Research Article

Studies on the Range of Plankton in River Benue, North Central, Nigeria, Western Africa

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ABSTRACT

Studies on range of plankton (phytoplankton and zooplankton) in River Benue North Central Nigeria Western Africa was carried out for 5weeks between August and October. Four sampling sites were selected based on the impact of human activities on the river biota, and denoted as A, B, C, D. Sampling site A is the outlet of Benue Brewery, sampling site B under new bridge located at the North bank, sampling site C is at the downstream of Wadata market and site D is at the downstream of the North bank old bridge. The pour through method was used for collecting plankton and standard identification keys were used to identify the planktons. Two major types of plankton were identified; phytoplankton and zooplankton. In increasing dominance phytoplankton have 7 divisions: Chlorophyta 49.32% > Bacilliarophyta 2.783% > cyanophyta 0.18% > Dinophyta 62% > Euglenophyta 1.8% > Chrysophyta 0.185% > Rodophyta0.09% with the total of 19 species while zooplankton in an increasing dominance have 5 divisions: Rotifera 52.75% > cladocera 31.41% > copeda 6.84% > ostracoda 5.40% and > decapoda 3.6% with a total of 16 species. This study showed abundant diversity in the range of plankton in river Benue and the implications of this to the state of the river vis- a- vis activities of humans along the banks and inside the river is discussed.

Keywords: Range; Plankton; River Benue; North Central: Nigeria.

1. Introduction

Plankton (singular plankter) is any drifting organisms (animals, plants, archaea, or bacteria) that inhabit the pelagic zone of oceans, seas, or bodies of fresh water. Plankton is defined by their ecological niche rather than phyolgenetic or taxonomic classification. They provide a crucial source of food to larger, more familiar aquatic organisms such as fish and Crustacean (Thurman, 1997).Plankton typically flows with ocean currents. While some forms are capable of independent movement and can swim hundreds of meters vertically in a single day (a behaviour called diel vertical migration). Their horizontal position is primarily determined by the surrounding currents. This is in contrast to nekton organisms such as squid fish, and marine mammals that can swim against the ambient flow and control their position (Emiliani, 1991).

Though many planktonic species are microscopic in size, plankton includes organisms covering a wide range of sizes, including large organisms such as jellyfish.

Plankton inhabits oceans, seas, lakes, ponds. Local abundance varies horizontally, vertically and seasonally. The primary cause of this variability is the availability of light. All plankton ecosystems are driven by the input of solar energy, confining primary production to surface waters, and to geographical regions and seasons having abundant light.

Within the planktons, holoplanktons spend their entire life cycle as plankton (e.g. most algae, copepods, salps, and some jellyfish). By contrast, meroplankton are only planktic for part of their lives (usually the larval stage), and then graduate to either a nektic or benthic (sea floor) existence. Examples of meroplankton include the larvae of sea urchins, starfish, crustaceans, marine worms, and most fish. Plankton abundance and distribution are strongly dependent on factors such as ambient nutrient concentrations, the physical state of the water column, and the abundance of other plankton.

2. Materials and Methods

Description of study Area:

River Benue is a freshwater flowing through Nigeria and it is the second largest river in the country. The river originates from the Adamawa mountains of Cameroun, some bounding the Nigeria frontier and flows eastward through the Nigeria territory before joining the River Niger at Lokoja, Kogi state, Nigeria (Okayi *et al*., 2001).

Benue State has a tropical climate with two marked seasons. The wet seasons characteristics with heavy rainfall between April and October and dry season which is usually marked with high temperature between November and April (Banks *et al*; 1985). The river Benue has features of a matured river with extensive achieved plains stretching for several kilometres.

The greater part of this plain is flooded during the rainy season and forms breeding ground for many fish species, most especially if it's bank is full. The area of river Benue is 129,000 ha (Welcomme, 1971), and there can be as much as 25M difference between the high and low water levels (Okayi, *et al.,* 2001).

Four sampling sites were selected along lower River Benue at Makurdi. The sampling sites were named A, B, C and D. Figure 1 show the map of the area where the study was carried out. Sampling sites A is the outlet of Benue Breweries Limited (BBL) on the bank of the River Benue. Sampling site B was selected at downstream of site A, it is under a new bridge located at the North bank, area of Makurdi Town.

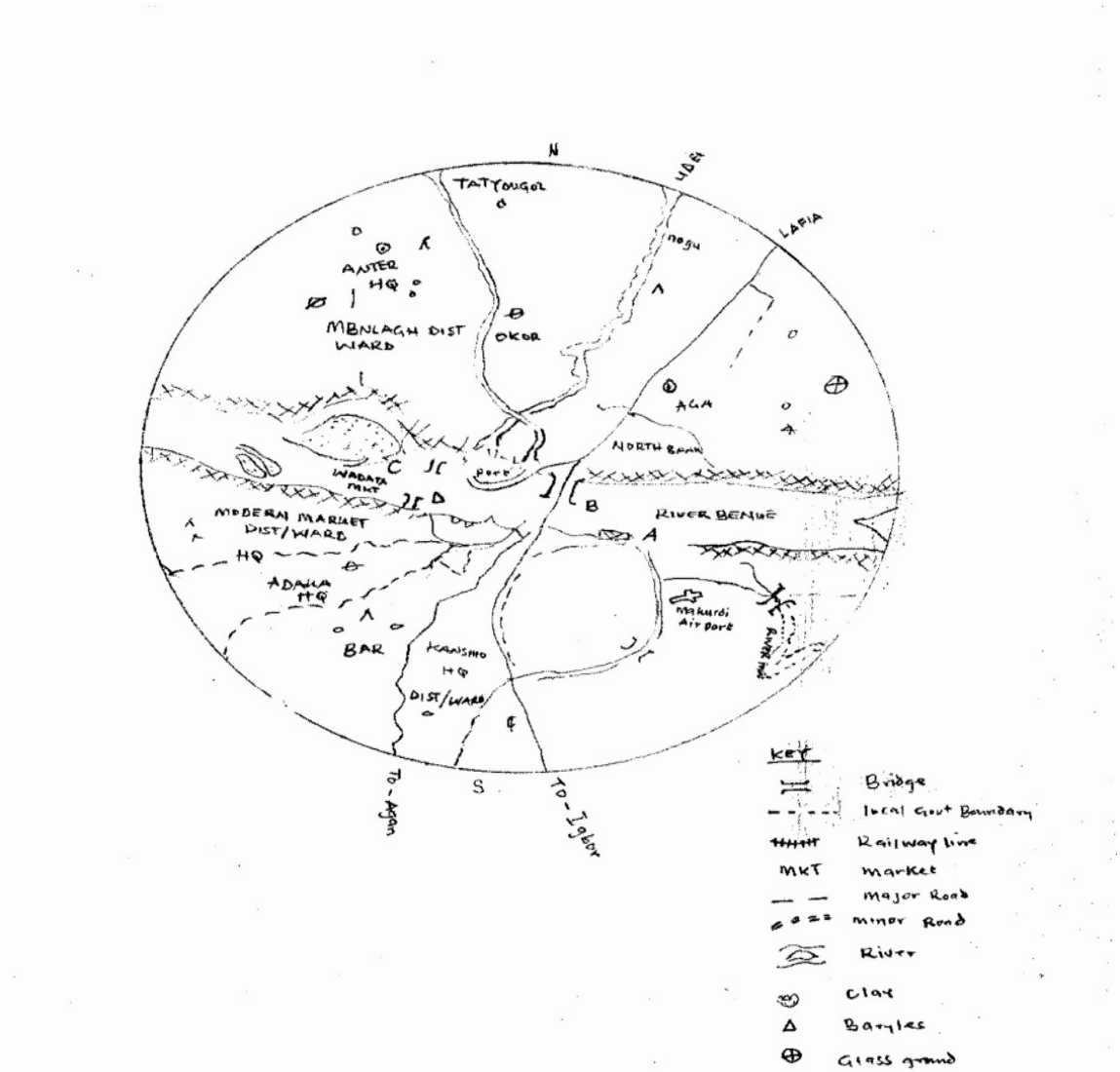

FIG. (1): MAP OF MAKURDI SHOWING THE SAMPLING SITES ALONG THE LOWER RIVER BENUE

On the River bank, is irrigation farming whereby runoff is washed into the River and has potential to impact on the waters. Sampling site C is further downstream at the Wadata market of Makurdi metropolis. The water body at this sampling site borders the Wadata market refuse dump site. People are normally seen at this site carrying out their domestic activities such as washing, bathing, and at times defecating. There is an abattoir close to this place and water from river is used to wash dung, debris and blood from slaughtered animals.

Sampling site D is at the downstream of the North bank old bridge Makurdi, close to the water board. In all the four sites, there is an enormous human impact on the river which may favour the growth and survival of both zooplankton and phytoplankton, thus justifying their selection for this study.

2.2. Sampling and Plankton Analysis:

Sampling was carried out twice a week for five weeks from August 29th to October 6th 2011. Sampling was done in the morning before 8:00am. The range of phytoplankton and Zooplankton at these four stations were determined by counting and identifying them using standard identification keys.

Pour through method was used to collect the samples. A 10-liter graduated bucket was used to collect the water at a depth of about 30cm below the water surface, poured into the plankton net and repeated 10 times to make a total of 100 litres of water filtered. The collected plankton were carefully poured into a plankton bottle, fixed with 5% formalin, corked and labelled properly and taken to the laboratory for further analysis. In the laboratory, each preserved plankton sample was poured into a graduated centrifuge tube and centrifuge using a Gallen Kamp-medico Centrifuge. This was to allow the plankton to settle and the supernatant was then decanted. After decanting, the concentrated plankton was then analyzed. A dropping pipette was used to place the concentrated plankton on a glass slide, covered with a cover slip and viewed under a light microscope. The plankton was counted (quantitative analysis) and then identified using standard identification keys and chart (Jeje and Fernando, 1986). This process was repeated five times.

2.3. Physico-chemical Parameter Analysis:

The physico-chemical parameter assay were; Air and water temperature, Hydrogen ion concentration (pH), Dissolved oxygen (DO), Biological oxygen (BOD) and total alkalinity.

To determine the dissolved oxygen, Winkler's method was used (APHA, 1999). To determine the BOD, four samples were collected from each site in BOD bottles. The dissolved oxygen content of the samples was determine immediately and recorded as initial DO. After which the samples were incubated in an incubator at 20ºC for five days, at the end of the five days, the oxygen content of the incubated samples was determined using the same Winkler's method and recorded as final DO. The BOD content of the test samples is then determined as BOD=initial DO-final DO.

The pH of the water samples was determined using a B.Bran scientific pH - meter (pH-25model).

Alkalinity was determined by taking 100ml of the water sample in conical flask to which three drops of methyl orange indicator was added. The solution was titrated against 0.01m sulphuric acid until the colour changed from orange to pale pink. The volume of standard 0.01m sulphuric acid used was noted and recorded as the volume for total alkalinity in parts per million (ppm or mg/L).

To determine free CO_2 100ml of the sample was placed in the conical flask, 8 drops of phenolphthalein indicator was added and titrated against 0.01m NaOH solution until the solution turns to pale pink. The volume of the NaOH used was recorded as free CO_2 (mg/L) was calculated using:

$$\frac{\text{Volume of titrant x N x 44000}}{\text{Sample volume used (ml)}}$$

Where N = Normal NaOH

3. Results.

Nineteen species of phytoplankton were identified ranging from six species of Chlorophyta, five species of Bacilliarophyta, three species of Cyanophyta, one of Dinophyta, two species of Euglenophyta, one of Chrysophyta and one of Rodophyta species appearing slightly. Also 14 species of zooplankton were identified during the study period ranging from six Rotifera, six Cladocera, two Copepoda, one Ostracoda and one Decapods. The plankton species are arranged in order of their abundance as summarised in tables1 and 2. The pattern of distribution of the plankton are presented in figures 2and 3.

Table 1: Phytoplankton Composition, Abundance And Their Range In River Benue

SPECIES COMPOSITION	A	B	C	D	TOTAL	PERCENTAGE
CHLOROPHYTA						
Oedoganium Sp.	32	89	31	20	172	
CladophoraOligoclona Sp.	12	80	25	13	130	
Ulothrix Tenuissima Sp.	3	73	19	2	97	49.32%
Spirogyra Sp.	2	62	13	2	79	
Mougeotia Sp.	13	14	12	5	44	
ZygnemaPectinatum Sp.	2	16	2	2	22	
					544	
BACILLIAROPHYTA						
Coscinodiscus Sp.	10	36	31	20	97	
AulacoSeira Sp.	13	31	31	5	80	
Fragillaria Sp.	11	25	23	8	67	27.83%
Nitzchia Sp.	6	16	11	4	37	
Navicula Sp.	7	10	2	7	26	
					307	
CYANOPHYTA						
Merismopedia Sp.	13	42	13	19	87	
Chroococcus Sp.	17	31	5	9	62	15.14%
Oscillatoria Sp.	2	9	6	1	18	
					167	
DINOPHYTA						
Dinophysis caudata Sp.	12	21	20	9	62	5.62%
.					**62**	
EUGLENOPHYTA						
Euglena Sp.	4	6	3	1	14	1.81%
Phacus Sp.	1	3	1	1	6	
					20	
CHRYSOPHYTA						
Synura Sp.	0	1	1	0	2	0.18%
					2	
RHODOPHYTA						
Batrachospermum Sp.	0	1	0	0	**1**	0.09%
					1103	100%

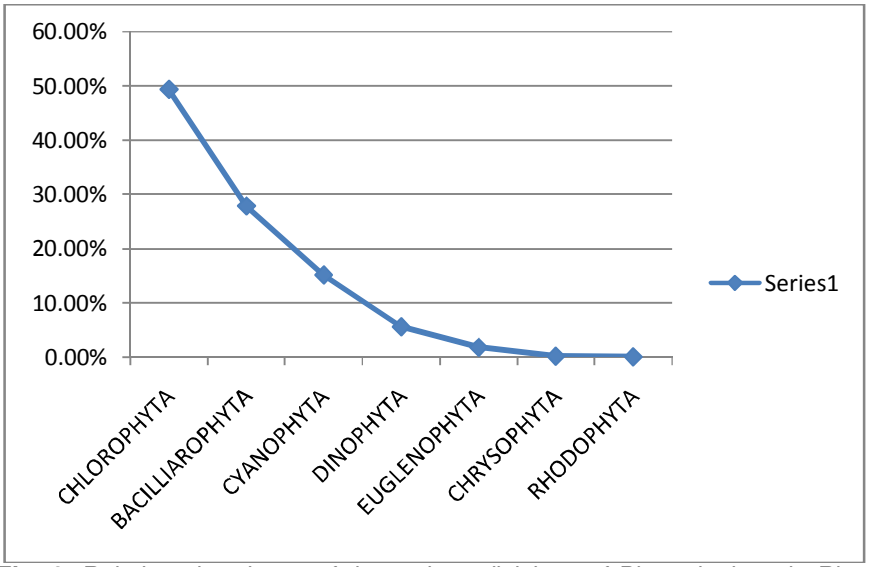

Fig. 2: Relative abundance of the various divisions of Phytoplankton in River Benue Makurdi.

Table 2: Zooplankton Composition, Abundance And Their Range In River Benue At Makurdi

SPECIES COMPOSITION	A	B	C	D	TOTAL	PERCENTAGE
ROTIFERA						
Branchionus SP.	96	110	42	17	265	
Nothola SP	31	62	5	1	99	
Trichocerca Sp.	13	35	19	6	73	
Asplanchna Sp.	25	19	12	12	68	52.75%
Testudinella Sp.	16	25	11	6	58	
Rotaria Sp.	3	9	7	4	23	
					586	
CLADOCERA						
Daphnia Sp.	25	27	39	9	100	
Nauplius Sp.	21	23	11	10	65	
Simocephalus Sp.	5	34	13	6	58	
Camptocerus Sp.	5	21	21	3	50	31.41%
Chydorus Sp.	6	20	17	2	45	
Ceriodaphnia Sp.	3	11	9	8	31	
					349	
COPEPODA						
Metacyclops Sp.	2	21	20	3	46	
Diaptonius Sp.	7	12	10	1	30	6.84%
					76	
OSTRACODA						
Cypridopsis Sp.	12	27	19	2	60	5.40%
					60	
DECAPODA						
Peneaus Sp.	2	4	31	3	40	3.60%
					40	100%

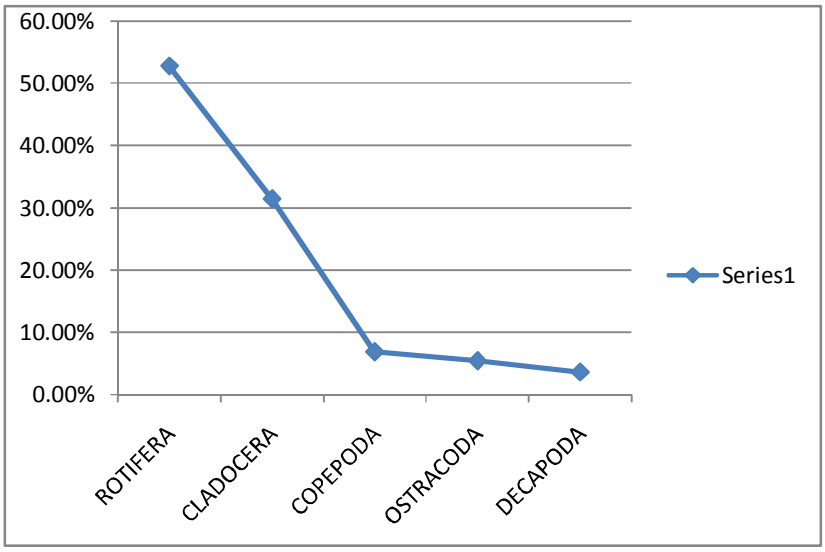

Fig. 3: Relative abundance of the various divisions of Zooplankton in River Benue Makurdi.

The Physico-chemical parameters recorded at the four sites during the study were; Air temperature 19-22, Water temperature 24-20, pH 7.6-7.6, DO 5.6-6.7mg/L, BOD 1.1-2.4mg/L, FreeCO_2 9.1-7.6mg/L and total alkalinity 12-6 mg/L. The mean values are given in Table 3.

Table 3: Physico-Chemical Parameters at the Four Sites in River Benue at Makurdi.

Parameters	Station A	Station B	Station C	Station D
AIR TEMP (^{o}c)	21.21± 0.2774	21.2± 0.2498	21.3± 0.2530	22 ± 0.1992
WATER TEMP (^{o}c)	26.9 ± 0.2024	27.4± 0.1328	27.5± 0.1518	28 ± 0.0822
pH	7.7 ± 0.0063	7.7 ± 0.0063	7.7 ± 0.0063	7.7 ± 0.0063
DO (mg/L)	5.8 ± 0.1139	5.9 ± 0.1265	5.9 ± 0.0822	5.8 ± 0.1207
BOD (mg/L)	2.01 ± 0.0404	2 ± 0.0569	1.8 ± 0.0791	1.9 ± 0.1170
FREE CO_2 (mg/L)	8.2 ± 0.474	8.02 ± 0.380	8.1 ± 0.0538	8.2 ± 0.0411
TOTAL ALKALINITY (mg/L)	9.22 ± 0.4067	8.7± 0.05028	9.0 ± 0.2878	9 ± 0.4143

BOD=Biological Oxygen Demanded; **DO**=Dissolved Oxygen

4. Discussions

In the study phytoplankton and zooplankton were isolated with phytoplankton having 7 divisions ranging from *chlorophyta, Bacilliarophta, Cyanophyta, Dinophyta, Euglenophyta, Chrysophyta* and *Rodophyta.* They have a total number of 19 species with C*hlorophyta* having an abundance of 49.32% and *Rodophyta* as the lowest with 0.90% in abundance. Zooplankton have 5 divisions ranging from *Rotifera, Cladocera, Copepoda, Ostracoda* and *Decapoda* with *Rotifera* having the highest abundance 52.75% and *Decapoda* as the lowest with 3.60% abundance, they have a total number of 16 species, this result agrees with that of (Osondu, 2007; Solomon *et al.,* 2009; Okayi *et al.*,2001).This study also shows significant differences in physico-chemical properties of Air and water temperature, pH, DO, BOD, Free CO_2 and total alkalinity in the four sample sites. It was observed that physico-chemical parameter also affect distribution, occurrence and diversity of the planktons. This agrees with Raymond, 1983. For instance, sampling site A which is adjacent to the Benue Brewery Limited, sampling site C at the Wadata market and sampling site D which is close to the Makurdi water board after the old bridge shows some signs of pollution due to anthropogenic activities as indicated by the concentration of BOD, FreeCO_2 and total alkalinity values of the test water samples. Sampling site B, where irrigation farming often occurs, did not indicate signs of toxicity as one would expect that the run-off water may support plankton growth through eutrophication. It could be observed that some plankton species are low in abundance at some of the sampling sites. This may be due to sensitive species disappearing as the water becomes polluted while tolerant ones survive pollution stress and readily recover downstream off the point of discharge (Ogbeibu and Edutie,2002).Based on these finding, the River Benue around Makurdi is rich in plankton with a good measure of abundance and diversity. However, the impact of various anthropogenic stressors can be felt, and care should be taken to minimize their effects. Not taking measures may result in waters around the sampling areas being unable to support some types of aquatic life, thereby destroying breeding grounds of planktons and other aquatic lives, eroding the river bank, reducing the warming up of water body as well as disrupting the particular ecological habitat that may affect the entire aquatic ecosystem within the study area.

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