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Length Weight relationship, condition factor of the Elephant snout, M*ormyrushasselquistii* (Valenciennes, 1847) in relation with the physiochemical parametersof Ebonyi river, South East Nigeria; Implication for fishery ecosystem assessment, management and policy

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Abstract
Mormyrushasselquistiiis easily recognizable by its long dorsal fin. M. hasselquistiiis widely distributed throughout Africa; it possesses electric organs for communication and electrolocation. M.hasselquistii species are relatively large fishes, and therefore of commercial interest. The length-weight relationship and condition factor of M. hasselquistiias well as the physiochemical parameters of Ebonyi River, Ebonyi State were studied total length and weight were measured using standard methods. The degree of association between the length and weight was computed from linear regression analysis using FAO/ICLARM Software Assessment Tool (FiSAT) II analysis tool. Length-weight relationship of M. hasselquistiiin Ebonyi River, Ebonyi State, Nigeria, was studied from February - July, 2018 and a total number of 111 samples of M. hasselquistiiwere sampled. Highest length and weight of 44cm and 400g were recorded in the month of February while the lowest length and weight of 7.5cm and 13.4g respectively were recorded in the month of May. The parameters 'a' and 'b' of the Length-weight relationship and correlation 'r', of the form $W= aL^b$ *and monthly condition factor K, were calculated. The value of the exponent (b) was 1.853 and this showed a negative allometric trend indicating that the fish increases faster in length than in weight. The Correlation coefficient 'r' was 0.937 and the 'a' value was -0.489. The mean condition factor of the specie was 1.115 the value obtained from this work showed that the specie studied were in good condition, indicating the potential of the river to support increased production of this species if appropriate management options are adopted. The physicochemical parameters are important factors when considering the quality of water which ensures optimum growth and survival of fish species. Physical and Chemical parameters such as Temperature, pH, Dissolved oxygen, Conductivity and Total Dissolved Solid were analyzed. The mean value of water temperature was* 28^0C*; TDS, 25mg/l; Conductivity, 50ms/cm; pH, 8 and Dissolved oxygen, 4.5 mg/l. All parameters were within the permissible limits and this indicates that Ebonyi River has favourable environment for the survival and growth of M.hasselquisti.*

Keywords: *length-weight relationship, condition factor, physiochemical parameters,EbonyiRiver, M. hasselquistii*

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I. Introduction

Fish is any aquatic vertebrate animal that is covered with scales and equipped with two sets of paired fins and several unpaired fins [1]. 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 [2]. Fish are important in that they contribute as much as 17% of the world's animal protein [3]. Inland fisheries play an important role in the provision of protein to Nigerians with a high population of about 178.5 million people [4], especially when imported fish is becoming too expensive for low income earners as observed by [3]. Fish constitutes an important and cheap source of animal protein to human beings and a large number of people depend on fish and fishing activities for their livelihood. Increasing human influences through heavy metal pollution have however led to the depletion of our fish resources and substantial reduction in the nutritive values [5]. 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 [6]. Detailed knowledge of the form and function of the river system and the responses of fish species are needed for effective fisheries management planning. [7]reported that such detailed knowledge of individual systems is generally lacking. [8]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 comparison between populations of the same species.Like any other morphometric characters, the Length-weight relationship can be used as a character for the differentiation of taxonomic units and the relationship changes with various developmental events in life such as metamorphosis, growth and the onset of maturity [9]. Besides this, the length-weight relationship can also be used in setting yield equations for estimating the number of fish landed and comparing the population in space and time [10]. Furthermore, the empirical relationship between the length and weight of the fish enhances the knowledge of the natural history of commercially important fish species, thus making the conservation possible. Sustainable exploitation requires knowledge of the ichthyofaunal composition of water bodies [6]. The Fulton's condition factor (K) is a quantitative parameter of the well-being state of the fish and reflects recent feeding conditions. This factor varies according to influences of physiologic factors fluctuating according to different stages of the development. [11]refer to length-weight data of population as basic parameters for monitoring study of fisheries, since it provides important information concerning the structure and function of the populations. Therefore this paper studies the length weight relationship and condition factor of *M. hasselquistii*in Ebonyi River, South East Nigeria.

II. Materials And Methods

Study Area

The study was carried out in Ebonyi River, Ezzagu in Izzi local government area of Ebonyi state, South Eastern Nigeria. This is a freshwater system and has its source from lower Benue River and opens into Cross River, but transverses the old Abakaliki Zone of Ebonyi State Nigeria. Its geographical coordinates are latitude of $6^0$19`29.796" N and Longitude $8^0$8`23.13" E. The vegetation of the river comprises mainly trees that are scarcely distributed with bamboo plants, palm trees and elephant grasses. The major occupations of the people within this area are fishing and farming due to the presence of the river. The river is subjected to annual water fluctuations which goes a long way to determine the level of the agricultural activities that takes place in each season. During rainy season (April – October), the water level increases and this leads to intense farming but towards dry season (November – March), the water level decreases so much that most times the floor of the river is seen and this leads to reduction in the activities of the fishermen, causing them to change to other agricultural activities until when the water level increases again.

Sample Collectionand Identification

Samples of *M. hasselquistii*were collected randomly from sampling site in Ebonyi River, a freshwater ecosystem between February 2018 and July 2018 using cast nets, gill nets of mesh sizes ranging from 150mm–200mm, hook and line and locally made hoop-pike traps by different Fishermen.

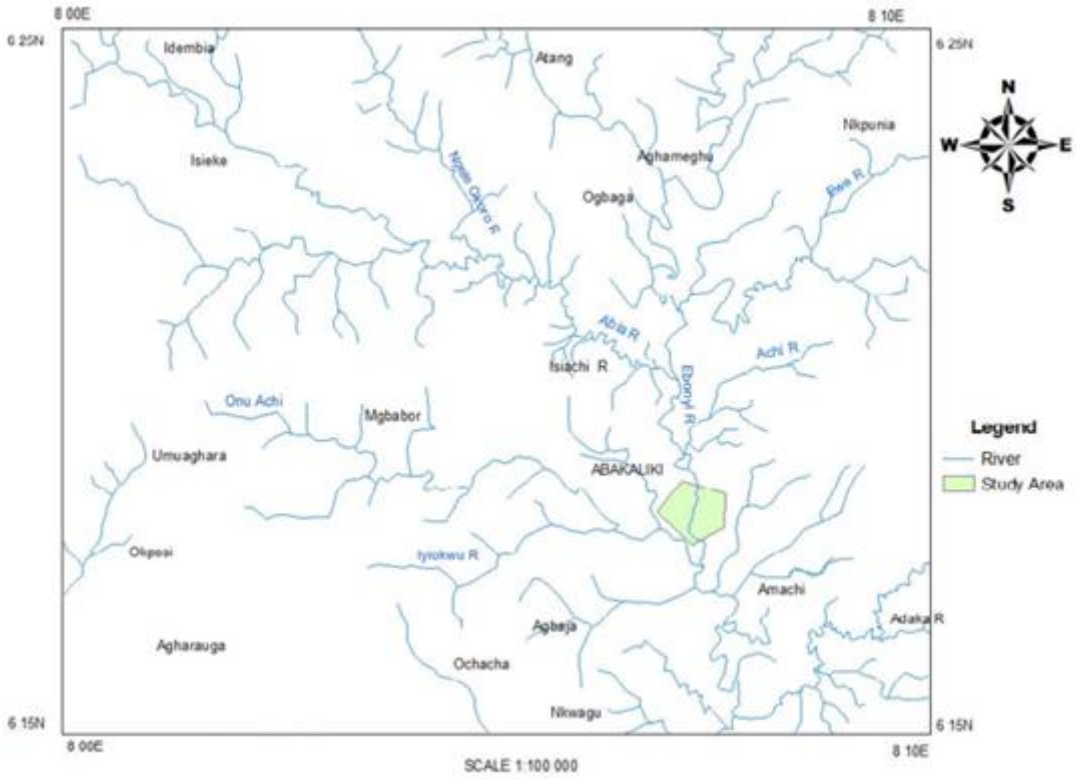

Figure 1: Map of Ebonyi River showing study area [12].

Laboratory Analysis

The samples were identified to species level using the guides of [13] then measured and weighed to determine the length and weight relationship. The identified species were weighed using FEJ-1500A electronic compact weighing balance after being cleaned. The species were weighed to the nearest 0.1g. Total length (TL) was measured to the nearest 0.1cm with a meter rule measuring board. Water samples were also collected for analysis. A clean washed high quality rubber was used to collect the water to check the physiochemical parameters. The laboratory analysis was carried out in Applied Biology Laboratory, Department of Applied Biology, Ebonyi State University, Abakaliki.

Mathematical and Statistical Analysis

Fish total length (cm) was measured using a standard meter rule mounted on a dissecting board. The weight was measured using electronic weighing balance with sensitivity of 0.1g after identification of the sampled species. Estimation of species length – weight relationship was done using formula:

$W = aL^b$

Where:W = weight of fish in (g), L = Total Length (TL) of fish in (cm), a = constant (intercept) and b = growth exponent (slope).

The formula was transformed using the regression equation:Log Y = a + b Log X

The "a" and "b" values obtained from a linear regression of the length and weight of fish. The correlation (r^2) that is the degree of association between the length and weight was computed from the linear regression analysis, using FAO-ICLARM FISAT II Analysis Tool[14]. The slopes of length - weight regression were compared to 3 to determine whether the fishes grew isometrically orallometrically. The Fulton'scondition factor (K) was computed using formula

$K = 100W/L^3$ Where: w = weight of fish (g)and L = Total length (TL) of fish in cm[15].

III. Results

A total of 111 *M. hasselquistii*was sampled and it have a total length ranging from 7.5cm to 44cm and a total weight of 13.4g to 400g. The species with the highest length was recorded in February and this species weighs more than other species in the remaining five months with a weight of 400g as seen in the Table 1 below. The values of the exponent b in the LWR varied between 1.443 and 1.630 and this indicate that the fishes exhibited negative allometry. The values of their various intercepts (a) and correlation coefficients (r) are also presented in Table 1. The overall length-weight relationship is as shown in Figure 1.The monthly condition

factor (k) of the species was observed during the 6 months. The results are shown in Table 1**.** The condition factor ranged from 0.692 to 1.649 with an overall mean k of 1.122. The lowest mean k value of 0.692 occurred in February while the highest mean k value of 1.649 occurred in the month of June.The physico- chemical characteristics in the water of EbonyiRiver are shown in Table 2 below. The pH recorded ranged from 7.1 to 8.5 with a mean value of 8. Temperature, TDS and conductivity remained constant at the three sites with values of 28^0C, 25mg/l and 50ms/cm respectively.

Table 1: Length-weight relationship and condition factor of *Mormyrushasselquistii*

		Length			Weight						
Month	N	Min	Max	Mean	Min	Max	Mean	a	b	r	c. f
February	17	20	44	34.94	100	400	278.71	-0.005	1.581	0.998	0.692
March	19	18.1	43.2	23.31	70.5	393.1	106.18	-0.098	1.498	0.910	0.769
April	19	14.8	37.1	23.4	50.2	350	163.08	-0.068	1.630	0.971	1.272
May	20	7.5	27.9	15.09	13.4	143.5	49.44	-0.110	1.493	0.968	1.649
June	18	12.4	26.7	19.81	35.1	200.9	101.97	-0.078	1.582	0.947	1.227
July	18	7.9	28.5	17.59	17.8	175.5	56.54	-0.086	1.443	0.933	1.081
Total	111							-0.489	1.853	0.937	

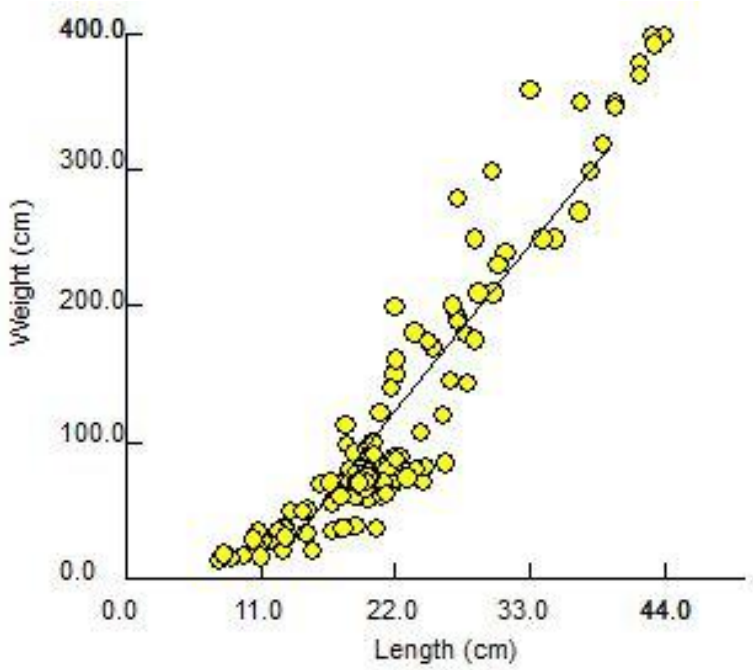

Figure 1:Overall Length-Weight Relationship of *Mormyrushasselquistii* in Ebonyi River

Table 2: Physicochemical parameter of Ebonyi River

Station	Temperature	TDS	Conductivity	pH	D.O
A (shallow region)	28^oC	25 mg/L	50 µ/cm	8.4	5 mg/L
B (Deep region)	28^oC	25 mg/L	50 µ/cm	8.5	4.4 mg/L
C (At the dam)	28^oC	25mg/L	50 µ/cm	7.1	4 mg/L
Mean	28^oC	25 mg/L	50 µ/cm	8	4.5 mg/L

IV. Discussion

Length-weight relationship is important in estimating the average weight of fish at a given length group, it is also useful in assessing the relative well-being of a fish population. The length-weight relationship of *M. hasselquistii*from this study showed a negative allometric b value of 1.853.[16]also studied the length weight relationship of the fish species in Ebonyi River reported that *M. hasselquistii*showed negative allometry. The negative allometric length-weight relationship of*M. hasselquistii,* from this studyagrees with [17], [8] and [18]also recorded similar results. However, the negative allometric length-weight relationship recorded in this work was higher than those recorded by the other authors. This implies that the fish becomes relatively slimmer as it increases in length. This is because increase in length is faster than increase in weight [19]. The Length-

weight relationship of fish species is an important factor in biological study and it is greatly affected by many factors and this is responsible for the varied results from different study areas. In fish, condition factor (k) reflects, through its variations, information on physiological state of the fish in relationship with its well-being. There was a general decrease in condition factor with increasing length of the specimens. This means that increase in length did not bring about proportional increase in weight. [20] attributed the decline in condition factor to the deposition of materials for gonad formation which lead to increase in weight and actual spawning which lead to reduction in fish weight respectively. The mean condition factor of 1.115 was obtained for this population of *M. hasselquistii*in Ebonyi River This is an indication of the good condition of the fishes. This showed the potential of the river to support increased production for mormyrid species if appropriate fisheries management strategies are adopted, which will enhance sustainable development of fishery.

The mean value of temperature in this work (28^oC) is within the recommended limit of [21],[22] and [23]for aquaculture and domestic use. The findings were different from the report of [24] in Abraka Delta State, Nigeria.Thedifferences in temperature could be due to the function of the climate condition at a particular geographical location and period of sampling. Vegetation along the river bank could also play a significant role in influencing the temperature of aquatic ecosystem. Water temperature is an important parameter which influences the onset of fish spawn, aquatic vegetation growth and biological demand of oxygen in rivers. Changes in temperature could affect the metabolism and physiology of fishes and its productivity [25].The mean conductivity recovered in this work (50µ/cm) is also within the permissible limits of set standards [21], [22] and [23] for aquaculture and domestic use. Report proves that high value of conductivity is an indication of water pollution [26], this however, may be as a result of high concentrations of cations and anions which alter the chemistry of the aquatic ecosystem. However, [27] have reported that fishes differ in their ability to maintain osmotic pressure, therefore the optimum conductivity for fish production differ from one species to another. The mean total dissolved solid (TDS) values in this work are consistent with the recommended limits of set standards [28],[21], [22] and [23]. These consistencies in the TDS values could be linked to relatively same geological drainage, atmospheric precipitation, water balance (evaporation–precipitation) and moderate concentrations of the ions in the surface runoff [29]. The average value recorded for water pH in this study is within the standards of[21], [22] and [23],optimal for fish productivity,an indication of balance between photosynthesis and respiration in Ebonyi River. This is also in agreement with the result of [24]. The results of the recorded values of DO in this work are within the permissible limit for aquaculture[30].

In conclusion,*M.hasselquistii*showed a negative allometry as it increases faster in length than in weight. The condition factor from this study indicates that the fish is in good condition. The levels of physicochemical parameters in the study area showed that most of the parameters determined did not exceed the permissible limit of set standards. The river was fit for aquaculture.Appropriate fisheries management strategies should be adopted to enhance sustainable development of the fishery.

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