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Environmental Characters of the Habitat of Chitala chitala (Hamilton-Buchanan, 1822) with Reference to Muhuri River of Tripura, India

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Abstract: *Chitala chitala (Hamilton-Buchanan, 1822) has been considered as an economically important freshwater fish species. As preferred food fish Chitala chitala (Hamilton-Buchanan, 1822) is very popular in Eastern India and North-Eastern India as well. As per IUCN it was enlisted as near threatened fish species. In the present observations it was sampled from some wild habitats of Muhuri river, Tripura, India. Muhuri river of Tripura, India is basically a freshwater ecosystem (Latitude $23^0$13.826' 33" N, Longitude 91^0 33.598' 03" E) located at south district of Tripura, a north-eastern state of India. While sampling the population of this fish species the environmental characters of its habitat river were also analysed. Some of those parameters were water temperature= 19.11-31.68 ^{0}C, pH= 6.4-7.6, water velocity= 1.68 - 4.29 m/sec, HCO_3= 132.22–167.34 ppm and DO_2= 4.26 - 7.11 ppm. On basis of the studies of multivariate regression analysis it may be concluded that water temperature (P <0.001), rainfall (P <0.001), pH (P <0.001), DO_2 (P <0.001) and HCO_3 (P <0.001) of lotic water have had significant correlation with population density of Chitala chitala. Apart from studies of those parameters two important physical parameters such as water velocity (P <0.001) and depth of river (P <0.001) had significant correlation. ANOVA exhibited that the regression was significant (P <0.001).*

Keywords: *Environmental character, Muhuri river, Chitala chitala, near threatened species.*

I. Introduction

In conservation view point knowledge of *Chitala chitala* (Hamilton-Buchanan, 1822) is important. This is a particular fish species whose biological knowledge is not adequately known. On the other sufficient studies on its habitat environment were not done till date. In India *Chitala chitala* (Hamilton-Buchanan, 1822) has bigger demand as preferred food fish. Its breeding biology has been controlled under lotic water only. Because of unauthorized collection of brood stock fish during rainfall period the density of this fish population has been declining day by day. On the other, also due to pesticide pollution in river water, sharp decline of water depth, gradual siltation, soil erosion etc the fish species has been reducing in lotic water (Banik 2011a,b, 2014, Banik and Bhattacharya 2012). In some parts of Asia such as North-East India, Bangladesh, Mynmar etc protein of this fish species was considered as a source of highly digestible animal protein to a large section of people once upon a time (Hepher 1988, Shepherd and Bromage 1988, Pillay 2000).

From different parts of the world such as North-East India, Bangladesh, Nepal, Bhutan, Pakistan, Myanmar, Indonesia, Malaysia, Thailand and Cambodia as well *Chitala chitala* was reported (Roberts 1992). In Indian sub-continent this fish was regarded as delicious food in the market of Uttar Pradesh, Bihar, West Bengal and North-Eastern India as well. Like India this fish also prefers by the people of Bangladesh, Nepal, Pakistan, Mynmar, etc. The dorso-ventral body areas of the fish possess specialized somatic tissue with thick epidermal lipo-proteinaceous layer due to which it makes the fish very tasty to the consumers. CAMP (1998) and IUCN (2010) have enlisted the fish species under near threatened category. So, in conservation view point knowledge of this fish species is definitely necessary. A survey into the existing literature explicitly reveals that ecological background of the fish is not sufficiently identified although some fragmentary information on biological studies are available (Mookerjee and Mazumdar 1950, Ricker 1956, Dehadrai 1960, 1962, Sharma and Chandy 1961, Das and Moitra 1963, Nickolsky 1963, Sundararaj and Prasad 1963, Parmeshwaran and Sinha 1966, Kulshreshtha 1967, Stewart *et al.* 1967, Kamal 1969, Moitra and Ghosh 1982, Ghosh *et al.* 1986, Wootton 1990, Roberts 1992, Sodsuk *et al.* 2000, Ayyappan *et al.* 2001, Sarkar *et al.* 2006a, b, 2007, 2008, 2009).

II. Materials and Methods

The wild population of *Chitala chitala* (Hamilton-Buchanan, 1822) was sampled from Muhuri river (Latitude $23^0$13.826' 33" N, Longitude $91^0$33.598' 03" E) of Tripura during different seasons. The fish sampling was done with repeated netting during early morning period and was kept in hapa of carp pond for proper acclimatization (fig. 1-6). After observing the fish for taking the data of length and weight, the fish samples were released into the river water immediately as far as possible. Simultaneously, water sample was also sampled from the river during early morning period in order to understand the ecological features of the water body. For

these purpose different parameters like water temperature, turbidity, water velocity, pH, DO_2, CO_2, HCO_3, Salinity, silicate, Dissolved organic matter, PO_4 P, NO_3 N etc were analyzed. Analysis of DO_2, CO_2, HCO_3, Salinity, PO_4 P, and NO_3 N was done with MERCK Kit (2012) and for the other parameters analysis was made adopting the methodology of APHA (2010). In order to understand the level of significant impact of different climatic parameters as well as physico-chemical characteristics of the studied river over the population density of *Chitala chitala* a multivariate regression analysis was done using SPSS version software.


Figs. 1-2 : Hatchlings of Fish was acclimatized in hapa of carp pond.

Fig. 3: Collection of hatchlings of *Chitala chitala* .

Fig. 4: Collection of fish sample with repeated netting from Muhuri river.

Fig. 5: Adult *Chitala chitala* (Hamilton, 1822) after sampling from Muhuri river.

III. Results and Discussion

In the present studies the data of physico-chemical features of lotic water was presented in table-1. The results of multivariate regression analysis of various habitat factors of Muhuri river water in relation to population density of *Chitala chitala* was presented in table 2.

Fig. 6: Adult *Chitala chitala* (Hamilton, 1822) during measurement.

Table 1: Physico-chemical features of the studied river water.

Sl. No.	Parameter	Range	Mean
1.	Water temperature	18.72-31.33	26.02^0C
2.	Water velocity	1.64 - 4.28	3.26 m/sec
3.	Turbidity	26 - 58	36.4 cm
4.	pH	6.2-7.6	7.1
5.	Free CO_2	2.96 – 8.82	4.19 ppm
6.	Dissolved Oxygen	5.26 - 7.84	6.22 ppm
7.	HCO_3	126.22 – 166.34	142.68 ppm
8.	Dissolved organic matter	6.42 – 12.34	7.23 ppm
9.	Salinity	0.0001 – 0.01	0.005 ppt
10.	Silicate	6.48 – 12.37	9.11 ppm
11.	PO_4 P	0.006 - 0.01	0.008 ppm
12.	NO_3 N	0.004 - 0.01	0.007 ppm

The climatic parameters depicted that over a period of six years the air temperature was increased little by little. At the same time, humidity was also increased gradually (figs. 7-8). On the other, rainfall and at the same time the depth of river water were also decreased regularly (fig.9-10) Banik (2004, 2010a), Banik and Roy (2014). An inverse correlation between air temperature and rainfall ($r = 0.9998$, $P<0.001$) and also between humidity and rainfall ($r = 0.9866$, $P<0.001$) were noticed. Similar information was also noticed by Banik (2004, 2009, 2011a,b,) who pointed out that the climatic feature of Tripura showing slow and gradual warming during last two decades which might be suppressing the diversity of fish fauna either directly or indirectly in the freshwater resources of Tripura in particular and North-eastern states in general. Banik (2004, 2010a,b,) further pointed out that such a bit by bit rise in temperature at one hand and continuing tendency of decrease of rainfall in the nature may develop an inhibition on the breeding prospective of the freshwater fish fauna. So, during monsoon period the fish breeding potential may be acutely affected which will possibly lead to suppression of onward fish progeny. Some researchers (Choudhuri 1982, 1983, Jhingran 2010) opined that optimum rainfall for the period of monsoon phase plays key role of stimulant in the maturation gonad in fish. Therefore, it becomes largely supportive to the fish species when an affinity of decline of temperature and increase of rainfall are found in the environment. Shepherd and Bromage (1988) and Pillay (2000) noticed that the rainfall to a great extent stimulate the male gonad for the release of 11-alpha-keto testosterone for maturation of spermatozoa in fish. They (Shepherd and Bromage 1988, Pillay 2000) further opined that at the same time the rainfall significantly stimulate the gonad of female fish for smooth function of beta-oestradiol for completion of maturation of ova.

As evident by multivariate regression analysis (table 2) certain physico-chemical parameters of freshwater such as water velocity, depth of water body, pH, DO_2, HCO_3 etc features were also found to play significant role behind the occurrence of the studied fish species. Water velocity being a physical parameter of water also plays key role in the maturation of gonad especially for the lotic fish species. When water velocity declines in lotic water ecosystem it acts as suppressor for the reproductive biology of a fish species. So, gonad cannot function proficiently and successfully during monsoon period. On the other, once the pre-mature gametes

could not full-grown in the gonad it may results into the shortening of life of the fish (Shepherd and Bromage 1988). *Chitala chitala* is basically a carnivorous species requires larger quantity of animal food during various stages of life for proficient survival and growth. When the depth of the river water is decreased (fig.10) it may affect availability of animal food for the carnivorous fish. So, it will also have an adverse consequence on the survival and growth of the studied fish species. Jhingran (2010) also pointed out that the carnivorous fish species which naturally inhabits in lotic water requires high depth water not only for food search but also for appropriate breeding and physiological purposes.

Some workers (Selye 1950, Nickolsky 1963, Wedemeyer *et al.* 1976, and Pickering 1981,) opined that for enhancing survival and growth rate of the fishes it is necessary to maintain suitable physiological conditions and effective metabolic activities both for the species of the lentic as well as lotic water. Thus, appropriate knowledge on certain physico-chemical parameters of freshwater are important and those parameters are pH, DO_2, CO_3, HCO_3 etc.

Table 2: Multivariate regression analysis of some climatic and environmental factors of river water over the population density of *Chitala chitala*.

Variables	**Reg. Coeff.**	**±S.E.**	**F**	**Beta coefficient**
Water temperature	100.95323	0.21524	14.82971	0.43598*
Rainfall	5.75373	0.83669	9.81359	0.72227*
Water velocity	342.87771	0.23595	13.23870	0.66020*
River depth	365.16614	0.98522	15.42244	0.37235*
pH	524.04632	0.96411	28.04038	6.37761*
DO_2	19.53198	0.18599	21.78526	0.85455*
HCO_3	31.98622	0.94372	28.96071	0.87309*

Multiple correlation coefficient (**R**) = 0.96858
Coefficient of multiple determination ($\mathbf{R^2}$) = 0.93815

Analysis of variance table:

Source	**Deg. of freedom**	**Mean sq.**	**F**	**Conf. level**
Regression	7	2.6825E+06	32.8645	100.00*
Residual	28	81623.1617		
Total	35			

*P <0.001

Table 3: Length-weight relationship in *Chitala chitala* during study period.

No of Observations	Length (cm)	Weight (gm)
1.	117	4700
2.	114	4400
3.	111	4100
4.	104	4020
5.	100	3900
6.	92	3700
7.	80	3400
8.	74	3100
9.	68	2800
10.	**62**	**2600**

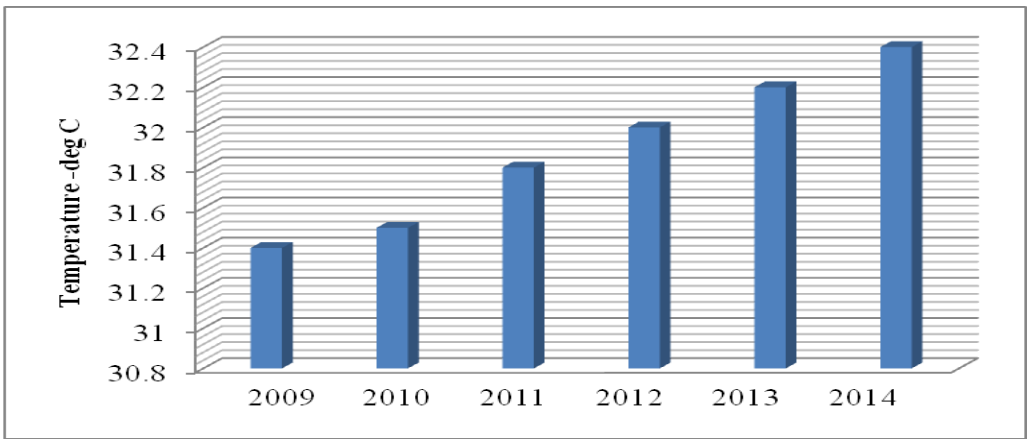

Fig. 7: Escalating tendency of air temperature (maximum value) in Muhuri river area.

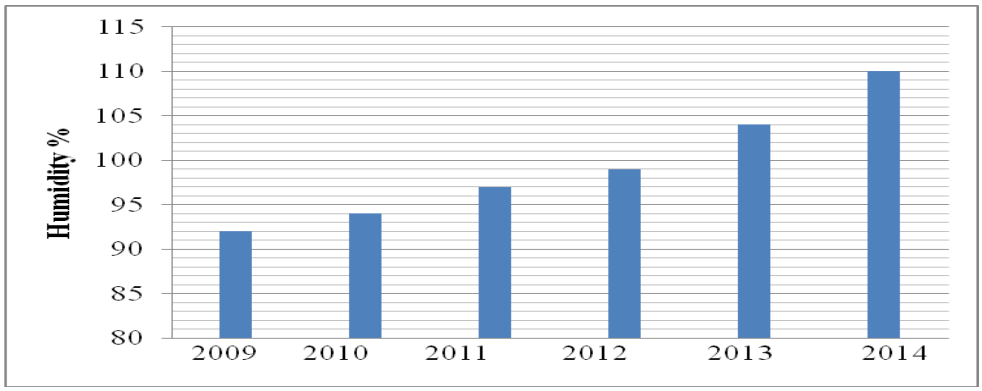

Fig. 8: Raising affinity of humidity (maximum value) in Muhuri river area.

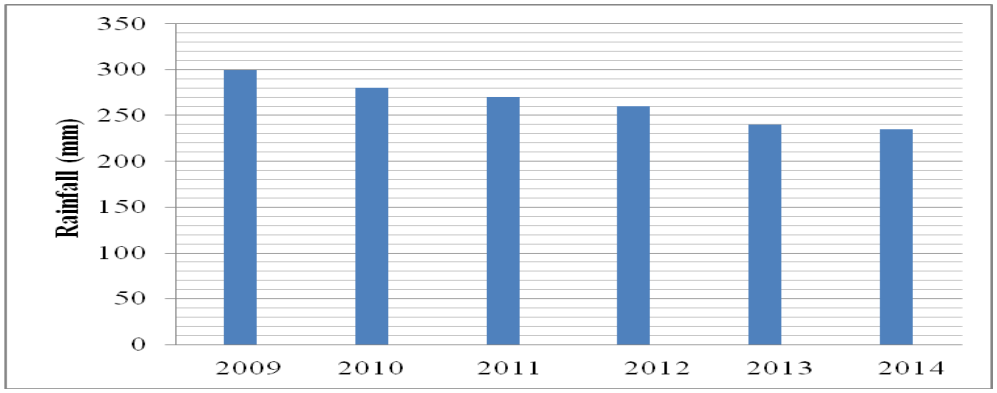

Fig. 9: Gradual decline of rainfall in Muhuri river area during different years.

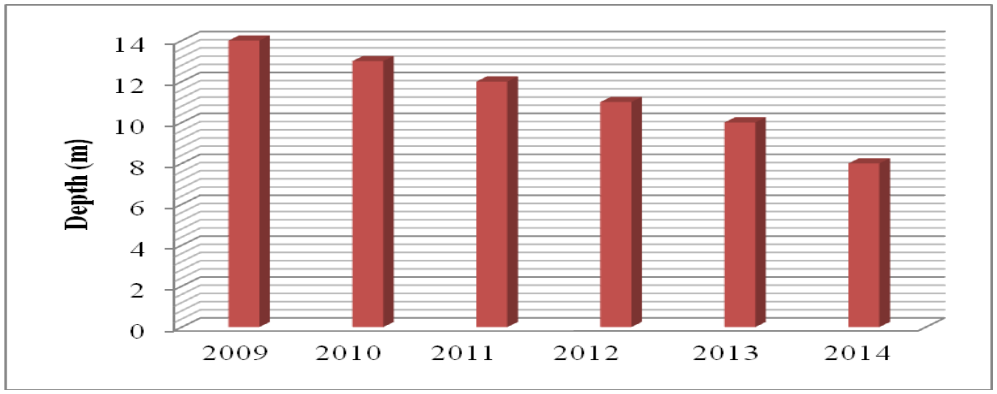

Fig. 10: Continuing decline of depth of Muhuri river area during different years.

Goldman and Horne (1983) and Wetzel (1983) opined that some specific parameters of water such as pH, CO_2, CO_3, DO_2, and HCO_3 etc. play very important role for sustaining healthy life of aquatic organisms. In the present studies multivariate regression analysis (table 2) showed that pH, DO_2, and HCO_3 have had significant correlation with the occurrence of the studied fish species (Wetzel 1983). The data on length-weight parameters (table 3) showed that there is a direct relationship on the growth pattern of the studied fish species ($r=0.998$, $P<0.01$). This result (table 3) also indicates that the ambient environmental character remain were in suitable condition which promotes smooth growth pattern of the species (Banik 2009).

IV. Conclusion

Over a period of six years in Muhuri river area an increase of air temperature and humidity was predicted. Trend of declining rainfall was also experienced. Gradual turn down of depth of Muhuri river was also noticed.

So, those characters might have affected the population density of *Chitala chitala* in nature in general and in Tripura in particular. So, further studies are required on this habitat parameter to conserve *Chitala chitala* in nature.

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