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# **ECOLOGY AND DIVERSITY OF FISH FAUNA IN THE SAKHYA SAGAR LAKE, SHIVPURI, MADHYA PRADESH, INDIA**

**Arya Mohit<sup>\*1</sup>, Rao R.J.<sup>2</sup> and Mishra Anand Kumar<sup>3</sup>**

1. Department of Zoology, Govt. K.R.G. (Auto.) P. G. College, Gwalior, M.P. (INDIA)
2. Conservation Biology Unit, SOS in Zoology, Jiwaji University Gwalior, M.P. (INDIA)
3. Department of Zoology, Govt. S.M.S.P.G. College, Shivpuri, M.P. (INDIA)

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## **ABSTRACT**

This paper deals with the 19 fish species (06 orders, 08 families and 12 genera) of the Sakhya Sagar Lake, Shivpuri, India in relation to the abiotic factors i.e. physical (water temperature, depth, colour, transparency, turbidity, conductivity) and chemical (pH, dissolved oxygen, free carbon dioxide, total alkalinity, total hardness, chloride, calcium). The limnological factors in Sakhya Sagar Lake were monitored for the period of one year (April, 2007 to March, 2008) altogether the ecology and richness of fish fauna in this lake.

**Key Words :** Sakhya Sagar Lake, Fish fauna, Habitat, Physico-chemical parameters, Water quality

## **INTRODUCTION**

Every living organism of the earth has some unique characteristics and plays an important role to maintain ecological balance of ecosystem. The ecology of water body determined the structure and composition of biotic community of any water body. Fish play a major role in aquatic systems and are also of great economic importance. Wetlands contributed a major share in inland fisheries and study of their ecosystem dynamics is necessary for optimum utilization and conservation.<sup>1</sup> The physico-chemical characteristics of water depends upon several factors including location of water bodies, types of sewage and domestic waste disposal, localization of human population and their activities<sup>2</sup>. Sakhya Sagar Lake is a large perennial water body situated inside the Madhav National Park, Shivpuri, M.P., India.

## **AIMS AND OBJECTIVES**

The present study has attempted to bring out the richness of fish diversity and effect of physico-chemical parameters upon fish habitat in this lake which receives water from local nala and wastes from adjacent areas.

## **Study area**

The Sakhya Sagar Lake is also known as Chandpatha lake. It lies between latitude 25° 26' to 25° 38' N and longitude 77° 43' to 77° 57' E. It spread about 309.01 hectares and it is located 4 km. from Shivpuri town. This is man-made lake situated in the central zone of the Madhav National Park. It provides a permanent source of water to the wildlife and drinking water for the peoples of Shivpuri town. The lake is bounded with a huge masonry wall situated along its eastern shore. The length of dam is 2164 m. and maximum height of dam is 13.81m. The catchment area of lake is 72.52 sq. km., submergence area is 217.06 ha. and gross storage capacity is 7.78 m.cum. A nala namely Karbala from the Shivpuri town joins the lake in the Southern bank of the lake. From winter onwards the nala which feeds the lake get dried up and only the used water of Shivpuri town flows into the lake. It carries sewage and waste water of the town.

## **MATERIAL AND METHODS**

To evaluate the water quality of lake and habitat conditions of the fishes, limnological and ecological studies were carried out at

\*Author for correspondence

Sakhya Sagar Lake. Physico-chemical characteristics of water are extremely valuable in the assessment of quality or pollution status of the water. In this context, the present study was conducted from April, 2007 to March, 2008. Four sampling stations namely A, B, C and D were established in the different areas of water body for the analysis of water quality. The superficial water samples were collected in the iodine treated double stoppers plastic bottles during the forenoon between 7.00 a.m. to 10.00 a.m. Different methods suggested by APHA<sup>3</sup> and Trivedi and Goel<sup>4</sup> were followed for water analysis. Fishes were collected from local fishermen who caught fish from the water body illegally. Fish samples were preserved in 5% formalin solution. Systematic identification of the fishes was done with the help of standard keys given by Jayaram<sup>5,6</sup> and Srivastava<sup>7</sup>.

## RESULTS AND DISCUSSION

For the study of ecology, total 19 physico-chemical parameters of water were analyzed along with the some biological parameters. The range of variation in various physico-chemical parameters at various stations and their annual mean values has been given in **Table 1**.

### **Water temperature**

It ranged between 20.25 °C (January, 2008) and 32.63°C (June, 2007).

### **Water depth**

It was varied from 11.25 feet (May, 2007) to 20.25 feet (October, 2007).

### **Colour**

It was found to vary from transparent, transparent green to turbid. The transparent colour of water was observed in October and November and transparent green colour of water was found in the month of April, May, June, December, January, February and March. Turbid water was observed in July, August and September during the study years.

### **Transparency**

It was fluctuated from 81.75 cm (September, 2007) to 108.75 cm (December, 2007).

### **Electrical conductivity**

It had a range between 348.75 µS/cm (January, 2008) to 500 µS/cm (July, 2007).

### **Turbidity**

It had a range from 6 NTU in March, 2008 to 16.75 NTU in August, 2007. The turbidity was low during post monsoon season and high during monsoon season.

### **Total dissolved solids**

It had shown a seasonal fluctuation between 176.25 mg/l (January, 2008) and 247.5 mg/l (June, 2007).

### **pH**

The pH varied from 7.28 (September, 2007) to 8.23 (April, 2007).

### **Dissolved oxygen**

The DO exhibited a large seasonal variation in the water body. The dissolved oxygen fluctuated between 6.25 (April and June, 2007) to 9.35 (January, 2008). It was observed the dissolved oxygen was found increasing continuously in winter season and then decreased continuously reaching to minimum in summer.

### **Free carbon dioxide**

It was found to be absent during most of the time. Maximum 2.33 mg/l free carbon dioxide was recorded in the month of October, 2007.

### **Total alkalinity**

The sum of bicarbonate and carbonate alkalinities is called as total alkalinity. It varied from 80.25 mg/l (January, 2008) to 122.5 mg/l (April, 2007).

### **Total hardness**

It fluctuated between 166.25 mg/l (October, 2007) to 205 mg/l (May and August, 2007).

### **Chloride**

It ranged between 143 mg/l (January, 2008) to 273.75 mg/l (September, 2007).

### **Calcium**

It fluctuated from 10 mg/l (February, 2008) to 23.81 mg/l (December, 2007).

### **Sulphates**

It fluctuated from 4.38 mg/l (June, 2007) to 10.3 mg/l (January, 2008).

### **Nitrate**

It fluctuated between 4.05 mg/l (April, 2007) to 6.83 mg/l (October, 2007).

### **Phosphates**

It fluctuated from 0.6 mg/l (April, 2007) to 0.91 mg/l (November, 2007).

**Table 1 : The mean values of various physico-chemical parameters of Sakhya Sagar Lake during April, 2007 to March, 2008**

S/N	Parameters	Units	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR
1	Temperature	°C	27.13	28.68	32.55	32.63	28.13	25.63	24.63	24.88	22.13	20.25	21	24.13
2	Depth	Feet	12.75	11.25	12.38	14.75	16	18	20.25	18.25	16.68	16.08	15.25	13.88
3	Color		T.G	T.G	T.G	Turbid	Turbid	Turbid	Turbid	T.G	T.G	T.G	T.G	T.G
4	Transparency	cm	97.5	92.5	108.75	90	108	100	92.5	81.75	75.75	91.5	83.25	98.50
5	Electrical conductivity	µS/cm	475	437.5	458.75	500	463	392.5	425	397.5	386.25	348.7	379.5	391.7
6	Turbidity	NTU	7.75	7.50	7.5	15.75	16.75	14.5	11.25	10.25	7.25	6.5	6	6.00
7	Total dissolved solids	mg/l	213.75	228.75	236.25	240.00	239.25	240.5	247.5	236.25	206.2	176.2	189.25	209.5
8	pH		8.23	8.00	7.88	7.58	7.85	7.28	7.35	7.45	7.6	7.55	7.75	7.9
9	Dissolved oxygen	mg/l	6.25	6.50	6.25	6.63	7.5	7.66	8.25	8.85	8.68	9.35	9.35	7.68
10	Free carbon dioxide	mg/l	Nil	Nil	Nil	2.33	Nil	1.8	2.14	Nil	Nil	Nil	Nil	Nil
11	Total alkalinity	mg/l	122.5	105	118.75	88.75	81.75	98.75	98.75	90	87	80.25	103.25	107.5
12	Total hardness	mg/l	182.5	205	202.5	178.75	210	178.75	166.25	166.25	188.75	178.7	171.75	177.5
13	Chlorides	mg/l	187.5	197.5	212.5	220	232.5	271.25	273.75	216.25	157.5	143	155	176.5
14	Calcium	mg/l	17.25	15.08	16.10	10	12.11	19.13	18.1	15.13	23.81	10.09	11.73	12.86
15	Sulphates	mg/l	7.38	5.50	4.38	6.43	5.19	7.13	8.05	10.25	8.81	10.3	6	6.85
16	Nitrate	mg/l	4.05	5.10	4.56	4.58	6.28	6.01	6.83	6.39	5.58	5.03	4.98	4.53
17	Phosphate	mg/l	0.60	0.84	0.73	0.65	0.69	0.63	0.84	0.91	0.89	0.72	0.63	0.66
18	BOD	mg/l	5.38	4.70	4.20	4.55	4.01	2.52	3.14	2.30	3.24	2.83	3.43	2.68
19	COD	mg/l	7.25	10.25	11.50	12.13	10	9.38	4.38	5.06	8.50	6.75	6.75	6.50

### Biochemical oxygen demand

The BOD fluctuated from 2.30 mg/l (November, 2007) to 5.38 mg/l (April, 2007).

### Chemical oxygen demand

The COD fluctuated between 4.38 mg/l (October, 2007) to 12.13 mg/l (July, 2007). The fish species identified are resulted into 19 species, belongs to 06 orders, 08 families and 12 genera. The identified fish species i.e., *Notopterus notopterus*, *Tor tor*, *Puntius sophore*, *P. ticto*, *Catla catla*, *Cirrhinus mrigala*, *C. reba*, *Labeo bata*, *L. calbasu*, *L. rohita*, *Aoric hthys aor*, *A. seenghala*, *Wallgo attu*, *Clarias batrachus*, *Heteropneutes fossilis*, *Mastacem-*

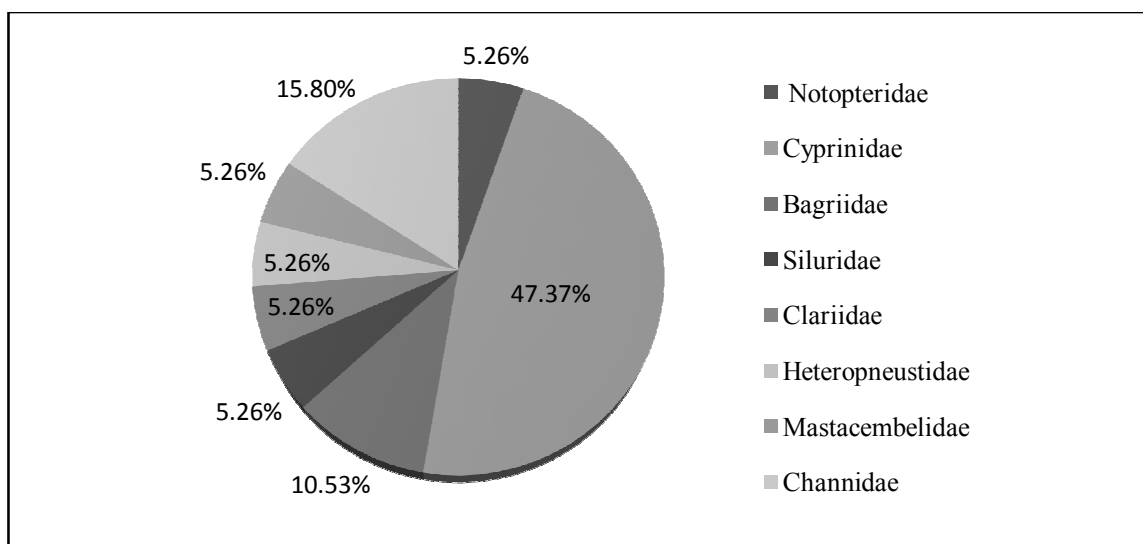
*balus armatus*, *Channa marulius*, *C. striata* and *C. punctatus* (**Table 2**). The maximum number of fish species 09, belongs to family Cyprinidae with 47.37% share. Family Channidae are represented by 03 species with 15.79%, while family Bagriidae represented by 02 species with 10.53%. The families Notopteridae, Siluridae, Clariidae, Heteropneustidae and Mastacem-belidae are having only one species with 5.26% each (**Table 3**) and (**Fig. 1**). Water temperature is a vital parameter for growth of aquatic organism.<sup>8,9</sup> Change in temperature affect aquatic life. Elevated temperatures increase the metabolism, respiration and oxygen demand of fish and other aquatic animals.

Table 2 : List of fish species recorded in Sakhya Sagar Lake

Order	Family	Subfamily genus species
Osteoglossiformes	Notopteridae	<i>Notopterus</i> (Lacepede)
		1. <i>N. notopterus</i> (Palas)
Cypriniformes	Cyprinidae	Cyprininae
		<i>Tor</i> (Gray)
		2. <i>T. tor</i> (Ham.-Buch.)
		<i>Puntius</i> (Hamilton-Buchanan)
		3. <i>P. sophore</i> (Ham.-Buch.)
		4. <i>P. ticto</i> (Ham.-Buch.)
		<i>Catla</i> (Valenciennes)
		5. <i>C. catla</i> (Ham.-Buch.)
		<i>Cirrhinus</i> (Oken)
		6. <i>C. mrigala</i> (Ham.-Buch.)
		7. <i>C. reba</i> (Ham.-Buch.)
		<i>Labeo</i> (Cuvier)
		8. <i>L. bata</i> (Ham.-Buch.)
		9. <i>L. calbasu</i> (Ham.-Buch.)
		10. <i>L. rohita</i> (Ham.-Buch.)
Siluriformes	Bagriidae	Bagrinae
		<i>Aorichthys</i> (Wu)
		11. <i>A. aor</i> (Ham.-Buch.)
		12. <i>A. seenghala</i> (Sykes)
Siluriformes	Siluridae	
		<i>Wallgo</i> (Bleeker)
		13. <i>W. attu</i> (Bloch and Schneider)
	Clariidae	
		<i>Clarias</i> (Scopoli)
		14. <i>C. batrachus</i> (Linnaeus)
	Heteropneustidae	
		<i>Heteropneustes</i> (Muller)
		15. <i>H. fossilis</i> (Bloch)
Synbranchiformes	Mastacembelidae	Mastacembelinae
		<i>Mastacembelus</i> (Scopoli)
		16. <i>M. armatus</i> (Lacepede)
Perciformes	Channidae	
		<i>Channa</i> ( <i>Ophiocephalus</i> ) (Scopoli)
		17. <i>C. marulius</i> (Ham.-Buch.)
		18. <i>C. striata</i> (Bloch)
		19. <i>C. punctatus</i> (Bloch)

**Table 3 : Fish species richness in Sakhya Sagar Lake**

S/N	Family	Genus	Species	Percentage of contribution of families
1.	Notopteridae	1	1	5.26%
2.	Cyprinidae	5	9	47.37%
3.	Bagriidae	1	2	10.53%
4.	Siluridae	1	1	5.26%
5.	Clariidae	1	1	5.26%
6.	Heteropneustidae	1	1	5.26%
7.	Mastacembelidae	1	1	5.26%
8.	Channidae	1	3	15.80%
<b>Total</b>		<b>12</b>	<b>19</b>	



**Fig. 1 : Percentage of different families of fish species in the Sakhya Sagar Lake**

Water depth is an important physical factor which affects some column and bottom dweller fishes. It has maximum depth of about 42 feet. The depth of this lake varies from place to place and its basin shows the presence of muram, clay, black soil and sandy loam. The diagnostic features of Sakhya Sagar Lake are typical hydric soil with submerged, floating and amphibious vegetation which provide food, shelter and suitable habitat for hiding, breeding and egg laying to many fish species. The various herbivorous fishes depend upon these aquatic vegetations for food. Some bottom dweller fishes forage in the wetland soils and sediments, some feed on small fishes and invertebrates in the water column and surface. The non-air breathers

avoid thick vegetation basically because of the low oxygen tension where as the air breathers were seen in widely different types of habitats. The higher TDS, BOD and COD values confirmed the input of sewage in the lake which deteriorated the water quality and ultimately influences the habitat of fish fauna. The presence of excess microsystems algae is also an indicator of the addition of sewage in this lake. Nutrients and sediments entering from different sources have increased algal blooms, decreased oxygen levels and decreased fish populations. The phosphate, calcium and nitrate are the important nutrients which influence the ichthyo biodiversity, productivity and food chain of aquatic ecosystem. According to Sakhre and

Joshi<sup>10</sup>, the level of dissolved oxygen in a water body depends on factors like temperature, salinity and density of phytoplankton. It was observed that DO was higher in open water and in winter months in comparison to deep water and summer months. Total CO<sub>2</sub> was recorded more in the areas of thick vegetations. It seems that these factors may be the limiting physico-chemical factors of the distribution of fish in the water body.

### CONCLUSION

Sakhya Sagar Lake is facing severe threats from human activities like illegal fishing activities, discharge of untreated sewage in the lake from the residential areas through the nala, dumping of garbage and other waste materials in the surrounding areas of lake. If the human activities continue the water quality of the lakes will deteriorate and so will the biodiversity dependent on them. The present study was undertaken to give a limnological knowledge and abundance of fish fauna of Sakhya Sagar Lake and also help in exploring the possibilities for better management, development and conservation of biodiversity of the lake.

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