Agro-Science Journal of Tropical Agriculture, Food, Environment and Extension
Volume 16 Number 1 (January 2017) pp. 1 - 4
ISSN 1119-7455

LENGTH-WEIGHT RELATIONSHIP AND CONDITION FACTOR OF *Clarias gariepinus* AND *Oreochromis niloticus* OF WUDIL RIVER, KANO, NIGERIA

Getso, B.U., Abdullahi, J.M. and *Yola, I.A.

Department of Biological Sciences, Bayero University, Kano
Department of Biology, Kano University of Science and Technology,
Wudil, P.M.B. 3244, Kano, Nigeria

*Corresponding author's email: yolai2006@yahoo.co.uk

ABSTRACT

The length-weight relationship and condition factor of Clarias gariepinus and Oreochromis niloticus from four study sites (Marmara, Ruwan Jaki, Kogin Mada, and Ruwan Yan akuya sites respectively) in Wudil River, Kano State Nigeria was evaluated over a period of four weeks in December 2010. A total of 120 mature fish samples which were caught during the study period using drag net and traps, were immediately immersed in 10% formalin and transported to laboratory. The growth coefficient (b) obtained of the two fish species ranged from 0.1441 to 0.8058 for Oreochromis niloticus, and from 0.1173 to 0.5457 for Clarias gariepinus. The 'b' differed significantly ($p < 0.05$) from 3, indicating negative allometric growth for all fish species. The condition factor (K) ranged from 0.516 (Clarias gariepinus) from Marmara site, to 1.809 (Oreochromis niloticus) from Kogin Mada sampling site. The condition factors of all fish species sampled fall outside the range recommended as suitable for matured fresh water fish species in the tropics.

Key words: length-weight relationship, condition factor, *Clarias gariepinus, Oreochromis niloticus*, Wudil River

INTRODUCTION

Fish is any aquatic vertebrate animal that is covered with scales and equipped with two sets of paired fins and several unpaired fins (Helfman *et al.,* 1997). They are found in diverse habitats, particularly, fresh and salt waters throughout the world. There are few fishes which live partly in fresh water and partly in marine waters, but some of them prefer brackish water (Yadav, 2002). Length-weight relationship (LWR) is of great importance in fishery assessments Ayoade and Ikulala (2007). Length and weight measurements in conjunction with age data can give information on the fish stock, age maturity, life span, mortality, growth and reproduction (Kumar *et al.,* 2014). Length-weight relationship of fish is widely recognized as an important tool in fisheries science especially in ecology population dynamic and stock management (Abdoli and Rasooli, 2008). For the reason that, the relationship permits estimating the weight of a specimen easily when the total length is known, these relationships are useful when rapid estimation of biomass is necessary (Froese, 1998). The relationship of length-weight estimates condition factor of the fish species and fish biomass through the length frequency (Fishbase, 2013). The condition factor is an index reflecting interaction between biotic and abiotic factors in the physiological conditions of fishes. Therefore, the condition factor may vary among fish species in different locations (Blackwell *et al.,* 2000).

In fisheries science, the condition factor (K) is used to compare the "condition", i.e., fatness or wellbeing of fish (Seher and Suleyman, 2012). It is based on the hypothesis that heavier fish of a particular length are in a better physiological condition. It is also a useful index for monitoring feeding intensity, age, and growth rates in fish (Ujjania *et al*., 2012). Fish is said to exhibit isometric growth when length increases in equal proportion with body weight, the regression co-efficient for isometric growth is '3' and values greater than '3' indicates allometric growth (Olurin and Aderibigbe, 2006) Fishing is one of the most important occupations of the people within the area of Wudil River. The damming at Challawa Gorge and Bagauda, coupled with industrial effluents has seriously affected the quality of water and fish catch in Wudil River (Dambazau, 2007). Wudil River is the dominant drainage system in Wudil town, the river being located in the tropical savanna. The river has a wide, alluvial channel with beds lower than the beds of the tributary, and gully channels draining into it without a true flood plain, termed a storm channel (Olofin, 2005). Abdullahi *et al.* (2014) reported negative allometric

Please cite as: Getso, B.U., Abdullahi, J.M. and Yola, I.A. (2017). Length-weight relationship and condition factor of *Clarias gariepinus* and *Oreochromis niloticus* of Wudil River, Kano, Nigeria. *Agro-Science*, **16 (1),** 1-4. DOI: https://dx.doi.org/10.4314/as.v16il.1

growth of *Bagrus bayad* in wudil river, with no available information on *Clarias gariepinus* and *Oreochromis niloticus* This study was carried out with the aim of assessing the growth pattern of the two species of fish with the view of bridging the information gap on the condition of fish inhabiting the River.

MATERIALS AND METHODS

Study Area

Wudil Local Government Area is situated in the east-central area of Kano State Nigeria, with an estimated land area of 458 km^2. It is located between longitude 8˚ 45 E and 8˚ 57 E, as well as between latitude 11˚ 37 12˚ N and 11˚ 56 N. Wudil River also tributary of River Hadejia, gets it water from River Challawa and River Kano and their tributaries, and flows northeast as River Hadejia and finally into Lake Chad. The river is an important part of the Hadejia and the Jama' are river system. The river basin occupies a total land area of about 16386.0136 km^2 and is part of the inland drainage system of the Chad Basin (Olofin, 2005). Four study sites were selected along the course of Wudil River for the collection of fish samples namely Marmara site (MS), for the first week, Ruwan Jaki site (RJS), for the second week, Kogin Mada site (KMS), for the third week, and Ruwan Yan akuya site (RYS), for the fourth week.

Sampling of Fish

Due to low temperature the catch by the fishers was generally low as such a total of 120 fish samples belonging to two species (*Clarias gariepinus)* and *Oreochromis niloticus*) were collected randomly from the sampling sites between 9:00am-11:00am in December, 2010. The local fishermen operating at the river deployed drag net and traps for their catches. The fish samples caught were immediately immersed in 10% formalin and transported to the laboratory for identification using key provided by Fishbase (2013).

Data Collection and Analysis

The measurements of length (cm), weight (g) and the condition factor of individual fish sampled were recorded. The relationship between length and weight of the fish was examined by simple linear regression using WINKS software. The variations in the length-weight represented by 'b' were recorded. The total length (TL) of each fish was measured from the tip of snout (mouth closed) to end of the caudal fin using meter rule. Body weight was measured using electronic digital balance (OHAUS). The parameter of length-weight relationship of sampled fish species were evaluated using the equation:

$$W = aL^b \quad \text{(Rickter, 1973)} \qquad \text{(eq. 1)}$$

where, *W* is weight of fish (g), *L* is length of fish (cm), *a* is initial growth coefficient, and *b* is growth coefficient. The values of constant 'a' and 'b' were estimated after logarithmic transformation of eq. 1 using the least square linear regression as described by Zar (1984) to give:

$$\log_{10}W = \log_{10}a + b\log_{10}L \qquad \text{(eq. 2)}$$

The 95% confidence interval (CI) of 'b' was computed using the equation (Egbal *et al.,* 2011):

$$CI = b \pm (1.96 \times SE) \qquad \text{(eq. 3)}$$

where SE is the standard error of 'b'. The condition factor was calculated by the formula (Pauly, 1983):

$$\text{Condition Factor (K)} = 100W/L^3$$

where *W* is weight (g) and *L* is total length (cm).

RESULTS

This study analyzed the length-weight relationship of the two major fish species collected from Wudil River. Table 1 shows the number of specimen, maximum and minimum length, maximum and minimum weight and condition factors. The length weight relationship parameters 'a', 'b', 95% confidence interval for 'b' and the coefficient of determination (r^2) are presented in Table 2. *Oreocromis niloticus* had the highest number of fish sampled; N = 80 with total length (TL), ranging from 5.0 to 16.3cm, and weight ranging from 8.5 to 60.1 g. *Clarias gariepinus* was the least species of fish sampled N = 40 with range from 8.0 to 25.6 cm in TL, and weight ranging between 16.7 and 97.5 g. The species has the largest species recorded from Kogin Mada site. The variation in number of samples according to the fish species was largely due to availability during collection. The estimated allometry coefficient value (b) of *Oreocromis niloticus* ranged from 0.1441 in Marmara site to 0.8058 in Ruwan Jaki, while that of *Clarias gariepinus* ranged from 0.1173 in Ruwan Jaki site to 0.5457 in Kogin Mada. The growth coefficient (b) differed significantly from 3 at the level of sampled fish species ($p < 0.05$), which indicated that all the fish species had negative allometric growth. The value of r^2 varied from 0.9087 in *Clarias gariepinus* from Marmara site to 0.1421 also in the same species but from Ruwan Jaki sampling site. About 8% of the species had $r^2 > 0.90$, while the rest had r^2 value less than 0.90. The highest condition factor (K) (1.809) was observed in *Oreocromis niloticus* from Kogin Mada sampling site, while the lowest condition factor (0.516) was recorded in *Clarias gariepinus* from Marmara site.

Table 1: Values of length, weight and mean relative condition factor of *Oreochromis niloticus and Clarias gariepinus* collected from sampling sites in Wudil River

Specie	Site	N	Total length (cm)		Total weight (g)		K
			min	max	min	max	
O. niloticus	MS	20	11	16.3	19.3	60.1	1.53
	RJS	20	9	13.3	12.3	33.3	1.52
	KMS	20	5	15	10	52.1	1.81
	RYS	20	7.6	15.5	8.5	49	1.72
C. gariepinus	MS	10	17.5	22	22.1	68.2	0.52
	RJS	10	15.5	25.6	22.1	82.6	0.62
	KMS	10	8	24	16.7	97.5	0.83
	RYS	10	15.5	23	29.2	78	0.83

N - number of samples, min. - minimum, max. - maximum,
K - condition factor

Table 2: Computed parameters of length-weight relationship of *Oreochromis niloticus* and *Clarias gariepinus* in Wudil River

Species	Site	'a'	'b'	95%Cl	r^2	GP
O. niloticus	MS	0.88	0.14	0.22	0.43	NA
	RJS	-0.05	0.8	1.16	0.51	NA
	KMS	0.32	0.51	0.62	0.82	NA
	RYS	0.72	0.19	1.62	0.29	NA
C. gariepinus	MS	1.86	0.25	0.29	0.91	NA
	RJS	1.12	0.11	0.32	0.14	NA
	KMS	0.35	0.55	0.74	0.78	NA
	RYS	0.94	0.19	0.39	0.29	NA

a - intercept of regression line, b - slope of regression line,
Cl - confidence interval, r^2 - coefficient of determination,
GP - Growth pattern, NA - negative allometric

DISCUSSION

The significance of the study is to assess the condition of the two major fish species in Wudil River and provide information on the species that will aid in management and maintenance of biological equilibrium of the ecosystem. The simple linear regression slope (b) of the fish species L-W from Wudil River recorded during the period of the study fell within 0.1173 and 0.8058. This result contradicts the reports of Egbal *et al.* (2011) whose study showed that the *b* value of fish species from both Atbara River and Khashm el-Girba reservoir in Sudan were within the range of 2.278 and 3.680, and Pauly (1983) who also recorded *b* value range of 2.5 to 4.0 for many fish species. It is reported that when $b = 3$, the fish grows isometrically, resulting in ideal shape of fish (Olurin and Aderibigbe, 2006). When the value of *b* is less than 3.0, the fish experiences a negative allometric growth (Sandon, 1950). However, when the value of *b* is more than 3.0, the fish grows following the positive allometric growth pattern. Ibrahim (1984) reported that, the value of *b* then becomes greater than 3 as the fish becomes fatter, or when the *b* value is lower than 3, the fish is slimmer. Nevertheless, it was observed that the two sampled fish species from all sampling sites in the present study neither showed isometric nor positive allometric growth patterns, but all suffered from negative algometric growth. All value observed for fish collected from the sites during the study period indicates that, the two sampled fish species experienced this pattern of growth. The coefficient of determination r^2 for length-weight relationship was high for *Oreocromis niloticus* in Kogin Mada site and for *Clarias gariepinus* in Marmara and Kogin Mada sites, indicating that the length increased with increase in weight of fish at these sites. This is in agreement with previous findings (Lalèyè, 2006). The 95% confidence interval of b ranged from 0.2211 to 1.1676. Lizama *et al.* (2002) however reported a 95% CI of *b* value range between 2.329 and 3.919 of 12 freshwater fish species in the Kerian River basin and Pedu Lake.

The condition factor (K) gives information on the physiological condition of fish in relation to its welfare. Perry *et al.* (1996) reported that fishes with a low condition index are presumably believed to have experienced adverse physical environment or insufficient nutrition. According to Maguire and Mace (1993), from a nutritional point of view, increase in K values indicates the accumulation of fat and sometimes gonadal development. Angelescu *et al.* (1958) reported that from a reproductive point of view, the highest K values are reached in species if the fish is fully mature, and have higher reproductive potentiality. It was observed that the two fish species sampled in the present study recorded inconsistent condition factors, with only fish from Marmara through Ruwan Yan Akuya sites showing slight increases in K and the others within the normal range as reported by (Maguire and Mace, 1993). All the fish species sampled in the different sampling sites in the present study had condition factors ≥ 1, and were within the normal ranges recommended by Ujjania *et al*. (2012) who stated that condition factor greater or equal to one is good, indicating a good level of feeding, and proper environmental condition. Bagenal and Tesch (1978) recommended K value range (2.9-4.8) as suitable for matured fresh water fish. The condition factors of the two fish species sampled in the present study revealed that the fish species had their K values outside and within the range recommended as suitable for matured fish in fresh water. This could be caused due to environmental factor such as damming the river. Abdullahi and Ahmad (2013) reported the predominance of Cyanobacteria and Spirogyra phytoplankton species in Wudil River, which suggest an indication of organic pollution, reflecting human interference to pollute the river. LWR parameters (α and b) and the K value of the fish has been reported to be affected by factors such as feeding intensity, availability of food, fish size, age, sex, season, stage of maturation, fullness of the gut, degree of muscular development, the amount of reserved fat and life history (Bagenal and Tesch, 1978; Ujjania *et al.,* 2012; Gupta and Banerjee, 2015). None of these effective factors on LWR and K in the studied fishes have been considered in the present study.

CONCLUSION

The two major fish species of Wudil River are experiencing insufficient nutrition, adverse environmental conditions and poor physiological conditions leading to very low reproduction rate of the fishes and in turn halt fishing activity of the area. Therefore, the results of the present study can serve as baseline data for these species and for comparisons with future studies.

REFERENCES

Abdullahi J.M. and Ahmad A.M. (2013). Survey of phytoplankton in Wudil River, Kano State Nigeria. *Aquatic Biology Research*, 1 (1), 10-16 DOI: 10.12966/abr.08.02.2013

Abdullahi J.M., Fagwalawa L.D. and Abdulkarim F. (2014). Length-weight relationship and condition factors of *Bagrus bayad* of wudil River, Kano Nigeria. *Aquatic Biology Research*, 2 (1), 13-16

Abdoli A., Rasooli P. (2008). Length-weight relationship of 10 Species of fishes collected from Iranian fresh waters, *Journal of Applied Itchyology*, 22, 156-157

Angelescu V., Gneri F.S. and Nani A. (1958). Argentine sea hake (biology and taxonomy) Secr. Mar. Serv. Hydrogenation. Nav. Public, H1004: 1-224

Ayoade A.A. and Ikulala A.O. (2007). Length weight relationship, condition factor and stomarch contents of *Hemichromis bimaculatus, Serotherodon melanotheron and Tilapia guetheri* (perciformes: Cichilidae) in Eleiyele Lake, Southwestern Nigeria. *Int. Journal of Tropical Biology,* 55 (3-4), 969-977

Bagenal T.B. and Tesch F.W. (1978). *Methods of Assessment of Fish Production in Fresh Waters*. IBP Handbook No. 3, 3rd ed. Oxford Blackwell Scientific Publication, London. pp. 101-136

Blackwel B.G., Brown M.L., Willis D.W. (2000). Relative weight (Wr) status and current use in fisheries assessment and management. *Reviews in Fisheries Science*, 8, 1-44

Dambazau A.M. (2007). The geography of Wudil Local Government Area. In: E.A. Olofin, A.B. Nabegu and A.M. Dambazau (eds.), *Wudil within Kano Region: a Geographical Synthesis*. Adamu Joji Publishers, Kano Nigeria. pp. 121

Egbal O.A., Mohammed E.A. and Afra A.A. (2011). Length-weight relationships and condition factors of six fish species in Atbara River and Khashm El-Girba Reservoir, Sudan. *International Journal of Agriculture Sciences*, 3 (1), 65-70

Fishbase (2013). Online fish identification sheet. Available at http://www.fishbase.org/search.php, accessed on 10/06/2013

Froese R. (1998). Length-weight relationship for 18 less studied fish species. *Journal of Applied Ichthyol*, 14, 117-118

Gupta S. and Banerjee S. (2015). Length-weight relationship of *Mystus tengara* (Ham.-Buch., 1822), a freshwater catfish of Indian subcontinent. *Int. Jour. of Aquatic Biology,* 3(2), 114-118

Helfman G., Collete and Facey B.J. (1997). *The Diversity of Fishes*. Blackwell Publishing Company, p. 80

Ibrahim A.M. (1984). The Nile: Description, hydrology, control and utilization. *Hydrobiologia*, 110, 1-13

Kumar D.B., Singh N.R., Bink D. and Devashish K. (2014). Length-weight relationship of *Labeo rohita* and *Labeo gonius* (Hamilton-Buchanan) from Sone Beel, the biggest wetland of Assam. *Indian Journal of Environmental Research and Development* 8 (3)

Lalèyè P.A. (2006). Length-weight and length-weight relationships of fishes from the Ouèmè River in Bènin (West Africa). *J. Appl. Ichtholo*, 22, 330-333

Lizama M., De Los A.P. and Ambroso A.M. (2002). Condition factor in nine species of fish of the Characidae family in the upper Paramá River floodplain, Brazil. *Braz. J. Biol*, 62 (1), 113-124

Maguire J.J. and Mace P.M. (1993). Biological reference points for Canadian Atlantic Gadoid stocks. In: Smith S.J., Hunt J.J. and Rivard D. (eds.), *Risk Evaluation and Biological Reference Points for Fisheries Management. Can. Spec. Publ. Fish. Aquat. Sci.,* 120, 67-82

Olofin E.A. (2005). Impact of dams construction on storm channel morphology. Local Field Course Lecture Series, Kano, Department of Geography, KUST

Olurin K.B. and Aderibigbe O.A. (2006). Length-weight relationship and condition factor of pond reared *Oreochromis niloticus*. *World Journal of Zoology*, 1 (2), 82-85

Pauly D. (1983). Some simple methods for the assessment of tropical fish stocks. FAO Fisheries Tech. Pap., FAO Rome, 234, 52

Perry R.I., Hargreaves N.B., Waddell B.J. and Mackas L. (1996). Spatial variations in feeding and condition of juvenile pink and chum salmon off Vancouver Island, British Columbia. *Fish Oceanogr*., 5 (2), 73-88

Rickter W.E. (1973). Linear regression in fisheries research. *J. Fish. Res. Board Can*., 30 (3), 409-434

Sandon H. (1950). An illustrated guide to the freshwater fishes of the Sudan. Sudan Notes and Rec., 25, 61

Seher D. and Suleyman C.I. (2012). Condition factors of seven cyprinid fish species from Çamligöze Dam Lake on central Anatolia, Turkey. *African Journal of Agricultural Research,* 7 (31), 4460-4464

Ujjania N.C., Kohli M.P.S. and Sharma L.L. (2012). Length-weight relationship and condition factors of Indian major carps (*C. catla, L. rohita* and *C. mrigala*) in Mahi Bajaj Sagar, India. *Research Journal of Biology*, 2 (1), 30-36

Yadav B.N. (2002). *Fish and Fisheries of Northern Nigeria*, 3rd edition. Published by Daya Publishing House Nigeria. pp. 1-10

Zar J.H. (1984). *Biostatistical Analysis*. Practice Hall, New Jersey, pp. 718