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EVALUATION OF GROWTH AND GONADOSOMATIC INDEX OF WILD AND CULTURED AFRICAN MUD CATFISH (*Clarias gariepinus* Burchell, 1822), FROM WATER BODIES AROUND SOKOTO METROPOLIS

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This research was carried out in Usmanu Danfodiyo University, Sokoto, to establish the growth patterns, condition factor and reproductive indices based on the ecotypes of three different population groups of *Clarias gariepinus*. Ninety (90) samples of 30 fish each were collected from, River Rima (wild), Premier farm and Magatakada farm, all within Sokoto metropolis. The results revealed significant (P<0.05) differences in the K-factor between cultured *C. gariepinus* and its wild conspecifics from river Rima. The Gonadosomatic index of the CSPF population group, with (5.965±0.95) was significantly (P<0.05) higher than those of the WSRR and CSMF population groups, with (3.37±1.02) and (3.10±0.85) respectively. The research drew a conclusion that, the difference in the population groups reflects superiority of the CSPF population group and attributed this to crosses that have occurred between the wild and the CSPF population groups over the years, as later discovered by this research. Therefore, it was recommended that a deeper investigation should be carried out into the possible growth potential, heterosis, vitality and vigor of the crosses between the two ecotypes and also on how to harness the wild conserved gene pool of these attributes for the improvement of the current aquaculture stock.

Keywords: Growth; gonadosomatic index; mud catfish

INTRODUCTION

Clarias gariepinus is an important tropical catfish species for aquaculture. It is very popular in both culture and artisanal fisheries sectors in Nigeria (Oyebola *et al*., 2013). It serves both socio-cultural and research purposes in most regions of the country. Researchers have been working tirelessly and extensively on its mass propagation techniques, development of Recirculatory System compatible for its culture along with quality feed development and genetic improvement of the brood stocks (FAO, 2012). The fish and its hybrids are known for their reproductive viability (Nukwan *et al*., 1990); therefore, they are cultured throughout Nigeria. The importance of the knowledge of genetic variation in the genus of the species cannot be over-emphasised. This is important so as to facilitate better identification (Teugels *et al*., 1992; Agnese *et al*., 1997; Rognon *et al*., 1998) as well as aid in the detection of introgression and hybridization as reported in other species (Billington *et al*., 1996). According to Teugels (1986), the Claridae family is known to have 14 genera, with 92 species distributed around the African continent and South-East Asia. *C. gariepinus* has increasing commercial importance in fisheries and aquaculture.

C. gariepinus is one of the commercially important fish species that occur naturally in the Nigerian freshwater bodies. Scientifically, sound management of any fish resources relies on basic knowledge of the biology of the species, including information on population structure; such information influences the development of strategies for its management and conservation. More so, there is no enough information available on the reproductive indices of *C. gariepinus* around Sokoto metropolis, that defines the gridlines from the wild to aquaculture conspecifics of this fish species. Therefore, there is the need to at least, proceed with some base line reproductive indexing data for more detailed research in the future.

The culture of the African catfish, *Clarias gariepinus* in Nigeria is hindered by the problem of high mortality at young stages and the resulting problem of seed scarcity. This problem might arise from the viability of the fish eggs or milt. The eggs and sperm from the wild could be introduced to augment the viability of the fish seeds and thus prevent mortality at the early stage of their growth. Little research has been done on sperm physiology and its interaction with the eggs in fertilization of *Clarias gariepinus*.The quality of sperm is highly variable and depends on various external factors such as feeding regime, the quality of the feed and the rearing temperature of the fish (Billard *et al*., 1995).

The first stock of cultured dutch domesticated *Clarias gariepinus* were imported from the Netherland in 2001, form the bases from which this strain was bred in Africa. (Cambray and Van der Waal, 2006). Initially, in the close recirculating system, this strain showed very good growth rate. However, reproductive problems were soon encountered; as this has been the situation of some farms consulted in Sokoto. The fish could be bred every month but produced few eggs and a low egg fertilization rate was observed. The low fertility problems could be overcome by back-crossing female domesticated fish with wild males obtained from the Kwalkwalawa or other way round, if the reproductive indices indicate that tendency. This therefore needs to be verified and ascertained by a standard research procedure to investigate the growth parameter and the reproductive indices from the wild to the aquaculture conspecifics, if it could possibly result in higher survival rate.

MATERIALS AND METHODS

Study Area

This research was conducted in Usmanu Danfodiyo University, Sokoto, located on 13^0 07’38.9’’N and 5^0 12’19.0 E within Sokoto ecological segment. Sokoto is located in the savannah agro-ecological zone (Latitude 13^0 00’27.0’’N and Longitude 5^0 15’05.6’’E), which is about 350m above the sea level. The climate is semi arid (SERC 2012). The area received an average annual temperature of 30.26^0C with average rainfall of 260 mm and an average annual relative humidity of 48.54% in the year 2012 (SERC, 2012).

Fish Sampling

A total of 90 live fish samples of 100g to 600g of *C.gariepinus* were collected, 30 each from the river Rima Kwalkwalawa area and from Magatakada and Premier fish farms, all within the Sokoto metropolis. The wild samples were randomly selected from the caught population made by the fisher-men at the bank of the river and these were transported to the laboratory of the Department of Fisheries and Aquaculture of Usmanu Danfodiyo University, Sokoto, where the necessary data were collected.

Growth pattern, Condition factor

The growth pattern of the different fish population group was determined, using Length-weight Relationship following LeCren (1951), condition factor was determined as described by previous authors (Nikolsky, 1963; Khanna and Singh 2006).

Reproductive Indices

The reproductive indices of the wild and the cultured *C. gariepinus* population groups were compared, using the standard formula for determination of Gonadosomatic index.

Growth Pattern

For the growth pattern of the species, the length-weight relationship was determined using the equation;

$$w = aL^b$$

$\text{Log } W = \log a + b \log L$ (Bagenal and Tesch, 1978)

Where, W = weight (gm); L = standard length (cm), a = constant; b = coefficient. (Soyinka and Hillary, 2012).

Condition Factor (K)

The condition factor of the samples under study was also determined using the following equation;

$K = \frac{100W}{L^b}$ (Bagenal and Tesch, 1978)

Where, K = condition factor; L = standard length (cm); W = weight (g).
Where W = total weight of the sample (gm)

L = standard length of the fish sample (cm)
b = coefficient of the regression

Gonadosomatic Index (GSI)

This was calculated using the formula;

$GSI = \frac{Weight\ of the\ gonad}{Weight\ of\ the\ fish} X\ 100$ (Khanna and Singh, 2006)

Data Analysis

The data were subjected to descriptive statistics, involving mean values and percentages. Correlation and regression, Analysis of variance. Mean separation was carried out using Duncan New Multiple Range Test (Steel and Torries, 1980). All descriptive and regression and other analysis were done using Statistical Package for Social Sciences.

RESULTS AND DISCUSSION

The results of Length-weight Relationship (LWR) regression equations from the three *C.gariepinus* population groups varied in their patterns as the *C. gariepinus* population group from river Rima and that of Magatakada Farm had negative allometric growth pattern. The Premier Farm *C. gariepinus* population group recorded a positive allometric growth. However, the *C.gariepinus* population group from river Rima had a 'b' value that was a bit higher than that recorded by Magawata (2007), from the same fish sampling location, for the same species and which he compared to agree with that of Olatunde (1983, and that of Qua Iboe and Ikpa rivers by King, (1996). By implication, if the fish population groups from River Rima which is wild and that of the pure culture media can exhibit a negative allometric growth pattern when the same species of fish from another culture media have a positive allometric growth when sampled within the same time of the year (between June and November), during the raining season, then it means, either the environment, feed type and feeding frequency favour the growth pattern of the Premier Farm population group or the genetic ontogenic relationship shared by the Premier Farm population group and the wild population group from river Rima manifests in their growth performance.

The condition factor of the three fish population groups did not vary significantly from one another which makes it difficult to state the best, with respect to either ecotype or the sampling locations. However, the *C. gariepinus* population group of Magatakada Farm had the highest condition factor, followed by that of Premier Farm and least was that of river Rima. This may be so, because the earlier mentioned two population groups were under intensive culture system, where feed were constantly fed to them. Adequate, timely medication, disease control routines and other managerial activities were constantly practiced to perfect their habitat. Contrarily, the latter population group had to compete in the wild for feeding and survival. This might have definitely affected their growth pattern and condition factor negatively, when compared to those from the culture ecotypes.

The most important reproductive parameter is the Gonadosomatic Index. The Gonadosomatic index (GSI) for the three fish population groups varied significantly, with the Premier Farm Population group having the highest mean value of GSI, this may also translate to higher fecundity (superiority in terms of potential hatchlings), viability and hatchlings survival potentials and the least GSI value was recorded for the Magatakada Farm population group, while the population group from River Rima (Wild) maintained an intermediate GSI value. Although, the Gonad weight (GndW) was not significantly different but the body weight was, and this infers that the difference in the body weight of the fish population groups influenced the variation in the GSI, due to the inverse relationship between the Gonad weight and the GSI, that as the Gonad maturation proceeds from flaccid ovaries to matured eggs, capable of ovulating, the ratio of the body weight index to the gonads decreases mathematically. This variation however, could not be of ordinary environmental or nutritional effects alone, but rather a genetic inheritance index, reflecting the superiority of the crosses between the wild and cultured population groups over the cultured or wild population groups, with respect to reproductive inherence of the population groups. Also, as discussed earlier, Turan *et al.* (2005) reported a negligible sex variation in *C. gariepinus* wild population groups in an experiment. Patiyal *et al*. (2014) also said that sex related variation does not exist in wild and captive stocks. Similarly, the only sex related phenotypic variation recorded in this research was in GSI, within each of the population groups. On the body weight class, the two varied indices were the GSI and the K factor of the wild population group from river Rima, while the two cultured population groups were the same, even between the body weight classes. This may reflect heterogeneity in the reproduction coding gene pool as may be drawn from the coefficient of variation of the wild population group for reproduction and that would be of optimal advantage for brood stock collection from the wild, for the improvement of aquaculture stocks. The growth pattern and the condition factor of the different *C. gariepinus* population groups, both from the river Rima (Wild) and that of Magatakada farms (cultured) exhibited negative allometric growth, while the *C. gariepinus* population group from Premier farm exhibited positive allometric growth pattern. This difference in the growth pattern was attributed to have originated from both the environmental variation and genotypic proteotypes of the different *C. gariepinus* population groups studied. More also, the condition factor of the three *C. gariepinus* studied were not significantly different across the population group. However, there was significant variation in the between body weight class of the *C. gariepinus* population group from river Rima, which infers heterogeneity of their gene pool.

Table 1: Growth patterns and condition factors of the three fish population groups

Location	N	Mean weight	‘a’ Value	‘b’ Value	SE of ‘b’	‘r’ Value	K – Factor
Wild *C.gariepinus* (River Rima)	30	248.33	-1.71	2.66	0.3241	0.93	0.88
Cultured *C.gariepinus* (Premier Farm)	30	306.67	-2.32	3.06	0.4894	0.88	0.91
Cultured *C.gariepinus* (Magatakada Farms)	30	315.00	-1.11	2.30	0.3068	0.91	0.95

WSRR = Wild fish Samples from River Rima; CSPF = Cultured Samples from Premier Farm; CSMF = Cultured Samples from Magatakada Farms; BW Body weight

Table 2: Variations in Growth and Reproductive indices of the three *C. gariepinus* Population groups in percentages of the Body Weight (%BW)

Phenotype	Mean ± SE			Standard Deviation (SD)			Coefficient of variation (CV)			Range		
Location	WSRR	CSPF	CSMF	WSRR	CSPF	CSMF	WSRR	CSPF	CSMF	WSRR	CSPF	CSMF
GndW	9.80±3.25[a]	15.87±2.38[a]	9.13±2.59[a]	17.804	13.03	14.18	180.56	82.16	153.86	0.03-20.86	0.20-20.70	0.03-16.03
GSI	3.37±1.02[b]	5.965±0.95[a]	3.10±0.85[b]	5.60	5.20	4.67	166.05	87.15	150.17	0.30-20.86	0.20-20.70	0.03-16.03
K	0.88±0.03[a]	0.91±0.03[a]	0.95±0.04[a]	0.15	0.15	0.20	16.99	17.02	21.14	0.60-1.32	0.62-1.23	0.74-1.77

Means in rows with same letters are not significantly different (P>0.05).
GndW= Gonad weight; GSI= Gonadosomatic Index; K= Condition factor;

Table 3: Variations in phenotypic growth and reproductive parameters between Body Weight Class of the three *C. gariepinus* population groups

C. Site	WSRR					CSPF					CSMF				
BW Class	< 300 g		≥300			< 300 g		≥300 g			< 300 g		≥300 g		
Phenotypes	Mean±SE	Range	Mean±SE	Range	Sig	Mean±SE		Mean±SE	Range	sig	Mean±SE	Range	Mean±SE	Range	Sig
GSI	2.40±1.06	0.07-16.00	4.48±1.82	0.03-20.86	*	7.17±1.51	2.40-20.70	5.53±1.26	0.20-14.60	Ns	3.06±1.40	0.08-14.60	3.12±1.11	0.03-16.03	Ns
K	0.86±0.02	0.71-1.06	0.91±0.05	0.60-1.32	*	69.89±4.77	32.40-82.50	106.92±9.16	63.00-225.70	Ns	0.94±0.09	0.74-1.77	0.95±0.03	0.74-1.28	Ns

Means in rows with same letters are not significantly different (P>0.05).
Key: GSI = Gonadosomatic Index; K = Condition factor

CONCLUSION

The growth pattern and the condition factor of the different *C. gariepinus* population groups, both from the river Rima (Wild) and that of Magatakada farms (cultured) exhibited lower growth pattern, while the *C. gariepinus* population group from Premier farm had a higher growth pattern. The superiority of the Premier Farm population group might have originated from both the environmental variations and genotypic proteotype of the different *C. gariepinus* population groups. These variation in the between body weight class of the *C. gariepinus* population group from river Rima, infers heterogeneity of their gene pool. This makes them a good substitute trials parent stocks for improvement of the current declining aquaculture stocks, to improve their survival rate and hatchlings quality.

The Dutch strain of *C. gariepinus*is worthy of more research in Nigeria, because it is currently posing threat on the genetic integrity of the local indigenous *C.gariepinus*. Despite the fact that the Dutch improved *Clarias* which is now the most commonly used in Nigerian aquaculture hub originated from Nigeria, Cameroon and the Central African Republic. It should be of concern to conservationists, because of the potential negative ecological impacts posed by the strain.

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