LENGTH-WEIGHT RELATIONSHIP OF SOME FISH SPECIES IN A TROPICAL RAINFOREST RIVER IN SOUTH-EAST NIGERIA

Godwin ADAKA *, *Eunice NDUKWE* ** and *Anthony NLEWADIM* **

* Federal University of Technology, Department of Fisheries, Owerri, revadaka@gmail.com
** Michael Okpara University of Agriculture, Department of Fisheries and Aquatic Resources Management, Umudike.

DOI: 10.1515/trser-2015-0065

KEYWORDS: Modelling ecosystem, condition Factor, morphometrics, climate.

ABSTRACT

The Length-Weight relationship of some fish species from Oramiri-Ukwa River, was studied from January to December, 2014. The slope (b) values obtained in the nine species ranged from 1.830 to 5.670 with most of the fishes indicating a negative allometric growth pattern except for *Papyrocranus afer*, with b value of 3.04, thus showing a positive isometric growth pattern. The following fish species showed a high degree of positive correlation at (P > 0.05); *Ctenopoma kingselyae, Alestes imberi, Channa obscura, Oreochromis niloticus, Tilapia mariae, Tilapia zillii, Synodontis omais*, and *Papyrocranus afer*. *Chrysichthys auratus* did not show this positive correlation. The condition factor (K) of the fish species ranged from 0.99 to 4.54, indicating that most of the fish were in good condition except for *Chrysichthys auratus* with 0.99.

ZUSAMMENFASSUNG: Die Länge-Gewicht-Beziehung einiger Fischarten in einem Regenwald Fluss in Südost Nigeria.

Das Länge-Gewicht-Verhältnis einiger Fischarten im Oramiri-Ukwa Fluss wurde von Januar bis Dezember 2014 untersucht. Die Gefälle (b)-Werte, die bei neun Arten festgestellt wurden, schwankten von 1.830 bis zu 5.670, wobei die meisten Fische ein negatives allometrisches Wachstumsmuster zeigten, mit Ausnahme von *Papyrocranus afer*, mit einem b-Wert von 3,04, somit ein positives isometrisches Wachstumsmuster aufwies. Die folgenden Fischarten zeigten einen hohen Grad einer positiven at-Korrelation (P > 0,05) und zwar *Ctenopoma kingselyae, Alestes imberi, Channa obscura, Oreochromis niloticus, Tilapia mariae, Tilapia zillii*, *Synodontis omais* und *Papyrocranus afer*, mit Ausnahme von *Chrysichthys auratus*. Der Zustandsfaktor (K) der Fischarten bewegte sich zwischen 0,99 und 4,54 und zeigte damit, dass die meisten Fische ein gutes Wohlbefinden aufwiesen, mit Ausnahme von *Chrysichthys auratus* mit einem Wert von 0,99.

REZUMAT: Relația dintre lungimea și greutatea unor specii de pești din pădurea tropicală, în sud-estul Nigeriei.

Relația lungime-greutate pentru unele specii de pești din râul Oramiri-Ukwa a fost studiată în intervalul ianuarie-decembrie 2014. Valorile pantei b în cazul a nouă specii au variat între 1,830 și 5,670, iar majoritatea peștilor au indicat un model de creștere alometrică negativ cu excepția specie *Papyrocranus afer* cu o valoare b de 3,04, deci un model de creștere isometrică pozitiv. Următoarele specii de pești au înregistrat un grad înalt de corelație pozitivă la (P > 0,05); *Ctenopoma kingselyae, Alestes imberi, Channa obscura, Oreochromis niloticus, Tilapia mariae, Tilapia zillii, Synodontis omais* și *Papyrocranus afer*, excepție făcând *Chrysichthys auratus*. Factorul de condiție (K) al speciilor de pești a înregistrat valori cuprinse între 0,99 și 4,54, ceea ce arată că majoritatea peștilor se aflau în condiții de viață bune cu excepția specie *Chrysichthys auratus*, care a înregistrat valoarea 0,99.

INTRODUCTION

Fish play an important role in the development of a nation. Apart from being one of the cheapest sources of highly nutrient protein, they also contain other essential nutrients required by the body (Sikoki and Otobotekere, 1999). The degradation of aquatic life and ecosystems in many parts of the world can lead to low fish composition which gives rise to insufficient fish product supply in the commercial market, thereby causing an increase in price of the limited supply in the commercial market. The relationship between length and weight can be used to assess the well-being of individual and to determine possible differences between separate unit stocks of the same species (King, 2007). In addition, length-weight relationships are also important in fisheries management for growth comparative studies (Moutopoulos and Stergiou, 2002).

Pauly (1993) stated that length-weight relationship (LWR) provides valuable information on the habitat where the fish live, while Kulbicki et al. (2005) stressed the importance of LWR in modelling aquatic ecosystems. For proper exploitation and management of the population of fish species, the length-weight relationship is very important (Anene, 2005).

The condition factor, which is referred to as the wellbeing of fish, is also a useful index for monitoring the feeding intensity, age, and growth rates in fish (Oni et al., 1983). The study was designed to provide basic scientific information on the length-weight relationship of some fish species in a tropical rain forest river in Southeast Nigeria.

MATERIAL AND METHODS

The study area was the Orammiri-Ukwa River (Fig. 1) located at Azaraegbulu, Emekuku in Owerri North Local Government Area of Imo State, southeast Nigeria at approximately latitude 5º30' N and longitude 7º19' E. Oramiri-Ukwa is a typical rain forest river. On both sides of the main river channel are large fringes of heavily forested swamps dominated by the raffia palm. The river flows from a highland in Okigwe and joins the Mbaa River to flow through Okahia Ezihe in Isiala Mbano Local Government Area, through Oparanadim in Mbaise to Onu-ngara Avuvu in Ikeduru Local Government Area of Imo-State, Nigeria.

Oramiri-Ukwa flows southward for about 5.8 km before discharging into Otamiri River and the Nworie River, both are tributaries of the larger Imo River which drains into the Atlantic Ocean, south-east Nigeria. The climate of the area is characterized by two distinct seasons; the dry (November-March), and rainy seasons (April to October). The River is the main source of water supply to the towns and villages through which it flows, especially during the dry season.

Three sampling stations (S_1 – Emekuku, S_2 – Avuvu, and S_3 – Amakohia) were established along the main course of the river. Fish species were collected bi-monthly for 12 consecutive months (January to December, 2014) from the three sampling stations with the assistance of local artisanal fishers using different types of nets namely gill nets, cast nets, hook and line, local traps, and bag nets. The sampling sites were also generally accessible throughout the year and shallow in depth, with surface to bottom transparency along sandy areas. Water lilly (*Nymphaea* ssp.) and floating filamentous plants were common.

The length-weight relationship of identified fish species were estimated using the equation:

$W = aL^b$ (Le Cren, 1951) ……..……... (1)

where

W = Weight of fish (g)

L = Standard Length of fish (cm)

a = Y – Intercept or the Initial growth index

b = Slope or the growth coefficient or an exponent

The values of constants "a" and "b" were estimated after logarithmic transformation of Equ. (1) Using Least square Linear regression (Zar, 1984).

The condition factor was calculated using the formula:

$K = 100\ w$ (Pauly, 1993)…… (2)

where $\overline{L^3}$

K = Condition factor

L = Standard Length (cm)

W = Weight (g)

Statistical evaluations of the variations observed in the different species were assessed using the SPSS (1999).

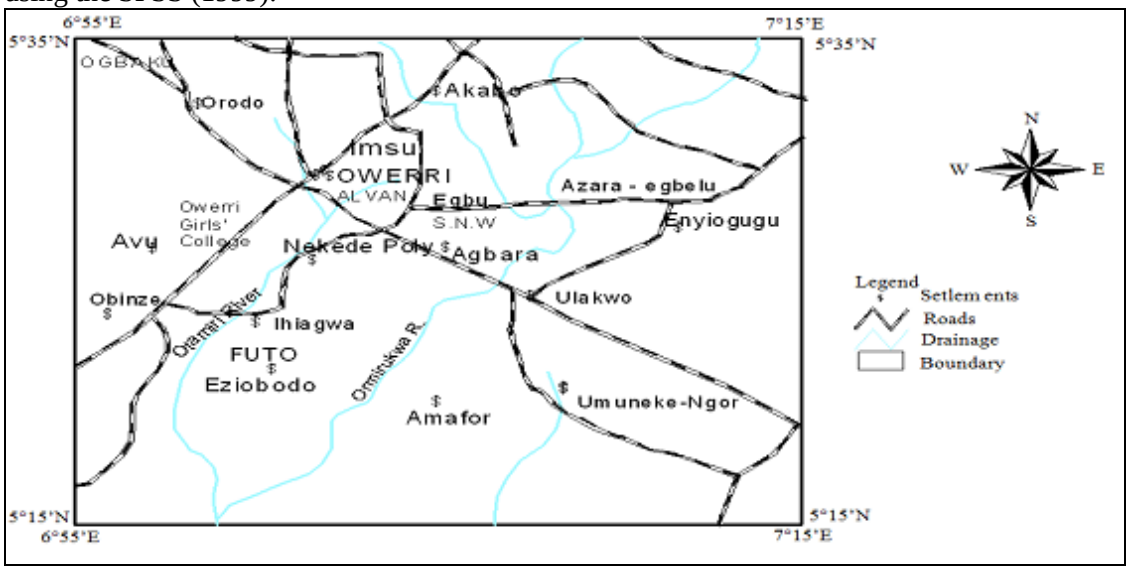

Figure 1: Map showing the location of Oramiri-Ukwa River in Imo State and sampling stations.

Fishes were collected from the different sample stations during the study period. Immediately after collection, photographs were taken prior to preservation since formalin decolorizes the fish on long preservation. Fishes were fixed in 4% formalin solution in separate bottles and brought to the laboratory. Fish identifications were carried out with the aid of Boulenger (1916), Talwar and Jhingran (1991), and Fishbase database (Froese and Pauly, 2010). The Total Length (TL) and Standard Length (SL) were measured in centimetre (cm), and the Body Weights (BW) were measured in grams (g). The Total Length (TL) of each fish was taken from the tip of the snout (mouth closed) to the extended tip of the caudal fin using a meter rule. The Standard Length (SL) was taken along the antero-posterior body axis, from mouth tip to the mid-point of caudal fin origin. The Body Weight (BW) was measured using a digital top-loading electronic weighing balance (Fafioye and Oluajo, 2005).

RESULTS AND DISCUSSION

The species, number of specimens, length-weight relationship parameters **a** and **b**, Correlation Coefficient (r), condition factor, mean length of fish species, mean weight of fish species and growth type (allometric or isometric) are presented in table 1.

Table 1: Length-weight relationship parameters and condition factor of some fishes from Oramiri-Ukwa River.

Species	No.	Standard Length (SL) (CM)		Body weight (BW) (g)		Regression Coefficient		Regression Coefficient	
		Range	Mean	Range	Mean	a	b	a	b
Anabantidae *Ctenopoma kingsleyae* (Gunther, 1896)	19	8.90-13.20	0.56 ± 0.27	17.05-66.00	33.2 ± 2.82	– 1.10	5.670	0.908	2.69
Bagridae *Chrysichthys auratus* (Ggeoffery St. Hilary, 1808)	4	13.50-20.00	16.89 ± 1.45	36.01-76.90	61.51 ± 8.37	– 0.40	2.538	0.188	0.99
Characidae *Alesters imberi* (Peters, 1852)	5	7.30-9.50	8.44 ± 0.34	13.00-16.10	14.6 ± 0.55	– 1.04	1.830	0.944	2.51
Channidae *Channa obscura* (Myers and Shaporador, 1932)	7	14.70-24.50	19.29 ± 1.25	98.10-135.04	121.54 ± 4.84	– 1.64	2.000	0.950	1.93
Cichlidae *Oreochromis niloticus* (Linne, 1758)	21	10.01-22.00	14.93 ± 0.76	40.21-182.30	82.57 ± 1159	– 1.30	4.615	0.939	2.37
Tilapia mariae (Boulenger, 1899)	60	10.00-15.80	11.76 ± 0.17	38.00-154.00	77.76 ± 3.34	– 3.47	5.026	6.600	4.54
Tilapia zillii (Gervais, 1848)	20	10.40-13.60	11.89 ± 0.19	23.00-49.08	30.93 ± 1.94	– 0.80	4.801	2.185	1.97
Mochokidae *Synodontis omais* (Gunter, 1852)	4	18.40-20.50	19.6 ± 0.39	109.20-122.0	118.18 ± 2.64	– 1.62	2.002		
Notopteridae *Papyrocranus afer* (Gunther, 1868)	28	9.80-26.00	13.61 ± 0.72	30.80-207.00	51.33 ± 6.52	– 1.24	3.040		
Total	168								

The study also showed that all the fish investigated exhibited negative allometric growth patterns with regression analyses exponents' **b** values less, or more than three, except for *Papyrocranus afer*, which exhibited a positive isometric growth pattern with exponent (**b**) value of 3.04. This is similar to the result of all fish species exhibiting negative allometric growth pattern reported by Obasohan et al. (2012). The following correlation coefficient (**r**) value 0.908, 0.950, 0.939, 0.9751, 2.185 and 6.600 at $P > 0.05$ indicated high degree of positive correlation between the standard lengths and body weights. Negative allometric was also reported for *Parachanna obsura* from Igwu and Itu Rivers wetlands, Nigeria (Bolaji et al., 2011). According to Adeyemi et al. (2009), negative allometric growth pattern in fish implied that the weight increased at a lesser rate than the cube of the body length. King (1996) reported similar negative allometric growth pattern in many fish in the Nigerian fresh waters. However, unlike the result in this study, isometric growth patterns were reported for *Mormyrus delicious* and *Gnathonemus tamandua* from Oramiri-Ukwa River (Nlewadim and Adaka, 2011). The differences in the results of these studies could be attributed to the age, sex, fecundity of the fishes, sampling methods, and sampling sizes as well as the prevailing ecological conditions in the water body at different times. The result of the study also shed light on the state of well-being of the fish examined. The value of the condition factor for *Chrysichythys auratus* was less than one; this implies a bad state or well-being, while the rest were more than one, implying a good state of well-being in the river. A different result was reported by Obasohan et al. (2012) where two out of five fish species condition factor were below one, and the remaining were above one. However, many factors such as sex, age, state of maturity, size state of stomach, illness, sampling methods, sample sizes and environmental condition affects fish condition and parameters of length-weight relationships in fish (Ama-Abasi, 2007; Yem et al., 2007; Adeyemi et al., 2009).

CONCLUSIONS

A comprehensive report on the species of fishes in this river should be carried out to know the actual population of fish species in the river.

Continuous evaluation should be constantly carried-out on the river and its resources to know its state at all time for proper management and control.

Fisheries activities should be encouraged in and around this river, especially on a commercial level, which will employ more local people living around the river.

ACKNOWLEDGEMENTS

The authors wish to thank the fishers in the study area for their immense contributions in collecting the samples during research work. Special thanks go to our employer; Federal University of Technology, Owerri, Imo State and Michael Okpara University of Agriculture, Umudike, Abia State for providing the financial platform for this research work.

REFERENCES

1. Adeyemi S. O., Bankole N. O., Adikwu I. A. and Akombo P. M., 2009 – Age, Growth and Mortality of some commercially important Fish species in Gbadikere Lake, Kogi State, Nigeria, *International Journal of Lakes and Rivers*, Research India Publications, 2, 1, 63-69.
2. Anene A., 2005 – Condition factors of four cichlid species of a man-made lake in Imo state, Southeast, Nigeria, *Turkish Journal of Fisheries and Aquatic Sciences*, 5, 43-47.
3. Ama-Abasi D., 2007 – A review of length-weight relationship and its parameters in Aquatic species, in Proceedings of the 22nd Annual Conference of the Fisheries Society of Nigeria, Kebbi, Kebbi State, Nigeria, 12th-16th November, 2007, 240-244.
4. Bolaji B. B., Mfon T. U. and Utibe D. I., 2011 – Prelimnary study on the aspects of the Biology of Snakehead fish, Prachannaobscura in a Nigerian wetland, *African Journal of Food, Agriculture, Nutrition and Development*, 1, 1-4.
5. Boulenger G. A., 1916 – Catalogue of the fresh water fishes of Africa in the British Museum (Natural History), 1-5.
6. Fafioye O. O. and Oluajo O. A., 2005 – Length-weight relationship of five fish species in Epe Lagoon, Nigeria, *African Journal of Biotechnology*, 4, 749-751.
7. Froese R. and Pauly D., 2010 – FishBase World Wide Web electronic publication, www.fishbase.org; accessed 2 April, 2014.
8. King R. P., 1996 – Length-weight relationships of Nigerian fresh water fishes, Naga, *The ICLARM Quaterly*, 19, 49-52.
9. King M., 2007 – Fisheries Biology, assessment and management, *Blackwell scientific publication*, Oxford, 2, 189-192.
10. Kulbicki M., Guillemot N. and Amand M., 2005 – A general approach to length-weight relationships of New Caledonian Lagoon fishes, *Cybium*, 29, 235-252.
11. Lecren E. D., 1951 – The length-weight relationship and seasonal cycle in gonad weight and condition in the perch Perca fluviatilis, *Journal of Animal Ecology*, 20, 2, 201-219.
12. Moutopoulos D. K. and Stergiou K. I., 2002 – Length-weight and length-length relationships of fish species from Aegean sea (Greece), *Journal of Applied Ichthyology*, 18, 200-203.
13. Nlewadim A. A. and Adaka G. S., 2011 – Length-weight Relationships of None Fish Species from Oramiri-Ukwa River, Imo State Nigeria, *Nigeria Agricultural Journal*, 42, 264-268.
14. Obasohan E. E., Imasuen J. A. and Isidahome C. E., 2012 – Preliminary Studies of the length-weight relationship and condition factor of five fish species from Ibiekuma Stream, Ekpoma, Edo state, Nigeria, *Journal of Agricultural research and development*, 2, 3, 061-069.
15 Oni S. K., Olayemi J. Y. and Adegboye J. D., 1983 – Comparative physiology of three ecologically distinct fresh water fishes, Alestes nurse (Ruppell), Synodontis schall (Bloch), S. schneider and Tilapia zilli (Gervais), *Journal Fish Biology*, 22, 105-109.
16. Pauly D., 1993 – Fishbyte section editorial, *Naga, The ICLARMQ*, 16, 26.
17. Sikoki F. D. and Otobotekere A. J. T., 1999 – Fisheries, in Alagoa E. C. (ed.), The Land People of Bayelsa State Central Niger Delta, Port Harcourt, 301-319.
18. Talwar P. K. and Jhingran A. G., 1991 – Inland fishes of India and adjacent countries, Oxford and IBH Publishing co. New Delhi, 1 and 2, 115-116.
19. Yem I. Y., Sani O. A., Mshelia M. B. and Onimisi H. U., 2007 – The length-weight Relationship and Condition Factor of the Banded Jewel Fish (Hemichromis mfasciatus Peters) from Kainji Lake, Nigeria, in Proceedings of the 22nd Annual Conference of the Fisheries Society of Nigeria (FISON), Kebbi, Kebbi State, Nigeria, 15-23.