

Species diversity of fishes in relation to physicochemical status of the Yamuna at Kalpi (UP) India

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Abstract

Fishes are the primary indicators of pollution of water bodies because they are conspicuous and changes in physicochemical characteristics of water affects their growth and reproductive multiplication rate. The study reveals the species diversity of fishes in relation to physicochemical status of the Yamuna river at Kalpi stretch. Four sampling station were selected on the Yamuna river for sample collection to analysis species diversity of fishes in relation to physicochemical status of studied river. Sampling for fish fauna and physicochemical analysis of water was done simultaneously for one year. The collected samples were analysed for selected physicochemical parameters and collected fishes was identified in the same time. Selected physicochemical parameters were Water Temperature (W.T.), pH, Conductivity, Turbidity, Total Dissolved Solids (T.D.S.), Total Hardness (TH), Total Alkalinity (T.A.), Chloride (Cl), Sulphate (SO₄), Phosphate (PO₄), Nitrate (NO₃), Dissolved Oxygen (D.O.), Biochemical Oxygen Demand (B.O.D.) and Chemical Oxygen Demand (C.O.D.). Mostly physicochemical parameters were found suitable for survival and growth of fish fauna. Yamuna river at Kalpi stretch have high potential for fish production which is not utilize till now.

Keywords: Fish diversity; Kalpi; Physicochemical status; Yamuna

1. Introduction

Natural or manmade pollution in the water changes Temperature, pH, Turbidity, Total Dissolved Solids, Dissolved Oxygen and B.O.D. which in turn affects the fish population. Fishes are the primary indicators of pollution of rivers because they are conspicuous. Changes in physicochemical characteristics of water affects the growth and reproductive multiplication rate of fishes, which are likely to vary among different species. Due to requirement of food for fast growing population in India, at least two-fold increment in fish production is called for within next few years. Now a day riverine fisheries have declined. So, it become necessary to study about fish fauna, their food ecology and their limnological status for better production of fish culture. Considering the importance of fresh water resources in inland fishery, number of studies have been conducted [1, 2, 3, 4, 5, 6, 7, 8, 9 and 10]. The present study reveals the species diversity of fishes in relation to physicochemical status of the Yamuna river at Kalpi stretch in which it is try to investigate the suitability of physicochemical condition of studied river water for fish growth and reproduction because Yamuna river at Kalpi stretch have high potential for fish production which is not utilize till now.

Objectives of the study is to assess the physicochemical characteristics of river Yamuna along with collection and identification of fish fauna and analysis the impacts of physicochemical parameters of this water on growth and reproduction of fish fauna.

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2. Material and methods

Kalpi is a historical city of district Jalaun of Uttar Pradesh located in between Jhansi and Kanpur on NH-25 lies to the south east bank of Yamuna and falls under $26^{\circ} 7' 14''$ N latitude to $79^{\circ} 44' 59''$ E longitude with an average elevation of 112 meters. 5 Km. length of Yamuna at Kalpi from in front of Vyas mandir (U/S) to Raid drain opening (D/S) is under the study programme (Fig. – 1). Four sampling stations named as S1- in front of Vyas Mandir, S2- Kila Ghat, S3- Peela Ghat and S4- just after Raid drain opening were selected for the sampling purpose. The samples were collected monthly till one year (October 2013 to September 2014) from selected sampling stations in sterilized plastic bottles. For physicochemical parameters samples were analysed according to the standard methods [11 & 12]. Water temperature was measured by thermometer and pH was measured by pen pH meter at sampling site. Other parameters like Cond., Turb., T.D.S., T.H., T.A., Cl, SO_4 , PO_4 , NO_3 , D.O., B.O.D. and C.O.D. were determined in the laboratory. Fishes were collected by monthly sampling using nets of various mesh size from the selected sampling sites. The identification of fish fauna was also carried out simultaneously with the help of standard books and monographs [13 & 14].



Figure 1 Location of study area (Kalpi) in map of the Yamuna river [Source: 15].

3. Results and discussion

The observed physicochemical parameters were tabulated and analysed to understand the physicochemical characteristics of water. Simultaneously the fish fauna was also observed and identified and efforts were made to understand the co-relation between them.

3.1. Physicochemical Parameters

The recorded physicochemical parameters of 4 sampling sites were tabulated and analysed (Table no-1). Water Temperature (W.T.) was recorded in range of $15.5^{\circ}C$ to $31.5^{\circ}C$ and average WT was $25.38^{\circ}C$. Fishes required moderate temperature for their best growth and reproduction. Temperature was found suitable for the survival and growth of fish fauna [16]. The pH value was in range from 7.60 to 8.70 and average value was 8.28. pH of Yamuna river was alkaline in nature, which is a good indicator for survival of fishes [17]. Conductivity was recorded in the range of $330 \mu S/cm$ to $1060 \mu S/cm$ during study period. The average value of Conductivity was $601.25 \mu S/cm$. The value of Turbidity was fluctuating from 26.0 to 200 NTU and average was 83.58 NTU. Turbidity of the Yamuna water was under the limit in most of the time of study period for fish growth and survival. Total Dissolved Solids (T.D.S.) was in range from 458 to 675 mg/l. while average value was 564.58 mg/l. Recorded Total Hardness (TH) of the Yamuna water was in the range of 84.5 mg/l to 148.9 mg/l while average was 111.48 mg/l.

Table 1 Physicochemical Parameters of Yamuna river at Kalpi. [Source: 9]

Period- 2013 to 2014		Physicochemical Parameters													
Season	Mon	Wt. (°C)	pH	Con. µS/Cm	Tur. NTU	T.D.S mg/L	T.H. mg/L	T.A. mg/L	Cl mg/L	SO ₄ mg/L	PO ₄ mg/L	NO ₃ mg/L	D.O. mg/L	BOD mg/L	COD mg/L
Winter Season	Oct.	28.0	7.85	490	76.0	545	96.2	139.62	16.98	25.0	0.65	0.95	7.25	6.9	24.0
	Nov	22.0	8.03	520	86.0	508	94.5	104.87	17.75	21.50	0.58	0.65	7.6	6.3	20.2
	Dec.	16.0	7.80	610	47.0	478	98.6	103.0	19.5	17.5	0.55	0.48	8.48	5.5	19.5
	Jan.	15.5	7.60	550	53.5	458	115.0	91.5	25.85	23.40	0.52	0.45	8.53	7.35	23.95
Summer Season	Feb.	19.8	8.20	600	26.0	464	125.0	187.5	29.30	24.50	0.56	0.58	8.35	7.8	23.0
	Mar	24.5	8.34	640	38.0	467	121.0	211.5	35.40	24.70	0.58	0.85	7.85	8.6	24.5
	Apr.	29.3	8.55	515	42.0	487	130.5	213.0	37.75	26.85	0.55	1.23	8.05	11.35	25.2
	May	30.5	8.68	990	46.5	607	141.5	213.5	48.5	25.80	0.85	3.03	7.2	11.50	26.0
Rainy Season	June	31.5	8.70	1060	48.0	634	148.9	215.6	41.0	29.75	0.87	4.6	6.0	12.00	26.8
	Jul.	28.5	8.48	550	160.0	640	95.0	214.5	18.5	17.89	0.95	1.25	6.5	6.5	13.50
	Aug	30.0	8.60	330	200.0	675	84.5	210.75	14.5	11.05	1.74	0.38	6.65	5.45	10.85
	Sep.	29.0	8.49	360	180.0	612	87.0	182.5	17.5	19.0	1.45	0.65	6.95	3.25	16.90
Minimum		15.5	7.60	330	26.0	458	84.5	91.5	14.5	11.05	0.52	0.38	6.0	3.25	10.85
Maximum		31.5	8.70	1060	200.0	675	148.9	215.6	48.5	29.75	1.74	4.6	8.53	12.00	26.80
Mean		25.38	8.28	601.25	83.58	564.58	111.48	173.92	26.88	22.25	0.82	1.26	7.45	7.71	21.2

Where: W.T. = Water Temperature, Con. = Conductivity, Tur. = Turbidity, T.D.S. = Total Dissolved Solids, T.H. = Total Hardness, T.A. = Total Alkalinity, Cl = Chloride
 SO₄ = Sulphate, PO₄ = Phosphate, NO₃ = Nitrate, D.O. = Dissolved Oxygen, B.O.D. = Biochemical Oxygen Demand, C.O.D. = Chemical Oxygen Demand.

Total Alkalinity (T.A.) value was found in between 215.6 mg/l and 91.5 mg/l while average value was 173.92 mg/l. T.A. of the Yamuna water was more than 100 mg/l in most of the time of study span thus it was suitable for fish culture [18]. Chloride (Cl) was varied from 14.5 mg/l to 48.5 mg/l and mean value was 26.88 mg/l. Recorded Sulphate (SO₄) range was 11.05 mg/l to 29.75 mg/l. The average value of recorded sulphate was 22.25 mg/l. Phosphate (PO₄) of Yamuna water was in the range of 0.52 mg/l to 1.74 mg/l. Average value of recorded phosphate was 0.82 mg/l. Nitrate (NO₃) was recorded in range of 0.38 mg/l to 4.60 mg/l and average value was 1.26 mg/l. The value of Dissolved Oxygen (D.O.) was ranged from 6.00 to 8.53 mg/l. Average value of recorded D.O. was 7.45 mg/l. During study period, recorded D.O. range in the Yamuna water was good for fish culture. Biochemical Oxygen Demand (B.O.D.) was recorded in between 3.25 mg/l to 12.00 mg/l and average value of 7.71 mg/l. Recorded B.O.D. was also satisfactory for fish growth and survival in most of the time of study period. Chemical Oxygen Demand (C.O.D.) of the Yamuna water was varied in between 10.85 mg/l to 26.80 mg/l. The average value of recorded C.O.D. was 21.2 mg/l. It was also under the limit for fish growth and reproduction.

3.2. Fishes

29 species of fishes have been recorded and identified in present study in Kalpi stretch of the Yamuna (Table no- 2 and photo no. 1- 23). 58 taxa of fishes in river Yamuna at Chilla (Banda, U.P.) reported in his study [19]. IIT_(s), have been recorded 67 species, 51 genus belonging to 23 families in Auraiyya to Allahabad stretch of Yamuna river [20].

Table 2: Recorded and identified Fish species from the river Yamuna at Kalpi stretch. [Source: 9]

	Fish	Species	Local Name	Family
1.	<i>Anabas</i>	<i>testudineus</i>	Kabai/Jalebi	Anabantidae
2.	<i>Barilius</i>	<i>barna</i>	Ghilra	Cyprinidae
3.	<i>Catla</i>	<i>catla</i>	Catla/Bosa/Bhakur	Cyprinidae
4.	<i>Chagunius</i>	<i>chagunio</i>	Chhagau	Cyprinidae
5.	<i>Channa</i> <i>Channa</i> <i>Channa</i>	<i>gachua</i> <i>marulius</i> <i>punctatus</i>	Girai/Bilaua Padam saur Sauri/Gurrie	Channidae Channidae Channidae
6.	<i>Cirrhinus</i> <i>Cirrhinus</i>	<i>mrigala</i> <i>reba</i>	Nain/Mrigla Raiya/Lahkariya	Cyprinidae Cyprinidae
7.	<i>Clarias</i>	<i>batrachus</i>	Mangur	Clariidae
8.	<i>Cyprinus</i>	<i>carpio</i>	Common Carp	Cyprinidae
9.	<i>Esomus</i>	<i>danricus</i>	Anjiara	Cyprinidae
10.	<i>Eutropiichthys</i>	<i>vacha</i>	Bachuwa	Schilbeidae
11.	<i>Heteropneustes</i>	<i>fossilis</i>	Singhi	Heteropneustidae
12.	<i>Hypophthalmichthys</i>	<i>molitrix</i>	Silver Carp	Cyprinidae
13.	<i>Labeo</i> <i>Labeo</i> <i>Labeo</i> <i>Labeo</i>	<i>bata</i> <i>calbasu</i> <i>gonius</i> <i>rohita</i>	Bata Karaunt/Calbasu Khursa Rohu	Cyprinidae Cyprinidae Cyprinidae Cyprinidae
14.	<i>Mastacembelus</i>	<i>armatus</i>	Bam	Mastacembelidae
15.	<i>Mystus</i> <i>Mystus</i>	<i>tengara</i> <i>seenghala</i>	Chhota tengra Tengan	Bagridae Bagridae
16.	<i>Notopterus</i> <i>Notopterus</i>	<i>chitala</i> <i>notopterus</i>	Chital/Moya Patra	Notopteridae Notopteridae
17.	<i>Ompok</i>	<i>bimaculatus</i>	Pabda/Jalkapoor	Siluridae
18.	<i>Oxygaster</i>	<i>bacaila</i>	Chelhua	Cyprinidae
19.	<i>Puntius</i>	<i>sarana</i>	Putiyah/Khabda	Cyprinidae
20.	<i>Rita</i>	<i>rita</i>	Rita	Bagridae
21.	<i>Wallago</i>	<i>attu</i>	Parhin/Lanchi	Siluridae

Fish species like *Anabas testudineus* (Kabai/Jalebi), *Catla catla* (Catla), *Channa marulius* (Padam saur), *C. punctatus* (Saurri/Gurrie), *Cirrhinus mrigala* (Nain/Mrigla), *Eutropiichthys vacha* (Bachuwa), *Labeo bata* (Bata), *L. calbasu* (Karaunt/Calbasu), *L. rohita* (Rohu), *Mastacembelus armatus* (Bam), *Mystus seenghala* (Tengan), *Notopterus chitala* (Chital/Moya), *N. notopterus* (Patra), *Oxygaster bacaila* (Chelhua), *Rita rita* (Rita), *Wallago attu* (Parhin/Lanchi) were common to most common while *Chagunius chagunio*, *Channa gachua*, *Clarias batrachus*, *Cyprinus carpio*, *Heteropneustes fossilis*, *Hypophthalmichthys molitrix* and *Mystus tengra* were rare and *Barilius barna*, *Cirrhinus reba*, *Esomus danricus*, *Labeo gonius*, *Ompok bimaculatus* and *Puntius sarana* were very rare during study period. Fishes from the family Cyprinidae dominates the other variety of fish species.

Photographs of recorded and identified fishes in the Yamuna river at Kalpi (Study Area)





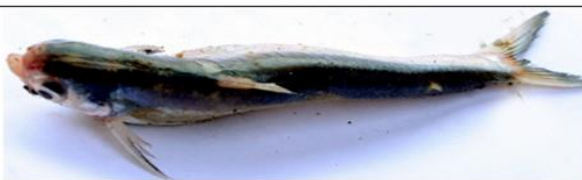







 <p>Photo No.1: <i>Anabas testudineus</i> (Kabai/Jalebi)</p>	 <p>Photo No. 2: <i>Catla catla</i> (Catla/Bhakur)</p>
 <p>Photo No. 3: <i>Chagunius chagunio</i> (Chhagau)</p>	 <p>Photo No. 4: <i>Channa marulius</i> (Padam saur)</p>
 <p>Photo No. 5: <i>Channa punctatus</i> (Sauri/Gurrie)</p>	 <p>Photo No. 6: <i>Cirrhinus mrigala</i> (Nain / Mrigla)</p>
 <p>Photo No. 7: <i>Clarias batrachus</i> (Mangur)</p>	 <p>Photo No. 8: <i>Esomus danricus</i> (Anjiara)</p>
 <p>Photo No. 9: <i>Eutropiichthys vacha</i> (Bachuwa)</p>	 <p>Photo No. 10: <i>Heteropneustes fossilis</i> (Singhi)</p>
 <p>Photo No. 11: <i>Hypophthalmichthys molitrix</i> (Silver carp)</p>	 <p>Photo No. 12: <i>Labeo bata</i> (Bata)</p>



Photo No. 13: *Labeo calbasu* (Karaunt/calbasu)



Photo No. 14: *Labeo rohita* (Rohu)



Photo No. 15: *Mastacembelus armatus* (Bam)



Photo No. 16: *Mystus tengara* (Chhota tengra)



Photo No. 17: *Mystus seenghala* (Tengan)



Photo No. 18: *Notopterus chitala* (Chital/Moya)



Photo No. 19: *Notopterus notopetrus* (Patra)



Photo No. 20: *Puntius sarana* (Khabda)



Photo No. 21: *Oxygaster bacaila* (Chelhua)



Photo No. 22: *Rita rita* (Rita)



Photo No. 23: *Wallago attu* (Parhin/Lanchi)

4. Conclusion

Survival and growth of fishes in the Yamuna river is depend totally upon its physicochemical parameters. Physicochemical parameters like W.T., pH, Conductivity, T.D.S., T.H., T.A., Cl, SO₄, PO₄, NO₃, D.O., were found always under the limit while Turbidity, B.O.D. and C.O.D. found mostly suitable for fish survival and good reproduction rate. Thus physicochemical quality of the Yamuna water in study area was fit for fish diversity, growth, reproduction and fish cultivation during study period. To improve water quality of the river, stop pollution creating activities like throwing of solid wastes and garbage, discharge of municipal sewage, discharge of industrial effluents, mass bathing, cattle bathing, immersion of idols, cremation of dead bodies in nearby areas and agricultural runoff. Periodic survey and follow up programme are also recommended to sustain pristine water quality of the holy river Yamuna.

Compliance with ethical standards

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Disclosure of conflict of interest:

Nil

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