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Morphometric and Meristic Characteristics of *Clarias gariepinus* from Controlled and Uncontrolled Population from Southwestern Nigeria

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Authors' contributions

This research work was carried out in collaboration between all authors. Author OF designed, wrote the procedures and supervised the experiment. Author JAO co-supervised experiment; and proof-read the write-up. Author MBO carried out the experiment and first draft write-up. Author OA did the statistical analysis. All authors read and approved the final manuscript.

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ABSTRACT

Studies on the nineteen morphological characteristics and meristic traits of *C. gariepinus* collected from those bred by a fish farmer in a fish pond in Emure- Ekiti (controlled population) and those from the wild population in Ogbese river (uncontrolled population), in Ado-Ekiti, Ekiti State Nigeria were carried out between August and December, 2012. One hundred and twenty –three (123) fish individuals collected by cast and dragging nets were bought, out of which sixty-one (61) were from the fish farm in Emure- Ekiti and sixty-two were from Ogbese river. The mean body weight and total length of the fish were 530.67±18.74g and 42.53±0.55cm and 507.02±26.26g; and 42.40±0.58cm for the controlled and uncontrolled fish population respectively. The length-weight relationship

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values were logW = -0.9961 +2.2781logL and logW = -1.3230 +2.4661logL for controlled and uncontrolled *C. gariepinus* population respectively. The results recorded on the mean body weights (530±18.74 and 507±0.02) and mean lengths (42.53±0.55 and 42.40±.0.58) of the fish from the two populations are not statistically different. But there are variations between and among the two fish populations. The condition factor (K) values are 0.69±0.02 and 0.67±0.01 for the controlled and uncontrolled fish population. The condition factor values which were not significantly different from each other showed that the fish from the two populations are not well fed. The robustness of the fish from uncontrolled population may be as result of enough fertility of the river or that there was a lesser competition from other fish species for the available food resources. There is need to determine the factor(s) which favours the growth and development of the fish from Ogbese river (uncontrolled population).

Keywords: Morphometric characteristics; Clarias gariepinus; population; condition factor.

1. INTRODUCTION

Clariid Catfishes are air breathing fishes naturally occurring in freshwater bodies in Africa, South-East Asia where they constitute significant component of catches. The Clariid catfishes are of great importance as food and vital in the sustainability of the aquaculture [1]. Catfish especially *Clarias gariepinus* aquacultural attributes include: ability to withstand handling stress, disease resistance, high growth rate, yield potential, fecundity and palatability. *C. gariepinus* is one of the most readily acceptable species of Clarias in Nigeria because they grow to large sizes hence the need to assess their abundance [1].

Morphometric and meristic analyses are part of important rigorous tools used to differentiate closely related species of organism having huge similarity indices of various parameters [2]. Morphometric characters are not only essential to the understanding of the taxonomy but also the health of a species as well as its reproduction in an environment. The shape and structures are unique to each species and the variations in its features are probably related to the habit and habitat among the variant of the species [3]. Although morphological characteristics are phenotypically plastic and are influenced seasonally by the physical environment factors during spawning and early juvenile stages of their life [4]. Morphometric assessment of an animal species determines the inter relation between the body parameters like length, weight, fecundity and so on. It is also helps in the understanding of the relation between body parts [3]. Morphometric assessment is also used in the identification of the differences in fish population [5,6-7].

Morphometric variation between stocks can form one of the bases for stock structure and may be applicable for studying a short-term, environmentally induced variation geared towards successful fisheries management [8-9]. These measurements are restricted to document the direction of the size of variation in animal stock. The measurement is believed to be a suitable technique for the recognizing the degree of reproductive maturation without sacrificing the animals [10].

The general health of a population of fish can be accessed through the growth features. So possible variations in the measurable and countable characters will reveal the adaptation to environmental condition and help in clarifying their identity in the location of the population [11]. Generally, species of fish that have different origin are morphologically differentiated from each other. It is on this note that the present study was based to provide some basic information on morphometric and meristic characteristics of *Clarias gariepinus* from a pond (controlled) and a river (uncontrolled) population in Ekiti State, Nigeria

2. MATERIALS AND METHODS

2.1 Study Area

Clarias samples were collected from river Ogbese in Ado-Ekiti and a fish pond in Emure-Ekiti. The fish in Emure- Ekiti pond were hatched in the in the fish farm. Ogbese river is a running stream where fishing activities are not restricted while the Emure fish ponds are owned by an individual fish farmer. The Ogbese river in Ado-Ekiti lies between latitude 7° 36' 24'' north and longitude 5° 18' 21'' east of the equator. Emure-Ekiti (the fish pond located) is located between 7° 21' 5'' north and 5° 24' 58'' east of the equator. Fish samples were collected from the fish mongers at the bank of the Ogbese river and at the site of the fish pond.

2.2 Collection of Fish Samples

Fresh live adults of *Clarias gariepinus* collected by using dragging and cast nets were bought from fishermen from the two locations were transported to the Postgraduate laboratory of Zoology Department, Ekiti State University, Ado-Ekiti for their body parts measurement.

2.3 Laboratory Examination of the Fish

In the laboratory, the fish were examined, washed properly, and separated into sexes.

2.4 Data Collection

One hundred and twenty-three matured fish samples comprising of sixty-two individuals from Ogbese river, Ado-Ekiti and sixty-one from a fish pond in Emure-Ekiti were collected. Nineteen morphometric measurements were carried out on each fish specimen. The body parts were measured following standard anatomical reference points [12]. The traits of the body measured were body weight (BW) (taken by using electronic weighing balance to the nearest 0.01g), total length (TL) (measured from the maxilla to the end of the caudal tail). Standard length (SL), body depth at anus (BDA), Caudal peduncle depth (CPA), Pre-anal distance (PAD), Pre-pelvic distance (PPLD), Pre-pectoral distance (PPCD), Dorsal fin length (DFL), Pectoral fin length (PCFL), Pectoral spine length (PCSL), Pelvic fin length (PEFL), Anal fin length (AFL), Head length (HL), Head depth (HD), Snout length (SNL), Nasal barbell length (NBL), Maxillary barbell length (MBL), Genital papillae length (GPL), Dorsal fin rays (DFR), Anal fin rays (AFR), Pectoral fin rays (PFR), Pelvic fin rays (PEFR) and caudal fin rays (CFR).

2.5 Condition Factor

The condition factor (K) which is defined as the well being of the fish was calculated. K is a useful index for monitoring of feeding intensity, age, and growth rates. The K was determined by

$$K=W.100/L3$$

Where W= weight of fish in grams
L= length of fish in centimeters

2.6 Length-weight Relationship

This relationship was determined following: [13]. Length-weight was expressed as $W = aL^b$, the logarithm transformation of which gives the linear equation.

$$LogW = a + b \log L$$

Where W = Weight in gram, L = length in (cm), a = a constant being the initial growth index, and b = growth coefficient. Constant 'a' represents the point at which the regression line intercepts the y-axis and 'b' the slope of the regression line.

3. RESULTS

Morphometric and meristic traits mean values of *Clarias gariepinus* from controlled (fish pond) and uncontrolled (wild) population are listed in Table 1. The results show that the mean body weight (BW) of *C. gariepinus* from the controlled environment ranged from 233.2g to 1038.0g with mean value of 530.57±18.74g while that of the uncontrolled environment ranged from 270.3 to 1847.5g and mean weight of 507.02±26.26g but, the mean weight of the *C. gariepinus* from the two populations were not significantly different from each other. The value of total length (TL) ranged between 28.6 and 52.9cm with mean value of 42.53±0.55cm in controlled population sample. Total length of uncontrolled population sample ranged from 35.7 and 63.2cm with mean value of 42.40±0.58cm. The values on the total length and standard length of the controlled and uncontrolled environment were not significantly different from each other. The mean values on other morphometric traits were similar in the two population samples.

The ratio of males to females of the controlled population sample did not conform to 1:1 ratio while that of the uncontrolled population conform to 1:1 ratio. The length-weight of the two populations can be expressed as logW = -0.9960 + 2.2781logL and LogW = -1.3230 + 2.4661logL for controlled and uncontrolled population respectively. The 95% confidence limits of 'b' values for controlled and uncontrolled population were 1.9401- 2.6161 and 2.1142- 2.8177. The correlation coefficient 'r' between log length and log weight was found to be 0.8690 and 0.8754 in controlled and uncontrolled population. The relationship between the logarithm of the total length and body weight of the controlled and uncontrolled population samples are further shown in Figs. 1 and 2.

The condition factor (K) values for the controlled and uncontrolled population samples are $0.69±0.02^a$ and $0.67±0.01^a$ respectively. The values are not significantly different from each.

Table 1. The t-test, probability and the mean of morphometric of *C. gariepinus* from controlled and uncontrolled population

TRAITS	Tstat	P	Controlled environment	Uncontrolled environment
			Mean	Mean
Body weight (BW) (g)	-0.7311	0.4661	530.67±18.74[a]	507.02±28.26[a]
Total length (TL)(cm)	-0.1701	0.8652	42.53±0.55[a]	42.40±0.58[a]
Standard length (SL) (cm)	0.6804	0.4976	37.50±0.51[a]	37.0±0.52[a]
Body depth at anus (BDA) (cm)	1.6704	0.0975	3.33±0.07[a]	3.12±0.10[a]
Caudal peduncle depth (CPD)(cm)	0.8664	0.3879	5.29±0.08[a]	5.16±0.12[a]
Pre-anal distance (PAD)(cm)	0.4993	0.6185	21.07±0.29[a]	20.82±0.40[a]
Pre-pelvic distance (PPLD)(cm)	1.6468	0.1022	17.54±0.24[a]	16.97±0.24[a]
Pre-pectoral distance (PPCD)(cm)	4.0026	0.0001	9.27±0.13[a]	8.45±0.15[a]
Dorsal fin length (DFL)(cm)	0.0981	0.9220	24.61±0.43[a]	24.55±0.39[a]
Pectoral fin length (PCFL)(cm)	-0.0802	0.9362	4.44±0.09[a]	4.45±0.11[a]
Pectoral spine length (PCSL)(cm)	-2.4518	0.0157	2.82±0.08[a]	3.11±0.09[a]
Pelvic fin length (PEFL)(cm)	0.4255	0.6712	3.49±0.07[a]	3.44±0.08[a]
Anal fin length (AFL)(cm)	1.8366	0.0687	16.94±0.34[a]	16.12±0.30[a]
Head length (HL)(cm)	1.6087	0.1103	10.69±0.14[a]	10.31±0.19[a]
Head depth (HD)(cm)	4.5200	1.45E-05	8.45±0.15[a]	7.38±0.19[a]
Snout length (SNL)(cm)	0.7218	0.4718	3.95±0.13[a]	3.85±0.08[a]
Nasal barbell length (NBL)(cm)	2.5345	0.0123	10.48±0.24[a]	9.63±0.24[a]
Maxillary barbell length (MBL)(cm)	2.0603	0.0410	7.76±0.17[a]	7.31±0.15[a]
Genital papillae length (GPL)(cm)	1.4686	0.1145	1.22±0.06[a]	1.09±0.07[a]
Dorsal fin rays (DFR)	1.1564	0.2498	66.0±0.81[a]	64±0.74[a]
Anal fin rays (AFR)	2.8964	0.0045	51.0±0.75[a]	48±0.68[a]
Pectoral fin rays (PFR)	7.4194	1.85E-11	8.0±0.19[a]	8.0±0.13[a]
Pelvic fin rays (PEFR)	4.2426	4.35E-05	6.0±0.04[a]	6.0±0.00[a]
Caudal fin rays (CFR)	3.8028	0.0002	18.0±0.24[a]	18±0.18[a]

Mean values in the same column with the same superscripts are not significantly different from each other (P≤0.05)

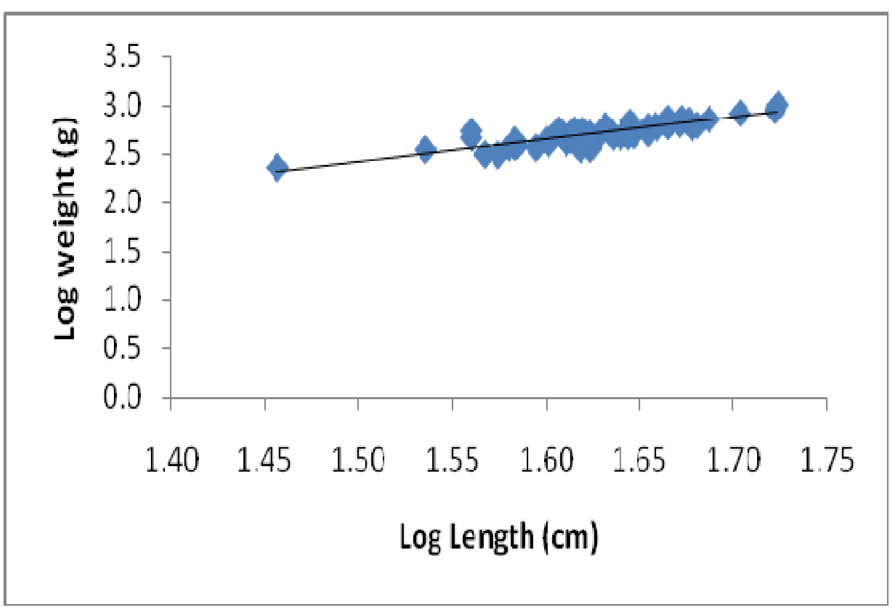

Fig. 1. Relationship between logarithm of the total length and body weight of *C. gariepinus* from a controlled population

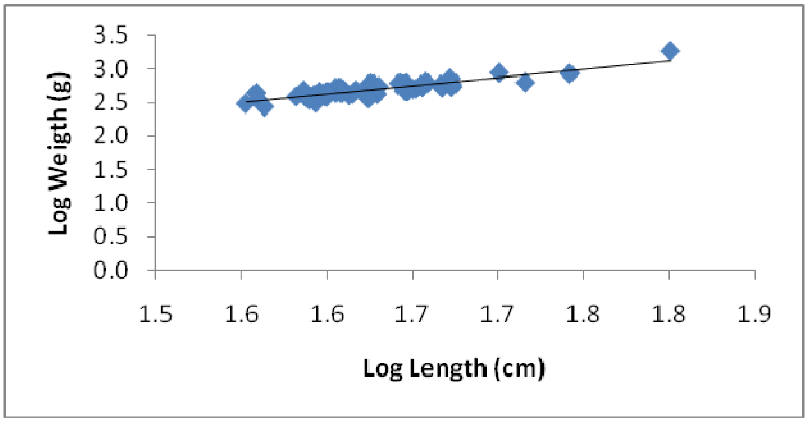

Fig. 2. Relationship between the logarithm total length and body weight of *C. gariepinus* from uncontrolled population

4. DISCUSSION

Clarias has a widespread distribution and is adapted to Nigeria and Africa [14]. *Clarias gariepinus* which is one of the most important economically species in Africa has also been introduced in Europe, America and south-east Asia for aquaculture purposes [15]. The catfishes from the *Clariidae* are not only used as important economic species but also as invasive species. It was noted that in most of the habitats where *C. gariepinus* has been introduced due to their high predatory nature along with omnivoracity and prolificacy, the species used to impose a great threat to the native fishes.

The use of predatory fish species such as *C. gariepinus* in controlling the population of fish at lower trophic level such as tilapia species, *Oreochromis niloticus* through culturing method has been an acceptable method worldwide. The proper use of predatory fishes considered as a safe biological method for covering tilapia overpopulation in ponds without affecting the bid size prey [16].

Meristic and morphometric analyses are important tools used to differentiate closely related species of organisms having huge similarity indices of various parameters. It is well known that morphometric characters in fishes can show high plasticity in response to difference in the environmental condition, such as food abundance and temperature [17-18].

The literature on the morphometric characteristics of catfish, *C. gariepinus* is very scarce. The morphometric characteristics of this species are significant for easy assessment of the pure strain stocks because both the interspecific, intraspecific and intergeneric hybrids of the *Clarias* are also cultured with the pure strains of the fish. Also, the more closely related species like *C. anguillaris* or *C. macrocephalus* even *Heterobranchus* species are cultured with *C. gariepinus* on a large scale, thus the morphometric features study may be used for proper identification of the *C. gariepinus* pure strains and the hybrids from other genus or similar species. It is also used in comparing fish of the same species just like it has been used for other fishes from different populations. The comparative study of the morphological and meristic traits of *C. gariepinus* collected for this study from two different environment will be able to reveal similarities or differences or possibly to determine the source(s) of their variation.

From this study, the mean body weights of the *C. gariepinus* from controlled and uncontrolled population are 530.67±18.74g and 507.02±26.26g respectively. Although; the weight values from the two population samples are similar statistically. The mean values of the total length of the two populations which are 42.53±0.55 and 42.40± 0. 58cm corroborate the values of the weight. These results from the body weight and length showed that the samples of fish from the wild (uncontrolled) environment have wide range of weight and length in comparison to those species of the controlled population. The wide range of growth and development in the wild species may be due to over cropping of the fish by villagers around Ogbese river. There are positive relationships between mean body weights and mean total lengths as represented in Figs.1 and 2. These relationships reveal that the weight and length are positive respond to the growth and development of the fish in their separate environment.

The regression coefficient 'b' values recorded in this study are 2.2781 and 2.4661 for controlled and uncontrolled *C. gariepinus* population respectively. It was reported that regression coefficient value (b) that equals three (3) for weight-length relationship indicates that the fish grow symmetrically or isometrically (provided its specific gravity remains constant). The values other than three (3) indicate allometric growth (i.e. body proportions change with growth). It was also reported that, fish having regression relationship value b=3 maintains their specific body shape throughout their life as reported by [19] The values of regression coefficient between weight and length may vary with feeding according to [13], level of maturity [20], sex [21], and geographical distribution of the population [22]. This study shows that the fish from the both controlled and uncontrolled fish population have exhibited allometric growth. The variation in the two samples growth may be as a result of geographical and ecological variation of their habitats, variations in the water quality parameters and food availability which are directly responsible for growth of the fish as reported by [21,23,24-25]. The allometric growth exhibition by the same or different fish species have been reported by many researchers [23-24].

The mean condition factor (K) of the fish which strongly depend on fish length, from the controlled population was slightly higher than that of uncontrolled population sample. When there is variation in the condition factor from two different populations, it suggests that the fish under the study are not from the same source. The condition factor defines the well being of the fish in a particular environment at a time. According to [26], fish with higher K values are in a better condition than fish with lower K values with respect to their lengths. Values of K for the two populations are lesser than 1. This indicates that the feeding of the fish from the two populations might be inadequate. This implies that the fish from the controlled population may not have been fed to the required level or that the fish from uncontrolled population are caught from well naturally fertilized stream or that there is little competition for available food materials in the stream. There is need to determine the reasons for better growth and development of *C. gariepinus* collected from Ogbese river, Ado-Ekiti, Ekiti State Nigeria. [27] reported that the fish sufficiently feed had "K" value equals or greater than 1 while undernourished fish had "K" less than 1. The results of this study suggest similarity in the morphological composition and the condition factor of *C. gariepinus* from controlled and uncontrolled population.

5. CONCLUSION

The results obtained in this study suggest similarities in the morphological composition and the condition factor of the controlled and uncontrolled population of the *Clarias gariepinus.* There is need to determine the favourable factors of the growth and development of the uncontrolled environment in the subsequent studies on Ogbese river in Ado- Ekiti, Nigeria.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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