EVALUATION OF LENGTH-WEIGHT RELATIONSHIP OF FISH SPECIES OF EBONYI RIVER, NIGERIA

[*1]UDE, E.F., [1]L.L.C. UGWU, [2]B.O. MGBENKA & C.D. NWANI
1. Department of Fisheries and Aquaculture, Ebonyi State University, P.M.B. 053, Abakaliki, Nigeria, 480001.
2. Fisheries and Hydrobiology Unit, Department of Zoology, University of Nigeria, Nsukka
3. Department of Applied Biology, Ebonyi State University, P.M.B. 053, Abakaliki, Nigeria,
*Corresponding Author: emm_ude@yahoo.co.uk

ABSTRACT

A study was conducted on the fishes of Ebonyi River to determine their length – weight relationships (LWR). Specimens of various fish species caught from the river were obtained from fishers on a monthly basis for 18 months. The values of the exponent b in the LWR ($W=aL^b$) varied between 1.4 and 3.5 for Ariid species, 0.9 and 5.3 for Characiid species, 2.4 and 3.4 for Cichlid species, 4.3 and 11.1 for Clariid species, 2.4 and 3.9 for Mormyrid species and between 2.7 and 2.8 for species of the family Schilbeidae. The b values recorded for Oreochromis niloticus, Schilbe mystus, Siluranodon auritus, Tilapia dageti and Hemichromis fasciatus were all isometric. Arius heudeloti, Labeo coubie, Alestes chaperi, Tilapia zilli and Mormyrus rume each had b values that are negatively allometric. Similarly, the b values recorded for the remaining species were positively allometric. The values of their various intercepts (a) and correlation coefficients (r) are also presented. In the light of these observations it was concluded that the data generated will form a baseline tool for enhanced fisheries management and utilization of the species that are of aquaculture importance to improve fish production in an economy where majority of the populace are undernourished.

Keywords: inland, freshwater biology, stock assessment

INTRODUCTION

The fish yield of most inland waters in Nigeria are generally on the decline for causes that may range from inadequate management of the fisheries to degradation of water bodies (Odo *et al*., 2009). Detailed knowledge of the form and function of the river system and the responses of fish species are needed for effective fisheries management planning. Welcomme and Halls (2001) reported that such detailed knowledge of individual systems is generally lacking.

Ayoade and Ikulala (2007) reported that length-weight relationships (LWRs) of fishes are important in fisheries biology because they allow the estimation of the average by establishing a mathematical relationship between the relative well being of the fish population. They further asserted that Length-weight relationship has a number of important applications in fish stock assessment. Among these applications are : estimating the standing stock biomass and comparing ontogeny of fish population from different regions. This information will enhance management, conservation and culture of these species. It will also allow for future comparisms between populations of the same species.

Similarly Odo *et al.* (2009) observed that sustainable exploitation requires knowledge of the ichthyofaunal composition of water bodies. Nwani *et al*. (2006) reported that basic information that relates weight to length of fish is of great importance in studies in fish biology.

Length-weight relationships (LWR) is represented by the power curve, $W = aL^b$ where W = weight (g), L = total length (cm), a = constant and b = growth exponent (Ayoade and Ikulala, 2007). When b is equal to 3 or close to 3, growth in the fish is said to be isometric i.e. fish becomes more robust with increasing length (Bagenal, 1978). Similarly when b is far less or greater than 3, growth in the fish is allometric i.e the fish becomes thinner with increasing length (King, 1996a), and noted that only a few estimates of species-specific length-weight relationship parameters are available for Nigerian fishes. Of the length-weight relationship parameters for 149 species of fish populations in Nigeria's inland and coastal waters compiled by King (1996a, 1996b) from various studies, none of the papers contained information on the length-weight relationship of *Heterobranchus longifilis*. Howevever, Anibeze (2000) conducted an investigation on Length-weight relationship and relative condition of *Heterobranchus longifilis* (Valenciennes) from Idodo River, Nigeria.

Abowei and Hart (2009) in an investigation of some morphometric parameters of 10 finfish species of lower Nun River, Niger Delta, Nigeria; observed that all species exhibited positive allometric growth. They concluded that these populations stand the risk of over-exploitation in the lower Nun River if urgent measures are not taken to protect their fisheries. Similarly, Nwosu (2008) observed that studies of the prawn genus *Macrobrachium* in the tropical and subtropical regions of the world range from biology - life history, reproduction and behaviour - to assessment of its fisheries and aquaculture potentials. In the Cross River Estuary and other parts of Nigeria, such studies have been carried out for *M. macrobrachion* and *M. vollenhovenii.*

Similarly, Hannifer (2006) investigated LWRs of *Channa punctata* from Western River in which the study showed no significant difference (P>0.05) in the LWR as a function of sex. Miranda *et al.* (2006) also reported b values ranging from 7.28 to 3.47 in an investigation of the LWR of Cyprinid fishes of Liberian peninsula. Laleye (2006) in an investigation of length-weight and length-length relationship of Quame River Benin (West Africa), recorded b values which ranged from 2.3307 to 3.5185 and revealed that 38.5% of the species had b values significantly different from 3.

In a study of the LWR of 33 cryptic reef fishes from South Western Gulf of California, Balart *et al.* (2006) observed b values which varied between 2.63 and 3.61 while in a related study, Britton and Harper (2006) observed b values which ranged between 2.90 and 3.22 in a study of the fish species in the freshwater rift valley lake of Kenya.

At the moment there is no published information on the LWR of fishes of Ebonyi River, Nigeria despite the fact that this is the main source of animal protein for the rural poor who depend on its resources for their livelihoods. Results from this research will therefore serve as baseline resource for deductions in fisheries management policy formulations, geared towards enhanced fisheries development.

STUDY AREA

The area of study is Ebonyi River which is a freshwater system that has its source from lower Benue River and opens into Cross River, but transverses the old Abakaliki Zone of Ebonyi State, Nigeria. Abakaliki is situated between 06° 19.370` North latitudes and 008° 07.692` East longitudes.

MATERIALS AND METHODS

Fish samples (fin-fish and shell-fish) were obtained three times monthly at 10 days interval from September 2006 to February 2008, from fishermen who used hook and line of size 13, gill nets and unselective fishing gears such as cast nets, bag nets and traps of diverse mesh sizes ranging from 50mm to 100mm, to catch the fish. The collected fish samples were taken to the laboratory, sorted and identified to families, genera and species levels, using the identification keys of Reed *et al.* (1967) and Olaosebikan and Raji (1998). The identified species were weighed to the nearest 0.1 g and total and standard lengths determined to the nearest 1 mm.

The length-weight relationship (LWR) was estimated by using the equation: $W = aL^b$ where W = weight (g), L = total length (cm), a = constant, b = growth exponent. For each species, the slopes of Length-weight regressions were compared to 3 using student's t-test (Sokal and Rohlf, 1987) to determine whether species grew isometrically.

RESULTS

The regression graphs of length-weight relationship of fish species of Ebonyi River is presented below. The growth trend of *Arius gigas* presented in Fig. 1 below is isometric. Conversely, the regression graph of LWR of *Arius heudloti* presented in Fig. 2 has a negative allometric growth trend. The regression graph of the LWR of *Chrysichthys longifilis* is presented in Fig. 3 below and showed weak isometric trend.

The LWR regression graph of *Alestes nurse* presented in Fig. 4 showed positive allometric trend while that of *Alestes imberi* was isometric (Fig. 5). Conversely, the regression graph of the LWR of *Alestes longifilis* presented in Fig. 6 showed strong positive allometric trend, that of *Alestes chaperi* (Fig. 7) below showed negative allometric trend. *Similarly*, the graph of the regression analysis of the LWR of *Alestes macrolepidotus* showed positive allometric growth (see Fig. 8).

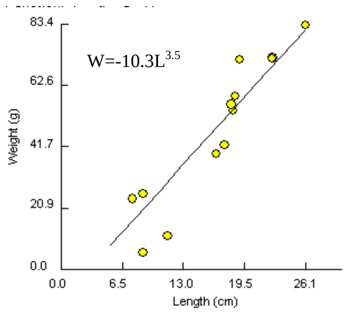

Fig. 1: Length-weight relationship of *Arius gigas*

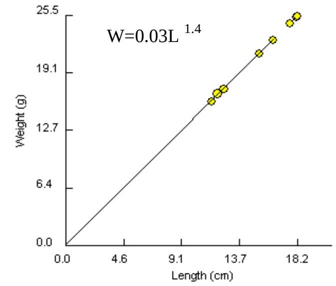

Fig. 2: Length-weight relationship of *Arius heudeloti*

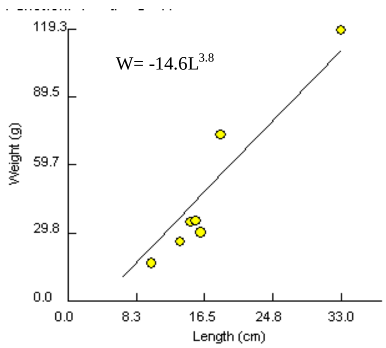

Fig. 3: Length-weight relationship of *Chrysichthys longifilis*

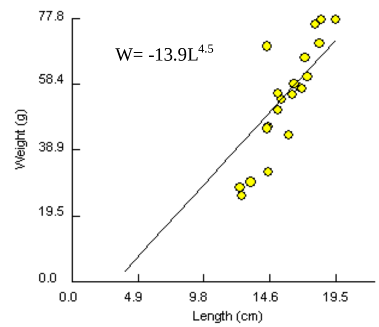

Fig. 4: Length-weight relationship of *Alestes nurse*

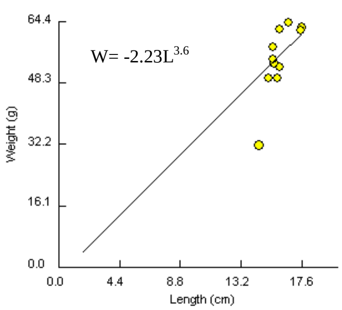

Fig. 5: Length-weight relationship of *Alestes imberi*

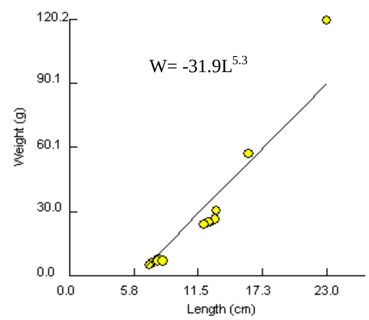

Fig. 6: Length-weight relationship of *Alestes longifilis*

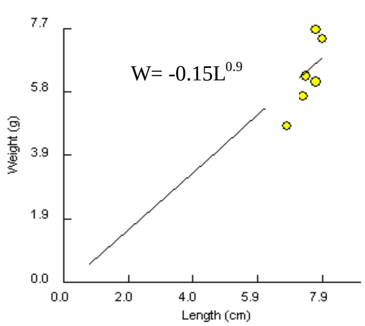

Fig. 7: Length-weight relationship of *Alestes chaperi*

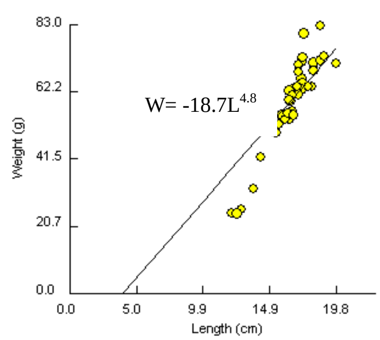

Fig. 8: Length-weight relationship of *Alestes macrolepidotus*

The LWR regression graph of *Alestes brevis* is presented in Fig. 9 and showed weak isometric growth trend. Similarly, the graph of the regression analysis of the LWR of *Bryconaethiops quenquesquamae* showed positive isometric growth trend as presented in Fig. 10.

The LWR regression graph of *Tilapia zilli* presented in Fig. 11 below showed negative allometric growth trend. Conversely, the regression graph of the LWR of *Tilapia guineensis* was to be isometric (Fig. 12). The LWR regression graph of *Tilapia dagetti* is also presented in Fig. 13 and showed weak allometric growth trend; while the graph of the regression analysis of the LWR of *Oreochromis niloticus* showed isometric growth trend as presented in Fig. 14. Similarly, the LWR regression graph of *Hemichromis fasciatus* is presented in Fig. 15 and showed isometric growth trend. For the claridae, the graphs depict positive allometric trend (see figures 16, 17, and 18).

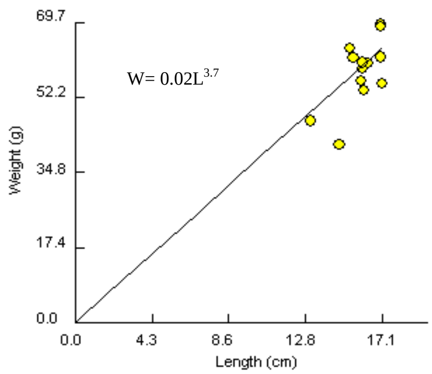

Fig. 9: Length-weight relationship of *Alestes brevis*

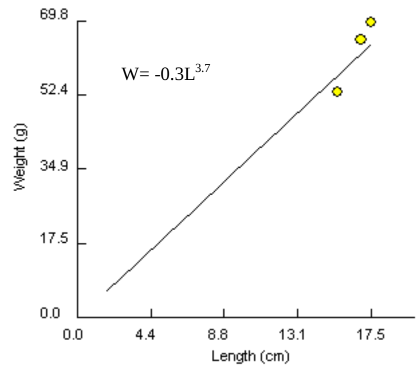

Fig. 10: Length-weight relationship of *Bryconaethiops quenquesquamae*

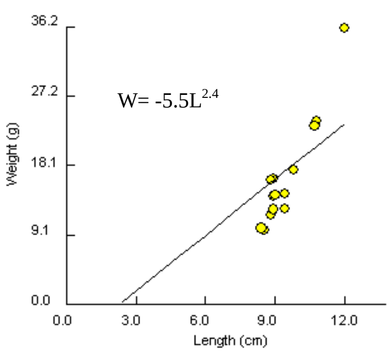

Fig. 11: Length-weight relationship of *Tilapia zilli*

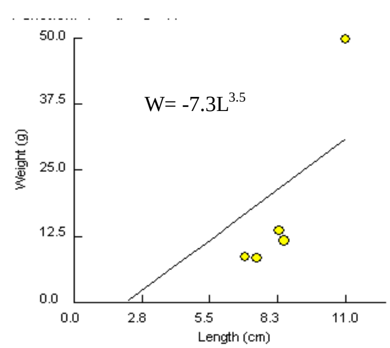

Fig. 12: Length-weight relationship of *Tilapia guineensis*

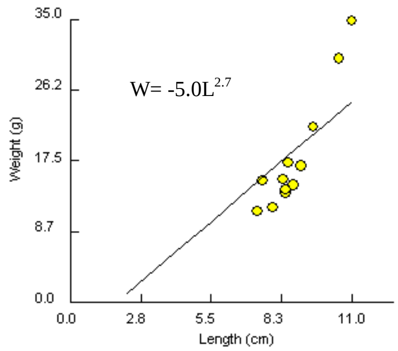

Fig. 13: Length-weight relationship of *Tilapia dagetti*

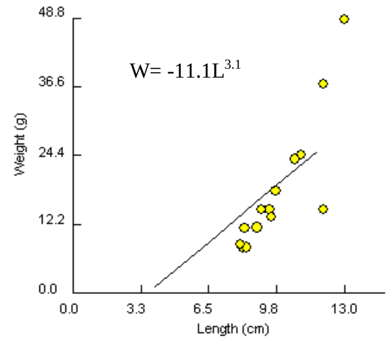

Fig. 14: Length-weight relationship of *Oreochromis niloticus*

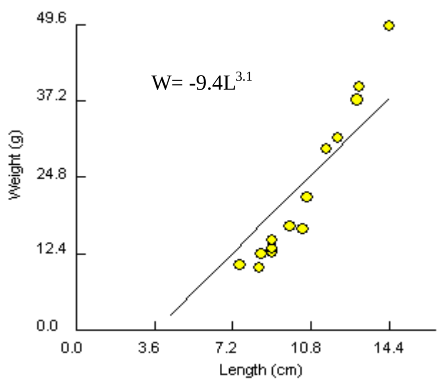

Fig. 15: Length-weight relationship of *Hemichromis fasciatus*

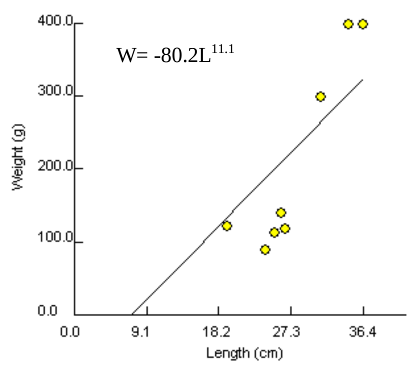

Fig. 16: Length-weight relationship of *Clarias anguillaris*

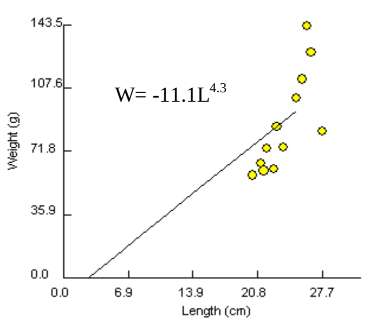

Fig. 17: Length-weight relationship of *Clarias gariepinus*

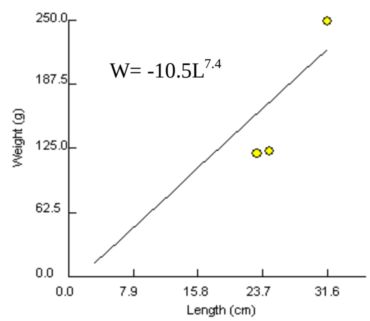

Fig. 18: Length-weight relationship of *Heterobranchus longifilis*

The results indicate that some fish species exhibited strong isometry (*Mormyrus rume, Schilbe mystus, Siluranodon auritus*), some negative allometry (*Labeo coubie,*), some positive allometry (*Hepsetus odoe, Malapterurus electricus, Hepsetus odoe* and *Macrobrachium vollenhovenii*), while *Mormyrus hasselquisti* depicts weak isometry (see Figs. 19 to 27).

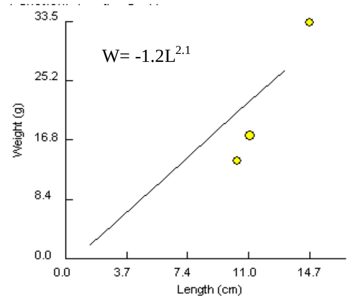

Fig. 19: Length-weight relationship of *Labeo coubie*

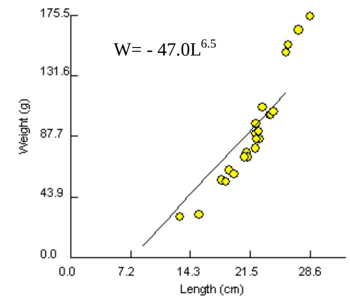

Fig. 20: Length-weight relationship of *Hepsetus odoe*

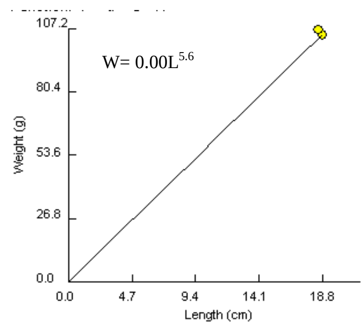

Fig. 21: Length-weight relationship of *Malapterurus electricus*

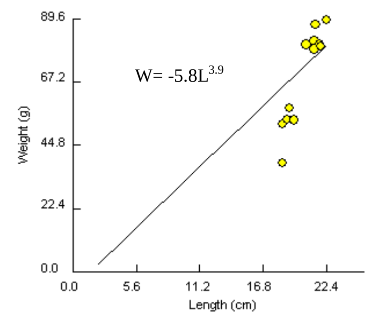

Fig. 22: Length-weight relationship of *Mormyrus hasselquisti*

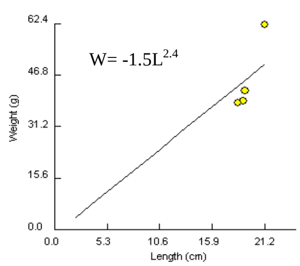

Fig. 23: Length-weight relationship of *Mormyrus rume*

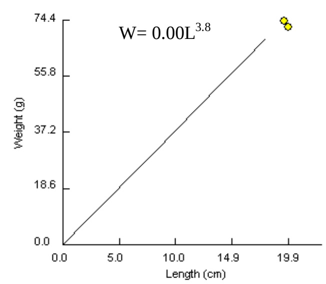

Fig. 24: Length-weight relationship of *Heterotis niloticus*

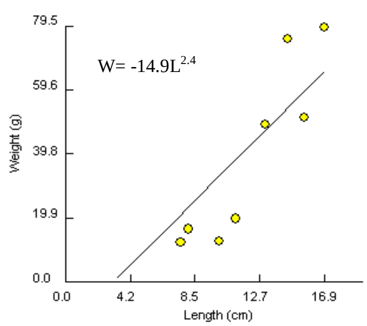

Fig. 25: Length-weight relationship of *Macrobrachium vollenhovenii*

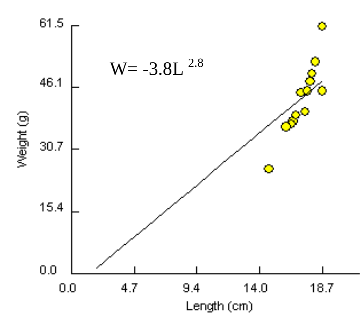

Fig. 26: Length-weight relationship of *Schilbe mystus*

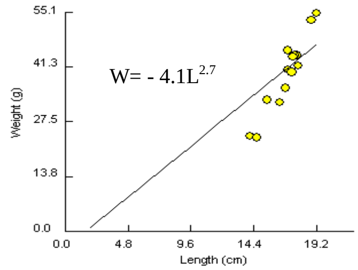

Fig. 27: Length-weight relationship of *Siluranodon auritus*

The LWR parameters of the fishes of Ebonyi River are presented in Table 1. The values of the exponent *b* in the LWR ($W=aL^{b}$) varied between 1.4 and 3.5 for Ariid species, 0.9 and 5.3 for Characiid species, 2.4 and 3.4 for Cichlid species, 4.3 and 11.1 for Clariid species, 2.4 and 3.9 for Mormyrid species, 2.7 and 2.8 for species of family Schilbeidae. The levels of significance of b values for each species is also presented. The b values recorded for *Oreochromis niloticus*, *Schilbe mystus, Siluranodon auritus*, *Tilapia dageti and Hemichromis fasciatus* were all isometric. *Arius heudloti*, *Labeo coubie*, *Alestes chaperi*, *Tilapia zilli and Mormyrus rume* each had b values that are negatively allometric. Similarly, the b values recorded for the remaining species were positively allometric as shown in Fig.5. The values of their various intercepts (a) and correlation coefficients (r) are also presented.

Table 1: Length-weight relationship parameters of Fishes from Ebonyi River

Fish species	Intercept (a)	Growth Exponent(b)W=aL^b	Correlation coefficient (r)	P
ARIIDAE				
Arius gigas	-10.3258	3.5302	0.9326	<0.001
Arius heudeloti	0.0331	1.3991	1.0000	<0.000
BAGRIDAE				
Chrysichthys longifilis	-14.5807	3.7889	0.9382	<0.001
CHARACIDAE				
Alestes nurse	-13.8760	4.3762	0.8718	<0.001
A. imberi	-2.2344	3.6079	0.9337	<0.004
A. longifilis	-31.8957	5.3029	0.8969	<0.000
A. chaperi	-0.1482	0.8869	0.9624	<0.021
A. macrolepidotus	-18.7358	4.7700	0.8899	<0.001
A. brevis	0.0181	3.7367	0.9667	<0.010
Bryconaethiops quenquesquamae	-0.3104	3.6966	0.9946	<0.032
CICHLIDAE				
Tilapia zilli	-5.4773	2.4206	0.8062	<0.002
Tilapia guineensis	-7.3119	3.4735	0.7479	<0.002
T. dageti	-4.9293	2.7085	0.8399	<0.260
Oreochromis niloticus	-11.0877	3.0925	0.7495	<0.246
Hemichromis fasciatus	-9.4251	3.0611	0.8633	<0.230
CLARIIDAE				
Clarias anguillaris	-80.2747	11.1037	0.8350	<0.001
C. gariepinus	-11.1729	4.2630	0.8230	<0.004
Heterobranchus longifilis	-10.4871	7.3557	0.9612	<0.093
CYPRINIDAE				
Labeo coubie	-1.1862	2.1135	0.9654	<0.001
HEPSETIDAE				
Hepsetus odoe	-46.9973	6.4689	0.8634	<0.000
MALAPTERURIDAE				
Malapterurus electricus	0.0000	5.5798	1.0000	<0.000
MORMYRIDAE				
Mormyrus hasselquisti	-5.8065	3.8467	0.9263	<0.001
M. rume	-1.5138	2.4399	0. 9453	<0.002
OSTEOGLOSSIDAE				
Heterotis niloticus	0.0000	3.8164	1.0000	<0.001
PALAEMONIDAE				
Macrobrachium vollenhovenii	-14.9283	4.7598	0.8517	<0.002
SCHILBEIDAE				
Schilbe mystus	-3.8096	2.7590	0.9092	<0.243
Siluranodon auritus	-4.1105	2.6654	0.9267	<0.241

DISCUSSION

The length – weight relationship of *Oreochromis niloticus, Schilbe mystus*, *Siluranodon auritus, Tilapia dageti and Hemichromis fasciatus* which showed isometric b values, were similar to results of Laleye (2006) who investigated the LWR of fish species of Quame River. Similarly, the negative allometric length-weight relationship of *Arius heudloti, Labeo coubie, Alestes chaperi, Tilapia zilli and Mormyrus rume* and the positive allometric legth-weight relationship of *Arius gigas, Chrysichthys longifilis, Alestes nurse, A. imberi, A. longifilis, A. macrolepidotus, A. bravis, Bryconaethiops quenquesquamae, Tilapia guineensis, C. gariepinus, Heterobranchus longifilis, Hepsetus odoe, Malapterurus electricus, Mormyrus hasselquisti*, *Heterotis niloticus* and *Macrobrachium vollenhovenii* agrees with Miranda *et al.* (2006), Ayoade and Ikulala (2007) and Abowei and Hart (2009) who recorded similar results. However the positive allometric LWR of *Clarias anguillaris* recorded in this work was much higher than those recorded by the authors. The isometric LWR of some species in this work implies that they become more robust with increasing length (Bagenal, 1978). Similarly the allometric relationship of the other species implies that the fish becomes thinner with increasing length (King, 1996a).

CONCLUSION

In the light of these observations it is concluded that the data generated will form a baseline tool for enhanced fisheries management and utilization of the species that are of aquaculture importance to improve fish production in an economy where majority of the populace are undernourished and living below poverty level.

REFERENCES

Abowei, F.N. and Hart, A.I. (2009). Some morphometric parameters of ten fin-fish species from the lower Nun River, Niger Delta Nigeria. *Research Journal of Biological Sciences* 4(3): 282-288.

Anibeze, C.I.P. (2000). Length-Weight Relationship and Relative Condition of *Heterobranchus longifilis* (Valenciennes) from Idodo River, Nigeria. *Naga ICLARM Quarterly.* (23): 2 34 – 35.

Ayoade, A.A. and Ikulala, A.O.O. (2007). Length weight relationship condition Factor and stomach contents of *Hemichromis bimaculatus*, *Sarotherodon melanotheron* and *Chromidotilapia guntheri* (Perciformes: Cichlidae) in Eleiyele Lake, South Western Nigeria. *Rev. Biol Trop*.Vol.55, 3-4.

Bagenal, T.B. and F.W. Tesch (1978). Methods for the assessment of fish production in fresh waters: Age and growth. Oxford, Blackwell Scientific Publication, London. 101-136p.

Balart, E.F., Gonzalez, A., Romero-Ponce, RC Zayas-Alvarez, A., Calderon-parra, M., Campos-Davila, L and Findley L. (2006). Length-weight relationships of cryptic reef fishes from the South Western Gulf of California, Mexico. *Journal of applied Ichthyology*. 22(4): 316-318.

Britton, J.R. and Harper, D.M. (2006). Length-weight Relationships of fish species in the freshwater rift valley lakes of Kenya. *Journal of applied Ichthyology.* 22(4): 334-336.

Hannifer, M.A., Nagaraja, M. and Gopalakrisnan (2006). Length- Weight Relationships of *Channa Punctata* (Bloch, 1793) from Western Ghats rivers of Tamil Nadu. *Journal of Applied Ichthyology* 22(5): 463 – 463.

King, R.P. (1996a). Length-weight relationship of Nigeria freshwater fishes. *Naga ICLARM Quarterly.* 19(3):49-52.

King, R.P. (1996b). Length-weight relationship of Nigeria coastal water fishes. *Naga ICLARM Quarterly.* 19(4):53-58.

Laleye, P.A. (2006). Length-Weight and Length-Length of Fishes from the Quame River in Benin (West Africa). *Journal of applied Ichthyology*. 22(4): 330-333.

Miranda, R,. Oscoz, J., Launda, P.M. and Escala, M.C. (2006). Weight-Length Relationships of Cyprinid fishes of Liberian Penninsula. *Journal of Applied Ichthyology* 22(4): 297-298.

Nwani, C.D. Ezenwaji H.M., Eyo, J.E and Ude. E.F. (2006). Length-weight relationship and condition factor of four Mormyrid species of Anambra River. *Animal Research International* 3(1). 426 – 430.

Nwosu, F. M. (2008). Growth and mortality of the rough river prawn *Macrobrachium equidens* Dana, 1852 (Crustacea, Palaemonidae) in Cross River Estuary, Southeast Nigeria. *Journal of Food, Agriculture and Environment.* (1): 186 - 189.

Odo, G.E., Nwani C.D. and Eyo J.E. (2009). The fish fauna of Anambra river basin, Mogeroa: Species abundance and morphometry. *Revista de Biologia Tropical.* 57(1-2): 177-186.

Olaosebikan, B.D. and Raji, A. (1998). Field Guide to Nigerian Freshwater Fishes. Federal College of Freshwater Fisheries Technology. New Bussa 106p.

Reed, W., Burchard, J., Hopson A.J., Jannes J. and Yaro, I. (1967). Fish and Fisheries of Northern Nigeria. Min of Agric Northern Nigeria. Zaria 220p.

Sokal, R.R. and Rohlf F.J. (1987). Introduction to Biostatistics. W.H. Freeman, New York, USA. 562p.

Welcomme, R.L. and Halls, A. (2001). Some considerations of the effects of differences in flood patterns on fish populations. *Ecohydrology and Hydrobiology* 1:313-321.