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Research Article

ABUNDANCE AND DIVERSITY OF ZOOPLANKTONS IN RELATION TO PHYSICO-CHEMICAL PROPERTIES OF WATER IN AMMANAGI POND (CHIKODI TALUKA)

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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-2015) 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 hypereutrophic 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.

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 gasses 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 freshwater 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, the 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 freshwater 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. Freshwater ecosystems provide the more convenient and cheapest waste disposal system.

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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 the 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 the simplest sense, means pollution of water or enrichment of nutrient and the resulting degradation of its quality accompanied by the 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 19^{th} 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 the 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 human activities.

Pjysico-chemical factors are very important in estimating the constituents of water and also the 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.

MATERIALS AND METHOD

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 in diameter 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 19^0C to 30^0C. In Ammanagi pond, the maximum temperature recorded in the month of May 30^0C and minimum of 19^0 C was recorded in the month of December during 2013-14 (Table-1). In the same pond, the maximum of 29^0C was recorded in May and minimum of 19^0C was recorded in the month of December during 2014-2015 (Table-2).

Water Temperature

The water temperature recorded at the time of sample collection, was ranging form 18C to 28^0C. In Ammanagi pond, a maximum of 27^0C was recorded in May, the minimum of 18^0C was recorded in December during 2013-2014 (Table-1). In the same pond, the maximum of 28^0C and minimum of 22^0C in the month of September was recorded during 2014-2015 (Table-2).

Water Transparency

In Ammanagi pond, water transparency varied from 12cm to 23cm. The maximum of 20 cm was recorded in March, April and May the minimum of 12 cm was recorded in July during 2013-2014 (Table-1). In the same pond, the maximum 23cm was recorded in May the minimum of 12cm was recorded in June and July of 2014-2015 (Table-2).

$_p$H.

The pH of Ammanagi pond varied from 7.12 to 9.00. The maximum of 9.00 was recorded in August and the minimum of 7.66 was recorded in April during 2013-2014 (Table-1). In the same pond, the maximum of 8.35 was recorded in March and July and the minimum of 7.12 was recorded in May during 2014-2015 (Table-2).

Electric Conductivity (EC)

The electric conductivity of Ammanagi pond, varied from 278 uScm^{-1} to 345 µScm^{-1}. The maximum of 320 uScm^{-1} was recorded in the month of July and October and the minimum of 278 uScm^{-1} was recorded in the month of February during 2013-2014 (Table-1). In the same pond, the maximum of 345uScm^{-1} was recorded in the month of June and the minimum of 279uScm^{-1} was recorded in the month of February during 2014-2015 (Table-2).

Total Dissolved Solids (TDS):

The total dissolved solids of Ammanagi varied from 141.3 mg/L to163.8mg/L. The maximum of 161.5 mg/L was recorded in the month of Jun in and the minimum of 145mg/L was recorded in the month of Jan during 2013-2014 (Table-1). In the same pond, the maximum of 163.8mg/L was recorded in June and the minimum of 141.3 mg/L was recorded in the month of December of 2014-2015 (Table-2).

Dissolved Oxygen (DO)

The dissolved oxygen in Ammanagi pond varied from 10.3 mg/L to 13.88 mg/L. The maximum of 13.62 mg/L was recorded in the month of February and the minimum of 10.3 mg/L was recorded in the month of April during 2013-2014 (Table-1). In the same pond, the maximum of 13.88 mg/L recorded in the month of March and the minimum of 10.41 mg/L was recorded in the month of August during 2014-2015 (Table-2).

Free Carbon Dioxide (Co_2)

The free carbon dioxide of Ammanagi pond varied from 4.2 mg/L to 11.2 mg/L in the study period. The maximum of 11mg/L was recorded in May and the minimum of 4.2 mg/ L was recoded in October during 2013-2014 (Table-1). In the same pond, the maximum of 11.2 mg/L was recorded in April and the minimum 5.0 mg/L was recorded in the month of September of 2014-2015 (Table-2).

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

Parameters Months	Air temp (˚C)	Water temp (˚C)	Secchi Depth (Cm)	pH	EC (µScm1)	TDS (mg/l)	DO (mg/l)	Free CO2 (mg/l)	CO2 (mg/l)	HCO3 (mg/l)	Total Alkalinity (mg/l)	Ca2+ (mg/l)	Mg2+ (mg/l)	Total Hardness (mg/l)	Chlorides (mg/l)	PO4 (mg/l)	SO4 (mg/l)	NH3 (mg/l)	BOD (mg/l)	COD (mg/l)	Salinity	Rain fall
Apr.	29C	26C	20cm	7.66	289	158.3	10.3	10.9	Nil	145	145	29	0.89	73	33.5	0.6	0.4	2.9	2.4	41	0.1	42.4
May	30C	27C	20cm	7.80	321	161.6	11.9	11.0	Nil	144	144	26	0.99	71	36.9	0.5	4.5	2.5	2.4	40	0.1	49.2
Jun	25C	24C	14cm	8.07	301	146.7	10.62	4.6	Nil	168	168	29	1.3	80	40.3	0.3	6.2	2.8	2.6	39	0.2	69.6
Jul	24C	25C	12cm	8.25	320	161.5	10.65	4.8	Nil	136	136	28	1.52	75	41.39	0.2	6.9	5.1	2.1	47	0.1	74.8
Aug	24C	24C	15cm	9.00	296	159.5	11.00	5.6	Nil	145	145	23.5	1.81	68	42.8	0.4	11.0	4.3	2.4	65	0.1	67.9
Sept	24C	24C	17cm	8.09	298	153.3	11.56	4.6	Nil	139	139	18.9	2.13	59	42.5	0.3	12.6	6.1	1.7	77	0.2	70.7
Oct	23C	24C	17cm	8.15	320	149.6	11.96	4.2	Nil	138	138	16.4	2.56	57	45.31	0.6	15.6	8.2	2.1	81	0.1	37.4
Nov	21C	22C	18cm	7.95	297	153.2	12.06	6.2	Nil	142	142	18.2	2.59	58	48.72	0.3	9.0	8.3	2.4	95	0.2	34.9
Dec	19C	18C	18cm	8.21	281	145.1	12.85	8.2	Nil	140	140	18.7	2.61	57	55.31	0.4	11.6	10.6	2.06	97	0.1	0.9
Jan	20C	21C	19cm	8.36	283	145	12.4	9.9	Nil	134	134	19.2	2.89	62	67.63	0.3	4.5	10.7	2.43	86	0.1	00
Feb	21C	23C	19cm	8.18	278	146.6	13.62	9.8	Nil	146	146	17.9	2.68	56	54.74	0.3	3	12.1	2.87	70	0.2	00
Mar	24C	25C	20cm	7.85	290	147.9	13.26	10.0	Nil	147	147	18.6	2.39	55	50.78	0.5	2.5	9.2	2.6	56	0.1	00

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

Parameters Months	Air temp (˚C)	Water temp (˚C)	Secchi Depth (cm)	pH	EC (µScm1)	TDS (mg/l)	DO (mg/l)	Free CO2 (mg/l)	CO2 (mg/l)	HCO3 (mg/l)	Total Alkalinity (mg/l)	Ca2+ (mg/l)	Mg2+ (mg/l)	Total Hardness (mg/l)	Chlorides (mg/l)	PO4 (mg/l)	SO4 (mg/l)	NH3 (mg/l)	BOD (mg/l)	COD (mg/l)	Salinity	Rain fall
Apr	26	27	20	7.5	281	152.1	13.12	11.2	Nil	140	140	22	1.3	60	41.23	0.2	2.5	7.6	2.3	49	0.1	15
May	29	28	23	7.12	312	159.3	12.61	9.8	Nil	145	145	21	0.98	55	40.12	0.3	1.6	2.6	2.8	36	0.2	14
Jun	25	25	12	7.59	345	163.8	12.03	5.3	Nil	154	154	18.2	1.51	51	37.23	0.1	5.2	3.9	2.8	51	0.1	10
Jul	22	24	12	8.35	330	160.5	11	9.1	Nil	153	153	19.9	1.25	57	42.15	0.3	5.9	5.2	3.89	65	0.1	120
Aug	22	25	13	8.21	301	154.1	10.41	7.3	Nil	161	161	16.4	1.98	49	41.5	0.5	8	6.4	2.4	74	0.1	60
Sept	21	22	15	8.11	298	156.8	10.88	5.0	Nil	154	154	15.6	1.68	49	39.28	0.4	10.9	7.2	2.37	79	0.2	52
Oct	21	23	16	7.93	312	148.6	11.13	5.1	Nil	150	150	17.8	2.11	56	43.49	0.4	14.3	8.9	2.10	81	0.1	21
Nov	20	23	16	7.81	289	149	11.32	6.3	Nil	141	141	18.9	2.01	58	41.27	0.2	12.5	10	2.36	90	0.1	33
Dec	19	23	18	8.05	283	150.1	12.13	6.9	Nil	139	139	16.1	1.89	49	51.91	0.2	7.1	10.9	2.11	82	0.2	11
Jan	20	23	18	8.13	289	146.2	13.86	7.9	Nil	138	138	17.5	1.81	51	65.31	0.3	3.2	8.5	2.65	75	0.1	00
Feb	22	24	19	8.2	279	141.3	13.35	8.3	Nil	134	134	18.3	1.32	52	53.08	0.4	0.9	5.6	1.98	64	0.1	00
Mar	24	25	19	8.35	283	149.5	13.88	9.1	Nil	125	125	18.1	1.56	51	50.61	0.3	1.4	2.8	2.3	52	0.1	00

Total Alkalinity

The total alkalinity of Ammanagi varied from 168 mg/L to 125 mg/L in the study period. The maximum of 168 mg/L was recorded in the month of June and the minimum of 134 mg/L was recorded in the month, January of during 2013-2014 (Table-1). In the same pond, the maximum of 161 mg/L was recorded in the month of August and the minimum of 125 mg/L was recorded in the month of March during 2014-2015 (Table-2).

Carbonates

Bicarbonates

In Ammanagi pond, bicarbonates varied from 168 mg/L to 125 mg/L in the study period. The maximum of 168 mg/L was recorded in the month of June and the minimum of 134 mg/L was recorded in the month, January of during 2013-2014 (Table-1). In the same pond, the maximum of 161 mg/L was recorded in the month of August and the minimum of 125 mg/L was recorded in the month of March during 2014-2015 (Table-2).

Calcium

In Ammanagi pond, calcium varied from 15.6 mg/L to 29 mg/L in the study period. The maximum of 29 mg/L was recorded in the month of June. The minimum of 17.9 mg/L was recorded in the month of February of 2013-2014 (Table- 1). In the same pond, the maximum of 28 mg/L was recorded in the month of April and the minimum of 16.2 mg/L was recorded in the month of September of 2014-2015 (Table-2).

Magnesium

The Magnesium in Ammanagi pond varied from 0.89 mg/L to 2.89 mg/L in the study period. The maximum of 2.89 mg/L was recorded in the month of January and the minimum of 0.89 mg/L was recorded in the month of April of 2013-2014 (Table-1). In the same pond the maximum of 2.11 mg/L was recorded in the month of October and the minimum 0.98 mg/L was recorded in the month of May of 2014-2015 (Table-2).

Total Hardness

In Ammanagi pond, the total hardness varied from 49 mg/L to 80 mg/L in the study period. The maximum of 80 mg/L was recorded in the month of June and the minimum of 55 mg/L was recorded in the month of March of 2013-2014 (Table-1). In the same pond, the maximum of 60 mg/L was recorded in the month of April and the minimum of 49 mg/L was recorded in the month of August, September and December of 2014-2015 (Table-2).

Chlorides

In Ammanagi pond chlorides varied from 33.5 mg/L to 67.63 mg/L in the study period. The maximum of 67.63 mg/L was recorded in the month of January and The minimum of 33.5 mg/L was recorded in the month of April of 2013-2014 (Table-1). In the same pond, the maximum of 65.31 mg/L was recorded in the month of January and the minimum of 37.23 mg/L was recorded in the month of June of 2014-2015 (Table-2).

Sulphates

The Sulphates of Ammanagi pond varied from 0.4 mg/L to 15.6 mg/L in the study period. The maximum of 15.6 mg/L was noticed in the month of October and the minimum of 0.4 mg/L was recorded in the month of March of 2013-2014 (Table-1). In the same pond, the maximum of 14.3 mg/L was recorded in the month of October and the minimum of 0.4 mg/L was recorded in the month of March of 2014-2015 (Table-2).

Phosphates

In Ammanagi pond, Phosphates varied from 0.2 mg/L to 0.6 mg/L in the study period. The maximum of 0.6 mg/L was recorded in the month of October and the minimum of 0.2 mg/L was observed in months of July of 2013-2014 (Table-1). In the same pond, the maximum of 0.5 mg/L was noticed in the month of August and the minimum of 0.1 mg/L was recorded in months of June and the maximum of 0.6 mg/L was recorded in months of August of 2014-2015 (Table-2).

Ammonical nitrogen

In Ammanagi Pond, the ammonical nitrogen varied from 2.5 mg/L to 12.1 mg/L in the study period. The maximum of 12.1 mg/L was recorded in the month of February and the minimum of 2.5 mg/L was recorded in the month of May of 2013-2014(Table-1). In the same pond, the maximum of 10.9 mg/L was recorded in the month of December and the minimum of 2.6 mg/L was recorded in the months of May of 2014-2015 (Table-2).

Biochemical Oxygen Demand (BOD)

The BOD of Ammanagi pond, varied from 2.1 mg/L to 3.89 mg/L in the study period. The maximum of 2.87 mg/L was recorded in the month of February and the minimum of 2.1 mg/L was recorded in the month of October of 2013-2014 (Table-1). In the same pond, the maximum of 3.89 mg/L was recorded in the month of July and the minimum of 2.3 mg/L was recorded in the month of March and April of 2014-2015 (Table-2).

Chemical Oxygen Demand (COD)

In Ammanagi pond, the COD varied from 36 mg/L to 97 mg/L in the study period. The maximum of 97 mg/L was recorded in the months of December and the minimum of 39 mg/L was recorded in the month of June of 2013-2014 (Table-1). In the same pond the maximum of 90 mg/L was recorded in the month of November and the minimum of 36 mg/L was recorded in the month of May of 2014-2015 (Table-2).

Salinity

In Ammanagi 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 June, September, November and February months the minimum of 0.1 mg/L was noticed in April, May, July, August, October, December, January and March of 2013-2014 (Table-1). In the same pond the maximum of 0.2 mg/L was noticed in May, September, and December months. In the remaining months of 2014-2015, the salinity was 0.1 mg/L (Table-2).

Rain fall

At Ammanagi pond catchment area, the annual rainfall recorded during 2013-2014 was from 0 to 74.8 cm. The maximum of 74.8 cm was recorded in the month of July and there was no rain in January, February and March (Table-1). In the second year (2014-2015) the annual rainfall varied from 0 to 102 cm. The maximum of 102 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 total forty-three species of zooplankton were noticed in two years of the study period (2013-2014 and 2014-2015) from Ammanagi pond. These species belong to four groups they are Cladocera, Copepods, Rotifera and Ostracods.

There were 16,030 zooplankton noticed in Ammanagi pond, consisting of 30% of Cladocera; 29.69% of Copepods; 35.18% of Rotifers and 5.11% of Ostracods during the year of 2013-2014. In the same pond there were 24,710 zooplankton noticed in the year of 2014-2015 that constituted 27.23% of Cladocera, 37.27% of Copepods, 32.23% of Rotifers and 3.15% of Ostracods (. &17).

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

The most abundant species of zooplankton during the two years of study period in Ammanagi pond were Ceriodaphnia corunta, Alona pulchella, Moina macrocopa, Bipertura karua, Diaphanosama excisum among the Cladocera, Heliodiaptomus viduus, Mesocyclops leuckarti, Tropocyclops prasinsus, Neodiaptomus strigilipes were among the Copepods. The Brachionus caudatus, Keratella tropica. Brachionus falcatus, Brachionus bidentata were among the Rotifera and the Hemicypris fossulata and Darwinula species were among ostracods.

Diversity and Uniformity

To determine the diversity and uniformity of zooplankton species, the method of Shannon-Wiener Index was followed. According to that method the Highest species diversity of the Cladocera was found at Ammanagi pond in the month of January; Copepoda in the month of June; Rotifera in the month of November and Ostracoda in the month of February during the year of 2013-2014 (Table-3).

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

GROUPS/MONTHS	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar
					CLADOCERA							
Shinnon-Wienner Index (H)	1.725	1.621	1.21	0.63	1.711	1.848	1.223	1.593	1.934	1.97	1.905	1.433
Evenness (E)	0.829	0.781	0.873	0.909	0.879	0.888	0.76	0.889	0.882	0.947	0.867	0.89
Total No. of Species	8	8	4	2	7	8	5	6	9	8	9	5
					COPEPODA							
Shinnon-Wienner Index (H)	1.771	1.626	1.783	1.553	1.272	1.621	1.371	1.119	0.733	1.346	1.656	1.695
Evenness (E)	0.91	0.907	0.916	0.889	0.79	0.905	0.765	0.807	0.667	0.836	0.851	0.871
Total No. of Species	7	6	7	7	7	5	6	6	4	3	5	7
					7ROTIFERA7							
hinnon-Wienner Index (H)	2.099	1.715	1.21	1.059	2.067	2.219	2.04	2.292	1.847	2.09	2.09	2.058
Evenness (E)	0.875	0.881	0.837	0.964	0.862	0.893	0.928	0.956	0.949	0.871	0.927	0.945
Total No. of Species	0.875	7	4	3	11	12	9	11	7	11	9	8
					OSTRACODA9							
Shinnon-Wienner Index (H)	0.689	1.316	0	0	1.038	1.028	1.274	0.87	0.595	0.969	1.349	1.205
Evenness (E)	0.922	0.949	0	0	0.945	0.936	0.919	0.792	0.858	0.882	0.973	0.869
Total No. of Species	2	4	1	1	3	3	4	3	2	3	4	4

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

GROUPS/MONTHS	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar
					CLADOCERA							
Shinnon-Wienner Index (H)	2.055	1.948	1.145	1.401	1.955	1.953	1.747	1.692	2.033	1.77 1	2.773	2.191
Evenness (E)	0.935	0.846	0.826	0.87	0.854	0.814	0.84	0.773	0.925	0.851	1.156	1.914
Total No. of Species	9	10	4	5	10	11	8	9	9	8	11	11
					COPEPODA							
Shinnon-Wienner Index (H)	1.96	1.784	2	1.808	1.939	1.871	1.758	1.733	1.283	1.828	1.708	1.875
Evenness (E)	0.937	0.968	0.962	0.928	0.932	0.899	0.903	0.967	0.797	0.879	0.878	0.901
Total No. of Species	8	6	8	7	8	8	7	6	5	8	7	8
					ROTIFERA8							
Shinnon-Wienner Index (H)	2.341	36.893	1.059	1.508	-	2.141	1.993	1.988	1.76	1.996	2.031	1.415
Evenness (E)	0.913	14.65	0.984	0.641	-	0.861	0.865	0.829	0.904	0.832	0.882	0.727
Total No. of Species	13	12	6	6	-	12	11	12	7	11	10	7
					OSTRACODA							
Shinnon-Wienner Index (H)	0.897	0.784	-	0.998	0.785	0.584	0.922	-	-	1.077	1.672	1.157
Evenness (E)	0.816	0.723	-	0.998	0.785	0.584	0.922	-	-	0.98	0.969	0.841
Total No. of Species	8	3	-	2	4	4	2	-	-	3	2	4

In the same pond, the highest species diversity of Cladocera was observed in the month of February, Copepoda in the month of April, Rotifera in the month of May and Ostracoda in the month of March of the year of 2014-2015 (Table-4).

The highest species uniformity observed in Ammanagi pond was that of the Cladocera in the month of January, Copepoda in the month of June, Rotifera in the month of July and Ostracoda in the month of February during the year of 2013-2014 (Table-3). In the same pond, the highest species uniformity of Cladocera was found in the month of February, Copepoad in the month of May. Rotifera in the month of May and Ostracoda in the month of July of the year of 2014-2015 (Table-4).

Trophic Stauts

The quotient $Q_{B/T}$ values of Ammanagi pond varied from two to eight during the year 2013-2014 (Table-5). It was mesotrophic in the month of June and July and rest of the ten months it was eutrophic and hypereutrophic. The quotient $Q_{B/T}$ Of the same pond in the year of 2014-2015 varied from two to nine (Table-5). It was mesotrophic only in the month of June and rest of the eleven months, it was eutorphic and hypereutrophic.

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

Temperature is a physical factor indicating the quality of water. It has effect on growth and distribution of aqauatic life, concentration of dissolved gases and chemical solutes.

In present study 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).

The water temperature recorded in Ammanagi Pond was (23.58±2.39) (Table-6) and in the second year (2014-2015) the water temperature recorded was (24.33±1.78) (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).

Table-5 Monthly variations of quotient of Ammanagi Pond

YEAR/ MONTHS	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar
2013-14	8	5	2	2	8	8	4	7	5	6	7	5
2014-15	6	9	2	4	7	7	7	7	5	6	7	6

DISCUSSION

In limnological study, the physicochemical 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.

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

Parameters	YEAR- 2013-2014		YEAR- 2013-2014	
	Mean + SD	Range	Mean + SD	Range
Air Temp	23 .67 + 3.31	19.00 - 30.00	22.58 + 2.91	19.00 - 29.00
Water Temp	23.58 + 2.39	18.00 - 27.00	24.33 + 1.78	22.00 - 28.00
Secchi	17.42 + 2.57	12.00 - 20.00	16.75 + 3.39	12.00 - 23.00
pH	8.13 + 0.34	7.66 - 9.00	7.95 + 0.38	7.1 2- 8.35
EC	297.83 + 15.28	278.0 - 321.00	300.17 + 20.98	279.00 - 345.00
TDS	152.36 + 6.44	145.00 -161.60	152.61 + 6.51	141.30 - 163.80
DO	11.85 + 1.07	10.30 - 13.62	12.14 + 1.21	10.41 - 13.88
Free CO2	7.48 + 2.73	4.20 - 11.00	7.61 + 1.99	5.00 - 11.20
CO2	0.00 + 0.00	0.00 - 0.00	0.00 + 0.00	0.00 - 0.00
HCO3	143.67 + 8.71	134.00 - 168.00	144.50 + 10.23	125.00 -161.00
Tot-Alkal	143.67 + 8.71	134.00 - 168.00	144.50 + 10.23	125.00 -161.00
Ca2+	21.95 + 4.81	16.40 - 29.00	18.32 + 1.92	15.60 - 22.00
Mg2+	2.03 + 0.70	0.89 - 2.89	1.62 + 0.36	0.98 - 2.11
Tot-Hard	64.25 + 8.69	55.00 - 80.00	53.17 + 3.86	49.00 - 60.00
Chlorides	46.66 + 9.40	33.50 - 67.63	45.60 + 8.09	37.23 - 65.31
PO4	0.39 + 0.13	0.20 - 0.60	0.30 + 0.11	0.10 - 0.50
SO4	7.32 + 4.65	0.40 - 15.60	6.13 + 4.55	0.90 - 14.30
NH3	6.90 + 3.40	2.50 - 12.10	6.63 + 2.71	2.60 - 10.90
BOD	2.34 + 0.31	1.70 - 2.87	67.17 + 16.50	41.00 - 93.00
COD	66.17 + 21.44	39.00 - 97.00	66.50 + 16.47	36.00 - 90.00
Salinity	0.13 + 0.05	0.10 - 0.20	0.13 + 0.05	0.10 - 0.20
Rainfall	36.48 + 30.62	0.00 - 74.80	28.00 + 34.99	0.00 - 120.00

Water temperature was also positively correlated with electric conductivity ($r=0.5799$, $P<0.05$), total dissolved solids ($r=0.6727$, $P<0.05$), calcium ($r=0.7448$, $P<0.01$), carbon dioxide ($r=0.7180$, $P<0.01$) in Ammanagi Pond.

Water Transparency

Suspended materials, restricting the photosynthetic zone often limit penetration of light. The turbidity especially when caused by clay suspended soil particles, fragments of dead plants and silt particles is often important as a limiting factor.

In the present study the value of transparency observed in Ammanagi Pond was (17.42+2.57 cm) in the year of 2013-2014 (Table-6). In the second year (2014-2015) the value of water transparency recorded in Ammanagi pond was (16.75+3.39cm) (Table-6).

In Ammanagi Pond water transparency is positively correlated with free carbon dioxide ($r=0.8163$, $P<0.01$), Dissolved oxygen ($r=0.6829$, $P<0.05$).

Muragavel and Ponden (2000) reported the positive correlation of water transparency with pH, free CO2, Phosphates, DO and nitrates. They had also reported the existence of a 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. 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 carbonates begins to be of importance.

In Ammanagi pond (7.95+0.38) was recorded in year (2014-2015) (Table-6) and the highest was recorded (8.13+0.34) during 2013-2014 (Table-6).

According to Saran and Adonis (1982), during photosynthesis free carbon dioxide and bicarbonates are utilized and there is the release of carbonates which increase the quantity of dissolved oxygen and pH. Thus a positive correlation was not found in Ammanagi. The seasonality or pH was not uniform in the water body. It increased from spring to summer. In the summer months pH value of 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.

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 the present study, the value of EC recorded in Ammanagi was (297.85+15.28, µs cm-1) (Table-6) during 2013-2014. In second year (2014-2015) the value of EC recorded in Ammanagi pond (300.17+20.98 µS cm-1) (Table-6).

The electric conductivity was positively correlated with total dissolved solids (r=0.8111, $P<0.01$), rain fall (r=0.6457, $P<0.05$), Bicarbonates (r=0.6749, $P<0.05$) and Air temperature (r=0.5799, $P<0.05$) in Ammanagi Pond. It was positively correlated with calcium (r=0.7864, $P<0.01$), pH (r=0.6164, $P<0.05$), Phosphate (r=0.6317, $P<0.05$) and rainfall (r=0.9294, $P<0.01$) in Jainapur. Electrical conductivity showing a significant positive correlation with chloride was also reported by Patil and Gouder (1985).

Total Dissolved Solids

Total dissolved solids denote mainly the various kinds of minerals present in the water. Dissolved solids do not contain any gas and colloidal etc (Trivedy and Goel, 1984). The concentration of dissolved solids is an important parameter in drinking water and other water quality standards.

In the present study, the values of total dissolved solids recorded in Ammanagi was (152.36+6.44 mg/L) during 2013-2014. In second year (2014-2015) the value of total dissolved solids recorded in Ammanagi pond was (152.61+6.51 mg/L) (Table-6).

In Ammanagi Pond the total dissolved solids positively correlated with rainfall (r=0.6727, $P<0.05$), atmospheric temperature (r=0.6935, $P<0.05$), Water temperature (r=0.6727, $P<0.05$), Calcium (r=0.5783, $P<0.05$), Electrolyte conductivity (r=0.8111, $P<0.01$) Bicarbonates and Alklinity (r=0.6399, $P<0.05$).

Similar observations were also made by Sunkad, (2002). 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 It is considered as the factor which can reveal the nature of the entire ecosystem. Atmospheric oxygen can directly diffuse through the exposed surface by water agitation through wind, human disturbances like swimming etc.. The biological process involves the photosynthetic evaluation of oxygen by autotrophy. Oxygen in the water body can be consumed by the respiration of and plant.

In the present study, the values of dissolved oxygen noticed was (11.85+1.07 mg/L) in Ammanagi Pond during 2013-14 (Table-6). In the second year 2014-15 the values of demand oxygen in Ammanagi pond was (12.14+1.21 mg/L) (Table-6).

The dissolved oxygen has positive correlation with Magnesium (r=0.7549, $P<0.01$), Chlorides (r=0.7138, $P<0.01$), ammonical nitrogen (r=8562, $p<0.01$) and water transparency (r=0.6829, $P<0.05$) in Ammanagi Pond.

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

Carbon dioxide is one of the most important substances in the life of organisms. The healthy growth of green plants are standing proof of the sufficiency of these small quantities (Welch 1935).

That amount of free carbon-di-oxide which inhibit the conversion of bicarbonate into carbonate is named equilibrium carbon dioxide by Runner (1953).

In the present study, the value of free carbon dioxide noticed in Ammanagi Pond was (7.48±2.73 mg/L) during 2013-2014 (Table-6). In the second year 2014-1015 the values of free carbon dioxide recorded was (7.61±1.99 mg/L) (Table-6).

In Ammanagi Pond, the free carbon dioxide shown positive correlation with water temperature (r=0.7180, $P<0.01$), water transparency (r=0.8163, $P<0.01$), and calcium (r=0.7371, $P<0.01$).

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 the present study, the values of bicarbonate noticed in Ammanagi Pond (143.67±8.71 mg/L) during 2013-2014 (Table-6). In the second year (2014-2015) the values of bicarbonate recorded in Ammanagi pond (144.50±10.23) mg/L (Table-6).

The bicarbonates of Ammanagi Pond positively correlated with electrict conductivity (r=0.6749, $P<0.05$), total alkalinity (r=0.1.000, $P<0.01$), total dissolved solids (r=0.6399, $P<0.05$), rain fall (r=0.6294, $P<.005$).

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

Alkalinity determination of the productive capacity of the aquatic environment (Philipase, 1959). Total alkalinity of an aquatic body is constituted by hydroxides, carbonates, and bicarbonate.

In the present, study the values of total alkalinity recorded in Ammanagi Pond was (143.67 ±8.71 mg/l) during 2013-2014 (Table-6). In second year (2014- 2015) the values of total alkalinlty recorded is (144.50±10.23 mg/L) (Table-6).

In Ammanagi pond, total alkalinity was positively correlated with electrict conductivity (r=0.6749, P<0.05), bicarbonates (r=0.1.000, P<0.01), total dissolved solids (r=0.6399, P<0.05), rain fall (r=0.6294, P<.005). 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 considered as a basic inorganic element of algae and regarded as a nutrient for various metabolic processes (Ruttner, 1953). Calcium is essential for maintenance of the structural and functional integrity of cell remembrance in ion absorption. (Wetzel, 1975).

In the present study, the value of calcium recorded in Ammanagi Pond is (21.95±4.81 mg/L) in 2013-2014 (Table-6). In second year (2014-2015) the value of calcium recorded in Ammanagi is (18.82±1.92 mg/L) (Table-6).

In Ammanagi Pond, calcium is positively correlated with atmosphere temperature (r=0.7017, P<0.05), rain fall (r=0.6337, P<0.05), total hardness (r=0.9671, P<0.01), total dissolved solids (r=0.5783, P<0.05), water temperature (r=0.7448, P<0.01) free carbon dioxide (r=0.7371, P<0.01).

Barbieri *et al*., (1999) reported that calcium showed a significant positive correlation of calcium with total hardness, electric conductivity, total dissolved solids, and Magnesium. These studies support our findings.

Magnesium

In present study, the value of magnesium recorded in Ammanagi Pond was (2.03±0.70 mg/L) in 2013-2014 (Table-6). In second year (2014-2015) the value of magnesium recorded in Ammanagi Pond was (1.62±0.36 mg/L) (Table-6).

In Ammanagi Pond, Magnesium Positively correlated with dissolved oxygen (r=0.7549, P<0.01), biological oxygen demand (r=0.8746, P<0.01), chloride (r=0.8672, P<0.01), chemical oxygen demand (r=0.6470, P<0.01), ammonical nitrogen (r=9362, P<0.01), sulphate (r=0.7457, P<0.01).

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

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 Ammanagi Pond was (64.25± 8.69 mg/L) in the year of 2013-2014 (Table-6). In second year (2014-2015) the value of total hardness recorded in Ammanagi pond was (53.17±3.86 mg/L) (Table-6).

In Ammanagi Pond, the total hardness was positively correlated with atmospheric temperature (r=0.6192, P<0.05), calcium (r=0.9671, P<0.01), rainfall_r=0.7018, P<0.05. In Jainapur, it was positively correlated with atmospheric temperature (r=0.7099, P<0.01), calcium (r=0.6864, P<0.05).

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

Chlorine in free state which is used as a disinfectant will be converted into chlorides or combines with organic matter to form toxic compounds (Adoni, 1985). According to Trivedi and Geol (1984), since the chlorides are highly soluble they can not be precipitated, sediment or removed biologically.

In the preset study, the values of chlorides observed in Ammanagi Pond was (45.60±8.09 mg/L) (Table-6). In second year (2014-2015) the values of chloride recorded in Ammanagi pond was (45.60±8.09 mg/L) (Table-6).

In Ammanagi Pond, chloride positively correlated with dissolved oxygen (r=0.7138, P<0.01), Magnesium (r=0.8672, P<0.01), ammonical nitrogen (r=0. 8794, P<0.01), chemical oxygen demand (r=0.6907, P<0.05).

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. Chloriderelation 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).

In the present study, the values of phosphate recorded in in Ammanagi Pond was (0.39±0.13 mg/L) in the year of 2013-2014 (Table-6). In the second year (2014-2015) the values of phosphate recorded in Ammanagi Pond was (0.32±0.12 mg/L) (Table-6).

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. Most of the salts of sulphate are soluble in water and as such it is not precipitated. 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 (7.32±4.65 mg/L) in the year of 2013-2014 (Table –6). In the second year (2014-2015) the values of sulphates recorded was (6.13±4.55 mg/L) (Table-6).

In Ammanagi Pond, sulphates positively correlated with biological oxygen demand (r=0.7797, P<0.01), ammonical nitrogen (r=0.6046, P<0.05), magnesium (r=0.7459, P<0.01), chemical oxygen demand (r=0.7649, P<0.01).

Rao *et al*, (1999) reported the existence of a positive correlation with calcium, magnesium Nandoni *et al*, (2001), observed negative correlation of sulphate with biochemical oxygen demand. The 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). The low value of sulphate during winter is due to higher phytoplankton population (Sneha, 1989).

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.

In the present study, the value of nitrates found in Ammanagi was (6.90±3.40 mg/L) in the year of 2013-2014 (Table-6). In the second year the value of amonical nitrogen recorded was (6.73±2.17 mg/L) (Table-6).

In Ammanagi Pond, nitrates positively correlated with biological oxygen demand (r=0.8343, P<0.01), chloride (r=0.8794, P<0.01), chemical oxygen demand (r=0.8371, P<0.01), dissolved oxygen (r=0.8562, P<0.05), sulphate (r=0.6046, P<0.05), magnesium (r=0.9362, P<0.01).

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.

In the present study, the values of BOD recorded in Ammanagi Pond was (2.34±0.31 mg/L) in the year of 2013-2014 (Table-6). In second year the values of BOD recorded in Ammanagi pond (2.71±0.59 mg/L) (Table-6).

In Ammanagi Pond, BOD positively correlated with ammonical nitrogen (r=0.8343, P<0.01), magnesium (r=0.8746, P<0.01), sulphate (r=0.7797, P<0.01), chemical oxygen demand (r=0.9895, P<0.01).

Chemical Oxygen Demand

In the present study, the value of COD recorded in Ammanagi Pond was (66.17±21.44 mg/L) in the year of 2013-2014 (Table-6). In the second year (2014-2015) the values of COD recorded was (66.50±16.47 mg/L) (Table-6).

In Ammanagi Pond, the COD Positively correlated with biological oxygen demand (r=0.9895, P<0.01), ammonical nitrogen (r=0.8301, P<0.01), magnesium (r=0.8709, P<0.01), chloride (r=0.6907, P<0.05), sulphate (r=0.7649, 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 the second year (2014-2015) the values of salinity recorded was (0.13±0.05) (Table-6).

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. Rainfall depicted significant annual verifications. It registered identical seasonal pattern and is distinctly influenced by the southeast monsoon which in turn coincided with the periods of relatively higher temperatures.

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

It showed positively correlation with electric conductivity (r=0.6457, P<0.05), total dissolved solids (r=0.6727, P<0.05), calcium (r=0.6337, P<0.01), total hardness (r=0.7018, P<0.05), bicarbonate (r=0.6294, P<0.05). positive correlation of rain fall with calcium. Magnesium, sulphate and sodium also reported by Sunkand and Patil (2001).

Biotic Factors

Zooplankton

In aquatic ecosystems zooplankton plays a critical role not only in converting plant food to animal food but also they themselves serve as a source of food for higher organisms including fish. 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.

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. 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 – 8 & 9. The correlation of zooplankton groups with physico- chemical variables and other zooplankton groups is presented in Table – 8 & 9

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. 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) and Daday (1889) revealed the valuable information about the Cladocerans.

In the two-year study period, a maximum of 13 species pf Cladocera were reported from Ammanagi pond. The higher Cladoceran specie in Ammanagi 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 greater 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 the lowest number of cladoceran species.

The highest Cladoceran density was observed in Ammanagi pond (6430 org/L) (.) that constitute 27.23% during 2013-2014. This variation might be due to rapid increasing in the D. excisum species. Similar observation was also noticed by the Rob Hart (2001).This species grow rapidly in high nutrient conditions (Jana and Pal 1984)because of the presence of lower water level in summer, Remains of dead and decaying vegetation as well as burnt and half brunt dead bodies which result into the increase of organic mater and growth of bacteria population. It increased the zooplankton population (Bohra and Kumar, 2004).

Among the Cladocera group three species were dominant namely ceriodaphina corunta, Diaphanosoma excisum and Alona pulchella. These three species found throughout in the study period. (2013-2014 and 2014-2015).

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

In Ammanagi pond, during 2013-2014 the cladocera group was positively correlated with free carbon dioxide (r=0.866, p<0.01), water transparency (r=0.698,p<0.05) copepods (0.702,p0.05), Rotifers (r=0.900,p<0.05), and negatively correlated with salinity (r=0-411,p<o.01). In the second year ,it was positively correlated water transparency (r=0.599,P<0.05) copepods (r=0.706,p<0.05), Rotifers (r=0.963,p<0.01) and ostracods (r=0.814,p<0.01) but there was no notice of negative correlation in the second year.

Copepods

In the present study, seven species of copepods documented in Ammanagi pond namely, Heliodiaptomus vidnus ,paracyclops , firmbritas prasinus, Messocyclops leukarti neodiaptomus strigilipes mesocyclops hyalinus and Rhinediaptmus indicusand. The smaller destiny recorded in Ammanagi ponds (4760org/L) which constituted 29.69percent during 2013-2014 of total zooplankton of the pond. The seven species belonging in the two families Diaptomidae and cyclopidea Diaptomidae represent three genera of three species cyclopidae represent three genera of four species. Patil and Goudar (1982c, 1989) also reported seven species from Dharwad district, Kudari *et al* (2005) also reported six species of copepods from Shiggaon taluk of Haveri district. In Copepods the most dominant species recorded was Heliodiaptomas viduus which accounted highest (32.02%) among copepod density in Ammanagi pond during 2014-2015.

In Ammanagi pond, during 2013-2014 the Copepod population showed strong postive correlation with dissolved oxygen (r=0.637, P<0.05), water transparency (r=0.0577, P<0.05), Cladocera (r=0.702,p<P0.05), Ostracods (r=0.896,P<0.01), and negative correlation with biochemical oxygen demand (r=0.-634, P<0.05), bicarbonates (r=0.692,P<0.05) and total alkalinity (r=0,-692,P<0.05). In the second year, it showed positive correlation with atmospheric temperature (r=00767,P<0.01), water temprature (r=0.818, P<0.01), rotifers (r=0.714, P<0.01), and negative correlation was observed with chemical oxygen demand (r=0.-747,P<0.01), and sulphate (r=0.-679.P<0.05).

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

Parameters	Air temp (˚C)	Water temp (˚C)	Secchi Depth (Cm)	pH	EC (µScm1)	TDS (mg/l)	DO (mg/l)	Free CO2 (mg/l)	HCO3 (mg/l	Ca2+ (mg/l)	Mg2+ (mg/l)	Total Hardness (mg/l)	Chlorides (mg/l)	PO4 (mg/l)	SO4 (mg/l)	NH3 (mg/l)	CLADOCERA	COPEPODA	ROTIFERA	OSTRACODA
YEAR 2013-2014																				
CLADOCERA	.444	.423	.696'	-.259	-.489	-.314	.579*	.866**	-.438	.173	-.324	-.147	.105	-.278	-.529	..348	1.000	.702	.900**	.565
COPEPODA	.123	-.062	.557	.098	-.506	-.374	.637*	.377	-.692*	-.120	-.251	-.512	.296	-.249	-.356	-..329	.702	1.000	.502	.896**
ROTIFERA	-.456	.509	.326**	-.363	-.487	-.362	.568*	.849	-.360	.224	-.288	-.007	.194	-.239	-.500	-.298	.900	.502	1.000	.518
OSTRACODA	.641	-.198	.462	.265	-.621*	-.483	.595*	.256	-.676**	-.289	-.117	-.577	.473	-.209	-.265	-.296	.565	.896**	.518	1.000
YEAR 2014-2015																				
CLADOCERA	.526	.457	.599*	-.204	.280	.013	-.066	.425	-..325	.011	-.264	.008	-.234	-.297	-.370	.365	1.000	.706*	.963**	.814**
COPEPODA	.767**	.318**	.275	-.257	.325	.044	-.035	.467	-.312	.399	-.550	.472	-.380	.032	-.679**	.393	.706	1.000	.714**	.669*
ROTIFERA	.534	.388	.601*	-.238	.453	.072	-.099	.428	-.283	.078	-.325	.103	-.291	-.319	-.346	.225	.963**	.714**	1.000	.748**
OSTRACODA	.353	.389	.240	-.152	-.028	.076	.294	.059	-.142	.093	-.117	-.199	-.018	-.156	-.127	.185	.814**	.669*	.748	1.000

** Correlation is significant at the 0.01 level (2 tailed)
* Correlation is significant at the 0.05 level (2 tailed)

In Copepodal densities naupli contributed 35.19 percent in Ammanagi pond (.). In the second year it contributed 27.14 percent in Ammanagi pond. Patil and Gounder (1985). Sampaio *et al*., (2002); Neves *et al*., (2003) and Kudari *et al*. (2005) also reported the numerical predominance of young forms of Copepods.

Rotifers

Rotifers are fresh water zooplanktons. Approximately, 1700 species of rotifers have been recorded from all over the world. As for the Rotifera a Fauna of Karnataka State there is a mention of 4 species of rotifers from Dharwad in an ecological study of Zooplankton (Gouder and Joseph, 1961), Recently a comprehensive survey of rotifers from Dharwad (Patil and Goudar, 1982a, b) was made in which 62 species of Rotifers have been recorded. Kudari at al (2005) also reported 38 species of Copepods from Shiggaon and Mundgod taluks.

The highest Rotifers density was observed in Ammanagi pond during 2014-2015(7990 org/L) which constitute 31.33%. the smaller density was recorded in Jainapur (3860 org/L) which constitute 25.68% in the year of 2014-2015.

In Ammanagi pond, Rotifer population showed positive correlation with free carbon-di-oxide (r=849, P< 0.01) water transparency (r=0.900, P< 0.01) and Cladocera (r=0.900, P< 0.01) but there was no negative correlation observed in the year of 2013-2014. In the second year it showed positive correlation with water transparency (r=0.601, P< 0.05), Cladocera (r=0.963, P< 0.01), Copepods (r=0.714, P< 0.01), Ostracods (r=0.748, P< 0.01) and negative correlation was observed with salinity (r=0.-593, P< 0.05),

Ostracoda

In Ammanagi pond during 2013-2014 Osracods population was positively correlated with dissolved oxygen (r=0.595, p, <0.05), Cladocera (r=0.896, P<0.01) and negatively correlated with biochemical oxygen demand (r=0.-720, P<0.01), electric conductivity (r=0.-624, P<0.05), bicarbonates (r=0.676, P<0.05) total alkalinity (r=0.-676, P<0.05). In the second year, these were posititvely correlated with Cladocera (r=0.814, P<0.01), Copepod (r=0.667, P<0.05) and Rotifers (r=0.748, P<0.01) but in second year Ostracods did not show negative correlations with any otherfactors

Trophic Status

In the present study, the Rotifera was the dominant group of zooplankton in all this water body and it coincided with the work of Sharma, (2005). Maximum number of Rotifers occurred during summer indicating the influence of temperature supported by the positive correlation between temperature and Rotifer population. Similar observations were also made by Kaushik and Sharma (1994) and Singh (2000). The species such as B. angularis, B. calcitlorus B.forficula and B. caudatus found in all the three water bodies indicating their diverse nature of occurrence from nonpolluted to highly polluted water bodies (Sharma and Dodani, 1992).

Rotifers respond more quickly to environmental changes than crustacean plankton and appear to be more sensitive indicators of change in water quality (Gannon and Stemberger, 1977; Sladecek, 1983; Baranco *et al*.,; 2002). Because the genus Brachinonus is connected with the eutrophic wates (except B. sericus which is typically acidophilic and B. plicatilis from brackish waters) and the genus Trichcerca is nearly purely oigotrophic, we can establish a Brachionus: Trichocerca quaotient($Q_{B/T}$) (Sladecek, 1983. This quotient can be established for individual water bodies of standing or slowly flowing character or even for individual samples, if representatives of at least one of these genera are present.

Based on the quotient $Q_{B/T}$ values (Table-5 and 31) it was observed that in monsoon all the three water bodies were nesortorphic and rest of the time they were eutrophic or hypereutorphic. This variation may be attributed to more water influx to the ponds during monsoon season which dilutes the concentration of nutrients and planktons. It was also observed by Bohra and Kumar, (2004); Hegde and Huddar, (1995); Kudari (2005). Hypereutrophic condition was noticed in summer due to a drastic reduction of water level in the ponds which increased the organic matter and growth of bacteria population and in turn increased the zooplankton population as explained by Bohra and Kumar (2004).

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 clothes 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 a taxonomically dominant group and its density was also high. The pond was mesotrophic in June and July remaining months it was eutrophic and hypereutrophic. 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 hypereutrophic 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.

References

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). 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.

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

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

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