Original Article

Assessment of Micro-flora and Fauna Diversity of Lapai Lake for Fisheries Potentials

Isah, M. C*[1]., Abdullahi, A[2]. and Ndatsu, Z. T[1].

[1]Department of Biological Sciences, IBB University, Lapai, Nigeria.
[2]Department of Biochemistry, Federal University of Technology, Minna, Nigeria.

ABSTRACT

This study investigated the fisheries potentials of Lapai Lake in relation to plankton ecology. There were more communities of zooplankton species (21) than that of phytoplankton species (18) but phytoplankton were more dominant with average comparative population of 137/10L against 59/10L of the zooplankton. The most populated species of phytoplankton were *Chlamydomonas* with 32/10L and *Anabaena* with 21/10L, while among the zooplankton, *Bosmina* spp were more with 16/10L, then *Amoeba* with 7/10L and *Cerodaphnia* with 6/10L. The communities identified and the physico-chemical parameters like temperature, pH, electrical conductivity, total hardness, total alkalinity, colour and transparency show that the water body can support fish population, thus contributing to the national food security.

Keywords: zooplankton, phytoplankton, physicochemical parameters, primary productivity.

*Corresponding Author: +2348037376393; isachado@yahoo.com

INTRODUCTION

Lapai lake is a reservoir constructed by Niger State Water Board along River Etswan to provide potable drinking water for the growing Lapai town. The reservoir water is extensively used by people for car-washing, bathing, washing plates, clothes etc. The water is believed to be habitat to reptiles, amphibians and also used as drinking water for grazing cattle, horses, sheep, and goats. Plankton represents the first level of integration of hydro-climatic factors affecting the pelagic food-web. Plankton diversity and composition has been useful and applicable in evaluating the ecosystem and regional responses by environmentalists. Jung and Houde (2005) stress the need for changes in the hydrologic characteristics and chemical changes in water bodies that affect populations in aquatic environment. Plankton diversity can serve as an early warning signal of toxic or hypoxia generating algal bloom. They support a community of other living things as the primary producers among them. Results of several studies have shown that physical and chemical condition of aquatic ecosystem determine the occurrence, diversity and density of both flora and fauna in any given habitat, which may change with the season of the year.

Green algae are extremely important as a source of food for other aquatic organisms and also make a major contribution to the world's oxygen supply. They can however, have negative effects when large populations produce an unpleasant taste and odor in drinking water or clog filtration equipments. In freshwater (lakes and ponds) polluted with nitrates and phosphates sometimes increase 'algae bloom', forming a dense, malodorous scum and drastically decreasing the oxygen supply available to other life forms.

Thébault *et al.* (2008) in their studies of ecological value of the newly opened San Francisco Bay water pond ecosystems considered the rate of phytoplankton activities to determine total ecosystem metabolic parameters. They converted net primary production (NPP) into potential carrying capacity of the forage biota that support targeted pond water-birds; and concluded that food quantity in the pond does not equals quality and these systems have the potential to produce toxic or inedible algae. Rajesh *et al*. (2001) in their studies of primary productivity of microalgae in the pond of Southwest Coast of India concluded that benthic diatoms may be the main food source for many of the meio- and macrofaunal grazers in shallow estuarine systems. Llorens *et al*. (1991) modeled primary productivity of ponds to ease research efforts on estimation of pond primary productivity.

Zooplankton plays an important role in the trophic structure of aquatic ecosystem as consumers of phytoplankton and a source of food for fishes. In addition, they serve as indicator organisms of water type, fish yield and/or total biological production. All these probably explain why much of the fascination in the study of lakes lies in the structure and dynamics of zooplankton populations. Plankton forms the basis of almost all life activities in the aquatic environments.

There are abundant literatures that stress the importance of phosphorous and nitrogen in shaping the structure and abundance of phytoplankton in dams. Nitrogen and phosphorous are considered because they are major factors that limit primary production of phytoplankton in dams. Nutrient–rich animals' excrement deposited along and within dams constitutes a major input of Nitrogen and Phosphorous in the area, and phosphorous can encourage excessive growths of plants and algae and also contribute to eutrophication of such environment.

Ongley (1996) predicted the crisis of freshwater quality to have the following global dimensions: decline in sustainable food resources due to pollution, cumulative effect of poor water resources management decisions which is as a result of inadequate water quality data in many countries that leads to high level of aquatic pollution.

Deterioration of water quality can lead to the destruction of ecosystem balance, contamination and pollution of ground and surface water resources. Rapid population growth coupled with intensive industrial and agricultural activities and the sprawling urban development resulted to significant stress to near-shore ecosystem. Anthropogenic activities could also result to changes in aquatic biota of an area and loss of many species. The plankton proliferation is greatly affected by the water quality and the predatory relationships in the lake (Arcifa *et al*., 1986). Water quality also is in turn affected by the land use and water sources.

MATERIALS AND METHODS

Plankton collection

Zooplankton samples were collected with a zooplankton net 75µm mesh size and $0.07m^2$ ream area while the phytoplankton samples were collected using similar nets of 20µm mesh size $0.07m^2$ ream area scoop horizontally for 1 meter, making total volume scooped $0.07m^3$ for each sample collected. The samples were collected using standardized method described by Edmondson and Weinberg (1971). The concentrated samples were collected in small 100ml bottles that were labeled A – D. Four samples each were collected for both zooplanktons and phytoplanktons from each of the four sampling sites. A preservative solution of 4% formalin was added to the zooplankton sample bottles and Lugols solution were added to phytoplankton sample bottles as fixative. The samples were then taken to the laboratory for analysis.

Taxa were then identified and counted under an inverted microscope.

Physical parameters
Transparency was measured using a Secchi disk noting levels of disappearance and appearance. A graduated rope was tied to a stonne and deepened inside the water to measure the depth and was recorded. The vegetation cover surrounding the dam was observed. Presence or absence of farms was observed and also the activities (anthropogenic) taking place in the vicinity was noted.

Water samples for water chemistry
Water samples were collected using a Rutner's bottle at 0.5m depth from the surface at four sampling sites located in the reservoir. These samples were immediately placed into a cooler box and kept at very low temperatures using ice blocks pending their transportation to the deep freezer in the laboratory. The following water quality parameters were later analyzed in the laboratory: Nitrogen, pH, phosphorous, total hardness, and electrical conductivity (EC). Dissolved oxygen samples were collected into reagent bottle A and B for analysis.

Data Analysis
The zooplankton and phytoplankton were grouped in terms of species composition, abundance and the Taxa also taken. Chi-square was used for the statistical analysis of the data collected.

RESULTS AND DISCUSSION

Water Quality
The physicochemical parameters considered were represented in table 1. The overall pH was slightly alkaline, the highest recorded was in April (7.7) while the lowest record was in June (6.7). The electrical conductivity measured 83µs/cm in April and the lowest been 48µs/cm in July. The total hardness/L of the water was recorded as 32.7 in February while it was highest in May with 52. Total nitrogen/L was highest in March/April having 0.40 and lowest in July with 0.17. The pH readings and all other chemical parameters showed differences with seasons. Values recorded during the dry season were considerably higher than those in the rainy season. The transparency of the Secchi depth was higher during the dry season (0.30m) in March as compared to June and July which has 0.15m.

Plankton Analysis
Result from the tables 2 and 3 and as illustrated in figs 1, 2and3 show the abundance and distribution of plankton in the sampling sites. Plankton represents the first level of integration of hydro climatic factors affecting the pelagic food-web. Blue-green algae and green-algae in any aquatic medium are indicators of high carbon-dioxide concentration and are also sensitive to pollution. According to Brettum and Anderson (2005), the species are a good indicator of water quality when that species are found frequently and in great numbers and also when the highest fraction of the total bio-volume lies only within narrow intervals along the scale of trophic level.

Blue-green algae dominate all the plankton found in the sampling site. Witzel (1983) have classified lakes in relation to the types of phytoplankton that dominates it. Those dominated by *Botrycoccus* are likely to be oligotrophic, and may also contain diatoms. Those dominated by blue-green algae like microcystis and anabaena are most likely to be eutrophic and this dam was dominated by blue-green algae. Though anabaena species is always associated with algal blooms, its abundance was not high enough to create an algal bloom. However, the presence of this species and others that prefer similar ecological conditions in areas where they are not expected to normally occur might be a sign of the enrichment of water, a term referred to as eutrophication.

The current aquatic community structure would likely change with the on-set of eutrophication, perhaps altering water quality and rendering the dam unsuitable habitat for a variety of plankton species and also unsuitable for human uses as they currently stand. One particular risk of this group is the fact that most species including anabaena contain toxic substances that can lead to fish kill wherever their blooms occur, especially in hyper-eutrophic ecosystem. They have nitrogen-fixing sites (heterocysts) on their organs and are therefore able to fix nitrogen; which means that they can proliferate rapidly. Anabaena is, particularly known to produce neurotoxins that affect the human central nervous systems and hepatotoxins that affect human liver.

The zooplankton community was less abundant and diverse as compared to the phytoplankton community, the lower diversity and abundance in this study might be due to the presence of planktivorous fishes and most probably low light penetration (low transparency).In the study area, humans were observed actively fishing, therefore, there seems to be a good zooplankton productivity which is well regulated by high predation by fish. This is in accordance with Hrbaeek *et al*. (1958) in Wetzel (1983) who shows that the size of the zooplankton community is regulated by the presence of fish predators.

The water quality parameters that were analyzed in the studied dam indicate a general trend that is acceptable in comparison with the World Health Organization (WHO) (1996) standards for drinking water. The pH readings and all other chemical parameters showed differences with seasons, values recorded during the dry season were considerably higher than those in the raining season.

Table 1. Average physicochemical composition of the Lapai dam water from February to July 2010.

S/N	Chemical Parameters	FEB	MAR	APR	MAY	JUN	JUL
1	pH	7.0	7.5	7.7	7.1	6.7	7.0
2	Electrical Conductivity(μs/cm)	80.0	80.0	83.0	62.0	53.0	48.0
3	Temperature (^{0}C)	29.20	28.30	29.30	26.20	26.10	26.50
4	Total Hardness ($MgCaC0_3$/L)	32.75	42.0	46.0	52.0	49.0	320.2
5	Nitrites as Nitrogen (mg/L)	0.37	0.40	0.40	0.20	0.22	0.17
6	Total Alkalinity ($MgCaC0_3$/L)	43.63	43.0	43.43	42.50	40.0	38.10
7	Secchi Depth (m)	0.28	0.30	0.29	0.24	0.15	0.15
8	Colour (Pt.co)	385	387	396	403	415	442

Table 2. phytoplankton composition of Lapai Dam per 70L reservoir water, February to July 2010

Class	Name of species	Feb	Mar	Apr	May	Jun	Jul	Abundance
Chlorophyta	*Spyrogyra*	15	17	12	6	7	4	61
(Green algae)	*Volvox*	32	24	13	0	0	2	71
	Desmid	14	1	3	1	0	0	19
	Ulva	0	0	2	0	0	0	2
	Pediastrum	11	8	16	5	2	1	43
Total		72	50	46	12	9	7	196
Percent total (%)								20.45
Cyanophyta	*Chlamydomonas*	95	74	32	14	10	0	225
(Blue-green algae)	*Anabaena*	75	32	11	13	6	7	144
	Coeloispharium	12	14	0	0	2	0	28
	Phomidium	0	1	0	0	1	0	2
	Oscillatoria	7	0	15	8	2	1	33
	Nostoc	2	5	12	4	2	1	24
Total		191	126	70	39	23	9	456
Percent total (%)								47.55
Diatoms	*Vaucheria*	17	8	12	8	5	3	53
	Nereocystis	12	0	4	1	0	0	17
	Fragilaria	0	0	0	2	0	0	2
	Navicula	17	8	6	2	0	0	33
	Melosira	26	31	16	7	1	2	83
	Cyclotella	29	36	12	7	0	3	87
Total		101	83	50	27	6	8	275
Percent total (%)								28.68
Dinoflagellates	*Pyrodinium*	0	12	14	2	1	3	32
Total		0	12	14	2	1	3	32
Percent total (%)								3.34

Table 3. Zooplankton composition of Lapai Dam per 70L reservoir water, February to July 2010

Group	Name of Species	FEB	MAR	APR	MAY	JUN	JUL	ABUNDANCE
Copepoda	*Nauplius*	4	4	0	2	6	2	18
	Diaptomus	1	5	2	0	0	0	8
	Mesocyclops	6	6	0	1	1	2	16
Total		11	15	2	3	7	4	42
Protozoa (ciliphora)	*Paramecium sp.*	8	11	9	2	5	3	38
	Vorticella sp.	7	1	0	0	4	1	13
	Metopus Sigmoides	3	3	2	0	0	0	8
Total		18	15	11	2	9	4	59
Rhizopoda	*Amoeba Proteus*	15	12	9	5	2	5	48
	Diffusa sp.	2	1	1	2	0	0	6
	Arcella discoides	1	0	0	1	0	0	2
Total		18	13	10	8	2	5	56
Rotifera	*Keratella cochleans*	7	0	6	0	2	0	15
	Branchionus sp.	0	0	0	0	3	2	5
	Phiodina rosoela	0	1	1	4	2	2	10
	Monostyla sp.	13	1	0	0	2	0	16
Total		20	2	7	4	9	4	46
Cladocera	*Daphnia cornuta*	18	0	7	0	3	5	33
	Cerodaphnia cornuta	21	14	0	0	8	2	45
	Bosmina sp	0	4	7	0	3	1	15
.	*Calanoida sp*	1	2	0	4	0	3	10
.	*Moina Braniniata*	6	3	0	0	0	0	9
Total		46	23	14	4	14	11	112

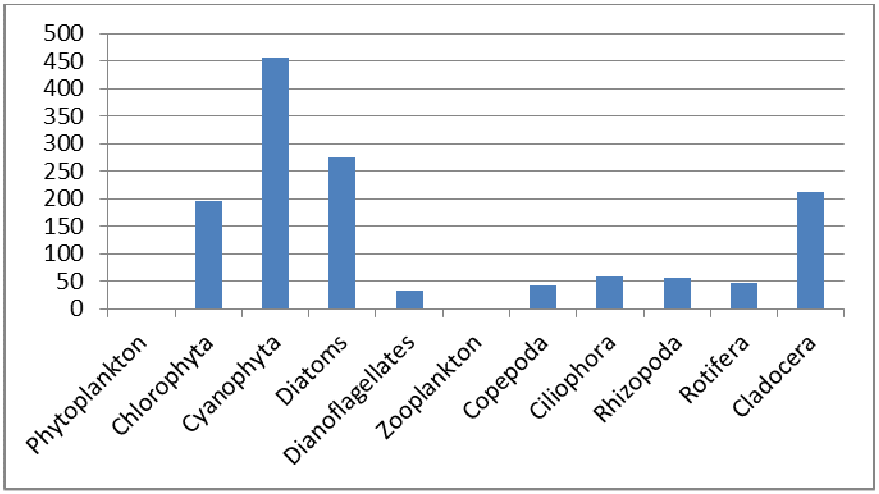

Fig 3: Comparison of classes of Plankton population of Lapai Dam reservoir(The values are mean of three replicates)

CONCLUSION

This result of assessment of plankton diversity serves as a water quality indicator of Lapai dam. The study hypothesized that the water in small dams might be turbid but richer in nutrients as an effect of water use. The expected richness of nutrient would in-turn influence phytoplankton abundance, which would therefore be expected to be greater and less diverse.

The study found that water quality throughout the study area was at acceptable level. This finding was contrary to expectations and indicates that water conditions may be better in areas of human influence than currently thought.

Seasonal changes in the plankton community structure of the dam were contrary to expectation, the diversity and abundance of plankton communities in the dam was influenced by the seasons (raining and dry).

The water should be treated properly before consumption by following the necessary steps of water treatment. Biological analysis should be carried out in the dam regularly to ensure the quality of the water and also bacteriological analysis to check for water borne diseases and micro-organisms like *E coli*, and coliform.

REFERENCES

Arcifa, M. S, Northcote, T. G. and Froehlich, O. (1986). Fish- Zooplankton interactions and their effect on water quality of a tropical Brazilian Reservoir. *Hydrobiologia*, 139: 49 – 58.

Brettum, P. and Anderson, T. (2005). The use of phytoplankton as indicators of water quality. Norwegian Institute for water Research – An institute in the environment research of Norway Report no. 4818.

Edmondson, W. T. and Weinberg, G. G. (1971). *A manual of methods for secondary productivity in freshwaters*. IBP Handbook 17. 358p.

Goldman, C. R. and Horne, A. J. (1983). *Limnology*. McGraw – Hill Book Company, New York. Page 221 – 241.

Jung. S. and Houde, E. D. (2005), Fish Biomass size spectra in Chesapeake Bay Estuaries: 28 (2) 226 – 24.

Llorens, M. J. Sáez, J. and Soler, A. (1991) Primary productivity in sewage pond: semiempirical model. *Journal of Environmental Engineering*, 117:6: 771-781. (doi 10.1061/(ASCE)0733-9372(1991)117:6(771).

Ongley, O. (1996). Control of water pollution agriculture – FAO Irrigation and Drainage Paper S. GEMS/Water collaborating center. Canada centre for – inland waters. Burlington, Canada.

Rajesh, K. M., Gowda, G., Mendon, M. R. and Gupta, T. R. C. (2001) Primary Production of Benthic Microalgae in the Tropical Semi-enclosed Brackishwater Pond, Southwest Coast of India. *Asian Fisheries Science*, 14:357-366.

Thébault, J., Schraga, T. S., Cloern, J. E. and Dunlavey, E. G. (2008) Primary Production and Carrying Capacity of Former Salt Ponds after Reconnection to San Francisco Bay. *Wetlands*, 28:3:841-851. doi: 10.1672/07-190.1 *http://www.bioone.org/loi/wetl*

Witzel, R. G. (1983). *Limnology*. Philadelphia, W.B. Saunders Co., 767 pp

WHO, (1996): *Guidelines for drinking water quality*.vol.2: Health Criteria and other supporting information.2nd ed, Geneva. pp 152-279