

The Implication of the Distribution, Species Diversity and Relative Abundance of Zooplankton in Wasai Reservoir Kano State Nigeria

Abstract: Studies on the distribution, species diversity and relative abundance of zooplankton in Wasai reservoir was undertaken from December 2005-February 2006. Variations in Physico-chemical parameters were also estimated. Highest temperature and transparency recorded were 23°C and 0.34m respectively. The pH ranged between 8.6 – 7.6. Highest and lowest range in Dissolved Oxygen and Biochemical Oxygen Demand were 4.7 mg/L and 3.6mg/L and 2.7mg/L and 2.0mg/L . Chemical concentration of Phosphates was between 0.78mg/L to 0.32mg/L. Nitrate was 0.017mg/L to 0.32mg/L while nitrite was 0.400mg/L to 0.00mg/L as the highest and the lowest concentrations recorded during the study. Distribution and relative abundance of zooplankton was found to be in the order Protozoa, Rotifer, Cladocera and Copepoda with *Arcella* spp, *Amoeba proteus* and *Actinophrys* spp, as the Zooplankton species identified which had the highest counts. Correlation analysis between zooplankton distribution and abundance and physico-chemical parameters revealed a weak positive relationship ($P < 0.05$) and in respect of the chemical factors revealed strong positive relationship ($P < 0.05$) the study showed that the river is not polluted and could serve as a good breeding site for production of fishes in large quantity for economic growth of the community.

Keywords: Zooplankton, Reservoir, Cladocera, Copepoda, Physico-chemical

1. Introduction

The world's fresh water fauna and flora are uniformly distributed and many species are cosmopolitan, restricted only by suitable water and climate. Man through his activities brought about ecological changes in the ecosystem and these changes largely stimulate interest and made researchers to focus attention on the various pollutants and the fate of aquatic organisms (Workton, 1993). Eutrophication of freshwaters causes great changes in structure of zooplankton communities. Many species disappear as consequences of algal toxins or the clogging of filter-feeding apparatus during algal blooms, especially those of cyanobacteria which may have both effects (Bekker and Berrendse, 1999). Distribution and abundance of zooplankton communities may be a reflection of three major environmental pressures, physical or chemical (food resources) and vertebrate predation (Post, 2002) it is evident that individual sizes, aggregation of clusters, vertical migration, filtration rate and birth of zooplanktons, size and density of the algae, predation and distribution pattern of the temperature and oxygen concentration with depth are among the most important factors influencing the structure of zooplankton association (Stibor, 2003) as such the need for a survey to ascertain their changes in the river.

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2.0 Materials and Methods

2.1 The Study Area

Wasai – reservoir is situated on the Jakar a river at a point about two kilometers Southeast of Wasai village in Minjibir Local Government Area of Kano State (Amin, 1992). It is located within the latitude 12°N and 13°N and longitude 8°E and 9°E. The reservoir was constructed in 1976 originally for recycling purposes. It has a maximum height of 9.33m, surface area of 1,250 hectares and a total storage capacity of 65.38m³, this places the reservoir among the medium size man-made lakes in Kano State.

2.2 Collection of Water Samples

Water samples were collected in acid rinsed plastic bottles monthly for the period of 3 months between 7:00 and 8:00 am and were determined for phosphorus, nitrate, and nitrite, Dissolved Oxygen contents and Biochemical Oxygen Demand, which was collected in BOD bottles.

2.3 Analysis of Physico-chemical Parameters

The surface water temperature was determined *in situ* using a mercury bulb thermometer as described by Bennett

and David (1989). Water transparency was determined using a 20cm Secchi disc (painted black and white at radius). The pH of the water was estimated *in situ* with a pH meter model 620 pH electrometer as adopted by Deninger (1980). Nitrite and Nitrate was analysed using HACH digital spectrophotometer and dissolved oxygen was determined by Winkler's method.

2.4 Biological Characteristics

2.4.1 Sampling of Zooplankton

Zooplankton was collected three times per week from five sampling points using 20µm mesh size plankton net, as adopted by (Boney,1989) and (Harris *et al.*, 2000).The net was held firmly by hand and lowered down onto the surface water level from a canoe, and drag slowly to a distance of 5-10m. The water that flowed through the net aperture filtered the Zooplankton and collected in a small bottle attached at the end of the net. The net and bottle content was emptied first in to a tray and then in to a sampling bottle.

2.4.2 Preservation of Zooplankton

Zooplankton samples were preserved in 70% formalin as suggested by Harris *et al.*, (2000).

2.4.3 Identification of Zooplankton

A binocular microscope was used for identification of Zooplankton with the help of illustrations and charts as described by Fischer and Frost, (1997).

2.4.4 Counting of Zooplankton

The procedure used was according to procedure adopted by Gannon, (1971). The Zooplankton was placed in graduated trays and enumeration was carried out this prevented duplication of count

2.4.5 Collection of Water Samples

Water samples was collected in acid rinsed plastic bottles monthly for the period of 3 months for the determination of Phosphate, Nitrite, Nitrate and Dissolved Oxygen (DO). Water for the determination of Biochemical Oxygen Demand (BOD) was collected in BOD bottles.

2.5 Physico-chemical Analysis

2.5.1Determination of Temperature

The surface water temperature was determined *in situ* using an ordinary mercury bulb thermometer as described by Bennett and David, (1974).

2.5.2Determination of Transparency

The transparency of water was determined using black and white painted Secchi disc. The disc was lowered in the water until it disappears and the depth was recorded. The disc was raised until it reappeared and the depth will be recorded in meters. Then average of the two readings was recorded to estimate the transparency (EPA 2006)

2.5.3 Determination of pH

The pH of water was estimated *in situ* with a 620 pH electro meter as described by Deninger, (1980)

2.5.4 Determination of Dissolved Oxygen (DO)

Dissolved oxygen was determined by Winkler method as adopted by Best and Ross (1977). The 200ml water sample was acidified by adding 2ml of concentrated sulfuric acid and then shaken. 100ml of the acidified sample was measured in conical flask and titrated with 0.0125N sodium thiosulphate solution until a faint yellow colour appeared. 2ml of starch solution was added and titration continues until the blue colour disappeared. Each 1ml of the sodium thiosulphate solution used trimetrically equivalent to 1ml of oxygen using the formula.

$$\text{Dissolve Oxygen (DO) (mg/L)} = \frac{(800 \times N) \times v}{V}$$

V = volume of the sample titrated

V = volume of the thiosulphate used

N = normality of thiosulphate used

2.5.5 Determination of Biochemical Oxygen Demand (BOD₅)

The 250 ml water in BOD bottles was incubated at 20°C for 5 days. Then the procedure used in determination of dissolved oxygen was carried out for BOD₅ determination as adopted by Best and Rosse, (1977).

$$\text{BOD}_5 \text{ (mg/L)} = \text{DO}_1 - \text{DO}_5$$

DO₁ (mg/L) = Dissolved Oxygen before incubation

DO₅ (mg/L) = Dissolved Oxygen after 5 days incubation

2.5.6 Determination of Nitrite (NO₂)

About 5ml of 4-chloroaniline and 2ml of 2M-hydrochloric acid was transferred to 250ml volumetric flask. The flask was then put into an ice water for 10 min then 5ml of the water sample was added. The resulting solution was mixed thoroughly for 2 min, followed by addition of 1ml of 10% sulfuric acid. The solution was then allowed to stand for 15 min with frequent shaking. Then 1ml of 1-naphthel and 3ml of 3M sodium hydroxide solutions was be added to the solution. The resulting solution was diluted to the mark with water sample. The absorbance will be read at 500nm. The experiment was repeated several times for each sample.

2.5.7 Determination of Nitrate (NO₃)

About 0.5 ml of the sample was taken using a micropipette and added into a test-tube. 1ml of salicylic acid solution was added and mixed. The solution was allowed to stay for 30 min. 10ml of sodium hydroxide solution was added and then allowed to stay for 1hour for colour to develop. The solution was analyzed using HACH digital spectrophotometer.

2.6 Statistical Analysis

Data for the physical and chemical analysis and distribution and abundance of Zooplankton recorded from this research work were analyzed using regression, Null Hypothesis and F – Tables for significance test, post – Experimental compares and contrast analysis.

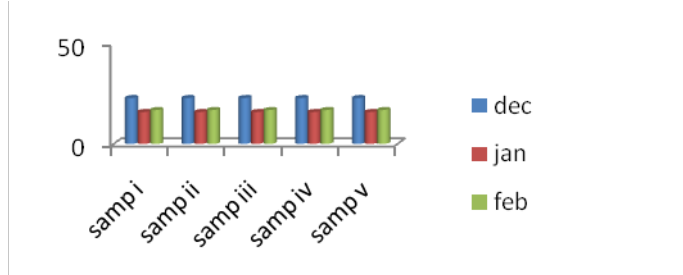


Figure 2. Variation in temperature December 2005 – January, 2006 Sampling Points

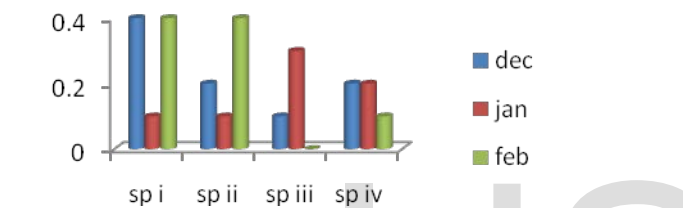


Figure 3. Variation in transparency (m) December 2005 – January, 2006 Sampling Points

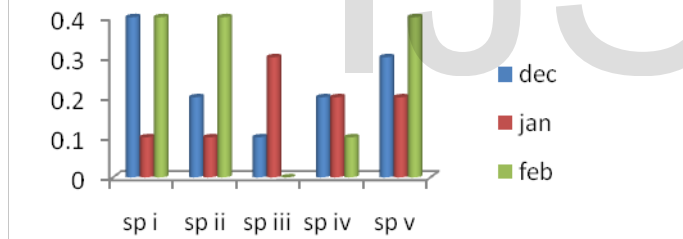


Figure 4. Variation in pH December 2005 – January, 2006 Sampling Points

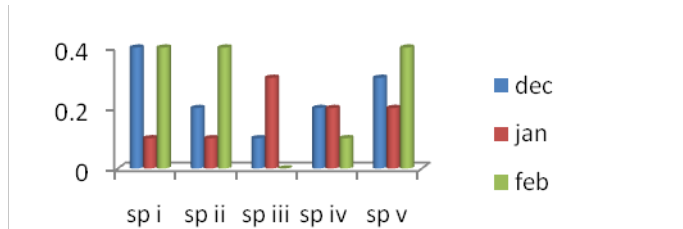


Figure 5. Variation in Dissolved Oxygen (mg/L) December, 2005 – January, 2006 Sampling Points

2.7 Results

Figures 1- Results for the physical, chemical and biological analysis obtained revealed that monthly variation in temperature was great. The highest temperature recorded during the period was 23°C at all the sampling stations in December 2005

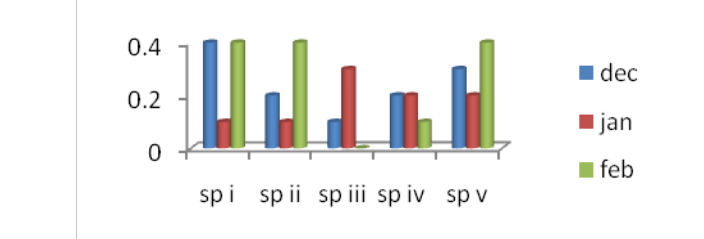


Figure 6. Variation in Biochemical Oxygen Demand (mg/L) December 2005 – January, 2006 Sampling Points

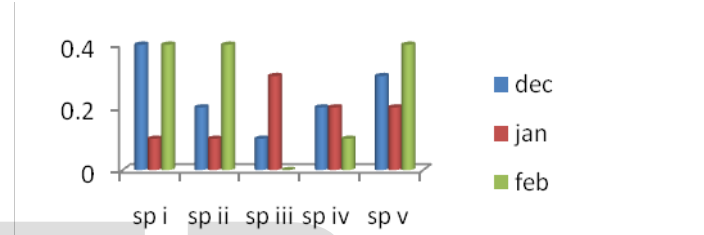


Figure 8. Variation in Phosphate (mg/L) December 2005 – January, 2006 Sampling Points

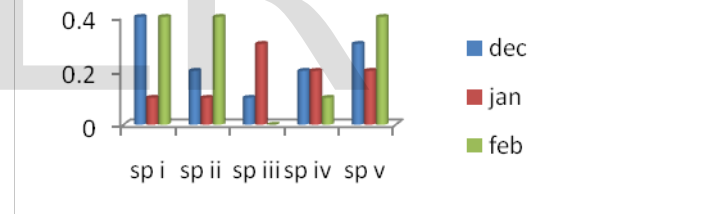


Figure 7. Variation in Nitrite (mg/L) December 2005 – January, 2006 Sampling Points

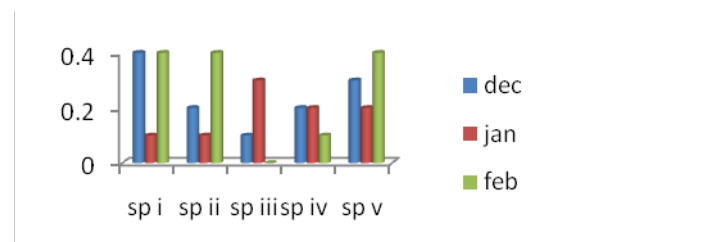
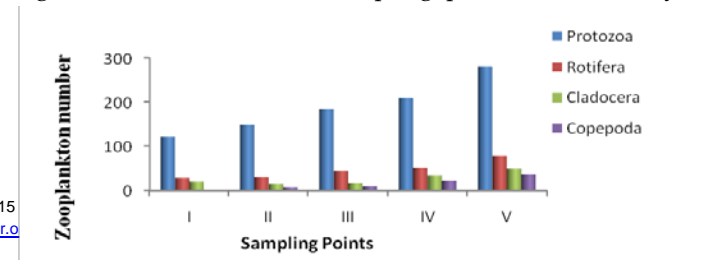


Figure 9. Variation in Nitrate (mg/L) December, 2005 – January, 2006 Sampling Points

Findings for Nitrite however showed 0.017 mg/L as the highest value recorded in sampling point III in January,



2006 and lowest value as 0.000 mg/L in the sampling point V and II in December, 2005 and January, 2006 respectively. Highest and lowest value recorded for phosphate was 0.78 mg/L in sampling point III in February, 2006 and 0.32mg/L in same sampling point III but in January, 2006. Nitrate results analysis was recorded as 0.400 mg/L as the highest value in sampling point I in both December, 2005 and February, 2006. Lowest results value 0.000 mg/L for nitrate was recorded in sampling point III only in February, 2006.

Figure 10: Species richness of zooplankton classes in each sampling points

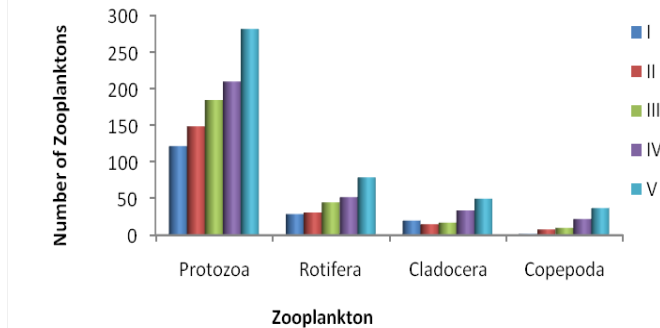


Figure.11: Distribution of zooplankton classes in each sampling points

2.8 Discussion

The physical factors (temperature and transparency) tested in this research work showed little variations and this resulted in a weak effect on the distribution and abundance of Zooplankton. But in respect to chemical factors showed great effect. Similar investigation by post (2002) indicated that distribution and abundance of Zooplankton may be a reflection of three environmental pressures, physical or chemical, food resources and vertebrate predation.

Total Zooplankton count occurred in sampling point I, II, III, IV and V were found to be 173, 203, 257, 318 and 448 respectively. Protozoa number (948) was higher than the other Zooplankton group throughout the period of study and in all the sampling points, and then followed by Rotifer (236), Cladocera (136) and Copepod (79). In a similar finding by Moss *et al.*, (2003) showed that Protozoa species are very numerous and that they occurred abundantly in all types of freshwater and in damp soil, also mode of their reproduction made them to multiply exceedingly, or reproduced either sexually or asexually or by both.

In all the sample taken from five sampling points of Wasai reservoir, a total of 1339 individual Zooplankton were identified, largest fraction of these number belong to fourteen genera of Protozoa, then six genera of Rotifera, four genera of Cladocera and two genera of Copepod.

2.9 Conclusion

This study has indicated strongly that chemical factors affected the distribution and abundance of Zooplankton organisms. As was recognized by Hanazato (1998), that chemical condition of aquatic environment decreases species richness, average size of the organism, reduces energy flow transfer efficiency, reduces food web complexity and shortening the length of the food chain.

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