ISSN: (P): 0976-7436, (e): 2455-054X
ICRJIFR
Impact Factor
3.8919

Voyager
A Journal of Sciences- Life Sciences

Abundance and Diversity of Zooplanktons in relation to Physico-Chemical properties of water in Vadral pond (Chikodi Taluka)

Shri Y. H. Yalavigi
Assistant Professor of Zoology
Basavapabhu Kore College, Chikodi
Belagavi, State: Karnataka.
E-mail- yhyalavigi@gmail.com

Abstract

Water is the most precious gift of nature to all the living organisms and provides the most extensive medium for aquatic animals to live as a universal solvent which contains several essential minerals and gases on which the life depends. To study of functional relationships and productivity of fresh water biotic communities in a pond two years limnological study (April-2013 to March-2016) was carried out on fresh water pounds situated at Ammangi village, Chikodi Taluk of Belagavi district. A total of 22 physico-chemical parameters were studied on monthly basis. The waters of this pond was being used for irrigation purpose and were subjected to biotic disturbances such as bathing, cattle bathing, washing of cloths etc. The study is oriented towards the comparison of biotic and abiotic factors in this pond, monthly variations of physico-chemical factors, quantitative and qualitative estimation of zooplankton, community diversity and uniformity monthwise, quotient QB/T, correlations among abiotic factors and correlations between abiotic factors and zooplankton community. A total of forty three species of zooplankton recorded from the Ammanagi pond. Rotifera was taxonomically dominant group and its density was also high. The pond was mesotrophic in June and July remaining months it was eutrophic and hyperutrophic. The atmospheric temperature, water temperature, bicarbonates. Total Dissolved solids, Magnesium, Chloride, sulphates, Phosophates, Ammonical nitrogen and chemical oxygen demand were high. The atmospheric temperature, water temperature, water transparency and free carbon dioxide were lower in the year of 2013-2014.

The present study clearly showed that all three ponds were eutrophic or hypereutorphic throughout the study period except June and July. The eutrophication in these water bodies is mainly due to increased anthories should take appropriate steps to make the pond clean and free from contamination otherwise water bodies may source of infection for many water born diseases.

Key words : *Ammangi pond, physicochemical parameters, Abiotic factors, Biotic factors, Zooplanktons*

INTRODUCTION

Water is the most precious gift of nature to all the living organisms. Water covers about 71% of the earth's surface and provides the most extensive medium for aquatic animals to live.

Water forms an important constituent of living organisms. Water as a universal solvent contains several essential minerals and gases on which the life depends. Water is the primary need to all life processes. There is no life without water.

To study of functional relationships and productivity of fresh water biotic communities, a new branch of science called Limnology emerged in the early 19th century . The functional relationships and productivity are affected by the dynamics of physical, chemical, biotic and environmental factors (Wetzel 1975). All these factors are essential for all kinds of biotic activities, thus, study of water attracts importance.

Fresh water is one of the most essential natural resources crucial for the survival of all living beings. Limnology, the science which deals with the fresh water environments, their physic-chemical properties their biota and the ecosystem processes. Therefore, it is universal in its significance. The importance fresh water to man is far greater than their area for the following seasons:

1. They are most convenient and cheapest source of water for domestic and industrial needs.
2. The fresh water components are the 'bottle neck' in the hydrological cycle.
3. Fresh water ecosystems provide the more convenient and cheapest waste disposal system.

Because man is this natural resource, so, is clear that major Efforts to reduce this stress must come quickly. Otherwise, water will become the limiting factor.

In Indian sub-continent, they are mostly man made and bear great economic significance. Indian history is full of events prompting construction of fresh water reservoirs for recreating , irrigation, flood control and drinking water supply. Some of these are big and beautifully set in natural surroundings. Increased construction of impoundments is likely to occure with increasing population and the accompanying urban and industrial growth.

Pure water is animating fluid while polluted water is a real cause for living beings. The global consciousness towards fresh water system arose in the beginning of the century and the International Biological Program (IBP) and Man and Biosphere Program (MBA) were floated to generate the information on structure and function of inland aquatic environment, their productivity and the impact of human interference.

In the past few decades natural polluted water has been studied in detail all over the world and a considerable data is now available on most kind of pollutants and their effects on ecosystems as well as organisms. The need of Water is increasing day by day, invariably due to the population explosion, unplanned urbanization etc.

The eutrophication of water, which in simplest sense, means pollution of water or enrichment of nutrient and the resulting degradation of its quality accompanied by luxuriant growth of micro and macrophytes. In order to study the fresh water ecosystems with respect to their chemistry and biological aspects, a new branch of science emerged in the 19th century, called 'Limnology'. Its credit must go to F. A. Forel, who for the first time began the study of fresh waters and described lake as 'microcosm' (Welch, 1935). Rapid development of limnology took place only after the invention of microscope and later Hensen (1887) discovered plankton.

Eutrophication means not only an increase in primary production but also an increase in higher trophic levels, changes of the community structure and may also mean, changes in the main paths of energy flow within the aquatic ecosystem (Kaglou, 2003), changes in the aquatic environment accompanying anthrophogenic pollution are cause of growing concern and require monitoring of the surface waters by hydrobiological parameters is among environmental priorities.

Sources of water pollution are countless. Industries are great concern and industrialization is contributing to water pollution has reached the alarming situation. The main pollutants of the factory wastes include oils, detergents, suspended particles, poisonous chemicals, including fertilizers and pesticides. Most important source of water pollution and of great concern is the the human activities.

Pjysico-chemical factors are very important in estimating the constituents of water and also concentration of pollutant or contaminant. The chemical and biological factors are interrelated and interdependent. The physical factors include water movement, light, temperature, turbidity and suspended solids. The chemical factors include pH, carbonates, oxygen, carbon-di-oxide, cations, anions and dissolved organic materials. The main object of the physic-chemical analysis of water is to determine the status of different chemical constituents which are present in the natural and disturbed aquatic ecosystem. The quality of water may be affected in various ways due to pollution. The pollution manifests itself either altering the existing elements in the water or by generating new substances. (e.g. Amnion, nitrates) which were not previously present (Janadhan Rao. 1982) . Therefore, the present study has been undertaken to understand the role of water with the different operative factors , both physical and chemical, in determining the zooplankton population of three ponds situated in and around Chikodi in Belagavi District.

MATERIALSAND METHOD

III. ii. Sampling Methods and Analyses

In two years study period, atmospheric temperature was recorded with the help of mercury thermometer. The transparency of water for light were determined using seechi disc.Which was about 20 cm indiameter devised by Italian scientist Seechi. The water temperature, dissolved oxygen (DO), pH, electric conductivity (EC), Total dissolved solids (TDS), salinity and free carbon dioxide (CO_2) were recorded by using Metler Toledo (MX-300) sensor. These above mentioned parameters were analyzed on the spot after collecting the samples. The estimation of carbonates, bicarbonates, total alkalinity, calcium (Ca^+) , magnesium Mg), total hardness, chlorides, phosphates, sulphates, Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and ammonical nitrogen (NH_3-N) were analyzed in the in the laboratory immediately after collecting the samples. For the analysis of physic-chemical factors the surface water was collected from fixed spots of each tank every month between 6 am to 8 am for a period of two years (April 2013 to March 2015)

Collection of Water Samples for the Study of Zooplankton:

Zooplankton samples were collected by sieving 50 liters of water through plankton hand net made of nylon bolting cloth 68 µm pore size for quantitative estimation. Samples were fixed in 4% formaldehyde. The zooplankton identified to the greatest possible taxonomic level (Genus/Species) by using an optical microscope and referring to a specialized bibliography of Edmondson, (1959), Dhanapathi (1974), Dumont and Velde, (1977), Dumont (1983), Sharma and Micheal, (1980, 1987),

Quantitative analysis of zooplankton was performed in Sedgwick Rafter cell using the Welch (1952) formula and counts were expressed by as number of organism

RESULTS

ABIOTIC FACTORS:

Temperature

Atmospheric Temperature:

The atmospheric temperature recorded at the time of sample collection was ranging from 20^0C to 28^0C. In Vadral pond, the atmospheric temperature varied from 20^0C to 28^0C. The maximum of 28^0C was recorded in the months of May and the minimum 20^0C was recorded in December during 2013-2014 (Table- 1). In the same pond, the maximum of 28^0C and minimum of 20^0C was recorded during 2014-2015 (Table-2).

Water Temperature:

In Vadral pond, water temperature ranged from 19^0C to 26^0C. The maximum of 26^0C was recorded in May and the minimum of 21^0C was recorded in December during 2013-2014 (Table-5). In the same pond, the maximum of 26^0C was recorded in April and May and minimum of 19^0C was recorded in December during 2014-15 (Table-2).

Water Transparency:

In Vadral Honda the water transparency varied from 41cm to 59cm during study period. The maximum of 59 cm was recorded in March and April, the minimum of 41cm was recorded in July during 2013-2014 (Table-1). In the same pond the maximum of 59cm was recorded in March and minimum of 44cm was recorded in July during 2014-15 (Table-2).

pH.

The pH of Vadral pond varied from 7.56 to 9.12. The maximum of 9.12 was recorded in September and the minimum of 7.56 was recorded in May during 2013-2014 (Table-1). In the same pond the maximum of 8.95 was recorded in August and the minimum of 7.61 was recorded in May in the year 2014-15 (Table-2).

Electric Conductivity (EC):

In Vadral Honda, the electric Conductivity varied from 321 $uScm^{-1}$ to 123 $uScm^{-1}$ the maximum of 321 $uScm^{-1}$ was recorded in the month of October and the minimum of 261 $uScm^{-1}$ was recorded in December of 2013-2014 (Table-1). In the same pond, the maximum of 278$uScm^{-1}$ was recorded in the month of July and the minimum of 223 μScm^{-1} recorded in the month of September during 2014-15 (Table-2).

Total Dissolved Solids (TDS):

The total dissolved Solids of Vadral pond, varied from 140.2 mg/L to 157 mg/L. The maximum of 157 mg/L was recorded in March and the minimum of 140.2 mg/L was recorded in the month of June during 2013-2014 (Table-1). In the same pond the maximum of 156.8 mg/L was recorded in the month of January and the minimum of 140.2 mg/ L was recorded in June and January of 2014-15 (Table-2).

ISSN: (P): 0976-7436, (e): 2455-054X
ICRJIFR
Impact Factor
3.8919

Dissolved Oxygen (DO):

The Dissolved Oxygen of Vadral pond varied from 7.4 mg/L to 14.1 mg/L during study period. The maximum of 14.1mg/L was recorded in the month of October and the minimum of 7.4 mg/L was recoded in the month of March of 2013-2014 (Table-1). In the same pond, the maximum of 14.1 mg/L was recorded in November and the minimum of 7.9 mg/L was recorded in the month of July of 2014-15 (Table-2).

Free Carbon Dioxide (Co_2):

In Vadral pond, the free carbon dioxide varied from 4.5 mg/L to 12.6 mg/L in the study period. The maximum of 12.3 mg/L was recorded in the month of April and the minimum of 4.9 mg/L was recorded in the month of September of 2013-2014(Table-1). In the same pond, the maximum of 12.6 mg/L was recorded in the month of April and the minimum of 4.5 mg/L was recorded in the month of September of 2014-15 (Table-2).

Total Alkalinity:

The total alkalinity of Vadral pond varied from 129 mg/L to 154 mg/L in the study period. The maximum of 154 mg/L was recorded in the month of September and the minimum of 129 mg/L was recorded in the month of April of 2013-14 (Table-1). In the same pond, the maximum of 154 mg/L was recorded in the month of September and the minimum of 129 mg/L was recorded in the month of April during 2014-15 (Table-2).

Carbonates:

In Vadral Honda the carbonates were completetly absent in two years study period.

Bicarbonates:

In Vadral Honda, bicarbonates varied from 129 mg/L to 154 mg/L in the study period. The maximum of 154 mg/L was recorded in the month of September and the minimum of 129 mg/L was recorded in the month of April of 2013-14 (Table-1). In the same pond, the maximum of 154 mg/L was recorded in the month of September and the minimum of 129 mg/L was recorded in the month of April during 2014-2015(Table-2).

Calcium:

In Vadral Honda, Calcium varied from 18 mg/L to 26 mg/L in the study period. The maximum of 24.1 mg/L was recorded in the month of July and the minimum of 18. mg/L was recorded in the month of December of 2013-2014(Table-1). In the same pond, the maximum of 26 mg/L was recorded in the month of July and the minimum of 18 mg/L was recorded in the month of February of 2014-15 (Table-2).

Magnesium:

The magnesium in Vadral Honda varied from 0.63 mg/L to 2.81 mg/L in study period. The maximum of 2.81 mg/l was recorded in the month of November and the minimum 0.86 mg/L was recorded in the month of May of 2013-2014 (Table-1). In the same pond the maximum of 2.32 mg/L was recorded in the month of April and the minimum of 0.63 mg/L was recorded in the month of March of 2014-15 (Table-2).

Total Hardness:

The total hardness of Vadral Pond varies from 44 mg/L to 71 mg/L in the study period. The maximum of 68 mg/L was recorded in the month of August and the minimum of 47 mg/L was recorded in the month of April of 2013-2014 (Table-1). In the same pond, the maximum of 71 mg/L was recorded in the month of June and the minimum of 44 mg/L was recorded in the month of March of 2014-15 (Table-2).

Chlorides:

The Sulphates to Vadral Pond varied from 0.2 mg/L 12.0 mg/L in the study period. The maximum of 12.0 mg/ L was recorded in the month of October and the minimum of 0.2 mg/L was recorded in the month of April of 2013-2014 (Table-1). In the same pond, the maximum of 10.0 mg/L was recorded in the month of October and the minimum of 0.9 mg/L was recorded in the month of May of 2014-15 (Table-2).

Phosphates:

In Vadral pond, Phosphates varied from 0.1 mg/L to 0.4 mg/L in the study period. The maximum of 0.4 mg/L was recorded in three different months and the minimum of 0.1 mg/L was observed in four different months of 2013-2014 (Table-1). In the same pond, the maximum of 0.4 mg/L was noticed in the month of July and February and minimum of 0.1 mg/L was recorded in three different months and the maximum of 0.0.4 mg/L was recorded in months September and December of 2014-15 (Table-2).

Ammonical nitrogen:

In Vadral Pond, the ammonical nitrogen varied from 1.5 mg/L to 8.4 mg/L in the study period. The maximum of 7.2 mg/L was recorded in the month of October and the minimum of 1.2 mg/L was recorded in the month of April of 2013-2014 (Table-1). In the same pond, the maximum of 8.4 mg/L was recorded in the month of August and the minimum of 1.5 mg/L was recorded in the months of March of 2014-15 (Table-2).

Biochemical Oxygen Demand (BOD):

In Vadral Pond, the BOD varied from 0.98 mg/L to 2.61 mg/L in the study period. The maximum of 1.98 mg/L was recorded in the month of April and the minimum of 0.98 mg/L was recorded in the month of February of 2013-2014 (Table-1). In the same pond, the maximum of 2.61 mg/L was recorded in the month of May and the minimum of 0.98 mg/L was recorded in the month of September of 2014-15 (Table-2).

Chemical Oxygen Demand (COD):

In Vadral Pond,COD varied from 32 mg/L to 72 mg/L in the study period. The maximum of 64 mg/L was recorded in the month of October and the minimum of 32 mg/L was recorded in the month of April of 2013-2014 (Table-1). In the same pond, the maximum of 72 mg/L was recorded in the month of September and the minimum of 34 mg/L was recorded in the month of December during 2014-15 (Taable-2).

Salinity:

In Vadral Pond, the salinity varied from 0.1 mg/L to 0.2 mg/L in the study period. The maximum of 0.2 mg/L was noticed in the months of June, July, August and September. The minimum of 0.1 mg/L was noticed in the remaining months of 2013-2014 (Table-1). In the same pond, the maximum of 0.2 mg/L was noticed in five months and the minimum of 0.1 mg/L was noticed in the remaining months of 2014-15 (Table-2).

Rain fall:

At Vadral pond catchment area, the annual rain fall recorded during 2008-2009 was from 0 to 90 cm. The maximum of 90 cm was recorded in the month of September and there was no rain in December, January and February (Table-1). In the second year (2014-15) the annual rain fall varied from 0 to 199 cm. The maximum of 199 cm was recorded in the month of July and there was no rain in December, January February (Table-2).

BIOTIC FATORS

Species Composition and Abundance:

A maximum of 44 species of zooplanktons were found in Vadral Pond. They are Cladocera, Copepods, Rotifera and Ostracods.

The species richness was also high in the month of April and May [summer] and was low in June and July [spring]. Hence maximum zooplankton were recorded in the month of March, April and May , and the minimum recorded in the month of June, July and August.

There were forty four species of zooplankton found in Vadral Pond during the year of 2013-2014. Of them there were twelve species of Cladocera, six species of Copedods, twenty two species of Rotifers and four species of Ostracods. In the same pond, there were forty three species of zooplankton noticed in the year of 2014-15. Of them there were twelve species of Cladocera, six species of Copepods, twenty one species of Rotifers and four species of Ostacods.

The most aboudant species of zooplankton noticed in the two year of study period werer Biaperatura karua. Moina micrura, Diaphanosma excisum Cerriodaphnia cornuta, Alona pulchella among Cladoera. Heliodiaptomus viduuss. Tropocyclops prasinus, Mesocyclops lecuckarti, Neodioptamus strigilipes of copepoda. Keratella tropica, Keratella cochlearis, Brachionus falcatus, Brachionus diversicrnis and Brachinonus plicatilis among Rotifera. Hemicypris fossulata and Darwinula species among Ostracods.

DIVERSITY AND UNIFORMITY

To determine the diversity and uniformity of zooplankton species, the mehod of Shannon-Wiener Index was followed. According to that method the highest species diversity in Vadral Pond was that of the Cladocera in the month of February, Copepoda in the month of December, Rotifera in the month of May and Ostracoda in the month of November during the year of 2013-2014 (Table-3). In the same pond, the highest species diversity of Cladocera was found in the month of April, Copepoda in the month of October, Rotifera in the month of May and Ostracoda in the month of April during the year of 2014-15 (Table-4).

The highest species uniformity of Vadral Pond was that of the cladocera in the mont of November, Copepoda in the month of December, Rotifera in the month of May and Ostarcoda in the month of Dcecmber during the year of 2013-2014 (Table-3). In the same pond, the highest species uniformity of Cladocera was in the month of February, Copepoda in the month of August, Rotifera in the month of November and Ostracoda in the month of February of the year 2014-2015 (Table-4)

TROPHIC STAUTS

The quotient QB/T values of Vadral Pond varied from two to eight during the year of 2013-2014 (Table-5). This pond was mesotrophic in the month of June and rest of the eleven months it was eutrophic and hypereutorphic. The quotient $Q_{B/T}$ of the same pond varied from three to seven in the year of 2014-15 (Table-5). This pond was compoletely eutrophic and hypereutrophic during all the twelve months.

<u>DISCUSSION</u>

In limnological study, the physico-chemical factors must be taken into consideration in understanding the eco-physiology of the natural bodies of water.
Each factor contributes in making of the specific ecosystem and thus determines the trophic dynamics of the aquatic body. Therefore any change in one factor directly or

indirectly alters the other parameters. Hence the study of the physico-chemical characteristics of aquatic systems are pertinent to the proper understanding of various limnological phenomena (Hutchinson, 1957).

ABIOTIC FACTORS

Temperature:

According to Welch (1952) in the trophics usually air temperature is more than water temperature. In present study, in all the three water bodies air temperature exceeded water temperature for most of the times. However, water temperature exceeded air temperature only in few months. Similar observations are those of John (1975) and Kumar et al, (1978). According to whom sometimes water temperature exceeds air temperature during rainy season and winter season.

The water temperature recorded in Ammanagi Pond was (23.58±2.23) (Table-6) and in second year (2014-2015) the water temperature recorded was (23.67±2.10) (Table-6).

According to Welch (1952) the response of water temperature to air temperature depends on the size of the water body. The smaller masses of water respond more quickly than bigger sheets having more surface area and mean depth (Munavar, 1970).

In this water body there was an existence of strong positive correlation between atmospheric temperature and water temperature. Kannan (1980) had shown positive correlation between water temperature and air temperature. In Vadral Pond, water temperature was positively correlated with atmosphere temperature ($r=0.8598$, $P<0.01$), carbon dioxide ($r=0.610$, $P<0.05$). Murugavel and Pandean (2000) also reported the existence of positive correlation between air temperatures other than ambient temperature.

Water Transparency:

It was devised by an Italian scientist in 1865 which consist of a disc about 20cm in diameter with alternating black and white quadrants. It is lowered from the surface until it just disappear from view. The depth of visual disappearance becomes the secchi disc transparency which will range from a few centimeters in very turbid bodies of water to 40 meters in a very clear unproductive high altitude lakes (Wetzel, 1975).

In the present study the value of transparency observed in Vadral Pond was (53.92+5.68 cm) in the year of 2013-2014 (Table-6). In second year (2014-2015) the value of water transparency recorded in Vadral pond was (54.65+4.48cm) (Table-6). In Vadral pond it was positively correlated with Biologiical oxygen demand ($r=0.7278$, $P<0.01$).

Muragavel and Ponden (2000) reported the positive correlation of water transparency with pH, free CO_2, Phosphates, DO and nitrates. They had also reported the existence of negative correlation between transparency and atmospheric temperature and water temperature.

pH :

pH is the hydrogen ion concentration expressed by a negative power of 10. It indicates whether the water body is acidic, basic or neutral in nature. In natural waters by far the most important are carbon dioxide, carbonates and bicarbonates which have control over the pH value. According to Hutchison, (1957), below pH 5, only total free carbon dioxide is of importance between 7 and 9 bicarbonate is of greatest significance and above 9.5 carbonate begins to be of importance.

In Vadral pond (8.36+0.51) was recorded in year (2013-2014) (Table-6) and the highest was recorded (8.28+0.43) during 2014-2015 (Table-6).

The seasonality or pH was not uniform in the water body. It increased from spring to summer. In the summer months pH value of all the this ponds was low.

According to Das (1961). the decrease in pH during summer was due to decrease in the amount of water which increased the concentration of free carbon dioxide released by respiration of aquatic organisms. This lowered the pH.

In Vadral Pond, pH was positively correlated with Magnesium (r=0.6174, P<0.05), ammonical nitrogen (r=0.8002, P<0.01), Bicarbonates (r=0.6253, P<0.05), sulphate (0.5946, P<0.05), total hardness (0.7968, P<0.01) and biochemical oxygen demand (r=0.6018, P<0.05). Barbieri et al, (1999), also observed the positive correlation of pH with calcium, Magnesium, alkalinity and negative correlation with nitrates. Patil and Goudar (1985) noticed the positive

Electric Conductivity :

Electrical conductivity is the capacity of water to carry the electric current. It varies with number and types of ions the solution contains. The distilled water has an electrical conductivity ranging between 1 to 5 µS cm-1. The presence of salts and contaminations increase the electrical conductivity of the water.

In present study, the value of EC recorded in Vadral pond was (286.17+18.07, µs cm-1) (Table-6) during 2013-2014. In second year (2014-2015) the value of EC recorded in Vadral pond (152.58+39.90 µS cm-1) (Table-6).

Electrical conductivity showing a significant positive correlation with chloride was also reported by Patil and Gouder (1985).

Total Dissolved Solids:

In waters. dissolved solids are composed mainly of carbonates, bicarbonates chlorides, sulphates, phosphates and nitrates of calcium, magnesium, sodium, potassium ion and manganese etc. In the polluted waters, the concentration of other substances increases depending upon the type of pollution. The determination of dissolved solids does not give a clear picture of kind of pollution.

In the present study, the values of total dissolved solids recorded in Vadral was (147.01+6.14 mg/L) during 2013-2014. In second year (2014-2015) the value of total dissolved solids recorded in Vadral pond was (147.59+6.10 mg/L) (Table-6).

It also showed very strong positive correlation with electric conductivity, total hardness, calcium, magnesium, alkalinity, , phosphates and dissolved oxygen.

dissolved Oxygen:

Dissolved oxygen is of great importance to all living aquatic organisms. Much characteristic of water can be learnt by series of determinations of oxygen than any other chemical data. The source of oxygen to any water body is mainly due to physical and biological process. Atmospheric oxygen can directly diffuse through the exposed surface by water agitation through wind, human disturbances like swimming. In the present study, the values of dissolved oxygen noticed was (10.19±1.79 mg/L) in Vadral Pond during 2013-14 (Table-6). In second year 2014-15 the values of demand oxygen in Vadral pond was (10.87±1.83 mg/L) (Table-6).

In Vadral Pond, it showed positive correlation with sulphates (r=0.7170 , P<0.01), magnesium (r=0.6366, P<0.05), ammonical nitrogen (r=0.8015, P<0.01). Similar observations were also made by Patil and Goudar (1985). They reported the existence of positive correlation between dissolved oxygen and water transparency, phosphates and nitrates. These studies support our findings.

Free Carbon-dioxide:

It is essential for all bacterial growth and development, therefore for life it self, although minimal quantities required are small. The health growth of green plants are standing proof of the sufficiency of these small quantities (Welch 1935). The concentration of free carbon dioxide in water limits pH and concentrations of HCO_3 , CO^2_3 and CO^2_2.

In the present study, the value of free carbon dioxide noticed in Vadral Pond was (8.81±2.30 mg/L) during 2013-2014 (Table-6). In second year 2014-1015 the values of free carbon dioxide recorded was (8.82±2.32 mg/L) (Table-6).

In Vadral pond, it showed positive correlation with atmospheric temperature (r=0.5882, P<0.05) and biological oxygen demand (r=0.7387, P<0.01) Many authors have reported an inverse relation between free carbon dioxide and pH (Atkins, 1926; Pearsall, 1930; Pringshem, 1946; Gonzalves and Joshi; 1946; Rao, 1955; Zafar 1964; Munawar, 1970; Hegde, 1983 and Nair et al, 1988).

Bicarbonate:

In present study, the values of bicarbonate noticed in Ammanagi Pond (138.67±6.76 mg/L) during 2013-2014 (Table-6). In second year (2014-2015) the values of bicarbonate recorded was (139.17±6.91) mg/L (Table-6).

In Vadral Pond, it was positively correlated with pH (r=0.6253, P>0.05), chemical oxygen demand (r=0.6482, P<0.05), sulphate (r=0.6538, P<0.05), Calcium (r=0.6077, P<0.05), magnesium (r=0.6310, P<0.05), total alkalinity (r=0.1.000, P<0.01), total hardness (r=0.6178, P<0.05), ammonical nitrogen (r=0.7164, P<0.01), phosphate (r=0.6210, P<0.05). According to Saran and Adoni (1982), Photosynthesis utilizes the total carbon-dioxide and bicarbonates, releases carbonates and increases the DO and pH. Hence a positive correlation can be established between these two parameters.

Total Alkalinity:

Total alkalinity of an aquatic body is constituted by hydroxides, carbonates and bicarbonate. Alkalinity, an important parameters of water quality and tropic status, plays vital role in determination of productive capacity of aquatic environment (Philipase, 1959).

In the present, study the values of total alkalinity recorded in Vadral Pond was (138.67±6.76 mg/l) during 2013-2014 (Table-6). In second year (2014- 2015) the values of total alkalinlty recorded was (139.17±6.91 mg/L) (Table-6).

In Vadral Pond, it was positively correlated with pH (r=0.6253, P>0.05), chemical oxygen demand (r=0.6482, P<0.05), sulphate (r=0.6538, P<0.05), Calcium (r=0.6077, P<0.05), magnesium (r=0.6310, P<0.05), total alkalinity (r=0.1.000, P<0.01), total hardness (r=0.6178, P<0.05), ammonical nitrogen (r=0.7164, P<0.01), phosphate (r=0.6210, P<0.05). Similar observations also made by Karikal, (1995), Judar, (1995), Patil and Karikal (2001) and Geeta Patil (1994).

Calcium:

Calcium is considered to be more important because it is an integral part of plant tissue as well as it increases the availability of other ions. It is also required as a nutrient for various metabolic processes and assists in proper translocation of carbohydrates and facilitates other ions (Wetzel, 1975). It is considered as a basic inorganic element of algae and regarded as a nutrient for various metabolic processes (Ruttner, 1953).

In the present study, the value of calcium recorded in Vadral Pond was (20.83±2.26 mg/L) in 2013-2014 (Table-6). In second year (2014-2015) the value of calcium recorded was (20.94±2.91 mg/L) (Table-6).

In Vadral Pond, it was positively correlated with bicarbonates (r=0.6077, P<0.05), total alkalinity (r=0.6077, P<0.05), ammonical nitrogen (r=0.8312, P<0.01), total hardness (r=0.6112, P<0.05), salinity (r=0.8623, P<0.01), chlorides (r=0.6436, P<0.05), sulphates (r=0.5998, P<0.05). Barbieri et al., (1999) reported that calcium showed significant positive correlation of calcium with total hardness, electric conductivity, total dissolved solids, and Magnesium. These studies support our findings.

Magnesium:

Magnesium is required universally by chlorophyllus plants as the Mg Porphyry component of the chlorophyll molecule and as a cofactor for various intracellular enzymatic transformations especially, in the trans-phorylation in algal, fungal and bacterial cells (Wetzel, 1975).

In present study, the value of magnesium recorded in Vadral Pond was (1.81±0.65 mg/L) in 2013-2014 (Table-6). In second year (2014-2015) the value of magnesium recorded was (1.44±0.50 mg/L) (Table-6).

In Vadral Pond, it was positively correlated with dissolved oxygen (r=0.6366, P<0.05), chemical oxygen demand (r=0.6927, P<0.05), chloride (r=0.6259, P<0.05), pH (r=0.6174, P<0.05), bicarbonates (r=0.6310, P<0.05), total hardness (r=0.6674, P<0.05), sulphate (r=0.9226, P<0.01), ammonical nitrogen (r=0.7819, P<0.01), rain fall (r=0.5941, P<0.05). Beriberi et al, (1999) reported that magnesium showed significant positive correlation with pH, electric conductivity calcium total alkalinity and sulphates. Similar observations were also noticed by Rao *et al*, (1999).

Total Hardness:

The term hardness is frequently used to express the quality of water. It is an important parameter as it indicates the intensity of some dissolved salts especially of calcium and magnesium which are the principal cations imparting hardness to the water. Hardness of water is due to the presence of certain salts of calcium, magnesium and other heavy metals dissolved in it (Jain and Jain 1988).

In the present study, the value of total hardness was recorded in Vadral Pond was (57.50± 6.01 mg/L) in the year of 2013-2014 (Table-6). In second year (2014-2015) the value of total hardness recorded was (58.42±9.24 mg/L) (Table-6).

In Vadral Pond, it was positively correlated with calcium (r=0.6112, P<0.05), pH (r=0.7958, P<0.01). Magnesium (r=0.6674, P<0.05), bicarbonates (r=0.6178, P<0.05), sulphate (r=0.7764, P<0.01) ammonical nitrogen (r=0.8377, P<0.01), Chlorides (r=0.6023, P<0.05), salinity (r=0.7996, P<0.01). Rao *et at*,. (1992) also reported the positive correlation of total hardness with calcium, electric conductively, total dissolved solids, magnesium, alkalinity, chlorides, and phosphates and dissolved oxygen. These studies support our findings.

Chloride:

A quality parameter of significance is the chloride concentration. Chloride concentration in natural waters results from the leaching of chloride containing rocks and soils with which water comes in contact Agricultural, industrial and domestic waste waters discharged to surface water are also sourse of chloride to the aquatic system. Chlorine in free state which is used as disinfectant will be converted into chlorides or combines with organic matter to form toxic compounds (Adoni, 1985).

In the preset study, the values of chlorides observed in Vadral Pond was (43.48±10.91 mg/L) (Table-6). In second year (2014-2015) the values of chloride recorded was (37.38±13.98 mg/L) (Table-6).

In Vadral Pond, chloride positively correlated with total hardness (r=0.6023, P<0.05), Sulphate (r=0.6174, P<0.05), ammonical nitrogen (r=0. 7020, P<0.01) calcium (r=0.6436, P<0.05), salinity (r=0.6234, P<0.05), magnesium (r=0.6259, P<0.05), chemical oxygen demand (r=0.7347, P<0.01) But according to Thresh *et al*, (1944) high chloride concentration indicate the presence of sufficient amount of oxidisable organic matter of animal origin, which on oxidation increases the nitrate content. Chloride relation with any other factor was not convincingly significant

Phosphates:

It is one of the most extensively studied element in limnology. The amount of phosphorus in the hydrosphere is very small but it is of prime importance in the field of ecology due to its major role in the plankton metabolism (Wetzel, 1975).

Phosphorus is important as a nutrient and also as a major component of the cell. It is required by the living organisms to carry out various vital activities like the synthesis of nucleic acid and energy release in the form of ATP etc. (Rai and Kumar 1976).

Phosphate:

In the present study, the values of phosphate recorded in in Vadral Pond was (0.23±0.12 mg/L) in the year of 2013-2014 (Table-6). In second year (2014-2015) the values of phosphate recorded was (0.24±0.11 mg/L) (Table-6).

In Vadral Pond, it was positively correlated with bicarbonates (r=0.6210, P<0.05),total alkalinity (r=0.6210, P<0.05). Murugavel and Pandian (2000) also reported positive correlation of phosphorus with water transparency, pH, free carbon dioxide, dissolved oxygen and alkalinity, this supports our findings.

Sulphates:

It is naturally occurring anion in all kinds of natural waters. Biological oxidation of reduced sulphur species to sulphate also increases its concentration. However, it may undergo transformations to sulphur and hydrogen sulphide depending upon the redox potential of the redox potential of the water (Trivedy and Goel, 1984).

In the present study, the values of sulphates recorded in in Ammanagi was (6.23±3.36 mg/L) in the year of 2013-2014(Table –6). In second year (2014-2015) the values of sulphates recorded was (5.52±3.26 mg/L) (Table-6).

In Vadral Pond, it was positively correlated with pH (r=0.7715, P<0.01), ammonical nitrogen (r=0.9056, P<0.01), magnesium (r=0.9226, P<0.01), bicarbonate (r=0.7655, P<0.01), dissolved oxygen (r=0.8015, P<0.01), chloride (r=0.6174, P<0.05), calcium (r=0.5998, P<0.05), chemical oxygen demand (r=0.7188, P<0.01). total hardness (r=0.582, P<0.05),

Rao et al, (1999)reported the existence of positive correlation with calcium, magnesium Nandoni et al, (2001), observed negative correlation of sulphate with biochemical oxygen demand. High value of sulphate during monsoon might be due to surface run off which brings more suspended solids along with organic and soluble salts (Sneha, 1986).

Nitrogen Complex:

Nitrogen present in the water bodies may be in the form of molecular nitrogen, organic nitrogen, free ammonia, nitrite and nitrate. Among these five forms ammonia is a major nitrogenous and product bacterial decomposition of organic matter and is an important excretory product of invertebrate animal (Jain and Jain, 1988). Nitrite is an important plant nutrient. It is a most oxidized form of nitrogen and more available form of nitrogen.

In the present study, the value of nitrates found in Vadral pond was (4.32±1.93 mg/L) in the year of 2013-2014 (Table-6). In second year the value of amonical nitrogen recorded was (4.24±2.39 mg/L) (Table-6).

In Vadral Pond, it was positively correlated with magnesium (r=0.7819, P<0.01), biocarbonate (r=0.7164, P<0.01), pH (r=0.6326, P<0.05), dissolved oxygen (r=0.7170, P<0.01), calcium (r=0.8312, P<0.01), chloride (r=0.7420, P<0.01), chemical oxygen demand (r=0.7188, P<0.01), sulphate (r=0.9056, P<0.01), total hardness (r=0.8377, P<0.01), water transperancy (r=0.6168, P<0.05), salinity (r=0.6628, P<0.05). A nitrate having significant positive correlation with dissolved oxygen was also reported by Zafar (1964), and Singh, (1960). Positive correlation with calcium was also reported by Rao et al, (1999).

Biochemical Oxygen Demand (BOD):

BOD is the amount of oxygen utilized by microorganisms in stabilizing the organic matter. On the average basis, the demand for oxygen is proportional to the amount of organic waste to be degraded aerobically. Hence, BOD approximates the amount of oxidizable organic matter present in the solution, and the BOD value can be used as measure of waste strength. It is highly important to know the amount of organic matter present in the water body (Trivedy and Goel, 1984).

In the present study, the value of BOD found in Vadral was (1.62±0.26 mg/L) in the year of 2013-2014 (Table-6). In second year the value of amonical nitrogen recorded was (1.69±0.49 mg/L) (Table-6).

In Vadral Pond, it was positively correlated with water transparency (r=0.6861, P<0.01). Free carbon-di-oxide (r=0.7367, P<0.01).

Chemical Oxygen Demand:

Chemical oxygen demand is the oxygen required by the organic substances in water to oxidizi them by strong chemical oxidant. The determinations of chemical oxygen values are of great importance where biochemical oxygen demand value can not be determined accurately due to the presence of toxins and other such unfavorable conditions for growth of microorganisms (Trivedy and Goel, 1984),

In the present study, the lowest value of COD was recorded in Vadral Pond was (50.83±14.83 mg/L) in the year of 2013-2014 (Table-6). In second year (2014-2015) the values of COD recorded was (48.50±13.17 mg/L) (Table-6).

In Vadral Pond, it was positively correlated with sulphate (r=0.7186, P<0.01). magnesium (r=0.6927, P<0.05), total alkalinity (r=0.6482, P<0.05), pH (r=0.6018, P<0.05), ammonical nitrogen (r=0.7188, P<0.01), bicarbonate (r=0.6482, P<0.05) chloride (r=0.7347, P<0.01)

Salinity:

The salinization due to human activities is distinct from the natural or primary salinization which is responsible for the development of natural salt lakes. Primary salinisation involves the accumulation in closed basins of salts from rain water and leached from terrestrial sources at rates unaffected by human activities (Williams, 2001).

In the present study, the value of salinity recorded in Ammanagi pond was (0.13±0.05) in the year of 2013-2014(Table-6). In second year (2014-2015) the values of salinity recorded was (0.13±0.05) (Table-6).

In Vadral Pond, it was positively correlated with ammonical nitrogen (r=0.6628, P<0.05), calcium (r=0.8623, P<0.01), chloride (r=0.6234, P<0.05),), total hardness (r=0.7996, P<0.01) Similar observations also made by Kudari et al,. (2006).

Rain fall:

It has been pointed out by Carter (1960) that in the trophics the amount of rainfall plays a significant part in regulating the various seasonal biological rhythms. The change in the concentration of certain chemical constituents observed here consequent to the entrance of rainwater into the ponds suggests its effects on them, which in turn influence and quality of plankton.

In present study, the values of rain fall recorded at Vadral pond was (44.21±39.04 mm) in the year of 2013-2014 (Table-6). In second year the values of rain fall recorded was (52.71±58.31 mm) (Table-6).

In Vadral pond it showed positive correlation with salinity (r=0.6397, P<0.05), magnesium (r=0.5941, P<0.05), calcium (r=0.6341, P<0.05). positive correlation of rain fall with calcium. Magnesium, sulphate and sodium also reported by Sunkand and Patil (2001).

BIOTIC FACTORS

Zooplankton:

Zooplankton biomass can give an index to the fertility of the area and is also an indirect measure of the exploitable fishery of the region. In aquatic eco-fishery of the region. In aquatic eco-systems zooplankton plays a critical role not only in converting plant food to animal food but also they them selves serve as a source of food for higher organisms including fish. The seasonal fluctuations of the zooplankton population is a well known phenomenon, In the temperate water bodies the plankton production often takes the form of a biomodel curve with a spring and autumn peak (Welch, 1952). This fluctuation is greatly influenced by the variation in the temperature along with many other factors. Among the several factors temperature seems to exhibit the greates influence on lthe periodicity of zooplankton (Byar's, 1960, and Battish and Kumari, 1986). In addition, the morphometry of the water body (sugunan, 1980), pH and alkalinity (Borecky, 1956 and Seksena, 1987). Dissolved oxygen (Nayar, 1965) and among other factors influence the periodicity of zooplankton in the water bodies. Therefore it requires a careful evaluation of various relationship between zooplankton population and other factors (Hazlwood and Parker, 1961). Evison and James (1978) rightly stated that the plankton including micro organisms of tropical waters still remain unexplored thus justifying the present studies.

In present study, the zooplankton community was represented by four groups namely Cladocera, Copepods, Rotifera and Ostracoda. The monthly variations of zooplankton and their population dynamics of water bodies recorded for two years are presented in Table-8. The systematic account of zooplankton is summarized in table-15. The species diversity (H), and uniformity (E) of Cladocera, Copepods, Rotifers and Ostracods is given in table – 3 to 4. The correlatiuon of zooplankton groups with physico- chemical variables and other zooplankton groups is presented in Table – 7

Cladocera;

The Clodocerans are the fresh water zooplanktonic forms inhabiting all the niches of the fresh water bodies. They are found more in the lentic environment than in the lotic waters such as lakes, tanks and ponds. In aqauatic vegetation usually show abundant cladocerans. Recently, they have been recorded from even the wet free trunks covered over by Bryopytes (Frey, 1980). Cladocerans are minute forms, the average body length being 0.2 mm to 3.5 mm. the cladocerons have been the objects of microscopic study dating back to 18th century. Swammerdan (1979), Muler (1785), Daday (1889) and Sars (1901) revealed the valuable information about the Cladocerans.

In the present study, a total of twelve species (26.80% in 2013-2014 and 31.45 % in 2014-2015) of Cladocera are reported from this pond. Chydoridae is he most frequently represented family with five genera and nine species, followed by moinidae with three species, families Daphnidae, Sididae are representing two species each, the Bosminidae and Macrothricidae are represented by one species each Sontos-Wisniewski (2002) reported that among the organisms inhibiting the littoral region the members of the family Chydoridae, belonging the Cladocera group were present. Similar observation was also made by Serafim et al., (2003).

The higher Cladoceran specie in the pond is due to the presence of extensive bans of macrophytes as observed by Pinto Coelho et al., (2005), Sharma and Sharma. (2001); Serapfim et al (2003); Santos- Wisniewski, (2002), the macrophytes allowed a grater heterogeneity of the environment which resulted in the availability of more niches (Enriquesz Garcia et al, 2003) Lack of such marcropytes banks in Doddakare might be the reason for lowest number of cladoceran species.

Statistical analysis was carried out by simple correlation coefficient tests .The degree of relationship between physico-chemmical parameters and zooplankton groups are presented in Table-7.

In Vadral Pond ,during 2013-2014 cladocera population Showed positive correlation with atmospheric temperature (r=0.831,p<0.01),biochemical oxygen demand (r=0.660,p<0.05), water transparency (r=0.842,p<0.01) water temperature (r=0.873,p<0.01),copepods (r=0.716,p,0.81), Rotifers (r=0.957,p<0.01) , Ostracods (r=0.766,p<0.01),and negatively correlated with calcium (r=0.662,p<0.05) ,chloride (r=0.-716,p<0.01),electric conductivity (r=0.616,p<0.05). ammonical nitrogen (r=0.644,p<0.05),pH (r=0.-714,p<0.01), and sulphate (r=0.-665,p<0.05) In the second year ,it showed positive correlation with atmospheric temperature (r=0.-747,p<0.01),water temperature (r=0.747,p<0.01)copepods (r=0.858,p<0.01) Rotifers (r=0913,p<0.01) ostracod (r=0.665,p<0.05), and negatively correlated with calcium (r=-619,p<0.05) ,electric conductivity (r=0.-915,p<0.05) and ph(r=0.-600,p<0.05).

Copepods:-

In the present study , six species of copepods documented in Vadral Pond namely ,Heliodiaptomus vidnus ,paracyclops , firmbritas prasinus ,Messocyclops leukarti neodiaptomus strigilipes and mesocyclops hyalinus. High copepodal destiny recorded in Vadral Pond during 2013-2014 (9190 org/L) (Table-8), that constituted 42.54 percent. The six species belonging in the two families Diaptomidae and cyclopidea Diaptomidae represent three genera of three species cyclopidae represent three genera of four species . Kudari et al (2005) also reported six species of copepods from Shiggaon taluk of Haveri district.

Rotifers:

In the present study, twenty three species of Rotifers were documented from this ponds. Which accounted 26.62 % (5750 org/L) in 2013-14 and 34.05 % (7210 org/L) (Table-8) percent of total zooplankton group. Barchionidae was the largesst family. Thirteen species belongs to this family, followed by family leacidae, Asplanchnidae, Tridhoeridae and Filinidae. Each represent two species and rest of five families represent each species namely Euchlanidae, Notommatidae, Mytilinidae,l Trichospharidae,l and philodinidae. Taxonomic dominance of Rotifers was also reported by Nogreira (2001), Cavalli et al, sampaio et al, (2002), Neves et al, (2003). More density of rotifers is due to their special characters such as less specialized feding high fecundity and frequent parthenogenic reproduction.

In Vadral Pond during 2013-2014 Rotifer showed positive correlation with atmospheric temperature (r=0.841, P< 0.01), Biochemical oxygen demand (r=0.613, P< 0.05), water transparency (r=0.845, P< 0.01), water temperature r=0.859, P< 0.01), cladocera (r=0.957, P< 0.01), Copeods (r=0.659, P< 0.05), ostracds 9r=0.669, P< 0.05), and negatively correlated with calcium (r=0.-643, P< 0.05), chloride (r=0.-729, P< 0.01), In the second year, which showed Positives correlation with atmospheric temperature (r=0.836, p< 0.01), water transparency (r=0.-759, p< 0.01), water temperature (r=0.834, p< 0.01), Cladocera (r=0.913, p< 0.01), Copepods (r=0.807, p< 0.05), electric consuctivity (r=0.660, p< 0.01) and pH (r=0.-623, p< 0.05).

Ostracoda:

In the present study, only four speocies of ostracodes were documented from this water body. Namely, llyocypris gibba, Darwinula sp, Hemicypris fossulata and senocypris hislopi. The density was 870 org/L (4.02 %) in 2013-14 and 710 org/L (3.36 %) in 2104-15 was recorded in Vadral Pond.

In Vadral Pond during 2008-2009 Ostracods showed positive correlation with Cladocera (r=0.766, P<0.01), Rotifers (r=0.669, P<0.05) and negatively
Correlated with electric conductivity (r=0.629, P<0.05). In the second year it was positively correlated with Cladocera (r=0.-665, P<0.05), Rotifers (r=0.750, P<0.05) and negatively correlated with electric conductivity (r=0.-657, P<0.05).

SUMMARY AND CONCLUSION

Two years limnological study (April-2013 to March-2016) was carried out on fresh water pounds situated at Ammangi village, Chikodi Taluk of Belagavi district. A total of 22 physico-chemical parameters were studied on monthly basis. The waters of this pond was being used for irrigation purpose and were subjected to biotic disturbances such as bathing, cattle bathing, washing of cloths etc. The study is oriented towards the comparison of biotic and abiotic factors in this pond, monthly variations of physico-chemical factors, quantitative and qualitative estimation of zooplankton, community diversity and uniformity monthwise, quotient QB/T, correlations among abiotic factors and correlations between abiotic factors and zooplankton community. A total of forty three species of zooplankton recorded from the Ammanagi pond. Rotifera was taxonomically dominant group and its density was also high. The pond was mesotrophic in June and July remaining months it was eutrophic and hyperutrophic. The atmospheric temperature, water temperature, bicarbonates. Total Dissolved solids, Magnesium, Chloride, sulphates, Phosophates, Ammonical nitrogen and chemical oxygen demand were high. The atmospheric temperature, water temperature, water transparency and free carbon dioxide were lower in the year of 2013-2014.

The present study clearly showed that all three ponds were eutrophic or hypereutorphic throughout the study period except June and July. The eutrophication in these water bodies is mainly due to increased anthories should take appropriate steps to make the pond clean and free from contamination otherwise water bodies may source of infection for many water born diseases.

REFERANCES

Das, S.M. 1961. Hydrogen ion concentration, plankton and fish in fresh water eutrophic lakes of India Nature, 191: 511-512.

Atkins, W. R. G. and Harris, G. T., 1924 Seasonal Changes in the Water and heleoplankton of Fresh water p onds, Sci. Proc. Roy Dublin Soc., 18: 1-29.

Barbieri, Alberto., Veronesi, Mauro., Simona, Marco., Malusardi Stefano. and Straskrabova. Viera. (1999). Limnological survey of eight high mountain lakes located in Lago Maggiore watershed (Switzerland). J Limnol. 58(2):179-192.

Bohra, Chandan. And Arvind Kumar. (2004). Plankton diversity in the wetlands

of Jharkhand. In: Arvind Kumar (eds), Biodiversity and environment. A. P. H Publishing Corp, New Delhi. Pp: 91-123.

Dhanapathi, M. V. S. S. S. (1974). Rotifers from Andra Pradesh, India-I. Hydrobiologia. 45(4):357-372.

Dhanapathi, M. V. S. S. S. (1974). Rotifers from Andra Pradesh, India-III. Hydrobiologia. 48(1):9-16.

Dumont J. Henri. (1983). Biogeography of rotifers. Hydrobiologia. 104:19-30.

Dumont J. Henri. and Isabella Van De Velde. (1977). Report on a collection of cladocera and copepoda from Nepal. Hydrobiologia. 53(10):55-56.

Edmondson W.T (1959). Freshwater biology. 2nd edn. John wiley & sons, New York, USA.

Hutchninsonson, G.E.(1957). Atreatise on limnology Vol. l. Geography, Physics and Chemistry. John Weiley and Sons, Inc; 1015 pp.

Serafim Jr. M., Lansac-Toha, F.A. Paggi. J.C., Velho, L.F.M. and B. Robertson. (2003). Cladocera fauna composition in a river lagoon system of the upper Parana river flood plain, with a new record for Braxil. Baz. J. Biol., 63(2):349-356.

Sharma B.K. and Sumita Sharma, (2001). Biodiversity of rotifers in some torpical flood planis lakes of the Brahmaputra river basin, Assam (N.E. India). Hydrobiologia. 446/447: 305-313.

Sharma, B . K. (2005). Rotifer ;;communities of floodplain lakes of the Brahmaputra basin of lower Assam (N.E. India): biodiversity, distribution and ecology. Hydrobiologia 533: 209-221.

Sharma, B.K. (1979). Rotifers from West Bengal III. Further studies on the Euratatoria. Hydrobiologia. 64(3): 239-250.

Sharma. B. K. (1983). The Indian Brachionidae (Euratatoria: monogononta).and their Hydrobiologia. 104:269-275.

Sharma, B.K. and R. G. Michael, (1980). Synopsis of taxonomic studies on the Indian Rotatoria. Hydrobiologia. 73: 229-236.

Singh, V.P.(1960). Phytolankton ecology of the inland water of Uttar-Pradesh. Proc.Symp. Alga. ICAR. New Delhi: 243-271.

Sunkad, B. N. and H.S. Patil. (2002). Biodiversity of rotifers in fort lake of Belgaum city North Karnataka. Was presented at a National symposium on conservation, restoration and management of aquatic ecosystem (Dec 9-13). Organised by CES, IISc, Bangalore.

Sunkad, B.N. and H.S. Patil 2001, Physico-chemical characteristics of Fort lake of Belgaum (Karnataka) Abst. Nat. Symp Karnataka University, Dharwad, pp 68.

Trivedy. R.K. and P.K. Goel. (1984). Chemical and biological methods for water pollution studies. Environ. public. Karad, India. PP.35-96.

Zafar, A. R. 1964: On the Ecology of Agae in Certain Fish Ponds in Hyderabad India, Physico-chemical Complexes, Hydrobiologia, 23: 179-195.

Zafar, A.R.(1964). On the ecology of algae in certain fish ponds of Hyderabad, India, Physico-chemical complexes. Hydrobiologia. 23:179-195.

Zafar. A.R. (1966) Limnology of the Hussain Sagarlake Hyderabad India, Phykos.6: 115-126

John, V.(1975). A preliminary ecological study on a fresh water lake in Kerala during

1972. J. Zool. Soc.India. **27:**85-92.

Kumar, Arvind and Chandan Bohra. (1998). Impact of human activites on the limnology of two religious ponds of Basukinath Dham, Dumka, Bihar. *Environ and Ecol*. **16(4):** 809-812.

Patil, C. S. and B.Y.M. Gouder. (1985). Ecological study of fresh water zooplankton of a subtropical pond (Kamataka state, India). int Revue, ges. *Hydrobiologia.* **70 (2):** 259-267.

Patil, C. S. and B.Y.M.Gouder. (1989). Freshwater invertebrates of Dharwad,

Prasaranga, Kamatak University, Dharwad. Pp

Rao, P.S. and V.S. Durve. (1989). The structure of the zooplankton community and the dynamics of its biomass in the Lake Jaisamand (Rajastan , India). Acta hydrochim. *Hydrobiologia.* **17:** 167-178.

Williams,W.D.(2001).Anthropogenic salinisation of inland waters. *Hydrobiologia.* **466:** 329-343

ISSN: 0976-7436, (e): 2455-054X
ICRJIFR
Impact Factor
3.8919

TABLES

Table – 1. Monthly average values of Physico- chemical variables of Vadral Pond during 2013 - 14

r n C)	Water temp (˚C)	Secchi Depth (cm)	pH	EC (µS cm1)	TDS (mg/l)	DO (mg/l)	Free CO2 (mg/l)	CO2 (mg/l)	HCO3 (mg/l)	Total Alkalinity (mg/l)	Ca2+ (mg/l)	Mg 2+ (mg/l)	Total Hardness (mg/l)	Chlorides (mg/l)	PO4 (mg/l)	SO4 (mg/l)	NH3 (mg/l)	BOD (mg/l)	COD (mg/l)
	24	59	7.81	281	146.3	8.7	12.3	Nil	129	129	18.1	0.98	47	25.9	0.3	0.2	1.2	1.98	32
	26	58	7.56	289	152.4	10.1	13	Nil	130	130	18.8	0.86	51	29.2	0.2	3.1	1.8	1.68	35
	25	57	8.51	262	140.2	10.3	9.1	Nil	136	136	22	1.15	59	31.2	0.4	4.5	5.1	1.45	34
	25	41	8.31	294	154.9	8.6	8.8	Nil	140	140	24.1	1.57	58	46.8	0.4	5.1	4.9	1.91	34
	25	46	8.61	297	143.5	9.9	7.3	Nil	145	145	24	2.34	68	38.3	0.1	9.0	6.4	1.81	51
	24	50	9.12	312	141	11.8	4.9	Nil	154	154	23	2.21	61	40.1	0.1	8.5	5.9	1.56	58
	24	53	8.68	321	144.7	14.1	6.5	Nil	140	140	21	2.51	65	51.2	0.2	12	7.2	1.56	64
	22	56	8.58	284	150.8	11.2	7.5	Nil	139	139	22	2.81	58	48.7	0.2	9.6	5.6	1.65	61
	21	58	8.14	261	139.4	11.5	7.8	Nil	143	143	18	2.32	55	51.4	0.3	8.3	4.9	1.71	60
	23	53	8.22	283	141.3	9.8	8.6	Nil	134	134	18.3	1.96	56	59.5	0.1	6.5	3.8	1.68	51
	24	57	9.11	278	152.6	8.9	9.8	Nil	136	136	19.4	1.78	61	57.2	0.4	4.8	2.7	0.98	76
	25	59	7.68	272	157	7.4	10.1	Nil	138	138	21.2	1.24	51	42.3	0.1	3.1	2.3	1.48	54

Table –2. Monthly average values of Physico- chemical variables of Vadal Pond during 2014 – 15

r n C)	Water temp	Secchi Depth	pH	EC (µS cm1)	TDS (mg/l)	DO (mg/l)	Free CO2	CO2 (mg/l)	HCO3 (mg/l)	Total Alkalinity (mg/l	Ca2+ (mg/l)	Mg 2+ (mg/l)	Total Hardness	Chlorides (mg/l)	PO4 (mg/l)	SO4 (mg/l	NH3 (mg/l	BOD (mg/l)	COD (mg/l)

	(˚C)	(cm)					(mg/l)			)			(mg/l)			)	)		
	26	59	7.81	278	147.5	9.6	12.6	Nil	129	129	20.1	2.32	60	35.4	0.3	1.8	1.9	1.85	41
	26	58	7.61	142	154.2	10.4	12.5	Nil	132	132	19	2.12	55	26.4	0.1	0.9	1.6	2.61	39
	25	55	8.27	138	140.2	9.4	8.2	Nil	135	135	24	1.75	71	48.4	0.2	6.7	4.6	1.47	41
	25	44	8.61	142	153.4	7.9	8.8	Nil	142	142	26	1.84	69	58.2	0.3	7.4	7.6	1.31	52
	24	49	8.95	147	142.5	10.3	7.4	Nil	146	146	25.3	1.56	72	48.9	0.3	8.3	8.4	0.94	61
	25	52	8.24	154	148.7	12.6	4.5	Nil	154	154	23.1	1.36	66	40.1	0.4	9.4	6.2	0.98	72
	24	53	8.71	139	145.1	13.6	6.8	Nil	141	141	21	1.42	58	43.2	0.1	10	5.8	1.76	58
	22	57	8.61	138	151.1	14.1	7.9	Nil	139	139	18.3	1.28	51	48.8	0.3	7.2	4.9	1.44	68
	19	58	8.14	145	139.2	11.2	7.9	Nil	145	145	18.9	1.21	52	37	0.4	6.7	3.6	1.97	34
	22	56	8.64	132	140.2	11.6	8.7	Nil	134	134	19.5	0.97	54	60	0.1	4.2	2.7	1.88	39
	24	57	8.12	136	152.2	9.5	9.9	Nil	137	137	18	0.87	49	30.1	0.2	2.1	2.1	1.84	36
	25	58	7.68	140	156.8	10.2	10.6	Nil	136	136	18.1	0.63	44	26.1	0.2	1.5	1.5	2.23	41

Table- 3. Species Diversity (H) and Uniformity (E) of Cladocera, Copepoda, rotifera and Ostracoda in Vadral pond During 2013-14

S/MONTHS	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb
CERA											
-Wienner Index	1.696	1.919	0.926	1.268	1.832	2.029	2.045	1.969	1.613	1.979	2.048
s (E)	0.871	0.923	0.852	0.914	0.881	0.881	0.93	0.947	0.900	0.9	0.932
o. of Species	7	8	3	4	8	10	9	8	6	9	8
ODA											
-Wienner Index	1.666	1.619	1.404	1.603	1.64	1.656	1.532	1.601	1.789	1.684	1.647

s (E)	0.856	0.869	0.783	0.895	0.843	0.851	0.855	0.823	0.919	0.865	0.846
o. of Species	7	7	6	6	7	7	6	7	7	7	7
ERA											
-Wienner Index	2.836	5.46	0.561	1.783	2.141	2.297	2.551	1.875	1.725	1.962	2.319
s (E)	1.106	1.969	0.809	0.916	0.93	0.895	0.966	0.901	0.886	0.852	0.878
o. of Species	13	16	2	7	10	13	14	8	7	10	14
CODA											
-Wienner Index	1.192	1.237	-	-	0.866	1.06	0.636	1.303	0.692	1.274	1.213
s (E)	0.86	0.892	-	-	0.788	0.965	0.917	0.94	0.998	0.919	0.876
o. of Species	4	4	-	-	3	3	2	4	2	4	4

Table- 4. Species Diversity (H) and Uniformity (E) of Cladocera, Copepoda, rotifera and Ostracoda in Vadral pond During 2014-15

S/MONTHS	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb
CERA											
-Wienner Index	2.131	1.965	1.15	1.627	1.832	1.996	1.9	1.931	1.3347	2.008	2.103
s (E)	0.925	0.853	0.829	0.836	0.881	0.908	0.913	0.928	0.837	0.913	0.957
o. of Species	10	10	4	7	8	9	8	8	5	9	9
ODA											
-Wienner Index	1.633	1.608	1.481	1.282	1.706	1.483	1.737	1.603	1.066	1.717	1.622
s (E)	1.836	0.826	0.92	0.924	0.952	0.828	0.893	0.895	0.769	0.882	0.833
o. of Species	7	7	5	5	6	6	7	6	4	7	7
ERA											
-Wienner Index	2.475	2.536	1.482	1.241	-	2.137	2.153	2.408	1.764	2.248	1.936
s (E)	0.892	0.914	0.921	0.895	-	0.891	0.839	1.004	0.906	0.904	0.841
o. of Species	16	16	5	4	-	11	13	11	7	12	10
CODA											
-Wienner Index	1.298	0.45	-	-	1.196	1.272	1.038	0.898	0.561	1.234	1.31
s (E)	0.936	0.649	-	-	0.862	0.917	0.945	0.817	0.809	0.89	0.945
o. of Species	4	2	-	-	4	4	3	3	2	4	4

ISSN: 0976-7436, (e): 2455-054X
ICRJIFR
Impact Factor
3.8919

Parameters	2013-14	2014-15

YEAR/ MONTHS	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar
2013-14	8	6	2	4	7	8	6	7	4	2	5	5
2014-15	7	3	4	3	5	6	6	5	4	5	4	1

Table-5. Monthly variations of quotient of Vadral Pond

Table – 6 Comparative view of physic-chemical parameters of Vadral ponds

ISSN: 0976-7436, (e): 2455-054X
ICRJIFR
Impact Factor
3.8919

	Mean + SD			Range			Mean + SD			Range		
Air Temp	23.58	±	2.23	20.00	-	28.00	23.67	±	2.10	20.00	-	28.00
Water Temp	24.00	±	1.41	21.00	-	26.00	23.92	±	2.02	19.00	-	26.00
Secchi	53.92	±	5.68	41.00	-	59.00	54.67	±	4.48	44.00	-	59.00
pH	8.36	±	0.51	7.56	-	9.12	8.28	±	0.43	7.61	-	8.95
EC	286.17	±	18.07	261.00	-	321.00	152.58	±	39.90	132.00	-	278.00
TDS	147.01	±	6.24	139.40	-	157.00	147.59	±	6.10	139.20	-	156.80
DO	10.19	±	1.79	7.40	-	14.10	10.87	±	1.83	7.90	-	14.10
Free CO2	8.81	±	2.30	4.90	-	13.00	8.82	±	2.32	4.50	-	12.60
CO2	0.00	±	0.00	0.00	-	0.00	0.00	±	0.00	0.00	-	0.00
HCO3	138.67	±	6.76	129.00	-	154.00	139.17	±	6.91	129.00	-	154.00
Tot-Alkal	138.67	±	6.76	129.00	-	154.00	139.17	±	6.91	129.00	-	154.00
Ca2+	20.83	±	2.26	18.00	-	24.10	20.94	±	2.91	18.00	-	26.00
Mg2+	1.81	±	0.65	0.86	-	2.81	1.44	±	0.50	0.63	-	2.32
Tot-Hard	57.50	±	6.01	47.00	-	68.00	58.42	±	9.24	44.00	-	72.00
Chlorides	43.48	±	10.91	25.90	-	59.50	37.38	±	13.98	6.00	-	58.20
PO4	0.23	±	0.12	0.10	-	0.40	0.24	±	0.11	0.10	-	0.40
SO4	6.23	±	3.36	0.20	-	12.00	5.52	±	3.26	0.90	-	10.00
NH3	4.32	±	1.93	1.20	-	7.20	4.24	±	2.39	1.50	-	8.40
BOD	1.62	±	0.26	0.98	-	1.98	1.69	±	0.49	0.94	-	2.61
COD	50.83	±	14.23	32.00	-	76.00	48.50	±	13.17	34.00	-	72.00
Salinity	0.13	±	0.05	0.10	-	0.20	0.13	±	0.05	0.10	-	0.20
Rainfall	44.21	±	39.04	0.00	-	92.30	52.71	±	58.31	0.00	-	199.70

ISSN: 0976-7436, (e): 2455-054X
ICRJIFR
Impact Factor
3.8919

Table- 7. Correlation of Zooplankton groups with physico-chemical variables and other zooplankton groups in Vadral Pond

	EC (µScm1)	TDS (mg/l)	DO (mg/l)	Free CO_2 (mg/l)	HCO_3 (mg/l	Ca^{2+} (mg/l)	Mg^{2+} (mg/l)	Total Hardness (mg/l)	Chlorides (mg/l))	PO_4 (mg/l)	SO_4 (mg/l	NH_3 (mg/l)	CLADOCE
**	-.606*	-.039	.374	.460	-.449	-.662	-.048	.217	-.716**	.910	-.665*	-.644*	1.000
*	-.024	-.303	-.318	.548	-.308	-.155	.338	.207	-.322	.149	-.947	-.438	.716**
*	-.639*	-.002	.415	.404	-.490	-.643*	-.078	.224	-.729**	-.194	-.635	-.526*	.957**
	-.629*	-.180	.266	.203	-.237	-.573	.038	-.047	-.290	.457	-.460	-.413	.596
**	-.615**	-.105**	.413	.258	-.305	-.619*	-.131	.160	-.551	.067	-.534	-.451	1.0000
	-.509	-.138	.329	.068	-.166	-.523	-.334	-.003	-.578	-.139	-.410	-.407	.358* *
*	-.660*	-.147	.330	.342	-.320	-.518	-.022	.361	-.597	-.157	-.524	-.522	.913**
	-.657*	-.337	.255	.298	-.233	-.278	-.125	.051	-.412	-.103	-.402	-.819	..665

** Correlation is significant at the 0.01 level (2 tailed)

* Correlation is significant at the 0.05 level (2 tailed)

Table-8. Zooplankton Population Density and percentage of Vadral pond (org/L)

ISSN: 0976-7436, (e): 2455-054X
ICRJIFR
Impact Factor
3.8919

Species	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Fe
Year- 2013- 2014											
Cladocera	660	820	80	120	380	490	410	490	260	540	76
Copepoda	1010	1090	730	770	760	760	640	710	380	630	82
Rotifera	790	780	70	190	400	450	540	340	270	550	68
Ostracoda	130	120	10	00	50	80	40	130	30	60	90
Total											
Year- 2014- 2015											
Cladocera	740	750	90	370	590	540	560	580	390	580	56
Copepoda	540	700	370	370	520	590	570	520	310	610	59
Rotifera	1000	890	810	140	630	660	690	580	250	660	61
Ostracoda	100	50	30	10	100	80	40	60	30	70	60
Total											