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Length-weight relationships and condition factor of four fish species in Lake Tatabu, Niger State, Nigeria

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Abstract

Length-weight relationship and condition factor of 640 fish populations covering four families, 4 genera and 4 species from Lake Tatabu were studied. The fishes (*Synodontis membranaceus*, *Hydrocynus forskalis*, *Auchenoglanis occidentalis* and *Lates niloticus*) were obtained from two different fish landing sites along the lake from November 2014 – February 2015. The regression constant (a) and allometric coefficient (b) extrapolated from the length-weight relationship $W = aL^b$ and condition factor (k) are presented for the four fish species. The b values range between 1.86 - 3.17 with mean value of 2.67 while the K value varied between 1.05 - 2.89 and with mean value of 1.78. Of the four fish species, *Lates niloticus* showed isometric growth while the others depicts allometry growth pattern.

Key words: Lake Tatabu, condition factor, growth pattern.

Introduction

Fisheries management and research often requires the use of biometric relationship in order to transform data collected in the field into appropriate indices (Ecoutin *et al.*, 2005). Length - weight relationship (LWR) of fishes are important in fisheries and fish biology because it allows the estimation of the average weight of the fish of a given length group by establishing a mathematical relationship between them (Mir *et al.*, 2012). Like any other morphometric characters the length - weight relationship can be used as a character for the differentiation of taxonomic unit and the relationship changes with various developmental events in life, such as, metamorphosis, growth, and on set of maturity (Thomas *et al.*, 2003). Beside this, LWR can also be used in setting yield - equation for estimating the number of fish landed and comparing the population in space and time. Condition factor refers to the wellbeing of a certain species and its degree of its fatness, which depends on the weight of fish sampled. Different values of the condition factor of a fish indicate the sexual maturity, the degree of food source availability, age and the system of the environment. It also reflects the effect of environmental changes on the fish species. The length -weight relationships and condition factor of several fish species in Nigerian waters have been documented. Ikongbeh *et al.* (2013) studied the length- weight relationship and condition factor of *Auchenoglanis occidentalis* from Lake Akata in Benue, while Akombo *et al.* (2011) examined the growth patterns of four species of *Synodontis* from the lower Benue River in Markudi. Growth pattern of the Nile perch (*Lates niloticus*) from river Rima in Northwest Nigeria (Shinkafi *et al.*, 2013) and two *Alestes* species in river Benue (Ogbe *et al.*, 2008) has also been documented. *Synodontis membranaceus*, *Hydrocynus forskalis*, *Auchenoglanis occidentalis* and *Lates niloticus*, forms parts of the important commercial catches in Tatabu Lake (Daddy and Falaye, 2005) and in Nigerian inland waters. There is dearth of information on the biology of these fish species in Tatabu Lake. This present study therefore examines the Length -weight relationships and condition factor of these fish species in order to determine their growth pattern and suitability of the environment for their growth and reproduction in this lake.

Materials and Methods

Description of study area:

Lake Tatabu (also called Ndakolowu Lake) is a floodplain lake of the River Niger downstream of Jebba Dam. It is located between 9° 12' - 9° 14' N and 4° 52' - 4° 58' E, about 24 km from Jebba with a surface area of about 9 km² which was reduced to about 3 km² after the damming of the Niger at Kainji and Jebba. Besides the Niger River, three other streams (Ebigi, Gbwadwa and Lyantelya) running in a south easternly direction empty into the flood plain, two of these are seasonal streams. The new flood regime in the middle Niger (Jebba - Lokoja), after the construction of the Kainji and Jebba Dams, has a regulated flow all year round with a reduced white flood and higher flow rates than previously during off-flood periods (Ita, 1993). The resultant effect of the changed flood regime on Tatabu Lake was the silting and gradual obliteration of the lake. The lake was later refilled in 1988 by the National Institute of Freshwater Fisheries Research (NIFFR) to give open water extending over 3 km and the species diversity increased to about 25 species of fishes (Daddy and Falaye, 2004). At high water, the ecosystems cover about 700 hectares and the lake serves three small fishing communities; Tatabu and Tsafa to the west and Bachwa to the east. Fishing constitutes the principal economic activity of the communities around the lake and gillnet, usually of 1.5" - 4" mesh, are used by the local fishermen and very rarely are hooks used.

Sample collection:

A total of 640 fishes which comprises of 160 samples each of *Synodontis membranaceus*, *Hydrocynus forskalis*, *Auchenoglanis occidentalis* and *Lates niloticus* were purchased from two different landing sites directly from the fishermen between November – February 2015. Forty samples of each species were collected randomly every month and samples were transported to the research laboratory in plastic containers containing ice blocks to prevent spoilage and keep the fish fresh.

Total length (cm) of each fish was taken from the tip of the snout (mouth closed) to the extended tip of the caudal fin using a measuring board. Body weight was measured to the nearest gram using a top loading Metler balance, while sex of each sample determined by visual examination of the genitals was recorded. The length-weight relationship (LWR) was estimated from the equation: $W = aL^b$. The values of the regression constant (a) and the allometric coefficient (b) were computed from the log transformed values of length and weight i.e. $\log W = \log a + b \log L$, via least square linear regression. The condition factor (K) was calculated from the equation: $100W/L^3$.

Results

Tatabu Lake is tabulated in Table 1. The total lengths ranged from 9.3- 44.8cm while the weights were between 15.2 - 840g. The largest species was *Hydrocynus forskalis* with total length (TL) ranging from 27.5 - 44.8cm and weight (Wt) between 15.2 - 840g while the smallest was *Auchenoglanis occidentalis* with TL range of 14.2 - 30.4cm and WT between 33.4- 333.1g. The correlation coefficient (b) and condition factor (K) obtained for all species under study is shown in Table 2. The b values ranged from 1.86 – 3.17 with mean value of 2.68 while the K value which ranges from 1.05 – 2.89 had a mean value of 1.78 ± 0.26 when all the four species were considered. *Lates niloticus* had the highest condition factor in the four fish species examined in this study in Tatabu Lake. Sex ratio were within the range of 1:1.05 - 1:1.42 which did not differ from the expected 1:1 ratio

Table 1: Ranges and mean values of total length and body weight of the fish species of from Tatabu Lake

Family	Species	Total Length (TL) (cm)		Total Weight (Wt) (g)	
		Range	Mean	Range	Mean
Bagridae	<i>Synodontis nigrodigidatus</i>	22 - 33.4	27.6 ± 2.32	143.42– 393.1	267.2 ± 56.6
Clarotidae	<i>Auchenoglanis occidentalis</i>	14.2 – 30.4	23.47 ± 6.09	34.4 – 333.1	163.75 ± 126.73
Centropomidae	<i>Lates niloticus</i>	9.3– 34.3	20.81 ± 7.4	15.2 – 750	263.1 ± 223.3
Alestadidae	<i>Hydrocynus forskalis</i>	27.5 – 44.8	33.85 ± 0.56	150 – 840	402 ± 28.21

Table 2: Length-weight relationship of the four freshwater fishes from Tatabu Lake

Table 2. Length-weight relationship of the four freshwater fishes from Tatabu Lake							
Family	Species			Sex		Correlation Coefficient (r)	Condition Factor (K)
		a	b	M	F		
Bagridae	<i>Synodontis nigrodigidatus</i>	0.12	2.69	47	33	0.827	1.27 ± 0.23
Clarotidae	<i>Auchenoglanis occidentalis</i>	0.19	3.17	43	37	0.967	1.9 ± 0.31
Centropomidae	<i>Lates niloticus</i>	0.043	2.96	46	34	0.942	2.89 ± 0.45
Alestidae	<i>Hydrocynus forskalis</i>	0.29	1.86	39	41	0.652	1.05 ± 0.08

a= regression constant; b= allometric coefficient; M= male; F= female.

Discussion

The length- weight distributions of the four different species of freshwater fishes from the two landing sites in the lake showed considerably variations in fish sizes indicating that sampling by fishermen with gill nets were carried out efficiently. This also suggests differences in their growth (Frota *et al.*, 2004). The slope (b) of the L-W regression line of the different fish species were between 1.86 - 3.17, while the K value were all above 1 (1.05 - 2.89) and the correlation coefficient (r) which ranged from 0.65 - 0.967 was high and positive for all the four species examined in Tatabu lake which indicates that the length increases with increase in weight of the fishes. In this present study, the growth pattern of *Synodontis membranaceus* and *Hydrocynus forskalis* shows negative allometry, the exponential growth "b" being much less than 3 while that of *Auchenoglanis occidentalis* exhibited positive allometric growth pattern ($b > 3$) which showed that the rate of increase in body length is not proportional to the rate of increase in body weight. Growth in *L. niloticus* in this study was isometric with b value of 2.96 which shows that length and weight of the fish increases proportionally. The negative allometric growth pattern obtained in *S. membranaceus* in this study which falls within the range of 2.5- 3.5 for most fishes (Pauly and Gayanilo, 1997) is in line with those obtained in study on three different species of *Synodontis* in lower Benue river (Akombo *et al.*, 2001) and in *S. Schall* in Asa dam (Adedeji and Araoye, 2005) but the condition factor (1.27) in this present study was higher than that of the lower Benue river which implies that Tatabu flood plain may be much more conducive for the growth of this fish species. The b value of *H. forskalis* (1.89) obtained in this study was higher than value of 1.12 for the same fish in another study in river Benue (Ogbe *et al.*, 2008) and were comparative lower than 2.99 reported in those from Jebel, Aulia dam in Sudan (Ahmed and Fathi, 2013). This could probably be associated with the difference in geographical location. Isometric growth has however been reported in *Hydrocynus forskalis* in the Lake Chad basin (Bauchot and Bauchot, 1978) and lake Kariba (Kolding *et al.*, 1992). Positive allometric growth and condition factor greater than 1.0

has also been observed in *A. occidentalis* in Kotongora river (Ibrahim, 2012), however negative allometric growth (2.81) were reported in those from Akata lake (Ikongbeh *et al.*, 2013) and river Rima (Shinkafi and Ipinjolu, 2010). Allometric growth patterns have also been documented in several fishes in Nigeria inland water bodies (Olatunde, 1980; Udeh, *et al.*, 2011). The condition factor of *A. occidentalis* in Tatabu Lake as reported in this study was a bit higher than those from Lake Akata (Ikongbeh *et al.*, 2013) but lower than those reported in River Rima thus, suggesting the suitability of Tatabu Lake for the growth of *A. occidentalis* since K value is above 1.0 but not compared to river Rima. The exponential growth ($b = 2.98$) of *L. niloticus* observed in this study is close to that obtained in combined sex ($b = 3.09$) of the same fish in in River Rima (Shinkafi *et al.*, 2013) but the condition factor of the fishes in Tatabu Lake in this study was however considerably higher (2.89). Generally as the value of b increased, the size of the fish also increased because the fish usually grows proportionally in all directions. The value of " b " becomes greater than 3 when the fish becomes fatter or is lower than 3 when the fish is slimmer (Jobling, 2002). Length- weight relationships are not constant over the years and the parameters may vary significantly due to biological, food availability, temporal and sampling factors, health and sex (Freese, 2006) all of which were not considered in this study.

Conclusion

Samples were collected between November - February and so are not representative of the entire year and therefore the exponential growth values (b) and condition factor (k) should be considered as mean values for the Harmattan season. Further study is encouraged for the whole season of the year to obtain the mean annual values for the fish species in this Lake.

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