DOI: 10.56892/bima.v7i2.438

DETERMINATION OF THE WELLBEING OF SILVER CATFISH IN DADIN KOWA RESERVOIR

[1]*ZALIHA ADAMU UMAR, [2]KOTOS A. ABUBAKAR, [1]NURU ADAMU GARKUWA and [3]ZAINAB ISAH

[1]Department of Zoology, Faculty of Science, Gombe State University, PMB 127 Gombe, Gombe state, Nigeria

[2]Department of Zoology, Faculty of Life Sciences, Modibbo Adama University Yola, Adamawa State, Nigeria

[3]Department of Biological Science, Faculty of Science, Gombe State University. PMB0127 Gombe, Gombe state, Nigeria

Corresponding Author: zaleehaadamu@gsu.edu.ng

ABSTRACT

Biomonitoring of the ecological conditions of the aquatic biota and its water quality are the keys for effective management of aquatic ecosystem. Physicochemical parameters and the general wellbeing of *Bagrus bayad* in Dadin Kowa reservoir were investigated. Water samples were collected from the three sampling stations on biweekly basis for physicochemical analysis. The range of air temperature, water temperature; pH; Transparency; Conductivity; Dissolved Oxygen; Biological Oxygen Demand BOD); Chemical Oxygen Demand (COD); phosphates and nitrate were 28.00±.88 to 33.00±1.00^{O}C; 24.00±0.99 to 28.00±0.58^{O}C; 7.53±.03 to 8.54±0.08; 6.86±0.87 to 10.00±0.28cm; 54.00±1.53 to 122.67±1.67µS/cm; 4.08±0.29mg/L to 6.97±1.27mg/L; 2.15±0.08 to 3.04±0.03 mg/L; 3.66±0.18 to 4.49±0.37 mg/L; 3.51±0.17 to 3.97±0.09mg/L; 7.43±.0.23 to 10.20±0.21mg/L, respectively. All the parameters were significantly different between sites and months (p-value ≤ 0.005). Negative allometric growth pattern was observed in male *Bagrus bayad* (b-values <3) with good condition factor (k-value >1) while positive allometric growth was observed in female *Bagrus bayad*. The mean condition factor was 1.22±0.77 and 1.04±0.01 for males and females, respectively, indicating that the species are in good physical state of wellbeing in the reservoir. There is need for regular examination of the physicochemical parameters and condition factor of the reservoir across different seasons of the year.

Keywords: *Bagrus bayad*, Physicochemical Factors, Weight-Length, Condition Factor, Reservoir

INTRODUCTION

Freshwater ecosystems have been used for the investigation of factors controlling the abundance and distribution of aquatic organisms (Esenowo and Ugwumba, 2010). It is well established that the productivity of a reservoir depends on its ecological conditions by monitoring the water quality to maintain maximum sustainable yield of aquatic biota (Mustapha, 2011; Usman, 2016). The genus *Bagrus* belongs to the family *Bagridae* which form a great proportion of the commercial catches in Nigerian Fresh waters (Reed *et al.,* 1967). The *bayad* is more or less elongated and has a maximum size and weight of about 112 centimetres (44.1 inch) and 12.5 kg, respectively. However, big size species may reach upto 100kg (Froese *et al.,* 2007).

Water quality assessment involves the analysis of physico-chemical, biological and microbiological parameters that reflect the biotic and abiotic status of the ecosystem (Verma *et al.,* 2012). To keep the aquatic habitat favourable for existence of living organisms, physical and chemical factors must be monitored regularly, individually or synergistically. Activity of living organisms

Bima Journal of Science and Technology, Vol. 7 (2) June, 2023 ISSN: 2536-6041

DOI: 10.56892/bima.v7i2.438

is influenced by the seasonal and diurnal changes of these parameters (Akinyeye *et al.,* 2011).

Length-weight relationship provides vital information on the condition and pattern of fish growth. The regression coefficients of length-weight relationships indicate either isometric or allometric growth pattern depending on the time (season), space, sex, maturity status, stock of the species and environmental factors (Olurin and Aderibigbe, 2006). Fulton's *K* condition factor is one of the methods often used for measuring both energy reserves and fish general health status (Koops *et al.,* 2004); representing the situation of fairly deep bodied or robust fishes.

Changes in the condition factor and the physico-chemical parameters may affect the biota of water bodies in a number of ways such as their survival and growth rates and these may eventually result in disappearance of some species of organisms or its reproduction (Edward and Ugwumba, 2010). Despite the commercial importance of *Bagrus bayad* in Gombe state, little information is known concerning its survival and growth rate in Dadin kowa reservoir, Hence the need for scholarly research. Therefore, the aim of this study was to assess some of the physicochemical parameters and relate it to general wellbeing of *Bagrus bayad* in Dadin Kowa reservoir.

MATERIALS AND METHODS

Study Area

Dadin Kowa Dam is located 5km North of Dadin Kowa village (about 37Km from Gombe town, along Gombe-Biu road) in Yamaltu Deba Local Government Area of Gombe State. The area lies within longitude 11◦ 30' E and 11o 32'E, and latitude 10◦ 17′ and 10 18 N of equator (UBRDA, 1980) (Figure 1). The Dam is part of River Gongola; its drainage basin is situated in North-Eastern Nigeria, with water capacity of 800 million cubes and surface area of 300 kilometers square, and has potential as a source of fish. Irrigation farming, cattle rearing, washing and bathing are some of the activities that take place around the reservoir.

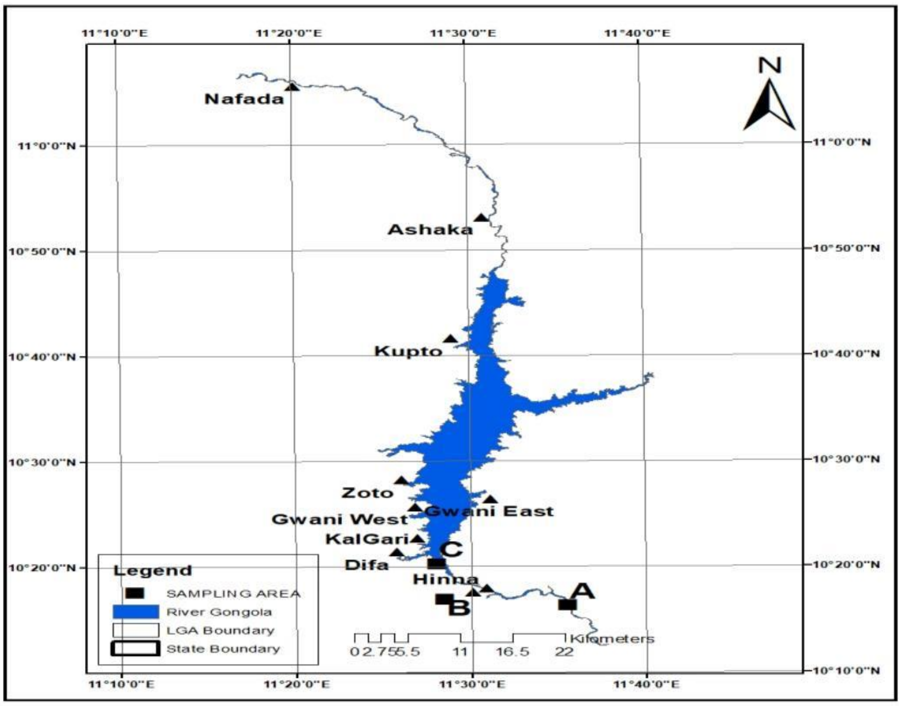

Figure 1: Dadin kowa Dam indicating sampling stations

DOI: 10.56892/bima.v7i2.438

Water Sampling and Regime

Water samples were collected from the three different stations (site A, site B and site C) on the reservoir and mean values of the three stations were calculated and recorded. The sampling was conducted fortnightly between the months March to August, 2019.

Determination of Physico-chemical Characteristics

Both air and water temperatures were determined in situ using bulb mercury in glass thermometer in accordance with the procedure used by Mohammed et al. (2017) and Saidu et al. (2018), respectively. pH, Transparency, DO, and BOD were determined using the procedure of Isah *et al*., (2018). Guidelines handbook was used in the determination of COD (APHA, 1999), and amount of nitrate and phosphate (APHA, 2005) presence in the water samples.

Fish Sampling and Morphometric Measurements

Bagrus bayad samples were obtained from the local fishermen and identified using standard reference identification guide (Dankishiya, 1991). Thereafter, transported to the laboratory for measurements. Total length, Standard length and weight of the fish were measured as described by Olatunde, (1983), using centimetre ruler and weighing balance, respectively. Nandlal and Pickering (2004) procedure was applied to determine the sex of *B. bayad* through critical observations of the differences in male and female openings.

Data Analysis

Data obtained was imported into the SPSS and one-way analysis of variance was used to test the significant differences in mean of physico-chemical characteristics among stations and Least Significance Difference (LSD) was used to separate the means of significant differences. Correlation was employed to test the relationship between the physico-chemical characteristics and the *Bagrus bayad* at $P<0.05$ level of significance.

Length-Weight Relationship

Linear transformation of length and weight of the fish was made using natural logarithm of the observed lengths and weights. The length-weight relationship (LWR) was calculated following Pauly (1983). The LWR was used to calculate the regression coefficient (slope of regression line of weight and length). The parameter "b" of the length weight relationship were estimated using the formula $W = aL^b$. Where: W = the weight of the fish in grams, L = the total length of the fish in centimetres a = exponent describing the rate of change of weight with length, b = weight at unit length. The expression of the relationship was represented by the following formula: $\text{Log } W = b \log L + \log a$.

Condition factor (K) was determined using conventional formula described by Le Cren (1951). $K = \frac{W}{L^3} \times \mathbf{100}$ Where: K = Condition factor, W = Weight in grams, L = Standard length in cm.

RESULTS

Physicochemical Parameters

The monthly mean variation of physicochemical parameters of Dadin Kowa Dam is shown in Table 1. The mean value of Air temperature, Water temperature, Water pH, Electric conductivity, Dissolved Oxygen, Transparency, Biological Oxygen Demand, Chemical Oxygen Demand, Phosphate and Nitrate were all recorded.

DOI: 10.56892/bima.v7i2.438

Table 1: Mean Monthly Variation of Physicochemical Parameters of Dadin Kowa Dam March-August 2019

	March	April	May	June	July	August
Air temp (°C)	33±1.0	31±0.58	31.67±0.33	36.3±0.35	28±0.88	29.00±0.15
Water temp (°C)	28.00±0.58	28.00±0.58	28.00±0.58	25.73±1.73	24.00±0.99	27.43±0.98
Water pH	7.53±0.03	7.57±0.06	7.70±0.17	7.83±0.06	8.47±0.23	8.54±0.08
Transparency (cm)	10.0±0.28	9.50±0.76	8.97±0.07	8.93±0.67	8.40±0.61	6.86±0.87
Conductivity (µS/cm)	97.00±9.64	92.33±4.33	88.33±2.73	122.67±1.67	66.33±1.45	54.00±1.53
DO (mg/L)	4.97±0.15	6.97±1.27	5.07±0.15	7.21±0.26	9.07±0.42	4.08±0.29
BOD (mg/L)	3.04±0.03	2.86±0.06	2.66±0.13	2.34±0.07	2.15±0.08	2.05±0.07
COD (mg/L)	3.85±0.13	3.66±0.18	4.49±0.37	4.20±0.17	3.77±0.24	4.13±0.47
Phosphate(mg/L)	3.51±0.17	3.67±0.18	3.97±0.09	3.93±0.09	3.92±0.03	3.92±0.03
Nitrate (mg/L)	7.50±0.06	7.43±0.23	7.97±0.12	8.93±0.47	9.66±0.43	10.20±0.21

P≥0.05. Key: pH: Percentage of hydrogen ion concentration; EC: Electrical conductivity; DO: Dissolved Oxygen; BOD: Biological Oxygen Demand; COD: Chemical Oxygen Demand.

Air Temperature

There was no significant difference at P≤0.05 level of significant among the three stations. Station C had the highest mean temperature value of 32.32±1.18°C, while station A had the lowest mean temperature value of 30.61±1.22°C (Table 2).

Water Temperature

The lowest mean water temperature value of 24.00±0.99°C was recorded in the month of August, while the highest temperature value of 28.00±0.58°C was recorded in the months of March, April and May (Table 1). A significant variation existed in water temperature between the three stations, with station C having the highest mean temperature value of 27.58±0.55°C and station A having the lowest mean temperature value of 26.33±0.92°C (Table 2).

pH

Highest pH value of 8.54±**0.08** was recorded in the month of August, while the lowest value of 7.53±**0.03** was recorded in the months of March (Table 1). There was no significant difference at p≤0.05 level of significant among the three stations, station A had the highest mean pH value of 8.06±0.22 and station C had the lowest mean pH value of 7.92±0.21 (Table 2).

Transparency

Highest transparency value of 10.0±0.28cm was recorded in the month of March, while the lowest value of 6.86±0.87cm was recorded in the month of August (Table 1). There was no significant difference at p≤0.05 level of significant among the three stations, station B had the highest mean transparency value of 8.9±0.31cm and station C had the lowest mean transparency value of 8.6±0.58cm (Table 2).

Electrical conductivity

The highest conductivity value of 122.67±1.67µS/cm was recorded in the month of June, while the lowest value of 54.00±1.45µS/cm was recorded in the month of August (Table 1). Station C had the highest mean conductivity value of 91.83±10.54µS/cm and station A had the lowest mean conductivity value of 83.00±9.91µS/cm (Table 2).

Dissolved Oxygen

The highest dissolved oxygen value of 9.07±0.42mg/L was recorded in the month

DOI: 10.56892/bima.v7i2.438

of July, while the lowest value of 4.08±0.29 was recorded in the month of August (Table 1). Station B had the highest mean dissolved oxygen value of 7.29±0.93mg/L and station A had the lowest mean dissolved oxygen value of 5.75±0.71mg/L (Table 2).

Biological Oxygen Demand

The highest biological oxygen demand value of 3.04±0.03mg/L was recorded in the month of April, while the lowest value of 2.05±0.07mg/L was recorded in the month of August (Table 1). Station B had the highest mean biological oxygen demand (BOD) value of 2.88±0.15mg/L while station A had the lowest mean oxygen value of 2.47±0.08mg/L (Table 2).

Chemical Oxygen Demand

When COD was observed across the months of the study, the highest chemical oxygen demand value of 4.49±0.37mg/L was recorded in the month of May, while the lowest value of 3.66±0.18mg/L in the month of April (Table 1). There was no significant difference of COD at $p \leq 0.05$ among the three stations. Station B had the highest mean chemical oxygen demand (COD) value of 4.1±0.24mg/L and station C had the lowest mean value of 3.96±0.17mg/L (Table 2).

Nitrate

The highest nitrate value of 10.20±0.43mg/L was recorded in the month of August while the lowest value of 7.43±0.23mg/L in the month April (Table 1). Station C had the highest mean nitrate value of 9.03±0.56mg/L, while station A had the lowest mean nitrate value of 8.28±0.44mg/L (Table 2).

Phosphate

The highest phosphate value of 3.96mg/L was recorded in the month of May while the lowest value of 3.5mg/L was recorded in the month of March (Table 1). Station C had the highest mean phosphate value of 3.94±0.05mg/L, while station A had the lowest mean phosphate value of 3.70±0.13mg/L (Table 2).

Table 2: The mean variation of physicochemical parameters between the three stations of Dadin Kowa Dam March-August 2019

	Station A Mean±SE	Station B Mean±SE	Station C Mean±SE	p-value
Air temperature (°C)	30.61±1.22[a]	31.88±1.11[a]	32.32±1.18[a]	0.322
Water temp.(°C)	26.33±0.92[b]	26.67±1.11[a]	27.58±0.55[a]	0.000
pH	8.06±0.22[a]	7.84±0.16[a]	7.92±0.21[a]	0.267
Transparency (cm)	8.83±0.68[a]	8.90±0.31[a]	8.60±0.58[a]	0.281
Conductivity (µS/cm)	83.00±9.91[a]	85.50±9.91[b]	91.83±10.54[c]	0.000
DO (mg/L)	5.75±0.71[a]	7.29±0.93[b]	6.32±0.85[c]	0.000
BOD (mg/L)	2.47±0.08[a]	2.88±0.15[b]	2.51±0.17[a]	0.000
COD (mg/L)	3.98±0.24[a]	4.1±0.24[a]	3.96±0.17[a]	0.747
Nitrate(mg/L)	8.28±0.44[a]	8.53±0.47[b]	9.03±0.56[c]	0.000
Phosphate(mg/L)	3.70±0.13[a]	3.81±0.08[b]	3.94±0.05[c]	0.000

Key: SE= standard error; temp = temperature; pH: Percentage of hydrogen ion concentration; EC: Electrical conductivity; DO: Dissolved Oxygen; BOD: Biological Oxygen Demand; COD: Chemical Oxygen Demand. The same superscript across the column indicates that there is no significant difference while different superscript across the column indicates significant difference at $p \leq 0.05$

DOI: 10.56892/bima.v7i2.438

Mean condition factor of *Bagrus bayad* (Silver catfish) in Dadin Kowa Dam March-August, 2019

The lowest mean condition factor value of 1.00 for male *Bagrus bayad* (Silver catfish) was recorded in the month of May, while the highest value of 1.47 was recorded in the month of April (Table 3). The lowest condition factor value of 1.00 for female *Bagrus bayad* (Silver catfish) was recorded in the month of May and June, while the highest value of 1.12 was recorded in the month of April (Table 3).

Table 3: Mean condition factor of Male *Bagrus bayad* (Silver catfish) in Dadin Kowa Dam March-August, 2019

Months	March	April	May	June	July	August	Mean±SE
No. of fish	20	20	20	20	20	20	20.0±0.00
Weight (g)	156.2	138.3	188.4	225.2	204.5	153.7	177.71±13.7
Length (cm)	22.2	21.1	28.8	26.4	26.8	23.4	24.78±1.22
Condition Factor	1.42	1.47	1.00	1.22	1.06	1.19	1.22±0.07

Key: SE = Standard error, No. number of fish.

Table 4: Mean condition factor of Female *Bagrus bayad* (Silver catfish) in Dadin Kowa Dam March-August, 2019

Months	March	April	May	June	July	August	Mean±SE
No. of fish	20	20	20	20	20	20	20±0.00
Weight (g)	269.6	190.4	169.2	361.2	312.2	269.6	262.03±29.5
Length (cm)	29.3	25.7	27.3	33.2	31.2	29.3	29.33±1.09
Condition Factor	1.07	1.12	1.00	1.00	1.02	1.07	1.04±0.01

Length-Weight and regression co-efficient of *Bagrus bayad* of Dadin Kowa Dam March-August 2019

The mean length for male *Bagrus bayad* was 24±0.41cm, while the mean weight was 177.72±4.98g. The mean length for female *Bagrus bayad* was 29.33±0.52cm, while the mean weight was 262.03±10.55g. The value of regression co-efficient 'b' obtained for the LWR for male *Bagrus bayad* 2.77 (Figure 2) while that of female *Bagrus bayad* was 3.49 (Table 5) (Figure 3).

Table 5: Length-Weight and regression co-efficient of *Bagrus bayad* of Dadin Kowa Dam March-August 2019

Sex	Mean Weight±SE	Mean Length±SE	N	Log a	B	Coefficient of correlation
Male	177.72±4.98	24.8±0.41	120	1.26	2.77	0.34
Female	262.03±10.55	29.33±0.52	120	0.23	3.49	0.87

Key: N= number, a= intercept, b= regression co-efficient, SE= standard error

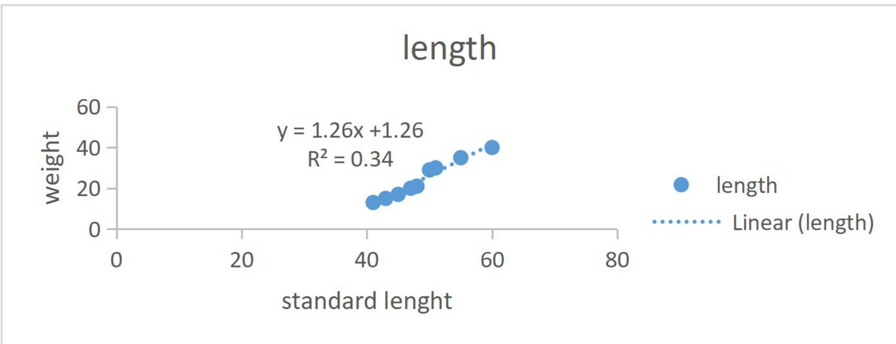

Figure 2: Length-weight relationship of male *Bagrus bayad* in Dadin kowa Dam (March-August 2019).

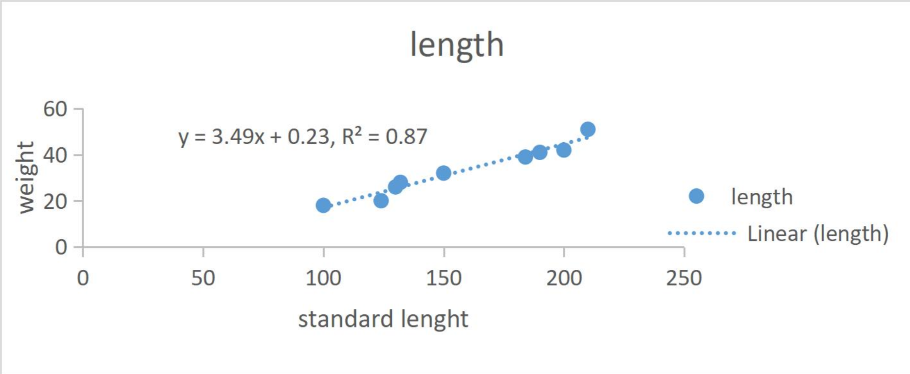

Figure 3: Length-weight relationship of female *Bagrus bayad* in Dadin kowa Dam (March-August 2019).

DISCUSSION

Physico-Chemical Characteristics

Physico-chemical characteristics refer to the physical and chemical attributes that signifies water quality and productivity of both lentic and lotic ecosystems. The recorded monthly variation and significance difference in physico-chemical characteristics of Dadin-Kowa dam is attributed to variation in environmental conditions.

Water Temperature

Temperature is the most vital factor that significantly affects productivity in lentic ecosystem and it depends on the climate, sunlight and depth (Abolude *et al*., 2012). Generally, aquatic organisms depend on certain water temperature range for their survival, growth and reproduction. The highest mean water temperature of 28.0±0.58^{o}C was recorded in the months of March, April and May while the lowest water temperature 24.0±0.99^{o}C was recorded in July, these fall within the normal range of 8-30^{o}C that fish adopt in the tropics (Alabaster and Loeys, 1980; Abubakar *et al.,* 2015). This result agreed with previous report that the temperature in tropics vary between 21^{o}C and 32^{o}C (Atobatele and Ugwumba, 2008; Ayoade *et al.,* 2006).

Temperatures between 20 and 36C have been reported by various researchers as being suitable for tilapia. Ayoade *et al*., (2006) for instance reported that the temperature ranges of 20^{o}C -30^{o}C for optimum fish growth including *Oreochromis niloticus* and *Bagrus bayad*. FAO (2012) reported the preferred temperature ranges of between 31 and 36^{0}C. This implies that Dadin Kowa Dam is suitable for the growth of fish and other aquatic organisms. Water temperature affects the rate of photosynthesis and solubility of oxygen in water (Bhavan *et al.,* 2009). The result shows that the higher the temperature, the lower the dissolved oxygen which agreed with the statement of Umar *et al.* (2017); that when water temperature increases, the evaporation and volatilization of chemical substances also increases, but conversely the solubility of gases such as oxygen decreases.

pH

The pH range recorded during the study period was 7.5-8.5 i.e the Dam is slightly alkaline (basic). The highest mean pH of 8.54±0.08 was recorded during the month of August and the least mean pH of 7.53±0.03 was recorded during the month of March (Fig. 3). Therefore, the water pH of Dadin Kowa Dam is within the required range of good water quality similar to the report of Umar *et al.* (2014) that water pH values range 6.5-8.5 mostly point out good water quality. These recorded values fall within the recommended values of 6-9 in most tropical natural water (ACTFR, 2000;

DOI: 10.56892/bima.v7i2.438

Abubakar *et al.* 2015). Boyd and Lichkoppler, (1979) also reported pH values of 6-9 as ideal for supporting aquatic life including *Oreochromis niloticus* and *Bagrus bayad.* Bryan *et al*. (2011) concurs that most fish would do better with a pH near 7.0, while a pH of less than 6.0 may result in stunting or reduced fish production. Fish have an average pH ranging from 4.0-6.5, and therefore a little deviation from this value. Generally, pH ranging within 7.0 - 8.5 is more optimum and conducive to fish life. However, fish can become stressed in water with a pH ranging from 4.0-6.5 and 9.0-11.0 and death is almost certain at a pH less than 4.0 or greater than 11.0 (Ekubo and Abowei, 2011).

Electrical conductivity (EC)

Electrical conductivity had its highest mean value of 122.67±1.67µS/cm during the month of June and lowest mean value of 54.00±1.53µS/cm during the month of August (Fig.4). The highest mean value of 91.83±10.5453µS/cm was recorded in station C and least mean value of 83.00±9.9153µS/cm was recorded in station C. The highest conductivity in station B resulted may be due to high concentration of contaminants of conducting materials, the range of mean value of conductivity (264.5-321µS/cm) suggest that the conductivity level is within the desired range or intermediate.

Ifon & Asuquo (2021) reported that Conductivity levels below 50µS/cm are regarded as low; those between 50-600µS/cm is within the medium class while those above 600µS/cm are high level conductivity according to National Environmental Standards and Regulation Agency’s guideline.

Transparency

Transparency is a measure of water clarity, the more materials suspended in water the less light can pass through the water column**.** Highest transparency value of 10.0±0.28cm was recorded in the month of March, while the lowest value of 6.86±0.87cm was recorded in the month of August (Table 1). The highest value found in the month of March might be attributed to the lack of the rainfall which is related to increase in debris load by water run-off. This agrees with Abubakar (2006); Abubakar *et al*. (2015) who reported that reduced activity and lack of rains accounted for higher transparency.

Dissolved Oxygen

Dissolved oxygen is an essential factor that facilitates the survival, growth and reproduction of aquatic organisms. The dissolved oxygen concentrations ranged between 4.08mg/L to 7.2 mg/L and hence, the concentrations were within the required range, similar to the report of Abubakar *et al.,* (2015), Its falls within the recommended values of Kolo and Tukura (2007) who reported that many species of fish can survive in dissolved oxygen concentrations well below 6 mg/L. But it is lower than that of Abubakar (2006) who obtained 12.02mg/l to 19.50mg/l.

The low amount of DO observed during the period of research might be due to high phosphorus and decomposition of organic matter resulting in use of oxygen. The amount of dissolved oxygen in water has been reported not static but dynamics, depending on temperature, depth, wind and extent of living organisms such as decomposition (Indabawa, 2009). Low dissolved oxygen affects the growth of many organisms and enhances the rate of metabolic activities (Charles, 2003); therefore, adequate dissolved oxygen is essential for all living organisms. The lower the dissolved oxygen the poorer will be the water quality (Umar, 2014).

Biological Oxygen Demand

The highest biological oxygen demand value of 1.8 mg/L was recorded in the month of August, while the lowest value of 1.47mg/L was recorded in the month of

March (Table 1). Station B had the highest mean biological oxygen demand (BOD) value of 1.88±0.15 mg/L while station A had the lowest mean oxygen value of 1.47±0.08 mg/L (Table 2). This study showed consistency in the BOD (2.6-5.4 mg/L) of the water body over the months of the study.

This BOD range makes the reservoir to slightly polluted. Clair *et al*. (2003) reported that water bodies with BOD in the range of 2-8 mg/L are moderately polluted according to UNEP (2021). Important factor influencing BOD include organic matter content, pH, reduction in organic matter, nitrification and types of microorganisms (Kumar and Bahadur, 2009). Higher level of BOD could be as a result of increase in phosphate from anthropogenic activities such as washing and high organic load from cattle using the reservoir as water drinking points.

Chemical Oxygen Demand (COD)

COD determines the amount of organic pollutants found in surface water such as lakes and rivers) or wastewater, making COD a useful measure of water quality. It is expressed in milligrams per litre (mg/L) also referred to as ppm (parts per million), which indicates the mass of oxygen consumed per litre of solution. When COD was examined across the months of the study, month of May showed the highest value of 4.49±0.37 while 3.66±0.18 COD value was obtained in April. On the other hand, Station B had the highest value of COD ($4.1±0.24^a$) while station C had the lowest ($3.96±17^a$).

All the values of the COD obtained in this study (between the months of the study and across the three sampling stations) are within the world health organization's recommended level (4.0 mg/L). The COD result obtained in this study is similar to the work of Swati Shrivastava, & Kanungo (2013), which assessed the pond water quality of Surguja district and found that both the highest and the lowest values were not in the level of pollution. This may be because most villages and towns are located a little bit far-away from the reservoir and Dadin Kowa village is at the lower reaches of the river. Conversely, the chemical oxygen demand of 10 village's pond water ranged from a minimum of Daultpur village pond water 9.15 (Mg/L) to a maximum Semighoghar village 18.00 (Mg/L) (Swati Shrivastava, & Kanungo 2013).

Nitrate-Nitrogen

The highest nitrate value of 10.2 mg/L was recorded in the month of august while the lowest value of 7.43 mg/L in the month April (Table 1). Station C had the highest mean nitrate value of 3.94±0.05 mg/L, while station A had the lowest mean nitrate value of 3.70±0.13 mg/L (Table 2). High amount of nitrate recorded during the month of August could be as a result of build-up of nitrate from farming activities during the raining season. Run-off water from agricultural activities from nearby farms might have elevated the concentration of nitrates in Dadin Kowa Dam.

Nitrate-nitrogen is required in aquatic and terrestrial ecosystem in a moderate quantity. The amount of nitrate in solution at a given time is determined by metabolic processes in water; that is production and decomposition of organic matter (Balarabe, 2001). Kigamba (2005) reported the increased level of nitrates leached into African lakes from the excessive use of nitrogen fertilizers. High amount of nitrogen in the water can cause over stimulation of growth of aquatic plants and algae. Excess growth of these organisms, in turn, can clog water intakes, use up dissolved oxygen as they decompose, and block light to penetrate to deeper water, these can lead to decrease in animals and plants diversity (www.freedrinkingwater.com).

DOI: 10.56892/bima.v7i2.438

Phosphate-phosphorus

The highest phosphate value of 3.96 mg/L was recorded in the month of May while the lowest value of 3.5 mg/L was recorded in the month of March (Table 1, Fig. 10). Station A had the highest mean phosphate value of 9.03±0.56mg/L while station C had the lowest mean phosphate value of 8.28±0.44mg/L (Table 2). This finding is not in agreement with Kolo and Yisa (2000) who reported 0.04 to 0.05mg/L in river Suka. The high level of phosphorus recorded in this study could be as of surface ruff-off, sewage, and other decomposing matter. All this additional phosphorus feeds and promotes toxic cyanobacteria, which in turn, can deplete oxygen from the environment and bock sunlight from reaching past the surface and this threatened plant and aquatic life (SLM, 2015).

Length-weight relationship and condition factor of *Bagrus bayad*

The mean length for male *Bagrus bayad* was 24±0.41cm, while the mean weight was 177.72±4.98g. The mean length for female *Bagrus bayad* was 29.33±0.52cm, while the mean weight was 262.03±10.55g. The value of regression co-efficient 'b' obtained for the LWR for male *Bagrus bayad*2.77 while that of female *Bagrus bayad* was 3.49 (Table 4), the male b value is less than 3, while the female is equal to 3 indicating isometric growth pattern. This result is in agreement with the works of King (1996) and Nwabueze & Garba (2015) who reported low values of 'b' for *Clarias gariepinus* and *Bagrus bayad,* when 'b' < 3, is indicative of negative allometry in growth pattern. Males *Bagrus bayad* had b-values lower than 3 indicating negative allometry of growth pattern. The means of the males *Bagrus bayad* of Dadin Kowa Reservoir does not grow fatter as the length of the fish increases.

Positive or negative allometry indicates a rounder or slimmer body, respectively, whereas isometric growth shows that the body grows in the same proportion in all dimensions (Jobling, 2008). Negative allometry in growth pattern has been reported for juvenile cichlids, *Chromidoptilapia guntheri* and *Hemichromis fasciatus* in Lake Eleiyele, Ibadan Southern Nigeria (Zelibe, 1982), *Clarias gariepimus* (King, 1996), Illesha Africana and *Heterobranchus longifilis* from River Idodo, Nigeria (Anibeze, 2002).

Weatherly and Gill (1987) reported that allometric growth pattern could be negative or positive and that in "isometric growth pattern", when the growth exponent 'b'= 3, the body form maintains a constant proportion to length but when 'b' ≠ 3 a positive or negative allometry is indicated with 'b' < 3 as negative and 'b' > as positive allometry. It has been observed that certain factors such as increase in weight due to intake of water or food, season of the year, and the time of the day when the fish was captured, loss of weight due to food regurgitation, spawning are among other things that affects 'b' values (Lagler, 1952).

It could also be as a result of stress cause by heavy metals concentration that is above standard limit. This study follows the cube law which according to Froese (2006) uses the Fulton's Condition Factor and attributes of length-weight exponential of b-value of 3 for isometric fish growth.

Nevertheless, in this survey, Females *Bagrus bayad* showed isometric growth patterns along with slopes b=3, indicating that the fish became more rotund as total length increased (Deekae and Abowei, 2010). Probably, Females *Bagrus bayad*, showed high tolerance to habitat disturbances, and therefore, was indifferent to critical habitat conditions. Similarly, positive allometric growth trends were reported by Arame *et al.,* (2020) in Niger River.

DOI: 10.56892/bima.v7i2.438

The mean condition factor (range between 1.00 - 1.47) of *B. bayad* in this study was observed to be favourable which agrees with Lagler (1952) and Abubakar *et al.,* (2015) who reported that the condition factor values are not constant for individual species or populations, but is subject to wide variations. Wade (1992) stated that condition factor greater or equal to 1.0 is good.

CONCLUSION

It can be concluded that most of the physicochemical parameters found are within the recommended values of most tropical water bodies. However, the amount of Dissolved Oxygen, Nitrate-nitrogen and phosphate-phosphorus are not within the recommended values. Run-off water from agricultural activities from nearby farms might have elevated the concentration of nitrates and phosphorus in Dadin Kowa Dam. The condition factors of *Bagrus bayad* found in this study are within the normal range. Males *Bagrus bayad* exhibit negative allometric growth pattern whereas female *Bagrus bayad* exhibit isometric growth pattern which means the body form maintains a constant proportion to its length. Therefore, the reservoir is suitable to support the life of aquatic organisms particularly *Bagrus bayad*.

REFERENCES

Abolude, D.S., Chia, A.M., Yahya, A.S. and Okafor D.C. (2012). Phytoplankton Diversity and Abundance as a function of Water quality for fish production; a case study of two Manmade Reservoir in Zaria, Nigeria. *Tropical fresh water Biology*, *21*(2):41-48.

Abubakar, M. M., Kutama, A. S. and Sulaiman, I. M. (2015). Preliminary Survey of Fish Diversity in the Hadejia-Nguru Wetlands, Jigawa State. *International Journal of Biological Sciences, 02* (01):23-29.

Akinyeye, A. A. Komolafe J. I., and Okorie T. G. (2011). Limnological assessment of effluents on invertebrates from Alaro River Oluyole, Ibadan, Oyo State, Nigeria. *Agriculture and Biology Journal of North America,2*(7), 1053-1058.

Alabaster, J.S. and Loeys, R. (1980). Water Quality criteria for fresh water fish 2nd edition pp32.

Anibeze, C.I.P. (2002). Length-weight relationship and relative condition of *Heterobranchus longifilis (Valenciennness)* from Idodo River, Nigeria. Naga, ICLARM Q.,23, 34-45.

APHA. (1999). Standard methods for the examination of water and wastewater. 20th Edn. Washington, D.C.P.2671p.

APHA. (2005). Standard methods for the examination of water and wastewater.21st Edn. Washington, D.C.P.126p.

Arame, H., Adite, A., Adjibade, K.N., Sidi Imorou, R., Sonon, P.S. (2020). Length-weight relationships and condition factors of Mochokidae (Pisces: Teleostei: Silurifurmes) from Niger River, Northern Benin. *Aquatic Research,* 3(2), 72-84. https://doi.org/10.3153/AR20007.

Atobatele O.E and Ugwumba O.A. (2008). Seasonal variation in the pyhsicochemistry of a small tropical reservoir (Aiba Reservoir, Iwo, Osun, Nigeria). *African Journal of Biotechnology* vol. 7(12) Pp. 1962-1971.

Balarabe, M.L. (2001). Effect of Limnological Characteristic on Zooplankton Composition and distribution in Dumbi and Kwangila Ponds, Zaria, Nigeria. Ph.D. Thesis, Department of Biological Sciences, Ahmadu Bello University.

Boyd, C. E., & Lichkoppler, F. (1979). Water Quality Management In Pond Fish Culture. International Centre for

Aquaculture. *Agriculture Experiment Station, Auburn University, Alabama*.

Bryan, R., Soderberg, W., Blanchet, H. and Sharpe, W.E. (2016). Management of Fish Ponds in Pennsylvania. 2011. Available at http://www.water-rresearch.net/Waterlibrary/Lake/waterqualityponds.pdf. Accessed 28 Nov 2016.

Deekae, S.N., & Abowei, J.F.N. (2010). *Macrobrachium macrobrachion* (Herklots, 1851) length-weight relationship and Fulton's condition factor in Luubara creek, Ogoni land, Niger Delta, Nigeria. *International Journal of Animal and Veterinary Advances*, 2, 155-162.

Edward, J.B. and Ugwumba, A.A.A. (2010). PhysicoChemical Parameters and Plankton Community of Egbe Reservoir, Ekiti State, Nigeria. *Research Journal of Biological Sciences,5* (5): 356-367.

Ekubo, A.A., & Abowei, J. F. N. (2011). Review of some water quality management principles in culture fisheries. *Research Journal Applied Science Engineering Technology,3*(2):1342–57.

Esenowo, I.K. and Ugwunba, A.A.A. (2010). Composition and abundance of Macrobenthes in Majidun River Ikorodu Lagos State. *N i g e r i a n R e s e a r c h J o u r n a l o f Biological Sciences*, *5*(8): 556-560.

FAO (2012). Fisheries global information system. FAO Fisheries and Aquaculture department, Food and Agricultural Organizations of the United Nations Rome.

Froese, R., 2006; Cube law, condition factor and weight-length relationships: history, meta-analysis and recommendations. *Journal of Applied Ichthyology*, *22*:241-253.

Froese, Rainer and Pauley, Daniel, eds. (2007). "*Bagrus bayad"* in FishBase. August 2007 version.

Ifon, H.T., & Asuquo, P.E. (2021). Tempo-spatial assessment of the Calabar River Using Marine crabs as bio-indicator of pollution.

Indabawa I.I. (2009). Studies on Limnological parameters and Phytoplankton dynamic of Ngure lake Yobe State Nigeria. *Bioscience Resources Communication*, 21(4): 45-50.

Isah, Z., Abubakar, K. A, Umar, D.M. and Hassan, S.K. (2018): a study on phytoplanktonic composition in Dadin kowa dam, Gombe State, Nigeria. *Greener journal of Biological Sciences*, *8*(2): 45-50.

King, R.P. (1996). Length-weight relationship of Nigeria freshwater fishes. *Naga ICLARM quarterly*. 19(3): 49-52.

Kolo, R.J. and Yisa (2000): Preliminary assessment of water quality of River Niger. *Federal College of Fisheries Technology.* New Bussa Nigeria. 2: 99-106.

Koops, M. A., Hutchings, J. A., & McIntyre, T. M. (2004). Testing hypotheses about fecundity, body size and maternal condition in fishes. *Fish and fisheries*, *5*(2), 120-130.

Kumar, A., & Bahadur, Y. (2009). Physico-Chemical Studies on the Pollution Potential of River Kosi at Rampur (India). *World Journal of Agricultural Sciences*, *5*(1), 1-4.

Lagler, K. F. (1952). Freshwater fishery biology.

Le Cren, E. D. (1951). The length-weight relationship and seasonal cycle in gonad weight and condition in the perch (*Perca fluviatilis*). *Journal of Animal Ecology*, *20*: 2.

Mohammed, S., Mosses, N., Saidu, H., Galadima, A.I., Umar, D.M., Abubakar, K.A., Kefas, M. and Billah, C. (2017). Determination of physicochemical parameters and riparian land effect on

DOI: 10.56892/bima.v7i2.438

Kwadon stream, *Journal of advanced research design* 36(1):13-24.

Mustapha, M. K. (2003). A pre-impoundment study of the limno-chemical conditions of Oyun Lake in Ilorin, Kwara State, Nigeria. *African Journal of Applied Zoology and Environmental Biology.* 5: 44-48.

Mustapha, M.K. (2011). Perspectives in the Limnology of Shallow Tropical African Reservoirs in Relation to Their Fish and Fisheries. *Journal of Environmental Studies, 10*(1):16-23.

Nwabueze, A. A., Garba, A. A. (2015). Growth Pattern and Condition Factor of *Bagrus Bayad* from Two Rivers in Southern Nigeria. *Global Journal of Bio-sciences and Biotechnology. 4*(4):330-334. www.scienceandnature.org.

Olurin, K. B., & Aderibigbe, O. A. (2006). Length-weight relationship and condition factor of pond reared juvenile *Oreochromis niloticus*. *World Journal of Zoology*, *1*(2), 82-85.

Saidu, H., Usman, B. and Umar, D. M. (2016): Studies of Species Distribution for Phytoplankton in Balanga Dam, *Journal of Advanced Research in Applied Sciences and Engineering Technology*, *3*(1): 2462-1943.

The Chemistry of Chemical Oxygen Demand: http://www.envexp.com/dowmload/techsupport/articles/COD%20Article.pdf.

Umar, D. M., Harding, J. S. and Chapman, H. M. (2014). Tropical land use and its effect on stream communities. *Journal of Environmental and Policy Evaluation.* 4(2), 165-195.

Usman, L. U. (2016). Some Limnological and Biological Aspects of Ajiwa Reservoir, Katsina State, Nigeria. (M.Sc. Dissertation). Department of Biological Sciences, Ahmadu Bello University, Zaria. Pp 112-118.

Verma, P., Chandawat, D., Gupta, U. and ///Solanki, H.A. (2012). Water quality analysis of an organically polluted lake by investigating different physical and chemical parameters. *International Journal of Research in Chemistry and Environment* 2: 105-112.

Weatherly, A.H. and Gills, H.S. (1987). The biology of fish growth, London, academic press. 433-443.

Zelibe, S. A. (1982). Ecology of Juvenile fishes at Eleiyele Lake in Ibadn. M.Sc. Thesis, University of Ibadan, Ibadan Nigeria. 24-30.