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Phytoplankton composition and physico-chemical parameters of lower river Niger, Agenebode, Edo state Nigeria

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Abstract
The phytoplankton composition and the physic-chemical parameters of the down-stream, mid-stream and upper-stream of Agenebode lower river Niger was investigated between April and October, 2015. A total of 80 phytoplankton species belonging to four divisions; Bacillariophyta, Chlorophyta, Cyanophyta and Euglenophyta which includes 34 genera, 10 orders and 17 families were observed. All the species of Bacillariophyta observed were pennate forms. Only *Surirella elegans* was observed in the three areas while *Aulacoseira granulata*, was observed in upper stream and *Spirogyra dubia* in the downstream of the river. The taxa were dominated qualitatively by green algae (desmids). The mid-stream accounted for most of the desmids encountered. Generally the division Chlorophyta had the highest percentage composition (45%), followed by Bacillariophyta (32.5%), Euglenophyta (15%) and Cyanophyta (7.5%). The physico-chemical parameters studied showed that temperature fluctuated between a mean of 27.5 ˚C to 31.75 °C. The pH values of the three areas had a mean range of 6.39 to 7.20; the DO for all the studied area were within 4mg/L to 10mg/L but there was variation in the mean conductivity values (DNS, 75.3µScm^{-1}; MDS, 67.58µScm^{-1}; UPS, 50µScm^{-1}).

Keywords: Phytoplankton, taxa, desmids

1. Introduction
Nigerian population, which was estimated at about 162.5 million in 2011 with an annual population growth rate of 2.1% is expected to be 258 million by 2030 [2]. Food supply is expected to triple to cater for this increase. The current demand for fish in Nigeria is 3.32 million tonnes [12]. The present situation calls for serious and urgent action on how to ensure sufficient and sustainable production of fish. The transition to scarcity of fish cannot be prevented by only intensive fishing and aquacultural practices, but rather by better management of fisheries resources. Maintaining the health of the water bodies in Nigeria is very crucial as the gap between the demand and supply for fish and fisheries products gets wider everyday due to continuous increase in the population [32]. The lower river Niger at Agenebode, Edo State, Nigeria serves a community of about 145,996 with annual growth rate of 2.8% [35]. The water body is used for fishing and other domestic activities. The major occupation of the inhabitants is fishing and boat building. Considering the importance of this water body to the livelihood of the immediate community and the several essential ecosystem services provided by this river, it is important to monitor the abundance of the primary producers (phytoplankton) of this resource.
To benefit from the algae of lakes, ponds, dam reservoirs and rivers, it is necessary to study the taxonomy of freshwater systems [7]. Algae (phytoplankton) are the source of oxygen in aquatic systems and are the main autochthonous primary producers. They also serve as indicators of pollution in any water body as primary producers and as such could be used in determining water pollution level.
This study therefore was carried out to contribute to the knowledge of freshwater algae of Edo State in particular and Nigeria in general. The significance of this study is to help narrow the dearth of phycological information on the lower Niger river at Agenebode as well as provide opportunity for monitoring changes in its physico-chemical parameters and algae composition.

2. Materials and methods

2.1 Study Area

Edo State is an inland state in western Nigeria. Its capital is Benin City. It is located on latitude 6°41′E6°43′E and longitude of 7. (Fig.1)

Agenebode is a serene, water-side town located by the banks of the river Niger in Edo state, South South geo-political zone of Nigeria with a population of 145,996. It is located on longitude $7^{0}06$'N and latitude of $6^{0}42$'E with temperature ranges from 22 ^{0}C to 31 ^{0}C. Agenebode has a tropical savannah climate with two clearly marked seasons of wet (May to September) and dry (October to April). River Niger serves as a boundary between Kogi state and Edo state and Agenebode is the commercial nerve centre between the two states for fisheries. The whole study area was divided into three sampling sites namely, Down Stream (DNS), Mid – Stream (MDS) and Upper stream (UPS). The phytoplankton composition and the physic-chemical parameters of the down-stream, mid-stream and upper-stream of Agenebode lower river Niger was investigated between April and October, 2015 representing dry and rainy months.

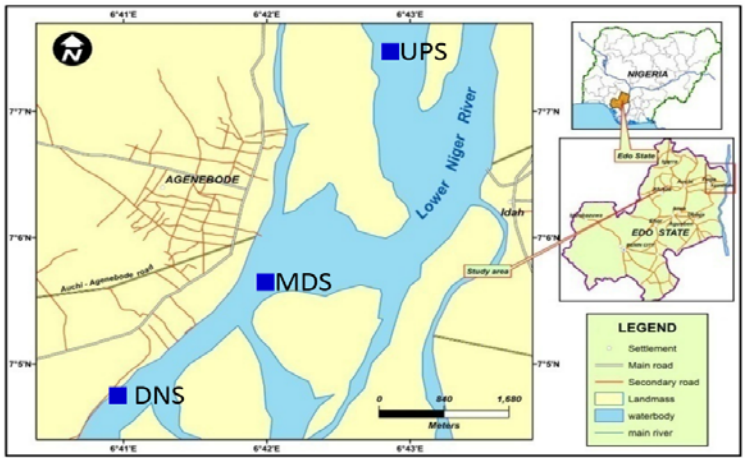

Fig 1: Map of Agenebode showing sampling sites.

2.2 Data Collection

Water samples for the study were collected bimonthly between April – October, 2015 Samples were taken from upstream of the river, midstream and downstream between 6.30 -7.00a.m at a depth of 20cm. Measurements of parameters studied (temperature, pH, conductivity and DO) were taken on site using a mercury in bulb glass thermometer, portable pH meter (Model Jenway®, 2010), and DO meter. Samples of plankton were collected using No. 20 silk bolting plankton net with mesh sieve of 76 µm and mouth diameter of 12.50 cm. and preserved in 4% formalin and was allowed to stand undisturbed for over 24hours on a flat surface. Thereafter, the sample volume was reduced to about 25 ml by siphoning with a pipette fitted with a flexible rubber tubing of 5 mm diameter. The tip of the pipette also fitted with a 76 µm mesh size zooplankton net to prevent accidental loss of organisms during siphoning.

Phytoplankton samples were collected by obtaining one litre of the river water to which two drops of Rose Bengal stain was added. The samples were then preserved in 4% formalin [34] and stored in the laboratory prior to microscopic analysis. Observation and identification of phytoplankton was carried out in the phycology laboratory of University of Benin, Edo State. The species were identified using relevant texts for Phytoplankton [18], and for Zooplankton [27]; and also with the help of a Botanist in University of Benin, Edo State, Nigeria.

3. Results

Physico-chemical characteristics of the water body were recorded during period of study (Table 1). The mean temperature for the sampling sites of 28.25 °C was recorded for upstream (UPS) and midstream (MDS) and 30°C for downstream (DNS); The pH value for the sampling sites was highest in MDS with 6.45 while UPS recorded the lowest pH value of 6.35 and the Conductivity values was highest in DNS with 75.3µScm^{-1}; and the lowest value of 50µScm^{-1} was recorded in UPS. The monthly mean temperature was highest in October with value of 30^{O}C and lowest in August with a monthly mean of 27 $^{\circ}$C (Table 1) while the monthly mean pH was highest in June with value of 7.20 and lowest with 5.80 in October. The highest monthly E. Conductivity value recorded was highest (85.00µ/cm) in April and lowest (41.30µ/cm) in August. The monthly mean value recorded for dissolved oxygen was highest in June (7.83) and lowest in October (5.13)

A total of 147 phytoplankton taxa comprising of Bacillariophyta, Chlorophyta, Cyanophyta and Euglenophyta divisions (Table 2) were recorded. Species encountered were more with 54 taxa in MDS (midstream) than UPS (upstream) and DNS (downstream), the lowest value of 40 taxa was recorded in DNS. Chlorophyta has the highest percentage composition with 45% while Cyanophyta on the other hand had the least percentage composition of 7.5% Table 2 and Fig. 2

Table 1: Monthly mean of the physico-chemical characteristics Lower Niger River at Agenebode.

Mean Values				
Month	**Temp. ^{O}C**	**pH**	**E. Cond. s/cm**	**DO**
Apr.	28.75 ± 1.37	6.45 ±0.18	85.00 ±35.00	4.72 ±1.94
Jun.	28.33 ± 1.33	7.17 ±0.15	75.00 ±10.61	7.83 ±3.43
Aug.	27.33 ± 1.08	6.20 ±0.07	50.00 ±0.00	5.90 ±1.09
Oct.	30.33 ± 0.10	5.82 ±0.08	62.25 ±10.41	5.13 ±0.88

Table 2: Distribution and composition of phytoplankton in Agenebode waterside.

PHYTOPLANKTON SPECIES	DNS	MDS	UPS
DIVISION: BACILLARIOPHYTA			
Anomoeneis serians	+	-	-
Aulacoseira granulata	+	+	+
A. granulata v. *angustissima* f. *spiralis*	+	+	+
A. granulata v. *curvata*	-	+	+
Cymbella puscilla	-	-	+
Cymbella. sp.	-	+	+
Eunotia asterionelloides	-	+	-
Eunotia. sp.	-	-	+
Navicula sp.	+	+	+
Nitzschia accicularis	+	+	+
N. palae	+	+	+
Pinnularia brebisonii	-	-	+
P. dactylus	-	+	-
P. divergens	+	+	+
P. gibba	-	-	+
P. subcapitata	-	+	-
P. viridis	+	-	+
Pinnularia. sp.	-	+	-
Pleurosigma angulatum	-	+	-
Pl. decorum	-	-	+
Pl. delicatulum	-	+	-
Surirella angusta	-	+	-
Sur. elegans	-	+	-
Sur. robusta	-	+	-
Synedra acus	+	+	+
S. ulna	+	+	+
DIVISION: CHLOROPHYTA			
Actinotaenium globosum	-	+	+
Closterium acerosum	+	+	+
C. closteroides	-	-	+
C. incurvum	-	-	-
C. lieblenii	+	-	+
C. monoliferum	-	-	-
C. pseudolulnula	+	+	-
C. subulatum	+	-	-
Cladophora oligoclona	+	+	-
Coelastrum microporum	-	+	+
Cosmarium contractum	-	+	+
Cos. decoratum	+	-	-
Cos. depressum	+	-	-
Cosmarium. sp.	-	-	+
Euastrum sp.	+	+	-
Eudorina elegans	+	+	+
Mougeotia sphaercarpa	+	+	+
Pediastrum duplex	+	+	+
Ped. gracillimum	-	+	-
Ped. simplex	-	+	-
Pleodorina illinosensis	+	+	+
Scenedesmus apiculatus	+	-	-
Sc. ovalternans	-	+	+
Sc. quadricauda	+	+	+
Spirogyra communis	-	-	+
Sp. dubia	+	+	+
Sp. majuscula	+	+	+
Sp. sp.	-	+	+
Staurastrum leptocladium	-	-	+
St. longispinum	-	-	+
St. octoverrucosum	-	+	-
Staurodesmus convergens	-	+	+
Std.curvatus	-	+	+
Ulothrix tenuissima	+	-	+
U. zonata	+	+	+
Volvox aureus	+	-	-
DIVISION: CYANOPHYTA			
Lyngbya majuscula	+	-	+
Microcystis aeruginosa	+	+	+
M. wesenbergii	-	+	-
Oscillatoria bornettia	+	-	+
O. limosa	+	+	-
Phormidium sp.	+	-	-
DIVISION: EUGLENOPHYTA			
Euglena acus	+	+	+
Eu. allorgei	+	-	-
Eu. gracilis	-	+	+
Eu. pisciformis	+	+	-
Eu. proxima	-	+	+
Eu. rubra	-	+	+
Eu. texta	-	+	+
Lepocinclis playfairiana	+	+	+
L. ovum	+	+	+
Strombomonas sp.	-	+	+
Trachelomonas hispida	+	+	+
T. armata	-	-	+
TOTAL No Of Phytoplankton	40	54	53

(+) means Presence UPS = Upstream
(-) means Absence DNS = Downstream
MDS = Mid-stream

Table 3: Summary of phytoplankton composition of Agenebode waterside.

	Order	Families	General	Total Taxa	% composition
Bacillariophyta	1	5	6	26	32.5
Chlorophyta	1	2	5	36	45
Euglenophyta	1	1	1	12	15
Cyanophyta	1	1	4	6	7.5
	4	8	16	80	100

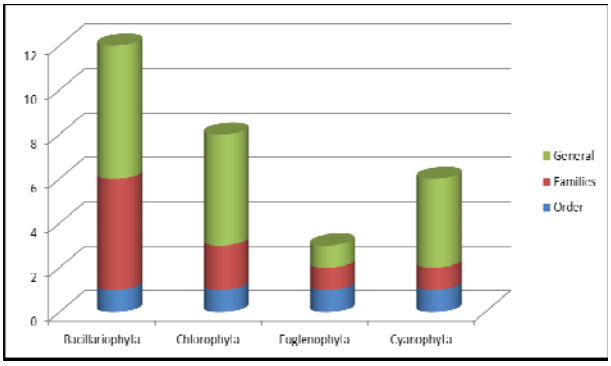

Fig 3: Phytoplankton composition of Agenebode waterside.

4. Discussion

The Nigeria climate is tropical, characterized by high temperatures and humidity as well as marked wet and dry seasons,[2]. Previous studies on limnological investigations of some Nigerian reservoirs, lakes, springs and streams have also been reported [25, 16, 22].

The temperature for all the sampling sites were normal for a tropical water body and this is in line with values between 26.5 and 32.8 ^{0}C recorded by [3] for tropical rivers [33, 6, 13]. also have similar observation. However, the temperature is within the recommended level (24-31 ^{0}C) for warm water fish [31]. Dissolved Oxygen in water is an important factor that determines the occurrence and abundance of aerobic aquatic organisms. Thus, the more dissolved oxygen available in water, the more the organisms it will support [1]. All the DO values were within the range (≥4mg/L) recommended for warm water fish [5, 28].

The pH values recorded in all the stations fall within the International Standard for freshwaters, and are optimum for fish culture [32]. This is supported by the findings of [31] that pH of 5.5 to 10 is recommended for tropical fishes. However, they all tend towards alkalinity which is in line with some researchers [8, 15, 33, 13]. The relatively high values of electrical conductivity observed are due to the evaporation of water, leaving a higher concentration of salt within a smaller volume of water [14, 26].

The observation of more Chlorophyta than Bacillariophyta (diatoms) in the study conformed to the typical trend in tropical water bodies [20, 24]. With the exception of *Ulothrix tennuisima*, all other species observed under Chlorophyta are desmids. High diversity of desmids is an indication that the water body is largely unpolluted. The desmids recorded could be a pointer that the river is poor in its ionic composition [23]. This is supported by the observation of just one species of *Euglena acus* (Euglenophyta), which is characteristic of eutrophic or nutrient rich water bodies [2].

5. Conclusion

The high diversity and abundance of the phytoplankton in the down-stream, mid-stream and upper-stream of lower river

Niger at Agenebode investigated between April and October, 2015 shows good water quality and hence sustainable fish production. The quality of water that is closely associated with sustainable fish production is a function of the quality of algae found in the aquatic system; Phytoplankton constitutes the base of the aquatic food web and the most important factors in organic matter production of the aquatic ecosystem. Hence Lower Niger River at Agenebode can be regarded as rich in phytoplankton composition and high in primary productivity. The health of the aquatic environment is the strategic base for the success of "fish for all and now" by the year 2020.

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7. References

1. Abolude DS. Water quality and metal concentrations in sediments and fish from Ahmadu Bello University Reservoir, Zaria, Nigeria. PhD Thesis, Ahmadu Bello University, Zaria. 2007.
2. Adesalu TA. Phytoplankton dynamics of River Oli in Kainji lake National Park, Nigeria, during dry season. International Journal of Botany. 2010; 6(2):112-116.
3. Adebisi AA. The Physicochemical Hydrology of a Tropical Seasonal River Upper Ogun. Building Nigeria's Hydrobiology, 1981; 79:157-165.
4. Adakole JA, Mbah CE, Dallah MA. Water quality impact Assessment Associated with urban stream in Zaria. Nigeria Society for Experimental Biology Journal. 2002; 2(3):195-203.
5. Ajani EK. Akinwole AO, Ayodele IA. Fundamentals of Fish Farming in Nigeria. Walecrown Publishers Ibadan, 2011, 158.
6. Akin-Oriola GA. On the Phytoplankton of Awbar Reservoir, Ibadan. Revista de Biological Tropical ISSN version impresa 0034-7744. Rev. biol. Trop. 2003; 51(1):99-106.
7. Atici T. Nineteen new records from Sariyar dam reservoir phytoplankton for Turkish freshwater algae. Turk J. Bot, 2002; 26:485-490.
8. Atobatele OE, Morenikeji OA, Ugwumba OA. Spatial variation in physical and chemical parameters and benthic macro-invertebrate Fauna of River Ogunpa, Ibadan. The Zoologist, 2005, 3:58-67.
9. Araoye PA. Man-made lakes, ecological studies and conservation needs in Nigeria. Rev. Biol. Trop., 50, 857-864.Edokpayi, C.A. and Osimen, E.C. (2001), Hydrobiological studies on Ibiekuma River, at Ekpoma, Southern Nigeria, after impoundment: The fauna characteristics. African Journal of Science and Technology, 2002; 2(1):72-81.
10. Edokpayi CA, Osimen EC. Impact of impoundment on the physical and chemical hydrology of Ibiekuma stream in Southern Nigeria. Tropical Ecology. 2002; 43(2):287-296.
11. Federal Department of Fisheries Fisheries Statistics of Nigeria. 2007-2014.5th Edition. 2014, 49.
12. Hassan AA, Jenyo-Oni A, Dauda AB. Assessment of Water Quality, Ichthyofauna and Macroflora Diversity of Lower Ogun River Wetlands: World Journal of Fish and Marine Sciences. 2014; 6(1):101-108, ISSN 2078-4589
13. Imoobe TOT, Oboh IP. Physical and chemical hydrology of River Jamieson, Niger Delta, Nigeria. Benin Sci. Dig., 2003; 1:105-119.
14. Idowu EO, Ugwumba AAA. Physical, Chemical and Benthic Faunal Characteristics of a Southern Nigeria Reservoir. The Zoologist, 2005; 3:15-25.
15. Indabawa II. Studies on limnological parameters and phytoplankton dynamics of Nguru lake, Yobe State, Nigeria. Bioscience Research Communications, 2009; 21(4):183-188.
16. Jackson DC. Dam Microsoft Encarta. Redmond, W. A. Microsoft Corporation, 2008, 2009.
17. Kadiri MO. Algae and primary productivity studies of Ikpoba reservoir. Unpublished Ph.D. thesis, University of Benin, 1987, 298.
18. Kadiri MO, Opute FI. A rich flora of *Micrasterias* from the Ikpoba reservoir, Nigeria. Arch. Hydrobiol., 1989; 116(3):391-399.
19. Kadiri MO. Phytoplankton distribution in the coastal areas of Nigeria. Nigerian J. Bot., 1999; 12:51-62.
20. Kadiri MO. Limnological studies of two contrasting but closely linked springs in southern Nigeria. Plant Biosystems, 2000b; 134:123-131.
21. Kadiri MO. Limnological studies of some springs in southern Nigeria. Tropical Journal of Environmental Research, 2001; 3:163-180.
22. Kadiri MO. A checklist of desmids in Nigeria. Global Journal of Pure and Applied Science, 2002; (2):223-237.
23. Kadiri MO, Omozusi HI. A pre-pollution study of the phytoplankton of an oligotrophic river in southern Nigeria. Afr. J. Enron. Pollut. Health, 2002; 1(1):19-27.
24. Mustapha MK. Assessment of the water quality of Oyun reservoir, Offa, Nigeria, using selected physico-chemical parameters. Turkish Journal of Fisheries and Aquatic Sciences, 2008; 8:309-319.
25. Olele NF, Ekelemu JK. Physico-chemical and periphyton/phytoplankton study of Onah lake, Asaba, Nigeria. African Journal of General Agriculture, 2008; 4(3):183-193.
26. Opute FI. Contribution to the knowledge of algae of Nigeria. I. Desmids from the Warri/Forcados Estuaries. Part II. The elongate baculiform desmids. Journal of Limnology, 2000; 59:131-155.
27. Sotolu AO. Feed Utilization and Biochemical Characteristics of *Clarias gariepinus* (Burchell, 1822) Fingerlings Fed Diets Containing Fish Oil and Vegetable Oils as Total Replacements, World Journal of Fish and Marine Sciences, 2010; 2(2):93-98.
28. Tiseer FA, Yanimu Y, Chia AM. Seasonal occurrence of algae and physico-chemical parameters of Samaru stream, Zaria, Nigeria. Asian Journal of Earth Sciences, 2008; 1(1):31-37.
29. UNDP. Human Development Report 2010: The Real Wealth of Nations: Pathways to Human Development. 20th Anniversary Edition. Palgrave Macmillan New York. 2010, 236.
30. Viveen WJAR, Riditer JJC, Oordtrot PGWI, Janseen JAL, Huisman EA. Practical Manual for the Culture of the African catfish, *Clarias gariepinus*. Directorate General for International Cooperation, The Hague, The Neitherlands, 1985, 94.
31. World Health Organization. WHO Guidelines for Drinking Water Quality Health criteria and other supporting information, Geneva, WHO. 2004, 2.

32. Yakubu AS, Ugwumba AAA. A study on Macroinvertebrate Fauna of Lower Ogun River at Ishasi, Ogun State, South-west Nigeria. The Zoologist, 2009; 7:65-74.
33. Zabbey N, Sikoki FD, Erondu J. Plankton assemblages and environmental gradients in the middle reaches of the Imo River, Niger Delta, Nigeria. Afr. J Aquat Sci., 2008; 33(2):241-248.
34. National Population Commission 2006. http://www.population.gov.ng/index.php/publications/138-national-and-state-population-and-housing-tables-2006-census-priority-tables-vol-1