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Dr. Rajesh Kumar Dubey
Head, Department of Zoology, SSSVS Government P.G. College, Chunar, Mirzapur, Uttar Pradesh, India

Dr. Awadhesh Singh Yadav
Assistant Professor, Department of Zoology, SSSVS Government P.G. College, Chunar, Mirzapur, Uttar Pradesh, India

Corresponding Author:
Dr. Rajesh Kumar Dubey
Head, Department of Zoology, SSSVS Government P.G. College, Chunar, Mirzapur, Uttar Pradesh, India

Limnological study of river Ganga at sindhora ghat with special reference to fish fauna resources

Rajesh Kumar Dubey and Awadhesh Singh Yadav

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Abstract
The river Ganga is the largest river in India and the fifth longest in the world. Although many studies on fish ecology and systematic research have been conducted largely to improve fisheries, fish diversity and their distribution pattern from conservation point of view have never been adequately addressed in the Ganges. In this connection, current distribution and abundance of freshwater fishes of river Ganges was studied. We documented and described freshwater fish species in all stretches of the river at Sindhora ghat which is higher than what was reported earlier. Some species were observed with shifts in their distribution ranges. Alterations of the hydrological pattern due to various types of hydro projects was seems to be the largest threat to fishes of Ganges. Indiscriminate and illegal fishing, pollution, water abstraction, siltation and invasion of exotic species are also threatening the fish diversity in the Ganges and as many as 29 species are listed under threatened category. The study advocates a need to identify critical fish habitats in the Ganga basin to declare them as conservation reserves to mitigate the loss of fish diversity from this mighty large river.
The present study relates to some limnological features in certain physico-chemical factors of river Ganga at Sindhora ghat from August 2023 to July 2024 in relation to percentage frequency of dominant macrophytes

Keywords: River Ganga, freshwater fish diversity, limnological, physico-chemical factors, distribution, fishing gears.

Introduction
River Ganga extending from 22° 18' 6.43" N to 31° 2' 49.31" N and 77° 58' 47.44" E to 88° 30' 37.89" E flows through the heart of the country since its inception covering states like Uttarakhand, Uttar Pradesh, Bihar and West Bengal. It has a total length of 2525 kilometers traversing a long course, emerging from Gangotri through different states and finally drains into the east coast of the country in Bay of Bengal. During its course of flow, the river navigates through a number of growing cities with a population of over 100000. The drainage area in India is 8, 62, 729 Km2 which is nearly 26% of the total geographical area of the country.
Limnology by Welch (1948) is the branch of science which deals with biological productivity of inland waters and with all the causal influences which determine it. Biological productivity includes qualitative and quantitative features and its actual and potential aspects. The aquatic environment in India is subjected to increasing pollution because of increasing industrialization and urbanization. Clean water is necessary not only for drinking purposes but also for the existence and health of aquatic fauna and flora.
Water is an absolute basic need for life, it is called "jeevan" in Sanskrit. First appearance of life has been recorded in an aquatic ecosystem. Water is not only essential for mankind but also equally indispensable for agriculture and industries. The quality of life depends upon the quality and quantity of water available for various needs. Safe and adequate water is not only a public health necessity but also an important infrastructure for economic development.
Water quality includes all physical, chemical and biological factors that influence the beneficial use of water. When fish culture is concerned any characteristic of water that affects the survival, reproduction, growth, production or management of fish in any way, is a water quality variable.

Water quality management forms an integral aspect of aquaculture operations.

Ecologically, river Ganga is a complete assemblage of various spectrums of habitat. The river supports a rich number of fish fauna on which thousands of people depend for their livelihood. But in the recent past, due to constant ecological degradation, man-made hindrances in the river basin there is a noticeable decline in both fish production and productivity. Therefore, it is a need of the hour to conserve and restore the Gangetic ecosystem in a sustainable way which will finally add the biotic components as a whole.

The National Mission for Clean Ganga (NMCG) under the Ministry of Water Resources, River Development and Ganga Rejuvenation is presently monitoring various aspects of the Ganga river system in different states of the country. To conduct study on the fish and fisheries of the Ganga river system the Ministry has financially supported a five year long term initiative with ICAR-Central Inland Fisheries Research Institute, Barrackpore (No: T-17 /2014 15/526/NMCG-Fish and Fisheries Dated 13/07/2015). The project was formally launched on 7th July, 2016 in a launching workshop held at ICAR CIFRI, Barrackpore, West Bengal and its regional center at Allahabad, Uttar Pradesh.

Historical Resume: In recent years deteriorating water quality has drawn the attention of scientists and ecologists. Various aspects of water pollution and its management have been studied by a number of workers. In India Prasad (1916) made the first limnological observation on physico-chemical characteristics governing the pond life in a pond ecosystem in Punjab. Besides, notable contribution in this field are of Allen (1920) [16], Pruthi (1933) [50], Smith and Swingle (1939) [51], Jenkin (1942) [52], Butcher (1946) [53], Chacko *et al.* (1953) [54], Siddiqui (1960) [55], George (1962) [56], Douglas (1965) and George (1969) [57]. Arora *et al.* (1970) [58] established the fact that slight variation in pH, chlorine and total solids will prove extremely toxic to the fish fauna. Toor and Gill (1974) [59] studied the distribution of fishes in relation to hydrobiological conditions of Budhanala.

Verma and Dalela (1975) [60] described the pollution in relation to fish and fisheries. Ali and Khan (1976) [61] performed the comprehensive study on the diurnal variations in some of the physico-chemical and biological parameters of three ponds at Aligarh. Sharma *et al.* (1978) [62] described the effect of temperature, pH and Co2 on phytoplankton and zooplankton.

Chakrabarti and Gupta (1981) [63] mentioned that Yamuna river has the poorest quality from the point of its confluence with Najafgarh drain to a point about 4 km. downstream between Wazirabad Berraj and the old Yamuna bridge. Similarly, Prakash and Rawat (1981) [64] reported high organic pollution (approxi. 160 millions liter of waste water per day) in river Yamuna at Agra in a 12 Km stretch.

Physico-chemical and biological properties of some ponds of Varanasi were studied by Sikandar and Tripathi (1985) [65]. Rana *et al.* (1985) [66] revealed high value of BOD, chlorides, amount of organic matter and different limnological factors and stated that it resembles the other high altitude oligotrophic lake. Nikolaev (1986) [67] observed ecological consequences of artificial changes in lake water regime and their prognostic significance.

Sangu *et al.* (1987) [68] made an observation on the hydrobiology of river Ganga at Garhmukteshwar. Kudesia (1988) [69] investigated physico-chemical characteristics of Ganga at Farrukhabad. Singh (1989) [70] monitored deterioration in the river Subarnarekha.

Tilwankar *et al.* (1989) [71] observed that certain factors (?) (dilution, pH, temp.) affect the BOD kinetics in water. Bharti and Krishnamurthy (1990) [72] studied deterioration in water quality of river Kali near Dandeli. While, Israily (1990) [73] gave an critical overview of the problem of waste in major Indian rivers and other water bodies flowing in western U.P.

Total pollution load was calculated 16774.52 metric tons, comprising 6322 million gallons waste water, 330 tons ofBOD together with 125 kg metallic and nonmetallic toxicant, are releasing per day into these rivers from 18 sugar, 7 textile, 10 pulp and paper, 3 rubber and plastic, 15 chemical manufacturing and 11 metal and nonmetal processing industries of western U.P.. Upadhyay and Rana (1991) [74] found excess chloride to be the best parameter for determining the extent of pollution in the river system.

Materials and Methods

Sindhora ghat is situated in between district Mirzapur and Varanasi at Saraiya Kamarghata sindhora village. Sindhora is a village in Pahari block in Mirzapur district of Uttar Pradesh state, India. It belongs to Mirzapur division. It is located 29 km towards East from district headquarters Mirzapur, 13 km from Pahari Bhojpur, 31 km from state capital Lucknow.

Sindhora Pin code is 231304 and postal head office is Chunar Tehsil.Biththalpur (3 KM), Saraiya Kamar Ghata (3 KM), Shilpi (3 KM), Sagar Semar (3 KM), Samas Pur (4Km) are the nearby Villages to Sindhora. Sindhora is surrounded by Pahari Block towards west, Majhawa Block towards North, Narainpur Block towards East, Arajiline Block towards North. Mirzapur, Varanasi, Shahganj, Robertsganj are the nearby Cities to Sindhora.

For analysis of chemical factors, samples in (triplicate) were collected from surface water from fixed spots of the river Ganga at Sindhora ghat at monthly intervals, from (9.00 AM to 12.00 Noon). The values incorporated in the tables are average values. Amongst The physical factors, the water temperature was recorded by a 0-100 degree celsius through thermometer.

Entire course of investigation is divided into following subheads-:

1. Survey of the site
2. Collection of water samples.
3. Physical analysis of water sample
4. Chemical analysis of Water sample
5. Biological analysis of water sample
6. Determination of LC50 value

Survey of the Site

Collection of water samples

The collection of the sample was done very carefully as all interpretations are based on the analysis report. The water samples were collected monthly at random, in 200 ml. plastic bottles, previously rinsed with river water. The samples for the analysis of dissolved oxygen were collected separately in 300ml. narrow mouthed flat stoppered bottles and preserved immediately by adding 2ml. each of alkaline potassium iodide and manganous sulphate (Mnso4) solution, through a pipette dipping below the water surface to arrest the microbial activities. For The biological examination the samples were collected in sterilized neutral glass stoppered 250 ml. bottles. The stopper was protected by a parchment paper as recommended by water sampling instructions. All samples were collected from the depth of 1 -2 feet of water surface.

Physical analysis of water sample

The water samples were analyzed for various physico-chemical parameters by following standard methods (APHA-1986).

Physical Parameters

1. Colour: The colour of water at Sindhora ghat was observed by visual appearance only
2. **Odour:** The odour is also realized by simply smelling the water at sampling stations.
3. **Temperature:** Water Temperature was noted in degree-centigrade by an ordinary thermometer at each site.
4. **Turbidity:** The turbidity of water was estimated by Peterson's turbidity meter at each site and expressed in mg/1.

Chemical analysis of the water sample

Chemical Parameters

Hydrogen Ion Concentration (pH value)-:

This was determined by means of BDH narrow range pH stripes, immediately after sample collection. To confirm the results, pH was measured by the digital portable kit apparatus (pH meter).

Total Alkalinity

The amount of acid required to titrate the bases in water is a measure of alkalinity of water. A number of bases occur in water but total alkalinity results primarily from bicarbonates and carbonates.

100 ml of water, sample after adding 2-3 drops of phenolphthalein indicator was titrated against N/50 H2So4, till the pink colour disappeared. The amount of acid used gave the value of carbonates.

To determine the bicarbonates methyl orange indicator (2-3 drops) was added to the same beaker and the titrant (N/50 H2So4) was mixed, till the end point reached. The total amount of acid so used, gives the amount of bicarbonates in the sample.

Total alkalinity (mg/L) = T x N x 50000/S
Where T = Volume in ml of H2So4
N = Normality of H2So4
S = Volume in ml. of sample

Dissolved oxygen (DO)

Oxygen was estimated by Winkler's method. Previously preserved water sample bottles were thoroughly shaken and the precipitate already present was allowed to settle down. To dissolve the precipitate, 2ml concentrated sulphuric acid was added to the bottle and it was again well shaken to mix the contents.

100 ml of this solution was titrated with N/80 sodium thiosulphate using starch as an indicator.

Biological oxygen demand (BOD)

For determination of BOD 1000 ml of sample water was bubbled in a glass container by compressed air in distilled water for 30 minutes to prepare dilution, to which was added 1ml of each phosphate buffer, magnesium sulphate, calcium chloride and ferric chloride solution. It was mixed thoroughly. Afterwards it was neutralized to pH 7.0 (Appx.) by using 1 NH2So4. Dilution ranges were prepared in a bucket by mixing the contents thoroughly and filled in 2 sets of BOD bottles. One set of bottles was placed in a BOD incubator at 20°C for 5 days and after that fixed period the DO contents were analysed while the oxygen contents in another set were determined immediately.

The BOD was calculated by the formula
BOD5 (mg/L) = (D0-D5) x dilution factor.

Chemical oxygen demand (COD)

20 ml of sample was shaken in a 250 ml COD flask (Erlenmeyer's flask) with a ground joint for Liebig's reflux condenser, to which was added 10 ml of 0.025 N Potassium dichromate solution. In this sample a pinch of Ag2So4, Hg-So4 and 30 ml of H2So4 was added then it was refluxed for two hours in a water bath after which flask was removed and was kept for cooling for 2-3 hours. Now distilled water was mixed in it to make the final volume to about 140 ml. Before titrating it with 0.1 N ferrous ammonium sulphate, 2-3 drops of ferroin indicator (end point, blue green —» reddish brown) were mixed thoroughly. A blank was run with distilled water, using the same quantity of chemicals.

COD was calculated by the following formula

COD (mg/ L) = (A-B) x N x 8000/ml. of Sample
Where A = ml. of FAS used for blank
B = ml. of FAS used for sample
N = Normality of FAS

Total suspended solids (T.S.S.)

The T.S.S. were calculated by the following formula -
T.S.S. (mg/L) = T.S.-T.D.S.

Total dissolved solids (T.D.S.)

An evaporating dish was taken and weighed. Now the filtered sample (250ml) was evaporated in the dish on a water bath and the final weight was recorded.

TDS were calculated by the formula

T.D.S. (mg/L) = (A-B) x 1000/V
where A = Final weight of dish in mg.
B = Initial weight of dish in mg.
V = Volume of sample taken in ml.

Total solids (T.S.)

Total solids were determined as the residue left after evaporation of unfiltered samples. For determination of total solids an evaporating dish (silica) of suitable size was taken and weighed. The Unfiltered 250ml of the sample was evaporated in this dish on a water bath and the final weight taken.

The T.S. were calculated by the formula

Total solids (mg/L) = (A-B) x 1000/V
Where A = Final weight of dish in mg.
B = Initial weight of dish in mg.
V = Volume of sample taken in ml.

Chlorides

Chlorine as chlorides was estimated according to Mohr's method.

100 ml sample water was titrated with N/35.5 silver nitrate, using 5% potassium chromate as indicator.

Nitrate

Nitrate reacts with phenoldisulfonic acid to form a nitro-derivative which in alkaline medium develops a yellow colour. The concentration of No3 was determined colorimetrically, since the colour so formed obeys the Beer's law.

50 ml of silver sulphate solution was added to 50ml. of sample water to remove chlorides. This mixture was heated slightly so that precipitate of AgCl appeared. Filtrate was

evaporated in a porcelain basin and cooled residue was dissolved in 2 ml phenol disulphonic acid and diluted the content upto 50 ml. 6 ml of liquid ammonia was added to this solution to get yellow colour. Finally the reading was taken at 41O nm. and concentration of nitrate nitrogen was calculated from the standard curve.

Biological analysis of the water sample

To study planktons, all glassware is made neutral. The glassware was cleaned first with hot water and soap then with tap water and finally with distilled water. To sterilize them all glassware was passed through Bunsen flame. The plankton study was made by concentrating the samples of water and wastewater. They were preserved in 5% formalin and the count was made in the sedgwick rafter counting cell.

The quantity was calculated with help of a formula given below

n = (a x 1000*)* C / L

Where n = The number of plankton per litre of original water.

a = The average number of plankton in all counts in a counting cell of 1 cu.mm. Capacity..

c = The volume of original concentration filtered in ml.

L = The volume of original water filtered, expressed in litre.

Bioassay studies

For The determination of toxicity ranges and LC50 value, bioassay procedures, as given in " Standard Methods " in the chapter " Toxicity to fish " were followed. The experimental fishes Labeo rohita, Catla catla, Cirrhina mrigala and Cyprinus carpio ranging 10-12 cm. in length were collected from river Ganga at Sindhora ghat, Mirzapur District. Firstly the fishes were observed for pathological symptoms and then placed in 0.1% solution of potassium permanganate (KMN04) for about 15 minutes so as to avoid any dermal infection. The fishes were then rinsed in freshwater and acclimated to the laboratory conditions in a 200 litres capacity glass aquarium, for two weeks. Every effort was made to provide optimum conditions of survival to the fishes. If mortality occurs under these conditions, dead fishes were immediately removed with the fear that such mortality may deplete dissolved oxygen, with resultant effect on the survivability of other fishes. DO and pH of the experimental solution were measured after every 24 hours. The fishes were fed upon the commercial fish food. The holding tanks were periodically cleaned to remove the metabolic wastes, unconsumed food and any other phytoplankton developed.

Determination of LC50 value

A group of 20 previously acclimatised fish of each species were transferred in each experimental container having a different concentration of brood pond water, together with a controlled set. Fishes were transferred with the help of small hand nets so as to avoid the possibility of any mechanical injury. Any food material was not provided to the fishes before 48 hours of experimentation and during the experiment period, to avoid any change in the toxicity of the chemicals by excretory matters. One set with normal water was also maintained side by side with an equal number of fishes. Zero percent mortality was noted in the set even after 96 hours.

The LC50 values for 24, 48, 72 and 96 hours were obtained by interpolation of concentrations and survival percentage on a graph paper. Survival percentages were plotted on the Y axis while the concentrations were plotted on the X axis of the graph. LC50 value was determined at 50% mortality value.

Physico-chemical characteristics of River Ganga at Sindhora ghat

Physico-chemical properties of River Ganga are different in different months at Sindhora Ghats -

Temperature

It is the important factor which influences the chemical, biochemical and biological characteristics of the aquatic system.The present investigation reveals that the temperature varied from a minimum 20.1±1.4 c in January to maximum 33.8±1.4 in June. The Temperature values were significantly higher in April to July and lower in October to December.

pH

The pH value of the water is found in the alkaline range of 7.10-9.18. The adverse effect of most of the acids appear below 5 and of alkalis above the pH 9.5.The pH values were significantly higher in March to May and September, November and December with the highest value 9.18 in January.

Acidity

The component of acidity in natural waters is Carbon dioxide. The Acidity values ranged from a minimum of 55.5 mg CaCO3/L to maximum of 69.3 mg CaCO3/L. A sharp increase in acidity in May and June may be attributed to the high temperature and therefore high microbial activities or discharge of some acidic substances.

Alkalinity

A variation in alkalinity values were recorded as a minimum of 260 mg CaCO3/L in June and a maximum of 310 mg CaCO3/L January.

Dissolved Oxygen
Temperature plays an important role in determining DO in an aquatic body. In the system where rate of respiration and organic decomposition are high,the DO values remain lower than those of system where the rate of photosynthesis is high.A high pollution load may also decrease the DO values to considerable level.The DO values range from a minimum of 2.2mg/L in June to maximum of 9.8mg/L in January. Lower DO values during summer may be attributed to the high temperature and its consumption due to high growth and activities of microorganism.

Biological Oxygen demand
It has been used as a measure of the amount of organic materialism and aquatic solution which support the growth of microorganism.The BOD values range from 1.9mg/L in January to a maximum of 87.5mg/L in June. Usually higher BOD values in summer and lower in the rainy season were recorded.

Chemical Oxygen demand (COD)
It determines the amount of oxygen required for chemical oxidation of organic matter using a strong chemical oxidant such as potassium dichromate under reflux conditions. The minimum COD values of 5.9mg/L in January and maximum of 170.5mg/L.

Chloride
Chloride is one of the major inorganic anions in water and waste water. The chloride written shows variation with a range of 8.2 in July to 81.5mg/L in February.The Chloride values remain higher in the rainy season.

Electrical conductance
Electrical conductance is reciprocal to electrical resistance and G values show total ion per cm.It is a numerical expression of the ability of a water sample to carry an electric current. The value ranged from a maximum of 843µs in January to minimum of 185µs in July.

Nitrate
It represents the end product of oxidation of Nitrogenous matter and its concentration may depend on the nitrification and denitrification activities of microorganisms. The concentration of microorganisms ranged from 0.015 mg/L to 0.985 mg/L. The recorded values were significantly higher in July to Sep and Jan.

Phosphate
Phosphate is an important plant nutrient and plays a role of limiting factor among all other plant nutrients so its determination is useful.The value of Phosphate varies from minimum of 0.005mg/L in January to maximum of 1.58mg/L in June.

Light penetration
The value of light penetration is low during summer and monsoon months (May and July). It increases and attains its maximum value in the month of April.

Biological characteristics of River Ganga at Sindhora ghat
Biological communities of fresh water bodies comprise the phytoplanktons, zooplanktons and macrophyte populations. A list of phytoplanktons and zooplanktons encountered during the study in river Ganga are given below -

Phytoplankton
The phytoplankton population in river Ganga displayed a bimodal pattern of fluctuation and the blue-green algae played a dominant role throughout the period of the present study. The pattern of fluctuation in the yield of total plankton mainly depends upon the phytoplankton. The chief groups of phytoplankton found in river Ganga were Cyanophyceae, Dinophyceae, Bacillariophyceae and Chlorophyceae. The other forms were also available but in negligible quantities.
List of Planktons Encountered -

Cyanophyceae
1. Microcystis aeruginosa 2. M. flos-aquae 3. Anabaena spiroides 4. A. cylindrica 5. Anabaenopsis sp. 6. Coelosphaerium kuetzinginum 7. Trachelomonas inconstans 8. T. hispida 9. Oscillatoria planktonica 10. O. splendida 11. Rivularia sp.

Dinophyceae
Ceratium hirundinella

Bacillariophyceae
1. Fragilaria sp. 2. Diatoma sp. 3. Synedra ulna 4. Synedra qffinis 5. Tabellaria sp. 6. Gomphonema sp. 7. Navicula sp. 8. Pinnularia sp. 9. Cymbella sp. 10. Nitzschia sp.

Chlorophyceae
1. Pediastrum simplexe 2. P. duplex 3. Actinastrum sp. 4. Closterium dianal 5. C. moniliformes 6. C. venus 7. Eudorina sp. 8. Pleodorina sp. 9. Pandorina sp. 10. Volvox sp.11. Mougeotia sp.

Zooplankton
Zooplankton formed a meager percentage of the total plankton population The data revealed that zooplankton exhibited two pulses, a major in December and a minor one in April. The zooplankton mainly consisted of Rotifera, Copepoda and Cladocera, among them the Rotifera dominated

their population. Protozoa and aquatic insects also appeared in large numbers.

List of Zooplankton encountered

Rotifera

1. Brachionus angularis 2. B. forficula 3. B. caudatus 4. B. calyciflorus 5. Keratella tropica 6. K. procurva 7. Monostyla sp. 8. Lecane stichaea 9. L. hamata 10. Filinia longiseta 11. Asplanchna sp. 12. Polyarthra vulgaris

Copepoda

1. Mesocyclops leuckarte 2. M. vidus 3. Heleodiaptomus sp. 4. Phyllodiaptomus sp.

Cladocera

1. Daphnia sp. 2. Ceriodaphnia cornuta 3. Chydorus sp. 4. Alonella sp. 5. Bosmina sp. 6. Sida sp. 7. Simocephalus sp.

Macrophytic Vegetation

The Macrophytic vegetation of the river Ganga comprises members of free floating, attached floating, submerged and attached emerged communities.

The free floating community is represented by Eichhornia crassipes, Azolla pinnata and Spirodella polyrhiza,Pistia stratiotes, Trapa bispinosa and the species of, Salvinia, Hygrorhiza, Nymphaea and Nymphoides.

The attached floating community includes Nymoholdes cristatum,Trapa bispinosa and Nelumbium speciosum.

The submerged community is represented by Hydrilla verticillata, Naja minor, Naja graminea, Potamooeton crizpus, P.indicum and vallisnaria spiralis, Aponogeton, Sagittaria, Nelumbium and Utricu.

The emergent vegetation included the species of Typha, Oryza, Eleocharis and Lyrix.

The marsh plants comprised Ipomoeafistulosa, Jussiaea repens and Ipomoea aquatica.

The dominant macrophytes of these communities are Hydrilla Major, H. verticillata. Naja minor and ceratophyllum demersum respectively.

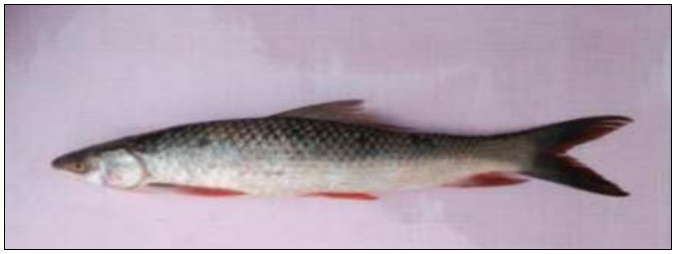
The water temperature seems to retard the growth of H. verticillata to some extent. The high value of transparency during the winter months favours the spread of H. verticillata but its low value in summer retards its growth as it restrains light penetration.

Fish Biodiversity of River Ganga at Sindhora Ghat

Salient identifying characters of selected fishes (Indian Major Carps) from the Ganga river system-

Species: Labeo rohita

1. Snout obtuse, mouth small and inferior.
2. Lips thick and fringed with a distinct inner fold to each lip.
3. Branched dorsal rays 12 to 14 (total dorsal fin rays 15 to 18).
4. Lateral line scales 40 to 44.
5. One pair of small, thin maxillary barbels concealed in lateral grooves.



Species: Gibelion catla

1. Body deep, head enormously large.
2. Mouth upturned and upper lip absent.
3. Barbels absent.
4. Dorsal fin with 17-20 fin rays (14 to 16 branched rays).
5. Scales large, lateral line with 40 to 43 scales.

Species: Cirrhinus mrigala

1. Body streamlined.
2. Lower lip indistinct.
3. One pair of short rostral barbels.
4. Dorsal fin with 15-17 rays (12 to 13 branched rays).
5. Lateral line with 40 to 45 scales.

Species: Labeo calbasu

1. Mouth inferior, lips thick and fringed, lower jaw more thickened.
2. Two pairs of barbels (rostral and maxillary).
3. Dorsal fin (16 to 18 rays) with a long base, branched dorsal rays 13 to16.
4. Lateral line scales 40 to 44.

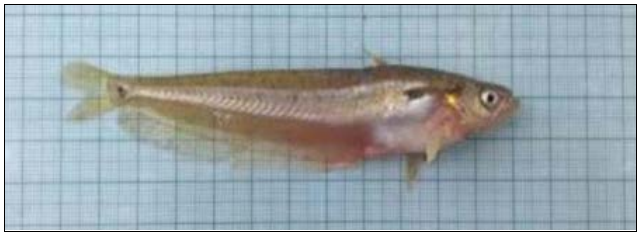
Species: Chitala chitala
1. Scales on the opercle and body are equal in size.
2. Pre-orbital smooth.
3. Pelvic fin rudimentary.
4. Anal fin is very long, confluent, with reduced caudal.
5. Transverse silvery bars (about 15) on back

Species: Anguilla bengalensis
1. Body elongated, robust head conical, flattened dorsally and tail compressed.
2. Mouth terminal, cleft of mouth wide extending to posterior margin of eye. 3. Lips thick and Eyes very small.
3. Villiform teeth to form bands on jaws and vomer.
4. Dorsal and caudal fins are well developed and caudal rounded.

Species: Tor putitora
1. Body streamlined, head broadly pointed.
2. Mouth small, lips thick and fleshy with the labial fold continuous.
3. Two pairs of barbels (maxillary & rostral) are more or less equal, as long as they orbit.
4. Dorsal spine bony, strong and smooth.
5. Scales large, lateral line with 25 to 28 scales.

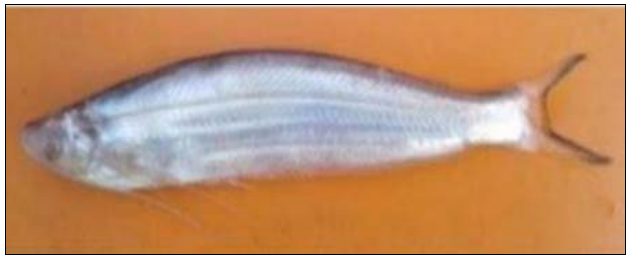
Species: Wallago attu
1. Gape of mouth wide and very long reaching beyond eye posteriorly.
2. Dorsal fin short with 05 rays and devoid of spine.
3. Barbels two pairs, maxillary barbels extending beyond origin of anal fin. 4. Upper lobe of the caudal fin is longer.

Species: Ompok pabo
1. Eyes moderate in size, its lower edge below the level of cleft of mouth.
2. Mouth large and oblique
3. Maxillary barbels short and extend slightly beyond posterior border of eye
4. Dorsal fin short with 05 rays, spine absent.



Species : Bagarius bagarius
1. Body elongated, head depressed and body covered with keratinized skin.
2. Mouth inferior, upper jaw longer.
3. Barbels 4 pairs, maxillary pair with stiff and broad bases.
4. Dorsal spine smooth.
5. Pelvic fin inserted anterior to base of last dorsal fin rays.

Species: Ailia coila
1. Rayed dorsal fin absent.
2. Barbel 04 pairs, well developed.
3. Adipose dorsal fin small.
4. Anal fin is very long with 58 to 75 rays.



Conclusion

It may be concluded from the above study that fishes of river Ganga at Sindhora ghat totally depend upon physico-chemical parameters. Although all the parameter are found favourable for fish survival but certain parameter such as turbidity which increase in monsoon season results in increased number of fish mortality due to choking of gills besides this the major problem is illegal fishing which results in declining of fish population in Ganga river at Sindhora ghat.

Range extension of certain species and reduction in ranges of few species is a serious concern in the long term conservation of fishes in the Ganges. Moreover, higher abundance of exotics, fragmentation and changes in the hydrology of river Ganga due to hydro projects and barriers are major threats to the fishes in the Ganges apart from indiscriminate fishing, pollution, poor land use pattern. So far, in India fishes are considered as commercial products and failed to appreciate

their ecological services which pushed a large number of species under threatened categories. Hence there is an urgent need for an action plan for conservation of fish habitat, fishery development etc. besides this safety measures should be taken to control illegal fishing by total ban on fishing especially in breeding season.

Fish conservation areas, landscape level conservation plan, proper Environment Impact Assessment for any developmental activities in the basin, habitat restoration plan, species recovery plan for certain threatened species in the Ganges etc. may help the native fish diversity restore in the Ganges. India has recently formed a National River Ganga Basin Authority (NRGBA), Chaired by the Honorable Prime Minister of India, would certainly help to mitigate the threats and conserve aquatic biodiversity.

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