

## Fish ecology of a lake at Haridwar district (U.A.) with special reference to its economics

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### Abstract

Padali Gujjar lake (29° 5' North latitude and 77° 53' East longitude) is situated at an elevation of 268 meter above sea level at Roorkee in district Haridwar. The surface area of the lake is 2,92,500 square meter (m<sup>2</sup>) and the catchment area of 2,92,400 m<sup>2</sup>. The present study was done to evaluate the broad limnological features of the lake with special reference to its economics, the physico-chemical and biological characteristics of lake plays an important role in determination of the structure and composition of biotic community.

The lake is used for composite fish culture practices since very long time, during the study period, 11 species of fishes were identified, out of which seven were culturable as *Catla-catla*, *Labeo-robota*, *Cirrhinus-mrigal*, *Hypophthalmichthys-molitis*, *Aristichthys-nobalis*, *Cyprinus-carpio*, *Clenopharyngodon-idella* and rest are categorized as weed fishes namely *Channa-stratius*, *Glossogobius-giurus*, *Notopterus-notopterus* and *Chanda-nama*.

The total expenditure on lake management was calculated as Rs. 12,015 which contributes its maintenance, removal of weed, aquatic vegetation etc. and purification of lake from time to time. The total expenditure in all the practices for composite fish culture was Rs. 23,885 and the total sale collection of fish production was Rs. 1,74,596.50 during one year. At last the net profit from this lake was found to be Rs. 1,50,711.50.

**Key words :** Ecology, lake, economics, weed fishes.

### Introduction

Nearly more than 75% of the earth's surface is covered by water either as ocean or freshwater, therefore earth is sometimes called as water planet. Water is in Sea, river, Ocean, lakes, Ponds, Streams etc.

Our country is bestowed with bountiful natural resources in the form of extensive coast line, river systems, estuaries, ponds, tanks, lakes reservoirs etc. these water bodies are exposed to warm, tropical climate, these water bodies are extremely productive and they harbour enviable spectrum of fish genetic resources. Optimum utilization of these resources lead to a many fold increase in inland fish production

earning the country a place among the top inland fish producing nations of the world.

Inland fish production in the country witnessed a six fold increases from 0.22 million ton in 1950-51 to 1.30 million in 1987-88. The over all growth rate in India fish production is almost on a par-with a global four fold increase. A quantum jump in inland fish production occurred during the 6<sup>th</sup> and 7<sup>th</sup> plan period which witnessed over all growth rate more than 5% per annum. Against a declining trend noticed in the world as a whole. The projectable achievable target of fish production by 2000 A.D. is 8.0 million ton, of which the share of inland fisheries is estimated as 4.5

million ton.

Therefore, there is an urgent need for scientific utilization of water resources, the study of phytoplankton and physico-chemical characteristics of water are of primary interest.

The "Padali Gujjar Lake" is situated at village Padali, Roorkee in district Haridwar of Uttaranchal. The western bank of lake touches Padali Gujjar village while eastern bank touches the Upper Ganga Canal, between Canal & lake a road is present which goes from Roorkee to Mangalore, along the Canal, world bank colony is also situated and Southern bank touches the fields of the farmers. Various types of crops are grown in the fields.

Lake receives little domestic sewage from drains of adjacent village and in rainy season fertilizers, pesticides are also swept with rain water and mixes into lake.

### Methodology

The lake is situated at village Padali-Gujjar, which is 3.5 Km away from bus stand and 0.5 Km away from railway station on Paniyala road. The study was conducted during three seasons pre-autumn, autumn and post-autumn. The samples were collected during morning hours (between 7.00 A.M. to 11.00 A.M.). Various physico-chemical and biological parameters were analyzed according to APHA (1998), Trivedy & Goel (1986) and fishes were identified according to Badola *et al.* (1973) and Jhingran (1982).

### Results and Discussion

The results of various observations of physico-chemical & biological parameters are tabulated in table 1-6 and the economics of composite fish culture during one year are tabulated in table no. 7.

The water temperature of the Padali Gujjar lake at Roorkee fluctuated between  $24.20^{\circ}\text{C} \pm 2.56$  to  $30.70^{\circ}\text{C} \pm 2.02$ . The temperature distribution in the water body is wholly dependent upon the thermal

regime of water.

Productivity of a water body is influenced by the degree of variation in temperature. Temperature is often a limiting factor for the growth, reproduction and distribution of plants and animals Michael (1986). The water temperature of study lake showed a decreasing trend. Similar observations was reported by Das and Srivastava (1956). The range was found to be conducive for growth of Indian major Carps Jhingran (1982).

The average value of total solids, Total dissolved solids and Total Suspended solids was recorded between  $250.11 \text{ mg/l} \pm 21.22$  to  $314.73 \text{ mg/l} \pm 24.71$ ,  $162.92 \text{ mg/l} \pm 15.09$  to  $214.87 \text{ mg/l} \pm 21.63$  and  $87.01 \text{ mg/l} \pm 6.61$  to  $101.80 \text{ mg/l} \pm 3.88$  respectively. According to Welch (1948) dissolved solids vary qualitatively and quantitatively in different waters depending upon the seasons, locations and other factors.

The average of Turbidity was found between  $23.90 \text{ J.T.U.} \pm 32.97$  to  $108.33 \text{ J.T.U.} \pm 26.70$ . Similar findings have been reported by Ray and Banerjee (1978) and Sugunan (1980). Dorris (1963) in the Mississippi noticed that the high water level is accompanied by less oxygen concentration brought about by washing of organic matters and decreasing photosynthesis due to turbidity. Conductivity of water fluctuated between  $157 \mu\text{mho} \pm 14.12$  to  $188 \mu\text{mho} \pm 7.77$ .

The pH of lake water was found slightly alkaline and ranged between  $8.30 \pm 0.04$  to  $8.47 \pm 0.02$ . This is in confirmity with the findings of Swarup and Singh (1979) and Jhingran (1982). Alkaline pH is good for life of fishes according to Khanna (1993).

In the present study, Dissolved Oxygen showed an increasing trend, DO showed an inverse relation with temperature, as also reported by Griffith (1955), Verma (1964). Adebisi (1981) observed high levels of dissolved oxygen on Ogun river in Nigeria during floods due to aeration of river waters.

BOD showed a negative relation with dissolved

Table 1 : Average value of Physico-Chemical parameters of the water of "Padali Gujjar Lake".

S. No.	Parameters	Pre-Autumn	Autumn	Post-Autumn	Average
1.	Temperature (°C)	30.70±2.02	28.73±0.63	24.20±2.56	27.83±2.72
2.	Total Solids (ppm)	314.73±24.71	275.28±3.42	250.11±21.22	280.13±26.78
3.	Total Dissolved Solids (ppm)	214.87±21.63	175.09±6.49	162.92±15.09	184.27±22.18
4.	Total Suspended Solids (ppm)	100.34±1.41	101.86±3.88	87.01±6.61	96.36±6.67
5.	Turbidity (J.T.U.)	108.33±26.79	79.84±6.29	23.90±32.97	70.53±35.10
6.	Conductivity (µmho/m)	188±7.77	185±5.65	157±14.12	177±13.96
7.	pH	8.36±0.007	8.30±0.04	8.47±0.02	8.37±0.40
8.	Dissolved Oxygen (ppm)	9.34±0.36	9.80±0.03	10.76±0.64	9.85±0.60
9.	B.O.D. (ppm)	2.79±0.14	2.76±0.12	2.22±0.26	2.59±0.26
10.	C.O.D. (ppm)	7.68±0.40	7.08±0.54	6.08±0.72	7.11±0.67
11.	Free Carbon-di-oxide (ppm)	1.63±0.06	2.20±0.33	1.86±0.09	1.72±0.29
12.	Alkalinity (ppm)	73.22±0.24	71.51±0.96	73.31±0.31	72.87±0.84
13.	Chlorides (ppm)	59.54±2.24	55.08±0.90	54.46±1.34	56.36±2.26
14.	Hardness (ppm)	76.32±3.54	69.83±1.04	67.88±2.42	71.31±3.60
15.	Calcium "Ca" (ppm)	66.71±1.52	62.86±1.19	64.22±0.23	64.55±1.59
16.	Magnesium "Mg" (ppm)	9.54±1.14	6.96±0.67	7.28±0.45	7.92±1.14
17.	Sodium "Na" (ppm)	4.16±0.68	2.81±0.40	2.62±0.39	3.19±0.65
18.	Potassium "K" (ppm)	3.51±0.16	4.51±0.86	1.85±1.01	3.28±1.09

± = Standard Deviation.

Table 2 : Average seasonal variation in heavy metals of water of "Padali Gujjar Lake".

S. No.	Heavy Metals (ppm)	Pre-Autumn	Autumn	Post-Autumn	Average
1.	Zinc (Zn)	0.037	0.035	0.035	0.035
2.	Iron (Fe)	0.701	0.679	0.699	0.693
3.	Manganese (Mn)	0.145	0.142	0.142	0.109
4.	Cobalt (Co)	0.045	0.045	0.044	0.044

oxygen as reported by Verma *et al.* (1984). COD in Padali Gujjar lake showed a decreasing trend during the study period. COD showed a positive relationship with BOD, while showed a negative relationship with DO as also observed by Chopra and Patrik (1994) in Ganga river at Rishikesh.

The alkalinity was found to be in range from 73.22mg/l±0.24 to 73.31mg/l±0.31 alkalinity above is supposed to be nutrient and such waters are often the best for fish culture Barrett (1953). Talling and Rzoska (1967) and Abdin (1948) found maximum concentration of alkalinity in summer season while

Table 3 : Qualitative fluctuation among plankton of "Padali Gujjar Lake".

S. No.	Parameters	Pre-Autumn	Autumn	Post-Autumn	Average
1.	Chlorophyceae	1010±135.05	1193±5.65	1404±143.5	1201±161.99
2.	Bacillariophyceae	588±138.50	444±36.76	448±39.59	392±121.41
3.	Cyanophyceae	228.66±49.96	131±19.09	117±28.99	158±49.67
4.	Total Phytoplankton	1627±127.98	1769±27.57	1969±113.84	1808±141.66
5.	Zooplankton	185±17.67	209±0.70	238±19.79	210±21.67
6.	Total Plankton	1812±145.66	1978±28.28	2207±133.64	2018±163.05
	Percentage				
1.	Chlorophyceae	55.8	60.2	63.5	59.8
2.	Bacillariophyceae	20.56	27.8	20.2	22.8
3.	Cyanophyceae	12.40	6.6	5.2	8.1
4.	Zooplankton	10.20	10.5	10.7	10.4

± = Standard Deviation

Table 4 : Average seasonal variation in MPN &amp; SPC of water at "Padali Gujjar Lake".

Parameters	Pre-Autumn	Autumn	Post-Autumn	Average
(MPN/100 ml)	176±33.35	123.80±3.55	87.73±29.06	128.83±36.23
(SPC/ ml × 10 <sup>6</sup> )	63.33±9.52	53.33±2.45	33±11.92	49.86±12.61

± = Standard Deviation

Table 5 : List of existing culturable fish species in "Padali Gujjar Lake".

S. No.	Name (Generic-Species)	Common Names	Family
1.	<i>Catla-catla</i>	Catla	Cyprinidae
2.	<i>Labeo-rohita</i>	Rohu	Cyprinidae
3.	<i>Cirrhinus - mrigala</i>	Mrigala	Cyprinidae
4.	<i>Hypophthalmichthys - molitris</i>	Silver carp	Cyprinidae
5.	<i>Aristichthys - nobalis</i>	Big head	Cyprinidae
6.	<i>Cyprinus - carpio</i>	China carp	Cyprinidae
7.	<i>Ctenopharyngodon - idella</i>	Grass cutter	Cyprinidae

Table 6 : List of existing weed fishes species in "Padali Gujjar Lake".

S. No.	Name (Generic-Species)	Common Names	Family
1.	<i>Channa-stratius</i>	Dolly	Ophiocephalidae
2.	<i>Glossogobius-giuris</i>	Gulwa	Gobiidae
3.	<i>Notopterus-notopterus</i>	Dhuta	Notopteridae
4.	<i>Chanda-nama</i>	Chandla	Centropomidae

Table 7 : Economics of composite fish culture during one year.

	Work		Expenditure
A.	Lake Management :-		(Rs.)
1.	Maintenance of lake embankment/outer boundaries	=	1,000
2.	Removal of weeds and aquatic vegetation/macrophytes	=	1,890
3.	Calcium carbonates for water purification (1500 Kg. @ 2/Kg., two application/year)	=	3,000
4.	Common salt (NaCl) (1750 Kg. @ 3.50., one time applied/year)	=	6,125
B.	Seed Stockment :-		
1.	No. of seed stocked (1,000,00) 20,000/ha/Annum @ 75/1000	=	7,500
2.	Transport charges from Hatchery To fish pond (by govt. agency)	=	Nil
C.	Supplementary feeds :-		
1.	Supplementary feed not given	=	Nil
D.	Harvesting practice :-		
1.	Net (gillnet) operation Labour charges.	=	2,370
2.	Rent of Nets	=	800
3.	Transport charges of fishes from pond to Market	=	1,200
	Total Expenditure	=	23,885

**Total Fish Production :-**

S. No.	Fish species	Total quantity (Kg.)	*Rate/Kg	Total income (Rs.)
1.	<i>Catla-catla</i>	1048.00	30-55	34,060.00
2.	<i>Labeo-robota</i>	1333.00	35-40	49,987.50
3.	<i>Cirrhinus-mrigala</i>	831.00	30-32	25,761.00
4.	<i>Hypophthalmichthys-molituris</i>	600.00	22-25	14,100.00
5.	<i>Aristichthys-nobalis</i>	525.00	20-25	11,812.50
6.	<i>Cyprinus-carpio</i>	395.00	20-25	8,875.00
7.	<i>Glenopbar yngodon-idella</i>	650.00	35-40	24,375.00
8.	Weed fishes	450.00	10-15	5,625.00
	<b>Total</b>	<b>5832.00</b>		<b>1,74,596.50</b>

Total Income (Rs.) :- = 1,74,596.50

Net Profit = Total Income - Total Expenditure

Net Profit = 1,74,596.50 - 23,885 = 1,50,711.50

Net Profit/Hectare = 31,398/Ha/Annum

\* The rate of different fishes was given according to the co-operative society. (Matasya Jeev Palan Sahkari Samiti, Roorkee, U.A.)

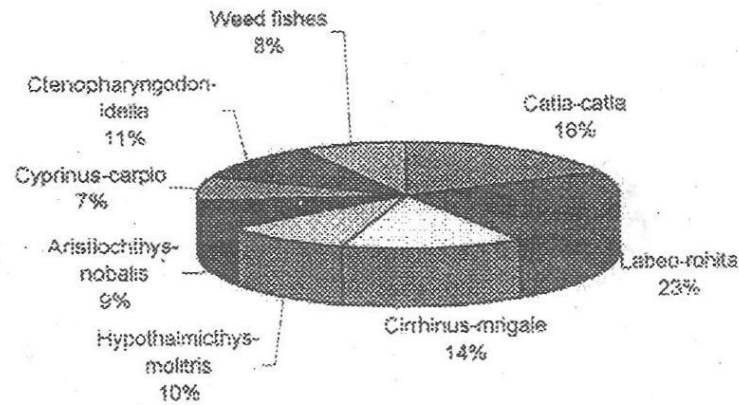


Fig. 1 : Total production percentage of fishes at Padali Gujjar lake.

lowest in winter season. The concentration of chlorides and hardness showed decreasing manner through out the study. Similar type of trend was observed by Singh (1960) and Munnawar (1970). The concentration of calcium in the Padali Gujjar lake found to be maximum as  $66.71\text{mg}/1\pm 1.52$  ppm in pre-autumn season. The lake may be regarded as rich in calcium content as also marked by Dwivedi (1995) in two pond at Patna.

The concentration of all heavy metals in lake water showed a decreasing trend it is quite favourable to the biota and not unfavourable in the water quality as suggested by Mathur (1982).

The plankton of Padali Gujjar lake showed a positive relation with dissolved oxygen, while showed a negative relationship with BOD, COD and temperature. The results indicate that the number of plankton were affected due to temperature and turbidity of water. Same type of results were also reported in different water bodies by Hutchinson (1967). Das and Akthar (1970) and Khanna and Singh (2000). But Holmes and Whitton (1981) have reported that the density of plankton become greater in late summer in river of north eastern England. In this study the chlorophyceae was found to be dominating group. The number of plankton were affected by the turbidity.

The increased turbidity reduce the plankton production as also reported by Das and Pathani (1978) and Khanna *et al.* (2000).

The standard plate count (SPC) and MPN are found maximum in pre-autumn and lowest in Post-autumn season.

In present study of fish culture practice in Padali Gujjar lake revealed some specific information regarding the nature of fish culture, growth and fish production. The Indian major carps usually tolerate the wide range of temperature ( $18.3\text{--}37.8^\circ\text{C}$ ). The gross-carp (*Ctenopharyngodon idella*) is known to stand in temperature upto  $40.0^\circ\text{C}$  Jhingran (1982). The pH range (8.36-8.47) of lake also exhibit the positive correlation with fish culture the waters having a pH range (7.5-9.0) provide the best medium for fish Culture Swingle (1967).

The economics of composite fish culture of the pond has contributed fish productivity  $1215\text{ Kg/ha/}$  year and the net profit was calculated as Rs. 31,398 per hectare/annum.

Finally all above observations and data indicated that the huge amount of proteins are achieved through conversion of biological waste material by composite fish culture.



### Conclusion

The study conclude that the fish production at Padali Gujjar lake during the course of study was found very low due to non-scientific fish culture. It is suggested to increase the fish production and proper scientific methods should be applied in lake.

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