IJABR Vol. 11(1): 17- 24 (2020)


Original article

# LENGTH-WEIGHT RELATIONSHIP AND CONDITION FACTOR OF SOME FISH SPECIES IN DADIN-KOWA RESERVOIR GOMBE NORTH EASTERN NIGERIA

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Submitted: March, 2020; Accepted: May, 2020; Published: June, 2020

## ABSTRACT

Length-weight relationship and condition factor of six fish species from Dadin-kowa Reservoir Gombe State, Nigeria were studied for Three months (April to June, 2018). A total of 60 fish belonging to six different species (*C. gariepinus*, *S. batensoda*, *S. mystus*, *M. rume*, *S. galilaeus*, and *B. docma*) were sampled monthly from the local fishermen and transported in an ice container to the laboratory for further analysis. Fish samples were identified using standard keys. For each of the specimen, length (cm) and weight (g) were measured. Length-weight relationship was described by the equation: $W = aL^b$ while the condition factor (K) was determined using the equation: $K = 100W/ L^3$. The respective exponential equation for the length-weight relationship are: *M. rume* ($W= 0.0600(TL)^{4.3221}$); *S. galilaeus* ($W= 0.6885(TL)^{3.5623}$); *S. mystus* ($W= 0.6421(TL)^{3.2402}$); *C. gariepinus* ($W= 0.6502(LT)^{3.1231}$); *S. batensoda* ($W= 0.6510(LT)^{3.0532}$); and *B. docmac* ($W=0.063(LT)^{2.0321}$). Three species studied Namely *S mystus*, *C. gariepinus*, and *S. batensoda* exhibited isometric pattern of growth with b=3.1, 3.0, and 3.05 respectively. While two species namely *M. rume* and *S. galilaeus* exhibited positive allometric pattern of growth with b=4.3 and 3.5 respectively. Only one species (*B. docmac*) exhibited negative allometric with b<3 (2.0).The condition factor ranged from 0.95 (*B. docmac*) to 2.72 (*S. galilaeus*). There was significant difference in the condition factors for the combined fish species. Moreover, variations in length-weight relationship between different size-groups could be attributed to the prevailing environmental conditions, available food and space. All the fish species studied were in good condition.

**Key words**: Fish species, Length-weight relationship, Condition factor, Dadin-kowa reservoir.

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## INTRODUCTION

Length–weight relationships (LWRs) and condition factors are common tools in studies of fish biology, ecology, and physiology, and they have been extensively used in fishery research and management [1, 2, 3]. Its importance is pronounced in estimating the average weight at a given length group [4], assessing the relative well-being of a fish population [5] and is widely applied in fisheries management as it provides information on stock condition. This relationship is used by fishery researchers and managers for two main purposes; to predict the weight from the length of a fish and to compare the average associated parameters between fish groups spatially or temporally. From this relationship, weight could be computed from a given length and vice versa through a mathematical equation. The length-weight relationship can be extended for the estimation of fish condition assuming that a heavier fish of a given length is in a better condition [6].

Condition factor (K) has been used as an index of growth and feeding intensity [7]. Condition factor decrease with the increase in length and also influence the reproduction cycle in fish [5]. In fish, the factor of condition (K) reflects, through its variations, information on the physiological state of the fish in relation to its welfare. From a nutritional point of view, there is the accumulation of fat and gonadal development. From a reproductive point of view, the highest K values are reached in some species. Condition factor (K) also gives information when comparing two populations living in certain feeding density, climate and other conditions; when determining the period of gonadal maturation and when following up the degree of feeding activity of a species to verify whether it is making good use of its feeding source [8]. Thus, condition factor is important in understanding the life cycle of fish species and it contributes to adequate management of these species, hence, maintaining the equilibrium in the ecosystem [9].

Despite the usefulness of LWRs, their availability is incomplete and frequently limited to the most common and more studied fish species [10]. Moreover, LWRs are rarely used as a dynamic concept, as if describing factors remain unaltered over time and are characteristic of an ecosystem. However, LWR variation could be a useful tool to evaluate the effects of ecosystem changes on a fish community. Therefore, a significant lack of knowledge of the ecological responses of fish communities to the intrinsic dynamics of restored ecosystems still exists, and research is necessary to better understand, model, and manage this kind of process.

## MATERIALS AND METHODS

### Study Area

Dadin- Kowa reservoir 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 (Figure 1). The area lies within longitude $11^0$ 30' E and $11^0$ 32' E, and Latitude $10^0$ 17' and $10^0$ 18°N of the equator. The Reservoir is located about 35 kilometers to the East of Gombe town, and provides drinking water for the town and has a capacity of 800 million cubic meters of water and a surface area of 30,000 hectares [11]. The surrounding settlements of Dan-Kowa majority depends on agriculture as a major source of live hood. It is basically an agrarian society that produces agricultural products such as millets, rice, maize, as well as fruit and engaged in activities which includes fishing and hunting among others [12].

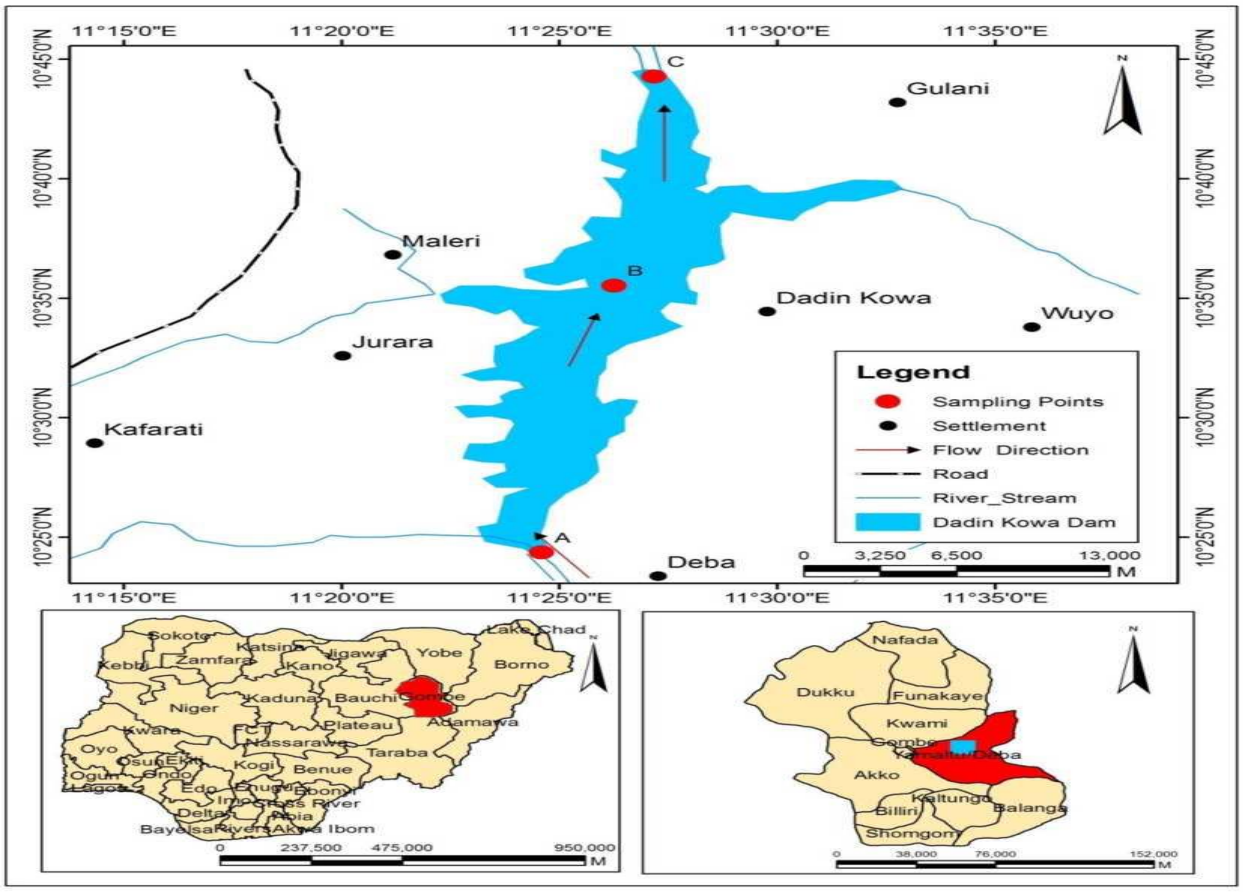


Figure 1: Map of Dadin-Kowa reservoir showing sampling Stations (A, B and C). (Source: NASA/NOAA Spot Image 2018)

**Fish Sampling and Identification**

Different fish species were sampled monthly from local fishermen in Dadin- Kowa reservoir from April to June 2018, and were placed in an ice box and transported to Biology laboratory Gombe State University for identification. The fish samples were identified using descriptive keys; such as [13, 14].

**Length-Weight Relationship and Condition Factor**

The Total Length (TL) of the fishes were measured from the tip of mouth to the distal tip of the longest caudal fin ray using meter rule calibrated in centimeters, weight of the fishes were measured after blot drying with a piece of clean hand towel. Weighing was done with an Electrical weighing balance (in gram). The lengths and weights of the fishes were used for data analysis, the relationship between the length (L) and weight (W) was computed by the equation [15]:

$W = aL^b$.

Where:

W = Weight of fish in grams (g)

L = Standard length of fish in centimeters (cm)

a = Intercept of the regression and b = Regression coefficient (slope).

The "a" and "b" values were obtained from the linear regression by converting length and weight to (l*n*L) and (*ln*W) of fish. When b is equal to three (3), isometric pattern of growth occurs but when b is not equal to 3, allometric pattern of growth occurs which may be positive if >3 or negative if <3. The correlation ($r^2$) that shows the degree of association between the length and weight were computed using SPSS version 6.0.

The weight and length of the experimental fish were used to estimate the condition factor (K), which shows the degree of wellbeing of the fish in their habitat using the equation:

$K = 100W/L^3$
Where:
K = Condition factor
W = Weight of fish in grams (g)
L = Standard length of fish in centimeters (cm) [16].

**Statistical analysis**
The data obtained were analyzed using linear regression equation (y = a + bx)
The regression coefficient ($r^2$) were obtained using statistical package for social science (SPSS) version 6.0.

## RESULTS

A total of sixty (60) individual fish representing six (6) species were identified; *Mormyrus rume, Sarotherodon galilaeus, Schilbe mystus, Clarias gariepinus, Synodontis batensoda* and *Bagrus docmac* and used in computing the length-weight relationship and condition factor.

**Length-Weight Relationship**
The length-weight relationships of the fish species from the reservoir are presented in Table 1. The 95% confidence interval values of the exponent 'b' in the relationship weree 4.32, 3.56, 3.304, 3.12, 3.05 and 2.03 for *Mormyrus rume, Sarotherodon galilaeus, Schilbe mystus, Clarias gariepinus, Synodontis batensoda* and *Bagrus docmac* respectively. Analysis of showed that three (3) of the species studied namely, *Schilbe mystus, Clarias gariepinus,* and *Synodontis batensoda* exhibited isometric pattern of growth with b=3.1, 3.0, and 3.05 respectively. While two species namely *Mormyrus rume* and *Sarotherodon galilaeus* exhibited positive allometric pattern of growth with b=4.3 and 3.5 respectively. Only one species (*Bagrus docmac*) exhibited negative allometric with b<3 (2.0).

Table 1: Morphometric and condition factor of selected fish species in Dadin-kowa Reservoir

| Species | N | L(cm) Mean | W(g) Mean | B | a | $r^2$ | K |
|---|---|---|---|---|---|---|---|
| *Sarotherodon galilaeus* | 10 | 23.8 | 112.44 | 3.5623 | 5.6885 | 0.6031 | 1.38 |
| *Synodontis batensoda* | 10 | 20.6 | 96.90 | 3.0532 | 4.6510 | 0.6932 | 2.72 |
| *Bagrus docmac* | 10 | 22.3 | 232.90 | 2.0321 | 3.0631 | 0.6721 | 0.71 |
| *Schilbe mystus* | 10 | 13.0 | 33.07 | 3.3040 | 5.5280 | 0.6523 | 1.83 |
| *Clarias gariepinus* | 10 | 26.20 | 238.8 | 3.1231 | 2.6502 | 0.6801 | 0.71 |
| *Mormyrus rume* | 10 | 23.5 | 88.40 | 4.3221 | 6.6000 | 0.6321 | 1.83 |

Number of samples (N), estimated parameters; a (intercept of regression line) and b (slope of regression line), regression coefficient ($r^2$).

**Condition factor (K)**
The mean condition factors (K) of all species studied are shown in Table 2, as shown in the Table 1, the condition factor for the 6 species recorded were 1.38, 2.72, 0.71, 1.83, 0.71 and 1.83 for *Sarotherodon galilaeus, Synodontis batensoda, Bagrus docmac, Schilbe mystus, Clarias gariepinus* and *Mormyrus rume* respectively. Fish exhibited different types of growth pattern depending on the value of **b** obtained. NA=Negative Allometric (b<3), IS=isometric (b=3), and PA=Positive Allometric (b>3). The parameter 'b' (also known as the allometry coefficient) has an important biological meaning, indicating the rate of weight gain relative to growth in length or the rate at which weight increases for a given increase in length.

Table 2: Growth pattern of selected fish species in Dadin-kowa Reservoir

| Species | B (Slope of regression line) | GP Growth pattern | $W=aL^b$ |
|---|---|---|---|
| *Mormyrus rume* | 4.3221 | PA | $W= 6.0600\mathbf{L}^{4.3221}$ |
| *Sarotherodon galilaeus* | 3.5623 | PA | $W= 5.6885\mathbf{L}^{3.5623}$ |
| *Schilbe mystus* | 3.3040 | IS | $W= 5.5280\mathbf{L}^{3.3040}$ |
| *Clarias gariepinus* | 3.1231 | IS | $W= 2.6502\mathbf{L}^{3.1231}$ |
| *Synodontis batensoda* | 3.0532 | IS | $W= 4.6510\mathbf{L}^{3.0532}$ |
| *Bagrus docmac* | 2.0321 | NA | $W= 3.0630\mathbf{L}^{2.0321}$ |

NA=Negative Allometric (b<3), IS=isometric (b=3), and PA=Positive, Allometric (b>3). 'b' also known as the allometry coefficient

## DISCUSSION

### Length-Weight Relationship

The result of the present study showed that the growth of the species in Dadin-kowa Reservoir were of different trend, The group and growth pattern of each fish species are summarized in Table 2. The b values of Length-Weight Relationship for *Schilbe mystus, Clarias gariepinus,* and *Synodontis batensoda* were 3.30, 3.12 and 3.05, respectively, hence indicating Isometric growth and representing the ideal shape of fish, *Mormyrus rume and Sarotherodon galilaeus* had positive Allometric pattern of growth with **b** values greater than 3.0. While *Bagrus docmac* exhibited Negative Allometric pattern of growth with **b** values Less than 3.0 this means that the fishes grow symmetrically [17] or the fish becomes thinner with increase in length [18]. This was similar with the findings of Fasakin [19] reported an isometric growth pattern for *Schilbe mystus* and *Clarias gariepinus*, from Cross River estuary in Cross River state. Olatunde [20] in commercial fish landings in Zaria central market and Abowei and Hart [21] in an investigation of some morphometric parameters of 10 fish species of Lower Nun Reservoir in Niger Delta. Ibrahim *et a*l. [22] observed allometric growth pattern for *Bagrus. docmac* in Kontagora Reservoir while Ude *et al*. [23] made similar findings in an evaluation of length- weight relationship of fish species of Ebonyi. The b values in length-weight relationships determine the growth pattern of the fish species. The *Sarotheredon galilaeus* and *Mormyrus rume* in the present study had b values 3.56 and 4.32 respectively. This agrees with the findings of Imam *et al*. [9] with a recorded b values 3.531and 4.251 in Wasai Reservoir in Kano, the similarity in the b values could be as a result of favourable environmental factor like abundance of food in the reservoir which the fishes thrive.

### Condition factor (K)

The condition factors (K) of the species in this study is in line with what was obtained and recorded by Nwadiaro and Okorie [24] in fresh water of Akwa Ibom state. Also Kumolu-Johnson and Ndimele [25] obtained a K-value of between 0.91 and 2.56 from Ologe Lagoon in Lagos. Ibrahim *et al*. [26] recorded a mean K-value of 1.98 ± 0.35 in Kontagora Reservoir in Niger State. The mean K-values of species sampled had their value greater than 1 which was an indication that the fish species were doing well in the Reservoir. The relationship of length-weight can be used in the estimation of condition factor (K) of fish species. In fisheries science, the condition factor is used in order to compare

the condition, fatness or wellbeing of fish [27]. It is based on the hypothesis that heavier fish of a particular length are in a better physiological condition [8]. Since Fulton's condition factor, K is a measurement involving the length and weight for a particular fish, therefore it could be influenced by the same factors as length-weight relationship. Barnham and Baxter [28] proposed that if the K value is 1.00, the condition of the fish is poor, long and thin. A 1.20 value of K indicates that the fish is of moderate condition and acceptable to many anglers. A good and well-proportioned fish would have a K value that is approximately 1.40 [29].

The length-weight relationship is very important in fisheries biology because it allow estimation of average weight of the fish of a given length group [4], assess the well-being of individuals and to determine possible differences between separate unit stocks of the same species [18]. The length weight relationship observed in this study reveal that the fishes are in good health condition, which is also important factor in fisheries management for comparative growth studies [30]. Also Pauly [15] stated that length-weight relationship (LWR) provides valuable information on the habitat where the fish lives while Kulbicki *et al*., [31] stressed the importance of LWR in modeling aquatic ecosystems.

## CONCLUSION

The six (6) fish species in the Dadin Kowa reservoir clearly shows that the b values in the length-weight relationship ranges from 3.56 - 4.32 and the condition factor K range between 0.95 - 2.72 these shows that all the fishes are in good condition of well-being.

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