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Spatio-Temporal Variations of Crustacean Zooplankton Population along the Stretch of River Kano

Getso B.U.[1]., Tijjani A. M.[1]., Lawan M.[1] Imam T. S.[2], Mustapha A.[3]
[1]*Department of Biology, Kano University of Science and Technology, Wudil*
[2]*Department of Biological Science, Bayero University, Kano*
[3]*Department of Geography, Kano University of Science and Technology, Wudil*

Abstract
Some physico-chemical parameters, diversity and seasonal variation of zooplanktons (crustaceans) of Kano River were studied between dry season October 2014 and wet season September 2015. Five sampling stations were randomly selected for water sampling based on anthropogenic activities within the stretch of River Kano.Physico-chemical parameters and crustacean community structure were analyzed in the laboratory using well established standard protocols. The data obtained were analyzed using basic statistical measurement of biodiversity indices to characterize the crustacean community of the River. The results obtained indicatedthat the following ranges: conductivity (93.57±61µS/cm-28±22.10µS/cm), pH (7.29 ± 0.77 - 6.96 ± 0.26), Temperature (25.83±4.36°C- 24.53± 4.23°C), Transparency (142.08 ± 77.31cm - 52.11 ± 8.40cm), DO (6.57 ± 2.75mg/l - 4.67 ± 2.03mg/l), and BOD_5 (3.30 ± 1.962 mg/l – 16 ± 1.59 mg/l). The values obtained were within the permissible limit for most tropical waters. The species richness, evenness and diversity of the plankton identified were typical of a tropical freshwater river. A total of 27 species of zooplankton were identified in the following order of decreasing abundance: Cladocerans 31.58% (12) >Rotifers 28.95% (11) >Copepods 23.68% (9)>Cyclopods 15.79% (6). Higher species numbers and densities were found in dry season of October 2014. Planktons identified during the seasons (dry and wet) show positive significant variation ($p<0.05$). Moreover, significant variation was positive between pH andtransparency ($P<0.05$).There was a negative significant correlation ($p<0.10$) between the zooplanktons and the physico-chemical parameters analyzed. The results further revealed that the physico-chemical conditions analyzed are conducive for the growth of aquatic organisms, the water may be said to be productive and suitable for irrigational, aqua-cultural and domestic purposes.

Keywords: *crustaceans; zooplankton; Kano River; physico-chemical parameters*

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I. Introduction

Water the most vital requirement after oxygen, as its supply is needed to replenish the fluids lost through physiological activities such as respiration, perspiration and urination (Shalom *et al.*2011). Water bodies are known to support a wide array of aquatic organisms which include phytoplankton, zooplankton, nektonic and other variety of small species substantially floating on the water (Hester, 1986).The health of an ecosystem is determined by composition of the community and its diversity (Laskar*et al*., 2009). Environment fluctuates timely in such ways that may be important for community structure and assembly (Lazo*et al.* 2009). The commonest zooplanktons in lotic ecosystems are the Rotifera and the Microcrustacean, Cladocera and Copepoda (McCann and Rooney, 2009). Hence, biological community gives an indication of and current situations of the aquatic ecosystem (Nkwoji*et al.*, 2010; Li et al. 2009). Food chain length influences structural attributes of communities like species diversity, trophic interactions and predator abundance (Post, 2002). Therefore, any negative effect caused by pollution in the community structure can affect trophic relationship (Sharma and Chowdhary, 2011).

In astudy conducted on Cladocera in the coastal rivers of western Nigeria, a least count of 100 species of *Cladocera* in the family Bosminiddae, Chydoridae, Daphnidae, Moinidae and Sididae in the inland waters of Nigeria (Ewa *et al.*, 2013). Adding that, over 50% of these Cladoceras were found in the net plankton sample from the coastal rivers.The importance of having surveys of biological diversity in aquatic environments provides baselines for comparison against future surveys used to document changes in habitat quality and availability, also in species richness and diversity. Thus, many studies have documented different benefits man derives from these assemblage of aquatic organisms,which include their use for medicinal or pharmaceutical purposes, sources of vitamins and proteins and sources of many industrial products (Adeyemi, 2011). However, this study was aimed at investigating the spatial temporal variations of the crustacean zooplankton community along the stretch of Kano River.

II. Materials And Methods

Description of the Study Area

Kano River is located at Latitude11°50'45" N and Longitude 8°30'21" E. The River is located on an elevation of 402 meters above sea level. Kano River emanates from the southern Kano highland which is also referred to as the foot slope of the Jos plateau. It flows up to central Kano where it makes a confluence at Tamburawa with River Challawa (Aliyu, 2012). For decades Kano River sustains local communities along its course particularly for domestic uses and irrigation agricultural activities.

Study Location and Sites Selection

Five sampling stations (A-E) alongthe strength of Kano River were selected from Tiga dam outlet (A) which is located on Longitude 8.345° (8°29' 45.6000"), Latitude 11.458° (11° 27' 28.8000") and 511m altitude; to where the River made a confluences with Challawa River at the in- take station (B) which is located at Longitude 8.489°(8° 29' 24.4000"), Latitude. 11.856° (11°51' 21.6000") and lies on 433m altitude. It is defined as relatively large water body, created by natural process and marked as a thin blue line on 1:875 OS maps and defined by the OS as being less than 8.25m in width (Fig. 1). Site C is located on Longitude 8.528° (8° 29' 40.8000") Latitude 11.768° (11°46'4.8000") and altitude of 434. Also, sites D and E are located on Longitude 8.833° (8° 49'58.800"), Latitude 1.809° (11° 48' 32.4000"), altitude 412m and Longitude 8.824° (8° 49' 26.4000"), Latitude 11.799° (11° 47' 56.4000") and altitude 411m respectively.

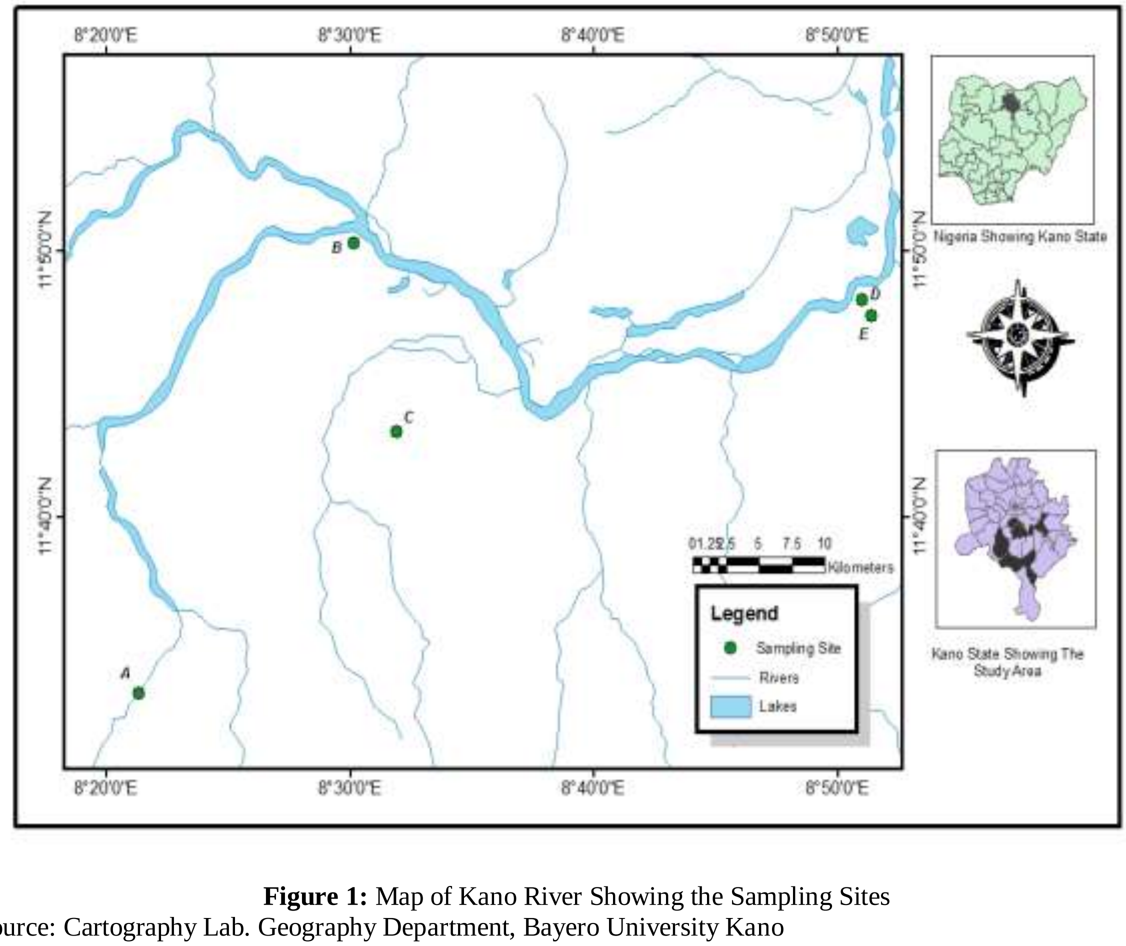

Figure 1: Map of Kano River Showing the Sampling Sites
Source: Cartography Lab. Geography Department, Bayero University Kano

Water Samples Collection

The procedures given by Ademoroti, (1996) and Goltermanet *al.*(1987), dip-in pH meter manual, Stirling (1985) were followed during water samples collection for the following physical and chemical parameters: Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD_5), Electrical conductivity (EC), pH, Temperature and Transparency from the five sampling sites selected (A, B, C, D and E) on monthly basis from October 2014 to September 2015.

Biological Parameters Sampling Collection

With the aid of a planktonic net of 55µm diameter andwater sample collection bottle of 50cm capacity attached at the base, water samples were collected between the hours of 7:00 and 12:00 every month fromthe five sampling sites selected (A, B, C, D and E), from October 2014 to September 2015. These samples were preserved with 5% formaldehyde at the sitebefore they were taken to the Biological Science Laboratory, Kano University of Science and Technology Wudil for zooplankton analyses.

Analysis of Physico-Chemical Parameters

Temperature:Water temperature was determined in-situ using mercury in-glass thermometer with range of 0° – 36°C. After calibration, the thermometer was immersed directly into the water for 5 minutes until a steady temperature measure was obtained (Adeyemi, 2012).

Transparency:Transparency was determined using Secchi disc with four graduant of alternate black and white coloration on the upper surface and a long rope at the centre. Measurement was achieved by lowering the disc into the water until it disappeared. At this point, the measurement was taken. The rope was released further down and then pulled up slowly until the disc re-surfaces, the point was also measured and the differences between these measurements were recorded. (Stirling, 1985).

Dissolved Oxygen (DO): This was determined using 200 model dissolved oxygen meter and the procedure followed was described by Ademoroti (1996), wherein zero oxygen solution was prepared by dissolving 2g of sodium sulphate in 100ml of water. This was allowed to stand for 2 to 5 minutes. The calibration key was pressed and then the meter proof was inserted into the prepared solution and was allowed to stand for 30 seconds to calibrate the meter to zero (0). Sample water was poured in to beaker up to 50ml mark, the calibrated meter proof was then inserted into the sample, this was allowed to stand for a minute and then final DO reading was recorded in mg/l.

Biochemical Oxygen Demand (BOD_5): The water sampled in a 250 ml bottle was incubated at a room temperature.Sample incubation was for 5 days at 20°C in BOD bottle and BOD_5 was calculated after the incubation period.

Electrical Conductivity: Conductivity of the water which isa measure of solution capacity to convey electric current (Golterman*et al.,* 1987)was measured using a Jenway Conductivity Meter model 4010. During the process, the water sampledin a 250ml capacity bottle was transferred into a beaker. The meter was calibrated and allowed to stabilize for about 15minute in a buffer solution of potassium hydroxide (0.001m). The electrode was washed with distilled water and dried with cotton woolthen dipped into the sampled water. This process was repeated after every usage and the conductivity reading was obtained.

pH:pHvalues were determined using dip-in mobile battery operated pH meter. During the process, the meter was calibrated using pH4, pH7 and pH10 buffer solutions. The sample was poured into 50ml beaker and the electrode meter was dipped in for a minute. Readings were taken directly from the meter.

Analyses of Biological Parameters

Analysis of Zooplankton (Crustaceans):

In the laboratory, each water sample fixed in 5% formalin solution was concentrated to 10 ml to enable analysis using the drop count method as described by Onyema*et al.* (2010a, b) The count of 3 drops were averaged and the total number of zooplankton in the entire samples was calculated per liter of water using the following formula:

$$no.\,of organisms per liter = \frac{\text{Organism in 1 ml of concentrate}}{\text{Volume of water filtered}} \times volume of concentrate$$

Identification and Enumeration of Crustacean Species:

Zooplankton species were identified and sorted into different taxonomical groups with the aid of appropriate identification schemes (keys) byNlewadim and Adeyemo (1998). However, pictures of some of the species identified were captured with the aid of an Amcap Digital Microscope Camera, (AmScope MD35 max. res. 640×480/0.3 mp live color image). Histogram was used to show percentage composition of each taxon and distribution of zooplankton per sampling stations.

Determination of Species Abundance:
Plankton abundance was estimated as described by Nlewadim and Adeyemo (1998) on a survey of zooplankton distribution using the following relationship;

$$A = \frac{YZ}{ax}$$

Where:
A = Average no. of plankton per liter, Y = Average no. of plankton per sample,
Z = Concentrate volume
a = original volume of sample per liter,
x = Volume of sample or counting chamber examined (ml)

Statistical Analysis
The physico-chemical and biological data generated were analysed statistically (OpenSata, 08.12.14) using analysis of variance (ANOVA) for significant differences or otherwise between the months. Pearson Product Moment Correlation Analysis was also carried out to assess the relationship between the studied parameters in the ecosystem.

Biological Diversity Indices
In this study, three ecological statistics were used to obtain the estimation of species diversity, richness and evenness.Margalef's index (d): is a measure of species richness (Margalef, 1949) is used to measure the biological diversity indices as describe by Okorafor*et al.*(2013)and is expressed as:

$$D = \frac{S-1}{\ln N}$$

Where;
S = No. of species in samples
N = No. of individuals in the samples

Shannon and Weaver's index (H): is a measure of species abundance and evenness Shannon and Weaver (1949) is used to measure the specie abundance and eveness as reported byOkorafor*et al. (*2013)and expressed as follow:

$$H = \sum_{i=1}^{s} PiInPi$$

Where;
$Pi =$ Total number of individual in the sample
$InPi =$ Total number of individuals of species *ith*in the sample
Species equitability or evenness (E) is determined by the equation:

$$E = \frac{H}{\ln S}$$

Where;
H = Shannon and Weaver's index
S = Number of species in sample

III. Results And Discussion

The temperature reading ranges from 19.80 °C – 27.84 °C in January and September 2015 (Table 1). The mean monthly range values of pH were from 6.54 to 7.47 in June and February 2015. Moreover,54.32µS/cm-113.18µS/cm were the mean range for electrical conductivity recorded in December and October 2014 respectively. The mean recorded range for Transparency was between 30.50cm- 58.20cm in February, May and September (2015) respectively. Moreover, mean monthly values of 1.50 to 7.99mg/l were recorded in September and January 2015 respectively for dissolved oxygen. The mean monthly values for BOD_5 rangedbetween 0.54 to 3.60mg/l recorded in September and February 2015.

However, on the spatial distribution of the physico-chemical condition (Table 2), the following mean ranges were obtained; temperature 23.61℃ recorded at B and 25. 83℃ recorded at site C while, the range of 6.51 to 7.81 were recorded for pH with the lowest at site C and the highest at site B. The electrical conductivity (EC) recorded range between 61.28 and 93.57µs/cm with the least and highest values at sites A and E respectively. The dissolved oxygen (DO) mean values ranged between 5.07 to 6.57mg/l with the lowest value recorded at site D and the highest recorded at site E, also the range of the BOD_5 was between 2.09 and 2.81mg/l with the least value recorded at site B and highest at site E. species densities for zooplankton recorded along the sites of sample showed least densities of the in sites C and A and highest densities in sites A and B respectively.

Table 1: Mean Monthly Variations in Physico-chemical Parameters and Plankton Distribution at the Sampling Sites

Sites	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Mean
Temperature (°C)	23.18	23.20	20.80	19.80	20.04	21.50	23.08	24.20	24.24	25.20	25.98	27.84	21.76
pH	7.30	7.17	7.05	7.30	7.47	7.00	7.18	7.16	6.54	6.80	7.03	7.06	7.09
E.C (µS/cm)	113.18	106.20	54.38	60.06	73.00	94.00	82.36	90.66	75.80	71.46	73.90	67.74	80.15
Transparency (cm)	44.20	53.00	50.30	53.00	30.50	38.50	37.50	38.50	56.00	55.30	58.00	58.20	47.75
BOD_5 (mg/l)	1.85	1.22	0.69	3.12	3.60	2.26	0.98	2.52	0.96	2.20	1.28	0.54	1.77
DO (mg/l)	5.46	4.03	6.69	7.99	6.98	6.26	4.62	5.80	2.06	3.50	2.63	1.50	4.27
Zooplankton Density (Org/l)	16.00	0.00	4.00	0.00	139	0.00	350	196	82	25	130	69	84

Table 2: Mean Variations in Physico-chemical Parameters and Zooplankton Composition/ Distribution at the Sampling Sites

Parameters/sites	A	B	C	D	E
Temp (°C)	24.99	23.61	25.83	23.94	25.02
pH	6.96	7.81	6.51	6.96	7.15
EC (µS/cm)	61.28	65.26	84.27	89.57	93.57
Transparency (cm)	30.5	38.5	60	37.5	50.3
BOD_5 (mg/l)	2.15	2.09	2.16	2.24	2.81
DO (mg/l)	5.54	5.31	5.3	5.07	6.57
Zooplankton (org/l)	159	334	183	257	175

The contour plot of temperature, EC, transparency and BOD_5 revealed in Figure 2a-e showed the density variations of the studied physicochemical parameters and zooplankton along the strength of Kano River. Kano River has high population growth coupled with high industrial and commercial activities, which may result in the disposal of domestic wastewater. Surface waters are facing a variety of pressures affecting both the ecosystem and human health through municipal wastewater discharge and disposal practices that lead to the introduction of high nutrient loads, hazardous chemicals, and pathogens (Mustapha et al. 2012a).

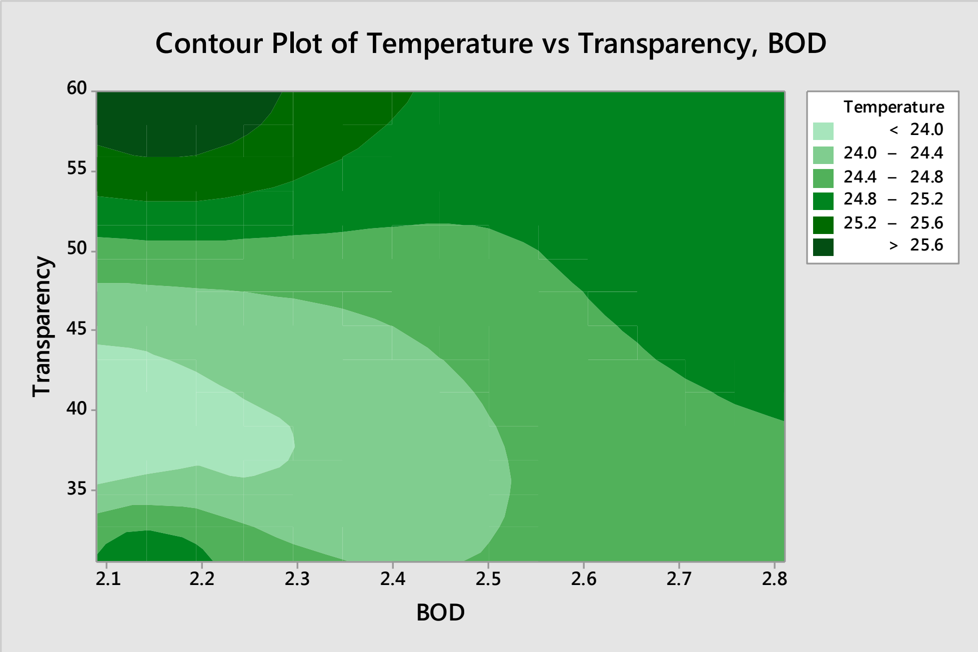

Fig. 2a The contour plot of temperature, transparency and BOD5

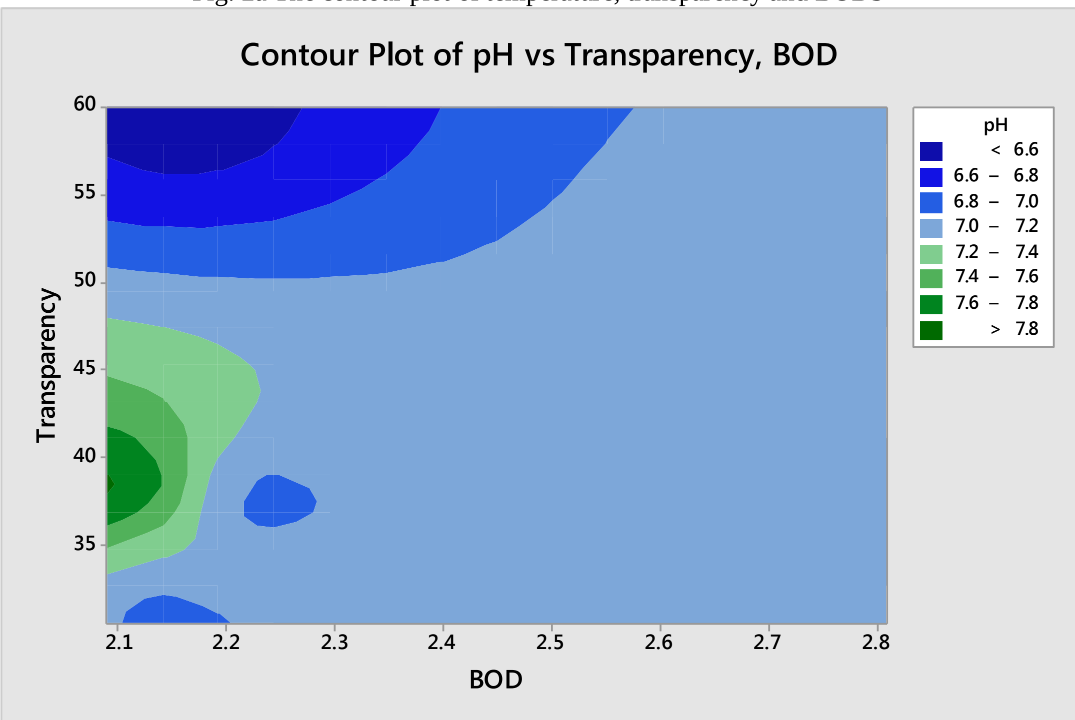

Fig. 2b The contour plot of pH, temperature and BOD_5

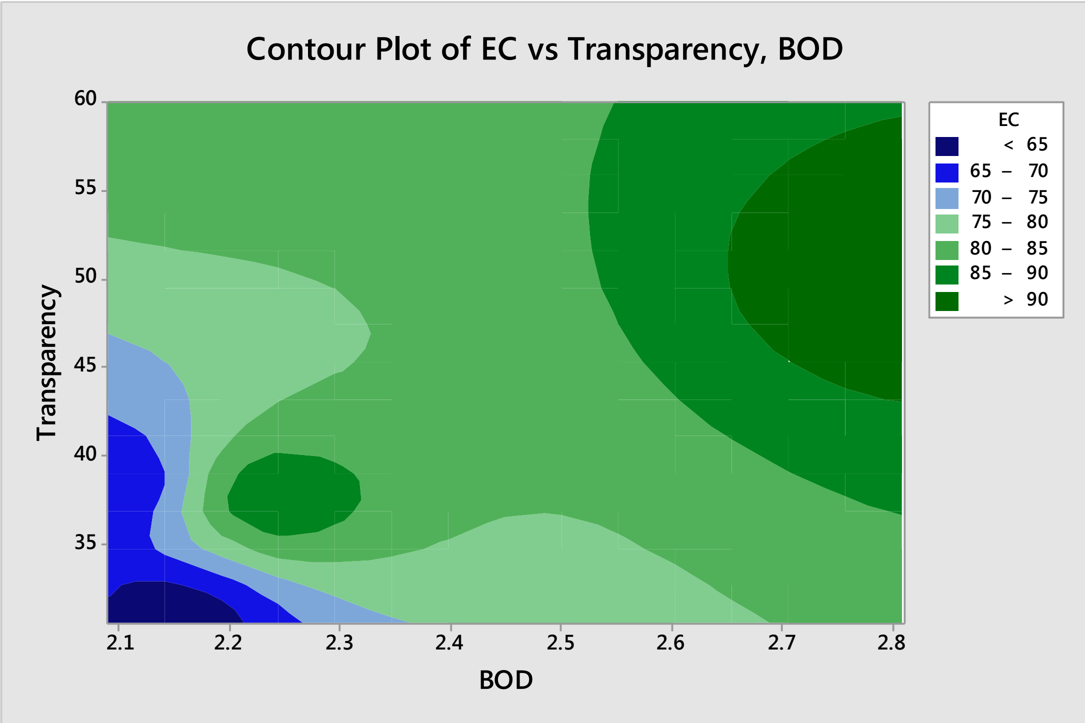

Fig. 2c The contour plot of EC, transparency and BOD_5

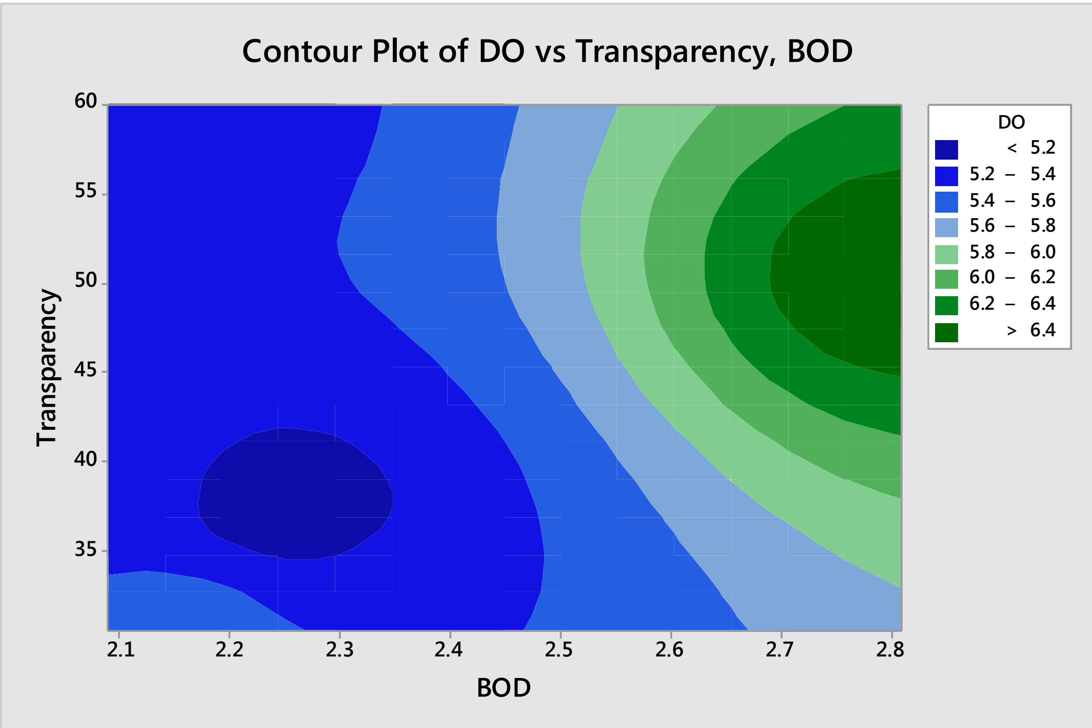

Fig. 2d The contour plot of DO, transparency and BOD_5

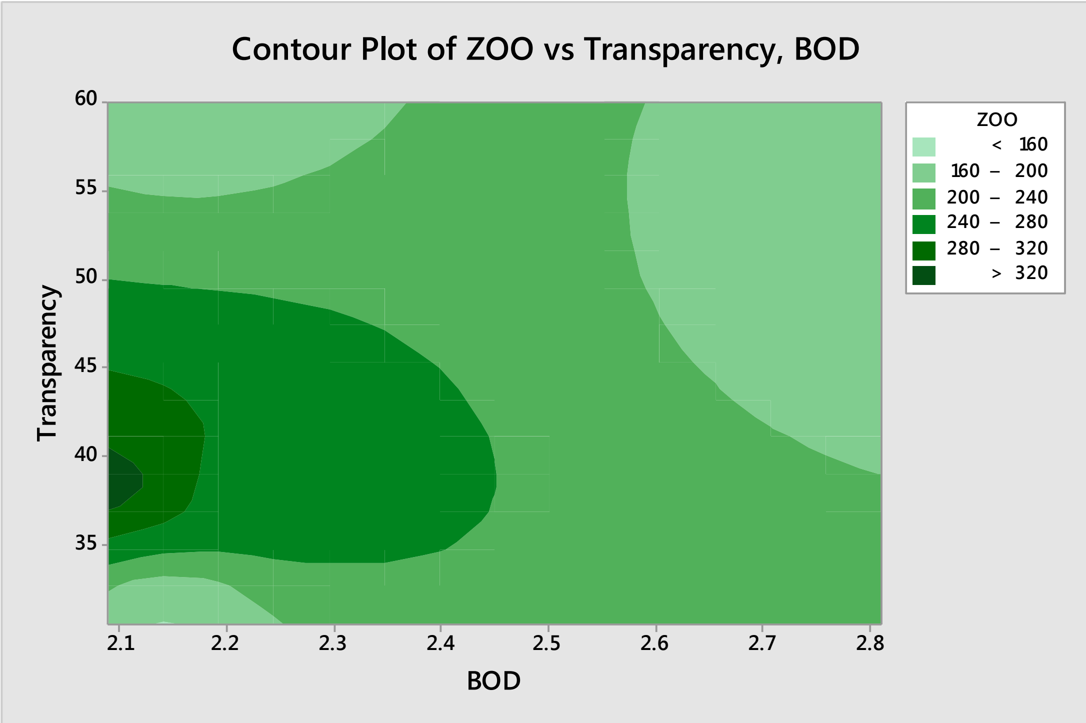

Fig. 2e Cotour plot of Zooplankton, transparency and BOD_5

The number of zooplankton species identified is presented on Table 3. A total of twenty seven (27) species were identified. These species belong to four taxonomic in the following order of decreasing capacity; 31.58% Cladoceran, 28.95% Copepod and 15.79%Cyclopoda

Table 3: Zooplankton Occurrence, Distribution and Relative Abundance among the Sample Stations on the Stretch of Kano River (October 2014- September 2015)

S/N	Taxa	SITES A	B	C	D	E	Total for All Sites (Org/l)	Frequency for Total (%)
	Phylum: Arthropoda							
	Sub phylum: crustacean							
	Class: Branchiopoda							
	Order: Cladocera							
	Family: Bosmidae							
	Sub genus: Bosmina							
1	*Bosminadaphnia*	-	24.44	-	20.37	12.22	57.03	60
2	*Bosminaliederi*	-	8.15	-	-	-	8.15	20
3	*Chydorusshaericus*	8.15	-	12.22	-		20.37	40
	Sub genus: eubosmina							
4	*Eubosminalongispina*	-	-	16.29	-	4.07	20.36	40
5	*Eubosminatubicen*	16.29	-	-	12.22	-	28.51	40
	Family: Daphniidae							
	Genus: *Ceriodaphnia*							
6	*Ceriodaphnialacustris*	-	8.15	-	-	16.29	24.44	40
	Genus: *Daphnia*							
7	*Daphnia ambigua*	-	20.37	-	8.15	-	28.52	40
8	*Daphnia longisremis*	-	16.29	-	-	8.15	24.44	40
	Family: Polyphemidae							
	Genus: *Polyphimus*							
9	*Polyphemuspediculus*	-	12.22	4.07	-	-	16.29	40

Cont. of Table 3: Zooplankton Occurrence, Distribution and Relative Abundance among the Sample Stations on the Stretch of Kano River

S/N	Taxa	SITES A	B	C	D	E	Total for All Sites (Org/l)	Frequency for Total (%)
	Family: sididae							
10	*Diaphanosomabirgei*	-	-	12.22	-	-	12.22	20
	Class: Maxiloida							
	Sub class: Copepoda							
	Order: Clanoida							
	Family: Centropagidae							
	Genus: Limnocalanus							
11	*Limnocalanusmacrurus*	-	28.52	4.07	-	-	32.59	40
12	*Centropages elongates*	-	12.22	-	-	16.29	28.51	40
	Family: Diaptomidae							
	Genus: *Holopedium*							
13	*Holopediumglacialis*	-	-	-	-	4.07	4.07	20
	Genus: *Leptodiaptomus*							
14	*Leptodiaptomus minutes*	12.22	4.07	16.29	4.07	12.22	48.87	100
15	*Leptodiaptomussicilis*	20.37	-	-	-	-	20.37	20
16	*Leptodiaptomussiciloides*	-	8.15	-	-	-	8.15	20
17	*Skistodiaptomusoregonensis*	-	24.44	12.22	-	-	36.66	40
	Family: Pseudocalanidae							
	Family Temoridae							
	Genus :*Epischura*							
18	*Epischuralacustris*	-	16.29	-	8.15	-	24.44	60
	Genus: *Temora*							
19	*Temora turbinate*	12.22	8.15	-	8.15	4.07	32.59	80

Cont. of Table 3: Zooplankton Occurrence, Distribution and Relative Abundance among the Sample Stations on the Stretch of Kano River

S/N	Taxa	SITES A	B	C	D	E	Total for All Sites (Org/l)	Frequency for Total (%)
	Order Cyclopoida							
	Family Cyclopoidae							
	Genus: *Acanthocyclops*							
20	*Acanthocyclopsrobutus*	4.07	16.29	12.22	20.37	12.22	65.17	100
21	*Acanthocyclopsvernalis*	-	12.22	-	-	12.22	24.44	40
	Genus: *Cyclops*							
22	*Diacyclopsbicuspidatusthomasi*	-	-	4.07	8.15	16.29	28.51	60
	Genus: *Eucyclops*							
23	*Eucyclopselegans*	4.07	-	-	20.37	-	24.44	40
	Genus: *Tropocyclops*							
24	*Tropocyclopsextensus*	20.37	4.07	8.15	4.07	-	36.66	80
25	*Metacyclopsedex*	-	12.22	-	-	16.29	28.51	40
	Family Moinidae							
	Genus: *Moina*							
26	*Moinamicrura*	-	-	8.15	12.22	4.07	24.44	60
27	*Moina daphnia macleayi*	-	-	12.22	8.15	-	20.37	40

Key: - no organism found

The Shannon weaver diversity index values for the season was 3.55- 3.13 (Table 4) for the total species recorded. These may mean that the species diversity of the zooplankton observed is relatively highly distributed /and or increases during the study period and the composition is much higher in the dry season than the rainy season. . Similarly, evenness and Simpson indices for the wet and dry season ranged between 0.97-0.95 for the zooplankton.

Table 4: Zooplankton Structures and Biological indices of the Sampling Sites Oct 14- Sept 15

Diversity indices/ Planktons	Wet Season	Dry Season
Zooplankton total fauna count (Org/l)	321.76	480.68
Shannon_H	3.55	3.13
Evenness_e^H/S	0.85	0.81
Simpson_1-D	0.97	0.95

Source: Past3 (Philippson, 1966)

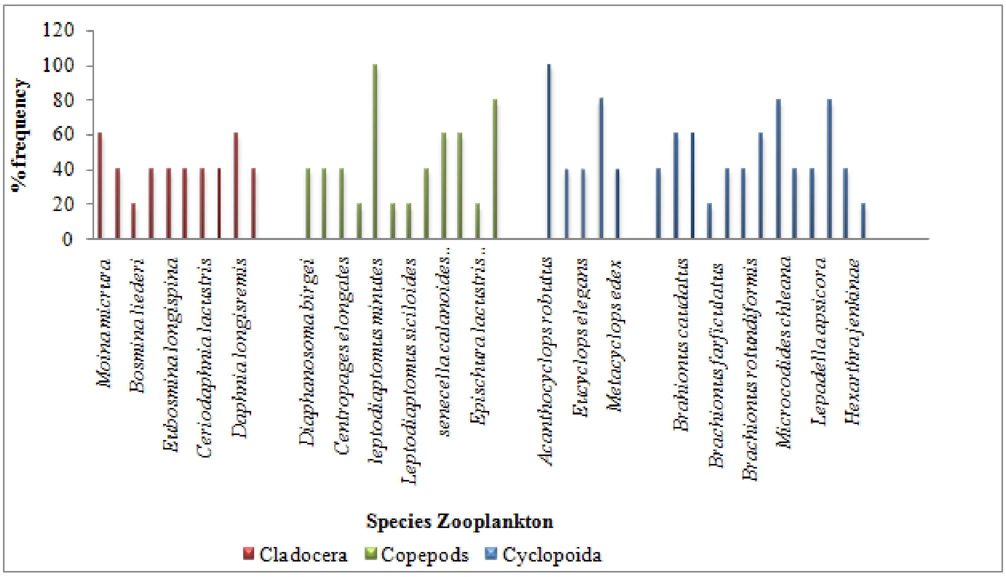

Fig. 3 Frequencies of zooplankton species along the strength of River Kano

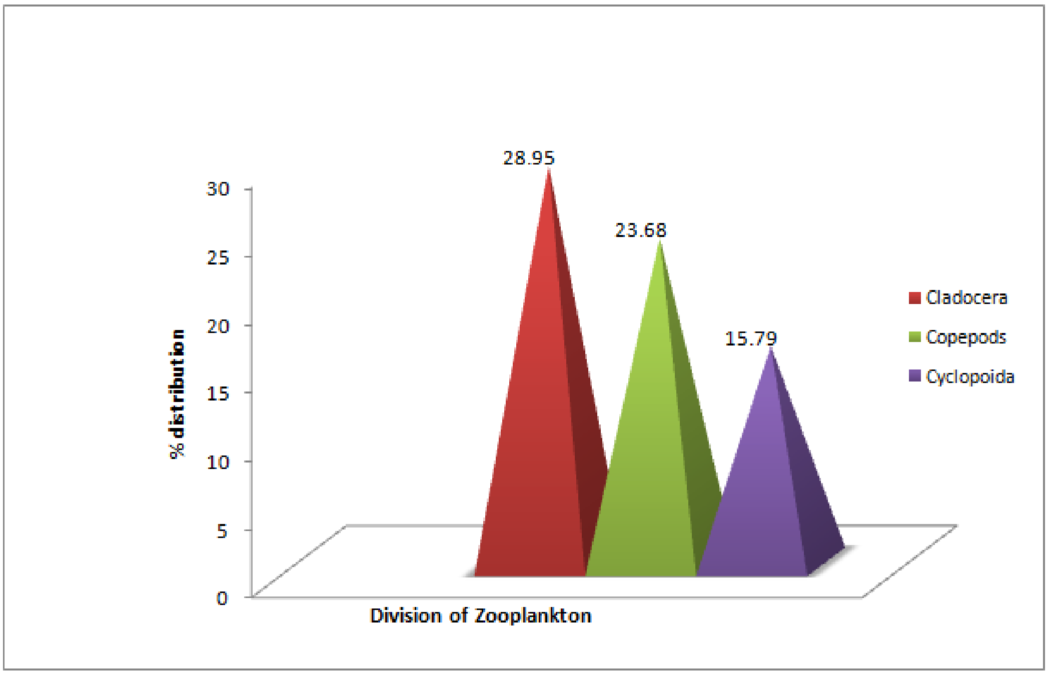

Figure 4: Frequency of Zooplankton Divisions Recorded During the Study

Besides, the physico-chemical parameters, biological indicators (phytoplankton and zooplankton) respectively, presented on Tables 5 and 6 for both months and sites mean standard deviations signified that both phytoplankton and zooplankton identified during the study period are significantly different with each other ($p<0.05$) whereas the significance is not different along the sites of sample ($p<0.05$). Hence, One-way ANOVA revealed that there was no significant difference ($p>0.05$) between the numbers of zooplankton species sampled along the respective sites.

Table 5: Mean Monthly Values of Plankton Conditions of the study stations, on the Stretch of Kano River during the Period

Month	Phytoplankton (org/l)	Zooplankton (org/l)
Oct	5.40 ± 3.21^{a}	1.80 ± 0.84^{a}
Nov	6.80 ± 5.36^{a}	1.60 ± 0.55^{a}
Dec	7.20 ± 1.19^{a}	1.80 ± 0.84^{a}
Jan	25.20 ± 15.48^{b}	2.20 ± 0.84^{a}
Feb	10.40 ± 5.22^{ac}	6.80 ± 4.76^{c}
Mar	20.80 ± 9.36^{bc}	1.60 ± 0.55^{a}
Apr	27.20 ± 11.37^{b}	17.20 ± 4.87^{b}
May	20.00 ± 18.21^{bc}	9.60 ± 8.65^{dc}
Jun	15.60 ± 4.83^{bc}	4.00 ± 1.00^{ac}
Jul	8.40 ± 2.07^{ac}	1.80 ± 0.84^{a}
Aug	16.60 ± 5.50^{bc}	6.40 ± 0.89^{c}
Sep	25.00 ± 11.34^{b}	3.80 ± 1.30^{ac}
LSD	12.54	4.16

Mean ± standard deviation with the same letter are not significantly different from each Fother ($P<0.05$)

Table 6: Mean Values of Plankton (Biological) Conditions of the Stations, On the Stretch Kano River during the Period of Study

Sites	Phytoplankton (org/l)	Zooplankton (org/l)
A	19.58±15.00[a]	3.50±3.37[a]
B	14.17±11.68[a]	5.83±6.86[a]
C	13.17±10.24[a]	5.42±6.92[a]
D	14.92±11.98[a]	5.83± 5.65[a]
E	16.75±10.06[a]	3.83±3.38[a]

Mean ±standard deviation with the same letter are not significantly different from each other ($P<0.05$).

On the other hand the relationship of physicochemical parameters and zooplankton were examined in the wet season data as presented on Table 7. Temperature and EC have a moderate positive correlation (r = 0.499). The EC invariably increases with increasing temperature. The relationship is affected by the nature of the ions and by viscosity of the water. The conductivity has a substantial dependence on temperature. The clarity or transparency of water through total dissolve solids increases the concentration of DO and BOD (r = 0.604). There is moderate negative correlation between chlorophyll and transparency (r = -0.502), chlorophyll is the natural compound present in green plants that give them their color. This shows that the more chlorophyll in water the less the water transparency (Mustapha et al. 2012b).

An inspection of zero order Pearson product Moment Correlations in the wet season samples between phytoplankton and zooplankton (r = -0.878) revealed a strong negative correlation (Tab.8) this relationship between phytoplankton and zooplankton is because phytoplankton structure influence the taxonomic composition dominance of the zooplankton (Goldyn and Madura, 2007). The zooplanktons are mainly filtrators, sedimentators or raptorial predators. The moderated correlation was observed between phytoplankton and dissolved oxygen (r = 0.567). This relationship justifies the assertion that the intermediate densities of phytoplankton are predicted to produce higher dissolved oxygen concentration in the water. Furthermore significant correlation between EC and BOD5 was observed (r = 0.572), EC and transparency (r = 0.695), EC and Chloropyll (r = 0.899) and DO and BOD5 (r = 0.927). This relationship revealed a common source of this parameters (Mustapha et al. 2013).

Table7: Monthly Correlation Coefficient of the Biological and Some Physico-chemical Conditions on the stretch of Kano River, During the Dry Season Period

Correlation coeffient	Phytopl. (Org/l)	Zoopl. (Org/l)	Temp. (°C)	pH	EC (μS/cm)	DO (mg/l)	BOD_5 (mg/l)	Transp (cm)	Chlorophyll 'a' (μg/l)
Phytopl.	1.000								
Zoopl.	**0.517**	1.000							
Temp	-0.364	-0.193	1.000						
pH	-0.089	0.126	-0.024	1.000					
Conduct.	-0.304	-0.020	**0.499***	0.310	1.000				
DO	-0.240	-0.306	0.216	0.114	0.338	1.000			
BOD	0.201	-0.107	0.119	0.093	-0.489	**0.604***	1.000		
Trnsp.	0.386	0.277	0.435	-0.423	-0.120	0.161	0.336	1.000	
Chloro.	-0.256	-0.389	-0.301	0.019	0.013	-0.195	-0.481	**-0.502***	1.000

*Significant at $P<0.10$

*Bold values are significance

Table 8: Correlation Coefficient of the Biological and Some Physicochemical Conditions on the Stretch of Kano River during Wet Season Period

Correlation coeffient	Phytopl. (org/l)	Zoopl. (org/l)	Temp(°C)	pH	EC (µS/cm)	DO (mg/l)	BOD_5 (mg/l)	Trnsp. (cm)	Chloro. (µg/l)
Phytopl.	1.000								
Zoopl	**-0.878***	1.000							
Temp.	0.223	-0.537	1.000						
pH	-0.495	0.307	-0.022	1.000					
Cond	-0.491	0.268	-0.317	0.084	1.000				
DO	**0.567**	**-0.686**	-0.057	0.088	0.243	1.000			
BOD	0.241	-0.456	-0.128	0.212	**0.572**	**0.927***			
Trnsp.	-0.179	-0.279	0.398	0.224	**0.695**	0.442			
Chloro.	-0.210	0.155	-0.592	-0.077	**0.899***	0.445			

*Significant at P<0.10
*Bold values are significance

IV. Conclusion

In this study spatio-temporal variations ofSome physico-chemical parameters, diversity and seasonal variation of zooplanktons (crustaceans) of Kano River were studied between dry season October 2014 and wet season September 2015. The species richness, evenness and diversity of the plankton identified were typical of a tropical fresh water river. A total of 27 species of zooplankton were identified in the following order of decreasing abundance: *Cladocerans* 31.58% (12) >*Rotifers* 28.95% (11) >*Copepods* 23.68% (9)>*Cyclopods* 15.79% (6). Higher species numbers and densities were found in dry season of October 2014. Pearson Product Moment Correlation revealed a negative significant correlation of phytoplankton and zooplankton (p<0.10), EC and BOD, transparency and chlorophyll in the wet season samples. Moreover, in the dry sample season, temperature and conductivity and a negative correlation between transparency and chlorophyll were observed.

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