Original Research Article

PHYTOPLANKTON DIVERSITY AND ABUNDANCE IN LAKE RIBADU, ADAMAWA STATE, NIGERIA

ABSTRACT

This study was carried out to look at the phytoplankton diversity and abundance in Lake Ribadu, Fufore Local Government Area, Adamawa State, Nigeria. The study was carried out for a period of 6 months (July to December 2016). Phytoplanktons sampling was carried out by using plankton net of mesh size 55µm by hauling horizontally for five meters. Frequency counts, percentages were used to analyze the phytoplankton species composition and abundance while ComEcolPaC (a Microsoft Excel 2003 based program) was used to analyze the variation in the diversity indices. A total of Twenty one (21) species were observed in the study sites. *Bacillariophyceae* recorded the highest with the percentage abundance of 37.8% followed by *Chlorophyceae* with 35.12%, *Cyxophyceae* with 25.82% while *Chrysophyceae* with 1.53% is the least abundant. The study recommends that Monitoring of the lake by the immediate community and regulation of all anthropogenic activities should be given topmost priority as part of the environmental management policy for sustainability of aquatic resources of the lake.

KEYWORDS: Diversity, Abundance, Phytoplankton, Lakes, Ribadu

1. INTRODUCTION

Lakes are very important part of our natural heritage, they have widely been utilized by mankind over the centuries to the extent that very few, if not many are now in a natural condition [1, 2]. Lakes and wetlands are dynamic ecosystems, continually undergoing natural changes due to infilling with sediments and nutrient subsidence and a rise in water levels during heavy floods. They sustain all life forms and perform some useful functions in the maintenance of overall balance of nature. Subsequently, it was observed that rapid urbanization, burgeoning human population and their various activities have contributed to the decline of the quality and quantity of these lakes [3]. Change in area (habitat loss), change in water regime, change in water quality, unsustainable exploitation of lake resources, interaction of alien species, Intensive farming practices along the lake plains causes changes in the lake soils, hydrology, vegetation condition and dynamics of the lakes or wetlands [3, 4].

The maintenance of healthy aquatic ecosystem is dependent on the quality of water and its biological diversity [5]. Ja'afaru *et al.,* [6] pointed out that the productivity of an aquatic ecosystem is dependent on its physico-chemical parameters and plankton diversity and distribution of the water. Physico-chemical parameters have been reported as one of the source of the variations in species composition, abundance, diversity and distribution of plankton [7]. The phytoplankton is an important water quality indicator due to their shorter life spans combined with their different tolerance levels towards physico-chemical parameters [8]. Research has also shown that phytoplankton species have different tolerance limits towards the physico-chemical parameters. Hence, it is imperative to focus on preservation of these endangered habitats to achieve ecological sustainability. Therefore, the present study aimed at assessing some physico-chemical parameters and its relationship with the abundance of phytoplankton in Lake Ribadu. Furthermore, the knowledge of phytoplankton distribution with reference to spatial pattern is important to determine the status of the ecosystem structure and functioning.

2. MATERIALS AND METHODS

Study area: Lake Ribadu is located in Ribadu village of Fufore Local Government Area, Adamawa State, Nigeria. As shown in Fig. 1, Lake Ribadu is a perennial lake situated in latitude 9.12 – 16.51 N and longitude 12.28 – 12.43 E [9]. Lake Ribadu is a wet flood plain adjacent to the Upper Benue River Basin.

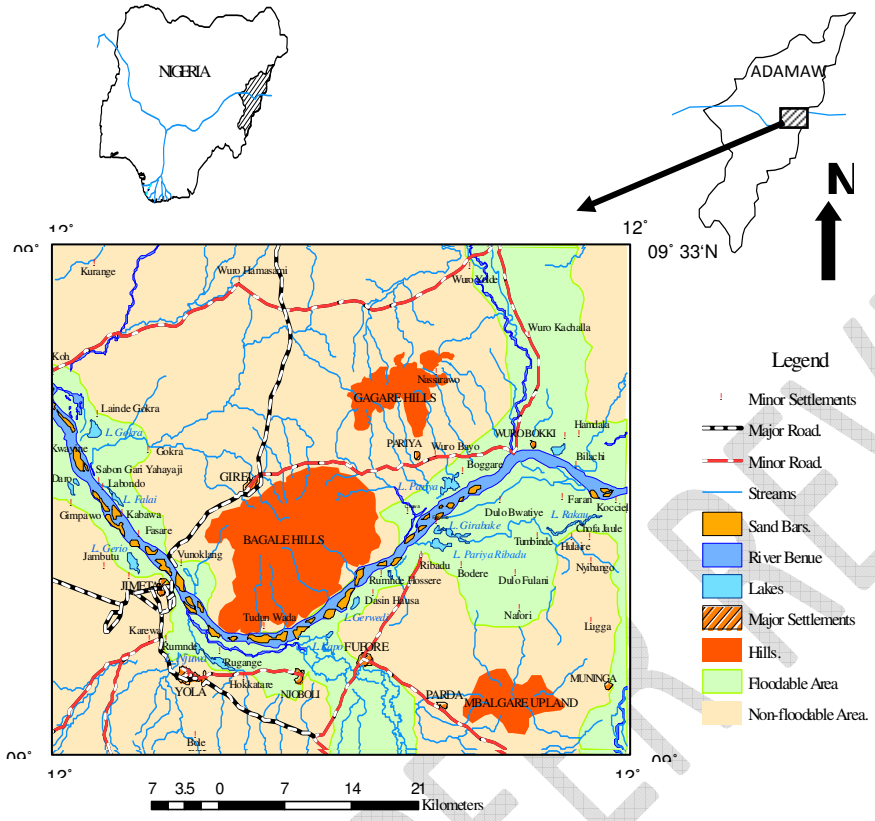

Fig 1: Map of Fufore LGA showing the study area (Lake Ribadu)

Method of Data Collection: The samples were collected once every month from Lake Ribadu during morning hours of 7:00am – 8:00am for a period of six months (July – December, 2016). The study area was categorized into three stations: A, B and C. Station A was located at the shore of the lake where human activities, like bathing, washing and other domestic activities are taking place. Station B was located at the middle of the lake where there is less human activities. Station C was located at the downstream of the lake were irrigation is the major activity. Plankton sampling was carried out by using plankton net of mesh size 55µm by hauling horizontally for five meters according to the method. Filtered water samples were stored in the sample bottle, and then preserved with Lugol solution of 10%. Identification of the phytoplankton species was according to Botes [10]; Emi and Andy [11].

Statistical Analysis: Frequency counts, Percentages and ComEcolPaC, a Microsoft Excel 2003 based program was used to calculate: Species richness and species diversity.

Specie richness seeks to ascertain the number of species per sample while species diversity seeks to provides more information about community composition than simply species richness (i.e., the number of species present); they also take the relative abundances of different species into account

H' - Shannon-Wiener diversity index

$$H' = \sum_{i=1}^{s} p_i \cdot \log_2 p_i$$

S - species richness (number of species),

p_i - proportion of species i

E – Pielou Evenness Index

$$E = \frac{H'}{H_{max}}$$

D - Simpson's index

$$D = \sum_{i=1}^{s} p_i^2$$

S - species richness, p_i - proportion of species i

D_{Ma} - Margalef Diversity Index

$$D_{Ma} = \frac{S-1}{\ln N}$$

S - species richness,

N - total abundance

D_{Me} – Menhinick Diversity Index

$$D_{Me} = \frac{S}{\sqrt{N}}$$

S - species richness,

N - total abundance

3. RESULTS

At the end of the six month long survey, four families (*Baciliariophyceae, Chlorophyceae, Chrysophyceae,* and *Myxophyceae*) comprising of 21 phytoplankton species were identified. *Flagillaria* recorded the highest with the percentage abundance of 28.8% followed by *Ankistrodesmus* with 22.54%, *Aphanocopsa* with 20.01% while *Synuva* with 0.05% is the least abundant (Table 1).

Table 2 and 3 of the study revealed the Shannon-Weiner Diversity Index (H') and the Spatial Variation in the Diversity indices of the study

Table 1: Species Composition and Abundance of Phytoplankton in Lake Ribadu

Specie	Total Abundance	%Abundance
Flagillaria	124896	28.80
Tabellaria spp	15235	3.51
Naviculales	4200	0.96
Nituschia	2456	0.56
Cyclotella	15896	3.66
Ankistrodesmus	97791	22.54
Chlorella	18741	4.32
Ulothrix	7358	1.69
Enteromorphy	1035	0.23
Closterium	5825	1.34
Eudorina	1053	0.24
Oocystic	13159	3.03
Zugrema	1579	0.36
Microspora	5791	1.33
Aphanocopsa	86801	20.01
Anabaena	14959	3.44
Oscillatoria	1594	0.36
Aphanizomenon	8637	1.99

Mallamonas	6415	1.47
Synuva	256	0.05
	433677	**100**

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Table 2: Shannon-Weiner Diversity Index of the Phytoplankton Species from the Study sites

Specie	Site A				Site B				Site C			
	N	Pi	LnPi	PiLnPi	N	Pi	LnPi	PiLnPi	N	Pi	LnPi	PiLnPi
Flagillaria	40945	0.26	-1.36	-0.35	45067	0.31	-1.18	-0.36	38884	0.30	-1.19	-0.36
Tabellaria spp	11025	0.07	-2.67	-0.18	1578	0.01	-4.53	-0.05	2632	0.02	-3.89	-0.08
Naviculales	1568	0.01	-4.62	-0.05	526	0.00	-5.63	-0.02	2106	0.02	-4.11	-0.07
Nituschia	1831	0.01	-4.47	-0.05	625	0.00	-5.45	-0.02	-			
Cyclotella	4843	0.03	-3.49	-0.11	7368	0.05	-2.99	-0.15	3685	0.03	-3.55	-0.10
Ankistrodesmus	37516	0.24	-1.45	-0.34	35268	0.24	-1.42	-0.34	25007	0.20	-1.63	-0.32
Chlorella	7637	0.05	-3.04	-0.15	3826	0.03	-3.64	-0.10	7278	0.06	-2.87	-0.16
Ulothrix	6305	0.04	-3.23	-0.13	-	-	-	-	1053	0.01	-4.80	-0.04
Enteromorphy	-	-	-	-	-	-	-	-	1035	0.01	-4.82	-0.04
Closterium	3685	0.02	-3.77	-0.09	1088	0.01	-4.90	-0.04	1052	0.01	-4.80	-0.04
Eudorina	1053	0.01	-5.02	-0.03	-	-	-		-	-	-	-
Oocystic	4737	0.03	-3.52	-0.10	4211	0.03	-3.55	-0.10	4211	0.03	-3.42	-0.11
Zugrema	-	-	-	-	-				1579	0.01	-4.40	-0.05
Microspora	2106	0.01	-4.33	-0.06	2106	0.01	-4.24	-0.06	1579	0.01	-4.40	-0.05
Aphanocopsa	27509	0.17	-1.76	-0.30	35263	0.24	-1.42	-0.34	24029	0.19	-1.67	-0.31
Anabaena	4063	0.03	-3.67	-0.09	6317	0.04	-3.14	-0.14	4579	0.04	-3.33	-0.12
Oscillatoria	562	0.00	-5.65	-0.02	-	-	-	-	1032	0.01	-4.82	-0.04
Aphanizomenon	1795	0.01	-4.49	-0.05	-	-	-	-	6842	0.05	-2.93	-0.16
Mallamonas	2106	0.01	-4.33	-0.06	2730	0.02	-3.98	-0.07	1579	0.01	-4.40	-0.05
Synuva	256	0.00	-6.43	-0.01	-	-	-	-	-	-	-	-
	159542	**1.00**		**3.12**	**145973**	**1.00**		**2.59**	**128162**	**1.00**		**3.04**

Table 3: Spatial Variation in Diversity indices of Phytoplankton population across the study sites

	Site		
	A	B	C
Shannon-Weiner Diversity Index (H')	3.12	2.59	3.04
Pielou Evenness Index (E)	0.74	0.70	0.74
Simpson's Density Index (D)	0.16	0.21	0.17
Margalef Density Index (DMa)	1.41	1.00	1.36
Menhinick Density Index (DMe)	0.04	0.03	0.04

4. DISCUSSION

Seasonal variation of phytoplankton community structure is generally understood to be driven by the water circulation dynamics, nutrient concentrations, rainfall patterns, location and the nature of the physical environment which varies mainly in accordance to the dry and wet periods in the tropical waters [3, 12]. A higher number of *Flagillaria* (28.8%), *Ankistrodesmus* (22.54%) was observed during the research period that lasted for six months (July-December, 2016). A total number of twenty one (21) species of phytoplankton were identified during the study period. Generally, plankton species composition was similar in all three sites. This is similar with the findings of Mohammed *et al.,* [13], Anago *et al.,* [14] who reported phytoplankton and zooplankton abundance in a study of phytoplankton diversity from Koil Coastal waters India and Awba Reservoir Ibadan Nigeria respectively. Furthermore, a study conducted by Fonge *et al.,* [3] on Phytoplankton diversity and abundance in Ndop wetland plain, Cameroon showed a high diversity of phytoplankton in study areas. The high abundance of the phytoplanktons in Station A may be attributed to the anthropogenic activities in the station. The findings agrees with Fonge *et al.* [3] who pointed out that the high abundance of

phytoplankton species may also be due to the constant addition of nutrient particularly through nitrate and phosphate fertilizers used close to the station.

Table 2 and 3 of the study revealed the Shannon-Weiner Diversity Index (H') and the Spatial Variation in the Diversity indices of the study. The Shannon-Weiner Diversity Index (H') ranged between 2.59 – 3.12 across the three study sites while the spatial variation in diversity indices of fish population across the three study sites are: Pielou Evenness Index (E) ranged between 0.70 - 0.74; Simpson's Diversity Index (D) ranged between 0.16 - 0.21; Others indices recorded included Margalef Diversity Index (DMa) with the range of 1.00 - 1.41 and Menhinick Diversity Index (DMe) ranged from 0.03 - 0.04. Species richness, diversity and evenness was observed to increase in all sites. This may be attributed to increased living space leading to increased number of microhabitats. The study agrees with the findings of Azma [15] who shows that a Simpson Index value of 0.83 - 0.93 indicates that the communities is mature and stable as the dominance is shared by large number of species. The Pielou index values which are more than 0.5 indicated that the zooplankton community is balance during the study period. According to Azma [15] and Frutos *et al*., [16] pointed out that if the Pielou Index values are less than 0.5, it could be an indicator of the presence of ecological stress.

5. CONCLUSION

Phytoplankton diversity and abundance were influenced by season and by. Thus, phytoplankton abundance and distribution were closely associated with environmental conditions. Hence further studies should be made to evaluate the physicochemical and planktons abundance and composition in different parts of the water throughout the year.

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