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The Relationship between Numbers of Gill Rakers and Seminal Vesicle Extensions of Male African Catfish (*Clarias gariepinus*) in Maiduguri, Nigeria

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Abstract: **This study was designed in order to investigate a relationship between numbers of gill rakers (GR) and seminal vesicles extensions (SVE) of male African Catfish (*Clarias gariepinus)* in Maiduguri, Nigeria. Twenty adult males of wild African catfish were used for this study. They weighed an average of 521±93.31 gm and measured a standard body length of 40.35±2.30 cm. The average numbers of gill rakers and seminal vesicles extension obtained in this study were 88.5±11.57 and 35.90±2.79 respectively. The results showed that there was a negative correlation between number of seminal vesicle extension (NSVE) and number of gill rakers (NGR), r = -0.1124 and is not significant (P>0.05). There was a low correlation between the weight of fish (WF) and NGR (r = 0.1527; P > 0.05) as well as negative correlation between the length of fish (LF) and WF (r = -0.2388; P > 0.05). Negative correlations was also observed between LF and NGR (r = -0.0227; P > 0.05) as well as a low positive correlation existed between LF and NSVE (r = 0.0386; P > 0.05). However, a negative and significant correlation were observed between WF and NSVE (r = -0.5286; p<0.0166). Higher variability was observed in the biometric variables of the African catfish. NGR, NSVE, WF and LF (CV= 13.05, 7.77, 17.91 and 5.70 respectively). The African catfish were clustered into 4 groups separated from each other by a specific mahalanobis distance. This reveals that in the study area, there is no positive correlation between the NGR and NSVE.**

Keywords: **African catfish, gill rakers, Maiduguri, Nigeria, seminal vesicles.**

I. INTRODUCTION

African Catfish (*Clarias gariepinus*) which is generally considered to be one of the most important tropical catfish species for aquaculture has an almost Pan-African distribution ranging from the Nile to West Africa and from Algeria to South Africa (Teugels*et al*.,1986). The catfish genus can be defined as displaying an eel shape, having an elongated cylindrical body with dorsal and anal fins being extremely long (nearly reaching the caudal fin) with both fins containing only soft fin rays (Reed *et al*., 1967, Teugels *et al*., 1986). The outer pectoral ray is in the form of a spine and the pelvic fin normally has six soft trays (Teugels *et al.*, 1986, Ben, 2003). The head is flattened, highly ossified, and the body is covered with a smooth, scaleless skin. The skin is generally darkly pigmented on the dorsal and lateral parts of the body. The colour is uniformly marbled and changes from greyish olive to blackish according to the amount of sun rays they are exposed. On exposure to light the skin colour generally becomes lighter.

The members of the genus clarias are closely related to one another but one distinguishing feature is the number of gill rakers that are located on the gill arches under the operculum. The gill rakers are bony or cartilaginous projections which point forward and inward from the gill arches. They aid in the fish's feeding. Their shape and number are a good indication of the kind of species of fish and the food they eat. Fishes which eat large prey such as other fishes and molluscs have short, widely spaced gill rakers (Reed *et al*., 1967). This type of gill rakers prevents the prey item from escaping between the gills. The numbers of gill rakers is often used in species differentiation of genus Clarias.

Another characteristic feature of clarias is that, they have seminal vesicles which are accessory sex glands present in the male reproductive system that are attached to the posterior region of the common spermatic duct (Van Teinhoven, 1983; Van den Hurk, 1987; Patzner, 1991; Singh and Joy, 1999). The functions of seminal vesicles in this species are largely unclear but may serve as storage and nutrition of spermatozoa. The seminal vesicle fluids may also immobilize the sperm cells after ejaculation, and possibly prolongs the period of sperm activity (van den Hurk, 1987). In the study area, the optimum numbers of gill rakers and seminal vesicles extensions have not been reported, also there is dearth of information on the relationship between these organs; therefore it necessitated this study.

II. MATERIALS AND METHODS

Study area:

The study was conducted in the Gross Laboratory of Department of Veterinary Anatomy, University of Maiduguri, Nigeria. Maiduguri is located between latitude 11º and 50º north and longitude 13° and 36º east. The annual rainfall average 320mm, rainy season begins in June and last till October and dry season begins in November and last till May. The rainfall is monsoonal, generally been heaviest in August. The annual temperature average 35.4ºC, the climate of Maiduguri can be divided into six zones: Guinea zone, Sunado-Guinea zone, Sunado-Sahelian zone, Sahelo-Sudanian, Sudano-Saharan zone and Saharan zone (Mayomi and Mohammed, 2014)

Sources of fish:

Twenty adult males of wild African catfish (*Clarias gariepinus*) were used for this study. They weighed an average of 550g and measured a standard body length of 42cm. All fish were procured from fish retailers in Gamboru fish market in Maiduguri, whose fish were from Lake Alau. It is located 20km South East of Maiduguri, Borno State. It is situated at the semi-Arid north Eastern Zone of Nigeria (11˚40N to 11˚45N and 13˚10′ E to 13˚20′ E). It is believed to be a remnant of former Mega Chad. It receives an annual delivery of water from Ngada and Yedzeram river system, but whiles the main rivers Ngada and Yedzeram and their other tributaries dry up completely during dry season, Lake Alau retains some water all year round (Bankole *et al*., 1994). The fish were transported alive in a plastic trough to the Gross Laboratory of the Department of Veterinary Anatomy University of Maiduguri, Nigeria.

Experimental design:

Each fish was euthanized using Tricaine (Metomidate Hydrochloride) anesthetic at the dose of 1600µl /litre of water (Bowser, 2001). After which an incision was made from the mouth through the operculum and the gill arches containing the gill rakers were removed, photographed using canon digital camera power shot (A470) and the numbers were determined. Afterwards a mid-ventral incision was made from mid way between the pectoral fins to the pelvic fins and the seminal vesicles were also exteriorized, photographed and the numbers determined. The incisions were made using scalpel, scissors and tissue forceps.

Statistical analysis:

The data generated in this study were analyzed using multivariate analysis (pairwise correlation, cluster analysis and principal component analysis) with JMP version 11 software (SAS Institute Inc., Cary, NC). Analyses were considered significant at a P value of ($P< 0.05$).

III. RESULTS

The result of the study is presented in Table1 to 3 and Figure1 to 3. Twenty adult males of wild African catfish were used for this study. They weighed an average of 521±93.31 gm and measured a standard body length of 40.35±2.30 cm. The average numbers of gill rakers and seminal vesicles extension obtained in this study were 88.5±11.57 and 35.90±2.79 respectively. The results showed that there was a negative correlation between number of seminal vesicle extension (NSVE) and number of gill rakers (NGR), $r = -0.1124$ and is not significant ($P>0.05$). There was a low correlation between the weight of fish (WF) and NGR ($r = 0.1527$; $P > 0.05$) as well as negative correlation between the length of fish (LF) and WF ($r = -0.2388$; $P > 0.05$). Negative correlations was observed between LF and NGR ($r = -0.0227$; $P > 0.05$) as well as a low positive correlation existed between LF and NSVE ($r = 0.0386$; $P > 0.05$). However, a negative and significant correlation were observed between WF and NSVE ($r = -0.5286$; $p<0.0166$). Higher variability was observed in the biometric variables of the African cat fish. NGR, NSVE, WF and LF (CV= 13.05, 7.77, 17.91 and 5.70 respectively).

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Even though they are all males and from the same source; but they were clustered into 4 groups. Each of the group was further separated from each other by a specific Mahalanobis distance. This indicates that the clusters are highly divergent from each other. The coefficient of variation values obtained for NGR, NSVE, WF and LF in the African catfish might reflect the sensitive response of these biometric to deviations in their cluster. Grossly, the gill rakers and seminal vesicles are presented in Figures 2 and 3 respectively.

Table1. The traits, mean, SD, and coefficient of variation of male African catfish (*C. gariepinus*)

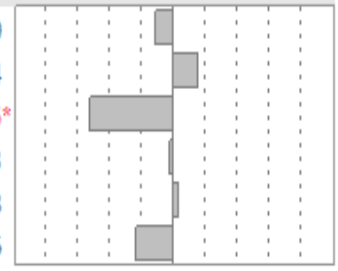
Traits	mean	SD	CV (%)
NGR	88.5	11.57	13.05
NSVE	35.90	2.79	7.77
WF	521.0	93.31	17.91
LF	40.35	2.30	5.70

Where NGR=Number of gill rakers, NSVE= Number of seminal vesicle extension, WF= Weight of fish, LF= Length of fish and CV= coefficient of variation.

Table2. Pairwise correlation between the traits in male African catfish (*C. gariepinus*)

Pairwise Correlations

Variable	by Variable	Correlation	Count	Lower 95%	Upper 95%	Signif Prob
NSVE	NGR	-0.1124	20	-0.5286	0.3474	0.6370
WF	NGR	0.1527	20	-0.3108	0.5575	0.5204
WF	NSVE	-0.5286	20	-0.7870	-0.1124	0.0166*
LF	NGR	-0.0227	20	-0.4606	0.4241	0.9243
LF	NSVE	0.0386	20	-0.4110	0.4730	0.8718
LF	WF	-0.2388	20	-0.6162	0.2278	0.3106



Where NGR=Number of gill rakers, NSVE= Number of seminal vesicle extension, WF= Weight of fish, LF= Length of fish.

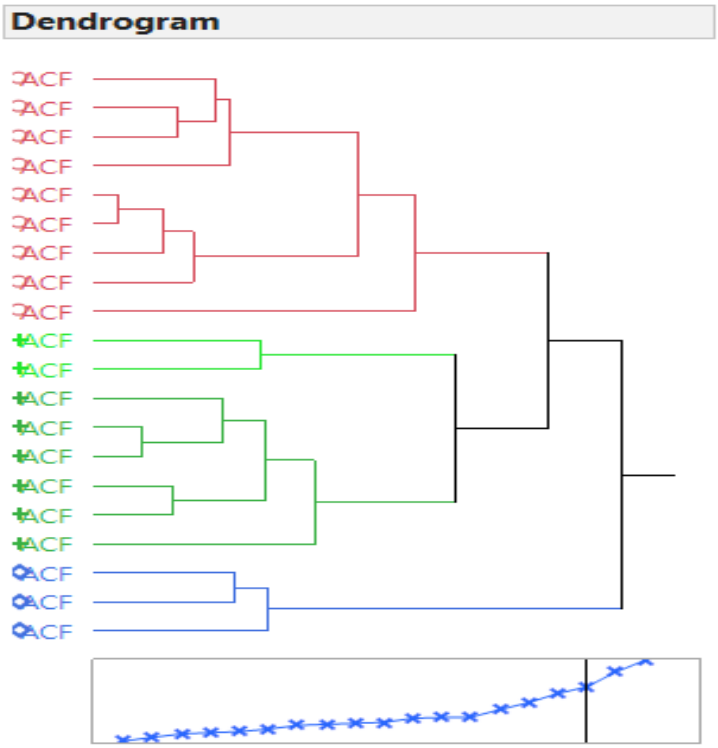


Figure 1: The cluster analysis of variables of male African catfish (*C. gariepinus*) ACF= African catfish

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Table3. The principal component analysis of the variables of male African catfish (*C. gariepinus*)

Eigenvalues

Number	Eigenvalue	Percent	20 40 60 80	Cum Percent
1	1.6487	41.217		41.217
2	0.9925	24.812		66.028
3	0.9270	23.174		89.202
4	0.4319	10.798		100.000

Eigenvectors

	Prin1	Prin2	Prin3	Prin4
NGR	0.27624	0.54622	0.78877	-0.05636
NSV	-0.61624	-0.20856	0.40610	0.64174
WF	0.67589	-0.06012	-0.14360	0.72037
LF	-0.29514	0.80903	-0.43852	0.25702

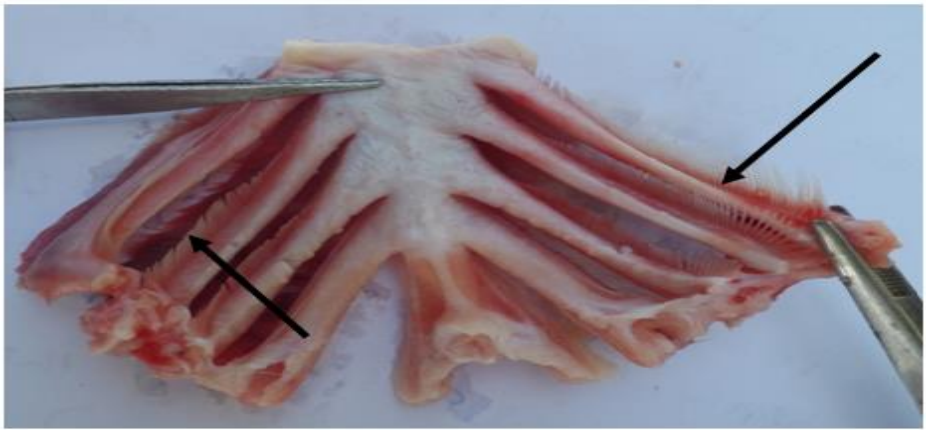

Figure 2: The dorsal view of gill arches of *C. gariepinus*, showing numbersof gill rakers (NGR) (arrows).

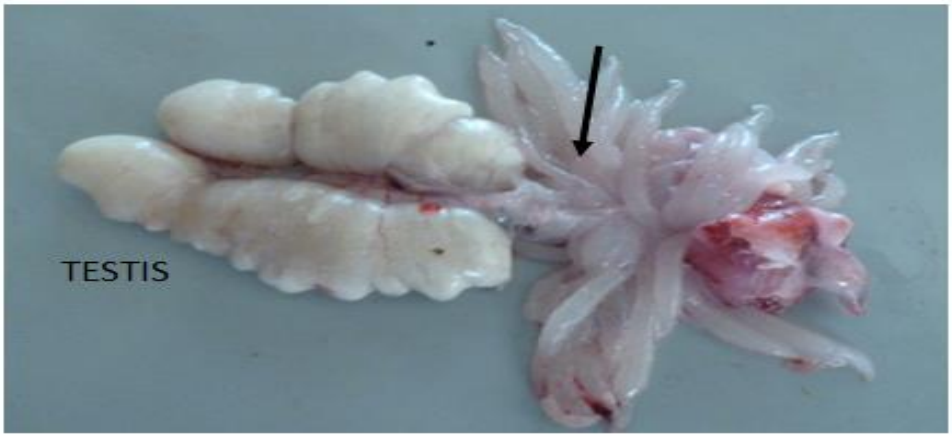

Figure 3: The reproductive organs of male *C. gariepinus*, showing number of seminal vesicles extensions (NSVE) (arrow).

IV. DISCUSSION

Fish are like other animals that exhibit unequal body proportional growth pattern; this is a situation whereby some parts of the body show different growth pattern from other parts (Martins *et al*., 2005). The mean values of length and weight of *C. gariepinus* obtained in this study which are often used as one of the factors for determining maturity of fish which agrees with the work reported by Nwokoye *et al*. (2007) and Ikpegbu *et al*. (2012). However unlike other vertebrates that stops growth at a certain age due to heredity, fish does not really lose the capacity to grow (Pauly, 1992) even though as the fish grows older, the growth rate slows down.

The number of seminal vesicles extension observed in this study did not agree with Fishelson *et al*. (1994) who reported that sperm ducts are surrounded by up to 50 finger-like extensions of the seminal vesicles. These may retain sperm flow when pressure is applied on the abdomen (Richter, 1976). However the number of seminal vesicles observed in this study falls within the range of work by van den Hurk*et al*. (1987), who reported a wide range numbers of seminal vesicles (34 to 44).

The number of gill rakers obtained in this study agrees with the report of Teugels *et al*. (1986) that *C. gariepinus* is closely related with other Clariid species but the number of gill rakers is one of the features differentiating them. According to him, if the numbers of gill rakers are from 50 and above then it is *C. gariepinus*; but if the number is below 40, then it is another Clarias species different from *C. gariepinus*. These further authenticate the species of fish under study as all the numbers of the gill rakers determined, none were below 50.

The cluster analysis of the variables of African catfish in this study reveals that even though the entire fish samples were from the same source; they are all males but they were clustered into three groups meaning each of the group was separated from each other by a specific Mahalanobis distance as illustrated by the dendrogram. This is in agreement with the report of (Gjedrem, 1997). According to him, growth is a complex process and can differ between species, strains or populations within the same species and different individuals within the same population. Among cultured animals, fish species exhibit the largest individual variation in growth (Gjedrem, 1997). For most farmed animals and fish, the coefficient of variation for growth varies between 7 and 10%, 20 and 35% respectively (Gjedrem, 1997).

The principal components (PC) analysis used in this study is a weighted linear combination of correlated variables which is one of the most important factors determining fish parameters; explaining a maximal amount of variance of the variables thereby aiding in data reduction. In the PC analysis, determinant of the correlation matrix was used to test for multicollinearity and singularity. The principal component of NGR accounted for 41.22% of biometric variables, NSVE accounted for 24.81%, WF accounted for 23.17% and LF accounted for 10.80%. All the fish samples were from the same source i.e. Lake Alau, but it has other tributaries such as Ngada and Yedzaram river system (Bankole *et al.*, 1994). This could be other reasons why there are biometric variables among the fish sample examined.

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