E-ISSN: 2347-5129
P-ISSN: 2394-0506
(ICV-Poland) Impact Value: 5.62
(GIF) Impact Factor: 0.549
IJFAS 2018; 6(2): 30-33

www.fisheriesjournal.com
Received: 12-01-2018
Accepted: 15-02-2018

Abdulkarim B
Department of Biology, Umaru Musa Yar'adua University Katsina, Katsina State Nigeria

Ibrahim A
Department of Biology, Federal College of Education, Katsina, Nigeria

Correspondence
Abdulkarim B
Department of Biology, Umaru Musa Yar'adua University Katsina, Katsina State, Nigeria

Phytoplanktonic species diversity in relation to Physico-Chemical parameters of Ajiwa Reservoir, Katsina State Nigeria

Abdulkarim B and Ibrahim A

Abstract
Phytoplankton composition governed the water quality parameters. The relationship that water quality share with Phytoplankton is reciprocal as the later strongly influence water quality through carbon dioxide uptake and oxygen production. The Ajiwa reservoir serves two main purposes which are irrigation and water supply. Phytoplankton samples were collected with one litter transparent plastic bottle by dipping the container bottle, sliding over the upper surface of water with its mouth against the water current to permit undisturbed passage of the water into the bottle. Counting of the individual Phytoplankton was done by 'Lackeys' dropping method. The Physico-chemical parameters ware determined using the Standard by method as described APHA (1999). The Phytoplankton composition identified in the three stations belongs to four groups, which include Chlorophyta, Bacillariophyta, Cyanophyta, and Dinophyta (Pyrrophyta). Phytoplankton percentage composition indicated, Chlorophyta have the highest percentage composition with 57.66% of the total population of identified. Bacillariophyta have the second highest percentage of 25.70%. The Cyanophyta, have the third with percentage composition of 14.73%. Dinophyta has the least percentage which represents 1.91% of the Phytoplankton composition. The result revealed no significant differences between the three stations in population composition and diversity of Chlorophyta ($P \geq 0.05$). There was a significant difference in the population count between months and seasons of Bacillariophyta at $P \leq 0.05$. Green algae has a higher abundance over other kinds of algae and has a positive correlation ($r>0.59$) with dissolved oxygen which revealed the productivity of the reservoir especially during wet season.

Keywords: Composition, Diversity Phytoplankton and Physico-chemical parameters

Introduction
It is well established fact that more than 75% of freshwater fishes feed on plankton at one or another stage of their life cycle. In the sea and in largest inland water the bulk of living matter found in water is phytoplankton and hence their biological importance is immense (Akomeah *et al.* 2010) [3]. Phytoplanktons are the primary producers of water bodies; these are the main source of food directly or indirectly for the fish population. Phytoplankton composition governed the water quality parameters. The relationship that water quality share with Phytoplankton is reciprocal as the later strongly influence water quality through carbon dioxide uptake and oxygen production. Phytoplanktons are an essential component of the aquatic food chain (Janjua, *et al.*, 2008) [6]. They are the primary producers in freshwater bodies including lakes where different forms present in various locations viz: epilithic (rock) epipsamic (mud), epiphytic (plant), epipelic (sediments) and epizoic (animals) forms (Kadiri, 2002) [7]. They constitute a heterogeneous assemblage of algae whose distribution and seasonal succession are of interest to limnologist. This is why they do not only influence the food chain but are also of economic value and biological significance to man (Araoye and Owolabi, 2005) [2]. It is therefore proper that their occurrence, composition and abundance be matched with their functions in the environment (Olele and Ekelemu, 2008) [11].
Ajiwa reservoir is exploited for its water resource, for irrigation and fisheries etc. The reservoir is presently under the threats of dumping of untreated effluent, sewage, mixing of agricultural runoff from the agricultural fields. Despite all these, the reservoir has remained a source of water for consumption and utilization; in return human beings have not maintained their purity.
Phytoplankton plays vital role in aquatic ecosystems as the basis of life. Through the food

chain organic materials can reach the consumer organisms of higher trophic levels (fish). The purpose of this study was therefore to determine the composition and density of phytoplankton and their relationship with respect to the physical-chemical parameters of the Ajiwa Reservoir.

Materials and Methods

Study Area

Ajiwa reservoir was located in a sub-desert area on Latitude 12°, 98'N, Longitude 7,°75'E, in Batagarawa Local Government, Katsina State, Nigeria (Figure.1). The main purpose of the reservoir is irrigation and water supply. The volume of the water is almost 22,730,000m^3; it serves as a source of livelihood for the neighbouring communities.

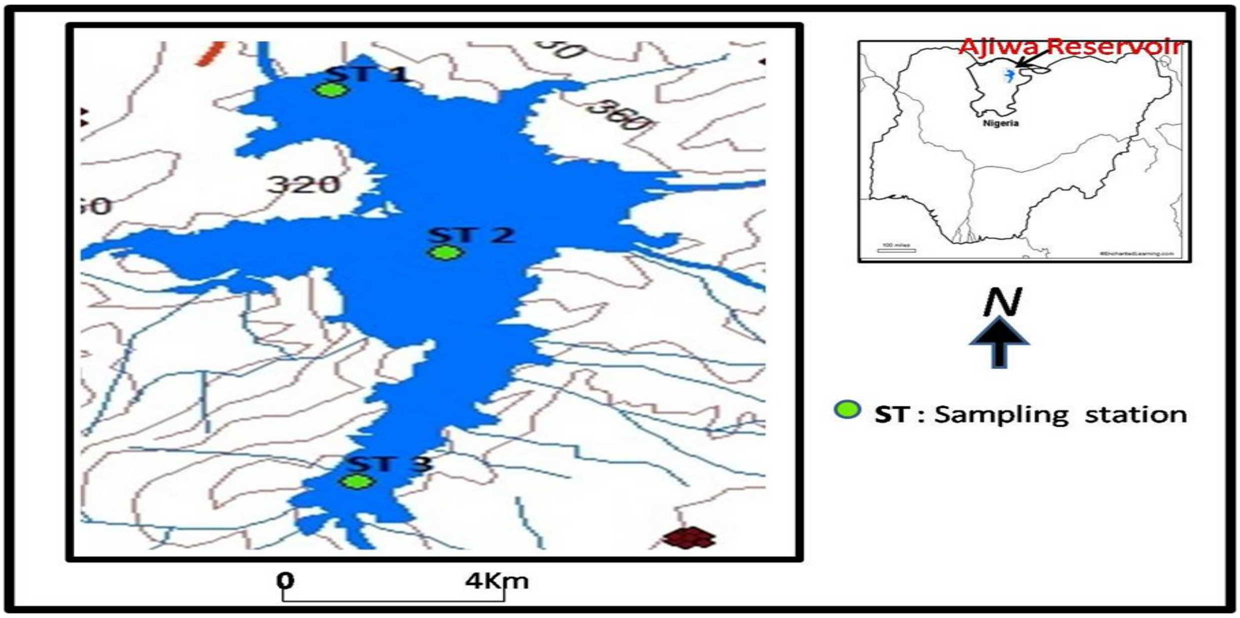

Fig 1: Map of Ajiwa Reservoir showing the sampling sites (Source: Cartography Unit, UMYU).

Phytoplankton samples were collected with one litter transparent plastic bottle by dipping the container bottle, sliding over the upper surface of water with its mouth against the water current to permit undisturbed passage of the water into the bottle (Tanimu, 2011) [12]. Counting of the individual plankton was done by "Lac keys" dropping method (1935) using the following formula:

$$\text{Plankton units/Litre} = \frac{\text{N} \times \text{C} \times 10}{\text{Y}}$$

- N = Number of plankton counted in 0.1 ml concentrate.
- C =Total volume of concentrate in ml.
- Y = Total volume of water filtered for sample in liters

The plankton density was expressed on individuals/liter.
Samples were preserved with Lugol's solution and brought to the laboratory. Slides were prepared and observed under a binocular microscope. Systematic identification of planktons was done according to Needham and Needham, (1975) [10] and APHA (1999) [4].
The Physico-chemical parameters ware determined using Standard methods as described by APHA (1999) [4].

Statistical Analysis

Data obtained from the study were statistically analysed using Analysis of Variance (ANOVA) and Pearson correlation at a significant level of p≤0.05. Shannon and Simpson's diversity index were used to determine diversity. The analyses were conducted using PAST (Paleontological Statistical Software).

Results and Discussions

The result revealed no significant differences between the three stations in population composition and diversity of Chlorophyta (*P*> 0.05). There was significant difference in population composition and diversity of Chlorophyta between months and seasons at *P*≤0.05; The species observed were *; Oocystis sp, Scenedesmus sp, Pediastrum sp, Dictyochloris sp, Closterium sp, Tetraedron sp, Ulotrix sp, Euastrum sp, Spirogyra sp, Zygnema sp, Oedegonium sp, Euglena sp* and *Volvox sp.* Among Chlorophyta *Oocystis sp* has the highest population abundance while *Volvox sp.* has the least population abundance. There was more diversity of Chlorophyta in the wet season as it was indicated by Simpson's and Shannon diversity Index. The results of analysis of variance revealed that there was no significant difference between the three stations in terms of *Bacillariophyta* composition and diversity (*P*> 0.05). There was significant difference between the population count between months and seasons at P < 0.05; with wet season having the highest count. The species identified include; *Cyclotella sp, Cymbella sp, Gyrosigsma sp, Epithemia sp, Diatomella sp* and *Anomoneis sp.* Among Bacillariophyta, *Cyclotella sp* has the highest population abundance in the reservoir while *Anomoneis sp.* has the lowest population count. The analysis of variance revealed significant differences in population composition and diversity of Cyanophyta between the three stations. There was significant differences between the population composition and diversity in the wet and dry season at *P*≤0.050; the species observed were; *Chroococcus sp, Gomphosphaeria sp, Microcystis sp, Anabaena sp, Oscillatoria sp* and *Nostoc sp.* Among the Cyanophyta, *Chroococcus sp.* has the highest species population abundance, while *Nostoc sp.* has the least population abundance with presence only in the rainy season. Cyanophyta revealed more diversity in the wet season than in the dry season as indicated by Simpson's and Shannon diversity index (Table: 1).

Analysis of variance revealed that there were no significant differences between the stations in terms of population composition and diversity ($P \leq 0.05$). There were significant differences in population composition and diversity of Dinophyta between the months and seasons at $P \leq 0.05$ (Table: 1); with wet season having the highest number of count than the dry season. The species recorded are *Pridinium sp* and *Ceratium sp.* Only few population counts ware recorded during the rainy season with *Peridinium sp.* having the highest while *Ceratium sp.* was the least. There were more diversity of Dinophyta in the wet season than in the dry season as indicated by Simpson's and Shannon diversity index (Table: 1)

Table 1: Phytoplankton Diversity indices of Ajiwa Reservoir, Katsina State.

Taxon	**Diversity Index**	**Wet**	**Dry**
Bacillariophyta	Taxa_S	6	5
	Individuals	332	99
	Shannon_H	0.24	0.35
	Dominance _D	0.54	0.07
	Simpson's _1-D	0.46	0.93
Chlorophyta	Taxa_S	12	10
	Individuals	434	143
	Shannon_H	0.23	0.35
	Dominance _D	0.53	0.07
	Simpson's _1-D	0.47	0.93
Cyanophyta	Taxa_S	6	5
	Individuals	181	66
	Shannon_H	0.25	0.36
	Dominance _D	0.48	0.09
	Simpson's _1-D	0.52	0.91
Dinophyta	Taxa_S	2	0
	Individuals	32	0
	Shannon_H	0	0
	Dominance_D	1	0
	Simpson's _1-D	0	0

Note: Simpson: < 0.5 indicate more diversity and > than 0.5 indicate less diversity.

Chlorophyta indicated a positive correlation with dissolved oxygen, biochemical oxygen demand, nitrogen and phosphate ($P > 0.57$) and showed negative correlation with pH, turbidity, depth, hardness and total dissolved solids ($p > -0.90$) (Table: 2). Bacillariophyta revealed a positive correlation with dissolved oxygen, biochemical oxygen demand, conductivity, nitrogen and phosphate, but revealed negative correlations with turbidity, pH, hardness, depth and total dissolved solids (Table: 2). Cyanophyta showed positive correlation with dissolved oxygen, biochemical oxygen demand, conductivity, nitrogen and phosphate and showed negative correlation with total dissolved solids, hardness, depth, pH and turbidity (Table:2). Dinophyta shown positive correlation with dissolved oxygen, biochemical oxygen demand, Phosphate and nitrogen while negative correlation with hardness, depth, total dissolved solids, pH and turbidity (Table: 2)

Table 2: Monthly Physico-chemical Parameters in Ajiwa Reservoir, Katsina State

	Months	**Temp. (°C)**	**pH**	**Turbidity (NTU)**	**DO (mgL^{-1})**	**BOD (mgL^{-1})**	**EC (µS/cm)**	**TDS (mgL^{-1})**	**Depth (m)**	**PO_4- P (mgL^{-1})**	**NO_3-N (mgL^{-1})**	**Hardness (mg($CaCO_3$L^{-1})**
	May	26.0^{ab}	6.9^{ab}	89.3^{bc}	7.2^{a}	3.6^{ab}	102.4^{c}	14.8^{bc}	5.3^{ab}	1.7^{bc}	6.3^{ab}	83.1^{ab}
	Jun.	25.3^{ab}	6.9^{ab}	89.3^{bc}	7.3^{a}	3.6^{ab}	112.4^{c}	14.0^{bc}	5.4^{ab}	2.5^{ab}	6.4^{ab}	84.1^{ab}
Wet Season	Jul.	27.7 ^{a}	6.7^{ab}	89.3^{bc}	7.3^{a}	3.6^{ab}	120.7^{bc}	10.1^{cd}	5.4^{ab}	2.7^{ab}	6.4^{ab}	84.1^{ab}
	Aug.	26.0^{ab}	6.5^{ab}	88.0^{bc}	7.1^{a}	3.6^{ab}	122.0^{bc}	10.2^{cd}	6.4^{a}	3.1 ^{a}	7.1^{a}	87.9^{a}
	Sept.	24.0^{ab}	6.9^{ab}	88.6^{bc}	7.5^{a}	3.6^{ab}	122.7^{bc}	13.4^{bc}	7.5^{a}	3.6 ^{a}	7.2^{a}	88.6^{a}
	Oct.	22.6^{b}	6.8^{ab}	95.7^{bc}	7.8^{a}	3.8^{a}	129.7^{b}	17.0^{bc}	6.1^{a}	3.8 ^{a}	6.5^{a}	84.3^{a}
	Nov.	23.7^{ab}	6.8^{ab}	98.3^{bc}	7.7^{a}	3.9^{a}	133.3^{ab}	19.3^{ab}	5.7^{ab}	2.4^{bc}	6.6^{a}	87.3^{a}
Dry Season	Dec.	18.3^{bc}	6.9^{ab}	101.3^{ab}	6.9^{ab}	4.0^{a}	136.6^{ab}	23.8^{a}	5.3^{ab}	2.7^{bc}	5.3^{bc}	90.7^{a}
	Jan.	20.6^{b}	7.0^{a}	128.3^{a}	5.7^{ab}	2.3^{bc}	140.3^{ab}	23.5^{a}	5.3^{ab}	2.4^{bc}	4.2^{c}	90.9^{a}
	Feb.	22.3^{b}	7.2^{a}	115.0^{ab}	5.2^{ab}	2.1^{bc}	144.1^{ab}	23.2^{a}	4.1^{c}	3.2^{ab}	5.4^{bc}	94.1^{a}
	Mar.	23.6^{b}	7.4^{a}	108.7^{ab}	5.0^{ab}	2.1^{bc}	144.6^{ab}	23.7^{a}	4.0^{c}	3.4^{ab}	5.9^{ab}	99.4^{a}
	Apr.	25.7^{ab}	7.8^{a}	100.0^{ab}	4.9^{bc}	2.0^{bc}	150.1^{a}	20.1^{ab}	4.0^{c}	3.2^{ab}	6.0^{ab}	91.5^{a}
	Mean ± SE	23.8±0.8	6.8±0.1	99.3±3.6	6.6±0.3	3.2±0.4	129.9±4.1	17.8±1.5	5.4 ±0.3	2.9±0.2	6.1±0.3	88.8±01.4
	SD	2.7	0.3	12.9	1.7	0.9	14.3	5.5	1.0	0.9	0.9	1.9
	Min	18.3	6.5	88.6	4.9	2	102.4	10.1	4.0	1.7	4.2	83.1.1
	Max	27.7	7.8	128.3	7.8	3.8	150.1	23.8	7.5	3.8	7.2	99.4
	Standard	23-35	6.5-9	100-125	≥5	>3	3.5	150		10	10	20-200

Key: Temperature (Temp.), Nephelometric Turbidity Unit (NTU), Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Electrical conductivity (EC), Phosphate-Phosphorus (PO_4-P), Nitrogen-Nitrite (NO_3-N).

*Columns with same superscript are not significantly different

Table 3: Correlation between Composition of Phytoplankton and Physico-chemical Parameters in Ajiwa Reservoir, Katsina State

	Bacillariophyta	Chlorophyta	Cyanophyta	Dinophyta
pH	-0.89*	-0.82*	-0.83*	-0.89*
Temp	0.36ns	0.44ns	0.65*	0.39ns
Turbidity	-0.82*	-0.82*	-0.90*	-0.82*
DO	0.89*	0.89*	0.71*	0.83*
BOD	0.84*	0.84*	0.63*	0.77*
Conductivity	0.84*	0.85*	0.88*	0.85*
Hardness	-0.29ns	-0.41ns	-0.52*	-0.40ns
Nitrate-Nitrogen	0.75*	0.71*	0.83*	0.72*
TDS	-0.86*	-0.90*	-0.94*	-0.89*
Phosphate-Phosphorus	0.62*	0.57*	0.66*	0.72*
Depth	-0.65*	-0.78*	-0.53*	-0.54*

*= significant ns= not significant

In general, green alga has a higher abundance over other kinds of algae and revealed a positive correlation with dissolved oxygen which indicated a good productivity of the reservoir especially during wet season. Mahar, (2003) [9] also observed succession of phytoplankton communities was affected by strong seasonal influence. In tropical regions the dry and rainy seasons showed distinct fluctuations with an abundance of phytoplankton (Abubakar, 2009) [1]. The monthly variation of population composition and significant difference with season may be due to the fluctuations of physico-chemical parameters of the water as suggested by Iqbal *et al.* (1990) [5]. The higher abundance during wet season could be due to the presence of more nutrients and water level in the reservoir at the time. The higher phytoplankton count during the rainy season indicated that the reservoir was more productive during the rainy season because phytoplankton's being the primary producers in freshwater bodies determines the link of feeding relationship in the aquatic ecosystem. Phytoplankton showed a positive relation with dissolved oxygen, biochemical oxygen demand, nitrogen and phosphate. Abubakar, (2009) [1] made similar observations in Sabke Reservoir Katsina State. The high concentration of nutrients like nitrogen and phosphates results into blooming of algae which is sign of eutrophication, but the concentration of both nitrogen and phosphates in the reservoir was within the acceptable range. Nutrient limitation is also an important factor for phytoplankton abundance in shallow freshwater as indicated by Araoye and Owolabi (2005) [2].

Conclusion

In conclusion, Ajiwa reservoir was more productive during the rainy season, because there was higher abundance of planktons during the rainy season than the dry season. The high abundance of Chlorophyta was an indication that the reservoir was productive because they are the primary producers in freshwater bodies that determine the link of feeding relationship with in the aquatic ecosystem.

Recommendations

1. Indiscriminate dumping of anthropogenic inputs should be discouraged in the reservoir because of its negative effect to the biodiversity of the reservoir.
2. Farmers around the reservoir should be educated on the effects of their activities into the body of the water, especially the application of chemical fertilizers and pesticide during period of rainy season farming and irrigation when the water level recedes.
3. As the phytoplankton serves as an important link in the food chain and they are the principal source of food for other living organisms, thus efforts should be done for their biodiversity conservation.

References

1. Abubakar I. Limnological Studies for the Assessment of Sabke Lake Katsina State Nigeria. *Unpublished MSc. Thesis*, Ahmadu Bello University, Zaria. 2009, 75.
2. Araoye PA, Owolabi O. Some changes in the animal and fish species composition due to the construction of Kampe (Omi) dam and irrigation project in Kogi State, Nigeria. Nigerian Journal of Pure & Applied Science. 2005; 20(1):1781-1789.
3. Akomeah PA, Ekhator O, Udoka C. Dry Season Phytoplankton Composition Of Ibiekuma Dam, Ekpoma, Edo State. Ethiopian Journal of Environmental Studies and Management. 2010; (3)3:36-40
4. APHA. Standard Methods for Examination of Water and Waste Water. American Public Health Association, New York, U. S.A, 1999.
5. Iqbal M, Kazmi A, Shoukat SA. Multivariate analysis of seasonal variation in zooplankton composition of Hub Lake. Pakistan Journal of Zoology. 1990; 22(2):123-131.
6. Janjua MY, Ahmad T, Gerdeau D. Comparison of different predictive models for estimating fish yields in Shahpur Dam, Pakistan. Lake Reservoir Management. 2008; (13):319-324.
7. Kadiri MO. Limnological Studies of two Contrasting but Closely Linked Springs in Southern Nigeria. *Plant Biosystems*. 2002; 13(4):123-131.
8. Lac key JB. The manipulation and counting of River Plankton and Changes in Some Organisms due to Formalin Preservations.US Public Health Reports. 1938; (63):208-2093.
9. Mahar MA. Ecology and Taxonomy of Plankton of Manchharl ake (Distt. Dadu), Sindh, Pakistan. Unpublished Ph D. Thesis. University of Sindh, Pakistan, 2003; 118.
10. Needham JG, Needham PR. A Guide to the Study of Freshwater Biology 4th edition, Holden - Day Inc., San Francisco, 1975, 75-82.
11. Olele NF, Ekelemu JK. Physicochemical and phytoplankton study of Onah Lake, Asaba, Nigeria., African Journal of General Agriculture. 2008; 4(3).
12. Tanimu Y. Diversity and Abundance of Phytoplankton in Relation to Water Quality Status of Three Reservoirs in Kaduna State Nigeria. Unpublished, MSc. Thesis. Ahmadu Bello University, Zaria. 2011, 87.