Length - Weight Relationship and Condition Factor of Three Commercial Fish Species in Juba- South Sudan.

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ABSTRACT

This study aimed to inspect the length-weight relationship and condition factors of three commercial fish species, *Distichodus niloticus, Oreochromis niloticus, Heterotis niloticus* in Juba, South Sudan. A total of 1800 fish specimens were collected from Juba fish landing sites during the study. Length-weight relationship, a and b were estimated. The means length for *Distichodus niloticus, Heterotis niloticus, Oreochromis niloticus were* 51.24±11.78, 57.66±13.91, and 34.96±4.10cm, respectively, and means weight were 306 ± 828.67, 2488 ± 962.91, and 1550 ±370.69g, respectively. Length weight relationship slope (b) value ranged from 1.70, 1.60 and 1.55, *respectively*. All the fish species in the study showed negative allometries b less than 3, and the condition factor, k, ranged from 1.80±0.53, 1.40±0.51, and 3.63±0.34 for *Distichodus niloticus, Heterotis niloticus, Oreochromis niloticus*, respectively. K values greater than 0.5, indicated that the fish species were in good condition during the study period. Therefore, more study on length-weight and condition factor for all commercial fish species all over South Sudan is recommended for effective stock management and monitoring in freshwater bodies within the country.

1. INTRODUCTION:

South Sudan is a state with plentiful natural resources, among them fisheries. Due to its location along the Nile River Basins and other rivers, and within the most significant wetland in the world, the fisheries sector has its own socio-economic and cultural importance., in addition to that, the total water surface area 70 000 km2, comprising 30 000 km2 for the Sudd region and adjacent areas, and another 40 000 km2 for the River Nile, lakes, tributaries and other floodplains. (FAO, 2014, and CAMP Team Task, 2013). had estimated an annual catch of 143 000 tonnes of fish worth USD 510 million. Length-weight relationship is a useful tool in fish growth, and age determination. It helps in predicting weight from length that is required in yield assessment and in the calculation of biomass. It provides an important information concerning the structure and function of fish populations at a particular time, and uses in comparison of fish species populations caught from various places at similar or different times

(Garcia CB, 1998, Martin-Smith KH, 1996, Pepple and Ofor, 2011, Thomas, J., S. Venu and B.M. Kurup, 2003). The values of Length Weight Relationship is a useful tools to differentiate between the isometric growths among different regions. Fish are considered to grow at isometric rate when the b-value is equals to 3.

Nevertheless, when the b value is less than 3, the fish has negative allometric growth, and when it is greater than 3, it exhibits a positive allometric growth **(Khairenizam and Norma-Rashid, 2002, Fagbuaro, O *et al.*; 2019).** Length –Weight Relationship allows fisheries scientists to convert growth in length equations to growth-in-weight in stock assessment models. The condition factor is shown as the relative degree of robustness or wellbeing of fish and reflects the degree of nourishment, state of sexual maturity or gonad growth, and the fitness of the atmosphere concerning the feeding form. It is influenced by sex, age, gonad maturity stage, type of fish species, food availability, physical factors, and physiology of fish and season of samplings, stress, and other water quality parameters. Once the condition factor value is higher, it shows that the fish has attained a better condition **(Oso and Iwalaye, 2016, Anyanwu *et al.*, 2007, Khallaf *et al.*, 2003**, **Nehemia A, *et al.*, 2012**). Therefore, this article was conducted to investigate the length-weight relationship and the condition factor of three commercial fish species at the Juba fish landing site to estimate their growth pattern and health conditions.

2. MATERIALS AND METHODS

2.1 Study Area:

The study was carried out at Juba fish landing sites, west north of Juba international airport. Juba is located between latitudes 4˚. 51 32 39 ˚N and longitude 31˚. 35 59 99 ˚E. It has been the capital of southern Sudan before the independence, and now it is the capital and biggest city of South Sudan, it also serves as the capital of Central Equatoria. The climate of Juba has a tropical wet and dry climate, and as it lies near the equator, temperatures are hot year-round. However, little rain falls from November to March, which is also the time of the year with the hottest maximum temperatures, reaching 38 °C (100 °F) in February. From April to October, more than 100 millimeters (3.9 in) of rain falls per month. The annual total precipitation is nearly 1,000 mm (39 in).

2.2 Fish Sample Collections

A total of 1800 specimens of the three species were collected from the Juba landing site for each commercially essential species*; Distichodus niloticus, Oreochromis niloticus, Heterotis niloticus* belong to three different families, *Distichodontidae, Cichlidade, Osteoglossidae*. Sampling was done from 1000g to 4500g. Fish weights were taken using sensitive digital balance and recorded in gram (0.g) for each sample. The total length (T.L.) of every specimen was measured in centimeters by measuring tape (100 cm) starting at the tip of snout to the end of caudal fin using measuring board.

2.3 Determination of Total Length and Weight

Length-weight relationship was calculated separately for each selected fish species. The length -weight relationship was calculated by using cubighc law suggested by (**Le Cren 1951**) revised and confirmed by **Ricker (1975).**

As the following:

$$W = aL^b$$

Whereas:

Whereas W is the total body weight of fish in grams, L is the total length in centimeters; parameter a is the intercept and b, is the exponent or regression slope.

Parameters a and b of the weight-length relationship was estimated by linear regression analysis based on logarithms:

$$\log(W) = \log(a) + b \log(L)$$

The 95% confidence limits of parameters a and b and the coefficient of determination were also calculated.

2.4 Condition factor

The condition factor (k) value was calculated with the help of following formula suggested by **(Offem et al. 2009, Adeyemi SO, 2014**), as follows:

$$K = W \times 100 / L^3$$

K is the condition factor, L is the total length (cm), and W is the total body weight (g).

2.5 Statistical analysis

This study's data were analyzed statistically using a statistical computer package for social science SPSS (version 21). Correlation and linear regression, as described by Gomez and Gomez (1984).

3. Results and Discussion

The length-weight association and condition factor of three commercial fish representing three families were determined in this study. Sample size (N), body weight, body length, length-weight relationships, parameters a and b, the slope's standard error, and the coefficient of determination r^2 are shown in table 1.2. The means length for *Distichodus niloticus, Heterotis niloticus, Oreochromis niloticus, were* 51.24±11.78, 57.66±13.91, and 34.96±4.10, respectively. While means weight for *Distichodus niloticus, Heterotis niloticus, Oreochromis niloticus,* 306 ± 828.67, 2488 ± 962.91 and 1550 ±370.69 respectively. There was a significant different at the level ($p<0.05$). Length–weight relationship is commonly used as a model to predict fish weights from fish lengths and it reveals the wellbeing of individual fish and determines the possible

differences between separate unit stocks of the same species **(King, 2007; Beyer, 1987, Ujjania *et al*. (2012).** Length-weight relationship slope (b) value ranged from 1.70, 1.60, and 1.55 for *Distichodus niloticus, Heterotis niloticus, Oreochromis niloticus*, respectively (Table 2 and (Fig 1, 2, and 3). Weight growth is isometric when the value of b is 3, and weight growth is allometric when the value of b differs from 3. Positive allometric b is greater than 3, whereas negative allometric b is far less than three growth type. The present results revealed that all the fish species showed negative allometries b less than 3. Similarly, when b is far less or greater than 3, growth in the fish is allometric, that is, the fish becomes thinner with an increase in length **(Bagenal T B and A T Tesch,1978, King, R.P. 1996, Ricker, W.E, 1973 and Sandon, 1950).** The difference in b values can be attributed to the combination of one or more factors such as the number of specimens examined, area / seasonal effect, habitat, water condition, degree of stomach fullness, gonadal maturity, sex, health and general fish condition, preservation technique, and differences in the observed length ranges of the specimens caught **(Wooten, 1998, Sarka, U.K. 2012),** all of these were not accounted in this study. All linear regressions were statistically significant (P<0.05). The `r` value ranged from 0.964 to 0.889 indicated a robust linear relationship between length and weight. The coefficient of determination was also high (r^2 = 0.929, 0.905, and 0.789 for *Distichodus niloticus, Heterotis niloticus, Oreochromis niloticus*, respectively. The coefficient of determination (r^2) values of all fish species revealed strong relationships between length and weight. It agrees with previous studies on different fish species from various water bodies **(Tah et al., 2012; Konan et al., 2007; Koffi et al., 2014; Konan, 2017).**

Table (1): The length and weight of the three species

No	Measurements Species	N	Body Length (cm)			Bodyweight (g)		
			Min	Max	Means ± S.D	Min	Max	Means ± S.D
1	*Distichodus niloticus*	600	33	73	51.24 ± 11.78	1000	3700	2306 ± 828.67
2	*Heterotis niloticus*	600	35	80	57.66±13.91	1000	2100	2488 ± 962.91
3	*Oreochromis niloticus*	600	28	41	34.96±4.10	1000	4500	1550 ±370.69

N = number of samples, Min = Minimum, Max = Maximum, S.D = Standard Deviation

Table (2): Regression parameters of the length-weight relationship of three commercial species.

No	Species	N	Log a	Log b	Se (b)	r^2	r	p-value	Growth type
1	*Distichodus nilooticus*	600	0.44	1.70	0.048	0.929	0.964	0.00a	Negative allometric
2	*Oreochromis niloticus*	600	0.57	1.60	0.058	0.905	0.949	0.00a	Negative allometric
3	*Heterotis niloticus*	600	0.79	1.55	0.053	0.789	0.889	0.00a	Negative allometric

Log W=log a+log b L of the four species of family Mugilidae. Length (L) in cm; Weight (W) in g; N=sample size, [a,] significant at 5% level (p<0.05).

Table (3): Condition factor (K) of different species. Total Bodyweight (g).

No	Species	N	Length range (cm)		Body weight range (g)		Condition factor (K) Range		Mean K value
			Min	Max	Min	Max	Min	Max	
1	*Distichodus niloticus*	600	33	73	1000	3700	0.93	2.78	1.80±0.53
2	*Heterotis niloticus*	600	35	80	1000	2100	0.78	2.39	1.40±0.51
3	*Oreochromis niloticus*	600	28	41	1000	4500	2.90	4.81	3.63±0.34

N=sample size, Length (L) in centimeters; Weight (Wt) in grams, (K), condition factor, [a] significant at 5% level ($p<0.05$).

The condition factor (K) ranged from (0.93 to 2.78), (0.78 to 2.39), and (2.90 to 4.81) for *Distichodus niloticus, Heterotis niloticus, Oreochromis niloticus* respectively. While the mean values were 1.80±0.53, 1.40±0.51 and 3.63±0.34 for *Distichodus niloticus, Heterotis niloticus, Oreochromis niloticus,* respectively, as shown in Table 3. All the fish species in the different families in the present study had condition factors ≥ 1. They were within good condition and normal ranges recommended by **Bagenal and Tesch 1978, Busacker *et al.* 1990, Ujjania *et al*. (2012),** who stated that a condition factor greater or equal to one is good, indicating a good level of feeding, and proper environmental condition.

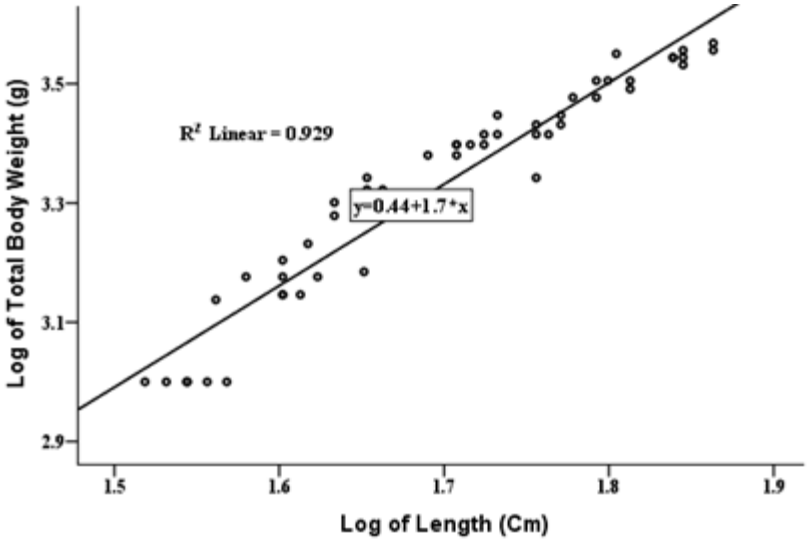

Figure (1): Length-weight Relationship of *Distichodus niloticus Function Y=a+b*X*

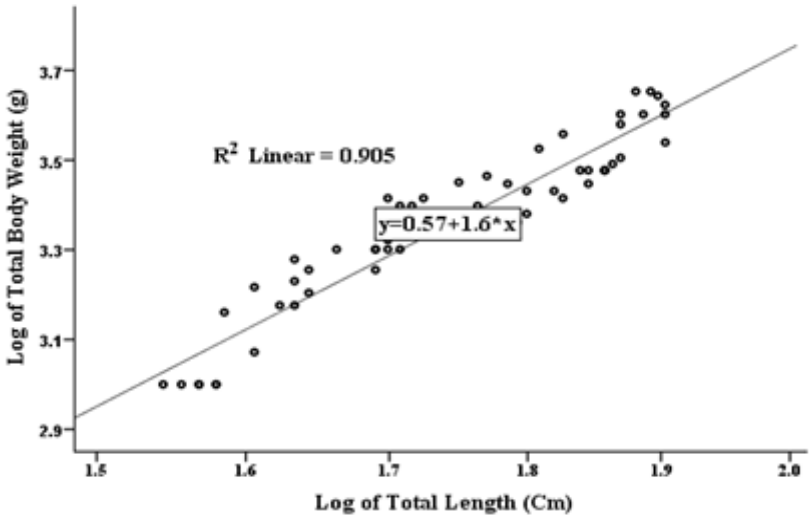

Figure (2): Length-weight Relationship of *Heterotis niloticus* Function Y=a+b*X

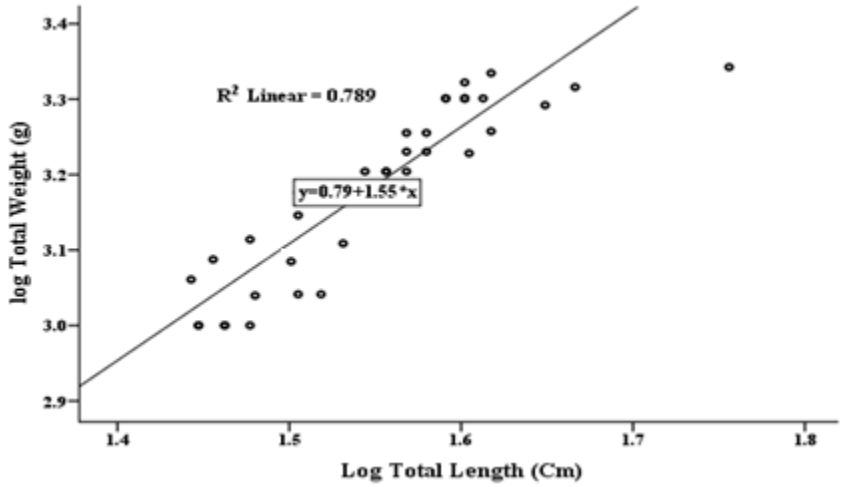

Figure (3): Length-weight Relationship of *Oreochromis niloticus* Function Y=a+b*X

4. CONCLUSION

This article was carried out to provide information on the length-weight relationship and condition factor of the three commercial fish species in Juba, South Sudan. The results revealed that all the fish species showed a negative allometric growth pattern for sampling was done in spawning periods. The condition factor 'K' value indicated that all fish species were in the right conditions and responding well to environmental conditions. The research recommended that population assessment on fisheries resources in the area should know the status of fishes.

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