Journal of Fisheries International 3 (2): 42-45, 2008
ISSN: 1817-3381

An Assessment of the Physico-Chemical Properties of a Tropical Reservoir, Southwestern, Nigeria

J.A. Oso and O. Fagbuaro
Department of Zoology, University of Ado-Ekiti, P.M.B 5363, Ado Ekiti, Nigeria

Abstract: Study on the physico-chemical properties of Ero reservoir, a tropical reservoir situated in Ekiti State, Southwest Nigeria, was carried out between April 2003 and March 2005. Monthly variations were observed in the parameters measured. During the period of this study, ranges of parameters were: 24.2 and 29.2°C for temperature; Turbidity 38.0-49.9 cm; pH, 6.8-7.7 and D.O, 4.7-5.2 mg L^{-1}. Generally, the ranges of these parameters fell within optimum limit for fish production.

Key words: Physico-chemical, tropical, ero reservoir, assessment, Nigeria

INTRODUCTION

According to Kolo (1996) considerable interest has been taken in the relevance of limnological information to the productivity, development and management of the aquatic environment within the recent past decades. Therefore, limnological studies are not only of major importance to understanding aquatic life but also for the development and management of such aquatic environment. The ultimate objective of limnology is therefore to understand the factors upon which the continued existence of nature depends and to find out causes of declination and in some cases, extinction. Francis *et al.* (2007) reported that the growth of fishes cannot be separated from the effects of physico-chemical characteristics of their aquatic habitat.

According to Adebisi (1981), knowledge of the physico-chemical regime of a water body is of great value in the determination of its productivity, usefulness and other characteristics which influence the vertical and horizontal migration of organisms, their distribution, diversity/composition and feeding pattern. The optimum levels of the various physical and chemical properties must be within the acceptable limits as reported by Boyd (1979) for optimum fish yield. Some of these physico-chemical properties include Dissolved Oxygen (D.O), pH, Temperature, alkalinity, CO_2 and conductivity.

Adebisi (1981) reported on the physico-chemical properties of the Ogun River, that in a lotic state, the water's transparency, pH, total alkalinity and conductivity were lower, while its dissolved oxygen and free carbon dioxide concentrations were higher than the corresponding condition in the resultant pools formed when the water was lentic. The physico-chemical characteristics and nutrient concentrations of river Suka were monitored by Kolo and Yisa (2000). The mean values for most of the parameters showed no significant differences. Egborge (1979) worked on the effects of impoundment on the water chemistry of Lake Asejire. He observed that chemical stratifications followed closely the pattern of thermal stratifications as the lake was chemically stratified from February to April and destratified from June to September as well as in January.

Seasonal variations in limnology and productivity of a tropical highland fishpond in Jos Plateau were observed by Ufodike and Garba (1992). The results showed that the mean temperature of water which was usually slightly below that of the air ranged from 17.8-26°C. Aguigwo (1998) investigated the physico-chemical parameters and plankton productivity of Nnamdi Azikiwe University stream. Results showed that the physico-chemical parameters particularly pH, alkalinity, nitrate-nitrogen and phosphate-phosphorus were adequately high for primary productivity. He reported further that rainfall also affected the level of primary productivity by stimulating increased production level and phytoplankton abundance.

Kolo (1996) assessed the physico-chemical parameters of Shiroro Lake and its major tributaries. He observed that the hydrological regime of the lake, precipitation chemistry, bedrock chemistry and hydro-electrical power generation influenced and determined the inputs of dissolved organic carbon, nutrient levels and water quality of the lake. Based on available information, not much has been done on the assessment of the physico-chemical properties of Ero reservoir. The dearth of such information forms the basis of this present study.

Corresponding Author: J.A. Oso, Department of Zoology, University of Ado-Ekiti, P.M.B 5363, Ado Ekiti, Nigeria

MATERIALS AND METHODS

The study site: Ero reservoir: Ero reservoir is situated in Ikun Ekiti, Moba local government of Ekiti State located entirely within the tropics. It is lies between longitudes 4° 45^{l}-5° 45^{l} East of the Greenwich Meridian and latitudes 7^{0} 15^{l} and 8° 5^{l} of the equator. The reservoir was commissioned in 1985. It has an earth-filled embankment with a length of 662 m with an impounded area of 4.5 km^{2} and a water level of 504.5 m. The capacity of the reservoir in million cubic meters is 209,000,000 m^{2}. Three locations were selected along the length of the reservoir for the purpose of this study. Collection of samples was done fortnightly between April 2003 and March 2005. Water samples collected for D.O were analyzed within a few hours after collection (less than 2 h) for accuracy. The following parameters were determined:

Temperature: Readings were taken using mercury-in-glass thermometer graduated in degree Celsius (°C). The thermometer was placed in the water body for about 5 min to stabilize after which the readings were taken and recorded. Turbidity was measured using secchi disc with a diameter of 20 cm was allowed to sink down the water body on a marked line until it just disappeared. pH was determined by electrical method involving the use of a pH meter (7020 model). Dissolved Oxygen (DO) was measured in (mg L^{-1}).

Data analysis: Data obtained in this study were analyzed using SAS software programme. Mean separation was done by Duncan Multiple Range Test (DMRT). Pearson correlation and T-test were done as appropriate.

RESULTS

Monthly variations of the physico-chemical parameters of Ero reservoir measured between April 2003 and March 2005 are presented in Fig. 1 and 2.

Temperature ranged between 24.4 and 29.2°C with mean of 26.48±1.52 in April 2003 to March 2004. Between April 2004 and March 2005, the range was 24.2 and 29°C with a mean of 26.43±1.34. The highest temperature of 29.2°C was recorded in April 2003, while the lowest value of 24.2°C was in August 2004. There was no significant variation in the values of dry and wet seasons at $p<0.05$ during the period of sampling.

Turbidity of water ranged from 39.0-49.9 cm with a mean of 44.59±4.17 between April 2003 and March 2004 while it ranged from 38-48.9 cm and a mean of 44.07±3.46 between April 2004 and March 2005. The highest value of turbidity (49.9 cm) was obtained in April 2003 while lowest value of 38.0 cm was obtained in September 2004. Analysis showed that there was a significant variation between wet and dry seasons at $p<0.05$.

pH values ranged between 6.8 and 7.7. pH was highest in August 2004 with a value of 7.7, while the value

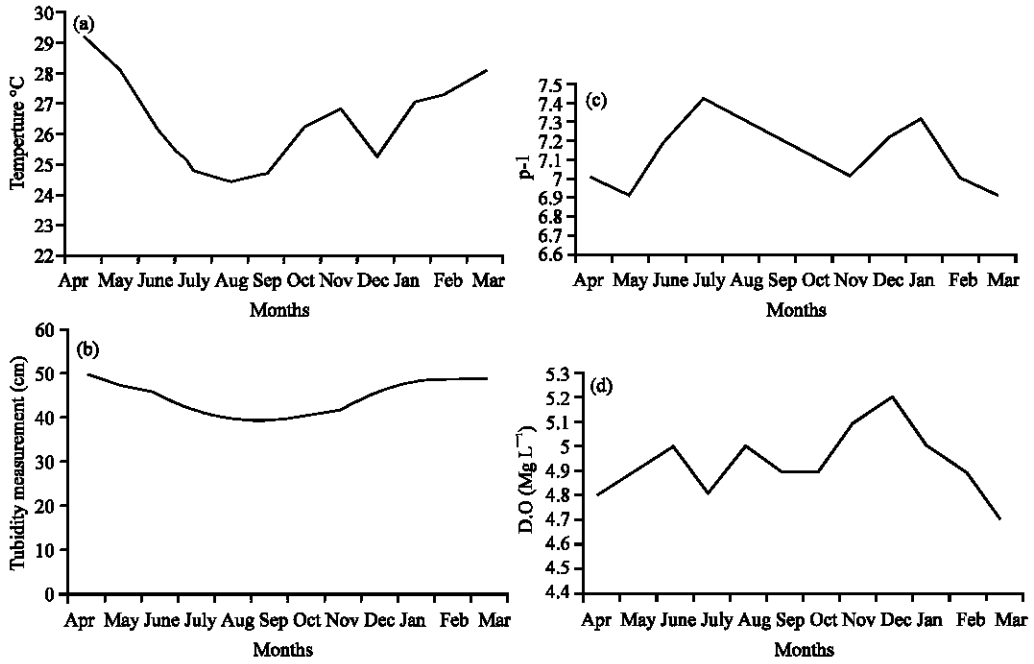

Fig. 1: Monthly variations of the physico-chemical parameters of Ero reservoir measured between April 2003 and March 2004

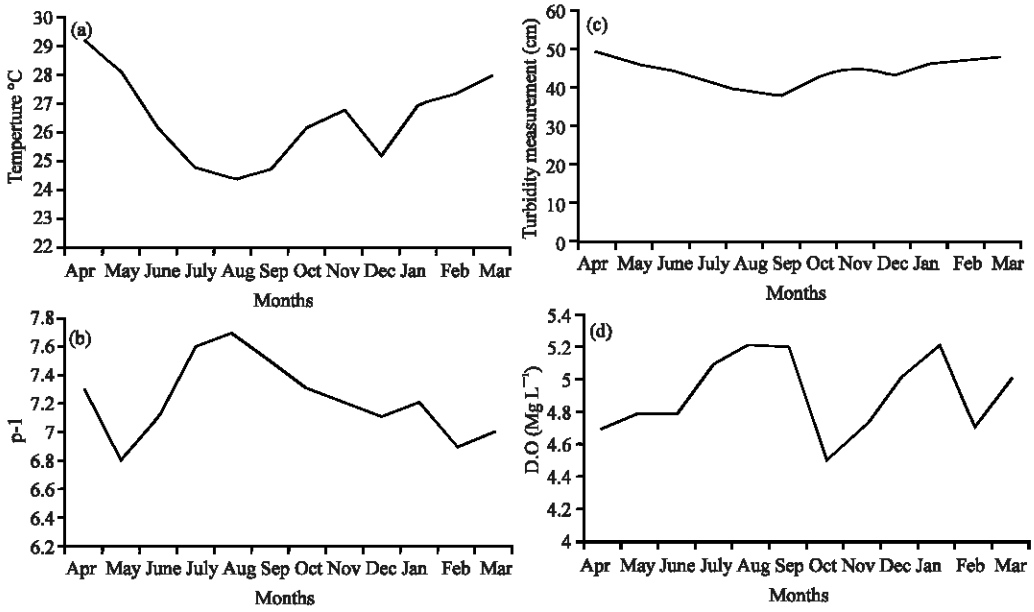

Fig. 2: Monthly variations of the physico-chemical parameters of Ero reservoir measured between April 2004 and March 2005

was lowest in May 2004 with a value of 6.8. There was no significant difference between dry and wet seasons mean values at $p<0.05$.

D.O concentration varied between 4.7 and 5.2 mg L^{-1}. Concentrations were highest in December 2003, August 2004 and January 2005 with a value of 5.2 mg L^{-1} each while the lowest value of 4.7 mg L^{-1} was recorded in March, April and November 2004 and February 2005. Between April 2003 and March 2004, the mean value was 4.92±0.15 mg L^{-1}, while it was 4.89±0.22 mg L^{-1} between April 2004 and March 2005. There was no significant difference between wet and dry season values at $p<0.05$.

DISCUSSION

Analyses carried out showed that there were no marked variations between months and seasons in most cases. These observations did not agree with the findings of Kolo (1996) in Shiroro dam. The highest temperature value of 29.3°C recorded in this study coincided with the peak of dry season in April while the lowest value of 24.2°C was in August during the rains. According to Aguigwo (1998), the reduction in temperature must have been as a result of the rains that lowered solar heat radiation. He said further that temperature reduction might also be as a result of accumulation of run-off into the water body, which may result in high increase in alkalinity, nitrate-nitrogen and phosphate-phosphorus concentrations. Ufodike and Garba (1992) also reported higher temperature value of 26°C towards the peak of dry months in March and a lower value of 23.5°C during the rainy due to cloudy weather that reduced solar radiation. The research was conducted in a tropical highland fishpond in Jos. The highly significant ($p<0.05$) and positive correlation between temperature and turbidity in this study agreed with the findings of Kolo and Yisa (2000) in their baseline assessment of the water quality of river Suka in Niger State.

Mean turbidity values in this study were lower in the rainy season within the period of sampling. This agreed with the report of Aguigwo (1998), who attributed this situation to high-suspended matter in the water column in Nnamdi Azikiwe University stream. Kolo (1996) also reported a lower turbidity value in the rainy season in Shiroro Lake and its tributaries.

The pH was generally alkaline throughout the period of sampling fluctuating between 6.8 and 7.7. Similar range of between 6.9 and 7.9 was obtained by Adebisi (1981), who worked on the physico-chemical hydrology of Upper Ogun River. The pH values obtained in this study is adequate for aquatic life including fish and falls within recommended range of 6.5-7.5 (Boyd, 1979).

Dissolved Oxygen (D.O) concentration of between 4.5 and 5.2 mg L^{-1} observed was relatively low in Ero reservoir. It was however noted that D.O concentration was higher during the part of the rainy season (July-Sept) when temperature was found to be lower than the dry season between February and April when temperature was higher. This shows that temperature decreases oxygen concentration (Huet, 1972). Silva and Ronaldo

(1987) reported a similar trend in their study seasonality of monsoon primary productivity in the 5 man-made lakes located within the same river basin in the dry zone of Sri-Lanka.

Generally, the ranges of the physico-chemical parameters of Ero reservoir fall within tolerable limit for fish species and as such can support fish production.

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