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Eco Biological Studies of Rural Fresh Water Bodies with Special Emphasis to Water Quality Assessment

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Abstract

The study aimed to understand the ecology and present status of the reservoir which is located in a semi-arid region where the water resource is limited. It provides drinking water for many villages of kalaburgi district and simultaneously is used for irrigation .A monitoring program of physical, chemical and biological variables of reservoir has being carried out for one calendar year from October to September. Water samples were collected on monthly basis .the parameters taken into consideration were water temperature, atmospheric temperature, PH, turbidity, dissolved oxygen, total solids, total dissolved solid chloride, biochemical oxygen demand carbonate, bicarbonate total hardness nitrate and phosphate content .In order to determine the pollution status of the lentic water body, the seasonal variation s encountered in these parameters were analyzed. The study indicated marked variation in many of these factors at different season and many occasions some of the parameters were found to surpass the respective permissible limit.

Keywords: Ecology, freshwater, reservoir, limnology and hydrology.

Introduction

Lakes and reservoirs hold a great promise as a source of freshwater demand of which will grow with passage of time. According to world health organization (WHO) estimates, about 80% of water pollution in developing countries like India is caused by domestic wastes[1]. In India, numbers of studies have been carried out to assess the water quality in terms of various physic-chemical biological characteristics and heavy metals of surface and ground water at various places[2]. Unfortunately, these ecosystems are being neglected and destroyed in rural as well as in urban areas. The main problem in their management involves responsible for water holding capacity. Innumerable lakes and reservoirs scattered all over the country need an urgent management plans for their protection, rehabilitation and conservation. By suitable remedial measures these water bodies can provide an ideal recreational site apart from other benefits like fish production, charging of groundwater table, conditioning of the climate etc. To achieve this, there is a need of a clear-cut lake and reservoir protection strategy as an integral component of natural water policy. In freshwater ecosystem there are some components of the biotic community. Among those, primary producer is more important component of the biotic community rather than secondary producer and carnivore because of the first one of the lowest tropic structure of aquatic ecosystem[3]. Due to the habitat of primary producer they could be divided into the phytoplankton and the periphyton (or benthic algae), and the periphyton could be also divided into epiphytic algae which may grow on plant leaves and stems, algae which may grow on stones and rock surfaces. In the present study an attempt has been made to bring out the present status of the reservoirs. It is includes the physical, chemical and biological aspects.

Ecology can give roughly accurate ideas of how populations of plants or animals are surviving in their environment. This can help determine whether a fading species is given protective status by governing bodies, or whether an already endangered species is recovering due to conservation efforts. Freshwater ecologists can give a fairly clear picture of which way a species is going, and identify key factors that determine its situation. Humans benefit from the studies of freshwater ecology as well. As the largest component of the ecosystem, the water is constantly tested and analyzed for important data such as chemical composition and possible hazards. The work of freshwater ecologists can be used to determine the viability of a new drinking water source, or test a current water source for possible contamination. By protecting drinking water sources, ecological studies are contributing not only to the good of the environment, but the good of their own species as well[4-7].

Saunders and Kalff studied on nitrogen retention in wetlands, lakes and reservoirs and Reservoirs. Kirk assessed the competition in variable environments with plank tonic rotifers[5]. Many researchers studied on metal uptake in edible lagoon fish species from Ban de Dames, Mauritius, recorded the monitoring changes in hydro biological system[6-7]. Studies on species distribution, percentage composition and numerical abundance in north Vembanad Reservoir. Worked on impacts of predation by fish on zooplankton and benthic community in the profoundal of reservoir[8]. Water quality management of sustainable storm water streams. Margarita Fernandez Alaez studied on nutrient and predator influences on food web constituents in a shallow lake of northwest Spain[9]. Limn logical studies have attracted renewed interest throughout the world only in the beginning of the 20th century. Since then voluminous

works have been undertaken and compiled in different parts of the world. The limn logical works on high altitude regions are still fragmentary[11]. Though some valuable work in the relevant field have been carried out in the other parts of the India. The humble beginning dating back to the later seven decades of freshwater studies by workers such as others has come a long way through the development of scientific temperament and concerned efforts in freshwater biology[12-16].

Fresh water ecosystem includes primary producers as phytoplankton, algae and hydrophytes, primary consumers as zooplankton as well as phytophagous fishes and secondary, tertiary consumers as fishes and some other organisms[17].

Present study focuses only on the physicochemical parameter and zooplankton fauna in the Rural Fresh Water Bodies of Kumnshi village.

Study area: Kalaburgi is township situated in the northern part of Karnataka state 76°-04" to 77°-42" longitude and 16°-12" to 17°-46" latitude. Reservoir is the major perennial source of water in kalaburgi, which is 11kms away from the Gulbarga university campus which falls under 17°-22'-30"Nlatittude and 76°-59'-0"E longitude. Harnessing of the reservoir for irrigation purpose was considered from a long time prior to 1956 to provide facilities to the drought prone of kalaburgi city. The maximum depth of the reservoir is 12.23mts.

Material and Methods

Collection of water samples: The water samples were collected on the monthly basis from the lake for the period of one year October to September 2013. In order to have the uniformity, water samples were collected from five fixed location in the lake. The samplings sites were selected in such a way that the distance between the sampling sites uniformly covered the entire area of the lake. All the samplings were done during the morning session 8.00 A.M to 12.00 A.M on the 5th of every month and were carried out according to the methods prescribe by APHA were referred for estimation of parameters like water temperature ,atmospheric temperature, pH, turbidity, dissolved oxygen, free carbon dioxide, total alkalinity hardness, chloride, ammonical nitrogen and phosphorus. The water temperature was recorded at a depth of about 10cm with a mercury thermometer. The same thermometer was used to determine air temperature also. While the water pH was measured in situ using a portable pen type pH meter, Do was measured by modified Winkler's method. Other parameters were analyzed following the standard method described by APHA[15]. Primary productivity was estimated using light and dark bottle method. Physic-chemical characteristic were analyzed immediately[21-22].

Collection and analysis of phytoplankton and zooplankton Samples: collection of plankton samples, 50 liters of surface water was filtered through Plankton net made up of bolting silk no. 30. The plankton samples so obtained were preserved in 70% alcohol. For the qualitative and quantitative studies in Plankton analysis was made using a C Z inverted microscope then analyzed[23]. Identification of the phytoplankton and zooplankton up to taxonomic precision of species level in cladocera , copepod and rotifera by using self made keys and standard identification keys and manual[27-30].

Results and Discussion

The investigated reservoir is surrounded by villages and agricultural land. This reservoir is perennial and coupled with the availability of food through the year has made it as favorite nesting place for resident, nonresident and some migratory birds. The reservoir covered with full of aquatic vegetation, which increased protection of fish population.

The rainfall data of Kumshi Reservoir for the period from october 2012 to september 2013 was collected from the Meteorological Department, kalaburgi Division, shown in table-1.

Table-1
Seasonal variation in rainfall of the kumnshi village

Month	Rainfall (mm)
Oct	0.0
Nov	46.4
Dec	13.2
Jan	81.8
Feb	52.1
Mar	103.0
April	0.0
May	0.0
June	222.00
July	514.00
Aug	11.0
Sept	00

Observations pertaining to different physic parameters and primary production of rural fresh water body are given in the table-2.

Atmospheric and water temperature at each stations were recorded using centigrade mercury thermometer to the nearest 0.1° C. The water temperature however was recorded at the depth of about 5 cm below the water surface level. Atmospheric temperature of the study area is varied from 24.0° to 38.0°Cin northeast monsoon season. The AT during summer month 27. 0° to 32.0°C.While the water temperature is less than the atmospheric temperature while the summer season it ranges between 28.0 to 29.2° C.

PH recording were made at five stations using a digital portable pH meter. (ELICO model Li-120).The pH hydrogen ion concentration expresses the intensity of the acid or alkaline condition of a solution. The pH of natural waters is an important chemical factor which is linked with all process of life and also influences the colonization of aquatic macro fauna in the water body. Hutchinson is of the opinion that nearly neutral pH of the water is regulated by the carbon dioxide and bicarbonates[24].

Table-2
Monthly variation in physico- chemical parameters of the rural reservoir

Month / Parameters	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
Atoms Temp (^{0}C)	31.2	30.1	24.4	31	31.7	28.6	29.6	29.2	31.5	31.9	36.6	38.1
Water Temp (^{0}C)	21.4	22.6	23.1	22.5	21.6	21.5	20.4	23.2	21.5	22.00	22.1	22.6
TDS (mg/I)	245.7	350.5	323.8	150.6	121.9	93.9	97.6	176.5	212.8	236.8	225.9	297.6
PH	6.8	7.3	7.4	7.0	7.0	7.1	7.4	7.5	7.1	7.1	7.1	6.3
DO (mg/I)	7.3	7.5	7.8	7.6	6.3	6.7	7.3	7.4	6.8	7.3	7.2	7.5
Alkalinity (mg/I)	159.5	159.0	164.0	160.7	159.8	146.3	160.5	160.6	161.4	165.0	161.9	164.3
Turbidity (mg/I)	26.0	28.1	31.0	34.5	34.3	35.0	35.2	39.0	48.0	51.0	45.0	30.1
Hardness (mg/I)	129.1	125.4	124.0	121.3	115.6	120.0	98.8	114.5	140.0	127.8	123.5	138.0
Calcium (mg/I)	54.0	47.0	45.5	45.8	56.1	65.4	56.4	58.4	55.1	60.0	48.2	42.3
Magnesium (mg/I)	24.0	26.0	30.2	35.8	45.6	50.0	45.6	50.1	46.7	55.2	45.8.	38.5
Nitrate (mg/I)	1.65	1.20	0.98	0.85	1.54	1.65	0.75	1.45	1.60	1.30	1.86	1.35
Chloride (mg/I)	115.2	117.3	110.0	98.2	75.5	70.6	75.4	67.9	90.2	98.5	105.8	111.0
Phosphate (mg/I)	0.06	0.6	0.5	0.6	0.10	0.5	0.7	0.5	0.6	0.9	0.07	0.50
BOD (mg/I)	10.9	10.1	14.0	13.2	10.3	12.6	14.1	15.0	13.9	13.7	14.2	12.9

Normally the pH of the reservoir water is strongly influenced by the nature of the terrain of the reservoir. Hence the pH can change from reservoir to reservoir. Since the freshwater has a weak buffering capacity and pH values of the reservoir were found to be on the alkaline side throughout the period of the study. In the present study higher concentration of pH was observed during summer and south west monsoon season could be attributed to enhanced rate of evaporation coupled with human interference are partly to enhanced photosynthetic activity. The maximum pH level is 7.5 and minimum level is 6.8 has been observed.

The reservoir showed wide fluctuation in its DO the values exhibited lower values in all five stations ranging between 6.3 to 7.2 mg/l in summer season and 7.3 to 7.8 mg/l in south west monsoon. On the other hand Hutchinson pointed out that the dissolved oxygen super saturation in water is mainly due to the photosynthetic activity of phytoplankton. The high dissolved oxygen contents during summer season and moderate values in northeast monsoon season may be due to luxuriant growth of phytoplankton in the Reservoir similar observations was also observed by others[24].

It is interesting to note that the increasing trend of the free CO_2 value coupled with decreasing trend of total alkalinity from all the five stations. Sometime inversely relationship is also noticed between CO_2 and O_2 though not clearly in some instances in all the stations of the reservoir. In case of the other parameters the maximum values were recorded during the monsoon and winter months it could be observed that the total alkalinity of Kumshi Reservoir varied seasonally. The statistical computation indicated a positive significant correlation to total alkalinity with TDS, conductivity, nitrate and dissolved oxygen. An increase in total alkalinity may be related with increase in pH as suggested[18-19]

The total hardness content during different months of southeast monsoon season varied from 120 to 138 mg/l; 120 to 136 mg/l; 120 to 130 mg/l; 118 to 138 mg/l; 110 to 140 mg/l; 110 to 128 mg/l and 115 to 138 mg/l. According to Barrett suggests that moderate hard water is more productive than the soft water. In the present investigation a similar observations has been observed where the productive of the reservoir is on the higher level[25.]

Calcium is the essential nutrient for animal life and aids in

maintaining the structure of plant cells and coils. Calcium is also found in abundance in all natural waters and its source is limestone from where it is leached. Calcium in an aquatic environment is an important macronutrient; it is needed in large quantities by molluscs and vertebrates[26]. Being an important contributor to hardness in water, it reduces the utility of water for domestic use. Lund suggests calcium main effect on phytoplankton to be the buffering the pH of water. The range of calcium in the water is largely dependent on the solubility of calcium carbonate, sulphates and rarely fluorides. The calcium content may range from 0-100 mg/l depending upon their source of water.

In the present study the calcium content in the reservoir water fluctuated to a great extent, on fixed trend of variation was observed. The higher calcium content was observed during northeast monsoon season and followed by southwest monsoon season, while low calcium content was observed during summer season. Similar observations were also made by Sahai and Sinha, Saran and Adoni, Bagde and Verma, Singhal, Yadav *et al.* and Deshmukh and Kanchan[10-12].

Magnesium is a necessary constituent of chlorophyll. Its high content induces the utility of water for domestic use. Magnesium ranks 8th among the elements in the order of abundance and common constituents of natural water. In the present study magnesium content always lower than the calcium and showed a definite variations and seasonal trend with higher concentration during southwest monsoon season and northeast monsoon season, while the lower values of calcium hardness was recorded during summer season in the reservoir

Chloride As depicted chloride concentrations varied between 67.9 mg/l to 117.3 mg/l with average values of 98.33.83 mg/l.
Potable water may contain small amount of chlorides without any harmful effects. Concentration of chloride ions in the excess of 250 ml as sodium chloride, impart a salty taste to waters. But, when potassium or magnesium ions are associated with chloride ions, the salty taste is not perceptible even up to 1000 mg/l chlorides. Concentrations of chlorides are considered to be an indication of pollution due to industrial waste[19]

Nitrate is one of the most stable forms of nitrogen, which enhances the growth of plankton, their density, and primary production. In the present study, the values of nitrate varied from 0.752 to 1.865 mg/l.
In the present investigation the phosphate content was more during northeast monsoon season and southwest monsoon seasons. The biochemical oxygen demand values during southwest monsoon season of varied between 10.0 to 14.0 mg/l at stations I and II; 10.5 to 14.2 mg/l.

In the present investigation the biochemical oxygen demand values were observed were in all the stations of Kumshi reservoir during northeast monsoon season and lower values were observed during summer season. A moderate high biochemical oxygen demand values were observed during southwest monsoon season

Gross Primary Productivity: Primary production involving chemoautotrophic process forms the base of the energy flow in an ecosystem while understanding of primary production becomes all the more essential in the evaluation of the capacity of any ecosystem, including that of standing water bodies. The primary productivity relates to the amount of organic matter synthesized in a certain space per unit term. Primary productivity can accessed as grass and net values while grass primary production is the total range of photosynthesis including organic matter used up in the respiration in a given time, net productivity is the total amount of chemical energy net after it has been utilized by plants for respiration, primary productivity have been used for potential index of productivity for many diverse ecosystem of the world[27]. Primary productivity is concerned with the evolution of the capacity of an ecosystem to the synthesis of organic matter of high potential chemical. Primary production in aquatic ecosystem is mainly controlled by interaction of many factors like environmental and biotic factors and nutrient status of the water body. Thus, this aspect has drawn the attention of numerous hydro biologists.

During the present study, gross primary production has been estimated by light and dark bottles methods. The overall mean values gross primary production values are given in table -3. Grass primary productivity of Kumshi Reservoir of all five stations and exhibited an increasing trend through the northeast monsoon season towards summer season with distinct peaks.

Table-3
Variation in gross primary productivity

Months / Stations	S-I	S-II	S-III	S-IV	S-V
Oct	0.600	0.506	0.740	0.612	0.656
Nov	0.562	0.534	0.637	0.703	0.656
Dec	0.562	0.900	0.646	0.768	0.712
Jan	0.665	0.703	0.581	0.628	0.609
Feb	0.525	0.375	0.693	0.600	0.618
Mar	0.684	0.412	0.665	0.515	0.628
April	0.637	0.421	0.600	0.618	0.628
May	0.468	0.525	0.618	0.646	0.609
June	0.693	0.581	0.721	0.590	0.609
July	0.656	0.693	0.759	0.646	0.759
Aug	0.693	0.731	0.862	0.675	0.881
Sept	0.634	0.590	0.759	0.675	0.759

Phyto-zooplankton occurrence, and seasonal density variation is presented in table-4.

Phytoplankton groups recorded in Kumshi reservoir comprises four major groups viz., Chlorophyceae, Bacillariophyceae, Cyanophyceae and Euglenophyceae. Among 4 groups Chlorophyceae members dominated followed by Bacillariophyceae, Cyanophyceae and Euglenophyceae respectively. Table -5.

Zooplankton groups in Kumshi reservoir, comprises of 3 major groups viz., Crustaceans, Protozoans and Rotifers have been identified. Table-6.

Table-4
Occurrence of the zooplankton and phytoplankton
*** - maximum ** - average * - minimum -- Nil

Month / Station	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
I	***	***	***	**	**	**	***	***	**	**	**	**
II	***	***	**	**	**	**	**	**	**	**	***	***
III	-	*	-	*	*	**	**	**	**	*	**	**
IV	**	**	**	*	*	*	**	**	*	*	*	-
V	**	**	*	*	*	*	*	*	*	-	*	*

Table-5
Monthly Variations of Phytoplankton groups (org/L^{-1})

Phytoplankton groups	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
Chlorophyceae	3454	3916	4545	4133	3600	4666	2200	2600	4000	3750	800	166
Bacillariophyceae	4090	4166	4363	2466	1850	2333	2533	2600	4333	4083	200	300
Cyanophyceae	3636	3083	4909	4266	3350	4750	2466	3066	4833	3833	866	291
Euglenophyceae	1363	1000	1181	1133	450	750	600	600	1333	1583	866	1250

Table-6
Monthly variation of zooplankton groups (org/L^{-1})

zooplankton group	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
Protozoans	1250	1250	1076	1071	1200	923	1000	800	714	583	110	818
Crustaceans	416	416	384	285	466	307	333	266	357	333	300	363
Rotifers	500	500	538	428	533	384	416	266	285	416	400	500

Conclusion

In general, the findings of the present study indicate that the topography and meteorological effect on the reservoir. Semi arid region characterized by precipitation during south west monsoon season which extends from June to September, overlapping and extension beyond the specific period. Rainfall plays a significant part in a regulating the seasonal biological rhythms of different parameters in the Reservoir. The atmospheric temperature and water temperature is followed a seasonal trend and varied at different times of a day and different month of the year. The temperature fluctuation in water was influenced considerably by air temperature, humidity, winds and solar radiation. The total dissolved solids were within the permissible limits of drinking standards and high total dissolved solids were observed during southwest monsoon while lower values were observed during northeast monsoon season. High concentration of total dissolved solid increases water turbidity, this intern decreases the light penetration, thus effects the photosynthesis, their by suppressing the primary producers in the form of algae and microphytes. The hydrogen ion concentration of natural is an important chemical factor, which is linked with all process of the life and also influences the colonization of aquatic micro and macro benthic in the reservoir.

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