physico-chemical parameters of Urpod beel in Winter season during March, 2014 – Feb, 2016.

	WT	TRN	p^H	DO	BOD	FCO_2	TA	TH	TDS	TSS
WT	1	-.715*	-.170	-.319	-.657*	.661*	.704*	-.695	.539	.659*
TRN		1	.386	.562	.622	-.964*	-.990*	.929*	-.947*	-.976*
p^H			1	.059	.128	-.526	-.398	.218	-.444	-.303
DO				1	.255	-.561	-.512	.475	-.590	-.520
BOD					1	-.464	-.658*	.745	-.523	-.609
FCO_2						1	.941*	-.828*	.948*	.915*
TA							1	-.963*	.941*	.982*
TH								1	-.869*	-.949*
TDS									1	.916*
TSS										1

Table 2.13(b): - Correlation coefficient matrix among certain physico-chemical parameters of Urpod beel in Winter season during March, 2014 – Feb, 2016.

	Cl	BIC	Ca	Mg	Na	K	SO_4	NO_3	PO_4	N
WT	.678*	.644*	.456	.653*	.602	.595	.720*	-.063	.335	.178
TRN	-.978*	-.977*	-.806*	-.975*	-.912*	-.804*	-.949*	.007	-.592	-.599
p^H	-.411	-.397	-.205	-.316	-.429	-.491	-.311	.161	-.350	-.645*
DO	-.508	-.481	-.505	-.516	-.689*	-.557	-.428	-.023	-.394	-.157
BOD	-.664*	-.627	-.784*	-.669*	-.570	-.647*	-.512	-.165	-.286	-.480
FCO_2	.940*	.925*	.667*	.910*	.903*	.811*	.925*	-.123	.616	.629
TA	.998*	.984*	.810*	.989*	.916*	.787*	.921*	-.032	.521	.613
TH	-.958*	-.939*	-.821*	-.975*	-.863*	-.695*	-.853*	-.039	-.352	-.517
TDS	.820*	.846*	.777*	.792*	.738*	.893*	.928*	.906*	.953*	.897*
TSS	.988*	.966*	.923*	.988*	.893*	.762*	.906*	-.039	.473	.580

Table 2.13(c): - Correlation coefficient matrix among certain physico-chemical parameters of Urpod beel in Winter season during March, 2014 – Feb, 2016.

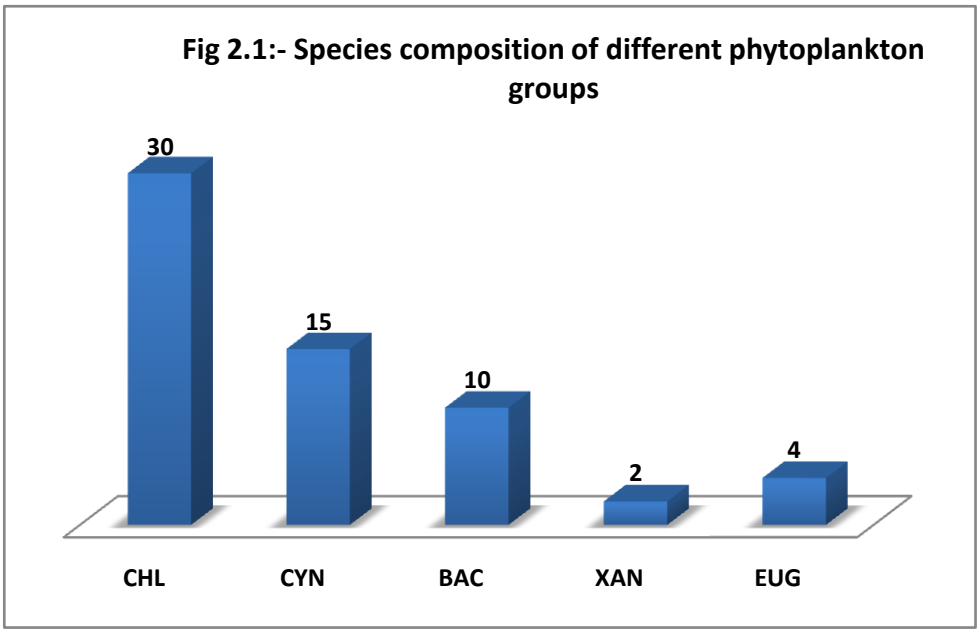
	Cl	BIC	Ca	Mg	Na	K	SO_4	NO_3	PO_4	N
Cl	1	.986*	.820*	.988*	.928*	.813*	.906*	.014	.552	.657*
BIC		1	.846*	.966*	.906*	.762*	.915*	.019	.576	.679*
Ca			1	.820*	.953*	.818*	.859*	.096	.622	.747*
Mg				1	.897*	.777*	.903*	-.009	.552	.555
Na					1	.884*	.755*	.233	.613	.671*
K						1	.630	.280	.782*	.735*
SO_4							1	-.294	.494	.472
NO_3								1	.271	.318
PO_4									1	.641*
N										1

4.2 PLANKTON ANALYSIS OF URPOD-BEEL

4.2. A PHYTOPLANKTON

The results of phytoplankton analysis of Urpod beel has been presented in tabular form (Table.3.1-3.9). The phytoplankton community of the beel all together comprised of 61 species under 41 genera, 18 families, 8 orders and 5 different classes namely Cyanophyceae (CYN), Chlorophyceae(CHL), Bacillariophyceae(BAC), Xanthophyceae(XAN) and Euglanophyceae (EUG) during the course of investigation.

The class chlorophyceae has been found to be comprises of 30 species, 20 genera belonging to 8 families under 3 orders. Class Cyanophyceae is comprised of 15 species, 10 genera of 4 families under 2 orders. The class Bacillariophyceae follows Cyanophyceae with 10 species, 8 genera belongs to 4 families under one order. Class Euglanophyceae is comprised of 4 species, 2 genera belong to one family and one order. Xanthophyceae is also constituted by 2 species, one genus under one family and one order (Fig.2.1).



4.2. A.1 SEASONAL FLUCTUATION OF PHYTOPLANKTON COMMUNITY

The seasonal observation of phytoplankton population during the period of investigation reveals that among the five classes, Chlorophyceae has been observed as the most dominant group during the study period.

Variation of phytoplankton abundance in different seasons of the study period is as follows:

Chlorophyceae>Cyanophyceae>Bacillariophyceae>Euglenophyceae>Xanthophyceae

4.2. A.2 SEASONAL ABUNDANCE OF PHYTOPLANKTON

The seasonal abundance of different phytoplankton classes are described in the following heads:

1. Cyanophyceae (CYN)

The abundance of Cyanophyceae is found in the range of 424.8±23.84 (post-monsoon) – 606.2 ±18.51 ul^{-1} during monsoon of the first year of observation (Table 3.10) while the next year it was 438.8 ±83.38 (post-monsoon) – 714 ±58.30 ul^{-1} in pre-monsoon (Table 3.10). The seasonal trend of Cyanophyceae has been observed as monsoon > winter >pre-monsoon > post-monsoon in the first year of observation. And

in the second year the trend for the groups are pre-monsoon > monsoon > winter > post-monsoon. In both the year of investigation the highest growth of Cyanophyceae was contributed by *Anabaena orientalis, A. fertilissima, Nostoc mascorum* and *Microcystis aeruginosa* (Photo Plate-2). CYN is positively correlated with CHL, BAC, EUG and TPHY and negatively correlated with XAN in pre-monsoon season (Table 3.11). Again it is positively correlated with CHL and TPHY in monsoon season (Table 3.12) and CHL, BAC, EUG, TPHY in post-monsoon season respectively (Table 3.13).

2. Chlorophyceae (CHL)

The abundance of Chlorophyceae is evaluated in the range of 923 ± 58.34 ul^{-1} in winter to1104.6 ± 66.82 ul^{-1} during pre-monsoon (Table 3.10) in the first year of observation, while the next year it is 696.2 ± 78.76 ul^{-1} in post-monsoon and 1515.2 ± 82.00 ul^{-1} in pre-monsoon season (Table 3.10). The seasonal trend of Chlorophyceae has been observed as monsoon > pre-monsoon > winter > post-monsoon in the first year of observation. The second year trend for the species has been evaluated as pre-monsoon > monsoon > winter > post-monsoon. In both the years of investigation, the highest growth of Chlorophyceae was contributed by *Pandorina* sp., *Volvox aureus, Micrasterias foliacea* (Photo Plate-3 & 6). CHL is positively correlated with BAC, EUG and TPHY and negatively correlated with XAN in pre-monsoon season (Table 3.11). In monsoon season CHL is positively correlated with TPHY (Table 3.12). In post-monsoon season CHL is positively correlated with BAC, EUG and TPHY (Table 3.13) and in winter it shows the positive correlation only with TPHY during the study period (Table 3.14).

3. Bacillariophyceae (BAC)

The abundance of Bacillariophyceae has been found in the range of 205.6 ± 37.09 ul^{-1} in post-monsoon to 299 ± 27.90 ul^{-1} during monsoon in the first year of observation (Table 3.10), against 189.4 ± 32.54 ul^{-1} in winter to 351.8 ± 42.58 ul^{-1} in pre-monsoon season of the second year (Table 3.10). The seasonal trend of Bacillariophyceae has been assessed as monsoon > pre-monsoon > winter > post-monsoon in the first year of observation. The second year the trend of the species has

been noted as pre-monsoon > monsoon > post-monsoon > winter. The highest growth of Bacillariophyceae hasd been attributed by *Navicula rhynchocephala* (Photo Plate-7).

4. Xanthophyceae (XAN)

The abundance of Xanthophyceae has been recored in the range of 51±12.71 ul^{-1} in post-monsoon to 87.6 ± 7.96 ul^{-1} in pre-monsoon (Table 3.10) of the first year, and the 2nd year showed 32.8±10.82 ul^{-1} in post-monsoon to 66.6 ± 7.32 ul^{-1} in pre-monsoon period (Table 3.10). The seasonal trend for Xanthophyceae has presented as pre-monsoon > monsoon > winter > post-monsoon in the first year of observation. The trend was for the next year prevaited as pre-monsoon > winter > monsoon > post-monsoon. The species *Botryococcus* has been observed in both the year of investigation (Photo Plate-7). XAN is negatively correlated with TPHY in pre-monsoon season (Table 3.11) and positively correlated with TPHY in winter season (Table 3.14).

5. EUGLANOPHYCEAE (EUG)

The abundance of Euglanophyceae (Photo Plate-8) was found to be in the range of 100.6 ± 21.80 ul^{-1} in post-monsoon to 168.2± 9.47 ul^{-1} in pre-monsoon (Table 3.10) against the second year of observation the range of 94.0± 6.32 ul^{-1} in post-monsoon to 195.8±18.79 ul^{-1} in pre-monsoon season (Table 3.10). The seasonal trend for Euglenophyceae has been arranged as pre-monsoon > monsoon > winter > post-monsoon for both first and second year of observation. EUG has been positively correlated with TPHY in pre-monsoon season (Table 3.11) and in post-monsoon season (Table 3.13).

Table 3.1: - Numerical abundance (ul^{-1}) of phytoplankton in Urpod beel during Pre-monsoon season of 2014-15.

Sites→ / Species ↓	S-1	S-2	S-3	S-4	S-5	Range	Mean ± SD
CYANOPHYCEAE							
Anabaena orientalis Dixit.	70	65	55	80	68	55-80	68±9.0
A .fertilissima C.B.Rao.	24	20	35	41	26	20-41	29±8
Gleocapsa atrata Kutz.	18	25	30	15	32	15-32	24±7
Nostoc muscorum C. Agardh.	48	64	56	55	69	48-69	58±8

N. commune Vaucher.	30	45	48	34	25	25-48	36±10
Oscillatoria acuminata Gomont.	50	55	45	68	70	45-70	60±11
O. rubescens DC.	15	20	25	32	18	15-32	22±7
Phormidium corium C. Agardh.	10	16	07	10	15	07-16	12±4
P. favosum Bory.	14	08	19	15	05	05-19	12±6
Gomphosphaeria aponina Kutz.	80	55	70	86	65	55-86	71±12
Aphanocapsa litoralis Hansg.	14	04	20	05	05	05-20	11±6
Aulosira fertilissima S.L. Ghose.	05	00	10	07	08	0-10	6±3
Calothrix marchica Lemmerm.	16	35	23	29	10	10-35	23±9
Microcystis aeruginosa Kuetz.	20	24	36	40	28	20-40	30±8
M. viridis A. Braun.	25	30	24	34	40	25-40	31±7
CHLOROPHYCEAE							
Pandorina sp.	25	30	36	34	45	25-45	34±7
Volvox aureus Ehrenb.	88	106	120	125	110	88-125	110±14
Volvox sp.	45	55	62	70	48	45-70	56±10
Sorastrum sp.	46	29	52	28	35	28-46	38±11
Tetraedron pusillum West.	50	62	76	54	68	50-76	62±10
Tetraedron sp.	24	32	26	15	14	14-32	22±8
Chlorella vulgaris Beijer.	32	24	45	35	43	24-45	36±9
Ankistrodesmus falcatus (Corda).	56	68	75	76	52	52-76	65±11
Closteriopsis longissima West.	30	45	34	43	40	30-45	38±6
Hormidium sp.	18	29	22	20	16	16-29	21±5
Zygnema sp.	12	10	22	17	20	10-22	16±5
Gonatozygon aculeatum Hastings.	06	00	00	03	04	0-06	3±3
G.monotaenium de Bary.	14	32	28	17	18	14-32	22±8
Gonatozygon sp.	10	14	23	25	09	09-25	16±7
Arthrodesmus sublatus Kutz.	22	34	29	30	20	20-34	27±6
Closterium calosporum Wittr.	82	76	65	60	62	60-82	69±10
Closterium sp.	29	35	39	20	25	20-39	30±8
Cosmarium auriculatum Reinsch.	68	76	75	56	65	56-76	68±8
Cosmarium sp.	10	06	00	05	15	0-15	7±6
Desmidium aptogonum Breb.	24	30	33	35	40	24-40	32±6
Desmidium sp.	12	20	23	05	10	05-23	14±7
Euastrum ansatum Ehrenb.	45	40	50	48	52	40-52	47±5
E. sinuosum West & G. S.	25	19	23	30	39	19-39	27±8
Micrasterias foliacea Baley.	130	124	98	93	90	90-130	107±19
M.radiosa Raffs.	05	11	06	19	08	05-19	10±6
M.rotata. Grev.	00	05	08	13	16	0-16	8±6
Pleurotaenium sp.	25	36	20	30	32	20-36	29±6
Staurastrum sp.	04	08	05	04	00	0-08	4±3
Triploceras gracile Bailey.	39	40	55	52	48	39-55	47±7
Xanthidium antilopaeum.Kutz.	29	14	30	20	11	11-30	21±8

BACILLARIOPHYCEAE							
Navicula rhynchocephala Kuetz.	45	59	62	43	68	43-68	55±11
N. viridula Kuetz.	14	10	21	30	34	10-34	22±10
Fragilaria brevistriata Grun.	12	10	06	08	10	06-12	9±2
Cyclotella bodanica Eul.	08	15	22	07	13	08-22	13±6
Cymbella affinis Kuetz.	20	12	15	23	28	12-28	20±6
Pinularia viridis (Nitz.) Ehr.	04	09	15	19	20	04-19	13±7
Nitzschia sp.	45	40	55	52	48	40-55	48±6
Surirella sp.	17	29	20	23	22	17-29	22±4
Gomphonema lanceolatum Ehr.	06	09	00	15	11	0-15	8±6
G. parvulum (Kuetz.) Grun.	00	07	12	10	13	0-13	8±5
XANTHOPHYCEAE							
Botryococcus braunii Kutz.	75	73	72	69	64	64-75	71±4
Botrococcus sp.	24	20	10	13	18	10-24	17±5
EUGLANOPHYCEAE							
Euglena gracilis Klebs.	58	50	47	42	43	42-58	48±6
E. viridis Ehr.	20	22	26	28	32	20-32	26±5
Phacus acuminatus A. Stokes.	65	60	68	73	70	60-73	65±6
Phacus longicauda (Ehr.)Dujard.	23	37	43	18	16	16-37	27±12

Table 3.2: - Numerical abundance (ul^{-1}) of phytoplankton in Urpod beel during Monsoon season of 2014-15

Sites→ Species ↓	S-1	S-2	S-3	S-4	S-5	Range	Mean ±SD
CYANOPHYCEAE							
Anabaena orientalis Dixit.	62	68	70	75	68	62-75	69±5
A.fertilissima C.B.Rao.	85	90	76	95	78	76-95	85±8
Gleocapsa atrata Kutz.	30	25	28	32	29	25-32	29±2
Nostoc muscorum C. Agardh.	135	120	90	100	107	90-135	111±16
N. commune Vaucher.	25	29	35	38	40	25-40	33±6
Oscillatoria acuminata Gomont.	40	54	58	47	50	40-58	50±7
O. rubescens DC.	22	18	39	35	28	18-39	28±9
Phormidium corium C. Agardh.	06	10	00	09	14	0-14	8±5
P. favosum Bory.	60	54	59	65	49	49-65	57±6
Gomphosphaeria aponina Kutz.	10	19	20	26	25	10-26	20±6
Aphanocapsa litoralis Hansg.	05	00	10	00	07	0-10	4±4
Aulosira fertilissima S.L. Ghose.	16	12	06	08	17	06-17	12±5
Calothrix marchica Lemmerm.	13	15	06	09	20	06-20	13±5
Microcystis aeruginosa Kuetz.	65	54	50	62	59	50-65	58±6
M. viridis A. Braun.	30	35	32	28	25	25-35	30±4

CHLOROPHYCEAE							
Pandorina sp.	185	190	169	176	182	169-190	180±8
Volvox aureus Ehrenb.	86	95	100	104	112	86-112	99±10
Volvox sp.	40	43	32	37	33	32-40	37±5
Sorastrum sp.	78	86	88	90	70	70-90	82±8
Tetraedron pusillum West.	53	48	58	64	45	45-58	54±8
Tetraedron sp.	08	12	00	00	05	0-12	5±5
Chlorella vulgaris Beijer.	30	35	38	40	22	22-40	33±7
Ankistrodesmus falcatus (Corda).	42	40	50	65	47	40-65	47±6
Closteriopsis longissima West.	39	43	40	30	32	32-43	37±5
Hormidium sp.	16	20	22	11	16	11-22	17±4
Zygnema sp.	09	10	15	14	06	06-15	11±4
Gonatozygon aculeatum Hastings.	14	18	08	09	10	08-18	12±4
G.monotaenium de Bary.	07	10	12	14	06	06-14	10±3
Gonatozygon sp.	12	14	21	09	10	09-21	13±5
Arthrodesmus sublatus Kutz.	48	40	36	42	39	39-48	41±4
Closterium calosporum Wittr.	33	21	20	29	36	20-36	28±7
Closterium sp.	22	25	38	30	23	22-38	28±6
Cosmarium auriculatum Reinsch.	40	44	38	57	50	40-57	46±8
Cosmarium sp.	06	09	11	00	00	0-11	5±5
Desmidium aptogonum Breb.	30	21	27	29	37	21-37	29±6
Desmidium sp.	08	00	15	00	21	0-21	9±9
Euastrum ansatum Ehrenb.	18	20	25	30	32	18-32	25±6
E. sinuosum West & G. S.	06	10	20	21	15	06-21	14±6
Micrasterias foliacea Baley.	76	76	80	85	82	76-85	79±6
M.radiosa Raffs.	08	19	20	27	21	08-27	19±7
M.rotata. Grev.	05	13	21	12	10	05-21	12±6
Pleurotaenium sp.	17	27	43	40	21	17-43	30±11
Staurastrum sp.	12	04	09	10	05	04-12	8±3
Triploceras gracile Bailey.	30	41	44	28	32	28-44	35±7
Xanthidium antilopaeum.Kutz.	34	17	13	32	15	15-34	22±10
BACILLARIOPHYCEAE							
Navicula rhynchocephala Kuetz.	120	122	100	88	99	88-122	106±15
N. viridula Kuetz.	45	46	29	30	33	30-46	37±8
Fragilaria brevistriata Grun.	11	16	21	22	29	11-29	20±7
Cyclotella bodanica Eul.	05	10	13	21	17	05-21	13±6
Cymbella affinis Kuetz.	29	30	21	18	25	18-30	25±5
Pinularia viridis (Nitz.) Ehr.	07	10	16	00	11	0-16	9±6
Nitzschia sp.	30	45	37	32	39	30-45	21±8
Surirella sp.	23	18	26	11	32	11-32	14±7
Gomphonema lanceolatum Ehr.	08	10	12	15	25	08-25	18±4
G. parvulum (Kuetz.) Grun.	11	18	21	22	16	11-22	18±4

XANTHOPHYCEAE							
Botryococcus braunii Kutz.	45	50	53	36	38	36-53	44±7
Botrococcus sp.	20	27	21	19	08	08-27	19±7
EUGLANOPHYCEAE							
Euglena gracilis Klebs.	30	36	39	45	46	30-46	38±6
E. viridis Ehr.	20	16	19	29	34	16-34	24±8
Phacus acuminatus A. Stokes.	45	40	54	59	62	40-62	52±9
Phacus longicauda (Ehr.)Dujard.	23	29	21	11	16	11-29	18±7

Table 3.3: - Numerical abundance (ul^{-1}) of phytoplankton in Urpod beel during Post-monsoon season of 2014-15.

Sites→ Species ↓	S-1	S-2	S-3	S-4	S-5	Range	Mean ±SD
CYANOPHYCEAE							
Anabaena orientalis Dixit.	30	28	43	43	45	28-45	38±8
A .fertilissima C.B.Rao.	25	30	34	32	43	25-43	33±7
Gleocapsa atrata Kutz.	19	07	10	13	15	07-19	13±5
Nostoc muscorum C. Agardh.	43	42	35	37	30	30-43	37±5
N. commune Vaucher.	25	32	30	20	21	20-32	26±5
Oscillatoria acuminata Gomont.	18	34	24	39	21	18-39	27±9
O. rubescens DC.	07	10	15	19	08	07-19	12±5
Phormidium corium C. Agardh.	06	10	07	00	08	0-10	6±4
P. favosum Bory.	06	12	11	12	06	06-12	9±3
Gomphosphaeria aponina Kutz.	47	50	34	31	58	31-58	44±11
Aphanocapsa litoralis Hansg.	06	14	21	09	14	06-21	13±6
Aulosira fertilissima S.L. Ghose.	08	12	16	21	09	08-21	13±5
Calothrix marchica Lemmerm.	12	20	11	15	09	09-20	13±4
Microcystis aeruginosa Kuetz.	79	86	69	74	75	69-86	77±6
M. viridis A. Braun.	65	74	59	66	55	55-74	64±7
CHLOROPHYCEAE							
Pandorina sp.	46	42	59	55	48	46-59	49±8
Volvox aureus Ehrenb.	39	36	54	47	50	36-54	45±8
Volvox sp.	16	12	25	28	22	12-28	21±7
Sorastrum sp.	65	54	50	57	58	50-65	57±6
Tetraedron pusillum West.	20	18	30	35	33	18-35	27±8
Tetraedron sp.	00	09	00	10	05	0-10	5±5
Chlorella vulgaris Beijer.	08	19	20	15	16	08-20	16±5
Ankistrodesmus falcatus (Corda).	20	26	30	25	31	20-31	26±4
Closteriopsis longissima West.	25	32	38	17	20	17-38	26±9

Hormidium sp.	12	21	20	25	23	12-25	20±5
Zygnema sp.	08	13	21	13	19	08-19	15±5
Gonatozygon aculeatum Hastings.	19	25	30	24	28	19-30	25±4
G.monotaenium de Bary.	11	07	10	05	14	07-14	9±4
Gonatozygon sp.	34	32	14	30	26	14-34	27±8
Arthrodesmus sublatus Kutz.	24	43	25	23	18	18-43	27±10
Closterium calosporum Wittr.	95	40	27	32	46	32-95	38±8
Closterium sp.	19	22	07	17	15	07-22	16±6
Cosmarium auriculatum Reinsch.	36	43	49	30	48	30-49	41±8
Cosmarium sp.	09	05	00	11	15	0-15	8±6
Desmidium aptogonum Breb.	22	16	33	30	26	16-33	25±7
Desmidium sp.	09	13	15	21	23	09-23	16±6
Euastrum ansatum Ehrenb.	21	27	22	39	32	21-39	28±7
E. sinuosum West & G. S.	20	13	10	25	33	10-33	20±9
Micrasterias foliacea Baley.	28	39	24	18	38	18-39	29±9
M.radiosa Raffs.	09	13	32	16	11	09-32	16±9
M.rotata. Grev.	08	17	15	10	21	08-21	14±5
Pleurotaenium sp.	13	21	07	16	20	07-21	15±6
Staurastrum sp.	05	09	00	13	18	0-18	9±7
Triploceras gracile Bailey.	43	52	29	39	32	29-52	39±9
Xanthidium antilopaeum. Kutz.	12	21	18	09	14	09-21	15±6
BACILLARIOPHYCEAE							
Navicula rhynchocephala Kuetz.	23	29	32	18	38	18-38	28±8
N. viridula Kuetz.	13	21	19	25	20	13-25	20±4
Fragilaria brevistriata Grun.	21	10	32	19	29	10-32	22±9
Cyclotella bodanica Eul.	38	32	29	43	26	26-43	34±7
Cymbella affinis Kuetz.	10	07	00	18	20	0-20	11±8
Pinularia viridis (Nitz.) Ehr.	07	21	11	18	16	07-21	15±6
Nitzschia sp.	24	18	32	39	32	18-39	29±8
Surirella sp.	18	12	32	36	27	12-36	25±9
Gomphonema lanceolatum Ehr.	10	08	21	16	15	08-21	14±5
G. parvulum (Kuetz.) Grun.	05	09	00	13	16	0-16	9±7
XANTHOPHYCEAE							
Botryococcus braunii Kutz.	32	29	43	27	49	27-49	36±10
Botrococcus sp.	12	08	21	18	16	08-21	15±5
EUGLANOPHYCEAE							
Euglena gracilis Klebs.	17	22	32	18	15	15-32	21±7
E. viridis Ehr.	15	10	32	25	27	10-32	22±9
Phacus acuminatus A. Stokes.	35	30	48	53	31	30-53	39±10
Phacus longicauda (Ehr.)Dujard.	19	10	13	21	30	10-30	19±8

Table3.4: - Numerical abundance (ul^{-1}) of phytoplankton in Urpod during Winter season of 2014-15.

Sites→ Species ↓	S-1	S-2	S-3	S-4	S-5	Range	Mean ± SD
CYANOPHYCEAE							
Anabaena orientalis Dixit.	87	80	72	68	76	68-87	77±7
A .fertilissima C.B.Rao.	58	62	69	76	72	58-76	67±7
Gleocapsa atrata Kutz.	21	20	28	32	13	13-32	23±7
Nostoc muscorum C. Agardh.	45	32	54	58	36	32-58	45±11
N. commune Vaucher.	65	50	55	48	58	48-65	55±8
Oscillatoria acuminata Gomont.	38	40	43	49	50	38-50	44±5
O. rubescens DC.	23	18	15	32	28	15-32	23±7
Phormidium corium C. Agardh.	05	09	12	00	21	0-21	9±8
P. favosum Bory.	10	16	14	09	19	09-19	15±4
Gomphosphaeria aponina Kutz.	67	60	49	50	54	50-67	56±8
Aphanocapsa litoralis Hansg.	06	00	12	21	19	0-21	12±9
Aulosira fertilissima S.L. Ghose.	13	21	22	16	14	13-22	17±4
Calothrix marchica Lemmerm.	12	06	18	21	24	06-24	16±7
Microcystis aeruginosa Kuetz.	94	98	80	83	85	80-94	88±8
M. viridis A. Braun.	54	60	40	43	46	40-60	49±8
CHLOROPHYCEAE							
Pandorina sp.	78	89	69	79	75	69-89	82±11
Volvox aureus Ehrenb.	79	89	100	70	85	70-100	85±11
Volvox sp.	30	20	25	34	39	20-39	30±7
Sorastrum sp.	38	32	45	53	50	32-53	44±9
Tetraedron pusillum West.	37	34	40	37	32	32-40	56±3
Tetraedron sp.	09	16	29	20	19	09-29	19±7
Chlorella vulgaris Beijer.	23	33	19	28	34	19-33	27±6
Ankistrodesmus falcatus (Corda).	43	46	50	38	48	38-50	45±5
Closteriopsis longissima West.	38	54	43	48	50	38-54	47±6
Hormidium sp.	08	16	21	23	28	08-28	19±8
Zygnema sp.	07	10	19	20	21	07-21	15±6
Gonatozygon aculeatum Hastings.	06	00	16	11	17	0-17	10±7
G.monotaenium de Bary.	10	08	28	25	16	08-28	17±9
Gonatozygon sp.	28	30	34	31	19	19-34	28±5
Arthrodesmus sublatus Kutz.	45	40	37	32	32	32-45	37±5
Closterium calosporum Wittr.	19	10	21	25	18	10-25	19±6
Closterium sp.	45	35	32	39	29	29-45	36±6
Cosmarium auriculatum Reinsch.	34	33	46	39	29	29-46	36±7
Cosmarium sp.	07	10	05	14	07	05-10	9±4

Desmidium aptogonum Breb.	47	40	39	54	50	39-54	46±6
Desmidium sp.	06	00	12	15	09	0-15	8±6
Euastrum ansatum Ehrenb.	39	54	45	48	43	39-54	46±6
E. sinuosum West & G. S.	28	32	19	35	43	19-43	31±9
Micrasterias foliacea Baley.	56	60	39	48	59	39-60	52±9
M.radiosa Raffs.	09	00	04	15	13	0-15	8±6
M.rotata. Grev.	00	13	14	06	09	0-14	8±6
Pleurotaenium sp.	23	19	28	30	33	19-33	27±6
Staurastrum sp.	05	00	13	10	18	0-18	9±7
Triploceras gracile Bailey.	45	39	49	29	36	29-49	40±8
Xanthidium antilopaeum. Kutz.	06	10	16	12	09	06-16	11±4
BACILLARIOPHYCEAE							
Navicula rhynchocephala Kuetz.	45	50	39	56	33	33-56	45±9
N. viridula Kuetz.	09	16	06	21	16	06-21	14±6
Fragilaria brevistriata Grun.	08	12	21	19	15	08-21	15±5
Cyclotella bodanica Eul.	09	13	31	24	15	09-31	18±9
Cymbella affinis Kuetz.	21	26	15	18	29	15-29	22±6
Pinularia viridis (Nitz.) Ehr.	19	07	21	18	26	07-26	18±7
Nitzschia sp.	32	16	34	43	40	16-43	33±10
Surirella sp.	34	29	25	32	40	25-40	32±6
Gomphonema lanceolatum Ehr.	05	00	08	13	14	0-14	8±6
G. parvulum (Kuetz.) Grun.	06	12	10	15	06	06-15	10±4
XANTHOPHYCEAE							
Botryococcus braunii Kutz.	43	38	29	35	34	29-43	34±8
Botrococcus sp.	19	17	25	29	22	17-29	22±5
EUGLANOPHYCEAE							
Euglena gracilis Klebs.	38	32	40	35	38	32-40	38±4
E. viridis Ehr.	27	22	29	15	21	15-29	21±7
Phacus acuminatus A. Stokes.	42	38	46	36	39	36-46	39±5
Phacus longicauda (Ehr.)Dujard.	25	30	23	15	22	15-30	22±6

Table 3.5: - Numerical abundance (ul^{-1}) of phytoplankton in Urpod during Pre-monsoon season of the year 2015-16

Sites→ Species ↓	S-1	S-2	S-3	S-4	S-5	Range	Mean ±SD
CYANOPHYCEAE							
Anabaena orientalis Dixit.	160	156	170	186	182	156-186	171±13
A. fertilissima C.B.Rao.	21	20	28	31	35	20-35	27±6
Gleocapsa atrata Kutz.	56	67	70	63	58	56-70	63±6
Nostoc muscorum C. Agardh.	89	76	79	87	92	76-92	85±7

N. commune Vaucher.	30	45	43	38	32	30-45	38±7
Oscillatoria acuminata Gomont.	20	26	28	36	40	20-40	30±8
O. rubescens DC.	26	20	35	39	19	19-39	28±9
Phormidium corium C. Agardh.	07	10	15	19	09	07-19	12±5
P. favosum Bory.	05	00	14	11	09	0-14	8±5
Gomphosphaeria aponina Kutz.	80	78	72	88	92	72-92	82±8
Aphanocapsa litoralis Hansg.	04	19	15	11	06	04-19	11±6
Aulosira fertilissima S.L. Ghose.	12	06	09	20	14	06-20	14±6
Calothrix marchica Lemmerm.	21	29	15	19	21	15-29	21±5
Microcystis aeruginosa Kuetz.	72	69	98	87	82	69-98	82±12
M. viridis A. Braun.	43	40	54	48	44	40-54	46±5
CHLOROPHYCEAE							
Pandorina sp.	87	80	78	73	70	70-87	78±7
Volvox aureus Ehrenb.	256	289	260	274	269	256-289	270±13
Volvox sp.	43	69	72	56	50	43-72	58±12
Sorastrum sp.	54	64	49	40	65	40-65	54±11
Tetraedron pusillum West.	69	76	88	95	75	69-95	81±11
Tetraedron sp.	29	11	26	15	09	11-29	18±9
Chlorella vulgaris Beijer.	65	69	52	48	60	52-69	59±9
Ankistrodesmus falcatus (Corda).	80	71	78	85	95	71-95	82±9
Closteriopsis longissima West.	40	39	54	50	48	39-54	46±6
Hormidium sp.	20	29	34	38	24	20-38	29±7
Zygnema sp.	19	10	23	16	17	10-23	17±5
Gonatozygon aculeatum Hastings.	34	29	32	40	44	29-44	36±6
G.monotaenium de Bary.	06	00	12	16	07	0-16	8±6
Gonatozygon sp.	32	29	40	21	34	21-40	31±7
Arthrodesmus sublatus Kutz.	20	22	27	39	43	20-43	30±10
Closterium calosporum Wittr.	54	68	70	59	65	54-70	63±7
Closterium sp.	21	24	15	19	30	15-30	22±6
Cosmarium auriculatum Reinsch.	30	43	40	39	47	30-47	40±6
Cosmarium sp.	30	43	49	38	44	30-49	41±7
Desmidium aptogonum Breb.	28	35	39	42	30	28-42	35±6
Desmidium sp.	20	18	26	31	26	18-31	24±5
Euastrum ansatum Ehrenb.	100	93	109	123	111	93-123	107±11
E. sinuosum West & G. S.	26	32	43	40	45	26-45	37±8
Micrasterias foliacea Baley.	68	65	74	80	85	68-85	74±8
M.radiosa Raffs.	25	20	32	26	17	17-32	24±6
M.rotata. Grev.	25	12	09	23	19	09-25	18±7
Pleurotaenium sp.	28	54	60	36	48	28-60	45±13
Staurastrum sp.	06	12	19	06	05	06-19	10±6
Triploceras gracile Bailey.	60	51	49	68	79	49-79	61±12
Xanthidium antilopaeum. Kutz.	21	07	23	20	17	07-23	18±6

BACILLARIOPHYCEAE							
Navicula rhynchocephala Kuetz.	98	110	134	92	100	92-134	107±17
N. viridula Kuetz.	19	32	23	28	34	19-34	27±6
Fragilaria brevistriata Grun.	15	27	30	21	26	15-30	24±6
Cyclotella bodanica Eul.	09	15	22	28	25	09-28	20±8
Cymbella affinis Kuetz.	04	13	00	10	09	0-13	7±5
Pinularia viridis (Nitz.) Ehr.	20	35	19	43	29	19-43	29±10
Nitzschia sp.	47	50	58	65	69	50-69	58±9
Surirella sp.	32	18	45	40	28	18-45	36±10
Gomphonema lanceolatum Ehr.	34	26	45	47	39	26-47	38±9
G. parvulum (Kuetz.) Grun.	08	06	00	14	18	0-18	19±7
XANTHOPHYCEAE							
Botryococcus braunii Kutz.	48	56	40	62	59	40-62	53±9
Botrococcus sp.	19	09	16	14	10	09-19	15±5
EUGLANOPHYCEAE							
Euglena gracilis Klebs.	89	95	73	80	69	69-95	81±11
E. viridis Ehr.	14	10	25	39	35	10-39	26±12
Phacus acuminatus A. Stokes.	59	68	76	83	78	59-83	73±9
Phacus longicauda (Ehr.)Dujard.	09	14	21	19	23	09-23	17±6

Table 3.6: - Numerical abundance (ul^{-1}) of phytoplankton in Urpod during Monsoon season of the year 2015-16

Sites→ Species ↓	S-1	S-2	S-3	S-4	S-5	Range	Mean ±SD
CYANOPHYCEAE							
Anabaena orientalis Dixit.	67	76	88	79	99	67-99	82±12
A .fertilissima C.B.Rao.	48	30	58	55	35	30-58	45±12
Gleocapsa atrata Kutz.	25	39	35	40	30	25-40	35±8
Nostoc muscorum C. Agardh.	30	20	28	34	39	20-39	30±7
N. commune Vaucher.	19	15	30	35	22	15-35	24±8
Oscillatoria acuminata Gomont.	20	35	43	26	30	20-43	31±9
O. rubescens DC.	18	30	16	36	25	16-36	25±8
Phormidium corium C. Agardh.	10	08	00	15	19	0-19	10±7
P. favosum Bory.	12	19	08	21	25	08-25	17±7
Gomphosphaeria aponina Kutz.	78	83	107	122	110	78-122	100±19
Aphanocapsa litoralis Hansg.	10	08	21	20	18	08-20	15±6
Aulosira fertilissima S.L. Ghose.	20	11	32	29	22	11-32	23±8
Calothrix marchica Lemmerm.	26	30	39	43	47	26-47	37±9
Microcystis aeruginosa Kuetz.	150	168	180	198	178	150-198	175±18
M. viridis A. Braun.	16	34	20	22	19	16-34	22±7

CHLOROPHYCEAE							
Pandorina sp.	79	68	80	96	98	68-98	84±13
Volvox aureus Ehrenb.	190	227	245	200	240	190-245	220±24
Volvox sp.	55	70	72	68	59	55-72	65±7
Sorastrum sp.	43	40	33	30	29	30-43	35±6
Tetraedron pusillum West.	55	60	63	72	64	55-72	63±6
Tetraedron sp.	14	06	21	08	11	06-21	12±6
Chlorella vulgaris Beijer.	36	40	54	50	58	36-58	48±9
Ankistrodesmus falcatus (Corda).	40	56	60	64	70	40-70	58±11
Closteriopsis longissima West.	54	46	38	40	35	35-54	43±8
Hormidium sp.	28	15	20	25	32	15-32	24±7
Zygnema sp.	06	13	19	20	26	06-26	17±8
Gonatozygon aculeatum Hastings.	43	45	37	30	26	26-45	36±8
G.monotaenium de Bary.	06	00	10	14	19	0-19	10±7
Gonatozygon sp.	18	20	32	10	13	10-32	19±8
Arthrodesmus sublatus Kutz.	29	19	32	38	43	19-43	32±9
Closterium calosporum Wittr.	46	50	58	73	65	46-73	58±11
Closterium sp.	20	27	19	37	42	19-42	29±10
Cosmarium auriculatum Reinsch.	19	10	23	30	34	10-34	23±9
Cosmarium sp.	20	29	35	28	34	20-35	29±6
Desmidium aptogonum Breb.	10	16	05	20	23	05-23	15±7
Desmidium sp.	24	35	43	29	40	24-43	34±8
Euastrum ansatum Ehrenb.	105	130	95	90	120	90-130	108±17
E. sinuosum West & G. S.	29	20	17	43	34	17-43	29±11
Micrasterias foliacea Baley.	88	97	104	130	135	88-135	111±20
M.radiosa Raffs.	23	34	40	31	20	20-40	30±8
M.rotata. Grev.	05	19	23	21	11	05-23	16±8
Pleurotaenium sp.	25	34	48	41	38	25-48	37±9
Staurastrum sp.	00	12	09	15	20	0-20	11±7
Triploceras gracile Bailey.	50	65	68	58	63	50-68	61±7
Xanthidium antilopaeum. Kutz.	28	32	36	48	27	27-48	34±8
BACILLARIOPHYCEAE							
Navicula rhynchocephala Kuetz.	78	70	85	89	90	70-90	82±8
N. viridula Kuetz.	21	29	25	32	34	21-34	28±5
Fragilaria brevistriata Grun.	08	16	19	23	26	08-26	18±7
Cyclotella bodanica Eul.	10	21	06	13	24	06-24	15±8
Cymbella affinis Kuetz.	23	12	15	29	32	12-32	22±9
Pinularia viridis (Nitz.) Ehr.	10	06	16	23	21	06-23	15±7
Nitzschia sp.	32	27	43	40	27	27-43	34±7
Surirella sp.	07	12	04	16	12	04-12	10±5
Gomphonema lanceolatum Ehr.	43	30	29	31	40	29-43	35±6
G. parvulum (Kuetz.) Grun.	04	00	12	10	06	0-12	6±5

XANTHOPHYCEAE							
Botryococcus braunii Kutz.	23	35	43	45	28	23-45	35±9
Botrococcus sp.	12	23	38	26	29	12-38	26±9
EUGLANOPHYCEAE							
Euglena gracilis Klebs.	56	76	70	47	58	56-76	61±12
E. viridis Ehr.	14	09	23	22	18	09-23	17±6
Phacus acuminatus A. Stokes.	73	68	45	56	59	45-73	60±11
Phacus longicauda (Ehr.)Dujard.	12	32	26	25	15	12-32	22±8

Table 3.7: - Numerical abundance (ul^{-1}) of phytoplankton in Urpod beel during Post-monsoon season of the year 2015-16

Sites→ Species ↓	S-1	S-2	S-3	S-4	S-5	Range	Mean ± SD
CYANOPHYCEAE							
Anabaena orientalis Dixit.	56	70	79	82	50	50-82	67±14
A .fertilissima C.B.Rao.	21	17	30	38	40	17-40	30±11
Gleocapsa atrata Kutz .	11	16	24	34	39	11-39	25±12
Nostoc muscorum C. Agardh.	23	14	32	18	26	14-32	23±7
N. commune Vaucher.	21	30	37	43	27	21-43	32±9
Oscillatoria acuminata Gomont.	05	14	20	09	16	05-16	13±6
O. rubescens DC.	00	08	13	19	16	0-16	11±7
Phormidium corium C. Agardh.	10	05	00	13	21	0-21	10±8
P. favosum Bory.	04	00	23	15	07	0-23	10±9
Gomphosphaeria aponina Kutz.	70	34	57	66	45	34-70	54±15
Aphanocapsa litoralis Hansg.	05	12	21	18	20	05-21	15±7
Aulosira fertilissima S.L. Ghose.	13	26	34	37	25	13-37	27±9
Calothrix marchica Lemmerm.	20	17	34	40	32	17-40	29±10
Microcystis aeruginosa Kuetz.	58	76	47	59	69	47-76	62±11
M. viridis A. Braun.	20	25	37	43	38	20-43	33±10
CHLOROPHYCEAE							
Pandorina sp.	38	45	59	62	43	38-62	49±11
Volvox aureus Ehrenb.	72	103	85	95	76	72-103	86±13
Volvox sp.	27	34	45	39	40	27-45	37±7
Sorastrum sp.	20	15	06	23	14	06-23	16±7
Tetraedron pusillum West.	23	18	34	27	25	18-34	25±6
Tetraedron sp.	07	00	14	18	05	0-18	9±7
Chlorella vulgaris Beijer.	21	23	38	12	10	10-38	21±11
Ankistrodesmus falcatus (Corda).	13	35	24	13	19	13-35	21±9
Closteriopsis longissima West.	32	39	24	42	22	22-42	32±9
Hormidium sp.	10	16	21	17	36	10-36	20±10

Zygnema sp.	08	10	05	19	21	05-21	13±7
Gonatozygon aculeatum Hastings.	21	20	11	09	13	09-21	15±5
G.monotaenium de Bary.	06	00	13	16	07	0-16	8±6
Gonatozygon sp.	23	17	08	11	13	08-23	14±6
Arthrodesmus sublatus Kutz.	12	34	39	16	18	12-39	24±12
Closterium calosporum Wittr.	32	16	22	11	23	11-32	21±8
Closterium sp.	14	19	32	26	29	14-32	24±7
Cosmarium auriculatum Reinsch.	13	17	23	21	18	13-23	18±4
Cosmarium sp.	00	12	06	15	06	0-15	8±6
Desmidium aptogonum Breb.	20	31	13	11	16	11-31	18±8
Desmidium sp.	24	35	43	29	40	24-43	34±8
Euastrum ansatum Ehrenb.	38	49	62	56	52	38-62	51±9
E. sinuosum West & G. S.	10	18	15	21	24	10-24	18±5
Micrasterias foliacea Baley.	45	56	69	54	67	45-69	58±10
M.radiosa Raffs.	00	00	13	19	18	0-19	10±9
M.rotata. Grev.	07	05	12	16	07	05-16	9±5
Pleurotaenium sp.	05	16	12	21	08	05-21	12±6
Staurastrum sp.	12	05	08	00	14	0-14	8±6
Triploceras gracile Bailey.	15	34	39	33	42	15-42	33±11
Xanthidium antilopaeum. Kutz.	06	13	09	13	23	06-23	13±6
BACILLARIOPHYCEAE							
Navicula rhynchocephala Kuetz.	56	49	40	59	62	40-62	53±9
N. viridula Kuetz.	17	33	11	18	29	11-33	22±9
Fragilaria brevistriata Grun.	05	00	14	18	11	0-18	10±7
Cyclotella bodanica Eul.	15	09	11	20	16	09-20	14±4
Cymbella affinis Kuetz.	00	16	11	14	07	0-16	10±6
Pinularia viridis (Nitz.) Ehr.	28	21	14	17	08	08-28	18±8
Nitzschia sp.	27	14	32	10	17	10-32	20±8
Surirella sp.	13	28	33	23	28	13-33	25±8
Gomphonema lanceolatum Ehr.	21	15	11	19	26	11-26	18±6
G. parvulum (Kuetz.) Grun.	00	06	10	11	21	0-21	10±8
XANTHOPHYCEAE							
Botryococcus braunii Kutz.	19	14	32	17	36	17-36	24±10
Botrococcus sp.	00	11	07	18	10	0-18	9±7
EUGLANOPHYCEAE							
Euglena gracilis Klebs.	38	28	31	41	40	28-41	36±6
E. viridis Ehr.	09	15	19	21	08	08-21	14±6
Phacus acuminatus A. Stokes.	31	39	37	15	17	15-39	28±11
Phacus longicauda (Ehr.)Dujard.	10	08	17	19	27	08-27	16±8

Table 3.8: - Numerical abundance (ul^{-1}) of phytoplankton in Urpod beel during Winter season of the year 2015 - 16.

Sites→ Species ↓	S-1	S-2	S-3	S-4	S-5	Range	Mean ± SD
CYANOPHYCEAE							
Anabaena orientalis Dixit.	67	84	97	69	76	67-97	79±12
A. fertilissima C.B.Rao.	58	68	76	63	88	58-88	71±12
Gleocapsa atrata Kutz.	25	36	14	18	23	14-36	23±8
Nostoc muscorum C. Agardh.	46	67	56	58	48	46-67	55±8
N. commune Vaucher.	09	05	13	15	28	05-28	14±9
Oscillatoria acuminata Gomont.	23	19	32	15	22	15-32	22±16
O. rubescens DC.	11	24	32	16	20	11-32	21±8
Phormidium corium C. Agardh.	07	10	16	05	11	05-16	10±4
P. favosum Bory.	12	21	23	15	06	06-23	15±7
Gomphosphaeria aponina Kutz.	88	75	61	88	78	61-88	78±11
Aphanocapsa litoralis Hansg.	05	12	16	07	18	05-18	12±6
Aulosira fertilissima S.L. Ghose.	16	25	32	16	18	16-32	21±7
Calothrix marchica Lemmerm.	32	36	16	39	25	26-39	30±9
Microcystis aeruginosa Kuetz.	48	36	62	57	49	36-62	50±10
M. viridis A. Braun.	10	21	15	19	23	10-23	18±5
CHLOROPHYCEAE							
Pandorina sp.	43	40	59	65	55	40-65	52±11
Volvox aureus Ehrenb.	89	93	79	103	110	79-110	95±12
Volvox sp.	34	58	45	55	40	34-58	46±10
Sorastrum sp.	29	09	23	13	11	09-29	17±9
Tetraedron pusillum West.	45	32	26	54	39	26-54	39±11
Tetraedron sp.	10	14	32	23	16	10-32	19±9
Chlorella vulgaris Beijer.	24	43	30	33	49	24-49	36±10
Ankistrodesmus falcatus (Corda).	57	87	70	69	82	57-87	73±12
Closteriopsis longissima West.	58	73	89	83	85	58-89	78±12
Hormidium sp.	32	38	24	42	25	24-42	32±8
Zygnema sp.	16	29	31	22	28	16-31	25±6
Gonatozygon aculeatum Hastings.	15	32	28	21	28	15-32	25±7
G.monotaenium de Bary.	05	`12	18	06	11	05-18	10±5
Gonatozygon sp.	15	32	17	11	28	11-32	21±9
Arthrodesmus sublatus Kutz.	32	45	54	49	50	32-54	46±8
Closterium calosporum Wittr.	16	19	21	24	32	16-32	22±6
Closterium sp.	32	23	43	47	37	23-43	36±9
Cosmarium auriculatum Reinsch.	10	16	23	22	21	10-23	18±5
Cosmarium sp.	19	21	10	16	24	10-24	18±5
Desmidium aptogonum Breb.	43	56	68	55	65	55-68	57±10

Desmidium sp.	05	12	19	20	05	05-20	12±7
Euastrum ansatum Ehrenb.	50	75	66	63	60	50-75	63±9
E. sinuosum West & G.S.	30	26	43	40	45	26-45	37±8
Micrasterias foliacea Baley.	79	74	99	87	102	74-102	88±12
M.radiosa Raffs.	06	14	19	06	11	06-19	11±6
M.rotata. Grev.	05	00	23	11	17	0-23	11±9
Pleurotaenium sp.	11	19	21	25	17	11-25	19±5
Staurastrum sp.	12	07	04	00	15	0-15	08±6
Triploceras gracile Bailey.	66	89	97	76	83	66-97	82±12
Xanthidium antilopaeum. Kutz.	06	18	00	11	05	0-18	08±7
BACILLARIOPHYCEAE							
Navicula rhynchocephala Kuetz.	28	35	54	18	23	23-54	32±14
N. viridula Kuetz.	08	12	20	18	14	08-20	14±5
Fragilaria brevistriata Grun.	08	00	10	05	11	0-11	7±4
Cyclotella bodanica Eul.	32	19	26	43	40	19-43	32±10
Cymbella affinis Kuetz.	12	08	16	21	18	08-21	15±5
Pinularia viridis (Nitz.) Ehr.	06	00	14	19	05	0-19	9±8
Nitzschia sp.	29	30	37	21	19	19-37	27±7
Surirella sp.	10	16	07	19	21	07-21	15±6
Gomphonema lanceolatum Ehr.	32	28	43	21	29	21-43	31±8
G. parvulum (Kuetz.) Grun.	00	12	15	07	08	0-15	8±7
XANTHOPHYCEAE							
Botryococcus braunii Kutz.	34	45	56	40	50	34-56	46±8
Botrococcus sp.	11	23	13	09	29	09-29	17±5
EUGLANOPHYCEAE							
Euglena gracilis Klebs.	10	23	17	15	19	10-23	17±5
E. viridis Ehr.	05	14	10	21	27	05-27	15±9
Phacus acuminatus A. Stokes.	50	45	40	67	69	40-69	54±13
Phacus longicauda (Ehr.)Dujard.	05	00	12	22	06	0-22	9±8

Table 3.9: - Numerical mean abundance (ul^{-1}) of phytoplankton in Urpod beel during the year 2014 - 16.

Phytoplankton Species	PR-MON (Mean±SD)	MON (Mean±SD)	PO-MON (Mean±SD)	WIN (Mean±SD)
CYANOPHYCEAE				
Anabaena orientalis Dixit.	120±11	76±9	53±11	78±10
A. fertilissima C.B.Rao.	28±7	65±10	32±9	69±10
Gleocapsa atrata Kutz.	44±7	32±5	19±9	23±8
Nostoc muscorum C. Agardh.	72±8	71±12	30±6	50±10
N. commune Vaucher.	37±9	29±7	29±7	35±9

Oscillatoria acuminata Gomont.	45±10	41±8	20±8	33±6
O. rubescens DC.	25±8	27±9	12±6	22±8
Phormidium corium C. Agardh.	12±5	09±6	08±6	10±6
P. favosum Bory.	10±5	37±7	10±6	15±6
Gomphosphaeria aponina Kutz.	77±9	60±13	49±13	67±10
Aphanocapsa litoralis Hansg.	11±6	10±5	14±7	12±8
Aulosira fertilissima S.L. Ghose.	10±6	18±7	20±7	19±6
Calothrix marchica Lemmerm.	22±6	25±7	21±7	23±7
Microcystis aeruginosa Kuetz.	56±11	117±12	70±9	69±9
M. viridis A. Braun.	39±6	26±6	49±9	34±7
CHLOROPHYCEAE				
Pandorina sp.	56±7	132±11	49±10	67±11
Volvox aureus Ehrenb.	190±14	160±17	66±11	90±12
Volvox sp.	57±11	51±6	29±7	38±9
Sorastrum sp.	46±9	59±7	36±7	31±9
Tetraedron pusillum West.	72±11	59±7	26±7	38±6
Tetraedron sp.	20±9	09±6	07±6	19±8
Chlorella vulgaris Beijer.	48±9	41±8	19±8	32±8
Ankistrodesmus falcatus (Corda).	74±10	53±9	24±7	59±9
Closteriopsis longissima West.	42±6	40±7	29±9	63±9
Hormidium sp.	26±8	21±6	20±8	26±6
Zygnema sp.	19±5	14±6	14±6	20±6
Gonatozygon aculeatum Hastings.	26±6	24±6	20±5	17±7
G.monotaenium de Bary.	06±5	10±5	09±5	10±6
Gonatozygon sp.	24±7	16±7	21±7	25±8
Arthrodesmus sublatus Kutz.	29±8	37±7	26±11	42±7
Closterium calosporum Wittr.	66±9	43±9	30±8	21±6
Closterium sp.	26±7	29±8	20±7	36±8
Cosmarium auriculatum Reinsch.	54±7	35±9	30±6	27±6
Cosmarium sp.	24±7	17±6	08±6	14±5
Desmidium aptogonum Breb.	34±6	22±7	22±8	52±8
Desmidium sp.	19±6	22±9	11±6	15±8
Euastrum ansatum Ehrenb.	77±8	67±12	40±8	55±8
E. sinuosum West & G. S.	32±8	22±9	19±7	34±9
Micrasterias foliacea Baley.	91±13	95±13	44±10	70±11
M.radiosa Raffs.	17±7	25±8	13±9	10±6
M.rotata. Grev.	13±10	14±7	12±5	10±8
Pleurotaenium sp.	37±6	34±10	14±6	23±6
Staurastrum sp.	07±5	10±5	09±7	09±6
Triploceras gracile Bailey.	54±7	48±7	36±10	61±10
Xanthidium antilopaeum. Kutz.	20±10	28±9	14±6	10±6

BACILLARIOPHYCEAE				
Navicula rhynchocephala Kuetz.	81±14	94±12	41±9	39±12
N. viridula Kuetz.	25±8	33±7	21±7	14±6
Fragilaria brevistriata Grun.	17±4	19±7	16±8	11±5
Cyclotella bodanica Eul.	17±7	14±7	24±6	25±10
Cymbella affinis Kuetz.	14±6	24±7	11±7	19±6
Pinularia viridis (Nitz.) Ehr.	21±9	12±7	17±7	14±8
Nitzschia sp.	53±8	36±8	25±8	30±9
Surirella sp.	29±7	16±6	25±9	24±6
Gomphonema lanceolatum Ehr.	23±8	25±5	16±6	20±7
G. parvulum (Kuetz.) Grun.	14±6	12±5	10±8	9±6
XANTHOPHYCEAE				
Botryococcus braunii Kutz.	62±7	40±8	30±10	40±8
Botrococcus sp.	16±5	23±8	12±6	19±5
EUGLANOPHYCEAE				
Euglena gracilis Klebs.	65±9	50±9	29±7	29±5
E. viridis Ehr.	26±9	21±7	18±8	48±8
Phacus acuminatus A. Stokes	69±8	56±10	34±11	47±9
Phacus longicauda (Ehr.)Dujard.	22±9	20±8	18±8	16±7

Table 3.10: - Total phytoplankton abundance (ul^{-1}) in Urpod beel during study period.

Year	**2014 - 15**				**2015 – 16**			
Class ↓	PR-MON	MON	PO-MON	WIN	PR-MON	MON	PO-MON	WIN
Cyanophyceae	488.6 ±42.11	606.2 ±18.51	424.8 ±23.84	594.8 ±17.34	714.0 ±58.30	670.6 ±91.22	438.8 ±83.38	504.2 ±56.68
Chlorophyceae	1104.6 ±66.82	1069.2 ±52.49	737.6 ±40.55	923.0 ±58.34	1515.2 ±82.00	1378.4 ±127.4	696.2 ±78.76	1135.8 ±61.73
Bacillariophyceae	219.2 ±35.85	299.0 ±27.90	205.6 ±37.09	214.4 ±32.43	351.8 ±42.58	254.2 ±57.25	198.8 ±17.84	189.4 ±32.54
Xanthophyceae	87.6 ±7.96	59.4 ±10.60	51.0 ±12.71	58.2 ±4.49	66.6 ±7.23	60.4 ±17.31	32.8 ±10.82	62.0 ±14.42
Euglanophyceae	168.2 ±9.47	134.8 ±16.57	100.6 ±21.80	122.6 ±14.13	195.8 ±18.79	160.8 ±14.69	94.0 ±6.32	95.4 ±25.62

Table 3.11: - Correlation coefficient matrix among the Plankton group(s) of Urpod beel in Pre-monsoon season during March, 2014 – Feb, 2016.

	CYN	CHL	BAC	XAN	EUG	TPHY	PRO	ROT	COP	CLA	OST	TZOO
CYN	1	.963*	.958*	-.822*	.838*	.980*	.347	-.300	-.047	.833*	.085	.463
CHL		1	.967*	-.864*	.835*	.996*	.266	-.316	.060	.820*	-.089	.434
BAC			1	-.835*	.826*	.979*	.459	-.213	.170	.893*	-.040	.547
XAN				1	-.503	-.856*	-.126	.375	-.052	-.738*	.063	-.335
EUG					1	.846*	.520	.007	.036	.718*	.163	.556
TPHY						1	.326	-.287	.052	.850*	-.026	.487
PRO							1	.583	.379	.636*	.491	.880*
ROT								1	.559	.141	.391	.651*
COP									1	.292	-.395	.553
CLA										1	.194	.827*
OST											1	.368
TZOO												1

Table 3.12: - Correlation coefficient matrix among the Plankton group (s) of Urpod beel in Monsoon season during March, 2014 – Feb, 2016.

	CYN	CHL	BAC	XAN	EUG	TPHY	PRO	ROT	COP	CLA	OST	TZOO
CYN	1	.734*	.382	.513	.184	.903*	.249	.575	.856*	.836*	.301	.759*
CHL		1	-.148	.317	.573	.942*	.271	.549	.734*	.838*	.152	.718*
BAC			1	.329	-.491	.162	.085	.061	.176	.172	.462	.165
XAN				1	-.121	.466	.419	-.148	.568	.433	.188	.268
EUG					1	.437	.289	.600	.452	.581	-.166	.586
TPHY						1	.332	.595	.848*	919*	.272	.804*
PRO							1	.445	.344	.533	.620	.677*
ROT								1	.582	.696*	.305	.886*
COP									1	.802*	-.035	.755*
CLA										1	.416	.921*
OST											1	.476
TZOO												1

Table 3.13: - Correlation coefficient matrix among the Plankton group(s) of Urpod beel in Post- monsoon season during March, 2014 – Feb, 2016.

	CYN	CHL	BAC	XAN	EUG	TPHY	PRO	ROT	COP	CLA	OST	TZOO
CYN	1	.955*	.727*	.517	.722*	.976*	.890*	.205	.793*	.914*	.245	.882*
CHL		1	.655*	.459	.833*	.991*	.884*	.080	.808*	.937*	.359	.869*
BAC			1	.648*	.458	.733	.564	.623	.811*	.605	.399	.751*
XAN				1	.455	.533	.194	.377	.498	.546	.484	.527
EUG					1	.823*	.648*	.082	.688*	.838*	.549	.749*
TPHY						1	.857*	.175	.837*	.940*	.371	.897*
PRO							1	.175	.797*	.884*	.222	.883*
ROT								1	.503	.209	.349	.488
COP									1	.850*	.669*	.947*
CLA										1	.473	.944*
OST											1	.533
TZOO												1

Table 3.14: - Correlation coefficient matrix among the Plankton group (s) of Urpod beel in Winter season during March, 2014 – Feb, 2016.

	CYN	CHL	BAC	XAN	EUG	TPHY	PRO	ROT	COP	CLA	TZOO
CYN	1	-.568	.547	.374	.304	.166	-.050	-.606	-.749*	-.480	-.611
CHL		1	-.037	.381	-.428	.687*	.525	.930*	.930*	.947*	.977*
BAC			1	.179	.080	.551	.654	-.190	-.328	-.064	-.127
XAN				1	-.053	.714*	.225	.213	.191	.436	.301
EUG					1	-.071	-.089	-.340	-.570	-.473	-.472
TPHY						1	.703*	.555	.395	.665*	.600
PRO							1	.369	.281	.467	.468
ROT								1	.905*	.928*	.966*
COP									1	.898*	.953*
CLA										1	.977*
TZOO											1

4.2. A.3 PERCENTAGE AVAILABILITY OF PHYTOPLANKTON

The present study showed that phytoplankton community comprised of Chlorophyceae (51.68%), Cyanophyceae (27.29%), Bacillariophyceae (11.84%), Xanthophyceae (2.95%) and Euglanophyceae (6.24%) (Table: 3.15).

Table 3.15: - The abundance of phytoplankton community (%) in the Urpod beel.

Year →	**2014 - 15**				**2015 - 16**				
Season → Class ↓	PR-MON	MON	PO-MON	WIN	PR-MON	MON	PO-MON	WIN	Avg. %
Cyanophyceae	23.61	28.02	27.90	31.09	25.17	27.12	30.04	25.41	27.29
Chlorophyceae	53.43	49.43	48.50	48.25	53.28	55.78	47.66	57.11	51.68
Bacillariophyceae	10.61	13.57	13.50	11.20	12.35	10.30	13.61	9.55	11.84
Xanthophyceae	4.21	2.74	3.50	3.05	2.32	2.44	2.24	3.12	2.95
Euglanophyceae	8.14	6.24	6.60	6.41	6.88	4.36	6.45	4.81	6.24

4.2. A.4 DIVERSITY INDICES OF PHYTOPLANKTON

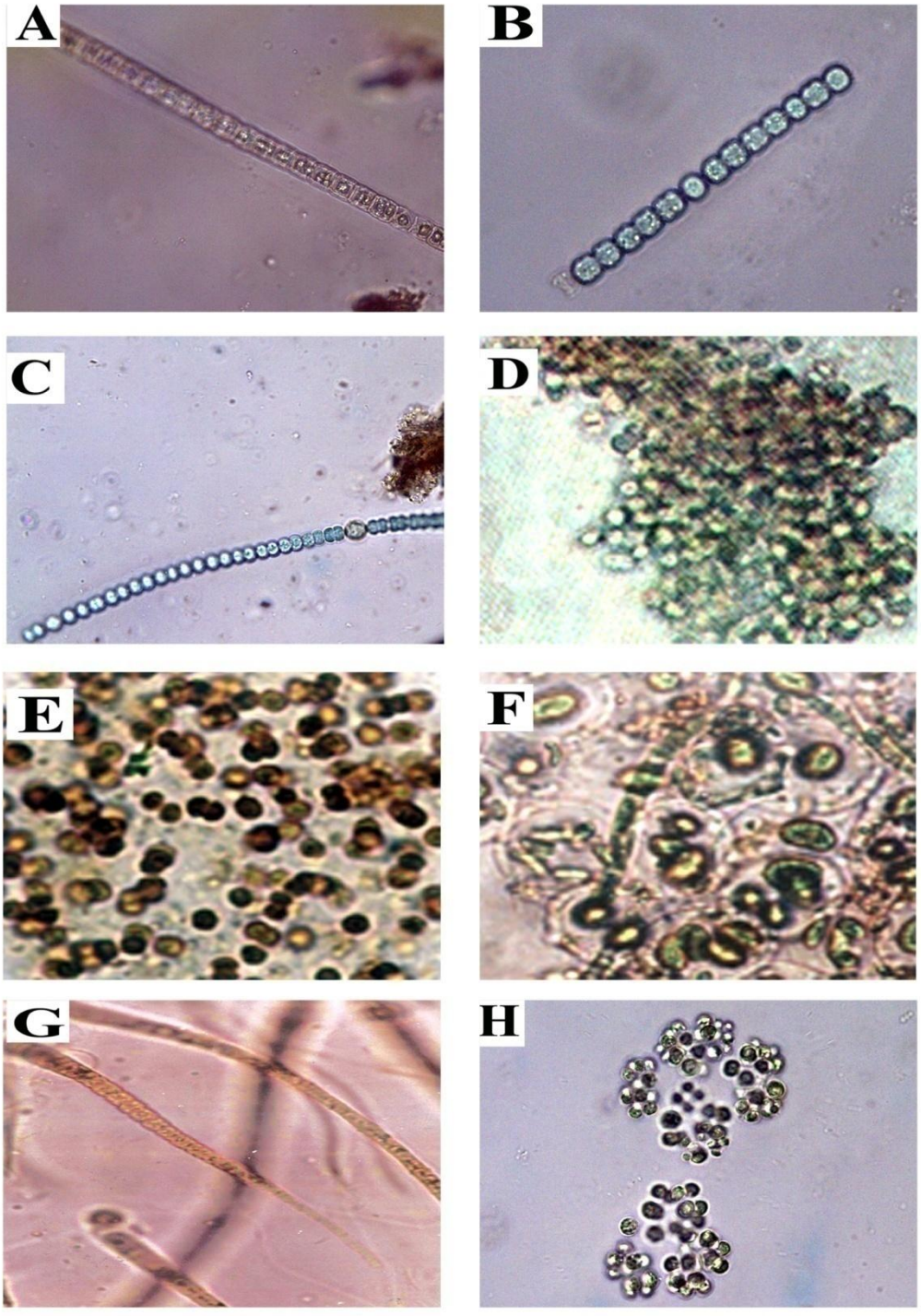
Analysis of diversity index showed that the Simpson index in the range of 0.021 – 0.028 for the first year, while 0.023 -0.029 has been calculated for the second year. In both the years the highest value is found in monsoon season and the lowest

Table 3.16: - Diversity Indices of phytoplankton species of Urpod beel.

Year →	**2014 - 15**				**2015 - 16**			
Season → Indices↓	PR-MON	MON	PO-MON	WIN	PR-MON	MON	PO-MON	WIN
No of Species	61	61	61	61	61	61	61	61
No of Organisms	2051	2150	1508	1944	2864	2548	1464	1971
Simpson Index	0.0242	0.0288	0.0211	0.0226	0.0290	0.0294	0.0234	0.0245
Dominance Index	0.9757	0.9711	0.9789	0.9773	0.971	0.9706	0.9765	0.9755
Shanon Index	5.587	5.482	5.714	5.65	5.511	5.502	5.643	5.586
Berger – Parker Dominance Index	0.0536	0.0837	0.0510	0.0452	0.0942	0.0863	0.0587	0.0482
Margalef Richness Index	7.868	7.819	8.198	7.923	7.538	7.65	8.232	7.909

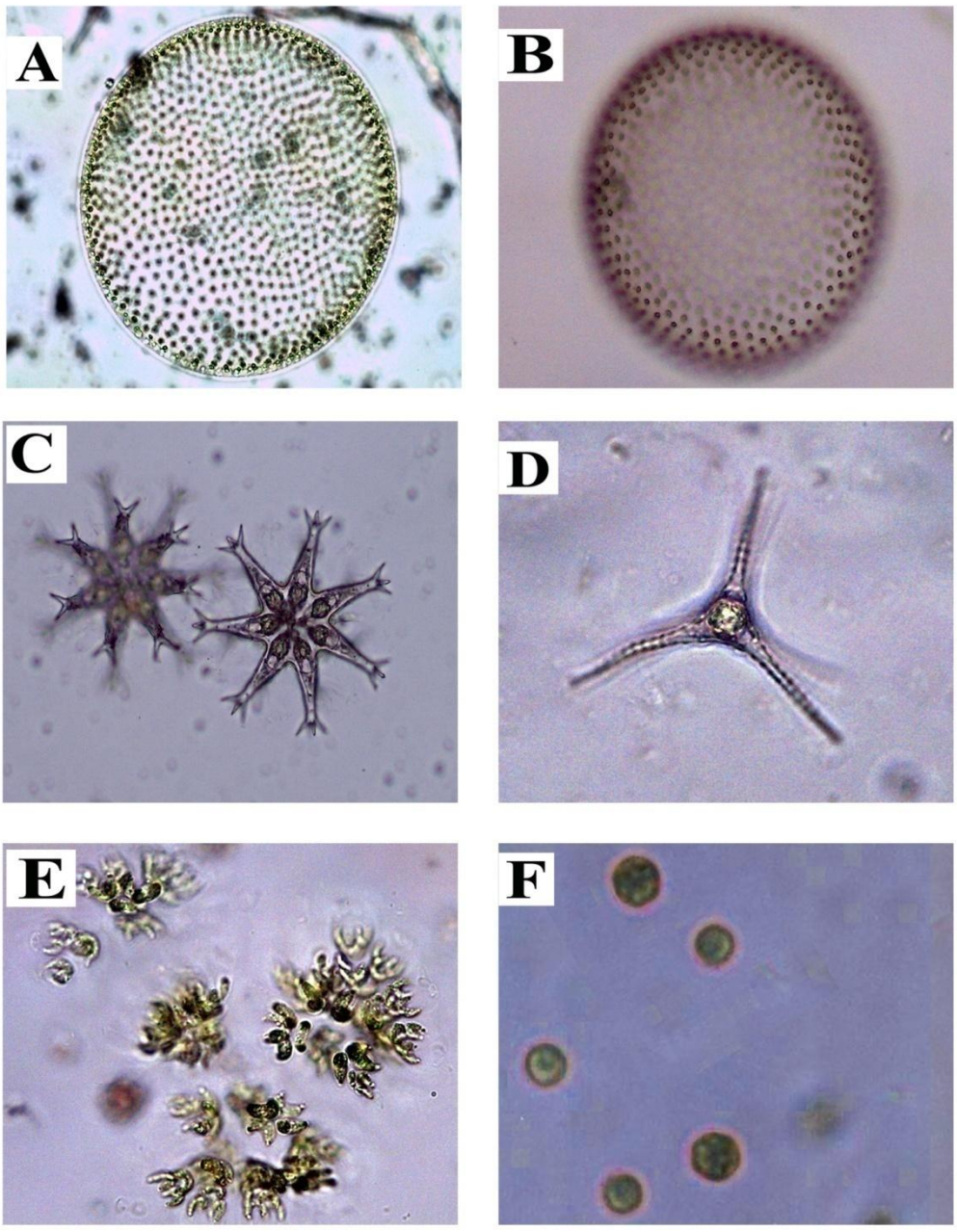
value is evaluated in the post-monsoon season during the study period. The Dominance Index ranges from 0.9711 to 0.9789 in the first year and 0.9706 – 0.9765 in the second year of investigation. In this index the highest value is found in the post-monsoon season and the lowest value during the monsoon season in both the years. The Shanon index ranges from 5.482 – 5.714 in the first year of observation and 5.502 – 5.643 in the second year of records. The lowest values are observed in monsoon season on both the years and the highest values are also observed in post-monsoon season for both the years. The Berger-Parker dominance index ranged between 0.0452 – 0.0837 in the first year of the study period and in the second year it ranged between 0.0482 – 0.0942. The highest values are observed in monsoon period during the first year and in the pre-monsoon season in the second year. The lowest values are observed in winter season of both the years. Margalef richness index is ranged between 7.819 – 8.198 in the first year and 7.538 – 8.232 in the second year. The highest values are found in post-monsoon season of both the years. The lowest values are observed in monsoon season in the first year and in pre-monsoon season of the second year of observation (Table 3.16).

PHOTO PLATE - 2



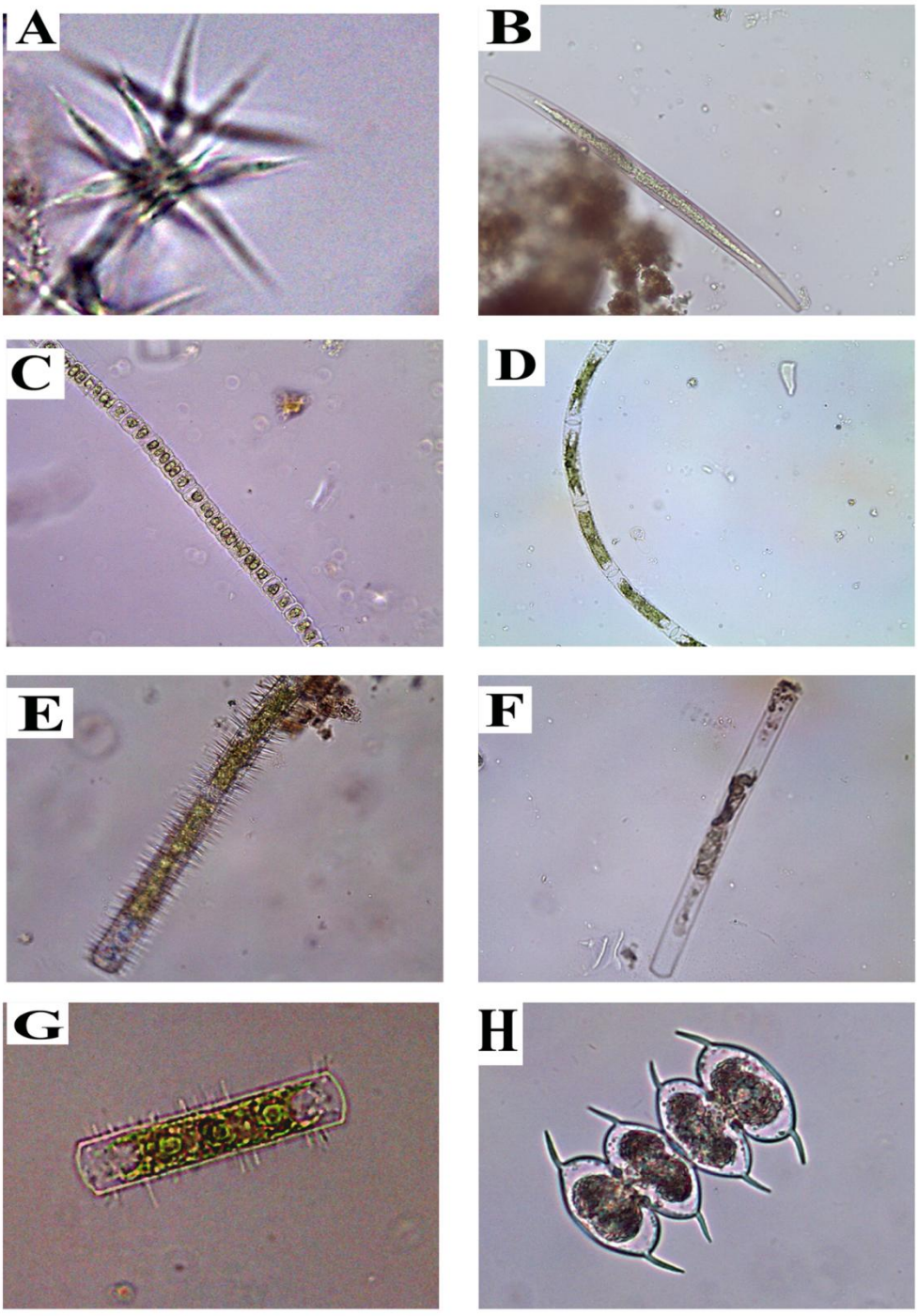
A- *Oscillatoria acuminata,* B- *Anabaena fertilissima,* C- *A. orientalis,*
B- *Microcystis aeruginosa,* E- *M. viridis,* F- *Gleocapsa atrata,*
G- *Calothrix marchica,* H- *Gomphosphaeria aponina*

PHOTO PLATE - 3



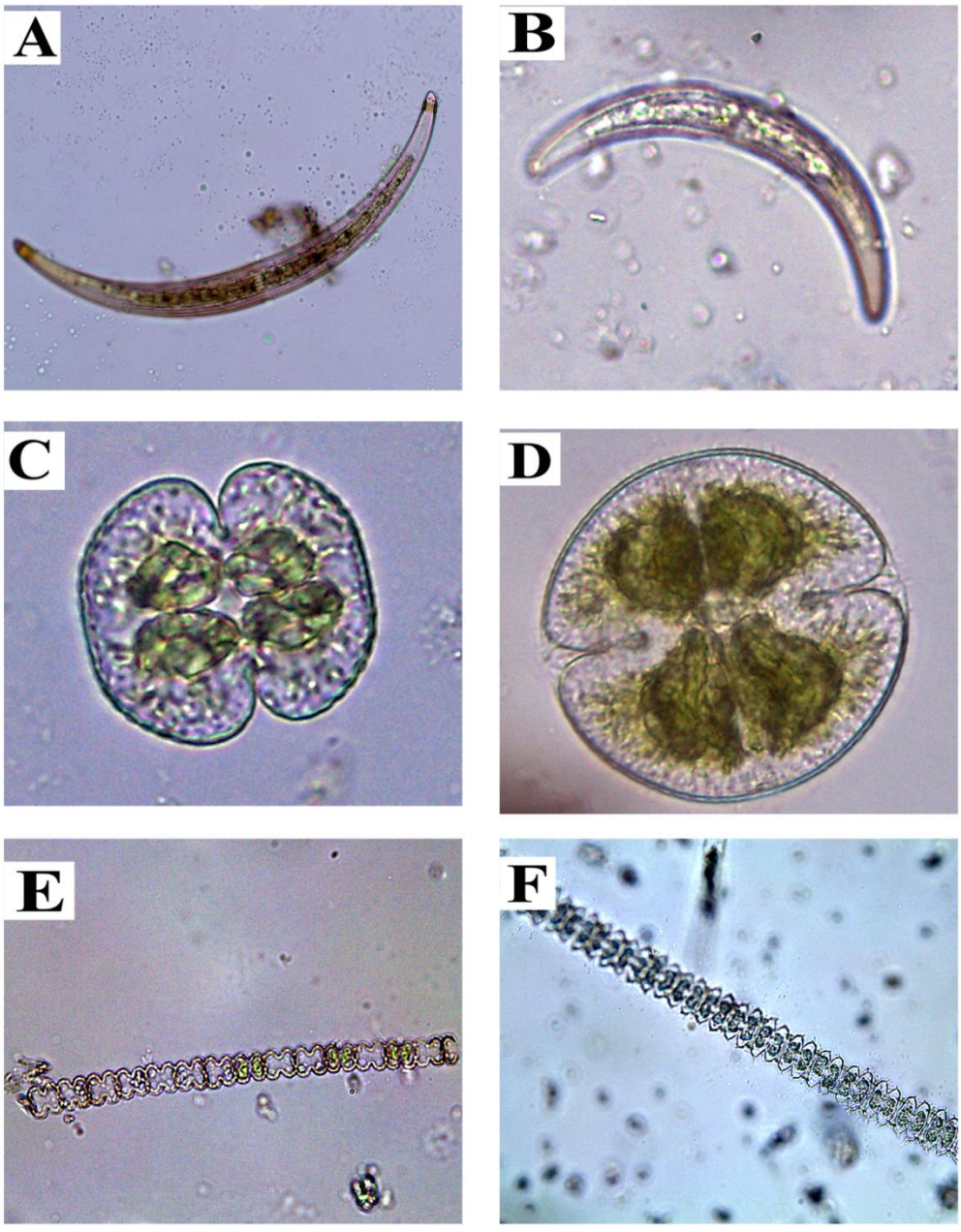
A- *Volvox aureus,* B- *Volvox* sp., C- *Staurastrum* sp.,
D- *Tetraedron* sp., E- *Sorastrum* sp. F- *Chlorella vulgaris*

PHOTO PLATE - 4



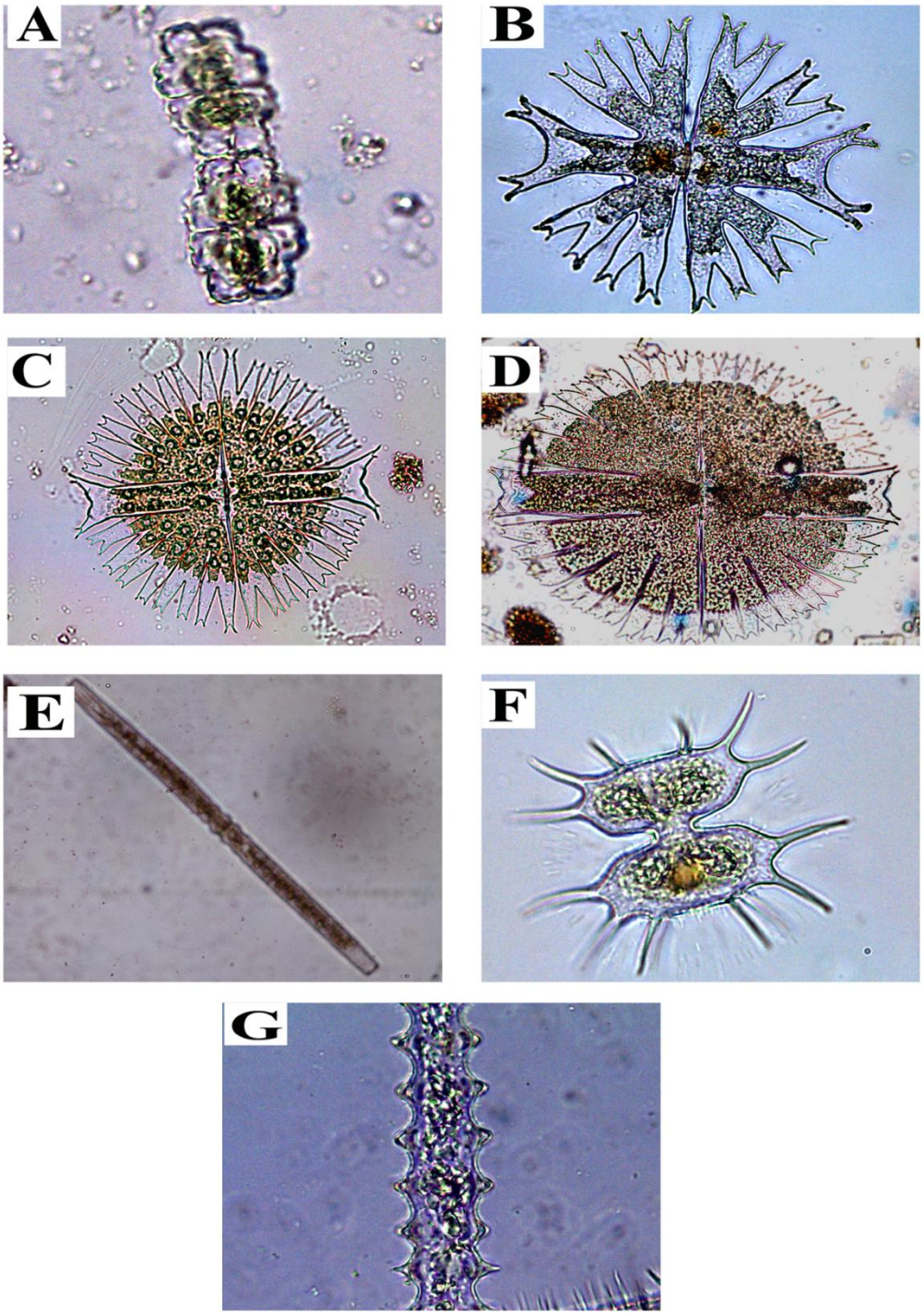
A- *Ankistrodesmus falcatus*, B- *Closteriopsis longissima*,
C- *Hormidium* sp., D- *Zygnema* sp., E- *Gonatozygon aculeatum*
G. monotaenium, G- *Gonatozygon* sp., H- *Arthrodesmus sublatus*

PHOTO PLATE - 5



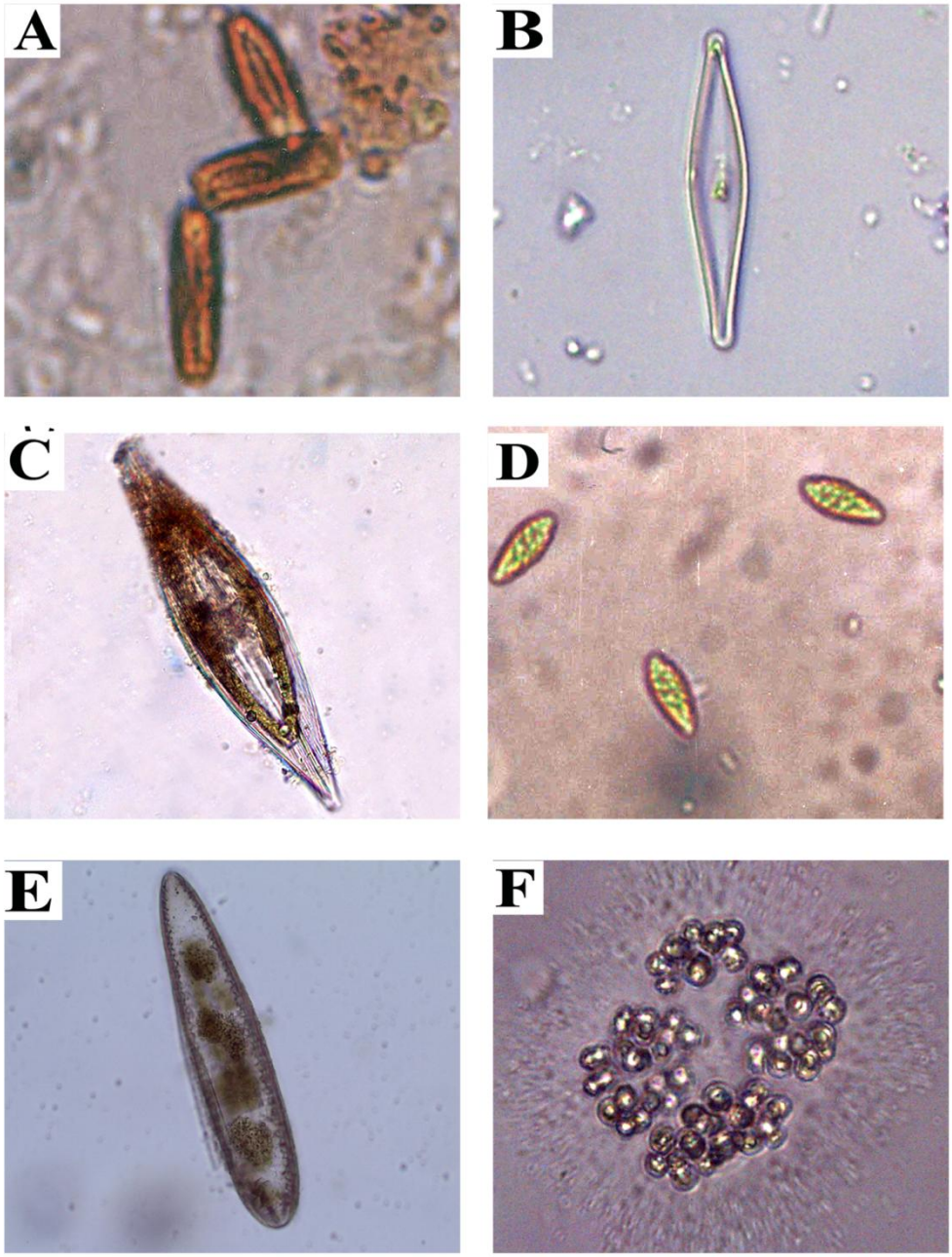
A- *Closterium calosporum,* B- *Closterium* sp.,
C- *Cosmarium auriculatum,* D- *Cosmarium* sp.,
E- *Desmidium aptogonum,* F- *Desmidium* sp.

PHOTO PLATE - 6



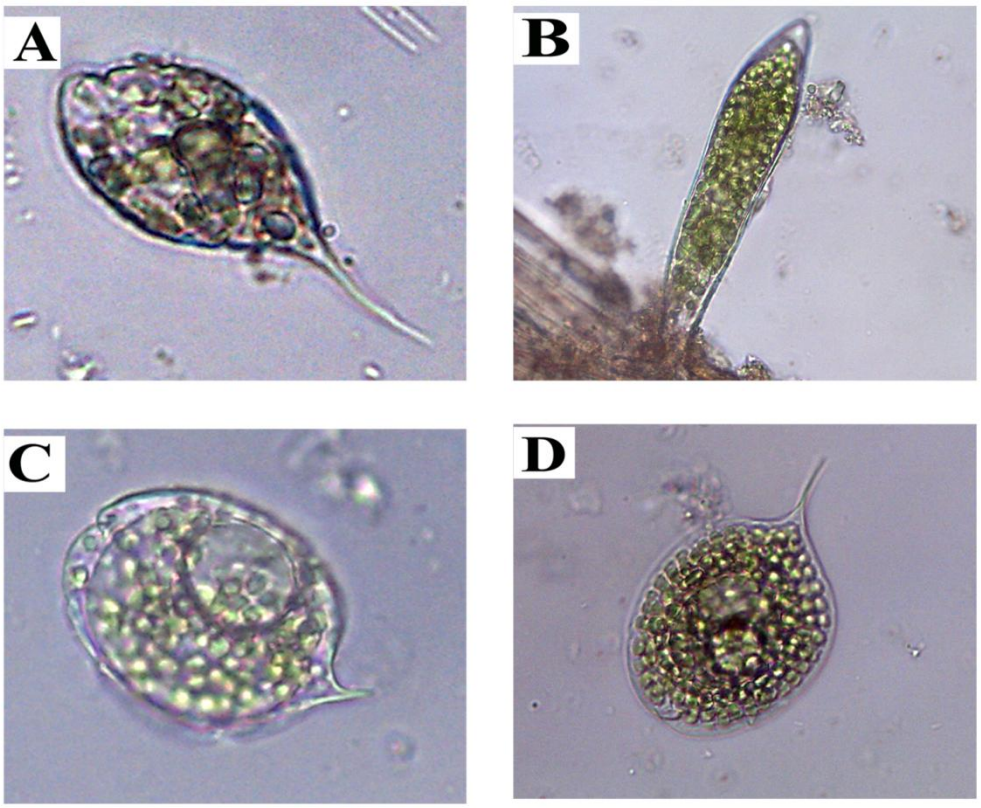
A- *Euastrum sinuosum,* B- *Micrasterias foliacea,*
C- *M. radiosa,* D- *M. rotata,* E- *Pleurotaenium* sp.
F- *Xanthidium antilopaeum,* G- *Triploceras gracile*

PHOTO PLATE - 7



A- *Pinularia viridis,* B- *Navicula rhynchocephala,*
C- *N. viridula,* D- *Gomphonema parvulum,*
E- *Surirella* sp., F- *Botryococcus* sp.

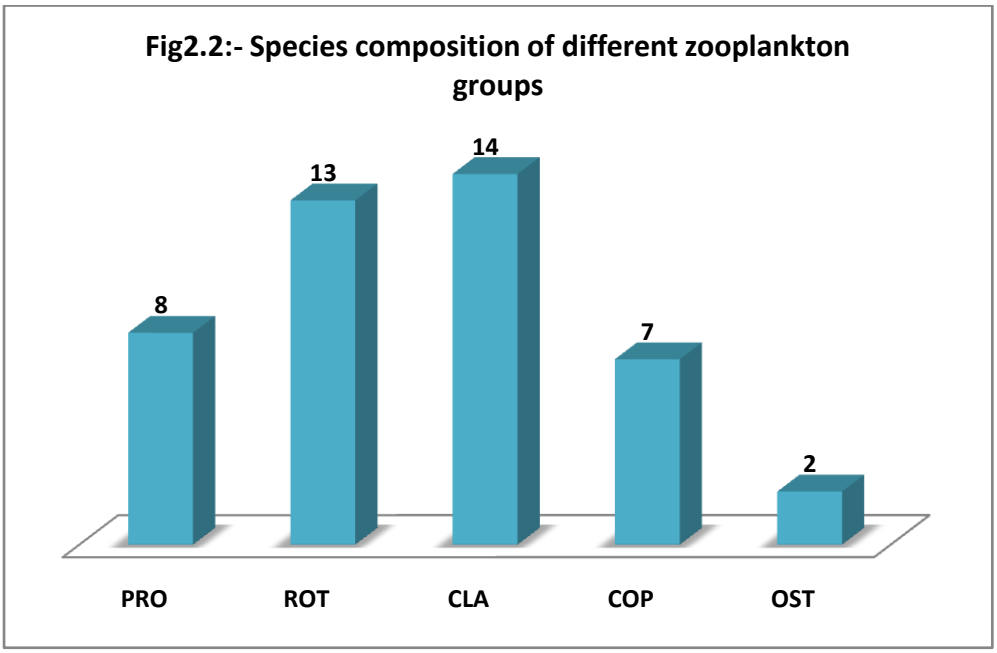
PHOTO PLATE - 8



A- *Euglena gracilis,* B- *E. virides,*
C- *Phacus acuminatus,* B- *P. longicauda*

4.2. B ZOOPLANKTON DIVERSITY

The results of zooplankton analysis of Urpod beel has been depicted in tabular form (Table 4.1 – 4.9). The zooplankton community of the beel all together comprised of 44 species under 29 genera, 20 families, 7 orders and 5 different classes namely Protozoa, Rotifera, Copepoda, Cladocera and Ostracoda during the course of investigation.



The class Cladocera and Rotifera have been found to be the most diverse groups during the study period. Class Cladocera comprised with 14 species, 7 genera belonging to 4 families under 2 orders. Class Rotifera was comprised of 13 species, 10 genera of 8 families under one order. Class Protozoa followed Rotifera with 8 species, 5 genera belongs to 5 families under two orders. Class Copepoda was comprised of 7 species, 5 genera belong to two families and one order. Class Ostracoda was constituted by 2 species, two genera under one family and one order (Fig.2.2).

4.2. B.1 SEASONAL FLUCTUATION OF ZOOPLANKTON COMMUNITY

The seasonal observation of zooplankton population during the period of investigation reveals that among the five classes, Cladocera has been found as most

dominant group in whole seasons except in post-monsoon. Variation of zooplankton abundance that occurred in different seasons of the year March, 2014 to February, 2016 in the beel has followed the trend below:

Monsoon – Cladocera >Rotifera > Protozoa > Copepoda >Ostracoda

Pre-monsoon – Cladocera >Rotifera > Protozoa > Copepoda >Ostracoda

Post-monsoon –Rotifera > Cladocera > Protozoa > Copepoda > Ostracoda

Winter – Cladocera >Rotifera > Protozoa > Copepoda

4.2. B.2 SEASONAL ABUNDANCE OF ZOOPLANKTON

The seasonal abundance of different zooplankton classes are described in the following heads:

1. PROTOZOA

The abundance of Protozoa is found in the range value of 163 ± 35.24 in monsoon to 397.4 ± 35.27 ul^{-1} in winter during the first year of observation, while inthe next year it is 161.6 ± 17.43 in monsoon – 442.6 ± 23.18 ul^{-1} in post-monsoon season (Table 4.10). The seasonal trend of Protozoa has been observed as monsoon < pre-monsoon < post-monsoon < winter in the first year of observation. And in the second year the trend is monsoon < pre-monsoon < winter < post-monsoon. In both the year of investigation the highest growth of Protozoa is contributed by *Arcella discoides*, *A. vulgaris*, *Difflugia corona* and *Centropyxis minuta* (Photo Plate-9). Protozoa showed significant positive correlation with Cladocera and Total zooplankton in pre-monsoon season (Table 3.11). Protozoa is positively correlated with Total zooplankton in monsoon season (Table 3.12). Protozoa was significantly positively correlated with Copepoda, Cladocera and Total zooplankton in post-monsoon season (Table 3.13).

2. ROTIFERA

The abundance of Rotifera was found in the range of 219.6±66.79 in monsoon – 519.4 ±69.25 ul^{-1} in post-monsoon season during the first year of observation, while

in the next year it was 248±37.58 in pre-monsoon – 643 ±34.44 ul^{-1} in winter season (Table 4.10). The seasonal trend of Rotifera has been observed as monsoon < pre-monsoon < winter < post-monsoon in the first year of observation. And in the second year the trend was pre-monsoon < monsoon < post-monsoon < winter. In both the year of investigation the highest growth of Rotifera was contributed by *Lecane lunaris, Horaella brehmi, Testudinella patina, Trichocera procellus* (Photo Plate-10). Rotifera showed significant positive correlation with Total zooplankton in pre-monsoon season (Table 3.11). Rotifera was positively correlated with Cladocera and Total zooplankton in monsoon season (Table 3.12). Rotifera also showed the significant positive correlation with Copepoda, Cladocera and Total zooplankton in winter season (Table 3.14).

3. COPEPODA

The abundance of Copepoda is found in the range of 123.6±5.86 in monsoon – 297.2 ± 36.27 ul^{-1} in post-monsoon during the first year of observation, while in the next year it is 141 ± 11.73 in pre-monsoon – 451 ± 10.01 ul^{-1} in winter season (Table 4.10). The seasonal trend of Copepoda has been observed as monsoon < pre-monsoon < winter < post-monsoon in the first year of observation. And in the second year the trend is pre-monsoon < monsoon < post-monsoon < winter. In both the year of investigation the highest growth of Copepoda has been contributed by *Mesocyclops leuckarti* (male and female) and *Cyclopoid copepoidite* (Photo Plate-11). Copepoda shows the significant positive correlation with Cladocera and Total zooplankton in monsoon season (Table.3.12). In post-monsoon season Copepoda positively correlated with Cladocera, Ostracoda and Total zooplankton (Table.3.13) and in winter season it shows the significant positive correlation with Cladocera and Total Zooplankton (Table.3.14).

4. CLADOCERA

The abundance of Cladocera is found in the range of 238 ± 34.52 in monsoon to 581.8 ± 44.52 ul^{-1} in winter during the first year of observation, while in the next

year it is 301.4± 53.13 in monsoon – 747.8 ± 63.98 ul^{-1} in winter (Table 4.10). The seasonal trend of Cladocera has been observed as monsoon < pre-monsoon < post-monsoon < winter in the first year of observation. And in the second year the trend is monsoon < pre-monsoon < post-monsoon < winter. In both the year of investigation the highest growth of Cladocera is contributed by *Acroperus harpae*, *Macrothrix spinosa, M. triseralis, Alona rectangula* (Photo Plate-12). Cladocera shows the significant positive correlation with Total zooplankton in pre-monsoon, monsoon, post-monsoon and winter seasons. (Table 3.11, 3.12, 3.13 and 3.14).

5. OSTRACODA

The abundance of Ostracoda is found in the range of 18.8 ± 9.36 in pre-monsoon – 29.4 ± 11.22 ul^{-1} in monsoon during the first year of observation, while in the next year it is 18.8 ± 4.49 in pre-monsoon – 27.0 ± 7.0 ul^{-1} in post-monsoon (Table 4.10). The seasonal trend of Ostracoda has been observed as pre-monsoon < post-monsoon < monsoon in the first year of observation. But in the second year the trend is pre-monsoon < monsoon < post-monsoon. The species *Centrocypris* and *Heterocypris* are observed in both the years of investigation. In the winter season the Ostracoda was not observed in both the years (Table 4.4 and 4.8).

Table 4.1: - Numerical abundance (ul^{-1}) of Zooplankton in Urpod beel, during 2014 – 15 in Pre-monsoon season.

Study sites→ Species ↓	S-1	S-2	S-3	S-4	S-5	Range	Mean ± SD
PROTOZOA							
Arcella discoides Ehrenberg.	28	46	49	53	50	28-53	45±10
A. vulgaris Ehrenberg.	18	05	19	29	32	05-32	25±6
Difflugia oblonga Ehrenberg.	06	00	15	18	19	0-19	10±7
D. corona Wallich.	25	13	29	32	25	13-32	25±7
Centropyxis minuta Deflandre.	32	43	45	22	29	22-45	34±10
Trinema enchelys Ehrenberg.	05	12	08	00	00	0-12	5±15
Pyxicola affinis Kent.	12	09	00	05	11	0-12	7±5
Lesquereusia modesta Rhumbler.	21	12	09	23	16	09-23	16±6

ROTIFERA							
Brachionus calyciflorus Pallas.	12	19	21	25	32	12-32	22±7
B. falcatus Zacharias.	04	08	13	19	06	04-19	10±6
Keratella tropica Apstein.	13	37	33	12	27	12-37	24±11
K. valga Ehrenberg.	19	28	06	18	06	06-28	14±9
Lecane lunaris O.F.Muller.	23	18	34	43	30	18-43	30±10
Filinia longiseta Ehrenberg.	14	21	24	19	11	11-24	18±5
Horaella brehmi Donner.	24	43	33	38	29	24-43	33±7
Testudinella patina Hermann.	31	25	14	18	15	14-31	21±7
Trichocera longiseta Schrank.	14	08	23	19	31	08-31	19±9
T. procellus Gosse.	22	35	21	18	29	18-35	25±7
Anuraeopsis fissa Gosse.	25	19	31	14	17	14-31	21±7
Scaridium longicaudum Muller.	25	15	28	32	17	15-32	23±7
Dicranophorus forcipatus Muller.	17	33	29	25	27	17-33	26±6
COPEPODA							
Mesocyclops leuckarti, male Claus.	28	43	38	36	44	28-44	38±6
Mesocyclops leuckarti, female Claus.	21	30	18	32	40	18-40	28±9
Heliodiaptomus sp.	07	13	31	14	00	0-31	13±12
Neodiaptomus sp.	13	23	10	15	28	10-28	19±7
Cyclopoid nauplii	06	18	13	05	20	05-20	12±7
C. copepoidite	34	29	22	17	26	17-29	26±7
Microcyclops varicans Sars.	13	07	09	16	10	07-16	11±4
CLADOCERA							
Daphnia sp.	11	06	10	17	05	05-17	10±5
Acroperus harpae Baird.	17	24	19	11	20	11-24	18±5
Camptocercus rectirostris Schoedler.	06	12	06	10	05	05-12	8±3
C. uncinatus Smirnov.	07	12	09	15	20	07-20	13±5
Chydorus sphaericus Muller.	17	23	30	40	32	17-40	28±9
C. faviformis Birge.	20	06	26	11	15	06-26	16±8
Macrothrix spinosa King.	26	39	32	48	53	26-53	40±11
M. triseralis Brady.	37	33	29	54	48	29-54	40±10
M.odiosa Gurney.	08	14	23	19	11	08-23	15±6
Macrothrix sp.	09	04	13	10	16	04-16	10±5
Alona globolusa Daday.	17	20	28	34	26	17-34	25±7
A. rectangula Sars.	12	32	18	22	28	12-32	22±8
Alona sp.	06	14	16	20	05	05-20	12±6
Bosmina longirostri O.F. Muller	06	18	15	08	10	06-18	11±5
OSTRACODA							
Centrocypris sp.	10	07	08	13	05	05-13	9±3
Heterocypris sp.	13	05	18	20	05	05-20	12±7

Table 4.2: - Numerical abundance (ul^{-1}) of Zooplankton in Urpod beel, during 2014 – 15 in Monsoon season.

Study sites→ Species ↓	S-1	S-2	S-3	S-4	S-5	Range	Mean + SD
PROTOZOA							
Arcella discoides Ehrenberg.	34	20	37	43	26	20-43	32±9
A. vulgaris Ehrenberg.	13	30	39	32	16	13-39	26±11
Difflugia oblonga Ehrenberg.	06	10	08	19	16	06-19	12±5
D. corona Wallich.	16	23	28	17	32	16-32	23±7
Centropyxis minuta Deflandre.	13	19	32	26	19	13-32	22±7
Trinema enchelys Ehrenberg.	07	18	21	18	13	07-21	15±6
Pyxicola affinis Kent.	14	08	17	25	11	08-25	15±7
Lesquereusia modesta Rhumbler.	17	10	08	25	29	08-29	18±8
ROTIFERA							
Brachionus calyciflorus Pallas.	23	14	18	28	35	14-35	23±8
B. falcatus Zacharias.	13	19	18	21	36	13-36	21±9
Keratella tropica Apstein.	00	12	16	07	09	0-16	9±6
K. valga Ehrenberg.	04	00	09	12	18	0-18	9±7
Lecane lunaris O.F.Muller.	10	16	19	31	25	10-31	20±8
Filinia longiseta Ehrenberg.	05	14	06	19	20	05-20	13±7
Horaella brehmi Donner.	10	15	17	28	21	10-28	18±7
Testudinella patina Hermann.	04	13	19	31	25	04-31	18±10
Trichocera longiseta Schrank.	24	17	12	15	14	12-24	16±5
T. procellus Gosse.	24	21	19	30	27	19-30	24±4
Anuraeopsis fissa Gosse.	03	18	14	21	06	03-21	12±8
Scaridium longicaudum Muller.	06	13	21	19	28	06-28	17±8
Dicranophorus forcipatus Muller.	12	08	16	23	27	12-27	17±8
COPEPODA							
Mesocyclops leuckarti, male Claus.	30	27	14	22	40	14-40	28±8
Mesocyclops leuckarti, female Claus.	25	08	12	18	15	08-25	18±7
Heliodiaptomus sp.	07	14	18	07	14	07-18	12±5
Neodiaptomus sp.	18	31	26	16	09	09-31	20±9
Cyclopoid nauplii	21	18	16	22	11	11-22	18±4
C. copepoidite	21	18	27	34	20	18-34	24±7
Microcyclops varicans Sars.	05	00	07	12	15	0-15	8±6
CLADOCERA							
Daphnia sp.	13	27	06	17	11	06-27	15±8
Acroperus harpae Baird.	10	14	15	21	33	10-33	19±9
Camptocercus rectirostris Schoedler.	14	23	16	06	08	06-23	13±7
C. uncinatus Smirnov.	05	12	21	06	10	05-21	11±6
Chydorus sphaericus Muller.	15	21	23	10	14	10-23	17±5

C. faviformis Birge.	26	12	18	21	30	12-30	21±7
Macrothrix spinosa King.	13	32	16	28	34	13-34	25±10
M. triseralis Brady.	27	24	21	36	43	21-43	30±9
M.odiosa Gurney.	04	13	21	17	08	04-21	13±7
Macrothrix sp.	08	12	16	18	21	08-21	15±9
Alona globolusa Daday.	13	27	32	12	11	11-32	19±10
A. rectangula Sars.	24	11	15	31	18	11-31	20±8
Alona sp.	04	09	13	17	21	04-21	13±7
Bosmina longirostri O.F. Muller	06	00	13	18	11	0-18	10±7
OSTRACODA							
Centrocypris sp.	05	18	21	12	16	05-21	14±6
Heterocypris sp.	05	14	18	22	16	05-22	15±6

Table 4.3: - Numerical abundance (ul^{-1}) of Zooplankton in Urpod beel, during 2014 – 15 in Post-monsoon season.

Study sites→ Species ↓	S-1	S-2	S-3	S-4	S-5	Range	Mean ± SD
PROTOZOA							
Arcella discoides Ehrenberg.	78	83	57	66	69	57-83	71±10
A. vulgaris Ehrenberg.	23	38	43	29	48	23-48	36±10
Difflugia oblonga Ehrenberg.	06	14	18	05	15	06-18	12±6
D. corona Wallich.	76	85	55	65	69	55-85	70±11
Centropyxis minuta Deflandre.	68	98	76	88	74	68-98	81±12
Trinema enchelys Ehrenberg.	13	08	21	26	09	08-26	15±8
Pyxicola affinis Kent.	13	28	21	25	26	13-28	23±6
Lesquereusia modesta Rhumbler.	32	46	49	50	47	32-50	45±7
ROTIFERA							
Brachionus calyciflorus Pallas.	26	32	29	43	38	26-43	34±7
B. falcatus Zacharias.	06	09	18	20	16	06-20	14±6
Keratella tropica Apstein.	16	21	36	39	32	16-39	29±10
K. valga Ehrenberg.	08	13	21	19	16	08-21	15±5
Lecane lunaris O.F.Muller.	48	76	56	65	63	48-76	62±10
Filinia longiseta Ehrenberg.	05	12	06	18	11	05-18	10±5
Horaella brehmi Donner.	76	65	79	87	85	65-85	78±9
Testudinella patina Hermann.	65	78	85	84	66	65-85	76±10
Trichocera longiseta Schrank.	50	54	67	64	74	50-74	62±10
T. procellus Gosse.	40	59	65	46	57	40-65	53±10
Anuraeopsis fissa Gosse.	25	31	39	21	14	14-39	26±10
Scaridium longicaudum Muller.	21	27	32	43	13	13-43	27±11
Dicranophorus forcipatus Muller.	25	43	36	40	23	25-43	33±9

COPEPODA							
Mesocyclops leuckarti, male (Claus)	56	67	64	79	82	56-82	70±11
M. leuckarti, female (Claus)	65	58	55	69	70	55-70	63±7
Heliodiaptomus sp	16	19	21	25	24	16-25	21±4
Neodiaptomus sp.	21	29	30	36	32	21-36	30±6
Cyclopoid nauplii	29	32	43	40	38	29-43	36±6
C. copepoidite	50	76	59	65	61	50-76	62±9
Microcyclops varicans Sars	06	13	16	19	21	06-21	15±6
CLADOCERA							
Daphnia sp.	04	13	19	11	16	04-19	13±6
Acroperus harpae Baird.	30	54	45	38	36	30-54	41±9
Camptocercus rectirostris Schoedler.	10	27	22	16	14	10-27	18±7
C. uncinatus Smirnov.	10	15	07	08	13	07-13	11±3
Chydorus sphaericus Muller.	32	38	40	46	43	32-46	40±5
C. faviformis Birge.	21	29	35	25	32	21-35	28±6
Macrothrix spinosa King.	53	47	65	60	69	53-69	59±9
M. triseralis Brady.	54	86	75	63	68	54-86	69±12
M.odiosa Gurney.	05	13	21	19	23	05-23	16±7
Macrothrix sp.	05	00	12	08	10	0-12	7±5
Alona globolusa Daday.	21	19	34	27	38	19-38	28±8
A. rectangula Sars.	38	63	45	54	59	38-63	52±10
Alona sp.	05	09	12	10	07	05-12	9±3
Bosmina longirostri O.F. Muller	05	18	14	06	15	05-18	12±6
OSTRACODA							
Centrocypris sp.	05	08	13	19	16	05-19	12±6
Heterocypris sp.	05	09	07	12	17	05-17	10±5

Table 4.4: - Numerical abundance (ul^{-1}) of Zooplankton in Urpod beel, during 2014 – 15 in Winter season.

Study sites→ Species ↓	S-1	S-2	S-3	S-4	S-5	Range	Mean ± SD
PROTOZOA							
Arcella discoides Ehrenberg.	90	87	120	126	104	87-126	105±7
A. vulgaris Ehrenberg.	96	133	107	130	123	96-133	118±16
Difflugia oblonga Ehrenberg.	05	12	09	16	10	05-16	10±4
D. corona Wallich.	35	59	40	46	49	35-59	46±9
Centropyxis minuta Deflandre.	37	53	33	50	43	37-53	43±8
Trinema enchelys Ehrenberg.	18	07	10	09	12	07-18	11±4
Pyxicola affinis Kent.	30	17	32	35	26	17-35	28±7
Lesquereusia modesta Rhumbler.	32	29	43	27	47	27-47	36±9

ROTIFERA							
Brachionus calyciflorus Pallas.	37	45	54	39	47	37-54	44±7
B. falcatus Zacharias.	17	28	32	29	22	17-32	26±6
Keratella tropica Apstein.	34	29	47	38	27	27-47	35±8
K. valga Ehrenberg.	18	21	28	11	08	08-28	17±8
Lecane lunaris O.F.Muller.	23	38	43	25	29	23-43	32±9
Filinia longiseta Ehrenberg.	16	21	18	09	28	09-28	18±7
Horaella brehmi Donner.	65	59	75	66	70	59-75	67±6
Testudinella patina Hermann.	45	49	54	57	63	45-63	54±7
Trichocera longiseta Schrank.	45	43	54	62	48	43-62	50±8
T. procellus Gosse.	58	64	72	60	76	58-76	66±8
Anuraeopsis fissa Gosse.	21	18	25	19	26	18-26	22±4
Scaridium longicaudum Muller.	07	10	21	17	15	07-21	14±6
Dicranophorus forcipatus Muller.	49	56	65	52	72	49-72	59±10
COPEPODA							
Mesocyclops leuckarti, male (Claus)	78	65	59	60	89	59-89	70±13
Mesocyclops leuckarti female (Claus)	69	58	76	80	60	58-80	69±10
Heliodiaptomus sp	10	21	16	11	25	10-25	17±6
Neodiaptomus sp.	10	22	16	19	20	10-22	17±5
Cyclopoid nauplii	12	28	32	25	26	12-32	25±8
C. copepoidite	32	49	53	45	40	32-53	44±8
Microcyclops varicans Sars	05	13	20	07	09	05-20	11±6
CLADOCERA							
Daphnia sp.	04	12	18	14	20	04-20	14±6
Acroperus harpae Baird.	48	65	72	57	63	48-72	61±9
Camptocercus rectirostris Schoedler.	20	21	32	28	37	20-37	28±7
C. uncinatus Smirnov.	06	12	19	21	09	06-21	13±6
Chydorus sphaericus Muller.	48	54	68	75	59	48-75	61±11
C. faviformis Birge.	29	45	36	53	30	29-53	39±10
Macrothrix spinosa King.	76	80	65	59	60	59-80	68±10
M. triseralis Brady.	89	79	56	74	84	56-89	80±16
M.odiosa Gurney.	33	23	43	40	37	23-43	35±8
Macrothrix sp.	07	13	20	19	21	07-21	16±6
Alona globolusa Daday.	50	65	70	67	55	50-70	61±9
A. rectangula Sars.	56	76	84	69	77	56-84	72±11
Alona sp.	25	21	19	11	09	11-25	17±7
Bosmina longirostri O.F.Muller	21	19	27	23	15	19-27	21±5
OSTRACODA							
Centrocypris sp.	00	00	00	00	00	0	0
Heterocypris sp.	00	00	00	00	00	0	0

Table 4.5: - Numerical abundance (ul^{-1}) of Zooplankton in Urpod beel, during 2015 – 16 in Pre-monsoon season.

Study sites→ Species ↓	S-1	S-2	S-3	S-4	S-5	Range	Mean ±SD
PROTOZOA							
Arcella discoides Ehrenberg.	15	21	23	16	19	15-23	19±4
A. vulgaris Ehrenberg.	26	34	43	50	48	26-50	40±10
Difflugia oblonga Ehrenberg.	00	12	16	17	06	0-17	10±7
D. corona Wallich.	32	27	21	20	43	20-43	29±9
Centropyxis minuta Deflandre.	07	25	13	21	10	07-25	15±8
Trinema enchelys Ehrenberg.	03	12	08	17	10	03-17	10±5
Pyxicola affinis Kent.	15	23	32	40	26	15-40	27±9
Lesquereusia modesta Rhumbler.	12	08	19	21	23	08-23	17±6
ROTIFERA							
Brachionus calyciflorus Pallas.	10	07	16	21	26	07-26	16±8
B. falcatus Zacharias.	07	10	19	21	17	07-21	15±6
Keratella tropica Apstein.	21	25	18	15	11	11-25	18±5
K. valga Ehrenberg.	06	12	09	10	15	06-15	10±4
Lecane lunaris O.F.Muller.	17	19	32	11	28	11-32	21±9
Filinia longiseta Ehrenberg.	06	11	09	16	21	06-21	13±6
Horaella brehmi Donner.	15	18	21	28	32	15-32	23±7
Testudinella patina Hermann.	19	37	27	40	42	19-42	33±10
Trichocera longiseta Schrank.	08	12	10	16	09	08-16	11±3
T. procellus Gosse.	43	39	28	40	33	28-43	37±6
Anuraeopsis fissa Gosse.	18	31	20	11	25	11-31	21±8
Scaridium longicaudum Muller.	06	15	18	21	10	06-21	14±6
Dicranophorus forcipatus Muller.	07	17	31	18	09	07-31	16±9
COPEPODA							
Mesocyclops leuckarti, male (Claus)	21	19	26	15	08	08-26	18±7
M. leuckarti, female (Claus)	17	21	27	26	21	17-27	22±4
Heliodiaptomus sp	07	09	11	10	14	07-14	11±3
Neodiaptomus sp.	12	09	20	11	08	08-20	12±5
Cyclopoid nauplii	38	43	30	36	49	30-49	39±7
C. copepoidite	21	28	32	30	34	21-34	29±5
Microcyclops varicans Sars	07	10	09	14	12	17-14	10±3
CLADOCERA							
Daphnia sp.	10	17	21	16	28	10-28	18±7
Acroperus harpae Baird.	15	64	64	72	75	15-75	67±7
Camptocercus rectirostris Schoedler.	18	15	21	19	27	18-27	20±5
C. uncinatus Smirnov.	05	16	11	18	06	05-18	11±6
Chydorus sphaericus Muller.	15	21	27	22	18	15-27	21±5

C. faviformis Birge.	26	17	15	10	11	10-26	16±6
Macrothrix spinosa King.	30	38	40	46	54	30-54	42±9
M. triseralis Brady.	34	49	53	32	52	32-53	44±10
M.odiosa Gurney.	17	28	20	22	25	17-28	22±4
Macrothrix sp.	10	06	09	13	12	06-13	10±3
Alona globolusa Daday.	28	32	29	37	43	28-43	34±6
A. rectangula Sars.	30	27	43	40	38	27-43	36±7
Alona sp.	10	06	00	08	13	0-13	7±5
Bosmina longirostri O.F. Muller	12	25	17	09	10	09-25	15±7
OSTRACODA							
Centrocypris sp.	05	09	12	10	14	05-14	10±3
Heterocypris sp.	06	10	09	12	07	06-12	9±2

Table 4.6: - Numerical abundance (ul^{-1}) of Zooplankton in Urpod beel, during 2015 – 16 in Monsoon season.

Study sites→ Species ↓	S-1	S-2	S-3	S-4	S-5	Range	Mean ±SD
PROTOZOA							
Arcella discoides Ehrenberg.	10	21	23	17	08	08-23	16±7
A. vulgaris Ehrenberg.	17	21	32	28	39	17-39	27±9
Difflugia oblonga Ehrenberg.	12	08	19	06	11	06-19	11±5
D. corona Wallich.	29	32	49	40	27	27-49	35±9
Centropyxis minuta Deflandre.	11	29	19	20	21	11-29	20±6
Trinema enchelys Ehrenberg.	05	10	06	15	09	05-15	9±4
Pyxicola affinis Kent.	29	20	26	21	30	20-30	25±5
Lesquereusia modesta Rhumbler.	16	20	11	18	16	11-20	16±3
ROTIFERA							
Brachionus calyciflorus Pallas.	16	32	20	30	36	16-36	27±8
B. falcatus Zacharias.	11	19	21	30	25	11-30	21±7
Keratella tropica Apstein.	09	10	06	17	20	06-20	12±6
K. valga Ehrenberg.	10	13	06	08	00	0-13	74±5
Lecane lunaris O.F.Muller.	32	28	17	39	30	17-39	29±8
Filinia longiseta Ehrenberg.	05	13	09	17	15	05-17	12±5
Horaella brehmi Donner.	21	30	14	28	11	11-30	21±8
Testudinella patina Hermann.	28	17	25	30	17	17-30	23±6
Trichocera longiseta Schrank.	12	28	20	23	26	12-28	22±6
T. procellus Gosse.	43	48	39	54	59	39-59	49±8
Anuraeopsis fissa Gosse.	22	20	25	39	37	20-39	29±9
Scaridium longicaudum Muller.	12	08	10	06	18	06-18	11±5
Dicranophorus forcipatus Muller.	07	10	05	17	06	05-17	9±5

COPEPODA							
Mesocyclops leuckarti, male (Claus)	22	30	37	41	38	20-41	34±8
M. leuckarti, female (Claus)	28	32	35	28	25	28-35	30±4
Heliodiaptomus sp	05	12	09	10	05	05-12	8±3
Neodiaptomus sp.	06	12	09	15	19	06-19	12±5
Cyclopoid nauplii	18	23	30	32	28	18-32	26±6
C. copepoidite	19	24	28	30	25	19-30	25±4
Microcyclops varicans Sars	06	18	00	10	05	0-18	8±7
CLADOCERA							
Daphnia sp.	18	21	35	16	30	18-35	24±8
Acroperus harpae Baird.	48	58	64	59	68	48-68	59±8
Camptocercus rectirostris Schoedler.	08	17	29	24	16	08-29	19±8
C. uncinatus Smirnov.	04	10	07	12	15	04-15	10±4
Chydorus sphaericus Muller.	04	12	21	17	15	04-21	14±6
C. faviformis Birge.	06	12	19	16	20	06-20	15±6
Macrothrix spinosa King.	27	23	26	32	34	23-34	28±5
M. triseralis Brady.	32	28	37	43	17	17-43	31±10
M.odiosa Gurney.	18	23	29	17	20	17-29	21±5
Macrothrix sp.	05	08	11	17	12	05-17	11±5
Alona globolusa Daday.	15	21	18	27	23	15-27	21±5
A. rectangula Sars.	21	29	30	36	35	21-36	30±6
Alona sp.	05	12	10	06	09	05-12	8±3
Bosmina longirostri O.F. Muller	04	13	08	16	09	08-16	10±5
OSTRACODA							
Centrocypris sp.	15	11	21	25	28	11-28	20±7
Heterocypris sp.	07	00	11	05	08	0-08	6±4

Table 4.7: - Numerical abundance (ul^{-1}) of Zooplankton in Urpod beel, during 2015 – 16 in Post-monsoon season.

Study sites→ Species ↓	S-1	S-2	S-3	S-4	S-5	Range	Mean ±SD
PROTOZOA							
Arcella discoides Ehrenberg.	105	91	109	127	125	91-127	111±5
A. vulgaris Ehrenberg.	85	80	78	93	105	80-105	88±11
Difflugia oblonga Ehrenberg.	05	12	10	06	09	05-12	8±3
D. corona Wallich.	87	69	83	70	73	69-87	76±8
Centropyxis minuta Deflandre.	67	89	55	62	60	55-89	67±13
Trinema enchelys Ehrenberg.	07	05	13	16	09	05-16	10±4
Pyxicola affinis Kent.	43	29	33	36	38	29-43	36±5
Lesquereusia modesta Rhumbler.	40	47	38	54	50	38-54	46±7

ROTIFERA							
Brachionus calyciflorus Pallas.	20	26	32	37	32	20-37	29±7
B. falcatus Zacharias.	20	32	26	24	28	20-32	26±4
Keratella tropica Apstein.	25	29	18	22	34	18-34	26±6
K. valga Ehrenberg.	05	13	10	07	04	04-13	8±4
Lecane lunaris O.F.Muller.	50	47	58	65	62	47-65	56±8
Filinia longiseta Ehrenberg.	07	12	19	08	15	07-19	12±5
Horaella brehmi Donner.	48	54	59	65	60	48-65	57±6
Testudinella patina Hermann.	80	76	97	93	100	76-100	89±11
Trichocera longiseta Schrank.	32	27	37	39	42	27-42	35±6
T. procellus Gosse.	58	69	70	69	75	58-75	68±6
Anuraeopsis fissa Gosse.	54	60	59	70	66	54-70	62±6
Scaridium longicaudum Muller.	21	18	16	23	30	16-30	22±5
Dicranophorus forcipatus Muller.	18	21	24	19	20	18-24	20±2
COPEPODA							
Mesocyclops leuckarti, male (Claus)	79	87	85	93	87	79-93	86±5
M. leuckarti, female (Claus)	85	96	90	84	98	84-98	91±6
Heliodiaptomus sp	07	12	15	09	20	07-20	13±5
Neodiaptomus sp.	23	10	14	19	16	10-23	16±5
Cyclopoid nauplii	60	58	76	63	70	58-76	65±7
C. copepoidite	65	58	76	70	69	58-76	68±7
Microcyclops varicans Sars	08	13	09	18	15	08-18	13±4
CLADOCERA							
Daphnia sp.	23	34	39	16	20	16-39	26±10
Acroperus harpae Baird.	108	97	134	126	117	97-134	116±15
Camptocercus rectirostris Schoedler.	24	26	32	30	37	24-37	30±5
C. uncinatus Smirnov.	07	13	19	21	15	07-21	15±5
Chydorus sphaericus Muller.	24	43	37	27	22	22-43	31±9
C. faviformis Birge.	31	33	28	25	43	25-43	32±7
Macrothrix spinosa King.	80	75	89	94	98	75-94	87±10
M. triseralis Brady.	86	76	89	93	78	76-93	84±7
M.odiosa Gurney.	39	26	42	24	27	24-39	32±8
Macrothrix sp.	04	08	11	13	09	04-13	9±3
Alona globolusa Daday.	60	76	73	65	59	59-76	67±8
A. rectangula Sars.	76	70	67	85	80	67-85	76±7
Alona sp.	05	08	13	09	10	05-13	9±3
Bosmina longirostri O.F. Muller	06	12	09	10	06	06-12	9±3
OSTRACODA							
Centrocypris sp.	15	21	18	12	13	12-21	14±5
Heterocypris sp.	07	13	17	08	11	07-17	11±4

Table 4.8: - Numerical abundance (ul^{-1}) of Zooplankton in Urpod beel, during 2015 – 16 in Winter season.

Study sites→ Species ↓	S-1	S-2	S-3	S-4	S-5	Range	Mean ±SD
PROTOZOA							
Arcella discoides Ehrenberg.	109	92	120	110	111	92-120	108±10
A. vulgaris Ehrenberg.	126	96	121	119	132	96-132	119±14
Difflugia oblonga Ehrenberg.	05	12	16	10	07	05-16	10±4
D. corona Wallich.	35	54	49	50	52	35-54	48±8
Centropyxis minuta Deflandre.	39	43	50	57	39	39-57	46±8
Trinema enchelys Ehrenberg.	00	12	07	09	10	0-12	8±5
Pyxicola affinis Kent.	29	21	34	18	39	18-39	28±9
Lesquereusia modesta Rhumbler.	40	43	36	50	37	36-50	41±6
ROTIFERA							
Brachionus calyciflorus Pallas.	36	47	54	55	39	36-55	46±9
B. falcatus Zacharias.	17	31	16	19	25	16-31	22±6
Keratella tropica Apstein.	38	40	42	27	30	27-42	35±7
K. valga Ehrenberg.	07	09	13	17	06	07-17	10±5
Lecane lunaris O.F.Muller.	43	39	35	54	50	35-54	44±8
Filinia longiseta Ehrenberg.	16	21	23	18	25	16-25	21±4
Horaella brehmi Donner.	70	65	89	95	74	65-95	79±13
Testudinella patina Hermann.	133	143	108	127	126	108-143	127±13
Trichocera longiseta Schrank.	65	60	76	84	80	60-84	73±10
T. procellus Gosse.	78	90	95	85	93	78-95	88±7
Anuraeopsis fissa Gosse.	39	54	40	46	46	39-54	45±6
Scaridium longicaudum Muller.	10	21	24	18	32	10-32	21±8
Dicranophorus forcipatus Muller.	30	36	43	21	27	21-43	31±8
COPEPODA							
Mesocyclops leuckarti, male (Claus)	169	150	154	126	139	126-169	148±16
M. leuckarti, female (Claus)	139	128	119	165	135	119-165	137±17
Heliodiaptomus sp	06	13	19	06	09	06-19	11±6
Neodiaptomus sp.	07	13	08	14	19	07-19	12±5
Cyclopoid nauplii	69	70	87	75	82	69-87	77±8
C. copepoidite	48	56	64	59	65	48-65	58±7
Microcyclops varicans Sars	06	09	12	05	10	05-12	8±3
CLADOCERA							
Daphnia sp.	21	20	16	32	37	16-37	25±9
Acroperus harpae Baird.	112	156	150	164	153	112-164	147±20
Camptocercus rectirostris Schoedler.	30	43	50	37	47	30-50	41±8
C. uncinatus Smirnov.	05	08	10	13	09	05-13	9±3
Chydorus sphaericus Muller.	38	48	54	40	50	38-54	46±7

C. faviformis Birge.	29	37	43	29	49	29-49	37±9
Macrothrix spinosa King.	99	95	119	100	88	88-119	100±12
M. triseralis Brady.	113	106	124	88	86	86-113	103±16
M.odiosa Gurney.	43	59	56	42	40	40-56	48±9
Macrothrix sp.	06	12	09	10	16	06-16	11±4
Alona globolusa Daday.	60	55	79	82	65	55-82	68±12
A. rectangula Sars.	76	102	87	84	97	76-102	89±10
Alona sp.	08	12	05	10	12	08-12	9±3
Bosmina longirostri O.F. Muller	07	13	19	06	19	06-19	13±6
OSTRACODA							
Centrocypris sp.	00	00	00	00	00	00	00
Heterocypris sp.	00	00	00	00	00	00	00

Table 4.9: - Seasonal variations in mean numerical abundance (ul^{-1}) of Zooplankton in Urpod beel (2014-2016)

Phytoplankton Species	Pre –Mon Mean±SD	Monsoon Mean±SD	Re-Mon Mean±SD	Winter Mean±SD
PROTOZOA				
Arcella discoides Ehrenberg.	32±7	24±8	91±8	107±9
A. vulgaris Ehrenberg.	33±8	27±10	62±11	119±15
Difflugia oblonga Ehrenberg.	10±7	12±5	10±5	10±4
D. corona Wallich.	27±8	29±8	73±10	47±9
Centropyxis minuta Deflandre.	25±9	21±7	74±13	45±8
Trinema enchelys Ehrenberg.	08±5	12±5	13±6	9±5
Pyxicola affinis Kent.	17±7	20±6	30±6	28±8
Lesquereusia modesta Rhumbler.	17±6	17±6	46±7	39±8
ROTIFERA				
Brachionus calyciflorus Pallas.	19±8	25±8	32±7	45±8
B. falcatus Zacharias.	13±6	21±8	20±5	24±6
Keratella tropica Apstein.	21±8	11±6	28±8	35±8
K. valga Ehrenberg.	12±7	8±6	12±5	9±7
Lecane lunaris O.F.Muller.	23±10	25±8	59±9	38±9
Filinia longiseta Ehrenberg.	16±6	13±6	11±5	20±6
Horaella brehmi Donner.	28±7	20±8	72±8	73±10
Testudinella patina Hermann.	27±9	21±8	83±11	91±10
Trichocera longiseta Schrank.	15±6	19±6	49±8	62±9
T. procellus Gosse.	31±7	35±6	61±8	77±8
Anuraeopsis fissa Gosse.	21±8	21±9	44±8	34±5
Scaridium longicaudum Muller.	29±7	14±7	25±8	18±7
Dicranophorus forcipatus Muller.	21±8	13±7	27±6	45±19

COPEPODA				
Mesocyclops leuckarti, male (Claus)	28±7	31±8	78±8	109±15
Mesocyclops leuckarti, female (Claus)	25±7	24±6	77±7	103±14
Heliodiaptomus sp	12±8	10±4	17±5	14±6
Neodiaptomus sp.	16±6	16±7	23±6	15±5
Cyclopoid nauplii	26±7	22±5	51±7	51±8
C. copepoidite	28±6	25±6	65±8	51±8
Microcyclops varicans Sars	11±4	8±7	14±5	9±5
CLADOCERA				
Daphnia sp.	14±6	20±8	20±8	20±8
Acroperus harpae Baird.	43±6	39±9	79±12	104±15
Camptocercus rectirostris Schoedler.	14±4	16±8	24±6	35±8
C. uncinatus Smirnov.	12±6	11±5	13±4	11±5
Chydorus sphaericus Muller.	25±7	16±6	36±7	54±9
C. faviformis Birge.	16±7	18±7	30±7	38±10
Macrothrix spinosa King.	41±10	27±8	73±10	84±11
M. triseralis Brady.	42±10	30±10	77±10	92±16
M.odiosa Gurney.	19±5	17±6	24±8	42±9
Macrothrix sp.	10±4	13±7	8±4	14±5
Alona globolusa Daday.	30±7	20±8	48±8	65±11
A. rectangula Sars.	32±8	15±7	64±9	81±11
Alona sp.	10±6	11±5	9±3	13±5
Bosmina longirostri O.F. Muller	13±6	10±6	11±5	17±6
OSTRACODA				
Centrocypris sp.	10±3	17±7	13±6	00
Heterocypris sp.	11±5	11±5	11±5	00

Table 4.10: - Total zooplankton abundance (ul^{-1}) in Urpod beel during the study period.

Year	**2014 - 15**				**2015 - 16**			
Class ↓	PR-MON	MON	PO-MON	WIN	PR-MON	MON	PO-MON	WIN
Protozoa	165.0 ±20.04	163.0 ±35.24	352.0 ±32.89	397.4 ±35.27	166.8 ±34.95	161.6 ±17.43	442.6 ±23.18	407.8 ±27.66
Rotifera	287.8 ±28.35	219.6 ±66.79	519.4 ±69.25	503.8 ±58.04	248.0 ±37.58	271.8 ±50.29	511.2 ±50.99	643.0 ±34.44
Copepoda	145.8 ±19.33	123.6 ±5.86	297.2 ±36.27	252.0 ±22.50	141.0 ±11.73	140.8 ±23.33	351.4 ±20.38	451.0 ±10.02
Cladocera	268.6 ±45.26	238.0 ±34.52	400.8 ±64.13	581.8 ±44.52	353.4 ±56.13	301.4 ±53.13	622.2 ±41.48	747.8 ±63.98
Ostracoda	18.8 ±9.36	29.4 ±11.22	22.2 ±9.68	0	18.8 ±4.49	26.2 ±9.90	27.0 ±7.0	0

4.2. B.3 PERCENTAGE AVAILABILITY OF ZOOPLANKTON

The present study showed that zooplankton community is comprised of Protozoa (20.14%), Rotifera (29.25%), Copepoda (16.82%), Cladocera (32.05%) and Ostracoda (1.74%) (Table - 4.11).

Table 4.11: - Total composition of zooplankton abundance in Urpod beel (in %).

Year →	2014 - 15				2015 - 16				
Season → Class ↓	PR-MON	MON	PO-MON	WIN	PR-MON	MON	PO-MON	WIN	Avg. %
Protozoa	18.58	21.04	22.12	22.89	17.97	17.75	22.65	18.13	20.14
Rotifera	32.41	28.34	32.63	29.03	26.72	30.12	26.16	28.58	29.25
Copepoda	16.42	15.95	18.67	14.52	15.19	15.83	17.98	20.05	16.82
Cladocera	30.25	30.87	25.18	33.56	38.08	33.39	31.83	33.24	32.05
Ostracoda	2.34	3.8	1.40	0	2.02	2.91	1.38	0	1.74

4.2. B.4 DIVERSITY INDICES OF ZOOPLANKTON

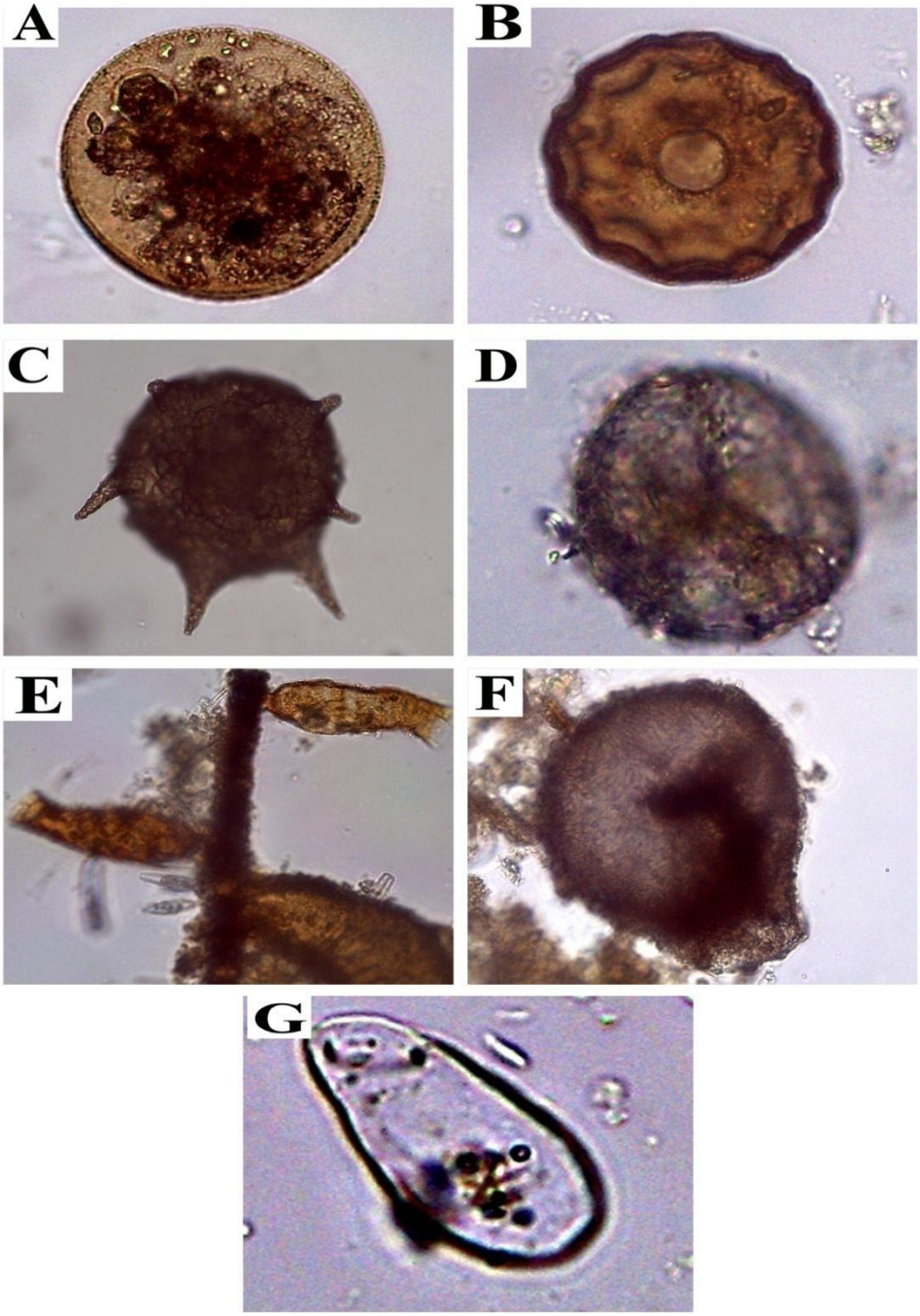
Analysis of diversity index showed that the Simpson index was in the range of 0.0237 (monsoon) to 0.0325 (winter) in the first year while 0.0291(pre-monsoon) to 0.0374 (winter) in the next year. In both the years the highest value was found winter

Table 4.12: - Diversity Indices of zooplankton species of Urpod beel.

Year →	**2014 - 15**				**2015 - 16**			
Seasons → Indices ↓	PR-MON	MON	PO-MON	WIN	PR-MON	MON	PO-MON	WIN
No. of Organisms	889	778	1594	1740	938	969	1952	2249
Simpson Index	0.0269	0.0237	0.0312	0.0325	0.0291	0.0301	0.0336	0.0374
Dominance Index	0.973	0.976	0.968	0.967	0.970	0.969	0.966	0.962
Shanon Index	5.295	5.388	5.168	5.121	5.294	5.23	5.092	4.98
Berger – Parker Dominance Index	0.051	0.041	0.050	0.068	0.071	0.076	0.059	0.066
Margalef Richness Index	6.333	6.46	5.831	5.495	6.283	6.254	5.675	5.571

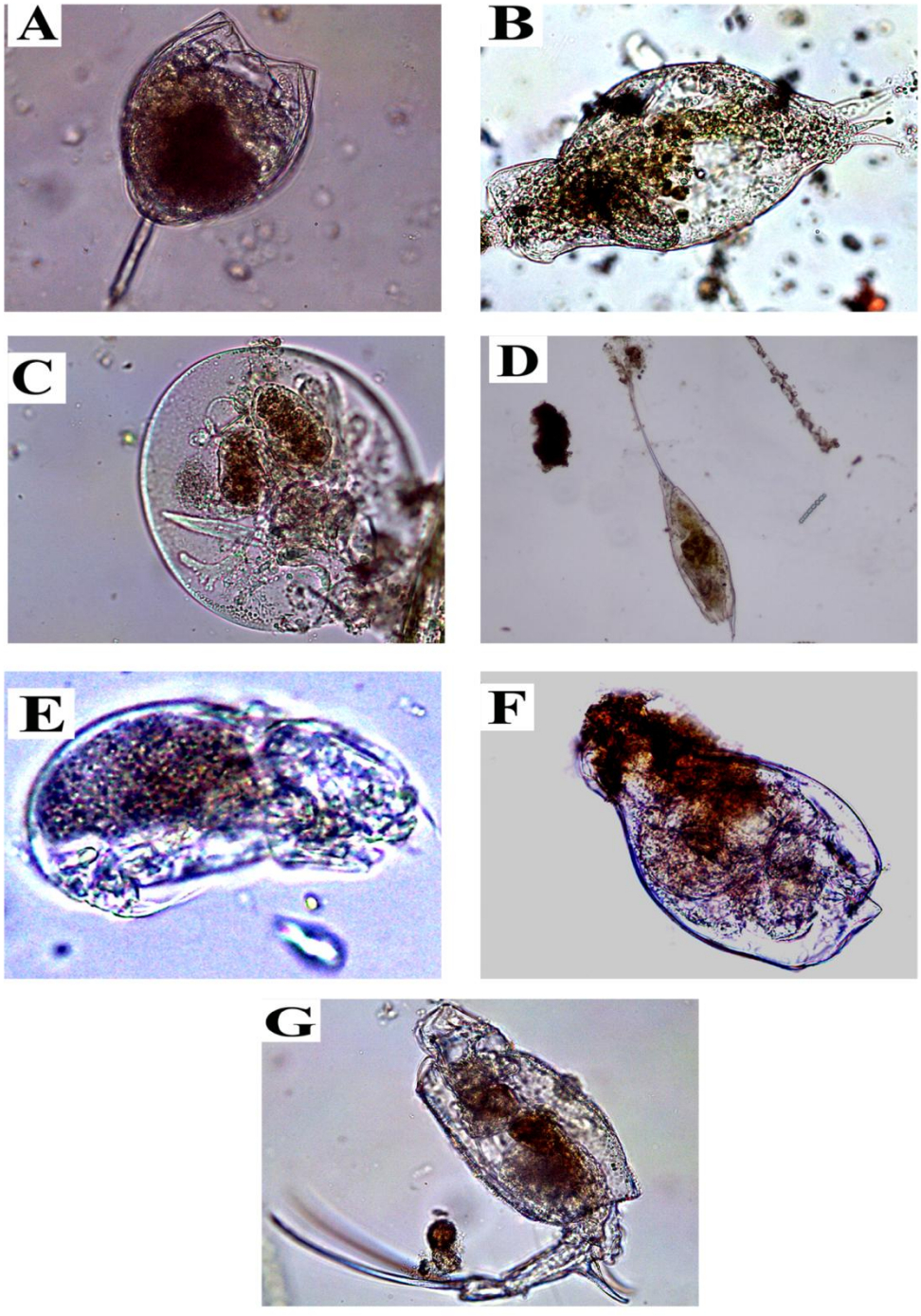
season and the lowest values are found in the monsoon and pre-monsoon seasons respectively .The Dominance Index ranges from 0.967 (winter) to 0.976 (monsoon) in the first year and 0.962 (winter) to 0.970 (pre-monsoon) in the second year of investigation. In this index the highest value has been found in the monsoon season and the lowest value is found in winter season in the first year of observations .In the next year, the highest value has been found in pre-monsoon season and the lowest value was found in winter season. The Shanon index ranges from 5.121 (winter) – 5.388 (monsoon) in the first year of observation and 4.98 (winter) – 5.294 (pre-monsoon) in the second year of observation. The lowest values are observed in winter season on both the years and the highest values are detected in monsoon and pre-monsoon seasons on both the years. The Berger-Parker dominance index ranges between 0.041(monsoon) – 0.068 (winter) in the first year of study period and in the second year it is ranges from 0.059(post-monsoon) – 0.076 (monsooon). The highest values are observed in winter season during the first year and monsoon season during the second year. The lowest values are observed in monsoon season in the first year and post-monsoon season in the second year. Margalef richness index ranged from 5.495 (winter) – 6.46 (monsoon) in the first year and 5.571(winter) – 6.283 (pre-monsoon) in the second year. The highest values are observed in monsoon season in the first year and in pre-monsoon season in the second year of observation. The lowest values are found in winter seasons of both the years. (Table - 4.12).

PHOTO PLATE - 9



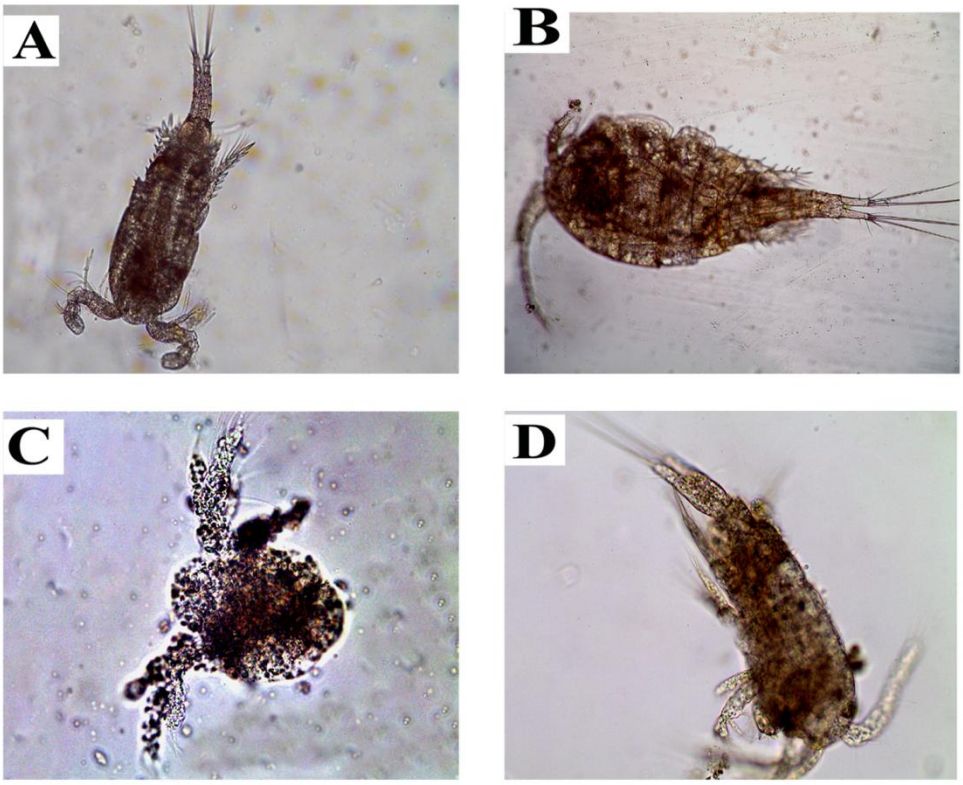
A- *Arcella discoides*, B - *A. vulgaris*, C - *Difflugia corona*, D - *Centropyxis minuta*, E - *Pyxicola affinis*, F - *Lesquereusia modesta*, G - *Trinema enchelys*

PHOTO PLATE - 10



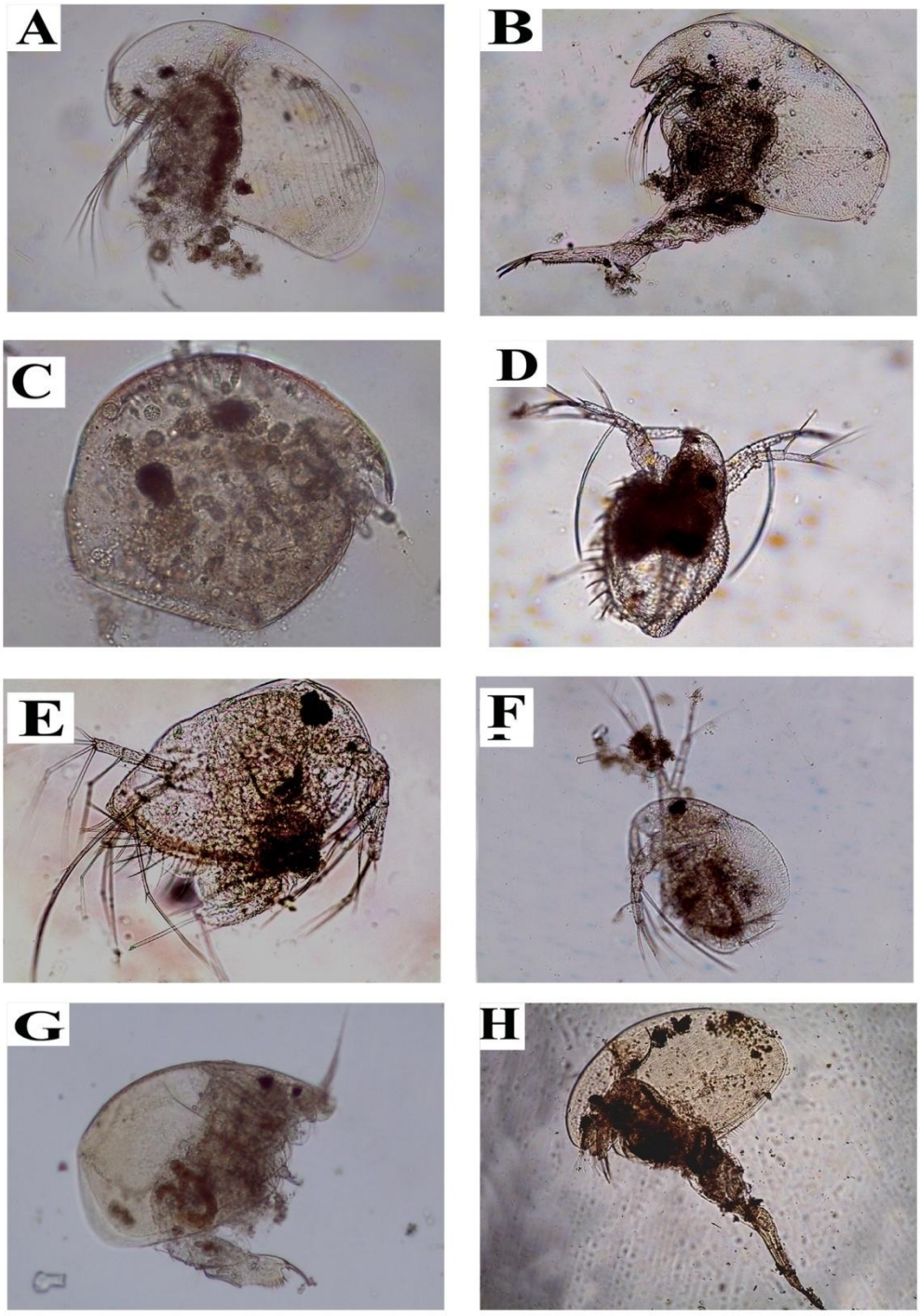
A- *Lecane lunaris,* B- *Horaella brehmi,*
C- *Testudinella patina,* D- *Trichocera longiseta,* E- *T. procellus,*
F- *Anuraeopsis fissa,* G- *Scaridium longicauda*

PHOTO PLATE - 11



A- *Mesocyclops leuckarti* (male), B- *M. leuckerti* (female),
C- *Cyclopoid nauplii,* D- *Cyclopoid copepoidite*

PHOTO PLATE - 12



A - *Acroperus harpae,* B - *Camptocercus rectirostris,*
C - *Chydorus sphaericus* , D - *Macrothrix spinosa,* E - *M. triseralis,*
F- *M. odiosa, G - Alona globolusa,* H - *A. rectangula*

4.2. C Canonical Correspondance Analysis (CCA)

a) Between phytoplankton groups and physico-chemical parameters

CCA method was used to determine the relationships between plankton and physico- chemical variables of the water body. CCA has been drawn between 16 physico-chemical parameters and 5 different classes of phytoplankton in different seasons namely pre-monsoon, monsoon, post-monsoon and winter (Fig.2.3). Eigen value for axis 1 (0.00863) explained 82.81% correlation and axis 2 (0.001455) explained 13.95% correlation between physico-chemical parameters and phytoplankton groups in different seasons.

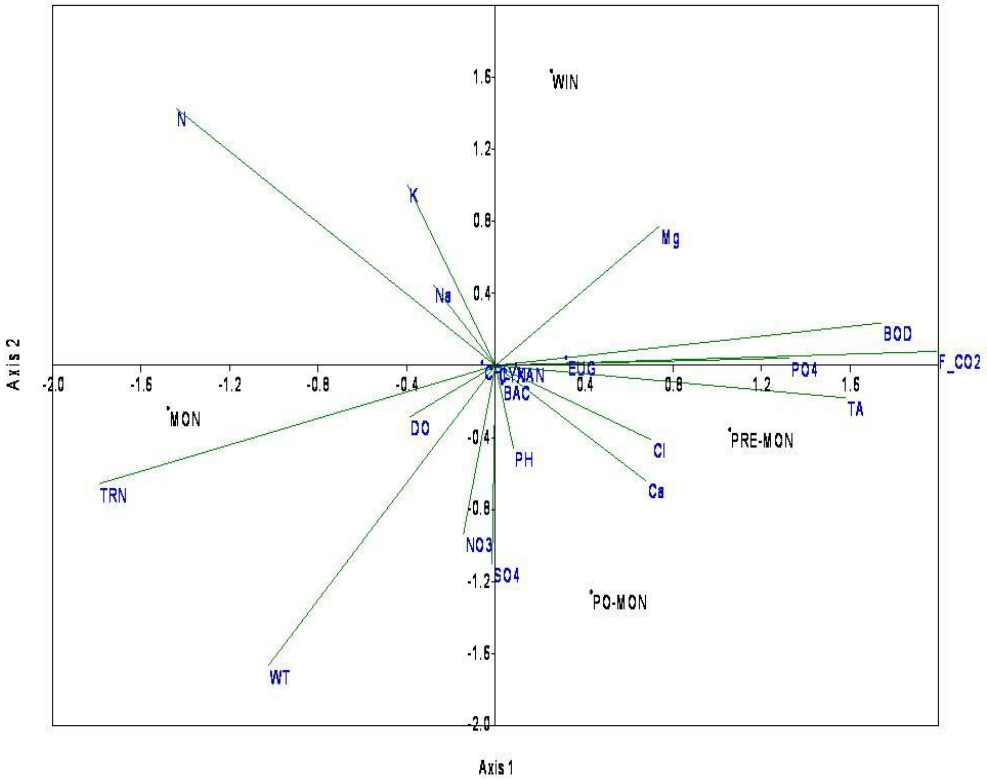


Fig. 2.3 CCA ordination showing relationships between physico-chemical parameters and phytoplankton abundance in different seasons.

The phytoplankton groups like BAC, CYN and XAN have been found to be positively correlated with p^H, Ca, Cl and TA in pre-monsoon and monsoon seasons and with transparency, water tempetrature, NO_3, DO, SO_4, in monsoon season. Similarly the group Chlorophyceae is positively correlated with N, K, TRN, WT, NO_3

and SO_4 in monsoon and negatively correlated with Mg, BOD, FCO_2, PO_4 in winter and with TA, Cl, Ca, P^H in post-monsoon. Euglenophyceae is positively correlated with Mg, BOD, PO_4 and FCO_2 in winter and negatively correlated with Cl, Ca, p^H, SO_4 in post-monsoon and TRN, WT, DO and NO_3 in monsoon season (Fig.2.3).

b) Between dominant phytoplankton species and physico-chemical parameters

CCA is done between 10 dominant phytoplankton species and 16 physico-chemical parameters of water in different seasons during the study period. Eigen value for axis 1 (0.014604) explained 52.94% correlation and axis 2 (0.011688) explained 42.37% correlation between physico-chemical parameters and certain dominant species of phytoplankton in different seasons (Fig.2.4)

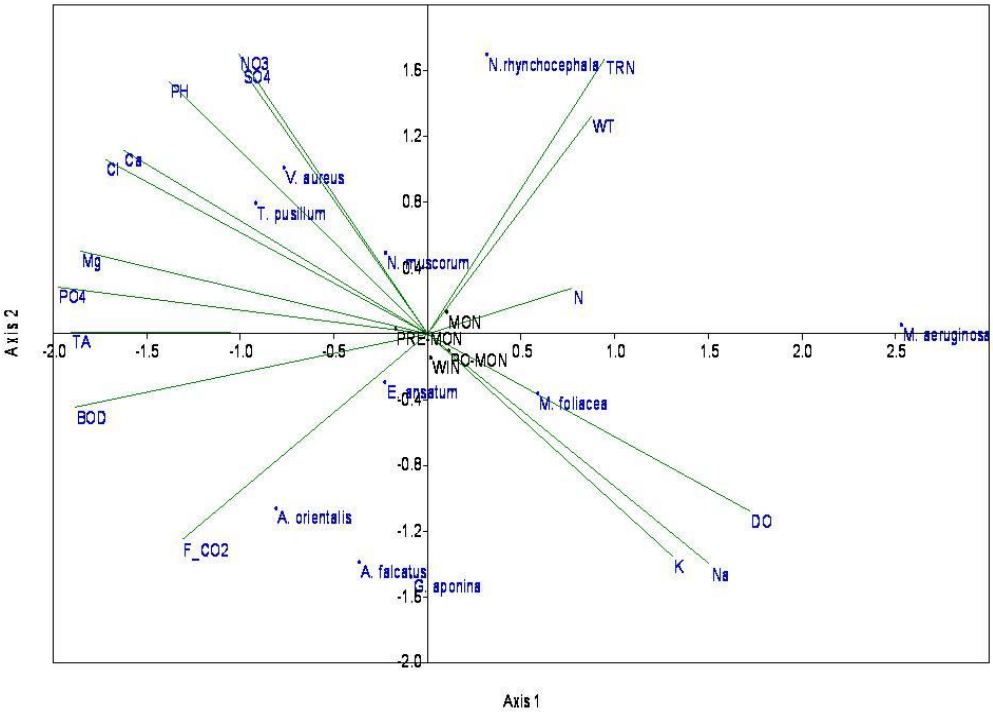


Fig. 2.4: - Canonical Correspondence Analysis (CCA) for the sixteen physico-chemical parameters and ten phytoplankton species in different season.

In monsoon, *Navicula rhynchocephala* and *Microcystis aeruginosa* are positively correlated with N, WT and TRN and negatively correlated with BOD and FCO_2, in winter and K, Na and DO in post-monsoon. In pre-monsoon season *Volvox*

aureus, *Tetraedron pusillum*, *Nostoc muscorum* are positively correlated with PO_4, Mg, Cl, Ca, p^H, SO_4, NO_3 and negatively correlated with K, Na, DO in winter and post-monsoon seasons. During post-monsoon and winter, the phytoplankton species like *Micrasterias foliacea*, *Gomphospharea aponina* are positively correlated with DO, Na and K. They are alo negatively correlated with TA, PO_4, Mg, Cl, Ca, p^H, SO_4, NO_3 in pre-monsoon season. Species like *Euastrum ansatum*, *Anabaena orientalis*, *Ankistrodesmus falcatus* are posssitively correlated with BOD and FCO_2 in pre-monsoon and negatively correlated with N, WT and Transperancy in monsoon season (Fig.2.4).

c) Between zooplankton groups and physico-chemical parameters

CCA has been incorporated between 16 physico-chemical variables in water and five different classes of zooplankton in different seasons. Eigen value for axis 1 (0.017487) explained 84.41% correlation and axis 2 (0.0025555) explained 12.33% correlation between physico-chemical parameters and zooplankton groups in different seasons (Fig.2.5).

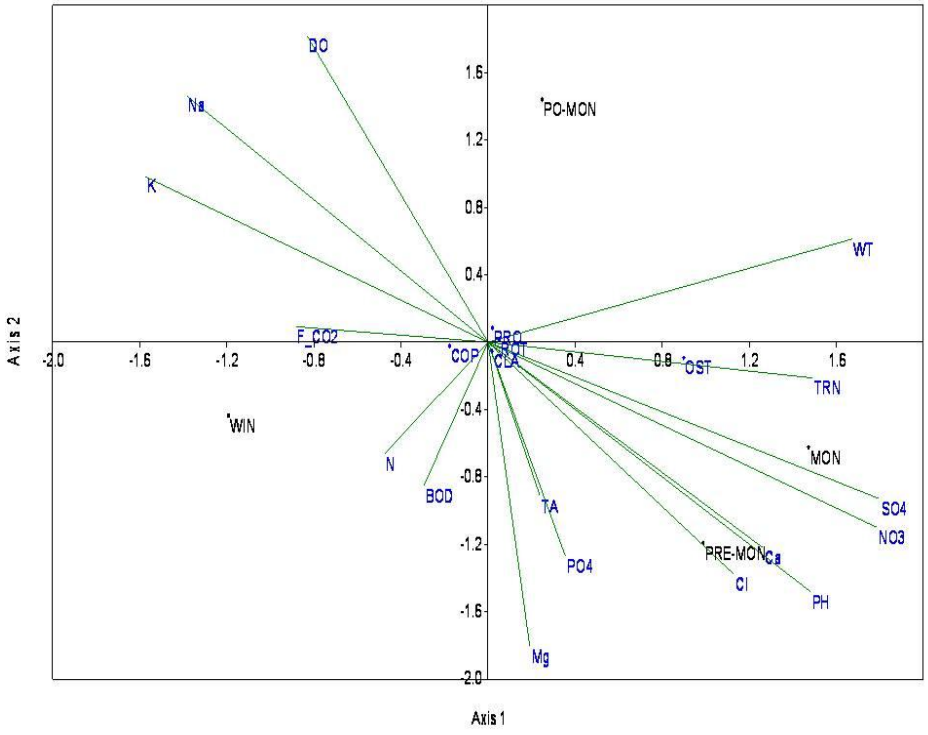


Fig. 2.5 CCA ordination showing relationships between physico-chemical parameters and zooplankton abundance in different seasons.

Group Rotifera and Cladocera have been found to correlate positively with TRN, SO_4, NO_3, p^H, Ca, Cl, TA, PO_4 and Mg in pre-monsoon and monsoon seasons. Rotifera and Cladocera are positively correlated with BOD and N in winter while negatively correlated with WT in post-monsoon season. Copepoda is recorded to be positively correlated with BOD, N, FCO_2, K, Na, DO in winter and negatively correlated with WT in post-monsoon; TRN, SO_4 and NO_3 in monsoon; Ca, p^H, Cl, PO_4 and TA in pre-monsoon season. Protozoa is positively correlated with WT in post-monsoon season and negatively correlated with N, BOD in winter season; TRN, SO_4, NO_3 in monsoon season and Ca, Cl, p^H, TA and PO_4 in pre-monsoon season. Ostracoda has been analyzed at positively correlated level with TRN, SO_4, NO_3, in monsoon; Ca, p^H, Cl, TA, PO_4 in pre-monsoon season and are negatively correlated with BOD, N in winter and WT in post-monsoon season (Fig.2.5).

d) Between dominant zooplankton species and physico-chemical parameters

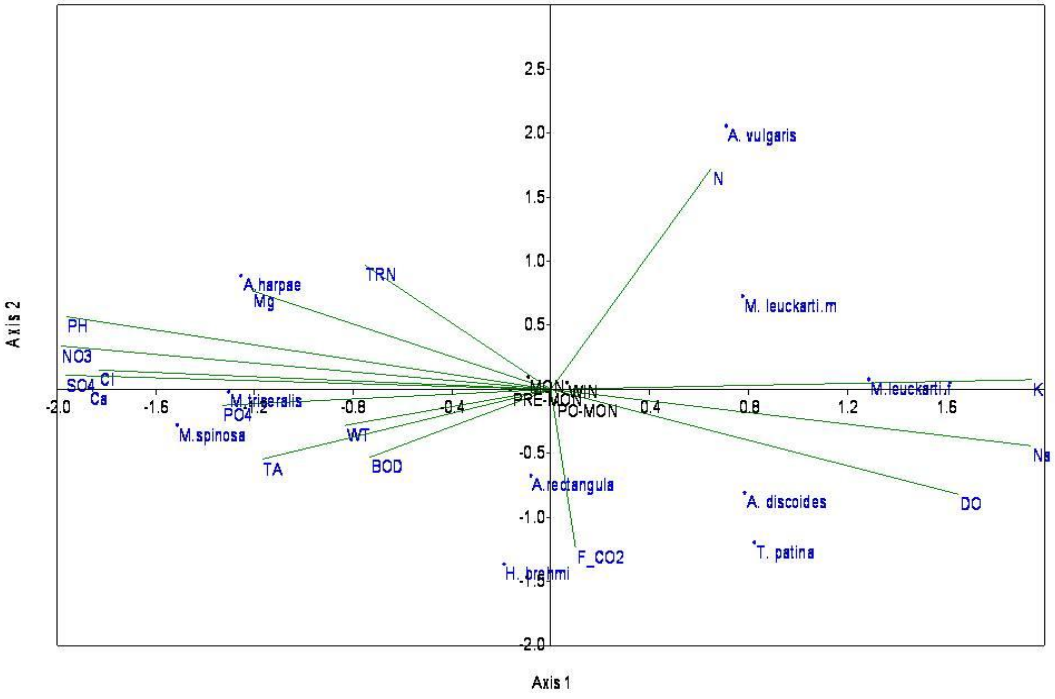


Fig. 2.6: - Canonical Correspondence Analysis (CCA) for the sixteen physico-chemical parameters and ten zooplankton species in different season.

During the study period CCA has been done between 10 dominant zooplankton species and 16 physico-chemical parameters of water sin different seasons. Eigen value for axis 1 (0.0062636) explained 45.67% correlation and axis 2 (0.005388) explained 39.29% correlation between physico-chemical parameters and certain dominant species of zooplankton in different seasons (Fig.2.6).

Arcella vulgaris, *Mesocyclops leuckarti* (male), *M. leuckarti* (female) have showed positive correlation with N and K in winter against the negative correlation with Na, DO, FCO_2 in post-monsoon period; BOD, WT, TA, PO_4, Ca in pre-monsoon and with Mg, p^H, NO_3, Cl, SO_4 in monsoon season. However, *Arcella discoides*, *Testudinella patina* showed positive correlation with Na, DO, FCO_2 in post-monsoon period against negative correlation with these of TRN, Mg, p^H, NO_3, Cl, SO_4 in monsoon season. *Alona rectangula*, *Horaella brehmi*, *Macrothrix spinosa*, *M. triseralis* are recorded to be positive correlated with BOD, TA, WT, PO_4 and Ca in pre-monsoon against negative correlation with N, K in winter. *Acroperus harpae* is positively correlated with TRN, Mg, p^H, NO_3, Cl, SO_4 in monsoon season and negatively correlated with FCO_2, DO and Na in post-monsoon season (Fig.2.6).

4.3 MACROPHYTIC DIVERSITY

Study of macrophytic community has been conducted in five different study sites during the period of March, 2014- February, 2016 covering four seasons of a year to find out different macrophyte species.

During the present study 82 species belonging to 60 different genera, 33 families have been recorded from Urpod beel, Goalpara, Assam (Table 5.1 and Fig. 2.7) with their reproductive phase. Out of 82 species 4 species were from Pteridophytes belonging to 4 families and others were Angiosperms. Among the Angiosperms 38 species were Dicotyledons under 18 families and 40 species are from Monocotyledons under 11 families (Table 5.1 and Fig.2.7)

Table 5.1: - List of macrophytes along with their habitat and reproductive phases in Urpod beel during the study period.

Name of species	Family	Habit	Reproductive Phase
Dicotyledonous (Angiosperms)			
Euryale ferox Salish	Nymphaeaceae	FA	May – Jul.
Nymphaea pubescens Willd.	Nymphaeaceae	FA	June – Nov.
N. nouchali Burm f	Nymphaeaceae	FA	Jul. – Oct.
N. rubra Roxb. ex. Salisb,	Nymphaeaceae	FA	Aug. – Dec.
Nelumbo nucifera Gaetrn.	Nelumbonaceae	FA	July.-Oct.
Oxalis corniculata L.	Oxalidaceae	MA	May – Dec.
Myriophyllum tetrandrum Roxb.	Haloragaceae	FA	May – Nov.
M. tuberculatum Roxb.	Haloragaceae	FA	Jan. – Dec.
Ludwigia adscendens (L.) Hara.	Onagraceae	FA	Jun – Oct.
L. parviflora Roxb.	Onagraceae	EA	June – Oct.
L. perennis L.	Onagraceae	EA	Aug. – Dec.
Jussiea repens L.	Onagraceae	EA	Mar. – Dec.
Trapa natans L.	Trapaceae	FA	Jul. – Dec.
Centela asiatica L.	Apiaceae	MA	Jan. – Dec.
Oenanthe javanica (Bl.) DC	Apiaceae	EA	Mar. – May
Enhydra fluctuans DC.	Asteraceae	EA	Mar. – Dec.
Grangea maderaspatana (L)Poir.	Asteraceae	MA	Apr. – Nov.
Nymphoides hydrophyllum Lour.	Menyanthaceae	FA	Sept.-- Oct.
N. indica (L.) Kuntze	Menyanthaceae	FA	Sept.-- Oct.
N. parvifolium Kuntze.	Menyanthaceae	FA	Mar.--Nov.
Heliotropium indicum (L) DC.	Boraginaceae	MA	May – Aug.
Ipomoea aquatica Forssk.	Convolvulaceae	EA	Sept. – Feb.
I.carnea Jacq.	Convolvulaceae	EA	Sept. – Feb.
I. obscura (L) Gawl.	Convolvulaceae	EA	Aug. – Sept.
Bacopa monnieri (L.) Pennel	Scrophulariaceae	MA	Jan.-- Dec.
Limnophila indica (L.) Druce	Scrophulariaceae	SA	July – Dec.
L. heterophylla (Roxb.) Benth.	Scrophulariaceae	SA	Aug. – Jan.
Utricularia scandens Benj.	Lentibularaceae	SA	July – Nov.
U. stellaris L.f.	Lentibularaceae	SA	Mar. – Nov.
Alternanthera philoxeroides L.	Amaranthaceae	EA	Oct. – Feb.
A. sessilis L.	Amaranthaceae	MA	Jan. – Dec.
Polygonum barbatum L.	Polygonaceae	MA	Oct. – Mar.
P. hydropiper L.	Polygonaceae	MA	Oct. – Mar.

P. orientale L.	Polygonaceae	MA	Apr. – Sept.
Rumex nepalensis Spreng.	Polygonaceae	MA	Apr. – Jul.
Podostemun subulatum Gardn.	Podostemaceae	SA	Jun. – Oct.
Ceratophyllum demersum L.	Ceratophyllaceae	SA	Jan. – June
C. tuberculatum Cham.	Ceratophyllaceae	SA	Jan. – Mar.
Monocotyledonous (Angiosperms)			
Hydrilla verticillata (Lf.) Royle	Hydrocharitaceae	SA	Oct. – Mar.
Hydrocharis dubia (Bl) Baker.	Hydrocharitaceae	SA	Mar. – Nov.
Blyxa aubertii Rich.	Hydrocharitaceae	SA	Jan. – Nov.
B. echinosperma (Clarke) Hook	Hydrocharitaceae	SA	Jan. – Nov.
Ottelia alismoides (L.) Pers.	Hydrocharitaceae	SA	Aug.-- Nov.
Vallisneria spiralis L.	Hydrocharitaceae	SA	Mar.-- Nov.
Eichhornia crassipes Solms.	Pontederiaecae	FF	Jan. – Dec.
Monochoria hastata L.	Pontederiaecae	EA	Feb. – Nov.
Commelina benghalensis L.	Commelinaceae	MA	Jan. – May
Floscopa scandens Lour	Commelinaceae	EA	Jan. – Jun
Murdannia nudiflora L.	Commelinaceae	MA	Jul. – Jan.
Alocasia fornicata (Roxb.) Schott	Araceae	MA	May – Sept.
Colocassia esculenta L.	Araceae	MA	May – Sept.
Pistia stratiotes L	Araceae	FF	Jun – Sept.
Lemna perpusilla Torr.	Lamnaceae	FF	May – Aug.
Spirodela punctata (Meyer) Thom	Lamnaceae	FF	May – Aug.
S. polyrhiza L.Sch	Lamnaceae	SA	Jan. – May.
Wolffia globosa Roxb.Griff	Lamnaceae	FA	Jun. – Sept.
Sagittaria sagittifolia L.	Alismataceae	EA	Feb. – Apr.
Alisma plantago-aquatica L.	Alismataceae	SA	Feb. – Apr.
Najas minor Al.	Najadaceae	SA	Jan. – Dec.
Potamogeton crispus L.	Potamogetonaceae	SA	Mar. – Dec.
P. nodosus Poir.	Potamogetonaceae	SA	Mar. – Dec.
P. octandrus Poir.	Potamogetonaceae	SA	Jan. – Dec.
Eriocaulon setaceum L.	Eriocaulaceae	SA	Jun. – Aug.
Cyperus compressus L	Cyperaceae	MA	July – Nov.
C. iria L.	Cyperaceae	MA	Aug. - Dec.
C. pilosus Vahl, Enum	Cyperaceae	MA	July – Dec.
C. rotundus L.	Cyperaceae	MA	Mar. – Nov.
Eleocharis congesta D. Don.	Cyperaceae	MA	Sept. – Dec.
Arundo donax L.	Poaceae	EA	Aug. – Jan.
Eragrostis unioloides (Retz)Nees.	Poaceae	MA	Jul. – Mar.

Hygroryza aristata Nees.	Poaceae	EA	Sept. – Mar.
Isachne globosa (Thun.) Ktze.	Poaceae	EA	Jan. – Dec.
Leersia hexandra Swartz	Poaceae	EA	Jan.-- Dec.
Oryza rufipogon Griffith, Notul	Poaceae	EA	Oct. – Jan.
Pseudoraphis brunoniana Griffith	Poaceae	FA	Jul. – Sept.
Phragmites karka (Retz.) Trin	Poaceae	EA	Sept. – Jan.
Setaria glauca Beauv	Poaceae	EA	Mar. –Nov.
Saccharum spontaneum L.	Poaceae	EA	Sept. - Dec.
Pteridophytes			
Equisetum diffusum D. Don.	Equisetaceae	EA	Dec.-- Mar.
Marsilea quadrifolia L.	Marsiliaceae	FA	May. – Sept.
Azolla pinnata R.Br	Azolaceae	FF	Mar. – Nov.
Salvinia natans (L) All.	Salviniaceae	FF	May – Sept.

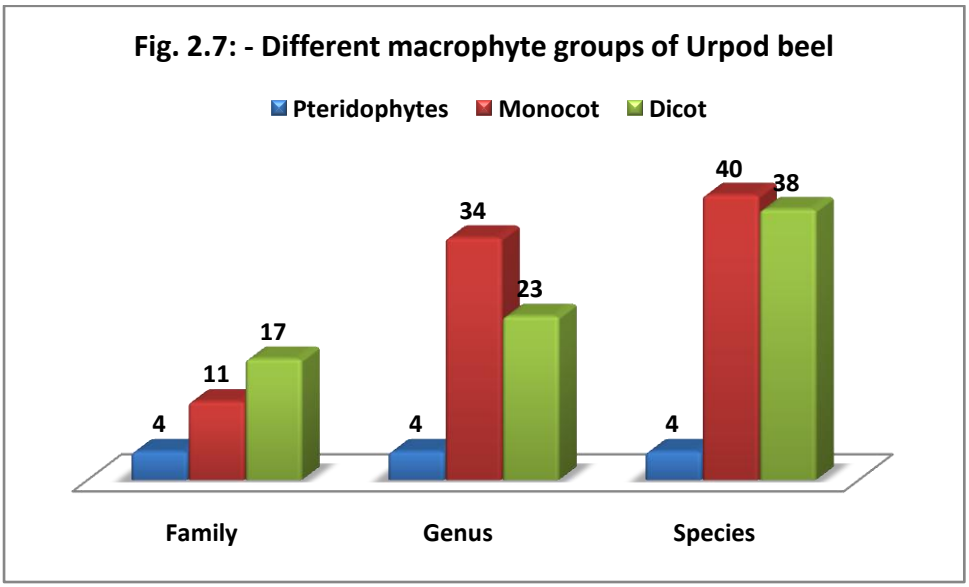
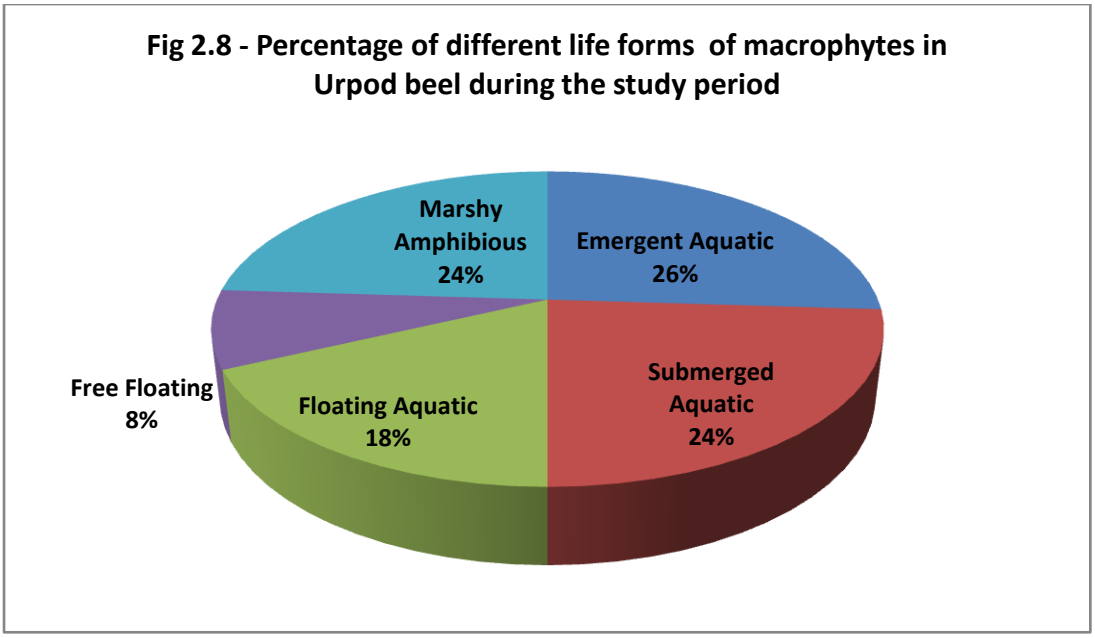


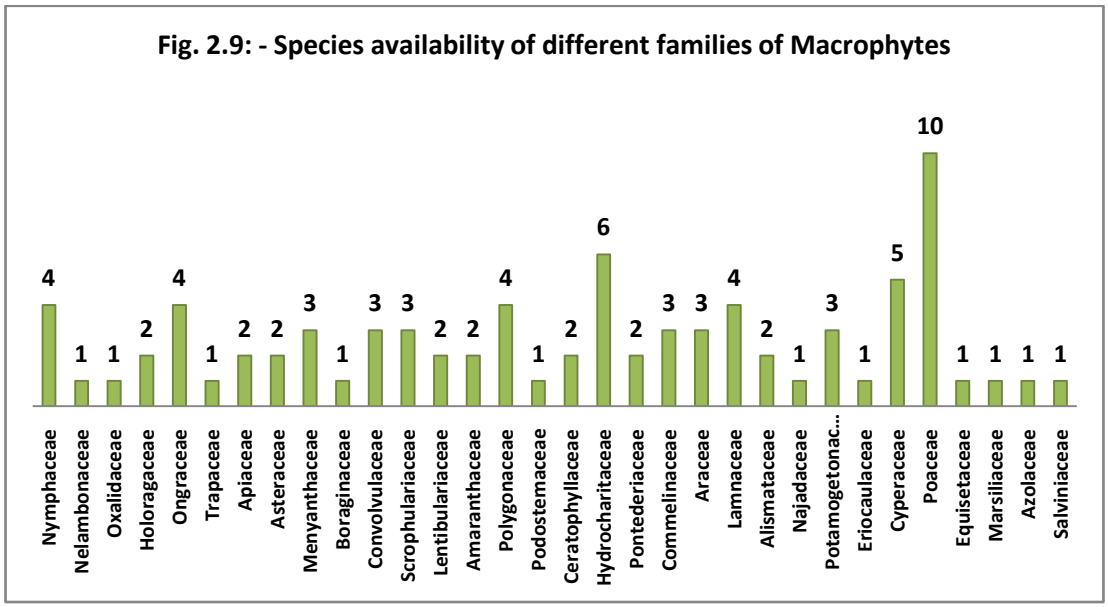
Fig. 2.7: - Different macrophyte groups of Urpod beel

Among the observed Macrophytes, 20 species are belonging to Marshy amphibious (MA), 15 species are Floating aquatic (FA), 20 species are Submerged aquatic (SA), 21species are Emergent aquatic (EA) and 6 species are found as Free floating (FF) (Fig.2.8). Family Poaceae is dominated with 10 species followed by Hydrocharitaceae with 6 species and Cyperaceae with 5 numbers of species followed by Nymphaceae, Onagraceae, Polygonaceae and Lamnaceae with of 4 species in each; Menyanthaceae, Convolvulaceae, Scrophulariaceae, Commelinaceae, Araceae,

Potamogetonaceae are of with 3 species in each; Halograceae, Apiaceae, Asteraceae, Lentibularace, Amaranthaceae, Caratophyllaceae, Pontederiaceae, Alismataceae are of



with 2 species each and other 14 families viz Nelumbonaceae, Oxalidaceae, Trapaceae, Boraginacea, Podostemaceae, Najadaceae, Erioculaceae, Equisetaceae, Marsiliaceae, Azolaceae, Salviniaceae are monospecific (Fig.2.9).



Habitat of Emergent Aquatic (EA) is the most dominant constituting 25.61%, followed by Submerged Aquatic and Marshy Amphibious with 24.39%, Floating Aquatic constituting 18.29%, Free Floating constituting 7.32% each of the total macrophytic species (Fig. 2.8). The diversity of macrophytes is observed in five study sites which are described in the following heads:

4.3.1 SITE - 1 (Table 5.2)

In this sampling Station 74 types of macrophytic species are recorded. In this site the RF value is found 0.69% to 2.083%. The RD value is found 0.330% to 6.468%. The RA value is found 0.453% to 11.056%. The total IVI value is found 2.058% to 19.346% (Table 5.2). The highest RF values 2.083% are found for *Nymphaea pubescens, N. nouchali, Myriophyllum tetrandrum, Jussiea repens, Trapa natans, Ipomoea aquatica, Utricularia scandens, U. Stellaris, Alternanthera philoxeroides, Valisneria spiralis, Eichhornia crassipes, Azolla pinnata*. The lowest RF value has been recorded against 18 species viz. *Ipomoea obscura, Polygonum orientale, Alocasia fornicata, Lemna perpusilla, Spirodela polyrhiza, Alisma plantago-aquatica, Najas minor, Potamogeton peclinatus, Cyperus iria, C. rotundus, Eleocharis congesta, Isachne globosa, Leersia hexandra, Oryza rufipogon, Pseudoraphis brunoniana, Phragmites karka, Equisetum diffusum, Marsilea quadrifolia.* The highest RD value has obtained against *Azolla pinnata* and the lowest value is calculated against *Phragmites karka, Equisetum diffusum.* The highest RA value has been noted for *Salvinia natans* (Photo plate-13) and the lowest is obtained in *Oenanthea javanica.* The highest IVI value has been calculated in *Azolla pinnata* and the lowest value has been evaluated for *Isachne globosa.*

Table 5.2: – Importance Value Index (IVI) of macrophytes during the year 2014 – 16 of the study site – 1 (RF = Relative Frequency, RD = Relative Density, RA = Relative Abundance)
(* indicates the lowest value and ** indicates the highest value)

Name of species	RF	RD	RA	IVI
Euryale ferox Salish	1.388	0.924	0.906	3.218
Nymphaea pubescens Willd.	**2.083****	0.990	0.647	3.72
N. nouchali Burm f	**2.083****	1.122	0.725	3.93
N. rubra Roxb. ex. Salisb,	1.388	0.594	0.582	2.564
Nelumbo nucifera Gaetrn.	1.388	0.718	0.712	2.818
Oxalis corniculata L.	-	-	-	-
Myriophyllum tetrandrum Roxb.	**2.083****	1.386	0.906	4.375
M. tuberculatum Roxb.	1.388	0.594	0.582	2.564
Ludwigia adscendens (L.) Hara.	1.388	0.718	0.712	2.818
L. parviflora Roxb.	-	-	-	-
L. perennis L.	-	-	-	-
Jussiea repens L.	**2.083****	1.782	1.165	5.03
Trapa natans L.	**2.083****	2.112	1.373	5.568
Centela asiatica L.	1.388	1.518	1.489	4.395
Oenanthe javanica (Bl.) DC	1.388	0.462	**0.453***	2.303
Enhydra fluctuans DC.	1.388	1.254	1.230	3.872
Grangea maderaspatana (L)Poir.	1.388	0.396	0.990	2.774
Nymphoides hydrophyllum Lour.	1.388	0.594	0.582	2.564
N. indica (L.) Kuntze	1.388	0.462	1.122	2.972
N. parvifolium Kuntze.	1.388	0.718	0.712	2.818
Heliotropium indicum (L) DC.	-	-	-	-
Ipomoea aquatica Forssk.	**2.083****	2.57	4.290	8.943
I.carnea Jacq.	1.388	1.254	3.135	5.777
I. obscura (L) Gawl.	**0.69***	0.792	3.960	5.442
Bacopa monnieri (L.) Pennel	1.388	2.772	6.930	11.09
Limnophila indica (L.) Druce	-	-	-	-
L. heterophylla (Roxb.) Benth.	-	-	-	-
Utricularia scandens Benj.	**2.083****	3.762	6.270	12.115
U. stellaris L.f.	**2.083****	2.310	3.828	8.221
Alternanthera philoxeroides L.	**2.083****	2.640	4.389	9.112
A. sessilis L.	1.388	1.650	4.125	7.163
Polygonum barbatum L.	1.388	1.650	4.125	7.163
P. hydropiper L.	1.388	1.848	4.620	7.856
P. orientale L.	**0.69***	0.858	4.290	5.838
Rumex nepalensis Spreng.	1.388	1.254	3.135	5.777
Podostemun subulatum Gardn.	1.388	0.990	2.475	4.853
Ceratophyllum demersum L.	1.388	1.188	2.970	5.546

C. tuberculatum Cham.	1.388	0.858	2.145	4.391
Hydrilla verticillata (Lf.) Royle	1.388	2.112	5.280	8.87
Hydrocharis dubia (Bl) Baker.	1.388	0.990	2.475	4.853
Blyxa aubertii Rich.	1.388	0.726	1.815	3.929
B. echinosperma (Clarke) Hook	1.388	0.990	2.475	4.853
Ottelia alismoides (L.) Pers.	1.388	0.726	1.815	3.929
Vallisneria spiralis L.	**2.083****	1.122	1.848	5.053
Eichhornia crassipes Solms.	**2.083****	3.234	5.379	10.696
Monochoria hastata L.	1.388	1.056	2.640	5.084
Commelina benghalensis L.	1.388	0.726	1.815	3.929
Floscopa scandens Lour	1.388	1.650	4.125	7.158
Murdannia nudiflora L.	1.388	0.462	1.122	2.972
Alocasia fornicata (Roxb.) Schott	**0.69***	**0.330***	1.650	2.67
Colocassia esculenta L.	1.388	1.056	2.640	5.084
Pistia stratiotes L	1.388	2.970	7.425	11.783
Lemna perpusilla Torr.	1.388	2.442	6.105	9.935
Spirodela punctata (Meyer) Thom	**0.69***	1.254	3.135	5.079
S. polyrhiza L.Sch	**0.69***	1.320	6.600	8.61
Wolffia globosa Roxb.Griff	1.388	3.102	7.755	12.245
Sagittaria sagittifolia L,	1.388	1.452	3.630	6.47
Alisma plantago-aquatica L.	**0.69***	0.528	2.640	3.858
Najas minor Al.	**0.69***	0.528	2.640	3.858
Potamogeton crispus L.	1.388	0.858	2.145	4.391
P. nodosus Poir.	**0.69***	0.660	3.300	4.65
P. octandrus Poir.	1.388	0.858	2.145	4.391
Eriocaulon setaceum L.	1.388	1.782	4.455	7.625
Cyperus compressus L	1.388	1.518	3.795	6.701
C. iria L.	**0.69***	0.594	2.970	4.254
C. pilosus Vahl, Enum	1.388	1.320	3.300	6.008
C. rotundus L.	**0.69***	0.594	2.970	4.254
Eleocharis congesta D. Don.	**0.69***	0.528	2.640	4.254
Arundo donax L.	1.388	0.858	2.145	4.391
Eragrostis unioloides (Retz)Nees.	1.388	0.726	0.712	2.826
Hygroryza aristata Nees.	1.388	1.650	7.425	10.463
Isachne globosa (Thun.) Ktze.	**0.69***	0.462	0.906	**2.058***
Leersia hexandra Swartz	**0.69***	0.396	1.980	3.066
Oryza rufipogon Griffith, Notul	**0.69***	0.528	2.640	3.858
Pseudoraphis brunoniana Griffith	**0.69***	0.660	3.300	4.65
Phragmites karka (Retz.) Trin	**0.69***	0.330	1.650	2.67
Setaria glauca Beauv	1.388	0.924	2.310	4.622
Saccharum spontaneum L.	-	-	-	-
Equisetum diffusum D. Don.	**0.69***	0.330	1.650	2.67

Marsilea quadrifolia L.	**0.69***	1.980	9.900	12.57
Azolla pinnata R.Br	2.083	**6.468****	10.759	**19.346****
Salvinia natans (L) All.	1.388	4.422	**11.056****	16.866

In the site 1 the fluctuation trend of the families are Poaceae> Hydrocharitaceae>Cyperaceae>Nymphaceae, Onagraceae, Polygonaceae, Lamnaceae > Menyanthaceae, Convolvulaceae, Commeelinaceae, Araceae, Potamogetonaceae > Haloragaceae, Apiaceae, Asteraceae, Lentibularaceae, Amaranthaceae, Ceratophyllaceae, Pontederiaecae, Alismataceae>Nelumbonaceae, Trapaceae, Scrophulariaceae, Podostemaceae, Najadaceae, Eriocaulaceae, Equisetaceae, Masiliaceae, Azolaceae, Salviniaceae (Table 5.2).

4.3.2 SITE - 2 (Table 5.3)

In this Station 72 types of macrophytic species are recorded. The RF value has been found 0.877% to 2.631%. The RD value is found 0.246% to 6.111%. The RA value is found 0.666% to 12.345%. The total IVI value is found 1.975% to 19.037% (Table 5.3). The highest RF values 2.631% have been found for *Euryale ferox, Hydrilla verticillata, Eichhornia crassipes, Setaria gluca, Azolla pinnata*. The lowest RF value has been calculated for 31 species viz. *Nymphaea rubra, Myriophylum tetrandrum, Oenanthea javanica* (Photo plate-14), *Nymphoides indica, N. parvifolium, Ipomoea aquatica, I. obscura, Bacopa monnieri, Polygonum hydropiper, Hydrocharis dubia, Blyxa echinosperma, Vallisneria spiralis, Monochoria hastata, Commelina benghalensis, Murdannia nudiflora, Alocasia fornicata, Colocassia esculenta, Pistia stratiotes, Lemna perpusilla, Spirodela polyrrhiza, Najas minor, Eriocaulon setaceum, Cyperus compressus, C. rotundus, Arundo donax, Eragrostis unioloides, Leersia hexandra, Oryza rufipogon, Equisetum diffusum, Marsilea quadrifolia.* The highest RD value has been noted for *Azolla pinnata* and the lowest value is recorded for *Equisetum diffusum.* The highest RA value is obtained for *Salvinia natans* and the lowest value for in *Oenanthea javanica, Grangea maderaspanta, Nymphoides parvifolium, Heliotropium indicum* have been recorded. The highest IVI value for *Salvinia natans* and the lowest values for *Oenanthea javanica, Nymphoides parvifolium* have been calculated (Table 5.3).

Table 5.3: – Importance Value Index (IVI) of macrophytes during the year 2014 – 16 of the study site – 2 (RF = Relative Frequency, RD = Relative Density, RA = Relative Abundance)
(* indicates the lowest value and ** indicates the highest value)

Name of species	RF	RD	RA	IVI
Euryale ferox Salish	**2.631****	1.851	0.950	5.432
Nymphaea pubescens Willd.	1.754	1.234	0.950	3.938
N. nouchali Burm f	1.754	1.049	0.808	3.611
N. rubra Roxb. ex. Salisb,	**0.877***	0.740	1.140	2.757
Nelumbo nucifera Gaetrn.	1.754	0.925	0.712	3.391
Oxalis corniculata L.	1.754	2.962	2.281	6.997
Myriophyllum tetrandrum Roxb.	**0.877***	0.802	1.235	2.914
M. tuberculatum Roxb.	1.754	1.543	1.188	4.485
Ludwigia adscendens (L.) Hara.	1.754	1.049	0.808	3.656
L. parviflora Roxb.	1.754	0.987	0.760	3.501
L. perennis L.	1.754	1.172	0.903	3.829
Jussiea repens L.	-	-	-	-
Trapa natans L.	1.754	2.469	1.902	6.125
Centela asiatica L.	1.754	3.827	2.949	8.53
Oenanthe javanica (Bl.) DC	**0.877***	0.432	**0.666***	**1.975***
Enhydra fluctuans DC.	1.754	1.666	1.284	4.704
Grangea maderaspatana (L) Poir.	1.754	0.864	**0.666***	3.284
Nymphoides hydrophyllum Lour.	-	-	-	-
N. indica (L.) Kuntze	**0.877***	0.679	1.046	2.602
N. parvifolium Kuntze.	**0.877***	0.432	**0.666***	**1.975***
Heliotropium indicum (L) DC.	1.754	0.864	**0.666***	3.284
Ipomoea aquatica Forssk.	**0.877***	2.345	11.728	14.95
I. carnea Jacq.	1.754	1.172	2.932	5.858
I. obscura (L) Gawl.	**0.877***	0.617	0.950	2.444
Bacopa monnieri (L.) Pennel	**0.877***	1.234	1.902	4.013
Limnophila indica (L.) Druce	1.754	1.234	0.950	3.938
L. heterophylla (Roxb.) Benth.	1.754	1.543	3.858	7.155
Utricularia scandens Benj.	-	-	-	-
U. stellaris L.f.	**0.877***	1.975	9.876	12.728
Alternanthera philoxeroides L.	-	-	-	-
A. sessilis L.	1.754	2.777	8.487	13.018
Polygonum barbatum L.	1.754	2.469	6.172	10.395
P. hydropiper L.	**0.877***	1.358	6.790	9.052
P. orientale L.	1.754	1.419	3.549	6.722
Rumex nepalensis Spreng.	1.754	2.962	7.40	12.116
Podostemun subulatum Gardn.	1.754	0.740	1.851	4.345

Ceratophyllum demersum L.	1.754	1.604	4.012	7.37
C. tuberculatum Cham.	1.754	0.740	1.851	4.345
Hydrilla verticillata (Lf.) Royle	**2.631****	2.962	4.938	10.531
Hydrocharis dubia (Bl) Baker.	**0.877***	0.308	1.543	2.728
Blyxa aubertii Rich.	1.754	1.049	2.623	5.426
B. echinosperma (Clarke) Hook	**0.877***	0.802	4.012	5.691
Ottelia alismoides (L.) Pers.	1.754	1.419	3.549	6.722
Vallisneria spiralis L.	**0.877***	2.160	5.401	8.438
Eichhornia crassipes Solms.	**2.631****	3.765	6.265	12.661
Monochoria hastata L.	**0.877***	0.679	3.395	4.951
Commelina benghalensis L.	**0.877***	0.432	2.160	3.469
Floscopa scandens Lour	1.754	1.851	4.629	8.234
Murdannia nudiflora L.	**0.877**	0.370	1.851	3.098
Alocasia fornicata (Roxb.) Schott	**0.877**	0.432	2.160	3.469
Colocassia esculenta L.	**0.877**	0.370	1.851	3.098
Pistia stratiotes L	**0.877**	1.543	7.716	10.136
Lemna perpusilla Torr.	**0.877**	1.111	5.555	7.543
Spirodela punctata (Meyer) Thom	-	-	-	-
S. polyrhiza L.Sch	**0.877**	1.728	8.641	11.246
Wolffia globosa Roxb.Griff	1.754	2.345	5.864	9.963
Sagittaria sagittifolia L,	1.754	1.728	4.320	7.802
Alisma plantago-aquatica L.	-	-	-	-
Najas minor Al.	**0.877**	0.617	3.086	4.58
Potamogeton crispus L.	1.754	1.049	2.623	5.426
P. nodosus Poir.	1.754	1.234	3.086	6.074
P. octandrus Poir.	-	-	-	-
Eriocaulon setaceum L.	**0.877**	1.049	5.246	7.172
Cyperus compressus L	**0.877**	0.617	3.086	4.58
C. iria L.	1.754	0.432	1.080	3.266
C. pilosus Vahl, Enum	-	-	-	-
C. rotundus L.	**0.877**	0.493	2.469	3.839
Eleocharis congesta D. Don.	-	-	-	-
Arundo donax L.	**0.877**	0.432	2.160	3.469
Eragrostis unioloides (Retz)Nees.	**0.877**	0.493	2.469	3.839
Hygroryza aristata Nees.	1.754	1.913	4.783	8.45
Isachne globosa (Thun.) Ktze.	-	-	-	-
Leersia hexandra Swartz	**0.877**	0.555	2.777	4.209
Oryza rufipogon Griffith, Notul	**0.877**	0.864	4.320	6.061
Pseudoraphis brunoniana Griffith	-	-	-	-
Phragmites karka (Retz.) Trin	-	-	-	-
Setaria glauca Beauv	**2.631**	1.543	2.561	6.735
Saccharum spontaneum L.	1.754	0.925	2.314	4.993

Equisetum diffusum D. Don.	**0.877**	**0.246***	1.234	2.357
Marsilea quadrifolia L.	**0.877**	1.666	8.333	10.876
Azolla pinnata R.Br	**2.631**	**6.111****	10.185	18.927
Salvinia natans (L) All.	1.754	4.938	**12.345****	**19.037****

In this study site (S-2) the fluctuation trend of the families are Poaceae > Hydrocharitaceae>Nymphaceae, Onagraceae, Polygonace>Convolvulaceae, Scrophulariaceae, Commeelinaceae, Araceae, Lamnaceae, Cyperaceae> Haloragaceae, Apiaceae, Asteraceae, Menyanthaceae, Ceratophyllaceae, Pontederiaecae, Potamogetonaceae>Nelumbonaceae, Oxalidaceae, Trapaceae, Boraginaceae, Lentibularaceae, Amaranthaceae, Podostemaceae, Alismataceae, Eriocaulaceae, Equisetaceae, Masiliaceae, Azolaceae, Salviniaceae.

4.3.3 SITE - 3 (Table 5.4)

In this sampling Station 51types of macrophytic species have been recorded with the RF value from 1.136% to 4.545%. The RD value noted from 0.179% to 6.319%. The RA value is recorded to be 0.372% to 4.597%. The total IVI value is found 1.723% to 13.368% (Table 5.4). The highest RF values 4.545% for *Euryale ferox.* The lowest RF values are found for 23 species viz. *Nymphaea nouchali, Oxalis corniculata, Centela asiatica, Oenanthea javanica, Grangea maderaspanta, Heliotropium indicum* (photo plate-16), *Ipomea carnea, Bacopa monnieri, Alternanthera philoxeroides, A. sessilis, Polygonum barbatum, P. hydropiper, Rumex nepalensis, Blyxa auberti, Ottelia alismoides, Murdannia nudiflora, Alocasia fornicata, Pistia stratiotes, Lemna perpusilla, Alisma plantago-aquatica, Cyperus rotundus, Isachne globosa.* The highest RD value is found in *Utricularia scandens* and the lowest value is found in *Alisma plantago-aquatica.* The highest RA value has been noted in *Polygonum barbatum* against the lowest value for *Alocasia fornicata.* The highest IVI value has been found in *Utricularia scandens* and the lowest values is obtained in *Alocasia fornicata.* In the site III the fluctuation trend of the families are Hydrocharitaceae>Nymphaceae, Onagraceae, Polygonace, Potamogetonaceae> Apiaceae, Asteraceae, Convolvulaceae, Lentibularaceae, Amaranthaceae, Pontederiaecae, Commelinaceae, Araceae, Lamnaceae, Alismataceae>

Nelumbonaceae, Oxalidaceae, Trapaceae, Boraginaceae, Scrophulariaceae, Ceratophyllaceae, Cyperaceae, Masiliaceae, Azolaceae, Salviniaceae (Table 5.4).

Table 5.4: – Importance Value Index (IVI) of macrophytes during the year 2014 – 16 of the study site – 3 (RF = Relative Frequency, RD = Relative Density, RA = Relative Abundance)
(* indicates the lowest value and ** indicates the highest value)

Name of species	RF	RD	RA	IVI
Euryale ferox Salish	**4.545****	6.104	1.522	12.171
Nymphaea pubescens Willd.	-	-	-	-
N. nouchali Burm f	**1.136***	1.508	2.609	5.253
N. rubra Roxb. ex. Salisb,	2.272	3.231	2.795	8.298
Nelumbo nucifera Gaetrn.	2.272	1.938	1.677	5.887
Oxalis corniculata L.	**1.136***	2.298	3.976	7.401
Myriophyllum tetrandrum Roxb.	-	-	-	-
M. tuberculatum Roxb.	-	-	-	-
Ludwigia adscendens (L.) Hara.	2.272	1.220	1.056	4.548
L. parviflora Roxb.	2.272	1.149	0.994	4.415
L. perennis L.	-	-	-	-
Jussiea repens L.	2.272	4.308	3.727	10.307
Trapa natans L.	2.272	3.159	2.733	8.164
Centela asiatica L.	**1.136***	2.082	3.603	6.821
Oenanthe javanica (Bl.) DC	**1.136***	0.861	1.491	2.988
Enhydra fluctuans DC.	2.272	1.579	1.366	5.217
Grangea maderaspatana (L) Poir.	**1.136***	0.502	0.869	2.507
Nymphoides hydrophyllum Lour.	-	-	-	-
N. indica (L.) Kuntze	-	-	-	-
N. parvifolium Kuntze.	-	-	-	-
Heliotropium indicum (L) DC.	**1.136***	0.574	0.994	2.704
Ipomoea aquatica Forssk.	3.409	6.175	3.553	13.137
I .carnea Jacq.	**1.136***	1.436	2.733	5.305
I. obscura (L) Gawl.	-	-	-	-
Bacopa monnieri (L.) Pennel	**1.136***	0.933	1.615	3.684
Limnophila indica (L.) Druce	-	-	-	-
L. heterophylla (Roxb.) Benth.	-	-	-	-
Utricularia scandens Benj.	3.409	**6.319****	3.640	**13.368****
U. stellaris L.f.	2.272	3.016	2.609	7.897
Alternanthera philoxeroides L.	**1.136***	0.574	0.994	2.704
A. sessilis L.	**1.136***	1.292	2.236	4.664
Polygonum barbatum L.	**1.136***	2.657	**4.597****	8.39

P. hydropiper L.	**1.136***	1.292	2.236	4.664
P. orientale L.	-	-	-	-
Rumex nepalensis Spreng.	**1.136***	2.298	3.976	7.41
Podostemun subulatum Gardn.	-	-	-	-
Ceratophyllum demersum L.	-	-	-	-
C. tuberculatum Cham.	3.409	2.369	1.366	7.144
Hydrilla verticillata (Lf.) Royle	3.409	2.441	1.404	7.254
Hydrocharis dubia (Bl) Baker.	-	-	-	-
Blyxa aubertii Rich.	**1.136***	0.861	1.491	3.488
B. echinosperma (Clarke) Hook	**1.136***	0.933	1.615	3.684
Ottelia alismoides (L.) Pers.	**1.136***	0.502	0.869	2.507
Vallisneria spiralis L.	3.409	2.154	1.242	6.805
Eichhornia crassipes Solms.	2.272	3.590	3.106	8.968
Monochoria hastata L.	2.272	1.508	1.304	5.084
Commelina benghalensis L.	-	-	-	-
Floscopa scandens Lour	2.272	1.149	0.994	4.415
Murdannia nudiflora L.	**1.136***	0.287	0.497	1.92
Alocasia fornicata (Roxb.) Schott	**1.136***	0.215	**0.372***	**1.723***
Colocassia esculenta L.	-	-	-	-
Pistia stratiotes L	**1.136***	1.508	2.609	5.253
Lemna perpusilla Torr.	**1.136***	2.298	3.976	7.41
Spirodela punctata (Meyer) Thom	-	-	-	-
S. polyrhiza L.Sch	-	-	-	-
Wolffia globosa Roxb.Griff	2.272	2.657	2.298	7.227
Sagittaria sagittifolia L,	2.272	1.364	1.180	4.816
Alisma plantago-aquatica L.	**1.136***	**0.179***	0.497	1.812
Najas minor Al.	-	-	-	-
Potamogeton crispus L.	2.272	0.718	0.621	3.611
P. nodosus Poir.	2.272	1.005	0.869	4.146
P. octandrus Poir.	2.272	1.508	1.304	5.084
Eriocaulon setaceum L.	-	-	-	-
Cyperus compressus L	-	-	-	-
C. iria L.	-	-	-	-
C. pilosus Vahl, Enum	-	-	-	-
C. rotundus L.	**1.136***	0.861	1.491	3.488
Eleocharis congesta D. Don.	-	-	-	-
Arundo donax L.	2.272	1.220	1.056	4.548
Eragrostis unioloides (Retz)Nees.	-	-	-	-
Hygroryza aristata Nees.	2.272	1.938	1.677	5.887
Isachne globosa (Thun.) Ktze.	**1.136***	0.646	1.118	2.9
Leersia hexandra Swartz	-	-	-	-
Oryza rufipogon Griffith, Notul	-	-	-	-

Pseudoraphis brunoniana Griffith	-	-	-	-
Phragmites karka (Retz.) Trin	-	-	-	-
Setaria glauca Beauv	3.409	2.010	1.159	6.578
Saccharum spontaneum L.	-	-	-	-
Equisetum diffusum D. Don.	-	-	-	-
Marsilea quadrifolia L.	2.272	2.585	2.236	7.093
Azolla pinnata R.Br	2.272	2.513	2.174	6.959
Salvinia natans (L) All.	2.272	4.452	3.852	10.576

4.3.4 SITE - 4 (Table 5.5)

In this sampling Station 48 types of macrophytic species are recorded. The RF value is found 1.666% to 5%. The RD value is noted at 0.594% to 8.354%. The RA value is obtained at 0.565% to 4.454%. The total IVI value has been calculated at 2.319% to 15.197% (Table 5.5). The highest RF value 5% is found for *Eichhornia crassipes, Monochoria hastata, Lemna perpusilla, Sagittaria sasittifolia* (Photo Plate-15). The lowest RF value is found for 15 species viz. *Nymphaea nouchali, N.rubra, Nelumbo nucifera, Oxalis corniculata, Myriophylum tetrandrum, Jussiea repens, Centela asiatica, Ipomea carnea, Bacopa monnieri, Utricularia scandens, Polygonum orientale, Rumex nepalensis, Ceratophylum demersum, Najas minor, Marsilea quadrifolia.* The highest RD value is found in *Centela asiatica* and lowest value is obtained for *Nelumbo nucifera, Grangea maderaspanta and Polygonum orientale*. The highest RA value has been recorded in *Hygoryza aristata* and the lowest value for *Grangea maderaspanta* is noted. The highest IVI value in *Lemna perpusilla* and the lowest values in *Blyxa auberti* hade been noted. In the site IV the fluctuation trend of the families are Polygonace>Hydrocharitaceae> Nymphaceae, Onagraceae, Poaceae >Haloragraceae, Asteraceae, Convolvulaceae, Amaranthaceae, Pontederiaecae, Araceae, Lamnaceae, Alismataceae > Nelumbonaceae, Oxalidaceae, Trapaceae, Apiaceae, Menyanthaceae, Lentibularaceae, Podostemaceae, Ceratophyllaceae, Commelinaceae, Najadaceae, Cyperaceae, Masiliaceae, Azolaceae, Salviniaceae (Table 5.5).

Table 5.5: – Importance Value Index (IVI) of macrophytes during the year 2014 – 16 of the study site – 4 (RF = Relative Frequency, RD = Relative Density, RA = Relative Abundance)
(* indicates the lowest value and ** indicates the highest value)

Name of species	RF	RD	RA	IVI
Euryale ferox Salish	3.333	1.188	1.131	5.652
Nymphaea pubescens Willd.	-	-	-	-
N. nouchali Burm f	**1.666***	0.668	1.272	3.606
N. rubra Roxb. ex. Salisb.	**1.666***	0.668	1.272	3.606
Nelumbo nucifera Gaetrn.	**1.666***	**0.594***	1.131	3.391
Oxalis corniculata L.	**1.666***	1.708	3.252	6.626
Myriophyllum tetrandrum Roxb.	**1.666***	0.891	1.696	4.253
M. tuberculatum Roxb.	3.333	1.559	1.484	6.376
Ludwigia adscendens (L.) Hara.	3.333	1.188	1.131	5.652
L. parviflora Roxb.	3.333	1.411	1.343	6.087
L. perennis L.	-	-	-	-
Jussiea repens L.	**1.666***	0.965	1.838	4.469
Trapa natans L.	3.333	2.450	2.343	8.126
Centela asiatica L.	**1.666***	**8.354****	3.535	13.555
Oenanthe javanica (Bl.) DC	-	-	-	-
Enhydra fluctuans DC.	3.333	2.005	1.908	7.246
Grangea maderaspatana (L) Poir.	3.333	0.594	**0.565***	4.492
Nymphoides hydrophyllum Lour.	-	-	-	-
N. indica (L.) Kuntze	-	-	-	-
N. parvifolium Kuntze.	3.333	1.261	1.201	5.795
Heliotropium indicum (L) DC.	-	-	-	-
Ipomoea aquatica Forssk.	3.333	2.745	2.61	8.688
I .carnea Jacq.	**1.666***	1.559	2.969	6.194
I. obscura (L) Gawl.	-	-	-	-
Bacopa monnieri (L.) Pennel	**1.666***	2.079	3.959	7.704
Limnophila indica (L.) Druce	-	-	-	-
L. heterophylla (Roxb.) Benth.	-	-	-	-
Utricularia scandens Benj.	**1.666***	2.079	3.959	7.704
U. stellaris L.f.	-	-	-	-
Alternanthera philoxeroides L.	3.333	2.005	1.908	7.246
A. sessilis L.	3.333	1.633	1.555	6.521
Polygonum barbatum L.	3.333	1.188	1.131	5.652
P. hydropiper L.	3.333	1.930	1.838	7.101
P. orientale L.	**1.666***	**0.594***	1.131	3.391
Rumex nepalensis Spreng.	**1.666***	0.891	1.696	4.253

Podostemun subulatum Gardn.	3.333	1.262	1.201	5.796
Ceratophyllum demersum L.	**1.666***	0.891	1.696	4.253
C. tuberculatum Cham.	-	-	-	-
Hydrilla verticillata (Lf.) Royle	3.333	1.262	1.201	5.796
Hydrocharis dubia (Bl) Baker.	-	-	-	-
Blyxa aubertii Rich.	3.333	1.188	1.131	**2.319***
B. echinosperma (Clarke) Hook	-	-	-	-
Ottelia alismoides (L.) Pers.	3.333	1.633	1.555	6.521
Vallisneria spiralis L.	3.333	1.262	1.201	5.796
Eichhornia crassipes Solms.	**5***	3.490	2.205	10.695
Monochoria hastata L.	**5***	2.302	1.456	8.758
Commelina benghalensis L.	3.333	3.044	2.898	9.275
Floscopa scandens Lour	-	-	-	-
Murdannia nudiflora L.	-	-	-	-
Alocasia fornicata (Roxb.) Schott	3.333	2.227	2.120	7.68
Colocassia esculenta L.	3.333	1.420	1.201	5.954
Pistia stratiotes L	-	-	-	-
Lemna perpusilla Torr.	**5***	6.238	3.959	**15.197****
Spirodela punctata (Meyer) Thom	3.333	2.599	2.474	8.406
S. polyrhiza L.Sch	-	-	-	-
Wolffia globosa Roxb.Griff	-	-	-	-
Sagittaria sagittifolia L,	**5***	4.084	2.587	11.671
Alisma plantago-aquatica L.	3.333	2.227	2.121	7.681
Najas minor Al.	**1.666***	2.599	2.474	6.739
Potamogeton crispus L.	-	-	-	-
P. nodosus Poir.	-	-	-	-
P. octandrus Poir.	-	-	-	-
Eriocaulon setaceum L.	-	-	-	-
Cyperus compressus L	3.333	5.012	1.908	10.253
C. iria L.	-	-	-	-
C. pilosus Vahl, Enum	-	-	-	-
C. rotundus L.	-	-	-	-
Eleocharis congesta D. Don.	-	-	-	-
Arundo donax L.	-	-	-	-
Eragrostis unioloides (Retz)Nees.	3.333	3.119	2.969	9.421
Hygroryza aristata Nees.	3.333	4.687	**4.454****	12.474
Isachne globosa (Thun.) Ktze.	-	-	-	-
Leersia hexandra Swartz	-	-	-	-
Oryza rufipogon Griffith, Notul	-	-	-	-
Pseudoraphis brunoniana Griffith	-	-	-	-
Phragmites karka (Retz.) Trin	-	-	-	-
Setaria glauca Beauv	3.333	2.970	2.828	9.131

Saccharum spontaneum L.	-	-	-	-
Equisetum diffusum D. Don.	-	-	-	-
Marsilea quadrifolia L.	**1.666**	1.485	2.828	5.979
Azolla pinnata R.Br	3.333	2.970	2.828	9.131
Salvinia natans (L) All.	3.333	2.970	2.828	9.131

4.3.5 SITE - 5 (Table 5.6)

In this sampling Station 47 species of macrophytes are recorded. In this site the RF value is found as 1.190% to 3.571%. The RD value is obtained at 0.202% to 6.556%. The RA value is noted as 0.775% to 5.782%. The total IVI value is found 2.871% to 14.718% (Table 5.6). The highest RF values 3.571% have been found for *Euryale ferox, Ludwigia adscendens, L. parviflora, Ipomoea aquatica, Hygoryza aristata.* The lowest RF value is found in 15 species viz. *Nelumbo nucifera , Oxalis corniculata , Trapa natans, Centela asiatica, Heliotropium indicum, Bacopa monnieri, Utricularia steiiaris, Alternanthera sessilis, Polygonum barbatum, P. hydropiper, Rumex nepalensis, Ceratophylum tuberculatum, Commelina benghalensis, Cyperus compressus, Saccharum spontaneum.* The highest RD value is found in *Azolla pinnata* and lowest value is found in *Bacopa monnieri.* The highest RA value is found in *Azolla pinnata* and the lowest value has been obtained in *Alisma plantago-aquatica.* The highest IVI value is found in *Azolla pinnata* and the lowest values are found in *Polygonum barbatum, Ceratophylum tuberculatum and Cyperus compressus* (Table 5.6). In the Site-5 the fluctuation trend of the families are Poaceae> Hydrocharitaceae>Nymphaceae, Onagraceae, Polygonace>Apiaceae, Convolvulaceae Lentibularaceae, Amaranthaceae, Ceratophyllacea, Pontederiaecae, Commelinaceae, Lamnaceae, Alismataceae>Nelumbonaceae, Oxalidaceae, Trapaceae, Asteraceae, Boraginaceae, Scrophulariaceae, Cyperaceae, Masiliaceae, Azolaceae, Salviniaceae.

Table 5.6: – Importance Value Index (IVI) of macrophytes during the year 2014 – 16 of the study site –5 (RF = Relative Frequency, RD = Relative Density, RA = Relative Abundance)
(* indicates the lowest value and ** indicates the highest value)

Name of species	RF	RD	RA	IVI
Euryale ferox Salish	**3.571****	3.987	2.336	9.894
Nymphaea pubescens Willd.	-	-	-	-
N. nouchali Burm f	2.380	2.838	2.503	7.271
N. rubra Roxb. ex. Salisb,	2.380	1.892	1.669	5.941
Nelumbo nucifera Gaetrn.	**1.190***	1.216	2.146	4.552
Oxalis corniculata L.	**1.190***	2.703	4.769	8.662
Myriophyllum tetrandrum Roxb.	-	-	-	-
M. tuberculatum Roxb.	-	-	-	-
Ludwigia adscendens (L.) Hara.	**3.571****	1.960	1.144	6.675
L. parviflora Roxb.	**3.571****	2.500	1.466	7.537
L. perennis L.	-	-	-	-
Jussiea repens L.	2.380	3.514	3.100	8.994
Trapa natans L.	**1.190***	2.095	3.696	6.981
Centela asiatica L.	**1.190***	1.960	3.457	6.607
Oenanthe javanica (Bl.) DC	2.380	1.013	0.894	4.287
Enhydra fluctuans DC.	2.380	2.027	1.788	6.195
Grangea maderaspatana (L) Poir.	2.380	2.500	2.205	7.085
Nymphoides hydrophyllum Lour.	-	-	-	-
N. indica (L.) Kuntze	-	-	-	-
N. parvifolium Kuntze.	-	-	-	-
Heliotropium indicum (L) DC.	**1.190***	1.554	2.742	5.486
Ipomoea aquatica Forssk.	**3.571**	2.568	1.502	7.641
I. carnea Jacq.	2.380	2.703	2.384	7.467
I. obscura (L) Gawl.	-	-	-	-
Bacopa monnieri (L.) Pennel	**1.190***	**0.202***	2.146	3.538
Limnophila indica (L.) Druce	-	-	-	-
L. heterophylla (Roxb.) Benth.	-	-	-	-
Utricularia scandens Benj.	2.380	1.419	1.251	5.05
U. stellaris L.f.	**1.190***	1.729	2.742	5.661
Alternanthera philoxeroides L.	2.380	1.824	1.609	5.813
A. sessilis L.	**1.190***	1.486	2.623	5.299
Polygonum barbatum L.	**1.190***	0.608	1.073	**2.871***
P. hydropiper L.	**1.190***	1.216	2.146	4.552
P. orientale L.	-	-	-	-
Rumex nepalensis Spreng.	**1.190***	1.554	2.742	5.486
Podostemun subulatum Gardn.	-	-	-	-

Ceratophyllum demersum L.	2.380	2.027	1.788	6.195
C. tuberculatum Cham.	**1.190***	0.608	1.073	**2.871***
Hydrilla verticillata (Lf.) Royle	2.380	2.703	2.384	7.467
Hydrocharis dubia (Bl) Baker.	-	-	-	-
Blyxa aubertii Rich.	2.380	1.081	0.953	4.414
B. echinosperma (Clarke) Hook	2.380	0.946	0.834	4.16
Ottelia alismoides (L.) Pers.	-	-	-	-
Vallisneria spiralis L.	2.380	2.568	2.146	7.094
Eichhornia crassipes Solms.	2.380	4.663	4.113	11.156
Monochoria hastata L.	2.380	1.824	1.609	5.813
Commelina benghalensis L.	**1.190***	0.811	1.430	3.431
Floscopa scandens Lour	2.380	1.824	1.609	5.813
Murdannia nudiflora L.	-	-	-	-
Alocasia fornicata (Roxb.) Schott	-	-	-	-
Colocassia esculenta L.	-	-	-	-
Pistia stratiotes L	-	-	-	-
Lemna perpusilla Torr.	2.380	4.224	3.636	10.24
Spirodela punctata (Meyer) Thom	-	-	-	-
S. polyrhiza L.Sch	-	-	-	-
Wolffia globosa Roxb.Griff	2.380	4.055	1.788	8.223
Sagittaria sagittifolia L,	2.380	2.433	2.146	6.959
Alisma plantago-aquatica L.	2.380	0.878	**0.775***	4.033
Najas minor Al.	-	-	-	-
Potamogeton crispus L.	-	-	-	-
P. nodosus Poir.	-	-	-	-
P. octandrus Poir.	-	-	-	-
Eriocaulon setaceum L.	-	-	-	-
Cyperus compressus L	**1.190***	0.608	1.073	2.871
C. iria L.	-	-	-	-
C. pilosus Vahl, Enum	-	-	-	-
C. rotundus L.	-	-	-	-
Eleocharis congesta D. Don.	-	-	-	-
Arundo donax L.	2.380	1.149	1.013	4.542
Eragrostis unioloides (Retz)Nees.	2.380	1.351	1.192	4.923
Hygroryza aristata Nees.	**3.571****	2.568	1.502	7.641
Isachne globosa (Thun.) Ktze.	-	-	-	-
Leersia hexandra Swartz	-	-	-	-
Oryza rufipogon Griffith, Notul	-	-	-	-
Pseudoraphis brunoniana Griffith	-	-	-	-
Phragmites karka (Retz.) Trin	-	-	-	-
Setaria glauca Beauv	2.380	1.824	1.609	5.813
Saccharum spontaneum L.	**1.190***	0.878	1.550	3.618

Equisetum diffusum D. Don.	-	-	-	-
Marsilea quadrifolia L.	2.380	3.447	3.040	8.867
Azolla pinnata R.Br	2.380	**6.556****	**5.782****	**14.718****
Salvinia natans (L) All.	2.380	3.176	2.801	8.357

The macrophytic abundance (based on IVI value) of families during the study period are showed the following trends:

Poaceae > Hydrocharitaceae > Polygonaceae > Lamnaceae > Nymphaceae > Convolvulaceae > Pontederiaceae > Onagraceae > Azolaceae > Lentibularace > Salviniaceae >Amaranthaceae > Araceae> Asteraceae> Commelinaceae> Cyperaceae> Alismataceae >Marsiliaceae > Apiaceae >Najadaceae >Ceratophyllaceae> Scrophulariaceae> Potamogetonaceae> Trapaceae> Oxalidaceae >Halograceae> Menyanthaceae>Nelumbonaceae> Podostemaceae> Erioculaceae> Boraginacea> Equisetaceae (Table.5.7 and 5.8).

Table 5.7: – Importance Value Index (IVI) of aquatic macrophytic species during the year 2014 – 16.

S. No.	Name of species	Family	Importance Value Index (IVI)
	Dicotyledons (Angiosperms)		
1	*Euryale ferox* Salish	Nymphaeaceae	7.24±3.64
2	*Nymphaea pubescens* Willd.	-do-	1.53±2.08
3	*N. nouchali* Burm f	-do-	4.72±1.58
4	*N. rubra* Roxb. ex. Salisb,	-do-	4.0±1.48
5	*Nelumbo nucifera* Gaetrn.	Nelumbonaceae	4.0±1.22
6	*Oxalis corniculata* L.	Oxalidaceae	5.92±3.40
7	*Myriophyllum tetrandrum* Roxb.	Haloragaceae	2.3±2.17
8	*M. tuberculatum* Roxb.	-do-	2.68±2.80
9	*Ludwigia adscendens* (L.) Hara.	Onagraceae	4.64±1.55
10	*L. parviflora* Roxb.	-do-	4.28±2.48
11	*L. perennis* L.	-do-	0.76±1.69
12	*Jussiea repens* L.	-do-	5.74±4.05
13	*Trapa natans* L.	Trapaceae	6.96±1.13
14	*Centela asiatica* L.	Apiaceae	7.96±3.42
15	*Oenanthe javanica* (Bl.) DC	-do-	2.28±1.56

16	*Enhydra fluctuans* DC.	Asteraceae	5.46±1.32
17	*Grangea maderaspatana* (L) Poir.	-do-	4.02±1.83
18	*Nymphoides hydrophyllum* Lour.	Menyanthaceae	1.16±1.35
19	*N. indica* (L.) Kuntze	-do-	1.1±1.50
20	*N. parvifolium* Kuntze.	-do-	2.1±2.4
21	*Heliotropium indicum* (L) DC.	Boraginaceae	2.3±2.34
22	*Ipomoea aquatica* Forssk.	Convolvulaceae	10.68±3.14
23	*I carnea* Jacq.	-do-	5.04±2.90
24	*I. obscura* (L) Gawl.	-do-	1.56±2.38
25	*Bacopa monnieri* (L.) Pennel	Scrophulariaceae	5.98±3.29
26	*Limnophila indica* (L.) Druce	-do-	0.78±1.74
27	*L. heterophylla* (Roxb.) Benth.	-do-	1.42±3.17
28	*Utricularia scandens* Benj.	Lentibularaceae	6.64±6.41
29	*U. stellaris* L.f.	-do-	6.9±4.62
30	*Alternanthera philoxeroides* L.	Amaranthaceae	4.96±3.62
31	*A. sessilis* L.	-do-	7.32±3.31
32	*Polygonum barbatum* L.	Polygonaceae	6.9±2.84
33	*P. hydropiper* L.	-do-	7.38±1.65
34	*P. orientale* L.	-do-	3.18±3.14
35	*Rumex nepalensis* Spreng.	-do-	6.98±3.08
36	*Podostemun subulatum* Gardn.	Podostemaceae	3±2.79
37	*Ceratophyllum demersum* L.	Ceratophyllaceae	4.66±2.85
38	*C. tuberculatum* Cham.	-do-	3.74±2.58
	Monocotyledons (Angiosperms)		
39	*Hydrilla verticillata (Lf.) Royle*	Hydrocharitaceae	7.98±1.78
40	*Hydrocharis dubia (Bl) Baker.*	-do-	1.5±2.18
41	*Blyxa aubertii Rich.*	-do-	3.9±1.14
42	*B. echinosperma (Clarke) Hook*	-do-	3.66±2.18
43	*Ottelia alismoides (L.) Pers.*	-do-	3.92±2.81
44	*Vallisneria spiralis* L.	-do-	6.6±1.28
45	*Eichhornia crassipes* Solms.	Pontederiaecae	10.8±1.31
46	*Monochoria hastata* L.	-do-	5.9±1.60
47	*Commelina benghalensis* L.	Commelinaceae	4±3.30
48	*Floscopa scandens* Lour	-do-	5.1±3.18
49	*Murdannia nudiflora* L.	-do-	1.58±1.51
50	*Alocasia fornicata* (Roxb.) Schott	Araceae	3.12±2.87
51	*Colocassia esculenta* L.	-do-	2.87±2.74
52	*Pistia stratiotes* L	-do-	5.42±5.50

53	*Lemna perpusilla* Torr.	Lamnaceae	10.02±3.12
54	*Spirodela punctata* (Meyer) Thom	-do-	2.68±3.86
55	*S. polyrhiza* L.Sch	-do-	3.96±5.49
56	*Wolffia globosa* Roxb.Griff	-do-	5.86±5.63
57	*Sagittaria sagittifolia* L,	Alismataceae	7.16±2.88
58	*Alisma plantago-aquatica* L.	-do-	3.44±2.84
59	*Najas minor* Al.	Najadaceae	2.95±8.72
60	*Potamogeton crispus* L.	Potamogetonaceae	2.68±2.52
61	*P. nodosus* Poir.	-do-	2.9±2.8
62	*P. octandrus* Poir.	-do-	1.9±2.61
63	*Eriocaulon setaceum* L.	Eriocaulaceae	2.94±4.02
64	*Cyperus compressus* L	Cyperaceae	4.8±3.85
65	*C. iria* L.	-do-	1.5±2.07
66	*C. pilosus* Vahl, Enum	-do-	1.2±2.68
67	*C. rotundus* L.	-do-	2.3±2.11
68	*Eleocharis congesta* D. Don.	-do-	0.84±1.87
69	*Arundo donax* L.	Poaceae	3.36±1.92
70	*Eragrostis unioloides* (Retz)Nees.	-do-	4.18±3.43
71	*Hygroryza aristata* Nees.	-do-	8.98±2.57
72	*Isachne globosa* (Thun.) Ktze.	-do-	0.98±1.37
73	*Leersia hexandra* Swartz	-do-	1.46±2.03
74	*Oryza rufipogon* Griffith, Notul	-do-	1.96±2.79
75	*Pseudoraphis brunoniana* Griffith	-do-	0.92±2.05
76	*Phragmites karka* (Retz.) Trin	-do-	0.54±1.20
77	*Setaria glauca* Beauv	-do-	6.54±1.65
78	*Saccharum spontaneum* L.	-do-	1.7±2.37
	Pteridophytes		
79	*Equisetum diffusum* D. Don.	Equisetaceae	0.98±1.35
80	*Marsilea quadrifolia* L.	Marsiliaceae	9.08±2.72
81	*Azolla pinnata* R.Br	Azolaceae	13.78±5.63
82	*Salvinia natans* (L) All.	Salviniaceae	12.76±4.83

Table 5.8: - List of families with number of genera, species and their total IVI value

S. No.	Name of families	Nos. of genus	Nos. of species	Total IVI Value
	Dicotyledons (Angiosperms)			
1	Nymphaceae	2	4	17.48
2	Nelumbonaceae	1	1	4.0
3	Oxalidaceae	1	1	5.92
4	Haloragaceae	1	2	4.98
5	Onagraceae	2	4	15.42
6	Trapaceae	1	1	6.96
8	Apiaceae	2	2	10.24
9	Asteraceae	2	2	9.48
10	Menyanthaceae	1	3	4.36
11	Boraginaceae	1	1	2.3
12	Convolvulaceae	1	3	17.28
13	Scrophulariaceae	2	3	8.18
14	Lentibulariaceae	1	2	13.54
15	Amaranthaceae	1	2	12.28
16	Polygonaceae	2	4	24.44
17	Podostemaceae	1	1	3.0
18	Ceratophyllaceae	1	2	8.4
	Monocotyledons (Angiosperms)			
19	Hydrocharitaceae	5	6	27.56
20	Pontederiaceae	2	2	16.7
21	Commelinaceae	3	3	10.68
22	Araceae	3	3	11.32
23	Lemnaceae	3	4	22.52
24	Alismataceae	2	2	10.6
25	Najadaceae	1	1	2.95
26	Potamogetonaceae	1	3	7.48
27	Eriocaulaceae	1	1	2.94
28	Cyperaceae	2	5	10.64
29	Poaceae	10	10	30.62
	Pteridophytes			
30	Equisetaceae	1	1	0.98
31	Marsiliaceae	1	1	9.08
32	Azolaceae	1	1	13.78
33	Salviniaceae	1	1	12.76
	Total	61	82	358.87

4.3.6 DIVERSITY INDICES OF MACROPHYTES

Analysis of diversity index shows that during the study period the Simpson index is in the range from 0.0208– 0.0261. The highest value is observed in S-3 and the lowest values are in the S-1 and S-2. The highest Dominance Index value is found in the S-1 and S-2 (0.9792) and the lowest value has been evaluated in S-3 (0.9739). Shannon index is recorded to be highest in S-1 (5.849) which is followed by S-2 (5.827), S- 4 (5.465), S-3 (5.414) and S-5 (5.402) respectively. The Berger-Parker dominance index is ranged from 0.0454 – 0.0529. The lowest value is observed in S-4 and the highest value has been observed at S-1. The present study indicate that the Margalef richness index has been highest in S -1 (5.778) during the study period. This value is followed by S-2 (5.348), S-3 (3.995), S-4 (3.695) and S-5 (3.666) respectively (Table 5.9).

Table 5.9: - Diversity indices of macrophytes during the study period in different sites of the Beel

	S - 1	**S - 2**	**S - 3**	**S - 4**	**S - 5**
No. of species	75	70	51	48	47
Simpson Index	0.0208	0.0208	0.0261	0.0242	0.0254
Dominance Index	0.9792	0.9792	0.9739	0.9758	0.9746
Shannon Index	5.849	5.827	5.414	5.465	5.402
Berger-Parker dominance Index	0.0529	0.0475	0.049	0.0454	0.0523
Margalef Richness Index	5.778	5.348	3.995	3.695	3.666

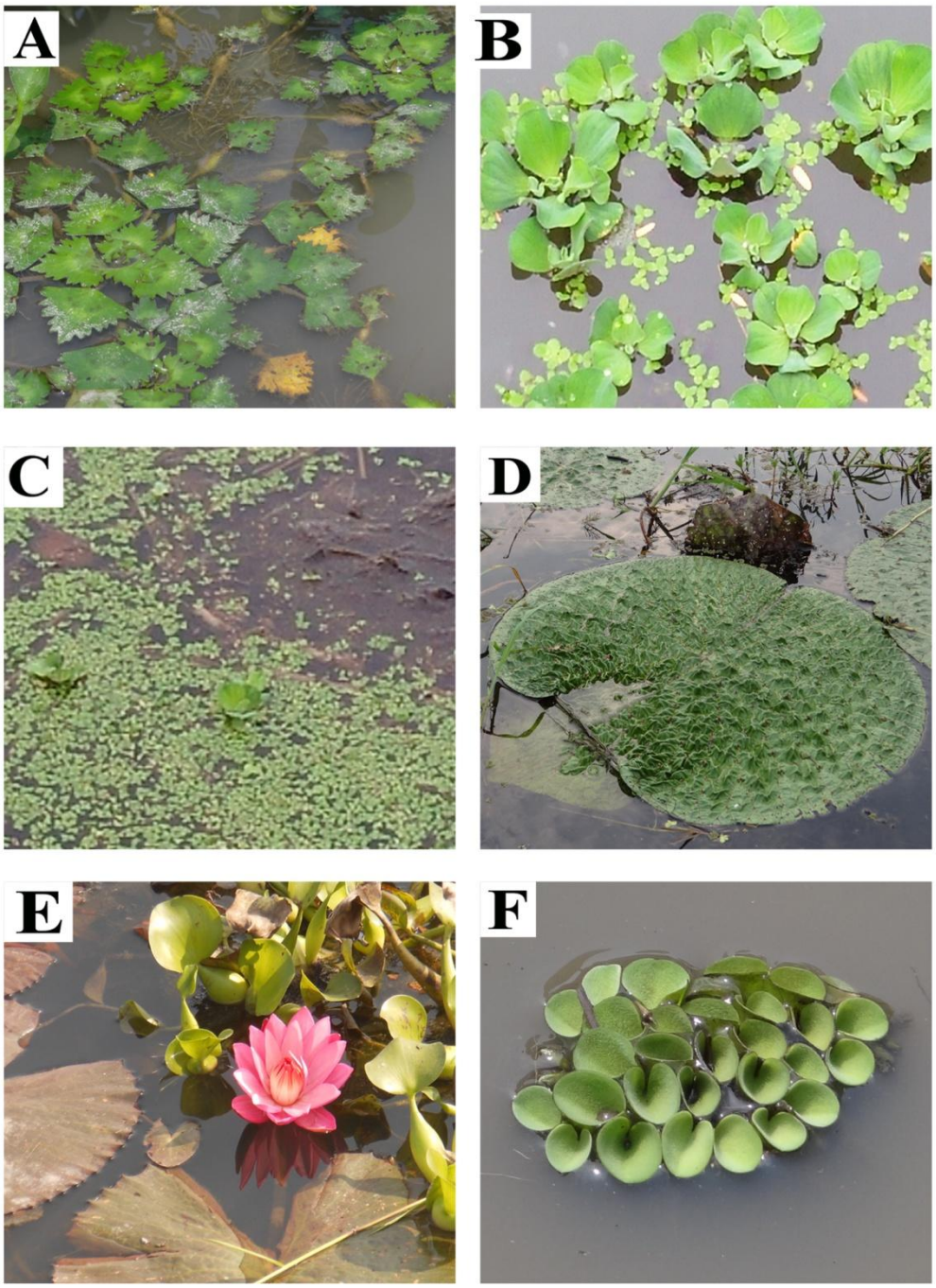
Table 5.10: - Similarity Index of macrophytes among the different sites of the beel during the study period

	S - 1	S - 2	S - 3	S - 4	S - 5
S-1	0	0.868	0.381	0.390	0.352
S-2		0	0.372	0.364	0.367
S-3			0	0.363	0.428
S-4				0	0.410
S-5					0

4.3.7 Similarity Index of Macrophytes

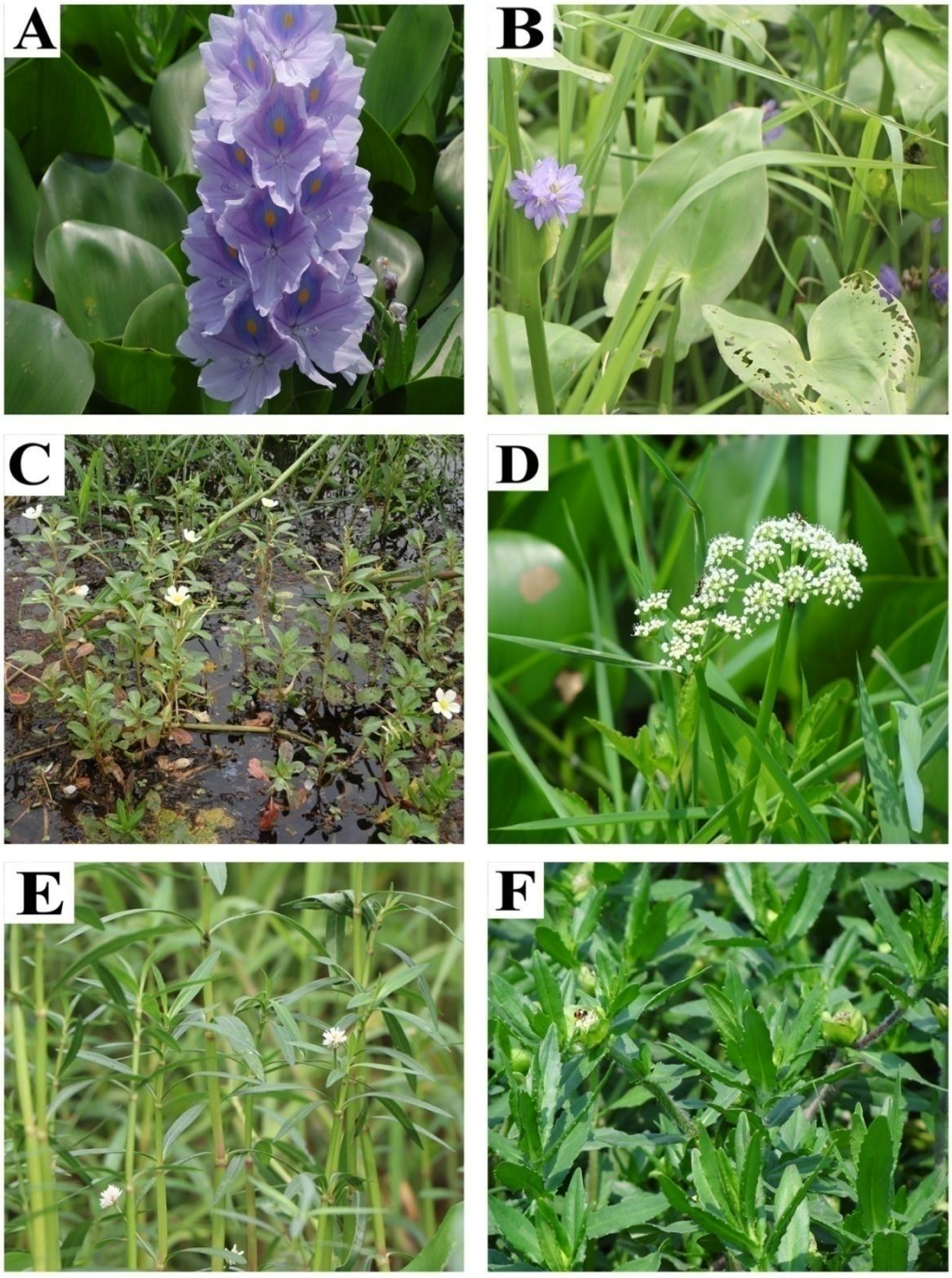
During the study period S-1 and S-2 shows the maximum similarity index (0.868) among the plant communities of the beel. The lowest similarity index value has been observed between S-1and S-5 (0.352). In this investigation highest similarity index indicates the availability of maximum number of similar species in S-1 and S -2 and lowest similarity index shows the harbouring of less similar species in S-1 and S-5 (Table 5.10).

PHOTO PLATE - 13



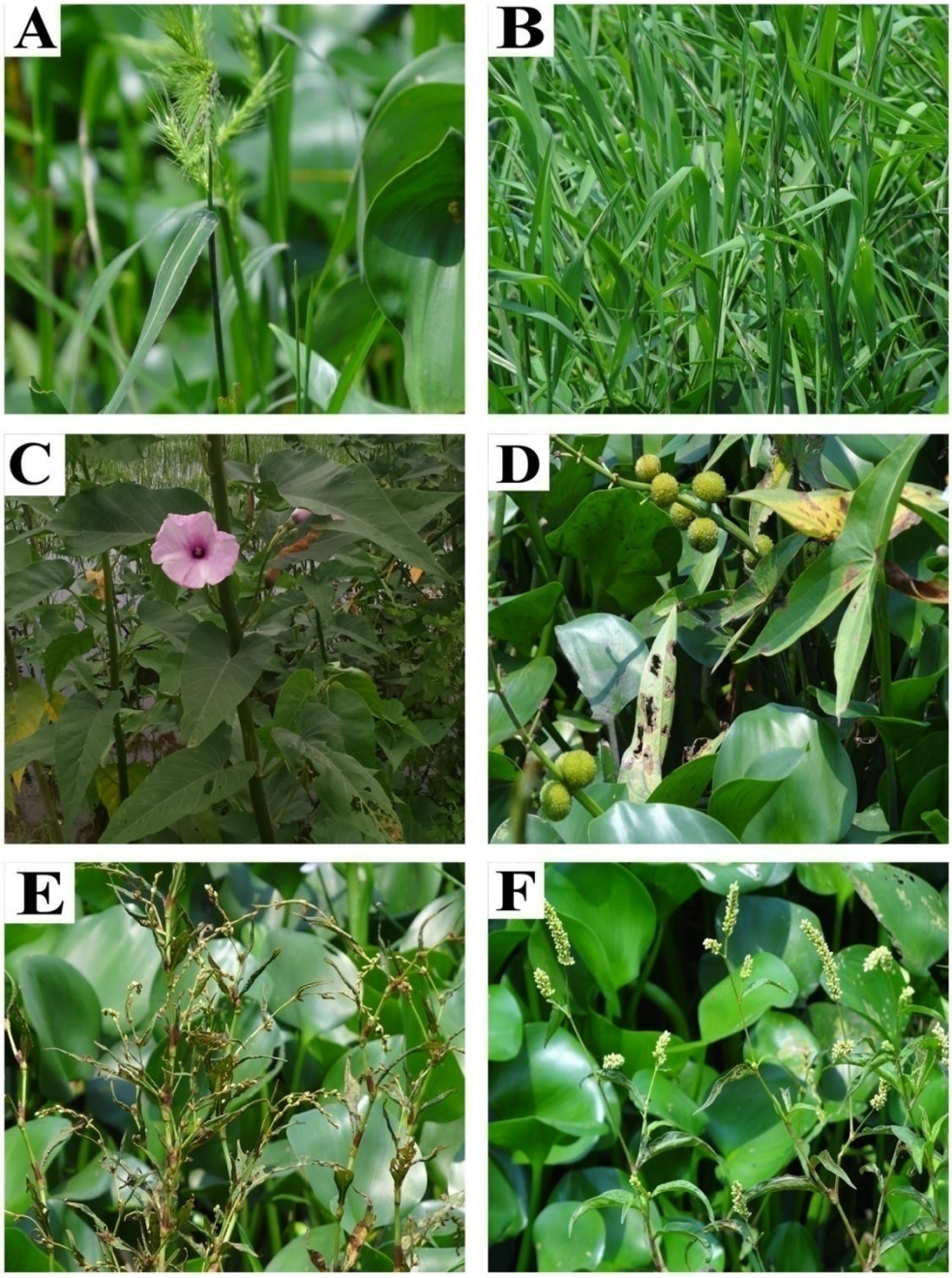
A-*Trapa natans,* B- *Pistia staratiotes*, C- *Lemna perpusilla*,
D- *Euryale ferox*, E- *Nymphaea rubra*, F- *Salvinia natans*

PHOTO PLATE - 14



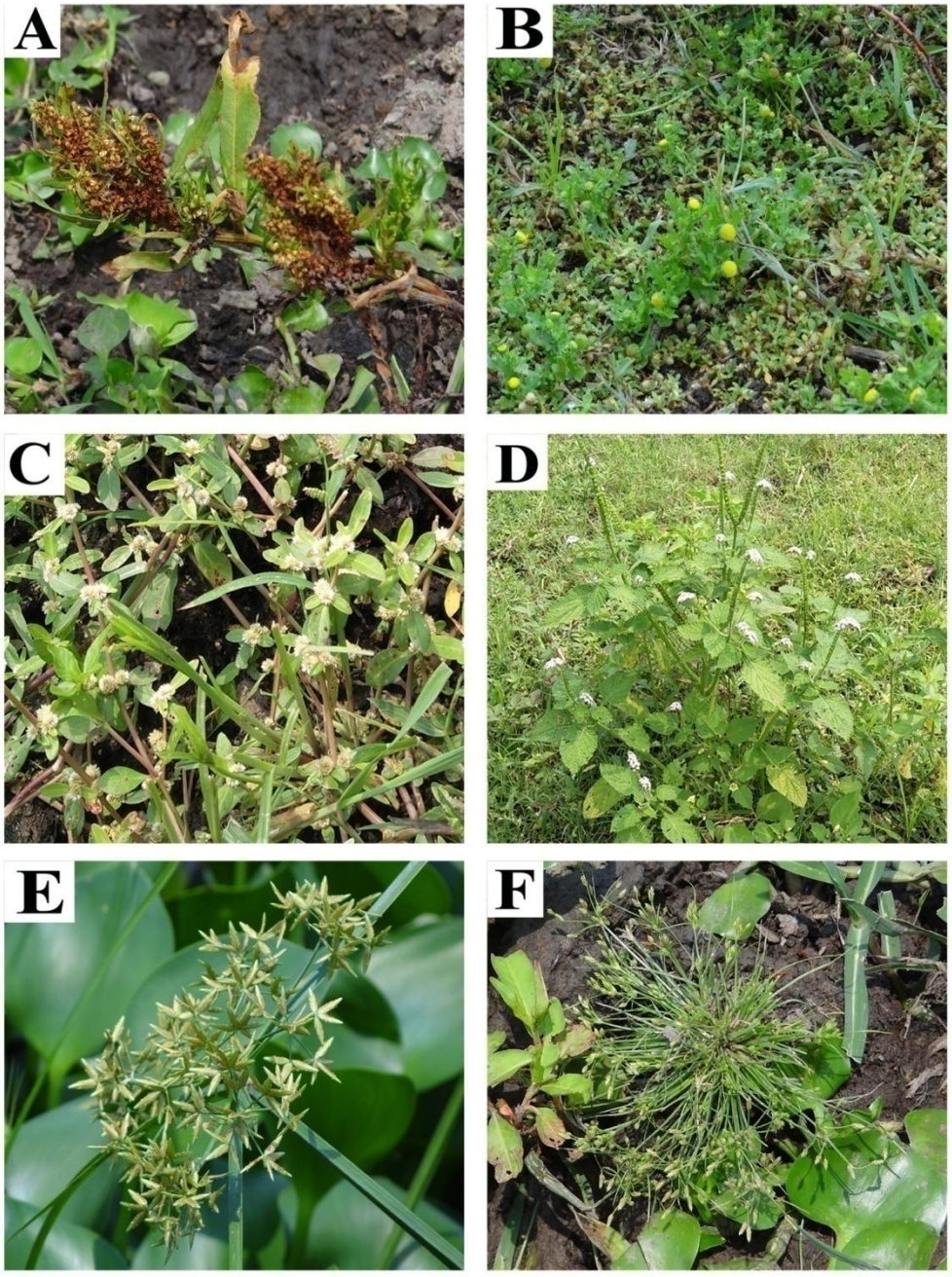
A- *Eichhornia crassipes,* **B-** *Monocharia hastata,*
C- *Ludwigia adscandans,* **D-** *Oenathe javanica,*
E- *Alternanthera philoxeroides,* **D-** *Enhydra fluctuans*

PHOTO PLATE - 15



A- *Setaria gluca*, **B-** *Hygroryza aristata*, **C-** *Ipomoea carnea*, **D-** *Sagittaria sagittifolia*, **E-** *Polygonum hydropiper*, **F-** *P. barbata*

PHOTO PLATE - 16



A- *Rumex nepalensis,* **B-** *Grangea maderaspatana,*
C- *Alternanthera sessilis,* **D-** *Heliotropium indicum,*
E- *Cyperus compressus,* **F**- *Cyperus rotundus*