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Quantitative Characterization of Farmed African Cat Fish (*Clarias gariepinus*) in Okitipupa, Ondo State, Nigeria

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ABSTRACT

Data on body weight and morphometric traits from one hundred and fifty-eight (158) live African cat fish sampled from two locations around Okitipupa within Ondo State, Nigeria was subjected to simple statistics analysis, Pearson's correlation and analysis of variance to test for the effect of sex, age, location and body size on the body weight and the morphometric traits. The coefficient of variation (CV) varied among the parameters were considered. Results obtained revealed that body weight had the highest value (46.18%) in the adult fish while it was 22.76% in juvenile fish. Insignificant effect of sex ($p > 0.05$) was observed in both adult and juvenile fish in all the parameters considered. Age had a very highly significant effect ($p < 0.0001$) on all the parameters considered. The adult had higher values compared to the juvenile in body weight and the morphometric traits. Effect of body size was significant ($P < 0.0001$) on body weight and morphometric traits, the estimates increased from small size to medium to big size. Significant effect ($P < 0.0001$) of location was observed only on body weight, total length, standard length and head length. The fish from farm A had higher values compared to farm B. The correlation coefficients among the traits for juvenile and adult fish ranged between low to high and were significant ($P < 0.05$, $P < 0.01$ and $P < 0.0001$). Morphometric traits can be used in characterizing African catfish based on age and body size.

***Keywords*:** African catfish; age; morphometric traits; Okitipupa and sex

1. INTRODUCTION

The family *Claridae* consists of 14 genera, which comprise 92 species distributed in Africa and South-East Asia (Teugels 1986). *Clarias gariepinus* has drawn attention of aquaculturist because of its biological attributes that include faster growth rate, resistance to diseases and possibility of high stocking density (Lal *et al.*, 2003).

It is native to Africa and has an almost African distribution, and occurs naturally in Asia, Jordan and Turkey (Teugels, 1986). Sound management of fish resources relies on basic knowledge of the biology of the species, including information on the population structure. Such information influences the development of the management strategies and strategies for conserving biodiversity.

Morphological traits such as morphometrics and meristics have been commonly used to identify and differentiate stocks of fish (Turan, 2004). Moreover, morphometric study is a vigorous tool (Naeem and Salam, 2014) for measuring discreetness of the same species.

Morphometric studies are not only essential to understand the taxonomy but also the health of a species (including reproduction) in an environment (Manimegalai, *et al*., (2010). The shape and structures are unique to the species and the variations in its feature are probably related to the habit and habitat among the variants of this species (Mauro Jose Cavalcanti, *et al*. 1999).

Morphological characters are phenotypically plastic and are influenced each year by the physical environment during spawning and early juvenile stages (Austin 1999). In many fishes, changes in the relative growth of the various body parts are known to occur at different stages of development and particularly at sexual maturity (Bhuiyan and Islam, 1990). Growth of the body parts is proportional to the growth of the total length. So, morphometric measurement of fishes and the study of statistical relationship among them are essential for taxonomic study of a species (Tandon *et al.*, 1993).

Researchers investigating on morphometric traits of animal species revealed the correlations between the various body parameters like length, weight, fecundity etc (Manimegalai, *et al*., 2010). Morphometric traits analysis helps to understand the relation between body parts (Carpenter, 1996) in Lettrinid fishes (Mauro Jose Cavalcanti, *et al.* 1999) in Penaeid prawns (Subramanian, 1987).

Morphometric study is a suitable technique for recognising the degree of reproductive maturation without sacrificing the animals (Manimegalai, *et al*., 2010).

However, there is dearth of information on the body weight and morphometric traits of farmed Africa catfish in Nigeria. Therefore, the objective of this study is to investigate the effect of sex, age, location and body size on the morphometric traits and body weight of farmed African catfish and to determine the relationships among the traits.

2. MATERIALS AND METHODS

2. 1. Description of the study area

The study was carried out in Okitipupa area in Ondo state, Nigeria. Okitipupa is located between latitude 6°53' N and longitude 4°53' E (Worldatlas.com). The area lies within the rain forest zone of Nigeria.

2. 2. Experimental animals

A total of one hundred and fifty-eight (158) live African catfish were sampled from two locations located around Okitipupa within Ondo State. This comprises of one hundred and four (104) adult fish (60 males and 44 females) and fifty-four (54) juvenile fish (32 males and 22 females) were used for this study.

2. 3. Management of the experimental animals

The African catfish used for this study include adult fish, raised for six months and juvenile fish raised for three months in the two locations. Management practices were carried out accordingly. From each location, samples were collected using cast net for morphometric measurements.

2. 4. Data collection

Data were collected from live fishes. Data were collected on live body weight and linear body measurements.

Sensitive weighing balance was used for taking the live body weight while simple tape rule was used to obtain the linear body measurements.

The fishes used for this study were categorized according to sex, age, body size and location. The fishes were grouped based on the body weight as follows:

1) Those whose body weight were greater than 1000g was classified as large size,
2) Those whose body weights were between 1000g and 500g were classified as medium size and
3) Those fishes whose body weights were below 500 g were classified as small size.

Data on body weight and linear body measurements were collected on each fish, these include;

- Body Weight (BWT): Individual fish was weighed in (g) using weighing scale.
- Total Length (TTL),
- Standard Length (SDL),
- Head Length (HDL),
- Pectoral Fin Length (PFL),
- Caudal Fin Length (CFL),
- Dorsal Fin Length (DFL) and
- Anal Fin Length (AFL).

Body linear measurements were taken from each in centimeter (cm). All measurements were done according to methods and reference points described and adopted by Teugels (1982), Teugels, (1988) and Turan, *et al* (2004).

2. 5. Statistical analyses

The data collected were subjected to statistical analysis using the General Linear Model Analysis of variance of SAS (1999) to test for the effect of sex, age, body size and location.

Means were separated using Duncan Multiple Range Test. Pearson correlation analysis was carried out to determine the phenotypic relationship among the morphometric traits measured.

The statistical model fitted is as outlined below:

$$Y_{ijklm} = \mu + S_i + A_j + B_k + C_l + e_{ijklm}$$

where:

Y = Observations of each morphometric traits
μ = Universal mean
S_i = Effect of sex
A_j = Effect of age
B_k = Effect of body size
C_l = Effect of location
e_{ijklm} = Error

3. RESULTS

Table 1 shows the summary statistics of the fish on age basis. Body weight of the adult fish has the highest (46.18) coefficient of variation while the least (11.01) is shown by total length. Similarly, among the juvenile caudal fin length has the highest (24.17) coefficient of variation, this was followed by body weight (22.76) and the least (6.17) shown by dorsal fin length.

Table 1. Summary statistics of morphometric traits of farmed African catfish.

Age	Parameters	N	Means	Std. Dev.	Min	Max	C.V
Adult	BWT	104	733.17	338.59	200.00	1500.00	46.18
	TTL	104	47.10	5.19	36.00	58.00	11.01
	SDL	104	40.76	5.69	3.90	50.00	13.96
	HDL	104	11.76	1.35	7.00	15.00	11.46
	AFL	104	17.99	2.24	14.00	27.00	12.45
	PFL	101	5.42	0.76	3.00	7.00	14.06
	DFL	103	25.01	4.45	2.40	33.00	17.81
	CFL	104	5.97	1.53	2.20	11.00	25.57
Juvenile	BWT	54	13.26	3.02	9.00	27.70	22.76

	TTL	54	14.06	0.97	12.00	17.50	6.90
	SDL	54	12.54	0.80	11.20	14.90	6.39
	HDL	54	4.69	0.38	3.50	5.70	8.01
	AFL	54	6.38	0.47	4.70	7.40	7.41
	PFL	53	1.12	0.15	0.70	1.50	14.03
	DFL	54	8.42	0.52	7.30	10.10	6.17
	CFL	54	1.51	0.36	0.70	2.60	24.17

Body Weight = BWT, Total Length = TTL, Standard Length = SDL, Head Length = HDL, Anal Fin Length = AFL, Pelvic Fin Length = PFL, Dorsal Fin Length = DFL and Caudal Fin Length = CFL

Table 2 shows the effect of age on the live body weight and the linear body measurements taken.

Age has significant effect ($P < 0.0001$) on all the morphometric traits considered in this study. The estimates were higher in the class of adult fish compared to the class of the juveniles.

The estimates for adult and juvenile fish respectively are: live body weight (733.17 ±33.20, 13.26 ±0.41); total length (47.10 ±0.51, 14.06 ±0.13); standard length (40.76 ±0.56, 12.54 ±0.11); head length (11.76 ±0.13, 4.69 ±0.05); anal fin length (17.97 ±0.22, 6.38 ±0.06); pelvic fin length (5.42 ±0.08, 1.11 ±0.02); dorsal fin length (25.01 ±0.44, 8.42 ±0.07) and caudal fin length (5.97 ±0.15, 1.51 ±0.05).

Table 2. Least square means (±SEM) of the effect of age on morphometric traits of farmed African catfish.

Parameters	N	Adult (g)	Juvenile (g)
BWT	158	733.17^{a} ± 33.20	13.26^{b} ±0.41
TTL	158	47.10^{a} ±0.51	14.06^{b} ±0.13
SDL	158	40.76^{a} ±0.56	12.54^{b} ±0.11
HDL	158	11.76^{a} ±0.13	4.69^{b} ±0.05
AFL	158	17.97^{a} ±0.22	6.38^{b} ±0.006
PFL	158	5.42^{a} ±0.08	1.11^{b} ±0.02

DFL	158	25.01[a] ±0.44	8.42[b] ±0.07
CFL	158	5.97[a] ±0.15	1.51[b] ±0.05

Body Weight = BWT, Total Length = TTL, Standard Length = SDL, Head Length = HDL, Anal Fin Length = AFL, Pelvic Fin Length = PFL, Dorsal Fin Length = DFL and Caudal Fin Length = CFL
[a,b] Means in the same row with different superscripts are significantly different ($p < 0.0001$)

The least square means for effect of sex on the morphometric traits are shown in Table 3. Sex has no significant effect ($P > 0.05$) on all the traits considered among the adult fish and juvenile fish, though the estimates were higher in males compared with the females in the two age groups.

Table 3. Least square means (±SEM) of effect of sex on the morphometric traits based on age.

Parameters	Adult			Juvenile		
	M	F	M & F	M	F	M & F
BWT	740.83±44.03	722.73±51.08	733.17±33.20	13.34±0.46	13.15±0.76	13.26±0.41
TTL	47.46±0.68	46.62±0.77	47.10±0.51	14.12±0.15	13.97±0.24	14.06±0.13
SDL	40.78±0.85	40.73±0.65	40.76±0.56	12.57±0.13	12.49±0.20	12.54±0.11
HDL	11.88±0.17	11.59±0.21	11.76±0.13	4.72±0.07	4.65±0.07	4.69±0.05
AFL	18.34±0.32	17.50±0.27	17.99±0.22	6.38±0.07	6.38±0.12	6.38±0.06
PFL	5.49±0.11	5.33±0.11	5.42±0.08	1.12±0.03	1.11±0.03	1.12±0.02
DFL	25.45±0.63	24.43±0.58	25.01±0.43	8.43±0.08	8.42±0.14	8.42±0.07
CFL	6.05±0.20	5.85±0.23	5.97±0.15	1.53±0.07	1.48±0.07	1.51±0.05

Body Weight = BWT, Total Length = TTL, Standard Length = SDL, Head Length = HDL, Anal Fin Length = AFL, Pelvic Fin Length = PFL, Dorsal Fin Length = DFL and Caudal Fin Length = CFL

Table 4 shows the effect of body size on the morphometric traits. Body size has a very highly significant ($P < 0.0001$) effect on all the traits. The large size has the highest estimates, followed by the medium size and lastly the small size.

Table 4. Least square means± SEM of effect of different body sizes on the morphometric traits of farmed catfish.

Parameter	Large Size	Medium Size	Small Size	Total
BWT	$1219.23^{a} \pm 33.06$	$690.82^{b} \pm 19.97$	$137.54^{c} \pm 19.04$	487.13 ± 34.91
TTL	$53.76^{a} \pm 0.60$	$46.65^{b} \pm 0.42$	$23.79^{c} \pm 1.48$	35.81 ± 1.30
SDL	$46.76^{a} \pm 0.61$	$39.76^{b} \pm 0.82$	$21.10^{c} \pm 1.29$	31.11 ± 1.13
HDL	$13.08^{a} \pm 0.26$	$11.63^{b} \pm 0.16$	$6.82^{c} \pm 0.33$	9.34 ± 0.28
AFL	$19.86^{a} \pm 0.51$	$17.69^{b} \pm 0.24$	$10.02^{c} \pm 0.56$	14.01 ± 0.46
PFL	$5.76^{a} \pm 0.15$	$5.42^{a} \pm 0.11$	$2.99^{b} \pm 0.22$	3.94 ± 0.17
DFL	$27.04^{a} \pm 0.99$	$25.27^{a} \pm 0.41$	$13.32^{b} \pm 0.80$	19.31 ± 0.69
CFL	$6.99^{a} \pm 0.33$	$6.09^{b} \pm 0.19$	$2.68^{c} \pm 0.19$	4.44 ± 0.20

^{a,b,c} means with different superscripts are significantly different ($P < 0.0001$)

Body Weight = BWT, Total Length = TTL, Standard Length = SDL, Head Length = HDL, Anal Fin Length = AFL, Pelvic Fin Length = PFL, Dorsal Fin Length = DFL and Caudal Fin Length = CFL

The effect of location of the fish has significant effect ($p < 0.0001$) on body weight, total length, standard length and head length as shown in Table 5. The fish from farm A had the highest values of the variables while the fish from farm B had the least values. No significant effect ($P > 0.05$) was observed in anal fin length, caudal fin length, pectoral fin length and dorsal fin length.

Table 5. Least square means± SEM of effect of location on the morphometric traits and body weight of African farmed catfish.

Parameters	N	Farm A	N	Farm B
BWT	46	$907.61^{a} \pm 50.74$	58	$594.83^{b} \pm 34.65$
TTL	46	$49.35^{a} \pm 0.80$	58	$45.32^{b} \pm 0.56$
SDL	46	$43.05^{a} \pm 0.68$	58	$38.92^{b} \pm 0.76$
HDL	46	$12.51^{a} \pm 0.18$	58	$11.15^{b} \pm 0.14$

AFL	46	17.75 ±0.29	58	18.17 ±0.32
PFL	44	5.44 ±0.11	57	5.40 ±0.10
DFL	46	25.67 ±0.66	57	24.48 ±0.59
CFL	46	6.27 ±0.17	58	5.73 ±0.23

[a,b] means with different superscripts on the row are significantly different ($P < 0.0001$)
Body Weight = BWT, Total Length = TTL, Standard Length = SDL, Head Length = HDL, Anal Fin Length = AFL, Pelvic Fin Length = PFL, Dorsal Fin Length = DFL and Caudal Fin Length = CFL

Table 6 shows the correlation coefficients among the various morphometric traits measured in adult and juvenile African cat fish. The result shows that the correlation coefficients among the morphometric traits measured are positively correlated. The correlation coefficient in adult (lower diagonal) and juvenile (upper diagonal) fish were significant ($P < 0.05$, $P < 0.01$ and $P < 0.0001$), except the correlation between pectoral fin length and other variables and between caudal fin length and dorsal fin length that were not significant ($P > 0.05$) in juvenile fish. The correlation between body weight and linear body measurements among the adult fish ranged between 0.92 and 0.34 while among the juvenile fish was 0.79 and 0.22.

Table 6. Correlation coefficients among morphometric traits and body weight in farmed juvenile and adult African catfish.

	BWT	TTL	SDL	HDL	AFL	PFL	DFL	CFL
BWT		0.79***	0.69***	0.45**	0.33*	0.22^{NS}	0.53***	0.65***
TTL	0.92***		0.94***	0.60***	0.50**	0.22^{NS}	0.71***	0.63***
SDL	0.67***	0.73***		0.60***	0.49**	0.21^{NS}	0.65***	0.35**
HDL	0.67***	0.71***	0.77***		0.47**	-0.01^{NS}	0.47**	0.33*
AFL	0.55***	0.59***	0.48***	0.37**		0.16^{NS}	0.71***	0.20^{NS}
PFL	0.34**	0.43***	0.42***	0.44***	0.36**		0.23^{NS}	0.12^{NS}
DFL	0.42***	0.50***	0.40***	0.53***	0.53***	0.33**		0.49**
CFL	0.60***	0.65***	0.29**	0.38***	0.43***	0.34**	0.33**	

NS = Not Significant, *$P < 0.05$, **$P < 0.01$, ***$P < 0.0001$

Body Weight = BWT, Total Length = TTL, Standard Length = SDL, Head Length = HDL, Anal Fin Length = AFL, Pelvic Fin Length = PFL, Dorsal Fin Length = DFL and Caudal Fin Length = CFL
Upper diagonal = Juvenile correlations, Lower diagonal = Adult correlations

4. DISCUSSION AND CONCLUSION

The result of this study revealed high coefficient of variation (46.18) in the body weight of the adult fish, this indicates that there were more variations in the body weight of the fish compared with the variations in other morphometric traits considered, thus genetic improvement of the traits through selection would be faster in body weight than other traits. Similar trend was also noticed in the juvenile fish.

The effect of age on the morphometric traits and body weight considered in this study was very highly significant. This report is in consonance with the reports of other authors (Wimberger, 1992 and Kramer and Bryant, 1995). The adult fish had higher estimates in all the traits considered compared with the juvenile fish. This result could be attributed to expected increase in all the body parts and organs as animals increase in age.

The effect of sex on body weight and the morphometric traits was not significant in the two age groups considered in this study. The insignificant difference of sex observed in this study is similar to the findings of Yusuf *et al.,* (2013) for *C. gariepinus* in Nasarawa State. Though not statistically different, males had higher values compared to females, this indicates sexual dimorphism which is a natural phenomenon which differentiate male animal from female. This indicates the deposition of materials for gonad formation which leads to an increase in weight and subsequent reduction due to spawning This agrees with the findings of Bayagbona (1968) of an annual cycle of low and high condition factor relative to peak and minimum spawning for *Pseudotoliothustypus.*

Body size is a function of body weight. Body weight had a very highly significant effect on body weight and the morphometric traits considered. A progressive increase in the values of the traits considered was observed from large mall size to medium to large size. This could be attributed to increase in all the body parts and organs of animals as they grow and increase in age. The significant difference observed between the two locations in the body weight, total length, standard length and head length could be attributed to differences in management practices, while the non-significant effect observed in the fins could be that at certain age the fins cease to grow while other traits considered continue to grow. The correlations between body weight and the linear body measurements in the adult fish were significantly positive and ranged between medium to high. This means that selecting for improvement for any of these linear measurements simultaneously will result to improvement in body weight. Similar trend was also observed in the juvenile fish except the relationship between body weight and pectoral fin length that was low and not significant. The correlations among the linear body measurements were also similar in the two age groups.

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