

Hydro Biological Characteristics of Some Semi-intensive Fish Culture Ponds of Lumding Town of Nagaon District, Assam

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ABSTRACT

Hydrobiological assessment is useful for assessing the ecological quality of aquatic ecosystem since biological communities integrate the environmental effects of water chemistry. Ten fish ponds from Lumding town, which were under semi-intensive culture practice, were selected for hydrobiological investigations. Physico-chemical properties were studied for a period of two years from July 2009 to June 2011. Some selected parameters like pH, dissolve oxygen, free carbon dioxide, TDS, total alkalinity, total hardness, sp. Conductivity, transparency and BOD were studied on some fish pond water. P^H ranges from 6.1 to 8.5. Temperature ranges from 18°C-32°C. Color shows light green to dirty green. Transparency ranges 17-42cm, dissolve oxygen ranges from 3.2-8.0 ppm, total alkalinity ranges from 7.9-20.0ppm, Hardness ranges from 60-135 ppm, sp. conductance ranges from 123-247µmhos/cm and BOD ranges from 3.1-5.0ppm. The phytoplankton belonging to division Chlorophyceae and Cyanophyceae are predominant over the others and zooplanktons belonging to group Protozoa, Rotifers are predominant. A total of 30 species of belonging to Chlorophyceae. Cyanophyceae were identified and a total of 20 species of Rotifera, 2 species of Cladocera and 1 genus of Copepods were found. The present study is expected to help achieve better and higher yield of fish by the fish farmer with increasing awareness regarding the hydrobiological feature of the pond and implement scientific management practices accordingly.

Key words: Hydrobiological characteristics, Chlorophyceae, Cyanophyceae, Euglenophyceae.

INTRODUCTION

Lumding is situated in Nagaon District of Assam and lies between 25°45' - 26°45' North latitudes and 91°50' - 93°20' East Latitudes. Lumding is the second biggest town in Nagaon district of Assam. A large section of the people of Lumding depends on Agriculture, Poultry, and Fishery etc. as their means of livelihood. There are about 171 fish ponds constructed and stocked with fish in Lumding and its adjacent area. Some of these are not utilized to its full potential. Studies on physico-chemical condition of ground water of Lumding have already been done by Mrinal Kanti Paul (M.K.paul & A.K.Mishra 2009) but the detailed data on the hydro-biology of available water bodies of Lumding still remained scanty. In view of the vast extension of such water bodies which occupies about one third of the plain area of Lumding, the

present study was undertaken to evaluate the hydrobiology of ten ponds of Lumding, which will provide certain information in the survey of the Fishery resources of Lumding and in the proper planning of the fisheries management programme of the town.

The interrelationship between the physico-chemical parameters and plankton production of pond water and its relation with fluctuation of plankton are of great importance and basically essential in fish culture. Fishes are dependent on physico-chemical parameters. Any change of these parameters may affect the growth, development and maturity of fish (Jhingran, 1985).

Phytoplankton is the major primary producers in many aquatic systems and is important food source for other organisms (Sukumaran et al,

2008). Phytoplanktons not only serve as food for aquatic animal, but also play an important role in maintaining the biological balance and quality of water (Pandey et al.). Zooplankton constitutes important food item of many fishes. The larva of carps feed mostly on zooplankton (Dewan et al,1977). Zooplankton also plays an important role in the food chain, as they are second in trophic level as primary consumers and also contributors to next trophic level(Quasim,1977). The productivity of freshwater community that determines the fish growth is regulated by the dynamics of its physico-chemical and biotic environment (Wetzel, 1983). The pH, dissolved oxygen, alkalinity and the dissolved nutrients are important for the phytoplankton production (Bais & Agarwal, 1990). Plankton diversity responds rapidly to change in the aquatic environment particularly in relation to nutrients.

MATERIALS AND METHODS

The study was conducted during July 2009 to June 2011.

Water samples were collected from ten locations randomly. Analysis of water samples were done following standard methods (APHA, 1995) and Trivedy & Goel(1984). Plankton samples for this study were collected with plankton net made of bolting silk cloth no.25 (mesh size: 0.03-0.04mm).Plankton net was used to collect plankton samples once in every month. Phytoplankton samples were preserved in Lugol's iodine solution, while zooplankton samples were preserved in 4% formalin solution and then transported to laboratory for plankton analysis (Lackey, 1938)

The preserved samples were allowed to settle for 24 hrs and the surface water free of phytoplankton was siphoned out until the sample was reduced to 10ml. 1ml is pipetted from 10ml after shaking in to a sedwick rafter counting cell and mounted on microscope. The phytoplankton were counted and then identified. The volume of water filtered was calculated using the formula: $\pi r^2 h$. r = radius of the net used

h = the distance of trawling

The actual number of each phytoplankton group/lit. of water filtered was calculated. This was then converted to number of individual group per cubic meter (m^3).

The zooplankton samples were analyzed in similar way like that of phytoplankton. The identification of plankton species was done with the aid of plankton identification key and monographs (Needham and Needham, 1962) , Tonapi (1980), Battish (1992) and Bellinger (1992).

Pond water was collected from various depths by using boat and was collected to laboratory and analysis of water samples were done following standard methods (APHA, 1992), Trivedy and Goel (1984).

RESULTS AND DISCUSSION

Depth

Minimum water depth was recorded during summer, which shows an increasing trend from July onwards and attained peak during August-September, followed by a gradual decreasing trend till May-June. The water depth in Pond NO.1 was highest (av. 3.26 m) and that at Pond No.6 was lowest (av. 1.41 m).

Transparency

Water transparency is an important factor that controls the energy relationship at different trophic levels. It is essentially a function of reflection of light from the surface and is influenced by the absorption characteristics of both of water and of its dissolved and particulate matter (Stepane,1959). Very high fluctuation of transparency was observed in Pond No.6 followed by others in decreasing order. From October to April, the poor to medium transparency were mainly caused by the abundance of zoo and phytoplankton population. The Murabasti ponds, which showed minimum transparency fluctuation, were most productive. In Pond No.6 transparency was very high (80-200cm) during initial period and the pond was very unproductive due to poor availability of plankton in pond water. A very high transparency, therefore, indicate the unproductive nature of water. Water transparency in the range of 20-50cm was found to be conducive for fish ponds.

Table 1: Physico-chemical parameters of Ten ponds of Lumding of Nagon district of Assam , India, during July2009-June 2011 (units in mg/l \pm Standard Deviation, unless otherwise mentioned). MEAN mg/l \pm SD

Parameter	Pond 1	Pond 2	Pond 3	Pond 4	Pond 5	Pond 6	Pond 7	Pond 8	Pond 9	Pond 10
Depth	2.2-4.5(3.3)	1.8-3.4 (2.5)	1.82-3.45 (2.52)	1.9-3.2 (2.5)	2.19-4.6 (3.26)	0.78-2.2 (1.4)	1.82-3.45 (2.5)	2.18-4.57 (3.26)	2.3-4.6 (3.2)	2.4-4.5 (3.4)
Transparency(cm)	24.2-39 (31.0)	25.6-42.2 (35.2)	18-35 (26.0)	25.7-42.0 (35.2)	17.5-35.5 (25.6)	31.6-36.0 (51.4)	18.0-35 (25.5)	18.4-34.8 (26.0)	17-35 (26.0)	25.6-42 (31.0)
Water temp°C	18-32 (26.6)	18.4-31.6 (27.6)	18-32 (26.6)	18-31.6 (27.0)	18-32 (26.0)	18-31.4 (26.4)	18-30 (25.5)	18-32 (27.0)	18-31 (25.6)	18.4-31.6 (28.0)
DO(ppm)	3.2 \pm 1.2	2.5 \pm 0.3	7.2 \pm 0.2	8.8 \pm 0.2	5.0 \pm 0.4	6.9 \pm 0.3	6.2 \pm 0.6	5.3 \pm 2.1	6.0 \pm 0.4	6.5 \pm 0.4
pH	7.1 \pm 0.2	8.5 \pm 0.7	8.4 \pm 0.4	7.1 \pm 0.06	6.6 \pm 0.8	6.9 \pm 0.4	6.2 \pm 0.9	7.7 \pm 0.4	6.1 \pm 1.1	8.0 \pm 0.4
Total alkalinity(ppm)	12.5 \pm 0.5	16 \pm 1.7	16 \pm 0.1	7.9 \pm 0.2	9.4 \pm 1.2	9.8 \pm 0.6	12.4 \pm 1.8	17 \pm 4.8	11.2 \pm 1.6	20.2 \pm 1.1
Free CO ₂ (ppm)	10 \pm 0.2	10.5 \pm 0.2	abs	3.9 \pm 2.9	7.7 \pm 1.2	12.7 \pm 2	7.6 \pm 2	22 \pm 3.5	15 \pm 1.7	12.2 \pm 1.2
T.Hardness(ppm)	1.3 \pm 0.2	1.3 \pm 0.2	1.6 \pm 0.1	1.5 \pm 0.2	1.4 \pm 0.3	1.2 \pm 0.2	1.5 \pm 0.08	1.36 \pm 0.26	1.5 \pm 0.08	1.3 \pm 0.1
Sp.Con.(μ mhos/cm)	123.2 \pm 2.9	142 \pm 4.9	93.2 \pm 2.4	247 \pm 64.3	142.3 \pm 4.9	150.9 \pm 7.5	93.2 \pm 2.9	123.2 \pm 2.9	142.3 \pm 4.9	123 \pm 3
TDS(ppm)	145.4 \pm 60.5	220 \pm 129	215.7 \pm 128.5	139.3 \pm 86.7	218.8 \pm 20.6	145.4 \pm 60.5	201 \pm 153.7	209 \pm 128	220 \pm 129	87.6 \pm 36.7
BOD(ppm)	5.5 \pm 0.1	4.2 \pm 0.4	4.3 \pm 0.3	2.0 \pm 0.13	2.5 \pm 0.06	3.5 \pm 0.08	3.6 \pm 0.13	3.1 \pm 0.1	3.3 \pm 0.08	2.4 \pm 0.06

Table 2: Plankton Composition in the water sample of Ten Semi-intensive fish culture ponds during July 2009-June 2011.

Parameter	Pond 1	Pond 2	Pond 3	Pond 4	Pond 5	Pond 6	Pond 7	Pond 8	Pond 9	Pond 10
Chlorophyceae										
1. Spirogyra	4	3	11	2	4	2	1	5	2	3
2. Chlorella	92	33	24	10	12	12	10	14	8	10
3. Ulothrix	2	6	-	-	2	3	1	6	2	4
4. Chlamydomonas	15	5	-	4	-	-	2	3	8	3
5. Volvox	10	15	22	11	4	20	15	11	14	10
6. Endorhina	-	12	-	2	3	1	1	2	-	2
7. Microcystis	20	12	10	6	4	4	6	4	8	2
8. Oedogonium	22	-	16	-	1	2	8	9	7	2
9. Closterium	-	2	13	1	-	-	2	4	-	-
Cyanophyceae										
1. Oscillatoria	5	22	11	4	2	2	5	5	4	2
2. Nostoc	42	5	12	21	1	2	10	8	9	-
3. Anabaena	5	24	20	1	2	-	-	3	2	4
4. Gloeotrichia	3	-	-	-	-	-	-	1	3	1
5. Spirulina	5	4	2	4	1	2	2	1	-	-
Euglenophyceae										
1. Euglena	12	4	5	8	2	1	2	-	1	1
Zooplankton(No. sp ⁻¹)										
Rotifers.										
1. Branchionus rubens (male & female)	2	2	6	2	3	5	2	-	2	2
Protozoans										
1. Paramoecium	12	10	8	4	2	7	4	4	2	1
2. Giardia	11	21	5	2	1	4	2	2	1	-
3. Amoeba	12	-	12	2	4	6	2	-	2	2
Copepods										
1. Cyclops	25	35	13	25	16	15	11	12	10	11
Cladocera										
1. Daphnia	28	12	14	16	50	35	21	22	23	38
2. Ceriodaphnia	11	2	-	2	-	-	2	1	3	-

Temperature

The water temperature at different location of Lumding ranged from 18-32°C with mean value of 26.5°C, 26°C, 27°C, 26°C, 26.5°C, 25°C, 26.4°C, 27°C, 25°C and 26°C respectively. The water temperature remained below 20°C for two months (December and January). The water temperature of the ponds remained within the range of 20-32°C for about ten months in a year. The comparative higher temperature in tropical waters than in temperate region is considered to be beneficial for higher productivity in the former. The average water temperature of the ponds at different locations ranged between 25-27°C. In the present study, it was generally noted that the growth of carps was optimum in the temperature range of 23-30°C.

Dissolved Oxygen

The dissolve oxygen is the most important and critical parameter requiring continuous monitoring in aquaculture production systems. This is due to the fact that fish aerobic metabolism requires dissolved oxygen (Timmons et al.2001). The dissolved oxygen content of ten ponds ranged

from 2.5-8.8ppm. Dissolve oxygen was higher during winter and lower during summer months. Bhowmick (1968), Jana(1973) and Chakraborty (1980) recorded a fluctuation of dissolve oxygen content in their experimental ponds located at West Bengal. During summer, when the temperature was high, fishes in some ponds at Lumding started surfacing during early in the morning when the oxygen content fell below 2.0ppm.

pH

The pH of water at different selected ponds ranged from 6.1-8.5. Pond No 2,3 and 10 were slightly alkaline whereas Pond No 5, 6, 7 and 9 were slightly acidic rests are within range. A slightly alkaline water (7.2-8.0) may be considered conducive for fish production. Nees (1946) and Banerjea (1967) observed the variation in water pH from 7.1-8.0 as optimum for fish production.

Total alkalinity

The total alkalinity of ten ponds of Lumding ranged from 7.9-20.5. Total alkalinity was minimum during the rainy day and maximum during

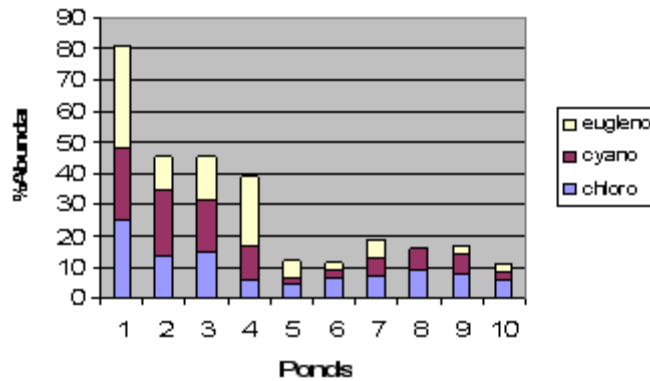


Fig. 1: Percentage abundance of major phytoplankton taxa in ponds 1-10

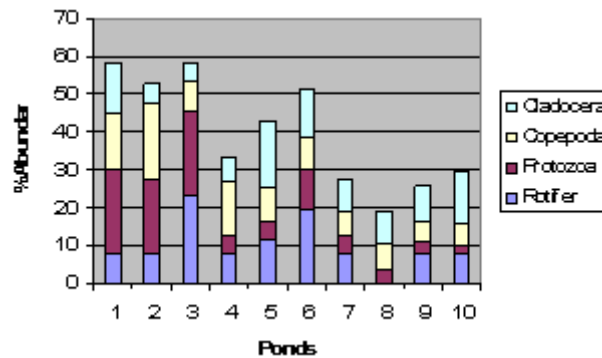


Fig. 2: Percentage abundance of major zooplankton taxa in ponds 1-10

summer season. However the total alkalinity is very low, indicating a paucity of carbonates. It implies that people would have to subject the water to treatment before fish farming as the changes of total alkalinity were influenced not only by climatic factors such as temperature and rainfall but also by fish culture practices such as liming and fertilization. Total alkalinity less than 100mg/l is not suitable for fish culture (Scroeder, 1980, Banerjea 1967).

Free Carbon dioxide

The free CO₂ content in ponds at ten centres ranged from 3.9-22mg/l. To maintain a moderate level of CO₂ in pond water, organic manures were applied uniformly at a regular interval to all the centres. But in the pond No 3 free carbon dioxide was absent. Absence of free carbon dioxide is due to its utilization by algae during photosynthesis or carbonate present (Manjare et al. 2010).

Total Hardness

The total Hardness (Calcium +Magnesium hardness) at ten ponds ranged from 3.1-8.0 ppm The growth of plankton and fish were low as hardness was very low. Lakshmanan et al (1967) also recorded poor production of plankton and fish in acidic ponds in Assam having poor calcium content.

Total Dissolved Solids

Electrical conductivity can be used as an index of TDS (Sreenivasan,1964). TDS may consists of different kinds of nutrients and minerals.High amount of total dissolved solids was observed in pond no 9 during survey period.The total dissolved solids in ten ponds of Lumding fluctuated between 87-220 ppm. Highest value was recorded during October and lowest was recorded in June.

Specific Conductivity

Conductivity is an important parameter to determine the quality of water. The specific conductivity of ten ponds ranged from 93-247 umhos/cm.The maximum conductivity was recorded during summer season while minimum during winter season. Bhatt et al. (1999) observed the highest conductivity values in the month of May and lowest in the month of December from Taudaha

lake. The specific conductivity of a freshwater pond should be in the range of 24-600 umhos/cm for optimum fish production and if less than 100 umhos/cm the pond might be poorly productive.

Biological Oxygen Demand

The BOD of ten ponds ranged from 0.6-7.2 mg/l. The normal level of Biological oxygen demand is 1.4-2.4 ppm. BOD is an indicator of organic pollution. BODs were more or less low in all the ten ponds of Lumding, which indicates low level of organic pollution of pond water.

Plankton composition was studied as the productivity of pond depends on plankton community. Plankton community is a heterogenous group of tiny plants (phytoplankton) and animals (zooplanktons) adapted to suspension in the sea and freshwater.

Phytoplankton and Zooplankton

The phytoplanktons of Assam beels were found very low except few beels. This was due to heavy growth of macrophytes, whereas availability of phytoplankton's in the West Bengal beels ranged from 396-14987UL⁻¹ (Sugunan, 2000). Quality composition of phytoplankton's also varied in the beels of Assam and West Bengal. It varied from beel to beel and no definite pattern was followed. The phytoplankton's comprises major portion in the pond. The basic process of phytoplankton production was dependent upon temperature, turbidity and nutrients as reported by Sreenivasan et al.(1979) and Sukumaran and Das(2002).The phytoplankton belonging to division Chlorophyceae and Cyanophyceae are predominant over the others. During the study period, a total of 1195 genera were observed among them 573 were phytoplankton and remaining 622 were Zooplankton. The phytoplankton's present in different divisions were chlorophyceae (515), cyanoplyeae (262) and Euglenophyceae(36). A total of 622 Zooplankton were observed among them Rotifers (26), protozoans (143), copepoda (173) and cladocera (280).

CONCLUSION

Quality of an ecosystem depends on the physico-chemical characteristics and biological

diversity of the system (Tiwari and Chauhan, 2006). Table 1 depicts the chemical variables of the water of ten ponds selected for study. The study clearly showed that the productivity of the ponds varied significantly depending upon the climatic conditions and their hydro biological and soil qualities. Pond No. 10 having high transparency, poor alkalinity was least productive whereas Pond No 5 having normal pH, Alkalinity having favourable physico-chemical conditions was highly productive. The physico-chemical characteristics of ten ponds are given below in Table 1.

Variations in percentage occurrence of major phytoplankton taxa in ponds 1 to 10 are shown in Fig 1. Major taxa present are Chlorophyceae, Cyanophyceae and Euglenophyceae. Among the three groups Chlorophyceae is present in all ponds. Euglenophyceae is totally absent in Pond 8. Cyanophyceae is present in Pond 5 and 6 in very low percentage. Planktonic algae are particularly sensitive to chemical changes and myriad environmental conditions promote the development of the algal spores present in the sediment (Rodhe, 1948). Chlorophyceae and Cyanophyceae are the most common group of phytoplankton in the ponds studied.

Variations in percentage occurrence of major zooplankton taxa in ponds 1 to 10 are shown in Fig 2. Major taxa are Rotifers, Protozoa,

Copepoda and Cladocera. Among the four groups Protozoa, Copepoda and Cladocera are present in all ponds. Rotifers are present in nine ponds but totally absent in pond 8. Protozoa is the most common group of zooplankton in the ponds studied but in pond 4, 5, 7, 8, 9, and 10 in low percentage whereas Cladocera are present in highest number than others. The highest phytoplankton abundance was found in August. The highest abundance of Zooplankton was recorded in July and lowest value was recorded in November.

The details of pond ecosystem in Luming of Nagaon district, Assam has not been studied earlier and perfect accounts of physico-chemical and biological aspects are not available and no such type of studies on fish culture in relation to water quality have been carried out here. Therefore, the present studies have been conducted, focusing monitoring of water quality and fish food organism of some semi-intensive fish culture ponds.

The present findings indicate that water quality of all the ten ponds have good potential for fishery practice. The small rural ponds can be a very good source of income from fishery which can be augmented with scientific management as small ponds are more manageable and high yielding than larger ones. Hence it is necessary to protect and conserve these small water bodies. This demands immediate action from fishery biologists, planners and policy makers.

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