Comparative and regression analysis of Nile tilapia, *Oreochromis niloticus* (Linnaeus, 1758) (Family: Chchlidae) from Bugungu, Eastern region, Republic of Uganda, East Africa (0°23'31.92"N 33°13'51.95"E)

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Abstract

Comparative and regression analysis of length-weight relationship of *Oreochromis niloticus* (Linneaus, 1785) for a period of six months from October 2020 to March 2021, Nile River, Bubungu, Eastern region, Uganda, East Africa, (0°23'31.92"N 33°13'51.95"E) (Fig 1). The slope value (b) estimated for *O. niloticus* of both sexes was found to be 3.4171. The regression equations derived for both sexes was estimated Log W=3.4171+0.1772 Log L. In spite of the fact that *O.* niloticus predetermined well in the wild collection of fish, there was a good statistical difference in their health and general wellbeing. The correlation coefficient was found to be ($p<0.01$). The significant difference between sexes of the species "*F*" value was at 1% level. The b value differed from the ideal cube law of "3" as is with the case of LWR studied in this region. The slope value was compared to Indo-Pacific regions.

Keywords: *Oreochromis niloticus,* Regression analysis, Population dynamics, Uganda

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Introduction

The Tilapia is one of the ideal species for culture because it grows fast, breeds easily and requires relatively less technical input. The *O. niloticus* is the most preferred species for farming because it is hardy and well adapted for farming in warm tropical countries. FiSAT computer tools to stock assessment of the length-weight relationships of between the two variables in which can be applied to predict weight of fish and monitoring by Morey *et.al.* (2002). In different stages of growth, fish can either record isometric growth, negative or positive allometric growth. Isometric growth is equal to 'b' value was >3.0 the fish does not change the shape of its body as it will be continuing to grow is similar and good weight. The length-weight relationship in any given study is significant biological study because it shows the change of two equations: growth-in-length and growth in-weight equations, where are very positive in fisheries executive such as stock assessment models and it supplementary permits the estimation of biomass from length surveillance by fisheries project managers as affirmed by Moutopoulos and Stergiou (2002). Blackwell *et al*. (2000) has reviewed the degree of well-being of the fish in their ecological niche as shown by length-weight factor as hint of dissimilar environmental either (Biotic and abiotic) and biological factors such as fitness, availability of feeds (either natural or supplementary feeds) it influence from only temperature, season, stress, and sex and gonad development and other water quality parameters and suit-ability of the mileu with regard to the feeding condition. When the higher value of the condition factor shows to indicate that the fish is good, healthy and growing optimistically.

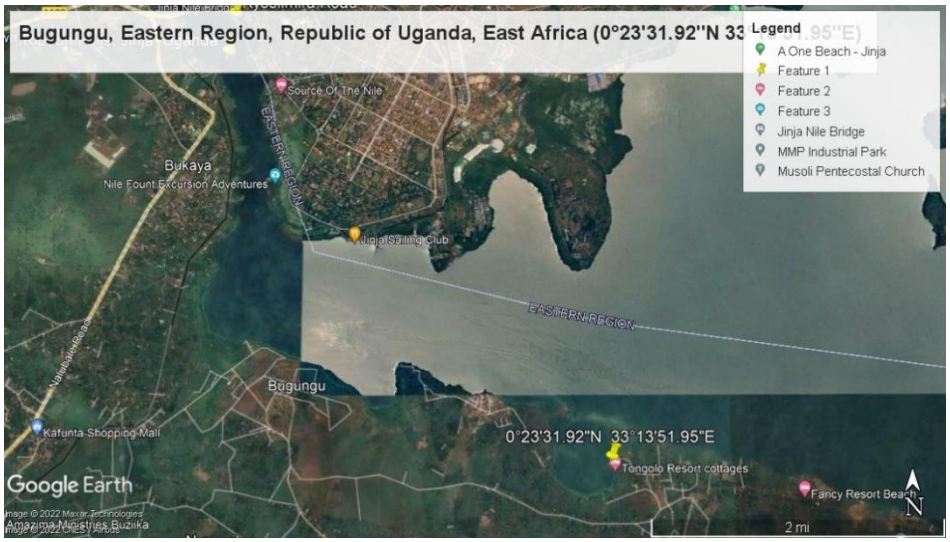

Figure 1: Overview map from Bugungu, Eastern Region, Republic of Uganda, East Africa (0°23'31.92"N 33°13'51.95"E), showing the sampling site of *O. niloticus.*

According to Gertrude Atukunda *et al.* (2021) has reviewed that around globally, Asian countries have leading production of aquaculture from 34.2 mt in 1996 to 82.1 mt in 2018. China has the topmost production at 47.5 mt, a share of 57.9% (FAO, 2020a). Moderately, African countries the production of 110 tonnes to 2,195.9 mt, an account of 17%. When comparatively Egypt has the leading production in Africa was 1.5 mt (FAO, 2020b). Similarly Nigeria was 0.2 mt (FAO, 2020b) followed by Uganda with 0.1 mt (FAO, 2004-2020). An increasing human population and high exploitation rate have threatened the health of Lake Victoria and its resources. Nile tilapia is important in the sense that fishery and fish products are very important in Uganda as far as support to livelihood, employment opportunity, local and foreign exchange earnings and food security are concerned.

Material and methods

The length frequency and catch data were collected from Bugungu region, Republic of Uganda from October 2020 to March 2021. Monthly length frequency data of the species in the catch data was used to estimate length-weight relationship of *Oreochromis niloticus*. Length-weight relationship study was carried out in 129 specimens of *Oreochromis niloticus* ranging from 87 to 286 mm in total length and weight range from 10 – 300 g. The length-weight relationship was calculated by the method of least squares using the equation of Le Cren (1951): $W= a. L^b$, where W= weight in fish, L total length of fish and 'a' and 'b' are the exponents. The same in the logarithmic form can be written as log W=log a+b log L. Analysis of covariance (Snedecor and Cochran, 1967) was employed to find out whether the regression coefficients differed significantly between males and females. The significance of difference in the estimate of 'b' in pooled data of sexes from the expected value of 3 (isometric growth) was tested by the 't' test as given by the formula.

t= b-3/ Sb; b=regression coefficient of log transformed data.

Results

In present investigation study the relationship between length and weight of *O. niloticus* in the wild collected specimens revealed a positive allometric growth where it recorded a 'b' value of 3.4171 (Table 2). The linear equation was also fitted separately for both sexes. The correlation coefficient derived for the length-weight relationship for both sexes are given in Table 1. The regression equations derived for both the sexes are presented below Table 2. The results showed significant of the both sexes of the species and the 'F' values were found to be significant at 1% level (Table 3). The correlations coefficient was found to be significant (p<0.01).

Table 1: Statistics in the length-weight relationship of males and females of *Oreochromis niloticus*

Sex	N	SX	SY	SX^2	SY^2	SXY
Male and Female	129	297.323	288.0459	613.0066	670.386	661.6083

N= Number of fish
SX^2, SY^2, SXY= Sum of squares and product
SX, SY = Sum of logarithmic values of length and weight respectively.

Table 2: Regression data for the length-weight relationship of males and females of *Oreochromis niloticus.*

Sex	Sum of Squares and Products					DF
	DF	X^2	XY	Y^2	b	
Male and Female	129	670.386	613.0066	661.6083	3.4171	128

DF: Regression freedom
B: Regression Co-efficient
SS: Sum of Squares

Table 3: Test of Significance.

Source of Variation	DF	Sum of Square	Mean Square	Observed F
Deviation from individual with in sexes	1	1331.9943	1331.9943	128.0000673
Difference between Regression	128	1331.9943	10.4062	
Deviation from Total Regression	127	2663.9886		Significant at 1% level

Discussion

Stock structure of fishery resources biology, there are four main characteristic aspects: age structure, individual composition (length-weight), sex structure, and sexual maturity composition. stock structure is the state of heterogeneity in the morphology of fish and their quantitative characteristics within a generation stock, specifically the proportion of the number and biomass of age and length groups within a stock, the proportion of sexually mature fish in a stock, when the proportion of older fish to the remainder of the same stock, the males and females in a stock as a biomass or age or length groups. Based on the results obtained from this study, fish health and well-being can be attained stipulation water quality parameters are well managed. The present study revealed a positive allometric growth in Bugungu region, Nile river and Victoria lake with a 'b' value of 3.42. According to Steve and Okeyo (2019) has reported a positive allometric growth of *O. niloticus* in the wild cage from winam gulf L. Victoria with a 'b' value was estimated 3.16. Vaitheeswaran *et.al*. (2013) has reviewed a positive allometric growth in Barur Reservoir, India, 'b' value was calculated 3.41. Pauly (1983) has reviewed the length-weight exponent *b* is equal to 3.0, the body uniform maintains a constant ratio to the length and the fish grows isometrically, results showing that an ideal shape. The slope value of *b* exceeds 3.0, fish become good consistent growth and weight, and when the value less than 3.0, fish become leaner. The slope value of *b* found in the present study is within the interval

ranges from 2.5 to 3.5 recorded for many fish species by Froese (2006), as well as between the values of 2.30 and 3.68 recorded for Nile tilapia in the Atbara River and Khashm EI-Girba reservoir, respectively (Ahmed *et al*., 2011). The variations in the value of the exponent *b* could be accredited to the influence of assorted factors such as seasonal environmental fluctuations, especially Bubungu, Eastern region of Uganda, the temperature should fall in throughout the year and seasonal changes of sudden rain. The physiological conditions of the fish at the time of growth, the phytoplankton and zooplankton intake natural feed and nutritive conditions of food intake of fish will varied geographical conditions, stage of maturation, fish size, fullness of the gut and degree of muscular development and depends of water current of Nile River and Victoria lake, Uganda. Beverton and Holt (1957) have suggested that the major deviations from isometric growth are very rare. The cubic relationship for fishes will be valid when fish augments isometrically. Naturally, the actual relationship between the two variables, length and weight frequency, may depart from this, either fish vary at different latitudes and longitudes. The present investigation of this studies showed that a positive allometric growth ('b' value of 3.42) pattern and there is strong relationship between body weight and length of Nile tilapia fish. *O. niloticus* grown this Eastern region of Nile river, Bubungu, have better healthier and good condition. It is suggested that, further studies to be done on other species so as to come up with the better species that can survive well in this regions.

References

Ahmed, E.O., Ali, Aziz. M.E. and 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 Agricultural Science*, 3, 65-70.

Atukunda G., Peter Atekyereza, P., Walakira, J.K., State, A.E., 2021. Increasing Farmers' Access to Aquaculture Extension Services: Lessons from Central and Northern Uganda. *Uganda Journal of Agricultural Sciences*, 20, 2, pp. 49-68.

Beverton, R.J.R. and Holt, S.J., 1957. On the dynamics of exploited fish population. Fishery Invest. *Lond Ser*, 2(**19**), 533.

Blackwell, B.G., Brown, M.L. and Willis, D.W., 2000. Relative Weight (Wr): Status and current use in fisheries assessment and management'. *Reviews in Fisheries Science*, 8, 1-44.

FAO, 2004-2020. Fishery and Aquaculture Country Profiles. Uganda (2004). Country Profile Fact Sheets. In: FAO Fisheries and Aquaculture Department [online]. Rome: FAO. Updated 1 December 2004 [Cited 25 May 2020]. http://www.fao.org/fishery/

FAO, 2020a. Fishery and Aquaculture Country Profiles. Nigeria. Country Profile Fact Sheets. In: FAO

Fisheries and Aquaculture Department [online]. Rome: FAO. Updated 1 November 2017 [Cited 25 May 2020]. http://www.fao.org/fishery/

FAO, 2020b. The State of World Fisheries and Aquaculture, 2012. Sustainability in Action. FAO, United Nations, Rome.

Froese, R., 2006. Cube law, condition factor and weight-length relationships: history, meta-analysis and recommendations. *Journal of Applied Ichthyology*, 22, 241-253.

Le Cren, E.D., 1951. Length-weight relationship and seasonal cycle in gonad weight and condition in perch (*Perca fluviatilis*). *Journal of Animal Ecology*, 20(**2**), 201-219.

Morey, G., Moranta, J. and Massut, E., 2002. Weight-length relationships of littoral to lower slope fishes from the western Mediterranean. *Fisheries Research Journal*, 62(**1**), 89-96.

Moutopoulos, D.K. and Stergiou, K.I., 2002. Length-weight and length-length relationships of fish species from the Aegean Sea (Greece). *Journal of Applied Ichthyology*, 18(**3**), 200-203.

Pauly, D., 1983. Some simple methods for the assessment of tropical fish stocks. FAO Fisheries Technical Paper No. 234. FAO, Rome.

Sendeor, G.W. and Cochran, W.G., 1967. Statistical Methods (6th Edn). Oxford and IBH publishing Co. New Delhi. 250P.

Steve, O.N. and Okeyo O.J.B., 2019. Assessment of length-Weight relationship condition factor of Nile tilapia (*O. niloticus*) in cage and open waters in Winam Guof of L.Victoria, Kenya. *International Journal of Environmental Sciences & Natural Resources*, 22(**3**), 97-101.

Vaitheeswaran, T., Karal Marx, K., Chidambaram, P., Sankarram, S. and Karthiga, P., 2013. Length-weight relationship of Nile tilapia of *O. niloticus niloticus* (Linnaeus, 1758) (Family: Cichlidae). *Indian Journal of Veterinary and Animal Sciences Research*, 43(**1**), 33-39.