

Fish Diversity and their Limnological Status of River Yamuna at Kalpi, U.P., India

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Abstract: We explore fish diversity and limnological status in the Yamuna River in Kalpi district, Uttar Pradesh, India. Several industrial and urban centers sit on the banks of the Yamuna in Uttar Pradesh. We selected four sampling stations on the Yamuna for purposes of fish fauna and water quality analysis over the course of a calendar year (October 2013 – September 2014). The samples were analyzed for selected physico-chemical analysis, and we recorded the types of fishes as well. We observed that most physico-chemical parameters were in a suitable range for the survival and growth of fish fauna. We recorded 29 species of fishes, belonging to 21 genera of 10 families.

Keywords: Limnological status, physico-chemical parameters, fish diversity, Kalpi, Yamuna

Introduction

Yamuna, the largest tributary of the Ganga River, is among the most polluted in the world due to heavy population and industrial plants on its banks. Pollutions from these two groups precipitate changes in the Yamuna's waters in terms of pH, turbidity, Total Dissolved Solids, Dissolved Oxygen, and Biochemical Oxygen Demand (BOD). Fishes in the Yamuna are strong indicators of pollution levels. By tracking changes in fish growth and reproduction rates, we can learn more about changes in the physico-chemical characteristics of the water.

Fishes constitute an economically significant group of aquatic animals due to their importance in providing food to riverine communities and urban centers. As a food, fishes provide a wide range of nutritional gains, including protein, fat, vitamins A, D & E, and phosphorus. The fishing industry produces by-products to support several related industries including fish meal, fish protein, manure, shagreen, isinglass, glue, and other products.

Because India's population continues to rise rapidly, at least a twofold increase in fish production within the next few years is projected as necessary. However, riverine fisheries are currently in decline to meet this need. So, in order to produce more fish, it is now more necessary than ever to study fish fauna, its food ecology, and its limnological status. Considering the importance of fresh water resources in inland fishery, numbers of studies have been conducted such as Grover and Gupta (1977) Sreenivasan (1979). The Hydro-biological features of primary production and fisheries of Sardar Sagar, Mishra and Moza (1997, 1998), Mishra and Moza (2001), Moza and Mishra (2001) Kanwate and Kulkarni (2006), Bhalerao (2012).

Collectively, these studies provide a broad cross-section of fish life on the Yamuna, but they do not account for the physico of the water as we will account for in this study.

Objectives

The objective of the present study is to assess the physico-chemical characteristics of river Yamuna at Kalpi to understand its impact on fish fauna. As well, we will collect and identify fish fauna at this point in

the river.

Material and Methods

Study area: Kalpi is an historical city in the district Jalaun of Uttar Pradesh in India. It is located in between Jhansi and Kanpur on NH-25, 30 kilometers away from district headquarters Orai. It lies on the southeast bank of Yamuna and falls at 260 7' 14" N latitude to 790 44' 59" E longitude with an average elevation of 112 meters. Our observation area is a five kilometer stretch of Yamuna from Vyas Mandir to the raid drain opening downstream. See figures 1 for an illustration of the study area.

Sampling and Analysis: We used four sampling stations named as follows:

- S1 - Vyas Mandir
- S2 - Kila Ghat
- S3 - Peela Ghat
- S4 - Near raid drain opening

Over the study area, four drains opened into the Yamuna and were named as follows:

- D1 - Jondhar drain
- D2 - Small drain
- D3 - Sua Baba drain
- S4 - Raid drain

We collected monthly samples for one year, from October 2013 to September 2014. Collected samples were properly packed in plastic bottles and transported to laboratory in the same day to avoid any changes in Physico-chemical parameters.

For analyzing parameters, we employed standard methods as used in APHA (2005) and Trivedi and Goel (1986).

Thermometers were used to record water temperature, while pH was measured using a pH pen at the sampling site. All other parameters-conductivity, turbidity, total dissolved solids (TDS), total hardness (TH), total alkalinity (TA), chlorides (Cl), sulphates (SO₄), phosphate (PO₄), nitrates (NO₃), dissolved oxygen (DO), biochemical oxygen demand (BOD), and chemical oxygen demand (COD) were determined in the laboratory.

We collected fishes using nets of varying mesh size to insure we gathered a full range of species from the various sampling sites. We identified the fish fauna at the sites, using Talwar and Jhingran (1991) and Jayram (2010) as guides for identification.

Result and Discussion

The observed physico-chemical parameters were tabulated and analyzed to understand the characteristics of water. Simultaneously, the fish fauna were also observed and identified and we explored possible correlations those water characteristics and the fish species (i.e., limnological status and productive capacity).

Physico-chemical parameters: The recorded average of selected physico-chemical parameters of our four sampling sites is presented in Table 1 below.

Water temperature: A maximum temperature (31.50 C) was recorded in June and minimum temperature (15.50 C) in month of January, for an average temperature of 25.380 C. As fishes require moderate temperature for growth and reproduction, the temperatures were found suitable for the survival and growth of fish fauna (Khanna and Bhutani, 2007).

pH: The pH value ranged from 7.60 to 8.70. The maximum pH value (8.70) was recorded in June and the minimum (7.60) in January with average value 8.28. The pH of Yamuna river was alkaline in nature, which is a good indicator for fish survival (Khanna et al., 2013).

Conductivity: Conductivity of the Yamuna water ranged from 330 $\mu\text{S}/\text{cm}$ to 1060 $\mu\text{S}/\text{cm}$ during our study period. The minimum conductivity was recorded in August and the maximum in June for an average value of 601.25 $\mu\text{S}/\text{cm}$.

Turbidity: Turbidity values ranged from 26.0 to 200 NTU. The minimum value of turbidity was recorded in February and maximum value in August. The mean value of turbidity was 83.58 NTU. Overall, the turbidity

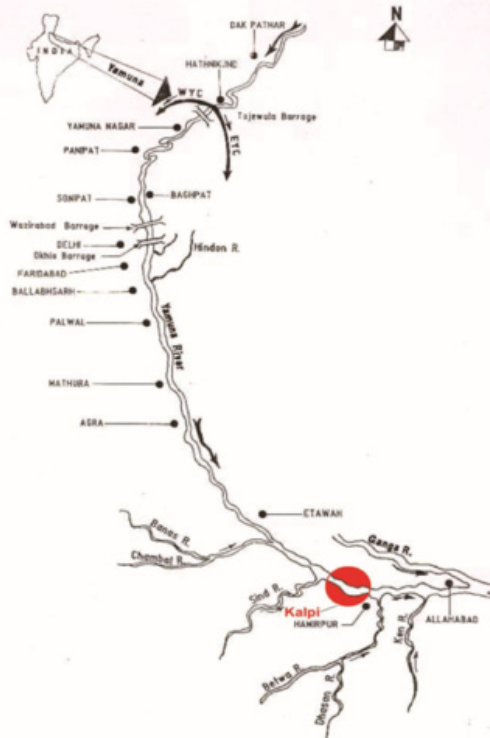


Figure 1: Map of the Yamuna and location of Study Area (Kalpi)

Period Oct. 2013 to Sep. 2014		Physico-chemical Parameters													
Sea- son	Mon.	Wt. (OC)	pH	Con. mS/ Cm	Tur. NTU	T.D.S mg/L	T.H. mg/L	T.A. mg/L	Cl mg/L	SO4 mg/L	PO4 mg/L	NO3 mg/L	D.O. mg/L	B.O.D mg/L	C.O.Dmg/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 Sea- son	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

Table 1: Average of all selected Physico-chemical Parameters of Yamuna River.

of the Yamuna stayed under the limits that would prevent fish growth and reproduction.

Total Dissolved Solid (TDS): The value of total dissolved solids in the Yamuna near Kalpi ranged from 458 to 675 mg/l. The minimum TDS levels were recorded in January and the maximum values in August for an average value of 564.58 mg/l.

Total Hardness (TH): Recorded total hardness of the Yamuna river water ranged between 84.5 mg/l (minimum) to 148.9 mg/l (maximum). Minimum hardness was recorded in August and maximum hardness in June. The average recorded hardness was 111.48 mg/l.

Total Alkalinity (TA): Maximum value (215.6 mg/l) of total alkalinity was recorded in June and the minimum value (91.5 mg/l) in January for an average value of 173.92 mg/l. Alikunhi (1957) reports that in highly productive water, the alkalinity ought to be higher than 100 mg/l. As the Yamuna was higher than that level for most of the year, it was suitable for productive fish cultures in terms of alkalinity.

Chloride (Cl): Chloride ranged from 14.5 mg/l to 48.5 mg/l for a mean value of 26.88 mg/l over the study period. Minimum chloride value was recorded in August and maximum in May.

Sulphate (SO₄): Minimum sulphate levels (11.05 mg/l) were recorded in August while maximum (29.75 mg/l) levels occurred in June. The average value of recorded sulphates was 22.25 mg/l.

Phosphate (PO₄): Phosphate levels in the Yamuna ranged from 0.52 mg/l (in January) to 1.74 mg/l (in August). Average value of recorded phosphates was 0.82 mg/l.

Nitrate (NO₃): Nitrates ranged from 0.38 mg/l (in August) to 4.60 mg/l (in June) for an average value of recorded nitrate was 1.26 mg/l.

Dissolved Oxygen (DO): The value of dissolved oxygen ranged from 6.00 to 8.53 mg/l. Minimum value of DO was recorded in June and maximum value in January. Average value of recorded DO for the observation period was 7.45 mg/l. This average is positive for a healthy fish culture.

Biochemical Oxygen Demand (BOD): Maximum value (12.00 mg/l) of biochemical oxygen demand was recorded in June and minimum value (3.25 mg/l) in September for an average value of 7.71 mg/l. Recorded BOD was also satisfactory for fish growth and survival on this stretch of the Yamuna.

Chemical Oxygen Demand (C.O.D.): The chemical oxygen demand of the Yamuna ranged from 10.85 mg/l (August) to 26.80 mg/l (June). The average value of recorded COD was 21.2 mg/l.

Fish Fauna: In the present study, we have recorded 29 species of fishes belonging to 21 genera and representing 10 families (see photos 1-23 below).

For comparison's sake consider the following studies: Grover and Gupta (1977) reported 58 taxa of fishes in the Yamuna at Chilla (Banda, U.P.). Alam (2013) reported 13 species of fishes from Yamuna at Kalpi stretch (Jalaun, U.P.). IIT (2012) recorded 67 species and 51 genus belonging to 23 families in the Auraiyya to Allahabad stretch of Yamuna.

We present a table of recorded fish fauna from our research site in Table 2.

	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

Table 2: Recorded Fish fauna from the river Yamuna at all sampling sites in Kalpi.

Fish species like *Anabas testudineus* (Kabai/Jalebi), *Catla catla* (Catla), *Channa marulius* (Padam saur), *C. punctatus* (Sauri/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.



Photo 1: Anabas testudineus (kabil/Jalebi)



Photo 2: Catla catla (Catla/Bhakur)



Photo 3: Chagunius chagunio (chhagau)



Photo 4: Channa marulius (padam saur)



Photo 5: Channa punctatus (Sauri/Gurrie)



Photo 6: Cirrhinus mrigala (Nain/Mrigla)



Photo 7: Clarias batrachus (Mangur)



Photo 8: Esomus danricus (Anjiara)



Photo 9: Eutropiichthys vacha (Bachuwa)



Photo 10: Heteropneustes fossilis (Singhi)



Photo 11: Hypophthalmichthys molitrix (Silver carp)



Photo 12: Labeo bata (Bata) carp



Photo 13: Labeo calbasu (Karaunt/calbasu)



Photo 14: Nabeo rohita (Rohu)



Photo 15: Mastacembelus armatus (Bam)



Photo 16: Mystus tengara (Chhota tengra)



Photo 17: Mystus seenghala (Tengan)



Photo 18: Notopterus chitala (Chital/Moya)



Photo 19: Notopterus notopetrus (Patra)



Photo 20: Puntius sarana (Khabda)



Photo 21: Oxygaster bacaila (Chelhua)



Photo 22: Rita rita (Rita)



Photo 23: Wallaago attu (Parhin/Lanchi)

Conclusion

Fish growth and productivity is highly dependent on the physico-chemical characteristics of the water, and in the Yamuna, we observe that relationship to be true. Most of the parameters were found suitable for fish survival and reproductive multiplication. Thus, the limnological status of fishes in the Yamuna River at our study area was satisfactory during our study period.

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