LENGTH-WEIGHT RELATIONSHIP AND ORGAN INDICES OF POND RAISED AND WILD POPULATION OF *C. gariepinus* (BURCHELL 1822) PISCES-CLARIDAE

S.M. TSADU

Fisheries Department,
School of Agriculture and Agricultural Technology,
Federal University of Technology, Minna.

ABSTRACT

Samples of *C. gariepinus* collected from the wild and cultured populations in Plateau and Niger States of Nigeria were analysed for length-weight relationship and organ indices (Gonadosomatic index (GSI), hepatosomatic index (HSI), renalsomatic index (RSI) and somatic fat deposit index (FDI). High correlation and linear relationship between body length and body weight was observed in all sample population ($P < 0.05$). A significant difference was observed between the GSI of males and females of both wild and cultured population and also between females of the wild and cultured population, ($P < 0.05$). There was no significant difference in HSI, CSI RSI and FDI of all the sample populations ($P < 0.05$). The importance of length-weight relationship and organ indices in fish production are discussed.

Keywords: Length, Weight, Organ, Indices

INTRODUCTION

Length-weight relationship of fish is often studied biologically. The result can be used to convert length into weight and vice versa. Length and weight data can also be used to determine the coefficient of condition or condition factor(K) or ponderance index in order to express the condition of the fish in numerical terms (Lagler, 1956). Weight in fish may be a function of their length (Hile, 1936). If form and specific gravity were constant throughout life, the relationship could be expressed by the cube law equation $K = w/L^3$. But in nature it has been found that the value of K is not constant for individuals, species or populations but is subject to wide variations (Lagler, 1956). For fish of average natural condition the K-factor should be equal to 1, while < 1 and > 1 indicate below and above average conditions respectively (Wade, 1992).

The values of K have been widely used by fishery scientists to express the relative robustness of fish. They have also been used along with age and growth studies to indicate the suitability of an environment for a specie. This is done by comparison of the average values of different localities. They have also been used to measure the effects of environmental improvement and stocking density (Lagler, 1956). Thus informations on condition indices, age and growth studies of fish stock are relevant for ascertaining its optimum stocking density. (Lagler 1956). Thus informations on condition indices, age and growth studies of fish stock are relevant for ascertaining its optimum environmental requirements, feeding regime and stocking density (Lagler 1956). The information on condition indices, age and growth studies of fish stock are relevant for ascertaining its optimum enviromental requirements, feeding regime and stocking density. Loss in condition can be associated with changes in any of these factors (Bagenal, 1978).

This study was conducted to investigate the suitability of the study areas Niger and Plateau States of Nigeria for growth and culture of *C. gariepinus*.

MATERIALS AND METHODS

Collection and Treatment of Samples

Cultured samples were obtained from Rockwater and Panyam fish farms, Plateau State Nigeria. The

wild samples were collected from Nanko pool, Niger State. Rockwater fish farm is located near Du village, south-east of Ray-field Jos. Fish samples were collected from this farm in May 1990. Panyam fish farm is located in the south-east of Jos, about 80 km from Jos Plateau State, Nigeria. Fish samples were collected from this farm in June 1990 from a storage pond, 0.3 ha. long and 1.5m deep. Nanko pool is a perennial pool lying on the flood plains of River Niger between Dokogi and Epegi in Doko district of Lavun Local Government area of Niger State, about 20km south of Bida. The pool is about 4000 $m^2$and 1.8m deep. Fish samples were transported in coldbox to the fisheries laboratory, University of Jos and preserved in deep freezer. A total of 120 samples were collected.

Prior to examination the fish were thawed thoroughly and water mopped out with towel. The standard length and total length of each sample was measured using fish measuring board. The total body weight was measured using fish measuring board. The total body weight was measured using mettler P. 1210 balance. Each specimen was dissected for determination of sex and gonad maturity. The gonad, liver, heart, kidney and visceral fat deposit were weighed. The gutted body weight was also measured. The range, mean, and standard deviations of standard length (SL), total length (TL) and total body weight (TBW) for male and female from each station were determined. Condition factor (K) of each specimen was calculated using Fulton's formula $K = \frac{100N}{L^3}$.

The mean condition factor (K) for males and female population samples were also calculated using the formula

$$\frac{K = K_1 + K_2 \ldots\ldots K_n}{N}$$

Gonadosomatic index (GSI), Hepatosomatic index (HSI), Cardiasomatic index (CSI), Renal somatic index (RSI) and somatic fat deposit index (FDI) were calculated using the expression

$$\frac{\text{organ wt (g)}}{\text{Total body wt (g)}}.$$

The length-weight relationships for males and females from each sample site were calculated by the equation $w = aL^b$. The total length and total body weight were used to determine length-weight relationship by correlation coefficient (r) and regression coefficient. Sexes were treated seperately. Their logarithmic transformations were also carried out to give a straight line relationship Log W = Log a + b Log L. The regression line was calculated by method of least squares according to Bagenal (1978),

$$b = \frac{E(x - x)(Y - Y)}{E(x - x)^2}$$

$$a = Y - bx$$

This was used to calculate the Log-log regression co-efficient of standard length (SL) and total body weight (TBW) for males and females of each sample populations. The correlation co-efficient (r) for males and females of each sample populations were calculated.

RESULTS

Size ranges of specimens

A total of 120 samples ranging from 25.00cm to 67.00cm total length and 107.25g to 2318.29g total body weight were examined. The size ranges of both males and females of the sample populations are presented in Table 1.

Length-weight relationship

The log regression co-efficient and correlation co-efficients obtained for males and females of the three areas are presented in figure 1 -3. Table 2 shows the regression and correlation co-efficient of the log-log transformations of the data. A high correlation was observed between total length and total body weight in the three sample populations ($p < 0.05$). Plots of Log-log transformations of standard length (SL) against total body weight (TBW) of the three sample populations shows a positive linear relationship (Figs 1-3).

Condition factor, visceral fat deposit and organ indices

Mean condition factor (K), organ indices (GSI, HSI, CSI, FSI, FDI) plus or minus mean standard deviations determined for males and females of the three sample populations are presented in Table 3. There was a significant difference between mean condition factors (K) of males and that of females in cultured populations as revealed by t-test ($P < 0.05$)In the wild population however, no

Table 1: Size Range and Mean (x) ± SE (Standard Error) of the Three Sample Population of Male and Female *C. gariepinus*

Station	Sex	Sample Size	TL (cm)	SL (cm)	(TBW (g)
Rockwater Fish Farm Ltd. Jos.	Male	30	27.00-50.50 x=34.89±0.89	24.00-43.50 x=30.68±0.78	120.00-675.38 x=280.68±18.94
	Female	10	25.00-48.00 x=36.01±2.04	22.00-43.00 x32.72±2.06	107.48-813.48 x=357.57±62.49
Panyam Fish Farm Ltd. Panyam	Male	17	26.50-41.00 x=29.68±3.83	22.50-35.50 x=25.68±0.73	119.52-434.00 x=168.22±17.83
	Female	23	26.00-49.00 x=32.22±1.21	22.50-43.00 x=28.00±1.08	123.66-802.40 x=251.95±33.18
Nanko (Niger State)	Male	22	26.40-67.00 x=40.19± 2.48	22.50-59.50 x35.00± 2.23	115.00-2318.29 x=517.89±121.77
	Female	18	29.00-52.80 x=35.37±1.65	23.50-46.50 x30.67±1.48	107.25-1133.25 x=319.39± 68.18

Table 2: Log regression and correlation coefficient of the relationship between log total length (TL) and log total body weight (TBW) of male and female *C. gariepinus* of the three sample populations.

STATION	COEFFICIENT	MALE	FEMALE
Rockwater Fish Farm	regression	Y= 1.26+2.47x	Y= -1.92+2.95x
	correlation	r= 0.95	r= 0.99
Panyam Fish Farm	regression	Y= -1.74+2.80x	Y= -1.89+2.87x
	correlation	r= 0.98	r= 0.99
Nanko Pool	regression correlation	Y= -2.38+3.21x r= 0.99	Y= -2.27+3.16 r= 0.96

Y = Log total body weight
x = Log total length
r = correlation coefficient

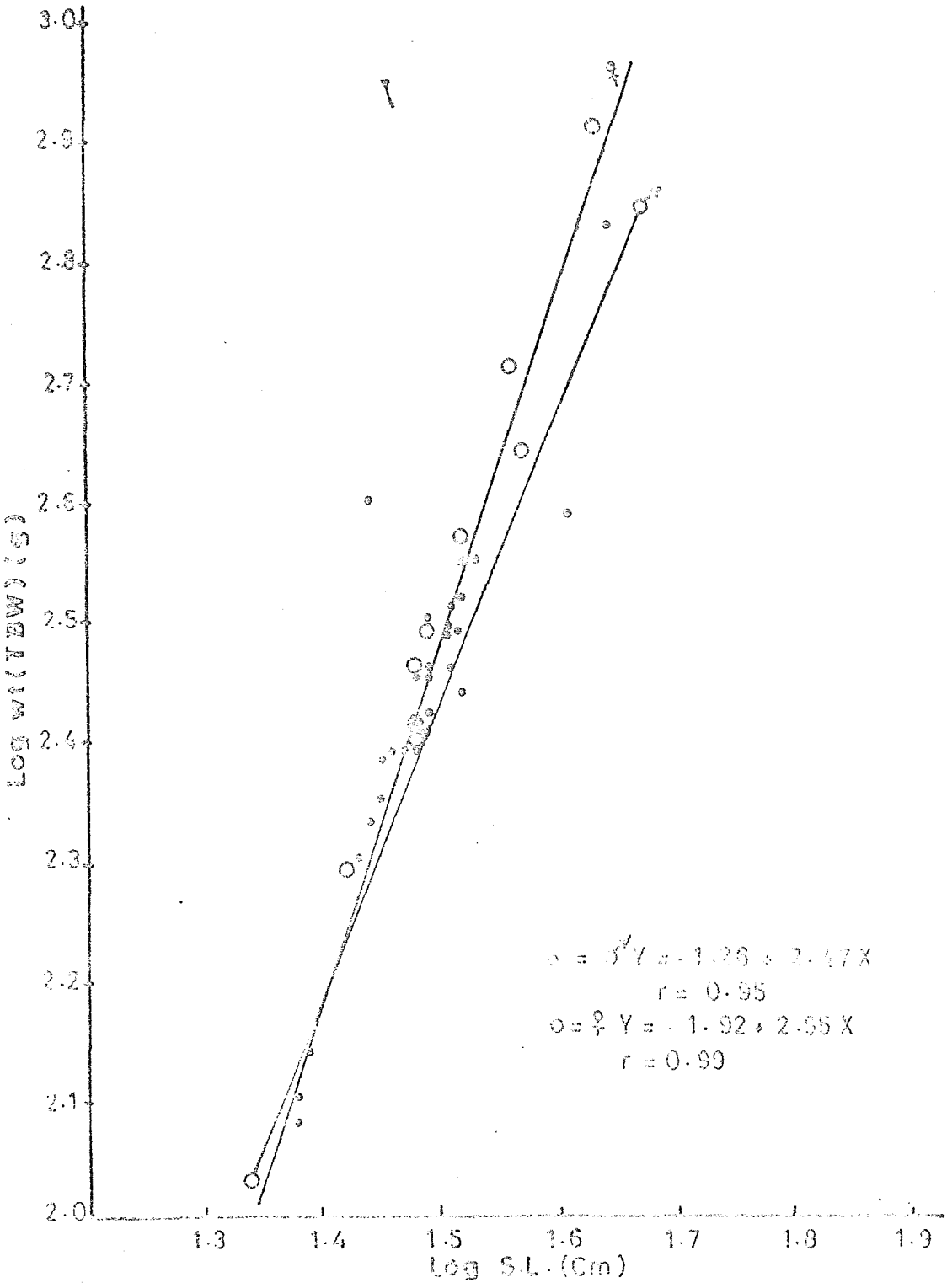

Fig 1 Log standard length (s.l) (Cm) / Log total body weight (TBW) (g) relationship of ♂ ♀ *Tilapia* samples from Rockwater fish Farm Jos.

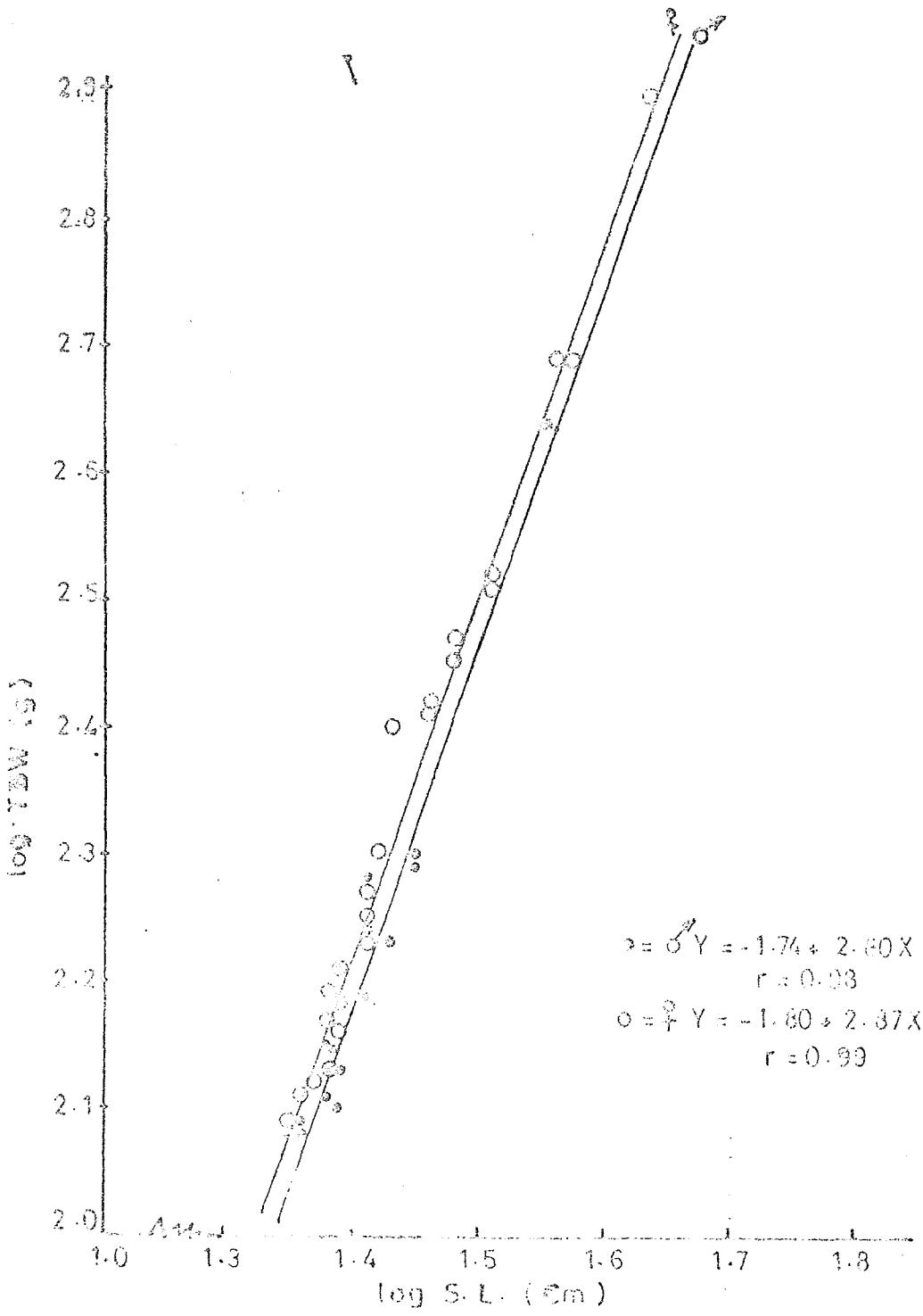

Fig 2. Log total body weight (TBW) (g) / Log standard length (sl) (Cm) relationship of *Liza tenuis* samples from Paryam Fish Farm.

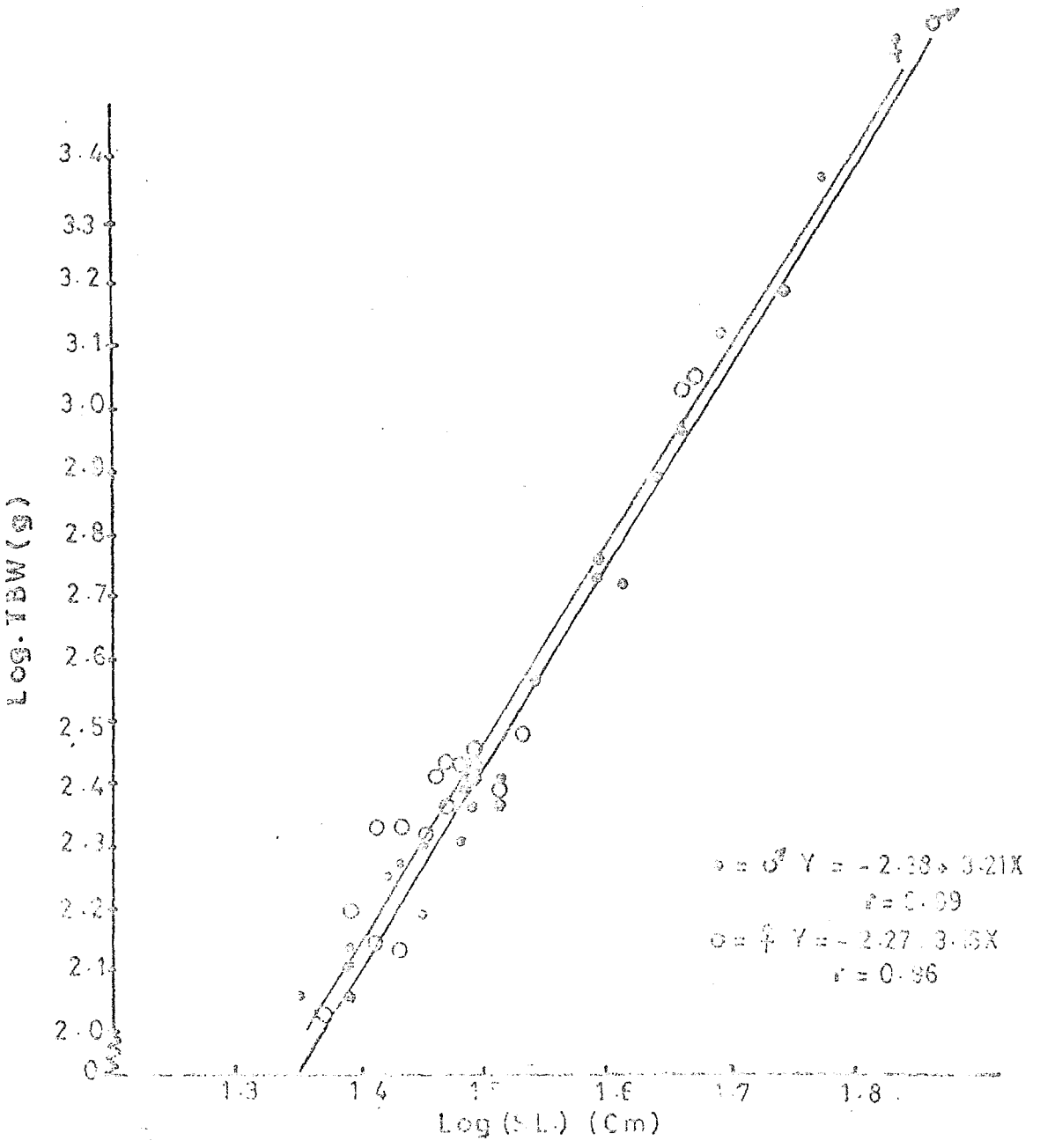

Fig 3 Log standard length (sl) (Cm) / Log total body weight (TBW) (g) relationship of C. gariepinus samples from Nanko Pool.

Table 3: **Mean Condition and Organ Indices ± Standard Deviation of Male and Female *C. gariepinus* of the three Sample Populations.**

Station	Sex	Mean condition factor (K)	Mean GSI	Mean MSI	Mean CSI	Mean RSI	Mean FDI
Rockwater Fish Farm	Male	0.931 ± 0.092	0.594 ± 0.239	0.952 ± 0.172	0.102 ± 0.003	0.676 ± 0.203	0.479 ± 0.414
	Female	1.009 ± 0.066	8.404 ± 3.829	0.895 ± 0.184	0.079 ± 0.018	0.443 ± 0.098	0.135 ± 0.222
Panyam Fish Farm	Male	0.958 ± 0.064	0.269 ± 0.086	0.558 ± 0.184	0.067 ± 0.36	0.346 ± 0.136	0.015 ± 0.036
	Female	1.049 ± 0.065	11.511± 4.773	0.519 ± 0.235	0.068 ± 0.027	0.290 ± 0.118	0.009 ± 0.026
Nanko Pool	Male	0.889 ± 0.112	0.225 ± 0.113	0.541 ± 0.257	0.105 ± 0.031	0.357 ± 0.169	0.430 ± 0.481
	Female	0.944 ± 0.147	4.732 ± 6.772	0.539 ± 0.160	0.096 ± 0.037	0.249 ± 0.094	0.224 ± 0.279

K = Mean condition factor.
GSI = Gonadosomatic index.
MSI = Mepatosomatic index.
CSI = Cardiasomatic index.
FDI = Fatdeposit index.

significant difference was found between males and females mean condition factors ($P > 0.05$).There was also no significant difference between mean condition factors of males of the three sample populations ($P > 0.05$). Females of the cultured population (Rockwater and Panyam fish farms) had slightly above average natural condition factor of 1, while females of the wild sample population and males of all the three sample populations had below average natural condition factor (Table 3).

There was significant difference in mean GSI between males and females of all the populations ($P < 0.05$)but no significant difference was observed in mean HSI, CSI, RSI and FDI between the three populations and also between males and females of each sample population ($P > 0.05$)(Table 3).

DISCUSSION

Analysis of data from biometrics examination of fish has been very useful in growth studies and estimation of the physiological state of fish (Lagier, 1956).

There was considerable variations in size range of both wild and cultured populations especially among males. This is due to fact that the sample were at varying ages. The large sizes encountered from samples indicate that under optimum environmental conditions and high survival rate *C. gariepinus* can attain a very large size. Hendley and Solomaon (1972) recorded specimens of *C. gariepinus* of 37.66 kg from the vaal River (South Africa). Also Benion (1923) in South Africa recorded a giant specimen of *C. gariepinus* more that 2m in length and weighed 59kg.

Significant difference were noted in mean weight between male and females of both cultured and wild populations studied ($P < 0.05$). In cultured populations females had higher mean weight than males while in wild populations males had higher mean weight. This is probably due to the fact that the specimens were collected during their breeding season and the higher weight of females under culture was contributed by the weight of the gonads which were full of matured eggs.

Khan *et al.* (1990) in their study of the reproductive physiology of *Mystus nemurus* in Malaysia observed that rainfall brought nutrient from the atmosphere, water temperature became cooler, littoral zones became inundated by rise in water level and all these seem to trigger off ovulation in gravid male and female *M. numerous*. In the wild populations most females appeared to have spawned their eggs by the time they were collected as only few of them were gravid. They also had lower condition factor and lower GSI. Schields (1957) observed that rainfall and changing water level during rainy season are among the determinant factors that bring about increased spawning activity during the wet season.

There was high correlation and a positive linear relationship between the total length and total body weight. This indicate that increase in weight may be a function of increase in length and vice versa, as observed by Hile (1936). Linear regression of standard length and weight gives very useful coefficient of regression 'b' in determining growth pattern. 'b' values of 3 indicates isometric growth while values less than 3 shows negatively allometric growth and values greater than 3 shows positively allometric growth (Lagler, 1956). In this study negatively allometric growth was observed in samples from Rockwater and Panyam fish farms ($b < 3$) while samples from Nanko pool show isometric growth. The significant difference noted between the mean condition factors of males and females under culture probably indicate that females were diverting more energy to laying down of food reserves in preparation for breeding. This is also reflected by the GSI of the females being higher than that of their male counterparts. Khan *et al.* (1990) reported that many intrinsic and extrinsic factors (hormonal, environmental, temporal and spatial) play vital role in gonadal development.

Samples from Rockwater had higher Hepatosomatic index (HSI) and Renalsomatic index RSI) than Panyam and Nanko samples. This may be due to the fact that Rockwater populations were feeding more on food with comparatively higher protein content and the liver and kidney were therefore more involved in protein domination and elimination. Observations of the sample areas also indicated abundance of *Clarias* food organisms such as tadpoles and benthic invertebrates in Rockwater ponds than Panyam and Nanko sample stations. Panyam samples had the lowest fat deposit

index (FDI) though the difference was not statistically significant ($P > 0.05$).

Though bigger sizes fish were encountered in the wild population, the cultured populations had higher mean condition factors. This indicate that culture environment provides more suitable conditions for the well being of the fish. Lack of large size fish from cultured populations may be due to limitation of culture duration for commercial purpose. Thus pond culturing has significant advantage over artisanal fisheries and both Niger and Plateau states of Nigeria have suitable environmental conditions to support fish culture.

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