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Water quality and fish diversity of Federal University of Agriculture Abeokuta reservoir

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Abstract

Federal University of Agriculture reservoir is one of the recently constructed in Abeokuta, Ogun state, Nigeria, therefore the need to assess the water quality, fish diversity and catch assessment of this new water body. Data on fish species were collected on a forthnight basis using multi-stage gillnet sampling techniques for four months (September- December, 2011). Three sampling stations were randomly selected from the entire reservoir. A variety of sampling methods were used at each site in order to reach every fish species. At the river channel and the floodplain sites, traps, cast nets (2.55cm mesh), seine nets (2.55 x 2 cm mesh), monofilament nylon gillnets (15.55 cm mesh), and hook and line were employed. Efforts were made in order to catch fish species in large abundance. Some sampled fish (dead) were collected and placed in cool boxes and examined within 18 hours of capture. Others were preserved in 15% formalin and stored for later examination. A total of 863 fish specimens were caught during the study period. These were identified and classified into 5 species belonging to 3 families. The percentage species composition of the harvest by numbers and weight for all fish species that contributed more than 1% in all the stations combined, were computed. Study of the physico-chemical parameter such as dissolved oxygen ranged from 5.03 to 7.19mg/l; 26 to 28^{0}C temperature; 64.8 to 148ppm alkaline; pH 6.67-6.90; 32.5 to 53.5m transparent; 8.86 to 13.72mg/l nitrate; 0.58 to 0.64mg/l phosphate; 0.024 to 0.069 $^o/_{oo}$ saline; 103-270cm deep. pH and water temperature serve as variables since the fluctuation of one affects the values of others. The water quality parameters were favourable for fish production. The gillnet fisheries indicated that different mesh sizes of experimental gillnets were sensitive to different fish species. 67.2mm, 78.4mm and 112mm, mesh sizes were efficient in catching Clarias gariepinus, Barbus occidentalis and the Cichlids respectively. The study has shown that middle water was the most suitable habitat for fish in the reservoir. Water level and temperature were observed to guarantee high fish yield in the reservoir.

Key words: Reservoir, Physico-chemical parameters, catch composition

Introduction

The chemistry of water bodies in Federal University of Agriculture Abeokuta (FUNAAB) is influenced principally by the physico-chemical nature of the inflow and the submerged vegetation and soils. The FUNAAB reservoir and other water bodies in the suburbs (Camp, Isolu and Alagogo) are utilized for fish culture, irrigation, domestic purposes and drinking. The common indicators for assessing water quality in Nigeria listed by Mbagwu and Adeniji (1994) are temperature, pH, biological oxygen demand, turbidity, dissolved oxygen, ammonia and nitrogen. Azionu (2001) showed that in Shen Reservoir, Jos,

Nigeria, carbon-dioxide sources in natural water include bacterial decomposition of organic matter, photosynthesis, respiration by animals and plants, flowing river and run-offs with their reservoir of nutrients.

Studies on water quality will mostly center on fish production and aquatic biotic integrity (Boyd, 1982; Abohweyere, 1990; King, 1998). The most notable important physico-chemical parameters are dissolved oxygen, temperature, transparency,

phosphate, nitrate, alkalinity, suspended solids and dissolved ions (Karr and Dudley, 1981). However the usage of water by man for survival is as important as that of fish. Aquatic resources are important food and economic resources for many countries. Nigeria is blessed with various aquatic ecosystems, which provide adequate resources for fisheries development system which include rivers, lakes, lagoons and marine environment.

These parameters in association with edaphic and climatic factors influence the fish diversity and composition of water bodies. This study investigates the fish diversity, water quality and catch assessment of FUNAAB reservoir.

Materials and Methods

Study area

The 3-hectare University reservoir was constructed by damming the seasonal Alabata stream in 1997. It is located at the Fisheries section of the University Farm located at latitude $7^{0}10^{1}$N and longitude $3^{0}2^{1}$E with a prevailing tropical climate and annual rainfall of about 1037mm. The ambient temperature lies within 28^{0}C in June and 36^{0}C in February with an average annual temperature of 34^{0}C. The vegetation presents an interphase between a tropical rainforest and a derived savannah. The reservoir was constructed to store and provide water for adjacent earthen ponds and also to serve as a fish production ground for research purposes.

Sampling procedure

The study area was assessed for four months (September- December, 2011) on a forthnight basis using multi-stage gillnet sampling techniques. Three sampling stations (1, 2 and 3) were selected from the entire reservoir. Sampling was done using various available gears, such as a fleet of eight graded experimental gillnets (mesh sizes from 25.4 to 177.8mm) and cast net (50.8mm) of similar surface area, which were done simultaneously in the various sampling station and sample collections were done for four months. Two months each for wet and dry season on a forthnight basis respectively. The choices of the station location were: the entry point (inlet), the distance between the sampling station.

In the sampling stations, various sampling methods were used in order to catch fish species in large abundance. Some sampled fish (dead) were collected and placed in cool boxes and examined within 18 hours of capture while others were preserved in 15% formalin and stored for later examination.

Analysis of the Frame Survey Data

Basic statistics relating to the structure of the fishery were extracted from the Microsoft Excel data spreadsheets which included total number of gill nets in the fishery by mesh size, and the total number of fishing gear in the fishery.

Study on physico-chemical parameters of the reservoir was assessed for four months (September- December) on a bi-monthly basis and three sampling areas were located in the course of the study. The choices of the station location were: The entry point of water (inlet), the middle point, shallow area (outlet).

The water temperature, pH, turbidity and depth were measured in the field using mercury-in-glass thermometer, pH meter (model 51. Japan), Secchi disc (diameter = 12.0) and graduated rope respectively.

These Dissolved Oxygen (DO) was measured with Model Mel. V and portable digital DO probes (Model Parker, 1987). Other parameters such as alkalinity, pH, phosphate, nitrate and salinity were also determined collected and transported in icebox to the laboratory for subsequent analysis. Samples were analysed within 24 hours of collection in the laboratory. The

Table 1: Mean values of the major Selected water quality parameters measure in UNAAB reservior.

	WET SEASON		DRY SEASON	
PARAMETERS	SEPT	OCT	NOV	DEC
Temperature(0C)	26 ± 0.0000	26.5 ± 0.707	27.5 ±0.707	28 ± 0.0000
Transparency(cm)	32.5 ± 0.035	35 ± 0.098	47.5 ± 0.007	53.5 ± 0.049
Water depth (cm)	270 ± 0.354	238 ± 0.113	115 ± 0.070	103 ± 0.028
Dissolved oxygen(mg/l)	7.19 ± 0.014	7.05 ± 0.070	5.03 ± 0.445	5.12 ± 1.944
Ph	6.67 ± 0.190	6.80 ± 0.183	6.74 ± 0.035	6.90 ± 0.395
Nitrate (mg/l)	13.72 ± 0.395	12.94 ± 0.078	8.96 ± 1.583	8.86 ± 3.563
Phosphate (mg/l)	0.63 ± 0.063	0.60 ± 0.035	0.58 ± 0.048	0.64 ± 0.056
Alkalinity (mg/l)	64.8 ± 11.313	85.2 ± 2.828	142 ± 8.485	148 ± 5.656
Salinity(0/00)	0.024 ± 0.013	0.0245 ± 0.003	0.066 ± 0.402	0.069 ± 0.436

Source: Field data

total alkalinity, nitrate, phosphate and salinity were determined titrimetrically using standard method (APHA 1980). The relationship between the physical and chemical parameters was correlated. One-way Analysis of Variance (ANOVA) followed by Duncan Multiple Range Test (DMRT) was also carried out using Statistical Package for Social Science (SPSS).

Results

The result obtained on the spatial seasonal variation in physico-chemical parameters assessed between the months of September and December 2007 is presented in Table1.

Results show the average values of all the physico-chemical parameters obtained from the reservoir in each month. The temperature ranged from 26^0C to 28^0C, transparency ranged from 32.5cm to 53.5cm, water depth ranged from 103cm to 270cm, dissolved oxygen ranged from 5.03 to 7.19mg/l, pH ranged from 6.67 to 6.90, nitrate ranged from 8.86 to 13.72mg/l, phosphate ranged from 0.58 to 0.64mg/lm, alkalinity ranged from 64.8 to 148mg/l, salinity ranged from 0.024 to 0.069 $^{o}/_{oo}$ respectively as shown in Table 1. There was no significant difference ($p>0.05$) in the physico-chemical factors of the reservoir in the three sampled stations in terms of dissolved oxygen, nitrate, phosphate, temperature, alkalinity and salinity.

Fish Species Composition

During the sampling period, six different species were encountered. The total number of fish species caught is shown in Table 2. The percentage composition, biomass and percentage biomass of the catch composition are also shown in the table.

Table 2: Species composition of UNAAB Reservoir within the study period

Fish species	Total no caught	Percentage composition (0/0)	Biomass (kg)	Percentage biomass (0/0)
Sarotherodon galilaeus	217	25.14	32.55	20.35
Barbus occidentalis	163	18.89	16.30	11.13
Oreochromis niloticus	137	15.87	17.81	10.19
Clarias gariepinus	108	12.52	54.00	33.75
Hemichromis fasciatus	138	15.99	19.32	12.08
Prawns	100	11.59	20.00	12.50

Source: Field data

Welcomme, R.L.1979. Fishery management in large rivers. FAO Fish Tech. Paper, 194: 60pp.

Discussion

This investigation shows that the colour of the water thus offer a certain criterion for estimating its productivity, provided that the influence of humic material (which would give a yellow or brown colour due to pigments) can be excluded. The colour of the water varying from tinge of yellow to greenish-yellow was a mark of its productivity. The greenish-yellow colour was deepest between the months of November and December. This study agrees with the report of Egborge (1977), that phytoplankton density was highest in the Asejire lake during the dry season and lowest during the rainy season in the surface waters in all part of the lake and that total phytoplankton was significantly correlated to temperature and significantly correlated to pH, dissolved oxygen concentration, nitrate nitrogen and water level. Phytoplankton abundance was positively correlated to temperature, pH, dissolve oxygen concentration and negatively related to nitrate nitrogen. Zooplankton was at all times of the year due to the abundance of rotifers.

This is similar to documentation on the phytoplankton response to artificial enrichment with nitrates and phosphates in an upland and lowland reservoir in Plateau State of Nigeria (Kemdrin and Ejike, 1992). The high biota production due to high pH values may have been supported by high free carbon dioxide. However no further work has been done to identify these micro-organisms. The turbidity value is fairly high at the time of study. Also, the free floating biota and fish eggs constituting pollutants will be easily exposed to bottom predators (Boyd, 1979).

The physico-chemical parameters documented in this study fall within the minimum permissible limits for aquatic organisms as stated by USEPA, (1979).

The abundance of *Sarotherodon galilaeus, Barbus occidentalis, Hemichromis fasciatus* and *Oreochromis niloticus* in this study could be attributed to their ability to tolerate low levels of oxygen and inability to neither bury themselves nor burrow into the muds.

The dissolved oxygen levels recorded from the reservoir were observed to be generally high and above the critical levels of 4mg/l. Higher values of dissolved oxygen concentration were observed during the raining season when nutrients and sediments were flushed into the reservoir from run-off as a result of rainfall. At higher temperatures, lower values of dissolved oxygen were observed and this agrees with Olaniyan (1969) who observed an inverse relationship between the two variables while working on the Lagos lagoon. The fairly uniform water temperature readings recorded during the study period may be linked to the shallow depth of the reservoir which eases the mixing of the water i.e no real temperature stratification will be present due to the shallowness of the reservoir. However, the relatively small range of variations in the water temperature observed in the reservoir is in line with the observation of Web and Hill (1958) and Olaniyan (1969). They reported that temperature is a stable environmental factor in the shallow fresh water environments of west-Africa and is most unlikely that this variation in temperature constitutes an important ecological factor in this area.

The pH of the reservoir varied between 6.67 and 6.90. The variation for most of the sampling period was very minimal. The neutral pH with slight fluctuation to acidic condition is suitable for fish production. Salinity is an important parameter having a great effect on the biotic life in the aquatic

ecosystem as different organisms have the optimum salinity level at which they perform best. However, the salinity of the reservoir is suitable for fish culture in fresh water. High salinity variations beyond bearable levels will have serious effect on the growth and development of the fishes. The high turbidity level observed during the rains was due to influx from run-off. The alkalinity of water normally reflects carbonate content of rocks and soils of watersheds and bottom mud. The relatively lower values of alkalinity recorded during the study period may be attributed to the dilution effect of the rain during this study period. Nitrate is an important nutrient but at high concentrations, it becomes toxic and capable of disturbing aquatic environment. The phosphate is also of great importance as essential nutrient in the aquatic system. The high difference in the water depth is an indication that rainfall contributed so much to the water level of the reservoir.

Generally, all these parameters have a great effect on the lives of the fishes present in the reservoir and only fish species that can acclimatize and adapt to the seasonal changes can live successfully and be optimally cultured in the FUNAAB reservoir. This accounts for the relative abundance of species known to be hardy (such as *Clarias gariepinus*) and prolific breeders (such as *Oreochromis niloticus*) in the reservoir.

The preponderance of Cichlids which account for over 57% of species composition in FUNAAB reservoir could be attributed to their ability to thrive on a wide variety of foods and the provision of suitable breeding and their shelter ground provided by colonization of the banks with green plants.

The results from the study show that fish species in the reservoir can be compared favourably with other fresh water bodies species. This information can be used for management decisions and formulation of resource development in the area in addition to the provision of a checklist for fisheries study.

Conclusion

The study provided baseline information on the abiotic parameters of the FUNAAB reservoir and the current state of fish species diversity in the reservoir. The study also provide knowledge of the physical and chemical factors of the aquatic environment and the complex biological interactions in the aquatic environment in order to make good and sound management decisions towards the wise use of the reservoir. Regular and periodic study of the physico-chemical parameters and species diversity should be encouraged.

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