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Certain limno-chemical characteristics and commercial fish catch in monoha beel ecosystem, Morigaon, India.

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Abstract

A detailed study of the limno-chemical characteristics of *Monoha beel* was conducted at four study sites at four seasons viz – Premonsoon, Monsoon, Retreating monsoon and winter of 2011 and 2012. A direct relationship of air temperature with water temperature, depth, transparency and dissolved oxygen and pH with chloride, carbonate and free carbon dioxide were recorded during the study period. The *beel* water found slightly alkaline throughout the study period. A total of 47 phytoplankton genera belong to 14 genera of Chlorophyceae, 11 genera of Cyanophyceae, 19 genera of desmids, 2 genera of Euglenophyceae and 1 genera of Dinophyceae were recorded. A total of 27 genera of zooplankton were recorded of which 13 genera belong to Rotifera, 6 genera belong to Copepoda, 5 genera belong to Cladocera and 3 genera belong to Protozoa. 54 species of fishes belong to 19 families were recorded of which Cypriniformes were the dominant group. Total fish catch during 2011 was 11114 kg and during 2012 was 26239kg. The average annual fish catch from *Monoha beel* has been estimated 152.3 kg/ ha/yr (Total 11114 kg) in 2011 and 359.5 kg/ha/yr (total 26239 kg) in 2012. The result of group catch shows that the composition of Indian Major carp ranged between 10.1% and 16.43% , Minor carp 27.37% and 62.22%, Cat fish 7.99% and 29.19%, Feather back 2.51 and 3.06%, Exotic carp 1.82% and Miscellaneous group 13.72 and 31.11%. On the basis of present findings it can be concluded that *Monoha beel* eco- system is suitable for fish culture.

Keywords: Limno-chemical characteristics, fish diversity, monoha beel ecosystem.

1. Introduction

Every organism is unique in its characteristics and contributes to the ecological equilibrium. Interaction of species with abiotic environment and biotic communities need to be studied in order to enhance fish stock and to formulate suitable measures for resource management (Das & Chand, 2003). Biodiversity is also essential for stabilization of ecosystem, protection of environmental quality and for understanding intrinsic worth of all species on the earth. The species diversity of an ecosystem is often related to the amount of living and non-living organic matter present in a particular environment and their interactions. Wetlands are water bodies of diverse origin, size, shape, depth, inundation pattern, ecological characteristics etc. The limno-chemistry of Wetlands that are susceptible to several anthropogenic factors is poorly understood. Thus the present study was undertaken to assess different physico-chemical characteristics of *Monoha beel* water, its plankton population and also the annual commercial fish catch of the beel.

2. Morphometry of the study sites

Monoha beel is situated 14 Km South-West from Morigaon town, Assam, at Latitude $26^0 12^{'} 10^{''}$ N, Longitude 92^0 $09^{'} 53^{''}$E.. The total catchment area of the beel is 73ha, maximum depth of the beel is 7.4m,

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mean depth of the beel is 4.2m, maximum width of the beel is 1128m and maximum length of the beel is 2400m.It is a closed system except during monsoon season, the beel inundates nearby rice fields and joins with other beels of the area viz, Pakoria, Debika, Saru Monoha and Garanga.

3. Materials and methods

A detailed study of the limno-chemical characteristics of *Monoha beel* was conducted at four study sites at four seasons viz – Premonsoon, Monsoon, Retreating monsoon and winter of 2011 and 2012.Water samples were collected from the sampling sites S_1, S_2, S_3 and S_4 and analysis was done following the standard methods of APHA (2005). The methodology used for analysis of phytoplanktonic and zooplanktonic communities and for species categorization is based on the works of Needham and Needham (1986), Battish (1992) and Datta Munshi *et al.,* (2010). Commercial fish catch study was based on daily landing. The methodology for identification of fishes was based on the works of Talwar and Jhingran (1991), Viswanath (2002) and Jayaram (2010).

4. Results - air and water temperature

Temperature is one of the most important physical factor which regulates natural processes in the environment. Air and water temperature varied between 30.3 and 32.0 °C in pre-monsoon period, 31.9 to 33.4 °C in monsoon period, 29.5 to 31.0 °C in retreating monsoon period and 20.5 to 22.6 °C in pre-monsoon period, 30.3 to 30.7 °C in monsoon period, 24.2 to 25.0 °C in retreating monsoon respectively. Increased solar radiation due to comparatively longer day length may explain gradual increased in both air and water temperature from June/ 2011 to September/2011. Maximum record of water temperature in these months may also be attributed to the low macrophytic production and highest load of suspended matter.

4.1 Depth

Depth varied between 3.3m–7.4m during monsoon period in Monoha beel ecosystem. The first annual increase was recorded from June to September with highest value in August, followed by a decline up to February. Fall in water level from December to March was associated with evaporation of water and increasing trend of air temperature. Lowest water level was recorded in February with water temperature 22.6 ^{0}C.

4.2 Transparency

The transparency values ranged between 31.2 cm to 61.0 cm, remained low during June to September and comparatively high in November to February may be due to decline and decomposition of submerged macrophytes. Erosion or movement of soil by biotic or abiotic factors and increased production of plankton may explain low values recorded in April, May, June, July and August.

4.3 pH

Among biotic factors, higher photosynthetic activity due to increased production of submerged macrophytes may support an increase in P^H observed from June to December. Presence of wide range of p^H is due to the presence or absence of free carbon dioxide, carbonate and macrophytic diversity during study periods. Low level of carbonate and presence of free carbon-dioxide (1.5–2.1 mg/l) may explain low value of P^H recorded during March to June (Table-1). Similarly, high level of free carbon-dioxide and high level of carbonate (0.7-1.2 mg/1) may explain the higher value of P^H (7.7-7.9) noticed from June to December.

4.4 Dissolved oxygen

Dissolved oxygen in Monoha beel ecosystem varied between 5.0 mg/1 (October) – 8.8 mg/1 (July). dissolved oxygen concentration remained low during October to January and higher from June to September. Low level of free carbon-dioxide from October to January appears as an additional factors explaining present increase of dissolved oxygen from June to September (7.5-8.8 mg/1).

4.5 Free carbon-dioxide

Free carbon-dioxide was very low from October to January (3.2-5.3mg/l) and high in between June and September (6.2-8.7mg/l). The value ranged from 3.2 to 8.7 mg/1. High level of free carbon-dioxide from June to September in the beel appears to be the effect of gradual rise in temperature and accelerating the decomposition of organic matters and its influx through rain water.

4.6 Chloride

The chloride values ranged from 9.94mg/1 to 12.78 in pre-monsoon, 7.81 to 9.23mg/l in monsoon and 15.6 to 21.3mg/l in retreating monsoon period.

Chloride content was lowest in retreating monsoon period and highest in monsoon period. Highest values of chloride from June to September, with annual highest value in the month of August.

4.7 Carbonate

The carbonate values showed a range from 0.1-1.2 mg/1. Carbonate was highest in monsoon period (0.7-1.2mg/l). The present study showed a direct relationship of carbonate with free carbon-dioxide.

4.8 Suspended matters

The suspended matter varied between 9.2 mg/1 to 58.8mg/l. The higher values of suspended matter recorded from June to September with highest in August. This peak in suspended matters is attributed to the re-suspension of soft sediments by biotic interferences. Comparatively low values of suspended matter from march to May related with the presence of thick mats of submerged macrophytes present in the beel.

Table 1 : Physico-chemical characteristics of Monoha beel water

Water parameters	Pre-monsoon	Monsoon	Retreating monsoon	Winter
Air temperature (°C)	31.5 ± 1.02	34.5 ± 2.72	30.3 ± 0.91	23.7 ± 1.07
Water temperature (°C)	20.4 ± 0.99	22.1 ± 1.81	20.0 ± 0.76	18.0 ± 0.23
Depth (m)	3.6 ± 0.29	5.6 ± 0.16	5.2 ± 0.11	2.9 ± 0.18
Transparency (cm)	42.4 ± 0.72	25.5 ± 2.58	39.6 ± 0.71	57.8 ± 2.45
pH	7.3 ± 0.27	7.9 ± 0.08	7.8 ± 1.10	7.7 ± 0.10
FCO_2 (mg/l)	5.3 ± 1.1	6.2 ± 0.5	8.7 ± 0.04	3.2 ± 0.2
DO (mg/l)	7.5 ± 0.11	8.8 ± 0.10	5.0 ± 0.31	7.1 ± 0.60
Chloride (mg/l)	10.9 ± 1.31	17.46 ± 2.08	7.2 ± 0.57	8.93 ± 0.16
Carbonate (mg/l)	0.1 ± 0.01	1.1± 0.08	0.1± 0.01	0.1 ± 0.01
Suspended Matter(mg/l)	12.1 ± 0.11	56.0 ± 0.71	50.3 ± 0.19	30.2 ± 0.22

Table-2 : Phytoplankton species identified in Monoha beel

Class	Sl. No.	Genera
Cyanophceae	1.	*Microcystes* sp.
	2.	*Synechococcus* sp.
	3.	*Aphanothece microscopica*
	4.	*Aphanocapsa sp.*
	5.	*Oscillatoria subbrevis*
	6.	*Oscillatoria curviceps*
	7.	*Nostoc sp.*
	8.	*Anabaena sphaerica*
	9.	*Lyngbya sp.*
	10.	*Scytonema* sp.
	11.	*Rivularia manginii*

Chlorophyceae	12.	*Docidium* sp.
	13.	*Chaetophora* sp.
	14.	*Microspora* sp.
	15.	*Chlorella* sp.
	16.	*Scendesmus armatus*
	17.	*Scendesmus quadricauda*
	18.	*Volvox aureas*
	19.	*Pediastrum* sp.
	20.	*Ulothrix* sp.
	21.	*Oedogonium* sp.
	22.	*Spirogyra* sp.
	23.	*Cladophora* sp.
	24.	*Bulbochaet*e sp.
	25.	*Penium* sp.
Bacillariophyceae	26.	*Closterium parvulum*
	27.	*Closterium rostratum*
	28.	*Closterium eherenbergii*
	29.	*Closterium setaceum*
	30.	*Euastrum inermius*
	31.	*Euastrum ansatum*
	32.	*Micrasteria foliacea*
	33.	*Micrasteria furcata*
	34.	*Staurastrum* sp.
	35.	*Spondylosium pulchellum*
	36.	*Synendra acus*
	37.	*Ankistrodesmus falcatus*
	38.	*Synedra ulna*
	39.	*Acanthes* sp.
	40.	*Caloneis* sp.
	41.	*Navicula* radiosa
	42.	*Pinnularia* sp.
	43.	*Cymbella* sp.
	44.	*Mastogloia* sp.
Euglenophyceae	45.	*Euglena viridis*
	46.	*Phacus caudata*
Dinophyceae	47.	*Ceratium*

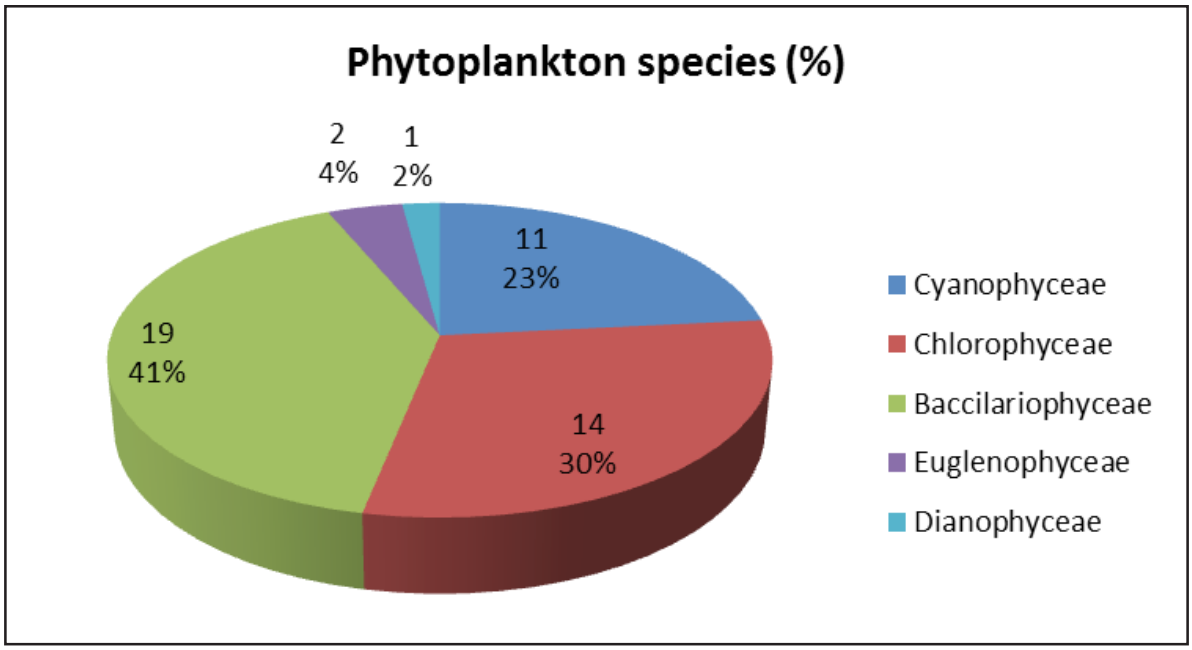


Table-3 : Zooplankton species recorded in Monoha beel

Class	Sl. No.	Genera
Protozoa	1.	*Amoeba* sp.
	2.	*Paramoecium* sp.
	3.	*Euglena* sp.
Rotifera	4.	*Brachionus angularis*
	5.	*Brachionus caudatum*
	6.	*Keratella tropica*
	7.	*Keratella cochlearis*
	8.	*Keratella procurva*
	9.	*Trichochera cilindrica*
	10.	*Trichochera eherenberg*
	11.	*Filinia bory*
	12.	*Filinia Zacharias*
	13.	*Polyarthra* sp.
	14.	*Moostyla Ehrenberg*
	15.	*Testudinella* sp.
	16.	*Lecane cornuta*
Cladocera	17.	*Ceriodaphnia* sp.
	18.	*Eurycerus* sp.
	19.	*Bosmina* sp.
	20.	*Moina* sp.
	21.	*Daphnia* sp.

Copepoda	22.	*Nauplii* sp.
	23.	*Cyclops muller*
	24.	*Mesocyclops* sp.
	25.	*Neodiaptomass* sp.
	26.	*Eucyclops* sp.
	27.	*Heliodiaptomus* sp.

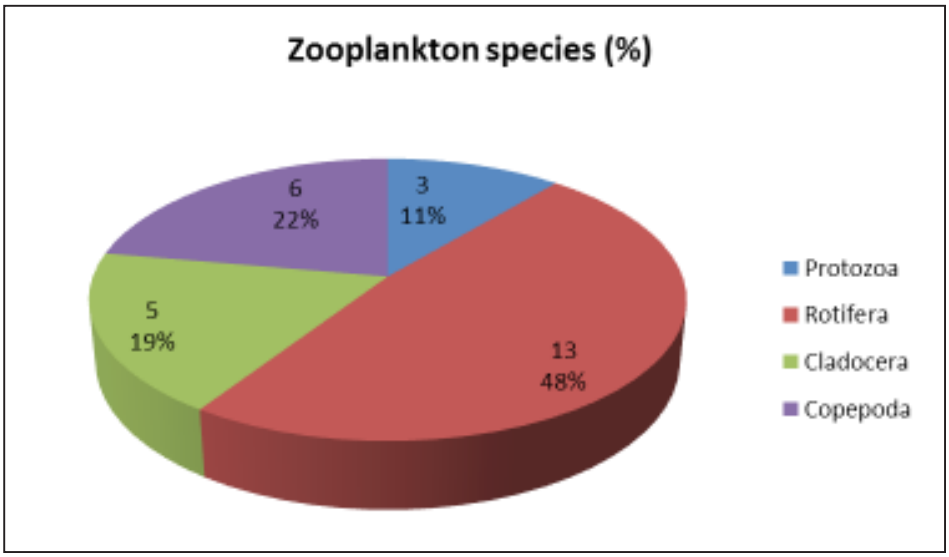
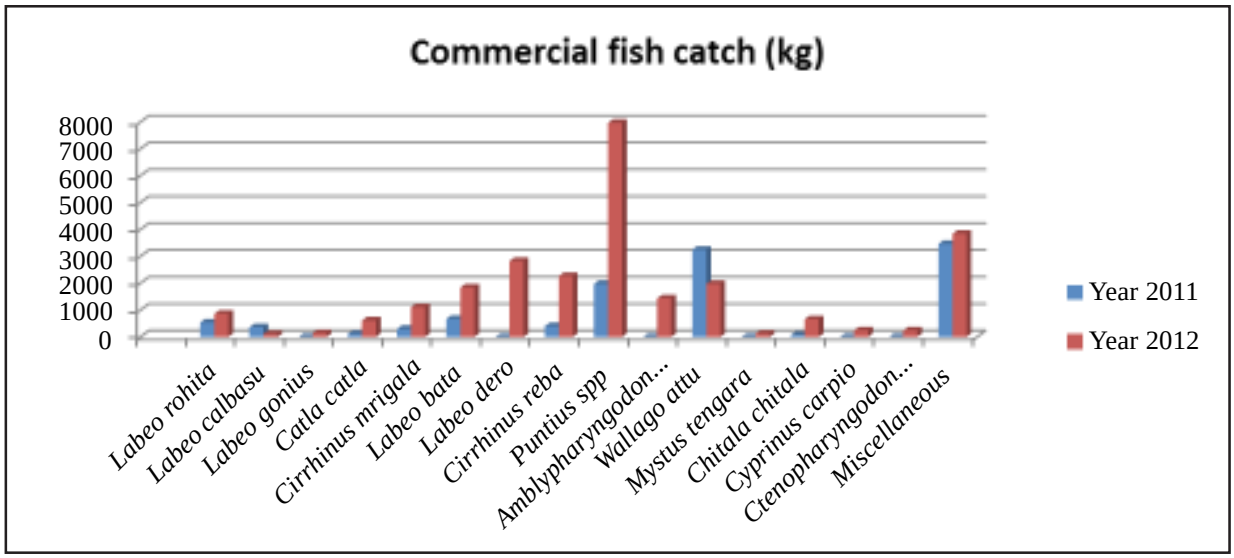


Table-4 : Commercial Fish catch composition

Sl. No.	Specis	Total catch (kg)			
		Year 2011	**%**	**Year 2012**	**%**
1	*Labeo rohita*	537	4.83	860	3.27
2	*Labeo calbasu*	359	3.23	107	0.4
3	*Labeo gonius*	0	0	148	0.56
4	*Catla catla*	107	0.96	614	2.34
5	*Cirrhinus mrigala*	296	2.66	1108	4.22
6	*Labeo bata*	666	5.99	1839	7
7	*Laeio dero*	0	0	2824	10.76
8	*Cirrhinus reba*	400	3.59	2263	8.62
9	*Puntius spp*	1974	17.76	7967	30.36
10	*Amblypharyngodon mola*	2	0.01	1435	5.46
11	*Wallago attu*	3245	29.19	1977	7.53
12	*Mystus tengara*	0	0	121	0.46
13	*Chitala chitala*	70	0.62	660	2.51
14	*Cyprinus carpio*	0	0	242	0.92
15	*Ctenopharyngodon idella*	0	0	238	0.9
16	Miscellaneous	3458	31.11	3836	14.61
		11114		**26239**	



5. Discussion

Temperature is one of the most important physical factor which regulates natural processes within the environment. Due to shallowness of experimental sites, the water temperature has shown a tendency to follow closely the atmospheric temperature. This type of observation for shallow water bodies is in conformity with the earlier findings of Reid and Wood (1976) and Malhotra *et al.*, (1986-87). Increased solar radiation due to comparatively longer day length may explain gradual increase of water temperature.

Monsoon and inflow of water from watershed may explain annual increase and spread of water. Similarly, the effect of summer rains is attributed to slight rise in water level recorded during June to September. Rise in water level during monsoon and summer rains has also earlier been reported by Dutta (1978) and Malhotra *et al.*, (1986-87). Fall in water level from October to March was associated with evaporation of water.

The transparency values ranged between 31.2 cm (July)- 61.0 cm (January), remained low during June to September and comparatively high from October to February. Decline and decomposition of submerged macrophytes takes place during this period. Agitation by biotic interferences and increased production of plankton may explain low values recorded in June. Increase in suspended matter during macrophytic decomposition is reported earlier by Sahai and Srivastava (1976). The relationship of turbidity with vegetation has also earlier been reported by Robel (1961).

Dissolved oxygen in Monoha beel varied between 5.0 mg/1– 8.8 mg/l). Dissolved oxygen concentration remained low during October to February and higher from March to September. Winter rise in dissolved oxygen has also earlier been worked out by Singh *et al.*, *(*1980) and Rao (1983) and it appears to be due to its greater solubility, reduced microbial decomposition of dead organic matter at low temperature and growth of submerged macrophytes, dissolved oxygen enrichment with increased production of submerged macrophytes is also reported by Sahai and Srivastava (1976) and Kalita *et al.*, (2006).

Wide range of annual p^H, free carbon dioxide, carbonate, and macrophytic diversity in Monoha beel ecosystem during the study period may be due to the decomposition and production of macrophytes and photoperiod also reported by Jhingran (1982). Among biotic or abiotic factors, higher photosynthetic activity, increase in water level and suspended matter, fall in transparency and low dissolved oxygen may explain low values of P^H recorded during the study period. Present summer increase in chloride is in conformity with the earlier observations of Munawar (1970) and Harshey *et al.*, (1982).

44 genera of phytoplankton were recorded during the study, of which 11 genera belong to Cyanophyceae, 14 genera belong to Chlorophyceae and rest of 19 genera belongs to Desmids. 27 genera of zooplankton were identified, among which 16 genera belongs to Rotifera, 5 Cladocera and 6 Copepoda. Phytoplankton populations were maximum during pre-monsoon, moderate during monsoon and retreating monsoon and minimum in winter. Zooplankton population were maximum in winter

season and minimum in monsoon season.

The result showed that total catch of *Monoha beel* in 2011 was 11114 kg (153 kg/ha/yr) and in 2012 total catch was 26239 kg (360 kg/ha/yr). The fish production of *Monoha beel* showed higher than average production from beels mentioned by Dutta and Lahon, (1987) and Chandra, (2010) as 160 kg/ha/yr and 172 kg/ha/yr.

In *Monoha beel* small fishes provide forage base for the development of predatory cat fishes, feather back etc. so the recruitment of commercially important carps and other fish catch were affected. Similar observations were also made by Acharjee (1997).

Fishery resources in Assam, particularly beel fisheries are facing resource depletion due to man – made environmental degradation with lack of proper scientific management, harvesting processes such as use of improper gears which kills juvenile and brood fishes, use of water for irrigation purpose, blocking of connecting channels, off season cultivation etc. Similar practices were also reported by Acharjee (1997).

Smaller fishes like minor carps ranged between 27.37% and 62.22% in *Monoha beel* Composition of Indian major carp ranged from 10.1% to16.43%. Water retention capacity (Depth), connection with the Parent River and composition of floating macrophyte may play some role behind it. It was observed that the sites infested with water hyacinth has low catch result of smaller fishes but with more catch of comparatively large sized fishes as was also reported by Mc Vea and Boyd (1975), Twongo and Howard (1998) and Sterner (2009). The reason behind it may be due to these larger carnivorous fishes were attracted by the smaller ones sheltered under the floating roots of water hyacinth. For new recruit of fishes and species diversity seasonal flood and connectivity seems to play a major role. It was observed that during rainy season good stock of fishes from Brahmaputra river enter this wetland via different other wetlands of the area. The flood also carried some exotic carps from the domestic culture pond. So, the presence of common carp and grass carp can be explained. Similar observations were also made by Slipke and Maceina (2005) and Ickes *et al.*, (2005).

6. Conclusion

From the study it can be concluded that the limno-chemical conditions of *Monoha beel* water is suitable for fish production. Seasonal flood plays an important role in annual commercial catch of the beel. Phytoplankton, zooplankton and fish fauna or ecological parameters and faunistic composition indicates that the beel is conducive for fish culture. Pan culture and cage culture can be suggested for live fish production.

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