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PHYSICOCHEMICAL PARAMETERS AND PHYTOPLANKTON DIVERSITY OF KWARE LAKE, NIGERIA

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ABSTRACT

Kware Lake is a popular natural lake in Sokoto which is used for domestic purposes, irrigation practices, and fisheries. Anthropogenic activities are routine at the catchment area. In this study, water and phytoplankton samples were collected for five months. Standard procedures were adopted for determination of physicochemical parameters viz; temperature, depth, turbidity, nitrogen, phosphorus, dissolved oxygen (DO), biological oxygen demand (BOD), etc. These parameters were observed to have varied within the period of study. Five species of phytoplankton were identified, and Volvox globator was recorded the highest percentage distribution during the study. The irregular fluctuations and variations observed between the parameters studied do not exceed the limit approved by WHO and EPA.

Keywords: Kware Lake, Limnological, Phytoplankton, Variables, Water.

Contribution/ Originality

This study contributes in the existing literature on this aspect of limnology, at the same time first of its kind in this part of the globe. Therefore more of such research should be encouraged in the area.

1. INTRODUCTION

Lakes and reservoirs are major water resources, both in terms of size and fisheries potentials (Khan *et al.*, 2008). The most important variable, which determines the composition and abundance of phytoplankton, is seasonal changes in nutrient availability (Reynolds, 1990; Reynolds, 1998; Marinho and Huszar, 2002; Khan *et al.*, 2008). The quantitative determination of

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Phytoplankton's provides good indices of productive capacity of a water body. There is a lot of information from around the globe about the estimation of the plankton and their productivity (Montecino, 1991; Mallin *et al*., 1994; Watson *et al*., 1997; Huszar and Caraco, 1998; Trifonova, 1998). In limnology, the seasonal patterns in tropical phytoplankton communities are still important (Figueredo and Giani, 2001). An estimate of the density of plankton, productivity and trophic status of lakes are very important for fisheries management. A standard indicator of water clarity is the Secchi disk transparency that strongly correlates with biomass and annual productivity of suspended algae (Peckham *et al*., 2006). The phenomena are also in close relation to the amount of sandy clay, detritus and suspended water organic matter and dissolved elements quantity (Sifa and Senlin, 1995). Most parts of Africa have a large density of small reservoirs, (Nhiwatiwa and Marshall, 2007), which have various impacts such as changing seasonal flow patterns of streams and rivers, anthropogenic influence (Jackson and Marmulla, 2001; Mccartney and Sally, 2005). The aim of this study was to determine the physical, chemical characteristics and the diversity of phytoplankton species of Kware Lake.

2. MATERIALS AND METHODS

2.1. Study Area

Kware Lake is natural water body that is fed by underground water sources located at various places. It is located within longitude $5^0$16E and latitude 13^0 13N. Its lentic water body (still) that is clear in appearance, usually used for irrigation practices as well as domestic uses (Yahaya *et al*., 2009).

2.2. Sample Collection

Samples were collected at three different locations for the period of five months from February to June (that is end of dry season and beginning of raining season). These were taken to the laboratory for analysis. Some of the parameters were measured *in situ*. Photoplankton samples were collected through standard plankton net (25 mesh size).

2.3. Determination of Physiochemical Parameters

Standard methods were followed for determination of limnological parameters. Temperature, depth and turbidity were determined *in situ* according to Panday *et al*. (2005). While chemical parameters namely; pH, nitrogen, phosphorus, calcium, magnesium, BOD, DO and TDS were determined as described by United Nations Environment Programme (2004)

2.4. Phytoplankton Identification

Phytoplankton was identified by pipeting 1ml from the sample on a slide, which was mounted on a light microscope. Each phytoplankton identified was compared with the phytoplankton

identification charts (Hotzel and Croome, 1999; Botes, 2003; Perry, 2003; Janse Van Vuuren *et al*., 2006; Yamaguchi and Gould, 2007) before recording the species.

2.5. Statistical Analyses

The data obtained from both field and laboratory were statistically analysed using Mintab statistical packaged. Two-way Analysis of Variance (ANOVA) was conducted at 5% probability.

3. RESULTS AND DISCUSSION

Limnological variables in Kware Lake were observed to fluctuate slightly within the period of study across the physical parameters studied which include temperature, depth and turbidity. These parameters were discovered to have varied gradually as the weather changes from February to June. The temperature of the lake ranged from 26-32 ^{0}C but the monthly means and standard errors were 27.0±1.00, 31.0±0.58, 30.3±0.88, 31.0±0.58 and 31.7±0.33 for February, March, April, May and June respectively. The maximum temperature of 32 ^{0}C observed in June for all the three locations may be due to an increasing photoperiod and longer day length (Mohan *et al*., 2013).

The lake was found to be shallower at the beginning of the study period; station 2 tends to be deep than the other stations, in which the highest depth of 3.8cm was recorded at the station. pH values recorded for the present study ranged from 6.9-8.0, though it was observed to increase slightly from February to June that also fall within the acceptable limits of (World Health Organization, 2004; Environmental Protection Agency, 2006). The level of both nitrogen and phosphorus were also found to be low, but a slight variation during the period of study was observed with an irregular pattern of fluctuation. Nitrogen recorded a mean and standard error of 0.87±0.18 in February but in June 0.53±0.18 was recorded and the minimum and maximum values were 0.20mg/l and 1.20mg/l respectively. Phosphorus recorded a range of 0.13-0.70mg/l, which also fluctuated irregularly (Table 2).

The results, therefore, contradict the findings of Magami (2011) that reported the level of phosphorus and nitrogen to increase from April to September. But in this present study it could be as the result of low inputs from sources for both nitrogen and phosphorus from the catchment area. This may be due none or less usage of fertilizer from the catchment irrigated land.

Biochemical Oxygen Demand (BOD), the required oxygen amount by bacteria while aerobically stabilizing decomposable organic matter. The range of BOD and DO was found to be from 12.9 mg/1 to 40 mg/l, 2.90mg/l to 6.0mg/l respectively. The comparison of BOD and DO in the present study indicated that there was an inverse relationship between both parameters as reported by Iqbal *et al*. (2004). Total dissolved solids was observed to fluctuate irregularly, with a range of 1.00mg/l to 2.00mg/l which is low according the EPA (2006) regulations.

Five species of phytoplankton were identified in Kware lake during the study period namely; *Spirogyra gratiana*, *Zygnema insigne*, *Volvox globator*, *Centric palmerina* and *Pennate asterionella*.

Volvox globator has the highest percentage distribution of 57.1% in April, which was followed by *Spirogyra gratiana* with 47.6% in March (Table 3). The few number of phytoplankton species identified may be because phytoplankton species are sensitive indicators of environmental changes (Hays *et al*., 2005). Monthly phytoplankton number per liter recorded revealed that April and May were months observed to have few phytoplankton species (Figure 1) this could be due to grazing effect by consumer, such as copepods, and other zooplankton species during the period of study.

4. CONCLUSION

From the obtained results, the conclusion will be that the change in the weather and anthropogenic inputs may have caused the slight variations in physicochemical parameters, and anthropogenic activities may have an effect on these variations. The variations could be as a result of usage of fertilizer, insecticide and pesticide applications at the catchment area by farmers. While biotic and other factors were likely to have caused the observed spatial effects on distribution of these phytoplankton species. Therefore, if these anthropogenic activities increase the lake may face challenges of algal bloom.

Table-1. Monthly Variation of Physical Parameters of Kware Lake from February to June 2013

Parameter	February	March	April	May	June	Min.	Max.
Temp (^{0}C)	27.0±1.00	31.0±0.58	30.3±0.88	31.0±0.58	31.7±0.33	26	32
Depth (m)	2.1±0.30	2.2±0.48	2.8±0.49	3.2±0.27	2.6±0.45	1.7	3.8
Turb (cm)	89.0±30.3	106.7±29.20	125.0±32.79	147.3±3.84	148.3±6.01	55	190

Table-2. Monthly Variation of Chemical Parameters of Kware Lake from February to June 2013

Parameter	February	March	April	May	June	Min.	Max.
pH	7.3±0.21	7.7±0.88	7.2±0.17	7.7±0.56	7.8±0.89	6.90	8.00
N(mg/l)	0.87±0.18	0.67±0.67	0.83±0.15	0.73±0.24	0.53±0.18	0.20	1.20
P(mg/l)	0.20±0.01	0.32±0.00	0.55±0.76	0.13±0.00	0.17±0.01	0.13	0.70
Ca(mg/l)	0.37±0.02	1.52±0.03	1.18±0.80	1.22±0.25	1.71±0.45	0.35	2.30
Mg(mg/l)	0.63±0.06	2.70±0.10	3.02±0.10	2.72±0.42	2.80±0.76	0.55	3.55
BOD(mg/l)	13.83±0.58	33.90±1.63	36.83±2.24	19.13±0.27	18.73±0.73	12.90	40.00
DO(mg/l)	4.63±0.20	3.67±0.19	3.20±0.17	5.67±0.18	4.50±0.25	2.90	6.00
TDS(mg/l)	1.33±0.33	2.00±0.00	1.33±0.33	1.00±0.00	1.33±0.33	1.00	2.00

Table-3. Monthly Distribution of Phytoplankton Species Identified in Kware Lake

Species	February	March	April	May	June
Spirogyra gratiana	11(45.8)	10(47.6)	1(14.3)	1(11.1)	9(42.9)
Zygnema insigne	7(29.2)	1(4.8)	2(28.6)	2(22.2)	2(9.5)
Volvox globator	6(25.0)	7(33.3)	4(57.1)	5(55.6)	4(19.0)
Centric palmerina	0(0)	0(0)	0(0)	1(11.1)	3(14.3)
Pennate asterionella	0(0)	3(14.3)	0(0)	0(0)	3(14.3)

Footnote: Percentage in Parenthesis

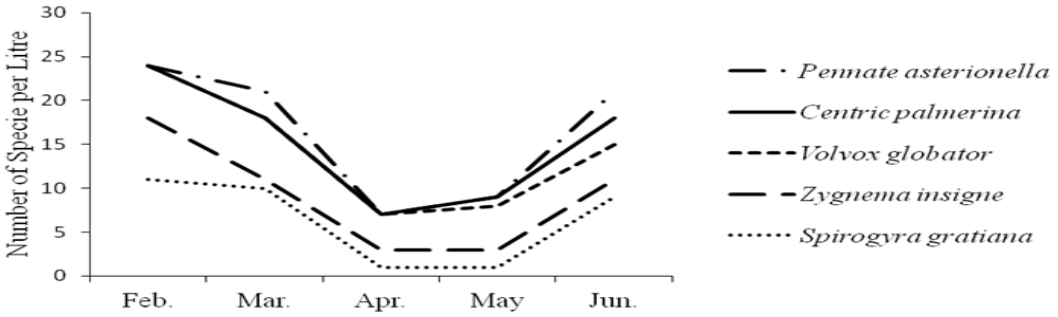

Figure-1. Monthly number of phytoplankton species identified in Kware Lake

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