International Journal of Ecology and Environmental Sciences 48: 85-101, 2022
ISSN: 2320-5199 (Online); https://doi.org/10.55863/ijees.2022.0016

A Study on Zooplankton Community with Respect to Abundance, Diversity, Trophic Status and Variations in Physico-chemical Factors at Bidi Minor Irrigation Tank of Khanapur Taluk, Belagavi District, Karnataka, India

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ABSTRACT

This study was conducted at Bidi minor irrigation tank (MIT) located in hilly zone of Khanapur taluk of District Belagavi to find the inter-relationships between water quality parameters and zooplankters and to enumerate species diversity, richness, abundance. During the 18 months of study, a total of 63 species of zooplankters belonging to five classes and 24 families were recorded. Family Brachionidae (Rotifera) represented by maximum number of species (16), followed by family Chydoridae (Cladocera) with 9 species. Species richness was highest for rotifers with 31 species whereas Cladocera group reported highest abundance of 10,862 individuals. Ostracoda group was represented with 2 species and 130 individuals only. Based on the higher values of electric conductivity and abundance of *Brachionus* and other trophic indicator species, the status of Bidi minor irrigation tank can be classified as eutrophic. Sustainable management practices like regular desilting, reduction in use of synthetic fertilizers and pesticides are essential to protect the water body from further degradation.

Key words: Bidi, Khanapur, Minor irrigation tank, Species diversity, Water quality, Zooplankton abundance, Trophic status.

INTRODUCTION

Irrigation tanks are prominent source of water in the semi-arid parts of western and central India. Southern states like Andhra Pradesh, Karnataka and Tamil Nadu have largest concentration of irrigation tanks numbering 0.12 million (Palanisami et al. 2010) and account for 60% of India's tank irrigated area. They play a vital role of harvesting surface runoff during monsoon, as a source of water for fisheries, domestic needs and nutrient rich soils, brick making (Kumar et al. 2013). In India, Ganapati (1940), Raj (1941) has pioneered the studies on limnology of impounded water. Sreenivasan (1964, 1965, 1966) has made an extensive study on limnology of fresh water impoundments in Tamil Nadu. Other workers (Rao and Govind 1964, Hussainy 1967) have studied on different aspects of impounded water. Venkateshwarlu (1969), Reddy et al. (1986) and Chandrasekhar (2007) have contributed to the studies of water bodies in and around Hyderabad.

Karnataka has 25,276 wetlands in the form of irrigation tanks, ponds and reservoirs. These are mainly used for irrigation, fisheries, water supply, domestic needs, recreation, ground water recharges and silt capture (Bassi 2014). They cover more than 80% of the irrigated area. They also serve in recharging the underground water table, maintain green belt, aid as pisciculture units, drinking water source for livestock especially in rural area. Most of these tanks are rainfed tanks formed by impounding the drainage from the catchment area by means of short embankment. In recent times these water resources are subjected to negligence and suffer from poor maintenance, siltation issues, anthropocentric interventions that have led to the deterioration of these resources. Zooplanktons are important link in aquatic food chain as they play major role in energy transfer from lower to higher trophic level (Tidame and Shinde 2012). Most of the studies on water bodies in Karnataka are mainly concentrated on larger reservoirs with more emphasis on the zooplankton diversity, trophic status and assessment of pollution status.

Patil (1982) worked extensively on ecological factors of freshwater zooplankton in several tanks in and around Dharwad. Kudari et al. (2006) and Kudari and Kanamadi (2008) have worked on some selected lentic habitats of Dharwad, Haveri and Uttara Kannada districts. Water quality assessment of Almatti Reservoir of Bijapur was conducted by Hulyal and Kaliwal (2008). Rajashekhar et al. (2009)

explored the zooplankton diversity in lakes with relation to trophic status from Gulbarga. Monthly changes in the abundance, biomass of zooplankton and water quality parameters at Hebbal, Lingambudi, Bannur, Kukkarahalli, Kalale, Alanahalli and Dalvoy lakes of Mysore was studied by Jalilzadeh et al. (2008), Joseph and Yamakanamaradi (2011) and Savita and Yamakanamaradi (2012), respectively. Veerendra et al. (2012) studied zooplankton diversity and their interrelationship with the physicochemical parameters in Mani reservoir of Western Ghat region of Hosanagar, Shivamogga. Seasonal variation in lake water quality of Byadagi taluka was studied by Shiva Keshava Kumar et al. (2013). Shivashankar and Venkataramana (2013) studied zooplankton diversity and their seasonal variations in Bhadra reservoir. Deepthi and Yamakanamardi (2014) focused on abundance of Cladocera from Varuna, Madappa and Giribettethe lakes of Mysore. Venkataramana et al. (2015) carried out taxonomical study and diversity of rotifers in Chikkadevarayan canal of Cauvery River. Assessment of zooplankton diversity of Nagaral dam of Chincholli at Kalburgi was carried out by Anita et al. (2018). Studies on zooplankters of Belagavi district are restricted to the rotifer diversity, water quality assessment of Fort Lake, Belgaum (Sunkad and Patil 2004) and Sogal pond (Abbai 2017).

As there are no reports with respect to zooplankton community from Khanapur taluk of Belagavi district, Karnataka, the present study was undertaken to understand the effects of physicochemical factors on zooplankton composition, species richness, diversity, evenness and trophic status of Bidi minor irrigation tank (MIT).

MATERIAL AND METHODS

Study area

Belagavi district is located east of the Western Ghats and is situated in the northwest part of Karnataka state (between 5^0 00’ and 17^0 00’ north latitudes and 74^0 00’ and 75^0 30’ east longitudes). The study area falls in the hilly zone of Khanapur taluk. The annual rainfall in this area is 1880.8 mm (Metrological station Sambra Belagavi, Station ID: IN009021000). Bidi minor irrigation tank (MIT) was built in the year 1989 by Minor irrigation department, Government of Karnataka to facilitate irrigation (Fig. 1) and lies in the southern part of Kadatanbagewadi village (15.58388 N, 74.64027 E; 80.06 m asl). It has a water spread area of 7,27,870 m². The catchment area is surrounded by mango plantations on northern and southern end. The eastern side of the tank is embanked by earthen bund with stone pitching measuring a length of 580 meters and attains a maximum height of about 11.67 m from the foundation and a spillway on south-east end. The south-west edge of the tank is bordered with farmlands and aquatic vegetation.

Physical factors and Plankton Analysis

Water samples were collected at regular intervals from January, 2017 to June, 2018 between 6:00 am to 10:30 am. Physical factors like atmospheric and water temperature were measured at the study site by using mercury thermometer, transparency was measured by secchi disk and humidity by hygrometer. Multi-parameter probe (Eutech PS Tester 35) was used to measure pH, electric conductivity (EC), total dissolved solids (TDS) and salinity in the field. Estimations of other parameters were carried out in the laboratory by standard methods (APHA 1980). For zooplankton studies 100 liters of water was sieved and stored in 1 liter bottles by adding 3 ml of 4% formalin to preserve the zooplankton. The preserved samples were kept for 24 hours undisturbed to allow the sedimentation of plankton. The supernatant was discarded carefully without disturbing the sediments and the final volume of concentrated sample was 120 ml. To retain the appendages intact and avoid brittling, 2 ml of glycerin was added to the final sample. The qualitative and quantitative analysis of zooplankton was performed by Lackey’s drop count method using MAGNUS MLX - TR optical compound binocular microscope. Species identification was carried out by using appropriate taxonomic keys (Sharma and Michael 1980, Patil and Gouder 1989, Dhanapathi 2000, Khan 2003, Sharma 1987, 2017, Michael and Sharma 1988, Sheil 1995, Dang et al. 2015, Sharma and Sharma 2008, 2010, 2014, 2017, Karuthapandi and Rao 2017). SPSS, IBM Version 21 software was used for statistical analysis. The total number of individual species, Simpson and Shannon diversity index (H’), species evenness and Dominance was

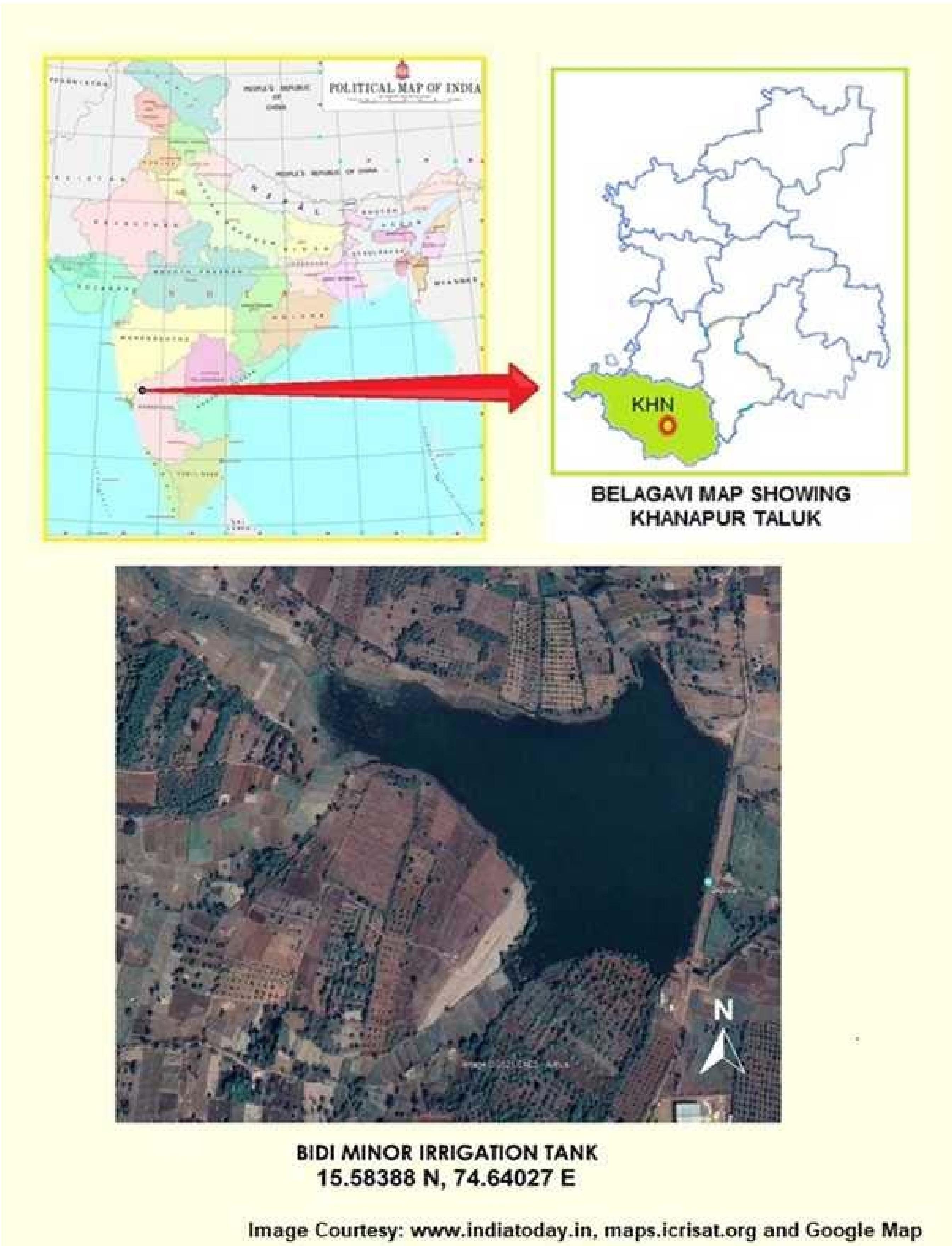

Figure 1: Map of study area showing the Bidi Minor irrigation tank of Khanapur Taluk, District Belagavi, Karnataka

calculated. Brachionus: Trichocerca quotient ($Q_{B/T}$) was established to understand the trophic status of the tank (Sladecek 1983). Pearson correlation was derived to find relationships between zooplankton groups and physicochemical factors.

RESULTS

Abiotic factors

The physico-chemical factors studied are summarized in Table1. The atmospheric temperature varied between 18 and 33^{0}C. While the minimum temperature was observed during the month of January, 2018, maximum was recorded during April, 2018. Water temperature ranged between 20.5^{0}C and 28^{0}C. Minimum was recorded in January, 2018 and maximum in May, 2018. Transparency of water was minimum (4cm) in March and May, 2018 and maximum (41cm) during October, 2017. Humidity ranged between 45 and 82%, minimum was in December, 2017 and maximum during January, 2017. The pH varied between 7.06 and 8.2. Minimum pH was observed in June, 2017 and the maximum in January, 2017.

Salinity ranged between 5.6 and 87 ppm, minimum and maximum in April, 2017 and April, 2018, respectively. Total Dissolved Solids (TDS) varied from 69.3 to 126 ppm, with lowest being in June, 2018 and highest in April, 2018. Electric conductivity (EC) ranged between 97.4 and 207 µS/cm with minimum in June, 2018 and maximum in January, 2018. Dissolved oxygen (DO) levels were minimum (2.016 mg/L) in February, March and May, 2017 and maximum (17.068 mg/L) in June, 2017. Free Carbon Dioxide (CO_2) ranged between 2.2 and 8.052 mg/L, minimum in January, March, May, June and November, 2017 and maximum in February, 2018. Total alkalinity ranged between 5 and 116.5 mg/L. Lowest value was recorded during January, 2017 and the highest in December, 2017. Total hardness was minimum (25.04 mg/L) during August, 2017 and maximum (200.64 mg/L) in December, 2017. Chloride content ranged between13.49 and 86.13 mg/L, minimum in July, 2017 and maximum in June, 2018. Sulphate was least (3 mg/L) during January and March, 2017 and maximum (19 mg/L) in April, 2017.

Nitrates ranged from 7 to 160 mg/L, minimum in January, 2017 and maximum in April, 2018. Chemical Oxygen demand (COD) values ranged from 0.01 and 128 mg/L, minimum during February, 2018 and maximum during June, 2018. Biological Oxygen demand (BOD) was lowest (0.1 mg/L) in February, 2018 and highest (52 mg/L) during June, 2017. Phosphate ranged between 0.01 to 35 mg/L, minimum in March, 2017 and maximum during March and April, 2018. Monthly rainfall values ranged from 4 to 244.6 mm; minimum during November and December, 2017 and maximum in June, 2018.

Biotic factors

Zooplankton composition, abundance and relative abundance

A total of 63 species of zooplankton belonging to five classes and 24 families were recorded (Table 2). Rotifera formed the most dominating group represented by 31 species composing 49% (Table 3 and Fig. 2), of which Family Brachionidae was the major group with 16 species. Trichocercidae and Testudinellidae were represented by three species each. Lepadellidae, Lecanidae, Synchaetidae, Flosculariidae, Habrotrochidae, Hexarthridae and Philodinidae were represented by one species each. Highest species richness of 25 species was observed in the month of February, 2017 and lowest (7 species) in May 2018. *Brachionus diversicornis, Brachionus calyciflorus* (17 months) and *Trichocerca cylindrica* (16 months) were observed almost throughout the study period. *Keratella tropica* (1497 ind/L); *Filina opolenisis* (1245 ind/L) and *Brachionus forficula* (1055 ind/L) were the most abundant species and *Keratella quadrata* and *Rotatoria neptunia* (13 ind/L) were the least. Total abundance recorded is 8213 individuals and the relative abundance is 31% (Fig. 3).

Cladocera group was represented by 19 species (30%) under seven families. Nine species belongs to family Chydoridae, families Bosminidae, Macrothricidae, Moinidae and Sididae were represented by two species each and Daphinidae and Eurycercidae by one species. Maximum number of cladocerans (16 species) were observed during March and June 2017 and minimum (6 species) in January, 2017. *Bipertura karua* and *Ceriodaphnia corunata* were recorded throughout the study period except during January (2017). *Bosminopsis deitersi*

Table 1. Physico-chemical parameters. AT = Atmospheric temperature; WT = Water Temperature; TR = Transparency; HY = Humidity; SY = Salinity; FCO = Free CO_2; TA = Total Alkalinity; TH = Total Hardness; CL = Chlorides; SL = Sulphates; NS = Nitrates; COD = Chemical Oxygen demand; BOD = Biological Oxygen demand; PS = Phosphates; RF = Rainfall; *Heavy rains at the time of sampling

Season	Month	AT °C	WT °C	TR (cm)	HY (%)	pH	SY	TDS (ppm)	EC (µs/cm)	DO (mg/l)	FCO (mg/l)	TA (mg/l)	TH (mg/l)	CL (mg/l)	SL (mg/l)	NS (mg/l)	COD (mg/l)	BOD (mg/l)	PS (mg/l)	RF (mm)
Winter	Jan-17	19.4	22.8	38	82	8.2	0	124.2	207	5.362	2.2	5	30	42.6	3	7	14.4	3.6	Nil	0
	Feb-17	18	22.8	35	70	7.8	66.6	95	133.4	4.83	2.75	11.66	82.64	46.38	0	9	17.2	5.73	Nil	0
Summer	Mar-17	24	26.8	33	69	7.68	71.6	102	143.5	6.653	2.2	11.25	74.64	44.47	3	10	10.8	2.7	0.01	0
	Apr-17	26	26.2	28.5	60	7.73	5.6	107	151.8	6.975	2.933	6.65	39.96	70.03	19	11	36	12	Nil	19
	May-2017*	27	25.5	15	64	7.23	75.5	108	151.9	8.6	2.2	11.65	47.96	47.14	11	20	44	17.6	Nil	60
Monsoon	Jun-2017*	28.3	25.5	14	61	7.06	70.4	99.6	140.6	17.068	2.2	11.65	36	18.74	16	22	116	52	Nil	149
	Jul-2017*	27	24.5	15	60	7.3	51.9	71.3	100.4	6.181	2.926	18.3	32.8	13.49	9	15	116	23.2	Nil	234
	Aug-17	25	25.5	28	65	7.74	57.2	79.8	112.4	5.645	3.52	8.75	25.04	21.75	18	15	76	25.33	Nil	64
	Sep-17	29	27	32	51	7.45	60.8	84	118.3	7.661	2.926	6.665	72	17.97	5	11	48	19.6	Nil	171
Post-monsoon	Oct-17	22	26	41	62	7.87	62.3	87.4	123.3	4.701	3.652	6.65	120	24.59	10	14	48.2	18.4	Nil	97
	Nov-17	25	24.5	38	62	8.13	65.2	92.4	130.3	6.584	2.2	10	114.4	19.88	4	8	96	38.4	Nil	4
	Dec-17	28	20.5	24	45	7.88	69	100	141.5	8.197	2.926	116.5	200.64	35.01	4	8	46.2	18.44	Nil	4
Winter	Jan-18	24	22	6	65	7.7	73.3	106	149.6	3.629	2.926	8.3	166.64	27.43	0.02	56	Nil	0	25	0
	Feb-18	32	24	14	72	7.44	78.2	113	158.9	2.016	8.052	11.3	142	74.14	0.21	140	0.01	0.1	29	0
Summer	Mar-18	29	25	4	82	7.83	83.8	121	170.6	2.016	3.652	6.65	158	35.01	1.61	110	Nil	0	35	4.4
	Apr-18	33	27	6	78	7.75	87	126	178	2.11	4.4	10	149.2	31.24	0.94	160	Nil	0	35	69.4
	May-18	29	28	4	64	7.53	74.9	106	153.3	2.016	3.3	15	157.28	35.01	0.03	122	Nil	0	9	180.8
Monsoon	Jun-2018*	26	25	5	65	7.18	50.3	69.3	97.4	3.088	3.652	10	141.32	86.13	6	8	128	30.4	5	244.6

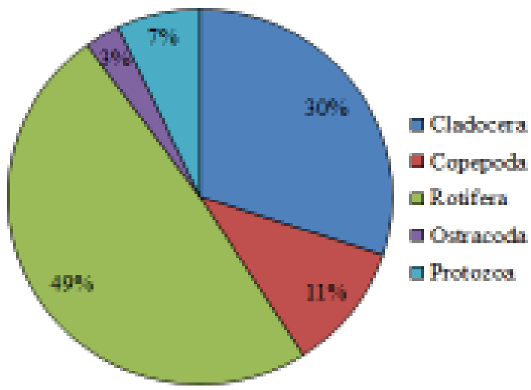

Figure 2. Relative species richness of zooplankton groups

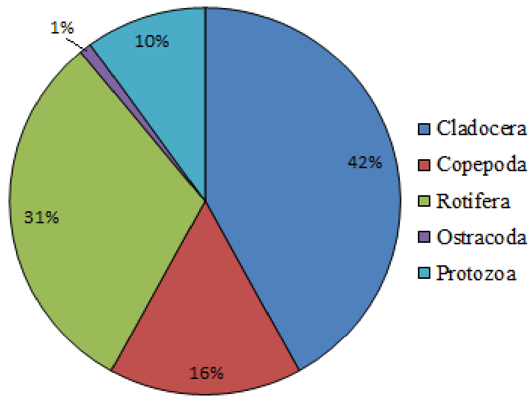

Figure 3. Relative abundance of zooplankton groups

and *Bosmina longirostris* were observed for 15 months. *B. deitersi* (3216 ind/L) was most abundant followed by *B. longirostris* (2712 ind/L). Total abundance is 10862 individuals and the relative abundance is 42% (Tables 4, 5 and Fig. 3).

Seven species of copepods (11%) belonging to Diaptomidae (3 species) and Cyclopidae (4 species) were recorded during the study. Highest number of species (7) was recorded during February, April, May, November, December, 2017 and January 2018, while lowest (3) during January, 2017. Among Copepoda, *Paracyclops fimbriatus*, a member of Cyclopoidae family was observed throughout the study period followed by

Table 2. Systematic account of zooplankters recorded from Bidi minor irrigation tank

CLADOCERA	25 *Mesocyclops leuckarti* Claus, 1857	**Family: Testudinellidae**
Family: Chydoridae	26 *Thermocyclops hyalinus* Rehberg, 1880	52 *Pompholyx sulcata* Hudson, 1885
1 *Alona taraporevalae* Shirgur & Naik, 1977	**ROTIFERA**	53 *Pompholyx companulata*
2 *Alona excisa*	**Family: Brachionidae**	54 *Testudinella patina* Hermann, 1783
3 *Alona rectangula* Richard	27 *Anueropsis coelata*	**Family: Habrotrochidae**
4 *Alona pulchella* King, 1853	28 *Anueropsis navicula*	55 *Habrotrocha bidens* Gosse, 1851
5 *Bipertura karua*	29 *Brachionus forficula* Wierzejski, 1891	**Family: Hexarthridae**
6 *Chydorus sphaericus* Muller, 1776	30 *Brachionus forficula minor*	56 *Hexarthra* Schmarda, 1854
7 *Pleuroxus* Baird, 1843	31 *Brachionus caudatus* Barrois & Daday, 1894	**Family: Philodinidae**
8 *Pleuroxus trigonellus* Muller, 1776	32 *Brachionus caudatus* var. *personatus* Ahlstrom, 1940	57 *Rotatoria neptunia* Ehrenberg, 1832
9 *Pleuroxus barrosi barrosi* Richard, 1894	33 *Brachionus diversicornis* Daday, 1883	**OSTRACODA**
Family: Daphnidae	34 *Brachionus angularis* Gosse, 1857	**Family: Cyprididae**
10 *Ceriodaphnia corunata* Sars, 1885	35 *Brachionus calyciflorus* Pallas, 1766	58 *Hemicypris fossulata*
Family: Sididae	36 *Brachionus falcatus* Zacharias, 1898	**Family: Ilyocyprididae**
11 *Diaphanosoma exicusm*	37 *Brachionus quadridentatus* Hermann, 1783	59 *Ilyocypris* sp.
12 *Diaphanosoma sarsi Richard*	38 *Keratella cochlearis* Gosse, 1851	**PROTOZOA**
Family: Macrothricidae	39 *Keratella tropica* Apstein, 1907	**Family: Heleoperidae**
13 *Echinisca odiosa*	40 *Keratella tecta* Gosse, 1851	60 *Difflugia* sp. 1 Ehrenberg, 1872
14 *Macrothrix goeldi* Richard, 1897	41 *Keratella lenzi* Hauer	61 *Difflugia* sp. 2 Ehrenberg, 1872
Family: Moinidae	42 *Keratella quadrata* Muller, 1786	62 *Difflugia* sp. 4 Ehrenberg, 1872
15 *Moina micrura* Kurz, 1875	**Family: Lepadellidae**	**Family: Nebelidae**
16 *Moina brachiata* Jurine, *1820*	43 *Lepadella rhomboides* Gosse, 1886	63 *Nebela* Leidy, 1874
Family: Bosminidae	**Family: Lecanidae**	
17 *Bosminopsis deitersi* Richard	44 *Lecane stenroosi* Meissner, 1908	
18 *Bosmina longirostris* Muller, 1776	**Family: Synchaetidae**	
Family: Eurycercidae	45 *Polyarthra* Ehrenberg, 1834	
19 *Alonella* Sars, 1862	**Family: Trichocercidae**	
COPEPODA	46 *Trichocerca similis*Wierzejski, 1893	
Family: Diaptomidae	47 *Trichocerca rattus* Muller, 1776	
20 *Heliodiaptomus viddus* Gurney, 1916	48 *Trichocerca cylindrica* Imhof, 1891	
21 *Sinodiaptomus indicus* Kiefer, 1934	**Family: Floscularidae**	
22 *Neodiaptomus strigilipes* Gurney, 1907	49 *Sinantherina* Bory de St.Vincent, 1826	
Family: Cyclopidae	**Family: Trochosphaeridae**	
23 *Paracyclops fimbriatus* Fischer, 1853	50 *Filina opolenisis*	
24 *Tropocyclops prasinus* Fischer, 1860	51 *Horaella brehmi* Donner, 1949	

Table3. Zooplankton abundance recorded from Bidi minor irrigation tank. *Heavy rains at the time of sampling.

	Zooplankton groups	2017												2018					
		Winter		Summer			Monsoon			Post-Monsoon				Winter		Summer			M
		J	F	M	A	M *	J *	J	A	S	O	N	D	J	F	M	A	M	J *
I	**CLADOCERA**																		
1	*Alona taraporevalae* Shirgur & Naik, 1977	0	18	13	7	12	10	7	13	27	31	7	12	14	8	3	0	0	1
2	*Alona excisa*	0	68	131	27	97	11	3	16	0	0	0	0	1	3	11	0	0	0
3	*Alonella* Sars, 1862	0	3	66	11	27	0	1	13	7	11	29	2	0	0	0	1	0	0
4	*Alona rectangula* Richard	0	0	23	3	0	3	0	0	0	0	1	5	1	0	0	1	1	3
5	*Alona pulchella* King, 1853	1	0	26	7	3	0	0	0	0	0	1	1	0	0	17	1	4	0
6	*Bosminopsis deitersi* Richard	9	182	1269	1071	292	74	71	5	3	72	0	12	41	19	0	0	92	4
7	*Bosmina longirostris* Muller, 1776	11	1062	657	642	161	75	16	24	1	13	0	0	6	13	19	0	1	11
8	*Bipertura karua*	0	129	586	56	42	49	13	32	5	32	9	46	7	7	5	52	17	9
9	*Ceriodaphnia corunata* Sars, 1885	0	26	127	104	46	171	5	127	97	63	72	13	9	8	131	97	78	102
10	*Diaphanosoma exicusm*	11	13	0	0	0	3	0	0	1	3	13	2	12	7	26	0	1	0
11	*Diaphanosoma sarsi Richard*	0	0	20	0	67	9	3	3	0	1	17	6	11	3	25	1	0	1
12	*Pleuroxus* Baird, 1843	0	9	3	1	11	1	1	0	7	6	13	0	9	0	0	0	1	2
13	*Pleuroxus trigonellus* Muller, 1776	0	6	0	0	1	3	0	0	3	4	11	4	0	0	0	1	2	0
14	*Pleuroxus barrosi barrosi* Richard, 1894	43	18	13	25	39	149	11	0	0	0	7	6	8	18	7	0	0	0
15	*Echinisca odiosa*	0	1	2	0	0	1	0	0	4	126	103	17	8	21	33	18	3	7
16	*Macrothrix goeldi* Richard, 1897	0	0	5	11	0	0	0	0	1	0	16	8	27	8	0	0	1	0
17	*Moina micrura* Kurz, 1875	0	26	4	21	23	24	0	3	0	0	0	1	0	0	0	0	34	17
18	*Moina brachiata* Jurine*, 1820*	0	0	0	0	0	17	0	6	3	11	17	9	2	0	0	0	1	0
19	*Chydorus sphaericus* Muller, 1776	14	78	10	2	133	71	57	1	0	0	0	0	6	11	0	1	3	9
	Total number of species (19)	**6**	**14**	**16**	**14**	**14**	**16**	**11**	**11**	**12**	**12**	**14**	**15**	**15**	**12**	**10**	**9**	**14**	**11**
II	**COPEPODA**																		
1	*Heliodiaptomus viddus* Gurney, 1916	0	2	11	129	14	35	26	13	20	17	21	3	36	11	0	0	3	0
2	*Sinodiaptomus indicus* Kiefer, 1934	0	22	5	134	65	99	19	27	8	43	12	7	27	12	3	0	0	0
3	*Neodiaptomus strigilipes* Gurney, 1907	0	3	0	14	2	12	0	0	0	0	26	9	31	59	18	7	4	9
4	*Paracyclops fimbriatus* Fischer, 1853	13	133	12	20	186	57	60	2	14	48	118	32	35	57	11	14	29	2
5	*Tropocyclops prasinus* Fischer, 1860	26	43	342	61	373	44	32	5	0	23	113	36	21	29	17	41	19	12
6	*Mesocyclops leuckarti* Claus, 1857	0	8	91	13	237	7	0	2	3	8	31	17	11	19	37	15	17	5
7	*Thermocyclops hyalinus* Rehberg, 1880	3	23	2	1	4	0	0	0	8	4	42	19	7	0	11	0	0	8
8	Nauplii	7	102	0	0	55	0	132	4	17	114	36	23	13	8	0	0	16	3
	Total number of species (07) (except nauplii)	**3**	**7**	**6**	**7**	**7**	**6**	**4**	**5**	**5**	**6**	**7**	**7**	**7**	**6**	**6**	**4**	**5**	**5**

	2017												2018					
	Winter		Summer			Monsoon			Post-Monsoon				Winter		Summer			M
Zooplankton groups	J	F	M	A	M *	J *	J	A	S	O	N	D	J	F	M	A	M	J *
III ROTIFERA																		
1 *Anueropsis coelata*	0	36	0	0	13	0	0	1	3	0	1	5	9	14	1	0	0	0
2 *Anueropsis navicula*	0	35	1	1	13	1	0	0	0	0	0	7	0	0	0	0	0	0
3 *Brachionus forficula* Wierzejski, 1891	45	49	270	221	196	33	49	5	0	18	47	95	0	0	8	0	19	0
4 *Brachionus forficula minor*	3	16	0	0	7	0	0	0	0	0	0	11	3	0	0	0	0	0
5 *Brachionus caudatus* Barrois & Daday, 1894	11	13	37	76	41	18	27	28	0	1	19	6	0	0	0	11	0	0
6 *Brachionus caudatus* var. *personatus* Ahlstrom, 1940	0	2	0	0	24	16	0	0	42	131	53	15	7	15	9	0	0	0
7 *Brachionus diversicornis* Daday, 1883	3	8	96	51	66	191	3	2	9	71	12	8	10	4	14	0	16	5
8 *Brachionus angularis* Gosse, 1857	0	3	0	2	0	0	0	7	3	0	0	0	0	1	0	0	0	0
9 *Brachionus calyciflorus* Pallas, 1766	1	0	13	54	203	139	21	6	2	1	31	11	7	4	11	17	19	44
10 *Brachionus falcatus* Zacharias, 1898	0	23	0	79	57	3	0	0	0	0	3	5	11	0	91	127	39	0
11 *Brachionus quadridentata* Hermann, 1783	0	3	0	0	0	0	0	0	0	0	0	9	1	0	7	0	13	8
12 *Filina opolenisis*	0	1	73	92	617	36	53	13	127	0	110	17	0	0	0	89	0	17
13 *Horaella brehmi* Donner, 1949	0	1	0	0	0	0	12	0	0	0	6	8	0	0	0	0	0	8
14 *Habrotrocha bidens* Gosse, 1851	0	0	0	32	0	0	0	0	0	10	0	3	0	0	0	0	0	7
15 *Hexarthra* Schmarda, 1854	0	11	0	12	0	2	12	28	1	0	6	0	0	0	2	0	0	0
16 *Lepadella rhomboides* Gosse, 1886	0	4	0	0	0	0	0	19	0	0	0	0	11	29	0	0	0	0
17 *Pompholyx sulcata* Hudson, 1885	0	12	0	0	37	0	0	13	7	13	13	8	7	0	0	0	0	0
18 *Pompholyx companulata*	1	15	4	0	0	0	0	0	0	0	0	0	0	0	12	1	0	0
19 *Keratella cochlearis* Gosse, 1851	3	60	2	0	21	7	0	0	15	0	0	11	0	0	0	12	0	0
20 *Keratella tropica* Apstein, 1907	5	166	38	503	405	118	27	70	12	41	47	22	29	11	0	0	0	3
21 *Keratella tecta* Gosse, 1851	4	54	17	2	0	0	0	0	0	6	0	0	0	0	9	1	0	0
22 *Keratella lenzi* Hauer	0	0	0	6	0	10	26	0	0	0	0	0	0	0	0	0	1	13
23 *Keratella quadrata* Muller, 1786	0	0	0	0	2	0	11	0	0	0	0	0	0	0	0	0	0	0
24 *Sinantherina* Bory de St.Vincent, 1826	0	1	2	0	0	0	0	0	0	0	0	0	0	13	0	7	9	0
25 *Lecane stenroosi* Meissner, 1908	0	0	0	0	0	0	23	0	0	0	0	0	0	0	0	3	0	0
26 *Testudinella patina* Hermann, 1783	0	9	2	0	0	0	55	3	0	0	0	0	0	0	0	0	0	0
27 *Trichocerca similis*Wierzejski, 1893	0	29	0	0	77	83	13	0	0	13	19	0	3	7	13	0	0	1
28 *Trichocerca rattus* Muller, 1776	7	49	3	2	7	18	87	69	114	36	17	19	23	0	17	0	0	0
29 *Trichocerca cylindrica* Imhof, 1891	2	22	14	19	61	26	2	27	91	17	76	13	27	19	8	3	0	0
30 *Rotatoria neptunia* Ehrenberg, 1832	0	0	2	1	2	2	2	0	0	0	1	0	3	0	0	0	0	0
31 *Polyarthra* Ehrenberg, 1834	0	3	0	0	8	9	0	0	0	0	0	0	0	12	0	0	0	0
Total number of species (31)	**11**	**25**	**15**	**15**	**19**	**16**	**16**	**13**	**12**	**11**	**16**	**18**	**14**	**11**	**13**	**10**	**7**	**8**

Zooplankton groups	2017 Winter J	F	Summer M	A	M *	Monsoon J *	J	A	Post-Monsoon S	O	N	D	2018 Winter J	F	Summer M	A	M	M J *
IV OSTRACODA																		
1 *Hemicypris fossulata*	0	0	0	0	12	16	4	15	17	9	2	1	12	0	0	13	1	10
2 *Ilyocypris* sp.	3	2	0	0	0	0	0	0	0	0	0	0	0	12	0	0	1	0
Total number of species (02)	**1**	**1**	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**0**	**1**	**2**	**1**
V PROTOZOA																		
1 *Difflugia* sp. 1 Ehrenberg, 1872	0	0	20	188	292	27	169	11	4	18	171	94	61	13	0	0	0	0
2 *Difflugia* sp. 2 Ehrenberg, 1872	0	0	2	6	96	3	27	80	17	65	164	34	93	47	0	0	0	0
3 *Nebela* Leidy, 1874	0	3	0	392	291	94	103	61	19	15	7	0	0	0	12	1	0	0
4 *Difflugia* sp. 4 Ehrenberg, 1872	0	0	0	0	0	4	18	0	0	0	0	0	0	0	0	0	0	0
Total number of species (04)	**0**	**1**	**3**	**3**	**3**	**4**	**4**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**1**	**1**	**0**	**0**
Total Zooplankton assemblage	**21**	**48**	**40**	**39**	**44**	**43**	**36**	**33**	**33**	**33**	**41**	**43**	**39**	**32**	**30**	**25**	**28**	**25**

Table 4. Monthly abundance of zooplankton groups. CL - Cladocera; CO - Copepoda; RO - Rotifera; OS - Ostracoda and PR - Protozoa

Season	**Months**	**Zooplankton group** CL	CO	RO	OS	PR
Winter	Jan-17	89	49	85	3	0
	Feb-17	1639	336	625	2	3
Summer	Mar-17	2955	463	574	0	22
	Apr-17	1988	372	1153	0	586
	May-2017*	954	936	1857	12	679
Monsoon	Jun-2017*	671	254	712	16	128
	Jul-2017*	188	269	423	4	317
	Aug-17	243	53	291	15	152
	Sep-17	159	70	426	17	40
Post-monsoon	Oct-17	373	257	358	9	98
	Nov-17	316	399	461	2	342
	Dec-17	144	146	273	1	128
Winter	Jan-18	162	181	151	12	154
	Feb-18	126	195	129	12	60
Summer	Mar-18	277	97	202	0	12
	Apr-18	173	77	271	13	1
	May-18	239	88	116	2	0
Monsoon	Jun-2018*	166	39	106	10	0

Note: * Heavy rain shower at the time of sampling.

Table 5. Abundance, relative abundance, dominance, diversity and evenness of zooplankton groups (groups as in Table 4)

	Zooplankton group CL	CO	RO	OS	PR
Mean	603.44	237.83	456.27	7.22	151.22
Standard Error (SE)	187.84	51.52	103.90	1.45	48.0
Range	89 - 2955	39 - 936	85 - 1857	1 - 17	1 - 679
Abundance	10862	4281	8213	130	2722
Relative abundance (RA%)	41.44	16.33	31.33	0.49	10.38
Dominance_D	0.1471	0.09989	0.1045	0.09408	0.1507
Simpson_1-D	0.8529	0.9001	0.8955	0.9059	0.8493
Shannon_H	2.29	2.56	2.548	2.469	2.138
Evenness_E	0.7923	0.8856	0.8815	0.9119	0.7896

Tropocyclop sprasinus for 17 months. Cyclopidae members were more abundant than Diaptomidae. *Tropocyclops prasinus* has maximum numbers (1237 ind/L) followed by *Paracyclops fimbriatus* (843 ind/L). Total abundance is 4281 individuals and the relative abundance is 16%. Nauplii larvae exceeded the abundance of the Diaptomidae members.

Ostracoda group was represented with a relatively small fraction of the reported species with two species belonging to family Cyprididae and one to Ilyocypridae with a relative species richness of 3%. *Hemicypris fossulata* was observed for 12 months while *Ilyocypris* sp. was found in four months. Ostracods were the least abundant of all the zooplankton groups. *H. fossulata* was observed in large numbers and *Ilyocypris* sp. the least. Total abundance is 130 individuals (1%) (Table 5 and Fig. 3).

Protozoans were represented by four species (7%) of which three species were from family Difflugiidae and one from Nebellidae (Table 3, Fig. 2). Highest number of species (4) was recorded during June and July, 2017 and lowest (1) during February, March 2017 and April, 2018. *Difflugia* sp.1 and *Difflugia* sp. 2 were observed for 12 months and *Nebela* sp. for 11 months.

Highest species abundance was recorded by *Difflugia* sp. 1 (1068 ind/L) followed by *Nebela* sp. (998 ind/L) and lowest by *Difflugia* sp. 4 (22 ind/L). The total abundance was 2722 individuals (10%).

DISCUSSION

The physicochemical characteristics of the aquatic environment directly influence the life inhabiting it. Temperature is an important factor in the ecosystem, as there are no other single factor having profound influence either directly or indirectly (Welch 1952). During January to April, August and October, 2017, the water temperature exceeded atmospheric temperature. Similar pattern of variation in water temperature was observed by Unni (1984). The atmospheric temperature varied with the variation in the seasons. Lowest was recorded during February, 2017 (winter season) and highest in April, 2018. Similar values were recorded by Shiddamallayya and Pratima (2008). The water temperature exhibits similarity with the observations of Patil et al. (2013) where, highest values were recorded during the summer (May 2018). Variations in atmospheric temperature having its minimum value in February, 2017 and maximum during April, 2018 was similar to the observations of Vijayakumar et al. (2014) at Thengaithittu estuary.

Atmospheric temperature showed significant positive correlation with salinity, nitrates and phosphates (Table 6). Venkatramana et al. (2015) also recorded correlation between phosphate and temperature.

Transparency is a measure to determine the clarity of the water body. More transparency more the penetration of sunlight. In the present study, water was more transparent in October, 2017 while its value was lowest in March and May, 2018 and it has exhibited positive correlation with humidity and pH. Higher values of pH can be resulted from very high concentration of bicarbonate in the lakes (Wetzel 1975). In the present study the tank was almost alkaline throughout the study period. Saksena and Adoni (1973) also reported alkaline pH in tropical waters throughout the year. pH was highest during January, 2017 (winter season), this increase during the winter can be attributed to the increased metabolic activities in aquatic vegetation (Sarma and Dutta 2012). Patil et al. (2013) also observed higher pH values during winter season (January). pH is negatively correlated to rainfall.

According to Rawson (1960), classification of water quality with ionic concentration of water is a measure for electric conductivity, values more than 200 µmhos are considered as eutrophic. In the present study, highest EC (207 µS/cm) was recorded during January 2017. Huddar (1995) also recorded similar results. With the onset of monsoon, its value dropped to a minimum and the value increased with the decrease in rainfall. Minimal conductivity values during monsoon season were also observed by Patil et al. (2013). Electric conductivity is significantly correlated with humidity and TDS and positively correlated with nitrate while negatively correlated with COD, BOD and rainfall.

DO concentration reflects the dominating biological and physical processes in aquatic environments and it is one of the important parameters that determine the water quality and abundance of zooplankters (Park and Marshall 2000). In the present study, DO was recorded highest in June 2017 (rainy season). Increase in DO during rainy season can be attributed to the increase in water volume, increase in surface area and more dissolution of atmospheric oxygen (Hegde and Huddar 1995). Thakur et al. (2013) observed inverse relation between DO and temperature at three lakes of Rewalsar, Kuntbhyog and Prashar of Mandi, Himachal Pradesh respectively. In the present study also lower values of DO was observed when temperature was high (Table 1). Dissolved oxygen is significantly correlated with BOD, Sulphate and COD. However, humidity, free CO_2, total hardness, nitrate and phosphate showed negative correlation.

Table 6. Interrelationships within and between water quality parameters and zooplankton groups

Sl. no	Interrelationships with Parameters							
1	Rainfall	COD (+)**	pH (-)**	TDS (-)**	EC (-)*			
2	Atmospheric temperature	Sal (+)*,	N (+)*	P (+)*	Tr (-)**			
3	Water temperature	TA (-)*						
4	Transparency	pH (+)*	N (-)**	P (-)**				
5	Humidity	TDS (+)*	N (+)*	P (+)*	EC (+)**	DO (-)*	TA (-)*	BOD (-)*
6	Salinity	TH (+)*	N (+)*	P (+)*				
7	Total Dissolved Solids	EC (+)**	N (+)*	P (+)*	COD (-)**	BOD (-)**		
8	Electric Conductivity	N (+)*	BOD (-)*	COD (-)**				
9	Dissolved Oxygen	BOD (+)**	S (+)*	COD (+)*	CO_2 (-)*	TH (-)*	N (-)*	P (-)*
10	Free CO_2	N (+)**	P (+)*					
11	Total Hardness	N (+)*	P (+)*					
12	Sulphate	BOD (+)**	COD (+)*	N (-)*	P (-)*			
13	Nitrate	P (+)**	COD (-)*	BOD (-)*				
14	COD	BOD (+)**	P (-)*					
15	BOD	P (-)*						

Note: Only those water quality parameters which showed significant correlation with other water quality parameters are shown in the table. Values are Pearson correlation coefficient, a 2-tailed test was applied and calculated after $\log_{10}$ transformation of all variables after scaling so that all values were > 1, *P <0.05, **P < 0.01 and N = 19, Rain – Rainfall, AT - Air Temperature, WT - Water Temperature, Tr - Transparency, Hu – Humidity, Sal – Salinity, TDS - Total Dissolved Solids, EC - Electric Conductivity, DO - Dissolved Oxygen, CO_2 – Free CO_2, TA - Total Alkalinity, TH - Total Hardness, S – Sulphate, N – Nitrate, COD - Chemical Oxygen Demand, BOD - Biological Oxygen Demand, P - Phosphate. Signs within parenthesis indicate positive (+) or negative (-) correlations.

Zooplankton group	Water quality parameters		
Cladocera	Rot (+)*		
Copepoda	Cla (+)*		CO_2 (-)*
Rotifera	Pro (+)**	CO_2 (-)*	TH (-)*
Ostracoda	pH (-)*		

Note: Values are Pearson correlation coefficient, a 2 tailed test was applied and calculated after $\log_{10}$ transformation of all variables after scaling so that all values were >1, *P < 0.05, **P < 0.01and N = 19, CO_2 – Free CO_2, TH - Total Hardness, Cla – Cladocera, Rot – Rotifera, Pro – Protozoa. Signs within parenthesis indicate positive (+) or negative (-) correlations

Sources of free CO_2 in water is due to the respiration by aquatic biota, decomposition of organic matter and influence of carbonates as well as bicarbonates in water (Sakhare 2012). In the present study, free CO_2 was maximum in February, 2018. Sarma and Dutta (2012) also recorded maximum value of free CO_2 in Urpodbeel of Goalpara district, Assam and assume that higher value is due to the decomposition of organic matter resulting in increased production of CO_2 in winter. Free CO_2 expressed significant correlation to nitrate and phosphate while negatively correlated to copepods.

Maximum value of hardness was recorded during December 2017 while minimum in August, 2017. Similar pattern of higher value of hardness in winter and lower levels in rainy season was observed by Patil et al. (2013) and Sarma and Dutta (2012). Total hardness showed significant correlation with salinity and phosphate while, negatively correlated to rotifers. The chloride levels were high in summer months when compared with winter period. This variation can be attributed to the loss of water by evaporation. Similar observations were made by Patil and Gouder (1985). No correlation with any other parameter. Nitrate levels were minimum during January 2017 and maximum in April, 2018. Patil et al. (2013) also reported similar pattern of higher nitrates during summer and minimum during winter season. In the present study nitrate values expressed significant correlation with phosphate and positively correlated with humidity, total hardness and TDS. Venkatramana et al. (2015) also reported correlation of nitrates with TDS and total hardness. However, it expressed significant inverse correlation with sulphate, COD and BOD. Measurement of COD is used to quantify the concentration of organics found in the water. The higher values of COD in the water indicates the presence of serious organic pollution. In the present study, highest value of 128 mg/L of COD was observed during May, 2018. COD is significantly correlated to rainfall and positively correlated with sulphate whereas, inversely correlated to TDS, electric conductivity, nitrate and phosphate.

Minimum value of BOD was recorded in February, 2018 during the winter period and highest in June 2017 during the rainy period. Similar observations were made by Shiddamallayya and Pratima (2008) and Tidme and Shinde (2012). BOD is significantly correlated to sulphate and COD while inversely correlated to TDS, humidity and phosphate. Jalilzadeh et al. (2008) also reported positive correlation of BOD with DO and COD.

The most important sources of phosphates are the discharge of domestic sewage, detergents and agricultural runoff. In the present study, phosphate concentration was almost nil during 2017 but, gradually increased in January, 2018. Maximum value was recorded during March and April, 2018. Goudar and Sayeswara (2011) also recorded higher values of phosphate in the month of April from Bhudhigere tank, Shivamogga. In the present study, phosphate levels were positively correlated with humidity, salinity, TDS and total hardness while inversely correlated with transparency and sulphate. Concentration of TDS from natural sources can vary depending on the solubility of minerals in different geological regions (WHO 1996). In the present study, TDS was maximum during April 2018 (mid-summer) while minimum in June 2018 (rainy season). Patil and Patil (2015) also reported the decrease of TDS in monsoon season and opined that such decrease was due to dilution by rainwater. The increase of TDS value during April, 2018 can be attributed to the increased rate of evaporation of water as also reported by others (Verma et al. 2012, Tiwari and Ranga 2012, Patil and Patil 2015). TDS exhibited positive correlation with humidity while showed significant inverse correlation with rainfall.

The zooplankters response to hydrological factors is complex, due to the interplay of environmental processes and the biology of zooplankters (Chaparro et al. 2011). The variable environmental conditions strongly affect the distribution of zooplankton species (Dauvin et al. 1998, Hulyal and Kaliwal 2008). In the present study, the total richness of zooplankters was low during winter but gradually increased in summer and was highest during monsoon. Similar observations were also made from Lake Bracciano by Polli and Simona (1992) and Ferrara et al. (2002). Rotifera are the predominant group of zooplankton found in the majority of reservoirs, constituting more than 60% of the total zooplankton present. This can be generally attributed to their high fecundity, parthenogenic reproduction and high growth rates (Abdulwahab and Rabee 2015, Balakrishna et al. 2013). In the present study Rotifers were represented with highest species richness (31 species).

Brachionidae was the major family amongst which *Brachionus* species were prominent. According to Khan and Ejike (1984) and Green (1994), *Brachionus* is a common genus of tropical waters. High abundance of *Brachionus* is considered as an indicator for eutrophy (Gannon and Stemberger 1978, Sladecek 1983, Noguiera 2001). *Brachionus angularis, B. calyciflorus, B.caudatus, B. falcatus, Keratella tropica, Pompholyx sulcata, Filinia opoliensis, Rotaria neptunia* and *Polyarthra* sp. are recorded as eutrophic indicator species (Sharma 2001). *Brachionus diversicornis, Brachionus calyciflorus* and *Trichocerca cylindrica* were observed almost throughout the study period. *Keratella tropica, Filina opolenisis* and *Brachionus forficula* were the most abundant species. Maximum abundance was recorded in summer season (in May, 2017). Sharma and Singh (2012) opine that, highest abundance during summer is due to short development rate and fish predation on larger zooplankton. Rotifers significantly correlated to protozoa while inversely correlated with free CO_2 and total hardness.

Cladocera was the most abundant group in the present study with highest number of individuals and maximum relative abundance represented with 19 species (Table 5). According to Santos–Wisniewski et al. (2002), Serafim et al. (2003), Garcia et al. (2009), submerged and emerging macrophytes favour flourishing of Chydoridae and Macrothricidae members. Even in the present study, family Chydoridae was represented with maximum species. Aquatic vegetation like *Cyperus* sp. and *Eleocharis* sp. found in the water body might have favoured the species richness.

According to Sampaio et al. (2002), cladocerans are claimed to be good indicators of trophic status in lentic ecosystem. *Ceriodaphnia corunata* represented the family Daphinidae. *Bosminopsis dietersi* and *Bosmina longirostris* proved to be the most abundant cladocerans during the study. According to Gannon and Stemberger (1978), species of *Bosminopsis dietersi* are the good indicators of trophic state. Among the family Sididae, *Diaphanosoma* (*D. excuism* and *D. sarsi*) along with *Moina micrura* were found relatively in low numbers. Similar observation was also made by Silva et al. (2003). Cladocera expressed positive correlation with rotifers and copepods.

The copepods showed much oscillation with respect to monthly abundance and did not exhibit any correlation with physicochemical factors. Thakur et al. (2013) have reported the irregular occurrence and similar observations. The cyclopoid copepods were present with relatively high abundance than the calanoids. *Tropocyclops prasinus* and *Paracyclops fimbriatus* followed by *Mesocyclops leuckarti* were the main contributors for the abundance. *P. fimbriatus* and *T. prasinus* were almost present throughout the study period exhibiting their better adaptability over Calanoida as suggested by Matsumara-Tundisi et al. (1981) and Nogueria (2001). Cyclopoids are more tolerant to the environmental parameters (Ferrara et al. 2002) and exhibited predominancy over low numbers of calanoids at high trophic levels indicates eutrophic conditions (Karabin 1983, Patil and Gouder 1985). Copepods showed inverse correlation with free CO_2.

Ostracods exhibited maximum abundance and species richness during September, 2017 (rainy season) and May, 2018 (late summer), respectively. Pullie and Khan (2003) reported highest population during monsoon. *Hemicypris fossulata* was recorded maximum during September, 2017 (rainy season) while *Ilyocypris* sp was observed abundant. Ostracods expressed inverse correlation with pH.

Amongst protozoans testate amoebae (Lobosa: Arcellinidae) are the shelled individuals that are widely distributed and particularly abundant in peat lands and lakes. They are benthic (rarely planktonic) microorganisms, characterized by the agglutinated vase-shaped shell (Qin et al. 2009) as they are environmentally sensitive, they can be useful as bioindicators of water quality for monitoring aquatic systems and paleo-environmental studies (Booth 2001, Song et al. 2014). In the present study, maximum species richness was observed in monsoon, followed by summer and minimum in winter their abundance was more during summer. Sharma and Singh (2012) also reported similar order of species richness during their study in Tighra river. Diversity indices serve as good indicator of pollution of water. Unpolluted waters are characterized by rich diversity and occurrence of large number of species (Thakur et al. 2013). Due to the adverse effect of pollutants, sensitive species get eliminated and only the tolerant species increase in number and attain dominance.

As per Dominance_D values, the highest to lowest dominance of zooplankton group lies in the following sequence; Protozoa > Cladocera > Rotifera > Copepoda > Ostracoda. The population of Protozoa dominates leading to the decrease in its diversity. This is followed by Cladocera (0.1471) with the diversity (0.8529). The dominance value of Rotifera (0.1045) decrease with the diversity value (0.8955). In case of copepods, the dominance value decreased (0.09989) while the diversity value of increased (0.9001). Ostracods were the least dominated group (0.09408) accords with the increase in the diversity value (0.9059).

According to the Simpson_1-D diversity values, Ostracoda with least number of species richness and abundance reveals highest diversity of 0.0959 followed by Copepoda (0.9001), Rotifera (0.8955), Cladocera (0.8529) and Protozoa (0.8493).

However, the Shannon (H) values revealed that Copepoda are more diverse than Rotifera followed by Ostracoda, Cladocera and Protozoa the least. Evenness (E) values reciprocates with the Simpson's diversity values displaying high evenness (0.9119) by Ostracoda followed by Copepoda, Rotifera, Cladocera and least by Protozoa (0.7896) (Table 5). According to $Q_{B/T}$ quotient (Sladecek 1983) the ratio between the number of species of *Brachionus* and *Trichocerca* reveals the trophic status of the water body. *Brachionus* genus is associated with eutrophic waters (except *B. sericus* and *B. plicatilis* while the genus *Trichocerca* is purely oligotrophic. In the present study, nine species of *Brachionus* and three species of *Trichocerca* were recorded. As per $Q_{B/T}$ quotient the study area is in eutrophic state.

CONCLUSIONS

In the present study higher values of electric conductivity (more than 200 µmhos), high abundance of trophic indicators like, *Brachionus angularis, B. calyciflorus, B. caudatus, B. falcatus, Keratella tropica, Pompholyx sulcata, Filinia opoliensis, Rotaria neptunia, Polyarthra* sp. indicate that, the status of Bidi minor irrigation tank is eutrophic. In the absence of effective water treatment facilities in rural areas a collective effort from the scientists, policy makers and public are essential towards the sustainable management of catchment area. The measures such as periodic desilting, implementation of organic farming, reduction in the use of chemical fertilizers, maintaining good vegetation patches that preventssoil erosion will not only reduce the pollution load but also aids in reviving of the tank and help in its intended use.

ACKNOWLEDGEMENTS

Authors thank Mr. Manjunath B. Hosamani for his assistance during field collection and Mr.Akshay V. Deshpande and Mr. Basavaraj S.K in the preparation of the manuscript.

Authors' Contribution: HN has done the field related work, collected and analyzed the water samples. GK has reviewed the manuscript and finalized for publication.

Conflict of interest: We declare that there is no conflict of interest.

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Received:1st October 2021
Accepted:17th February 2022