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Seasonal rhythms in the physico-chemical characteristics of the Swamps of Purnia, (Bihar)

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ABSTRACT

Physico-chemical parameters of the swamps of Harda, Purnia were studied to know their roles in production and distribution of biota, especially air-breathing fishes in this freshwater ecosystem. It was observed that the physico-chemical environment of this water body was quite suitable for the growth of air-breathing fishes as relative temperature, high value of dissolved oxygen and the highest production range of alkalinity favour the production of these aquatic fauna. Ten species of air breathing fishes were found in the swamps. The interaction of various physico-chemical factors was also found to decide the fate of the biological conditions of this freshwater body.

KEYWORDS

Swamps, Physico-chemical parameters, Air breathing fishes, Hypoxic and hypercarbic conditions.

INTRODUCTION

Swamps are transitional between terrestrial and aquatic ecosystems, which are wide water bodies having shallow and slow water current, usually connected with rained river or 'dhar'. Swamps are characterized by profuse growth of macrophytic vegetations developed due to rich decaying organic matters, lesser water level and slow water current. Swamps provide a unique habitat for a wide variety of flora and fauna. They provide better shelter for breeding and development of air-breathing fishes (Towheed *et. al*., 1988).

One of the important features of Purnia district (Koshi zone) is the presence of a large number of swamps, marshes and wetlands covering a considerable area. High rate of primary production, luxuriant growth of macrophytes for shelter, lesser water level with slow current, favour the growth and development of air-breathing fishes.

The maintenance of a healthy aquatic ecosystem depends on the physico-chemical properties of water. Lots of works have been performed on the seasonal changes in the physico-chemical parameters of rivers, lakes, ponds, reservoirs and streams in India by several workers as Pahwa and Mehrotra (1966), Mishra and Yadav(1978), Singh(1985), Pandey *et al* (1989), Bohra(1990), Birsal *et al*. (1991), Pandey *et al*. (1992), and others, but the swamps of Purnia district are more or less untouched and neglected. Keeping in mind the socioeconomic importance of swamps in human life, the present work has been undertaken which deals with the monthly and seasonal variation in the physico-chemical parameters of the swamps of Purnia and its impact on air-breathing fish life.

TERRAIN

The Study site is located at a distance of 7 Km from Purnia district headquarter in the southward direction by NH 31 near Harda a local Hatt. It is situated on 25º4' north latitude and 87º28' east longitude and at an altitude of 40 m. above sea level. The swamps of Harda are spread on either sides of the Saura river.

MATERIALS AND METHODS

Water samples for the physico-chemical analysis were collected from sampling stations every month at a regular interval, for one year from March 2007 to February 2008. Most of the parameters were analysed at the sampling sites. Atmospheric and water temperature were recorded with a mercury thermometer and pH of water was measured by a portable pH meter. The transparency of the swamp water was found out by the help of secchi disc. Chemical parameters like DO_2 free CO_2, HCO_3^-

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alkalinity chloride phosphate, nitrate, silicate etc. were estimated according to standard methods of APHA, 1989 and Trivedy and Goel, 1984.

RESULTS

The monthly and seasonal fluctuations in physico-chemical parameters of the swamps water are shown in Table-1. Ten species of air breathing fishes were found in the swamps (Table – 3). Water temperature was recorded between 18.2ºC and 31.5ºC, while atmospheric temperature varied between 20.8ºC and 33.8ºC. The water was observed mostly transparent except the monsoon season. Maximum turbidity (8.5 cm) was observed in July which was due to monsoon rain which brought additional water from catchments areas, transforming the water muddy and turbid.

Table 1-Physico-chemical parameters of swamps of Purnia (Bihar)

a) Monthly Variation

Months Parameters	Air Temp.	Wat. Temp	Trans. (Con.)	pH	DO_2 mgl^{-1}	Free CO_2 mgl^{-1}	HCO_3 alkalinity mgl^{-1}	Chloride mgl^{-1}	SiO_3 mgl^{-1}	PO_4 mgl^{-1}	NO_3 mgl^{-1}
2007 Mar.	26.0	23.1	Tr.	7.3	7.0	18	135	20	22.7	0.338	**0.335**
Apr.	30.2	27.0	Tr.	7.2	6.8	20	130	18	33.3	0.368	**0.360**
May	33.8	31.5	Tr.	6.9	6.2	31	120	20	25.0	0.435	**0.330**
June	32.5	30.2	10.0	6.8	5.8	28	102	24	20.6	0.438	**0.295**
July	33.0	30.0	8.5	6.6	5.2	38	110	20	21.5	0.125	**0.258**
Aug.	30.6	28.2	9.4	6.8	5.0	36	125	18	20.2	0.212	**0.260**
Sep.	29.5	27.3	12.0	7.0	4.8	16	130	16	24.3	0.320	**0.256**
Oct.	28.0	25.2	14.5	7.2	5.2	18	132	20	26.4	0.300	**0.288**
Nov.	26.5	21.0	Tr.	7.4	6.4	14	140	18	24.8	0.476	**0.300**
Dec.	22.0	18.9	Tr.	7.3	8.0	10	130	14	26.5	0.500	**0.306**
2008 Jan.	20.8	18.2	Tr.	7.2	8.2	12	128	20	31.2	0.406	**0.320**
Feb	**23.7**	**20.2**	**Tr.**	**7.4**	**7.6**	**8**	**142**	**20**	**35.6**	**0.363**	**0.360**

b) Seasonal Variation

Summer	30.6	27.9	-	7.0	6.4	24	122	20.5	25.4	0.395	0.330
Monsoon	30.3	27.7	-	6.9	5.0	27	124	18.5	23.1	0.239	0.265
Winter	23.2	19.6	-	7.3	7.5	11	135	18.0	29.5	0.436	0.321

Table 2: Coefficient of Correlation (r) computed among various physico-chemical factors of the swamps of Purnia.

Relationships	r	Prob.
Wat.temp. Vs pH	0.928	P< 0.001
Wat.temp. Vs DO_2	0.862	P<0.001
Wat.temp.Vs free CO_2	0.971	P<0.001
Wat.temp. Vs HCO_3	0.786	P<0.005
HCO_3 Vs pH	0.883	P<0.001
Free CO_2 Vs HCO_3	0.759	P<0.005
Free CO_2 Vs pH	0.91	P<0.001
Free CO_2 Vs DO_2	0.658	P<0.02

N.B. Prob = Probability Level

Table3 : Air breathing fishes of swamps of Purnia

S.No.	Name of Fishes	Local Name
1	*Heteropneustes fossils*	Singhi
2	*Heteropneustes microps*	Singhi
3	*Clarias batrachus*	Mangur
4	*Anabas testudineus*	Kawai
5	*Anabas oligolepis*	Kawai
6	*Channa gachua*	Chenga
7	*Channa marulius*	Saur
8	*Channa punctatus*	Garai
9	*Channa striatus*	Sauri
10	*Monopterus cuchin*	Anhaiya

The pH value of the swamps varied between 6.8 and 7.4 and it was slight acidic (pH 6.9) in monsoon season. The value of dissolved oxygen varied between 5.0 mgl^{-1} to 8.2 mgl^{-1}. The average value of DO_2 was observed minimum (5.0 mgl^{-1}) in monsoon and maximum (7.5 mgl^{-1}) in winter.

The free CO_2 concentration of the swamps water ranged from 8 mgl^{-1} to 38 mgl^{-1} and it was observed higher in monsoon and summer seasons. Carbonate alkalinity was found absent throughout the year, Bicarbonate alkalinity ranged from 102 mgl^{-1} to 142 mgl^{-1}. The average value of HCO_3^- was found highest (135 mgl^{-1}) in winter and lowest (122 mgl^{-1}) in summer. The chloride content of the water ranged from 16 mgl^{-1} to 24 mgl^{-1} and not a wide fluctuation was observed in different seasons. The average values of NO_3^-, $PO_4^{--}$and SiO_3^{--} were found higher in winter and summer and lower in monsoon (Table -1b).

DISCUSSION

The water temperature and atmospheric temperature were found interrelated like the other aquatic ecosystems. Normally the atmospheric temperature affects the temperature of a water body. Unlike the above condition the water temperature of a thermal spring is always higher and almost constant at the source (Sarkar 1953, Saha et al., 1978, 1980 and Tanti and Saha, 1993).

In order to evaluate the relationships among the various physico-chemical parameters during different months and seasons coefficient of correlation "r" has been computed (Table-2). The swamps water was found slight acidic (pH = 6.8) in monsoon season. This might be due to cyclic production of more H^+ (Towheed et al. 1988). According to Zafar (1966), pH of water is controlled by the relative quantity of bicarbonate and free CO_2. Higher value of HCO_3^- and lower value of free CO_2 favour the higher value of pH. A highly significant value of negative correlation (r) between pH and free CO_2 and positive correlation (r) between pH and bicarbonate was estimated (Table-2). A significant negative correlation was also computed between free CO_2 and $HCO3^-$. According to Banerjee and Ghosh (1967) pH 6.5-7.8 is most suitable for fish production.

The low concentration of dissolved O_2 (5.0 mgl^{-1}) during monsoon season might be due to highly turbid water reducing the rate of photosynthesis, at the same time the high rate of free CO_2 in this season is due to not proper utilization of free CO_2 by the primary produces facing the problem of low transparency. Pahwa and Mehrotra(1966) observed the lowest range of free CO_2 in the river Ganga from

January to June due to increased photosynthetic activity of higher amount of phytoplankton. The value of DO_2 in the swamps was found between 5.0 mgl^{-1} and 8.2 mgl^{-1}. This value of oxygen is best for fish production (Reddy, 1982).

The lower value of free CO_2 (11 mgl^{-1}) and higher value of DO_2 (75 mgl^-) in winter were observed due to comparatively clear water and cloudless sky facilitating more and more photosynthesis. A significant negative correlation (r= -0.858) was found between these two parameters. The free CO_2 concentration was also observed high in summer and early monsoon (March to August). It was probably due to comparatively higher temperature which accelerated the decay and decomposition of submerged vegetation causing the release of free CO_2. Pandey *et al.* (1989) also reported the hypoxic and hypercarbic conditions due to decay of organic matters during day time in Shivganga pond of Deoghar (South Bihar). Aeration and increasing of pH can control the high concentration of CO_2. Experiment have shown that 1.0 mg/litre of hydrated lime can remove 1.68 mg/litre of free CO_2 (Adhikari, 2006)

Bicarbonate alkalinity was found higher in all seasons (Table-1). As the alkalinity was always found more than 100 mgl^{-1}, on the basis of Moyle's (1946) classification and Phillipose (1959) the swamps water can be classified as hard water type and kept under the high category of nutrient type. A negative significant correlation (r=-0.759) was also observed between free CO_2 and HCO_3^-.

The chloride content was found high and more or less constant. High chloride content in the present work can be cited as an index of pollution of animal origin. On the banks of Harda Swamps there is a dense population and sewage from their houses may be the causes of pollution.

The values of nitrate and phosphate were found higher in winter and summer (Table-1) which supported the luxuriant growth of macrophytes. The

higher content of SiO_3^{--} during winter might favour the growth of diatoms which utilize silica in the construction of their shells. As the values of NO_3^- and PO_4^- are high (0.265- 0.330 mgl^- and 0.239 – 0.436 mgl^- respectively), so the investigated ecosystem may be categorized as moderate trophic level (Sarwar and Wazir, 1991).

Thus it may be concluded that the swamp water having higher value of O_2 and higher productive range of alkalinity favour the production of air-breathing fishes. The low water current in the swamps also might have been favourable for spawning of air-breathing fishes (Towheed et al., 1988).

REFERENCES

Adhikari S. (2006). Soil and water quality management in aquaculture, Hand Book of Fisheries and Aquaculture. Indian Council of Agricultural Research, New Delhi. pp. 1-30.

APHA (1989). Standard methods for the examination of water and waste water, 17th ed., Washington, U.S.A.

Banerjee S. and Ghosh A.N. (1967). Water quality and soil condition of fish pond in some states of India in relation to fish production. Ind. J. Fish, 14(182):15-144.

Birsal N.R., Nadkarni V.B., Krishnamurthi S.K. (1991). The Physico-chemical status of Kali River after the closure of the Supa Dam; A preliminary Report, J. Freshwater Biol. 3(4):251-257.

Bohra C. (1990). Limnological Survey of an ancient pond at Barharwa, (Bihar). J. Freshwater Biol 2(4):361-364.

Mishra G.P., and Yadav A.K. (1978). A comparative study of physico-chemical characteristics of river and lake of Central India. Hydrobiol., 59:275-278.

Moyle J. B. (1946): Some indices of lake productivity. Trans. Amer. Fish. Soc., 76:322-334.

Pahwa D.V. and Mehrotra S.N. (1966). Observations and fluctuations in the abundance of Planktons in Relation to certain Hydrobiological conditions of River Ganga Proc. Nat. Acad. Sci, USA, 36B:157-189.

Pandey B.N., Lal R.N., Mishra P.K. and Jha A.K. (1992). Seasonal rhythms in the physico- chemical properties of river Mahananda (Katihar) Bihar. Environment and Ecology, 10(2):354-357.

Pandey R.S., Verma P.K. and Dardhiyar S.K. (1989). Diurnal changes of certain physico-chemical Factors of Shivganga Pond of Deoghar, South Bihar, India. Environment Ecology, 7(2): 483-485.

Phillipose M.T. (1959). Freshwater phytoplankton of Inland Fisheries. Proc. Symp. Algolo. I.C.A.R. New Delhi, 4: 275-291.

Reddy Y.V.R. (1982). Studies on the Phosphorus cycle and its Influence on the standing crop of plankton in the estuarine and near shore waters of Manglore. M.F.Sc. Thesis. Univ. Agril. Sci. Banglore, India.

Saha S.K. and Munshi J.S.D. (1980). Biota in Relation to physico-chemical Environments along Thermal Gradient of a hot Spring of Bhimbandh, Bihar, India. Pol. Arch. Hydrobiol, 27(3):337-347.

Saha S.K., Munshi J., Munshi J.S.D. and Sarkar H.L. (1978). Limnobiotic survey of thermal Springs of Bhimbandh. Geobios, 5(5):205-207.

Sarkar H.L. (1953). On a collection of fish from Rajgir, Patna District, Bihar. Jour. Asia, Soc. 9:117-119.

Sarwar S.G. and Wazir M.A. (1991). Physico-chemical characteristics of a freshwater pond of Srinagar (Kashmir). Poll. Res., 10(4):223-227.

Singh B.K. (1985). Limnological observations on Rihand Reservoir (U.P.) with reference to the physical and chemical parameters of its water. Hydrobiol, 70(6): 857-875.

Tanti K.D. and Saha S.K. (1993). Hydrobiological profiles along a thermal gradient of the Hot Springs of Rajgir (Bihar), India. J. Freshwater Biol., 5(2):107-117.

Towheed M.A., Singh R.K. and Singh, B.N. (1988). Physico-chemical factors of swamps of Koshi region and main Koshi river of North eastern Bihar in relation to yield of air breathing fishes. Env. & Eco, 6(2):386-389.

Trivedy R.K., and Goel P.K. (1984). Chemical and Biological methods for Water Pollution Studies, Env. Pub., Karad India.

Zafar A.R. (1966). Limnology of the Hussainsagar Lake, Hyderabad, India. Phykos, 5(1&2):115–126.