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Research Article

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Physico-chemical Parameters Study in Oriyanrin Lower Ogun River Water Body

Oyekanmi Funmilayo Bosede[1*], Adeosun Olamide Modinot[2], Adeosun Festus Idowu[3], Akin-Obasola Bola Joyce[4], Moradeyo Olusola Stephen[4], & Oyekanmi Oluwatomisin Adediji[5]

1Department of Agricultural Science Education, University of Ilesa, Ilesa
2Agricultural Media Resources and Extension Centre, Federal University of Agriculture, Abeokuta
3Department. of Aquaculture and Fisheries Management, Federal University of Agriculture, Abeokuta
4Department of Fisheries and Aquaculture Management, Ekiti State University, Ado-Ekiti
5Department of Fisheries and Aquaculture, Federal University Lokoja

[*]Corresponding author: Oyekanmi Funmilayo Bosede, Department of Agricultural Science Education, University of Ilesa, Ilesa.

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Abstract

The physico-chemical parameters were sampled from February to September, 2019. Surface water samples were collected from three sampling sites for physico-chemical analysis in 1-litre plastic bottle. Water samples for water quality were collected not below 0.5 m. Water temperature (mg/L), pH, electrical conductivity (µS/cm) and total dissolved solids (mg/L) were determined in-situ using Hannah instrument while secchi disc was used for transparency (m). Results were presented using inferential and descriptive statistics, while diversity dat was analyzed using diversity software. Range of values of physico-chemical parameters measured were water temperature (27.2 to 32.6°C), air temperature (26.0 to34.8°C), transparency (0.61 to 1.04 m), pH (5.4 to 7.9), total dissolved solids (799 to 2000 mg/L), conductivity (1714 to 3999 µmhos/cm), salinity (15.0°c to 34.8%), Nitrate (2.49 to 3.23 mg/L) dissolved oxygen (5.40 to 8.3mg/L) and alkalinity (3.0 to 73.3 mg/l). High variation in salinity shows that Lagoon is brackish water environment.

Introduction

The knowledge of the physico-chemical regime of a water body is of great value in the determination of its productivity, usefulness and other characteristic [1]. Dependence on these water bodies as a valuable resource, demands for adequate understanding of their dynamics, since water is the only medium in which members of the aquatic community live and reproduce. This implies that the aquatic organisms must be able to find shelter and food, make use of dissolved gases in it and reproduce without compromising need for a change environment. The diversity of fish mainly depends upon the abiotic factors and types of ecosystem [2]. Environmental degradation, through pollution of the aquatic environment, flooding and aquatic weed infestation has all tended to reduce the capacities of these natural bodies of water. To support optimum fish population for preservation of natural stocks capacity exist in the man-made reservoir and dams for fish production through stocking and expansion of aquaculture through utilization of vast wetland for pond construction in order to boost fish production. Multidisciplinary approach should be adopted for future water resource development project where dams for domestic water supply and irrigation should also incorporate fisheries. The objectives of this study are to determines some physico-chemical parameters of the river, identify the available fish fauna with view of assessing its fisheries potentials.

Water is essential to the life of fish, it is the medium that must supply or support all fish needs, including breathing, feeding, reproduction, and growing [3]. Water quality is an attribute that affects the biodiversity of aquatic systems. Water quality is the sum total of the physical and chemical characteristics of a water body [4]. It is one of the most important factors influencing successful freshwater fisheries, if the water quality is good, survival, growth, and reproduction of fish can reach high values; if not fish production will be decreased or even impossible.

Fish perform all their bodily functions in water. Because fish is totally dependent upon water to breathe, excrete waste, maintain

a salt balance and reproduce. Understanding the physical and chemical qualities of water is critical to successful abundance of fish. To a great extent, water quality determines the success or failure of fish diversity.

Methodology

Description of the Study Area

The Oriyanrin Lagoon, Abeokuta, Ogun State is approximately 60 km long and 3 km wide, lies between longitudes 3°0′ and 3°45′ E and between latitudes 6°25′ and 6°30′ N. It is part of a continuous system of lagoons and creeks along the coast of Nigeria from the border with the River Ogun to the Niger delta. Its water depth ranges from 1 m to 10m. The lagoon experiences two seasons: the dry season (December - May) and the wet season (June - November) [5]. Most of the year it is characterized by fresh and slightly brackish water. The lagoon is approximately equi-distant from the entrances of Ogun and Cotonou harbors. It is influenced by tides and floods from the Ogun Lagoon and Cotonouharbour through Lake Nokue and Lake Porto-Novo [6]. The River with its tributaries Italu and Itomo is the major river emptying into the lagoon. Creeks connected to the lagoon include Bawa and Doforo. Major weeds occurring in the lagoon yearly in December and January include the common water hyacinth (Eichiorniacrassipes) and ceratophyllum and pistia sp. The lagoon is surrounded by large areas of swamps covered with vegetation among which the raphia palm (Raphiasudanica), the African oil palm (Elaeisguineensis), and the coconut palm (Cocosnucifera) are dominant [5].

Determination of Physico-chemical Parameters

Water samples of the lagoon were collected at each location from the surface not below 50 cm, at every sampling visit. The following physico-chemical parameters were analyzed:

Temperature (ºC)

Mercury in glass thermometer (50c) was used to determine atmospheric temperature at each station. The thermometer was allowed to stabilize for 2 minutes and reading was taken in degree Celsius (ºC). Water temperature was also determined using pH EC-TDS meter (HANNA HI 9810), a multipurpose meter.

The pH meter was standardized with distilled water before dipping it into the water waited for two minutes for the readings to stabilize and the result were displayed on the instrument and reading were recorded instantly.

Transparency (M)

A weighed secchi disc of 20 cm in diameter, painted in alternative black and white colour was lowered into the water at each station until it just disappeared and pulled up until it appeared again. The two readings were recorded and average value was calculated to give secchi disc transparency in meters.

Determination of pH

The pH of samples was measured using a hand pH-EC-TDS meter (Hannah H1 9810). The instrument was dipped in water and the mode was switched to pH. The reading was allowed to be stable before the reading was recorded.

Determination of Dissolved Oxygen (mg/l)

The dissolve oxygen of the Lagoon water was done using Winkler's method. The water was collected with the use of BOD bottle carefully to prevent bubbles. 1ml of manganese sulphate, 1ml of potassium iodine and 1ml of concentrated sulfuric acid (H2So4) were added respectively, and the bottles were covered carefully to avoid bubbles, kept in a dissolved oxygen box to prevent light penetration and were taken to the laboratory for titration analysis. The apparatus used for the titration in the laboratory were restore stand, burette, measuring cylinder, pipette, beaker, conical flask, and all apparatus were cleaned with distilled water. Beaker was used to fill the burette, with sodium thiosulfate. 100ml of the water sample was put in the conical flask, 2-3 drops of starch solution was added to the water sample as indicator (no colour change). The water sample was then titrated with sodium thiosulfate till it turns colourless and the reading of the titration was taken. The titrate value was used to calculate for the dissolved oxygen in mg/l.

Electrical Conductivity (µS/cm)

This was determined using a hand pH-EC-TDS meter (Hannah H1 9810). The instrument was dipped in water and the mode was switched to EC, the reading was allowed to be stable before the reading was recorded.

Determination of Nitrate (mg/l)

Sodium salicylate (colorimetric) method was used to measure the concentration in the water sample collected [7]. Water sample was flocculated (to remove interfering organic and metallic substance) by addition of mercury (ii) oxide.

The solution was allowed to settle for 5 minutes and later filtered. 2ml of the filtrate was pipetted into the evaporation dish. 1ml of 1% sodium salicylate was added and evaporated to dryness for at least 30 minutes in a drying oven at 105ºC. Sample residue was removed from oven and allowed to cool after which 2 ml concentrated sulphuric acid was added to dissolve the solid with occasional swirling. After the dissolution of the solids, 15 ml of distilled water was added by 15 ml sodium-hydroxide-potassium-sodium titrate to develop a yellow colour in the presences of nitrate, Blank sample was prepared (with the addition of sodium salicylate) in the same manner. Spectrophotometer (Jenway 6405 uv/vis) was used to determine the absorbance level at the wavelength of 210 nm. Dilution was made where necessary.

The intensity of the developed yellow colour is proportional to nitrate concentration in the water sample and also bears a linear relationship.

Determination of Total Hardness (mg/l)

50 ml of each water sample was measured using a measuring cylinder. 1ml of ammonium buffer and three drops of Eriochrom black T was added and titrated against EDTA water. A sky blue colouration indicates reaction is complete. (titre value * 20).

Determination of phosphate (mg/l)

Vanado-molybido-phosphoric acid colorimetric method was used to measure the concentration of phosphate in the water sample collected. 0.2 g of activated carbon was added to 50 ml of each sample to remove any excessive colour and allowed to settle for about 5 minutes [7]. The mixture was filtrated through Whatman filter paper. 25 ml of the filtrate was pipetted into 50 ml volumetric flask,10 mls of vanadate-molybdate reagent was pipetted to develop a yellow colour and diluted to the mark dis-

tilled water. 25 ml of distilled water was substituted for sample solution and used as black. Spectrophometer (Jenway 6405uv/vis) was used to determine the absorbance level at the wavelength of 470 nm. The intensity of the developed yellow colour is directly proportional to phosphate concentration in the water sample.

Results

Water Quality Parameters

The results obtained on the physico-chemical parameters assessed between the months of February to September are presented in Figures 1 to 8.

Mean monthly air temperature ranged from 26.0°C to 34.8°C. Water temperature ranged between 27.2°C to 32.6°C. dissolved oxygen values between 5.40 to 8.27 pH ranged between 5.36 to 7.87, transparency from 0.61 to 1.04, alkalinity was 3 to 73.3, total hardness from 190 to 124, total dissolved solid from 799 to 2000mg/L, conductivity (1714 to 3999 µs/cm), salinity (15.0% to 34.8%), Nitrate (2.49 to 3.23 mg/L) and finally phosphate value ranged between 0.04 to 28.

The dissolved oxygen levels recorded from the lagoon were observed to be generally high and above the critical level of 4 mg/L while high levels of dissolved oxygen concentration were observed at the peak of the rainy season. There was no correlation between temperature and dissolved oxygen. This may be due to the time of the days in which the sample was collected.

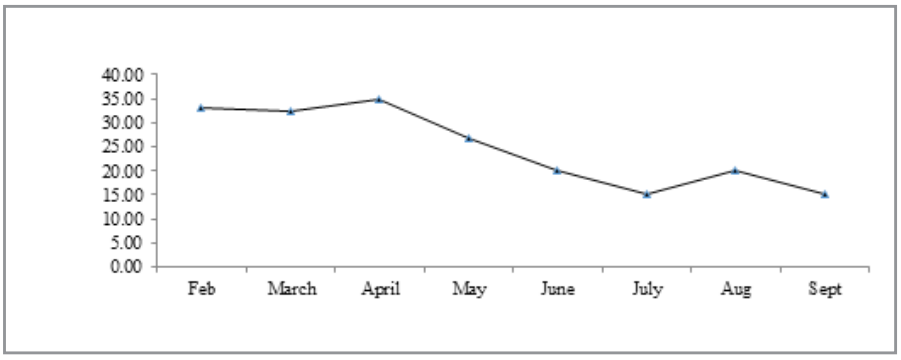

Figure 1: Monthly Mean Variation of Salinity in Oriyanrin Lagoon, Abeokuta, OgunState.

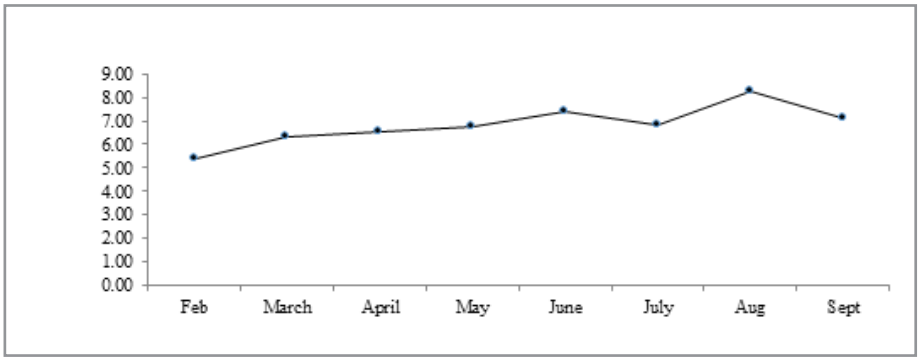

Figure 2: Monthly Mean Variation of Dissolved Oxygen in Oriyanrin Lagoon, Abeokuta, OgunState.

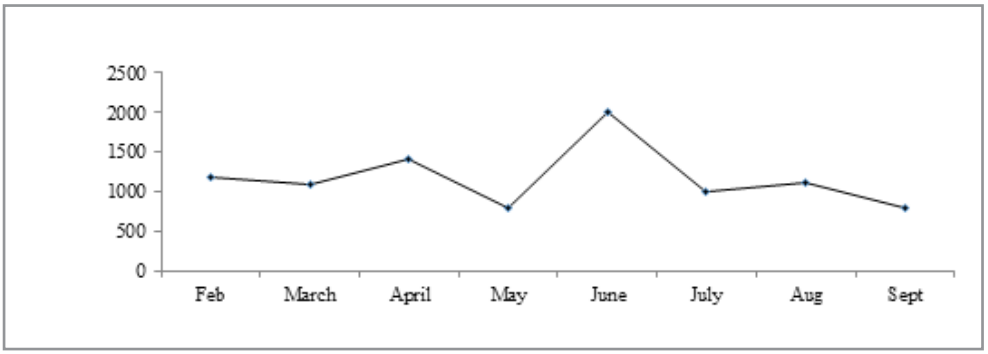

Figure 3: Monthly Mean Variation of Total Dissolved Solids in Oriyanrin Lagoon, Abeokuta, Ogun State.

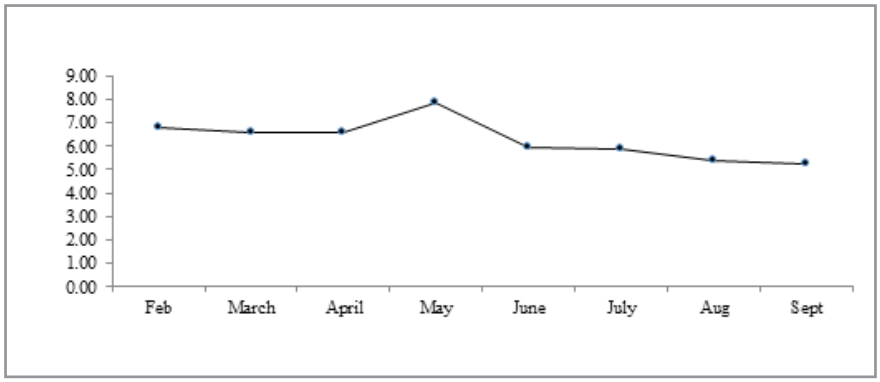

Figure 4: Monthly Mean Variation of pH in Oriyanrin Lagoon, Abeokuta, OgunState.

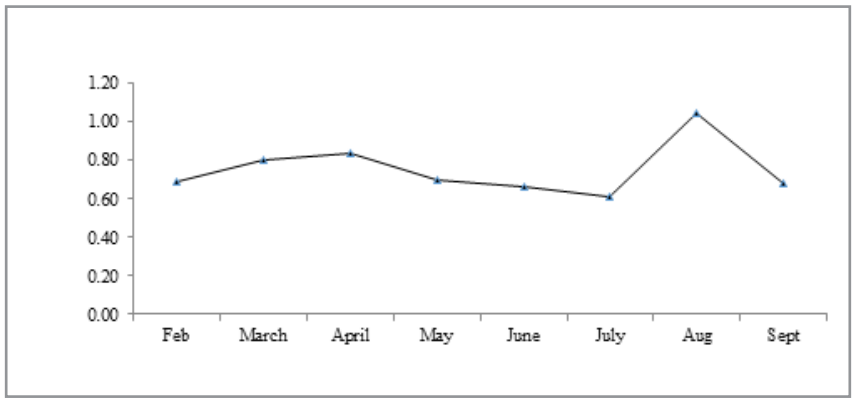

Figure 5: Monthly Variation of Water Transparency in Oriyanrin Lagoon, Abeokuta, OgunState.

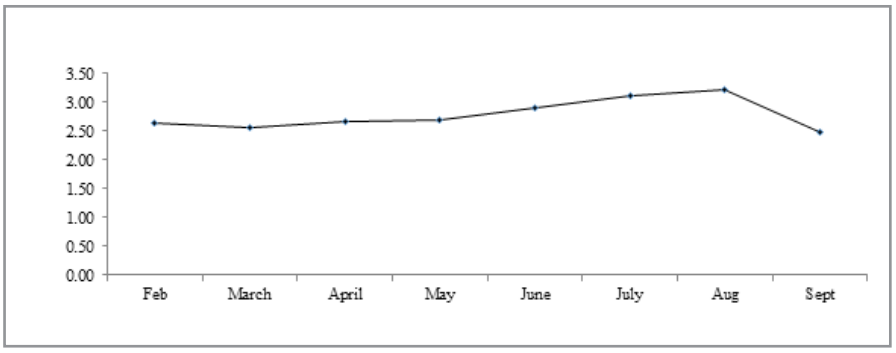

Figure 6: Monthly Mean Variation of Nitrate in Oriyanrin Lagoon, Abeokuta, OgunState.

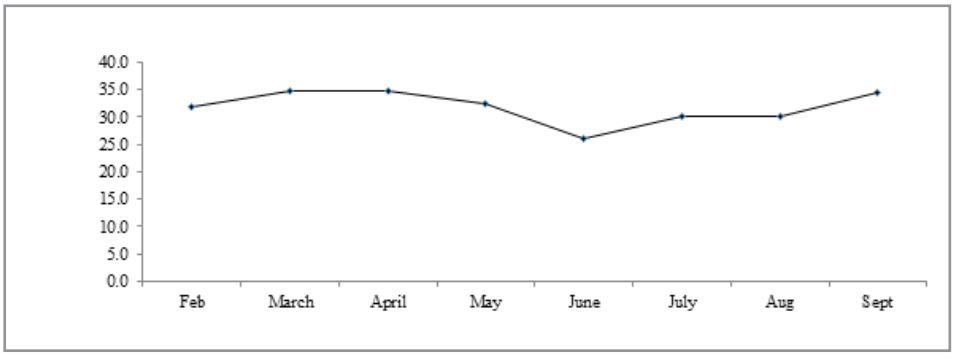

Figure 7: Monthly Mean Variation of Air Temperature in Oriyanrin Lagoon, Abeokuta, OgunState.

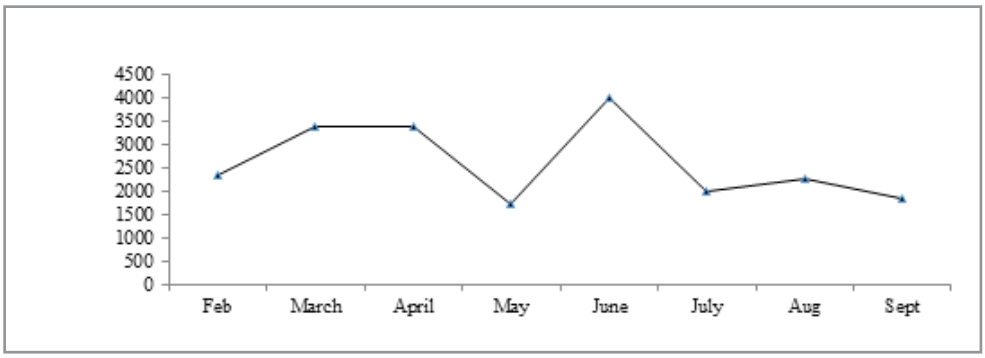

Figure 8: Monthly Mean Variation of Electrical Conductivity in Oriyanrin Lagoon, Abeokuta, OgunState.

Discussion

The physico-chemical parameters of Oriyanrin lagoon show variation in the values of water quality parameter. These variations may be associated with patterns of water use and rainfall [8]. Temperatures were relatively lower in June-July than in April-May. Water temperature values followed closely changes in air temperature. This may be attributed to the sampling time which was between 9:00 and 11:00 am, when the water is warmer than air. The relationship between surface water temperature and transparency were significant positively. This could be possible because light heats the surface of the water before penetrating into other depths. Temperature is an important factor that influences primary production in lagoons [9]. The dissolved oxygen value for the reservoir was very low. This depression in dissolved oxygen level could be due to chemical and biological oxidation process in water.

The pH range shows that the lagoon is tending towards alkalinity. Recorded similar pH values ranging from 5.52 to 6.74, while reported a pH range 5.52 to 6.74 of in Oriyanrin lagoon [10, 8]. This suggests that the lagoon water is good for fish production.

The values of salinity recorded throughout the study period were constant. The fluctuations in total alkalinity of tropical water bodies depend on the location, season, plankton population and nature of the bottom deposits. The values of alkalinity obtained were very low. The mean value of conductivity (1883-1887 µmhos/cm) shows that the conductivity level is intermediate. Conductivity levels below 50 µmhos/cm are regarded as low; those between 50-600 µmhos/cm are medium while those above 600 µmhos/cm were high conductivity [11]. Adebayo and Ayoade, 2019 opined that the conductivity of Oriyanrin lagoon could be regarded as intermediate [12].

The Total Dissolved Solid (TDS) values obtained during the study periods were relatively constant all through the stations. This may be due to organic and inorganic substances dissolved and washed into the reservoir by runoffs. The correlation between TDS and air temperature suggests that the dissolved solids in the lagoon are mainly ionic. The decrease in transparency from May to July may be due to the increase in turbidity of the water as a result of run-off carried into the lagoon. This agrees with Emmanuel and Chukwu, 2010 who reported that the pattern of change of transparency varies inversely with that of turbidity and rainfall and that higher transparency leads to deeper light penetration and consequently a wider depth of photosynthetic activity of phytoplankton [13].

Conclusion

The study served as an eye opener on the need to have good knowledge of the physical and chemical factors of the environment in order to make good and sound management decisions towards the effective and wise use of the aquatic environment.

The monthly monitoring of the parameter showed that the fluctuations in the physical and chemical factors were not entirely nature induced (as clearly seen in case of high nitrate and phosphate value) as some alternations or variations could have been anthropogenic in nature.

Recommendation

A detailed and regular study of physical and chemical status of the lagoon water is recommended in order to tackle the problem of poor aquatic environment.

There is also a need for further studies on the nature and level contribution by Man`s activities to the variations in the physical and chemical variable of the water body.

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