The effects of climatic change on the diversity & composition of phytoplankton community in Tungabhadra Reservoir

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Abstract- The autotrophic plankton comprising the major position in reservoirs acts as a basic food material in the aquatic food-chain. Plankton acts as biomarkers for the water quality assessment which facilitates fish production. 21 hydrological parameters with meteorological factors were studied in Tungabhadra reservoir (TBR) at 15° 12' 18" N and 76° 13' 30" E from Jan 2009 to Dec 2010 covering summer, monsoon & transition periods chiefly to understand the plankton productivity. Qualitative analysis varied significantly during the study period. Maximum diversity was recorded in the months of Dec-Mar. A total of 53 species of phytoplankton representing four classes were recorded in the up-streams. Among the Bacillariophyceae, melosira was significantly dominant. Abundance of desmids was the indication of relatively unpolluted condition in the up-streams of Tungabhadra Reservoir. Yet it is experiencing drastic climatological changes.

Index Terms- Tungabhadra reservoir, phytoplankton, climatic change and hydrology

I. INTRODUCTION

Both phytoplankton and zooplankton play a significant role in the aquatic food chain. Phytoplankton form primary producers of food on which zooplankton feed upon. Some genera of phytoplankton act as biological indicators of water quality (Patrick, 1971). Zooplankton ecology is closely related to fishery limnology.

The sustainability of fish diversity and its abundance is based on the quality of water existing in that locality. All the hydrological parameters as well as plankton diversity influences the production of fish species. The plankton diversity is solely dependent upon the hydrological parameters. The present investigation is aimed at studying hydro-biological status of Tungabhadra Reservoir (TBR) with special reference to plankton.

II. METHODOLOGY

STUDY AREA:

Tungabhadra reservoir is geographically located at 76° 21' 10" E latitude and 15° 15' 19" N longitude, near Mallapur village about 5 kilometers away from Hospet. Sampling was done at 15° 12' 18" N and 76° 13' 30" E from Jan 2009 to Dec 2010 for the period of 24 calendar months.

SAMPLING STATION:

The sampling station is highly prone to change characteristics. Satellite imagery of the reservoir is depicted in the plates 1-3.

ANALYTICAL METHOD

SAMPLING PROGRAM AND LABORATORY PROCEDURES:

Water samples were collected in the one liter plastic bottles and transported to the laboratory for analysis. Air and water temperature were measured at the sampling site itself at 8 a.m. and recorded. pH of water body was also recorded at the sites using pH meter. Further analysis of water parameters such as free CO2, Dissolved Oxygen (DO), Total alkalinity (TA), Total Dissolved Solids (TDS), Total Suspended Solids (TSS), phosphates, sulphates, nitrates, total hardness, electrical conductivity, fluoride, chloride, turbidity, iron, magnesium, calcium including BOD & COD were carried out as per the standard methods (APHA, 1992) and presented in the table-1&2. Phytoplankton samples were collected monthly for the same period. Phytoplankton was collected by filtering 100 liters of water through the nylon bolting cloth (mesh 25nm). Plankton samples fixed at 100ml were kept for about 24hr to settle & stored in small vials. The samples were used for further investigation. For microscopic investigation one ml. sample was taken on "Sedgewick Rafter cell". Averages of 5 to 10 counts were made for each sample and the results are expressed as number of organisms per liter of sample. The identification of phytoplankton was done with the help of standard books and monographs (Smith, 1950; Ward and Whipple 1959; Desikachary, 1959; Prescott, 1962; and Turner, 1982). The total number of phytoplankton present in a liter of water sample was calculated using the formula:

$$N = \frac{n \times v}{V} \times 1000$$

Where N: total number of phytoplankton cells per liter of water filtered,

n: average number of phytoplankton cells in 1 ml of plankton sample,

v: volume of plankton concentrate (ml),

V: volume of total water filtered (lit).

III. RESULTS & DISCUSSION

Plate 1: Satellite pictograph of Indian sub-continent

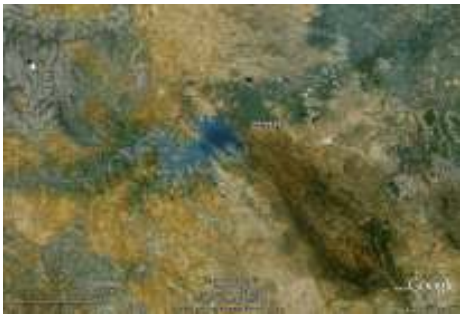

Plate 2: Tungabhadra Reservoir elevation at 50 miles

Plate 3: Tungabhadra Reservoir elevation at 15 miles

The results on various physico-chemical parameters data on water quality parameters having a direct bearing upon the distribution and ecology of various phytoplankton communities in the reservoir were collected. Monthly fluctuations of different phytoplankton groups are also presented.

Phytoplankton ('phyto' = plant; 'planktos' = made to wander) are single celled algae, some of which are capable of movement through the use of appendages while the others drift with currents. In the present study phytoplankton community during 2009 is represented by the members of Cyanophyceae, Bacillariophyceae, Chlorophyceae, Dinophyceae and Euglenophyceae. The phytoplankton members comprised of 53 species of which 09 belonging to Cyanophyceae, 24 to Chlorophyceae, 16 to Bacillariophyceae, 01 to Dynophyceae and 3 to Euglenophyceae. Among the total phytoplankton, Chlorophyceae contributed 45.28% of the total population during the study period. The next dominant group was the Bacillariophyceae which comprised of 30.19% followed by Cyanophyceae that were 16.98% and Euglenophyceae 5.66% during Dec 2009 - Jan 2010 study period. (Fig.1)

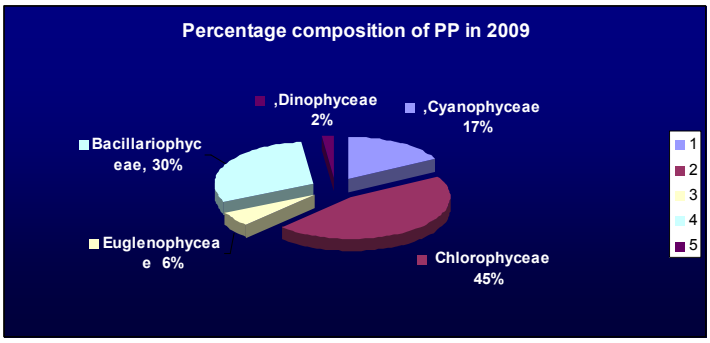

Fig 1: Percentage composition of phytoplankton community in TBR

Similarly percentage composition of phytoplankton community during 2010 is represented by the members of Bacillariophyceae, Chlorophyceae, Cyanophyceae, Euglenophyceae and Dinophyceae respectively (Fig.2).

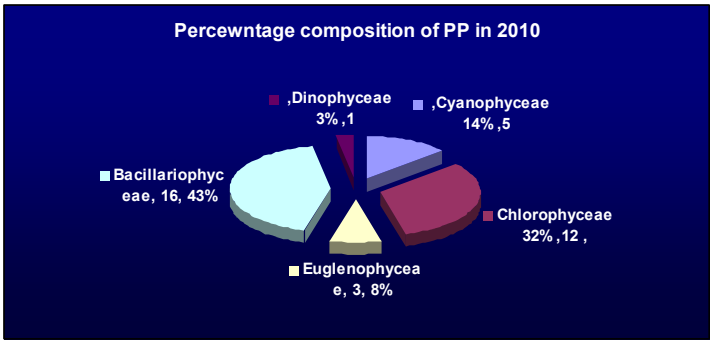

Fig 2: Percentage composition of phytoplankton community in TBR

Srinivasan (1964) and Jepachandramohan et al., (2009) observed similar results in Amaravathi reservoir and in Pechiparai reservoir in the earlier studies. In the present study the maximum diversity was recorded in the post monsoon period that is in the months of Dec - Mar. This could be due to the prolonged availability of light in the post monsoon period and significantly high inflow of nutrients during the monsoon. Based on the studies it is concluded that there exists a strong correlation between the population, diversity and the productivity of the phytoplankton. Naik et al., (2005) stated that maximum value of pH and nitrate supports the growth of Cyanophyceae. The inland freshwater ecosystems are being increasingly subjected to greater stress from various human activities.

	2009	JAN'09	FEB'09	MAR'09	APR'09	MAY'09	JUN'09	JUL'09	AUG'09	SEP'09	OCT'09	NOV'09	DEC'09	Unit
1	Air temp	30.50	31.50	31.50	30.50	31.00	31.00	30.00	29.00	29.80	30.50	30.00	31.00	°C
2	Water temp	28.00	30.00	30.00	28.50	30.00	29.50	28.90	27.00	28.00	29.00	29.00	29.50	°C
3	Turbidity	15.00	12.00	18.00	15.00	16.00	16.00	10.00	15.00	20.00	18.00	10.00	12.00	NTU
4	TDS	110.00	180.00	300.00	260.00	250.00	200.00	190.00	260.00	210.00	180.00	220.00	150.00	mg/L
5	TSS	50.00	20.00	70.00	70.00	90.00	60.00	30.00	120.00	140.00	50.00	80.00	20.00	mg/L
6	E Cond	210.00	200.00	350.00	290.00	260.00	290.00	280.00	390.00	410.00	200.00	260.00	250.00	µS/cm
7	Total alkalinity	145.00	90.00	80.00	75.00	95.00	40.00	30.00	90.00	100.00	90.00	70.00	70.00	mg/L
8	COD	40.00	100.00	110.00	110.00	90.00	80.00	40.00	100.00	130.00	510.00	400.00	340.00	mg/L
9	BOD	2.00	3.00	3.00	4.00	3.00	2.00	2.00	3.00	4.00	3.00	3.00	4.00	mg/L
10	D O	6.00	6.20	5.00	5.50	6.00	4.50	5.20	6.00	4.00	6.50	5.00	6.20	mg/L
11	Sulphate	30.00	20.00	40.00	60.00	50.00	20.00	30.00	60.00	60.00	50.00	40.00	30.00	mg/L
12	Nitrate	2.00	2.00	2.50	2.60	1.80	2.50	2.20	2.10	2.60	2.00	3.00	2.90	mg/L
13	Phosphate	2.00	1.00	1.00	2.00	1.00	1.00	3.00	4.00	2.00	2.00	2.00	2.00	mg/L
14	Ca	27.00	20.00	35.00	40.00	32.00	25.00	23.00	35.00	40.00	30.00	32.00	20.00	mg/L
15	Mg	3.00	11.50	8.60	13.00	12.00	7.50	3.80	15.00	14.00	8.00	8.50	9.00	mg/L
16	Fe	1.50	2.00	1.50	2.00	2.00	2.50	3.00	3.50	4.00	3.00	2.50	1.50	mg/L
17	Flouride	0.90	0.50	0.40	0.50	0.40	1.00	0.50	0.50	0.40	0.50	0.50	0.40	mg/L
18	CO2	1.20	1.70	1.60	1.60	1.70	1.20	1.80	2.00	1.50	1.60	1.50	1.40	mg/L
19	pH	8.50	8.30	8.30	8.40	8.50	8.10	8.00	7.90	8.30	8.30	8.40	8.00	-- --
20	Cl	29.00	22.00	29.00	40.00	42.00	38.00	40.00	40.00	36.00	32.00	30.00	30.00	mg/L
21	Hardness	85.00	70.00	90.00	95.00	110.00	50.00	45.00	130.00	120.00	70.00	80.00	65.00	mg/L

Table 1. Hydrological data from January2009 to December 2009
from Tungabhadra reservoir.

	2010	JAN'10	FEB'10	MAR'10	APR'10	MAY'10	JUN'10	JUL'10	AUG'10	SEP'10	OCT'10	NOV'10	DEC'10	Unit
1	Air temp	29.0	30.0	30.5	29.0	29.5	30.0	30.5	29.0	29.5	30.0	30.0	30.0	°C
2	Water temp	26.0	28.0	29.0	27.0	29.0	29.0	28.0	26.0	27.0	29.0	28.0	29.0	°C
3	Turbidity	14.0	12.0	18.0	16.0	12.0	14.0	12.0	18.0	20.0	16.0	14.0	12.0	NTU
4	TDS	98.0	156.0	289.0	260.0	240.0	200.0	220.0	280.0	260.0	198.0	200.0	160.0	mg/L
5	TSS	40.0	16.0	80.0	66.0	88.0	60.0	40.0	140.0	120.0	40.0	80.0	20.0	mg/L
6	E Cond	214.0	198.0	356.0	340.0	360.0	285.0	272.0	410.0	400.0	240.0	280.0	260.0	µS/cm
7	Total alkalinity	134.0	80.0	78.0	84.0	96.0	30.0	30.0	80.0	98.0	86.0	68.0	72.0	mg/L
8	COD	40.0	60.0	160.0	120.0	80.0	60.0	40.0	120.0	160.0	540.0	340.0	320.0	mg/L
9	BOD	3.0	2.0	3.0	4.0	3.0	2.0	2.0	3.0	4.0	3.0	4.0	3.0	mg/L
10	D O	6.0	6.0	5.0	6.0	6.0	4.0	5.0	6.0	4.0	6.0	4.0	6.0	mg/L
11	Sulphate	30.0	20.0	40.0	40.0	60.0	20.0	20.0	40.0	60.0	40.0	36.0	30.0	mg/L
12	Nitrate	2.6	2.0	2.5	1.5	2.0	2.0	2.0	2.0	3.0	2.0	3.0	1.6	mg/L
13	Phosphate	2.0	1.0	1.0	2.0	2.0	1.0	1.0	3.0	4.0	2.0	4.0	2.0	mg/L
14	Ca	28.0	24.0	48.0	32.0	38.0	20.0	22.0	40.0	46.0	28.0	32.0	22.0	mg/L
15	Mg	2.6	11.7	8.3	13.6	13.1	7.8	4.4	17.5	14.0	7.8	8.6	9.7	mg/L
16	Fe	2.0	2.0	1.5	2.0	2.0	3.0	4.0	4.0	3.0	3.0	2.0	2.0	mg/L
17	Flouride	0.6	0.4	0.4	0.5	0.5	1.0	0.5	0.5	0.5	0.6	0.5	0.2	mg/L
18	CO2	1.5	1.7	1.6	1.7	1.8	1.6	1.4	2.0	1.8	1.6	1.4	1.6	mg/L
19	pH	8.3	8.5	8.4	8.3	8.4	8.3	8.2	8.3	8.4	8.2	8.4	8.0	-- --
20	Cl	30.0	20.0	28.0	42.0	40.0	32.0	32.0	40.0	38.0	34.0	28.0	24.0	mg/L
21	Hardness	94.0	72.0	82.0	88.0	92.0	52.0	46.0	112.0	128.0	60.0	64.0	62.0	mg/L

Table 2. Hydrological data from January2010 to December 2010
from Tungabhadra reservoir.

IV. CONCLUSION

The present study revealed that the distribution and population density of phytoplankton species depend upon the physico-chemical parameters of the environment. It is clear from the results that the reservoir is mesotrophic and aging towards eutrophication especially in the upstreams. Hence measures should be taken to minimize the pollution by preventing entry of debris from the anthropocentric activities, controlled disposition from the neighboring farm lands. To monitor the continuous potential fish yield from the reservoir, annual documentation is necessary. Any fluctuation in the plankton biomass and diversity will reflect upon the zooplankton community thereby affecting fish production as certain plankton are the indicators of water quality. In addition the data generated is essential so that this information may be used in taking decision for conservation and effective utilization of water bodies. In the climate-warming scenario, it is expected that low flows in rivers would be more severe along with a general water stress. Water demand in coming years by municipal and industrial sectors would increase; substantial increases in withdrawals for irrigation are expected; a growing human population will increase water demand more. The adaptive capacity under such situation will depend on the abilities to implement integrated water resource management approaches for the sustenance of reservoir productivity.

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