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MORPHOMETRIC AND MERISTIC DIVERSITY BETWEEN STRAINS OF *CLARIAS GARIEPINUS* (BURCHELL, 1822) FROM TWO ECO-REGIONS OF NIGERIA

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ABSTRACT

This study was carried out at Mediatrix Fish Farm, Federal Capital Territory, Abuja, to determine the morphometric and meristic diversity between strains of Clariasgariepinusfrom two eco-regions of Nigeria.50 matured samples of Clariasgariepinus of different sizes were collected from two eco-regions, Jigawa and Cross River States of Nigeria using traps, gill nets and cast net. Morphometric measurements in centimeters and meristic counts in numbers were determined. Using the equation $K= 100W/L^3$, the condition factor (k) of the fish samples was determined. Of the 42 morphometric characteristics of the strains of C. gariepinus measured from both eco-regions, there was no significant difference (p>0.05) among the features between the strains from Jigawa and Calabar irrespective of the variation. Of these parameters, while Jigawa strains had higher values in 19, Calabar strains had higher values in 17 parameters. Out of the 5 meristic features of Clariasgariepinusfrom the two eco-regions of Nigeria, there was no statistical significant difference (p>0.05) among the features between the strains of the two eco-regions.Results of the length weight relationship of the strains of C. gariepinus from Jigawa and Calabar, Nigeria revealed that the mean total length, mean body weight and mean condition factor for the strains of C. gariepinus from Jigawa were 32.40±0.83, 366.19±39.05 and 0.87±0.05, respectively while the mean total length, mean body weight and mean condition factor for the strains of C. gariepinus from Calabar were 35.99±1.22, 516.50±62.31 and 0.94±0.06, respectively. C. gariepinus from Calabar had higher mean total length and mean condition factor than the C. gariepinus from Jigawa. Contrastingly, C. gariepinus from Jigawa had higher body weight than C. gariepinus from Calabar. Also, C. gariepinus from Jigawa had a b value (3.82) than C. gariepinus from Calabar (3.21).

Key words: African catfish, Morphometric parameters, Meristic count, Eco-regions, Nig.

INTRODUCTION

According to Teugels(1996), clarias species are freshwater catfish characterized by their ability to to make use of atmospheric air and remain on the land for several hundred meters with the help of their pectoral spines. They are exposed to many physical and chemical changes, ranging from human activities, temperature, and salinity changes through threatened ecosystems. Catfishes are the most diverse in the tropical South American, Africa and Asia.Owing to the fact that these organisms are restricted to the bottom of the waterby lying on the mud which forms substantial part of their diet, they are commonly referred to as mud fishes (Teugels, 1982a). Catfishes are frequently exploited by fishermen and produced infarms. Essential source of proteins from animal origin, they have gained a major economic importance (Legendre *et al.* 1992).Catfish is a choice food species in Nigeria. They commands high demand from Aquaculturists. Fagbuaro,(2010) reported that *C. gariepinus*has high growth rate at high stocking densities most especially, under culture condition, high fecundity rate ,resistance to diseases, ability to tolerate a wide range of environmental extremes.

Clarias accepts wide range of natural and artificial food and adapts to a variety of feeding mode in expanded niches, good meat quality and smoking characteristics as well as year round production. Other attributes such as desiccation, ability to endure long drought and scarcity of food have endowed this fish species with one amazing capacity to survive(Dunn, 2000).The exact identification of the fish species used in cultureis a major problem facing the African aquaculture industry..

According to Turan *et al.* (2006) decades of introduction and domestication of a fish species most especially from the wild, leads to high adaptation to a wide range of geographical location shence leading to phenotypic variations with respect to the pure stock (strains) of the brood stock probably due to the effects of the environment or hybrids evolving through extensiveintra-breeding (El Serafy*et al.* 2007). Although the comparisons of the morphology between the reared and wild salmon stocks have been already conducted by a number of authors(Swain et al. 1991, von Cramon-Taubadel *et al.*2005, Solem *et al.* 2006), there is drought ofManuscript2information on the level of this variation for most tropical fish species, while difference among cultured and wild

Clarias gariepinus stocks based on morphological characters arenot studied.

The study of differences and variability in morphometric and meristic characters of fish stocks is important in phylogenetics and this also helps in providing information for subsequent studies on the genetic improvement of stocks.

Morphometric and meristic characters in fish species have been commonly used to identify fish stocks (Turan*et al.* 2004) and as such, these characters remains the simplest and most direct way among methods of species identification. According to the reported works of Mamuris*etal.* (1998); Bronte *et al.* (1999); Hockaday*et al.* (2000)), analysis ofphenotypic differences in morphometric characters or meristic counts is the method most commonly used to delineate stocks of fish. According to Avsar(1994) this is often been used in discrimination andclassification studies by statistical techniques but despite theadvent of techniques which directly considers the biochemical or molecular genetic variation,these conventional methods still play vital functions in stock identification even to date (Swain and Foote 1999). The differences in the morphometric and meristic characters of a species between between sexes of a particular environment or regions may result from differences in genotypes, or environmental factors operating on one genotype, or both of these acting together (Parish and Sharman1958). While both morphometric and meristic characters respond to changes in environmental factors, their responses are different in some situation and may differ from species to species.

MATERIALS AND METHODS

The Study Area

This experiment was carried out at Mediatrix Fish Farm, Federal Capital Territory, Abuja located between 9.0^{0}N latitude and 7.50E longitude with average rainfall of 0.0 – 729mm per month and average temperature of 18.45 – 36.05^{o}C (Nlewadim 2002). Federal Capital Territory, Abuja has two main seasons, the dry season which start October and ends in April and the wet seasons which last between May and the month of October. It has an average annual rain fall of 1000 to 15000mm.

Experimental Fish and Data Collections

50 matured samples of *Clarias gariepinus*were collected from two eco-regions of Nigeria (Jigawa, Dutse and Cross River, Calabar) of Nigeriausing traps, gill nets and cast net. Morphometric measurements and meristic counts in numbers in centimeters were determined using the techniques described by Teugels (1986).Using the equation $K=100W/L^3$,the condition factor (k) of thefish samples was calculated;

Where k= condition factor, L= Standard length (cm), and W= Weight (g) of the fish samples.

Statistical analysis

Data collected were subjected descriptive statistics using Genstat® discovery edition 12 as well as Minitab 14. Where significant differences occurred, Duncan's least significant difference was used to separate the mean values of morphometric and meristic parameters.

RESULTS

Tables 1 and 2 show the results of the morphometric and meristic diversity between the strains of *Clarias gariepinus* (Burchell) from the two eco-regions of Nigeria, respectively. The results of the morphometric characteristics (Table 1) revealed that out of the 42 morphometric characteristics of strains of *C. gariepinus* measured from both eco-regions of Nigeria,there was no significant difference (p>0.05) among the features between the strains of *C. gariepinus* from Jigawa and Calabar, irrespective of the variation. Of these parameters, while Jigawa strains had higher values in 19, Calabar strains had higher values in 17 parameters.

The results of the meristic characteristics (Table 2) revealed that out of the 5 morphometric characteristics *Clarias gariepinus* (Burchell) from the two eco-regions of Nigeria, it was observed that there was no statistical significant difference (p>0.05)among the features between the strains ofthe two eco-regions.

Table 1: Mean (±SEM) morphometric characteristic measurements of strains of C. *gariepinus* from Jigawaand Calabar

Morphometric parameters	**Eco-regions**		**P-value**
	Jigawa	**Calabar**	
Head length	8.08 ± 0.25^{b}	$8.27\pm0.0.25^{a}$	0.642
Head width	5.96 ± 0.24^{b}	6.41 ± 0.26^{a}	0.203
Body dept	5.77 ± 0.10^{a}	5.53 ± 0.16^{b}	0.213
Body weight	366.19±39.05	516.50±62.31	0.04
Standard length	27.18 ± 0.8^{b}	29.99±0.97	0.03
Total length	32.40±0.83	35.99±1.22	0.02
Inter-orbital distance	3.59 ± 0.12^{b}	3.60 ± 0.17^{b}	1.00
Eye diameter	1.00 ± 0.08^{a}	1.21 ± 0.09^{a}	0.09
Pre anal distance	$15.75.\pm0.51^{a}$	15.61 ± 0.66^{b}	0.87
Anal fin length	12.99 ± 0.41^{a}	12.52 ± 0.52^{b}	0.92
Anal fin height	1.87 ± 0.09^{b}	2.08 ± 0.12^{a}	0.17
Occipital fontanelle length	0.98 ± 0.11^{b}	1.21 ± 0.94^{a}	0.19
Occipital fontanelle width	0.71 ± 0.80^{b}	$0.92\pm0.0.09^{a}$	0.11
Distance between the occipital process and dorsal fin	2.10 ± 0.12^{b}	2.25 ± 0.12^{a}	0.34
Pre dorsal length	10.09 ± 0.29^{a}	9.82 ± 0.38^{b}	0.57
Dorsal fin length as % of standard length	18.37 ± 0.56^{a}	$18.36\pm0.74^{\mathbf{b}}$	1.00
Dorsal fin height	2.46 ± 01.00^{b}	2.53 ± 0.13^{a}	0.70
Anterior dorsal fin to anterior anal fin	8.59 ± 0.15^{a}	8.26 ± 0.24^{b}	0.26
Posterior dorsal fin to anterior pelvic fin	15.92 ± 0.42^{a}	15.21 ± 0.59^{b}	0.33
Caudal fin length	4.38 ± 0.21^{b}	4.40 ± 0.23^{a}	0.96
Caudal fin height	4.73 ± 0.14^{a}	4.58 ± 0.16^{b}	0.47
Caudal peduncle depth	2.99 ± 0.10^{a}	2.95 ± 0.13^{b}	0.81
Caudal peduncle length	1.40 ± 0.11^{b}	1.68 ± 0.13^{a}	0.11
Pre pectoral length	6.47 ± 0.20^{b}	6.67 ± 0.26^{a}	0.56
Pectoral fin length	3.60±0.19	3.56 ± 0.18^{b}	0.85
Pectoral fin height	3.19 ± 0.65^{a}	2.86±0.95	0.05
Pectoral fin distance to pelvic fin	7.41±0.20	9.61 ± 1.51^{a}	0.15
Pectoral spine length	2.76 ± 0.11^{b}	2.87 ± 0.13^{a}	0.52
Pelvic fin length	3.13 ± 0.10^{b}	3.09 ± 0.13^{b}	0.82
Pelvic fin height	2.47 ± 0.92^{a}	2.36 ± 0.81^{b}	0.47
Pre pelvic length	13.04 ± 0.4^{A}	13.28 ± 0.53^{a}	0.75
Distance from pelvic fin to anal fin	2.80 ± 0.11^{b}	3.08 ± 0.14^{b}	0.13
Lower mandibular length	3.86 ± 0.95^{a}	5.86 ± 1.37^{a}	0.99
Upper mandibular length	5.21 ± 0.16^{b}	5.07 ± 0.26^{b}	0.63
Vomerine length	0.26 ± 0.01^{a}	$0.26\pm0.0.1^{b}$	0.91
Vomerine width	1.65 ± 0.80^{a}	1.61 ± 0.09^{b}	0.74
Vomerine gap	0.15 ± 0.01^{a}	0.15 ± 0.01^{b}	1.00
Snout length	2.09±0.10	2.48±0.14	0.02
Pre maxillary length	0.95 ± 0.14^{b}	1.08 ± 0.14^{a}	0.52
Pre maxillary width	2.22±0.13	2.67±0.14	0.02
Maxillary barbell length	$6.96\pm0.0.30^{a}$	6.96 ± 0.30^{b}	0.86
Nasal barbell length	3.13 ± 0.14^{B}	3.93 ± 0.17^{a}	0.24

Means in the same row with different superscripts are not significantly different (P>0.05)

Table 2: Mean (±SEM) meristic characteristic of strains of *C. gariepinus* from Jigawa and Calabar

Meristic characteristics	**Eco-regions**		**P-value**
	Jigawa	**Calabar**	
Anal fin ray count	55.14±0.50[b]	56.06±0.39[a]	0.15
Caudal fin ray no	19.90±0.24[a]	19.82±0.28[b]	0.83
Dorsal fin ray no	72.26±0.67[b]	72.40±0.47[a]	0.86
Pelvic fin ray no	5.82±0.10[b]	6.06±0.13[a]	0.16
Pectoral fin ray no	8.12±1.16[b]	8.36±0.16[a]	0.29

Means in the same row with different superscripts did not differ significantly (P>0.05) from each other.

Results of the length weight relationship of the strains of *C. gariepinus* from Jigawaand Calabar, Nigeria are shown in figures 1and 2, respectively. The mean total length, mean body weight and mean condition factor for the strains of *C. gariepinus*from Jigawa were 32.40±0.83, 366.19±39.05 and 0.87±0.05, respectively while the mean total length, mean body weight and mean condition factor for the strains of *C. gariepinus* from Calabar were 35.99±1.22, 516.50±62.31 and 0.94±0.06, respectively. It was observed that the *C. gariepinus* from Calabar had higher mean total length and mean condition factor than the *C. gariepinus* from Jigawa. Contrastingly, *C. gariepinus* from Jigawa had higher body weight than *C. gariepinus* from Calabar. Also, *C. gariepinus* from Jigawa had a b value (3.82) than *C. gariepinus* from Calabar (3.21)

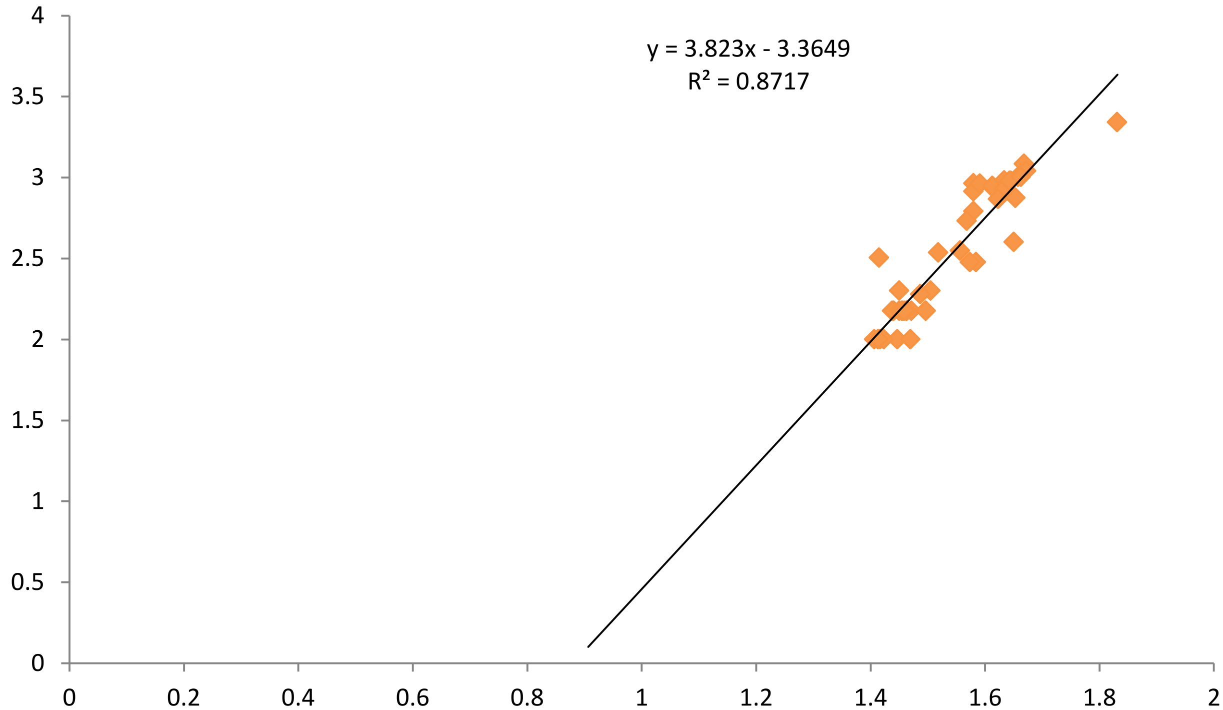

Fig 1: Length weight relationship of strain f *C. gariepinus* from Jigawa State of Nigeria

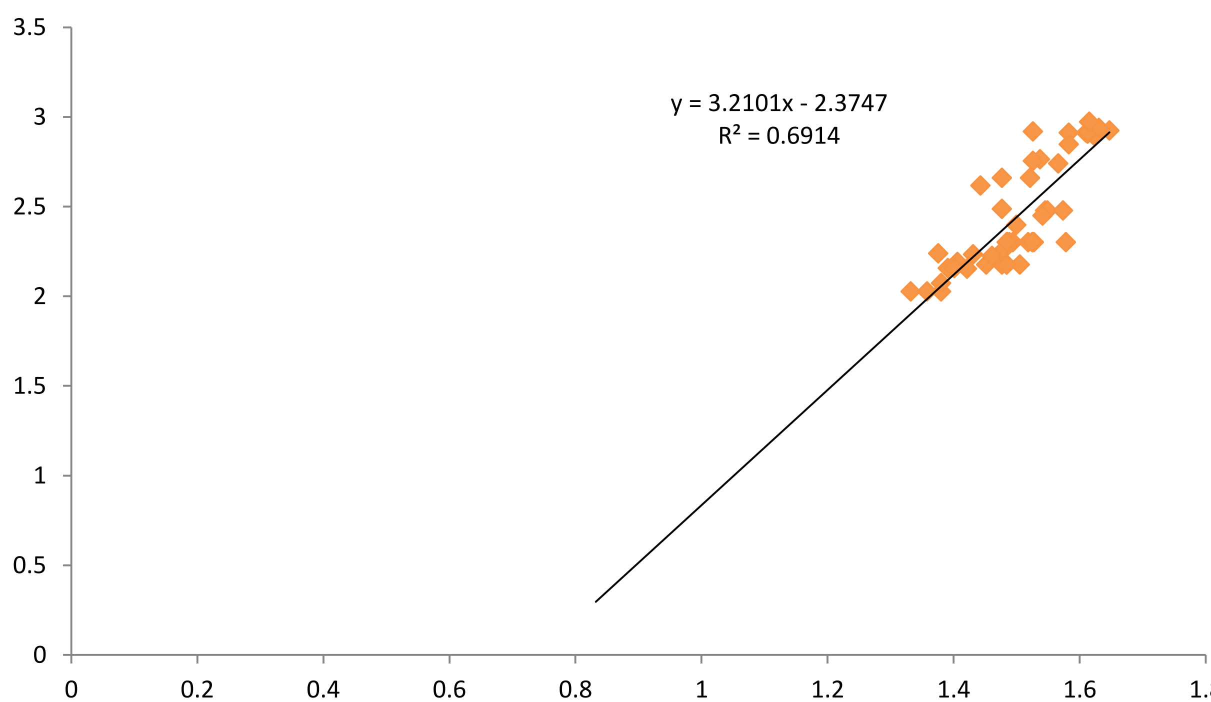

Fig 2: Length weight relationship of strains of *C. gariepinus* from Calabar, State of Nigeria

DISCUSSION

Fish are most susceptible to environmentally induced morphological variations; hence, they demonstrate greater variances within and between populations than do any other vertebrate (Wimberger 1992). This present study reveals the phenotypic plasticity of strains of African catfish to be high between two eco-regions and for different environments (wild). This agrees with the reported work of Solomon *et al* (2015) who reported high phenotypic plasticity of African catfish from the University of Agriculture, Makurdi, Fishery Research Farm, Benue State, Nigeria but disagrees with the reported work of Turan*et al.* (2005) who reported negligible sex variation in *C. gariepinus* from six wild populations in Turkey.

It was observed in the present work that there were no significant differences in most of the morphometric parameters except for a few but in meristic counts, no signicant differences occurred. Stearns (1983) reported that fish adapt quickly by modifying their physiology and behavior to environmental changes hence changing their morphology. It may be ideal to infer that the fish stock examined in this study had made morphological modifications to better adapt to their present environmental conditions. The high value of the weight of the females stock recorded in this study can be linked to their ability to feed on anything in order to meet their physiological requirements for egg development. In this present work, it was observed that the female fish had higher condition factor than the male. The higher condition factor recorded by the female fish compared to the male fish could be attributed to the gonad condition of the female (gravid). Allendorf and Phelps (1988), Swain *et al*. (1991), and Wimberger (1992) highlight environmental conditions such as food abundance and temperature as causes of fish morphological plasticity. Morphometric differences among stocks have also been linked to differences in ancestral origins by Hossain*et al*. (2010). However, breeding over several years may have diluted the initial gene pool of the domesticated fish leading to genetic variation (translated to morphological differences). This is why genetic studies are required to establish these facts. Turan*et al*. (2004) reports similar findings for *Liza abu*(Heckel) populations from the Orontes, Euphrates, and Tigris rivers in Turkey. They concluded that decades of introduction and domestication of *L. abu*has lead to high adaptation to a wide range of geographical locations that are shown in phenotypic variations with respect to the pure strains. El-Serafy*et al*. (2007) reports that hybridization through extensive inbreeding is a possible course of morphological variation.

Fishes generally demonstrate greater variance in morphological traits both within the same species, different species, and between populations than do any other vertebrate. This largely reflects differences in feeding environments, prey types, food availability, and other features (Dunham *et al.* 1979, Allendorf 1988, Thompson 1991, Wimberger 1992). As a result of all these, more research, especially genetic studies, are needed to better understand, the effect environment can have on the morphometric parameters of wild and cultured African catfish.

The high positive correlations (r) exhibited by the males, females and combined sexes of *C. gariepinus* in this study indicated that as length of the fish increased, its body weight also increased. This could be attributed to the availability of quality and quantity of food and plankton yield resulting from the water body within the ecological niches of the fish. Peepple and Ofor (2011) had made similar observation.

According to Bagenal and Tech (1978), Kurtakis and Tsikliras (2003), allometric coefficients may range from 2 to 4. The ‘b’ values for males, females and combined sexes obtained in this present work fell within the range of 'b' values reported by Bagenal and Tech (1978), Kurtakis and Tsikliras (2003). Length-weight relationship parameters (a and b) of fish are affected by a series of factors such as season, habitat, gonad maturity, sex, diet, stomach fullness, health, preservation techniques and annual differences in environmental conditions (Bagenal and Tech, 1978; Froese, 2006). Differences in value 'b' can be ascribed to one or a combination of most of the factors including differences in the number of specimens examined, area/seaon effects and distinctions in the observed length ranges of the specimens caught, to which duration of sample collection can be added as well (Moutopoulos and Stergio, 2002).

CONCLUSION

Fish generally demonstrate greater variance in morphological traits both within the same species, different species, and between populations than do any other vertebrate. This largely reflects differences in feeding environments, prey types, food availability, and other features. More research, especially genetic studies, are needed to better understand the effect environment can have on the morphometric parameters of wild as well as cultured African catfish.

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