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Research Article

Length-Weight Relationship and Condition Factor of Three Commercial Fish Species of River Nile, Sudan

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Abstract

This study investigated the length - weight relationships and condition factor of three freshwater fishes from the River Nile: *Hydeocyon forskalii, Lates niloticus* and *Labeo niloticus*. The results of the length-weight analyses showed that all the three fish species exhibited negative allometric growth pattern with regression exponent (b) values less than (3), while the correlation coefficients (r) obtained which ranged from 0.8964 to 0.9903 revealed a high degree of positive correlation. The analyses also showed that the condition factors (K) of the three fish species were greater than (1) and implied that they were in good physiological condition.

Keywords: *Fish Growth; Length-Weight Relationship; Condition Factor; Hydeocyon forskalii; Lates niloticus; Labeo niloticus*

Introduction

The relationship between body length and weight of fish presents great importance in fisheries biology and population dynamics where many stock assessment models require the use of length-weight parameters [1]. Knowledge of length-weight relationships is useful for the prediction of weight from length values, condition of fish, stock assessment, and estimation of biomass [2-4]. In addition to growth pattern or age determination and fishery assessment [5].

These factors are applicable in population dynamics and aquatics ecology science [6,7] also data of length-weight are useful for fishery biologists for monitoring the state of health of a population [8,9].

Fish condition factor, defined as the robustness or well being of an individual fish. It is an essential component of fishery biology used to assess the general health of populations [10]. Condition can vary both within and among populations; and it is therefore critical to identify environmental predictors of this variation to optimize fishery production.

Condition factor is also a useful index for monitoring of feeding intensity, age, and growth rates in fish [11]. It is strongly influenced by both biotic and a biotic environmental conditions and can be used as an index to assess the status of the aquatic ecosystem in which fish live [12-15].

In spite of the importance of length-weight relationship and condition factor in fisheries science, information about the length-weight relationships and condition factors of Nile fish in the Sudan is very scarce and incomplete.

The aim of the study was to provide information on the length–weight relationships and condition factor of three commonly found fish species in the River Nile in Sudan namely: *Hydeocyon forskalii*, *Lates niloticus* and *Labeo niloticus*.

Materials and Methods

Total weight and total length of 120 fish of *Hydrocyon forskalii*, *Lates niloticus* and *Labeo niloticus*, 40 specimens representing each species, were measured during this study. *Hydrocyon forskalii* ranged between 29.1 – 68.9 (cm) in length and 161 – 1897 (gm) in weight. *Lates niloticus* ranged between 23.8 – 36.3 (cm) in length and 140 – 501 (gm) in weight. *Labeo niloticus* ranged between 25.5 – 53 (cm) in length and 171 – 1299 (gm) in weight.

The Total Length (TL) of the fish was measured from the tip of the anterior part of the mouth to the caudal fin using meter ruler calibrated in centimeters to the nearest (0.1) centimeter. Fish weight was measured using a triple beam balance to the nearest (0.1) gram.

The length-weight relationship (LWR) of fish was estimated using linear regression [16]. The technique is incorporated in the FAO ICLARM, Stock Assessment Tool (FISAT) [17]. The length weight relationship was obtained from the relationship.

$$W= aLb \text{ [17]}$$

Where:

W = Total Weight of fish (g)

L = Total Length of fish (mm)

a = Intercept (describe the rate of change of weight with length)

b = Slope (weight at unit length)

The values of (a) and (b) were given a logarithmic transformation according to the following formula:

$$\text{Log } W = \log a + b\log L \text{ [17]}$$

The correlation i.e., the degree of association between the variables was determined by computing the correlation co-efficient (r) from the regression equation information (r2) [18] using the relationship:

$$r = \sqrt{R^2}$$

The condition factor was determined by using the equation:

$$K = 100W/ L^b \text{ [17]}$$

Where:

K = condition factor

W = the weight of the fish in gram (g)

L = the total length of the fish in centimeters (cm)

b = the value obtained from the length-weight equation.

The exponent b value, that is equal to 3, was not used to calculate the K value, Bolger and Connolly [2] claim that it is not a real representation of the length-weight relationship for greater majority of fish species, therefore the b value used was obtained from the estimated length-weight relationship equation ($W = aL^b$) as suggested by Lima-Junior., *et al.* [19].

One way analysis of variance (ANOVA) and Duncan multiple range tests with significant level (0.05) were carried out for the data obtained during this study.

Results and Discussion

Relationship between length and weight (represented by b) and condition factor (represented by K) of the fish was examined by simple linear regression analysis.

The effective management of any fishery requires considerable knowledge of population parameters such as length-weight relationship. This relationship is very important in fisheries biology because it allow estimation of average weight of the fish of a given length group [20-22].

Length–weight relationship parameters (a and b) are useful in fisheries science in many ways: to estimate weight of individual fish from its length, to calculate condition indices, to compare life history and morphology of populations belonging to different regions [3] and to study ontogenetic allometric changes [23].

Relationship of fishes are important in fisheries biology because they allow the estimation of the average weight of fish of a given length group by establishing a mathematical relation between the two. When the b-value is less than 3, the fish has a negative allometric growth but when it is greater than 3, it has a positive allometric growth and when it is equal to 3, the fish has isometric growth [24] and [25]. Similarly when b is far less or greater than 3, growth in the fish is allometric i.e. the fish becomes thinner with increase in length [26].

The r value of *Hydrocyon forskalii, Lates niloticus* and *Labeo niloticus* from the River Nile was (r = 0.9409, 0.9903 and 0.8964 for *Hydrocyon forskalii*, *Lates niloticus* and *Labeo niloticus* respectively) (Figures 1, 2 and 3). This means that there was a high correlation between the total length and total weight [27]. This means that as the length of fish increases the weight increases in the same proportion. Coefficient of determination was also high (R^2 = 0.8853, 0.9807 and 0.8037 for *Hydrocyon forskalii*, *Lates niloticus* and *Labeo niloticus* respectively) which indicated that the model used for the analysis fits the data [28].

Hydrocyon forskalii, Lates niloticus and *Labeo niloticus* during this study have showed negative allometric growth pattern indicated by the growth coefficient (b = 2.9241, 2.9276 and 2.8808 for *Hydrocyon forskalii, Lates niloticus* and *Labeo niloticus* respectively) (Figures 1, 2 and 3). The calculated condition factor (K) was 1.2199, 1.3749 and 1.4216 for *Hydrocyon forskalii, Lates niloticus* and *Labeo niloticus* respectively (Tables 1,2 and 3). Indicated that the three fish species in this study was in a good condition (K > 1) [29]. A comparison between three species condition factor is shown in table (4) and figure (4).

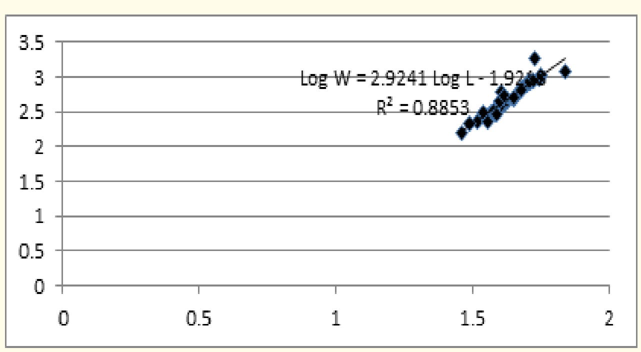

Figure 1: *Length – weight relationship of Hydrocyon forskalii.*

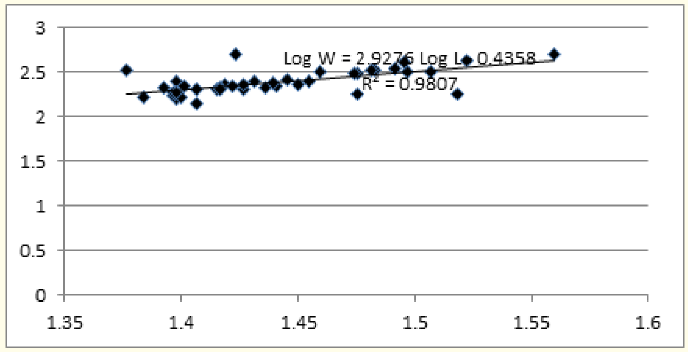

Figure 2: *Length – weight relationship of Lates niloticus.*

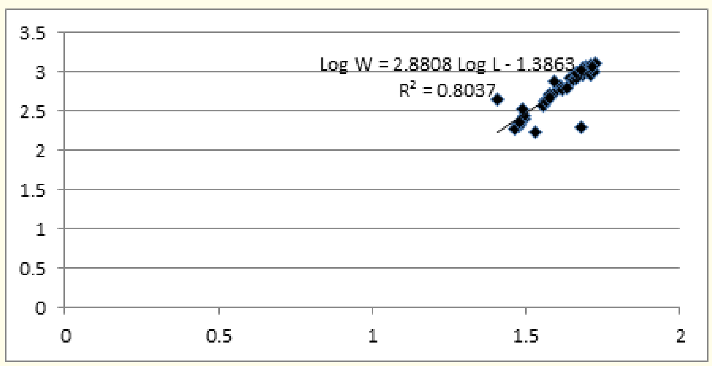

Figure 3: *Length – weight relationship of Labeo niloticus.*

B	R^2	r	Condition factor (K)		
			Mean ± Std.	Minimum	Maximum
2.9241	0.8853	0.9409	1.2199 ± 0.2718	0.7705	2.5347

Table 1: *Condition factor (K) of Hydrocyon forskalii.*

B	R^2	r	Condition factor (K)		
			Mean ± Std.	Minimum	Maximum
2.9276	0.9807	0.9903	1.3749 ± 0.4131	0.5729	3.0386

Table 2: *Condition factor (K) of Lates niloticus.*

B	R^2	r	Condition factor (K)		
			Mean ± Std.	Minimum	Maximum
2.8808	0.8037	0.8964	1.4216 ± 0.5016	0.2855	4.0458

Table 3: *Condition factor (K) of Labeo niloticus.*

Fish species	Condition factor (K)	Sig.
Hydrocyon forskalii	1.2199 ± 0.2718[a]	0.042
Lates niloticus	1.3749 ± 0.4131[ab]	
Labeo niloticus	1.4216 ± 0.5016[b]	

Table 4: *Condition factor (K) of Hydrocyon forskalii, Lates niloticus and Labeo niloticus.*
**Means with similar superscript (in a column) are not statistically significantly different (p > 0.05), those with different superscript are statistically significantly different*

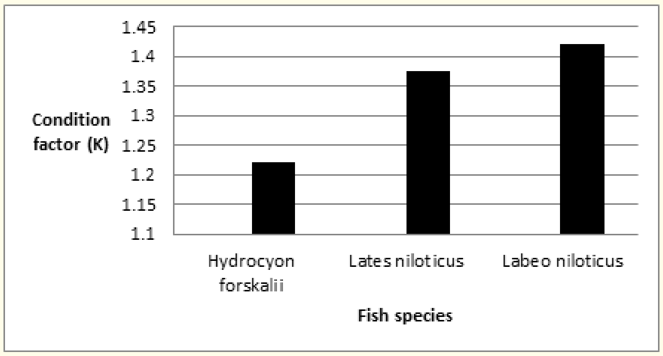

Figure 4: *Condition factor (K) of Hydrocyon forskalii, Lates niloticus and Labeo niloticus.*

Conclusion

In conclusion, it can be said that *Hydrocyon forskalii, Lates niloticus* and *Labeo niloticus* in this study showed negative allometric growth pattern indicated by the growth coefficient (b < 3). The three fish species were in a good condition indicated by the calculated condition coefficient (K > 1).

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