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Study of Some Physico-chemical Parameters and Their Effect on Potential Fish Yield in Gbedikere Lake, Bassa, Kogi State, Nigeria

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Abstract: The study of physico-chemical parameters and their effect on potential fish yield in Gbedikere Lake was carried out. Water samples were collected between 9 am and 10 am every fourth nightly from three sampling points marked A, B and C between September 2006 and December 2008. Temperature and Transparency were measured on the field using Temperature Meter (9091 model) and Secchi-disk. 250 ml of water samples were collected and transported to the Biological Sciences Laboratory for analysis of pH, Dissolved Oxygen (DO_2), Conductivity and Total Dissolved Solids (TDS). The result showed that Temperature, pH, Conductivity, DO_2, TDS and Transparency ranged from 26-29^{o}C, 5.08-8.02, 0.04-42.19 ms/m^{2}/mol^{-1}, 6.1-19.85 mg/l, 13.00-45.00 mg/l and 8.0-68.7 cm respectively. The correlation matrix for physico-chemical parameters revealed that there was no significant difference between Temperature, pH and Conductivity ($p<0.05$) with a significant difference ($p>0.05$) between Temperature, TDS, pH and Conductivity in the three sampling points. Water quality parameters of the lake were found to be suitable for fish production.

Key words: Temperature, pH, conductivity, dissolved oxygen, total dissolved solids, transparency

INTRODUCTION

Water as a habitat for fish must carry dissolved useful gases, minerals and other substances of sorts and in such amounts that are not harmful to fish (Adeyemi and Ipinjolu, 1999). The habitat also consists of physical features, basically the contours of the lake basin with depths, high ridges, rocks, gravel beds, silt areas, marl deposits, stumps and fallen trees. Also growths of submerged aquatic plants, filamentous algae and shoreline vegetation are part of the physical habitat as well as of the biological environment (Adeyemi and Ipinjolu, 1997). Other parts of the biological environment include bacteria, plankton, fungi, aquatic invertebrate fauna and a few kinds of vertebrates other than fish (Adeyemi *et al*., 2009). Some of these organisms provide food, some are enemies and others change with time, being enemies of small fishes at first and later as these same fishes grow becoming their food supply (Adeyemi *et al*., 2007).

Henderson (1971) revealed that the yield of a particular body of water may be regarded as being determined by the tropho-dynamic efficiency of the particular assemblage of species which compose the local ecosystem and the basic productivity of the lake perhaps, largely determined by the chemical fertility of the water and similar environmental parameters and the trophic level upon which the fishery is based (yield levels).

Limnological parameters of the aquatic environment have been found to influence yields and production from lakes. Rawson (1952) demonstrated that it was possible to estimate fish yields for a particular set of lakes from a lake's mean depth. Ryder (1965) later introduced the effect of Lake Fertility, indicated by total dissolved solids and with that developed the now well-known Morpho-Edaphic Index (MEI) which has become an empirical concept. Other workers have shown that factors such as primary production (Adeyemi and Ipinjolu, 1997) or total phosphorus (Hanson and Leggett, 1982) may be better predictors of fish yields than MEI.

Temperature plays a very important role in the aquatic environment. Certain organisms including fish are very sensitive to water temperatures. According to De Graaf *et al*. (1995) the maturation of *Clarias gariepinus* is influenced by annual changes in water temperature and periodicity. Schlesinger and Regier (1982) used it in conjunction with MEI to predict fish yields.

MATERIALS AND METHODS

Study area: The study area is Gbedikere Lake. Lake Gbedikere is a natural lake located between Latitudes 7^{o}25^{N} and Longitudes 7^{o}30^{E} and is about 10 km to the East of Oguma the Head quarter of Bassa Local Government Area of Kogi State. Water enters the Lake from tributaries that run from River Benue during rainy or flood season. When the season is over, the Lake separates out. The Lake is about 450 m north of Gbedikere village. The water body covers an area of about 400-450 m with a mean depth of 10-14 m (AIFP, 2003) depending on the season.

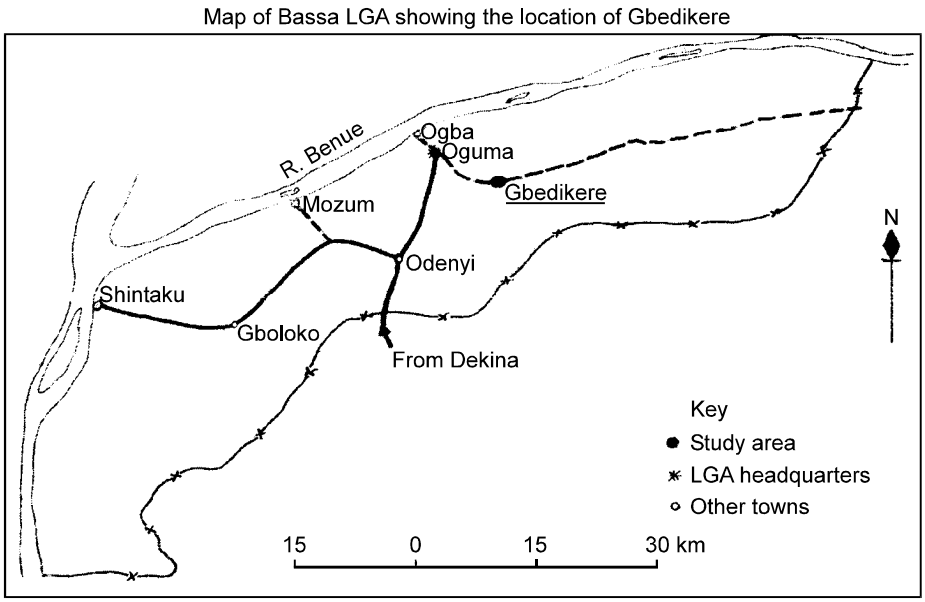

Fig. 1: Map of Bassa Local Government Area showing the location of the study area

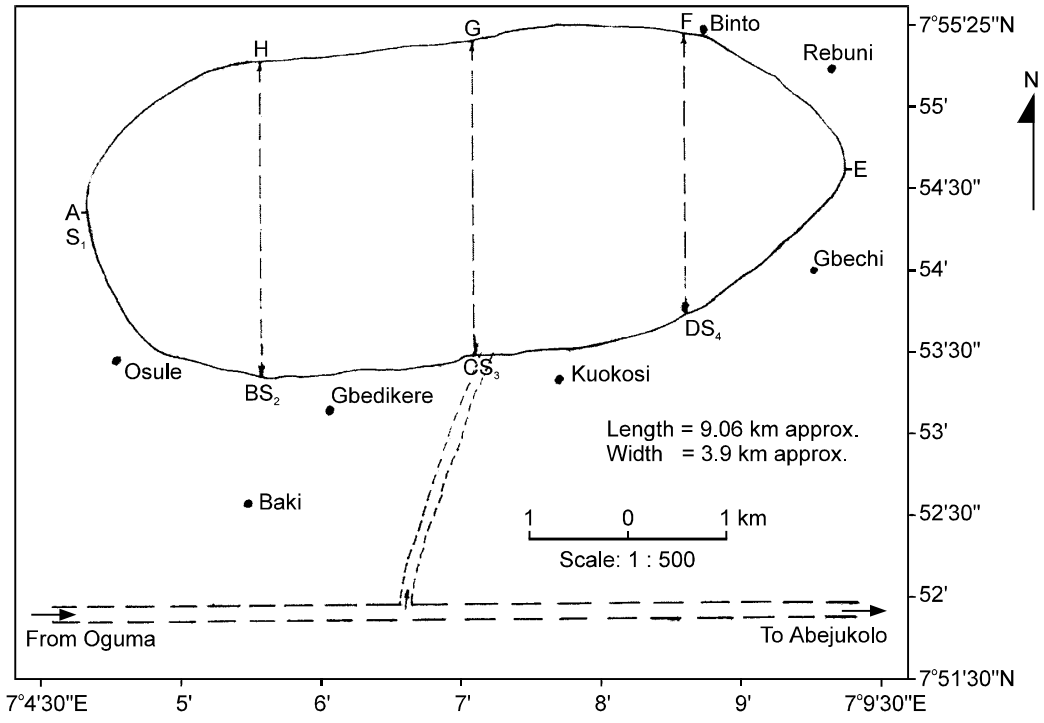

Fig. 2: Map of Gbedikere Lake showing sampling points

Sampling points: Sampling points were labeled A, B and C. The sample point A (Lower course) is the western part of the lake. It has some unclear stumps and covers an extensive sandy beach. It has a mean depth of 12.1 metres. Sample point B (Middle course) falls within the middle of the lake. It is close to the course of the River Benue adjacent to the Biroko Landing site. The mean depth is about 15 meters with muddy bottom. Sample point C (Upper course) is adjacent to the inlet of the lake. It is located to the extreme east of the lake and has a mean depth of 13.2 meters (Fig. 2).

Collection of samples: Water samples were collected between 9.00 am and 10.0 am every forth nightly for twenty four months. The water samples were collected from three different points on the lake namely; the lower course, middle course and the upper course and labeled stations A, B and C respectively. Parameters such as temperature and transparency were analyzed at the lake site. 250 ml of water samples were transported to the laboratory for further analysis of pH, dissolve oxygen, conductivity and total dissolved solids and the mean reading recorded.

RESULTS AND DISCUSSION

Temperature: The overall mean temperature was 27.50°C. It ranged from 26.00-29.00°C. The lower temperature of 26.00°C was recorded in October 2006 and January 2008 while the highest for all the sample points (29.00°C) was recorded in March 2007 (Fig. 3).

pH: The pH ranged from 5.08-8.02. The overall mean pH was 6.55. The highest pH was 8.2 and was recorded in March, 2007 while the lowest was 5.1 recorded in July 2008 (Fig. 4).

Conductivity: The overall mean conductivity was 14.07 $mS/m^2/mol^{-1}$. The lowest were 0.04 $mS/m^2/mol^{-1}$ in January 2008 while the highest was 42.19 $mS/m^2/mol^{-1}$ in October 2006 (Fig. 5).

Dissolved oxygen: The overall dissolved oxygen for the Lake was 8.65 mg/l. The DO_2 ranged from 6.1-19.85 mg/l the highest DO_2 was 19.85 mg/l and was recorded in November 2007 and the lowest 6.10 mg/l recorded October 2006 (Fig. 6).

Total Dissolved Solids (TDS): The overall mean TDS is 19.33 mg/l and it ranged from 13.00-45.00 mg/l. The highest TDS was 45.0 mg/l recorded in December 2006 and the lowest 13.00 mg/l recorded in August 2007 (Fig. 7).

Transparency: The overall mean Secchi disc transparency was 25.6 cm ranging from 8.00-68.7 cm. The highest transparency was 68.7 cm was recorded in October 2006 while the lowest was 8.0 cm recorded in July 2008 (Fig. 8).

Interrelationships between biotic factors on Gbedikere Lake: Table 1 shows a correlation matrix for physico-chemical parameters on Gbedikere Lake and for the various points sampled. This reveals that there was a negative correlation between temperature and pH in all the sample points. These differ in values but the correlations are not significant ($p<0.05$). For sample point A, it was -0.61, for B it was -0.56 and for C it was -0.43. The same relationship obtains between

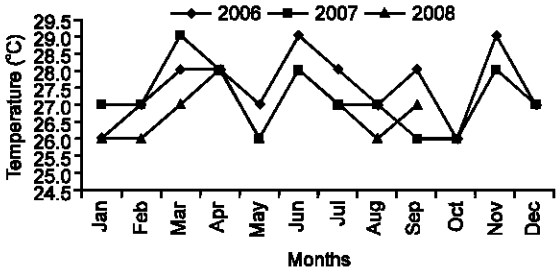

Fig. 3: Surface temperature for Gbedikere Lake, Bassa, Kogi State

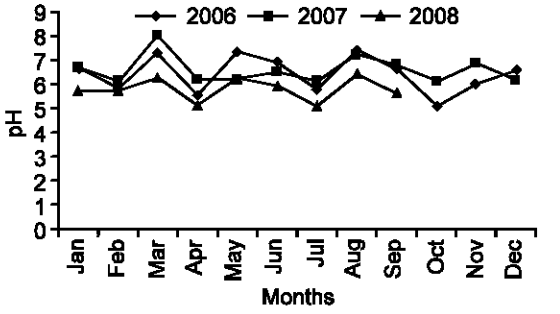

Fig. 4: pH for Gbedikere Lake, Bassa, Kogi State

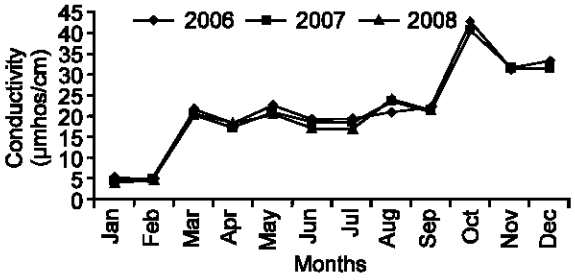

Fig. 5: Conductivity for Gbedikere Lake, Bassa, Kogi State

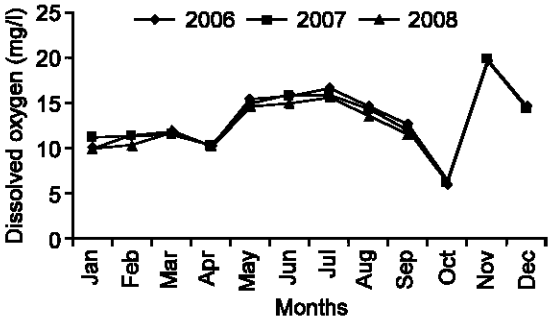

Fig. 6: Dissolved oxygen for Gbedikere Lake, Bassa, Kogi State

temperature and conductivity for sample point A, B and C. For temperature and Total Dissolved Solids (TDS), the relationship was insignificant for all the sample

points ($p<0.05$). The relationship between pH and conductivity for the three sample points were negative but insignificant ($p<0.05$). This was not the same for the relationship between conductivity.

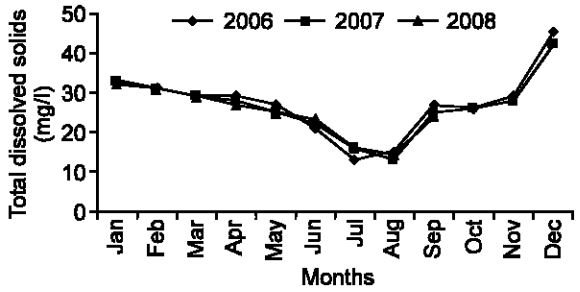

Fig. 7: Total dissolved solids for Gbedikere Lake, Bassa, Kogi State

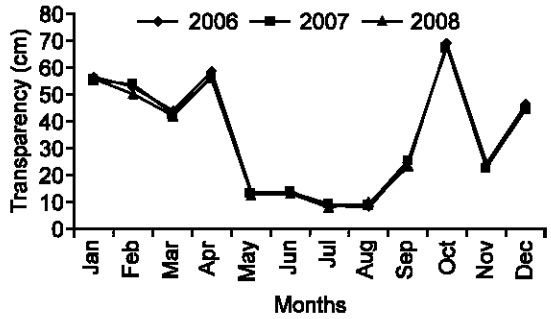

Fig. 8: Transparency for Gbedikere Lake, Bassa, Kogi State

Water temperature is uniform in the three sample points. This reflects the prevailing weather conditions. This favours the performance of its function as a regulator of the physiological and ecological parameters of fish (Boyd and Lichtkoppler, 1979). It enhances both the production of food for fish as well as influences the spawning time and year class strengths these agrees with the study of Alabaster and Downing (1966) and Mills and Mann (1985) that showed field and Laboratory Investigation of heated effluents on fish in the United Kingdom. pH fluctuations are known to be related to biochemical events in water (Wright, 1975). The overall result of the pH tends towards a nutrient fair system this is similar to the study of Yakubu *et al*. (2007) in Nun River, Nigeria. Pattern of variation in conductivity for the three sample points showed some uniformity throughout the study period. Mbagwu (1994) made similar observations on Jakara lake, these results are however much below the limit/level at which osmotic stress effect may occur (Roundsfell and Everhart, 1953). The Dissolved oxygen values are typical of those for freshwater systems ranging from 5.1-9.5 mg/l. The values obtained follow the general trend of being higher during the early rainy season. The same trend had been obtained in the lower reaches of the Nun River (Yakubu *et al*., 2007). Either conductivity or Total Dissolved Solids are possible candidates for use in the formulation of Morpho-Edaphic Index (MEI). The total dissolved solid values obtained for Gbedikere Lake are not dangerous for the fish species of the lake. The relationship obtained between Temperature and pH reveals that as

Table 1: Correlation matrix for physico-chemical parameter of sample stations in Gbedikere Lake, Kogi State

	Temp.	pH	DO_2	Transp.	TDS	Conduct.
Sample point A						
Temperature	1					
pH	-0.61	1.00				
DO_2	0.07	0.38	1.00			
Transp.	0.52	-0.62	0.14	1.00		
TDS	0.26	-0.54	-0.36	-0.35	1.00	
Conductivity	-0.22	-0.32	-0.52	-0.02	-0.15	1
Sample point B						
Temperature	1					
pH	-0.56	1.00				
DO_2	0.16	0.00	1.00			
Transp.	0.48	-0.92	0.13	1.00		
TDS	0.40	-0.73	-0.09	-0.67	1.00	
Conductivity	-0.27	-0.65	-0.27	-0.57	-0.48	1
Sample point C						
Temperature	1					
pH	-0.43	1.00				
DO_2	0.13	0.62	1.00			
Transp.	0.01	-0.49	0.32	1.00		
TDS	0.42	-0.59	-0.41	-0.10	1.00	
Conductivity	-0.06	-0.18	-0.03	-0.80	-0.36	1

temperature increased, pH decreased though the values were not significant. This could due to various interplay of phytoplankton production and concentration of carbon dioxide as observed by Adeyemi *et al*. (2009). The pH observed is within those considered best for fish production. This is in agreement with the study of Boyd and Lichtkoppler (1979). The negative correlations that existed between water temperature and dissolved oxygen content in all sample points confirm the inverse relationship that exists between these parameters in the water body.

REFERENCES

Adeyemi, S.O. and J.K. Ipinjolu, 1997. Assessment of primary productivity of Goronyo Dam in Sokoto State using fish and plankton. J. West Africa Fish., 40: 15-17.

Adeyemi, S.O. and J.K. Ipinjolu, 1999. Study of some physico-chemical parameters and their effect on potential fish yield in Kware Lake, Sokoto State. J. West Africa Fish., 60: 54-58.

Adeyemi, S.O., S.A. Adegoke, A.O. Ogbe and P.A. Audu, 2007. Resource productivity in fish farming in Bassa Local Government Area of Kogi State. Inter-World J. Sci. Technol., Vol 13 (1).

Adeyemi, S.O., I.A. Adikwu, P.M. Akombu and J.T. Iyela, 2009. Survey of Zooplanktons and Macroinvertebrates of Gbedikere Lake, Bassa, Kogi State, Nigeria. Int. J. Lakes and Rivers, 1: 55-62.

Alabaster, J.S. and A.L. Downing, 1966. A field and Laboratory Investigation of heated effluents on fish. Fish Invest., Ministr. Agric. Fish Food, (U.K.) 6: 42.

Boyd, C.E. and Lichtkoppler, 1979. Water quality management in pond fish culture. Research and Development Series No 22. Project: AID/DSAN-G. 0039.

De Graaf, G.J., F. Galemoni and B. Banzoussi, 1995. The artificial reproduction and fingerling production of the african catfish *Clarias gariepinus* (Burchell, 1822) in protected and unprotected ponds. Aquac. Res., 26: 233-242.

Hanson, J.M. and W.C. Leggett, 1982. Empirical prediction of fish biomass and yield. Can. J. Fish Aquat. Sci., 39: 257-263.

Henderson, H.F., 1971. Estimation of potential catch of fish from Kainji Lake Based on the general ecology of the Lake. FI: SF/NIR 24/S. FAO Rome, pp: 12.

Mbagwu, I.G., 1994. Effect of pollution on macrozoobenthic invertebrates in Jakara Reseroir Kano State. Nigeria. Ph.D Thesis. Dept of Biological Sciences, Bayero University Kano, pp: 231.

Mills, C.A. and R.H.K. Mann, 1985. Environmentally induced fluctuation in year-class strength and their implications for management. J. Fish Biol., 27 (A): 209-226.

Rawson, D.S., 1952. Mean depth and fish production in large lakes. Ecology, 33: 513-521.

Roundsfell, G.B. and W.A. Everhart, 1953. Fishery Science: Its methods and Applications. John Wiley and Sons, New York, pp: 444.

Ryder, R.A., 1965. A method for estimating the potential fish production of North temperature Lakes. Trans. Am. Fish Soc., 94: 214-218.

Schlesinger, D.A. and H.A. Regier, 1982. Clamatic and morphoedaphic indices of fish yields from natural Lakes. Trans. Am. Fish. Soc., 111: 141-150.

Wright, R.F., 1975. Acid precipitations and its effect on freshwater ecosystems. Proc. Sym on Acid Prec and Forest Ecosystems. Ohio State University Ohio.

Yakubu, A.F., F.D. Sikoki and M. Horsfall Jr., 2007. An investigation into the physico-chemical conditions and planktonic organism of the lowers reaches of the Nun River, Nigeria. J. Applied Sci. Environ. Manage., 1: 38-41.