ASSESSMENT OF PHYSICO-CHEMICAL PARAMETERS OF DIHING RIVER-TRIBUTARY OF ALMIGHTY BRAHMAPUTRA, ASSAM, NE INDIA

Bhenila Bailung* and S.P. Biswas
Dibrugarh University, Assam-786004
*Corresponding Author

Abstract
Water quality of Dihing river, a tributary of the Brahmaputra, was assessed for fish production. In spite of various human activities such as disposal of sewage and input of fertilizers from paddy fields, less eutrophication was noticed in the Dihing river. Water qualities parameters were found almost within the desirable limits of standard indexes of BIS (1983). Fish culture was also observed during the study period by different fisherman folks and self-help groups.

Key words: Dihing river, abiotic parameter, fish culture

INTRODUCTION
A suitable environment is necessary for any organism since life depends upon the continuous exchange of necessary components with the surrounding environment (Chetia 2014). A wide array of physical and chemical factors affect lentic and lotic freshwater (Sharma and Biswas 2014), which alter number and diversity of their fauna. Physico-chemical factors of the aquatic habitat not only affect health of fishes but also their maturity and breeding cycle.

This study was aimed to assess physico-chemical parameters of Dihing river for fish culture and domestic use purpose. The main aim of the present work is to develop a structure for the better growth and management of fish production.

MATERIALS AND METHODS

Study area: Dihing river is the largest south-bank tributary of the Brahmaputra. It originates from the Patkai hills in Nagaland (close to Indo--Myanmar border) and flows through Tinsukia and Dibrugarh district of Assam to its confluence with the Brahmaputra at Dihingmukh. The catchment area of the river is about 6000 km² and runs through the plains of Assam valley for about 300 km before joining the Brahmaputra river (Sarma et al. 1986).

Water Sampling: Regular sampling of water was done from three sites of the river. In all the stations, human activities especially, fishing was observed. A total of 11 abiotic parameters like total alkalinity (TA), dissolved oxygen (DO), free carbon-dioxide (FCO₂), total suspended solid (TSS), total dissolved solids, air and water temperature, water current, pH and transparency were measured following standard protocols of APHA (1998), Trivedy et al. (1987) and digital gadgets. All the analysis was done in the laboratory of Fish & Fisheries in Dibrugarh University, Assam, India.

RESULTS
The water temperature of river fluctuated seasonally. Since no significance difference was found between stations and so, all the data were combined and considered the average value (Fig. 1). The mean atmospheric temperature (AT) was found maximum (28.7±0.98°C) in August and minimum (12.5±1.41°C) in January. Incidentally maximum (27±1.41°C) and minimum (14.9±2.54°C) water temperatures (WT) were also recorded in August and January respectively.

In the present study water current flow was found between 0.43 and 1.51 m/sec with a mean maximum value (1.47± 0.03 m/sec) in July and minimum (0.55± 0.12 m/sec) in January (Fig 2). The current flow rate increased from pre-monsoon (March – May) to monsoon (June- August) and reached its minimum in winter (Dec. - Feb.) months. The transparency was found minimum (11.5 ± 3.04 cm) in August and maximum in February (70.3 ± 3.74 cm) (Fig. 3).

As far as pH of river water is concerned, monthly minimum (7.23±0.19) and maximum (7.85± 0.21) values of pH were recorded in December and March respectively. Minimum dissolved oxygen (DO) was recorded (8.2 ±0.72 mg/L) in January (Fig. 4). Thereafter, its value increased steadily and was maximum in August (11.1 ± 0.96 mg/L). Free CO₂ value was having an increasing trend from winter and reached its peak in pre-monsoon (March-May). Its maximum value (5.07 ± 0.3) was recorded in June and minimum (1.67±0.13 mg/L) in October (Fig.5). The monthly mean value of total alkalinity of the river varied from 28.3 ± 7.15 mg/L (January) to 75 ± 5.29 mg/L (August) (Fig. 6).

Statistical analysis: Statistical analysis of data was done using SPSS (2008) and MS excel (2010) and significance of correlation was recorded at 0.01 & 0.05 level.
The monthly (mean) variations in TDS and TSS followed similar trend (Fig. 7, 8). TDS increased from January towards monsoon and was maximum in July and later again dropped down.

Multiple correlations between abiotic factors are presented in Table 1. Air and water temperatures were found to be positively correlated with all the parameters except transparency and pH; both the variables showed inverse relationship with temperature. DO was negatively correlated with transparency ($r = -0.892$) and pH ($r = -0.186$); but positively correlated with other parameters. Similarly, FCO$_2$ was positively correlated with all the studied parameters except transparency ($r = -0.241$). Water velocity was positively correlated with most of the abiotic parameters except transparency ($r = -0.871$) and pH ($r = -0.83$). Again, pH was positively correlated with transparency, free CO$_2$ and TSS but negatively correlated with alkalinity, TDS, DO, water current and temperature. Total alkalinity was found positively correlated with DO ($r = 0.906$), free CO$_2$ ($r = 0.319$), TDS ($r = 0.942$), TSS ($r = 0.849$), water current ($r = 0.873$) and both atmospheric temperature ($r = 0.983$) and water temperature ($r = 0.9381$) while negatively correlated with pH ($r = -0.055$) and transparency ($r = -0.944$) (Table 1). Further TDS and TSS showed positive correlation with air and water temperature and negatively correlated with transparency. Due to presence of minimal quantities of suspended matter, transparency was maximum in February ($70.3 \pm 3.74$ cm) and minimum ($11.5 \pm 3.04$ cm) in August (Fig.3). The transparency was found to be negatively correlated with all studied parameters except pH ($r = -0.1742$).

Table 1. Multiple correlations of abiotic parameters

<table>
<thead>
<tr>
<th></th>
<th>WT</th>
<th>AT</th>
<th>Trans</th>
<th>WC</th>
<th>DO</th>
<th>Free CO$_2$</th>
<th>pH</th>
<th>Alk</th>
<th>TDS</th>
<th>TSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>WT</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AT</td>
<td>0.971**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trans</td>
<td>-0.897**</td>
<td>-0.949**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WC</td>
<td>0.842**</td>
<td>0.874**</td>
<td>-0.871**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DO</td>
<td>0.795**</td>
<td>0.874**</td>
<td>-0.892**</td>
<td>0.893**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FCO$_2$</td>
<td>0.331</td>
<td>0.283</td>
<td>-0.241</td>
<td>0.558</td>
<td>0.318</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td>-0.223</td>
<td>-0.137</td>
<td>0.174</td>
<td>-0.083</td>
<td>-0.186</td>
<td>0.436</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alk</td>
<td>0.938**</td>
<td>0.983**</td>
<td>-0.944**</td>
<td>0.873**</td>
<td>0.906**</td>
<td>0.319</td>
<td>-0.056</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TDS</td>
<td>0.945**</td>
<td>0.966**</td>
<td>-0.967**</td>
<td>0.905**</td>
<td>0.882**</td>
<td>0.259**</td>
<td>-0.263</td>
<td>0.942**</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>TSS</td>
<td>0.743**</td>
<td>0.797**</td>
<td>-0.819**</td>
<td>0.911**</td>
<td>0.868**</td>
<td>0.621*</td>
<td>0.138</td>
<td>0.849**</td>
<td>0.786**</td>
<td>1</td>
</tr>
</tbody>
</table>

** Correlation is significant at the 0.01 level (2-tailed)
* Correlation is significant at the 0.05 level (2-tailed)

Fig. 1. Mean variation of air & water temperature

Fig. 2. Mean variation of water current
**DISCUSSION**
Aquatic ecosystem is not only source of water and resources such as fish and crop for household and agro-industrial uses, but also a vital part of natural environment for our own survival (Singh et al. 2010). Abiotic parameters influence structuring assemblages of fish (Mathew et al. 1994) and therefore, limnological knowledge and its proper applications is an important tool for better fish yield and management of the aquatic ecosystems.
In the present study January was found to be the coldest month. Similar trends of air temperature were also recorded by Bordoloi et al. (2012), Dutta et al. (2014) and Laishram and Dey (2014) in their studies. Higher air temperature in monsoon may be due to high solar radiation whereas low temperature in winter may be due to shorter day length in the Indian sub-continent. Air and water temperature showed a very characteristic annual cycle, with higher during summer and lower during winter (Fig. 1). Similar fluctuation pattern of water temperature was reported by several workers in recent years elsewhere in N.E. India (Abujam et al. 2009, Singh et al. 2010, Dutta et al. 2014). Changes in the air temperature naturally affect the water temperature (Kumar 1997, Singh and Mathur 2005). Photoperiod is directly related to temperature (Odum 1971). The summer temperature was always found above the winter temperature due to abundant sunlight (Sinha and Biswas 2011).

Alkalinity of water is the capacity to neutralize the acid and maintained homeostasis in animals. It is usually taken as an index of productive potential of the water (Datar and Vashistha 1992). Seasonally it was found maximum in monsoon and minimum in winter during study period. Hujare (2008) also reported similar results and attributed maximum value in monsoon to high photosynthetic rate. Larger quantities of bicarbonates during summer may be due to the liberation of free carbon-di-oxide in the process of decomposition of bottom sediments and domestic waste (Yerel 2009) which probably resulted in conversion of insoluble carbonates to soluble bicarbonates (Sahni 2012). Total alkalinity ranging between 20 and 100 mg/L is optimal for primary and secondary production in aquatic ecosystems (Stickney 1979). Thus the river might be a good habitat for ichthyofaunas.

Dissolved oxygen is an important parameter which has a direct impact on the survival and distribution of flora and fauna in an ecosystem. In the present study, DO was found to be lowest in January but increased steadily and reached its maximum in August (Fig. 4). Das et al. (2014) reported that long day period accelerate photosynthesis that increase DO in summer. Moreover, bright sunlight in summer influences the percentage of soluble gases in water. Dissolved oxygen (DO) concentration is directly related to flow velocity (Marques et al. 2003). During non-rainy months, especially in winter, flow rate became feeble and consequently DO level dropped down. The high values in the rainy season might be due to aeration with continuous disturbance of the water from wind storms usually occurring in rainy months. In the present study too, DO values altered by changing pattern of the current velocity in the river.

High values of TDS and TSS during monsoon were due to increase in sediment load from catchment such as agricultural fields and mixing of effluents released from nearby collieries with the river water. With rising temperature, organic matter mineralized faster and increase TDS and TSS. The acceptable limit of TDS in drinking water is 500 mg/L (EPA 1976, WHO 1997). The range of TDS (112 to 281 mg/L) fell within the permissible limit. Thus, water is potable and may be utilized for human and animal consumption.

Transparency was found low during rainy seasons. This may be due to number of reasons like excess sediments carried by runoff from the catchment areas, high water current eroded the bank of the river, suspended matter and dissolved particles. Moreover Dihing river has many sub tributaries. The higher transparency during winter (dry season) might be due to settling of particles at the bottom.

pH of an aquatic ecosystem is important because it is closely linked to biological productivity (Baruah et al. 2011). pH range of water determines fish survivability and its use as drinking water. pH remained alkaline throughout the study period and its range (7.04 to 8.14) fell within the desirable limits of drinking water and fish culture as it did not exceed 6.5-8.5 (BIS 1983). pH variations were due to the seasonal fluctuations of free CO$_2$ and carbonate which were higher in the pre-monsoon and monsoon but lower in the post-monsoon (Fig. 5).

The free CO$_2$ content found between 1.52 and 5.79 mg/L were well below the permissible limit and is an indicator of good water quality. It increased along with ambient temperature from winter to monsoon (Fig.5). The higher values of free CO$_2$ in pre-monsoon and monsoon might have been due to deoxygenation (Talling 1957) as well as higher rate of decomposition of organic matters by the microbes (Sinha 1986). Natural acidity in rainwater is caused by the dissolution of atmospheric CO$_2$ (Carr and Neary 2008). The high CO$_2$ value is due to the entry of organic and inorganic nutrients from the surrounding areas.

The velocity of river was found to be directly proportional to the ‘flood pulse’ and also with gradient of the river stretch. The seasonal flooding in the tropical river was due to extreme rainfall during monsoon (Baruah et al. 2012). It determines both food supply rates and energetic costs for fishes, affecting their behavior, position choice, and intra- and interspecific interactions (Hughes and Dill 1990, Beecher et al. 1993).

The range of abiotic parameters of Dihing river water was compared with the standard indexes and found within the desirable limit recognized by BIS (1983), WHO (1997), APHA (1998) for drinking water purpose and fish production. Despite of human activity, less eutrophication was observed in the river. However, excessive fishing in the river may threat ichthyofauna and therefore, it has to be stopped.
REFERENCES


BIS. 1983. Tolerance limits for inland surface waters subject to pollution, 2296.


