Morphometric and Meristic Characteristics of Hybrid Catfish from Selected Fish Farms in Southern Nigeria

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ABSTRACT- *Morphological and meristic characters of hybrid clariid catfish from selected fish farms in Abia and Akwa-Ibom states were investigated. Ten juveniles of the hybrid clariid catfish were obtained from each of the farms to give a total of forty. Thirty morphometric and meristic characters were measured. The data obtained were subjected to different statistical techniques. Analysis of variance (ANOVA) at P≤0.05 showed that dorsal fin ray number was significant in Abia 1 (53.79) than Abia 2 (48.05), Akwa Ibom 1 (49.04) and Akwa Ibom 2 (47.00). Adipose fin length which is a major distinguishing character among "Hetero x Clarias" hybrid were observed to have varying proportions among the farms with Abia 2 having a significant length of 9.8cm followed by Abia 1 (8.09cm), Akwa Ibom 1(6.12cm) and Akwa Ibom 2 having the least (3.32cm). Pearson's correlation coefficient matrix showed that adipose fin length (r=0.89, P≤0.04) is dependent on dorsal fin length which is the usual trend in Heterobranchus spp. These characters were further subjected to a multivariate statistical technique (principal component analysis) to ascertain the characters that account for the variations. The Principal component analysis showed that principal component 1 and 11 with Eigen values 22.81 and 3.01 respectively accounted for 91.75% of the total variance in the data set. In addition, the PCA biplot revealed that the hybrids differed meristically and the characters accounting for these are; pectoral fin-ray, caudal fin-ray, anal fin-ray, dorsal fin-ray, pelvic fin-ray, eye diameter, anal fin height, weight and body depth at anus.*

Keywords: Morphometric, meristic, characters

1. INTRODUCTION

Fish identification and classification sometimes help fish breeders to determine if samples are from different populations and to determine the relative contribution of stocks to a mixed fishery [1]. Among the wide array of fish species, proper identification of each is a problem without reference to certain parameters of distinction. These parameters are drawn around both external and internal features. Occasionally, the breeding pattern according to [2] is used but this requires close examination of the fish in its habitat. Some authors have reported that the most common features used in identifying fish are the number of dorsal and anal fin spines and rays, position of mouth, number and location of teeth, type and number of scales in the lateral line, shape of caudal fin, number of gill rakers and colour.

According to [3] hybrid catfish can be identified through the dorsal and adipose fins relationship. [4] reported that the hybrid morphology was intermediate to that of parents. [5] gave practical example and reported that *Clarias anguillaris* does not have the adipose fin which is prominent in *"Heteroclarias*" and the reciprocal *"Clariabranchus*" hybrid possesses an adipose fin which means that they could be confused with *Heterobranchus* at first glance. [6] also stated that hybridization studies involving the two genera (*Clarias* and *Heterobranchus*) have shown that their hybrids generally exhibit intermediate phenotypic characters in the inheritance pattern of the dorsal fin when the two genera are crossed with each other.

[7], [4], [8], [9] and [10] reported that hybrids must be properly identified so as not to replace them with *Heterobranchus spp*. F_1 intergeneric hybrids of Heterobranchus x clarias have been observed to be fertile. [6] also stated that aquaculture practitioners in Nigeria have exploited the fertility of the F_1 hybrid**s** by using these hybrids as breeders for further propagation. Studies have revealed that the presence of natural hybridization in any two species is an indication that the two species are generally very close and inter-fertile. However, there is no evidence in the literature that the F_1 hybrids of these two species could hybridize naturally in the wild [10].

Morphological characters have been commonly used in Fisheries biology to measure discreteness and relationships among various taxonomic categories [11]. There are many well documented morphometrics which provide evidence for stock discreteness [12], [13], [14], [15], [16], [17] and [18].

[19] documented that most good characters used in fish taxonomy are morphological features of the body form and structure. Morphological characters may be divided into those that are directly measurable and those that are not. A character is any attribute of an organism that can be distinctively detected and described. A good taxonomic character must be easily observable and vary from one taxonomy to another

and therefore must be genetically, rather than environmentally inherent [20]. A detailed description of the biometric features of a fish is important for the identification and studies on the extent of racial variation of the species [21]. However, the major limitation of morphological characters at the intra-specific level is that phenotypic variation is not directly under genetic control but subject to environmental modifications [22]. Morphological studies have been used in defining species and in organizing these species into genera. This research was carried out to investigate distinctive characters in hybrid catfish species in selected fish farms in southern Nigeria.

2. MATERIALS and METHODS

A. *Description of Study Area*

Abia and Akwa Ibom States are located in the humid tropics of South-Eastern region of Nigeria with a mean annual rainfall of 2000mm and 2400mm respectively. They lie within latitude 5^0 36′ N, longitude 7^0 46′ E and latitude 5^0 29′ N, 8^0 4′ E respectively and with an annual temperature range of 27^0C and 29^0C.

B. *Collection of Fish Samples*

Ten juveniles each of the hybrid were collected from Chiweoke’s farm in Amapuife, Ishialangwa North Local Government Area and from the Department of Fisheries, Michael Okpara University of Agriculture, Umudike, all in Abia State. Vika Farms Limited, Mbak-Etoi, Uyo, and Department of Fisheries, State Ministry of Agriculture Ikot Abasi were sampled in Akwa Ibom State, thus making a total of forty juveniles.

C. Phenotypic Analysis

Ten juveniles from each of the farms were described according to [23] description key for the following morphometric characters: Total length (TL), standard length head width, head length, eye diameter, body depth at anus; nasal barbel length, premaxilliary barbel length, premaxillary width, dorsal fin length, dorsal fin height, pre dorsal length, pectoral fin length, pelvic fin length, pre pelvic length, adipose fin length, adipose fin height, gap between adipose and rayed fins, anal fin length, anal fin height, caudal fin length, caudal fin height and caudal peduncle width. These measurements were taken in centimetres using a metric ruler on the left side of each fish sample. The meristic counts were made with the aid of hand lens and dissecting microscope for dorsal fin rays, pectoral fin rays, pelvic fin rays, anal fin rays and caudal fin rays.

D. STATISTICAL ANALYSIS

Statistical Package for Social Science (SPSS) Data editor Version 17.0 was used to compute all measures of central tendencies and dispersion, to characterise the farms and states using one way analysis of variance (ANOVA) and the graphics were computed with Microsoft Excel. The means were separated using Turkey-Kramer method ($P<0.05$). Pearson’s Correlation Coefficients analyses were conducted to establish relationships within the variables based on sex. Principal Component Analysis (PCA) was designed to transform the original variables into new; uncorrelated variables (axes) called the principal components, which are linear combinations of the original variables. The new axes lie along the directions of maximum variance. The importance of each axis on the ordination diagram was determined by the magnitude of the eigenvalues (A). The unrestricted Mounte Carlo permutation test was used to determine whether the ordination significantly accounted for the variation in sex among the farms.

3. RESULTS and DISCUSSION

A combined one way Analysis of Variance for the mean values of some of the hybrid characters considered based on farms and states is shown in Table 1. Dorsal fin ray numbers (soft) was observed to be higher in Abia 1 (53.79) than Abia 2 (48.05), Akwa Ibom 1 (49.04) and Akwa Ibom 2 (47.00), also between the states Abia (50.92) was higher than Akwa Ibom State (48.02). These figures are in line with an earlier report by Legendre *et al.*, (1992) who observed that dorsal fin ray number of hybrids between *H. longifilis* and *C. gariepinus* ranges between 43 to 54 rays. According to [6] the situation with intergeneric hybrids is such that their dorsal fin ray numbers are intermediate between those of their parents. In dorsal fin length, all the farms were distinctively different with Abia 2 having the highest mean value of 9.8cm and Akwa Ibom 2 having the least value of 3.32cm indicating a kind of inheritance towards the maternal line of *H. longifilis*, which is characterized with a shorter dorsal fin (Legendre *et al.*, 1992). It was noted that apart from Akwa Ibom 2, the rest of the hybrids were *H. longifilis* (male) x *C. gariepinus* (female) while Akwa Ibom 2 were *C. gariepinus* (male) x *H. Longifilis* (female). Observable variations were also noted in dorsal fin height character across the farms and between states.

Similarly, the adipose fin length character which is a major distinguishing character in *Heterobranchus spp.* [4, 24] were observed to have varying proportions as shown in Table 1. It is clear that their hybridization resulted in a significant over dominance of *Heterobranchus* in both crosses. According to [6], the normal trend is towards an inheritance of very small adipose fin length. These authors also stated that a mean adipose fin length range of 4.08 – 4.41cm compares favourably with those of the parental group and are evidence that with continuous hybridization, hybrids with relatively same adipose fin length with the parental adipose fin could be produced. Although juveniles were used in this study, it could be inferred that at maturity, the adipose fin length will fall in line within this range and this will make it difficult to identify and separate properly the hybrids and parents thereby creating problems in breeding exercises.

TABLE 1
THE MEAN VALUES of MORPHOMETRIC and MERISTIC CHARACTERS of the HYBRIDS

	Dorsal Rays Number(soft)	Dorsal Fin length(cm)	Dorsal Fin Height(cm)	Anal Fin Rays Number(soft)	Anal Fin Length(cm)	Anal Fin Height(cm)	Adipose Fin Length(cm)	Predorsal length(cm)	Adipose Fin Height(cm)
ABIA 1	53.79^{A}	8.69^{B}	1.72^{B}	46.57^{A}	6.98^{AB}	1.02^{A}	2.63^{A}	0.25^{B}	6.29^{A}
ABIA 2	48.05^{B}	9.8^{A}	1.94^{A}	45.43^{A}	7.62^{A}	1.11^{A}	2.95^{A}	0.48^{A}	6.93^{A}
AKWA IBOM1	49.04^{B}	6.12^{C}	1.22^{C}	47.50^{A}	4.89^{B}	0.82^{B}	1.51^{B}	0.23^{B}	4.52^{B}
AKWA IBOM2	47.00^{B}	3.32^{D}	0.51^{D}	44.00^{A}	2.67^{C}	0.40^{C}	1.22^{B}	0.13^{C}	2.37^{C}
ABIA	50.92^{A}	9.25^{A}	1.83^{A}	46.00^{A}	7.30^{A}	1.07^{A}	2.79^{A}	0.37^{A}	6.61^{A}
AKWA IBOM	48.02^{B}	6.25^{B}	0.87^{B}	45.75^{A}	3.78^{B}	0.61^{B}	1.37^{B}	0.18^{B}	3.45^{B}

*Means with same letters are not significant

A. Pearson's Correlation Coefficient (r) of some of the morphometric and meristic characters of the hybrid.

The correlation matrix of the hybrids catfish is shown in Table 2. The correlation amongst the parameters is indicated in bold coefficient values in the table. Total length is observed to have a strong correlation with standard length (r=0.98, P≤0.001), weight (r=0.90, P≤0.003), dorsal fin length (r=0.89, P≤0.04), anal fin length (r=0.91, P≤0.03). Standard length on the other hand was observed to show positive correlation with dorsal fin length (r=0.89, P≤0.04) and anal fin length (r=0.98, P≤0.04). Dorsal fin length was also observed to show good correlation with adipose fin length (r=0.89, P≤0.04) and anal fin length (r=0.93, P≤0.01). Dorsal fin height also showed good correlation with weight (r=0.94, P≤0.01) anal fin length (r=0.91, P≤0.03) and anal fin height (r=0.97, P≤0.003).

Also observed to show good correlation is adipose fin length with dorsal fin length (r=0.89, P≤0.04), anal fin length (r=0.98, P≤0.002) and anal fin height (r=0.95, P≤0.01). This result agrees with a previous work [6] where the dorsal fin related characters correlated positively and gave an indication that as dorsal fin decreases, the adipose fin increase, which is a generic difference between *Heterobranchus* and *Clarias spp*. Standard length, total length and anal fin length were observed to follow this trend. This also agrees with [25] who opined that the morphological characteristics of the hybrids at the fingerlings and juvenile stages resembled those of *H. longifilis* species phenotypically.

TABLE 2 PEARSON'S CORRELATION COEFFICIENT of SOME of the MORPHOMETRIC and MERISTIC CHARACTERS of the HYBRID CATFISH

	Total length	Standard length	Weight	Head length	Dorsal fin length	Dorsal fin height	Predorsal length	Adipose fin length	Anal fin length	Anal fin height	Dorsal fin ray	Anal fin ray
Total length												
Standard length	**0.98* P≤0.001**											
Weight	**0.90* P≤0.03**	0.82 P≤0.08										
Head length	0.85 P≤0.06	**0.91* P≤0.03**	**0.55* P≤0.33**									
Dorsal fin length	**0.89* P≤0.04**	**0.89* P≤0.04**	0.84 P≤0.07	0.66 P≤0.21								
Dorsal fin height	0.74 P≤0.14	0.66 P≤0.22	**0.94* P≤0.01**	0.31 P≤0.60	0.76 P≤0.13							
Predorsal length	0.61 P≤0.27	0.72 P≤0.16	0.23 P≤0.70	**0.89* P≤0.03**	0.52 P≤0.35	0.05 P≤0.92						
Adipose fin length	0.86 P≤0.05	0.85 P≤0.06	0.83 P≤0.05	0.63 P≤0.25	**0.89* P≤0.04**	0.87 P≤0.05	0.50 P≤0.38					
Anal fin length	**0.91* P≤0.03**	**0.88* P≤0.04**	**0.93* P≤0.01**	0.62 P≤0.25	**0.93* P≤0.01**	**0.91* P≤0.03**	0.44 P≤0.45	**0.98* P≤0.002**				
Anal fin height	0.81 P≤0.09	0.76 P≤0.13	**0.94* P≤0.01**	0.45 P≤0.43	0.84 P≤0.07	**0.97* P≤0.003**	0.24 P≤0.69	**0.95* P≤0.01**	**0.96* P≤0.006**			
Dorsal fin ray	-0.76 P≤0.13	-0.67 P≤0.20	-0.87 P≤0.05	-0.50 P≤0.38	0.51 P≤0.37	-0.81 P≤0.08	-0.16 P≤0.789	-0.71 P≤0.17	-0.73 P≤0.15	-0.80 P≤0.10		
Anal fin ray	-0.60 P≤0.27	-0.54 P≤0.34	-0.06 P≤0.27	-0.40 P≤0.50	-0.51 P≤0.34	-0.38 P≤0.51	-0.05 P≤0.93	-0.24 P≤0.68	-0.43 P≤0.47	-0.34 P≤0.57	0.38 P≤0.51	

E. Principal Component Analysis (PCA)

This was based on some of their morphometric and meristic characters. Principal Component 1 (PC1) with eigen value 22.81 showed positive loadings for the characters measured except pectoral fin ray (-0.17), and caudal fin ray (-0.13) and accounted for 81% of the total variance in the data. While component 2 showed negative and low loadings in most of the characters measured except eye diameter (0.26), dorsal fin ray (0.44), pelvic fin ray (0.47) and anal fin-ray (0.36) accounted for 10.75% of the total variance in the data. Also component 3 showed negative and low loadings for most of characters measured (Table 3) except characters like premaxillary barbel length (0.19), dorsal fin height (0.12), fontamelar (0.12), eye diameter (0.41), pectoral fin ray (0.42), anal fin ray (0.42) and accounted for 4.62% of the total variance in the data. Component 4 with eigenvalue 0.54 was also seen to follow the same trend but showed highest loadings for anal fin (0.66) and accounted for 1.9% of the total variance in the data set.

The PCA biplot of PC1 and PC11 explained 91.75% of the variance in the data (Table 3 and Fig. 1). The highest loadings came from10 variables namely: pectoral fin-ray, caudal fin-ray, anal fin-ray, Dorsal fin-ray, Pelvic fin-ray, Eye diameter, Anal fin height, weight and body depth at anus. These characters are unclustering on the PCA biplot (Fig.1) which indicates that they are similar in terms of their values.

This result indicates that meristic variation exists amongst the farms sampled and it can be presumed to be due to differences in the rearing environment.

TABLE 3

PRINCIPAL COMPONENT LOADINGS for the FOUR PRINCIPAL COMPONENTS (PC1-4).

Variable	PC1	PC2	PC3	PC4
Weight	0.19	-0.16	-0.06	0.28
Total length	0.21	0.00	-0.01	0.04
Standard length	0.21	0.00	-0.04	0.04
Head width	0.21	-0.02	-0.05	-0.07
Head length	0.21	-0.01	0.03	-0.11
Eye Diameter	0.15	0.26	0.41	-0.32
Body Depth at anus	0.16	-0.28	0.35	-0.01
Nasal barbel length	0.20	-0.12	0.05	-0.03
Premaxillary barbel length	0.20	-0.03	0.19	-0.08
Premaxillary width	0.21	-0.03	-0.07	0.01
Dorsal Fin Length	0.21	0.02	-0.07	0.07
Dorsal Fin Height	0.20	-0.07	0.12	-0.17
Predorsal Length	0.21	0.04	-0.06	0.05
Pectoral Fin Length	0.21	-0.03	0.02	0.08
Pelvic Fin Length	0.20	-0.10	-0.13	0.15
Predorsal Fin Length	0.21	0.03	-0.08	-0.07
Adipose Fin Length	0.19	-0.06	-0.26	0.14
Anal Fin Length	0.21	0.04	-0.09	0.01
Anal Fin Height	0.20	0.03	-0.01	-0.15
Caudal Fin Length	0.20	-0.03	0.06	-0.12
Caudal Fin Height	0.19	-0.21	0.03	0.09
Caudal Peduncle Width	0.21	-0.06	-0.06	0.10
Dorsal Fin Ray	0.09	0.44	-0.38	0.22
Pectoral Fin Ray	-0.17	0.09	0.42	0.13
Pelvic Fin Ray	0.12	0.47	0.02	-0.06
Anal Fin Ray	0.7	0.36	0.42	0.66
Caudal Fin Ray	-0.13	-0.41	0.06	0.37
Font	0.20	-0.12	0.12	0.05
Eigenvalue	22.81	3.01	1.29	0.54
Variance %	81	10.75	4.62	1.9
Cumulative	81	92.2	96.8	98.8

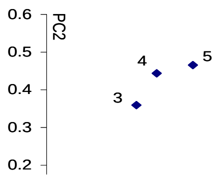

Fig 1. Principal component analysis biplot of fish attributes in Abia and Akwa Ibom State. Unclustered variables are represented as: 1 = Pectoral fin ray, 2 = Caudal fin ray, 3 = Anal fin ray, 4 = Dorsal fin ray, 5 = Pelvic fin ray, 6 = Eye diameter, 7 = Anal fin height, 8 = weight, 9 = Caudal fin height, 10 = Body depth at anus.

3. CONCLUSION and RECOMMENDATIONS

Phenotypic characterization of hybrid clariid catfish was carried out in two farms each from Abia and Akwa Ibom states. Thirty morphometric and meristics characters were described according to [23] description key. The result of the phenotypic characterization reveals variations in some characters across the farms sampled. Abia farm 1 was observed to have significant mean value for all the characters. Generally amongst the states, hybrids from Abia showed good mean values for the characters measured. The result obtained indicated that variations noted in the phenotypic characters are not genetic but maybe partly due to inbreeding depression from continuous use of F1, F2, etc, as parents or partly the differences in the management practices in the different farms sampled. Therefore, it is recommended that farmers should avoid using hybrids in breeding practices except for experimental purposes in order to avoid the contamination of the natural stock.

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