SPATIO-TEMPORAL VARIATION OF THE PLANKTON COMMUNITY OF TAGWAI LAKE MINNA, NIGERIA.

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ABSTRACT

Plankton community serves as indicators of the quality of the surface water bodies; they are also the primary and secondary producers in the aquatic ecosystem, as they serve as food for higher organisms. Their monthly variation was assessed at Tagwai Lake, Minna, Niger state, Nigeria between the months of April and August 2015. Collection was done with plankton net from five sample stations, which were chosen due to their strategic position from the bank, inlet, middle to the opposite bank and finally the outlet. A total of 46 species of plankton was recorded, 15 belonging to phytoplankton and 31 belonging to the zooplankton. The abundance of phytoplankton was in the order: Chlorophyceae > Zygnemophyceae > Dinophyceae > Bacillariophyceae > Fragillariophyceae > Chrysophyceae > Coscinodiscophyceae. While, the zooplankton was in the order: Copepoda > Cyclopoda > Diplostraca > Cladocera > Plioma. The most dominant species was *Microspora floccossa* for phytoplankton and *Bryocamptus birsteini* for the zooplankton. *Coscinodiscus anomalus* was the least dominant species for the phytoplankton while *Leptodiaptomus minutus* was the least dominant species for the zooplankton. The presence of *Ceratium furca* in the lake might be an indication of the rate of pollution. Plankton abundance and species diversity varied both spatially and temporally. The result above indicates that the lake is productive but could be polluted if not properly manage.

Keywords: Spatio-Temporal, Variation, Plankton Community,Tagwai Lake.

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INTRODUCTION

Most Fish in water bodies rely on live food for survival, a particular range of organisms fall into the category of food for the fish, smaller organisms like shrimps, prawns, worms and most commonly plankton. The word plankton comes from the word '*planktos*' which means 'drifting' they are diverse group of non-motile organisms that live in the water column and because they have limited motility, they exist in a drifting, floating state (Ikenweiwe, et al.,2011). Plankton are tiny microscopic plants (cellular or multi-cellular) called phytoplankton and tiny microscopic animals called zooplankton. (Ansari *et al.*, 2008). They are crucial source of food to many large aquatic organisms ranging from the small tilapia fish in ponds to the big whales in large ocean bodies, because they serve as the base of the food chain and are the major producers of oxygen in high quantities. They usually live near the surface of the water because they require sunlight to carry out photosynthesis. Zooplankton on the other hand, are secondary producers; they feed solely on these phytoplankton's and transfer energy to larger organisms that prey on them, Ariyadej et al. (2004). Zooplankton are small animals that occur in the water column of either marine or freshwater ecosystems. They are a diverse group defined based on their size and function, rather than on their taxonomic affinities, Ariyadej *et al.* (2004). They also span a range of organism sizes including small protozoans and large metazoans. It includes holoplanktonic organisms whose complete life cycle lies within the plankton, as well as meroplanktonic organisms that spend part of their lives in the plankton phase before graduating to either nekton or a sessile, benthic existence. Although, zooplanktons (are primarily transported by ambient water currents), may have locomotion, used to avoid predators or to increase prey encounter rate, Jeje and Fernando (1986).

MATERIALS AND METHODS

Study Area

The study was carried out in Minna, Niger State, located within longitude 6°33'E and latitude 9°37'N, covering a land area of 88km^2 with an estimated human population of 1.2 million. The area has a tropical climate with mean annual temperature, relative humidity and rainfall of 30°C, 61.00% and 1334.00mm, respectively. The climate presents two distinct seasons, a rainy (between April to October) and a dry season (between November and March). . The vegetation in the area is typically grass dominated savannah with scattered tree species. Tagwai Lake is about 10km away from Minna town. Mean maximum temperature remain high throughout the year having about 30°C, particularly in March and June. The vegetation cover is characterized by woodland and tall grasses inter-spread with tall dense species. In some areas, traces of rain forest species are seen of Sudan savannah alongside the plain of the river (Chukwuemeka *et al.*, 2014).

Methodology

A motorize canoe was used to navigate between the stations in the water body, on arrival at each station, plankton net was used to sample the lake for planktons for a period of five (5) months (from April to August 2015). The five sampling stations were as follows: Station One – Tasabo ,Station Two – Lokoto ,Station Three – Dutsen Kura ,Station Four – Kwatan Bello ,Station Five – Damn Crest / spill-way

The stations were chosen because of their strategic locations, the stations stretched from the bank of the Lake, to the inlet, through the middle, to the opposite bank of the Lake, to the outlet.

Plankton samples were collected using 55µm mesh size standard plankton net by trawling horizontally and filling into airtight 120 ml well-labeled plastic bottles. It was ensured that fixation and preservation of the samples with 4% formalin for one of the bottles and Lugol's iodine for the second bottle which was used to preserved the phytoplankton immediately after collection. The fixed samples were taken to the laboratory for further analysis. In the laboratory, the water samples were steered to allow the organisms spread evenly throughout the water and a 1ml pipette was used to collect water from the bottle and placed on the glass slide. The water was pour at 0.5ml at a time to ensure a more accurate counting result. The plankton were identified under the stereo microscope using suitable identification keys, APHA (1998).

Data Analysis

The sample of plankton from all stations were pooled together for analysis. Results were subjected to statistical analysis using Statistical Package for Social Sciences (SPSS) to calculate the means, standard mean error of the data from the study. It was further subjected to Duncan's Multiple Range to separate the means.

RESULTS

A total of 15 species belonging to six (6) classes of phytoplankton were collected throughout the period of study and between the months of April and August 2015.The abundance of phytoplankton in Tagwai Lake, Minna was in the order: *Chlorophyceae> Zygnemophyceae> Dinophyceae> Bacillariophyceae> Fragilariophyceae > Chrysophyceae> Coscinodiscophyceae* with 2, 2, 3, 3, 2, 1 & 2 species respectively.. There were variations monthly. Some species were not consistent throughout the period of collection, species like *Coscinodiscus anomalus* only occurred in April, May, while species like *Ditylum brightwelli*, and *Micrasterias rotata* occurred only in the first two and three months respectively, while species like *Ceratium furca, Ceratium longipes, Closterium calosporum, Diatoma vulgare, Microspora floccosa, Navicula tripunctata, Pleurosigma strigosum* and *Protoperidinium acutipes* occurred throughout the months of sampling.

Table 1: Mean Monthly Abundance of Phytoplankton in Tagwai Lake From April to August 2015. (Mean ± S.E)

Taxonomic Order	Months of Occurrence					Total
	April	May	June	July	August	
Bacillariophyceae	11±1.99^{c}	12±2.22^{b}	7±1.61^{b}	2±1.33^{a}	3±0.51^{a}	35
Dinophyceae	6±1.59^{b}	11±3.99^{b}	4±0.89^{ab}	9±1.81^{c}	7±1.68^{b}	37
Coscinodiscophyceae	1±0.33^{a}	3±0.62^{a}	2±0.35^{a}	1±0.33^{a}	2±1.33^{a}	9
Chlorophyceae	8±1.45^{b}	14±2.97^{b}	8±1.45^{b}	9±1.80^{c}	5±1.37^{ab}	44
Chrysophyceae	0±0.00^{a}	1±0.33^{a}	3±0.62^{a}	8±1.45^{c}	3±0.51^{a}	15
Fragilariophyceae	3±0.51^{b}	7±1.82^{b}	5±1.37^{ab}	4±1.25^{ab}	6±1.58^{ab}	25
Zygnemophyceae	9±1.52^{c}	10±1.82^{b}	9±1.52^{b}	6±1.59^{b}	4±0.99^{a}	38

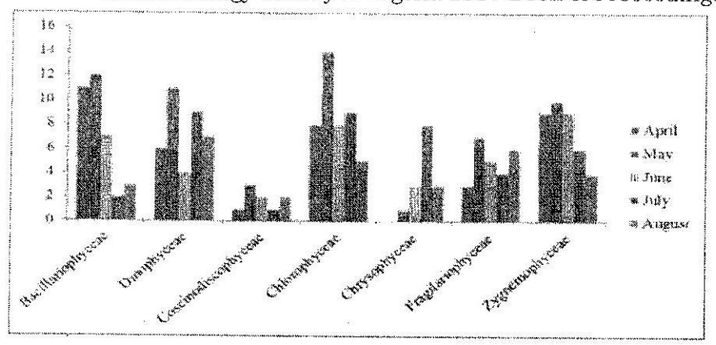

Figure 1: Representation of the Abundance of Phytoplankton in Tagwai Lake from April to August 2015

Result of the abundance of zooplankton in Tagwai Lake between April and August 2015 showed monthly variation in the diversity of Copepoda which recorded the highest abundance throughout the period of collection, although; it did not occur in the month of August, the next most dominant order was Cyclopoda with its highest occurrence in April and May and its least occurrence was in June and July. Diplostraca also had its least occurrence in July while it was more abundant in the month of April. Cladocera occurred throughout the period of collection with its peak in May and its least occurrence was recorded in August. Calanoida was most abundant in the month of August and the least occurrence was in the month of June (Table 2).

Table 2: Monthly Abundance of Zooplankton in Tagwai Lake From April to August 2015. (Mean ± S.E)

Taxonomic Order	Months of Occurrence					Total
	April	May	June	July	August	
Calanoida	3±0.51^{a}	8±1.45^{a}	2±0.00^{b}	3±1.80^{b}	11±1.70^{c}	27
Cladocera	12±2.22^{b}	22±2.36^{b}	2±0.33^{b}	12±2.67^{c}	4±0.74^{b}	52
Copepoda	94±5.91^{c}	66±7.54^{c}	6±2.76^{b}	4±2.32^{b}	0±0.00^{a}	170
Cyclopoda	59±14.51^{bc}	40±10.32^{c}	1±0.33^{b}	1±0.33^{ab}	5±1.23^{bc}	106
Diplostraca	30±2.74^{bc}	24±4.54^{b}	18±3.83^{c}	1±0.33^{ab}	2±0.33^{b}	75
Plioma	1±0.33^{a}	3±1.33^{a}	0±0.00^{a}	0±0.00^{a}	0±0.00^{a}	4

Values with the same superscripts are not significantly different at P > 0.05

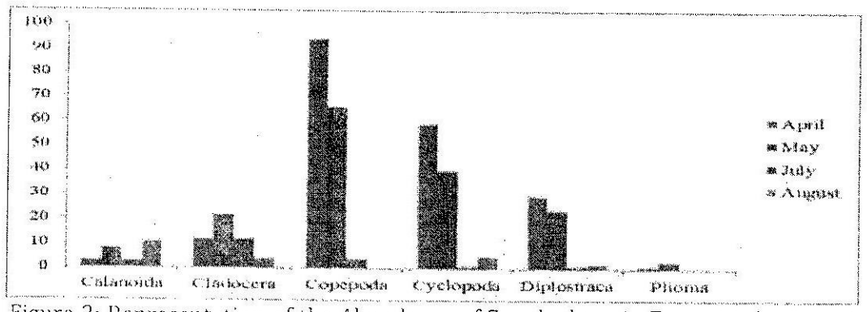

Figure 2: Representation of the Abundance of Zooplankton in Tagwai Lake from April to August 2015

DISCUSSION

There were a total of 15 species belonging to six (6) classes of phytoplankton found throughout the period of collection and between the months of April and August 2015 the abundance of phytoplankton in Tagwai Lake Minna was in the order: *Chlorophyceae* > *Zygnemophyceae*>*Dinophyceae*>*Bacillariophyceae*>*Fragilariophyceae*>*Chrysophyceae*>*Coscinodisc*ophyceae with 2, 2, 3, 3, 2, 1 & 2 species respectively. species like *Coscinodiscus anomalos* only occurred in April and May. However, the presence of *Closteriumfurca* may be an indication that the water body is slightly polluted; this is in line with the works of Anago *et al.* (2013) worked on the physio-chemistry and plankton diversity of awba reservoir and also observed the presence of *Ceratium sp.* a pollution indicator, in the water body that was studied. Zooplankton varied temporally with, a total of 31 species recorded and the most dominant species was the *Bryocamptus birsteini* while the least was *Brachionus falcatus,* Tunde, (2011) observed contrary result.. The abundance of zooplankton in Tagwai Lake, Minna between April and August was in the order; *Copepoda*> *Cyclopoda*> *Diplostraca*> *Cladocera*> *Calanoida*> *Plioma* with 170, 106, 75, 52, 27 & 4 species respectively. Just like the phytoplankton, some of the zooplankton species did not occur throughout the period of collection Dimowo, (2013). Some species like *Guernellara phaellis*only occurred only in April while species like *Ceriodaphniacornuta*, *Mesocyclopsleuckarti* &*Moinamicrura* occurred throughout the months. Some species only occurred in one month, like *Eurytemoraaffinis* &*Leptodiapto musminutus*.The tables 1 and 2 the distribution of phytoplankton and zooplankton respectively. The population of plankton reduced after the third month, this might be because of the increase in volume of the lake due to increased rainfall. Sinha and Islam (2002) reported similar trend. Also, the samples collected from the station closest to the bank of the lake indicated low population density of plankton organisms which may be due to the anthropogenic activities occurring around the area, Verma,et al, (2011). Another observation from the result was that the population density of zooplankton was much higher than that of the phytoplankton. Kolo *et al.*, 2010 reported a higher population density of zooplankton compared to phytoplankton in Tagwai Lake, although his report showed that during his period of study, the class *Bacillariophyceae* was more dominant than *Chlorophyceae*. The significant difference in the population density may be due to a feeding relationship that might exist between the phytoplankton and the zooplankton according to Olele, and Ekelemu (2008). Other factors that may have influenced the alteration of results may be due to the difference in months in relation to weather conditions of sample collection and an increase in anthropogenic activities as observed byKensa (2011).

CONCLUSION

Plankton species in Tagwai Lake are diverse with the highest population density recorded in May. Although, the population density varied monthly,

Bryocamptus birsteini was the most dominant species while *Ceriodaphnia dubia* was the least dominant species recorded for the zooplankton population. For the Phytoplankton, *Microsplora floccosa* was the most dominant while *Coscinodis cusanomalus* was the least dominant species recorded. The population density varied monthly and a notable drop in numerical population density was observed in the month of June.

Further studies should be conducted on the diurnal movement of plankton species in relation to the physico-chemical parameters of the water. The anthropogenic activities carried out around the body of the water should be controlled to reduce to rate of pollution and conserve the natural Bio-diversity of the plankton organisms observed in the lake.

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