THE LENGTH-WEIGHT RELATIONSHIP AND CONDITION FACTOR OF FISH SPECIES IN DADIN-KOWA RESERVOIR GOMBE STATE, NIGERIA

YERIMA, R[1]*, BOLORUNDURO, P.I[2], SULEIMAN, B[3], UMAR, D.M[1] AND BAYERO, U[3]

[1]Department of Biological Sciences, Gombe State University, Gombe
[2]National Agricultural Extension and Research Liaison Services, Ahmadu Bello University Zaria;
[3]Department of Biology, Ahmadu Bello University Zaria.

ABSTRACT

The length-weight relationship and condition factor of eleven resident fish species belonging to the eleven families in Dadin-Kowa reservoir were studied. Fish were sampled from three stations using conventional fishing gears from landing sites of the reservoir. The fish samples were identified using standard descriptions keys. A total of 283 individual fish were sampled, with one (1) species per family from the reservoir. The families include Mormyridae, Bagridae, Cichlidae, Mochokidae, Alestidae, Cyprinidae, Clariidae and Claroteidae, Malapteruridae, Polypteridae and Schilbeidae. The weight-length relationship varied within the ranges of 7 – 40cm and 100 – 500g for total length and body weight respectively. The regression coefficient *b* ranged between 1.034 – 2.124, and the intercept was within the range of 0.276 – 0.932. There was high positive correlation between the length and weight, with *Chrysichthys auratus longifilis* having the highest (r = 0.98) and the least in *Mormyrus rume* (Mormyridae) with r value of 0.41. The condition factors of representative fish species showed the highest mean condition factor of 8.00±1.31 in *Malapterurus minjiriya* while *Mormyrus rume* had the least (2.98±0.33). This indicates that the fish species in this study showed good physiological state and health condition.

Keywords: Fish Species, Length-Weight Relationship, Dadin-Kowa Reservoir.

INTRODUCTION

The concepts of length- weight relationships for estimating the condition of fish have been used in fisheries research since the beginning of the 20th Century (Froese, 2006). The weight corresponding to a given length and condition factors are used for comparing the condition, fatness, or well-being (Tesch, 1968) of fish, based on the assumption that heavier fish of a given length are in better condition. Fisheries researchers have used the length-weight relationship study in fisheries management to provide information on stock condition (Bagenal and Tesch, 1978). This is applied in other to predict the weight from the length of a fish and to compare the average associated parameters between fish groups spatially or temporally. Pauly (1993) reported that length-weight relationships can be used to predict weight from length measurements made in the yield assessment. The exact relationship between length and weight differs among species of fish according to their inherited body shape, and within a species according to the condition (robustness) of individual fish (Scheneider *et al*., 2000). Furthermore, 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, in yield assessment (Garcia *et al.*, 1998) and in the calculation of biomass (Martin-Smith, 1996).

Different growth patterns in fish have been attributed to length-weight factors as highlighted by Riedel *et al*. (2007), where isometric growth is associated with no change of body shape as an organism grows. Negative allometric growth implies the fish becomes slenderer as it increases in weight while positive allometric growth implies the fish becomes relatively stouter or deeper-bodied as it increases in length. Hamid *et al.* (2015) provided baseline data on length-weight relationship and condition factor for seven major species sampled from Temengor Lake. The sampled fishes in the lake were in good condition except for two of the species (*Oxygaster anomalura* and *Labiobarbus leptocheilus*) that showed negative allometric growth. Studies on the length-weight relationship and condition factor have been well documented in many Nigerian freshwater fishes. Ighwela *et al.* (2011) reported significant correlation between length and weight, while the condition factor computed for *Oreochromis niloticus* were 1.64, 1.77, 1.74, 1.72 and 1.79, which indicated good health condition during the experiment, and it is indicating an isometric growth. According to Dankishiya (2012) the length-weight regression analysis for five fish species gave coefficients that varied between 2.2 and 2.3 for *Tilapia zilli*, 1.4 and 1.6 for *Tilapia mariae. Oreochromis niloticus* had values that range between 2.1 to 2.3 while *Barbus occidentalis and Barilius loati* had values that range between 1.9 to 2.2 and 2.3 to 2.4, respectively with the condition factor for the five species ranged between 1.06 and 2.02. Analysis of both the males and females separately and combined showed that all the species exhibited negative allometric growth pattern.

The condition factor in fish serves as an indicator of physiological state of the fish in relation to its welfare (Le Cren, 1951) and also provides information when comparing two populations living in certain feeding density, climate and other conditions (Weatherly and Gills, 1987). 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 (Imam *et al*., 2010). The condition factor which show the degree of well-being of the fish in their habitat is expressed by ‘coefficient of condition’ also known as length – weight factor. This factor is a measure of various ecological and biological factors such as degree of fitness, gonad development and the suitability of the environment with regard to the feeding condition (Mac Gregoer, 1959). When condition factor value is higher it means that the fish has attained a better condition. The condition factor of fish can be affected by a number of factors such as stress, sex, season, availability of feeds, and other water quality parameters (Khallaf *et al*., 2003).

Bhatnagar and Devi (2013) proposed that if the condition factor K value is 1.00, the condition of the fish is poor, long and thin. The K value of 1.20 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. Gupta *et al*. (2011) reported that availability of food organisms at a particular time as well as the difference of gonad development could be responsible for the difference in condition factor in fish. Kouamelan *et al*. (2000) emphasized that measurements of condition factor are generally intended to act as indicators of tissue energy reserves. This is with the expectation that a fish in relatively good condition should demonstrate higher growth rates, greater reproductive potential and higher survival than a lower conditioned counterpart, given comparable environmental conditions (Cone, 1989). This study was therefore designed to determine the length-weight relationship and the condition factor of the resident fish species in Dadin-Kowa reservoir.

MATERIALS AND METHODS

Study Area

Dadin-Kowa Reservoir is located 5 km North of Dadin-Kowa village about 37 km from Gombe Town, along Gombe - Biu Road in Yamaltu Deba Local Government Area of Gombe State in the North East of Nigeria. The area lies within Longitude and Latitude 10^0N coordinates of the equator (UBRDA, 1980) (Figure 3.1). The reservoir was completed by the Federal Government in 1984 with damming of River Gongola. The reservoir had a capacity of 800 million cubic meters of water and a surface area of 30, 000 hectares (William, 2001).

The surrounding settlements of Dadin-Kowa majority depend on agriculture as major source of livelihood. The flood plains known as Fadama lands, as a result of the Dadin-Kowa River, a tributary to river Benue makes both ground water and surface water available and accessible. It is basically an agrarian society that produces agricultural products such as sorghum, millet, cotton, vegetables, rice, maize, groundnut, bambara-nut, as well as fruits and engaged in activities like include weaving, fishing, hunting among others (Ahmed and Philip, 2012).

Sampling Stations

Three sampling stations were selected in the reservoir as follows: Station A was area around the entrance of water into the reservoir. The water movement was relatively obvious due to ingress of large amount of water at this Station compared to other parts of the reservoir. Station B was the area around the central portion of the reservoir with no obvious sign of water movement. The third Station, C, was the part of the reservoir where the water is shallower and with a lot of human activities.

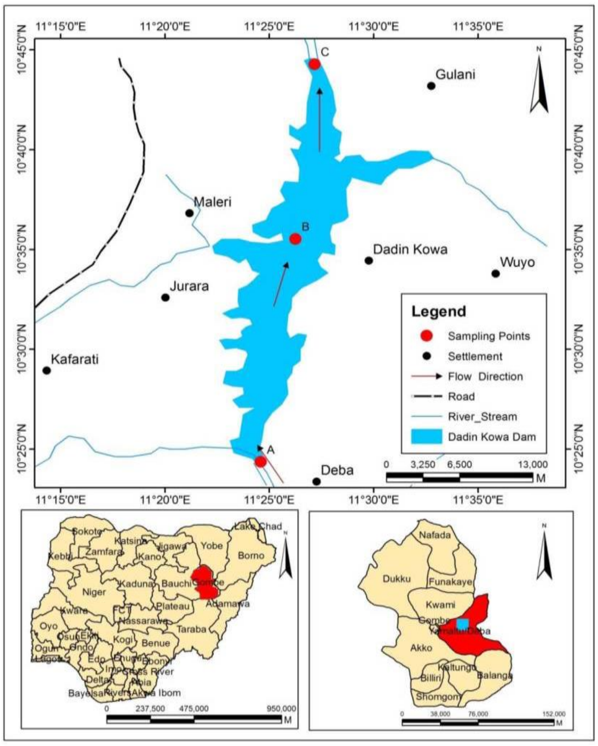


Figure 1: Map showing Dadin-Kowa reservoir and the sampling Stations (A, B and C). (UBRDA,1980)

Fish Sampling

The commercial catches of the fishermen operating in the reservoir (upstream and downstream) were assessed. The types of fishing gear employed by the fishermen in Dadin-
Kowa reservoir were also documented.

Identification of Fish Samples

The fish samples obtained from the fishermen were identified using two methods; firstly, fishermen identification in the local language was done and secondly the fishes were transported to the Hatchery Unit/Laboratory, Department of Biology, A.B.U. Zaria in an ice- box where they were identified up to family and generic levels using description keys such as Balogun (2006) and Suleiman (2016). Fish identification was then to species level using description keys of Holden and Reed (1992) and Babatunde and Raji (1998), in line with FishBase.

Morphometrics of Fish Samples

The fish sampled were mopped using filter paper before weighing to remove excess water from their body in order to ensure accuracy (Anderson and Gutreuter, 1985). The weight of individual fish was measured using a sensitive digital Sartorius™ weighing balance to the nearest gram. The length was measured to the nearest centimeter using meter rule calibrated in centimeters, as distance from the snout to the tip of the caudal fin.

Determination of Length - Weight Relationship (LWR)

The relationship between the length (L) and Weight (W) were calculated using:

Log W=loga+b log (Begeneal and Tesch, 1978).

Where:

W= Weight of fish (g), L=length of fish (cm), a=constant,
b= exponent.

Condition Factor

The relative condition factor K (Gomiero and Braga, 2005) was calculated using equation:

K=100W/Lb

Where:
W=Weight of the fish (g),

L=Length of the fish (cm), b=coefficient obtained from LWR

RESULTS

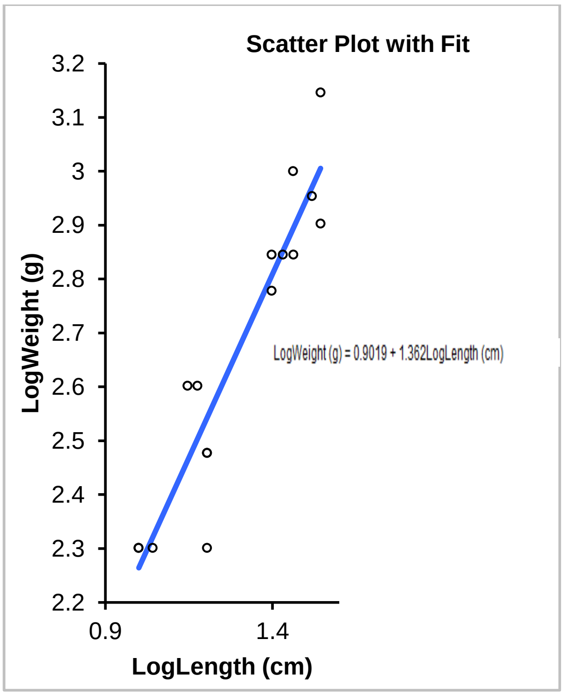
The length-weight relationships of 283 individual fish belonging to eleven species, representing the 11 families from Dadin-Kowa reservoir are shown in Table 1. The table showed the weight-length relationship to vary within the range of 7 – 40cm and 100 – 500g for total length and body weight respectively. The regression coefficient *b* ranged between 1.034 – 2.124, and the intercept was within the range of 0.276 – 0.932. There was high positive correlation between the length and weight, with *Chrysichthys auratus longifilis* (Family: Claroteidae) having the highest (*r* = 0.98) and the least in *Mormyrus rume* of the family Mormyridae (*r* = 0.41).

The condition factors of representative fish species showed the highest mean condition factor of 8.00±1.31 in *Malapterurus minjiriya* while *Mormyrus rume* had the least (2.98±0.33). Figure 2 (A-K) shows the relationship between the length and weight of the selected sampled fish species in the reservoir. There was high positive relationship in every change in weight of fish to corresponding change in fish length.

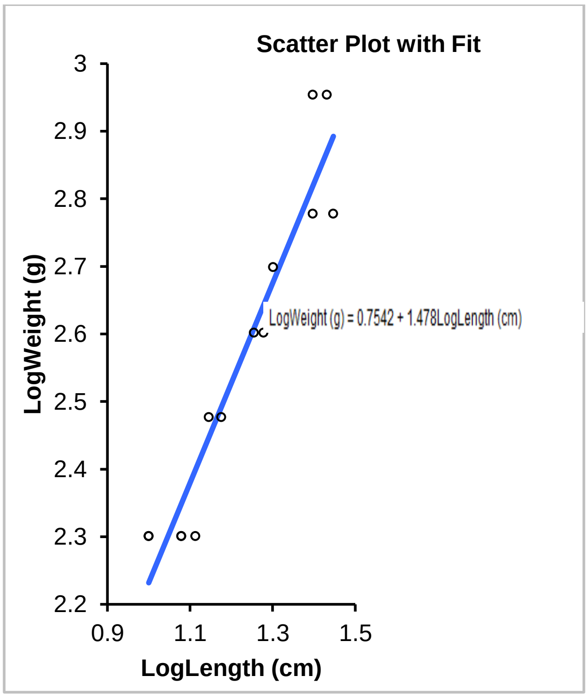
Table 1: Morphometrics and condition factor of selected fish species in Dadin-Kowa Reservoir

Species	Family	n	TL Range (cm)	WT Range (g)	a	b	R^2	K - Factor Range	K - Factor Mean
Clarias anguillaris	Clariidae	60	10-35	200-1000	0.901	1.362	0.87	2.87-4.48	3.77±0.27
Schilbe mystus	Schilbedae	59	10-28	200-900	0.754	1.478	0.91	2.73-6.86	4.76±0.55
Malapterurus minjiriya	Malapteruridae	5	10-22	100-700	0.040	2.124	0.74	6.11-11.85	8.00±1.31
Synodontis nigrita	Mochokidae	30	8-32	100-1200	0.833	1.395	0.83	2.59-5.00	3.37±0.43
Bagrus bajad	Bagridae	20	19-40	500-1300	1.390	1.034	0.72	2.33-3.64	3.11±0.28
Chrysichthys auratus longifilis	Claroteidae	21	20-35	400-1000	0.403	1.700	0.98	1.85-15.02	5.57±1.96
Polypterus senegalus	Polypteridae	10	8-32	100-900	0.927	1.402	0.83	2.75-12.21	7.44±1.75
Coptodon zillii	Cichlidae	30	10-30	100-1000	0.629	1.570	0.77	3.05-14.81	6.78±1.60
Brycinus nurse	Alestidae	13	7-36	100-1500	0.932	1.360	0.83	2.59-5.00	3.37±0.43
Labeo cuobie	Cyprinidae	15	12-35	200-1200	1.021	1.297	0.90	2.78-5.63	3.37±0.34
Mormyrus rume	Mormyridae	20	15-37	200-1300	0.276	1.734	0.41	2.22-5.12	2.98±0.33

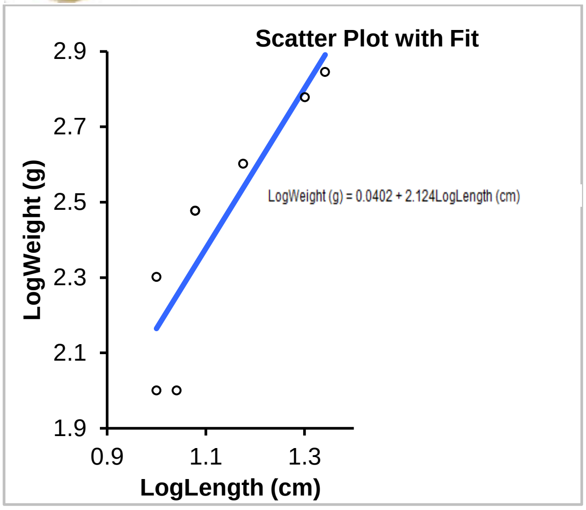
KEY: a – Intercept of Regression Line, b – Slope of Regression Line, R^2 – Correlation Coefficient, K – Condition Factor, TL – Total Length, WT – Weight.



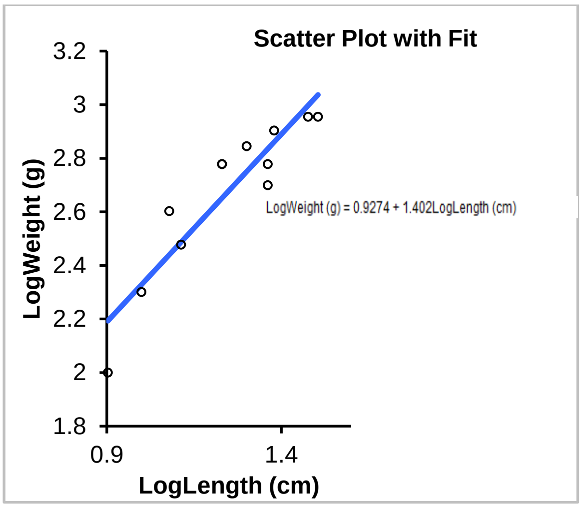
A. *Clarias anguillaris*



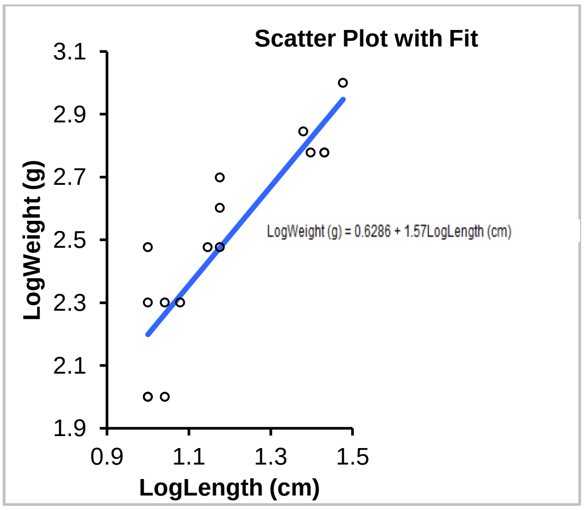
B. *Schilbe mystus*



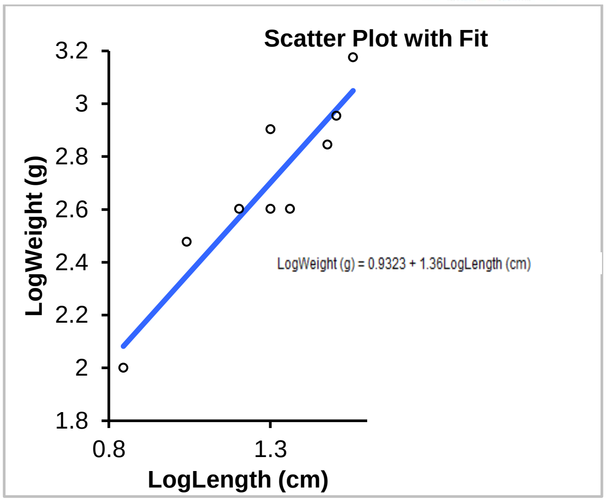
C. *Malapterurus minjiriya*



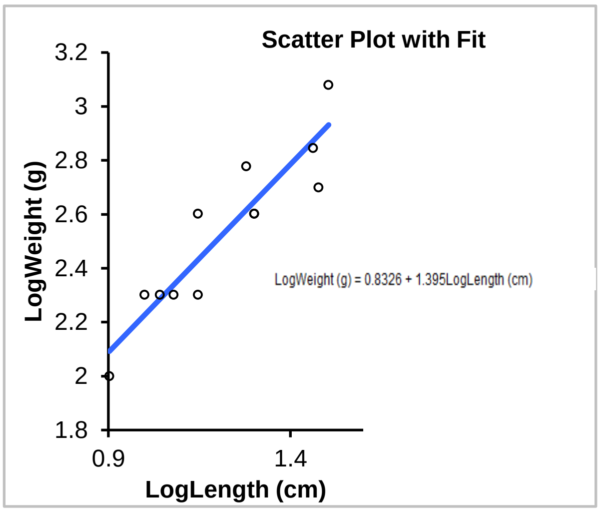
D. *Polypterus senegalus*



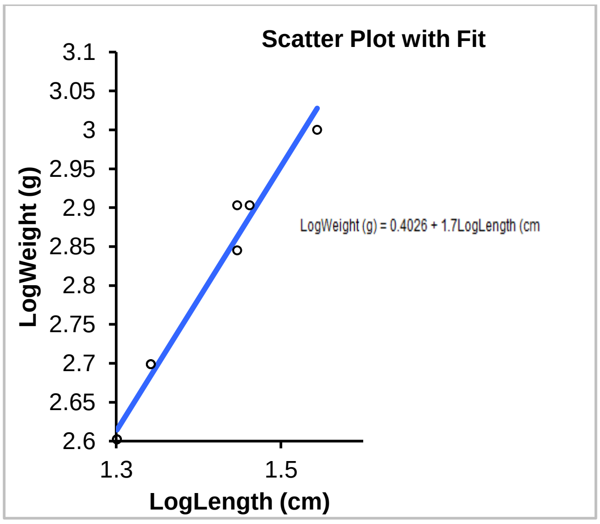
E. *Coptodon zillii*



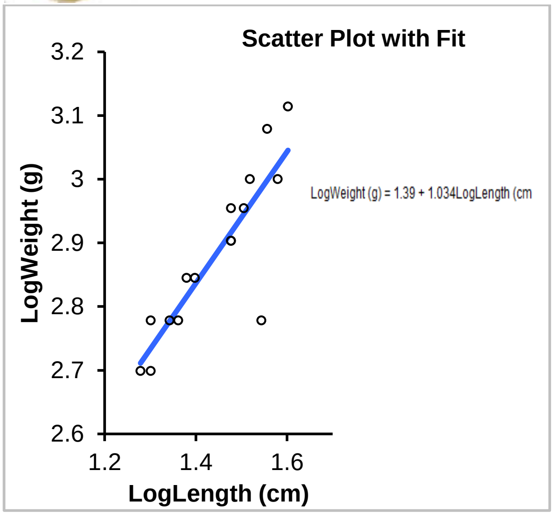
F. *Brycinus nurse*



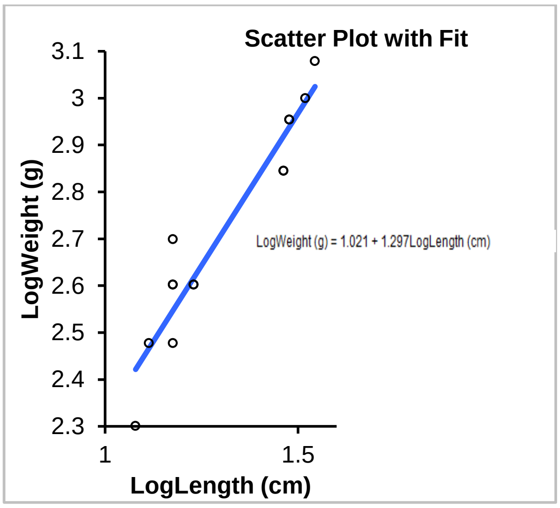
G. *Synodontis nigrita*



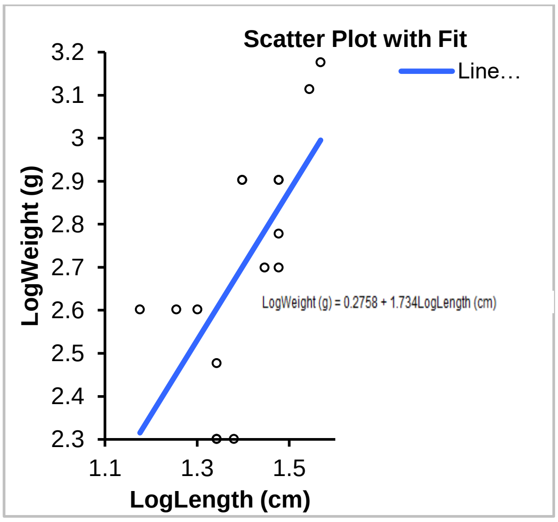
H. *Chrysichthys auratus longifilis*



I. *Bagrus bajad*



J. *Labeo cuobie*



K. *Mormyrus rume*

Figure 2: Length-weight relationships (A-K) of selected fish species from Dadin-Kowa Reservoir.

DISCUSSION

The length-weight relationship is an important parameter for stock assessment and understanding of the population dynamics (Sivashanthini, 2008). which could be used to promote the species in the wild. The correlation coefficient (*r*) established the length-weight relationship of the fishes in this study as positive and high. This is an indication that to every increase in unit length of fish there was a corresponding increase in weight. The range of the *b* values of the fish species in this study indicated negative allometric growth pattern that favoured increase in length than body mass. The availability of the needed environmental resources especially food in Dadin-Kowa reservoir could have played important role in establishing this growth pattern in the fish species. Similar findings were reported in fish from reservoirs and lakes in Nigeria. Dankishiya (2013) reported negative allometric growth (with *b* values range of between 1.4 and 2.3 obtained at $P<0.001$) of fish species in Lower Usuma Reservoir in Abuja, Nigeria. Observed growth pattern among some cichlids (*Hemichromis fasciatus*, *Tilapia mariae* and *Oreochromis niloticus*) in Anambra River in Nigeria showed negative allometric growth (Atama *et al*. 2013). The symmetrical fish growth in different Nigerian inland waters (Ude *et al.*, 2011; Nazeef and Abubakar, 2013) has been documented. On the contrary, some fishes from Nigerian waters exhibited isometric growth pattern (Ayoade and Ikulala, 2007; Ndimele, *et al*. 2010; Ayoade, 2011).

The high condition factor from this study can be considered as morphometric expression of the overall physiological state of the fishes (Onuoha *et al*., 2010). The relatively high condition factor obtained in *Alestes nurse*, *Tilapia zillii* and *Malapterurus minjiriya* could be an indication of good wellbeing and expression of proper utilization of environmental resources. The variation in condition factors (K) of the fish species in the reservoir could be as a result of inconsistency in the natural conditions in the reservoir. Lagler (1985) stated the value of K is not constant for individual species or populations. Condition factors greater than 1.0 has been reported in fish species from Dadin-Kowa reservoir (Nazeef and Abubakar, 2013). The condition factor, K, is an index of general well-being or fitness of fish population (Bolger and Cannolly, 1989) and assumes that the heavier fish of a given length is in better condition. This depicts that most of the fish were in fairly good condition.

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