International Journal of Fisheries and Aquaculture Research
Vol.7, No.1, pp.1-10, January 2021
Published by ECRTD-UK
ISSN: ISSN 2397-7507, Online ISSN: ISSN 2397-776

RELATIONSHIP BETWEEN BODY MEASUREMENT AND GONADOSOMATIC INDEX OF *CLARIAS GARIEPINUS* (BURCHELL 1822) AND *HETEROBRANCHUS LONGIFILIS* (VALENCIENNES 1840) BROODSTOCKS

JIMOH, Olatunji Abubakar[1*], RAIMI, Christie Oluwatosin[1], ADEBAYO, Ebenezer Temitope[2], BALOGUN Ayodeji Temitope[3], AKOMOLEDE Olumide Olawole[3], SALAMI Segun Rasaki[3] and AWONIYI Olakunle Oluwaseun[3]
Animal Production Unit, Agricultural Technology Department, Federal Polytechnic Ado Ekiti, Ekiti State, Nigeria
Department of Biological Sciences, University of Medical Sciences Ondo city, Ondo State, Nigeria
Fisheries Technology Department, Federal Polytechnic Ado Ekiti, Ekiti State, Nigeria
Corresponding author: abubakarjimoh2011@gmail.com Phone: +234 8066058134

ABSTRACT: This study aims to evaluate body measurement and reproductive traits of two adult catfish species broodstocks and their relationships. Total of 80 catfish broodstocks of *Clarias garepinus* and *Heterobranchus longifilis* (20 male and 20 females per species) weighing 2.54±0.12 and 2.11±0.15 kg, respectively were acclimated and conditioned for use in the study. Live weight and morphometric measurements were carried out on each fish, gonadal traits were assessed, and gonadosomatic index computed using standard procedures. Results obtained revealed that *Clarias garepinus* possess significantly ($p<0.05$) superior male reproductive quality than *Heterobranchus longifilis*. Both species possess similar gonadosomatic index. Live weight of female *Clarias garepinus* and *Heterobranchus longifilis* catfish can be predicted with their body measurement especially standard length and the total length, while reproductive indices of male *Clarias garepinus* and *Heterobranchus longifilis* catfish can be used to predict the gonadosomatic index. The gonadosomatic index and reproductive traits of male *Clarias garepinus* are superior to *Heterobranchus longifilis* and would account for the difference in breeding performance and seeds production in captivity.

KEYWORDS: Clariidae; Broodstocks; Breeding soundness; Reproductivity; Southwest Nigeria

INTRODUCTION

Clarias gariepinus (Burchell 1822) and *Heterobranchus longifilis* (Valenciennes 1840) are amongst the most acceptable clariidae species, this makes them command good commercial value in Nigeria (Offem *et al.*, 2008). The minimum fish fingerling requirement is 4.3 billion, while the total fingerling supply from all sources is 55.8 million (FDF, 2007). Thus catfish fingerlings production in Nigeria is not enough to meet the fish farmers' demands (Adewumi, 2006). *C. gariepinus* is more popular in the market, while *H. longifilis* is scarce and command a premium because it is known to attain large sizes in ponds. There is a massive demand for *H. longifilis*, but its fingerlings are largely scarce due to difficulties in the production of seeds in captivity (Adeebayo and Fawole, 2012). Both clarridae species has great potentials to boost the rapidly growing Nigerian aquaculture, however, with the shortage of fish seeds supply, the goal of mitigating animal protein deficit with fish will be a mirage in Nigeria. The yearnings of

Vol.7, No.1, pp.1-10, January 2021
Published by ECRTD-UK
ISSN: ISSN 2397-7507, Online ISSN: ISSN 2397-776

farmers and scientists to have a farmed catfish that combines the fast growth traits of *Heterobranchus* spp and early maturing traits of *C. gariepinus* that will lead to the development of a hybrid *'Heteroclarias'*. This breeding goal does not emphasize seeds culture, but rather productivity of table size. These necessitate a new approach to characterise the reproductive performance of these species in culture (broodstocks). Knowledge of relationship between gonadosomatic indices and body measurement will be crucial to selection and predicting reproductive outcomes of broodstock.

Few studies had been conducted on the reproductive biology of *H. longifilis* in the River and water bodies of Southern Nigeria. Due to the diversity of the aquatic environment, the differences in reproductive biology are observed not only in individual species, but also in populations from various water bodies. Thus, capture and culture studies of fish species within similar aquatic environment is important as a basis for comparison. There is paucity of report on their potentials in culture and estimate of broodstock yield through gonadosomatic indices, partly due to the high cost of the broodstocks. The current study was designed to evaluate reproductive traits in *C. garepinus* and *H. longifilis* and relationship with broodstock sizes.

MATERIALS AND METHODS

Forty (40) catfish broodstocks each of *C. garepinus* and *H. longifilis* (20 male and 20 females per species) were procured from reputable breeder farms in Ogun, Osun, Ekiti and Ondo states Nigeria. All the broodstocks were of similar weight of 2.54±0.12 and 2.11±0.15 kg for *C.s garepinus* and *H. longifilis,* respectively. The basis for selecting the broodstocks were the readiness of the genitals; gravid female were based on swollen, reddish genital opening while male were based on reddish and pointed genital papillae. Broodstocks were transported in plastic troughs from the farms to the Fisheries laboratory. Broodstocks were acclimated and conditioned in separate tanks for one week and were fed with 40% crude protein commercial pelleted feed at 3% body weight twice daily at 9.00 and 18.00 hours. Live weight and morphometric measurements were carried out on each fish specimen. The body parts were measured following standard anatomical reference points. The traits of the body measured are body weight (taken by using electronic weighing balance to the nearest 0.01g), total length (measured from the maxilla to the end of the caudal tail), Standard length and Head length were measured.

Feeding was suspended 24 hours prior to inducement. The female broodstocks were hormonally induced intramuscularly at an angle 45° above the lateral line towards the head using ovaprim at 0.5 ml/kg fish. Induced females were condition in a separate 40L trough, and each containing 10L of water for conditioning (Olaleye, 2005). The total egg weight, weight of fish after spawn and count of a gram egg was; used to extrapolate the total egg population. Calculation of number of eggs released, the weight of the broodstock after stripping (Wb, grams) was subtracted from the weight of the brood stock before stripping (Wa) and the difference multiplied by number of eggs in a gram.

The formula is shown as: No of eggs released=(Wb-Wa) g × N
Where Wa is the weight of broodstock before stripping; Wb is the weight of broodstock after stripping; g is gram; n is number of eggs in a known weight.

The male broodstocks were dissected ventro-posteriorly to remove the testes (Omitogun, *et. al.*, 2012). Both left and right testis were obtained, weighed and semen was collected after dissection. The gonadal weight and volume of semen from each testis were recorded. After the testicular weights were obtained, a longitudinal incision was made on each testes and the milt was then collected into calibrated glass tubes to obtain semen volume (Ariola and Okpokwasili, 2012, and Oyeleye and Omitogun, 2007).. Motility of the sperm cell in the milt sampled was observed under the microscope after activation using a hypertonic solution. Milt were squeezed and washed into already prepared physiological saline. Thereafter, milt was sieved to remove dead tissues.The fish were slaughtered and eviscerated to obtain eviscerated weight. The gonadosomatic index was computed. The gonadosomatic index (GSI) was estimated by:

$$GSI = \frac{W_g}{W_e} \times 100$$

where Wg = gonad weight (g); and We = eviscerated weight (g).
The fish condition factor was calculated:
$K = (W/L^3) X 10^2$
Where; W = weight, L = Length

Determination of water quality
Physicochemical parameters such as temperature, pH, conductivity, total alkalinity, total hardness and dissolved oxygen of the water in the experimental troughs were determined following a standard method (APHA, 1998) using Probes and LaMotte Fresh Water analysis test kit, model AQ2/3.

Statistical Analysis: Data obtained were subjected to T- test using the general linear model procedure of IBM SPSS Version 25. Correlation analysis was used to check the association among the body measurements and gonadal indices.

RESULTS

The results of male reproductive characteristics of adult broodstocks of *C. garepinus* and *H. longifilis* is shown in Table 1. All parameters assessed were significantly different ($p<0.05$) based on species, except right testis weight. The trend shows that *C. garepinus* possess significantly ($p<0.05$) superior male reproductive quality than *H. longifilis*. This is revealed by a superior gonadosomatic index in *C. garepinus* compared with *H. longifilis*. The reproductive traits of female broodstock of *C. garepinus* and *H. longifilis* were statistically ($p>0.05$) similar as shown in Table 2. Despite the apparent higher live weight of *H. longifilis* which could lead to higher apparent egg weight and egg population per female, the gonadosomatic index of *C. garepinus* was apparently higher. The correlation between body measurement and gonadosomatic index of male *C. garepinus* is shown in Table 3. It is revealed that significantly ($p<0.05$) negative correlation exist between head length and gonadosomatic index (-0.974). The weight of right testis significantly correlates with volume of semen obtained in the right testis (0.977), weight of left testis (0.95), total gonadal weight (0.995) and gonadosomatic index (1). Total semen volume is significantly influenced by semen volume of the right testis (0.982) and weight of left testis (0.982). The correlation between body measurement and gonadosomatic index of female *C. garepinus* broodstock is shown in Table 4. The live weight is significantly correlated with head length (0.934), standard length (0.982) and total length

(0.983). The correlation between body measurement and gonadosomatic index of male *H. longifilis* is shown in Table 5. The live weight significantly correlates with standard length (0.934) and total length (0.948), thus can predict the liveweght of male *H. longifilis* . The gonadosomatic index significantly correlates with right testis weight (0.98), right testis semen volume (0.968), left testis weight (0.952), left testis semen volume (0.969), total semen volume (0.970), total gonadal weight (0.986). The correlation between body measurement and gonadosomatic index of female *H. longifilis* broodstock is shown in Table 6. It reveals that the live weight significantly correlates with standard length (0.894) and total length (0.965).

DISCUSSION

The trend of results shows a superior gonadosomatic index in *C. garepinus* compared with *H. longifilis*. The superior testicular sizes in *C. garepinus* enhanced semen volume obtained from the males. The volume of semen obtained in *C. garepinus* (17.69 vs 1.49ml) is a pointer to the fact that less males will be required to fertilize eggs, due to its abundant semen output, in comparison to *H. longifilis* in which more males will be required to fertilise in cultured breeding. Bromage and Roberts (1995) reported that testis size is a good indicator of the efficiency of spermatogenesis, thus suggesting higher spermatozoa production efficiency in *C. garepinus*. Despite the apparent higher live weight of *H. longifilis* which could lead to higher apparent egg weight and egg population per female, the gonadosomatic index of *C. garepinus* was apparently higher. The similar female reproductive traits of both species indicates that difficulties in production of *H. longifilis* catfish seeds in captivity is associated to male gonadal deficiencies. Offem *et al.* (2008) also reported lower gonadosomatic index in male *H. longifilis* in comparison to females (0.91± 0.87 in males vs 2.34± 2.22 in female). This suggests that it is cheaper to breed *C. garepinus* compared with *H. longifilis*, considering the cost of males required. Considering the economic importance of *H. longifilis* in catfish market, it is imperative that fish breeding goals should be geared at improving its reproductive performance. *H. longifilis.* Despite the fast growth rate of *H. longifilis,* but its fingerlings are largely scarce is explained by its low gonadosomatic index of males revealed in this study.

The results of this study implies that in male *C. garepinus* whole right and left testis weight, right testis semen volume and total gonadal weight are closely associated with gonadosomatic index. This is not in line with Bromage and Roberts, (1995) that live weight of male had a strong positive correlation with testis weight in *C. garepinus*. This study shows body measurements can be used to predict the live weight of female *C. garepinus*. This trend follows Ataguba *et al.* (2013) that reported larger broodstocks catfish had better breeding traits in *C. garepinus*. This study reveals that effort to influence enhance gonadosomatic index of male *H. longifilis* could target the enhancing gonadal development. The trend shows that live weight of female catfish (*C. garepinus* and *H. longifilis*) can be predicted by their body measurement especially standard length and total length. While body measurements can be used to predict the live weight of female *H. longifilis*. Unlike Bromage and Roberts, (1995) and Ataguba *et al.,* (2013) that reported positive correlation in female with egg weight, fertility and hatchability. The reproductive indices of male catfish (*C. garepinus* and *H. longifilis*) can only be used to predict and influence the gonadosomatic index. This could be attributed to the claims of Bromage and Roberts (1995) that testis size is a good indicator of the efficiency of spermatogenesis.

CONCLUSION

The study revealed that specie differences influence male reproductive traits in the two catfish broodstock, while similar reproductive capacity are possessed by female *C. garepinus* and *H. longifilis*. The gonadosomatic index and reproductive traits of male *C. garepinus* was largely superior to *H. longifilis*. The poor reproductive indices of male *H. longifilis* broodstocks could be responsible for seeds scarcity and difficulties in seeds production attributed to the specie.

Funding
The research outcome presented in this article was funded by Tertiary Education trust Fund TETFUND 2018 institution based research intervention of the Nigeria government

References

ADEEBAYO O. T. and F. J. FAWOLE (2012). Growth and reproductive performance of African giant catfish, *Heterobranchus longifilis* Valenciennes 1840 broodstock on ascorbic acid supplementation. *Indian J. Fish.*, 59(2): 135-140.

ADEWUMI A.A. (2006). The growth and gonadal maturation of the African catfish, *Clarias gariepinus* (Burchell) broodstock fed differently heated soybean-based diets. Aquaculture Nutrition 12: 267–274

APHA AMERICAN PUBLIC HEALTH ASSOCIATION. (1998). Standard Methods for the Examination of Water and Wastewater. 20th ed. APHA/AWWA/WEF: Washington DC. USA. 1213p.

ARIOLA, C.N. and OKPOKWASILI, G.C. (2012). The effects of indigenous probiotics on egg hatchability and larval viability of Clarias gariepinus. An interdisciplinary Journal of Applied Science,7:1

ATAGUBA, G.A., OKOMODA, V.T. and ONWUKA M.C. (2013) Relationship between broodstock weight combination and spawning success in African catfish (*Clarias gariepinus)*. Croatian Journal of Fisheries, 71: 176-181.

BROMAGE, N.R. and ROBERTS, R.J. (1995). Broodstock management and egg and larval quality. Blackwell Science, Oxford OX2 OEl, pp424

OFFEM, B.O., E.O. AYOTUNDE and G.U. IKPI (2008). Dynamics in the reproductive Biology of *Heterobranchus longifilis* Val, (Pisces: 1840) in the Inland Wetlands of Cross River, Nigeria. Research Journal of Fisheries and Hydrobiology, 3(1): 22-31.

OLALEYE, V.F. (2005). A review of reproduction and gamete management in the African catfish, Clarias gariepinus (Burchell, 1822). Ife Journal of Sci. Vol. 7, No 1, pp63-70

OMITOGUN, O.G., OLANREWAJU, I., OLANIYAN, O., AMUPITAN, P., ORESANYA, T., ALADELE, S. and ODOTIN, W. (2012). Cryopreservation of the sperm of the African catfish for the thriving Aquaculture industry in Nigeria.

OYELEYE, O.O. and OMITOGUN, O.G. (2007). Evaluation of motility of the short term cryopreserved sperm of African giant catfish- *Clarias gariepinus*. Ife Journal of Agricultural vial. Ile Ife Nigeria 22:11-16.

Table 1: Gonadosomatic index and testicular characteristics of adult broodstock of *Clarias garepinus* and *Heterobranchus longifilis*

Parameters	*Clarias garepinus* N=20	*Heterobranchus longifilis* N=20	P value
Right whole testis weight (g)	13.21±4.61	2.64±1.33*	0.04
Right testis weight (g)	4.81±1.73	1.52±0.53	0.08
Right testis semen volume (ml)	8.41±3.08	1.12±0.80*	0.03
Left whole testis weight (g)	13.40±2.55	1.45±0.32*	0.00
Left testis weight (g)	4.82±1.30	1.09±0.17*	0.01
Left testis semen volume (ml)	8.58±1.92	0.37±0.18*	0.00
Total semen volume (ml)	17.69±5.58	1.49±0.98*	0.01
Total testis weight (g)	10.25±3.36	2.60±0.67*	0.03
Liveweight (kg)	2.54±0.12	2.11±0.15*	0.04
Total gonadal weight (g)	27.94±8.17	4.09±1.63*	0.01
Gonadosomatic Index	1.15±0.38	0.19±0.06*	0.02
Condition factor	0.84±0.07	0.66±0.06	0.01

(Data are presented as mean ± standard deviation, n: number of samples)

Table 2 : Gonadosomatic index and egg output of adult Broodstock of *Clarias garepinus* and *Heterobranchus longifilis*

	Clarias garepinus (n=20)	*Heterobranchus longifilis* (n=20)	P Value
Live weight (kg)	2.07±0.11	3.66±1.18	0.08
Weight of eggs (g)	166.67±31.69	233.33±55.48	0.30
Egg Population (x10^3eggs/female)	77.28±22.52	94.08±44.63	0.72
Gonadosomatic Index	8.24±1.62	7.04±1.64	0.66
Condition factor	0.85±0.13	0.85±0.08	0.32

(Data are presented as mean ± standard deviation, n: number of samples)

Acknowledgement
The authors are grateful to the Tertiary Education trust Fund of the Federal Republic of Nigeria for providing funds to undertake the research.

International Journal of Fisheries and Aquaculture Research
Vol.7, No.1, pp.1-10, January 2021
Published by ECRTD-UK
ISSN: ISSN 2397-7507, Online ISSN: ISSN 2397-776

Table 3: Correlations of body measurement and gonadosomatic index of male *Clarias garepinus* broodstock

	Head length	Standard length	Total length	Live-weight	WRT weight	RT semen volume	WLT weight	LT semen volume	Total semen volume	Total gonadal weight	GSI
Head length	1	0.64	0.817	0.828	-0.103	-0.142	-0.863	-0.551	-0.829	-.952*	-.974*
Standard length	0.64	1	.962**	0.689	-0.352	-0.241	-0.258	0.18	-0.203	-0.461	-0.532
Total length	0.817	.962**	1	0.771	-0.24	-0.163	-0.307	0.146	-0.241	-0.504	-0.572
Live-weight	0.828	0.689	0.771	1	-0.152	-0.202	-0.37	-0.294	-0.474	-0.49	-0.541
WRT weight	-0.103	-0.352	-0.24	-0.152	1	.977**	.950*	0.703	0.921	.995**	1.000**
RT semen volume	-0.142	-0.241	-0.163	-0.202	.977**	1	.982*	0.835	.982*	.989*	.982*
WLT weight	-0.863	-0.258	-0.307	-0.37	.950*	.982*	1	0.871	.982*	.976*	.954*
LT semen volume	-0.551	0.18	0.146	-0.294	0.703	0.835	0.871	1	0.924	0.763	0.717
Total semen volume	-0.829	-0.203	-0.241	-0.474	0.921	.982*	.982*	0.924	1	0.95	0.929
Total gonadal weight	-.952*	-0.461	-0.504	-0.49	.995**	.989*	.976*	0.763	0.95	1	.996**
GSI	-.974*	-0.532	-0.572	-0.541	1.000**	.982*	.954*	0.717	0.929	.996**	1

* Correlation is significant at the 0.05 level (2-tailed); ** Correlation is significant at the 0.01 level (2-tailed); GSI: Gonadosomatic Index; WRT: whole Right testis; WLT: whole Left Testis; LT; left testis; RT; right testis.

International Journal of Fisheries and Aquaculture Research
Vol.7, No.1, pp.1-10, January 2021
Published by ECRTD-UK
ISSN: ISSN 2397-7507, Online ISSN: ISSN 2397-776

Table 4: correlations of body measurement and gonadosomatic index of female *Clarias garepinus* broodstock

Parameters	Head length	Standard length	Total length	Liveweight	Egg population	GSI
Head length	1	.941*	.948*	.934*	-0.27	-0.633
Standard length	.941*	1	1.000**	.982**	-0.508	-0.83
Total length	.948*	1.000**	1	.983**	-0.498	-0.823
Liveweight	.934*	.982**	.983**	1	-0.42	-0.773
Egg population	-0.27	-0.508	-0.498	-0.42	1	0.926
GSI	-0.633	-0.83	-0.823	-0.773	0.926	1

* Correlation is significant at the 0.05 level (2-tailed); ** Correlation is significant at the 0.01 level (2-tailed); GSI: gonadosomatic index

International Journal of Fisheries and Aquaculture Research
Vol.7, No.1, pp.1-10, January 2021
Published by ECRTD-UK
ISSN: ISSN 2397-7507, Online ISSN: ISSN 2397-776

Table 5: Correlations of body measurement and gonadosomatic index of male *Heterobranchus longifilis* broodstock

	Head length	Standard length	Total length	Liveweight	WRT weight	RT semen volume	WLT weight	LT semen volume	Total semen volume	Total gonadal weight	GSI
Head length	1	.934**	.948**	.993**	0.538	0.546	0.472	0.559	0.549	0.531	0.391
Standard length	.934**	1	.987**	.894*	0.409	0.435	0.384	0.439	0.437	0.409	0.255
Total length	.948**	.987**	1	.908*	0.436	0.465	0.367	0.451	0.464	0.427	0.27
Liveweight	.993**	.894*	.908*	1	0.562	0.563	0.486	0.588	0.569	0.553	0.421
WRT weight	0.538	0.409	0.436	0.562	1	.997**	.929**	.991**	.998**	.997**	.980**
RT semen volume	0.546	0.435	0.465	0.563	.997**	1	.914*	.987**	1.000**	.992**	.968**
WLT weight	0.472	0.384	0.367	0.486	.929**	.914*	1	.920**	.917*	.953**	.952**
LT semen volume	0.559	0.439	0.451	0.588	.991**	.987**	.920**	1	.991**	.989**	.969**
Total semen volume	0.549	0.437	0.464	0.569	.998**	1.000**	.917*	.991**	1	.993**	.970**
Total gonadal weight g	0.531	0.409	0.427	0.553	.997**	.992**	.953**	.989**	.993**	1	.986**
GSI	0.391	0.255	0.27	0.421	.980**	.968**	.952**	.969**	.970**	.986**	1

** Correlation is significant at the 0.01 level (2-tailed); GSI: Gonadosomatic Index; WRT: whole right testis; WLT: Whole Left Testis; LT; left testis; RT; right testis

Table 6: Correlations of body measurement and gonadosomatic index of female *Heterobranchus longifilis* broodstock

	Head length	Standard length	Total length	Liveweight	Egg population	GSI
Head length	1	0.61	0.8	0.855	0.365	-0.579
Standard length	0.61	1	0.797	.894*	0.049	-0.809
Total length	0.8	0.797	1	.965**	0.619	-0.317
Liveweight	0.855	.894*	.965**	1	0.376	-0.569
Egg population	0.365	0.049	0.619	0.376	1	0.548
GSI	-0.579	-0.809	-0.317	-0.569	0.548	1

* Correlation is significant at the 0.05 level (2-tailed); ** Correlation is significant at the 0.01 level (2-tailed); GSI: Gonadosomatic Index