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SEASONAL VARIATION OF PHYSICO-CHEMICAL PROPERTIES OF KAMALA BASIN OF DARBHANGA DISTRICT, BIHAR

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ABSTRACT
An experiment was conducted to study the physical, chemical characteristics of different habitat of selected fresh water fish species in Darbhanga region. The fish community of the Kamala and Balan reservoir of Darbhanga district in relation to physico-chemical parameters was studied by seasonal variation and the confluence of the these reservoir. Fish collections were done with bag-nets of standardized dimensions with several mesh sizes. 85 fish fauna identified during the study belongs to 22 family few includes Cyprinidae 31 species, Cobitidae 4 species, Ophiocephalidae 4 species, Bagridae 6 species etc., Besides identification, relative occurrence and economic importance of fishes are discussed. All fishes are useful as food fishes, and few of which are useful as ornamental and larvicidal fishes. The species diversity is peak in post monsoon, coinciding with favorable conditions such as sufficient water and ample food resources. The diversity was low in pre monsoon probably due to the shrinkage of the water spread of the reservoir. The high value of dissolved oxygen coupled with low biochemical oxygen demand and other nutrient levels indicate that the water body is moderately oligotrophic in nature. The factors responsible for declining population of fish species is discussed in detail. To save this diversity and to develop a sustainable fishery practices and proper documentation leading to diversity information system is an urgent need.

KEY WORDS: Carp, fresh water, climatic factor

INTRODUCTION

Reservoirs present a good opportunity for studying the effect of scale on the relative importance of climatic factors that determine diversity. On a broad scale, reservoirs are recent and their communities are a combination of species from the former riverine fish fauna as well as introduced species (Fernando & Holcík 1991; Oliveira & Goulart 2000; Oliveira *et al.*2004). Due to irrational fishing practices, environmental aberrations like reduction in water volume, increased sedimentation, water abstraction, and pollution over the years this diversity is on a decline and few species have been lost from the freshwater ecosystem of India and some are belonging under endemic, endangered and threatened category. The freshwaters of India have been viewed from a single perspective: that of economic production. The country is endowed with vast and varied resources possessing river ecological heritage and rich biodiversity. According to the State Fisheries Department, North Bihar comprises of 821 sq. kms. Wetland areas in the form of lakes (36548 ha), Oxbow lakes (4735 ha) and ponds and swamps (46800 ha) Pandey *et al.,* (1998). About 21,730 species of fishes have been recorded in the world of which, about 11.7% are found in Indian waters. Out of the 2546 species so far listed (ICBD 1994), 73 (3.32%) belong to the cold freshwater regime, 544 (24.73%) to the warm fresh waters domain, 143 (6.50%) to the brackish waters and 1440 (65.45%) to the marine ecosystem. The Indian fish fauna is divided into two classes, viz., Chondrichthyes (cartilage fishes) and Osteichthyes (bony fishes). The endemic fish families form 2.21% of the total bony fish families of the Indian region. 223 endemic fish species are found in India, representing 8.75 % of the total fish species known from the Indian region. India's inland water resources are diversified, as they are plentiful. Reservoirs contribute the single largest inland fishery resources both in terms of size and production potential. Fish fauna of a reservoir basically represents the fish diversity and their abundance. Indian reservoirs preserve a rich variety of fish species, which supports to the commercial fisheries. The objectives of the present study were to document the fish species in relation to physico-chemical characteristics of water and suggest appropriate conservation and management strategies.

MATERIALS AND METHODS

Kamala reservoir is located at Darbang district of Biraul taluk near Pokhram village, of Bihar. The reservoir is situated at latitude 26^0 27' 26.81 North and longitude 86^0 11' 20.98 East. It is located at an elevation of 601 m above msl. The kamala basin gets the inflows from the north east monsoon (June-September). The catchment area of the study site is about 1.6km at a stretch. the average rainfall of that area is 105 cm. The water of the reservoir is used for fisheries, and irrigation. The climate of this area is extreme ends of both warm and cool.

The fishes were collected from the kamala reservoir with the help of local fishermen during the year June 2007 to May 2008. The fishes were preserved in 10% formaldehyde solution for taxonomic analysis. The physical and chemical properties viz., water temperature, pH, EC, dissolved oxygen, organic carbon, organic matter, alkalinity, total hardness, calcium, sodium, nitrates,

phosphates, chlorides, silicates, are determined (APHA, 1998; Trivedi and Goel (1984) Identification and economic importance of fishes was carried out with the help of standard literature (Day, 1951; Jayaram, 1981; Datta Munshi and Shrivastava, 1988; Talwar and Jhingran, 1991). Water samples were collected at early hours between 8 am to 10 am and further transported to the laboratory immediately for further analysis. Water temperatures was measured at the time of sampling using mercury thermometer, pH was measured with standard pH meter (Global DPH 500), while other parameters were analyzed in the laboratory according to the methods suggested by Trivedy and Goel (1986) and APHA (1998).

RESULT AND DISCUSSION

The water quality data is depicted in **Table 1**. Water temperature ranged from 22.2^{0}C to 31.4^{0}C throughout the study period. Highest water temperature was recorded during summer season (31.40^{0}C) whereas least was observed in winter season (22.2^{0}C). Turbidity is due to the presence of suspended matter, silt, clay, colloidal particles, plankton, and other microorganisms (Kataria *et al*. 1996).The pH was observed in the range of 6.1 to 7.6 which indicates that water was slightly alkaline in nature. The carbonate alkalinity ranged from 5.8 to 26.4 mg/l and bicarbonate alkalinity ranged from 93 to 110 mg/l. it was highest during summer season.

Electrical conductivity (EC) of an aqueous solution is a measure of the ability to carry out an electric current (Parashuram and Singh 2007). EC ranged between 180 to 240mhos/cm. High electrical conductivity was recorded during winter season. This may be due to greater ionic concentration of the inlet flow (Prithwiraj Jha and Sudip Barat 2003).

Dissolved oxygen (DO) is the most important parameter which can be used as an index of water

quality, primary production and pollution. DO values ranged from 5.4 to 6.6 mg/l. Minimum values of DO were recorded during monsoon season and maximum during summer months. Minimum DO in months may be due to high metabolic rate of organisms. Maximum DO may be due to low atmospheric temperature. Similar trends were made by Adebisi (1981) and Deshmukh and Ambore (2006). The DO level (75 mg/l) of reservoir water may be favorable for aquatic organisms (Rajashekara *et al*. 2007).

Biochemical oxygen demand has been used as a measure of the amount of organic materials in aquatic solution, which support the growth of micro organisms. Biochemical oxygen demand values ranged from 0.5 to 2.75 mg/l. Maximum values during winter was probably due to presence of high amount of organic matter brought in by the surface run off of heavy rain (Rice 1938). During rainy season, Biochemical oxygen demand values were low; this is because the temperature retards the rate of reproduction of organisms.

Total hardness is a measure of the capacity to precipitate soap. It is the sum of the polyvalent cations present in water. The total hardness ranged from 64.1 to 114.2 mg/l. Maximum hardness was recorded during summer season due to the accumulation of precipitated and evaporated particles which may due to high temperature. The total hardness values were within the permissible limits prescribed by WHO.

Chlorides are important in detecting the concentration of ground water by waste water. In the present study, the chloride value ranged between 9.6 and 12.03 mg/l. Similar results were observed by Damodharan and Suresh (2005). The calcium reflected a high value of 28.0 mg/l during winter and lowest value of 17.6 mg/l during monsoon season, while magnesium was high during summer 8.9 mg/l and low 6.0 mg/l during winter. Similar trend was observed in case of sodium which ranged between 13.6 mg/l –16.2 mg/l. Level of potassium and silicate varied between 1.43 mg/l – 4.2 mg/l and 4.54 mg/l – 6.1 mg/l respectively. The level of phosphate and nitrate showed a poor concentration in comparison to river Kamala being in the range of 0.003 mg/l – 0.004 mg/l and 0.42 mg/l – 0.55 mg/l. Nutrients like phosphate, nitrate, calcium, magnesium, and ammonia were in low level, indicates the moderately oligotrophic status of the water body.

TABLE 1. Physico-chemical analysis of the surface water of river Kamla stretch (site 1) in village Pokhram, Biraul during summer, monsoon and winter season

Characters	Summer	Monsoon	Winter	Range
Appearance	Normal	Normal	Normal	Normal
Water color	LG	DG	DG	NG to DG
Temp. (^{0}C)	31.4	28.6	22.2	22.2 – 31.4
pH	6.1	7.2	7.6	6.1 – 7.6
Conductivity (mhos/cm)	210	180	240	180 – 240
Dissolved O_2 (mg/l)	6.6	5.4	6.2	5.4 – 6.6
Free CO_2 (mg/l)	4.8	2.6	3.7	2.6 – 4.8
Carbonate alkalinity (mg/l)	26.4	18.6	5.8	5.8 – 26.4
Bicarbonate alkalinity (mg/l)	110.0	93.0	104.0	93.0 – 110.0
Chloride (mg/l)	9.6	12.0	10.8	9.6 – 12.0
Total hardness (mg/l)	114.2	76.4	64.1	64.1 – 114.2
Calcium (mg/l)	38.4	33.00	17.36	17.36 – 38.4
Magnesium (mg/l)	10.2	9.7	6.6	6.6 – 10.2
Sodium (mg/l)	14.8	16.2	16.4	14.8 – 16.4
Potassium (mg/l)	1.34	1.22	1.46	1.22 – 1.46
Silicate (mg/l)	6.2	4.76	5.2	4.76 – 6.2
Phosphate (mg/l)	0.004	0.002	0.002	0.002–0.004

Nitrate (mg/l)	0.42	0.53	0.41	0.41 – 0.53

Apart from agriculture, all other human activities are negligible considering pollution factor in the catchment area agriculture is the main activity with significant usage of fertilizers and pesticides. These pollutants ultimately reach the reservoir due to run off. Even though there is no possibility of a high pesticide level in the reservoir water, in the higher order organism like fishes it becomes significant due to bio magnification. Thus, it shows that there is a great need for measuring the effect of pesticide on aquatic species.

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