



Length-weight relationship and condition factor of Nile perch (*Lates niloticus*, Linnaeus 1762) at Goronyo Dam, Sokoto-Nigeria

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Abstract

Lates niloticus is widely spread in most parts of Africa and despite the wide geographic distribution of this species, only few studies have been conducted on its biology including its length-weight relationship and condition factor. *Lates niloticus* have been on decline due to over fishing and competition with other fish species before they reach maturity. Therefore, this study was undertaken to address the information and knowledge gap in length weight relationship and condition factor of *Lates niloticus* in Goronyo Dam, A total of 51 fish samples were collected from Goronyo Dam for a period of 12 weeks. The Length and weight of each individual sample was taken separately using a calibrated measuring board (cm) and a mechanical weighing balance of 20kg capacity respectively. The relationship between the length (L) and weight (W) was calculated by a logarithmically transformed equation of length-weight relationship to give a linear regression. The mean Total length recorded was 43.52 ± 1.39 , mean Total weight TW was 1300.0 ± 138.63 , while a mean value of Standard Length recorded was 36.58 ± 1.19 . The B-value obtained for all the fish populations was 2.72, indicating negative allometric growth pattern and the condition factor (K-Value Total) for combined population has a value greater than 1 in both the sizes classes population groups and sex classes population groups of *Lates niloticus* studied.

Keywords: *Lates Niloticus*, length-weight, condition factor

Introduction

Lates niloticus, commonly known as Nile Perch, is the only species of the Family Centropomidae found in northern Nigeria^[1]. It is widely spread in most parts of Africa, being native to the rivers Congo, Nile, Senegal, Niger and Lakes Chad, Volta, Turkana another river basin^[2]. It is one of the largest freshwater fishes, reaching a maximum length of nearly two meters (more than six feet) and weighing up to 200kg^[3]. The females are generally larger than the males^[4]. The Nile perch becomes sexually mature when it is around 3 years of age and can live for up to 16 years, with each individual capable of spawning numerous times and producing an abundance of offspring^[5]. The species also spawn most of the year^[1]. The female Nile Perch commences spawning when it has grown up to 50-80 cm and can produce up to 16 million eggs at a time^[6]. This species does not guard eggs or raise fry^[7].

Knowledge of length-weight relationship has numerous practical applications in Fisheries Sciences. It is required for the estimation of individual fish weight from length, with the weight being added up to obtain total biomass or standing stock^[8]. In fisheries science, the condition factor is a term used to compare the "condition of fatness or well-being of the fish. It is based on the hypothesis that the heavier the fish of a particular length, the better their physiological condition^[9]. Condition factor is also a useful index for monitoring of feeding intensity, age and growth rates in fish^[10].

There are several reports on length-weight relationship and condition factor of fish from different regions of the world including Africa, one of such works was that of^[11] who worked on some aspects of growth and reproductive indices of *L. niloticus* from river Rima, Sokoto. Despite the wide geographic distribution of *L. niloticus*^[12] only few studies

have been conducted on its biology including its length-weight relationship and condition factor. *L. niloticus* have been on decline due to over fishing and competition with other fish species before they reach maturity^[13]. Therefore, this study was undertaken to address the information and knowledge gap in length weight relationship and condition factor of Goronyo Dam, to help in the management of the fisheries resources (*L. niloticus*) for sustainable food security and socio-economic growth.

L. niloticus is one of the largest fresh water fishes in Nigeria, it reaches a maximum length of nearly 2 meters weighing up to 200kg^[2]. 121-137cm on average at maturity^[14]. Although many of the fishes are caught before maturity^[13]. *L. niloticus* is silver in colour with a blue tinge; it has distinctive dark black eyes with a bright yellow outer ring. It has total dorsal spines of 7-8, Total dorsal soft ray as of 10-14 and rounded caudal fin^[15]. Pre-orbital and pre-opercular bones armed with spines, a large spine on the free edge of the operculum. It is dark greyish blue dorsally, greyish silver in flank and ventrally^[16].

Taxonomy of *L. niloticus* depicts from Kingdom as Animalia, belonging to the Phylum Chordata, Class of Actinopterygii, Order of Perciformes and Family of Centropomidae, Genus *Lates* to Specie as *niloticus* as identified by Linnaeus^[11]. *L. niloticus* is well distributed in most parts of Africa. It is a fresh water fish, native to the called trophic ecozone, where it is found in the River Congo, the Nile River, Senegal River, the Volta River and lake Chad^[5]. It can also survive in brackish water environment and it is common in Lake Maryut in Egypt^[16]. It was introduced to Lake Victoria in East Africa in the 1950s^[1] and since then it has been on commercial fishing records^[17]. After being introduced to Lake Victoria it has been attributed to endangering several other species^[18].

Initially the Nile perch's diet consists of native cichlids, but with decreasing availability of this prey, it now consumes mainly small shrimp's and minnows [17].

Ecology and Feeding habits of *L. niloticus* describes it as demersal, potamodromous that inhabits channels, lake and irrigation canals. It prefers Sandy bottom zones with vegetation in calm waters that provides shelter to its larvae and young ones [19]. Adults inhabit deep waters while juveniles are found in shallow waters [20]. It is not present in littoral Rocky habitat [21]. It is a voracious predator, which predominantly feeds on *Tilapia species*, *Alestes species* and shrimps [22], although the juveniles feed on large crustaceans and insects and are planktivorous [19].

Knowledge of some quantitative aspects such as length-weight relationship is important in studying fish biology. Length-weight relationships can be used to predict weight from length measurements made in the yield assessment [22]. Fish can attain either isometric growth, negative allometric growth or positive allometric growth. 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 comes relatively stouter or deeper-bodied as it increases in length. Length-weight relationship is also used for the estimation of the condition factor of the fish, which is used to compare the health of fish populations. A high condition factor indicates that fish is heavier than a fish of the same length with lower condition factor and thus always refers to a deviation from the average length-weight relationship for a population [23-25]. The analysis of length-weight relationship and condition factor of fish population are important tools to support the rational management of fisheries resources and may help in the implementation of public policies [26]. The condition factor in fish serves as an indicator of physiological state of the fish in relation to its welfare [23] and also provides information when comparing two populations living in certain feeding density, climate and

other conditions [27]. 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 [28]. Condition factors of different populations of the same species give some information about food supply, timing and duration of breeding, and can also be used in assessing well-being of fish [27]. The study area, Goronyo dam, is located between latitudes 13°30'N to 14°N and longitudes 5°30'E to 6°E [29]. The Reservoir has a length of about 20km with a width of about 10km and an area of about 200km² with a storage capacity of 942 million cubic meters [29]. The study area is located in Goronyo Local Government Area, Sokoto State in Northwest Nigeria.

Methodology
The study area

Goronyo dam is unit of the Sokoto-Rima basin, which has a total catchment area of about 193,000km distributed in Nigeria and the Niger Republic [29]. The location of the basin has a semi-arid tropical climate with a prolonged dry season from October to May and a short-wet season from end of May to early October³⁰. Temperature depicts both seasonal and diurnal variations in the area [31]. Two temperature maxima of over 35°C are common between April to May and between Octobers to November³¹ Two minimum temperature periods below 20°C are also common between December to January and in August [29, 32]. During the rainy season, the diurnal range of temperature in the area is low but during the dry season it is high [31]. Rainfall in the area shows both spatial and temporal variations [33]. The mean annual rainfall varies from about 700mm in the northern part of the Rima basin to about 1,100mm in the south [29, 31-32]. The duration of the rainy season is also longer in the southern part [31] since it begins earlier and ends later than in the north [29]. The study area has mostly sandy soils which have low organic matter and nutrients. Nitrogen, phosphorus, and potassium [34-35].

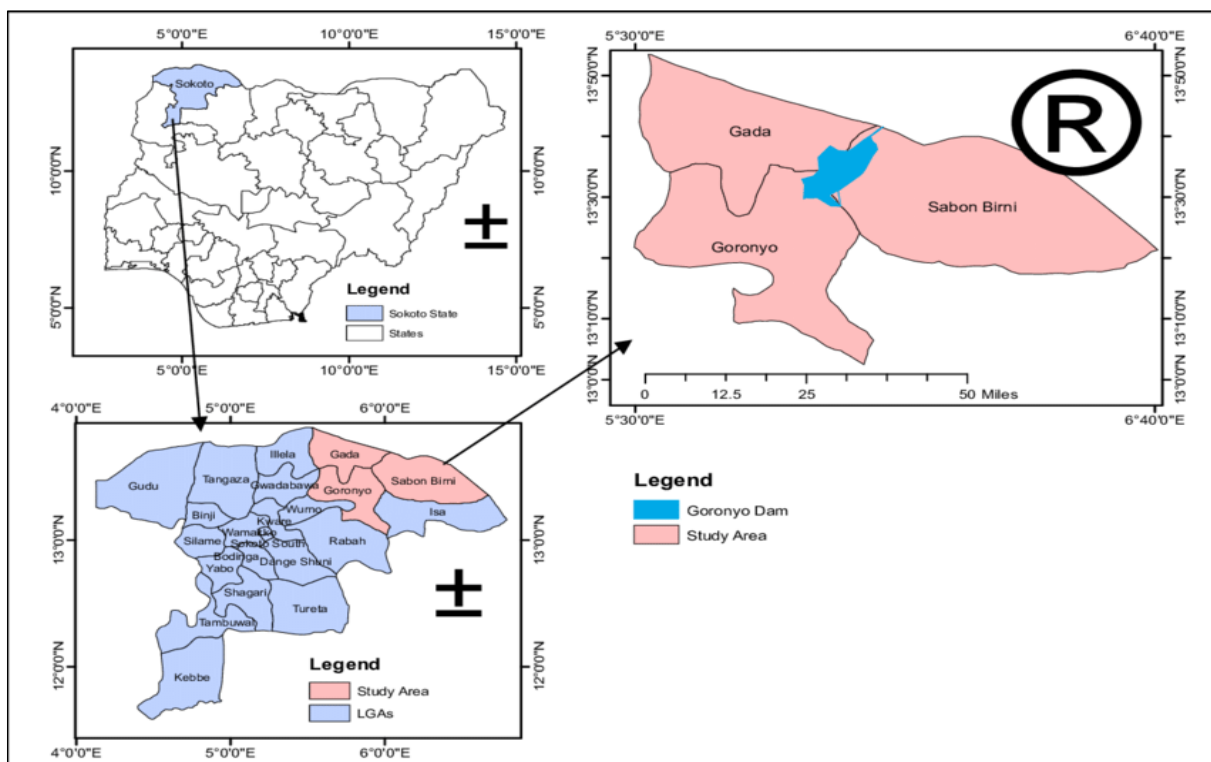


Fig 1: Descriptive map of the Research Area. Goronyo Dam

Data collection

A total of 51 fish samples were collected from Gronyo Dam for a period of 12 weeks. The Length and weight of each individual sample was taken separately using a calibrated measuring board (cm) and a mechanical weighing balance of 20kg capacity respectively

Statistical Analysis

Length-Weight Relationships.

The relationship between the length (L) and weight (W) was calculated by a logarithmically transformed equation of length-weight relationship to give a linear one as;

$$\text{Log } W = \text{Log } a + b \text{ Log } L \quad [36]$$

Where: W = weight of fish (g); L = length of fish (cm); a = constant; b = exponent. The values of 'a' and 'b' are estimated by least squares regression analysis [37].

Condition Factor (K-value)

For calculating condition factor or K [26], the equation below was used:

$$K = \frac{100}{L^3}$$

$K=100W/L^3$, where: K = Condition factor; W= weight of fish (g); L =length of fish (cm); b = coefficient obtained from LWR. Analyses for the length-weight relationships and relative condition factor were carried out based on total number of the samples.

Results

Size Distribution of *L. niloticus* from Goronyo dam

The size distribution of the *L. niloticus* from Goronyo dam is presented in Table 1 above, the mean Total length recorded was 43.52 ± 1.39 , mean Total weight TW was 1300.0 ± 14.63 , while a mean value of Standard Length recorded was 36.58 ± 1.19 .

Length weight relationship of *Lates niloticus* form Goronyo Dam

The results for the growth pattern are presented in Table 2. The B-value obtained for all the fish populations (2.72), indicating negative allometric growth pattern.

The b-value for males (2.54) indicates negative allometric growth pattern for females (2.91), it also shows negative allometric growth. The smaller sizes population group (3.04) exhibited relative isometric growth pattern and the bigger sizes population group (4.45) show positive allometric growth pattern.

Table 3 represents the condition factor K-value of *Lates niloticus* from Goronyo dam. (N=51) The minimum condition factor for all samples was (0.41) and maximum (4.51) mean (1.44 ± 0.104), indicate that the samples were in good condition as indicated by the K value greater than 1. Females' minimum was 0.86 maximum was 3.32 mean 1.33 ± 1.0 , males minimum was 0.41 maximum was 4.51 mean was 1.55 ± 0.19 were in better condition than females and the smaller sizes population groups' minimum was 0.86 maximum 4.5 mean was 1.53 ± 0.13 were in better condition than the bigger sizes population groups' minimum with 0.41 and maximum of 1.88 having a mean value of 1.18 ± 0.10 .

Table 1: Size Distribution of the *L. niloticus* in Goronyo Dam

Parameters	N	Minimum	Maximum	Mean \pm S. E	S. D
TL (cm)	51	31.10	66.10	43.52 ± 1.39	9.90
TW (cm)	51	270.00	4100.00	1300.0 ± 138.63	990.01
SL (cm)	51	25.50	57.10	36.58 ± 1.19	8.53

Table 2: The Length-weight Relationships of *L. niloticus* from Goronyo Dam

Parameters	N	A	R	B	SE
All samples	51	1.42	0.71	2.72	0.166
Males	25	1.12	0.55	2.54	0.203
Females	26	1.74	0.83	2.91	0.127
<50cm	38	1.91	0.55	3.04	0.167
>50cm	13	4.49	0.58	4.45	0.153

a = Constant (intercept)

b= Slope (change in weight per unit change in length)

r = Correlation coefficient

Table 3: Condition Factor of the *L. niloticus* in Goronyo Dam

Parameter	N	Min	Max	Mean \pm SE
All sample	51	0.41	4.51	1.44 ± 0.104
Males	25	0.41	4.51	1.55 ± 0.187
Females	26	0.86	3.32	1.33 ± 0.096
<50cm	38	0.86	4.51	1.53 ± 0.134
≥ 50 cm	13	0.41	1.88	1.18 ± 0.097

Discussion

According to this study, 51 samples of *L. niloticus* were used in order to determine the growth pattern (b-value) and condition factor (K-value) of the species. The maximum length of *L. niloticus* sampled in this study was (66.10 cm) and weight (4100g/4.1kg) whereas the minimum length is (31.10cm) and the weight of (270g/0.27kg), the minimum K-value of all the sampled was 0.41 and maximum was 4.51 with the mean K-value of 1.44 ± 0.194 . The b-value total obtained from this research was 2.72 ± 0.17 which agrees with [10] who recorded negative allometric growth patterns from their calculated b-values for some samples of *L. niloticus* collected from river Rima. This implies that the sampled population groups of *L. niloticus* in Goronyo dam are of negative allometric growth as recorded by [10]. The condition factor (K-value) of overall mean sampled *L. niloticus* recorded from Goronyo dam was 1.44 ± 0.10 which is higher than that of [10] who recorded a K-value of 0.96 ± 0.79 for a population of *L. niloticus* Sampled from Rima River. This implies that there is more abundance of foods and nutrient to support the growth of the species under study in Goronyo dam than could be obtainable from river Rima. Also, it may be that over the years, there has been accumulation of more nutrients for the species due to time difference between this research and the periods of sampling by the fore authors or simply because of difference in sampling locations. Obviously, the *L. niloticus* population groups from the current sampling location were in good condition throughout the study period in Goronyo Dam. Because, the condition factor (K-Value Total) for combined population has a value greater than 1 and in both the size classes population groups and sex classes population groups of *L. niloticus*. This result revealed that over the period of time of data collection for this study, the Dam still had its adequate availability of foods and nutrients for the growth of this fish species (*L. niloticus*). In terms of growth pattern *L. niloticus* also exhibits a negative allometric growth pattern, which means the fish, grows more in length than in weight; the rate of increase in body length is

not proportional to the increase in body weight.

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