Phytoplankton Dynamics of River Oli in Kainji Lake National Park, Nigeria during Dry Season.

Adesalu, Taofikat. Abosede.

University of Lagos, Department of Botany and Microbiology, Lagos, Nigeria

boseadesalu@yahoo.com

Abstract: This paper examined the phytoplankton of River Oli (Borgu sector) of kainji Lake National Park for the first time. It recorded total of fifty five taxa, belonging to four major divisions; bacillariophyta, chlorophyta, euglenophyta and cyanophyta. The taxa were dominated qualitatively by green algae and quantitatively by euglenoids in particular *Euglena acus.* [The Journal of American Science. 2010;6(5):72-76]. (ISSN 1545-1003).

Keywords: River Oli, phytoplankton, Nigeria, diversity.

1. Introduction

The Nigerian climate is tropical, characterized by high temperatures and humidity as well as marked wet and dry seasons. The coastal areas have an annual rainfall ranging between 1, 500 and 4,000 mm (Kuruk, 2004). The surface water of the Nigerian coast is basically warm with temperature generally greater than 24^0C. Kuruk (2004) reported that the hydrology of Nigeria is dominated by two great river systems, the Niger-Benue and the Chad systems.

With the exception of a few rivers that empty directly into the Atlantic Ocean, all other flowing waters ultimately find their way into the Chad basin or down the lower Niger to the sea. It was also stated that the two river systems are separated by a primary watershed extending northeast and north-west from the Bauchi Plateau which is the main source of their principal tributaries. Algological studies on lotic system in Nigeria are few and these include that of Egborge (1973, 1974, 1979) who reported the phytoplankton of Oshun river, Egborge and Sagay (1979) on freshwater ecosystem in Ibadan, Holden and Green (1960) on the River Sokoto , Nwadiaro and Ezefili (1986) and Erondu and Chindah (1991) reported the phytoplankton of new Calabar River, while Kadiri (1999) studied the lower River Niger phytoplankton, Kadiri and Azomani (2000) studied the effect of brewery effluent on the growth of two chlorophytes in Ikpoba River, Kadiri and Omozusi (2002) reported the phytoplankton of River Okhuahe in Benin and most recently Kadiri (2007) reported the phytoplankton of River Ethiope.

Of all the mentioned rivers above, River Oli in Kainji Lake National Park and several other water bodies remain without phycological information hence such study remain important because majority of the riverine inhabitant most of the time depend on their surrounding water (River) apart from rain water for their water needs. This study is a pioneer phycological investigation of River Oli in Nigeria.

Description of study area

Kainji Lake National Park was established by Decree 46 of 1979 and is located in Niger and Kwara states of Nigeria, is 560 km north of Lagos, close to the border with the Republic of Benin. It covers an area of about 5340 km^2 and the most important landmark of the park is Kainji Lake. Adjoining the western side of the lake is the 3972 km^2 Borgu sector of the park which harbours River Oli, the major river found in this park. The river is perennial as it breaks into pools during the dry season. At this period its surface rate of flow reduces but the pool remains and is often quite large and provides a source of water to the wildlife population while the wet season is characterized by a period of maximum volume. River Oli takes its source from the River Niger which is the third longest river in Africa and the longest river in West Africa with watershed area covers of about 1,250,000km^2 (John 1986) and finally crossing Nigeria from north-west to south (Iloeje 1991). On the eastern side is the Zugurma sector, both sectors are not connected by land. The larger of the two distinct sectors of the park, Borgu is an ecosystem in Northern Guinea vegetation zone characterized by tall grasses and savannah woodland.

The vegetation of the park is typical of the Sudan-Guinea Savanna, although in some areas it appears more Sahelian. Riparian forests occur on the banks of the larger watercourses and some of the vegetation identified around this river are *Cola laurifolia, Terminalia aficiodis, Xylopia sp., Irvingia smithii, Bambus vulgaris, Burkea Africana, Diaspyrus mesfiformis, Symchnos spinosa, Grewia cubicens, Nauclea latifolia, Maytanus senegalensis* and *Mallotus oppositifolis*. There is a distinct raining season from May to October with maximum rains in

August and September. The park retains a robust animal population including antelope, lion, hippopotamus, buffalo, roan antelope, jackal, baboon, monkey and crocodile. The park is usually open from December to June, with the best time to visit towards the end of the dry season, when the grass has dried out and the animals move closer to the water.

2. Materials and Methods

Collection of samples

The study was based on a single sampling strategy during reconnaissance field trips in the Kainji Lake National Park, Borgu sector. Samples were collected on 16 April, 2009 from two locations due to accessibility as the river has separated into pools which harbors animals like Hippopotamus and crocodile. Station A (Latitude: 09^0 53^1 53.6N, Longitude: 003^0 59^1 07E) was called Hippopotamus pool by the workers in the Park while station B (Latitude: 09^0 54 43.4, Longitude: 003^0 57^1 13.5E) was very close to the Park hostel. Few of the physical parameters analysed include surface water temperature which was measured by mercury in glass thermometer, surface water conductivities and salinity values were recorded using conductivity meter and hand refractometer for stations A and B.

Biological samples were stored in 5 L, concentrated, fixed with 4% unbuffered formalin and analysed with the aid of Olympus XSZ-N107 photomicroscope. Taxanomic keys employed in the identification included Hustedt (1930, 1937, 1942 and 1971); Patrick & Reimer (1966, 1975); Prescott (1964, 1973 and 1982; Whittford and Shumacher 1973). Community structure analyses used in this study have been described elsewhere (Adesalu et al., 2008).

3. Results

Surface water temperature recorded 31^0C for both stations, the pH values of (7.08 and 7.20), surface water conductivities (70.0µScm^{-1} and 71.0µScm^{-1}) and salinity values recorded 0.01‰ and 0.02‰ for stations A and B respectively.

Phytoplankton composition

A total of 55 taxa classified into four major divisions namely, Bacillariophyta, Chlorophyta, Euglenophyta and Cyanophyta were observed in this study. The green algae dominated the phytoplankton spectrum of both stations, it recorded 32.50% and 54.99% of total phytoplankton for stations A and B (Figure 1) respectively with *Scenedesmus quadricauda* and *Pediastrum boryanum var longicorne* accounted for 7.50% and 6.67% of station A and *P. simplex (*13.78%) with *S. quadricauda (*13.63%) for station B. For station A, the diatoms, euglenoids and blue green algae recorded 30.42%; 19.38%; and 17.71% of total phytoplankton in that sequence making the blue-green algae the least represented with only three genera *Oscillatoria, Merismopedia* and *Chroococcus*. Interestingly, Station B did not follow that sequence rather the least represented division was bacillariophyta (9.50%) with *Navicula decusis* accounted for 2.30% (Table 1).

The overall observation showed that the green algae were ably represented by chlorococcales particularly Scenedesmaceae (mostly *Scenedesmus* spp) and the hydrodictyaceae mainly *Pediastrum* spp. *Euastrum sinuosum* and *Tetraedron* sp were among the rare species encountered during investigation. Although the euglenoids recorded lower percentage values for both stations, the taxon had a wide distribution with *Euglena acus* as dominant species. Shannon-Weaver information (H^l) value (3.23) was higher in station A while low equitability value (0.81) was recorded for station B. Species richness d recorded its highest value (5.67) in station A (Figure 2).

Dominance of phytoplankton samples by a few species was reflected by low equitability 'j' value recorded and since Margalef's 'd' value is influenced by the number of species and individuals, high 'd' values recorded in station A reflected high species number and relatively low numbers of individuals. The Shannon-Weaver diversity index (H^1) is influenced by both number of species and equitability. In River Oli, higher H^1 values observed could be attributed to high 'j' value recorded (Table1).

Table 1: Phytoplankton abundance and percentage composition (cells mL^{-1}) of Oli River, Kainji Lake National Park (17/4/09) (%A=Percentage composition of species in station A; %B=Percentage composition of species in station B).

Taxa	**Station A**	% A	**Station B**	% B
Division: Bacillariophyta				
Class: Bacillariophyceae				
Order 1: Aulacoseirales				
Family 1: Aulacoseiraceae				
Aulacoseira granulata (Ehrenb) Ralfs.	14	2.92	4	0.30
Aulacoseira granulata var angustissima O.Muller	37	7.71	26	1.93
Order 2: Achnanthales				

Family: Achnanthaceae				
Achnanthes sp.	4	0.83		
Order 3: Fragilariales				
Family: Fragilariaceae				
Synedra sp.	4	0.83		
Ulnaria ulna (Nitzsc) P Compère	18	3.75	2	0.15
Order 4 : Tabellariales				
Family :Tabellariaceae				
Tabellaria fenestrata (Lyng.)Kutzing			2	0.15
Order 5: Bacillariales				
Nitzschia sp.			2	0.15
Order 6: Naviculales				
Family 1: Naviculaceae				
Frustulia rhokmboides var saxonica (Rabh) de Toni			4	0.30
Gyrosigma scalproides (Raph.) Cleve			4	0.30
Luticola mutica Kutzing.	20	4.17	15	1.11
Mastogloia sp.			14	1.04
Navicula cryptocephala Kutzing	8	1.67	1	0.07
N. decusis Ostrup	4	0.83	31	2.30
N. exigua (Greg.) O. Muller	14	2.92		
N. rhyncocephala Kutzing			12	0.89
Navicula sp.	4	0.83	12	0.89
Pinnularia biceps Gregory	6	1.25	4	0.30
Pinnularia sp.	4	0.83		
Family 2: Cymbellaceae				
Cymbella ventricosa Kutzing			2	0.15
Cymbella sp	3	0.63		
Family 3: Gomphonemataceae				
Gomphonema angustatum var producta Grunow	3	0.63		
*G. parvulum (*Kutzing) Kutzing			2	0.15
Gomphonema sp.	3	0.63		
Division: Chlorophyta				
Class: Chlorophyceae				
Order 1: Chlorococcales				
Euastrum sinuosum Lenor	3	0.63		
Pediastrum boryanum var longicorne Raciboski	32	6.67	128	9.48
P. duplex Meyen			96	7.11
P. simplex (Meyen) Lemm	17	3.54	186	13.78
P. simplex var echinulatum (Wittr)	11	2.29		
P. tetras (Ehr.) Ralfs			16	1.19
Scenedesmus acuminatus (Lag.) Chodat	8	1.67		
S. armatus			24	1.78
S. armatus var bicaudatus (Gugl.-Printz)Chodat	12	2.50		
S. bicaudatus Dedus			104	7.70
S. denticulatus Lagerh.	8	1.67		
S. dimorphus (Turp.) Kutz			16	1.19
S. quadricauda (Turp) Breb	36	7.50	184	13.63
S. quadricauda var maxima W & G.S West	4	0.83	20	1.48
Tetraedron sp.	1	0.21		
Order 2: Desmidiales				
Family: Closteriaceae				
Closterium sp.			4	0.30
Order 3: Volvocales				
Family: Volvocaceae				
Volvox sp	24	5.00	7	0.52
Division: Euglenophyta				
Class: Euglenophyceae				
Order: Euglenales				
Euglena acus Ehr.	34	7.08	234	17.33
E. deses Ehr.			4	0.30
Euglena ehrenbergii Klebs			14	1.04
E. limnophila var limnophila Lemm			14	1.04
Euglena viridis	18	3.75	42	3.11
Euglena sp.	13	2.71		
Phacus longicauda				
Phacus orbicularis Hubner	19	3.96	40	2.96
Phacus sp.	1	0.21		
Strombbonas ovalis	4	0.83		
Strombbonas sp			8	0.59
Trachelomonas sp.	4	0.83		
Division: Cyanophyta				
Class: Cyanophyceae				
Order 1: Chroococcales				
Family 1: Chroococcaceae				
Chroococcus sp.	21	4.38	80	5.93
Family 2:Merismopediaceae				
Merismopedia glauca (Ehr.) Nag	48	10.00	48	3.56
Order				

2:Oscillatoriales				
Family 1:Oscillatoriaceae *Oscillatoria formosa* Bory	16	3.33	28	2.07
Number of Species	36		38	
Total Number of Individuals	480		1442	
Margalef species diversity (d)	5.67		5.09	
Shannon-Weaver (H^1)	3.23		2.96	
Species Evenness (j)	0.90		0.81	

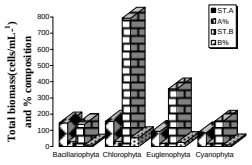

Figure 1: Percentatage composition of different divisions in Oli River

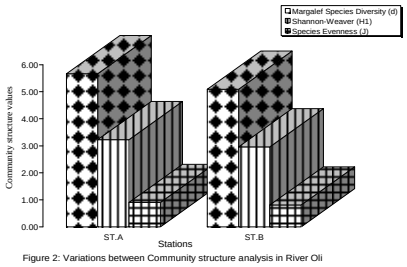

Figure 2: Variations between Community structure analysis in River Oli

4. Discussion

The paucity of phytoplankton population in the River Oli may be partly due to the poor light penetration into highly turbid water, which reduced photosynthetic depth as a result of natural habitat that the river created for hippopotamus and crocodiles which most often mixes up the water for their own body temperature regulation especially during dry season when this study was undertaken. In this study, the Euglenophyceae had a wider distribution and two of the organic pollution indicators species observed were *Euglena acus* Ehr. and *Phacus orbicularis* Hubner.

The observation of more chlorophytes than diatoms and very few cyanophytes in this study conformed to typical trend in tropical water bodies (Kadiri 1999; Kadiri & Omozusi 2002; Coute & Rousselin 1975; Kebede & Belay 1994). Wetzel (1983) reported that chlorococcales inhabit waters of differing salinity and alkalinity. The low desmids recorded could be a pointer that the river is poor in its ionic composition (Kadiri 1993; Nwankwo 1996) because high diversity of desmids is an indication that the water body is largely unpolluted (Egborge and Sagay 1979) and this is supported with *Euglena acus* recording the highest percentage composition (17.33%) for the overall phytoplankton spectrum. According to Caljon (1987) and Conforti (1991) this group is characteristic of eutrophic or nutrient rich water bodies and there abundant is a pointer that probably the study area is organically polluted which could be due to animal faecation. So far, no work has been done on the algal flora of River Oli; hence all these forms constitute new records and this study has provided baseline data for the River Oli.

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Corresponding author:
Adesalu, Taofikat Abosede.
Department of Botany and Microbiology
University of Lagos, Akoka, Nigeria
E-mail: boseadesalu@yahoo.com

References

1. BirdLife International. BirdLife's online World Bird Database: the site for bird conservation. Version 2.1. Cambridge,UK:BirdLife International.2008; Available from: http://www.birdlife.org (accessed 24/4/2009).
2. Caljon A. G. A recently ladlocked brackish water lagoon of Lake Tanganyika: Physical and chemical characteristics snd spatio-temporal distribution of phytoplankton. Hydrobiol. 1987; 153: 55-70.
3. Couté A., Rousselin, G. Contribution á l'etude des algues d'eau douce du Moyen Niger (Mali). Bull. Mus. Natn. Nat. Paris, Ser. 3, 277, Bot. 1975; 21: 75-175.
4. Conforti, V. Taxonomic study of Euglenophyta of highly polluted river of Argentina. Nova Hedwigia 1991; 53: 73-98.
5. Egborge, A. B. M. A preliminary checklist of the phytoplankton of Oshun River, Nigeria. Freshwater Biology.1973*;* 4: 569–72.
6. Egborge, A. B. M. The seasonal variation and distribution of phytoplankton in the river Oshun, Nigeria. Freshwater Biology.1974; (4) 2: 177–91.

7. Egborge, A. B. M. The effect of impoundment on the phytoplankton of the River Oshun, Nigeria. Nova Hedwigia. 1979; (31) 1–2: 401–17.
8. Egborge, A.B.M., Sagay, E. G. The ddistribution of phytoplankton and zooplankton in some Ibadan Freshwater ecosystem. Pol. Arch. Hydrobiol. 1979; 26: 323-35.
9. Erondu, E. S., Chindah, A. C. Physico-chemical and phytoplankton changes in a tidal freshwater station of the new Calabar River, South Eastern Nigeria.Environmental and ecology.1991; 9: 561-70.
10. Holden, G. J., Green, J. The hydrology and plankton of River Sokoto.J. Anim. Ecol.1960; 29: 65-84.
11. Hustedt, F. Die. Kiselalgen 7. In Rabenhorst (Ed.) Kryptogemen-flora von Deutshland Österreichs un der Schweiz. A Kademiscehe Vergasell Schaft M.L.H. Leipzing. 1930–1937: 466pp.
12. Hustedt, F. Kryptogamen-flora von Deutschland, Österreichs un der Schweiz. A Kademiscehe Vergasell Schaft M.L.H. Leipzing.1971: 816pp.
13. Iloeje, N.P. New geography of Nigeria .Lagos-Ibadan, Longman, 1991: 201pp.
14. John D.M. The inland waters of tropical West Africa.Arch.Hydrobiol. 1986; 23: 1-244.
15. Kadiri, M.O. Phytoplankton distribution in the coastal areas of Nigeria. Nigeria
16. Journal of Botany. 1999; 12: 51-62.
17. Kadiri, M.O. Phytoplankton dynamics of a tropical river: A dry and rainy season comparison. Journal of Aquatic Sciences. 2007; 22: 11-26.
18. Kadiri, M.O., Omozusi, H.I. A pre-pollution study of the phytoplankton of an oligotrophic river in southern Nigeria. Afr. J.Environ. Pollut. Health. 2002; 1:19-27.
19. Kadiri, M.O., Azomani, L.I. Effect of brewery effluent into Ikpoba River on the growth of two chlorophytes, J. Environment and toxicology. 2000; 2: 14 -18.
20. Kuruk, P. Customary Water Laws and Practices: Nigeria. 2004 Available from: http://www.fao.org/legal/advserv/FAOIUCNcs/Nigeria.pdf.
21. Kebede, E., Belay, A. Species composition and phytoplankton biomass in a tropical African lake (Lake Awasa, Ethiopia) Hydrobiol. 1994; 288: 13-32.
22. Patrick, R., Reimer, C.W. The diatoms of the United States exclusive of Alaska and Hawaii. Vol. 1–Monographs. Academy of Natural Sciences, Philadelphia. 1966: 688pp.
23. Patrick, R., Reimer, C.W. The diatoms of the united states exclusive of Alaska and Hawaii. Vol. 2, Part 1–Monographs. Academy of Natural Sciences, Philadelphia. 1975: 213pp.
24. Prescott, G. W. Algae of the Western Great Lake Area. Wm. C Brown Co. IOWA. 1961–1973: 977pp.
25. Prescott, G. W. Algae of the Western Great Lakes area with an illustrated key to the genera of desmids and freshwater diatoms. Brown Co Publishers, Dubuque IOWA. 1982: 977pp.
26. Nwadiaro, C. C., Ezefili, E.O. A preliminary checklist of phytoplankton of New Calabar River, Lower Delta. Hydrobiological bulletin 1986; 19: 133-38.
27. Nwankwo, D. I. Phytoplankton diversity and succession in Lagos lagoon, Nigeria. *Archiv fur Hydrobiologie*. 1996; 135 (4): 529–42.
28. Wetzel, R.G. Limnology (2nd edn.) Philadelphia, Saunders, 1983: 853pp.
29. Whitford, L. A., Schumacher, G. J. A manual of fresh water algae. Spark Press, Raleigh, N.C 1973:.324pp.

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