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Studies on Physico-Chemical Parameters in Relation to Zooplankton Diversity of Bonal Wetland

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ABSTRACT

The present communication deal with the study of physico-chemical parameters and zooplankton diversity and its seasonal variation in Bonal wetland was conducted to check the status in the area and provide new insights into its ecology. The study was carried out during the period from October 1999 to September 2001. Various parameters such as temperature, total dissolved solids (TDS), pH, alkalinity, electrical conductivity, total hardness, calcium, magnesium, dissolved oxygen (DO) and biochemical oxygen demand (BOD). The analytical data of various physico-chemical values of all water samples are found below the prescribed limit Phosphate, Nitrate, Chloride. A total of 23 species were found in this reservoir. Among these, rotifers comprise of 20 species (58%), Cladocera 8 (23%), Copepods 6 (10%) and Ostracoda 5 (9%).

Keywords Bonal wetland, Physico-chemical parameters, Zooplankton, Kalaburagi.

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INTRODUCTION

The quality of surface water is a very sensitive issue and it is a great environmental concern worldwide. It is critical for long-term economic development, social welfare, and environmental sustainability. Distribution of fresh water resources is uneven throughout the world and the fresh water availability is becoming scarce day by day owing to population growth and diverse human activities Annapurna and Janardhan (2015). India is a tropical county with a vast diversity of climate, topography and vegetation. Though blessed with fairly high annual rainfall, it is not uniformly distributed in time and space resulting in bulk of the rainfall escaping as runoff Sarala and Ravi (2010). Safe and affordable water is essential for public health. It is used for drinking, food production, domestic use and recreational purposes. Access to improved water supplies and sanitation, along with better management of water resources, plays a crucial role in developing countries by impacting on communities' well-being and on national development plans (Wedgworth and Brown 2013, Nagar et al. 2015).However, access to safe drinking water is limited by global warming, rapid human population growth, inappropriate waste and wastewater managementhousing styles, and geographical location.

The pollution of drinking water sources is gradually increasing, due to limited financial capabilities and poor infrastructure, which force communities to directly consume water from farm wells, springs, and rainwater stores without prior treatment (Bempah and Ewusi 2016, Sahoo and Patra 2018).

On the global scale, wetlands maintain air, water equality including nitrogen, sulfur, methane and carbon dioxide cycles. They have been found to cleanse polluted water, prevent floods, protect shoreline and recharge groundwater. Further more wetlands play major role in the landscape by providing unique habitat for a wide variety of flora and fauna. These wetlands are of direct and immediate importance to millions of people who subject them to multiple uses from gathering food to disposal of wastes, the form of resource utillization in each case remaining in consonsnce or otherwise with environmental considerations.

This main objective of current study to observe water quality in relation to zooplankton diversity of Bonal wetland in different weather conditions. Regular water quality assessment would help water resource managers, environmental health officers, and the whole community to better understand and correlate seasonal varability and drinking water quality.

Study area

Bonal wetland is located between Bonal, Pet Ammapur and Hal Ammapur (Shorapur taluk, Gulbarga district and 110 km away from Gulbarga University campus. Falls under 77^0 45´ E longitude and $16^0$33´ latitude.Which has natural hillocks that forms a natural wall. The total catchment area of the reservoir is 40.96 sq miles and maximum depth 12 ft and minimum 4 ft.

MATERIALS AND METHODS

Water sample were collected on a monthly basis from

Table 1. Monthly variations of physico-chemical parameters of Bonal wetland.

Months	At. Temp.	Water Temp.	Turbidity (NTU)	Electrical conductivity	TDS	pH	DO	CO_2	TA	Total hardness	Ca	Mg	Cl_2	Ammonical nitrogen	PO_4	BOD
Oct 1999	32.2	28.9	105	407	313	7.6	6.4	48	119	123	85	38	73	0.22	0.91	22.3
Nov	28.7	27.5	93	428	389	7.8	5.5	53	155	133	99	34	71	0.25	1.16	24.1
Dec	30.2	25.4	92	409	286	7.9	6.1	50	176	128	86	39	71	0.28	1.23	22.6
Jan 2000	31.1	25.8	100	425	259	7.1	6.9	77	211	138	111	26	75	0.27	0.91	14.3
Feb	34.6	29.8	61	446	105	7.8	8.4	81	229	56	31	24	90	0.04	0.45	4.8
Mar	38.7	32.4	61	447	116	8.1	8.5	90	232	66	37	29	119	0.05	0.34	5.2
Apr	39.9	34.7	64	482	91	8.5	9.2	97	244	62	41	21	127	0.04	0.28	5.3
May	40.4	34.9	70	541	90	8.1	8.9	95	243	84	44	39	121	0.04	0.19	4.8
Jun	37.4	32.3	114	564	647	6.9	3.7	109	137	139	86	47	62	0.12	0.24	10.2
Jul	34.3	30.7	124	608	646	7.1	3.4	108	107	155	87	48	68	0.15	0.33	14.2
Aug	33.8	28.3	123	388	509	6.9	4.0	98	100	130	74	55	64	0.11	0.36	18.2
Sep	33.2	27.7	122	402	343	7.1	3.6	93	89	126	86	40	62	0.17	0.48	20.4
Oct	33.4	26.5	120	401	377	7.8	6.5	59	124	132	89	43	75	0.25	1.11	23.6
Nov	34.5	27.1	102	436	349	7.7	6.1	62	155	136	84	51	73	0.27	1.26	24.5
Dec	30.9	25.1	102	415	348	8.1	6.2	59	185	140	110	28	73	0.23	1.57	32.3
Jan 2001	31.7	26.2	103	434	336	7.4	6.9	87	209	128	102	31	73	0.24	0.92	18.3
Feb	34.2	29.7	91	461	103	7.8	8.1	82	233	64	43	21	143	0.10	0.54	5.3
Mar	37.2	32.4	91	445	125	7.9	8.6	98	248	63	44	15	117	0.05	0.46	5.8
Apr	39.6	34.2	90	489	101	8.6	8.9	113	272	69	46	21	136	0.06	0.44	7.4
May	40.7	34.7	87	568	96	8.2	9.1	99	266	89	60	29	138	0.03	0.45	5.1
Jun	37.1	32.9	123	556	583	7.1	4.0	109	153	133	85	48	58	0.14	0.23	10.1
Jul	34.4	30.1	119	616	591	7.2	4.4	115	117	138	85	52	64	0.13	0.30	13.8
Aug	34.4	28.4	123	389	429	6.9	4.6	105	114	113	77	39	56	0.13	0.32	17.9
Sep	33.2	27.7	129	401	305	7.1	3.7	93	108	125	94	31	58	0.17	0.38	20.0

October1999 to September 2001. Surface water samples were colected using a clean plastic container for the study of various physiology-chemical parameters. Water samples were collected from sevenselected stations in the Bonal reservoir. All samples collection and observations were made between 09.00 to 12.00 hr throughout the study period. The atmospheric and water temperature pH and free CO_2 were measured

Table 2. Monthly fluctuations of zooplankton of Bonal weand (No. org/liter).

Species	Oct 2017	Nov	Dec	Jan 2018	Feb	Mar	April	May	Jun	Jul	Aug	Sep
Brachionus angularis	40	50	60	65	80	93	43	45	18	2	4	30
B.caudatus	20	32	28	30	32	40	42	18	2	2	-	6
B.calciflorus	130	236	180	224	230	294	40	60	10	12	-	34
B. falcatus	92	158	182	198	180	20	110	32	10	-	20	20
B. bidentis	28	710	802	400	600	402	300	120	22	-	-	-
B.patulus	140	240	170	210	202	264	38	52	8	10	-	38
B. quadridenatus	112	160	180	192	208	302	218	128	21	-	-	-
Keratalla tropica	32	180	180	300	704	428	280	160	12	-	-	-
K. cochleasis	120	120-	180	301	320	120	180	-	-	-	18	10
Macrochaetus sericus	10	8	20	38	42	60	88	40	-	-	-	-
Lapdelle bicornis	2	2	6	10	12	20	18	12	-	-	-	2
L. ovaliss	8	10	16	12	18	16	22	12	-	6	-	2
Lacane, bulla	6	8	19	11	22	24	28	10	-	-	6	2
L. hemita	12	16	12	18	52	60	44	19	10	2	-	16
L. luna	9	12	16	22	36	42	30	20	8	-	-	12
Cephalodlla gibba	26	28	46	32	60	110	130	80	-	-	16	16
Asplanchan pilina	62	76	82	10	10	13	-	-	-	-	-	2
Felina longiseta	12	8	16	12	40	48	50	14	-	-	2	2
Rotatoria neptuniar	6	6	13	18	32	53	68	19	-	-	-	-
Testidunella	3	2	6	8	10	14	19	2	-	-	-	-
Cladocera												
Diaphanosoma sarst	760	302	98	52	50	-	-	-	14	420	560	840
D.excisum	290	92	102	38	62	-	-	-	180	360	512	518
Moina, brachiata	60	-	12	18	22	-	-	-	110	-	-	-
M. rectirostris	30	-	10	32	-	-	-	42	-	-	28	52
M.rectirostris	-	-	28	-	-	-		-	-	40	-	50
*Macrothris laticorni*s	420	328	92	62	48	-	-	-	15	432	572	760
Basnia sp.	190	68	62	42	-	-	-	-	-	368	480	520
Euryalona orientalis	-	18	-	-	-	-	-	-		-	12	12
Copepoda												
Mesocyclops leukarii	-	-	120	140	52	34	20	-	-	-	-	-
M. hylalinus	-	-	210	46	190	562	140	30	50	-	-	-
Phyllodiaptomus anne	-	-	292	48	100	140	80	40	20	-	-	-
Paracyclops funbriatus	-	-	98	172	480	300	260	120	80	110	110	
							170					
Heliodiaptomus vidus	-	-	120	142	68	38	34	40	-	-	-	-
Rhinediaptomus indicus	4	3	10	14	18	26		12	-	-	-	-
Ostracoda												
Stenocypris	-	-	28	120	462	162	131	78	28	52	59	-
Heterocypris	-	-	22	136	382	182	156	54	34	68	60	-
Chrissa halyi	-	-	158	62	160	320	121	28	42	-	-	-
C.humulis	40	8	-	-	-	-	-	-	-	-	22	-
C.subglobosa	-	-	32	122	422	180	142	68	32	58	59	-

Table 2. Continued.

Species	Oct	Nov	Dec	Jan 2019	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Avg
Brachionus argularis	40	48	68	65	76	87	95	113	16	4	5	28	47.9
B.caudatus	18	16	22	29	34	38	40	38	-	-	-	2	19.9
B. calciflorus	236	180	170	200	230	429	40	42	12	-	12	38	1274
B. calciflarus	80	167	194	200	100	290	92	-	-	-	-	12	97.4
B. falcatus	20	692	502	150	429	810	315	70	-	-	-	20	266.3
B. patulus	226	170	162	180	210	328	29	15	2	-	26	6	113.5
B. quadridenatus	-	18	230	400	160	515	480	48	-	-	-	98	144.5
Keratalla tropica	28	162	188	200	407	904	318	98	-	-	78	128	200.1
K. cochleasis	18	136	626	180	409	918	320	72	-	-	-	122	173.6
Macrochaetus sericus	8	12	18	42	52	56	40	20	-	-	-	6	22.0
Lapdelle bicornis	2	3	8	12	16	18	22	10	-	-	-	1	6.9
L. ovalis	4	8	18	10	12	18	24	19	-	-	6	2	9.1
Lacane, bulla	2	4	10	12	16	18	28	9	-	-	-	2	10.1
L.hemita	18	19	22	61	72	40	20	8	4	-	-	12	53.2
L. luna	10	14	18	24	32	40	26	19	6	-	10	10	21.7
Cephalodlla gibba	32	42	54	65	125	140	152	92	-	-	-	12	53.2
Asplanchan pillina	58	69	96	10	12	16	-	-	-	-	2	6	21.7
Felina longiseta	10	12	18	10	52	68	48	10	-	-	4	2	18.2
Rotatoria neptutiar	2	4	8	28	40	62	71	40	-	-	-	7	20
Testidunella	2	4	8	12	16	22	16	6	-	-	-	2	6.3
Cladocera													
Diaphnanosoma sarsi	281	70	82	40	48	-	-	-	66	432	580	740	226.4
D. escisum	292	60	92	44	52	-	-	-	98	600	650	790	203.4
Moina,brachiata	-	110	58	42	30	-	-	-	-	10	52	110	28.1
M. macrocopa	-	30	-	-	54	-	-	-	-	52	112	172	23.8
M.recturostris	-	-	32	-	-	-	-	-	-	38	-	48	9.8
Macrathrix laticornis	182	80	92	38	32	-	-	-	16	289	382	602	187.5
Bosnia sp.	182	60	79	38	49	-	-	-	35	264	382	614	143.9
Euryalona orientalis	-	20	-	-	32	-	-	-	-	50	162	112	18.5
Copepoda													
Mesocyclops leukarti	-	-	160	180	18	50	79	-	-	-	-	-	36.2
M. hylalinus		-	270	30	380	80	128	-	-	-	-	60	60.4
Phyllodiaptonus anine	-	-	328	30	202	312	312	108	-	-	-	18	84.5
Paracyclops funbriatus	-	-	80	160	366	478	510	100	40	30	70	65	1512
Heliodiaptonus vidus	-	-	89	152	52	32	58	32	-	-	-	-	43.1
Rhinediaptomus incicus	2	6	12	9	16	22	32	8	-	-	-	-	9.5
Ostracoda													
Stenocypris	-	-	38	120	280	152	118	62	20	38	42	-	82.9
Heterocypris	-	-	47	142	395	176	148	86	24	62	86	-	94.1
Chrissa halyi	-	-	148	98	-	-	-	-	-	12	128	10	53.6
C.humulia	12	-	-	-	-	-	-	-	-	2	190	68	14.2
C. subglobosa	-	-	49	130	380	160	120	52	18	52	56	-	88.8

in the field and samples collected for further physico-chemical analysis according to APHA (2005) and Trivedi and Goel (1986). The data of physico-chemical characteristics were subjected to correlation and linear regression osing IBM SPSS (√20.0).

RESULTS AND DISCUSSION

The annual and seasonal fluctuations and composition and percentage were depicted inTables 1-3. The percentage of zooplankton groups depicted in Figs 1-3.

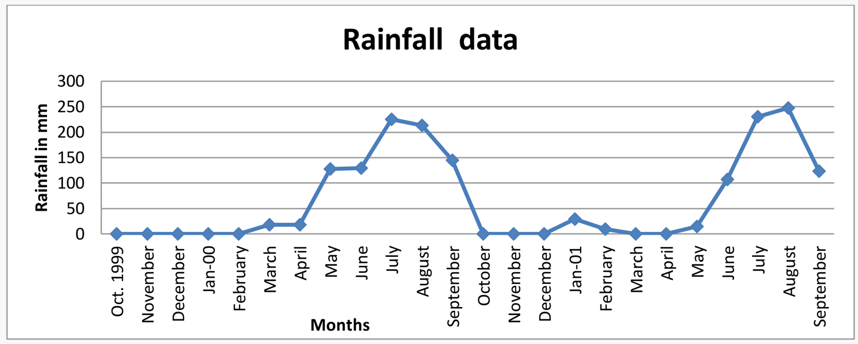

Fig. 1. Monthly fluctuations of rainfall of Shorapur from October 1999 to September 2001.

Shows that the rotifers have dominated among the zooplankton the rotifers represents 58%, Cladocera 23% , Copepoda 10% and Ostracoda 9%. The composition of Rotifera population showed distinct peak in the summer reason both 2000 and 2001. They varied between 843 to 2890 No. of Individual/lit and 721 & 4817 No. of Individual/lit and incidentally maximum peaks were observed in the month of Feb 2000 and March of 2001 respectively.

In the present investigations, 20 rotiferans species have been identified. *B. bidens* species were more abundant among all rotiferans. *B. calciferous* also showed a similar trend. Higher population of rotifer species were observed during summer season and NEM season while lower rotifers wee observed during SWM season. During SWM season was drastically low when compared to that of the other two seasons. This perhaps is due to the influence of copious quantity of rainwater, which gets drained into reservoir.

In the present investigations various species of cladocerans were found to belong to eight genera such as *Diaphanosoma sarsi, D. excisum, Moina brachiata, M. macrocopa, M. rectirostris, Macrithris laticornis, Bosnia* sps. and *Euryalona orientalis.* The two years observations were made during the present study revealed their presence during NEM season and SWM season while, their population was absent during summer months especially March, April and May of study period. Cladocera higher composition during SWM season followed by NEM season. While it was low during summer season.

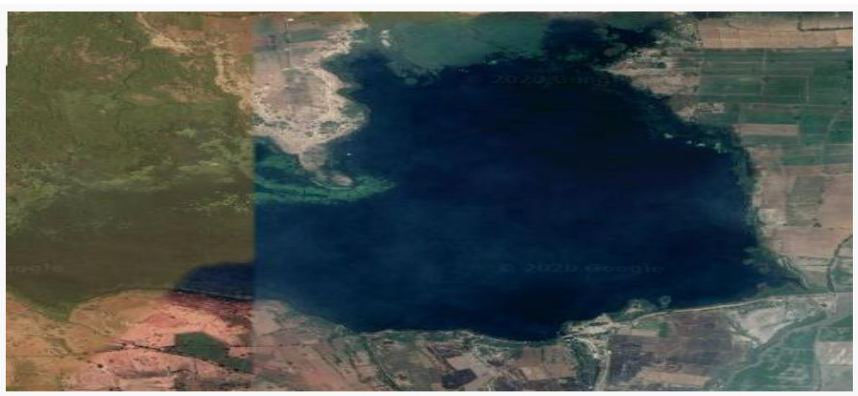

Fig. 2. Bonal wetland of Shorapur.

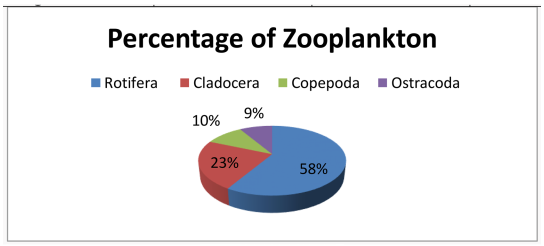

Fig. 3. Percentage of zooplankton.

In the present study, the population of this group exhibit distinct peaks during summer and northeast monsoon season especially during December and January months of study period . While during SWM seasons, Copepoda were absent during July to November. However *Paracyclops funbriatus* was observed all most all the seasons.

In thepresent investigation atmospheric and water temperature folowed more or less similar trend of oscillations. The higher air and water temperature was observed during summer season and NEM season. The atmospheric temperature and water temperature were almost similar trend was observed. Small peak was observed in the month of December exhibiting more or less bimodal seasonal oscillations. It was possibly due to the presence of cloudy weather. Temperature fluctuation in water are influenced considerably by meteorojogical factors such as air temperature, humidity, winds and solar radiations. Munawar (1070) reported a direct relationship between bright sunshine and air temperature. Hutchinson (1967) and Gamir (1958) have opined the same.

In the present investigations Turbidity of the Bonal wetl and varied considerable between stations and frpm season. It is noticed that the high Turbidity during NEM (91.15 to 108-91 NTU) and SWM season (113.4 to 126.9) NTU due to the rains that wash silt sand and allochthonous organic matter in the water bodies and decreased trend was noticed during summer season (60.0 to 70.0 NTU) Presently it is opined thatturbidity wascontributed mostly by particulate suspended matter rather than by the planktonic organisms which could have entry into reservoir th rough the inflowing water and sudden contribution of wind blown material as described by Welch (1952).

Present results showed a range of conductivity in surface water 400.6 to 440.0 µmhos/cm during NEM season of 1999-2000. The high conductivity values were observed during summer season and lower conductivity were noticed during NEM season. Maximum summer season may be due to evaporation of water which is in confirmation with theobservation of Verma et al (1984), Vijaykumar (1991).

The concentration of TDS having common effects in reducing light penetration there by suppressing primary producers in the form of algae and macrophytes. The will further effect the macro and micro invertebrates dependent directly or indirectly on plants for food. The invertebrates are therefore suppressed or even eliminated in severe condition. The hydrogen ion concentration was observed during summer seasons could be attributed to enhanced rate of evaporation coupled with human interference. Maximum pH in summer season has also been reported by Shastry et al. (1970), George (1976), Vijaykumar (1991). The relate high pH with photosynthetic activity and more conductivity for net production. Among the chemical substance in natural waters oxygen is possibly one of the primary important both as regulator of metabolic process of plant and animal community and as of water conditions. The dissolved oxygen of Bonal wetland on an average fluctuated between 4.9 to 7.1 mg/l. During summer season DO concentration was observed 8.1 to 9.4 in 2000 and 2001. The observations in the present work, the whole lead to understanding that perhaps, the levels of oxygen in lentic environments of smaller dimensions are not governed by single parameters individually but by combined influence of several parameters. Similar works done by Jaydev Naik and Majagi (2019), Anita et al. (2019). The free carbon dioxide was recorded in the surface waters throughout the period of investigation. The free carbon dioxide concentration was considerably more during SWM season.. Where as the free carbon dioxide concentration was declined in the NEM season and lower concentration was observed in all stations of Bonal wetland. During study period indicating iri-model oscillations in the Free carbon dioxide. The higher concentration of Free carbon dioxide during SWM season is possibly due

Table 3. Composition of zooplankton of Bonal wetland.

	Planktonic groups			
Months	Rotifera	Cladocera	Copepoda	Ostracoda
Oct 1999	870	1758	4	40
Nov	2062	808	3	8
Dec	2232	404	859	240
Jan 2000	211	244	556	440
Feb	2890	182	908	1426
Mar	2605	0	1100	844
Apr	1718	0	704	550
May	843	42	242	228
Jun	121	319	150	136
Jul	34	1620	110	178
Aug	66	2164	110	200
Sep	192	2772	0	0
Oct	814	937	2	12
Nov	1778	450	6	0
Dec	2440	435	939	282
Jan 2001	1890	202	561	490
Feb	2500	297	1054	1055
Mar	4817	0	1082	488
Apr	2177	0	1159	386
May	721	0	240	200
Jun	40	268	40	62
Jul	4	1735	30	166
Aug	144	2320	70	502
Sep	516	3206	143	78

to less photosynthetic activity. The total alkalinity is the result of carbonate and bicarbonate in water, In the present investigation, it could be observed that the total alkalinity if the Bonal wetland varied seasonally. The values tended to increase during NEM season and summer season with distinct peak in the month of April. While during SWM season low total alkalinity values recorded. This low values of total alkalinity may be due to influx of rain water. Hardness commonly is reported as an equalent concentration of calcium carbonate and consider water bodies with 0.75 mg/l as soft 75-150 mg/l moderately hard, 150-300 mg/l hard, 300 mg/l and above very hard.In the present investigations, the total hardness shows trimodel oscillation, higher values observed during NEM season while, lower values were observed during summer months. In the present study the Bonal wetland falls under moderately hard conditions. According to Barrett (1953) moderate hard water, is more productive than the soft water. Jana (1979) reported similar observations in total hardness and alkalinity. Arce and Boyd (1980) and Singh (1986) reported a highly significant positive correlation between hardness and alkalinity. Pendse et al. (2000) also reported a similar observation. Chloride plays a important role in determining the water quality in water bodies indicates the presence of high organic matter presumably of animal origin. Chloride boccurs in most freshwater as the salt of sodium or chloride. Chloride in reasonable concentrations are not harmfull to human as concentration above 250 mg/l they hive a salty taste to water, which is objectionable to many people. During the present study, the chloride concentration exhibited increasing trend from NEM season to summer season while less chloride content was observed during the SWM season in the Bonal reservoir. Gonzalves and Joshi (1946), Singh (1960) and Vijaykumar (1991) reported similar observations in their studies. Precipitation and evaporation are the main factors governing the fluctuations of chlorinity. Former leads to dilution and low levels of chloride

Table 4. Statistical analysis different parameters of Bonal wetland.

Parameter	Positively correlated ($p<0.01$)
Atmospheric temperature	Water temperature, Electrical conductivity, Total alkalinity, Chloride
Water temperature	Electrical conductivity, Free CO_2, Chloride
Turbidity	TDS, Total hardness, Calcium Magnesium, BOD, Chloride
Electrical conductivity	Atmospheric temperature, Water temperature, CO_2
TDS	Turbidity, Total hardness, Calcium,Magnesium hardness
pH	DO, Total alkalinity, Chloride, Rotifera, Copepoda and Ostracoda
DO	Total hardness, Total alkalinity, Chloride, Rotifera, Ostracoda
CO_2	Atmospheric temperature, Water temperature, Electrical conductivity
Total alkalinity	Atmospheric temperature, pH, DO, Chloride, Rotifera
Total hardness	TDS, Calcium, Magnesium, Ammonical nitrogen, BOD
Chloride	Atmospheric temperature, Water temperature, Total hardness, CO_2, Total alkalinity, Copepoda
Ammonical nitrogen	Total alkalinity, Total hardness, PO_4, BOD
PO4	Total hardness, Ammonical nitrogen, BOD
BOD	Turbidity, Total hardness Calcium, magnesium hardness, Ammonical nitrogen, PO_4
Rotifera	Copepoda, Ostracoda, Chloride
Cladocera	
Copepoda	Ostracoda, Rotifera, BOD, Chloride
Ostracoda	DO, Total alkalinity, Rotifera, Copepoda

Table 5. Statistical analysis of zooplankton of Bonal wetlands.

Indices	Rotifera	Cladocera	Copepoda	Ostracoda
Taxa_S	24	19	23	22
Individuals	31685	20163	10063	8011
Dominance_D	0.07694	0.09651	0.08467	0.08715
Shannon_H	2.727	2.537	2.607	2.684
Simpson_I-D	0.9231	0.9035	0.9153	0.9129
Evenness_e^H/S	0.6368	0.6656	0.5897	0.6656
Menhinick	0.1348	0.1338	0.2293	0.2458
Margalef	2.219	1.816	2.387	2.336
Equitability_J	0.858	0.8618	0.8315	0.8683
Fisher_alpha	2.545	2.069	2.811	2.759
Berger-Parker	0.152	0.159	0.1152	0.178

while later trends to have an opposite effect. The role of dissolved nitrogen in water bodies and its importance in aquatic productivity is well recognized. As a constituent of protein nitrogen occupies a highly important place in aquatic ecosystem. The optimal limit of nitrogen given earlier is 0.3 to 1.3 mg/l. These however, may not hold true under natural conditions. In the present investigations the high values of ammoniacal nitrogen content was observed during NEM and SWM season. While lower values were observed during the summer season. In the present investigations the low and high values in summer and SWM season respectively can be explained on the basis of evaporation and precipitation. It is interesting to note that in the present investigation, resident, local migratory and migratory birds population is more during NEM season may contribute higher level of Ammoniacal nitrogen. It is thus discernible that the nutrient concentration in the protected water bodies of such small dimensions are governed by local influence along with the changes in the seasonal influences rather than following a set pattern. Phosphorus is essential for all living organism, living matter contains about 0.3% dry weight phosphorus.

Statistical analysis of the all parameters are analyzed and depicted in the Table 4 and the diversity indices of zooplankton were analyzed seasonally and results are given in Table 5. The dominance of the species found to be maximum 0.09651 in Cladocera. Based on the Shannon wiener index the aquatic environment is classified as very good when H' >4,good at 4-3, moderate at 3-2, poor at 2-1 and very poor at <1. The Shannon diversity indes is good and moderate in Bonal wetland. Staub (1970) has described the scale of pollution regarding species diversity and reported the values as 3.0 to 4.5 (slight) 2.0 to 3.0 (Light), 1.0 to 2.0 (Moderate) and 0 to 1.0 (Heavy pollution). In the present investigation, the rotifer has shown the highest diversity indices 2.727 and the lowest 2.527 in Cladocera group.

CONCLUSION

The present study reveals seasonal variation in the diversity and distribution of zooplankton in relation to water quality of Bonal wetland. All the physico-chemical parameters are with in the permissible limit. Al four groups of zooplanktons were recorded throughout the study period. The number was highest during summer and lowest during winter. The study indicates that temperature has important role in the distribution of zooplanktons in a fresh water habitat. This is a proposed bird sanctuary and it requires the attention for monitoring the water quality for agriculture, fishing and drinking purpose.

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