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ASSESSMENT OF WATER QUALITY AND FISH DIVERSITY OF TONS RIVER, SATNA (M.P)

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ABSTRACT : The over-exploitation of fish resources coupled with fish habitat destruction result in the shrinkage of fish production. The growth of fish and productivity is highly dependent on the physico-chemical characteristics of the river water. Fish samples were collected quarterly during March,2013-February,2015 from river Tons with the help of local fishermen. Ecological features of the fish habitat and color of fish species were recorded throughout collection. Scientific identification of fishes is based mainly on external characters such as body shape, length, mouth and nature of fish spines, scales etc. The dissolved oxygen and biological oxygen demand were recorded satisfactory in the river for fish growth and survival. Most of the physico-chemical parameters were found pertinent for fish survival and reproductive multiplication. Thus, the observation of limnological status of river is satisfactory for fishes during our examination period. Various quality parameters were measured including pH, total suspended solid, total dissolved solid, total hardness, calcium hardness, magnesium hardness, total alkalinity, chloride, dissolved oxygen and biochemical oxygen demand. All parameters of river Tons was found within the permissible limit. The fish species belonging to 06 orders, 09 families were collected from river Tons. The data analyses suggested that fishes of Cyprinidae family were found predominantly in the locations considered for present study.

Key words : *Assessment of water quality, Physico-chemical characteristics, Fish diversity.*

INTRODUCTION

Water is the most significant overabundant compound of the earth. Water is life, no life can live without water. Good quality water is essential for all living organisms and the characteristics of water affect the survival, growth and reproduction of aquatic organisms. A change in water quality affects the biotic community of an aquatic ecosystem ultimately reducing the primary productivity and several deviated physico-chemical factors could cause stress thereby adversely affecting the aquatic fauna. In this respect a regular monitoring of water quality is essential to determine the status of water bodies with reference to aquatic fauna. Water quality assessment generally involves analysis of physico-chemical, biological and microbiological parameters and reflects the abiotic and biotic status of the ecosystem (Kulshrestha & Sharma,2006; Mulani *et al.*,2009; Dhinamala *et al.*,2015 and Sinha & Sinha,2019).

The fish habitat destruction is mainly due to alteration of river system, increased water abstraction, over fishing of economically important fishes, pollution of fishing water, land development and demonstration of species have been going on indiscriminately. Nowadays, water pollution is considered as one of the most important universal challenges facing both developed and developing states, affecting greatly environmental health. While all globally focus on water quality, water conservation and distribution matters, bad dealing with wastewater resulted in severe problems in many countries, worsening the water crisis all over the world (FAO,2017).

The major known sources of water pollution are from human settlements, agriculture and industries. Continuous population growth, increased economic movements in addition to climate change all participate in spoilage of natural water resources, so threatening aquatic systems and the whole ecosystem as well. Recently, it was noted that aquatic biodiversity faces many damages and consequently is subjected to severe decline in many countries. The most terrible issue is that almost primitive ecosystems are amongst the threatened ones (UNEP,2016). According to a report of World Water Assessment Program (WWAP,2017), globally about 80% of municipal wastewater is released untreated into water streams, also industrial activities are well known for their irresponsibility on dumping millions of tons of pollutants (solvents, heavy metals, toxic sludge) every year into wetlands.

There are many sources of aquatic pollutants *i.e.* industrial effluents, agriculture runoffs in addition to municipal sewage that are dumped in river, gradually transferring water to be ineligible for human consumption. Agricultural wastewater contains many pollutants from herbicides and pesticides that have negative impacts on river and people using its water. Most of the aquatic organisms are very sensitive to any variation in the environment, they respond to any pollution by different ways. The most drastic responses are represented in death or migration to any other habitat. Fewer responses may include reduction in reproductive capacity and also suppression of some enzyme systems needed to conventional metabolism (Chapman,1992).

Many factors such as altitude, water temperature, habitat type, food availability, predator and ecological barrier etc. are some of the determining factors for distribution of aquatic fauna in river/stream habitats. Biodiversity loss also include the decrease in common species numbers and shifts in domination patterns of species. It can be said that common species

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are the drivers of any ecosystem process and any decline could lead to bad implications for the ecosystem main function. For example, dominant fish have vital roles in freshwater ecosystems, mostly joining benthic and pelagic parts through their rapid mobility in addition to flexible foraging acts (Moore, 2006). In India, several studies have documented on fish diversity *i.e.* Rao,1999; Paik & Chakraborty,2003; Ojha & Thilak,2008; Tamboli & Jha,2012; Sarma *et al*.,2012; Banyal & Kumar,2017; Ranjan & Verma,2017; Ratan *et al.*, 2017; Kushram & Singh,2018; Singh & Fatima,2018 and Kushram *et al.*,2019.

Human activities are the major factors that cause the changes in the diversity and distribution of freshwater fish. The development of freshwater ecosystem by human being has lead to drastic changes in freshwater fish fauna including the gain of non-natives species and loss of many natives.

MATERIAL AND METHODS

Samples were collected from Tones river of Satna. For sample collection, handling and preservation standard methods were followed. Present study was carried out from March, 2013 to February,2015 covering different seasons. Sampling sites were randomly chosen based on accessibility and similarity in physical habitat. Fish sampling was conducted at each of the sampling site to record fish diversity. Water temperature was measured using hand held glass thermometer at each study site. TDS, TSS, TS, pH, Total hardness, Calcium hardness as $CaCO_3$, Mg hardness as $MgCO_3$, Total alkalinity, Chloride were analyzed as per standard methods (APHA-AWWA WPCF,2005).

Fish samples were collected from river Tones with the help of local fishermen and kept in 10% formalin for 48 hrs. Afterwards they were transferred to 30% formalin and preserved for detail study. Identification of collected fishes is based mainly on external characters such as body shape, length, mouth and nature of fish spines, scales etc. and were done by referred books (Day's fauna,1994; Jayaram,1999 and Jhingran,1991) and experts of Dept. of Fisheries, Satna (M.P.).

RESULTS AND DISCUSSION

The water quality parameters like temperature, hardness, pH, dissolved gases (oxygen and carbon-dioxide), salinity etc. must be watched regularly, individually or synergistically to keep the aquatic habitat favorable for existence of fish (Usha Anandhi *et al.*,2013). The main physico-chemical factors that affect aquatic environments are temperature, discharge, dissolve oxygen, pH, nutrients and specific conductivity (Boney,1989). The seasonal variation of physico-chemical characteristics of Tons river water *i.e.* Temperature, pH, Total suspended solid (TSS), Total dissolved solid (TDS), Total solid (TS), Calcium hardness, Magnesium hardness, Total hardness (TH), Chloride, Total alkalinity, Dissolved oxygen (DO) and Bio-chemical oxygen demand (BOD) were observed for two years, 2013 & 2014 (Tables1&2).

Temperature : The seasonal variation of temperature was 18.30-27.67°C. The minimum temp was observed for station 20.43°C in winter-2013 and 18.30 in winter,2014. The max value was found 27.67°C in pre-monsoon,2013 and 26.23°C in post monsoon season,2014.

pH : The seasonal variation of pH was 7.67-8.03. The minimum pH 7.67 was observed in winter,2013 and 7.86 in winter, 2014. The max value was found 7.83 in post-monsoon, 2013 and 8.03 in post-monsoon,2014. Higher pH value is normally associated with the high photosynthetic activity in water (Hujare,2008).

Total suspended solid (TSS) : The seasonal variation of TSS was 114.67-141.00 mg/l. The minimum TSS 116.00 mg/l was observed in pre-monsoon,2013 and 114.67 mg/l in pre-monsoon,2014. The max value was found 127.00 mg/l in winter,2013 and 163.00 mg/l in post-monsoon,2014.

Total dissolved solid (TDS) : The seasonal variation of TDS was 556.33-829.33 mg/l. The minimum TDS 556.33 mg/l was observed in pre-monsoon,2013 and 656.67 mg/l in winter,2014. The max value was found 829.33 mg/l in post-monsoon, 2013 and 766.67 mg/l pot-monsoon,2014.

Table. 1 Seasonal variation of different water quality parameters of river Tons.

S.	Parameters	Year-2013			Year-2014		
		Pre-monsoon	Post-monsoon	Winter	Pre-monsoon	Post-monsoon	Winter
1.	Temp. (°C)	27.67 (5.97)	26.03 (2.99)	20.43 (2.12)	22.87 (3.08)	26.23 (3.94)	18.30 (3.87)
2.	pH	7.77 (0.06)	7.83 (0.71)	7.67 (0.38)	7.93 (0.12)	8.03 (0.29)	7.86 (0.10)
3.	TSS (mg/l)	116.00 (19.92)	141.00 (38.43)	127.00 (55.34)	114.67 (27.30)	163.00 (127.39)	116.00 (69.66)
4.	TDS (mg/l)	556.33 (57.88)	829.33 (149.14)	593.67 (238.45)	702.67 (168.59)	766.67 (461.88)	656.67 (115.90)
5.	TS (mg/l)	672.33 (76.72)	970.33 (175.67)	720.67 (191.34)	817.33 (174.73)	929.67 (589.20)	772.67 (123.39)
6.	Ca hardness (mg/l)	193.00 (52.94)	234.67 (40.07)	233.33 (12.86)	220.00 (40.00)	237.33 (18.90)	213.33 (80.83)
7.	Mg hardness (mg/l)	40.00 (20.78)	25.33 (16.17)	24.67 (8.08)	24.00 (14.42)	33.33 (16.65)	26.67 (11.55)
8.	Total hardness (mg/l)	233.00 (32.23)	260.00 (28.00)	258.00 (7.21)	244.00 (26.23)	270.67 (30.55)	240.00 (87.18)
9.	Chloride (mg/l)	53.52 (12.25)	63.31 (11.54)	44.62 (5.55)	54.98 (8.66)	54.98 (15.00)	36.65 (10.41)
10.	Total alkalinity (mg/l)	282.67 (15.53)	290.00 (26.46)	274.00 (22.54)	253.33 (20.82)	303.33 (41.63)	219.33 (44.06)
11.	DO (mg/l)	4.80 (0.49)	6.70 (0.35)	7.30 (0.46)	6.67 (0.70)	7.13 (0.40)	7.03 (0.35)
12.	BOD (mg/l)	1.07 (0.23)	2.27 (2.02)	0.83 (0.21)	0.80 (0.10)	2.67 (1.89)	1.00 (0.17)

Total solid (TS) : The seasonal variation of TS was 672.33-970.33 mg/l. The minimum TS 672.33 mg/l was observed in pre-monsoon,2013 and 772.67 mg/l in winter,2014. The max value was found 970.33 mg/l in post-monsoon,2013 and 929.67 mg/l in post-monsoon,2014.

Calcium hardness : The seasonal variation of calcium hardness was 193.00-237.33 mg/l. The minimum calcium hardness 193.00 mg/l was observed in pre-monsoon, 2013 and 213.33 mg/l in winter,2014. The max value was found 234.67 mg/l in winter,2013 and 237.33 mg/l in post-monsoon,2014.

Magnesium hardness : The seasonal variation of magnesium hardness was 24.00-40.00 mg/l. The minimum magnesium hardness 24.67 mg/l was observed in winter,2013 and 24.00 mg/l pre-monsoon,2014. The max value was found 40.00 mg/l in pre-monsoon,2013 and 33.33 mg/l in post-monsoon in 2014.

Total hardness (TH) : The seasonal variation of Total hardness was 233.00-270.67 mg/l. The minimum Total hardness 233.00 mg/l was observed in pre-monsoon, 2013 and 240.00 mg/l in winter,2014. The max value was found 260.00 mg/l in post-monsoon,2013 and 270.67 mg/l in post-monsoon in 2014.

Table. 2 WQI at different sampling station in different season Year 2013 & 2014.

S.	Seasons	Year 2013	Year 2014
1.	Pre-monsoon	48.69	44.77
2.	Post-monsoon	52.90	57.09
3.	Winter	44.32	46.50

Chloride : The seasonal variation of chloride was 36.65-63.31 mg/l. The minimum Chloride 44.62 mg/l was observed in winter, 2013 and 36.65 mg/l in winter,2014. The max value was found 63.31 mg/l in post-monsoon, 2013 and 54.98 mg/l at in pre-monsoon and post-monsoon in 2014.

Total alkalinity : The seasonal variation of total alkalinity was 219.33-303.33 mg/l. The minimum total alkalinity 274.00 mg/l was observed in winter,2013 and 219.33 mg/l in winter,2014. The max value was found 290.00 mg/l in post-monsoon,2013 and 303.33 mg/l in post-monsoon in 2014.

Dissolved oxygen (DO) : The seasonal variation of DO was 4.80-7.30 mg/l. The minimum DO 4.80 mg/l was observed in pre-monsoon,2013 and 6.57 mg/l in pre-monsoon,2014. The max value was found 7.30 mg/l at S5 in winter,2013 and 7.13 mg/l in post-monsoon in 2014. Deficiency of DO gives bad odor to water due to anaerobic respiration of organic matter. DO does not have any direct bearing on the health risks of humans but can predict the water quality of the system. DO levels in surface water body indicate the ability to support aquatic life.

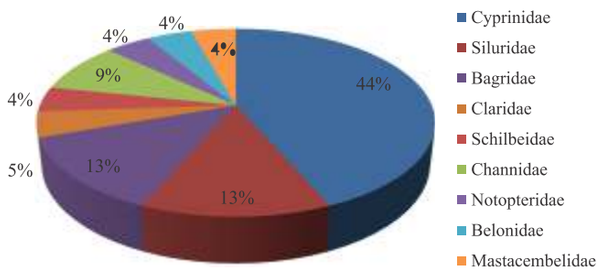

Fig. 1 Percentage composition of among different fish family.

Table. 3 Details of collected various fishes of Tons river (March,2013-February,2014).

Order	Family	Scientific Name	Local name
Cypriniformes	Cyprinidae	1. *Labeo rohita*	Rohu
		2. *Labeo calbasu*	Karouchar
		3. *Labeo gonius*	Kuri
		4. *Labeo boga*	Pathachati
		5. *Puntius sarana*	Pardi
		6. *Puntius sophore*	Sighdi
		7. *Puntius chola*	Pothi
		8. *Cirrhinus mrigala*	Mrigal
		9. *Catla catla*	Catla
		10. *Oxygaster bacaila*	Chahal
Siluriformes	Siluridae	11. *Wallago attu*	Padhin
		12. *Ompak bimaculatus*	Jal Kapoor
		13. *Ompak papda*	Pavda
	Bagridae	14. *Mystus aor*	Tengra
		15. *Mystus cavasius*	Tengra
		16. *Mystus seeghala*	Tengra
	Claridae	17. *Clarias batrachus*	Magur
	Schilbeidae	18. *Silonia silondia*	Siland
Channiformes	Channidae	19. *Channa gachua*	Saur
		20. *Channa marulius*	Saur
Clupeiformes	Notopteridae	21. *Notopterus notopterus*	Patola
Beloniformes	Belonidae	22. *Xenentodon cancila*	Sujna
Synbranchiformes	Mastacembelidae	23. *Mastacembelus armatus*	Baam

Bio-chemical oxygen demand (BOD) : The seasonal variation of DO was 0.80-2.67 mg/l. The minimum BOD 0.83 mg/l was observed in winter,2013 and 0.80 mg/l in pre-monsoon, 2014. The max value was found 2.27 mg/l in post-monsoon, 2013 and 2.67 mg/l in post-monsoon in 2014.

Total 23 fish species belonging to 06 orders, 09 families were collected from river Tons, Satna. Among the family, Cyprinidae had the highest number of species (44%) followed by Siluridae (13%), Bagridae (13%), Channidae (9%) and Claridae (5%). Other families accounted for about 4% with each of single species were Schilbidae, Notopteridae, Belonidae and Mastacembelidae (Table.3 & Fig.1).

Satna city lays in Vindhyan plateau comprises of mainly limestone, sandstone and shale. However, the chemical composition of water parameters will vary depending upon several factors, like frequency of rain, which will leach out the salts, time of stay of rain water in the root-zone and intermediate zone, presence of organic matter etc. All parameters were found within the permissible limit except alkalinity. The values of alkalinity was found higher than the permissible limit 200 mg/l (BIS), overall study reveals that water of the study area was not fit for directly drinking purpose need proper treatment to minimize the contamination. However, the WQI values in the present investigation was found in a good status in pre monsoon and winter, in year 2013 and 2014, while in post-monsoon season value was found poor indicating the water was unfit for drinking and domestic purpose.

The diversity of the fishes mainly depends upon the biotic and abiotic factors and type of the ecosystem, age of the water body, mean depth, water level fluctuations, morphometric features and bottom have great implications. The hydro-biological features of the collection centers also play an effective role in fisheries output to a greater extent (Senthil and Prabaharan,2012).

The growth of Fish and productivity is highly dependent on the physico-chemical characteristics of the river water. The Dissolve oxygen and Bio-chemical oxygen demand were recorded satisfactory in the river for fish growth and survival. Most of the physico-chemical parameters were found pertinent for fish survival and reproductive multiplication. Thus, the observation of limnological status of river is satisfactory for fishes during our examination period.

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