Bangladesh J. Fish. Res., **1**(1) 31-40
Bangladesh Fisheries Research Institute

Limnology of Chanda beel

M. A. Ehshan, M. S. Hossain*, M. A. Mazid, M. F. A. Mollah [1], S. Rahman and A. Razzaque

Bangladesh Fisheries Research Institute, Mymensingh-2201, Bangladesh
[1] Dept. of Fisheries Biology & Genetics, BAU, Mymensingh

Corresponding author

Abstract

A limnobiological investigation was conducted in Chanda beel over a period of 8 months from June' 95 to January' 96. The floodplain showed temporal spatial and vertical variation in physico-chemical as well as biological conditions. During study period, physico-chemical parameters were with in the suitable range for fish culture. Plankton population was higher in true beel areas. Both phytoplankton and zooplankton showed direct relationship among themselves. Presence of several indication plankton genera showed that the floodplain was eutrophic in nature.

Key words : Floodplain, Phytoplankton, Zooplankton

Introduction

Bangladesh is very rich in water resources. Her floodplains cover an estimated area of 2.833 million ha, while that of beels stand at 0.114 million ha (Mazid *et al.* 1996). These openwater floodplains /beels were once exceptionally rich in fisheries resources, contributing significantly to meet the national nutritional requirements. In recent years, fish production from these sources has alarmingly declined due to various reasons. The floodplain by virtue of their continuous productivity, constitute one of the front-line areas capable of yielding at least 0.5 million MT of fish per year. Floodplain fisheries have received particular attention because of enormous potential with managerial issues critical to sustainable development (DOF 1995). Enormous investigations have been accomplished in various aspects of limnology but in Bangladesh, floodplain still remains a virgin field for such investigation.

Chanda beel having a total area of 10,870 ha (BCAS 1991) at the Faridpur-Madaripur belt of Bangladesh plays an important role in the economy of surrounding people, providing fish and fishery product. Recently government of Bangladesh has taken a massive programme on releasing fingerlings aiming sustainable increase of fish production. This study was undertaken for understanding the ecological status of a natural floodplain beel ecosystem, "the Chanda beel".

Materials and methods

Physico-chemical data and plankton samples were collected fortnightly from nine different spots which were stratified into several categories considering the coverage of area and different habitat conditions. Samples were collected between 08.00 hours and 11.00 hours. Temperature, turbidity, pH and dissolved oxygen were measured with the help of Aquamate (Model WQA-1A-Japan) and conductivity by a conductivity meter (Model 44600 Hach-USA). Rainfall data was collected from local office of Bangladesh Water Development Board.

For plankton study water was collected by Kemmerer water sampler (Model 1904-E-307) from the selected spots. Phytoplankton was sampled after settlement of collected water. To make zooplankton sample, 10 litre water were sampled and subsequent filtration was performed through a 55mm mesh plankton net and concentrated to 20 ml. The filtrates were immediately preserved in 5% formalin. Microscopic identification was performed up to genera. Each sample was stirred smoothly just before microscopic analysis. One ml from agitated sample was then withdrawn with wide mouth graduated pipette and poured in a Sedge-Wick Rafter counting cell. Identification and enumeration of each sample were done by a binocular microscope (Model Olympus CK-2, ULWCD-Japan). The mean of 3 of such estimates was then calculated for each component occurring in the total count. Finally the existing phytoplankyon and zooplankton were expressed in no./ml and no./l, respectively. Monthly quantitative fluctuation and percent composition of various groups were also determined. Qualitative studies were done according to Presscott (1964), Needham and Needham (1972). Statistical analysis was done to find out the deviation of different parameters from the mean and to determine the extent of correlation amongst different parameters.

Results

Depth : Water invaded the Chanda beel in May-June, reached maximum in September and then dropped sharply (Fig 1). In January, there was some rise in water level.

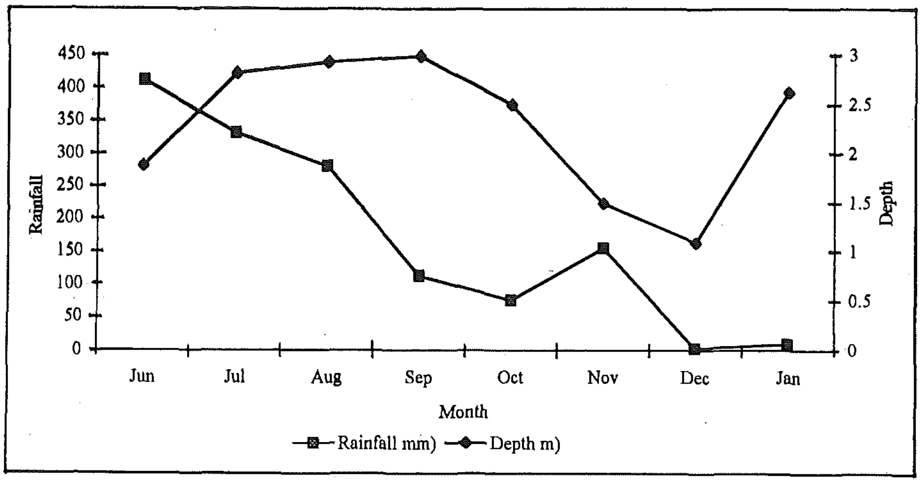


Fig. 1. Monthly fluctuation of rainfall (mm) and water depth (m).

***Air temperature* :** Air temperature was the highest in the month of June and the lowest in the month of January. It ranged between 33.67 ^{0}C and 26.6 ^{0}C (Fig 2).

***Water temperature* :** It ran almost parallel to ambient air temperature in most parts of the floodplain. The highest temperature (31.7 ^{0}C) was recorded in the month of June and the lowest (25.2 ^{0}C) in January (Fig 2). Air temperature and water temperature showed strong positive (r=0.89) correlation.

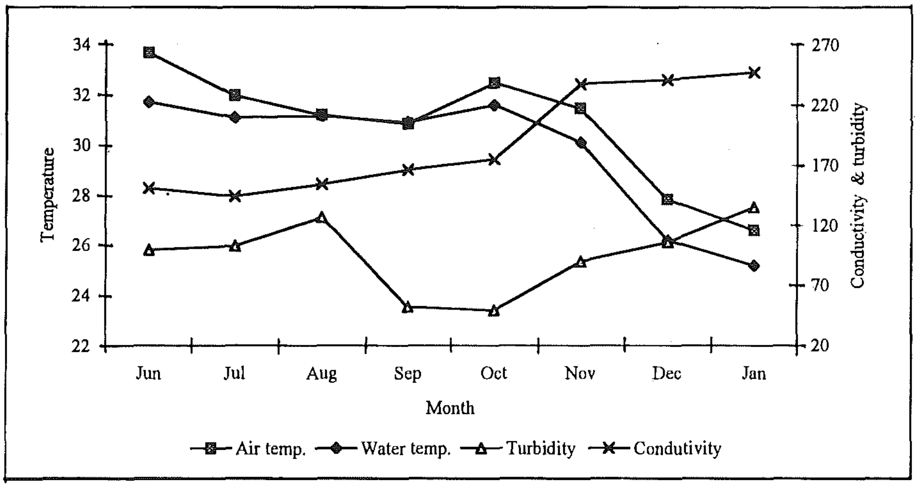


Fig. 2. Monthly fluctuation of air temp. (^{O}C), water temp. (^{O}C), conductivity (µs) and turbidity (ppm).

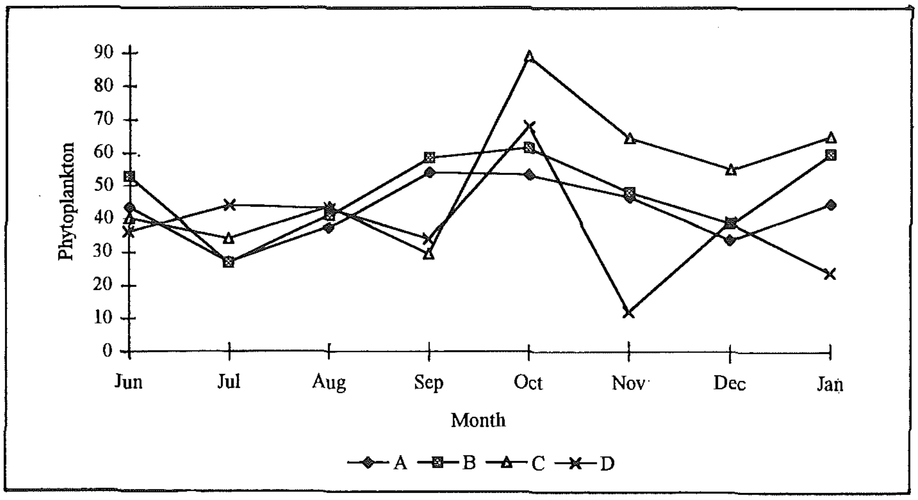
***Turbidity* :** The water of Chanda beel was not highly turbid. Water was comparatively more turbid in August and January (Fig 2). Canal water showed more turbid and it was clearly different from the rest parts of the beel. Turbidity showed negative and weak relationship (r=-0.25) with temperature.

***Dissolved oxygen* :** Dissolved oxygen (DO) content prevailed around or above 6 ppm. The highest value (6.96 ppm) was recorded in December and the lowest (5.46 ppm) in August. DO content showed negative relationship (r=-0.39) with temperature.

***pH* :** The pH values remained around neutral throughout the study period. It showed a sharp rise during July-August. January was the month when the pH value (7.46) was the highest. Seasonal and temporal fluctuation of pH was very conspicuous. pH values were more acidic at the bottom layer than the surface. Relationship of pH with temperature was not significant (r=0.03).

***Conductivity* :** Conductivity values remained between 144 ms/cm and 240.63 ms/cm during the study period (Fig 2). It showed a strong negative relationship (r=-0.63) with temperature.

Phytoplankton : The monthly abundance of total phytoplankton varied from 30±10/ml (July) to 66±19/ml (October). The temporal and spatial fluctuation of total number of phytoplankton in different areas are shown in Fig 3. In the area of true beel portion the content of phytoplankton was always relatively high.



(A = Aman paddy area, B=true beel area, C= canal, D=deep waterhyacinth area)

Fig. 3. Temporal and spatial fluctuation of total number of phytoplankton (nos/ml).

A total of 43 genera of phytoplankton were identified. Among these the most abundant genera were *Chlorella, Scenedesmus, Spirogyra, Ulothrix, Aphanocapsa, Anabaena, Lyngbya, Diatoma, Navicula, Synedra, Phacus, Closterium* etc. All phytoplankton genera belonged to five groups and these were Chlorophyceae, Myxophyceae, Bacillariophyceae, Desmid and Protozoa. The percent composition of these groups in different months are shown in Fig 4. Chlorophytes and Myxophytes showed their maximum abundance in June to August whereas Protozoans and Desmids were higher in percent composition during winter.

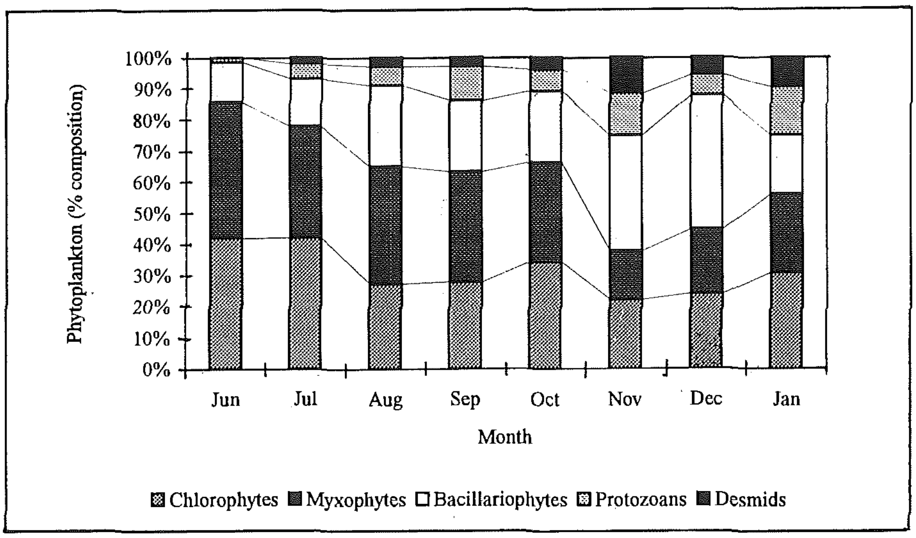
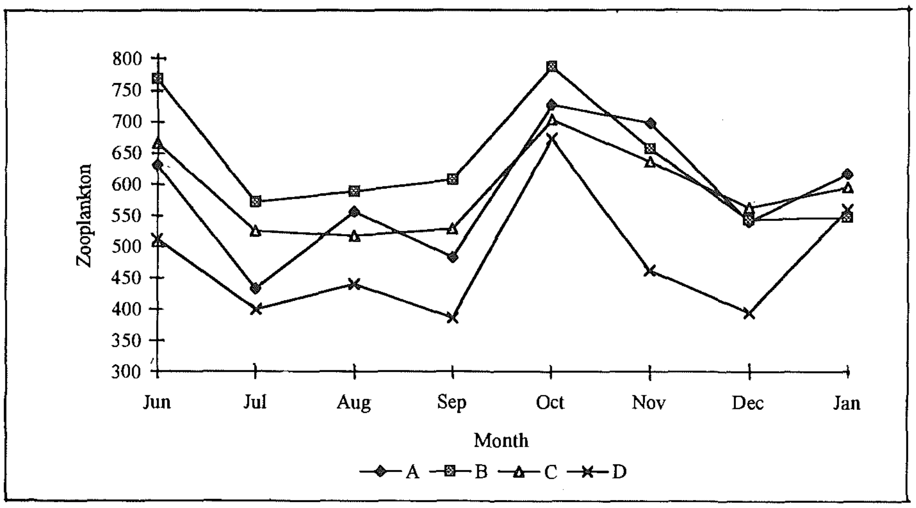


Fig. 4. Temporal fluctuation in percent compostion of various Phytoplankton groups.

Chlorophyceae and Myxophyceae were the most dominant groups followed by Bacillariophyceae, Desmid and Protozoa. Yearly mean phytoplankton population during investigation was 46±10/ml. Relationship of phytoplankton with temperature (r=0.19) and with turbidity (r=-0.22) were not significant.

Zooplankton : The average number of zooplankton fluctuated between 496±90/l and 735±52/l. The temporal and spatial fluctuation of total number of zooplankton (nos/l) in different areas of the floodplain are shown in Fig 5



(A= Aman paddy area, B= true beel area, C=canal, D= deep waterhyacinth area)

Fig. 5. Temporal and spatial fluctuation of total number of zooplankton (nos./l)

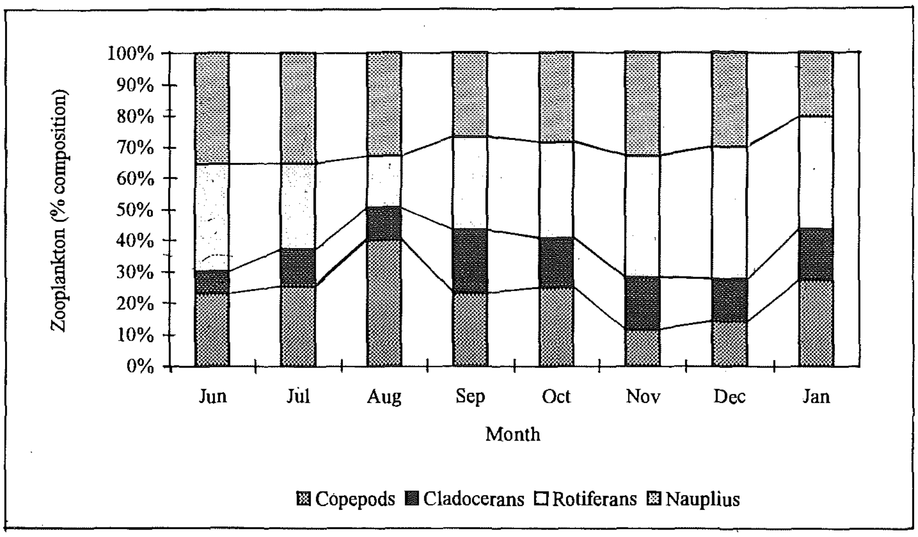


Fig. 6 . Temporal variation in percent composition of various zooplakton groups.

Like phytoplankton, zooplankton population was also relatively high in true beel area. A total of 26 genera of zooplankton were identified. Among these the most abundant genera were *Cyclops, Diaptomous, Bosmina, Daphnia,* *Diaphanosoma, Sida, Moina, Brachionus, Keratella, Lecane* and *Polyarthra*. All zooplankton genera belonged to four groups which are Rotifera, Copepoda, Cladocera and Nauplius. Monthly variation in percent composition of various zooplankton groups is shown in Fig 6. Rotifera and Nauplius were higher in percent composition during winter whereas Copepoda and Cladocera were found to be higher in percent composition during summer. Rotifera was the most dominant group followed by Nauplius, Copepoda and Cladocera.

Yearly mean of zooplankton population was 575±90/l. Relationship of zooplankton with temperature (r=-0.18) and turbidity (r=-0.08) was negative and insignificant. Phytoplankton and zooplankton showed positive correlation (r=0.41).

Discussion

Natural waterbody is an ecosystem with a complicated network of various physico-chemical and biological parameters and its biota.

Depth **:** Chanda reached in maximum water depth in the month of September. Similar phenomena was observed by Hasanat *et al.* (1996) in the river of Old Brahmaputra. In January there was some rise in water level in the canal due to occasional rain. Minimum depth was registered in winter. Leaching and evaporation were supposed to be important operatives behind lower water depth.

Water temperature **:** Water temperature is highly synergistic with the air temperature. The water temperature is influenced by the air temperature, hours of sunshine, rainfall, depth of water and overall weather condition.

Chanda showed the highest temperature in June and the lowest temperature was found in the month of January is supported by Mathew (1975). Temperature between surface and bottom water did not differ notably throughout the study period possibly due to flow of water and wave action. Data pertaining to temperature showed that water temperature fairly followed air temperature as it is generally known except few exceptions. Water temperature showed direct relationship with air temperature, also reported by Ismail *et al.* (1984) and Begum *et al.* (1989).

Turbidity **:** The turbidity of water is caused by silting, microorganisms and suspended organic matter in the water (Hutchinson 1957). Waterbody showed two distinct maxima, one in monsoon i.e. in the month of August and another in dry season. Hussainy (1967) registered the highest water turbidity in the month of August. Ahmed *et al.* (1992) recorded the lowest water transparency in January in Kaptai lake. The turbidity of the canal and rest parts of the beel were clearly different, canals being more turbid, perhaps due to continuous movement of water.

Dissolved oxygen **:** As oxygen regulates the most of the vital process of plants and animals, it is the most important factor in both aquatic and terrestrial environment (Rahman 1992). DO content in Chanda was in expected level throughout the study period. The highest values of DO were recorded in winter and the lowest in summer. Similar was recorded by Dewan (1973).

The high concentration of dissolved oxygen content was possibly because of low temperature, low rainfall and low pH. Due to low temperature and low rainfall, the decomposition of organic matter was less with low production of free CO_2 and low consumption of DO. The low DO content during summer and autumn was possibly due to high temperature and heavy rainfall which enhanced the oxidation of organic matter by the consumption of DO and the high production of free CO_2. Annual average DO content was around the optimum productive range 5-7 ppm.

pH **:** pH is considered as an important factor in fish culture. It indicates the acidity-alkalinity condition of a waterbody. Observed pH value was alkaline in nature with small variation. Ruttner (1953) stated that a eutrophic lake normally maintains alkaline pH. Comparatively low values of pH in monsoon agree with the findings of Banerjea and Roy (1970). The floodplain showed its highest pH values in the month of January and October. pH values had been observed to be more acidic at the bottom water than the surface.

Conductivity **:** Electrolytic conductivity is the ability of a solution to pass an electric current and the reciprocal of the solution resistivity. It is closely related to the chemical purity of water, the amount of dissolved solids in a solution and the efficiency of various treatments processes. Conductivity was observed to increase during winter months. Similar observation was made by Ahmed *et al.* (1992), and Khondker and Parveen (1992).

Phytoplankton **:** The productivity of a waterbody has a direct bearing upon the welfare of fish life and the role of plankton in the tropic cycle has been well recognized. During the present study a distinct fluctuation of both phytoplankton and zooplankton in different months as well as seasons was observed. Similar observations were noted by Chowdhury and Sultana (1989) and Mathias (1991) in various habitats.

It is evident from the observation that a variation with the months existed in the phytoplankton standing crop. It varied between 30 ± 10/ml and 60 ± 19/ml. More or less similar was found in some other floodplains (FRI 1995). The phytoplankton bio-mass showed mainly two peaks in the present study, the first peak in October and the second peak in January. Patra and Azadi (1987) registered two high peaks, one in February and another in August, minimum count was in May.

Chlorophyceae and Myxophyceae were the most abundant group followed by Bacillariophyceae, Protozoan and Desmid. Chlorophytes and Myxophytes showed their maximum abundance in June to August whereas, Protozoans and Desmids was higher in percent composition during winter. Findings of Mathew (1975) that Desmids though represented by several species, formed a very limited part of the plankton, were similar to present investigation. Kaliyamurthy (1974) observed Protozoan plankters were very rare in Pulicat lake in India.

Total number of zooplankton also varied with the months as well as seasons, between 496±90/l and 735±52/l. Like phytoplankton, zooplankton also showed two peaks, first peak in October and second peak in January. Patra and Azadi (1987) found two peaks of zooplankton, one in August and another in February.

Rotifera was the most dominant group followed by Nauplius, Copepoda and Cladocera. Rotifera and Nauplius were higher in percent composition in winter, whereas Copepoda and Cladocera were found to be higher in percent composition in summer. Patra and Azadi (1987) noted that zooplankton was mainly dominated by Copepoda, Cladocera and Rotifera. They added that Copepoda attained the highest peak in June, minimum in December. Ahmed *et al.* (1992) found Rotifera was the most dominant group followed by Copepoda and Cladocera in Kaptai lake.

Both phytoplankton and zooplankton showed direct relationship between themselves. Similar relationship were found by Kaliyamurthy (1974) in Pulikat lake, India; Patra and Azadi (1987) in Halda river. Several plankton obtained in present observation composed of typically eutrophic. *Melosira, Ceratium, Anabaena , Anacystis* etc. are mentioned as indicator of eutrophic nature Mathew (1975).

The physico-chemical parameters of Chanda beel were in the suitable range. Obtained planktons also indicate that this beel is eutrophic in nature. Through stocking with carp fingerlings fish production may be increased in this beel.

References

Ahmed, K.K., G.C. Halder and S.B. Saha, 1992. *Limnological Studies on Kaptai Lake*. Final Report. Fisheries Research Institute, Riverine Sub-station, Rangamati. 36 pp .

Banerjea, S.M. and N.C. Roy, 1970. Observations on some physico-chemical features of the Chilka lake. *Indian J. Fish.*, **13:** 395-429.

BCAS, 1991. *Floodplain Production Monitoring*. Initial Study Report. Bangladesh Centre for Advanced Studies, Dhaka. / pp.

Begum, A., G. Mustafa, S. Ali and K.. Ahmed, 1989. Studies on limnology in a minipond and growth of *Tilapia* (=*Oreochromis*) *nilotica*. *Bangladesh J. Zool.*, **17**(1): 35-45.

Chowdhury, A.N.B. and N. Sultana, 1989. Occurrence and seasonal variation of zooplankton in a fish pond in relation to some physico-chemical factors. *Bangladesh J. Zool.*, **17**(2) : 101-106.

Dewan, S. 1973. Investigation into the Ecology of Fishes of a Mymensingh Lake. A Ph.D. thesis submitted to the Department of Aquaculture and Management, Faculty of Fisheries, Bangladesh Agricultural University, Mymensingh. pp. 191-202.

DOF (Department of Fisheries), 1995. *Project Proforma (revised)*, Third Fisheries Project. Department of Fisheries, GOB, Bangladesh. 126 pp .

FRI, 1995. *Research Progress Report on Limnological Investigation into New Floodplains.* November '95. Fisheries Research Institute, Third Fisheries Project, Santahar, pp. 11-13.

Hasanat, M.A., M.A. Islam, M.A. Khair and M.S. Alam, 1996. *Studies on the Plankton of the river Old Brahmaputra. In:* Souvenir on Tenth Zoological Conference of the Zoological Society of Bangladesh. May 28-30, 1996. 72 p.

Hutchinson, G.E., 1957. A Treatise on Limnology. Vol. 1. Geography, Physics and Chemistry. John Wiley and Sons Inc., New York, USA. 1051 pp.

Hussainy, S.V., 1967. Studies on the limnology and primary production of a tropical lake in India. *Hydrobiologia*, **30**: 335-352.

Ismail, M., A. Rahman, S. Ali, and K. Ahmed. 1984. Studies on limnology and some aspects of biology of *Oreochromies niloticus* (L) in a pond Juran, Dhaka. *Proc. Fourth. Nat. Zool. Conf. Bangladesh* : 97-105.

Kalyiamurthy, 1974. Observation on the plankton ecology of Pulicat lake, *Hydrobiologia*, **45:** 86-95.

Khondker, M.. and L. Parveen, 1992. Study on the physical and chemical limnology of a shallow, hypertrophic artificial lake. *Bangladesh J. Sci. Res.*, **10**(1): 9-16.

Mathew, P. M., 1975. Limnology and productivity of Govindgarh lake, Maddhya Prodesh, India. *J. Inland. Fish. Soc. India*, **11:** 16-24.

Mathias, P.M., 1991. Seasonal trends in the fluctuation of phytoplankton and physico-chemical factors in a tropical lake (Govindgarh lake, Maddhya Pradesh, India) and their interrelationship. *J. Inland. Fish. Soc. India*, **17**(1-2): 11-24.

Mazid, M.A., M.S. Hossain, A. Razzaque, and S. Rahman, 1996. Fishing Methods in the Floodplains and Measure to Control. FRI Publication No. 13. Fisheries Research Institute, Mymensingh, Bangladesh. 15 pp.

Needham, J.G. and R.P. Needham, 1972. A Guide to the Study of Freshwater Biology. Holden-Dey, Inc Cali., 94 (III), USA.

Patra, R.W.R. and M.A. Azadi, 1987. Ecological studies on the planktonic organisms of the Halda river. *Bangladesh J. Zool.*, **15**(2): 109-123.

Presscott, G.W., 1964. How to Know the Freshwater Algae. Brown Co., Inc., Dubupue, Lowa. 272 pp.

Rahman, M.S, 1992. Water Quality Management in Aquaculture. BRAC prokashona, Dhaka, Bangladesh. pp. 71-72 .

Ruttner, F., 1953. Fundamentals of Limnology. Univ. of Toronto Press. Toronto, Canada. 242 pp.

(Manuscript received 2 December 1996)