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THE ZOOPLANKTON OF OJOFU LAKE IN ANYIGBA, DEKINA L.G.A., KOGI STATE, NIGERIA

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ABSTRACT

Zooplankton in the littoral zone of Ojofu Lake, Anyigba, Dekina Local Government Area of Kogi State of Nigeria were studied between April to August of 2008. A total of eleven species were identified in the lake. This includes six species of rotifers, (Kerafella sp, Conochilus sp, Ascomorpha sp, Brachinus sp, Gastropus sp, Asplainchina sp, Bosmina sp, Holopedium sp.) Cladocera include Daphinia sp and four genera of copepods. All identified species were found in all three stations. The zooplankton community showed abundance distribution and some of the physicochemical factors that may be responsible for this distribution were measured under each group of organisms. This includes water temperature, dissolved oxygen, PH and water transparency. Rotifers species among others zooplankton recorded the highest population with means percentage of 51.2%.

Keywords: Lake, Littoral zone, Zooplanktons, Ojofu, Anyigba, Nigeria.

INTRODUCTION:

Aquatic ecosystem is the most diverse ecosystem in the world. The first life originated in the water and first organisms were also aquatic where water was the principle external as well as internal medium for organisms. Thus water is the most vital factor for the existence of all living organisms. Water covers about 71% of the earth of which more than 95% exists in the oceans. A

much less amount of water is contained in river (0.00015%) and lakes (0.01%) which comprise the most valuable fresh water resources Tideman (2000).

Global aquatic ecosystem fall under two broad classes defined by salinity – fresh water ecosystem and salt water ecosystem. Fresh water ecosystems are inland and have low concentration of salts (< 599mg/L). The saltwater ecosystem has high concentration of salt (averaging about 3.5%) (Tideman 2000).

The study of freshwater habitants is known as limnology. Fresh water habited can be further divided into two broad groups, the lentic and lotic ecosystems based on the differences in the water residence time and flow velocity. The water residence time in a lentic ecosystem is 2 weeks. In lotic ecosystem, the average flow velocity ranges from 0.1 to 1m/s where as lentic ecosystems are characterized by an average flow velocity of 0.001 to 0.01m/s (Wetzel, 2001). The lentic habitant further differentiates from lotic habitat by having a thermal stratification which is created in a lake due to differences in densities. Water reaches a maximum density at 4^{o}C a warm lighter water floates on top of the heavier cooler water thus creating thermally stratified zones which corresponds to the epilimnion, the warm layer, the hypolimnion, the colder layer separated by a thermocline. The lotic ecosystem is characterized by stream orders depending on the origin and flow. There are various types of stream pattern namely dendritic, radial, rectangular, centripetal, pinnate etc which determines the flooding and soil erosion hazards of the region. However, the basic things among these ecosystems is that any alternation in their catchments area will affect the water quality whether lotic or lentic (Davie 2002, Tideman 2000).

The Ojofu Lake is a lentic ecosystem. The physical, chemical and biological characteristics were considered.

MATERIALS AND METHODS:

Study Area:

This study was carried out in Ojofu located at Anyigba (figure1a) in the Eastern part of Kogi State in Dekina Local Government. Anyigba lies between longitude 7^{o} 12^{1} East of the Greenwich meridian and latitude 7^{o} 36^{1} North of the Equator. It is on the South Eastern direction of Lokoja (Kogi State Capital). The young lake sprang up 14 years ago in September 1994 toward the end of the raining season. It started at a sport in form of a spring which later expounded to occupy a vast area of land with an elongated shape. The lake has a surface area of 8 hectares approximately the maximum length is 1.60km, the width of the upper section is 15m, the mean depth of the lake is 10.50m and the depth of the upper course is 5.00m.

Zooplankton Sampling:

Zooplankton sample were collected at each station with a standard hand-net sampler with a mouth diameter of 17.5cm, attached with a No. 10 straining net (158um) and a bucket with the same mesh size straining net.

Samples were collected by towing the sampler horizontal for a distance of five meters which was established by using calibrated twine (interval of 1m) to mark the distance trawled. Samples were then transferred from the bucket attached to the end of the sampling net to sampling bottles and immediately preserved with 1ml of 4% formalin solution.

Calibration of Sampling Net:

The percentage efficiency of the sampler was determined using a rubber bucket (25.0 litres) to collect water two times making a total of fifty litres from the lake which was filtered through the net. The number of organisms, present in the filtered water was noted.

The net was then used directly for zooplankton and the density of organisms also estimated. The percentage efficiency of the net was then calculated using the following relationship.

$$\% \text{ efficiency} = \frac{\text{No of organisms per litre of bucket water}}{\text{No of organisms per litre of water trawled}} \times \frac{100}{1}$$

The percentage efficiency of this net was 75%

The volume of lake water filtered by the sampler was calculated using the equation

$V = \pi r^2 h$ Where $\pi = 3.1415$ r = radius of sampler's opening = 0.086m

h = distance trawled by net = 5.0m

thus for a 5m distance in water, the volume (v) of filtered lake water was $V = 3.1415 \times (0.086m)^2 \times 5 = 1.351125m = 1351.13$ litres. The volume (v) must however be adjusted for the efficiency of the net. Thus $v^1 = 61.34 \times 0.75 = 46.005$ litres.

ZOOPLANKTON ANALYSES:

Qualitative Explanation of Zooplankton:

Before a qualitative explanation of the different organisms in each group was done, each zooplankton sample was concentrated to 25ml volume by using a pipette as described below.

Whenever a sample volume was smaller than required, the sample was diluted with distilled water and later reduced to 25ml volume by using 1ml pipette with a siphon attached to the end part of the pipette and net 158um mesh size attached to the tip to prevent accidental loss of organisms from the sample.

The sample bottle was agitated thoroughly before a 1ml. sub-sample was quickly taken with a widebore (diameter 3mm) automatic pipette. The sample was introduced carefully into a standard sedgewick-filter concerning chamber with a cover slip.

Counts of various groups of organisms present were made with an inverted compound microscope. Two sub-samples were taken from each bottle counted. The means number of individuals per ml was computed from these two sub samples. The number of organisms per litre was calculated from the following relationship.

$$\text{Number of organisms} = \frac{\text{organisms per ml of concentrate}}{\text{Per litre of lake water}} \times \frac{\text{volume of concentrate}}{\text{volume of lake water filtered}}$$

Where volume of the lake filtered = $\pi r^2 h$

Where $\pi = 3.1415$

Where r = radius of sampler's opening

That is radius = diameter of the hand-net sampler = 17.5cm = 8.6cm
2 2

Where h = distance trawled by net = 5.0m

⇒ Volume of the concentrate = 165ml

Water quality parameters:

Some water quality parameters monitored during the period of the study were temperature, dissolved oxygen, transparency, PH and turbidity.

Temperature:

The temperature of the water samples were measured at the station by the use of mercury thermometer (range of 0^0 to 40^0) which was calibrated at 0.2^0C. Immediately each water sample was emptied into the plastic sample bottle, the thermometer was dropped into the bottle and the temperature reading then taken and recorded.

Water Transparency:

This was done with a sechi disc. Measurement was achieved by lowering the disc into the water gradually until it disappeared from sight then it was gently raised till it appeared faintly. The average depth of disappearance and reappearance was recorded as the depth of sechi disc transparency.

PH:

The pH values were determined using pH – meter with standard indicators namely buffer 7, 4, 10 and distilled water. All these indicators were used to standardize the pH meter before used. The water sample was collected in three different sites in the river namely: the upper course (U), the middle course (M) and the lower course (L). in each of these sites the corresponding pH value was then read and recorded.

Dissolved Oxygen (DO):

Multiphotometer (dissolved oxygen analyzer) was used directly to determine the dissolve oxygen. This was done by collecting water sample in a cylindrical bottle from different part of the lake. The upper course (U), the middle course (M) and the lower course (L). The corresponding value was then read and recorded. This equipment also read out the temperature value simultaneously along side the dissolved oxygen reading.

RESULTS:

DISSOLVED OXYGEN (Mg/L) DO:

The weekly dissolved oxygen concentration for all the stations during the period of the study is as shown in table 1 below. The comparison of oxygen with temperature is shown in Figure 1. It was observed that the dissolved oxygen in the three stations was generally low. This might be due to human activities and dumping of wastes and refuse. This depleted oxygen level and increases the

Biochemical Oxygen Demand (BOD) of the lake. The highest Dissolved Oxygen (DO) was 3.24 mg/L and recorded in April at the lower course (station 3) of the lake white the lowest DO was recorded at the upper course (station 1) which had a concentration of 2.63mg/L.

The lower course of the lake appeared cleaner compared with other stations because there was less human activities such as domestic sewage and refuse dumping. This is known to increase the DO of the lower course.

Table 1 Title: Variation in DO value in all the three stations during the period of the study.

TABLE 1: UPPER COURSE ZOOPLANKTON DISTRIBUTION

Sampling Date	Total Zooplankton	copepods	cladoceran	Rotifer	Protozoans	Insect Larvae
26/4/08	11	4	2	2	2	3
10/5/08	8	1	1	2	2	4
24/5/08	13	3	1	5	3	4
7/6/08	17	1	1	11	3	4
21/6/08	38	15	1	20	2	2
5/7/08	51	21	2	27	2	1
19/7/08	47	12	3	30	3	2
2/8/08	21	9	4	6	3	2
Total	206	66	15	103	20	22

TABLE 2: MIDDLE COURSE ZOOPLANKTON DISTRIBUTION

Sampling Date	Total Zooplankton	copepods	Cladoceran	Rotifer	Protozoans	Insect Larvae
26/4/08	12	4	3	2	2	3
10/5/08	8	-	1	2	2	4
24/5/08	13	3	1	5	3	4
7/6/08	17	1	-	12	3	4
21/6/08	37	14	2	19	2	2
5/7/08	52	22	2	27	3	1
19/7/08	49	12	6	30	3	2
2/8/08	20	9	4	7	3	2
Total	208	65	19	104	20	22

TABLE 3: LOWER COURSE ZOOPLANKTON DISTRIBUTION

Sampling Date	Total Zooplankton	copepods	Cladoceran	Rotifer	Protozoans	Insect Larvae
26/4/08	11	4	2	2	3	2
10/5/08	9	1	2	2	4	2
24/5/08	13	3	1	5	4	3
7/6/08	19	2	1	12	4	2
21/6/08	37	14	1	20	2	3
5/7/08	54	22	2	29	1	3
19/7/08	47	12	4	29	2	3
2/8/08	21	9	4	6	2	3
Total	220	67	17	95	22	21

TABLE 4: SHOWING MEANS PERCENTAGE DISTRIBUTIONS OF ZOOPLANKTON OF THE THREE STATIONS

Zooplankton Species	% Distribution			
	S1	S2	S3	Average
Copepod	41.5	32.2	3.2	25.3
Cladoceran	9.4	9.1	8.1	8.9
Rotifers	53.5	50.0	50.0	51.2
Protozoan	12.6	10.6	12.0	11.7
Insects	16.4	8.2	10.0	11.5

Zooplankton (genera) composition in the lake during study period.

1. Asplanchna sp
2. Ascomorpha sp
3. Brachionus sp
4. Bosmina sp
5. calanoid sp
6. conochilus sp
7. Daphnia sp
8. Gastropus sp
9. helopedium sp
10. Nauplius sp
11. Protozoans
12. Insects

DISCUSSION:

INSECTS AND PROTOZOAN:

The population of insects and protozoans appeared consistence. There was no period through the study that they were not found. Looking at table 1, 2 and 3, insects and protozoan population range from 20 to 22. Even though the population fluctuates but all groups seem to have seasonal abundance and they were evenly distributed in the lake.

RELATIONSHIP BETWEEN PHYSICO CHEMICAL PARAMETERS AND ZOOPLANKTON VARIATION:

During the period of study physico-chemical parameters of water bodies were recorded. The computational analysis using statistical analysis of variance (anova) and multiple comparison showed the there was no significant difference in all the physico-chemical parameters of the three stations. Temperation increased from 29.5^0C to 33.1^0C this in turn increased the population of Zooplankton most especially the rotifer and copepod species.

Wetzel (1983) observed that increase in temperature increased the rate of molting and brood production.

Other factors that sustain the population of Zooplankton, example food supply, may affect the rate of development of the population by increasing survivorship fecundity (Wetzel, 1983).

Dissolved oxygen concentration showed positive response to Zooplankton abundance. But the DO was generally low this accounted forsome Zooplankton species – mostly cladocerans which were adversely affected by having the lowest population.

Turbidity during the period of the study does not have negative effect on the Zooplankton population. Because at 0.59m the populations of rotifers and copepods were still high.

The pH of the lake generally did not contribute negatively to the Zooplankton population because the pH of 7.1 to 8.12 recorded is still normal for aquatic life.

A total of 10 species of Zooplankton were identified in Ojofu lake, Anyigba Dekina Local Government Area, Kogi State. These included six genera of rotifers four genera of copepods, a genus of cladocera. The rotifers include, *Keratella sp*, *Conochilus sp*, *Ascomorpha sp*, *Brachionus sp*, *Gastropus sp*, *Asplanchina sp*, *Bosmina sp*, *Holopedium sp*. Cladocera include Daphnia sp. The rotifers accounted for approximately 51.2% diversity; they constituted a major fraction of the total monthly Zooplankton.

As indicated in figure 10, Table 5, 6, 7 and 8 the rotifers dominated the Zooplankton.

ZOOPLANKTON SPECIES AND SEASONAL TRENDS:

In term of species occurrence, the rotifer had the highest number of individual of the total Zooplankton found in the lake and was closely followed by the copepods and then the cladocerans. The rotifers represented a major fraction of total Zooplankton available as a food base for aquatic organisms utilizing Zooplankton as food.

SEASONAL TRENDS ROTIFERS:

Brachionus rubens species was the most abundant Zooplankton species in the lake, dominating the entire zooplankton population. It showed a seasonal abundance with population peaks occurring in August and July during the period. The much greater abundance of *Brachionus rubens* during this period might be as a result of food being washed in by rain (Apstein, 1907).

However, the claim may still be subject to examination in case of rain because from the inception of the study, the species was known to be more populated than others. It might be other factor such as temperature increases which happen to be incidentally high from the range of 32.9^0C to 33.1^0C. This resulted in more rapid biomass turn over rate (Bosbelman, 1979b).

COPEPODS:

Calanoid copepod was the second most abundant Zooplankton species in the lake. The population of the calanoid reached their highest density in May.

The much greater abundance of calanoid species might be that the species in question needed little water for production unlike other Zooplankton species.

This can be deduced from the means mostly distribution of Zooplankon species. Here, the population of calanoid copepod dropped from 5.5 to 3 (May to June). When the heavy rain commerce in July there was no single calanoid species while only one species was identified in August.

CLADOCERA:

There was general decrease in population of this species both at beginning of the rain and during the heavy rain. Daphnia species recorded its peak during the rainfall and this might due to low water temperature. Because species increases in population with a corresponding increase in water temperature. Adeniyi (1976) that is 29.6^0C in April and no daphnia was identified but when there was increases in temperature from 32.9 to 33.1^0C (July to August) their population also increased. In all the rotifers has a total of 51.2% followed by 25.3% copepod and 8.9% of cladoceran in that order.

There was a district seasonal succession and abundance with *Brachionus rubens* and calanoid copepod being the most abundant Zooplankton.

There was evidence from this study that human activities mostly the refuse dumping, domestic sewage, detergent run-off as a result of washing activities (especially in the upper course of lake) and changing environmental conditions might be responsible for the low Zooplankton abundance and seasonal succession zooplankton in the lake.

CONCLUSION:

Looking at the statistical anova and multiple variations, results, the F. ratio or the overall significant do not show a negative sign. This supports my Null hypothesis (HO): that Ojofu Lake is habitable for Zooplankton that can support fish populations.

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