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Studies of Species Distribution for Phytoplankton in Balanga Dam

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Abstract – *Dam construction often causes spatiotemporal changes of physicochemical parameters and integrity of water flow which affect the biological community of phytoplankton. However, due to gradual successional process, identification of the highly tolerant species has become a great challenge. The present study was carried out to analyse the phytoplankton abundance and distribution in Balanga dam, area of Gombe State. A total number of 21 phytoplankton species were identified from the three sampling stations belonging to about seven taxa. Chlorophyceae was recorded as taxa with highest species score of about 28.6%, followed by Baccillariophyceae, Cyanophyceae, Desmidiaceae and Chrysophyceae of about 19%, 19%, 14.3% and 9.5% respectively. Five physicochemical parameters were studied and their variations greatly affect the distribution of phytoplankton species. This study shows that, despite the variation in species abundance, the physical chemistry of the water did not vary greatly.*

Keywords: Phytoplankton, Species, Balanga dam, Spatiotemporal

1.0 INTRODUCTION

Difference species of phytoplankton in a community respond differently in term of behavioural, intrinsic and extrinsic factors. Slight alteration of those factor due agricultural and anthropogenic activities might have a direct effect on the species distribution and abundance, that is why research on the recent investigations have been directed to species diversity indices. Phytoplankton is a collective term referring to both organism plants and animals which are unable to resist movement of water current (drifters) [1]. Based on the taxonomic schemes, phytoplanktons consist of 24 classes and about 26,000 species were identified [2]. The interaction between of physical, chemical and biological properties of water often determined their production, while their distribution, composition and diversity is also structured by these factors [3]. Phytoplanktons in tropical reservoir ecosystem are often important in estimating potential fish yield [4], water quality [5], energy flow [6], food chain [1], and pollution assessment [7]. The use of macro (e.g. fish) or micro phytoplankton (e.g. microalgae) for assessment of water quality was reported in many instances [8].

Algae constitute the most common photosynthetic plankton and they are described as large heterogeneous assemblage of plants which are diverse in habitat, size, organization,

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physiology, biochemistry and reproduction. The population of plankton varies seasonally both in number and species composition. Plankton distribution and abundance are affected by season [9]. For example, the variation of species richness in checklist of the tropical West African algae both fresh and brackish water form [10]. The productivity of any aquatic water body depends on the abundance of plankton present. In addition, physical and chemical parameters also were found to be the factors affected their distribution, sequential occurrence and species diversity [11]. Human factors such as agriculture irrigation, farming and logging of forest tree for fire wood causes variation in phytoplankton species distribution seasonally [12]. Such diversity changes are common community respond to environmental alteration.

Balanga dam present an important opportunity for studying phytoplankton periodicity respond to ecological succession and species richness. In the recent years, attention has been focused on the use of phytoplankton species for combine bio-assessment and multivariate statistical analysis to identify water quality impact on the phytoplankton and epiphyte community distribution [12]. However, Balanga dam is a very large dam of economic importance, the survey of the phytoplankton species available in the dam and their interaction with physicochemical parameters will provide a good base for research especially on the pollution related issues, this is one the biomonitoring technique that will provide a healthy ecological integrity of the dam. Therefore, the current study aimed to determine the diversity and abundance of phytoplankton species and its relationship to physio-chemical factors that affect their succession in Balanga dam.

2.0 METHODOLOGY

2.1 Study Area

The study was conducted at Balanga dam, Balanga local government area located at southern Gombe State. It lies on latitude $10^0 16'^0$N and longitude 11^0 $16'6^0$E of the green witch meridian. The area has an estimated annual rainfall of 850 mm, with two distinct major season (i.e. rainy and dry) season. Balanga dam is one of the rivers of high economic value with about 600 (ha) surface areas and it major location is waja.

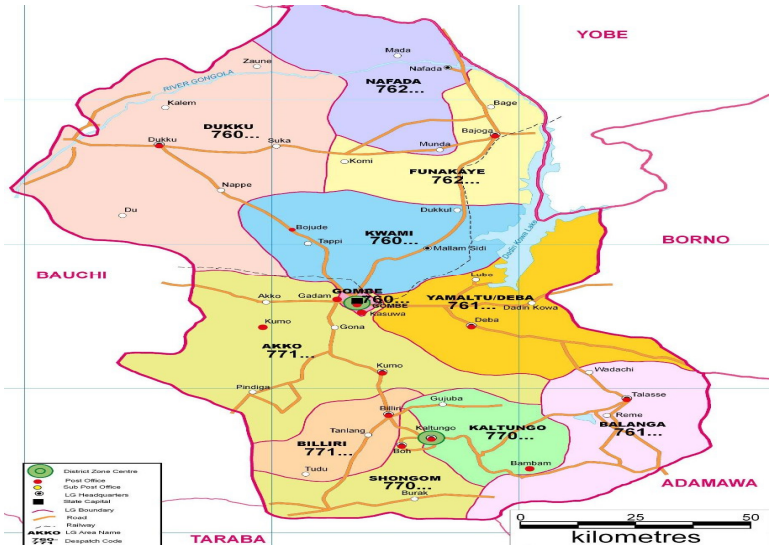

Figure 1: Map of Gombe State showing the location of sampling site (Balanga)

2.3 Sampling Station

Three sampling stations were identified based on preliminary study along Balanga dam and was utilized for the purpose of the study. These include side A, B and C. The various activities taken place at side A involved washing of cloths and batching, side B livestock activities and fisheries while side C is the spill way (direct outflow of the water).

2.4 Determination of Water Quality Characteristics

Water temperature and pH was determined in-situ using broad mercury bulb thermometers of model 403 according to the method describes by [13]. Water transparency was determined using Secchi disc. Determination of water velocity was done by taking the speed of a floating object against time it takes. The water conductivity was determined using conductivity meter model Henna Instrument (HI 9813-6N).

For the collection of phytoplankton, 250ml of water samples were filtered on membrane filters. The filter papers were then immersed and washed in water [26]. The prepared samples were fixed with 4-5% of formaldehyde according to the method described by [14]. Identification of the microphytes was done using microscope (10×) counting technique as described by [25]. Alternatively, the sample was identified on glass slides and the cell count was made on counting chamber based on cell number per litre computation. Subsequently, counting and identification of microalgae was done accordingly [14]. In addition, both colonial and filamentous cells like *Protococcus* sp and *Synedra* sp respectively were counted as one.

3.0 RESULTS AND DISCUSSION

The composition of phytoplankton species in Balanga dam were summarized in Table 1. The result of the study shows that a total of 21 phytoplankton species were identified from the sampling area belonging to about seven different taxa. Chlorophyceae was recorded as taxa with highest species score of about 28.6% of the overall taxa. Baccillariophyceae and Cyanophyceae have a species composition of about 19% species, whereas Desmidiaceae and Chrysophyceae have species of about 14.3 and 9.5% respectively. The taxa having the least species composition were Euglenophyceae and Rhaphidiophyceae with a record of 4.8% (Table 1).

In Balanga dam, a total of 426 phytoplankton species were quantified and identified and their respective distribution are summarized in Table 2**.** As earlier stated, the three sampling stations harbour different types of phytoplankton species. Based on species occurrence, phytoplanktons identified in Side A are *Synedra* spp (50), *Oscillatoria* spp (56), *Protococcus* sp (9), *Clostridium* spp (10), *Botryococcus* spp (4), Spirogyra spp (30) and *Protococcus* spp (9).

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Table 1: Percentage of species per taxa

Algal Taxa	**Species score**	**Types of Species**	**Percentage (%)**
Chlorophyceae	6	*Clostridium* sp, *Protococcus sp, Spirogyra, and Staurastrum* sp, *B. braunii* and *Schneiderian* sp	28.6
Cyanophyceae	4	*Oscillatoria* spp, *Aphanocapass sp, Nostoc* sp, *Tetrapedin*	19.0
Baccillariophyceae	4	*Synedra* spp, *Diatoms* spp, *Chaetophora* sp, *Nitzschi* sp.	19.0
Desmidiaceae	3	*Groenbladia* sp, *Pleurotaenium* sp *Staurastrum brachiatum*	14.3
Chrysophyceae	2	*Dinobryon sociale, Chrysococcus minutus*	9.5
Euglenophyceae	1	*Astasia* sp	4.8
Rhaphidiophyceae	1	*Gonyostomun* sp	4.8

In station B also *Synedra* spp were the dominant composed of (53), *Oscillatoria* spp (80), *Protococcus* (7), *Clostridium* spp (6), *Botryococcus* spp (2), Spirogyra spp (33) and *Protococcus* spp (7) whereas at station C, *Synedra* spp (40) were the abundant species fallowed by *Oscillatoria* spp (33), *Protococcus* (3), *Clostridium* spp (2), *Botryococcus* spp (6), Spirogyra spp (23) and *Protococcus* spp (3) Table 2.

The high abundant of species belonging to the taxa Bacillariophyceae and Cyanophyceae indicated evidently the occurrence of pollution load in Balanga Dam and the study were found to be comparable with the research of Shektar *et al*., [14]. The high number of Bacillariophyceae and Cyanophycea were also reported [15]. The findings of this study also contradict with another separate research which stated that; one of the most common filamentous algae in the Dam of their study is Spirogyra [16] while on this research the result shows that *Oscillatoria* and *Synedra* species are most the common and abundant filamentous algae identified. *Synedra* and *Oscillatoria* sp were the most common occurring species in all the sample side with *B. barunii* having the least species occurrence (Table 3). The high occurrence of *Synedra* species belongs to the class Baccillariophyta could be as a result of its ability to withstand high level of nutrient load [17]. The present of colonial and filamentous Cyanobacterium in the Dam indicated that species have an excellent capacity for vertical migration [18].

Table 2: Mean relative abundance and diversity of occurring species in sampling stations

SPECIES	SITE A	SITE B	SITE C	TOTAL
Synedra spp	50	53	40	103
Oscillatoria spp	56	80	33	169
Protococcus sp	9	7	3	19
Clostridium spp	10	6	2	18
B. braunii	4	2	6	12
Spirogyra spp	30	33	23	86
Protococcus sp	9	7	3	19

Analysis of phytoplankton community in the Balanga dam reveals similar situation observed some areas of same incidence such reservoirs in Banglang reservoir, Yala Province [2], Central and North of Cote d'ivoire [19], lake Guievs in Senegal [20] and lake tana in Ethiopia [21]. Furthermore, even though, many species from the genus Spirogyra could successfully thrive in eutrophic and polluted waters, overall species richness do not differ significantly between sampling sides, but it could be seen that, sampling side (A) and (B) have the highest taxa score compare to side (C) which is moderate in termed of species richness. This results was found to concur with the research of [22, 23] where high number of phytoplankton species during raining season was reported in Pampulha reservoir, Brazil and Ounde· municipal lake, Cameroun respectively. The above mention researchers argue that, the onset of rainfall has a direct impact of the phytoplankton growth, this therefore destabilizes the lither to create a favourable condition for phytoplankton active growth, which also agree with this finding.

The composition and abundance of phytoplankton species is determined by the level of physicochemical parameters estimated at three sampling station. The water temperature which is one of the important factors determining the species abundance was found to be at range of 31ºC-34ºC. The temperature was low in Side A (31ºC) and high in side C (34ºC). This variation could be due to difference in sampling station. In addition, sampling station A was closer to nearby vegetation, the shading effect of the vegetation partially blocked the area from receiving direct sun light thereby lowering the temperature. The pH of the water was 7.2 and it was observed in all the sampling station. pH ranges of 7-8 fall within the pH permissible limit for drinking water (Sarojini, 2013).

Table 3: Mean physicochemical parameters of sampling sides

Physicochemical parameters	Side A	Side B	Side C	Mean
Temperature (^oC)	31.00	32.00	34.00	32.30
Water pH	7.2	7.2	7.2	7.2
Water conductivity (µs)	66.70	69.17	68.20	68.02
Water transparency (cm)	20.20	30.70	40.00	30.30
Currency velocity (ms^{-1})	0.75	0.95	0.60	0.77

The water conductivity range of 66.70 to 68.02 found in all the sampling stations were within the values specified for conductivity values of streams of 50 to 1500 µS [24]. Transparency of water body is strongly correlated with the depth that light will penetrate water, for that reason, the transmission of light into water body is extremely important since the sun is the primary source of energy for all biological phenomena. This could be the reason why the low transparency level of Side A (20.2cm) harbours the highest phytoplankton composition. Side B and C have the highest transparency of 30.7 and 40 cm respectively (Table 3). Anthropogenic activities such as batching, livestock deposit, irrigation, and farming were the major contributing factors affecting the transparency level of Balanga dam. The current velocity of the water dependent upon the inflow speed of the water and highest value was recorded as 0.95 ms^{-1} and lowest value as 0.60 ms^{-1}.

4.0 CONCLUSION

The survey of phytoplankton species in Balanga dam, which is one of the productive water body show that, about 21 species and seven taxa were identified. The composition of phytoplankton species were structured by favourable physicochemical parameters. Study of phytoplankton diversity does not only provide information on ecological system but emphasizes on the efficacy of employing phytoplankton as effective technique of biomonitoring of water pollution. This study revealed that the water quality parameters, such as temperature, pH, transparency and conductivity have a great impact for structuring phytoplankton distribution. The fact that, phytoplankton form essential link of the total food web in the aquatic environment, study of their composition is of enormous important especially on phytoplankton conservation.

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