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PHYSICO-CHEMICAL PARAMETERS AND PLANKTON DIVERSITY OF GHANPUR LAKE, WARANGAL, A.P., INDIA

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Abstract- The planktonic population and the physico chemical parameters of the Ghanpur Lake have been studied for a period of twelve months. Ghanpur lake is situated Warangal district, Andhra Pradesh, India. The physico chemical parameters and planktonic diversity was studied from February 2009 to January 2010. The physico chemical parameters includes Temperature, pH, Transparency, Turbidity, Conductivity, Total Dissolved Solids (TDS), Dissolved Oxygen (DO), Free CO2, Alkalinity, Total Hardness, Chlorides, Sulphates, Phosphates, Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD). During summer Temperature, pH, Conductivity, TDS, DO, Alkalinity, Total Hardness, Chlorides and BOD was found to be increased and gradually decreased in rainy season. Sulphates and phosphates were found to be high in winter season and low in summer season. Therefore this lake has rich number of species and biodiversity of aquatic animals. A total of 13 Zooplanktons were identified, among these rotifers 7 species, Copepods 3 species, Cladocera 2 species, Ostracoda 1species, of which rotifers and copepods are dominating. Rotifera, Cladocera and Copepod populations were high during summer season and low in rainy season. While the Ostracode species were recorded high in rainy season and low in winter season.

Keywords- Ghanpur lake, planktons, diversity, Shannon, Simpson, Evenness, physical parameters, Chemical parameters

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Introduction

Dry lands are located in arid, semi-arid or dry sub humid climatic zones, comprising 41% of all continental areas of the Earth's surface and are home to more than 2 billion people, or approximately one-third of the world population. It is estimated that around 20% of the dry lands of the planet are already completely decertified and that the decertified areas will increase considerably in the coming decades. In semi-arid regions, the droughts and the highly irregular rainfall, together with high evaporation rates, cause the loss of a great part of the surface waters. As a result, almost the entire hydrologic network is alter, which leads to a severe problem for the storage and uses of this essential resource. Therefore, many reservoirs are constructed in these regions with the main purpose of storing water for various purposes.

The frequent alterations in tropic state, other physico-chemical factors in these waterboides represent an important selective factor for the success of potentially colonizing species. Furthermore, these reservoirs are relatively shallow environments, highly vulnerable to wind action and to oscillations in climatic conditions, which represent other important selective factors for the biota. Hence, the composition and the relative abundance of species in the aquatic communities must be influenced by the variations in the tropic state, seasonal changes of physico-chemical variables of the waterbody.

Zooplankton has been recommended as regional bioindicators of lake eutrophication [1-6] acidification [6], disturbances by agriculture [7]. Although zooplankton are usually considered to be good indicators of environmental changes and have a fundamental role in energy flow and nutrient cycling in aquatic ecosystems, these organisms have been little studied in aquatic ecosystems of Warangal District. Therefore, their potential value as indicators of alterations in the water quality of waterboides in this region needs to be assessed. Also, there is an increasing demand by environmental monitoring programs for bioindicators of water quality.

This study attempted to investigate the physico-chemical parameters and composition of the zooplankton community Ghanapur lake.

Study Area

The Ghanapur lake a major perennial water of the district and located at near Warangal city, which is falls under 17°22'30" N latitude and 76°59'0" E longitude.

The total catchment area of Ghanapur lake is 165.70 Sq.Km and live storage capacity is 4.235mm^3 and grass storage of the reservoir is 5.2364mm^3. This Lake water is used for drinking purpose and irrigation purpose. The maximum depth of reservoir is 9 meters.

Materials and Methods

Monthly zooplankton samples were obtained from each of these

sites for the period February 2009 to January 2010. Concurrently, water samples were taken for measuring selected physico-chemical variables. For zooplankton samples, we filtered 40 liters of water using plankton net of 50 μm mesh size. Samples were collected from the surface (0.5 m) during the morning hours.

Zooplankton samples were preserved in 10% formalin at the site itself. At the time of sampling, we measured the surface water temperature and pH, conductivity and secchi depth. Analyses of other variables were conducted in the laboratory using standard procedures [8] Identification of zooplankton species was done using standard literature. For quantitative analysis, we counted the number of individuals for each species present in aliquot of 1ml from the concentrate (100 ml) of field-collected zooplankton. The data were later converted to the actual quantity of water filtered from the lake. We used 3-4 aliquots for each sample. Density of zooplankton was expressed as number of individuals per liter.

Results and Discussion

The water quality parameters of the samples analyzed have been presented and discussed with reference to their seasonal variations. The values of monthly variation of physico-chemical parameters are shown in the [Table-1].

Temperature is one of the physical parameters, which is directly related with chemical reaction in the water and biochemical reaction in the living organisms. It is very important in the determination of solubility of dissolved oxygen, carbon dioxide bicarbonates, carbonates equilibrium and determination of pH and conductivity. In the present investigation the atmospheric temperature ranged from 22 to 33.2ºC and the water temperature was recorded between 19.5 to 32.0ºC respectively. During the study period the atmospheric and water temperature were recorded high during the summer seasons (May) and low temperature was recorded during winter season (January) respectively. It must be possible due to the presence of cloudy weather according to Vasumathi Reddy, et al [9] long rains responsible for following temperature during southwest monsoon and northeast monsoon season. Temperature fluctuations in water are influenced considerably by meteorological factors such as air temperature, humidity, winds and solar radiation. According to Welch [10] pH is a very important factor and it can be ignored when other factors are in the favorable range. It plays a limiting role in the growth of flora and fauna of the aquatic body. The measurement of pH has great importance because chemical and biochemical relation in an aquatic body takes place at a particular pH. The pH values of Ghanapur Lake were increased in the summer seasons and slightly decreased in southwest and north east monsoon season. The high pH value was noticed in the April month and low value was observed in the month of July. The high values may be attributed to high photosynthetic activity in summer.

Table 1- Physico-chemical parameters of Ghanapur lake during study period Feb 2009 to Jan 2010

Month	At	Wt	pH	Transparency	Turbidity	TDS	Conductivity	DO	Co2	Alkalinity	Cl	Sulphate	Phosphate	TH	COD	BOD
February	26.1	25.2	8.4	85.4	5	286	395	8.9	6.3	113	129	3.4	2.05	120	6.2	3
March	32.1	30	8.13	89.6	4	320	405	9.1	6.7	118	155	3.2	1.99	132	7.1	3.2
April	32.5	31	8.68	96.2	3	389	480	8.8	8.1	128	150	4.2	2.6	138	6.8	3.9
May	33.2	32	8.41	90.1	4	486	586	6.2	0	121	145	4.5	2.4	93	8.1	3.6
June	30.4	28.2	8.25	93.2	4	436	568	5.2	0	98	150	5.2	2.2	89	9.5	2.4
July	31.2	28.2	8.1	91.6	4	405	384	4.5	0	101	126	4.9	3	78	9.1	2.9
August	28.1	26.5	7.01	50.9	11	390	400	3.9	0	94	106	4.7	2.1	69	8.9	2.6
September	26.2	25	7.42	43.8	14	340	402	4.9	0	105	117	5.3	3	75	8.4	1.9
October	23	22	7.29	40.7	15	301	446	6.3	0	95	130	5.6	2.2	84	8.7	2
November	24	21.1	7.25	53.4	10	315	420	6.7	4.42	109	98	5.2	2.9	91	6.4	2.3
December	23	20.5	7.38	58.2	9	286	432	7.4	0	96	118	4.7	2.6	95	5.9	2.8
January	22	19.5	8.12	63.9	8	226	450	8.3	4.14	82	138	3.9	1.8	105	6.8	2.9

The maximum transparency of lake was observed in the summer season and while low transparency of lake was noticed in northeast monsoon season. The turbidity of lake was high in the south west monsoon season and low turbidity was recorded in the month of April (summer season). Dissolved oxygen is an important parameter in water quality assessment. Its presence in water is essential for aquatic life. Usually non-polluted surface water normally saturated with dissolved oxygen. The depletion of oxygen from water body depends on the pollution quantity. Inorganic reducing agents such as hydrogen sulphide, ammonia nitrates, ferrous ions certain available oxidisable substances also tend to decrease the oxygen in water.

The dissolved oxygen concentration was high during the months of summer season (9.1 mg/l in March), while low dissolved oxygen was noticed in the month of August (3.9 mg/l). The high values may be in coupled with high rate of photosynthetic activity during the summer season and low values of dissolved oxygen due to less sun radiation in the months of northeast monsoon season which influence on photosynthetic rate. The CO_2 values were recorded high in the months of summer season and absent in the south west monsoon season. During the summer season the metabolic rate is high due to increase in the temperature, which influence on the liberation of CO_2. The alkalinity results clearly state that the lake has high productivity during the summer season and low were in northeast monsoon season. Similar observations were also made by David [11]. The total dissolved solids were within the permissible limit in the present investigation.

The chloride content of the lake was between 98 mg/l to 155 mg/l. the high chloride content was noticed in the summer season, while low concentration was observed during the northeast monsoon season. The rate of evaporation of water increases the concentration of salts content in the water bodies. The sulphate content of lake water was noticed between 3.2 mg/l to 5.6 mg/l. The high values were noticed in the northeast monsoon season, while low values were observed in the summer season respectively.

During the study period the total alkalinity values were high during the summer season (128mg/l) and followed by southwest monsoon season and minimum values were recorded during the northeast monsoon season respectively similar results were observed by Abdar [12]. The phosphate concentration was high during the northeast monsoon season followed by south west monsoon season and low values were noticed during the summer season. The total hard-

ness of the lake was observed during the summer season and followed by northeast monsoon season and minimum values were observed during the southwest monsoon season. The chemical oxygen demand values were high during the south west monsoon season, while minimum values were noticed during the northeast monsoon season and biological oxygen demand values were high during the summer season and minimum values were recorded during the northeast monsoon season respectively.

Zooplankton

Zooplankton are often an important link in the transfer of energy from producers to carnivores. Zooplankton due to their large density, shorter life span, drifting nature, high group or species diversity and different tolerance to the stress, they are being used as a indicator organisms for the physical, chemical and biological process in the aquatic ecosystem [13]. Zooplankton has been recommended as regional bioindicators of lake eutrophication [1-6] acidification [6], disturbances by agriculture [7]. Although zooplankton are usually considered to be good indicators of environmental changes and have a fundamental role in energy flow and nutrient cycling in aquatic ecosystems.

In the present investigation, 13 species of zooplankton were recorded and which belongs to four groups, i.e. rotifera, copepoda, cladocera and ostracoda. Among the all, 5 species were belongs to rotifera, 4 species were belonging to the copepod, 3 species belonging to the cladocera and 1 species belonging to the ostracoda.

Rotiferans form a significant component of the zooplanktons. The rotiferans exhibit a very wide range of morphological variations and adaptations. Rotifers are prominent group among the zooplankton of a water body irrespective of its trophic status. This may be due to the less specialized feeding, parthenogenetic reproduction and high fecundity [14]. Among the zooplankton rotifers respond more quickly to the environmental changes and used as a change in water quality [15]. Rotifers are regarded as bioindicators of water quality [16,17] and high rotifer density has been reported to be a characteristic of eutrophic lakes. During the study period the rotifera group showed high abundance in the month of April (129ind/l), while low abundance was recorded in the month of August (54ind/l). among the rotifera group *Brachinous fulcatus* species showed high in number followed by *Lecane luna* (165 ind/l), *Cephalodella gibba* (124ind/l), while low abundance was noticed by *Keratella tropica* (113 ind/l) respectively shown in the [Table-2].

Table 2- Diversity indices of Zooplankton groups during the study period Feb 2009 to Jan 2010.

Zooplankton /Diversity indices	Rotifera	Copepod	Cladocera	Ostracoda
Taxa	7	3	2	1
Individuals	966	435	783	93
Dominance_D	0.149	0.373	0.858	1
Shannon_H	1.925	1.039	0.27	0
Simspson_1-D	0.85	0.626	0.141	0
Evenness_e^{U}H/S	0.979	0.942	0.655	1

Seasonal abundance of rotifera was observed during the study period. High number of individuals were encountered during the summer season (411 ind/l) followed by south west monsoon season (317 ind/l) and north east monsoon season (238 ind/l) respectively. Similar reports were reported by Shahikanth & Vijaykumar [18] and Vijaykumar & Rajashekhar [19].

Copepods are considered as important food item for various kinds of fish, play a key role in the energy transformation at different trophic levels. It is reported that calanoid copepods best adapt to oligotrophic lakes, and cyclopoid copepods best adapt to eutrophic lakes [15].

During the study period the copeopda group showed high abundance in the month of June (50 ind/l), while low abundance was recorded in the month of November (23 ind/l). Among the copepoda group *Paracyclops fimbriatus* species were dominated (213 ind/l) followed by *Tropocyclops prasinus* (130 ind/l), while minimum abundance showed by *Mesocyclops hyalinus* (92 ind/l) respectively.

Seasonal abundance of copepod was observed during the study period. High number of individuals were observed during the southwest monsoon season (159 ind/l) followed by summer season (154 ind/l) and north east monsoon season (122 ind/l) respectively.

From the ecological point of view cladocerans considered to be most important components of zooplankton community. The group appears to prolifer more in ponds, lakes and reservoirs. As cladocers prefer to live in clear waters [20]. Kirk & Gilbert [21] reported that the decrease in the water level, live stock disturbances and anthropogenic activities increase the turbidity and thus inhibits the competitive abilities of Daphnia species. Boucherle & Zullig [22] reported that the *Ceriodaphnia cornuta* is present only oligotrophic lakes. Present study findings are agreeable with earlier reports.

Among the cladocera *Ceriodaphnia cornuta* were dominate species and showed high abundance in southwest monsoon season, while low abundance was recorded during the summer season. Similar findings were reported by Trivedy, et al [23] and Wagh [24].

The ostracoda are the entromostracans crustaceans having the bivalve carapace enclosing the laterally compressed body. They inhabit all kinds fresh and marine water. Kumar [25] studied on the species composition, total abundance periodicity of dominant ostracoda species in relation to certain physico-chemical factors in subtropical pond of Jammu and observed a direct correlation of ostracoda with protozoa and rotifera. Shahikanth & Vijaykumar [18] studied on the seasonal variations of physico-chemical parameters and zooplankton communities of Karanja reservoir in Karnataka.

Ostracoda group was represented by *Cypris sp* only. High individuals were noticed during the southwest monsoon season and low abundance was recorded during the summer season respectively. Kadam [26] reported that high abundance and diversity ostracods occurred in hard water.

Diversity Indices

Diversity indices results indicate that, among the zooplankton, rotifera has high number of individuals followed by cladocera, copepod and ostracoda. The high dominance values were showed by cladocera (0.858), followed by copepoda (0.373), rotifera (0.149) respectively. The high Shannon values were noticed in the rotifera group (1.925) followed by copepod (1.039), cladocera (0.270) respectively. The Simpson index values were high in rotifera (0.850) followed by copeopda (0.626), cladocera (0.141) respectively. The evenness index of rotifera (0.979), copepod (0.942) and cladocera (0.655) respectively.

The diversity index of rotifer group showed [Table-3]. Among the rotifera the *Brachinous angularis* species showed high dominance values, while low index was showed by *Keratella cochlearis* (0.088). High Shannon index value was showed by *Keratella cochlearis* species (2.449) followed by *Keratella tropica* (2.438) and low index values exhibited by *Brachionus angularis* (2.368) respectively.

The diversity index of copepod group showed [Table-4]. Among the copepoda group *Paracyclops fimbriatus* was showed high dominance index value (0.0941), while low values recorded by *Tropocyclops prasinus* (0.0892) respectively. High Shannon index value was showed by (2.449) *Tropocyclops prasinus* followed by *Mesocyclops hyalinus* (2.437) and *Paracyclops fimbriatus* (2.242) respectively. While Simpson index were calculated for the three species, among three species *Tropocyclops prasinus* (0.910), *Mesocyclops hyalinus* (0.909), *Paracyclops fimbriatus* (0.905) respectively. High evenness index values were showed by *Tropocyclops prasinus* (0.964) followed by *Mesocyclops hyalinus* (0.953), *Paracyclops fimbriatus* (0.941) respectively.

The diversity index of cladocera group showed [Table-5]. Among the cladocera, *Monia macrocopa* showed high (0.449) and *Ceriodaphnia cornuta* showed high Shannon index (2.449), and high Simpson index value (0.910) and high evenness values (0.964) respectively.

The diversity results clearly indicate that the rotifera groups showed high diversity and ostracoda group was showed low diversity values during the study period. Seasonal variations of abundance in zooplankton community reveals that, the summer seasons coupled with high productivity, which in turn support the high degree of diversity. All the physico-chemical and biological parameters indicate the lake is good in productivity and support the high diversity.

Table 3- Diversity indices of rotifera of lake during study period Feb 2009 to Jan 2010.

Zooplankton species / Diversity indices	Individuals	Dominance_D	Shannon_H	Simspson_1-D	Evnness_e^H/S
Brachionus angularis	121	0.1	2.368	0.889	0.889
Brachionus caudatus	123	0.0928	2.431	0.907	0.947
Brachionus fulcatus	189	0.0925	2.434	0.907	0.95
Keratella tropica	113	0.0915	2.438	0.908	0.954
Keratella cochlearis	121	0.088	2.449	0.911	0.964
Cephalodella gibba	124	0.0956	2.409	0.904	0.927
Lecane luna	165	0.0972	2.405	0.902	0.923

Table 4- Diversity indices of copepod during study period Feb 2009 to Jan 2010.

Zooplankton species / Diversity indices	Individuals	Dominance_D	Shannon_H	Simspson_1-D	Evnness_e^H/S
Paracyclops fimbriatus	213	0.0941	2.242	0.905	0.941
Mesocyclops hyalinus	92	0.0907	2.437	0.909	0.953
Tropocyclops prasinus	130	0.0892	2.449	0.910	0.964

Table 5- Diversity indices of cladocera during study period Feb 2009 to Jan 2010.

Zooplankton species / Diversity indices	Individuals	Dominance_D	Shannon_H	Simspson_1-D	Evnness_e^H/S
Ceriodaphnia cornuta	693	0.0895	2.449	0.910	0.964
Moina macrocopa	149	0.449	1.369	0.550	0.327

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