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Physical-chemical analysis of Wetlands with variety in Zooplankton and Phytoplankton

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Abstract - The variety and richness of zooplankton and phytoplankton populations within these habitats are significantly influenced by the physical and chemical properties of wetlands. This research sought to determine how the physical-chemical characteristics of wetlands and the variation in zooplankton and phytoplankton populations related to one another. The study entailed collecting and analysing water samples from several wetlands with a variety of physical characteristics, including size, depth, and water flow patterns. Measurements were made of a number of chemical factors, such as pH, dissolved oxygen levels, nutrient concentrations, and organic matter content. Samples of phytoplankton and zooplankton were also taken at the same time and identified to determine their relative quantity and composition. The distribution of zooplankton and phytoplankton species and the physical-chemical characteristics of wetlands were shown to be significantly correlated in the findings. In conclusion, our research showed how diverse zooplankton and phytoplankton populations interact intricately with physical-chemical factors in wetland ecosystems. Understanding these connections may help with efforts to conserve and manage wetlands in the face of environmental changes by revealing important information about their ecological health and functioning. The dynamics of these interactions throughout time and how they affect the stability and resilience of an ecosystem as a whole might be the subject of future study.

Keywords - Physical-chemical, zooplankton, phytoplankton

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INTRODUCTION

Freshwater resources are essential for life. They occur in minute proportions relative to all water sources on Earth and are inequitably distributed and used. Although Gujarat and Madhya Pradesh are reputed to be adequately endowed with freshwater resources, significant threats to the quality and quantity of those resources are apparent. Surface waters provide about three-quarters of the total volume of water supplied for domestic, industrial/ commercial and irrigation purposes in Gujarat and Madhya Pradesh.

The dynamics of phytoplankton are a function of many of the some environmental processes that affect species diversity. For example, the onset of the spring bloom in dimitic lakes is controlled by the relief of light limitation at a time when nutrient concentrations are high and growth abundance is low (Roelke and Buyukates, 2002). The abundance of algae of different kinds is rather closely associated with restricted seasonal periodicity, differing of course in widely separated geographical locations(Smith, 1951). Within reservoirs, the irregular dynamics of inflow and variable flushing rates markedly alter environmental conditions for biotic communities. A reservoir can be viewed as a very dynamic lake in which a significant portion of its volume possesses characteristics of, and functions biologically as,a river (Wetzel, 2001).

The zooplanktons are animal plankton and move at the mercy of water currents. They occupy central position between the autotrophs and other heterotrophs in an aquatic ecosystem and form a major link in the entire food chain and main energy source for fishes truly planktonic animals in fresh waters are dominated by Rotifera, Cladocera and · Copepoda. Protozoans also form a significant part of fresh water zooplankton.

REVIEW OF LITERATURE

Most of the Indian lakes are alkaline in nature (Singh and Mathur, 2005; Abd- Ellatif *et al*., 2016). pH affects the solubility and availability of micronutrients like Fe, Cu, Mn and Zn and also controls the water treatment systems and disinfectants in municipal water supply (Mallampati and Osman, 2015). It also controls the chemical state of DO, nitrate and phosphate (Kumar *et al*., 2017).Variation of pH was seen between 6.3 and 8.5; lowest in Khanduwa Dam (S4) in winter 2021 and highest Parsada Lake (S1) in post monsoon 2019 (Shrivastava and Kanungo, 2013; Saad *et al*., 2017; Satyanarayana and Krishna, 2017). But in most of the samples, pH was maintained at an average of 7.5. On an average, the pH was high in winter and pre monsoon (tables 4.1 and 4.2). Higher pH was usually observed in post monsoon and winter in the first sampling period, and

in winter and pre monsoon in the second sampling period in most of the samples. In dry season, increased decomposition increases CO_2 which increases the amount of carbonates and bicarbonates resulting in higher pH (Manohar *et al*., 2017). This variation was due to variation in rainfall in the two sampling years (figure 4.2). Increase in pH in pre monsoon was affected by temperature, waste disposal, photosynthesis, respiratory and decomposition activities (Abowei, 2010; Manohar *et al*., 2017). High pH may increase water temperature and decrease germicidal capacity of Cl. Lower pH was due to hydrolysis of cations, oxidation of sulphur compounds and due to dissolved acidic gases (Ojok *et al*., 2017).

Sharma (2010) studied the Phytoplankton communities of the sampled pats are characterized by higher species diversity, higher evenness and lower dominance. The related works from northeastern India are confined to preliminary reports (Yadava et al. 1987; Goswami & Goswami 2001) from certain floodplain lakes ('heels') of Assam while Sharma (2004) initiated detailed analysis of phytoplankton of a heel of upper Assam and Sharma (2010) studied their ecology in Deepor heel (a Ramsar site). On the contrary, the studies in the floodplain lakes('pats') of Manipur refer to a recent contribution (Sharma 2009) on phytoplankton diversity of Loktak Lake (Ramsar site).

Hafsa and Gupta (2009) studied the Phytoplankton diversity and reported that growth of phytoplankton is governed by transparency, total suspended solids, calcium and total hardness. These types of studies are prerequisites for evolving fish culture programmes and management of water resources. Diversity, distribution, abundance and variation in the biotic factors provide information of energy turnover in the aquatic systems (Forsberg, 1982). In these systems phytoplankton is of great importance as a major source of organic carbon located at the base (Gaikwad et al., 2004). Their sensitivity and large variations in species composition are often a reflection of significant alteration in ambient condition within an ecosystem (Devassy and Goes, 1988, 1989). Hence for any scientific utilization of water resources plankton study is of primary interest. Several studies on phytoplankton diversity made in India and abroad on the ponds, lakes and reservoirs (Tiwari and Chauhan, 2006; Sridhar et al., 2006; Tas and Gonulol, 2007; Senthilkumar and Sivakumar, 2008) also revealed the importance of this type of study. In this paper an attempt has been made to study the seasonal variation of phytoplankton diversity and dynamics of a part of Chatla floodplain lake and its correlations with the physico-chemical properties of water. This study may be of help to the poor people of Chatla as abundance of phytoplankton is of considerable assistance in evolving fish culture programmes (Bohra and Kumar, 2002).

MATERIALS AND METHODS

Sample site

The wetlands of New Raipur are considered as ecological important wetlands. Ecological wetlands are among the most productive ecosystems in the world they also are a source of substantial biodiversity in supporting numerous species. Wetlands provide habitat for assortment of wild life species.

Table 1: Wetlands and Diversity

S. No.	Wetland	Diversity
1.	Parsada Lake	1.54
2.	Bandha Dam	1.42
3.	Khuteri Lake I	1.20
4.	Khanduwa Dam	1.35
5.	Khuteri Lake II	1.16
6.	Chherkapur Lake	1.13
7.	Maharajabandh Lake	1.14

Sample collection

Analysis of physico-chemical parameters of water samples help to determine the type of pollution that may be affecting a waterway and can provide some clues as to the sources. Water quality is good if naturally occurring substances are present at levels that support aquatic life. Problems occur when activities alter natural levels or introduced substances that are toxic to aquatic life. In the present investigation, the physico-chemical parameters used to analyze the water quality are pH, temperature, turbidity, electrical conductivity (EC), total hardness (TH), Calcium (Ca), Magnesium (Mg), alkalinity (Al), Chloride (Cl), Fluoride (Fl), Nitrate (NO_3), Sulphate (SO_4), Phosphate (PO_4), Ferrous (Fe), Dissolved oxygen (DO), Biochemical oxygen demand (BOD) and Chemical oxygen demand (COD).

Physico-chemical parameters

The pH and temperature were recorded on spot. To estimate DO, samples were collected in separate sterilized 300 ml BOD bottles immediately fixed using Winkler's reagent. In addition, samples acidified with H_2SO_4 and nitric acid were collected in three separate bottles of 50 ml. The samples were used for the analysis ofBOD and for acidity, alkalinity and inorganic ions in laboratory.

Statistical analysis

The relationship between the parameters was examined using Pearson's correlation coefficient which ranges from -1 to +1.

The obtained data were subjected to PCA, using PAST statistical software program.

Water quality assessment using water quality index (wqi)

The WQI can be calculated using information software and is compared with water quality ratings.

Biological examination of water samples to determine potabilityand sanitary quality

Bacteriological parameters were analyzed by following methods of AWWA (1995) and APHA (1995). For H_2S strip test, updated protocols from Manja *et al.* (1982) were used. The growth and plating media used in this study were dehydrated media from Hi-media, Mumbai, India. The following bacterial parameters were enumerated and various bacteria were isolated and identified.

The presence of H_2S producing pathogenic bacteria was identified by filling the H_2S strip bottle up to the mark with lake water sample and was incubated for 24- 48 h at 37□C. Development of black precipitation indicates the presence of H_2S producing bacteria. The sample was culture on agar plate and the colonies were subjected to triple sugar iron test for further identification.

Observation and identification of important phytoplankton

The water samples were collected from sampling lakes for microphytoplankton analysis in plastic containers of 1 L. Filamentous algae and other floating debris were avoided. About 25 ml of 4% formaldehyde was added to 1 L water sample (Welch, 1948). Few drops of Lugol's iodine were added for preservation until analysis. Sedimentation was done in glass columns; the sediment was finally reduced to 20 ml and was preserved in a glass vial. A drop was mounted on a slide from each vial and a cover slip was carefully placed over it. Five high power fields, one in each corner of the cover slip and one at the centre were performed and the algal populations were calculated. Random observations were made and it was repeated four times for each sample. This procedure was repeated for each sample and the number of each repeated organisms were estimated for organism/L (Rao, 1995). Identification of plankton to species level were made using the monographs of Welch (1948), Desikachary (1962), Philipose (1960), Prescott (1982), Philipose (1967), Sarode and Kamath (1984), Gandhi (1998) and Taylor *et al*. (2007). The collections, preservation, enumeration of plankton were made as described by Hosmani and Kumar (1996). The calculation was made using Lackey's drop method (1938) as mentioned in APHA (1985) and modified by Saxena (1987) using the formula,

$$\text{Phytoplankton Unit/liter} = n \times c / v \times 100$$

where, n = total number of phytoplankton counted in 0.1 ml concentratec = total volume of concentrate in ml

v = total volume of water filtered through the net

The plankton were expressed as organism per liter and data were subjected to PAST program for calculating diversity indices. The biological data were used for determining the ecological conditions of water and the trophic status was subjected for statistical analysis. Few of the indices like, dominance index, species richness and species evenness index, Simpson index and Shannon and Weaver's diversity index have been applied.

Various indices applied to analyse the water quality based onphytoplankton diversity

A diversity index is a quantitative measure that reflects types (such as species) and evenness (such as individuals) of distribution among plankton. The value of a diversity index increases with increase in types and evenness. For given number of types, the value of a diversity index is maximized when all types are equally abundant (table 3.5). This was calculated by using Paleontological software.

The Shannon index is originally an information statistic index, which assumes that all species are present in a sample and the sampling is done in random way. Shannon index can be calculated by,

$$\text{Shannon Index (H)} = -\sum_{i=1}^{s} p_i \ ln \ p_i$$

p, = proportion (n/N) of individuals of one particular species found (n) divided by the total number of individuals found (N); **ln**, = natural log; **Σ**, = sum of the calculations, and **s**, = number of species.

The Index of saprobity-Eutrophication (IDSE) conception is the diatom index of saprobity (Louis-Leclercq, 2008) with index values from 1 to 5 which indicates the levels of degradation in the lake. It also classifies the lakes based on eutrophication and organic pollution for group E of taxa with saprobic values from 3.0 to 3.5, and group S of taxa with values from 1.0 to 2.9.

The surface water samples collected for identifying microzooplankton was preserved immediately with the help of 4% formalin. The samples were analyzed qualitatively under the microscope for different types of zooplankton by wet mounting of technique using safranine dye. Identification of zooplankton was carried out by using the keys in published literature (Dhanapathi, 2000; Altaff, 2003).

Interrelationship between physico-chemical and biological parameters ofwater samples

The result of the study of physico-chemical and microbiological parameters in different seasons during the sampling period were compared to understand the relation between them. Experimental values were compared with the standard values, by traditional approaches to conclude the quality of water and its seasonal variation. Transfer and interpretation of complex data into useful and understandable way to technicians, policy makers and general public can be achieved to some extent by integrating the obtained data set, manual comparison of occurrence and variation in population and by application of statistical methods (Mahadev *et al*., 2010). Correlations were examined using PCM.

Interrelationship between indicator bacteria and plankton of lake water

Values of Pearson's correlation coefficient, calculated after log10 transformation, were generally used in interpreting the results and it is described in the thesis. All the statistical analyses were carried out by using SPSS for Windows release 16.0 and PAST.

RESULT AND DISCUSSION

Physico-chemical analysis

The sampling was done for two years and in each year the sampling was done in four seasons. Sampling and analysis was carried out on the selected lake water for eight times in the whole study period. Physico-chemical parameters analyzed were pH, Temperature, EC, Turbidity, Alkalinity, TH, Ca, Mg, Cl, Fl, Nitrate, Sulphate, Phosphate, Fe, DO, BOD and COD. The physico-chemical result obtained is represented in the following tables 1 and 2.

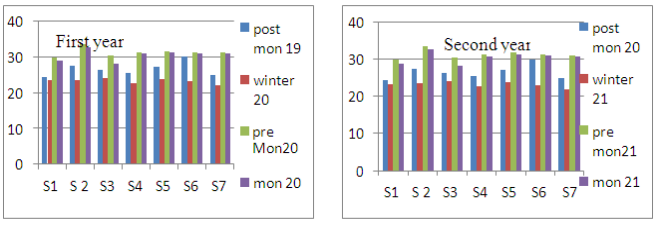

Figure 1: Seasonal variations in temperature (□C)

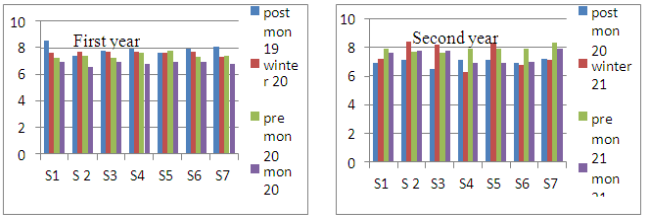

Figure 2: Seasonal variations in pH

Bacteriological analysis

In Parsada Lake, APC ranged between 54×10^4 CFU ml^{-1} (monsoon) and 29×10^4 CFU ml^{-1} (winter) and maintained an average of 38.6×10^4 CFU ml^{-1}in the sampling period (Krishnan *et al*., 2007). HPC ranged between 57×10^4 CFU ml^{-1} (monsoon) and 24×10^4 CFU ml^{-1} (winter) and average of 38.8×10^4 CFU ml^{-1} was maintained (Hasan *et al*., 2006). In Bandha Dam, Fecal streptococci ranged between 270 MPN 100 ml^{-1} (monsoon) and 33 MPN 100 ml^{-1} (winter) with an average of 139.5 MPN 100 ml^{-1}. *Escherichia coli* count ranged from 77 CFU 100 ml^{-1} (pre monsoon) to 8 CFU 100 ml^{-1} with an average of 41 CFU 100 ml^{-1} (winter) (Usha *et al*., 2008; Negera *et al*., 2017). In Khuteri Lake I, Fecal streptococci ranged between 350 MPN 100 ml^{-1} (pre monsoon) and 70 MPN 100 ml^{-1} (winter), with an average of 191.3 MPN 100 ml^{-1} (Mishra *et al*., 2009). *Escherichia coli* count ranged from 94 CFU 100 ml^{-1} (pre monsoon) to 4 CFU 100 ml^{-1} (winter), with an average of 54.6 CFU 100 ml^{-1} (Omezuruike *et al*., 2008; Negera *et al*., 2017). In Khanduwa Dam, APC ranged from 186×10^4CFU ml^{-1} (monsoon) to 9 CFU$\times10^4$ ml^{-1} (post monsoon), with an average of 88.3×10^4CFU ml^{-1} (Abila *et al*., 2012). HPC ranged from 164×10^4CFU ml^{-1} (monsoon) to 73×10^4CFU ml^{-1} (winter), with an average of 111.3×10^4CFU ml^{-1}. In Khuteri Lake II, APC ranged from 62×10^4 CFU ml^{-1} (pre monsoon) to 35×10^4 CFU ml^{-1} (winter), with an average of 47.9×10^4 CFU ml^{-1} (Krishnan *et al*., 2007). HPC count was from 62×10^4 CFU ml^{-1} (pre monsoon) to 29×10^4 CFU ml^{-1} (winter), with an average of 44.5×10^4 CFU ml^{-1} (Hasan *et al*., 2006). TC count rangedfrom 1600 MPN 100 ml^{-1} (pre monsoon) to 110 MPN 100 ml^{-1} (winter), with an average of 441.3 MPN 100 ml^{-1}(Shahapure *et al*., 2014). Fecal streptococci count ranged between 21 MPN 100 ml^{-1} (pre monsoon) and 4 MPN 100 ml^{-1} (winter), with an average of 12.9 MPN 100 ml^{-1} (Krishnan *et al*., 2007). *Escherichia coli* count ranged between 71CFU 100 ml^{-1} (pre monsoon) and 0 CFU 100 ml^{-1} (winter), with an average of 21.4 CFU 100 ml^{-1} (Usha *et al*., 2008; Negera *et al*., 2017). Tables 1 - 7: Seasonal variations of bacteriological parameters for the studyperiod

Table 1: Seasonal variations of bacteriological parameters in Parsada Lake

S1	Seasons	APC	HPC	TC	FC	Staph	Strep	*E. coli*
First sampling year	Post Mon 2019	41×10^4	35×10^4	240	110	63	79	43
	Winter 2020	31×10^4	36×10^4	140	14	70	63	19
	Pre Mon2020	45×10^4	41×10^4	>2400	>2400	94	110	84
	Mon 2020	54×10^4	57×10^4	920	79	79	240	27
Second sampling year	Post Mon 2020	31×10^4	31×10^4	540	94	70	79	53
	Winter 2021	29×10^4	24×10^4	220	21	26	79	35
	Pre Mon 2021	36×10^4	40×10^4	1100	170	33	94	95
	Mon 2021	42×10^4	46×10^4	920	130	34	280	71

APC: Aerobic Plate Count (CFU ml^{-1}); **HPC**: Heterotrophic Plate Count (CFU ml^{-1}); **TC**: Total Coliform (MPN 100 ml^{-1}); **FC**: Fecal Coliform (MPN 100 ml^{-1}); **Staph**: fecal staphylococci (MPN 100 ml^{-1}); **Strep**: fecal streptococci (MPN 100 ml^{-1}); ***E. coli****: Escherichia coli* (CFU 100 ml^{-1})

Table 2: Seasonal variations of bacteriological parameters in Bandha Dam

S2	Seasons	APC	HPC	TC	FC	Staph	Strep	*E. coli*
First sampling year	Post Mon 2019	63×10^4	57×10^4	540	94	31	110	20
	Winter 2020	48×10^4	41×10^4	220	14	27	33	8
	Pre Mon2020	103×10^4	97×10^4	>2400	220	110	240	57
	Mon 2020	82×10^4	73×10^4	220	23	31	270	72
Second sampling year	Post Mon 2020	56×10^4	32×10^4	920	110	43	130	19
	Winter 2021	32×10^4	27×10^4	240	34	22	34	15
	Pre Mon 2021	93×10^4	63×10^4	1600	540	94	220	77
	Mon 2021	62×10^4	39×10^4	350	220	79	79	60

APC: Aerobic Plate Count (CFU ml^{-1}); **HPC**: Heterotrophic Plate Count (CFU ml^{-1}); **TC**: Total Coliform (MPN 100 ml^{-1}); **FC**: Fecal Coliform (MPN 100 ml^{-1}); **Staph**: fecal staphylococci (MPN 100 ml^{-1}); **Strep**: fecal streptococci (MPN 100 ml^{-1}); ***E. coli****: Escherichia coli* (CFU 100 ml^{-1})

Table 3: Seasonal variations of bacteriological parameters in Khuteri Lake I

S3	Seasons	APC	HPC	TC	FC	Staph	Strep	*E. coli*
First sampling year	Post Mon 2019	41×10^4	75×10^4	220	140	94	170	70
	Winter 2020	44×10^4	51×10^4	94	43	70	130	13
	Pre Mon2020	61×10^4	92×10^4	540	540	140	350	80
	Mon 2020	58×10^4	101×10^4	220	240	26	240	76
Second sampling year	Post Mon 2020	38×10^4	52×10^4	240	240	110	110	46
	Winter 2021	31×10^4	39×10^4	140	43	43	70	4
	Pre Mon 2021	54×10^4	74×10^4	540	540	63	280	94
	Mon 2021	49×10^4	96×10^4	240	220	49	180	54

APC: Aerobic Plate Count (CFU ml^{-1}); **HPC**: Heterotrophic Plate Count (CFU ml^{-1}); **TC**: Total Coliform (MPN 100 ml^{-1}); **FC**: Fecal Coliform (MPN 100 ml^{-1}); **Staph**: fecal staphylococci (MPN 100 ml^{-1}); **Strep**: fecal streptococci (MPN 100 ml^{-1}); ***E. coli****: Escherichia coli* (CFU 100 ml^{-1})

Table 4: Seasonal variations of bacteriological parameters in Khanduwa Dam

S4	Seasons	APC	HPC	TC	FC	Staph	Strep	*E. coli*
First sampling year	Post Mon 2019	9×10^4	92×10^4	1600	220	94	110	41
	Winter 2020	75×10^4	80×10^4	540	140	94	79	47
	Pre Mon2020	116×10^4	119×10^4	>2400	1600	110	240	101
	Mon 2020	186×10^4	164×10^4	>2400	220	220	540	99
Second sampling year	Post Mon 2020	72×10^4	91×10^4	1600	540	130	94	63
	Winter 2021	64×10^4	73×10^4	350	240	22	110	39
	Pre Mon 2021	83×10^4	109×10^4	>2400	2400	46	240	98
	Mon 2021	101×10^4	162×10^4	920	540	63	920	94

APC: Aerobic Plate Count (CFU ml^{-1}); **HPC**: Heterotrophic Plate Count (CFU ml^{-1}); **TC**: Total Coliform (MPN 100 ml^{-1}); **FC**: Fecal Coliform (MPN 100 ml^{-1}); **Staph**: fecal staphylococci (MPN 100 ml^{-1}); **Strep**: fecal streptococci (MPN 100 ml^{-1}); ***E. coli****: Escherichia coli* (CFU 100 ml^{-1})

Table 5: Seasonal variations of bacteriological parameters in Khuteri Lake II

S5	Seasons	APC	HPC	TC	FC	Staph	Strep	*E. coli*
First sampling year	Post Mon 2019	43×10^4	32×10^4	220	110	70	70	57
	Winter 2020	39×10^4	29×10^4	110	11	63	63	20
	Pre Mon2020	53×10^4	54×10^4	1600	1100	130	280	66
	Mon 2020	56×10^4	44×10^4	350	23	79	220	74
Second sampling year	Post Mon 2020	43×10^4	41×10^4	350	540	27	43	47
	Winter 2021	35×10^4	42×10^4	220	79	26	94	36
	Pre Mon 2021	63×10^4	62×10^4	540	240	79	350	74
	Mon 2021	52×10^4	52×10^4	140	220	70	170	80

APC: Aerobic Plate Count (CFU ml^{-1}); **HPC**: Heterotrophic Plate Count (CFU ml^{-1}); **TC**: Total Coliform (MPN 100 ml^{-1}); **FC**: Fecal Coliform (MPN 100 ml^{-1}); **Staph**: fecal staphylococci (MPN 100 ml^{-1}); **Strep**: fecal streptococci (MPN 100 ml^{-1}); ***E. coli****: Escherichia coli* (CFU 100 ml^{-1})

Table 6: Seasonal variations of bacteriological parameters in Chherkapur Lake

S6	Seasons	APC	HPC	TC	FC	Staph	Strep	*E. coli*
First sampling year	Post Mon 2019	35×10^4	77×10^4	94	79	46	140	59
	Winter 2020	31×10^4	53×10^4	79	43	26	94	24
	Pre Mon2020	44×10^4	91×10^4	240	170	49	170	95
	Mon 2020	63×10^4	123×10^4	220	94	70	280	61
Second sampling year	Post Mon 2020	25×10^4	59×10^4	220	130	63	79	50
	Winter 2021	23×10^4	39×10^4	140	63	49	46	41
	Pre Mon 2021	30×10^4	76×10^4	920	1600	70	140	99
	Mon 2021	39×10^4	100×10^4	240	350	110	350	85

APC: Aerobic Plate Count (CFU ml^{-1}); **HPC**: Heterotrophic Plate Count (CFU ml^{-1}); **TC**: Total Coliform (MPN 100 ml^{-1}); **FC**: Fecal Coliform (MPN 100 ml^{-1}); **Staph**: fecal staphylococci (MPN 100 ml^{-1}); **Strep**: fecal streptococci (MPN 100 ml^{-1}); ***E. coli****: Escherichia coli* (CFU 100 ml^{-1})

Table 7: Seasonal variations of bacteriological parameters in Maharajabandh Lake

S7	Seasons	APC	HPC	TC	FC	Staph	Strep	*E. coli*
First sampling year	Post Mon 2019	36×10^4	39×10^4	110	21	0	14	12
	Winter 2020	31×10^4	42×10^4	43	4	2	17	0
	Pre Mon2020	61×10^4	73×10^4	160	43	9	21	22
	Mon 2020	49×10^4	54×10^4	94	23	4	14	35
Second sampling year	Post Mon 2020	41×10^4	48×10^4	94	27	6	5	2
	Winter 2021	32×10^4	31×10^4	70	14	0	4	0
	Pre Mon 2021	58×10^4	69×10^4	220	79	7	17	71
	Mon 2021	50×10^4	52×10^4	140	63	5	11	29

APC: Aerobic Plate Count (CFU ml^{-1}); **HPC**: Heterotrophic Plate Count (CFU ml^{-1}); **TC**: Total Coliform (MPN 100 ml^{-1}); **FC**: Fecal Coliform (MPN 100 ml^{-1}); **Staph**: fecal staphylococci (MPN 100 ml^{-1}); **Strep**: fecal streptococci (MPN 100 ml^{-1}); ***E. coli****: Escherichia coli* (CFU 100 ml^{-1})

CONCLUSION

Physico-chemical characters govern the stability of aquatic ecosystem. The planktonic communities are impacted by the changes in abiotic features (Riddhi *et al*., 2011). Complicated circulation and mixing pattern of lake water, chemical and biological process in lake water column due long retention affect the flora and fauna and the quality of lake water. Parameters like pH, temperature drives many of chemical reaction in living organisms.

REFERENCES

1. Agnieszka, P. and Walk-Wozniak, E. (2007). Effect of environmental conditions on rotifers and selected phytoplankton species in three sub mountain Dam Southern Polands, Central Europe. Ekologia, 26(2): 132– 142.
2. Campbell, P. G. C. and Stokes, P. M. (1985). Acidification and toxicity of metals to aquatic biota. Canadian Jour. Fish. Aquat. Sci., 42: 2034- 2049.
3. Fee, E. J. (1998). Computer Programs for calculating in situ phytoplankton photosynthesis. Canadian Technical Report of Fisher. and Aquatic Scie. 1740.
4. Ferrarra, O., Vagaggini, D. and Margaritora, F.G. (2002). Zooplankton abundance and diversity in Lake Bracciano, Latium, Italy. Jour. Limnol., 61(2): 169-175.
5. Frisch, D. and Green, A. J. (2007). Copepods come in first: rapid colonization of new temporary ponds. Fundam. and Appl. Limnol.- Archiv fur Hydrobiol. 168(4): 289-297.
6. Hashimoto, S., Horimoto, N., Yamaguchi, Y., Ishimaru, T. and Saino,T. (2005). Relationship between net and gross primary production in the Sagami Bay, Japan. Limnol. and Oceanogr., 50(6): 1830–1835.
7. Isaiarasu, L. and Mohandoss, A. (1998). Hydrobiological survey in ponds around Sivakasi. The Proceeding of National Symposium on Environment Biology. P. 212. St. XaviersCollege, Palayamkottai, India.
8. Issarapon, J. and Ladda, W. (2006). Composition and distribution of zooplankton in the Pasak Jolasid reservoir, Lop Buri Province. Kasetsart University Fisheries Research Bulletin, 30: 1-18.
9. Ndome, C. B., Udo, I.U., Akpan, I. I. and Udom, C. (2012). Effect of water quality and bottom soil properties on the diversity and abundance of macrobenthic founa in some Tropical Grow-out earthen fish pond, Nigeria. Ecologia, 2(1):12-22.
10. Neves, I. F., Recha, O., Roche, K. F. and Pinto, A. A. (2003). Zooplankton community structure of two marginal lakes of the river Cuiaba (Mato Grosso, Brazil) with analysis of Rotifera and Cladocera diversity. Braz. Jour. Biol., 63: 1-20.
11. Nogueira, M.G. (2001). Zooplankton composition, dominance and abundance as indicators environmental compartmentalization in Jurumirim reservoir (Paranapanema river), Sao Paulo, Brazil. Hydrobiol., 455: 1-18.
12. Ogbuagu, D. H., Ngozi, A. C. C., Okoli, C. G. and Tony R. F. N. (2011). Physico chemical gradients and in situ yields in pelagial primary production of the middle reaches of Imo river in Etche, South-eastern Nigeria. Jour. of Ecol. and the Natural Envir., 3(2): 47-53.
13. Paulose, P. V. and Maheshwari, K. (2008). Seasonal variation in zooplankton community structure of Ramgarh lake, Jaipur, Rajasthan. Proceedings of Taal2007: 12Th world lake conference: 82-87.
14. Pawar, S. K. and Pulle, J. S. (2005). Qualitative and quantitative study of zooplankton in Pethwaraj Dam, Nanded Ditrict , Maharashtra, India. Jour. Agro. Biol., 20(2): 53-57.
15. Peggy, W. L., Sommer, T. and Rivard, L. (2007). The influence of floodplain habitat on the quantity and quality of riverine phytoplankton carbon produced during the flood season in San Francisco Estuary. Aqua. Ecol, 1-16.
16. Prabhahar, C., Saleshrani, K. and Enbarasan, R. (2011). Studies on the ecology and distribution of zooplankton biomass in Kadalur coastal zone, Tamil nadu, India. Curr. Bot. 2(3): 01-04.
17. Prabhakar, V. M, Vaidya, S. P., Garud, V. S. and Swain, K. K. (2009). Trend of Primary Production in Khadakwasla Reservoir. 13th World Lake Conference, Wuhan, China.
18. Prakash, S. and Srivastava, R. R. (2001). Effect of hydrological parameters on the population of cladoceran and copepods of Motisagar tal. Balrampur, UP. Acta Ecol., 23(1).
19. Sachidanandamurthy, K. L. and Yajurvedi, H. N. (2006). A study on physicochemical parameters of an aquaculture body in Mysore city, Karnataka, India. Jour. Environ. Biol., 27: 615-618.
20. Sahni, K. and Yadav, Y. (2012). Seasonal variations in physico- chemical parameters of harawas Pond, Rewari, Haryana, Asian Jour. Exp. Sci., 26(1): 61-64.
21. Sahuquillo, M. and Miracle, M.R. (2010). Crustacean and rotifer seasonality in a Mediterranean temporary pond with high biodiversity (Lavajo de Abajo de Sinarcas, Eastern Spain). Limnetica, 29(1):75-92.
22. Sharma, Y. and Jaiswal, R. (2011). Pollution status of a hypertrophic fresh water Pond of

District Mirzapur. Jour. of Pure and Appl. Scie. & Technol. 1:23-30.

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