LENGTH-WEIGHT RELATIONSHIP AND CONDITION FACTOR OF *Hemichromis fasciatus* (Peters, 1857) AND *Tilapia melanopleura* THYS VAN DE (Dumeril, 1859) IN KONTAGORA RESERVOIR, NIGER STATE, NIGERIA

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Abstract

The length-weight relationship and condition factor of *Hemichromis fasciatus* and *Tilapia melanopleura* in Kontagora Reservoir were studied. Two thousand eight hundred and seventy-two specimens were collected between January and December 2007 using a fleet of graded experimental gill nets and analysed. The parameters *a* and *b* of the length-weight relationship and condition factor *K* are presented for the fish species. The value of *b* varied between 3.093 and 3.312, with the mean $b = 3.203 \pm 2.07$ at $p < 0.05$ and the *K*-values significantly ($p < 0.05$) ranged between 2.76 and 4.14. This indicates that the two species had positive correlation and positive allometric growth, with the rate of increase in body length being proportional to the rate of increase in body weight. The condition of the lake is favourable for the survival and growth of the fish species.

Keywords: length-weight, condition factor, cichlids, Kontagora Reservoir, Nigeria.

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Introduction

Hemichromis fasciatus and *Tilapia melanopleura* (Fam: Cichlidae) are important freshwater species of Nigeria, and a large number are found inhabiting Kontagora Reservoir, in Niger State, Nigeria, where they are of economic importance.

Fishes in tropical water bodies usually experience frequency fluctuations in growth, due to certain factors. According to Mshelia *et al* 2008, some of the factors include environmental changes, availability of food and spawning rate. The knowledge of the length-weight relationship is very essential in assessing the influence of the above mentioned factors (Kulbicki *et al* 1993). The use of the length-weight relationship (LWR) make possible the estimation of the mean weight of fish of a given body length, determination of condition factors (as index of relative well-being of fish) and conversion of length-growth models to corresponding weight-growth models (Tylor and Gallucci, 1980; Bolger and Coinnolly, 1989; Kulbicki *et al* 1993).

This study examined the length-weight relationships and condition factor of *H. fasciatus* and *T. melanopleura*, in Kontagora Reservoir, as it is one of the important requirements for fishery management purposes.

Materials and methods

Study area

Kontagora Reservoir lies in the Northern Guinea Savannah zone between Latitude 3° 20' and 7° 40' East and Longitude 8° and 11°3' (Figure 1), the climate is characterized by distinct dry and wet season. The reservoir located on River Kontagora, a seasonal river, has a surface area of 143 km^2 and a total storage capacity of 17.7 million cubic metres. The height of the reservoir is 20 metres and the crest length is 1,000 metres. For the purpose of this study, three sampling stations were located on the reservoir: the southern basin of the reservoir (I), the middle of the reservoir (II) and the northern part of the reservoir (III)

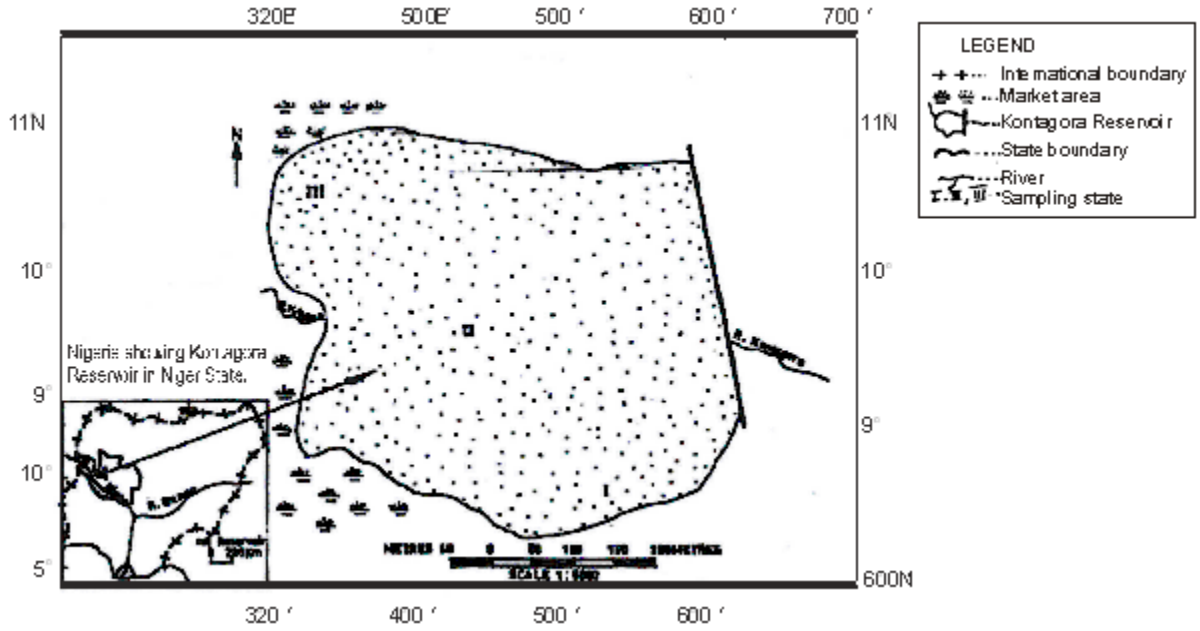

Figure 1: Map of Kontagora Reserve at Tunga Kowa.
(*Source:* Niger State Ministry of Land and Survey, Kontagora Area Office.)

Fish samples were collected monthly from January, 2007 to December, 2007, from the three sampling stations on the reservoir, using a fleet of graded experimental gill net, made up of nine multifilament nets of 25.4 mm, 38.1, 50.8, 63.5, 76.2, 88.9, 101.6, 127.0 and 177.8 mm stretched meshes. The nets were used to sample the shore, surface and bottom waters, at the sampling stations on the reservoir. The nets were set daily at 5 p.m. and checked at 8 a.m. the next day and cover a period of 14 hours.

Fish samples were identified, weighed at the landing sites to the nearest grams with a weighing balance. Total lengths (TL, cm) were also measured using a measuring board.

The length-weight relationship of each species was calculated using the formula described by Le-Cren (1951):

$$W = aL^b \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

The data were transformed into logarithms before the calculations were made. The logarithm transformed data will give the linear regression equation:

Thus, equation (1) was transformed into:

$$\text{Log } W = \text{Log } a + b \text{ Log } L \quad \ldots\ldots\ldots\ldots \quad (2)$$

Where, W = Weight of fish (gm).
L = Total length of fish (cm).
a = Constant.
and, *b* = an exponent (Regression coefficient).

The condition factor *K* was calculated for each species using the relationship described by Ikomi and Odum (1998):

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

Where, *K* = Condition factor.
W = Weight of the fish (gm).
and L = Total length of the fish (cm).

Results

The number of fish species caught, the mean total length and the mean weight of *H. fasciatus* and *T. melanopleura,* were presented in Table 1. The total number of fish caught was two thousand, eight hundred and seventy two, and *H. fasciatus* was the most abundant species *n* = 1886*, n* = 986 for *H. fasciatus* and *T. melanopleura* respectively. The mean total length of 8.35 cm ± 1.42 was recorded for *H. fasciatus* with a range of 7.20-8.90 cm, while *T. melanopleura* recorded the mean total length of 10.33 cm ± 4.24, with a range of 8.60-14.30 cm. The mean weight for *H. fasciatus* was 16.81 gm ± 3.42, with a range of 10.90-19.10 gm, while *T. melanopleura* recorded mean weight of 93.46 gm ± 6-42, with a range of 28.0-168.50 gm.

Table 1: Total length and weight of *H. fasciatus* and *T. melanopleura* in Kontagora Reservoir, Niger State, Nigeria. (January-December, 2007).

Month	*n* ***H. Fasciatus***	***T. Melano Pleura***	**MTL(cm)± S.D** ***H. Fasciatus***	***T. Melano Pleura***	**Mwt.(gm) ± S.D** ***H. Fasciatus***	***T. Melano Pleura***
January	82	52	8.80± 1.41	9.60±4.24	11.80±3.41	30.20±15.56
February	106	41	7.20±1.40	8.70±4.22	11.20±3.41	36.30±14.46
March	122	63	8.90±1.43	8.60±4.23	10.90±3.40	28.0±13.46
April	118	51	8.60±1.41	9.20±4.22	12.40±3.43	68.0±12.42
May	98	46	7.60±1.43	10.10±4.22	16.20±3.42	86.20±14.62
June	111	42	8.20±1.40	10.30±4.21	13.40±3.41	46.30±14.42
July	162	86	8.80±1.41	8.80±4.20	15.10±3.43	68.40±15.62
August	293	126	8.60±1.39	14.30±4.24	19.10±3.44	168.50±23.42
September	182	85	8.90±1.42	12.60±4.24	16.20±3.42	162.50±18.62
October	192	110	8.50±1.40	13.40±4.22	12.40±3.40	134.0±16.42
November	234	124	7.60±1.40	8.60±4.23	18.20±3.43	146.50±19.43
December	186	160	8.60±1.42	9.80±4.24	16.30±3.40	146.20±18.62
Total	1886	986	–	–	–	–
Mean±SD	--	--	8.35±1.42	10.33±4.24	16.81±3.42	93.46±16.42
Range	--	--	7.20 – 8.90	8.60-14.30	10.90-19.10	28.0-168.50

n – Number of fish. MTL – Mean Total Length (cm). Mwt. – Mean weight (gm). ±SD – Standard Deviation.

The log, weight-log length relationship for *H. fasciatus* and *T. melanopleura* is presented in Figures 2 and 3 respectively. The least square common fit of the transformed data gave the following linear equation for *H. fasciatus*: log Y = 6.8547X-38. 283 (*n* = 1886, *r* = 0.8949) and *T. melanopleura*: log Y = 20.236X-157.75 (*n* = 986, *r* = 0.8915).

The parameters *a, b* and *r* of the length-weight relationship and condition factor *K* of *H. fasciatus* and *T. melanopleura* are presented in Table 2. The mean value of *b* recorded for both *H. fasciatus* and *T. melanopleura* was 3.093 ± 2.11 and 3.312 ± 2.02 respectively. The condition factor *K* for the species were significantly different, and it ranged between 2.52-2.97(2.76±2.12) for *H. fasciatus* and 3.61-4.66 (4.14±1.62) for *T. melanopleura* . The condition factor *K*-values were higher in the months of May-September for the species, and this corresponds with the rainy season. This implies that the rainy season values of condition factor were higher than the values during dry season. The mean correlation coefficient value *r* was 0.8949 and 0.8915 for *H. fasciatus* and *T. melanopleura* respectively.

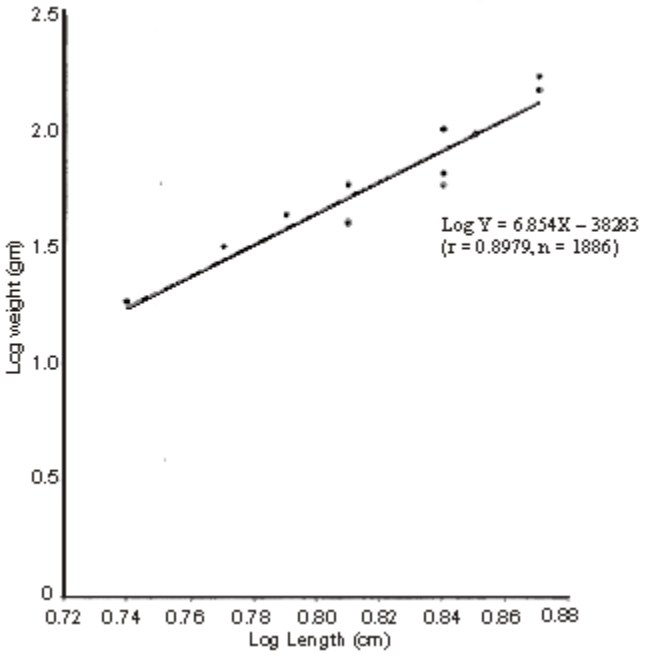

Figure 2: Length-weight relationship of *H. fasciatus* in Kontagora Reservoir (Jan. 2007-Dec. 2007).

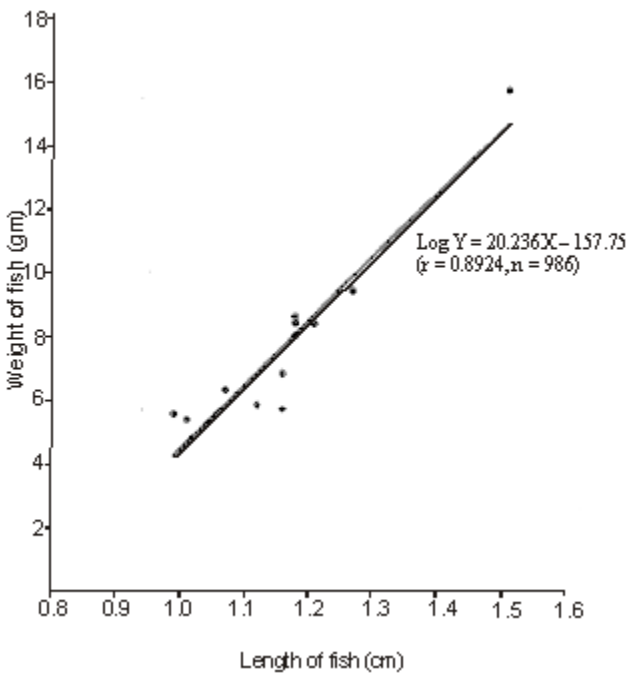

Figure 3: Length-weight relationship of *T. melanopleura* in Kontagora Reservoir (Jan. 2007-Dec. 2007).

Table 2: Length-weight relationship parameters and mean condition factor of *H. fasciatus* and *T. melanopleura* (Fam: Cichlidae) in Kontagora Reservoir, Niger State, Nigeria (January-December, 2007).

Month	*a*		*b*		*r*		K ± SD	
	H. Fasciatus	***T. Melano Pleura***	***H. Fasciatus***	***T. Melano Pleura***	***H. Fasciatus***	***T. Melano Pleura***	***H. Fasciatus***	***T. Melano Pleura***
January	0.0064	0.0072	3.112	3.310	0.8979	0.8921	2.81±2.31	3.65±1.56
February	0.0069	0.0074	3.114	3.314	0.8671	0.8924	2.52±2.10	3.61±1.61
March	0.0056	0.0069	3.112	3.312	0.8972	0.8922	2.64±2.10	4.42±1.59
April	0.0062	0.0071	3.002	3.311	0.8976	0.8862	2.66±2.14	3.80±1.60
May	0.0058	0.0073	3.113	3.310	0.8973	0.8912	2.79±2.12	4.61±1.68
June	0.0063	0.0068	3.111	3.313	0.8974	0.8920	2.84±2.11	4.64±1.62
July	0.0068	0.0072	3.112	3.314	0.8975	0.8924	2.96±2.13	4.62±1.62
August	0.0062	0.0071	3.001	3.308	0.8972	0.8922	2.97±2.14	4.66±1.63
September	0.0064	0.0066	3.115	3.310	0.8978	0.8910	2.94±2.10	4.58±1.65
October	0.0061	0.0075	3.113	3.312	0.8971	0.8920	2.62±2.12	3.65±1.62
November	0.0067	0.0072	3.102	3.311	0.8976	0.8921	2.66±2.09	3.82±1.61
December	0.0063	0.0073	3.112	3.313	0.8971	0.8923	2.71±2.11	3.62±1.60
Mean	0.0063	0.0071	3.093	3.312	0.8949	0.8915	2.92	4.48
± SD	±2.13	±1.43	±2.11	±2.02	±1.62	±1.41	±2.12	±1.62

a – Regression intercept. *b* – Regression coefficient. *r* – Correlation coefficient. *K*– Condition factor
SD – Standard Deviation.

Table 3: ANOVA showing variations of the condition factor *K* in the sampling stations, species, seasons and size of the fish for the year 2007 (January-December, 2007).

Sources of variation	*Df*	Condition factor *K*	Length of fish (cm)	Weight of fish (gm)
Factors	27	1.28^{xx}	27.6^{xx}	$2,866.3^{xx}$
Species	2	3.42^{xx}	14.72^{xx}	$3,918.5^{xx}$
Size	2	1.52^{xx}	7.02^{xx}	$3,735.7^{xx}$
Station	2	1.32^{x}	14.9^{x}	$9,759.8^{x}$
Season	1	2.48^{xx}	14.01^{xx}	$27,954.4^{x}$
Season X Species	1	1.21^{x}	8.10^{x}	$3,660.8^{x}$
Season X Station	2	1.34^{x}	19.8^{x}	$120,065.4^{xx}$
Size X Species	5	1.42^{x}	12.6^{x}	$30,723.2^{x}$
Species X Station	2	2.32^{x}	2.0^{ns}	$2,071.1^{ns}$
Size X Station	2	1.64^{x}	9.3^{x}	$18,247.8^{x}$
Season X Species X Station	4	1.12^{ns}	1.9^{ns}	$15,289.2^{xx}$
Size X Species X Station	4	1.06^{ns}	2.4^{ns}	$44,435.2^{xx}$
Error	22	1.16	106	18,695.1

X – Significant (p<0.05).
XX – Highly Significant (p<0.01).
ns – Non Significant (p>0.05).

Table 3, analysis of variance (ANOVA), showed variation of the condition factor *K* with species, season, size and sampling stations for the year 2007 sampling period (January-December, 2007). It showed that there was significant variation (p<0.05), in the condition factor among the species of fish, sampling station, season and size of fish. Table 3, showed that the interaction between season and species showed a significant variation (p<0.05) in the condition factor, likewise the interaction between season and station, size and species, species and station, and, size and station showed significant variation (p<0.05) in the condition factor *K*.

However, the interaction between season, species and station showed no significant variation in the condition factor *K* (p>0.05), likewise the interaction between size, species and station. When considering the length of fish, the analysis of variance (ANOVA) (Table 3), showed that the interaction between the species and station showed no significant variation (p>0.05), likewise the interaction between season, species and station, as well as the interaction between size, species and station. The analysis of variance (ANOVA) (Table 3), when considering the weight of fish showed significant variation (p<0.05) among species, station, season and size. The interaction between season and species, season and station, size and species, and, size and station showed significant variation (p<0.05) for the year 2007 sampling period. A non significant variation (p>0.05) existed in the interaction between species and station for the year 2007.

Discussion

Efficient sampling was carried out in this study using experimental gill nets of various mesh sizes, so as to include the widest possible range of lengths, generally obtainable with large samples. The differences in fish sizes show that the fish populations ranged from immature specimens to fully matured ones. This also suggests differences in their growth (Fafioye and Oluajo, 2005). The minimum fish total length (TL) of 7.20 cm recorded by *H. fasciatus* in the samples may be due to the selectivity of the mesh sizes of the nets used in the sampling.

The *b*-values of 3.093 and 3.312 recorded for *H. fasciatus* and *T. melanopleura* respectively, shows that the rate of increase in body length is proportional to the rate of increase in body weight. This is a positive allometric growth based on Bagenal and Tesh (1978)

and, Pauly (1984). Yem *et al* (2007), also obtained *b* value 3.442 for *H. fasciatus* in Kainji Lake, indicating a positive allometric growth that is as the fish increases in length, the heavier it becomes. Adikwu and Zaki (2001), recorded *b* value of 3.2 for *H. fasciatus* in the study of length-weight relationship of endemic fish species in Hadeija-Nguru wet land. Similar values of *b* were obtained for *Chysichthys walkeri* (3.114), *C. nigriodigitatus* (3.042) and *Ethmalosa fimbriata* (3.210), showing positive allometric growths (Fafioye and Oluajo, 2005). Abdallah (2002), recorded *b* values of between 2.5 to 3.44 for fishes studied in different marine bodies. Pauly and Gayannilo (1997), reported that *b* value may ranged from 2.5 to 3.5, which suggest that the result of this study is valid.

The correlation coefficient value *r* was high for both *H. fasciatus* (r = 0.8949) and *T. melanopleura* (r = 0.8915), which indicated a high positive correlation. This result was similar to length-weight relationship with a high correlation coefficient value *r* of 0.9313 recorded for *Pellonula afzeliusi* from Lagos Lagoon (Ikusemiju *et al* 1983).

The differences in weight of *H. fasciatus* and *T. melanopleura*, may be due to the individual condition factor *K*, which relates to their well being and degree of fatness (Pauly, 1983, Ikom and Odum, 1998). The condition factor value *K* of 2.92±2.12 and 4.48±1.62 obtained for *H. fasciatus* and *T. melanopleura* species respectively, are within the range (2.9-4.8) documented by Bagenal and Tesch (1978) for mature freshwater fish. This suggests that the condition of Kontagora Reservoir in comparison to other freshwater bodies like Kainji Lake, Hadeija-Nguru wetlands and Zaria Reservoir, are favourable for the survival of the fishes in the reservoir, irrespective of the season. Yem *et al* (2007) and Komolafe and Arawomo (2011), recorded a condition factor value range of 0.67-2.42 for the Cichlid *H. fasciatus* in Kainji Lake and 2.29-2.50 for Cichlid *T. melanopleura* in Erinle Lake, Osun State respectively, compare to the present study with a range of 2.92-4.48. This value is greater than 1, which indicates that the fish is also doing well in Kainji Lake, as it does in Kontagora Reservoir, but the value less than 2.9-4.8 documented by Bagenal and Tesch (1978), for mature freshwater fish. The differences could be due to variation in the weight of individual fish sample and period of sampling. However, Meye and Ikomi (2011), in the study of Cichlids in River Orogodo, Delta State, Nigeria obtained negative allometric growth pattern, with condition factor range of 2.0-3.60 for *H. fasciatus*, when compared with the present study. Although the condtion factor increases with the individual length of the fish species (Meye and Ikomi , 2011).

In conclusion, the result of this study shows that *H. fasciatus* and *T. melanopleura* exhibited positive allometric growth in Kontagora Reservoir, and the reservoir had favourable water environment for their growth and survival.

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